

# An Initial Estimate toward Identifying and Numbering the Ark Turtle and Crocodile Kinds

Tom Hennigan, Truett-McConnell College, Cleveland, Georgia.

## Abstract

Biosystematics is in great flux today because of the plethora of genetic research continually shedding light on organism relationships. Despite the large amount of data being published, the challenge is having enough knowledge about genetics to draw conclusions regarding the biological history of organisms and their taxonomy. Based on the analyses of molecular data, hybridization capability, and statistical baraminology it is estimated that 11 extant turtle kinds and three extant crocodile kinds were brought on the Ark.

**Keywords:** Ark Encounter, biosystematics, taxonomy, amniotes, reptiles, testudines, crocodylia, turtles, alligators, archosaurs, kind, baraminology

## Introduction

Creation research should be guided by God's Word which is foundational to the scientific models that are built. The Ark Encounter Project has tasked creation researchers to investigate several questions, some of which include:

- What did God mean by *kind* when He told Noah to bring two of each and *seven—sevens* of clean animals on board (Turner 2009; Williams 1997)?
- How have organisms diversified from their Ark ancestors (Wood 2003)?
- Can the Ark *kind* be recognized from today's organisms (Brophy and Kramer 2007; Lightner et al. 2011; Sanders and Wise 2003)?
- How many *kinds* were taken on board the Ark (Woodmorappe 1996)?

In previous papers the number of amphibian kinds were estimated (Hennigan 2013a; Hennigan 2013b). The purpose of this paper is to use all available information to make an initial estimate of the identity and number of extant turtle and crocodile *kinds* taken on board the Ark.

## The State of Biosystematics and Taxonomy Today

Biosystematics is the science of discovering, classifying, and organizing biological diversity. The science of identifying taxa and naming organisms is taxonomy. There is no universally accepted procedure for organism classification and currently these disciplines are in great flux as researchers are putting more importance on new genetic and molecular data being accumulated for phylogeny development and much is being changed accordingly. Therefore, how organisms are named and organized today may change tomorrow, depending on the data and assumptions about that data. For example,

naturalists assume randomness and common descent and in keeping with these assumptions, are gradually moving away from Linnaean hierarchies and toward the PhyloCode system based on assumed evolutionary relationships (Vitt and Caldwell 2009, pp.20–25). In contrast, creation biologists recognize the God of Scripture as the Creator of all “kinds” and assume “forest,” rather than “tree” thinking. For the creationist, instead of the tree (or trees) of life that represent evolutionary random processes and common descent from life's beginnings, creationists visualize individual trees in a forest as the originally created kinds. The separation of each tree represents the discontinuity between kinds and the degree of branching represents the diversification of that kind over time. Whereas the philosophical and/or materialistic naturalist may interpret continuity between taxa as evidence for common descent or similar environmental pressures, the Christian theist may interpret continuity between taxa as either limited common descent (e.g., hybrids between *Emys* and *Glyptemys* turtles) or products of a common Designer. Specifically, creationists are interested in how creatures have diversified from the originally created baramins and the archetypes that left the Ark. While genetic and molecular data will be incorporated in this taxonomic analysis, there is still not enough knowledge about biochemistry and genetics to draw conclusions regarding the biological history and taxonomy of organisms. Therefore, other variables will also be incorporated such as hybridization data (which has its limitations) and holistic continuity and discontinuity amongst and between organisms using statistical baraminology (Lightner et al. 2011; Genesis 1; Genesis 7; Sanders and Wise 2003; Wood 2006a; Wood 2006b).

The following precautions and perspectives are in order. Baraminologists tend to equate kinds with the family (Wood 2006a). However, we should carefully analyze the structures, behaviors, and physiologies of members of a putative kind and look at the genetic reasons why a certain member of a kind doesn't have characters that the other members possess. Scripture, especially for herptiles, does not shed much light about their kinds. The challenge is to demonstrate where discontinuities lie, and there is not enough information to do that. There is a need to compare whole genomes of species and genera in order to see if there is genomic equivalence (Wilson 2010). Did any members of a kind have features not present in other members of the same kind and if so, why? Hybridization data is also limited. Biogeographic data may shed light on geographic patterns based on Ark dispersal; however, until we can demonstrate either empirically or theoretically that fairly disparate species can arise from a founder population of two, we have to be careful about lumping smaller taxa into large ones and calling the larger taxon an Ark kind. Therefore, this research is meant to be a foundation upon which further research and understanding of God's diverse organisms can be built. Within His Trinitarian character God is diverse, and we would expect that His creation would reflect that diversity in His creatures. When we better understand what mechanisms are involved in the production of differences since the initial creation, we should be better able to infer whether they are traits produced by direct creation, post-Flood diversification through unknown genetic preprogrammed mechanisms, and/or random mutations.

