ANALYSIS OF INTRASPECIFIC AND ONTOGENETIC VARIATION IN THE DENTITION OF *COELOPHYSIS BAURI* (LATE TRIASSIC), AND IMPLICATIONS FOR THE SYSTEMATICS OF ISOLATED THEROPOD TEETH.

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Abstract—Isolated theropod teeth provide useful data for paleogeographic and paleoecologic studies, although tooth morphotypes with ambiguous taxonomic affinity are frequently recovered from Late Cretaceous microfossil localities. It is not known if these morphotypes result from individual or ontogenetic variation within known theropod taxa from the Late Cretaceous. To test whether ontogenetic variation could produce seemingly novel tooth morphologies, 848 teeth from 23 skulls of the Late Triassic (Apachean) theropod *Coelophysis bauri* from Ghost Ranch, New Mexico, were analyzed using statistical and multivariate analyses. Principal component and discriminant analyses reveal that, despite heterodontic morphology, premaxillary, maxillary, and dentary teeth, and teeth from small (juvenile) and large (adult) skulls occupy a similar morphospace and would not be mistakenly identified as new taxa. However, canonical variate analyses show that teeth from small and large skulls are significantly different. Teeth with longitudinal ridging that only occur in small (juvenile) skulls occupy the same morphospace as non-ridged teeth, and may be an ontogenetically controlled character of tooth morphology in *C. bauri*. Ridged tooth morphotypes from Late Cretaceous microfossil localities may be ontogenetic variants of known theropod taxa.

INTRODUCTION

Theropod skeletal elements have a low preservation potential due to their fragile osteology. Theropods, as with other non-mammalian tetrapods, exhibit polyphyodonty (Bolt and DeMar 1986), and theropod teeth, being more mechanically and chemically resistant than bone, are commonly recovered from microfossil localities as isolated, shed elements. Continuous tooth replacement cycles in archosaurs also are a factor in that a single animal (represented by one skeleton) produces many shed teeth during its lifetime. Determining the presence or absence of theropod taxa at a locality based on the occurrence of shed teeth is more practical than relying on the occurrence of other skeletal elements for faunal and paleobiological studies (Currie et al., 1990; Brinkman, 1990; Ryan et al., 1998; Fiorillo, 1999; Fiorillo and Currie, 1994; Fiorillo and Gangloff, 2000; Sankey, 2001, 2008a, b; Vullo et al., 2007; Fanti and Miyashita, 2009; Larson and Currie, 2013). Shed theropod teeth are often used in the identification of new taxa (Currie et al., 1990; Baszio 1997a, b; Sankey 2001; Sankey et al., 2002), and in studies of theropod niche partitioning and feeding behavior (Bakker, 1998; Henderson, 1998; Holtz et al., 1998; Ryan et al., 1998; Bakker and Bir, 2004), and for faunal turnover (Larson and Currie, 2013). Shed tooth distribution within the Late Jurassic Como Bluff locality were also used by Bakker and Bir (2004) to interpret parental care, potential prey, and habitat selection of allosauroids, ceratosauroids, and megalosauroids. However, there are few studies on intraspecific dental variation in theropods (Smith, 2005), resulting in uncertainty surrounding the usefulness of shed theropod teeth for taxonomic purposes (Smith, 2002). Theropod tooth morphology has also been used in phylogenetics: Holtz (1998) used tooth number, relative size of maxillary and denary teeth, denticle morphology, crown root constriction, and the presence of enamel crenulations associated with serrations as characters in revising the phylogeny of the Theropoda, while Rauhut (2004) used the number of premaxillary alveoli as a character in the systematic analysis of the Theropoda.

Variation among skeletal elements of the Theropoda summarized by Molnar (1990, p. 76) attributes morphologic variation to individual, sexual, ontogenetic, geographical, chronological, and intraspecific population variation. Among the skeletal elements susceptible to variation, teeth were described to vary in number (Molnar, 1990). Variation in shed teeth of multiple taxa of theropods has been addressed (Currie et al., 1990; Sankey et al., 2002), but the amount of intraspecific variation in tooth morphology remains uncertain. Unless skulls have *in situ* teeth, the potential for intraspecific variation in theropod tooth morphology cannot be directly linked with a single theropod taxon. The low preservation potential of theropod skeletal material also makes it difficult to document ontogenetic variation in theropod tooth morphology. Ontogenetic variation in teeth of juvenile and adult specimens within the Tyrannosauridae has been discussed (Currie et al., 1990; Carr, 1999; Brochu, 2003; Currie, 2003; Holtz, 2004), although there are few confirmed juvenile specimens of any tyrannosaurid taxa (e.g., *Tyrannosaurus rex*) with which to accurately document ontogenetic variation of teeth. Statistical tests on small samples are not practical (Molnar 1990), but studies on multiple specimens of known taxa of theropods have the potential to produce significant results. In order to increase the utility of isolated theropod teeth for paleoecology studies, and to determine whether a distinct tooth morphology reflects a distinct theropod taxon, morphologic variation due to ontogenetic and intraspecific variation within a single taxon of theropod needs to be documented.

Documentation of Theropod Tooth Morphology

The first documentation of theropod tooth morphology was included as part of larger osteological descriptions of skull material. The observations were generally limited to the number of alveoli present in the tooth-bearing elements, overall tooth shape, and the presence or absence of serrations on the anterior and posterior carinae.

However, there are exceptions. Ostrom (1969) provides a detailed description of the dentition of *Deinonychus antirrhopus*, and uses the discrepancy in size between the denticles on the anterior and posterior carinae as a diagnostic character of the subfamily Velociraptorinae, supporting a phylogenetic relationship between *D. antirrhopus* and *Velociraptor mongoliensis*.

Currie et al. (1990) completed the first comprehensive multi-taxon study of theropod tooth morphology on the late Campanian theropod teeth of the Judith River Group, showing that shed theropod teeth are identifiable to the familial, generic, and specific levels. Smith and Dodson (2003) proposed a standard for vertebrate dental terminology, with modifications made to the original terminology used in Currie et al. (1990) for describing theropod teeth (Fig. 1). Smith (2002) developed a model with which to identify shed tyrannosaurid teeth, and the multivariate analyses of Smith et al. (2005) separated shed teeth of close taxonomic affinity within the Tyrannosauridae, although the analyses could not separate teeth from closely related species.

Individual Variation in Theropod Teeth

Madsen (1976) notes that in *Allosaurus fragilis* the number of maxillary tooth alveoli vary from 14 to 16 and in the dentaries from 14 to 17, and that the variation was likely individual and not ontogenetic. Dental variation in *Coelophysis bauri* was concluded to be due to individual rather than ontogenetic variation, and the number of maxillary alveoli is dependent on the length of the maxilla (Colbert, 1990), while in tyrannosaurids there is no correlation between alveoli number and age and/or size of the individual (Currie, 2003). Currie (2003) also notes that in the Tyrannosauridae tooth alveoli number can vary between the left and right maxillae and the left and right dentaries within an individual. Smith (2005) and Smith et al. (2005) also show that the dentition of *Tyrannosaurus rex* exhibits a high degree of positional variation.

Ontogenetic Variation in Theropod Teeth

The most detailed work on ontogenetic variation in theropod tooth morphology focuses on genera within the Tyrannosauridae. However, the status of the type specimen of *Nanotyrannus libratus*, whether it is a distinct taxon (Bakker et al., 1988) or a juvenile specimen of *Tyrannosaurus rex* (Carr, 1999; Carr and Williamson, 2005), polarizes the literature on tyrannosaurid ontogeny. Carr (1999) reported an increase in tooth width and a decreased number of maxillary alveoli from 16 in juvenile specimens to 13 in adult specimens of *Albertosaurus libratus*, although this interpretation is treated with some scepticism. *T. rex* was documented to lose up to three alveoli from the anterior end of the tooth row during ontogeny (Carr, 1999; Carr and Williamson, 2005). However, this observation is only valid if *N. libratus* is treated as a juvenile specimen of *T. rex*.

An alternate hypothesis is that tyrannosaurids may not change the number of tooth positions during ontogeny, as the number of maxillary tooth positions in tyrannosaurids was shown to be not ontogenetically controlled (Currie, 2003). Hypotheses that tyrannosaurid tooth counts either increase or decrease with age have no statistical support when comparing tooth number with tooth row length in the Tyrannosauridae (Currie, 2003). Colbert (1990) documents a gain in tooth alveoli during the ontogeny of *Coelophysis bauri*, but notes that the number of alveoli in the maxillae is "not entirely related to size" (Colbert, 1989, p. 70), although he also states "there probably was some increase in the number of teeth during growth" (Colbert 1989, p. 133).

While the support for ontogenetic change in tooth counts is equivocal, evidence to support ontogenetic change in tooth shape and tooth features (denticles) is less controversial. Currie (2003) showed that tooth crown basal shape in the Tyrannosauridae changes from laterally compressed in juvenile specimens to conical in adults. The presence or absence of denticles on the premaxillary teeth, once thought to be diagnostic of the genus *Aublysodon*, now considered a *nomen dubium* by Holtz (2004) and Carr and Williamson (2005), may be due either to post-mortem damage (although teeth do not appear to be damaged through those authors' personal observations) or to ontogenetic factors (Brochu, 2003). Other than in the Tyrannosauridae (Carr, 1999; Smith, 2002, 2005; Currie, 2003; Smith et al., 2005; Carr and Williamson, 2006), and in isolated shed teeth with uncertain taxonomic affinity (Sankey et al., 2002), there has been little documentation of the range of morphologies due to ontogenetic and individual variation within one theropod taxon.

Wrinkles, Ridges, and Tooth Crowns

Certain features previously used as diagnostic characters for isolated crowns have been shown to either have no diagnostic power, or their diagnostic strength is questionable. One of these features is the presence of enamel wrinkles oriented perpendicular to the long axis of the tooth crown. Once considered diagnostic of the Carcharodontosauridae, their presence on shed teeth was used to identify shed teeth as carcharodontosaurid (Vullo et al., 2007). However, these ridges are also documented in several genera within the Spinosauroidea, Allosauroidea, and the Tyrannosauroidea in varying strengths and sizes (Brusatte et al., 2007). Also, some carcharodonosauid teeth do not possess wrinkled crowns (Brusatte et al., 2007). The presence of enamel wrinkles should not be considered a diagnostic feature of the Carcharodontosauridae, although large and well developed wrinkles (when present) may be a feature restricted to the Carcharodontosauridae (Brusatte et al., 2007).

Another characteristic often seen in shed theropod tooth crowns are ridges oriented along the long (apicobasal) axis of the tooth crown, here referred to as "longitudinal ridges," or simply "ridges." Longitudinal ridges are frequently documented in spinosaurid teeth (Brusatte et al., 2007), *Ceratosaurus nasicornis*, *C. magnicornis*, and *C. dentisulcatus* (Madsen and Welles, 2000), and in teeth identified as *Paronychodon lacustris* (Currie et al., 1990; Sankey, 2008), cf. *Saurornitholestes* sp., cf. *Troodon* sp. , cf. *Pectinodon bakkeri* (Carpenter, 1982; Longrich, 2008), cf. *Richardoestesia* sp. (Longrich, 2008; Sankey, 2008), birds (Sankey, 2008), and in "*Dromaeosaurus* Morph A," a tooth morphology of uncertain taxonomic affinity (Sankey et al., 2002; Longrich, 2008). It is not known if the presence of these ridges (in taxa other than those in the Spinosauridae) is the result of intraspecific individual or ontogenetic variation, or if the presence of longitudinal ridging on theropod teeth is diagnostic of certain taxa. Despite the large volume of study conducted on the identification of isolated theropod teeth, especially those teeth from Upper Cretaceous deposits, these issues are not yet resolved.

RATIONALE FOR STUDY

The goal of this study is to address uncertainties regarding ontogenetic and individual variation in theropod tooth morphology. The *in situ* teeth (teeth within their original alveoli) in multiple individuals of a single theropod species were documented via measurements and photography. Tooth data were analyzed using bivariate and multivariate analyses, and the results used to interpret the acceptable amount of morphologic variation potentially displayed in the teeth of closely related species. The study taxon is the Late Triassic (Apachean) coelophysoid ceratosaurid *Coelophysis bauri*.

BACKGROUND TO *COELOPHYSIS BAURI*

The Ghost Ranch Whitaker quarry occurs within the "siltstone member" of the Rock Point Formation of the Chinle Group (Rinehart et al., 2009), which was dated palynologically to be in the Late Triassic (late Norian: Litwin et al., 1991). *Coelophysis* was first described from material discovered in 1881 by David Baldwin (Colbert, 1989) as *Coelurus longicollis* and *C. bauri* (Cope, 1887a) and then changed to *Tanystrophaeus longicollis* and *T. bauri* with the addition of a new species, *T. willistoni* (Cope, 1887b). The generic assignment of the three species was later changed by Cope to *Coelophysis longicollis*, *C. bauri*, and *C. willistoni* (Cope, 1889). The material was redescribed by von Huene (1906, 1915) as being from the Arroyo Seco area of New Mexico as the original material was described with only vague locality information (Colbert 1989).

The Ghost Ranch Whitaker quarry in Arroyo del Yeso, New Mexico, now famous for the numerous complete and partially articulated specimens of *C. bauri* and representing a range of ontogenetic stages, was discovered in 1947 (Colbert, 1989, 1990; Rinehart et al., 2009). Twenty-nine bone-bearing blocks excavated from the quarry are now deposited in multiple institutions (Table 1). The site is interpreted as a mass death assemblage of a population of *C. bauri* that was fluvially transported (Colbert, 1989, 1990; Schwartz and Gillette, 1994; Rinehart et al., 2009).

Taxonomy of the Ghost Ranch *Coelophysis bauri*

There was debate as to whether the original material of *Coelophysis bauri* is diagnostic and comparable to the Ghost Ranch specimens (Hunt and Lucas, 1991). A new name, *Rioarribasaurus colberti* (holotype AMNH 7224), was proposed for the Ghost Ranch coelophysoids (Hunt and Lucas 1991), but a neotype specimen from the Ghost Ranch quarry (AMNH 7224) was erected for *C. bauri* by the International Commission on Zoological Nomenclature (1996) on petition (Colbert et al., 1992), resulting in all Ghost Ranch coelophysoids being classified as *C. bauri* (Tykowski and Rowe, 2004).

Colbert's (1989) Description of *Coelophysis bauri* Dental Formulae and Morphology

A revised diagnosis of the genus *Coelophysis* (Colbert, 1989) describes the dental formula (premaxilla + maxilla/dentary) as both 4 + 23 - 26/25 - 27 (p. 29, 33, and 68), and 4+22 – 26/? (p. 60, 69). Dentary teeth are more difficult to document, as the jaws are usually tightly occluded in most skulls (Colbert, 1989). The following description of *C. bauri* tooth morphology is modified from Colbert (1989). Premaxillary teeth P1 – P 3 are rounded in cross-section, with P4 elliptical and with anterior and posterior carinae. P1 – P4 lack serrations. Premaxillary teeth of small individuals are "ribbed" (Colbert, 1989, p. 70). There is a diastema at the contact between the premaxilla and maxilla. Maxillary teeth are laterally compressed, strongly recurved and have anterior and posterior carinae. Maxillary tooth M1 anterior and posterior carinae lack serrations, and M2 lacks serrations on the anterior carinae only. All other teeth in the maxilla are serrated.

Anterior serrated carina lengths vary from the distal half of the tooth crown to the entire carinae length. Posterior serrated carinae lengths run the entire posterior edge of the crown. Serrations are small (eight to nine per millimeter). Maxillary teeth decrease in size anteroposteriorly along the tooth row, with the smallest teeth seen in M21 – M26. Dentary teeth D1 – D 4 are elliptical in cross-section, with the rest of the teeth being laterally compressed. D1 – D7 lack serrations, D8 only has posterior serrations. The remaining dentary teeth have anterior and posterior serrations.

Institutional Abbreviations

Institutional abbreviations: **AMNH**, American Museum of Natural History, New York, New York; **DMNS**, Denver Museum of Nature and Science, Denver, Colorado; **MNA**, Museum of Northern Arizona, Flagstaff, Arizona; **NMMNH**, New Mexico Museum of Natural History and Science, Albuquerque, New Mexico; and **RTMP**, Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta, Canada.

MATERIALS AND METHODS

Specimen Variables Affecting Data Collection

Data were collected from 848 *in situ* tooth positions (**Appendix 1**) in 23 complete and partially complete skulls of *Coelophysis bauri* (**Appendix 2**). Partial skulls either lacked certain elements (premaxillae were the most common element missing) or possessed tooth-bearing elements that were too damaged from which to collect data along their total lengths. RTMP 1984.063.0001 is the catalogue number for a block bearing the remains of several individuals of Ghost Ranch *Coelophysis*. Data from three complete and partial skulls were collected from this block. The complete skull, the anterior portion of one skull, and the disarticulated large maxillae and dentaries are denoted in the text as RTMP 1984.063.0001-1, RTMP 1984.063.0001-2, and RTMP 1984.63.0001-3, respectively.

Five skulls are fully prepared with both lateral views visible (AMNH 7239, AMNH 7240, AMNH 7242, DMNS 39022, MNA V3315), and five skulls have both left and right lateral views exposed due to disarticulation of skull elements (MNA V3318, NMMNH P-42353, NMMNH P-42579, NMMNH P-44555, NMMNH P-50530). Seven skulls are only visible on the left side (AMNH 7227, AMNH 7228, AMNH 7230, AMNH 7231, NMMNH P-42200, RTMP 1984.063.0001-1 and RTMP 1984.063.0001-3) and six skulls are exposed on the right side (AMNH 7241, DMNS 30596, DMNS 31256, NMMNH P-44551, NMMNH P-50529, RTMP 1984.063.0001-2). One isolated premaxillary tooth crown possessing longitudinal enamel ridges and root, associated with the skull NMMNH P-44551, was treated as part of that specimen. However, the tooth could not be confidently assigned to that specimen because the premaxillae are not preserved, and no *in situ* teeth in the maxilla have ridges.

Many teeth were only partially visible (due to the incomplete removal of sediment or coating adhesives), were missing (due to natural tooth replacement processes or post-mortem damage), or were not visible due to preservational positioning or jaw occlusion. *In situ* teeth are usually only visible in labial view in articulated skulls. Some teeth are visible in lingual view in partially disarticulated skulls. Measurements from total dentary tooth rows were not available in articulated skulls due to dentary occlusion (Colbert, 1989). Premaxillary and anterior maxillary teeth often hide anterior dentary teeth, and the posterior tooth row was not visible at all, with the maxillary tooth row overlapping the most posterior dorsal margin of the dentary.

Equipment Used for Data Collection

Data were collected using Marathon (CO 030150) electronic digital calipers for measurements of tooth morphology, skull element lengths, and femur lengths. Measurements were taken in millimeters from each visible tooth position. An Olympus SZ61 dissecting scope with ocular micrometer was used where teeth were inaccessible to digital calipers and for small-scale measurements. Digital pictures were taken of each tooth with an Olympus C5060 5.1 megapixel camera and a Pentax Optio W30 7.4 megapixel camera.

Data were processed in Excel 2003 spreadsheets and PAleontological STatistics software (PAST) ver. 2.17 (Hammer et al. 2001). The PAST program is constantly updated: the most current version available of PAST will be more up-to-date than the version used for these analyses, although the results of analyses from different versions of PAST do not differ.

Data Collected

Teeth were measured using the parameters established by Currie et al. (1990), Sankey et al. (2002), and Smith and Dodson (2003) (Fig. 1). Where possible, denticle measurements were collected from unworn, unbroken denticles near the middle of the denticulate

Table 1: Repositories of blocks removed from the Coelophysis bauri Ghost Ranch quarry (modified from Colbert 1990). Many blocks are in various stages of preparation.

Ghost Ranch Quarry Block Number	Repository of Material (as of 1990)
AM I	Ghost Ranch (GR)
AM II	Yale Peabody Museum (YPM)
AM III	American Museum of Natural History (AMNH)
AM IV	Connecticut State Dinosaur Trackway Park
AM V	American Museum of Natural History (AMNH)
AM IV	American Museum of Natural History (AMNH)
AM VII	Museum of Northern Arizona (MNA)
AM VIII	American Museum of Natural History (AMNH)
AM IX	American Museum of Natural History (AMNH)
AM X	Harvard Museum of Comparative Anatomy
AM XI (not productive)	
AM XII	Cleveland Museum of Natural History
C-1-81	Royal Ontario Museum (ROM)
C-2-81	Carnegie Museum
C-3-81	Royal Ontario Museum (ROM)
C-4-81	Carnegie Museum
C-5-81	Museum of Northern Arizona (MNA)
C-1-82	Carnegie Museum Royal Tyrrell Museum of Palaeontology (RTMP)
C-2-82a	Carnegie Museum
C-2-82b	Carnegie Museum
C-3-82	Smithsonian Institution
C-4-82	Carnegie Museum
C-5-82	Carnegie Museum
C-6-62	Carnegie Museum
C-7-82	Carnegie Museum
C-8-82b	New Mexico Museum of Natural History (NMMNH)
C-9-82	Ghost Ranch Museum, Ruth Hall Wing
C-10-82	Carnegie Museum
Ph-1-81	Carnegie Museum

portion of the carinae. Refer to Figure 1 for descriptions of the measurements taken. Tooth positions are designated as originating from the left (l) or right (r) premaxilla (P), maxilla (M) or dentary (D), followed by the alveolus number. Alveoli are numbered from 1 to *n* in the anteroposterior direction, with "1" being the most anterior alveolus of the tooth row in the tooth-bearing element. Tooth-bearing elements often have visible alveoli but do not display whole tooth crowns due to either preservation factors or tooth replacement processes. In these cases, data were still collected for fore-aft basal length (FABL), crown basal width (CBW), and inter-alveolar distance (IAD), and observations on cross-sectional shape for these tooth positions. However, the qualifiers "adult" and "juvenile" were determined based on the groupings of skull sizes in Figure 2, although the qualifiers used to make such assignments in a sample that represents a continuous ontogenetic range have the potential to be somewhat arbitrary (Tykoski and Rowe, 2004). However, using femoral lengths, Rinehart et al. (2009) correlate estimated age with size of individuals of Ghost Ranch *C. bauri*. Based on skull and femur lengths collected by the first author and presented in Rinehart et al. (2009) the specimens of *C. bauri* in the sample used in this study can that can be categorized with some confidence fall within size classes 1 (AMNH 7230, AMNH 7231, AMNH 7242, MNA 3318, NMMNH P-42200, RTMP 1984.063.0001-1), 2 (MNA MV3315, NMMNH 42353) and 3 or higher (AMNH 7227, AMNH 7228, AMNH 7240). The size classes of Rinehart et al. (2009) were not used in the *a priori* categories for the statistical analyses as most of the skulls used herein were incompletely preserved and were not associated with complete femora.

Statistical Analyses

Analyses performed using PAST version 2.17 were basic descriptive univariate statistics and multivariate analyses (principal component analysis, discriminate analysis, canonical variate analysis) on unadjusted and $\log_{10}$-transformed data. Prior to bivariate and multivariate analyses, the dataset was tested using the Shapiro-Wilk test to determine if the sample data were collected from a population with a normal distribution (Sokal and Rohlf, 1995; Hammer and Harper, 2006). Analyses performed were the t-test (bivariate), and principal component, discriminant, and canonical variate analyses (multivariate: Hammer and Harper, 2006).

Principal component analysis (PCA) is the two-dimensional projection of multivariate data to identify the components that account for the maximum amount of variance in the data (Hammer and Harper, 2006). It reveals the relative variation contributed to the data set by each measured variable, producing principal component ordinance plots that visually project three-dimensional plots of specimens in two dimensions, and may reveal discrete groupings among specimens. PCA ordinance plots are often displayed with variance vectors that show the relative amount of variation that each measured variable contributes to the overall variation in the data set (Hammer and Harper, 2006). The first principal component represents variation based on size and is usually the largest principal component in terms of percentage of total variance within the sample (Hammer and Harper, 2006). However, careful examination of the variance vectors is required to determine the exact nature of principal component (PC) PC 1. PCA was used to find the percentage of total variation (variance) that each measured variable, or combination of variables, contributed to the total variation in the data set. It replaces missing data using pairwise substitution (Hammer et al., 2001). The strength in PCA is not in determining the significance of the differences among qualitative groupings (PCA is not statistics: Hammer and Harper, 2006), but in revealing which variables contribute to distinguishing among taxonomic groups.

Discriminant analysis (DA) projects a multivariate data set down to one dimension in a way that maximizes separation between two *a priori* separated groups. This is a useful tool for testing hypotheses of morphologic similarity or difference between two groups. A 90% or greater separation between two groups is considered sufficient support for the presence of two taxonomically distinct morphotypes (Hammer and Harper, 2006), however, 100% is ideal (see Discussion). Canonical variate analysis (CVA) compares specimens a priori categorized in three or more groups using the same principles as discriminant analysis. The p_{same} between two *a priori* groups was determined using Hotelling's t^2 test (the multivariate version of the t-test: Hammer and Harper, 2006) to determine significance at $p_{same} \geq 0.05$. Skulls were divided *a priori* into two groups based on size for the purposes of the discriminant analysis (Fig. 2).

Canonical variate analysis (CVA) performs a similar function to that of discriminant analysis, but three or more groups are determined *a priori* in the dataset (Hammer and Harper, 2006). CVA was used to visually evaluate differences among premaxillary, maxillary, and dentary teeth. DMNS 31256, an incomplete, partially exposed tooth-bearing element, was removed from analyses that required accurate tooth-bearing element identification. This is because it could not be confidently identified as either a maxilla or dentary.

Refer to Figure 1 for a schematic of measured variables.

Anatomical abbreviations are D, dentary; M, maxilla; P, premaxilla; l, left; and r, right. Measurement abbreviations are:

ACL - anterior carina length,

ACDL - anterior carina denticulate length,

CA - crown angle, or apex displacement of Smith (2005) was calculated using the Law of Cosines:

Angle (θ) = arcos ($a^2 + b^2 - c^2/2ab$),

with a = for-aft basal length (FABL), b = crown curvature (Curv), and c = crown height (CH),

CBW - crown basal length,

CH - crown height,

Curv - crown curvature,

FABL - fore-aft basal length,

H - denticle height,

L - denticle length,

PCL - posterior carina length,

PCDL - posterior carina denticulate length,

W - denticle width.

RESULTS

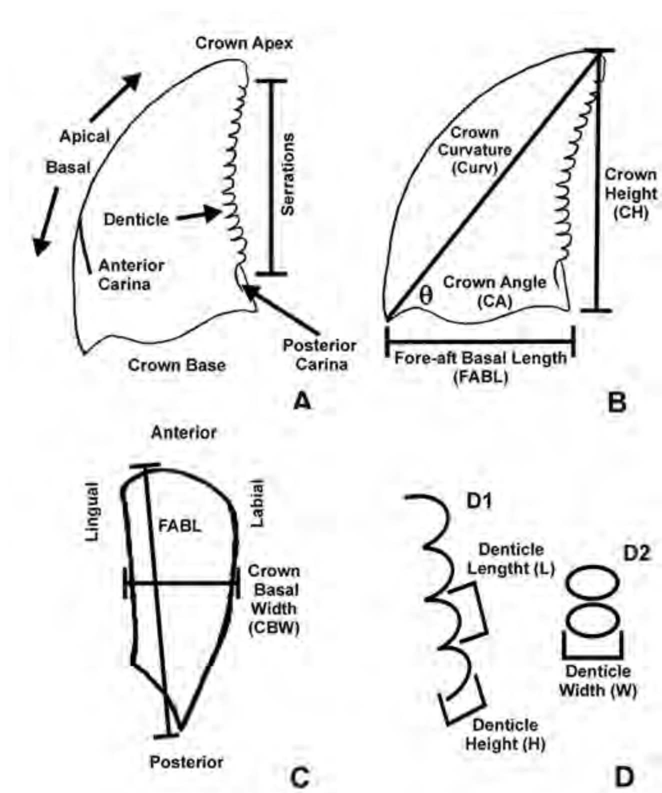

Figure 1: Data collected on in situ teeth of Coelophysis bauri. A, terminology used in this study. B, Schematic tooth showing linear data collected, and used to calculate crown angle (CA). C, schematic in situ tooth in cross section. When only tooth alveoli were preserved, or where teeth were broken at the base of the tooth bearing element, only FABL and CBW were collected. D, Measurements of denticle length (L) and denticle height (H, D1), and denicle width (W, D2) taken from the largest denticle from the anterior carina (LAD) and the largest denticle of the posterior carina (LPD). Schematics and terminology modified from Sankey et al. (2002) and Smith et al. (2003).

Description of Ghost Ranch *Coelophysis bauri* Teeth

Overall Description

Unless otherwise stated, the following description is characteristic of all teeth in the *Coelophysis bauri* sample. Fore-aft basal length (FABL) was the most common measurement collected for each tooth position (71.3%, N = 605). Teeth of *C. bauri* are typically laterally compressed and recurved. Maxillary teeth have a larger average FABL, crown height (CH), and crown angle (CA) than do teeth from the premaxillary and dentary (Tables 2-5). The largest average crown basal width (CBW) is found in the premaxillary teeth (1.54 mm). Teeth exhibit a wide range of crown curvatures, from weakly (97.3°) to strongly (26.6°) curved. Maxillary teeth are on average more curved (average 61.2°) than premaxillary teeth (average 74.3°), but are similar in average curvature to dentary teeth (average 62.2°).

Anterior carinae, when present, average 72.7% of the crown angle length (Curv) and range from 0% (on premaxillary and most anterior dentary teeth) to 100% (for the most posterior tooth positions in the maxilla and dentary). When present, anterior and posterior carinae are finely serrated (average serration anteroposterior length

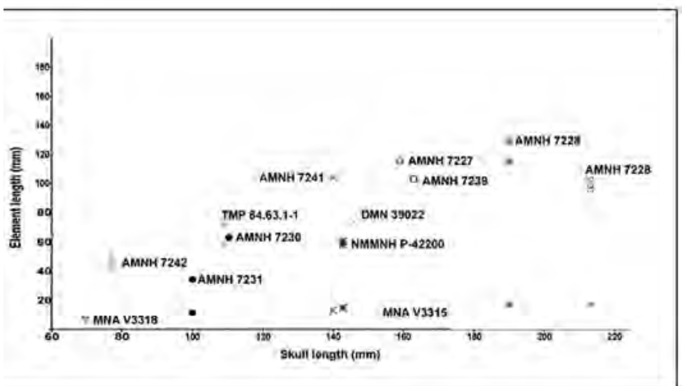

Figure 2: Graph of division between examined large and small skulls of Coelophysis bauri, with premaxillary, maxillary, and dentary lengths plotted against premaxilla-quadrate skull length to show the continuum in size. A break in the continuum allowed for the designation of small skulls to be applied to those that have a premaxillary tooth row length of less than 14.0mm, and large skulls with a premaxillary tooth row length of 14.0mm or larger.

