The Case for Holobaraminic Status in Bears (Family Ursidae) and the Implications within a Creation Model of Ecology

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Abstract

Extant bears (Family Ursidae) are currently classified into three subfamilies, three genera, eight species, and numerous subspecies. They inhabit the continents of Eurasia, North America, and South America. Previous research has identified all eight species as sharing biologically meaningful similarity among its members, making them a monobaramin. A literature search was initiated to determine the extent of unique suites of ursid traits that significantly distinguish them from other taxa, making them an apobaramin. In current baraminological thought, if a taxon is both monobaraminic and apobaraminic, it becomes a holobaramin, or the best determination of the created bear kind. Creation research should focus on revealing how genetic mechanisms may be influenced by environmental factors that trigger them. It is predicted that an understanding of these processes will reveal insights into how the Creator ensured creature persistence in the face of changing environments and the mechanisms involved with rapid ursid diversification in less than 4500 years.

Introduction

"Better to meet a bear robbed of her cubs than a fool in his folly" (Proverbs 17:12 NIV).

For many who enjoy wilderness wanderings, the mere thought of startling a grizzly bear slumbering in the thick bramble or getting between a mama bear and her cubs invokes fear and awe. Though such creatures have been worshipped and elevated as status symbols for their strength and courage, the knowledgeable hiker also is aware of their unpredictability and sometimes deadly demeanor. For these reasons they have been extensively eradicated throughout their range. Conversely, I have had experiences with both black and grizzly bears, and with proper understanding of their behavior they can be enjoyed and respected. They are formidable creatures designed by God to operate in a cursed world. In general, they also fear man (Gen. 9:2), and it is out of this fear that unpredictable attacks may occur. Bears are the most studied wild carnivores because the survival of many species is now a concern (Krause et al., 2008).

Common traits include less developed carnassial teeth, production of hybrid offspring in seven of the eight species, specific chromosome banding patterns, biomolecular data, trophic flexibility, unique bile salt metabolism,

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non-obligate hibernative metabolism, plantigrade feet, and premature birth with the smallest young compared to the size of the mother than any other placental mammal (Weissengruber et al., 2001; Lindburg and Baragona, 2004; Breiter, 2005; North American Bear Center, 2009). These traits demonstrate that ursids possess biologically meaningful similarity and therefore are classified as a *monobaramin* (Tyler, 1997, Weston and Wieland, 1998; Wood, 2003; Lamb, 2006; Tyler, 2006; Wood, 2006).

In contrast, an *apobaramin* is identified if the extant and extinct bears are bound by biologically meaningful differences, when compared with other taxa, but without regard to similarities between them (Wood, 2003). If biologically meaningful suites of characters indicate that the ursids are both a monobaramin and an apobaramin, they are designated a *holobaramin*, or the closest approximation of the created bear "kind." A few dissimilar traits in the giant panda and the difficulty in delineating suites of biologically meaningful traits make an ursid apobaramin and holobaramin hard to demonstrate.

Turner (2009, pp. 56–57) stressed the importance for creation scientists to be careful with the identification of "kind" (Heb. *mîn*), emphasizing the following conclusions.

- *Mîn* is often related thematically and theologically in the main contexts of its use.
- It is unclear if the word is used in a technical or nontechnical sense and, therefore, to demand a precise technical definition is inappropriate and dogmatism, for its use in modern biological taxonomy is unwarranted.
- *Mîn* does assume certain discontinuities, but it is impossible to determine how many "kinds" there were. Consequently, the "kinds" determined by creationists may not be equal to Biblical kinds.

He warns that creation researchers "could fall into the same modernist trap of spending more time on getting behind the text and wrestling with scientific reconstructions rather than sitting under the text's authority, being informed and transformed by its message and theology" (Turner, 2009, p. 58).

With the above in mind, one researcher, using fossil data, has proposed placing Ursidae as sub-baraminic, using a post-Flood fossil continuity criterion (Wise, 2008; Wise, 2009a). Under this criterion, taxa that are sub-baraminic are defined as having diversified well after the Flood, as evidenced by their first appearance in the fossil record. Figure 1 depicts the extant fossil evidence for bears. The dark grey box illustrates a time interval of massive global changes around the Miocene-Pliocene boundary. Before that boundary, older fossils tend to be incomplete and their relationships to living bears are unknown and subject to the interpretation of the investigator. Many evolutionists tend to hypothesize that bears evolved from the canids, while many creationists see canids and ursids as separate baramins and discontinuous. The early fossil evidence is lacking for either interpretation.

Genetic research on bears is greatly expanding, and new insights continue to be discovered. For example, recently it has been shown that the geographic ranges of cave bears extend as far east as Transbaikalia, Eastern Siberia. Knapp et al. (2009) compared mitochondrial DNA and morphology of Asian and European cave bear fossils. The data suggest that these bears are morphologically different from one another, and their diversity was greater than assumed. This is consistent with ursid heterotrophic flexibility as it relates to their morphology, discussed later in this paper.

Many evolutionists and creationists believe that ursid diversification happened rapidly, but the time frames vary due to differing presuppositions. For example, according to evolutionary assumptions, mtDNA evidence favors rapid diversification of both extant and extinct bears starting around the Miocene-Pliocene boundary, about five million years ago (Figure 1) (Krause et al., 2008). Creationary presuppositions posit a more rapid radiation from the original bear kind that survived the Flood. Assuming the general completeness of the fossil record, and a Flood/post-Flood delineation around the K/T boundary (Figure 1), which not all creation researchers would agree with, the fossil record of bears begins well after the Flood, less than 4500 years ago (Wise, 2008).