### **The Non-Avian Reptiles**

Extant reptiles consist of the following taxa: birds, turtles, tuataras, snakes, amphisbaenas, lizards, and crocodiles (Pough et al. 2004 p.8; Vitt and Caldwell 2009, p.24). Birds will not be discussed here, but are the subject of another paper (Lightner 2013). Reptiles, along with mammals, are amniotes and have an amniotic membrane that encloses the embryo in a fluid-filled sac. Based on current taxonomy, all extant reptiles, with the possible exception of the turtles, are classified in the taxon Diapsida. This is because they share the diagnostic character of temporal fenestrae which are a pair of holes on each side of the skull and behind the eyes (Vitt and Caldwell 2009, p. 18). Extant turtles, depending on the source, are either classified in the Anapsida because they do not have temporal fenestrae and have skulls completely roofed, or in the Diapsida with the lack of temporal fenestrae considered a modified or derived character

developing from the original diapsid condition. Complicating matters, this character is absent in fossils interpreted to be diapsid ancestors and are present on fossils interpreted to be anapsid ancestors, and is therefore not considered a reliable guide in phylogenetic studies (UC Berkeley Museum of Paleontology 2013). In fact, much about turtle taxonomy and evolutionary history is *incertae sedis* (of uncertain placement) and those issues will be briefly discussed later.

All extant diapsids are classified in the taxon Sauria which also include the extinct ancestors and, depending on the researcher, may or may not include turtles. Sauria is further subdivided into the Archosauromorpha (crocodiles, dinosaurs, birds, and possibly turtles) and Lepidosauromorpha (tuataras, lizards, amphisbaenas, and snakes; Vitt and Caldwell 2009, p.19). The rest of this paper will focus on Archosauromorpha, specifically the Orders; Testudines (turtles, tortoises) and Crocodylia (crocodiles, gharials, alligators). Taxon Lepidosauromorpha will be the subject of later papers.

In terms of reproduction both turtles and crocodiles are oviparous and must lay their hard-shelled or leathery shelled eggs on land. In many reptile species, including turtles and crocodiles, the gender of the embryo is not determined by parental genetics, but is instead determined by soil temperature. Temperature-dependent sex determination (TSD) is species dependent and sex is determined based on the average temperature during the second trimester (Vitt and Caldwell 2009, pp. 121–124).

### **Testudines**

Turtles belong to the Order Testudines. Currently they consist of 14 Families and 328 species (Complete Chelonian Taxonomy List 2003; Reptile database 2013). They are unique in the animal world and are easily identified because of the shells that give them a tank-like look. Turtles are the only group of vertebrates with the limbs encased within the rib cage (since the ribs form part of the shell). Other names are used to describe turtles and, though they are not precise, they include *tortoise* and *terrapin*. Generally speaking tortoises are land-dwelling turtles that typically have high-domed, hard shells and short powerful legs; some of which have spade-like front feet used for burrowing (Jensen et al. 2008, pp. 440–443; Pough et al. 2004, p. 8). Terrapin is an Algonquin word that usually refers to an edible aquatic turtle. Aquatic turtles tend to have flatter, lightweight shells with either flippers (marine turtles) or webbed feet that are optimally designed for aquatic environments (Jensen et al. 2008, p. 440).

The shell is comprised of a dorsal carapace and ventral plastron that are shields formed by the fusion of the vertebrae, clavicles, and ribs as well as dermal bones. The outer epidermis (scutes) on most turtles is made of the fibrous protein, keratin. These scutes overlap between the seams on the shell for extra strength. Other turtles like the softshells and one marine species do not have scutes and instead have a leathery epidermis (Pough et al. 2004, p.8). Contrary to cartoon caricatures, because the carapace and plastron are connected to other portions of the skeleton, turtles cannot separate themselves from their shells.

Extant and extinct turtles, (with the exception of *Odontochelys*) share the following unique skull morphology; a horny sheath and no teeth on the dentary, maxillary present, premaxillary present, lacking postparietal, postfrontal, and ectopterygoid bones, large quadrate bone, small or absent lacrimal bone, a rodlike stapes without a foramen or processes (Vitt and Caldwell 2009, p.484). Other unique characters shared include a nonsensory pineal gland that is strongly secretory, absence of nasal conchae, presence of a lower eyelid tendon, a unique groove on the humerus, an elevated and subspherical femur head (Vitt and Caldwell 2009, pp.483–484).

Extant turtles can be further subdivided into two suborders based on both morphology and molecular data. Suborder Pleurodira includes the *side-necked* turtles, which cannot withdraw their head and neck into the shell but instead lay them laterally, inside the space between the carapace and plastron (Vitt and Caldwell 2009, p.483). Suborder Cryptodira are the *hidden neck* turtles which includes the more familiar North American turtles that can retract the neck into a slot inside the body cavity and, depending on species, can completely disappear inside the shell or not (Vitt and Caldwell 2009, p.483).