0.10 mm). Denticles of the anterior carinae have an average smaller width (LAD-W), length (LAD-L), and height (LAD-H) (LAD-W = 0.053mm, LAD-L = 0.088mm, LAD-H = 0.090mm) than those of the posterior carinae (largest posterior denticle width = 0.10 mm, largest posterior denticle length = 0.10mm, largest posterior denticle height = 0.10mm). Denticles are on average higher than long or wide, and are rounded in lateral profile (Fig. 3).

Premaxillary and Anterior Maxillary and Dentary Teeth

Premaxillary and anterior dentary teeth are round to sub-round in cross section (Fig. 4) with a fore-aft basal length (FABL) to crown basal width (CBW) ratio (FABL/CBW) of 1.50 (N = 10). They are on average more rounded in cross section than anterior dentary (D) teeth D1 – D5, which have a FABL/CBW ratio of 1.63 (N = 10). Premaxillary and anterior dentary teeth in juvenile-sized skulls usually lack anterior and posterior carinae and serrations (Colbert, 1989), but serrations are present on the posterior carinae of DMN 39022 left (l) premaxillary (P) tooth P4 and AMNH 7240 right (r) P3 (Fig. 5), and (contra Colbert, 1989) on the anterior and posterior carina of NMMNH P-50529 rD4. The denticles are within the size range observed on denticulate teeth of the maxillae and dentaries. Anterior maxillary teeth typically possess a fully denticulated posterior carina, with the anterior carina only partially denticulate (Fig. 6, Table 5).

Colbert (1989) reports a gain in denticles on the anterior carina at maxillary tooth M3; however, serrations were observed on left maxillary tooth lM2 on AMNH 7240 (Fig. 7). Four skulls (AMNH 7242, MNA V3318, NMMNH P-42200, RTMP 1984.063.0001-1) possess premaxillary and anterior maxillary and dentary teeth with longitudinal ridging (Figs. 8 – 10, Table 6). The isolated premaxillary tooth crown associated with skull NMMNH P-44551 is also longitudinally ridged.

Mid-tooth Row Maxillary and Dentary Teeth

Maxillary teeth from the middle of the tooth row have a morphology that is consistent with the overall tooth morphology. Mid-tooth row maxillary tooth positions M5 - M9 are the largest teeth in the skull, larger than the most anterior teeth. Mid-row maxillary and dentary teeth have smaller fore-aft basal lengths relative to crown heights, and are the most recurved (Fig. 11). Maxillary tooth positions M6 - M20 have on average larger fore-aft basal lengths (FABL) and crown heights (CH) (Tables 3 - 5).

Posterior Maxillary and Dentary Teeth

Posterior maxillary and dentary tooth positions 21 through 28 have a proportionally larger fore-aft basal length (FABL) than crown height (CH), giving the teeth a squat, triangular shape (Fig. 12). The FABL/CH ratio for maxillary (M) teeth M21 – M27 and teeth D21 – D28 is higher than the FABL/CH ratio of the anterior and mid-skull teeth (Tables 3 – 5).

Longitudinally Ridged Teeth in *Coelophysis bauri*

The specimens described below are presented in the order they appear in Table 6. MNA V-3318 has ridged teeth in positions lP2 and rP1 – P2 of the premaxilla, and rM2 and rM4 of the maxilla (Fig. 10). Other teeth in the premaxilla are either incomplete or not visible. In AMNH 7242 weak ridges were present on the crowns of tooth positions of the right maxilla M1 - M2. Ridges are more prominent toward the apex of the crown. There was no ridging observed on the tooth crowns posterior to tooth position rM3. Apparent weak ridging was also observed on the partial crown in the left maxilla lM5, though the ridging may be due to color striations in the tooth enamel and not structural. There are no teeth preserved in maxilla positions lM1 – M4. RTMP 1984.63.1-1 preserves ridged teeth in premaxilla positions lP1, maxilla lM1 – M5, and dentary lD3. Teeth are either missing or hidden for premaxillary teeth lP2 - P4 and dentary teeth lD1 – D2 (Fig. 8). Skull NMMNH P-42200 has ridged teeth in premaxilla teeth lP1 – P4, rP1 – P4, maxilla tooth lM1, and dentary teeth lD1 – D6, and rD1 (Fig. 9). Maxillary tooth lM2 is not ridged, and the crown in position lM3 was not preserved. There are no ridged crowns posterior to position lM4.

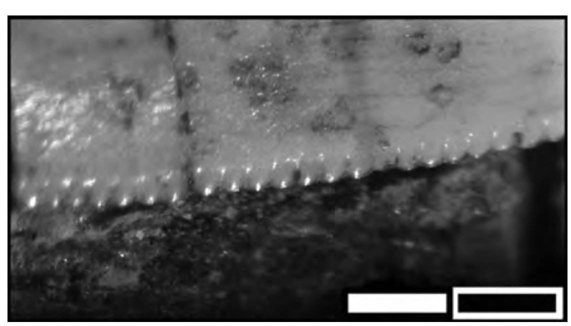

Figure 3: Photograph of the anterior denticles of left maxillary tooth M5 of Coelophysis bauri NMMNH P-44555, labial view. Scale = 1.0mm.

Table 2: Dimensions of premaxillary teeth of Coelophysis bauri from studied sample. Univariate statistics showing the mean, minimum, maximum, standard deviation (s.dev), and number of tooth measurements for the dentigerous elements of C. bauri study skulls. FABL, fore-aft basal length; IAD, interalveolar distance; CH, crown height; Curv, curvature length; CBW, crown basal length; CA, crown angle; ACL, anterior carina length; ACDL, anterior carina denticulate length; PCL, posterior carina length; PCDL, posterior carina denticulate length; LAD, largest denticle on anterior carina; LPD, largest denticle on posterior carina; W, width; L, length; H, height.

Variable	Mean	Minimum	Maximum	St. Dev.	Number
FABL	1.82	0.700	3.70	0.631	59
IAD	0.658	0	1.80	0.376	30
CH	4.68	1.10	9.72	1.83	42
CAL	5.31	2.20	9.90	1.90	26
CBW	1.54	0.50	3.00	0.699	16
CA	74.3	41.3	97.3	2.71	21
ACL	4.43	4.00	4.90	0.451	3
ACDL	2.51	0	5.02	3.55	2
PCL	0	0	0	0	2
PCDL	4.70	3.70	5.70	1.00	3
LAD-W	N/A	N/A	N/A	N/A	N/A
LAD-L	N/A	N/A	N/A	N/A	N/A
LAD-H	N/A	N/A	N/A	N/A	N/A
LPD-W	N/A	N/A	N/A	N/A	N/A
LPD-L	0.088	0.088	0.088	N/A	1
LPD-H	0.066	0.044	0.088	0.022	3

Table 3: Measured variables of maxillary teeth of Coelophysis bauri from the study sample. Univariate statistics showing the mean, minimum, maximum, standard deviation (s.dev), and number of tooth measurements for the dentigerous elements of C. bauri study skulls. FABL, fore-aft basal length; IAD, interalveolar distance; CH, crown height; Curv, curvature length; CBW, crown basal length; CA, crown angle; ACL, anterior carina length; ACDL, anterior carina denticulate length; PCL, posterior carina length; PCDL, posterior carina denticulate length; LAD, largest denticle on anterior carina; LPD, largest denticle on posterior carina; W, width; L, length; H, height.

Variable	Mean	Minimum	Maximum	St. Dev.	Number
FABL	2.85	0.600	6.36	1.09	311
IAD	0.980	0	2.75	0.522	185
CH	4.19	0.700	11.4	2.28	181
CAL	5.36	1.06	13.7	2.86	135
CBW	1.20	0.400	2.38	0.493	60
CA	61.2	26.6	86.02	1.14	108
ACL	4.09	0.880	8.60	2.00	65
ACDL	3.82	0.780	8.60	2.03	64
PCL	4.30	0.880	9.90	2.17	81
PCDL	4.42	0	9.90	2.27	62
LAD-W	0.103	0.100	0.110	0.006	3
LAD-L	0.088	0.022	0.250	0.026	151
LAD-H	0.085	0.044	0.154	0.023	140
LPD-W	0.106	0.067	0.150	0.042	3
LPD-L	0.100	0.040	0.250	0.026	160
LPD-H	0.100	0.022	0.154	0.024	145

Table 4: Measured variables of dentary teeth of Coelophysis bauri from the study sample. Univariate statistics showing the mean, minimum, maximum, standard deviation (s.dev), and number of tooth measurements for the dentigerous elements of C. bauri study skulls. FABL, fore-aft basal length; IAD, interalveolar distance; CH, crown height; Curv, curvature length; CBW, crown basal length; CA, crown angle; ACL, anterior carina length; ACDL, anterior carina denticulate length; PCL, posterior carina length; PCDL, posterior carina denticulate length; LAD, largest denticle on anterior carina; LPD, largest denticle on posterior carina; W, width; L, length; H, height.

Variable	Mean	Minimum	Maximum	St. Dev.	Number
FABL	2.39	0.500	4.30	0.761	184
IAD	0.566	0.100	1.35	0.262	135
CH	3.65	0.600	8.20	1.56	71
CAL	4.54	1.30	8.30	1.59	52
CBW	1.40	0.700	1.70	0.250	34
CA	62.2	42.7	80.4	1.45	37
ACL	2.99	2.18	4.50	0.684	15
ACDL	3.03	2.18	4.50	0.736	18
PCL	3.80	1.02	6.00	1.48	24
PCDL	3.43	0	6.00	1.76	24
LAD-W	0.022	0.022	0.022	0	3
LAD-L	0.077	0.033	0.132	0.021	44
LAD-H	0.085	0.022	0.110	0.019	46
LPD-W	0.088	0.088	0.088	N/A	1
LPD-L	0.099	0.066	0.154	0.020	68
LPD-H	0.101	0.066	0.132	0.015	68

Individual Variation in the Teeth of *Coelophysis bauri*

Skulls of *Coelophysis bauri* have variable tooth numbers in relation to tooth-bearing element size, with the exception of the premaxillae: regardless of tooth row length, premaxillae of *C. bauri* invariably possess four teeth. The dental formula range (number of premaxillary alveoli + number of maxillary alveoli/number of dentary alveoli) for the skulls examined with complete tooth-bearing elements is P4 + M13 - M28/D17 – D27.

Average fore-aft basal length, crown basal width (Fig. 13), crown height and crown angle measurements (Fig. 14) were plotted for each tooth position. Much of the variation in tooth crown morphology for *Coelophysis bauri* is due to positional variation. The positional variation graphs (Figs. 13-14) show the heterodonty described for *C. bauri* by Colbert (1989, 1990). The largest crowns are in maxilla positions M3 – M13, whereas the crowns in positions M15 – M28 become progressively smaller. Premaxillary and dentary teeth show less positional variation than do maxillary teeth. The largest average crown sizes for fore-aft basal length (FABL) are seen in positions M5 and D19 (Fig. 13), and positions M9 and D5 for crown height (Fig. 14).

Heterodonty is seen in both small and large skulls. Positional variation graphs were constructed for specimens AMNH 7242, NMMNH P42200 (small skulls, Fig. 15), and AMNH 7240 (large skull, Fig. 16). The largest maxillary tooth in AMNH 7240 is M11, and the largest dentary tooth is D19. The largest maxillary tooth in NMMNH P-42200 is M7, and the largest dentary tooth is D14. In AMNH 7242 the largest maxillary tooth position is M6 (there was no dentary visible). The largest tooth position shifts posteriorly as skulls increase in size.

Figure 4: Photograph of NMMNH P-50529 right dentary tooth rD3 of *Coelophysis bauri*, showing the sub-rounded cross section (average FABL/CBW ratio = 1.63) and adenticulate morphology typical of anterior dentary teeth. FABL, fore-aft basal length; CBW, crown basal width. Scale = 2.0mm.

Multivariate Statistical Analyses Results

Normality and Specimen Variation

Shapiro-Wilks analysis on the dataset shows that data for each variable were falsified as having a non-normal distribution (Table 7). Principal component analyses (PCA) on unadjusted data do not show a distinct separation of any specimen based on variation within the dataset (Fig. 17, Table 8). Principal component (PC) 1 (size) accounts for 63.6% of the variation within the dataset. PC 2 is interpreted as crown size-denticle length and height variance (11.2%), and PC 3 is interpreted as the variation contributed along the denticle width-anterior carinae length axis (8.25%). In other words, taller crowns have a relatively smaller FABL, and larger teeth have relatively smaller denticles. Principal components 4 through 14 account for the remaining 16.6% of the variation (Table 8).

Table 5: Mean (x) and number of teeth available for measured variable (N) of variables measured (in millimetres, crown angle CA in degrees) for teeth of Coelophysis bauri, showing data for premaxillary teeth P1 – P4, anterior maxillary teeth M1 - M5, mid-row maxillary teeth M6 – M20, posterior maxillary teeth M21 – M28, anterior dentary teeth D1 – D5, mid-row dentary teeth D6 – D20, and posterior dentary teeth D22 – D27. ACDL, anterior carina denticulate length; ACL, total anterior carina length; CA, crown angle; CBW, crown basal width; CH, crown height; FABL, fore-aft basal length; PCDL, posterior carina denticulate length; PCL, total posterior carina length. *The mean is recorded for the PCDL, but the individual measurements indicate a large amount of variation (0.00mm, 0.800mm, 5.84mm); ^ The mean is recorded for ACL for premaxillary teeth, but the individual measurements indicate a large amount of variation (5.02mm, 0.00mm).

Tooth Position	Data	Variable							
		FABL	CH	CBW	CA	ACL	ACDL	PCL	PCDL
Premaxillary teeth P1 – P4	X	1.87	4.66	1.54	72.9	5.02	3.46	4.21	3.92
	N	59	42	16	28	2^	88	119	101
Maxillary teeth M1 – M5	X	1.83	3.55	1.41	65.1	NA	3.48	4.81	2.21
	N	60	32	13	22	0	2	3	3
Maxillary teeth M6 – M20	X	3.01	4.10	1.12	58.4	3.04	3.03	3.66	3.32
	N	188	115	35	74	12	13	22	23
Maxillary teeth M21-M28	X	2.19	2.10	0.800	57.5	2.10	2.23	2.02	2.25
	N	32	15	10	10	7	4	6	4
Dentary teeth D1 – D5	x	1.83	3.55	1.41	65.1	NA	3.48	4.81	2.21*
	N	60	32	13	22	0	2	3	3
Dentary teeth D6 – D20	x	2.60	3.81	1.33	62.6	3.04	3.03	3.66	3.32
	N	129	47	22	31	12	13	22	23
Dentary teeth D21 – D27	x	2.79	2.67	1.15	63.3	2.79	2.72	2.66	2.66
	N	15	4	6	3	3	3	2	2

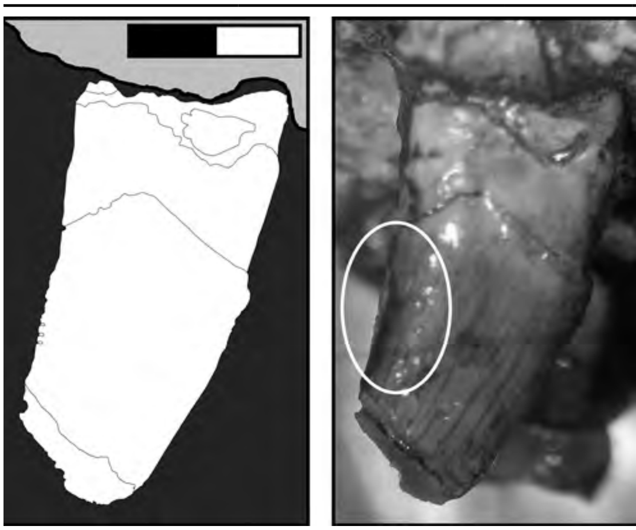

Figure 5: Line drawing (left) and photograph (right) of right premaxillary tooth P3 of Coelophysis bauri specimen AMNH 7240 showing denticles on the posterior carina. Scale = 2.0mm.

Discriminant analyses on teeth that are *a priori* separated into groups based on their tooth-bearing elements (premaxilla, maxilla, dentary) show that, while the Hotelling's t^2 p_{same} values (premaxilla versus maxilla: p_{same} = 1.5 X 10^{-15}; premaxilla versus dentary: p_{same} = 5.2 X 10^{-07}; maxilla versus dentary: p_{same} = 5.3 X 10^{-09}, 68.8%) indicate that each group is significantly different from the others, the percentage of correctly identified teeth in each comparison is low (premaxilla versus maxilla, 80.0%; premaxilla versus dentary, 69.0%; maxilla versus dentary, 68.8%). The teeth most commonly misidentified by the discriminant analysis were those teeth of the anterior maxilla (M1 – M4) and anterior dentary (D1-D5). Given the morphologic similarity between the most anterior maxillary and dentary teeth (wide CBW, relatively straight crowns, short to absent denticulate carinae) these statistical misidentifications are not unexpected. Canonical variate analyses also show similar results: Hotelling's t^2 p_{same} values indicate a significant difference among premaxillary, maxillary, and dentary teeth despite the close groupings in morphospace (Figs. 18-19, Table 9).

Separating Teeth From Large (Adult) and Small (Juvenile) Specimens

Bivariate plots of the 13 complete skulls with both dentigerous element and skull lengths available (Fig. 2) show there are two groupings based on size within this data set. The skulls are listed in order from smallest to largest skull length in the sample ontogenetic series (Fig. 2). Skulls AMNH 7242 and MNA V3318, AMNH 7227, AMNH 7230, AMNH 7231, AMNH 7239, AMNH 7241, DMN

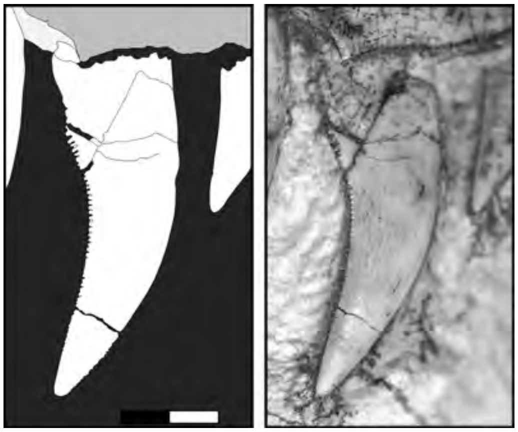

Figure 6: Line drawing (left) and photograph (right) of NMMNH P-44551 right maxillary tooth rM4 of *Coelophysis bauri*, showing the denticulate posterior carina. Scale = 2.0mm.

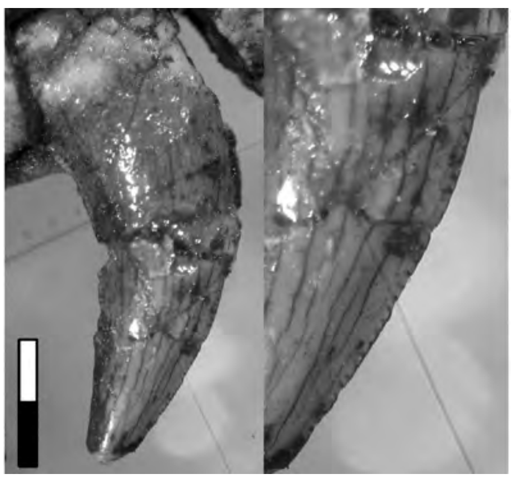

Figure 7: Photographs of AMNH 7240 left maxillary tooth lM2 of *Coelophysis bauri* (left), showing denticles on the anterior carina (right). Scale = 2.0mm.

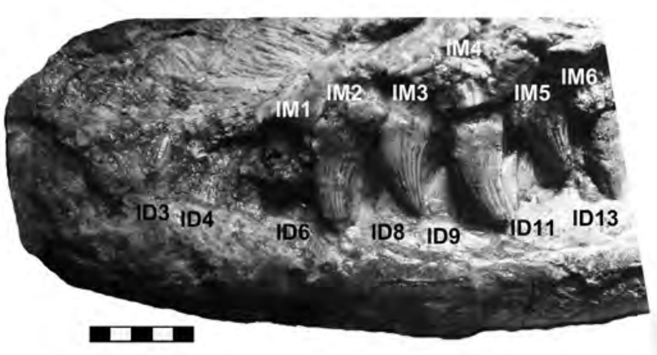

Figure 8: Photograph of *Coelophysis bauri*, specimen RTMP 1984.063.0001-1, left lateral view, showing longitudinally ridged maxillary teeth. M, maxilla; D, dentary; Dt, uncertain dentary tooth position; l, left; r, right. Scale = 5.0mm.

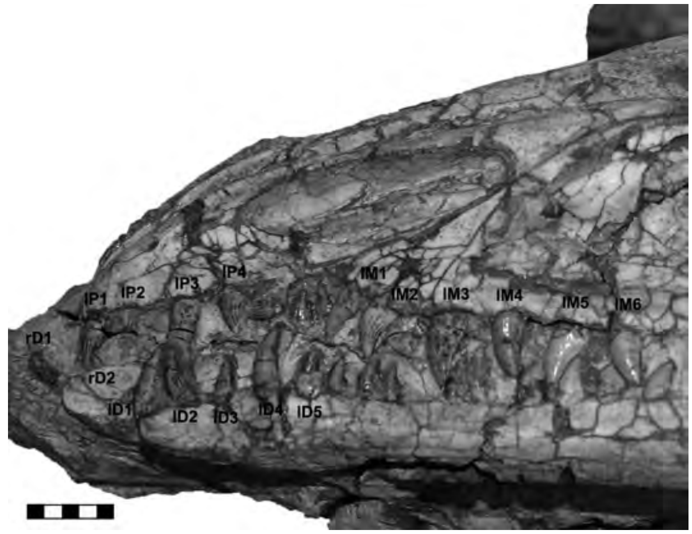

Figure 9: Photograph of *Coelophysis bauri*, specimen NMMNH P-42200, left lateral view of longitudinally ridged premaxillary, maxillary, and dentary teeth. P, premaxilla; M, maxilla; D, dentary; l, left. Scale = 5.0mm.

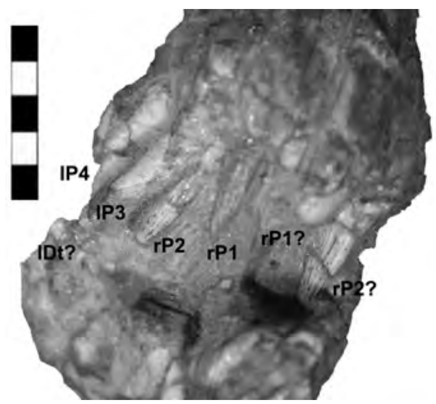

Figure 10: Photograph of *Coelophysis bauri*, specimen MNA V3318, premaxilla and anterior dentary, rostral view, showing longitudinally ridged premaxillary teeth. P, premaxilla; D, dentary; l, left; r, right; t, tooth. Scale = 5.0mm.

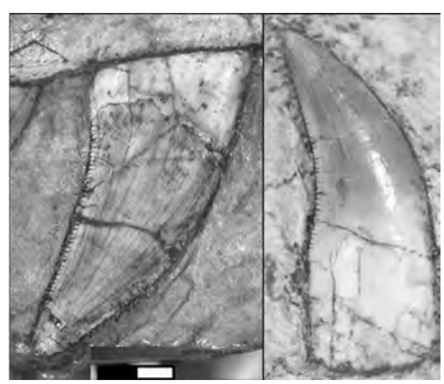

Figure 11: Photograph of AMNH 7240 right maxillary tooth rM10 (left) and NMMNH P-50529 right dentary tooth rD10 (right) of Coelophysis bauri, showing the laterally compressed, recurved morphology typical of mid-row maxillary and dentary teeth. Both anterior and posterior carinae are fully denticulae. Scale = 2.0mm.

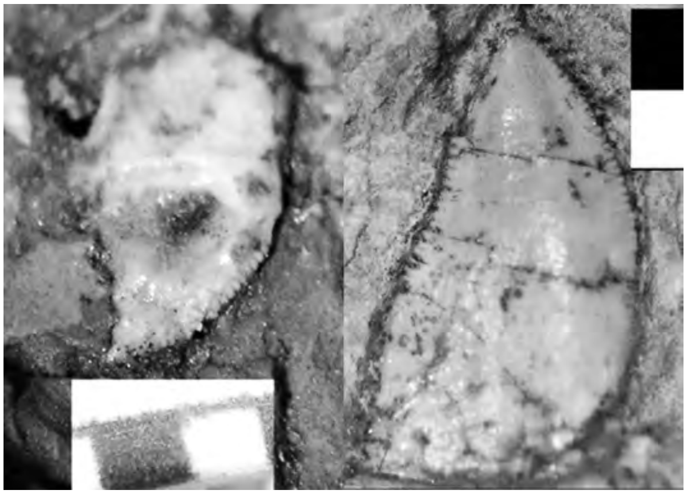

Figure 12: Photographs of AMNH 7240 right maxillary tooth rM24 (left) and NMMNH P-50529 right dentary tooth rD25 (right), showing the labiolingually compressed, broad fore-aft basal length morphology of a typical posterior maxillary and dentary crown of *Coelophysis bauri*. Denticles run the entire length of both anterior and posterior carinae, and relative denticle size is larger compared to overall crown size: denticle size is relatively constant regardless of tooth position. Scale = 2.0mm.

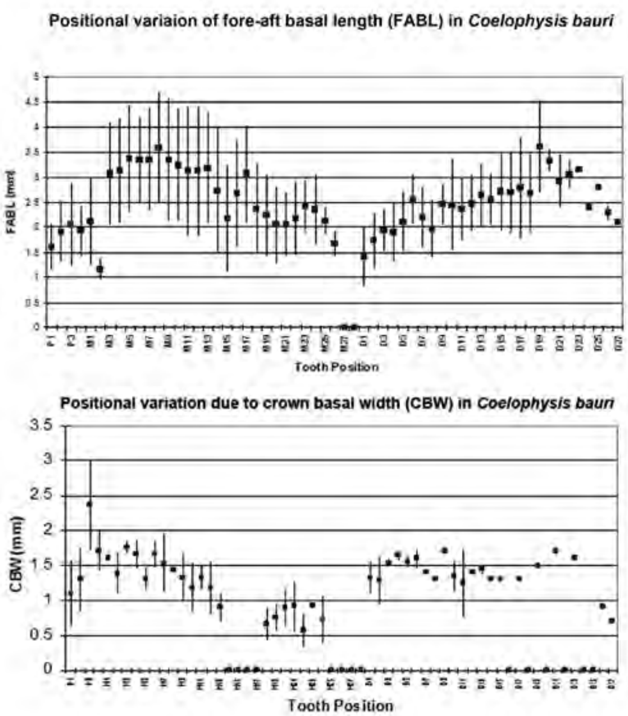

Figure 13: Positional variation and average fore-aft basal length (FABL, top) and crown basal width (CBW, bottom) for all specimens, showing +/- one standard deviation. Zero values indicate tooth positions for which data were not available. P, premaxilla; M, maxilla; D, dentary.

39022, MNA V3315, NMMNH P-42200, and RTMP 1984.063.0001-1 fall into a small group, and AMNH 7228 and AMNH 7240 fall into a large group. Multivariate statistical analyses were performed on $\log_{10}$-transformed data to reduce the influence of size on the analyses.

The teeth from juvenile- and adult-sized skulls fall into distinct clusters in PCA, but there is considerable overlap between the juvenile and adult groupings (Fig. 20, Table 10). The differences in proportions of tooth dimensions between skulls in the juvenile and adult categories show that teeth from juvenile-sized skulls plot lower along PC1 (x-axis) than teeth from adult-sized skulls. In other words, the only visual difference in terms of measured variables between teeth of small and large skulls of *Coelophysis* is size. Discriminant analysis on the skulls in the juvenile- and adult-sized categories shows 70.5% of correctly identified tooth positions (Hotelling's t^2: p_{same} = 1.53 X 10^{-25}, Fig. 21). This percentage is not high enough to assign teeth from the two skull categories to two distinct morphotypes.

Comparisons of Ontogenetic Heterodonty

Separating teeth into *a priori* groupings based on their tooth-bearing elements does not provide increased resolution in either the effect of heterodonty or ontogeny on the teeth of *Coelophysis bauri* (Fig. 22). The major axes show that smaller teeth have relatively larger denticles, an observation made by Currie et al. (1990), and that teeth with shorter crown heights have relatively longer, denticulate posterior carinae. This is due to the posterior maxillary and dentary teeth, in which the denticulate portions of the posterior carinae extend the full height of the crown (Fig. 12). Canonical variate analysis (Table 11) on the tooth groupings reveals that the differences among these groups are significant: the exception is the comparison of small and large premaxillary teeth (p_{same} = 0.136). Canonical variate analysis on denticle measurements reveal there is no significant difference (Hotelling's t^2: $p_{same} > 0.01$) in denticle proportions due to either tooth-bearing element or skull size (Fig. 23, Table 12).

SYSTEMATIC PALEONTOLOGY

Revised dental description of *Coelophysis bauri*

Theropoda Marsh, 1881

Ceratosauria Marsh, 1884

Coelophysoidea Holtz, 1994

Coelophysis Cope, 1889

C. bauri Cope, 1889

Original Diagnosis: The original diagnosis of *Coelurus bauri* modified from Cope (1887, p. 368) states ". . . the sides of the cervical centra are deeply and widely grooved on the posterior half, and the [dorsal] face of the neural arch is strongly grooved on each side of the anterior half. The femur is not so strongly grooved at the third trochanteric ridge."

Revised Diagnosis by Cope (1887, 1889): The first revision of the *Coelurus bauri* diagnosis was completed by Cope (1887) to reassign the species he named from the genus *Coelurus* to *Tanystrophaeus*. Cope (1889, p. 626) later reassigns *Tanystrophaeus bauri* to *Coelophysis bauri*, and stated that the skeletal material in question ". . . [differs] from *Coelurus* in the biconcave cervical vertebrae, and from *Megadactylus* in the simple femoral condyles. . . "

Revised Dental Anatomical Description by Colbert (1989): "Four premaxillary teeth with rounded cross-sections; 23 to 26 laterally compressed, serrated, pointed maxillary teeth; 25 to 27 dentary teeth" (Colbert 1989, p. 33). Refer to Colbert (1989, p. 33-34) for his complete revised osteological description of *Coelophysis bauri*, and to Rinehart et al. (2009) for a detailed description of the

Table 6: Fourteen near complete skulls of *Coelophysis bauri* were examined for the presence of teeth with longitudinal enamel ridging. While the study sample is not a complete ontogenetic series, there is a correlation between skull premaxillary-quadrate length and the presence of ridged teeth in the most anterior tooth positions (premaxillary, anterior maxillary, and anterior dentary teeth), with small skulls (less than 143.0mm in length) having a higher probability of possessing ridged teeth. However, the pattern is not consistent: there is a weak correlation between skull length and number of ridged teeth. M, maxilla; D, dentary.

Specimen	Premaxilla-quadrate skull length (mm)	Most posterior ridged maxillary tooth	Most posterior ridged dentary tooth
MNA V3318	69.7	M4	Not visible
AMNH 7242	77.0	M2	Not visible
AMNH 7231	100.0	Unridged teeth	Unridged teeth
RTMP 1984.063.0001-1	109.9	M5	D3
AMNH 7230	110.5	Teeth missing	Teeth missing
AMNH 7241	140.0	Unridged teeth	Unridged teeth
NMMNH P-42200	142.8	M1	D6
DNM 39022	145.9	Unridged teeth	Unridged teeth
MNA V3315	152.3	Unridged teeth	Unridged teeth
AMNH 7227	159.0	Unridged teeth	Unridged teeth
AMNH 7239	163.0	Unridged teeth	Unridged teeth
AMNH 7228	190.0	Unridged teeth	Unridged teeth
AMNH 7240	213.2	Unridged teeth	Unridged teeth

postcranial elements of multiple specimen preserved within the NMMNH Whitaker quarry block.

Emended Dental Anatomical Description: Four premaxillary teeth with rounded cross-sections, with the variable presence of denticles on the posterior carina of premaxillary tooth P4; 13-28 maxillary teeth; 17-27 dentary teeth. The remaining anatomical description of *Coelophysis bauri* by Colbert (1989) is emended by Rinehart et al. (2009).

Remarks: The anatomical description of *Coelophysis bauri* is emended to account for the range of dental formulae exhibited by individuals at different ontogenetic stages. It is unclear which skull sizes Colbert (1989) referred to in the revised description. The emended description also accounts for the possibility of denticulate premaxillary teeth, which differs from the description of the premaxillary teeth by Colbert (1989, p. 71). The emended dental characters are not included in the diagnosis of *C. bauri* as they are not autapomorphies of this species, and the diagnosis remains unchanged.

DISCUSSION AND CONCLUSIONS

Amendments to Colbert's (1989) Description of Dentition of *Coelophysis bauri*

Colbert (1989) presented ambiguous descriptions of the dental formulae of *Coelophysis bauri*, and it is uncertain whether he referred to specimens of similar skull size or several skull sizes when presenting the two formulae: 4 + 23 - 26/25 - 27 (Colbert 1989, p. 29, 33, 68), and 4+22 – 26/? (Colbert 1989, p. 60, 69). There was no explanation given for the discrepancy between the dental formulae. There is one additional maxillary tooth position (dental formula 4 + 13 - 28/17 – 27) added to the previous maximum number of positions presented in dental formulae of Colbert (1989), while there were no changes to the maximum number of tooth positions in the premaxillae and dentaries.

Denticulate premaxillary teeth occur in both the adult (AMNH 7240) and juvenile (DMN 39022) groups. The sample size is small (n = 2), but suggests that denticulate premaxillary teeth are not limited to skulls of *C. bauri* of a certain size or ontogenetic stage. Observations made on the lack of serrations on premaxillary teeth by Colbert (1989) are revised to include the presence of serrations

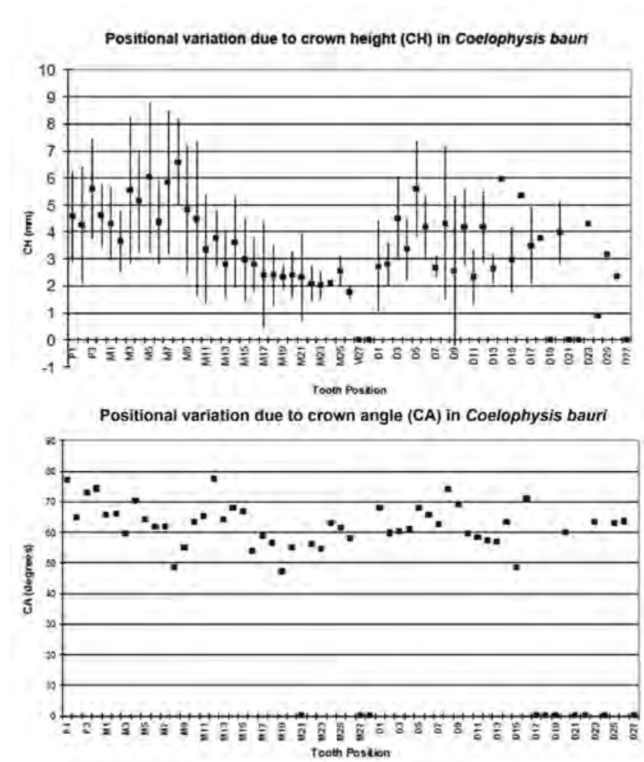

Figure 14: Positional variation in average crown height (CH) +/- one standard deviation (top) and average crown angle (CA, bottom) in all specimens of *Coelophysis bauri*. Crown angles of zero show tooth positions for which data were not available. P, premaxilla; M, maxilla; D, dentary.

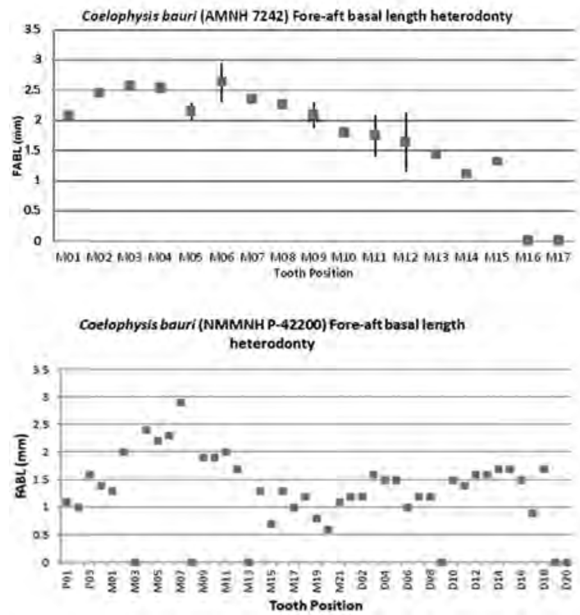

Figure 15: Fore-aft basal length (FABL) heterodonty in a small (juvenile) skull of *Coelophysis bauri*, as represented by AMNH 7242 (top) and NMMNH P-42200 (bottom). When compared to a large skull (Fig. 16), the tooth with the largest FABL in the maxilla is M06, compared to the largest FABL in tooth position M11 for AMNH 7240. P, premaxilla; M, maxilla; D, dentary.

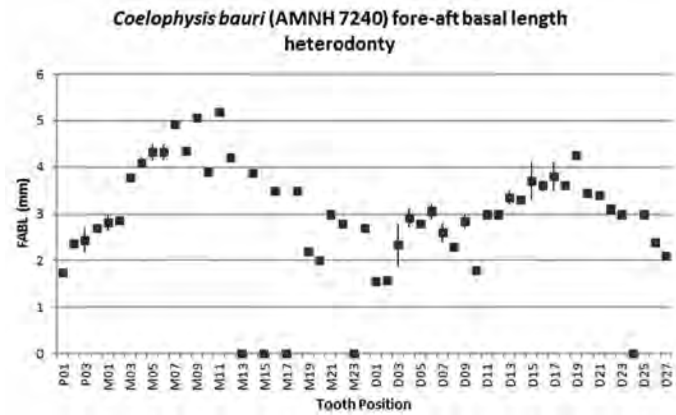

Figure 16: Fore-aft basal length (FABL) heterodonty in a large (adult) skull of *Coelophysis bauri*, as represented by AMNH 7240. The tooth with the largest FABL is in tooth position M11, while the largest dentary tooth is in position D19. Teeth with 0.00mm FABL were either missing from the tooth row or were not yet erupted. The largest tooth positions in a small (juvenile) skull (Fig. 15) occupy more anterior maxillary and dentary tooth positions. This indicates that as individuals of *C. bauri* age, tooth positions may be added that shift the largest alveoli more posterior simultaneous with increasing the overall anteroposterior length of the alveoli. Zero values indicate tooth positions for which data were not available. P, premaxilla; M, maxilla; D, dentary.

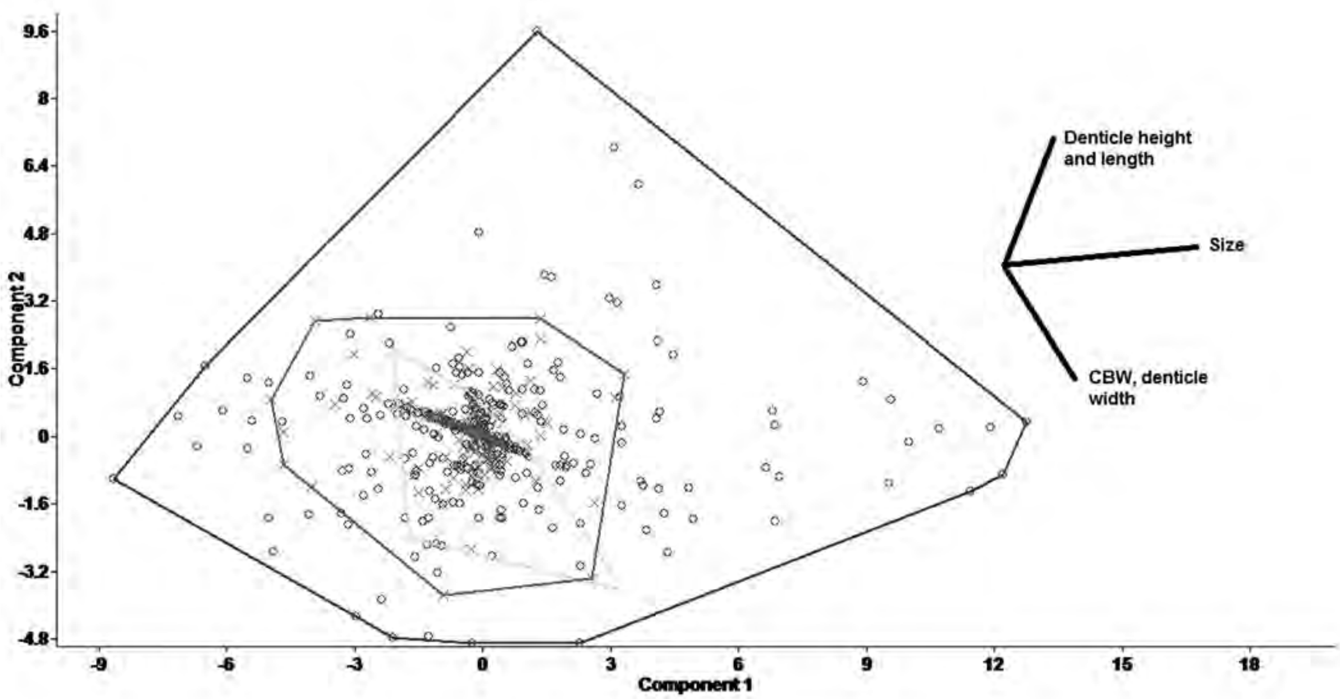

Figure 17: Principal component analysis graphical results for principal component (PC) 1 vs PC2 (top) and PC1 and PC3 (bottom) on C. bauri teeth from the premaxilla (blue), maxilla (purple), and dentary (green). There is no separation of teeth based on tooth - bearing element origin.

Table 7: Shapiro-Wilks normality test results of Coelophysis bauri sample. All variables were collected from a sample whose population has a not non- normal distribution (p < W). W, Shapiro-Wilks test statistic; pnormal, probability; N, number of teeth that have measured variable. ACDL, anterior carina denticulate length; ACL, total anterior carina length; CA, crown angle; CBW, crown basal width; CH, crown height; FABL, fore-aft basal length; H, height; L, length; LAD, largest anterior denticle; LPD, largest posterior denticle; PCDL, posterior carina denticulate length; PCL, total posterior carina length; W, width.

Variable	W	pnormal	N	Proportion of dataset
FABL	0.985	5.80 X 10-06	605	0.713
CH	0.977	4.32 X 10-05	322	0.380
Curv	0.982	5.05 X 10-03	233	0.275
LPD-L	0.893	1.02 X 10-11	231	0.272
LPD-H	0.842	4.63 X 10-14	216	0.255
LAD-L	0.866	3.98 X 10-12	196	0.231
LAD-H	0.895	3.52 X 10-10	186	0.219
CBW	0.953	2.44 X 10-04	127	0.150
PCL	0.971	0.0110	119	0.140
PCDL	0.944	3.18 X 10-04	101	0.119
ACDL	0.882	8.30 X 10-07	88	0.104
ACL	0.964	0.0164	87	0.103
LAD-W	0.707	7.35 X 10-03	6	0.007
LPD-W	0.981	0.906	4	0.005

on premaxillary tooth positions P3 and P4, although this was not observed for all specimens.

The presence of serrated carinae is considered the plesiomorphic state in theropods (Abler, 1997; Smith, 2005), and the absence of serrations in premaxillary teeth is often used for identifying isolated premaxillary teeth in other theropod taxa. For example, the absence of serrations has been used to identify shed tyrannosaurid teeth recovered from the Upper Cretaceous Dinosaur Park (late Campanian) (Currie et al., 1990) and Hell Creek (late Maastrichtian) formations (Molnar and Carpenter, 1989; Carpenter, 1992) as belonging to *Aublysodon* sp.; however, studies of tyrannosaurid skull anatomy show that the isolated, unserrated premaxillary teeth may be the result of ontogenetic or individual variation (Brochu, 2003; Currie, 2003; Holtz, 2004; Carr and Williamson, 2004), and do not support the validity of *Aublysodon* sp.

Absent or reduced denticles on premaxillary carinae are listed as a feature common in the Coelophysoidea, and were used as a character in a phylogenetic analysis of *Segisaurus halli* (Carrano et al., 2005). Given Colbert's (1989, 1990)original description of *C. bauri* premaxillary teeth as unserrated, isolated premaxillary teeth from *C. bauri* with serrations have the potential to be identified as a separate (albeit invalid) tooth taxon, as was once the case with *Aublysodon*.

Sexual Variation and Tooth Morphology in *Coelophysis bauri*

Results from the bivariate and multivariate analyses on the teeth of *Coelophysis bauri* correspond with the multivariate analyses on skulls of *C. bauri* of Smith and Merrill (2006), when they described a population composed of this single, but highly variable species. However, neither bivariate nor multivariate analyses on teeth reveal the two similarly sized "morphotypes" (gracile and robust) seen in the facial analysis of Smith and Merrill (2006), and documented by Colbert (1989, 1990) and Rinehart et al. (2009).

Specimen AMNH 7227 was described by Smith and Merrill (2006) as being shorter and deeper than the other skulls in their sample, and it groups closer with *Megapnosaurus kayantakatae* than with other specimens of *C. bauri*. AMNH 7227 does not cluster distinctly in multivariate analyses based solely on tooth morphology. The variables that separated the skull of AMNH 7227 from the rest of the *C. bauri* sample in Smith and Merrill (2006) would not cause any teeth shed from the individual represented by AMNH 7227 to be misidentified as a distinct morphotaxon. This suggests that, while a species of theropod may exhibit a high degree of morphologic variability, this variability may not be expressed in terms of tooth morphology.

Variation and Heterodonty in *Coelophysis bauri*

The heterodont dentition seen in the study sample of *Coelophysis bauri* is characteristic of Coelophysoidea dentition (Tykowski and Rowe, 2004), and is the source of much of the variation seen in the dataset. Anterior maxillary teeth are on average both larger in fore-aft basal length and crown height (CH), and are more curved than those of the premaxilla, posterior maxilla, and anterior dentary. The smaller tooth size seen in the anterior dentary is explained by the dorsal elevation of the anterior tip of the dentary above the rest of the dentary tooth row (Tykowski and Rowe, 2004), giving dentary positions D1 – D4 less space for crown height. Variation in tooth morphology caused by heterodonty is ontogenetically independent as seen by the low percentage of separation between tooth positions of juvenile- and adult-sized skulls in discriminant and canonical variate analyses. However, certain crown features are exaggerated by ontogeny (see "Ontogenetic change, sexual variation, and teeth of *Coelophysis bauri*" in this section).

Ontogenetic Change, Sexual Variation, and Teeth of *Coelophysis bauri*

Discriminant analysis shows that there is little difference in tooth morphology between the juvenile- and adult-sized skulls, with a less than 90% separation of tooth positions. Results from both principal component and canonical variant analyses show that teeth from juvenile- and adult-sized specimens form distinct groupings. However, there is such a high degree of overlap between the two groups that only the data points at the extreme ends of the cluster along the x-axis are distinct.

Tooth positions from the juvenile-sized skulls that fall into outlier positions of the principal component analysis data cluster include all premaxillary tooth positions, posterior maxillary teeth (M11 – M26), and anterior dentary teeth (D1 – D10). These teeth have proportionally smaller fore-aft basal length (FABL) and crown curvature (Curv) measurements (low x-axis values). In the adult-sized skulls, the outlying tooth positions are those of the anterior maxilla (M1 – M10), with proportionally larger FABL and Curv dimensions (high x-axis values). This can be interpreted as an ontogenetic exaggeration of the heterodonty in the Coelophysoidea. The outlying tooth positions in smaller (juvenile-sized) skulls (AMNH 7239, AMNH 7242, DMN 39022, MNA V-3315, and NMMNH P-42200), and the larger (adult-sized) skulls (AMNH 7240, NMMNH P-42579, NMMNH P-44555, and NMMNH P-50530) represent the extreme examples of coelophysoid heterodonty in the study skulls.

One possible explanation for the variation present in the Ghost Ranch sample of *Coelophysis bauri* is sexual variation (Colbert, 1989, 1990; Smith and Merrill, 2006; Rinehart et al., 2009). Two specimens of *C. bauri* (AMNH 7223 and AMNH 7224) are approximately the same size but have different skull and neck proportions, different skeletal fusion patterns, so that the "gracile" or "long" skull and neck morph (represented by AMNH 7223) and "robust" or "short" skull and neck morph (represented by AMNH 7224) are significantly different (Rinehart et al., 2009). It is unknown if the osteologic differences described in AMNH 7223 and AMNH

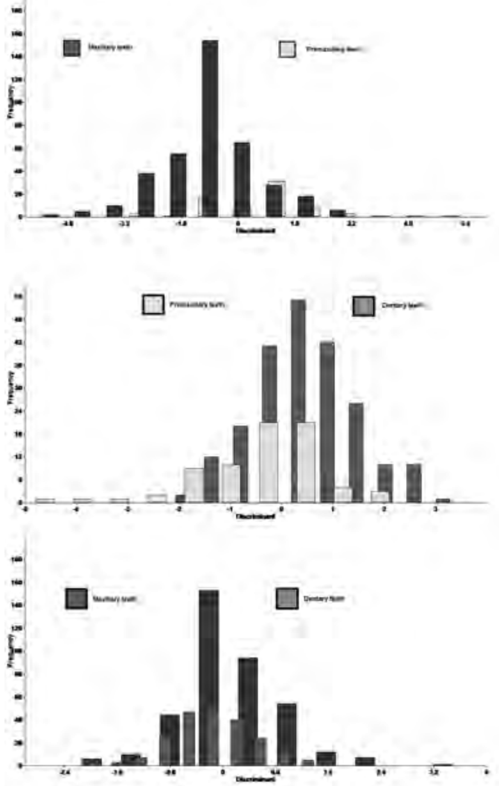

Figure 18: Discriminant analysis graphical results on *Coelophysis bauri* tooth data coded from the premaxilla (blue), maxilla (purple), and dentary (green). Premaxillary - maxillary teeth: Hotelling's t2 psame = 1.5 X 10-15, 80.0% correctly identified (top); premaxillary – dentary: Hotelling's t2 psame = 5.2 X 10-07, 69.0% correctly identified (middle); maxillary - dentary teeth: Hotelling's t2 psame = 5.3 X 10-09, 68.8% correctly identified (bottom). The percent separation is not high enough (> 90%) to consider teeth from different tooth-bearing elements different morphotaxa, even though the Hotelling's t2 values indicate morphologic distinctiveness. These comparisons serve as a caveat for using multivariate statistics to differentiate among morphotaxa.

7224 (Colbert, 1989, 1990; Rinehart et al., 2009) are reflected by their respective tooth morphologies, as these skulls were on display at the time of data collection. Multivariate analyses on tooth morphology do not show the bimodal distributions expected from a population exhibiting sexual variation. A larger sample size of skulls at the extreme ends of the ontogenetic series may resolve the juvenile and adult categories more distinctly in multivariate analyses. At this time there is no evidence to support the expression of sexual variation in tooth morphology.

Longitudinally Ridged Tooth Crowns and Ontogeny

Longitudinally ridged tooth crowns were noted by Colbert (1989) to be present on the premaxillary teeth of small skulls (though no quantitative information was given to define a "small skull") of *Coelophysis bauri*. This observation can be updated to include the maxillary tooth positions M1 – M4 for skulls in which premaxillae tooth rows are 14.0 mm or smaller and a skull length smaller than 143.0 mm (Fig. 2; Table 6), although the presence of ridged premaxillary, maxillary, and dentary tooth crowns is not consistent in skulls smaller than 143.0 mm.

The smallest skull, AMNH 7242, has the most posterior ridged tooth position (M2) in a more anterior position than the next largest skull (MNA V-3318), which has a ridged premaxillary tooth P4. The third, and next largest skull in the ontogenetic series (AMNH 7231), does not have ridged crowns, and AMNH 7230 only preserves alveoli and cross-sectional views of crown bases. RTMP 1984.063.0001-1 plots closely in size to AMNH 7230 and has ridged crowns as far posteriorly as M5 and D3. The next largest skull to RTMP 1984.063.0001-1 in the ontogenetic series (NMMNH P-42200) has only position M2 with a ridged crown while the rest of the crowns lack ridges, although the crown in position M3 is missing so it cannot be determined whether the crown has ridges. The remaining skulls in the ontogenetic series do not have ridged crowns.

The results suggest a strong relationship between the presence of longitudinally ridged premaxillary, anterior maxillary, and anterior dentary teeth and skull size. However, there are some exceptions. AMNH 7231 does not possess ridged premaxillary teeth, contrary to what was expected in the ontogenetic series where skulls larger and smaller than AMNH 7231 possess ridged teeth. Partial skulls that do not have ridged teeth include AMNH 7241 and RTMP 1984.063.0001-2. AMNH 7241 is only slightly smaller than NMMNH P-42200, yet does not possess ridged teeth. RTMP 1984.063.0001-2 is an incompletely exposed skull in which premaxillary tooth row length falls within the size range expected for the presence of ridged premaxillary teeth (> 15.0mm). The sample size used for this study

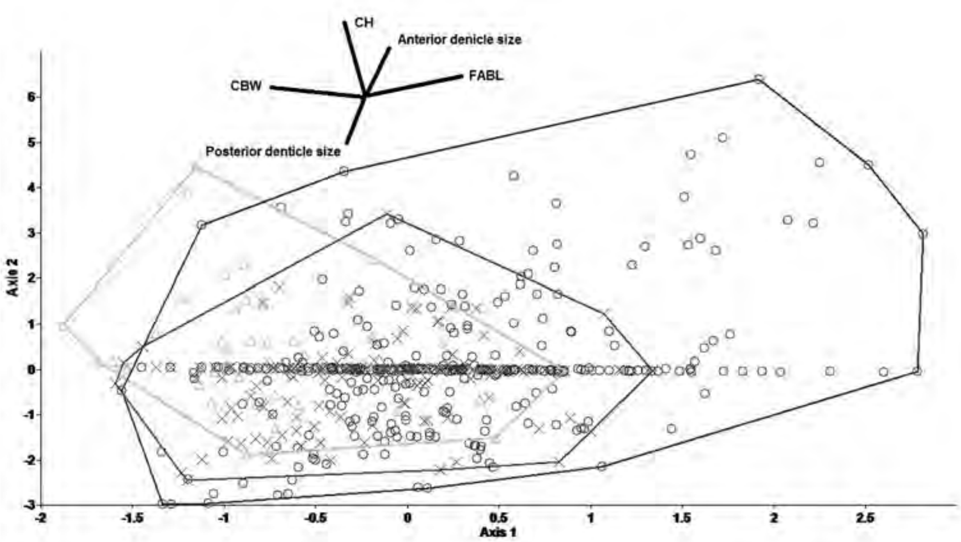

Figure 19: Canonical variant analysis (CVA) graphical results of teeth of *Coelophysis bauri* from the premaxilla (blue), maxilla (purple), and dentary (green), showing a high degree of overlap of tooth morphology among premaxillary, maxillary, and dentary teeth Refer to Fig. 1 for measurement abbreviations.

Table 8: Principal component results on non log10-transformed data of linear measurements of in situ tooth crowns of *Coelophysis bauri*. Size accounts for 63.6% of total dataset variation: however, tooth crowns show little differentiation in morphospace when principal component (PC) 1 is removed.

Principal Component	Percentage Variation	Descriptor
1	63.6	Tooth crown size
2	11.2	Crown size – denticle length and height variance
3	8.25	Denticle width – anterior carinae length axis
4-14	16.95	Remaining variation

Table 10: Principal component results of log10-transformed data of linear measurements of tooth crowns of *Coelophysis bauri*, a priori separated into small and large skulls. Once size (principal component 1) is removed from the graphical analysis, there is no differential grouping between teeth of small skulls and teeth of large skulls.

Principal Component	Percentages	Descriptors
1	43.8	Size
2	13.4	FABL – CH ratio
3	10.3	CBW – Carinae lengths ratio
4 - 14	32.5	Remaining variation

Table 9: Canonical variate analysis (CVA) of unadjusted (non log10-transformed) linear data of in situ tooth crowns of *Coelophysis bauri*. The CVA shows that while Hotelling's t2 psame values are low enough to consider the premaxillary, maxillary, and dentary teeth as morphologically distinct groups, the CVA graphical results show that teeth a priori categorized as premaxillary, maxillary, and dentary teeth occupy a similar morphospace.

Coelophysis bauri tooth crowns	Premaxillary teeth	Maxillary teeth	Dentary teeth
Premaxillary teeth	0	1.85 X 10-15	9.57 X 10-06
Maxillary teeth	1.85 X 10-15	0	2.65 X 10-08
Dentary teeth	9.57 X 10-06	2.65 X 10-08	0

may be too small to thoroughly explain these three exceptions.

As ridged teeth fall within the morphologic range of unridged teeth but are only present in the juvenile-sized skulls, there is no indication that Ghost Ranch specimens with longitudinally ridged teeth represent a novel taxon of coelophysoid. The presence of longitudinal ridges on the premaxillary, anterior maxillary and anterior dentary teeth appears to be an ontogenetically controlled characteristic of *Coelophysis bauri*.

Longitudinally Ridged Teeth in the Ceratosauria

Longitudinally ridged teeth are present in the non-coelophysoid Ceratosauria. Ridging on the lingual surfaces of premaxillary and the anterior three dentary teeth is described as diagnostic of the genus *Ceratosaurus* (Madsen and Welles, 2000, p. 35, fig. 11). However, figures of the type specimen of *C. magnicornis* (Madsen and Welles, 2000) show that there are no teeth preserved in the premaxillae, so the presence of ridged premaxillary teeth cannot be confirmed. *C. dentisulcatus* is described as having longitudinal ridges on the anterior three dentary teeth, although tooth crowns are only preserved in positions D1 and D2 of the left dentary (Madsen and Welles, 2000, p. 65, pl. 13).

The validity of *Ceratosaurus magnicornis* and *C. dentisulcatus* is uncertain, as these specimens may represent later ontogenetic stages of *C. nasicornis* (Tykowski and Rowe, 2004). If correct, it is possible that longitudinally ridged premaxillary and anterior dentary teeth are ontogenetically controlled and are only expressed in the later ontogenetic stages of the genus *Ceratosaurus*. There are also reports of longitudinal ridging on the anterior teeth of the ceratosaur *Masiakasaurus* (Fowler, 2007), although no mention was made of the ontogenetic stage of the specimen. There was no mention of ridged teeth in the description of teeth from the skull of *Zupaysaurus rougieri* (Ezcurra, 2007) or for the teeth of *Dilophosaurus wetherilli* (Welles, 1954, 1970, 1985). The presence of longitudinal ridging was not mentioned in dentition descriptions of *Megapnosaurus* (= *Syntarsus*) *kayantakatae* (Rowe, 1989). Only partial tooth crowns are preserved in *Cryolophosaurus ellioti* (Smith et al., 2007), so information on the presence of ridged tooth crowns was not available.

Longitudinal ridging was also used as a diagnostic character to identify isolated large theropod teeth from Upper Jurassic-Lower Cretaceous deposits as *Ceratosaurus* sp. (Madsen and Welles, 2000). Large theropod teeth that lack ridging but are morphologically similar to the ridged cf. *Ceratosaurus* sp. teeth from the same deposits were not identified as cf. *Ceratosaurus* sp. (Madsen and Welles, 2000). This

Table 11: Canonical variate analysis of in situ teeth of skulls of *Coelophysis bauri*, a priori separated into tooth bearing elements (premaxillary, maxillary, and dentary teeth) and separated into small and large groups (e.g., small premaxillary teeth, etc.). With the exception of the small versus large premaxillary teeth, all Hotelling's t2 show that the tooth groups are significantly different (psame < 0.05). Using multivariate statistical analyses alone, or misinterpreting the results, shows that teeth from differing tooth elements and different ontogenetic stages have the potential to be misinterpreted as originating from more than one theropod taxon.