Evolutionists generally agree on the monophyly of Testudines, but trying to explain their origin in the greater reptile context, by random mutation and common descent, remains fleeting; hence the *incertae sedis* designation for certain taxa. From a naturalist perspective it has been hypothesized that the shell components have slowly evolved from backbone and rib extensions over time, but for centuries both extinct and extant turtles were always found with complete carapace and plastron structures. These data were used by creationists to show that turtles have been fully formed from the beginning, with no evidence of random mutations causing intermediate forms (Bergman and Frair 2007). However, in recent years a turtle-like fossil was uncovered in Triassic deposits, *Odontochelys semitestacea* (“half-shelled turtle with teeth”), that seems to be consistent with evolutionarily predicted intermediate turtle

morphology (Li et al. 2008). It had teeth, unlike any turtle found until that time, and a partial carapace. Wise (1995) discussed how creationists could interpret “transitional forms” within a biblical paradigm and defined a morphological intermediate as “a fossil which is in some sense morphologically intermediate between two other fossils or between the shared characters of each of two other fossil groups.” Wood (2009) performed statistical baraminology using osteological and morphological data obtained for *Odontochelys* and suggested that though this species may be a good example of a morphological intermediate, there is too little data to draw any firm conclusions at this time.

Turtle origin explanations are fraught with inconsistencies and while some researchers have placed turtles as anapsids (UC Berkeley Museum of Paleontology 2013) others controversially place them firmly as diapsids and interpret fossil and extent morphological inconsistencies as reversions rather than descent (Rieppel and deBraga 1996). Lyson et al. (2012) emphasize that the evolutionary debate surrounding turtle origins revolve around three hypotheses; they are a sister to Diapsida, a sister to Lepidosauria, or sister to, or within, Archosauria. Using micro-RNA analysis, Lyson et al. (2012) conclude that turtles are closer to Lepidosaurs than they are to Archosaurs. Chiari et al. (2012) used a phylogenomic dataset based on 248 nuclear genes from 16 vertebrate taxa and conclude that their data unambiguously supports turtles as a sister group to Archosaurs.

Creationists have been trying to identify turtle kinds for some time. Frair (1967) used turtle proteins in order to compare and contrast turtle families and identify baramins. He also proposed four diversification groups that included Pleurodira, sea turtles (superfamily Chelonioidea), Cryptodira (except the marine turtles and softshells (family Trionychidae), and Trionychidae (Frair 1984). Though Frair (1991) did not abandon the possibility of the four diversification groups, he updated his proposal and hypothesized that all turtles were descended from an original turtle ancestor. Wise (1992) suggested that turtles were *apobaraminic* (a group of known organisms bounded by biologically meaningful differences without taking into account the biologically meaningful similarities) and consist of four *holobaramins* (organisms that share significant biological similarity with at least one other in the group and are also bounded by biologically meaningful differences with all other taxa—Wood et al. 2003). Wise (1992) identified the four turtle holobaramins as pleurodires, cheloniids, trionychids, and the rest of the cryptodires. Robinson (1997) analyzed nine mitochondrial genes and concluded

that DNA analysis supported the apobaraminic hypothesis for turtles and when comparing the non-trionychoidea cryptodires that they were composed of at least two monobaramins (organisms sharing biologically meaningful similarity without considering biologically meaningful differences with other taxa) that included family Cheloniidae and genus *Gopherus*. Wood (2005, p. 78), using statistical baraminology, concluded that the data were consistent with five holobaramins within Testudines that include Pelomedusidae (side-necked turtles of Africa, Madagascar, and northern South America), Chelidae (side-necked turtles of most of South America, Indonesia, Australia, and New Guinea), Trionychoidea, cryptodires (excluding trionychids), and *Proganochelys*.