Tooth-bearing element	Large Premaxillary Teeth	Large Dentary Teeth	Small Premaxillary Teeth	Large Maxillary Teeth	Small Dentary Teeth	Small Maxillary Teeth
Large Premaxillary Teeth	0	3.48 X 10-05	9.09 X 10-03	2.93 X 10-10	1.65 X 10-09	8.57 X 10-11
Large Dentary Teeth	5.22 X 10-04	0	9.73 X 10-10	3.72 X 10-03	1.64 X 10-08	0.0219
Small Premaxillary Teeth	0.136	1.46 X 10-08	0	2.91 X 10-12	4.67 X 10-07	7.86 X 10-08
Large Maxillary Teeth	4.39 X 10-09	0.0558	4.37 X 10-11	0	1.41 X 10-19	1.0 X 10-11
Small Dentary Teeth	2.47 X 10-08	2.45 X 10-07	7.00 X 10-06	2.12 X 10-18	0	1.46 X 10-06
Small Maxillary Teeth	1.29 X 10-09	0.328	1.18 X 10-06	1.62 X 10-10	2.19 X 10-05	0

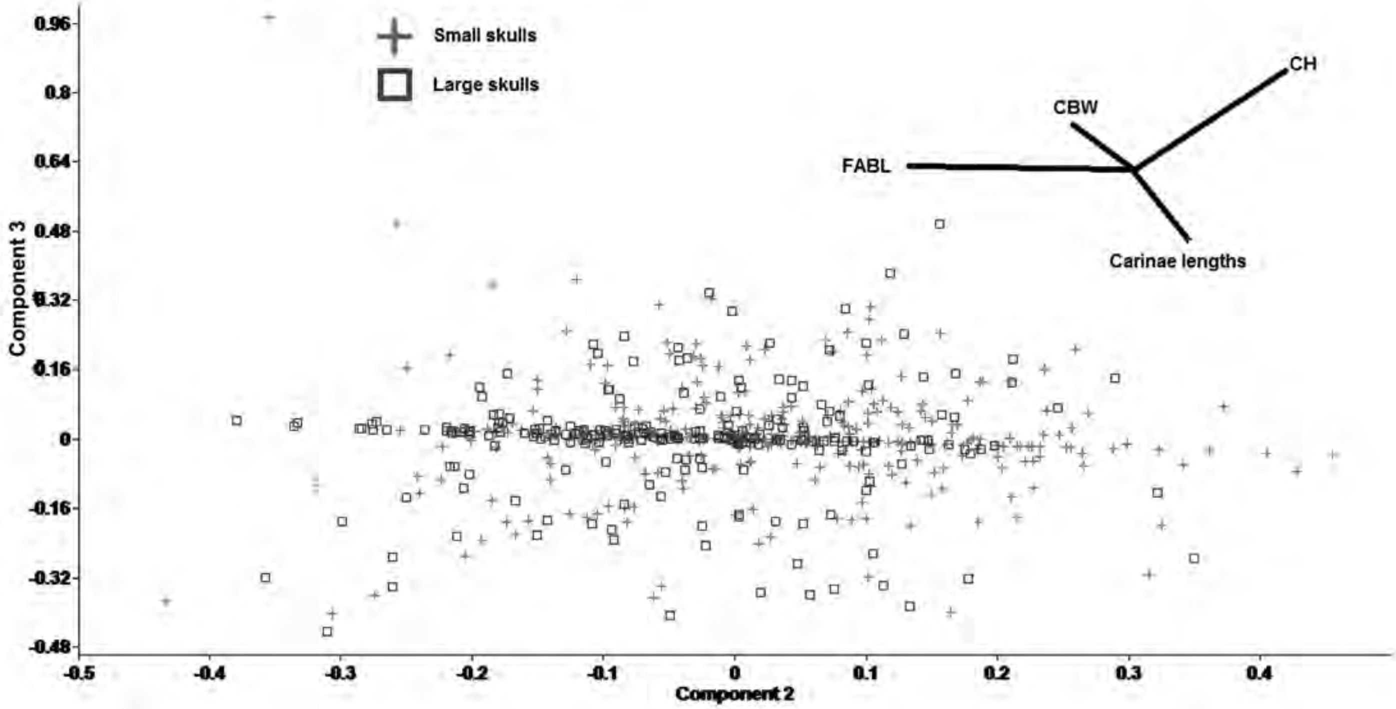

Figure 20: Principal component analysis graphical results of log10-transformed linear tooth data of Coelophysis bauri, a priori separated into small (red cross) and large (blue square) skulls. Principal component (PC) 1 (not shown) accounts for 43.8% of the variation in the dataset. Once size is removed, there is no distinct separation between small and large skulls. See Table 10 for the principal component descriptors.

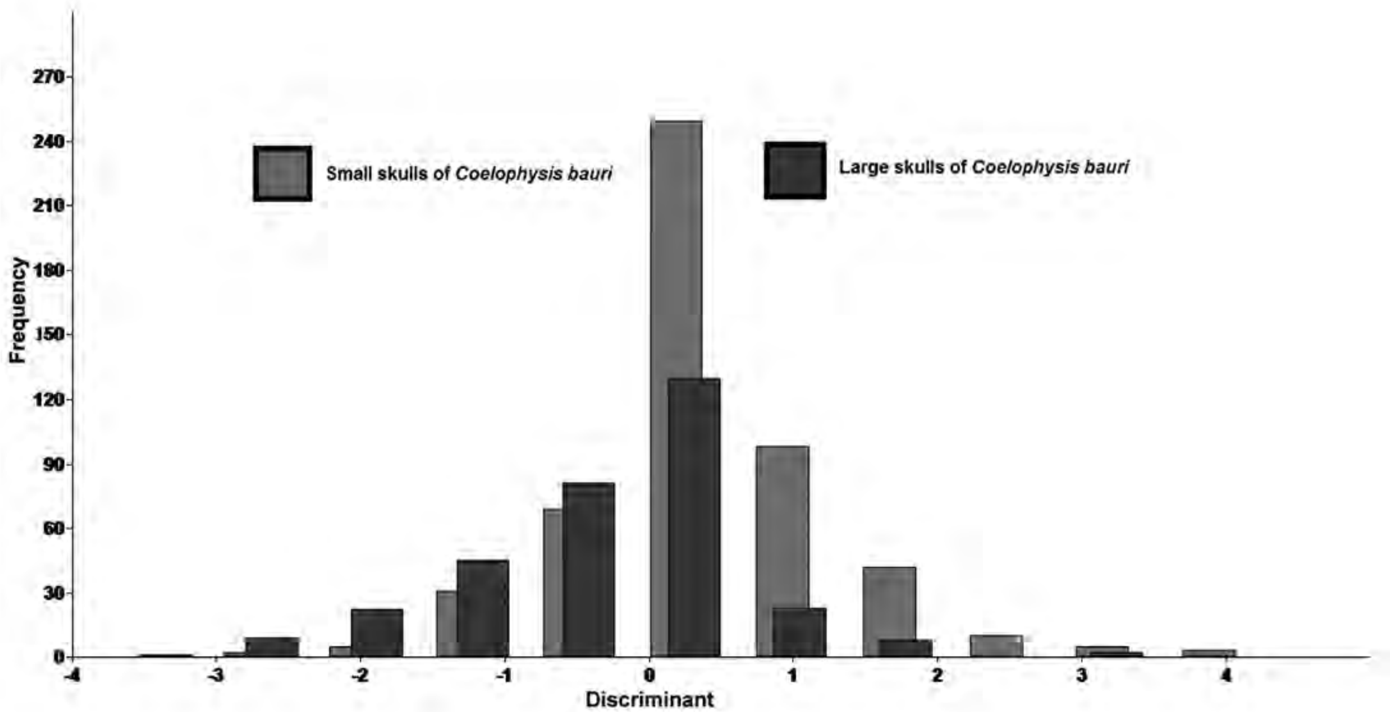

Figure 21: Discriminant analysis on small (juvenile) and large (adult) skulls of Coelophysis bauri, showing 70.5% correct placement of individual teeth into a priori categories of small (red) and large (blue) skulls. Although the Hotelling's t2 psame = 1.53 X 10-25, the percent separation between groups is too low (less than 90%) to consider teeth from small, juvenile skulls to be a distinct morphogroup from teeth of large adults.

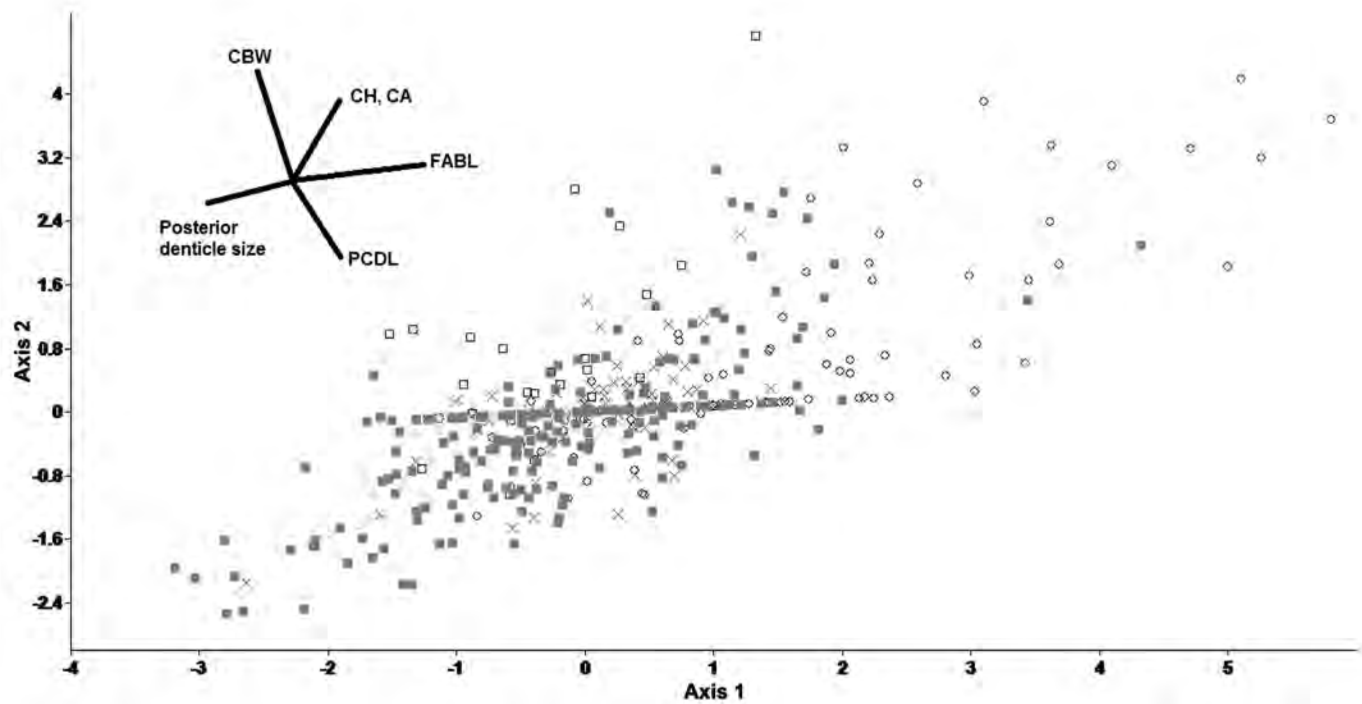

Figure 22: Canonical variate analysis of tooth crowns of *Coelophysis bauri* comparing data from juvenile premaxillary (light blue), juvenile maxillary (light purple), and juvenile dentary (light green) teeth to those teeth from adult premaxillae (dark blue), adult maxillae (dark purple) and adult dentaries (dark green). Hotelling's t2 show that these groups are significantly different (psame < 0.01); however, there is considerable overlap in morphospace among all tooth groups.

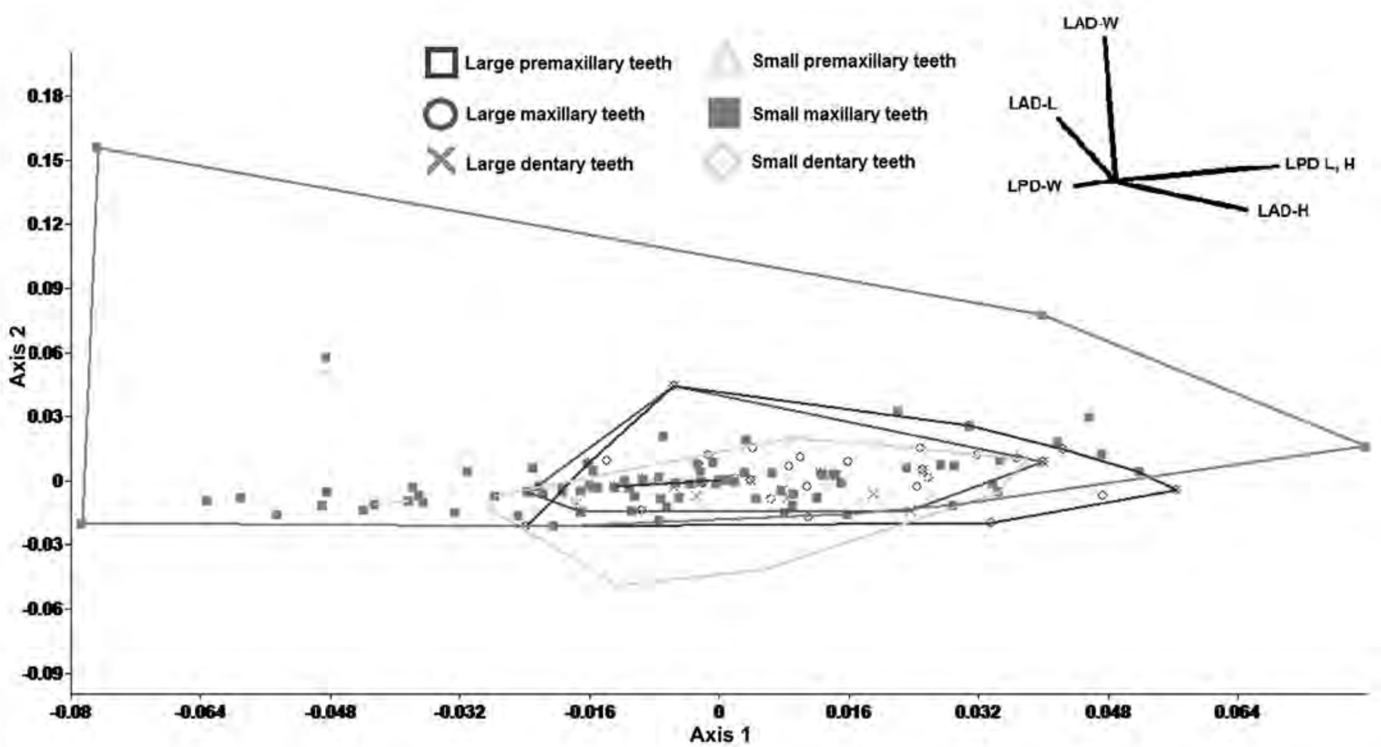

Figure 23: Canonical variate analysis of linear data collected from the largest anterior and posterior denticles of in situ teeth of *Coelophysis bauri*, comparing data from small premaxillary (light blue)), small maxillary (light purple), and small dentary (light green) teeth to those teeth from large premaxillae (dark blue), large maxillae (dark purple) and large dentaries (dark green). Hotelling's t2 show that these groups are not significantly different (psame > 0.01), as visualized by the large amount of overlap in morphospace among the a priori groups.

Table 12: Mean (X) and number (N) of measured denticles of in situ teeth of *Coelophysis bauri*. * indicate that the data was not available for analysis, as the denticles were hidden from view. ^ indicates that the sample size was not large enough to obtain a mean. ACDL, anterior carina denticulated length; H, denticle height; L, denticle length; LAD, largest anterior denticle; LPD, largest posterior denticle; W, denticle width.

Tooth Position	Data	Variable							
		ACDL	PCDL	LAD-W	LAD-L	LAD-H	LPD-W	LPD-L	LPD-H
Premaxillary teeth P1 – P4	X	NA*	0	NA	NA	NA	NA	0.0807	0.0660
	N	0*	3	0	0	0	0	3	3
Maxillary teeth M1 – M5	X	3.60	4.84	NA*	0.0827	0.0821	NA*	0.0943	0.0958
	N	18	23	0*	33	30	0*	34	31
Maxillary teeth M6 – M20	X	3.85	4.50	0.103	0.0928	0.0871	0.106	0.104	0.100
	N	38	32	3	81	74	3	85	80
Maxillary teeth M21- M28	X	2.23	2.25	NA*	0.124	0.0794	NA*	0.0902	0.0967
	N	4	4	0*	14	13	0*	18	14
Dentary teeth D1 – D5	X	3.48	2.31	NA*	0.0523	0.0825	NA*	0.0974	0.0880
	N	2	5	0*	4	4	0*	7	7
Dentary teeth D6 – D20	X	3.03	3.40	0.0440	0.0786	0.0850	0.0880^	0.0975	0.102
	N	13	21	4	35	37	1	53	53
Dentary teeth D21 – D27	X	2.72	2.66	NA*	0.0880	0.0836	NA*	0.110	0.110
	N	3	2	0*	5	5	0*	7	7

suggests that the presence of ridging was the primary feature used to classify these teeth, creating apparent support for the diagnostic strength of tooth ridges that may not exist.

Longitudinal Ridged Teeth in Other Groups of Theropoda

The presence of longitudinal ridging on teeth is not limited to taxa within the Ceratosauria. Longitudinal ridging is found on isolated teeth of multiple, distantly related taxa within the Theropoda (Sankey et al., 2002; Longrich, 2008; Sankey, 2008a). There have been a few attempts to use longitudinal ridges for shed tooth identification. Fowler (2007) suggests that tooth ridges may support a close phylogenetic relationship of the Spinosauridae and the Ceratosauridae. Longrich (2008) suggests that isolated teeth from the Lance Formation (Upper Cretaceous: upper Maastrichtian) identified as cf. *Richardoestesia gilmorei*, cf. *R. isosceles*, and cf. *Paronychodon* sp. represent a single taxon based on the presence of "*Paronychodon*-like" ridging in cf. *R. gilmorei* and *R. isosceles* teeth. These taxonomic interpretations are speculative in the absence of more complete specimens. That the presence of tooth ridges may be an ontogenetic factor (as suggested for *C. bauri*) suggests ridging alone should not be the basis for the taxonomy of shed theropod teeth. Isolated tooth crowns with ridging should be identified by features of their overall shape and serration characteristics (if present).

Functionality of Longitudinally Ridged Tooth Crowns

What are the potential functions of longitudinally ridged teeth in a small (juvenile) *Coelophysis bauri*? Are there dietary niches that a juvenile *C. bauri* with ridged teeth could more efficiently exploit that a large *C. bauri* with unridged teeth could not? Tooth morphology and diet are closely related, and changes in tooth morphology can correspond with changes in diet. One example is the blunt, rounded teeth in fossil and extant varanoids used for crushing insects and mollusks (Molnar, 2004). Ontogenetic changes in tooth morphology correspond with a change in diet in some varanoids. Hatchling *Varanus niloticus* are mostly insectivorous (Lenz, 2004) and possess slender slightly curved teeth (Lonnberg, 1903; Mertens, 1942a, 1942b), but their diet shifts to include mollusks, amphibians, and carrion as they age (Lenz, 2004) with a corresponding change in dentition from curved to bulbous teeth (Mertens, 1942a, 1942b).

Long, slender, and conical teeth are often used to infer a piscivorous diet (Baszio, 1997b; Sankey, 2001, 2008a; Brinkman, 2008). Conical teeth with ridges, such as those found in the spinosaurid *Irritator challengeri*, are described as being well-suited for impaling and gripping prey (Sues et al., 2002). Sankey (2008b) suggests that this morphology may be convergent with the slender, ridged teeth attributed to cf. *Richardoestesia isosceles*. Small, young *Coelophysis bauri* with ridged teeth may have been able to exploit a diet high in arthropods and fish, with the loss of tooth ridging in larger adults corresponding with a transition to an adult diet where holding and gripping smooth or slippery prey with teeth is less important.

Implications of Dental Variation in *Coelophysis bauri* for Shed Tooth Identification

Documentation of dental variation was completed for *Tyrannosaurus rex* by Smith (2005) and Smith et al. (2005) and for *Majungasaurus crennatissimus* by Smith (2007). Using the results of this study on the dental variation of *Coelophysis bauri*, combined with the results of previous analyses on shed and *in situ* theropod teeth, preliminary comments on the potential range of variation in tooth morphology for one taxon of theropod are presented to aid in the identification of shed theropod teeth.

Variable 1: Premaxillary Carinae may or may not Possess Denticles

Two out of the 23 skulls of *Coelophysis bauri* that were examined (AMNH 7240 and DMNS 39022) have serrated posterior carinae on tooth positions P3 – P4 (contra Colbert, 1989). The morphology of these denticulate premaxillary teeth does not differ from teeth with no visible denticles. It is possible that more specimens of *C. bauri* contain serrated premaxillary teeth, but the mediolingual aspects of teeth on most of the examined specimens are not visible.

Variation in the presence and absence of serrated premaxillary teeth is not a new observation for theropods: there are similar observations for the Tyrannosauridae in reference to the validity of the now *nomem dubium* genus *Aublysodon* sp. (Holtz, 2004). The presence of serrated premaxillary teeth in *Coelophysis bauri* does not appear to be ontogenetically controlled, as the two specimens with serrated premaxillary teeth represent adult (AMNH 7240) and juvenile sizes (DMNS 39022). It is uncertain whether the variable presence of premaxillary serrations is due to ontogenetic (as is suggested for tyrannosaurines) or individual variation (as in *C. bauri*). Regardless of the mechanism of variation, the presence of premaxillary serrations is a variable feature, and should be used with caution when identifying isolated small theropod teeth.

Variable 2: The Presence of Longitudinal Ridges on the Lingual and/or Labial Surfaces of Premaxillary, Anterior Maxillary and Anterior Dentary Teeth is Variable

Longitudinally ridged tooth crowns were observed on the most anterior tooth positions in several juvenile-sized specimens in the sample of *Coelophysis bauri*, but are conspicuously absent in adult-sized specimens. There are taxa for which ridged teeth have not yet been reported (i.e., tyrannosaurids), but ridges are reported for tooth morphologies attributed to small theropods such as troodontids, dromaeosaurines, velociraptorines, and theropods of uncertain taxonomic affinity (i.e., *Richardoestesia*). Teeth with longitudinal ridging are reported regularly in spinosaurids (Fowler, 2007), and to a lesser degree in the most anterior tooth positions of ceratosaurids (Colbert, 1989; Madsen and Welles, 2000).

Given that several distantly related theropod taxa possess (or have the potential to possess) longitudinally ridged crowns, it is possible that ridged teeth are the result of convergence in young individuals of the Theropoda exploiting niches different than those of the adults. Longitudinal ridging appears to be ontogenetically controlled in *Coelophysis bauri*, and isolated coelophysoid teeth recovered from Ghost Ranch equivalent deposits should not be mistakenly identified as belonging to a taxon different from *C. bauri*. The data from *C. bauri* suggest that longitudinal crown ridging has the potential to be ontogenetically controlled in theropods, and should not be used as part of the criteria for identifying shed theropod teeth.

Variable 3: Teeth from Small (Juvenile) Individuals Occupy a Similar Morphospace with Teeth from Large (Adult) Individuals, but can be Statistically Different

Multivariate statistical analyses show that while teeth from small (juvenile) and large (adult) skulls do form separate groups, there is enough overlap between the two groups (Figs. 20-22) that they can be considered to represent the same morphology. However, statistical analyses also produce results that state teeth from small *Coelophysis bauri* are significantly different from those of large *C. bauri*. They also show that premaxillary, maxillary, and dentary tooth crowns form significantly discrete groupings, even if they show a great deal of overlap in morphospace. The same issue was found in the shed teeth of *Albertosaurus sarcophagus* from the Dry Island Buffalo Jump bonebed: small (juvenile) and large (adult) teeth formed significantly discrete groupings with morphospace overlap (Buckley et al., 2010).

If one relies solely on the results of a multivariate statistical analysis, and interprets the data on the p_{same} values, one will risk incorrectly interpreting the groups as representing discrete morphotaxa. It is imperative that multivariate statistical analyses are not treated as a "plug and play" tool for paleontological data analysis, especially when analyzing a seemingly novel tooth morphology. False positives can be obtained, such as those seen when comparing small and large teeth of *Coelophysis bauri*, and small and large teeth of *Albertosaurus sarcophagus* (Buckley et al., 2010). If two *a priori* groups are distinct both in their morphospace groupings and in their p_{same} values, one can be more confident that the two groups represent discrete morphotaxa.

Variable 4: Size, Shape and Density of Denticles are Similar Between Small (Juvenile) and Large (Adult) Individuals

Discriminant analysis shows that teeth from small and large skulls cannot be considered distinct morphotypes based on either denticle dimensions or denticle density. This is a similar result to observations made by Currie et al. (1990) that denticles of teeth from juveniles tended to be relatively larger (when compared to tooth size) than those on adult teeth, and have fewer denticles per unit measurement. In *Coelophysis bauri*, denticle density of small (juvenile) and large (adult) skulls is not different enough to confidently distinguish between the two groups. Teeth from small (juvenile) and large (adult) individuals of a theropod species would not be mistakenly identified as belonging to different taxa on the basis of denticle size or density.

CONCLUSIONS

Redescription of the dentition of *Coelophysis bauri*, first described by Colbert (1989), shows the varied presence of serrations on the posterior carinae of premaxillary tooth positions P3 and P4. Premaxillary, anterior maxillary (up to M5), and anterior dentary (up to D6) teeth from skulls of juvenile individuals have longitudinal ridging on both labial and lingual surfaces. Individual and ontogenetic variation in tooth morphology accounts for much of the variation seen in the dataset of *C. bauri*. Crown morphology, denticle morphology, and denticle density of teeth from juvenile and adult specimens do not show significant discrete clusters in morphospace (but may show significant differences) in multivariate statistical analyses.

Quantitative and qualitative observations of in situ tooth crowns from the 23 skulls of *Coelophysis bauri* suggest that ontogenetic and heterodont variation in tooth morphology can show morphologies that would be different enough to result in diagnosing new tooth taxa if one relies on statistical analyses and characters of ambiguous systematic value. Some dental morphologies of *C. bauri*, were they to be found as isolated teeth and identified by qualitative methods alone, may be mistaken for novel tooth taxa even though they occupy the same morphospace as other typical teeth of *C. bauri*. When possible, novel-looking isolated teeth should be analyzed in multivariate analyses with temporally equivalent teeth to test if the new teeth occupy distinct morphospace. However, ontogenetic change can result in tooth morphologies that will appear significantly different in a multivariate statistical analysis, so caution is needed when applying *a priori* assumptions to the systematics of theropod teeth.

There are visual differences in the tooth crowns of *Coelophysis bauri* that could prompt the erection of new tooth taxa if they were found in isolation. Visual differences in the teeth of theropods with heterodont dentitions could be mistaken for new tooth morphotaxa if isolated teeth are analyzed as individual elements instead of as small parts of a larger, variable population. Longitudinal ridging on the anterior tooth crowns of *C. bauri* is an indicator of age rather than taxon. Ridging on crowns, restricted to the premaxillary, anterior maxillary, and anterior dentary teeth of juvenile specimens of *C. bauri*, could result in these teeth being mistakenly identified as a different morphospecies from *C. bauri*, if they were to be recovered as isolated teeth.

ACKNOWLEDGMENTS

We wish to extend our thanks to the following for their aid in the completion of this study: M. Caldwell (University of Alberta) and D. Brinkman (Royal Tyrrell Museum of Palaeontology) for their discussions and critiques of this study; E. Koppelhus for her aid in coordinating my thesis activities; R. McCrea (Peace Region Palaeontology Research Centre) and J. Sankey (University of California - Stanislaus) for discussions on theropod tooth morphology; M. Norell and C. Mehling (American Museum of Natural History), K. Carpenter and L. Ivy (Denver Museum of Nature), D. Gillette and J. Whitmore-Gillette (Museum of Northern Arizona), S. G. Lucas, J. Spielmann, and L. Rinehart (New Mexico Museum of Natural History), and A. Neuman and B. Strilisky (Royal Tyrrell Museum of Palaeontology) for access to their institution's collections and for their hospitality during the study. Funding was provided by the University of Alberta Queen Elizabeth II Scholarship. The manuscript was greatly improved by reviews from D. Brinkman, S. G. Lucas, and L. Rinehart

REFERENCES

Abler, W. L. 1997, Tooth serrations in carnivorous dinosaurs, *in*, Padian, K., and Currie, P. J., eds., Encyclopedia of dinosaurs. Academic Press, San Diego, California, p. 740-743.

Atchley, W., Gaskins, C., and Anderson, D., 1976, Statistical properties of ratios, I. Empirical results, Systematic Zoology v. 25, p. 137-148.

Bakker, R. T., 1998, Brontosaur killers: Late Jurassic allosaurids as saber-tooth cat analogues, *in*, Perez-Moreno, B. P., Holtz, Jr., T., Sanz, J. L., and Moratalla, J., eds., Theropod Paleobiology, Gaia v. 15, Museu Nacional de Historia Natural, Lisbon, Portugal, p. 145–158.

Bakker, R. T., Williams, M, and Currie, P. J., 1988, *Nanotyrannus*, a new genus of pygmy tyrannosaur, from the latest Cretaceous of Montana, Hunteria, v. 1, p. 1-30.

Bakker, R. T, and Bir, G., 2004, Dinosaur crime scene investigations: theropod behavior at Como Bluff, Wyoming, and the evolution of birdness, *in*, Currie, P. J., Koppelhus, E. B., Shugar, M. A., and Wright, J. L., eds., Feathered dragons: studies on the transition from dinosaurs to birds, Indiana University Press, Bloomington, Indiana, p. 301-342.

Baszio, S. 1997a, Investigations of Canadian dinosaurs: palaeoecology of dinosaur assemblages throughout the Late Cretaceous of south Alberta, Canada, Courier Forschungsinstitut Senckenberg, v. 196, p. 1 - 33.

Baszio, S. 1997b, Investigations of Canadian dinosaurs: systematic palaeontology of isolated dinosaur teeth from the Latest Cretaceous of south Alberta, Canada. Courier Forschungsinstitut Senckenberg, v. 196, p. 33 - 77.

Bolt, J. R., and DeMar, R. E., 1986, Computer simulation of tooth replacement with growth in lower tetrapods, Journal of Vertebrate Paleontology, v. 6, p. 233 - 250.

Brinkman, D. B., 1990, Paleoecology of the Judith River Formation (Campanian) of Dinosaur Provincial Park, Alberta, Canada: evidence from vertebrate microfossil localities. Palaeogeography, Palaeoclimatology, Palaeoecology, v. 78, p. 37 - 54.

Brinkman, D. B., 2008, The structure of Late Cretaceous (late Campanian) nonmarine aquatic communities: a guild analysis of two vertebrate microfossil localities in Dinosaur Provincial Park, Alberta, Canada, *in*, Sankey, J. T., and Baszio, S., eds., Vertebrate microfossil assemblages: their role in paleoecology and paleobiogeorgraphy, Indiana University Press, Bloomington, Indiana, p. 33 - 60.

Brochu, C. A., 2003, Osteology of *Tyrannosaurus rex*: insights from a nearly complete skeleton and high-resolution computed tomographic analysis of the skull, Society of Vertebrate Paleontology Memoir v. 7, p. 1 - 138.

Brusatte, S. L., Benson, R. B. J., Carr, T. D., Williamson, T. E., and Sereno. P. C., 2007, The systematic utility of theropod enamel wrinkles, Journal of Vertebrate Paleontology, v. 27, p. 1052 - 1056.

Caldwell, M. W., 2007, Ontogeny, anatomy, and attachment of the dentition in mosasaurs (Mosasauridae: Squamata), Zoological Journal of the Linnean Society, v. 150, p. 687 - 700.

Carpenter, K., 1982, Baby dinosaurs from the Late Cretaceous Lance and Hell Creek formations and a redescription of a new species of theropod, University of Wyoming Contributions to Geology, v. 20, p. 123 - 134.

Carpenter, K., 1992, Tyrannosaurids (Dinosauria) of Asia and North America, *in*, Mateer, N., and Chen, P. J., eds., Aspects of non-marine Cretaceous geology, Ocean Press, Beijing, China, p. 250 - 268.

Carr, T. D., 1999, Craniofacial ontogeny in Tyrannosauridae (Dinosauria, Coelurosauria), Journal of Vertebrate Paleontology, v. 19, p. 497 - 520.

Carr, T. D., and Williamson, T. E., 2004, Diversity of late Maastrichtian Tyrannosauridae (Dinosauria: Theropoda) from western North America, Zoological Journal of the Linnean Society, v. 142, p. 479 - 523.

Carrano, M. T., Hutchinson, J. R., and Sampson, S. D., 2005, New information on *Segisaurus halli*, a small theropod dinosaur from the Early Jurassic of Arizona, Journal of Vertebrate Paleontology, v. 25, p. 835 - 849.

Colbert, E. H., 1989, The Triassic dinosaur *Coelophysis*, Museum of Northern Arizona Bulletin v. 57, p. 1 – 160.

Colbert, E. H., 1990, Variation in *Coelophysis bauri*, *in*, Carpenter, K., and Currie, P. J., eds., Dinosaur Systematics: perspectives and approaches, Cambridge University Press, Cambridge, England, p. 81 – 90.

Colbert, E. H., Charig, A. J., Dodson, P., Gillette, D. D., Ostrom, J. H., and Weishampel, D., 1992, Case 2840: *Coelurus bauri* Cope 1887 (currently *Coelophysis bauri*; Reptilia, Saurischia): proposed replacement of the lectotype by a neotype, Bulletin of Zoological Nomenclature, v. 49, p. 276 - 279.

Cope, E. D., 1876a, Descriptions of some vertebrate remains from the Fort Union beds of Montana, Academy of Natural Sciences of Philadelphia Proceedings, v. 1876, p. 248 - 261.

Cope E. D., 1887a, A contribution to the history of the Vertebrata of the Trias of North America, Proceedings of the American Philosophical Society, v. 24, p. 209 - 228.

Cope, E. D., 1887b, The dinosaur genus *Coelurus*. American Naturalist, v. 21, p. 367 - 369.

Cope, E. D., 1889, On a new genus of Triassic Dinosauria, American Naturalist, v. 23, p. 626.

Currie, P. J., 2003, Allometric growth in tyrannosaurids (Dinosauria: Theropoda) from the Upper Cretaceous of North America and Asia, Canadian Journal of Earth Sciences, v. 40, p. 651 - 665.

Currie, P. J., Rigby, Jr., J. K., and Sloan, E. D., 1990, Theropod teeth from the Judith River Formation of southern Alberta, Canada, in, Carpenter, K. and Currie, P. J., eds., Dinosaur systematics:

perspectives and approaches, Cambridge University Press, Cambridge, England, p. 107 - 125.

Currie, P. J., Hurum, J. H., and Sabath, K., 2003, Skull structure and evolution in tyrannosaurid dinosaurs, Acta Palaeontologica Polonica, v. 48, p. 227 - 234.

Dodson, P., 1975, Taxonomic implications of relative growth in lambeosaurine hadrosaurs, Systematic Zoology, v. 24, p. 37 - 54.

Edmund, A. G., 1962, Sequence and rate of tooth replacement in the Crocodilia. Royal Ontario Museum Life Sciences Division Contribution, v. 56, v. 1 - 42.

Ezcurra, M. D., 2007, The cranial anatomy of the coelophysoid theropod *Zupaysaurus rougieri* from the Upper Triassic of Argentina, Historical Biology, v. 19, p. 185 - 202.

Fanti, F., and Therrien, F., 2007, Theropod tooth assemblages from the Late Cretaceous Maevarano Formation and the possible presence of dromaeosaurids in Madagascar, Acta Palaeontologica Polonica, v. 52, v. 155 - 166.

Fanti, F., and Miyashita, T., 2009, A high latitude vertebrate fossil assemblage from the Late Cretaceous of west-central Alberta, Canada; evidence for dinosaur nesting and vertebrate latitudinal gradient, Palaeogeography, Palaeoclimatology, Palaeoecology, v. 275, p. 37 - 53.

Fiorillo, A. R., 1999, Non-mammalian microvertebrate remains from the Robison Eggshell Site, Cedar Mountain Formation (Lower Cretaceous), Emery County, Utah, in, Gillette, D. D., ed., Vertebrate palaeontology in Utah. Utah Geological Survey Miscellaneous Publication, v. 99, Salt Lake City, Utah, p. 259 - 286.

Fiorillo, A. R., and Currie, P. J., 1994, Theropod teeth from the Judith River Formation (Upper Cretaceous) of south-central Montana, Journal of Vertebrate Paleontology, v. 14, p. 74 - 80.

Fiorillo, A. R., and Gangloff, R. A., 2000, Theropod teeth from the Prince Creek Formation (Upper Cretaceous) of Northern Alaska, with speculations on Arctic dinosaur paleoecology, Journal of Vertebrate Paleontology, v. 20, p. 675 - 682.

Fowler, D., 2007, Recently rediscovered baryonychine teeth (Dinosauria: Theropoda): new morphologica data, range extension and similarity to *Ceratosaurus*, Journal of Vertebrate Paleontology, v. 27, p. 76A.

Hammer, O., Harper, D. A. T., and Ryan, P. D., 2001, PAST: Paleontological Statistics software package for education and data analysis, Palaeontologica Electronica, v. 4, p. 1 - 9.

Hammer, O., and Harper, D. A. T., 2006, Paleontological data analysis. Blackwell Publishing, Ltd., Malden, Massachusetts, USA, 351p.

Henderson, D. M, 1998, Skull and tooth morphology as indicators of niche partitioning in sympatric Morrison Formation theropods, *in*, Perez-Moreno, B. P., Holtz, Jr., T., Sanz, J. L., and Moratalla, J., eds., Theropod Paleobiology, Gaia, v. 15, Museu Nacional de Historia Natural, Lisbon, Portugal, p. 219-226.

Holtz, T. R., Jr. 1998. A new phylogeny of the carnivorous dinosaurs, *in*, Perez-Moreno, B. P., Holtz, Jr., T., Sanz, J. L., and Moratalla, J., eds., Theropod Paleobiology, Gaia, v. 15, Museu Nacional de Historia Natural, Lisbon, Portugal, p. 5 – 61.

Holtz, T. R., Jr., 2004, Tyrannosauroidea, in, Weishampel, D. B., Dodson, P., and Osmolska, H., eds., The Dinosauria, second edition, University of California Press, Berkeley, California, p. 111-136

Holtz, T. R., Jr., D. L. Brinkman, D. L., and Chandler, C. L., 1998, Denticle morphometrics and a possible omnivorous feeding habit for the theropod dinosaur *Troodon*, *in*, Perez-Moreno, B. P., Holtz, Jr., T., Sanz, J. L., and Moratalla, J., eds., Theropod Paleobiology, Gaia, v. 15, Museu Nacional de Historia Natural, Lisbon, Portugal, p. 159 – 166.

Holtz, T. R., Jr., R. E. Molnar, and P. J. Currie. 2004. Basal Tetanurae, *in*, Weishampel, D. B., Dodson, P., and Osmolska, H., eds., The Dinosauria, second edition, University of California Press, Berkeley, California, p. 71 – 110.

von Huene, F., 1906, Uber die Dinosaurier der ausser-europäischen Trias, Geologische und Palaeontologische Abhandlungen, Berlin, Jena, v. 8, p. 97 – 156.

von Huene, F., 1915, On reptiles of the New Mexican Trias in the Cope collection, Bulletin of the American Museum of Natural History, v. 34, p. 485 – 507.

Hunt, A. P., and Lucas, S. G., 1991, *Rioarribasaurus*, a new name for a Late Triassic dinosaur from New Mexico (USA), Palaeontologica Zoologica, v. 65, p. 191 – 198.

International Commission on Zoological Nomenclature, 1996, Opinion 1842. *Coelurus bauri* Cope, 1887, (currently *Coelophysis bauri*; Reptilia, Saurischia): lectotype replaced by a neotype, Bulletin of Zoological Nomenclature, v. 53, p. 142 – 144.

Kardong, K. V., 1995, Chapter 13: The digestive system, in, Vertebrates: comparative anatomy, function, evolution, Wm. C. Brown Communications, Inc., Dubuque, Iowa, p. 491 – 532.

Larson, D. W., and Currie, P. J., 2013, Multivariate analyses of small theropod dinosaur teeth and implications for paleoecological turnover through time. PLoS ONE, v. 8, e54329, doi:10.1371/journal.pone.0054329

Lenz, S., 2004, *Varanus niloticus*, *in*, Pianka, E. R., King, D. R., and King, R. A., eds., Varanoid lizards of the world, Indiana University Press, Bloomington, Indiana, p. 133 – 138.

Litwin, R.J., Traverse, A., and Ash, S.R., 1991, Preliminary palynological zonations of the Chinle Formation, southwestern U.S.A., and its correlation to the Newark Supergroup (eastern U.S.A.): review of the palaeobotany and palynology, v. 68, p. 267 – 287.

Lonnberg, E., 1903, On the adaptations to a molluscivorous diet in *Varanus niloticus*, Arkiv for Zoologi, v. 1, p. 65 – 83.

Longrich, N., 2008, Small theropod teeth from the Lance Formation of Wyoming, USA, *in*, Sankey, J. T., and Baszio, S., eds., Vertebrate microfossil assemblages: their role in paleoecology and paleobiogeography, Indiana University Press, Bloomington, Indiana, p. 135 – 158.

Madsen, J., 1976, *Allosaurus fragilis*: a revised osteology, Utah Geological and Mineralogical Survey Bulletin, v. 109, p. 1 – 163.

Madsen, J. H., Jr., and Welles, S. P., 2000, *Ceratosaurus* (Dinosauria, Theropoda): a revised osteology, Utah Geological Survey Miscellaneous Publications, v. 2000, p. 1 – 80.

Marsh, O. C., 1881, Principal characters of American Jurassic dinosaurs: Part V, American Journal of Science, v. 21, p. 417 – 423.

Marsh, O. C., 1884, Principal characters of American Jurassic dinosaurs, Part VIII: The Order Theropoda, American Journal of Science, v. 27, p. 329 – 340.

Mertens, R., 1942a, Die familie der Warane (Varanidae). Ester Teil: Allgemienes, Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft Abhandlung, v. 462, p. 1 – 116.

Mertens, R., 1942b, Die familie der Warane (Varanidae). Zweiter Teil: Der Schädel, Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft Abhandlung, v. 465, p. 117 – 234 .

Molnar, R. E., 1990, Variation in theory and in theropods, *in*, Carpenter, K., and Currie, P. J., eds., Dinosaur systematics: perspectives and approaches, Cambridge University Press, Cambridge, England, p. 71 – 79.

Molnar, R. E. 2004. The long and honorable history of monitors and their kin, *in*, Pianka, E. R., King, D. R., and King, R. A., eds., Varanoid lizards of the world, Indiana University Press, Bloomington, Indiana, p. 10 – 67.

Molnar, R. E., and Carpenter, K., 1989, The Jordan theropod (Maastrichtian, Montana, U.S.A.) referred to the genus *Aublysodon*, Geobios, v. 22, p. 445 – 454.

Neill, W. T., 1971, The last of the ruling reptiles: alligators, crocodiles, and their kin, Columbia University Press, New York, New York, p. xvii – 486.

Ostrom, J. H., 1969, Osteology of *Deinonychus antirrhopus*, an unusual theropod from the Lower Cretaceous of Montana, Peabody Museum of Natural History Bulletin, v. 30, p. 1 – 165.

Rauhut, O. W. M., 2004, The interrelationships and evolution of basal theropod dinosaurs, Special Papers in Palaeontology, v. 69, p. 1 – 213.

Rinehart, L. F., Lucas, S. G., Heckert, A. B., Spielmann, J. A., and Celeskey, M., 2009, The paleobiology of *Coelophysis bauri* (Cope) from the Upper Triassic (Apachean) Whitaker Quarry, New Mexico, with detailed analysis of a single quarry block, New Mexico Museum of Natural History Bulletin, v. 45, p. 1 – 260.

Rowe, T., 1989, A new species of the theropod dinosaur *Syntarsus* from the Early Jurassic Kayenta Formation of Arizona, Journal of Vertebrate Paleontology, v. 9, p. 125 – 136.

Sankey, J. T., 2001, Late Campanian southern dinosaurs, Aguja Formation, Big Bend, Texas, Journal of Paleontology, v. 75, p. 208 – 215.

Sankey, J. T., 2002, Theropod dinosaur diversity in the Latest Cretaceous (Maastrichtian) of North America, Journal of Vertebrate Paleontology, v. 22, p. 103A.

Sankey, J. T., 2003, New theropod and bird teeth from the Late Cretaceous (Maastrichtian) Hell Creek and Lance Formations, Journal of Vertebrate Paleontology, v. 23, p. 93A.

Sankey, J. T., Brinkman, D. B., Guenther, M, and Currie, P. J., 2002, Small theropod and bird teeth from the Late Cretaceous (late Campanian) Judith River Group, Alberta, Journal of Paleontology, v. 76, p. 751 – 763.

Sankey, J. T., 2008a, Vertebrate paleoecology from microsites, Talley Mountain, Upper Aguja Formation, (Late Cretaceous), Big Bend National Park, Texas, USA, *in*, Sankey, J. T., and Baszio, S., eds., Vertebrate microfossil assemblages: their role in paleoecology and paleobiogeography, Indiana University Press, Bloomington, Indiana, p. 61 – 77.

Sankey, J. T., 2008b, Diversity of Latest Cretaceous (late Maastrichtian) small theropods and birds: teeth from the Lance and Hell Creek formations, USA, *in*, Sankey, J. T., and Baszio, S., eds., Vertebrate microfossil assemblages: their role in paleoecology and paleobiogeography, Indiana University Press, Bloomington, Indiana, p.117-134

Schwartz, H. L., and Gillette, D. D., 1994, Geology and taphonomy of the *Coelophysis* quarry, Upper Triassic Chinle Formation, Ghost Ranch, New Mexico, Journal of Paleontology, v. 68, p. 1118 – 1130.

Smith, D. K., 1998, A morphometric analysis of *Allosaurus*, Journal of Vertebrate Paleontology, v. 18, p. 126 – 142.

Smith, D. K., and Merrill, A., 2006, Facial variation in *Coelophysis bauri* and the status of *Megapnosaurus* (*Syntarsus*), *in*, Harris *et al*. (eds.) The Triassic-Jurassic Terrestrial Transition, New Mexico Museum of Natural History and Science Bulletin, v. 37, p. 592 – 598.

Smith, J. B., 2002, Dental morphology and variation in *Tyrannosaurus rex*: implications for taxonomy, systematics, and the identification of shed teeth, Journal of Vertebrate Paleontology, v. 22, p. 109A.

Smith, J. B., 2005, Heterodonty in *Tyrannosaurus rex*: implications for the taxonomic and systematic utility of theropod dentitions, Journal of Vertebrate Paleontology, v. 25, p. 865 – 887.

Smith, J. B., 2006, Dental morphology and variation in *Majungasaurus crenatissimus* (Theropoda: Abelisauridae) from the Late Cretaceous of Madagascar, Journal of Vertebrate Paleontology Memoir, v. 8, p. 103 – 126.

Smith, J. B., and Dodson, P., 2003, A proposal for a standard terminology of anatomical notation and orientation in fossil vertebrate dentitions, Journal of Vertebrate Paleontology, v. 23, p. 1 – 12.

Smith, J. B., Vann, D. R., and Dodson, P., 2005, Dental morphology and variation in theropod dinosaurs: implications for the taxonomic identification of isolated teeth, The Anatomical Record, v. 285A, p. 699 – 736.

Smith, N. D., Makovicky, P. J., Hammer, W. R., and Currie, P. J., 2007, Osteology of *Cryolophosaurus ellioti* (Dinosauria: Theropoda) from the Early Jurassic of Antarctica and implications for early theropod evolution, Zoological Journal of the Linnean Society, v. 15, p. 377 – 421.

Sokal, R. R., and Rohlf, F. J., 1995, Biometry: the principles and practice of statistics in biological research, 3rd edition, W. H. Freeman and Company, New York, New York, p. vii-xix, 1-887.

Sues, H. – D., Frey, E., Martial, D. M., and Scott, D. M., 2002, *Irritator challengeri*, a spinosaurid (Dinosauria: Theropoda) from the Lower Cretaceous of Brazil, Journal of Vertebrate Paleontology, v. 22, p. 535 – 527.

Tykowski, R. S., and Rowe, T., 2004. Ceratosauria, *in*, Weishampel, D. B., Dodson, P., and Osmolska, H., eds., The Dinosauria, second edition, University of California Press, Berkeley, California, p. 47 – 70.

Vullo, R., Neraudeau, D., and Lenglet, T., 2007, Dinosaur teeth from the Cenomanian of Charentes, western France: evidence for a mixed Laurasian-Gondwanan assemblage, Journal of Vertebrate Paleontology, v. 27, p. 931 – 943.

Welles, S. P., 1954, New Jurassic dinosaur from the Kayenta Formation of Arizona, Bulletin of the Geological Society of America, v. 65, p. 591 – 598.

Welles, S. P., 1970, *Dilophosaurus* (Reptilia: Saurischia), a new name for a dinosaur, Journal of Paleontology, v. 44, p. 98.

Welles, S. P., 1984, *Dilophosaurus wetherilli* (Dinosauria, Theropoda) osteology and comparisons, Palaeontographica Abt. A, v. 185, p. 87 – 180.

APPENDIX 1

Tooth data – Linear data were measured as described in Figure 1. Linear measurements were taken either directly from the tooth using digital calipers, or were measured using an ocular micrometer. Crown angle was calculated as described in the Materials and Methods section of the main text. Measurement abbreviations: CA, crown angle; CBW, crown basal width; CH, crown height; CURV, crown curvature straight-line length; D, dentary; FABL, fore-aft basal length, M, maxilla; P, premaxilla; t, tooth; l, left; r, right. Linear data in millimeters. Angle data in degrees, with angles approaching 90° representing a straighter crown, and angles approaching 0° representing a more curved crown.

Institutional Abbreviations – DMNH, Denver Museum of Natural History, Denver, Colorado; MNA, Museum of Northern Arizona, Flagstaff, Arizona; NMMNH, New Mexico Museum of Natural History, Albuquerque, New Mexico; RTMP, Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta.

Specimen	Description	Position	FABL	CBW	CH	CURV	CA
AMNH 7227, left maxilla	Base only	lM 01	1.94	?	?	?	?
	Alveolus	lM 02	3.48	?	?	?	?
	Alveolus	lM 03	2.94	?	?	?	?
	Crown	lM 04	4.21	?	7.18	7.27	71.9
	Missing	lM 05	3.15	?	?	?	?
	Partial	lM 06	4.20	?	?	?	?
	Crown	lM 07	3.68	?	7.55	9.13	53.6
	Alveolus	lM 08	3.28	?	?	?	?
	Partial	lM 09	3.84	?	?	?	?
	Damaged	lM 10	3.18	?	?	?	?
	Damaged	lM 11	4.79	?	?	?	?
	Broken, erupting	lM 12	3.61	?	?	?	?
	Missing	lM 13	?	?	?	?	?
	Missing	lM 14	?	?	?	?	?
	Missing	lM 15	?	?	?	?	?
	Alveolus	lM 16	4.11	?	?	?	?
	Damaged	lM 17	3.94	?	?	?	?
	Base only	lM 18	3.65	?	?	?	?
	Missing	lM 19	?	?	?	?	?
	Missing	lM 20	?	?	?	?	?
	Pushed up into maxilla	lM 21	2.97	?	4.66	?	?
	Base only	lM 22	2.64	?	?	?	?
	Base only	lM 23	3.14	?	?	?	?
	Erupting	lM 24	3.31	?	?	?	?
	Alveolus damaged	lM 25	?	?	?	?	?
	Alveolus damaged	lM 26	?	?	?	?	?
	Alveolus damaged	lM 27	?	?	?	?	?

	Base only	lD 01	2.54	?	?	?	?
	Partially hidden	lD 02	2.59	?	3.60	?	?
	Missing/hidden	lD 03	2.43	?	?	?	?
	Alveolus	lD 04	?	?	?	?	?
	Partial crown	lD 05	?	?	?	?	?
	Hidden by maxilla tooth	lD 06	2.26	?	?	?	?
	Alveolus	lD 07	2.77	?	?	?	?
	Partially hidden	lD 08	?	?	?	?	?
	Crushed/hidden	lD 09	2.99	?	?	?	?
	Partial crown	lD 10	4.27	?	?	?	?
AMNH 7227, left dentary	Crushed	lD 11	?	?	?	?	?
	Alveolus	lD 12	3.08	?	?	?	?
	Crushed base	lD 13	2.59	?	?	?	?
	Alveolus	lD 14	2.33	?	?	?	?
	Alveolus	lD 15	2.11	?	?	?	?
	Partial crown	lD 16	3.08	?	?	?	?
	Missing	lD 17	2.65	?	?	?	?
	Partial crown	lD 18	2.35	?	3.77	?	?
	Alveolus	lD 19	2.29	?	?	?	?
	Alveolus	lD 20	3.01	?	3.17	?	?
	Base only	lD 21	3.20	?	?	?	?
	Partially hidden	lD 22	2.77	?	?	?	?
AMNH 7228, left premaxilla	Crown	lP 01	1.58	?	1.64	?	?
	Partial crown	lP 02	2.16	?	?	?	?
	Missing	lP 03	1.54	?	5.18	5.15	73.5
	Crown	lP 04	3.03	?	4.58	4.67	76.3
AMNH 7228, left maxilla	Missing	lM 01	?	?	?	?	?
	Crown base only	lM 02	2.03	?	1.57	?	?
	Alveolus	lM 03	2.75	?	?	?	?
	Crown	lM 04	3.96	?	5.27	6.06	59.1
	Tip erupting	lM 05	?	?	?	?	?
	Crown	lM 06	2.69	?	2.89	3.50	53.8
	Crown	lM 07	3.50	?	2.71	3.19	47.5
	Missing	lM 08	?	?	?	?	?
	Missing	lM 09	?	?	?	?	?
	Erupting tip	lM 10	?	?	?	?	?
	Crown	lM 11	3.99	?	6.98	7.24	70.2
	Missing	lM 12	?	?	?	?	?
	Erupting	lM 13	2.36	?	3.06	3.24	64.0
	Missing	lM 14	?	?	?	?	?
	Crown	lM 15	3.68	?	4.92	5.55	60.5
	Plaster cover	lM 16	?	?	?	?	?
		lM 17	3.96	?	5.29	6.12	58.7
	Erupting	lM 18	2.18	?	2.43	2.86	55.7
	Crown	lM 19	3.52	?	2.69	3.15	47.2
	Damaged	lM 20	2.78	?	1.97	?	?
	Alveolus	lM 21	2.44	1.15	?	?	?
	Crown	lM 22	2.66	?	1.43	?	?
	Alveolus	lM 23	2.23	0.92	?	?	?
	Crown	lM 24	2.78	1.09	?	?	?
	Crown	lM 25	2.42	1.00	?	?	?
	Missing	lM 26	?	?	?	?	?
	Missing	lM 27	?	?	?	?	?
	Missing	lM 28	?	?	?	?	?

	Hidden	lD 01	?	?	?	?	?
	Base only	lD 02	2.45	?	3.60	?	?
	Base only	lD 03	2.09	?	?	?	?
	Base only	lD 04	2.41	?	?	?	?
	Tip hidden	lD 05	2.18	?	?	?	?
	Base only	lD 06	2.73	?	?	?	?
	Base only	lD 07	1.80	?	?	?	?
AMNH 7228, left dentary	Base only	lD 08	1.95	?	?	?	?
	Base only	lD 09	2.84	?	?	?	?
	Missing	lD 10	?	?	?	?	?
	Partial crown	lD 11	2.18	?	?	?	?
	Missing	lD 12	?	?	?	?	?
	Missing	lD 13	?	?	?	?	?
	Base of crown	lD 14	2.48	?	?	?	?
	Alveolus	lD 15	2.70	?	?	?	?
	Alveolus	lD 16	2.04	?	?	?	?
	Alveolus	lD 17	2.84	?	?	?	?
	Alveolus	01	1.40	1.68	?	?	?
	Alveolus	02	1.36	1.79	?	?	?
	Alveolus	03	1.70	1.30	?	?	?
AMNH 7230, left upper element	Alveolus	04	1.46	1.35	?	?	?
	Alveolus	05	1.34	?	?	?	?
	Alveolus	06	1.45	?	?	?	?
	Alveolus	07	1.28	?	?	?	?
	Alveolus	08?	?	?	?	?	?
AMNH 7230, right upper element	Alveolus	01	1.74	?	?	?	?
	Alveolus	02	2.01	?	?	?	?
	Hidden	lP 01	?	?	?	?	?
AMNH 7231, left premaxilla	Partial crown	lP 02	1.66	?	2.87	?	?
	Crown	lP 03	2.49	?	4.60	4.84	?
	Base	lP 04	2.10	?	?	?	?
AMNH 7231	Left maxilla	lM 01	1.55	?	?	?	?
	Missing	lD 01	?	?	?	?	?
	Missing	lD 02	?	?	?	?	?
	Base visible	lD 03	1.30	?	?	?	?
	Partial base	lD 04	1.38	?	?	?	?
	Partial base	lD 05	1.81	?	?	?	?
	Crown, part hidden	lD 06	2.00	?	?	?	?
	Alveolus	lD 07	1.61	?	?	?	?
AMNH 7231, left dentary	Alveolus	lD 08	1.67	?	?	?	?
	Alveolus	lD 09	1.87	?	?	?	?
	Alveolus	lD 10	2.14	?	?	?	?
	Alveolus	lD 11	2.00	?	?	?	?
	Alveolus	lD 12	2.77	?	?	?	?
	Alveolus	lD 13	2.21	?	?	?	?
	Alveolus	lD 14	2.46	?	?	?	?
	Cross section	lD 15	2.02	?	?	?	?
	Cross section	lD 16	2.13	?	?	?	?
	Cross section	lD 17	1.90	?	?	?	?

	Covered	lM 01	1.84	?	4.08	4.06	77.5
	Erupting	lM 02	2.24	?	1.79	?	?
	Tip missing	lM 03	2.86	?	2.39	?	?
	Erupting	lM 04	?	?	1.47	?	?
	Broken at base	lM 05	3.36	?	?	?	?
	Broken, shifted	lM 06	2.54	?	4.10	4.30	68.1
	Hidden	lM 07	?	?	?	?	?
	Anterior hidden	lM 08	?	?	?	?	?
	Erupting	lM 09	?	?	0.83	?	?
	Base	lM 10	3.55	?	2.35	?	?
	Erupting	lM 11	?	?	3.25	?	?
	Fragmented	lM 12	2.98	?	?	?	?
	Crown and tip	lM 13	4.41	?	?	?	?
AMNH 7239, left maxilla	Missing	lM 14	?	?	?	?	?
	Worn	lM 15	2.17	?	3.82	3.51	80.8
	Gap near base	lM 16	2.30	?	2.36	?	?
	Base	lM 17	2.37	?	1.79	?	?
	Fractured	lM 18	?	?	?	?	?
	Cross section	lM 19	?	0.95	?	?	?
	Tip missing	lM 20	2.09	?	2.68	3.90	40.5
	Ready to be shed	lM 21	2.11	?	1.87	?	?
	Complete tooth	lM 22	1.72	?	2.01	2.37	56.2
	Complete, shifted	lM 23	1.97	?	1.66	2.01	49.3
	Root with base	lM 24	1.50	0.65	?	?	?
	Erupting tip	lM 25	?	?	?	?	?
	Erupting tooth	lM 26	1.84	?	1.61	2.17	46.4
	Missing	rM 01	?	?	?	?	?
	Broken at base	rM 02	2.56	?	?	?	?
	Erupting	rM 03	?	?	1.47	?	?
	Broken at base	rM 04	3.14	1.52	?	?	?
	Erupting	rM 05	?	?	?	?	?
	Broken near base	rM 06	4.20	1.49	2.09	?	?
	Tip missing	rM 07	3.35	2.01	3.75	?	?
	Alveolus	rM 08	3.90	1.43	?	?	?
	Crown base	rM 09	2.97	?	?	?	?
	Erupting	rM 10	3.63	1.45	?	?	?
	Crown, base	rM 11	3.42	1.48	2.19	?	?
AMNH 7239, right maxilla	Erupting	rM 12	3.27	1.17	?	?	?
	Alveolus	rM 13	3.36	0.70	?	?	?
	Crown	rM 14	?	?	4.29	?	?
	Base	rM 15	3.14	?	2.87	?	?
	Missing	rM 16	?	?	?	?	?
	Missing	rM 17	?	?	?	?	?
	Root base	rM 18	2.14	0.87	?	?	?
	Basal crown	rM 19	2.22	0.94	1.81	?	?
	Shifted tooth	rM 20	1.91	1.07	2.71	2.62	71.5
	Shifted crown	rM 21	2.29	1.11	1.90	?	?
	Alveolus	rM 22	2.00	0.75	?	?	?
	Hidden	rM 23	?	?	?	?	?
	Erupting	rM 24	1.95	0.43	?	?	?
AMNH 7239, right maxilla	Posterior	rM 25	2.06	?	2.54	2.61	64.6
	Missing denticles	rM 26	1.50	?	1.91	1.81	69.8
	Tip missing	lP 01	?	1.34	3.82	?	?
AMNH 7240, left premaxilla	Crown base	lP 02	2.46	1.71	?	?	?
	Crown base	lP 03	2.18	1.61	?	?	?
	Missing	lP 04	?	?	?	?	?