Using hybridization data, Brophy, Frair, and Clark (2006), did not find hybrid data that connected Wood's five proposed holobaramins and thus were not able to reject his hypothesis. However, they did find the following data: evidence of interspecific hybridization in eight of the 14 turtle families. Of 74 species pairs, one-third were intergeneric and 18 monobaramins were identified within the families Pelomedusidae, Chelidae, Kinosternidae, Trionychidae, Emydidae, Geoemydidae, and Testudinidae. Five of the six species in the family Cheloniidae were connected by hybridization, forming a single monobaramin. In the family Emydidae (pond turtles) hybridization with at least 13 species were reported in the genera *Pseudemys*, *Trachemys*, *Chrysemys*, and *Graptemys*. Within this monobaramin there were eight instances of intergeneric hybridization between the following: *Emys* x *Glyptemys*, *Graptemys* x *Trachemys*, *Pseudemys* x *Chrysemys*, and *Pseudemys* x *Trachemys*. Another large monobaramin, including at least 14 species, was identified in the family Geoemydidae (Eurasian aquatic turtles and Neotropical wood turtles). Genera include *Mauremys*, *Cuora*, *Sacalia*, *Cyclemys*, *Geoemyda*, *Chinemys*, and *Heosemys*. Within this monobaramin, the following intergeneric hybrids were identified: *Mauremys* x *Chinemys*, *Mauremys* x *Cuora*, *Mauremys* x *Cyclemys*, *Mauremys* x *Heosemys*, *Mauremys* x *Sacalia*, *Cuora* x *Geoemyda*, and *Cuora* x *Sacalia*.

What follows is a listing and number of the proposed turtle kinds *with* brief descriptions of their taxonomy and average carapace length (CL). Based on the overall molecular, hybridization, statistical baraminology data, and to avoid underestimating what has been proposed above, delineated kinds are estimated below until there is a better understanding of taxonomic continuity and discontinuity.

### Marine Turtle Kind or Kinds

Superfamily—Chelonioidea

Families Cheloniidae

5 genera—6 species: CL=80cm (31in)

*Dermochelyidae*

monotypic: CL=150cm (59in)

(Reptile Database 2013; Vitt and Caldwell 2009, pp. 490–492)



Fig. 1. *Chelonia mydas*. Source: <http://en.wikipedia.org/wiki/Cheloniida>.



Fig. 2. *Dermochelys coriacea*. Source: <http://animals.nationalgeographic.com.au>. Photograph: Brian Skerry.

Sea turtles are uniquely pelagic and come on land to lay eggs and, once in a while, to bask. Because of their fully aquatic lifestyle, they were probably not on the Ark and I do not include them in the count. Nevertheless, they are creatures worth briefly describing. Both families have a flat, streamlined shell but, depending on the family, differ in shell construction. The monotypic dermochelyid (leatherback sea turtle) is the largest turtle in the world and lacks epidermal scutes. Other differences include uniquely lacking  $\beta$ -keratin in their scales, no claws on their flippers, having points instead of teeth on their upper lip, and backward spines in the throat to prevent animals from escaping and

to help it swallow. Leatherbacks are also unique in that where most reptiles are ectothermic, jellyfish consuming leatherbacks are inertial endotherms and can generate body heat through elevated metabolism (Frair, Ackmen, and Mrosovsky 1972). They seem to be able to maintain this body temperature by mechanisms such as large body size and a thick oil-filled skin that is equivalent to blubber on a whale (Vitt and Caldwell 2009, pp. 203–204). It is quite possible that leatherbacks are a separate kind from the cheloniids. In contrast, cheloniids have scutes hence they are described as hard-shelled sea turtles (Vitt and Caldwell 2009, pp. 490–492). Characters both families share include similar skeletal structures, forelimbs modified into large paddles, specialized physiology for prolonged and deep diving, and specialized lacrimal glands for excreting excess salt, which is an important design for osmoregulation in a marine environment (Lightner 2007; Vitt and Caldwell 2009, pp. 490–493). Hybridization has been reported for loggerhead sea turtles with Kemp’s ridley, olive ridley, hawksbill, and green sea turtles (Brophy, Frair, and Clark 2006; Lightner 2007). Though there are solid continuities within this superfamily that suggest they belong to one holobaramin, there are also significant discontinuities that might suggest they are two different kinds. Either way, their ancestors probably survived the Flood

#### **Suborder Pleurodira**

##### **1. Australo-American Side-Neck Turtle kind—**

*Chelidae*

13 genera

52 species—CL=29cm (11in)

(Reptile Database 2013; Vitt and Caldwell 2009, p.485)



**Fig. 3.** *Chelus fimbriatus*. Source: <http://en.wikipedia.org/wiki/Chelidae>.

##### **2. Afro-American Side-Neck Turtle kind—**

*Pelomedusidae*

2 genera

19 species—CL=26cm (10in)

(Reptile Database 2013; Vitt and Caldwell 2009 p.487)



**Fig. 4.** *Pelomedusa subrufa*. Source: <http://en.wikipedia.org/wiki/Chelidae>.

##### **3. Madagascar Big-Headed Turtle kind—**

*Podocnemidae*

3 genera

8 species—CL=50cm (19in)

(Reptile Database 2013; Vitt and Caldwell 2009, p.489)



**Fig. 5.** *Podocnemis unifilis*. Source: <http://en.wikipedia.org/wiki/Podocnemidae>.

#### **Suborder Cryptodira**

##### **4. Softshelled Turtle kind**

Superfamily Trionychoidea

Families—

*Carettochelyidae*—monotypic

*Trionychidae*—

11 genera—30 species—CL=45cm (17in)