	Crown base	lM 01	2.65	1.60	?	?	?
	Whole crown	lM 02	2.87	1.37	?	6.21	?
	Whole crown	lM 03	3.85	1.83	8.39	8.58	74.1
	Whole crown	lM 04	4.20	?	6.00	9.70	21.7
	Alveolus only	lM 05	4.14	?	?	?	?
AMNH 7240, left maxilla	Crown base	lM 06	4.15	?	?	?	?
	Root alveolus 1	lM 07	4.92	?	?	?	?
	Root alveolus 2	lM 08	4.34	?	?	?	?
	Root alveolus 3	lM 09	5.05	?	?	?	?
	Root alveolus 4	lM 10	3.89	?	?	?	?
	Root alveolus 5	lM 11	5.18	?	?	?	?
	Root alveolus 6	lM 12	?	?	?	?	?
	Base only	lD 01	1.55	1.52	?	?	?
	Erupting crown	lD 02	1.57	1.55	?	?	?
	Base only	lD 03	1.87	1.57	?	?	?
	Erupting crown	lD 04	2.73	1.60	?	?	?
	Base only	lD 05	2.80	1.60	?	?	?
	Erupting crown	lD 06	2.90	1.70	?	?	?
	Damaged	lD 07	2.40	?	2.97	?	?
	Erupting crown	lD 08	?	?	?	?	?
	Crown tip worn then broken	lD 09	2.70	?	?	?	?
	Erupting crown	lD 10	?	1.50	?	?	?
	Tip missing	lD 11	3.00	?	6.00	6.50	67.0
	Tip missing	lD 12	?	1.40	?	?	?
AMNH 7240, left dentary	Base only	lD 13	3.50	1.50	?	?	?
	Base only	lD 14	3.30	1.30	?	?	?
	Base only	lD 15	4.10	1.30	?	?	?
	Base only,	lD 16	3.50	?	?	?	?
	Base only	lD 17	4.10	1.30	?	?	?
	Worn/damaged	lD 18	3.60	?	?	?	?
	Base only	lD 19	4.20	1.50	?	?	?
	Worn/damaged	lD 20	3.40	?	?	?	?
	Base only	lD 21	3.40	1.70	?	?	?
	Base only	lD 22	3.10	1.00	?	?	?
	Erupting crown	lD 23	3.00	1.60	?	?	?
	Alveolus	lD 24	?	?	?	?	?
	Alveolus	lD 25	3.00	1.00	?	?	?
	Base only	lD 26	2.40	0.90	?	?	?
	Base only	lD 27	2.10	0.70	?	?	?
	Whole crown	rP 01	1.75	?	4.81	?	?
AMNH 7240, right premaxilla	Erupting crown	rP 02	2.30	?	2.71	?	?
	Basal crown	rP 03	2.70	2.08	?	?	?
	Alveolus with erupting crown	rP 04	2.70	1.50	?	?	?

	Base only	rM 01	3.00	1.00	?	?	?
	Base only	rM 02	?	1.10	?	?	?
	Erupting crown	rM 03	3.70	1.70	?	?	?
	Damaged crown	rM 04	3.99	?	6.48	10.7	?
	Erupting crown	rM 05	4.50	1.30	?	?	?
	Missing	rM 06	?	?	?	?	?
	Missing	rM 07	?	?	?	?	?
	Erupting crown	rM 08	?	?	?	?	?
	Whole crown	rM 09	5.10	?	8.50	12.8	26.6
	Tip missing	rM 10	?	?	?	?	?
	Missing	rM 11	?	?	?	?	?
AMNH 7240, right maxilla	Crown	rM 12	4.20	?	4.50	?	?
	Missing	rM 13	?	?	?	?	?
	Crown	rM 14	3.88	?	4.26	?	?
	Missing	rM 15	?	?	?	?	?
	Damaged	rM 16	3.50	?	4.10	5.70	45.6
	Missing	rM 17	?	?	?	?	?
	Base damaged	rM 18	3.50	?	3.50	?	?
	Base only	rM 19	2.20	0.70	?	?	?
	Base only	rM 20	2.00	0.70	?	?	?
	Damaged	rM 21	3.00	?	?	?	?
	Damaged base and displaced tip	rM 22	2.80	?	?	?	?
	Missing	rM 23	?	?	?	?	?
	Damaged	rM 24	2.70	?	?	?	?
	Alveolus	rD 01	?	1.40	?	?	?
	Alveolus	rD 02	?	1.40	?	?	?
	Damaged	rD 03	2.80	1.50	?	?	?
	Erupting crown	rD 04	3.10	1.70	?	?	?
	Base only	rD 05	2.80	1.50	?	?	?
	Erupting crown	rD 06	3.20	1.50	?	?	?
	Base only	rD 07	2.80	1.40	?	?	?
	Base only	rD 08	2.30	1.30	?	?	?
	Base only	rD 09	3.00	1.70	?	?	?
AMNH 7240, right dentary	Base only	rD 10	1.80	1.20	?	?	?
	Base only	rD 11	3.00	1.60	?	?	?
	Base only	rD 12	3.00	1.40	?	?	?
	Alveolus	rD 13	3.20	1.40	?	?	?
	Alveolus	rD 14	?	?	?	?	?
	Alveolus	rD 15	3.30	?	?	?	?
	Base only	rD 16	3.70	?	?	?	?
	Base only	rD 17	3.50	?	?	?	?
	Alveolus	rD 18	?	?	?	?	?
	Alveolus	rD 19	4.30	?	?	?	?
	Alveolus	rD 20	3.50	?	?	?	?
	Alveolus	rD 21	?	?	?	?	?
	Alveolus	rD 22	?	?	?	?	?
AMNH 7240, right dentary	Alveolus	rD 23	?	?	?	?	?
	Alveolus	rD 24	?	?	?	?	?
	Missing	rP 01	?	?	?	?	?
AMNH 7241, right premaxilla	Shifted ventral	rP 02	1.18	?	3.34	3.47	73.9
	Crown	rP 03	1.30	?	4.30	4.30	81.3
	Crown	rP 04	1.65	?	4.29	4.10	85.2

AMNH 7241, right maxilla	Crown	rM 01	1.83	?	4.53	4.64	75.1
	Small crown	rM 02	1.72	?	3.57	3.25	86.0
	Missing tip	rM 03	2.66	?	5.51	5.62	73.9
	Crown no tip	rM 04	2.50	?	4.86	4.89	74.5
	Whole crown	rM 05	3.18	?	8.09	7.78	84.0
	Whole crown	rM 06	3.25	?	5.67	5.73	72.4
	Whole crown	rM 07	3.40	?	7.9	7.95	76.8
	Whole crown	rM 08	3.25	?	6.04	6.20	71.9
	Tip broken	rM 09	3.38	?	6.99	7.02	75.5
	Tip broken	rM 10	3.44	?	6.17	5.86	78.4
	Erupting tooth	rM 11	3.42	1.36	0.74	?	?
	Crown	rM 12	3.34	?	4.83	4.62	72.7
	Alveolus only	rM 13	2.96	0.91	?	?	?
AMNH 7241, right dentary	Base	rD 01	2.21	?	?	?	?
	Erupting tooth	rD 02	1.41	?	2.53	?	?
	Tip missing	rD 03	1.98	?	4.03	?	?
	Lower base	rD 04	1.43	?	1.43	?	?
	Not visible	rD 05	?	?	?	?	?
	Base visible	rD 06	1.84	?	?	?	?
	Not visible	rD 07	?	?	?	?	?
	Not visible	rD 08	?	?	?	?	?
	Not visible	rD 09	?	?	?	?	?
AMNH 7242, left maxilla	Barely visible	lM 01	?	?	?	?	?
	Only root visible	lM 02	?	?	?	?	?
	Covered	lM 03	?	?	?	?	?
	Only root visible	lM 04	?	?	?	?	?
	Partial crown	lM 05	2.00	1.47	?	?	?
	Partial crown	lM 06	2.32	1.63	?	?	?
	Partial crown	lM 07	2.35	1.40	?	?	?
	Missing	lM 08	?	?	?	?	?
	Base only	lM 09	2.30	1.08	?	?	?
	Erupting	lM 10	1.83	0.78	?	?	?
	Base only	lM 11	2.09	1.14	?	?	?
	Base only	lM 12	2.13	1.03	?	?	?
	Missing	lM 13	?	?	?	?	?
	Base only	lM 14	?	?	?	?	?
	Missing	lM 15	?	?	?	?	?
	Base only	lM 16	?	?	?	?	?
	Missing	lM 17	?	?	?	?	?
AMNH 7242, right maxilla	Crown	rM 01	2.07	?	4.71	5.41	59.5
	Crown	rM 02	2.45	?	4.10	4.09	72.8
	Erupted	rM 03	2.57	?	2.94	?	?
	Crown	rM 04	2.54	?	3.97	4.04	70.0
	Crown	rM 05	2.29	?	3.95	3.89	74.5
	Missing	rM 06	2.95	?	?	?	?
	Crown	rM 07	2.36	?	4.05	4.03	73.5
	Erupted	rM 08	2.26	?	?	?	?
	Crown	rM 09	1.88	?	3.26	3.19	75.1
	Crown shifted	rM 10	1.77	?	2.90	?	?
	Crown	rM 11	1.41	?	2.32	2.54	64.7
	Crown	rM 12	1.15	?	2.24	2.09	82.0
	Erupted	rM 13	1.43	?	0.96	?	?
	Crown	rM 14	1.10	?	1.29	1.12	71.0
	Missing	rM 15	1.31	?	?	?	?
	Broken	rM 16	?	?	?	?	?
	Posterior carina	rM 17	?	?	?	?	?
DMNH 30596, right premaxilla	Barely visible	rP 01	?	?	?	?	?
	Whole crown	rP 02	2.00	?	4.70	5.04	68.7
	Whole crown	rP 03	2.00	?	5.04	5.64	62.5
	Crown base	rP 04	1.70	?	?	?	?

DMNH 30596, right maxilla	Whole crown	rM t01	1.65	?	3.50	4.00	60.6
	Broken base	rM t02	1.10	?	?	?	?
	Erupting	rM t03	?	?	?	?	?
	Erupting	rM t04	?	?	?	?	?
	Damaged	rM t05	?	?	?	?	?
	Crown base	rM t06	1.90	?	?	?	?
	Crown base	rM t07	1.75	?	?	?	?
DMNH 32156, damaged tooth-bearing element	partial alveolus	T01	2.80	?	?	?	?
	partial alveolus	T02	2.80	?	?	?	?
	partial alveolus	T03	2.70	?	?	?	?
	partial alveolus	T04	3.20	?	?	?	?
	partial alveolus	T05	2.80	1.00	?	?	?
	erupting tooth	T06	2.50	?	?	?	?
	worn crown	T07	2.50	?	?	?	?
	whole crown	T08	2.50	?	?	?	?
	Erupting crown	T09	?	?	?	?	?
	Tooth tip	T10	2.50	?	?	?	?
	Crown	?	2.70	?	4.80	5.00	70.0
	Ex situ crown	?	1.50	0.90	4.20	4.40	72.5
	Tip missing	?	3.10	0.90	?	?	?
DMNH 39022, left premaxilla	Crown	lP 01	0.80	0.50	2.20	2.20	79.5
	Crown	lP 02	1.90	?	6.90	7.20	73.3
	Tip broken	lP 03	1.10	?	5.30	5.50	73.8
	Tip broken	lP 04	1.80	?	5.00	5.40	67.6
DMNH 39022, left maxilla	Maxilla damaged	lM 01	?	?	?	?	?
	Maxilla damaged	lM 02	?	?	?	?	?
	Erupting crown	lM 03	1.30	?	3.30	3.80	58.0
	Broken crown	lM 04	3.00	?	8.20	9.10	63.3
	Maxilla damaged	lM 05	?	?	?	?	?
	Maxilla damaged	lM 06	?	?	?	?	?
	Maxilla damaged	lM 07	?	?	?	?	?
	Maxilla damaged	lM 08	?	?	?	?	?
	Erupting crown	lM 09	3.20	?	4.20	4.40	64.9
	Base only	lM 10	3.50	1.00	?	?	?
	Tip broken	lM 11	3.70	?	6.00	7.90	46.7
	Only partial base	lM 12	?	0.80	?	?	?
	Base only	lM 13	3.20	1.10	?	?	?
	Tip broken	lM 14	3.70	?	?	?	?
DMNH 39022, left dentary	Small crown	lD 01	1.20	?	3.00	3.30	65.1
	Partial alveolus	lD 02	?	?	?	?	?
	Crown	lD 03	1.40	?	2.90	?	?
	Alveolus	lD 04	2.00	?	?	?	?
	Crown	lD 05	2.00	?	5.20	5.30	76.2
	Erupting tooth	lD 06	?	?	?	?	?
	Crown	lD 07	1.80	?	?	?	?
	Hidden	lD 08	?	?	?	?	?
	Base broken	lD 09	2.10	?	4.50	4.80	69.1
	Base broken	lD 10	2.30	?	4.60	5.00	66.6
	Base only	lD 11	3.20	0.90	?	?	?
	Crown	lD 12	2.30	?	4.20	4.70	63.2
	Tip broken	lD 13	2.00	?	3.20	3.80	57.4
	Mostly hidden	lD 14	2.50	?	?	?	?
	Partial base only	lD 15	?	?	?	?	?
DMNH 39022, right premaxilla	Crown	rP 01	1.50	0.90	5.04	5.76	54.5
	Erupting	rP 02	?	?	4.30	4.70	?
	Crown	rP 03	2.00	?	6.12	6.36	74.0
	Crown	rP 04	1.40	?	?	?	?

	Crown	rM 01	2.20	?	5.16	5.64	66.2
	Partial	rM 02	1.50	1.00	?	?	?
	Crown	rM 03	2.00	?	8.10	9.00	57.4
	Erupting	rM 04	2.00	?	3.50	4.50	48.2
	Crown	rM 05	3.40	?	8.30	9.30	62.5
	Crown	rM 06	3.30	?	5.90	7.20	54.0
	Base only	rM 07	2.40	1.20	?	?	?
DMNH 39022, right maxilla	Covered	rM 08	?	?	?	?	?
	Damaged	rM 09	?	?	?	?	?
	Damaged	rM 10	?	?	?	?	?
	Damaged	rM 11	1.10	?	3.80	?	?
	Covered	rM 12	3.40	?	6.00	6.70	63.3
	Tip missing	rM 13	4.40	?	3.50	5.00	43.1
	Alveolus	rM 14	?	?	?	?	?
	Alveolus	rM 15	?	?	?	?	?
	Alveolus	rM 16	?	?	1.90	2.20	?
DMNH 39022, right maxilla	Partial alveolus	rM 17	3.40	1.00	?	?	?
	Partial alveolus	rM 18	2.10	0.70	?	?	?
	Alveolus	rM 19	2.60	0.70	?	?	?
	Crown	rD 01	1.30	?	4.0	4.6	55.1
	Erupting	rD 02	2.20	0.90	2.7	?	?
	Crown	rD 03	2.0	?	6.1	6.6	66.9
	Crown	rD 04	1.8	?	4.1	4.4	68.6
	Alveolus	rD 05	2.3	1.0	?	?	?
	Crown	rD 06	2.1	?	4.6	5.0	66.9
	Alveolus	rD 07	2.8	1.4	?	?	?
	Crown	rD 08	2.0	?	4.0	4.4	65.3
	Erupting	rD 09	2.4	?	3.0	?	?
	Tip hidden	rD 10	2.3	?	?	?	?
	Tip broken	rD 11	2.5	?	4.0	4.5	62.2
DMNH 39022, right dentary	Tip erupting	rD 12	2.7	1.0	?	?	?
	Crown	rD 13	2.5	?	5.0	5.6	63.2
	Erupting tooth tip	rD 14	2.8	1.0	?	?	?
	Tip broken	rD 15	2.7	?	3.8	?	?
	Erupting	rD 16	3.0	1.0	4.0	?	?
	Tip and alveolus	rD 17	2.9	1.0	4.5	5.0	63.0
	Tip hidden	rD 18	2.4	?	3.0	?	?
	Hidden	rD 19	?	?	?	?	?
	Hidden	rD 20	?	?	?	?	?
	Hidden	rD 21	?	?	?	?	?
	Hidden	rD 22	?	?	?	?	?
	Hidden by p2	lP 01	1.2	?	?	?	?
MNA V3315, left premaxilla	Crown	lP 02	1.9	?	6.2	6.5	72.5
	Tip hidden	lP 03	1.7	?	?	?	?
	Tip hidden	lP 04	1.9	?	?	?	?

	Crown	lM 01	1.8	?	4.1	4.7	59.8
	Crown and root	lM 02	2.3	?	5.3	5.5	72.9
	Crown	lM 03	2.5	?	5.7	6.5	60.5
	Missing	lM 04	?	?	?	?	?
	Crown	lM 05	3.15	?	6.2	7.36	56.4
	Erupting crown	lM 06	3.78	?	?	?	?
	Crown	lM 07	3.5	?	7.09	7.6	68.2
	Tip displaced	lM 08	2.97	?	5.37	?	?
	Broken crown	lM 09	?	?	?	?	?
	Tip missing	lM 10	3.3	?	5.7	?	?
MNA V3315, left maxilla	Erupting crown	lM 11	?	?	?	?	?
	Missing	lM 12	?	?	?	?	?
	Base and root	lM 13	3	?	3.7	?	?
	Erupting crown	lM 14	?	?	?	?	?
	Crown	lM 15	2.7	?	3.6	4.6	51.4
	Crown,	lM 16	3.5	?	3.7	4.5	53.3
	Hidden by phalanx	lM 17	?	?	?	?	?
	Tip missing	lM 18	2.8	?	?	?	?
	Erupting crown	lM 19	2.7	?	?	?	?
	Tip damaged	lM 20	2.5	?	3.4	?	?
	Tip damaged	lM 21	2.3	?	?	?	?
	Damaged at base	lM 22	2.3	?	2.7	?	?
MNA V3315, left maxilla	Damaged	lM 23	2.0	?	2.0	2.2	56.6
	Alveolus	lM 24	?	?	?	?	?
	Hidden by p2	lD 01	?	?	6.3	6.5	?
	Hidden by p3	lD 02	1.3	?	?	?	?
	Alveolus	lD 03	1.7	?	?	?	?
	Crown	lD 04	1.8	?	4.1	4.9	53.7
	Tip only	lD 05	?	?	?	?	?
	Crown	lD 06	?	?	3.7	?	?
MNA V3315, left dentary	Hidden by m2	lD 07	?	?	?	?	?
	Partially visible	lD 08	?	?	?	?	?
	Hidden by m3	lD 09	?	?	?	?	?
	Tip hidden	lD 10	2.0	?	?	?	?
	Tip hidden	lD 11	2.1	?	2.5	3.6	42.7
	Hidden	lD 12	?	?	?	?	?
	Hidden	lD 13	?	?	?	?	?
	Base only	lD 14	?	?	?	?	?
	Broken	rP 01	1.4	?	?	?	?
MNA V3315, right premaxilla	Crown	rP 02	1.4	?	3.3	3.8	58.8
	Crown	rP 03	2.0	?	5.7	6.0	71.8
	Base only	rP 04	1.6	?	?	?	?

	Tip missing	rM 01	3.0	?	?	?	?
	Tip missing	rM 02	2.2	?	3.7	4.5	54.8
	Alveolus	rM 03	2.3	?	?	?	?
	Alveolus	rM 04	3.0	?	?	?	?
	Missing	rM 05	?	?	?	?	?
	Missing	rM 06	?	?	?	?	?
	Missing	rM 07	?	?	?	?	?
	Erupting crown	rM 08	2.7	?	?	?	?
	Crown	rM 09	3.3	?	6	7	58.9
	Missing	rM 10	?	?	?	?	?
	Missing	rM 11	?	?	?	?	?
MNA V3315, right maxilla	Damaged	rM 12	3.0	?	4.2	?	?
	Missing	rM 13	?	?	?	?	?
	Crown	rM 14	3.0	?	4.3	5.2	55.8
	Erupting crown	rM 15	?	?	0.7	?	?
	Crown	rM 16	2.5	?	3.1	?	?
	Erupting crown	rM 17	?	?	1.3	?	?
	Damaged	rM 18	?	?	?	?	?
	Tip displaced	rM 19	2.4	?	2.5	?	?
	Crown	rM 20	2.4	?	2.8	3.5	52.7
	Tip displaced	rM 21	2.1	?	?	?	?
	Crown	rM 22	?	?	?	?	?
	Crown	rM 23	2.3	?	2.4	2.5	59.8
	Crown	rM 24	1.9	?	2.1	2.1	63.1
	Crown	rM 25	1.9	?	1.8	1.8	58.1
	Hidden by p2	rD 01	1.0	?	?	?	?
	Hidden	rD 02	?	?	?	?	?
	Hidden	rD 03	?	?	?	?	?
MNA V3315, right dentary	Hidden by p4	rD 04	1.4	?	?	?	?
	Crown	rD 05	1.3	?	?	?	?
	Crown	rD 06	2.0	?	4.8	5.0	72.7
	Hidden	rD 07	?	?	?	?	?
	Hidden	rD 08	?	?	?	?	?
	Hidden	rD 09	?	?	?	?	?
	Erupting crown	rD 10	?	?	?	?	?
	Tip hidden	rD 11	2.1	?	?	?	?
	Crown	rD 12	1.9	?	2.8	3.7	47.7
	Tip hidden	rD 13	2.3	?	?	?	?
	Tip hidden	rD 14	2.2	?	?	?	?
MNA V3315, right dentary	Tip hidden	rD 15	2.2	?	?	?	?
	Tip hidden	rD 16	2.2	?	?	?	?
	Hidden	rD 17	?	?	?	?	?
	Hidden	rD 18	?	?	?	?	?
	Hidden	rD 19	?	?	?	?	?
	Hidden	rD 20	?	?	?	?	?
	Base only	rD 21	2.2	?	?	?	?
	Partially hidden	rD 22	?	?	?	?	?
	Ridged crown	rP 01	?	0.92	1.8	?	?
	Ridged crown	rP 02	?	0.7	3.2	?	?
	Damaged crown	rP 03	1.41	?	3.86	?	?
	Damaged crown	rP 04	?	?	?	?	?
	Partially hidden	rM 01	?	?	?	?	?
MNA V3318, right premaxilla	Weak ridging	rM 02	?	?	?	?	?
	Tip hidden	rM 03	1.21	?	?	?	?
	Weak ridging	rM 04	1.33	?	?	?	?
MNA V3318, right maxilla	Crown	rM 05	1.8	?	3.25	3.35	71.1
	Partially exposed	rM 06	?	?	2.62	?	?
	Crown	rM 07	1.94	?	2.81	2.93	66.9
	Missing	rM 08	?	?	?	?	?
	Tip missing	rM 09	1.6	?	?	?	?
	Missing	rM 10	?	?	?	?	?
	Missing	rM 11	?	?	?	?	?
	Erupting tip	rM 12	?	?	?	?	?

MNA V3318, right dentary	Crown	*d1	1.66	?	2.61	3.5	45.2
	Crown	*d2	2.08	?	2.8	3.06	62.6
	Tip hidden	*d3	1.79	?	2.85	?	?
	Partial base	*d4	?	?	?	?	?
MNA V3318, left premaxilla	Crown base	lP 01	?	1.0	?	?	?
	Ridged crown	lP 02	1.1	?	3.6	?	?
NMMNH P42200, left premaxilla	Ridged crown	lP 01	1.6	?	?	?	?
	Ridged crown	lP 02	1.4	?	2.8	2.6	83.1
	Ridged crown	lP 03	1.2	?	1.9	2.0	67.6
	Ridged crown	lP 04	?	?	1.2	?	?
NMMNH P42200, left maxilla	Weak ridging	lM 01	1.2	?	2.5	2.7	67.5
	No ridging	lM 02	1.2	?	3.2	3.6	61.2
	Missing	lM 03	1.6	?	3.0	3.3	65.1
	Crown	lM 04	1.5	?	3.9	4.0	75.3
	Crown	lM 05	1.5	?	?	?	?
	Crown	lM 06	1.0	?	2.4	2.4	78.0
	Crown	lM 07	1.2	?	2.4	2.7	62.7
	Missing	lM 08	1.2	?	2.3	2.4	70.6
	Crown	lM 09	?	?	?	?	?
	Crown	lM 10	1.5	?	2.6	3.1	56.7
	Tip hidden	lM 11	1.4	?	3.3	3.4	74.0
	Whole crown	lM 12	1.6	?	3.0	?	?
	Missing	lM 13	1.6	?	2.6	3.1	57.0
	Whole crown	lM 14	1.3	?	1.8	1.9	65.4
NMMNH P42200, left maxilla	Erupting tip	lM 15	0.704	?	1.1	1.06	74.4
	Erupting tip	lM 16	1.3	?	1.6	1.7	62.8
	Erupting tip	lM 17	1.0	?	1.1	1.1	63.0
	Erupting tip	lM 18	1.2	?	1.2	1.3	57.2
	Tip hidden	lM 19	0.8	?	?	?	?
	Tip broken	lM 20	0.6	?	0.9	1.0	62.7
	Erupting tip	lM 21	1.1	?	0.9	1.0	50.5
NMMNH P42200, right premaxilla	Ridged crown	rD 01	1.2	?	1.9	2.0	67.6
	Erupting tip	rD 02	?	?	1.2	?	?
NMMNH P42200, left dentary	Ridged crown	lD 01	1.2	?	2.5	2.7	67.5
	Ridged crown	lD 02	1.2	?	3.2	3.6	61.2
	Ridged crown	lD 03	1.6	?	3.0	3.3	65.1
	Ridged crown	lD 04	1.5	?	3.9	4.0	75.3
	Broken	lD 05	1.5	?	?	?	?
	Ridged crown	lD 06	1.0	?	2.4	2.4	78.0
	Damaged	lD 07	1.2	?	2.4	2.7	62.7
	Crown	lD 08	1.2	?	2.3	2.4	70.6
	Missing	lD 09	?	?	?	?	?
	Crown	lD 10	1.5	?	2.6	3.1	56.7
	Crown	lD 11	1.4	?	3.3	3.4	74.0
	Damaged	lD 12	1.6	?	3.0	?	?
	Crown	lD 13	1.6	?	2.6	3.1	57.0
	Tip hidden	lD 14	1.7	?	?	?	?
	Crown	lD 15	1.7	?	2.1	2.8	48.4
	Missing	lD 16	1.5	?	?	?	?
	Missing	lD 17	0.9	?	?	?	?
	Missing	lD 18	1.7	?	?	?	?
	Missing	lD 19	?	?	?	?	?
	Missing	lD 20	?	?	?	?	?
NMMNH P42353, left maxilla	Crown	lMt 1	2.0	?	4.0	5.9	14.9
	Tip hidden	lMt 2	4.0	?	1.65	9.0	?
	Tip hidden	lMt 3	4.0	?	?	8.4	?
	Alveolus only	lMt 4	3.5	2.38	?	?	?
	Alveolus only	lMt 5	3.5	2.27	?	?	?
	Erupting tip	lMt 6	3	?	?	?	?
	Broken at base	lMt 7	3.5	?	?	?	?
	Tip hidden	lMt 8	3.1	?	?	4.6	?
	Erupting tip	lMt 9	1.5	?	?	?	?
NMMNH P42353, right maxilla	Erupting tip	rMt 1	2.0	?	1.2	?	?
	Base only	rMt 2	3.0	?	?	?	?
	Base only	rMt 3	3.3	?	1.65	2.5	29.1

NMMNH P42579, right premaxilla	Crown	rP 01	2.0	?	4.8	5.0	72.7
	Crown	rP 02	3.22	1.58	8.04	?	?
	Erupting crown	rP 03	3.7	?	?	?	?
	Base only	rP 04	2.4	1.9	?	?	?
NMMNH P42579, right maxilla	Broken from base	rM 01	2.5	?	5.31	2.8	?
	Tip missing	rM 02	3.3	?	?	?	?
	Erupting crown	rM 03	3.0	?	?	?	?
	Tip missing	rM 04	4.7	1.82	?	?	?
	Tip missing	rM 05	4	?	?	?	?
	Missing	rM 06	?	?	?	?	?
	Crown	rM 07	?	?	9.68	9.9	?
	Alveolus only	rM 08	?	?	?	?	?
	Whole crown	rM 09	4.5	?	7.02	9.8	40.6
	Erupting tip	rM 10	?	?	?	?	?
NMMNH P42579, right dentary	Erupting crown	rD 01	0.5	?	1.5	1.5	80.4
	Badly damaged	rD 02	?	?	?	?	?
	Tip hidden	rD 03	2.3	?	4.6	5.5	55.4
	Tip only	rD 04	?	?	?	?	?
	Tip missing	rD 05	3.0	?	4.5	5.8	50.0
	Erupting crown	rD 06	?	?	?	?	?
	Base only, hidden	?1	2.2	?	?	?	?
	Base only, broken	?2	2.3	?	?	?	?
NMMNH P42579, left premaxilla	Crown and root	lP 01?	1.5	?	6.7	?	?
NMMNH P42579, left maxilla	Distal half only	?1	?	?	?	?	?
	Partially exposed	?2	?	?	?	?	?
	Base of root	?3	3.7	?	?	?	?
	Damaged crown	?4	1.5	?	?	?	?
	Damaged	?5	?	?	?	?	?
	Tip exposed	?6	?	?	?	?	?
	AC exposed	?7	?	?	?	?	?
	Base only	?8	?	?	?	?	?
	Tip displaced	?9	?	?	?	?	?
	Tip displaced	?10	?	?	?	?	?
NMMNH P44551, right maxilla	Crown	rM 01	0.9	?	2.0	2.4	53.5
	Crown	rM 02	2.28	?	4.66	5.6	54.5
	Crown	rM 03	?	?	?	?	?
	Crown	rM 04	2.8	?	6.31	6.8	68.0
	Crown and root	rM 05	2.88	?	6.26	6.92	64.8
	Missing	rM 06	?	?	?	?	?
	Crown	rM 07	3.06	?	5.38	6.23	59.7
	Erupting crown	rM 08	3.41	?	2	?	?
	Crown	rM 09	3.05	?	5.07	6.91	42.0
	Crown	rM 10	3.66	?	?	?	?
	Crown	rM 11	3.14	?	5.49	5.82	68.2
	Crown	rM 12	3.25	?	4.17	?	?
	Alveolus only	rM 13	2.86	?	?	?	?
	Partially hidden	rM 14	2.7	?	?	?	?
	Tip missing	rM 15	?	?	3.7	?	?
NMMNH P44551, isolated crown	Isolated ridged premaxillary tooth	Tooth	?	1.6	3.66	?	?
NMMNH P44555, left premaxilla	Broken base	lP 01	1.4	?	?	?	?
	Badly damaged	lP 02	?	?	?	?	?

	Tip missing	lMt 01	3.31	?	?	?	?
	Alveolus missing	lMt 02	4.8	1.7	?	?	?
	Shedding crown	lMt 03	4.8	?	7.93	?	?
	Base covered	lMt 04	3.2	?	?	?	?
	Base only	lMt 05	2.6	1.15	?	?	?
	Base only	lMt 06	3	?	?	?	?
	Root and crown	lMt 07	3.2	?	?	?	?
NMMNH P44555, left maxilla	Crown	lMt 08	3.1	?	2.4	5	21.5
	Crown base with impressed tip	lMt 09	2.6	?	4	5	52.7
	Crown	lMt 10	2	?	3	4.3	38.3
	Erupting tip	lMt 11	1.9	?	?	?	?
	Base only	lMt 12	3.2	?	?	?	?
	Alveolus	lMt 13	3	?	?	?	?
	Alveolus	lMt 14	3.5	?	?	?	?
	Crown	lMt 15	2.1	?	1.9	2.7	44.5
	Crown	lMt 16	2.3	?	3.5	3.5	70.8
NMMNH P44555, right premaxilla	Crown	rP 01?	1.5	?	5	5.5	63.0
	Tip missing	rMt 01	4.3	?	?	?	?
	Tooth displaced	rMt 02	?	?	?	?	?
	Broken crown	rMt 03	?	?	?	?	?
	Erupting tip	rMt 04	4.11	?	6.87	?	?
	Alveolus hidden	rMt 05	3.2	?	?	?	?
NMMNH P44555, right maxilla	Crown	rMt 06	3.82	?	6.47	7.94	53.9
	Alveolus hidden	rMt 07	?	?	?	?	?
	Crown	rMt 08	3.92	?	6.71	9.05	42.6
	Erupting crown	rMt 09	3.15	?	4.24	5.54	49.6
	Damaged crown	rMt 10	2.22	?	1.98	?	?
	Crown	rMt 11	2.07	?	1.98	2.04	57.6
	Base only	rD 01	1.7	1.08	?	?	?
	Crown	rD 02	1.4	?	3.5	4.1	55.4
	Crown	rD 03	2.2	?	6.5	7.1	65.4
	Crown	rD 04	2.4	?	4.2	4.9	59.0
	Crown	rD 05	3	?	8.2	8.3	77.7
	Crown	rD 06	2.9	?	5.4	5.9	65.7
NMMNH P50529, right dentary	Alveolus only	rD 07	2.56	?	?	?	?
	Crown	rD 08	2.7	?	6.31	6.31	77.6
	Erupting crown(1)	rD 09	2.24	?	0.6	?	?
	Crown	rD 10	2.8	?	5.34	6.03	62.3
	Erupting crown(2)	rD 11	3.1	?	0.9	?	?
	Crown	rD 12	2.97	?	5.51	6.31	60.8
	Erupting crown(3)	rD 13	3.17	?	2.10	?	?
	Crown	rD 14	3.27	?	5.96	6.67	63.2
	Erupting crown(4)	rD 15	3.51	?	2.00	?	?
	Damaged crown	rD 16	3.35	?	5.35	5.40	71.0
	Erupting crown(5)	rD 17	3.45	?	2.50	?	?
NMMNH P50529, right dentary	Tip missing	rD 18	3.32	?	?	?	?
	Erupting crown(6)	rD 19	3.64	?	?	?	?
	Crown	rD 20	3.39	?	4.79	5.49	59.9
	Tip missing	rD 21	2.89	?	?	5.20	?
	Crown base	rD 22	3.29	?	?	?	?
	Crown	rD 23	3.15	?	4.28	4.63	63.4
	Erupting crown	rD 24	2.40	?	0.90	?	?
	Crown	rD 25	2.80	?	3.15	3.19	63.1
	Crown	rD 26	2.18	?	2.35	2.28	63.5

NMMNH P50530, left premaxilla	Erupting tip	lP 01	2.70	1.9	?	?	?
	Crown	lP 02	2.50	?	7.70	9.40	41.3
	Erupting tip	lP 03	3.30	3	?	?	?
	Tip missing	lP 04	1.80	?	6.30	?	?
	Crown	lM 01	2.30	?	4.00	4.60	60.4
	Crown	lM 02	2.20	?	3.60	4.60	49.9
	Crown	lM 03	4.30	?	9.30	12.3	38.0
	Erupting crown	lM 04	?	?	2.70	?	?
	Crown	lM 05	5.50	?	11.35	12.4	66.1
NMMNH P50530, left maxilla	Tip missing	lM 06	?	?	5.10	?	?
	Tip missing	lM 07	4.70	?	9.40	11.24	55.4
	Tip missing	lM 08	5.81	?	9.24	13.74	30.8
	Alveolus	lM 09	5.68	1.56	?	?	?
	Alveolus	lM 10	5.90	1.30	?	?	?
	Erupting crown	lM 11	?	?	?	?	?
	Alveolus	lM 12	3.12	?	?	?	?
	Erupting crown	lM 13	4.80	?	5.00	?	?
RTMP 1984.063.0001-1, left premaxilla	lP 01	1.77	?	4.4	4.49	75.7	
	lP 02	?	?	?	?	?	

Specimen	Position	ACL	ACDL	PCL	PCDL	LAD-W	LAD-L	LAD-H	LPD-W	LPD-L	LPD-H
AMNH 7227, left maxilla	IM 01	?	?	?	?	?	?	?	?	?	?
	IM 02	?	?	?	?	?	?	?	?	?	?
	IM 03	?	?	?	?	?	?	?	?	?	?
	IM 04	?	?	?	?	?	?	?	?	?	?
	IM 05	?	?	?	?	?	?	?	?	?	?
	IM 06	?	?	?	?	?	?	?	?	?	?
	IM 07	?	?	?	?	?	?	?	?	?	?
	IM 08	?	?	?	?	?	?	?	?	?	?
	IM 09	?	?	?	?	?	?	?	?	?	?
	IM 10	?	?	?	?	?	?	?	?	?	?
	IM 11	?	?	?	?	?	?	?	?	?	?
	IM 12	?	?	?	?	?	?	?	?	?	?
	IM 13	?	?	?	?	?	?	?	?	?	?
	IM 14	?	?	?	?	?	?	?	?	?	?
	IM 15	?	?	?	?	?	?	?	?	?	?
	IM 16	?	?	?	?	?	?	?	?	?	?
	IM 17	?	?	?	?	?	?	?	?	?	?
	IM 18	?	?	?	?	?	?	?	?	?	?
	IM 19	?	?	?	?	?	?	?	?	?	?
	IM 20	?	?	?	?	?	?	?	?	?	?
	IM 21	?	?	?	?	?	?	?	?	?	?
	IM 22	?	?	?	?	?	?	?	?	?	?
	IM 23	?	?	?	?	?	?	?	?	?	?
	IM 24	?	?	?	?	?	?	?	?	?	?
	IM 25	?	?	?	?	?	?	?	?	?	?
	IM 26	?	?	?	?	?	?	?	?	?	?
	IM 27	?	?	?	?	?	?	?	?	?	?
AMNH 7227, left dentary	ID 01	?	?	?	?	?	?	?	?	?	?
	ID 02	?	?	?	?	?	?	?	?	?	?
	ID 03	?	?	?	?	?	?	?	?	?	?
	ID 04	?	?	?	?	?	?	?	?	?	?
	ID 05	?	?	?	?	?	?	?	?	?	?
	ID 06	?	?	?	?	?	?	?	?	?	?
	ID 07	?	?	?	?	?	?	?	?	?	?
	ID 08	?	?	?	?	?	?	?	?	?	?
	ID 09	?	?	?	?	?	?	?	?	?	?
	ID 10	?	?	?	?	?	?	?	?	?	?
	ID 11	?	?	?	?	?	?	?	?	?	?
	ID 12	?	?	?	?	?	?	?	?	?	?
	ID 13	?	?	?	?	?	?	?	?	?	?
	ID 14	?	?	?	?	?	?	?	?	?	?
	ID 15	?	?	?	?	?	?	?	?	?	?
	ID 16	?	?	?	?	?	?	?	?	?	?
	ID 17	?	?	?	?	?	?	?	?	?	?
	ID 18	?	?	?	?	?	?	?	?	?	?
	ID 19	?	?	?	?	?	?	?	?	?	?
	ID 20	?	?	?	?	?	?	?	?	?	?
	ID 21	?	?	?	?	?	?	?	?	?	?
	ID 22	?	?	?	?	?	?	?	?	?	?
AMNH 7228, left premaxillary	IP 01	?	?	?	?	?	?	?	?	?	?
	IP 02	?	?	?	?	?	?	?	?	?	?
	IP 03	?	?	?	?	?	?	?	?	?	?
	IP 04	?	?	?	?	?	?	?	?	?	?

AMNH 7228, left maxilla	IM 01	?	?	?	?	?	?	?	?	?	?
	IM 02	?	?	?	?	?	?	?	?	?	?
	IM 03	?	?	?	?	?	?	?	?	?	?
	IM 04	?	?	?	?	?	?	?	?	?	?
	IM 05	?	?	?	?	?	?	?	?	?	?
	IM 06	?	?	?	?	?	?	?	?	?	?
	IM 07	?	?	?	?	?	?	?	?	?	?
	IM 08	?	?	?	?	?	?	?	?	?	?
	IM 09	?	?	?	?	?	?	?	?	?	?
	IM 10	?	?	?	?	?	?	?	?	?	?
	IM 11	?	?	?	?	?	?	?	?	?	?
	IM 12	?	?	?	?	?	?	?	?	?	?
	IM 13	?	?	?	?	?	?	?	?	?	?
	IM 14	?	?	?	?	?	?	?	?	?	?
	IM 15	?	?	?	?	?	?	?	?	?	?
	IM 16	?	?	?	?	?	?	?	?	?	?
	IM 17	?	?	?	?	?	?	?	?	?	?
	IM 18	?	?	?	?	?	?	?	?	?	?
	IM 19	?	?	?	?	?	?	?	?	?	?
	IM 20	?	?	?	?	?	?	?	?	?	?
	IM 21	?	?	?	?	?	?	?	?	?	?
	IM 22	?	?	?	?	?	?	?	?	?	?
	IM 23	?	?	?	?	?	?	?	?	?	?
	IM 24	?	?	?	?	?	?	?	?	?	?
	IM 25	?	?	?	?	?	?	?	?	?	?
	IM 26	?	?	?	?	?	?	?	?	?	?
	IM 27	?	?	?	?	?	?	?	?	?	?
	IM 28	?	?	?	?	?	?	?	?	?	?
AMNH 7228, left dentary	ID 01	?	?	?	?	?	?	?	?	?	?
	ID 02	?	?	?	?	?	?	?	?	?	?
	ID 03	?	?	?	?	?	?	?	?	?	?
	ID 04	?	?	?	?	?	?	?	?	?	?
	ID 05	?	?	?	?	?	?	?	?	?	?
	ID 06	?	?	?	?	?	?	?	?	?	?
	ID 07	?	?	?	?	?	?	?	?	?	?
	ID 08	?	?	?	?	?	?	?	?	?	?
	ID 09	?	?	?	?	?	?	?	?	?	?
	ID 10	?	?	?	?	?	?	?	?	?	?
	ID 11	?	?	?	?	?	?	?	?	?	?
	ID 12	?	?	?	?	?	?	?	?	?	?
	ID 13	?	?	?	?	?	?	?	?	?	?
	ID 14	?	?	?	?	?	?	?	?	?	?
	ID 15	?	?	?	?	?	?	?	?	?	?
	ID 16	?	?	?	?	?	?	?	?	?	?
	ID 17	?	?	?	?	?	?	?	?	?	?
AMNH 7230, left upper element	01	?	?	?	?	?	?	?	?	?	?
	02	?	?	?	?	?	?	?	?	?	?
	03	?	?	?	?	?	?	?	?	?	?
	04	?	?	?	?	?	?	?	?	?	?
	05	?	?	?	?	?	?	?	?	?	?
	06	?	?	?	?	?	?	?	?	?	?
	07	?	?	?	?	?	?	?	?	?	?
	08?	?	?	?	?	?	?	?	?	?	?
AMNH 7230, right upper element	01	?	?	?	?	?	?	?	?	?	?
	02	?	?	?	?	?	?	?	?	?	?
AMNH 7231, left premaxilla	IP 01	?	?	?	?	?	?	?	?	?	?
	IP 02	?	?	?	?	?	?	?	?	?	?
	IP 03	?	?	?	?	?	?	?	?	?	?
	IP 04	?	?	?	?	?	?	?	?	?	?
AMNH 7231, left maxilla	IM 01	?	?	?	?	?	?	?	?	?	?

AMNH 7231, left dentary	lD 01	?	?	?	?	?	?	?	?	?	?
	lD 02	?	?	?	?	?	?	?	?	?	?
	lD 03	?	?	?	?	?	?	?	?	?	?
	lD 04	?	?	?	?	?	?	?	?	?	?
	lD 05	?	?	?	?	?	?	?	?	?	?
	lD 06	?	?	?	?	?	?	?	?	?	?
	lD 07	?	?	?	?	?	?	?	?	?	?
	lD 08	?	?	?	?	?	?	?	?	?	?
	lD 09	?	?	?	?	?	?	?	?	?	?
	lD 10	?	?	?	?	?	?	?	?	?	?
	lD 11	?	?	?	?	?	?	?	?	?	?
	lD 12	?	?	?	?	?	?	?	?	?	?
	lD 13	?	?	?	?	?	?	?	?	?	?
	lD 14	?	?	?	?	?	?	?	?	?	?
	lD 15	?	?	?	?	?	?	?	?	?	?
	lD 16	?	?	?	?	?	?	?	?	?	?
	lD 17	?	?	?	?	?	?	?	?	?	?
AMNH 7239, left maxilla	lM 01	?	?	?	0	?	?	?	?	?	?
	lM 02	?	?	?	?	?	?	?	?	?	?
	lM 03	?	?	?	?	?	?	?	?	?	?
	lM 04	?	?	?	?	?	?	?	?	?	?
	lM 05	?	?	?	?	?	?	?	?	?	?
	lM 06	?	?	?	?	?	0.05	?	0.1	?	?
	lM 07	?	?	?	?	?	?	?	?	?	?
	lM 08	?	?	?	?	?	?	?	?	0.067	?
	lM 09	?	?	?	?	?	?	?	?	?	?
	lM 10	?	?	?	?	?	?	?	?	?	?
	lM 11	?	?	?	?	?	0.05	?	?	0.067	?
	lM 12	?	?	?	?	?	0.05	?	?	0.067	?
	lM 13	?	?	3.15	?	?	0.25	?	?	0.25	?
	lM 14	?	?	?	?	?	?	?	?	?	?
	lM 15	?	?	?	?	?	?	?	?	0.1	?
	lM 16	?	?	?	?	?	0.05	?	?	0.067	?
	lM 17	?	?	?	?	?	?	?	0.067	?	?
	lM 18	?	?	?	?	?	?	?	?	?	?
7239, left maxilla	lM 19	?	?	?	?	?	?	?	?	?	?
	lM 20	?	?	?	?	?	0.067	?	?	?	?
	lM 21	?	?	?	?	?	?	?	?	0.05	?
	lM 22	1.91	?	?	?	?	0.25	?	?	0.067	?
	lM 23	1.84	?	1.72	?	?	0.05	0.05	?	0.067	0.1
	lM 24	?	?	?	?	?	0.5	0.1	?	?	?
	lM 25	?	?	?	?	?	?	?	?	?	?
	lM 26	2.02	?	1.41	?	?	0.067	0.1	?	0.05	0.1
AMNH 7239, right maxilla	rM 01	?	?	?	?	?	?	?	?	?	?
	rM 02	?	?	?	?	?	?	?	?	?	?
	rM 03	?	?	?	?	?	0.05	?	?	0.04	?
	rM 04	?	?	?	?	?	?	?	?	?	?
	rM 05	?	?	?	?	?	0.1	?	?	?	?
	rM 06	?	?	?	?	?	?	?	?	?	?
	rM 07	?	0.08	?	?	0.1	0.067	?	?	0.1	0.1
	rM 08	?	?	?	?	?	?	?	?	?	?
	rM 09	?	?	?	?	?	?	?	?	?	?
	rM 10	?	?	?	?	?	?	?	?	?	?
	rM 11	?	?	?	?	0.1	0.067	0.07	0.15	0.1	0.1
	rM 12	?	?	?	?	?	0.067	?	?	?	?
	rM 13	?	?	?	?	?	?	?	?	?	?
	rM 14	3.99	?	?	?	?	0.05	0.1	?	?	?
	rM 15	?	?	?	?	?	?	?	?	0.067	0.1
	rM 16	?	?	?	?	?	?	?	?	?	?
	rM 17	?	?	?	?	?	?	?	?	?	?
	rM 18	?	?	?	?	?	?	?	?	?	?
	rM 19	?	?	?	?	?	0.1	0.1	?	0.1	0.1
	rM 20	?	?	2.15	?	?	0.1	0.1	?	0.1	0.1
	rM 21	?	?	?	?	?	?	?	?	0.1	0.07
	rM 22	?	?	?	?	?	?	?	?	?	?
	rM 23	?	?	?	?	?	?	?	?	0.1	0.15
	rM 24	?	?	?	?	?	?	?	?	?	?
	rM 25	?	?	?	?	?	?	?	?	0.1	0.1
	rM 26	?	?	?	?	?	0.07	0.1	?	0.1	?
AMNH 7240, left premaxilla	lP 01	?	?	?	?	?	?	?	?	?	?
	lP 02	?	?	?	?	?	?	?	?	?	?
	lP 03	?	?	?	?	?	?	?	?	?	?
	lP 04	?	?	?	?	?	?	?	?	?	?

AMNH 7240, left maxilla	**lM 01**	**0**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 02	**3.73**	**3.73**	**5.27**	**5.27**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.088**
	lM 03	**0**	**?**	**6**	**6**	**?**	**?**	**?**	**?**	**0.088**	**0.088**
	lM 04	**7.8**	**5.6**	**6.8**	**6.8**	**?**	**0.132**	**0.088**	**?**	**0.132**	**0.132**
	lM 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.132**	**0.11**
	lM 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 08	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 09	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 10	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 12	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
AMNH 7240, left dentary	**lD 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**
	lD 08	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 09	**?**	**?**	**?**	**?**	**?**	**0.066**	**0.088**	**?**	**0.11**	**0.11**
	lD 10	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**
	lD 12	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	lD 13	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 14	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 15	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 16	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 17	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 18	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 19	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 20	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 21	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 22	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 23	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**
	lD 24	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 25	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 26	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 27	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
AMNH 7240, right premaxilla	**rP 01**	**?**	**?**	**3.7**	**0**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**
	rP 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
AMNH 7240, right maxilla	**rM 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 04	**6.79**	**6.79**	**7.93**	**7.93**	**?**	**0.11**	**0.088**	**?**	**0.11**	**0.132**
	rM 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 08	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.066**	**?**	**0.11**	**0.088**
	rM 09	**6.97**	**6.97**	**8.5**	**8.5**	**?**	**0.11**	**0.088**	**?**	**0.11**	**0.132**
	rM 10	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
	rM 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 12	**6.26**	**6.26**	**?**	**?**	**?**	**0.11**	**0.066**	**?**	**0.11**	**0.11**
	rM 13	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 14	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**0.11**	**0.11**
	rM 15	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 16	**4.1**	**4.1**	**4.1**	**4.1**	**?**	**0.11**	**0.088**	**?**	**0.11**	**0.11**
	rM 17	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 18	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.088**
	rM 19	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 20	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 21	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**
	rM 22	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.11**
	rM 23	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
AMNH 7240, right maxilla	**rM 24**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**	**?**	**?**	**?**

AMNH 7240, right dentary	rD 01	?	?	?	?	?	?	?	?	?	?
	rD 02	?	?	?	?	?	?	?	?	?	?
	rD 03	?	?	?	?	?	?	?	?	?	?
	rD 04	?	?	?	?	?	?	?	?	?	?
	rD 05	?	?	?	?	?	?	?	?	?	?
	rD 06	?	?	?	?	?	?	?	?	?	?
	rD 07	?	?	?	?	?	?	?	?	?	?
	rD 08	?	?	?	?	?	?	?	?	?	?
	rD 09	?	?	?	?	?	?	?	?	?	?
	rD 10	?	?	?	?	?	?	?	?	?	?
	rD 11	?	?	?	?	?	?	?	?	?	?
	rD 12	?	?	?	?	?	?	?	?	?	?
	rD 13	?	?	?	?	?	?	?	?	?	?
	rD 14	?	?	?	?	?	?	?	?	?	?
	rD 15	?	?	?	?	?	?	?	?	?	?
	rD 16	?	?	?	?	?	?	?	?	?	?
	rD 17	?	?	?	?	?	?	?	?	?	?
	rD 18	?	?	?	?	?	?	?	?	?	?
	rD 19	?	?	?	?	?	?	?	?	?	?
	rD 20	?	?	?	?	?	?	?	?	?	?
	rD 21	?	?	?	?	?	?	?	?	?	?
	rD 22	?	?	?	?	?	?	?	?	?	?
	rD 23	?	?	?	?	?	?	?	?	?	?
	rD 24	?	?	?	?	?	?	?	?	?	?
AMNH 7241, right premaxilla	rP 01	?	?	?	?	?	?	?	?	?	?
	rP 02	?	?	?	?	?	?	?	?	?	?
	rP 03	?	?	?	?	?	?	?	?	?	?
	rP 04	?	?	?	?	?	?	?	?	?	?
AMNH 7241, right maxilla	rM 01	?	?	?	?	?	?	?	?	?	?
	rM 02	?	?	2.91	?	?	?	?	?	?	?
	rM 03	?	3.48	4.74	?	?	?	?	?	?	?
	rM 04	4.63	?	4.48	?	?	?	?	?	?	?
	rM 05	5.92	?	6.6	?	?	?	?	?	?	?
	rM 06	5.69	?	4.87	?	?	?	?	?	?	?
	rM 07	5.48	?	6.11	?	?	?	?	?	?	?
	rM 08	5.82	?	5.47	?	?	?	?	?	?	?
	rM 09	6.04	?	6.55	?	?	?	?	?	?	?
	rM 10	5.13	?	5.34	?	?	?	?	?	?	?
	rM 11	?	?	?	?	?	?	?	?	?	?
	rM 12	?	?	4.4	?	?	?	?	?	?	?
	rM 13	?	?	?	?	?	?	?	?	?	?
AMNH 7241, right dentary	rD 01	?	?	?	?	?	?	?	?	?	?
	rD 02	?	?	?	?	?	?	?	?	?	?
	rD 03	?	?	?	?	?	?	?	?	?	?
	rD 04	?	?	?	?	?	?	?	?	?	?
	rD 05	?	?	?	?	?	?	?	?	?	?
	rD 06	?	?	?	?	?	?	?	?	?	?
	rD 07	?	?	?	?	?	?	?	?	?	?
	rD 08	?	?	?	?	?	?	?	?	?	?
	rD 09	?	?	?	?	?	?	?	?	?	?
AMNH 7242, left maxilla	lM 01	?	?	?	?	?	?	?	?	?	?
	lM 02	?	?	?	?	?	?	?	?	?	?
	lM 03	?	?	?	?	?	?	?	?	?	?
	lM 04	?	?	?	?	?	?	?	?	?	?
	lM 05	?	?	?	?	?	?	?	?	?	?
	lM 06	?	?	?	?	?	?	?	?	?	?
	lM 07	?	?	?	?	?	?	?	?	?	?
	lM 08	?	?	?	?	?	?	?	?	?	?
	lM 09	?	?	?	?	?	?	?	?	?	?
	lM 10	?	?	?	?	?	?	?	?	?	?
	lM 11	?	?	?	?	?	?	?	?	?	?
	lM 12	?	?	?	?	?	?	?	?	?	?
	lM 13	?	?	?	?	?	?	?	?	?	?
	lM 14	?	?	?	?	?	?	?	?	?	?
	lM 15	?	?	?	?	?	?	?	?	?	?
	lM 16	?	?	?	?	?	?	?	?	?	?
	lM 17	?	?	?	?	?	?	?	?	?	?

AMNH 7242, right maxilla	rM 01	?	?	?	?	?	?	?	?	?	?
	rM 02	?	?	2.91	?	?	?	?	?	?	?
	rM 03	?	3.48	4.74	?	?	?	?	?	?	?
	rM 04	4.63	?	4.48	?	?	?	?	?	?	?
	rM 05	5.92	?	6.6	?	?	?	?	?	?	?
	rM 06	5.69	?	4.87	?	?	?	?	?	?	?
	rM 07	5.48	?	6.11	?	?	?	?	?	?	?
	rM 08	5.82	?	5.47	?	?	?	?	?	?	?
	rM 09	6.04	?	6.55	?	?	?	?	?	?	?
	rM 10	5.13	?	5.34	?	?	?	?	?	?	?
	rM 11	?	?	?	?	?	?	?	?	?	?
	rM 12	?	?	4.4	?	?	?	?	?	?	?
	rM 13	?	?	?	?	?	?	?	?	?	?
	rM 14	?	?	?	?	?	?	?	?	?	?
	rM 15	?	?	2.91	?	?	?	?	?	?	?
	rM 16	?	3.48	4.74	?	?	?	?	?	?	?
	rM 17	4.63	?	4.48	?	?	?	?	?	?	?
DMNH 30596, right premaxilla	rP 01	?	?	?	?	?	?	?	?	?	?
	rP 02	?	?	?	?	?	?	?	?	?	?
	rP 03	?	?	?	?	?	?	?	?	?	?
	rP 04	?	?	?	?	?	?	?	?	?	?
DMNH 30596, right maxilla	rM t01	?	?	?	?	?	?	?	?	0.11	0.066
	rM t02	?	?	?	?	?	?	?	?	?	?
	rM t03	?	?	?	?	?	0.11	0.088	?	0.11	0.11
	rM t04	?	?	?	?	?	0.066	0.088	?	?	?
	rM t05	?	?	?	?	?	?	?	?	?	?
	rM t06	?	?	?	?	?	?	?	?	?	?
	rM t07	?	?	?	?	?	?	?	?	?	?
DMNH 32156, damaged tooth-bearing element	T01	?	?	?	?	?	?	?	?	?	?
	T02	?	?	?	?	?	?	?	?	?	?
	T03	?	?	?	?	?	?	?	?	?	?
	T04	?	?	?	?	?	?	?	?	?	?
	T05	?	?	?	?	?	?	?	?	?	?
	T06	?	?	?	?	?	?	?	?	?	?
	T07	?	?	?	?	?	?	?	?	?	?
	T08	?	?	?	?	?	0.088	0.088	?	?	?
DMNH 32156, damaged tooth-bearing element	T09	?	?	?	?	?	?	?	?	0.11	0.11
	T10	?	?	?	?	?	0.088	0.088	?	0.088	0.11
	?	?	?	?	?	?	?	?	?	?	?
	?	?	5.8	?	5.2	?	?	?	?	?	?
	?	?	?	?	?	?	0.066	0.11	?	0.11	0.132
DMNH 39022, left premaxilla	lP 01	?	?	?	?	?	?	?	?	?	?
	lP 02	?	?	?	?	?	?	?	?	?	?
	lP 03	?	?	?	?	?	?	?	?	?	?
	lP 04	?	?	?	?	?	?	?	?	0.066	0.066
DMNH 39022, left maxilla	lM 01	?	?	?	?	?	?	?	?	?	?
	lM 02	?	?	?	?	?	?	?	?	?	?
	lM 03	?	?	?	?	?	?	?	?	?	?
	lM 04	?	?	?	?	?	?	?	?	0.066	0.088
	lM 05	?	?	?	?	?	?	?	?	?	?
	lM 06	?	?	?	?	?	?	?	?	?	?
	lM 07	?	?	?	?	?	?	?	?	?	?
	lM 08	?	?	?	?	?	?	?	?	?	?
	lM 09	?	?	?	?	?	0.11	0.088	?	0.088	0.11
	lM 10	?	?	?	?	?	?	?	?	0.11	0.11
	lM 11	?	?	?	?	?	0.088	0.132	?	0.11	0.132
	lM 12	?	?	?	?	?	?	?	?	?	?
	lM 13	?	?	?	?	?	?	?	?	?	?
	lM 14	?	?	?	?	?	?	?	?	0.11	0.132
DMNH 39022, left dentary	lD 01	?	?	?	?	?	?	?	?	?	?
	lD 02	?	?	?	?	?	?	?	?	?	?
	lD 03	?	?	?	?	?	?	?	?	?	?
	lD 04	?	?	?	?	?	?	?	?	?	?
	lD 05	?	?	4.5	0.8	?	0.044	0.088	?	0.066	0.11
	lD 06	?	?	?	?	?	?	?	?	?	?
	lD 07	?	?	?	?	?	?	?	?	0.088	0.11
	lD 08	?	?	?	?	?	?	?	?	?	?
	lD 09	?	?	3.7	2.6	?	?	?	?	0.088	0.11
	lD 10	4.5	4.5	?	?	?	0.066	0.066	?	0.066	0.088
	lD 11	?	?	?	?	?	?	?	?	?	?
	lD 12	2.8	2.8	?	?	?	0.066	0.11	?	0.088	0.132
	lD 13	2.9	2.9	?	?	?	0.066	0.11	?	0.088	0.11
	lD 14	?	?	?	?	?	?	?	0.088	0.088	?
	lD 15	?	?	?	?	?	?	?	?	?	?