(Reptile Database 2013; Vitt and Caldwell 2009, pp.492–495)



**Fig. 6.** *Pelodiscus sinensis*. Source: <http://en.wikipedia.org/wiki/Trionychidae>.

**5. Snapping Turtle kind—*Chelydridae***

2 genera—2 species—CL=60cm (23in)

(Reptile Database 2013; Vitt and Caldwell 2009, p. 489)

**Fig. 7.** *Chelydra serpentina*. Source: <http://en.wikipedia.org/wiki/Chelydridae>.**6. Pond Turtle kind—*Emydidae***

9 genera—50 species—CL=20cm (8in)

(Reptile Database 2013; Vitt and Caldwell 2009, pp. 497–498)

**Fig. 8.** *Glyptemys muhlenbergii*. Source: <http://en.wikipedia.org/wiki/Emydidae>.**7. Tortoise kind—*Testudinidae***

15 genera—60 species—CL=100cm (39in)

(Reptile Database 2013)

**Fig. 9.** *Aldabrachelys gigantea*. Source: <http://en.wikipedia.org/wiki/Tortoise>.**8. Asian River and Box Turtle kind—*Geoemydidae***

9 genera—70 species—CL=46.5cm (18in)

(Reptile Database 2013; Vitt and Caldwell 2009, p. 500)

**Fig. 10.** *Rhinoclemmys pulcherrima manni*. Source: <http://en.wikipedia.org/wiki/Geoemydidae>.**9. Big-Headed Turtle kind—*Platysternidae***

monotypic—CL=18cm (7in)

(Reptile Database 2013)

**Fig. 11.** *Platysternon megacephalum*. Source: <http://en.wikipedia.org/wiki/Platysternidae>.**10. Musk and Mud Turtle kind—*Kinosternidae***

4 genera—25 species—CL=20cm (8in)

(Reptile Database 2013)

**Fig. 12.** *Sternotherus odoratus*. Source: <http://en.wikipedia.org/wiki/Kinosternidae>.

### 11. River Turtle kind—*Dermatemydidae*

1 extant genus and 1 species—CL=65 cm (25.5 in)  
(Reptile Database 2013)



**Fig. 13.** *Dermatemydidae*. Source: <http://en.wikipedia.org/wiki/Dermatemydidae>

### Order Crocodylia

Depending on the researcher, Order Crocodylia currently consists of three families, nine genera, and 25 species (Reptile Database 2013). Families are the monotypic Gavialidae (gharials), Alligatoridae (4 genera and 8 species), and Crocodylidae; consisting of two subfamilies; Crocodylinae (three genera, 15 species) and Tomistominae (one genus and one species [Britton 2013]). The classification of this taxon continues to be in flux especially with the placement of caimans and gharials.

Naturalists do not question their monophyly because of the unique shared characters that include long body, robust skull, strongly toothed jaws with a long snout, thick laterally compressed tail, short, strong limbs, earflap on the skull table, basioccipital and exoccipital forms the foramen magnum, pit and ridge sculpturing of the skull, bony eustachian tubes, unfused osteoderm (bony plates) covered with thick skin forming a shield covering the body, a unique rod-shaped pubic process, horizontal anterior and posterior edges on the scapula, nest building for eggs, parental care in most if not all (usually females, but sometimes males), semiaquatic (Vitt and Caldwell 2009, pp. 505–506).

### General Biology and Anatomy

There are differences between alligators, gharials, and crocodiles but there are few clear-cut rules in distinguishing them. Aside from being in separate families, alligators and caimans tend toward fresh water habitats and have U-shaped jaws with an upper jaw wider than the lower jaw allowing the lower teeth to be more hidden when the mouth is closed (Britton 2013). Crocodiles tend to be marine creatures, but are also found in fresh water, with

V-shaped jaws where the upper jaw is about the same width as the lower jaw. When their mouth is closed, the lower teeth are not hidden, which gives them a more toothy appearance (Britton 2013). An exception to the jaw rule is the Indian mugger crocodile (*Crocodylus palustris*) that has a U-shaped jaw similar to the American alligator (*Alligator mississippiensis* [Britton 2013]).

All have specially designed sense organs known as integumentary sense organs (ISO). Though not completely understood, caimans and alligators have them in the head area only, where crocodiles and gharials have them all over their bodies (Britton 2013). ISOs around the head probably function as pressure detectors for sensing prey but on true crocodiles they can also be found as spots on almost every scale (which is how one can tell an alligator skin from a crocodile skin) but their functions are unknown (Britton 2013). As many crocodiles are saltwater species, one hypothesis is that they may be involved with salt secretion, but currently there is no evidence to support this.