DMNH 39022, right premaxilla	**rP 001**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 0	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
MNA V3315, left maxilla	**lM 10**	**?**	**3.3**	**?**	**?**	**?**	**0.11**	**0.066**	**?**	**0.11**	**0.088**
	lM 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 12	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 13	**?**	**2.7**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**0.088**	**0.11**
	lM 14	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.066**
	lM 15	**?**	**?**	**3.6**	**?**	**?**	**0.088**	**?**	**?**	**0.11**	**0.11**
	lM 16	**3**	**3**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
	lM 17	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 18	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	lM 19	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 20	**?**	**?**	**3.6**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**
	lM 21	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 22	**2.5**	**2.5**	**2.7**	**2.7**	**?**	**0.088**	**0.088**	**?**	**0.11**	**0.088**
	lM 23	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**	**?**	**0.088**	**?**
	lM 24	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
MNA V3315, left dentary	**lD 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 04	**?**	**?**	**4.1**	**0**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 08	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 09	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 10	**?**	**?**	**3.8**	**3.8**	**0.022**	**?**	**?**	**?**	**0.088**	**0.088**
	lD 11	**2.2**	**2.2**	**2.5**	**2.5**	**0.022**	**0.066**	**0.044**	**?**	**?**	**?**
	lD 12	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 13	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 14	**?**	**?**	**?**	**?**	**0.022**	**?**	**?**	**?**	**0.088**	**0.11**
MNA V3315, right premaxilla	**rP 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 03	**?**	**?**	**5.7**	**0**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
MNA V3315, right maxilla	**rM 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.044**	**0.022**
	rM 02	**?**	**2.5**	**3.7**	**3.7**	**?**	**0.066**	**0.044**	**?**	**0.066**	**0.066**
	rM 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 08	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**0.088**	**0.066**
	rM 09	**4.8**	**4.8**	**6**	**6**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.088**
	rM 10	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 12	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	rM 13	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 14	**?**	**?**	**4.3**	**4.3**	**?**	**0.066**	**0.066**	**?**	**0.11**	**0.11**
	rM 15	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
	rM 16	**2.6**	**2.6**	**3.1**	**3.1**	**?**	**0.088**	**0.066**	**?**	**0.088**	**0.066**
	rM 17	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.044**	**?**	**0.066**	**0.066**
	rM 18	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
	rM 19	**?**	**?**	**2.5**	**2.5**	**?**	**?**	**?**	**?**	**0.11**	**0.088**
MNA V3315, right maxilla	**rM 20**	**3.4**	**3.4**	**2.8**	**2.8**	**?**	**0.088**	**0.066**	**?**	**0.088**	**0.066**
	rM 21	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**	**?**	**0.11**	**0.088**
	rM 22	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.088**
	rM 23	**2.5**	**2.5**	**2.4**	**2.4**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.11**
	rM 24	**2.1**	**2.1**	**2.1**	**2.1**	**?**	**0.088**	**0.066**	**?**	**0.088**	**0.088**
	rM 25	**1.8**	**1.8**	**1.8**	**1.8**	**?**	**0.088**	**0.066**	**?**	**0.11**	**0.11**
MNA V3315, right dentary	**rD 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 06	**?**	**?**	**?**	**0**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**

MNA V3315, right dentary	**rD 08**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 09	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 10	**?**	**?**	**?**	**?**	**?**	**0.044**	**0.022**	**?**	**?**	**?**
	rD 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**
	rD 12	**2.4**	**2.4**	**2.8**	**2.8**	**?**	**0.066**	**0.066**	**?**	**0.088**	**0.088**
	rD 13	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**
	rD 14	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**
	rD 15	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**
	rD 16	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**
	rD 17	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 18	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 19	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 20	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 21	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 22	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
MNA V3318, right premaxilla	**rP 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 03	**?**	**?**	**5.7**	**0**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
MNA V3318, right maxilla	**rM 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 05	**1.7**	**1.7**	**?**	**?**	**?**	**0.066**	**0.066**	**?**	**?**	**?**
	rM 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 07	**?**	**?**	**?**	**?**	**?**	**0.066**	**0.066**	**?**	**?**	**?**
	rM 08	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 09	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
	rM 10	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 12	**?**	**?**	**?**	**?**	**?**	**0.066**	**0.044**	**?**	**?**	**?**
MNA V3318, right dentary	***d 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	***d 02**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	***d 03**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	***d 04**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
MNA V3318, left premaxilla	**lP 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42200, left premaxilla	**lP 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lP 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lP 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42200, left maxilla	**lM 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 04	**?**	**1.5**	**?**	**?**	**?**	**0.044**	**0.132**	**?**	**?**	**?**
	lM 05	**?**	**?**	**?**	**3.2**	**?**	**?**	**?**	**?**	**0.044**	**0.11**
	lM 06	**?**	**?**	**?**	**3.7**	**?**	**0.066**	**0.088**	**?**	**0.066**	**0.088**
	lM 07	**?**	**1.97**	**3**	**3**	**?**	**0.066**	**0.088**	**?**	**0.088**	**0.088**
	lM 08	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 09	**?**	**1.5**	**2.5**	**2.5**	**?**	**0.088**	**0.11**	**?**	**0.11**	**0.11**
	lM 10	**?**	**2.4**	**2.3**	**2.3**	**?**	**0.088**	**0.11**	**?**	**0.088**	**0.11**
	lM 11	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**	**?**	**0.066**	**0.088**
NMMNH P42200, left maxilla	**lM 12**	**1.8**	**1.8**	**2.4**	**2.4**	**?**	**0.066**	**0.088**	**?**	**0.088**	**0.11**
	lM 13	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 14	**1.21**	**1.21**	**1.69**	**1.69**	**?**	**0.088**	**0.088**	**?**	**0.066**	**0.088**
	lM 15	**?**	**?**	**0.88**	**0.88**	**?**	**?**	**?**	**?**	**0.066**	**0.066**
	lM 16	**?**	**?**	**1.3**	**1.3**	**?**	**?**	**?**	**?**	**0.066**	**0.088**
	lM 17	**?**	**?**	**1**	**1**	**?**	**?**	**?**	**?**	**0.066**	**0.088**
	lM 18	**0.88**	**0.88**	**1.19**	**1.19**	**?**	**0.066**	**0.066**	**?**	**0.088**	**0.066**
	lM 19	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lM 20	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**	**?**	**0.088**	**0.088**
	lM 21	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.044**	**0.066**
NMMNH P42200, right dentary	**rD 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**

NMMNH P42200, left dentary	**lD 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**
	lD 08	**?**	**?**	**1.024**	**1.024**	**?**	**?**	**?**	**?**	**0.088**	**0.088**
	lD 09	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 10	**?**	**?**	**1.28**	**1.28**	**?**	**?**	**?**	**?**	**0.066**	**0.088**
	lD 11	**?**	**?**	**1.92**	**1.92**	**?**	**?**	**?**	**?**	**0.066**	**0.11**
	lD 12	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.11**	**?**	**0.088**	**0.11**
	lD 13	**?**	**?**	**1.88**	**1.88**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	lD 14	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 15	**?**	**?**	**4.8**	**4.8**	**?**	**?**	**?**	**?**	**0.066**	**0.088**
	lD 16	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 17	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 18	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 19	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lD 20	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42353, left maxilla	**lMt 1**	**?**	**?**	**4.5**	**4.5**	**?**	**0.088**	**0.132**	**?**	**0.088**	**0.154**
	lMt 2	**?**	**?**	**5**	**5**	**?**	**?**	**?**	**?**	**0.11**	**0.154**
	lMt 3	**5.4**	**?**	**?**	**?**	**?**	**0.11**	**0.132**	**?**	**0.088**	**0.132**
	lMt 4	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 5	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42353, left maxilla	**lMt 6**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.132**	**?**	**0.11**	**0.132**
	lMt 7	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.132**	**?**	**0.11**	**0.132**
	lMt 8	**?**	**?**	**?**	**?**	**?**	**0.055**	**0.11**	**?**	**0.11**	**0.132**
	lMt 9	**?**	**?**	**?**	**?**	**?**	**0.022**	**0.044**	**?**	**0.044**	**0.088**
NMMNH P42353, right maxilla	**rMt 1**	**?**	**?**	**?**	**?**	**?**	**0.022**	**0.066**	**?**	**?**	**?**
	rMt 2	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.132**	**?**	**?**	**?**
	rMt 3	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42579, right premaxilla	**rP 01**	**?**	**?**	**4.7**	**0**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42579, right maxilla	**rM 01**	**?**	**0**	**3.97**	**3.97**	**?**	**?**	**?**	**?**	**0.11**	**0.066**
	rM 02	**?**	**?**	**3.7**	**3.7**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	rM 03	**5.7**	**5.7**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
	rM 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**
	rM 05	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.066**	**?**	**?**	**?**
	rM 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 07	**7.5**	**7.5**	**?**	**?**	**?**	**0.11**	**0.11**	**?**	**?**	**?**
	rM 08	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 09	**8**	**7.4**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
	rM 10	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
NMMNH P42579, right dentary	**rD 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**
	rD 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.066**
	?1	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**
	?2	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42579, left premaxilla	**lP 01?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
NMMNH P42579, left maxilla	**?1**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
	?2	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
	?3	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	?4	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
	?5	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	?6	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
	?7	**?**	**?**	**?**	**?**	**0.11**	**0.11**	**0.088**	**?**	**?**	**?**
	?8	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	?9	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.11**	**?**	**?**	**?**
	?10	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
NMMNH P44551, right maxilla	**rM 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 04	**?**	**?**	**5.58**	**4.3**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	rM 05	**?**	**?**	**5.31**	**5.31**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	rM 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 07	**3.3**	**3.3**	**4.54**	**4.54**	**?**	**?**	**0.088**	**?**	**0.11**	**0.11**
	rM 08	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.088**	**?**	**0.066**	**0.066**

NMMNH P44551, right maxilla	rM 09	3.54	3.54	4.89	4.89	?	0.088	?	?	0.11	0.11
	rM 10	3.55	3.55	?	?	?	?	0.088	?	0.11	0.132
	rM 11	4.94	4.94	5.09	5.09	?	?	0.088	?	0.11	0.11
	rM 12	?	?	3.54	3.54	?	0.066	0.088	?	0.11	0.132
	rM 13	?	?	?	?	?	?	?	?	?	?
	rM 14	?	?	?	?	?	?	?	?	0.11	0.11
	rM 15	?	?	?	3.74	?	?	?	?	0.132	0.11
NMMNH P44551, isolated crown	Tooth	?	?	?	?	?	?	?	?	?	?
NMMNH P44555, left premaxilla	lP 01	?	?	?	?	?	?	?	?	?	?
	lP 02	?	?	?	?	?	?	?	?	?	?
NMMNH P44555, left maxilla	lMt 01	?	?	?	?	?	?	?	?	?	?
	lMt 02	?	?	?	?	?	?	?	?	?	?
	lMt 03	?	?	?	?	?	?	?	?	?	?
	lMt 04	?	?	?	?	?	?	?	?	?	?
	lMt 05	?	?	?	?	?	?	?	?	?	?
	lMt 06	?	?	?	?	?	?	?	?	?	?
	lMt 07	?	?	?	?	?	0.088	0.066	?	0.11	0.088
	lMt 08	3.87	3.87	?	?	?	0.088	0.066	?	?	?
	lMt 09	?	?	?	?	?	?	?	?	?	?
	lMt 10	3	3	3	3	?	0.066	0.088	?	0.088	0.088
	lMt 11	?	?	?	?	?	0.088	0.066	?	?	?
	lMt 12	?	?	?	?	?	?	?	?	?	?
	lMt 13	?	?	?	?	?	?	?	?	?	?
	lMt 14	?	?	?	?	?	?	?	?	?	?
	lMt 15	2.7	2.7	1.9	1.9	?	0.066	0.066	?	0.088	0.066
	lMt 16	3.5	3.5	3.5	3.5	?	0.088	0.088	?	0.088	0.11
NMMNH P44555, right premaxilla	rP 01?	?	?	?	?	?	?	?	?	?	?
NMMNH P44555, right maxilla	rMt 01	?	?	?	?	?	?	?	?	0.11	0.11
	rMt 02	?	?	?	?	?	?	?	?	?	?
	rMt 03	?	?	?	?	?	?	?	?	0.11	0.066
	rMt 04	?	?	?	?	?	0.088	0.066	?	0.11	0.088
	rMt 05	?	?	?	?	?	?	?	?	?	?
	rMt 06	6.03	6.03	6.47	?	?	0.088	0.066	?	0.088	0.11
	rMt 07	?	?	?	?	?	?	?	?	?	?
	rMt 08	6.46	5.64	6.71	6.71	?	0.088	?	?	0.11	0.088
	rMt 09	4.77	4.77	4.24	4.24	?	0.088	0.066	?	0.11	0.088
	rMt 10	?	?	?	?	?	?	?	?	0.088	0.11
	rMt 11	2.04	?	1.98	1.98	?	?	?	?	0.088	0.11
NMMNH P50529, right dentary	rD 01	?	?	?	?	?	?	?	?	?	?
	rD 02	?	?	?	?	?	?	?	?	?	?
	rD 03	?	?	?	?	?	?	?	?	?	?
NMMNH P50529, right dentary	rD 04	?	?	?	?	?	?	?	?	0.066	0.088
	rD 05	?	2.45	5.84	5.84	?	0.066	0.066	?	0.088	0.088
	rD 06	?	2.85	5.03	5.03	?	0.066	0.066	?	0.11	0.11
	rD 07	?	?	?	?	?	?	?	?	?	?
	rD 08	2.34	2.34	4.36	4.36	?	0.066	0.088	?	0.088	0.11
	rD 09	?	?	?	?	?	?	?	?	?	?
	rD 10	2.64	2.64	4.69	4.69	?	0.066	0.088	?	0.088	0.11
	rD 11	?	?	?	?	?	0.066	0.088	?	0.066	0.088
	rD 12	3.06	3.06	4.93	4.93	?	0.088	0.088	?	0.11	0.11
	rD 13	?	?	?	?	?	0.066	0.066	?	0.088	0.11
	rD 14	?	?	?	?	?	?	?	?	0.11	0.11
	rD 15	?	?	?	?	?	0.088	0.088	?	?	0.088
	rD 16	?	?	?	?	?	?	?	?	0.11	0.11
	rD 17	?	?	?	?	?	0.088	0.088	?	0.088	0.11
	rD 18	?	?	?	?	?	0.044	0.088	?	0.11	0.11
	rD 19	?	?	?	?	?	0.088	0.088	?	0.11	0.11
	rD 20	3.55	3.55	4.39	4.39	?	0.088	0.088	?	0.11	0.11
	rD 21	?	?	?	?	?	0.088	0.066	?	0.088	0.11
	rD 22	?	?	?	?	?	0.088	0.088	?	0.132	0.132
	rD 23	3.3	3.3	3.29	3.29	?	0.088	0.088	?	0.088	0.11
	rD 24	?	?	?	?	?	?	?	?	?	?
	rD 25	2.88	2.69	?	?	?	0.088	0.088	?	0.11	0.11
	rD 26	2.18	2.18	2.02	2.02	?	0.088	0.088	?	0.132	0.11
NMMNH P50530, left premaxilla	lP 01	?	?	?	?	?	?	?	?	?	?
	lP 02	0	?	?	?	?	?	?	?	?	?
	lP 03	?	?	?	?	?	?	?	?	?	?
	lP 04	?	?	?	?	?	?	?	?	?	?

NMMNH P50530, left maxilla	lM 01	?	?	?	?	?	?	?	?	?	?
	lM 02	?	?	?	?	?	0.044	0.066	?	0.066	0.088
	lM 03	?	5.01	?	?	?	0.088	0.088	?	0.088	0.11
	lM 04	?	?	?	?	?	0.088	0.11	?	0.088	0.11
	lM 05	?	?	9.9	9.9	?	0.088	0.088	?	0.132	0.132
	lM 06	?	?	?	?	?	0.088	0.11	?	0.088	0.11
	lM 07	?	4.5	9	9	?	0.088	0.11	?	0.11	0.11
	lM 08	?	7.56	8.22	8.22	?	0.066	0.132	?	0.11	0.132
	lM 09	?	?	?	?	?	?	?	?	?	?
	lM 10	?	?	?	?	?	?	?	?	?	?
	lM 11	?	?	?	?	?	0.088	0.099	?	0.11	?
	lM 12	?	?	?	?	?	?	?	?	?	?
	lM 13	?	?	?	?	?	0.088	0.11	?	0.11	0.088
NMMNH P50530, right premaxilla	rP 01	?	0	?	?	?	?	?	?	?	?
	rP 02	?	?	?	?	?	?	?	?	?	?
	rP 03	?	?	?	?	?	?	?	?	?	?
	rP 04	5.02	0	?	?	?	?	?	?	?	?
NMMNH P50530, right maxilla	rM 01	4.32	?	?	?	?	0.044	0.044	?	0.088	0.11
	rM 02	6.08	3.63	?	?	?	0.044	0.088	?	?	?
	rM 03	6.32	2.81	?	?	?	0.11	0.11	?	?	?
	rM 04	?	?	?	?	?	0.066	0.088	?	?	?
	rM 05	6.37	6.37	8.5	8.5	?	0.11	0.11	?	0.132	0.11
	rM 06	?	?	?	?	?	0.11	0.11	?	?	0.11
	rM 07	?	?	?	?	?	0.132	0.11	?	?	?
	rM 08	?	?	?	?	?	0.088	0.11	?	0.11	0.11
NMMNH P50530, right maxilla	rM 09	8.6	8.6	?	?	?	0.088	0.088	?	0.132	0.11
	rM 10	7.18	7.18	8.53	8.53	?	0.11	0.11	?	0.154	0.11
	rM 11	?	?	?	?	?	0.088	0.088	?	?	?
	rM 12	?	?	?	?	?	?	?	?	?	?
	rM 13	?	?	?	?	?	?	?	?	?	?
	rM 14	?	?	?	?	?	?	?	?	0.088	0.11
RTMP 1984.063.0001-1, left premaxilla	lP 01	?	?	?	?	?	?	?	?	?	?
	lP 02	?	?	?	?	?	?	?	?	?	?
	lP 03	?	?	?	?	?	?	?	?	?	?
	lP 04	?	?	?	?	?	?	?	?	?	?
RTMP 1984.063.0001-1, left maxilla	lM 01	?	?	2.4	0	?	?	?	?	?	?
	lM 02	?	?	?	?	?	?	?	?	?	?
	lM 03	?	?	3.4	3.4	?	?	?	?	0.088	?
	lM 04	?	?	3.3	?	?	?	?	?	?	?
	lM 05	2.1	2.1	2.6	2.6	?	0.088	0.044	?	0.088	0.066
	lM 06	?	?	?	?	?	0.088	0.066	?	0.088	0.066
	lM 07	2.5	2.5	3.7	3.7	?	0.11	0.066	?	0.11	0.066
	lM 08	?	?	?	?	?	?	?	?	0.088	0.066
	lM 09	2	2	3.3	3.3	?	0.088	0.066	?	0.132	0.066
	lM 10	?	?	?	?	?	0.11	0.066	?	0.11	0.066
	lM 11	?	?	?	?	?	?	?	?	0.088	0.044
	lM 12	?	?	?	?	?	?	?	?	?	?
	lM 13	?	?	?	?	?	?	?	?	0.088	?
	lM 14	?	?	?	?	?	?	?	?	?	?
	lM 15	?	?	?	?	?	?	?	?	?	?
	lM 16	1.5	1.5	?	?	?	0.099	0.044	?	?	?
	lM 17	?	?	?	?	?	?	?	?	?	?
	lM 18	?	?	?	?	?	?	?	?	?	?
	lM 19	?	?	?	?	?	?	?	?	?	?
	lM 20	?	?	?	?	?	?	?	?	?	?
	lM 21	?	?	?	?	?	?	?	?	?	?
	lM 22	?	?	?	?	?	?	?	?	?	?
RTMP 1984.063.0001-1, left dentary	lD 01	?	?	?	?	?	?	?	?	?	?
	lD 02	?	?	?	?	?	?	?	?	?	?
	lD 03	?	?	?	?	?	?	?	?	?	?
	lD 04	?	?	?	?	?	?	?	?	?	?
	lD 05	?	?	?	?	?	?	?	?	?	?
	lD 06	?	?	?	?	?	0.088	0.066	?	?	?
	lD 07	?	?	?	?	?	?	?	?	?	?
	lD 08	?	?	?	?	?	?	?	?	?	?
	lD 09	?	?	?	?	?	?	?	?	?	?
	lD 10	?	?	?	?	?	?	?	?	?	?
	lD 11	?	?	2.6	2.6	?	?	?	?	0.11	0.066
	lD 12	?	?	?	?	?	?	?	?	?	?
	lD 13	?	?	?	?	?	?	?	?	?	?
	lD 14	?	?	?	?	?	?	?	?	?	?
	lD 15	?	?	?	?	?	?	?	?	?	?

RTMP 1984.063.0001-2, left maxilla	**lMt 01**	**2.8**	**2.8**	**4.2**	**4.2**	**?**	**0.088**	**0.044**	**?**	**0.11**	**0.066**
	lMt 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 03	**?**	**?**	**8.7**	**8.7**	**?**	**?**	**?**	**?**	**0.132**	**0.11**
	lMt 04	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
	lMt 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 06	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 07	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 08	**?**	**?**	**6.6**	**6.6**	**?**	**0.11**	**0.088**	**?**	**0.176**	**0.11**
	lMt 09	**6**	**6**	**7.5**	**7.5**	**?**	**0.132**	**0.088**	**?**	**0.132**	**0.132**
	lMt 10	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 11	**7.1**	**7.1**	**8.6**	**8.6**	**?**	**0.154**	**0.088**	**?**	**0.176**	**0.132**
	lMt 12	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 13	**?**	**?**	**?**	**?**	**?**	**0.154**	**0.088**	**?**	**0.154**	**0.11**
	lMt 14	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 15	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
	lMt 16	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lMt 17	**?**	**?**	**?**	**?**	**?**	**0.132**	**0.11**	**?**	**0.154**	**0.132**
	lMt 18	**4.7**	**4.7**	**4.8**	**4.8**	**?**	**0.132**	**0.088**	**?**	**0.132**	**0.154**
RTMP 1984.063.0001-2, left dentary	**lDt 01**	**?**	**?**	**?**	**0**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.066**
	lDt 03	**?**	**?**	**4.9**	**4.9**	**?**	**?**	**?**	**?**	**0.132**	**0.088**
	lDt 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.132**	**0.088**
	lDt 06	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.066**	**?**	**?**	**?**
	lDt 07	**4**	**4**	**5.7**	**5.7**	**?**	**0.11**	**0.066**	**?**	**0.11**	**0.088**
	lDt 08	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.066**	**?**	**0.11**	**0.088**
	lDt 09	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**
	lDt 10	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 11	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 12	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 13	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 14	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 15	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 16	**?**	**?**	**6**	**6**	**?**	**?**	**?**	**?**	**0.132**	**0.132**
	lDt 17	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.11**	**?**	**0.132**	**0.11**
	lDt 18	**3.6**	**3.6**	**5.2**	**5.2**	**?**	**0.132**	**0.088**	**?**	**0.132**	**?**
	lDt 19	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.066**	**?**	**0.154**	**0.11**
	lDt 20	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	lDt 21	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.11**
	lDt 22	**?**	**?**	**?**	**?**	**?**	**0.11**	**0.088**	**?**	**?**	**?**
RTMP 1984.063.0001-2, right pre maxilla											
	rP 01	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rP 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**0.088**	**0.044**
RTMP 1984.063.0001-2, right maxilla	**rM 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rM 04	**?**	**?**	**6**	**6**	**?**	**?**	**?**	**?**	**0.11**	**0.066**
	rM 05	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
RTMP 1984.063.0001-2, right dentary	**rD 01**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 02	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 03	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
	rD 04	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**
RTMP 1984.063.0001-3	**No data collected**										

APPENDIX 2

Images of the skulls of *Coelophysis bauri* (Late Triassic: Carnian – Norian) from the Ghost Ranch Quarry that were analyzed in this study.

Institutional abbreviations: **AMNH**, American Museum of Natural History, New York, New York; **DMNH**, Denver Museum of Natural History, Denver, Colorado; **MNA**, Museum of Northern Arizona, Flagstaff, Arizona; **NMMNH**, New Mexico Museum of Natural History, Abuquerque, New Mexico; RTMP, Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta.

Figure A2-1: Specimen AMNH 7227, *Coelophysis bauri*, left lateral view. Specimen still in block at the American Museum of Natural History.Scale = 5.0cm.

Figure A2-2: Specimen AMNH 7228, *Coelophysis bauri*, left lateral view. Specimen still in block at the American Museum of Natural History. Scale = 5.0cm.

Figure A2-3: Specimen AMNH 7230, *Coelophysis bauri*, ventral view, no teeth preserved. Specimen still in block at the American Museum of Natural History. Scale = 5.0cm.

Figure A2-4: Specimen AMNH 7231, *Coelophysis bauri*, left lateral view, only most anterior teeth preserved. Specimen still in block at the American Museum of Natural History. Scale = 5.0cm.

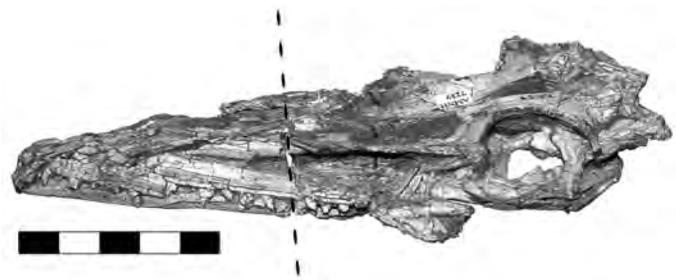

Figure A2-5: Specimen AMNH 7239, *Coelophysis bauri*, left dorsal lateral view. Skull in two pieces, as indicated by dashed line. Scale = 5.0cm.

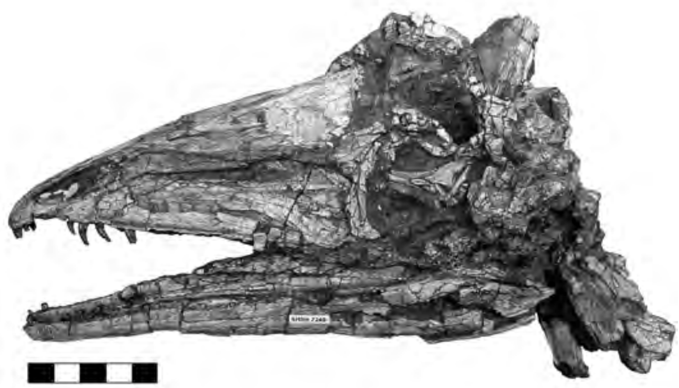

Figure A2-6: Specimen AMNH 7240, *Coelophysis bauri*, left lateral view. Scale = 5.0cm.

Figure A2-7: Specimen AMNH 7242, Coelophysis bauri, right ventral lateral view (top, scale = 5.0cm) and left lateral view (bottom, scale 5.0mm).

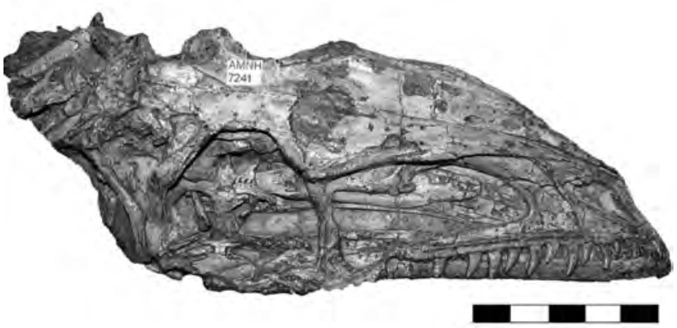

Figure A2-8: Specimen AMNH 7241, *Coelophysis bauri*, right dorsal lateral view. Scale = 5.0cm.

Figure A2-9: Specimen DMNH 30596, *Coelophysis bauri*, partial skull, right lateral view of premaxilla and maxilla. Scale = 5.0cm.

Figure A2-10: Specimen DMNH 32156, partial tooth bearing element of *Coelophysis bauri*. Scale = 5.0cm.

Figure A2-11: Specimen DMNH 39022, *Coelophysis bauri*, left lateral view. Scale = 5.0cm.

Figure A2-12: Specimen MNA 3318, *Coelophysis bauri*, right lateral view. Specimen still in block at the Museum of Northern Arizona. Scale = 5.0cm.

Figure A2-13: Specimen NMMNH P-42200, complete skull of *Coelophysis bauri*, left lateral view. Specimen still in block at New Mexico Museum of Natural History. Scale = 5.0cm

Figure A2-14: Specimen NMMNH P-42353, partial skull of *Coelophysis bauri*, right lateral view of tooth bearing elements. Skull still in block at New Mexico Museum of Natural History. Scale = 5.0cm.

Figure A2-15: Partially preserved skull of *Coelophysis bauri*, specimen NMMNH P-42577, dorsal view and partially preserved tooth bearing elements. Skull still in block at New Mexico Museum of Natural History. Scale = 5.0cm.

Figure A2-16: Specimen NMMNH P-42579, partially visible skull of *Coelophysis bauri*, right ventral lateral premaxilla, right ventral lateral maxilla, and left and right anterior ventral dentaries visible. Specimen still in block at New Mexico Museum of Natural History. Scale = 5.0cm.

Figure A2-17: Specimen NMMNH P-44551, *Coelophysis bauri*, right maxilla, lateral view. Specimen still in block at New Mexico Museum of Natural History. Scale = 5.0cm.

Figure A2-18: Specimen NMMNH P-50529, right and left dentaries of *Coelophysis bauri*, right lateral view of right dentary. Specimen still in block at New Mexico Museum of Natural History. Scale = 5.0cm.

Figure A2-19: Specimen NMMNH P-50530, *Coelophysis bauri*, left lateral view of left premaxilla and left maxilla, and medial view of right maxilla. It is not certain if NMMNH P-50529 represents the dentaries of this specimen. Specimen still in block at New Mexico Museum of Natural History. Scale = 5.0cm

Figure A2-20: Specimen RTMP 1984.063.0001-1, complete skull of *Coelophysis bauri*, left lateral view. Skull still in block at Royal Tyrrell Museum of Palaeontology. Scale = 5.0cm.

Figure A2-21: Specimen RTMP 1984.063.0001-2, right lateral view of right premaxilla and anterior right maxilla of *Coelophysis bauri*. Specimen still in block at Royal Tyrrell Museum of Palaeontology. Scale = 2.0cm.

Figure A2-22: Specimen RTMP 1984.063.0001-3, left lateral view of left premaxilla, maxilla, and dentary of *Coelophysis bauri*. Skull still in block at Royal Tyrrell Museum of Palaeontology. Scale = 10.0cm.