Gharials and crocodiles have functional lingual salt glands on the tongue (modified salivary glands) and alligators and caimans do not. It is possible that this design feature has deteriorated over time in alligators as they moved from salt to freshwater or that there are designed genetic mechanisms that are phenotypically plastic enough that salivary gland function doubles as an osmoregulatory function when changing environmental stresses are applied to the organism. In the natural world, we see many forms of phenotypic plasticity, from increasing red blood cell counts with increasing elevation to variable tadpole herbivore/carnivore phenotypes depending on aquatic environment (Hennigan 2013b). These design capabilities are consistent with a Creator who desires to see His creatures persist in a changing world.

All crocodylians are ambush predators and often drown their prey. To avoid drowning themselves, they have a palatal valve that closes over their oesophagus and trachea allowing them to open their mouth underwater without inhaling or ingesting excess water (Britton 2013).

In terms of growth rates, there has been controversy and misunderstanding about their size as it relates to age. Crocodiles grow all of their lives, and it used to be thought that the largest animals were the oldest. Research suggests that this thinking may be too simplistic. Recent growth rates measured for saltwater crocodiles (*Crocodylus porosus*) show rapid growth in the first years of their life and depend on variables like genetics, food availability, incubation temperature, and social interactions. Therefore, the biggest crocodiles may not be the oldest animals but the ones that started life under optimum conditions (Britton 2013; Hennigan 2008).

## Origins

Though naturalists are generally united on the idea that this order is monophyletic, there are at least two hypotheses being debated concerning the crocodylian family relationships. Is Gavialidae a sister group of Crocodylia (supported by morphological characters) or nested within Crocodylia (supported by molecular characters [Vitt and Caldwell 2009, p.506])? The “false” gharial (*Tomistoma schlegelii*) depending on the source, is currently in Crocodylidae, but used to be in Gavialidae. From an evolutionist worldview the data are contradictory (Vitt and Caldwell 2009, p.506).

Below is a brief description of each estimated crocodylian kind including its taxonomy, a brief description, and average total length (TL). Though it is possible, even probable, that Crocodylia is a holobaramin, the kind is delineated at the family level because of their strong cognita, interspecific hybridization reported within (but not across) some families, and the need for more understanding of what the molecular data mean.

### 1. The Gharial kind—*Gavialidae*

2 genera—2 species—TL=4 m (13ft)



**Fig. 14.** *Gavialis gangeticus*. Source: <http://en.wikipedia.org/wiki/Gharial>.



**Fig. 15.** *Tomistoma schlegelii*. Source: [http://en.wikipedia.org/wiki/False\\_gharial](http://en.wikipedia.org/wiki/False_gharial).

The “false” gharial (*Tomistoma schlegelii*) inhabits Malaysia, Borneo, Sarawak, and Borneo. Though it is presently classified in Crocodylidae by some taxonomists, it used to be with Gavialidae and because of its strong cognitum with the gharial (*Gavialis gangeticus*) they are kept together in this analysis. No reported hybridization was located for this taxon.

### 2. The Alligator/Caiman kind—*Alligatoridae*

4 genera—8 species—TL=3.5 m (11.5ft)



**Fig. 16.** *Alligator mississippiensis*. Source: <http://en.wikipedia.org/wiki/Alligator>.



**Fig. 17.** *Caiman crocodilus*. Source: <http://en.wikipedia.org/wiki/Caiman>.

The word alligator comes from the Spanish *el lagarto*, which is translated lizard (Hennigan 2008). The American alligator (*Alligator mississippiensis*) is the only crocodylian that can survive temporary freezing water temperatures and, under those conditions, has its snout above water while preventing ice from freezing around it (Vitt and Caldwell 2009, p.508). There are unconfirmed reports, by some breeders, that diamond caimans are hybrids of the spectacled caiman (*Caiman crocodilus*) and Yacare caiman (*Caiman yacare*).

### 3. Crocodile kind—*Crocodylidae*

3 genera—15 species—TL=5.5 m (18 ft)



**Fig. 18.** *Crocodylus acutus*. Source: <http://en.wikipedia.org/wiki/Crocodile>.

The largest crocodylian is found in this family and is the estuarine or saltwater crocodile (*Crocodylus porosus*) that can reach lengths of over 6 m (19.5 ft) and weights of 1000 kg (Britton 2013). In fact, this species is, on average, the largest living reptile when both weight and length are taken into account. Other species that can attain large sizes include the Nile crocodile (*Crocodylus niloticus*—6 m [19.5 ft]), Orinoco crocodile (*Crocodylus intermedius*—5–6 m [16.5–19.5 ft]), and Indian mugger crocodile (*Crocodylus palustris*—5 m [16.5 ft] [Britton 2013]). Interspecific hybridization producing fertile young has been reported for two species pairs. The estuarine crocodile (*C. porosus*) and the Siamese crocodile (*C. siamensis*) form hybrids where hybrid vigor often results in larger and fitter animals. The relatively well-known captive croc Yai, which is just over 6 m (19.5 ft) and is in the *Guinness Book of World Records* as the largest captive crocodile today, is an estuarine x Siamese hybrid (Britton 2013). Dell'Amore (2011) reports hybrids between the American crocodile (*Crocodylus acutus*) and the Cuban crocodile (*Crocodylus rhombifer*).

### Summary

After carefully reviewing the molecular, hybridization, cognitum recognition, and statistical baraminology data, it is suggested that 11 turtle and three crocodylian extant kinds were aboard the Ark and since that time they have diversified into the plethora of species we marvel at today. No matter how many were included on the Ark, the fossil record of reptiles reminds us that there is a Creator God to whom we are accountable.

The fact that naturalists have a hard time connecting turtles to other reptiles is a testament for their design and discontinuity with other taxa, and against random descent with modification. That turtles and crocodiles are marvelously designed with systems and organs well beyond the technology man can produce are a testament for a wise and all-powerful engineer. A just God cannot allow wickedness and hatred to go unpunished. The other side of the darkness of His judgment is the light of His grace. The sheer diversity of turtles and crocodiles is a reminder that God has equipped them to persist so as to meet the challenges of harsh environments in a fallen world. Their survival is also a reminder that the first time God's grace is reported in Scripture was the grace He showed to Noah, Noah's family, and air-breathing terrestrial animals (Genesis 6:9). That by showing favor to both the animals and to Noah and then later showing even greater favor toward us by dying in our stead, His actions confirm that He does not want anyone to perish, but all to come to repentance, that we might live and enjoy Him as the Author and Finisher of our faith (Hebrews 12:2).

### References

- Bergman, J., and W. Frair. 2007. Evidence for turtle evolution. *Journal of Creation* 21, no. 3:24–26.
- Britton, A. 2013. Crocodylians: Natural history and conservation. Retrieved from <http://crocodylian.com/> on October 23, 2013.
- Brophy, T., W. Frair, and D. Clark. 2006. A review of interspecific hybridization in the order testudines. *Occasional Papers of the BSG* 8:16.
- Brophy, T.R., and P.A. Kramer. 2007. Preliminary results from a baraminological analysis of the mole salamanders (Caudata: Ambystomatidae). *Occasional Papers of the BSG* 10:10–24.
- Chiari, Y., V. Cahais, N. Galtier, and F. Delsuc. 2012. Phylogenomic analyses support the position of turtles as the sister group of birds and crocodiles (Archosauria). *BMC Biology* 10:65.
- Complete Chelonian Taxonomy List. 2003. Retrieved from [http://www.chelonia.org/Turtle\\_Taxonomy.htm](http://www.chelonia.org/Turtle_Taxonomy.htm) on October 23, 2013.
- Dell'Amore, C. 2011. Hybrid Cuban-American crocodiles on the rise. Retrieved from <http://news.nationalgeographic.com/news/2011/06/110624-cuban-american-crocodile-animals-hybrids-science/> on October 23, 2013.

- Frair, W. 1967. Some molecular approaches to taxonomy. *Creation Research Quarterly* 4, no. 1:18–22, 47.
- Frair, W. 1984. Turtles now and then. In *Proceedings of the Northcoast Bible-Science Conference*, pp.33–38. Minneapolis, Minnesota: Bible-Science Association.
- Frair, W. 1991. Original kinds and turtle phylogeny. *Creation Research Society Quarterly* 28, no. 1:21–24.
- Frair, W., R.G. Ackmen, and N. Mrosovsky. 1972. Body temperature of *Dermochelys coriacea*: Warm turtle from cold water. *Science* 177, no. 4051: 791–793.
- Hennigan, T. 2008. A fearsome reptile. *Creation* 30, no. 3:20–22.
- Hennigan, T. 2013a. An initial estimate toward identifying and numbering amphibian kinds within the orders caudata and gymnophiona. *Answers Research Journal* 6:17–34. Retrieved from <http://www.answersingenesis.org/articles/arj/v6/n1/amphibian-kinds>.
- Hennigan, T. 2013b. An initial estimate toward identifying and numbering the frog kinds on the Ark: Order anura. *Answers Research Journal* 6:335–365. Retrieved from <http://www.answersingenesis.org/articles/arj/v6/n1/frog-kinds-on-ark>.
- Jensen, J.B., C.D. Camp, W. Gibbons, and M.J. Elliot (eds). 2008. *Amphibians and reptiles of Georgia*. Athens, Georgia: University of Georgia Press.
- Li, C., X.-C. Wu, O. Rieppel, L.-T. Wang, and L.-J. Zhao. 2008. An ancestral turtle from the Late Triassic of southwestern China. *Nature* 456:497–501.
- Lightner, J. 2007. Sea turtles: one of today's living fossils. Retrieved from <http://www.answersingenesis.org/articles/am/v2/n3/sea-turtles> on October 23, 2013. Lightner, J.K. 2013. An initial estimate of avian Ark kinds. *Answers Research Journal* 6:409–466. Retrieved from <http://www.answersingenesis.org/articles/arj/v6/n1/avian-ark-kinds>.
- Lightner, J.K., T. Hennigan, G. Purdom, and B. Hodge. 2011. Determining the Ark kinds. *Answers Research Journal* 4:195–201. Retrieved from <http://www.answersingenesis.org/articles/arj/v4/n1/ark-kinds-flood-baraminology-cognitum>.
- Lyson, T.R., E.A. Sperling, A.M. Heimberg, J.A. Gauthier, B.L. King, and K.J. Peterson. 2012. MicroRNAs support a turtle + lizard clade. *Biology Letters* 8, no. 1:104–107.
- Pough, F.H., R.M. Andrews, J.E. Cadle, J.E. Crump, A.H. Savitsky, and K.D. Wells. 2004. *Herpetology*, 3rd ed. Upper Saddle River, New Jersey: Pearson Prentice Hall.
- Reptile Database. 2013. Retrieved from <http://www.reptile-database.org/db-info/taxa.html> on October 23, 2013.
- Rieppel, O., and M. deBragga. 1996. Turtles as diapsid reptiles. *Nature* 384:453–455.
- Robinson, D.A. 1997. A mitochondrial dna analysis of the testudine apobaramin. *Creation Research Society Quarterly* 33, no. 4:262–272.
- Sanders, R.W., and K.P. Wise. 2003. The cognitum: A perception-dependent concept needed in baraminology. In *Proceedings of the Fifth International Conference on Creationism*, ed. R.L. Ivey, pp.445–456. Pittsburgh, Pennsylvania: Creation Science Fellowship.
- Turner, K.J. 2009. The kind-ness of God: A theological reflection of *min*, “kind.” In *CORE issues in creation* no. 5, ed. T. C. Wood and P. A. Garner, pp.31–64. Eugene, Oregon: Wipf and Stock.
- UC Berkeley Museum of Paleontology. 2013. Retrieved from <http://www.ucmp.berkeley.edu/anapsids/anapsidamm.html> on October 23, 2013.
- Vitt, L.J., and J.P. Caldwell. 2009. *Herpetology: An introductory biology of amphibians and reptiles*, 3rd ed. Burlington, Massachusetts: Academic (Elsevier) Press.
- Williams, P.J. 1997. What does *min* mean? *Creation Ex Nihilo Technical Journal* 11, no. 3:344–352.
- Wilson, G. 2010. Classic multidimensional scaling isn't the *sine qua non* of baraminology. Retrieved from <http://www.answersingenesis.org/articles/aid/v5/n1/cmds-baraminology> on October 23, 2013.
- Wise, K.P. 1992. Practical baraminology. *Creation Ex Nihilo Technical Journal* 6, no. 2:122–137.
- Wise, K.P. 1995. Towards a creationist understanding of “transitional forms”. *Creation Ex Nihilo Technical Journal* 9, no. 2:216–222.
- Wood, T.C. 2003. Mediated design. *Impact #363* Institute for Creation Research: El Cajon, California. Retrieved from <http://www.icr.org/i/pdf/imp/imp-363.pdf>. on October 23, 2013.
- Wood, T.C. 2005. A creationist review and preliminary analysis of the history, geology, climate, and biology of the Galápagos Islands. In *CORE issues in creation*, no. 1, ed. T. C. Wood, pp.63–82. Eugene, Oregon: Wipf and Stock.
- Wood, T.C. 2006a. The current status of baraminology. *Creation Research Society Quarterly* 43, no. 3:149–158.
- Wood, T.C. 2006b. Statistical baraminology workbook. Unpublished workbook presented at workshop during the BSG conference June 13, 2007, Liberty University, Lynchburg, Virginia.
- Wood, T.C. 2009. *Odontochelys* as an intermediate form. *Occasional Papers of the BSG* 13:9.
- Wood, T.C., K. Wise, R. Sanders, and N. Doran. 2003. A refined baramin concept. *Occasional Papers of the BSG* 3:1–14.
- Woodmorappe, J. 1996. *Noah's Ark: A feasibility study*. Santee, California: Institute for Creation Research.