Because older fossils are questionable due to their fragmentary nature and a whole paper can be dedicated to bear genetics alone, this paper focuses on the current metabolic, behavioral, and anatomical suites of traits that may indicate their apobaraminic status. The ecological implications of the data also will be explored within a young earth paradigm.

The Extant Bears

Bears are diverse in some ways and similar in many others. The giant panda (*Ailuropoda melanoleuca*) has been historically problematic because it has several traits that are inconsistent with other bear species. To have an appreciation for Ursidae unity and diversity in light of how much they have changed since the Flood, it is important to briefly distinguish each species. Tables 1 and 2 summarize the descriptions, range, chromosome numbers, subspecies, general behavior, and conservation status for the extant bears (American Zoo and Aquarium's Bear Taxon Group, 2009; North American Bear Center, 2009; Lindburg and Baragona, 2004). Table III is the most current and complete summary of hybridization data (Hennigan, 2009a; Hennigan, 2009b). Taxonomically, bears comprise three subfamilies: Ailurinae, Tremarctinae, and Ursinae.

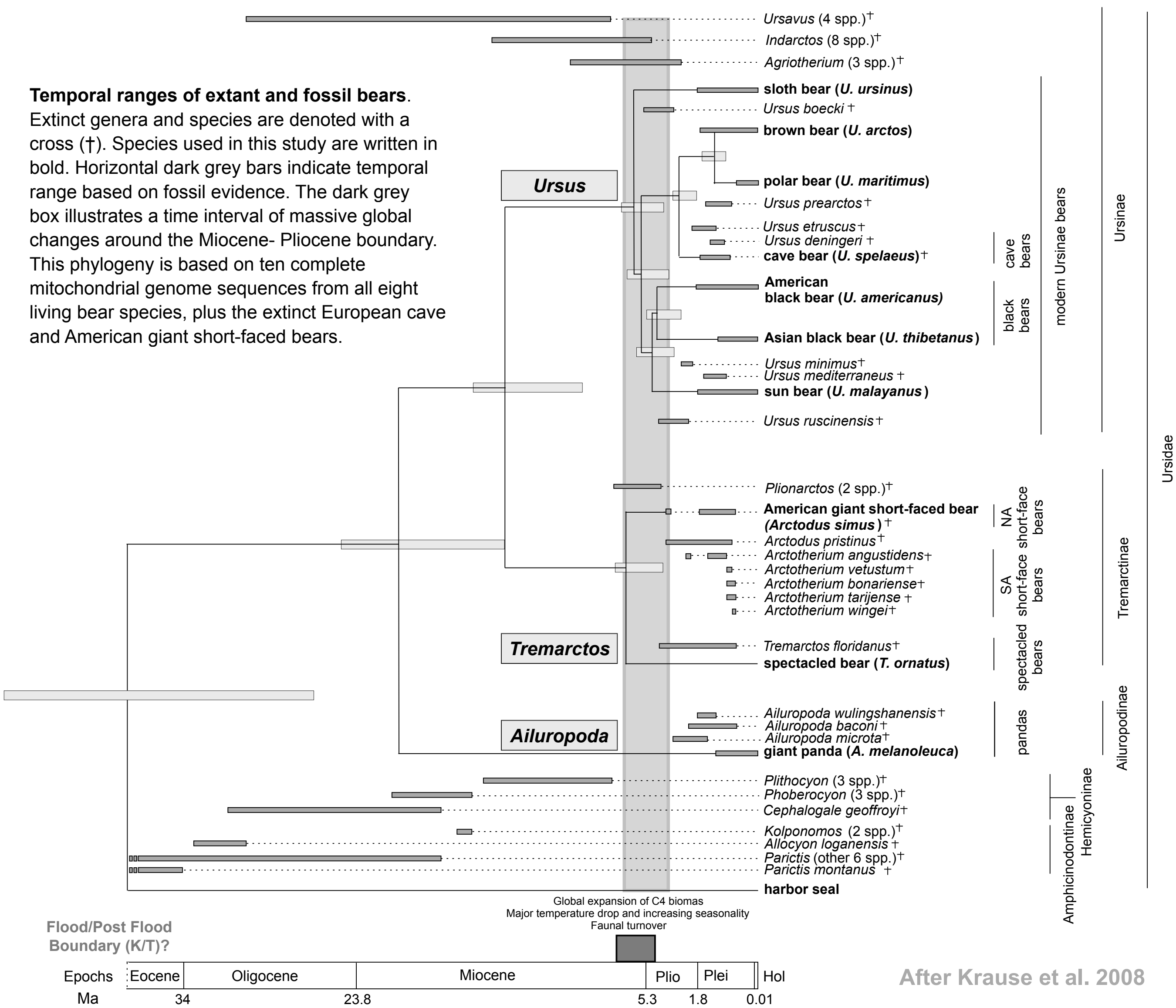

Figure 1. The extant fossil evidence for bears. Genera and species are denoted with a cross (†). (Used by permission from BioMed Central.)

The Giant Panda

Subfamily Ailurinae contains the giant panda (*Ailuropoda melanoleuca*), which is its only living member. The giant panda is known as an umbrella species for conservation because it is endangered and declining. As an umbrella species, it represents an animal that people can connect with and care for. The hope is that a caring public may enhance the chances of survival for both the panda community and its habitat. The giant panda has a distinctive white face and black eye patches. It probably has the smallest home range and is sometimes sympatric with the Asiatic black bear (*U. thibetanus*).

Fossil evidence of *Ailuropoda* usually consists of scattered teeth and a few rare skulls. Two of the extinct species discovered in China (Figure 1) include *A. baconi*, which is a larger version of today's panda. *A. microta* is a fairly recent discovery of a much smaller version and is interpreted as the oldest fossil of the giant panda genus (Jin et al., 2007).

In some ways the giant panda is similar to the lesser (red) panda (*Ailurus fulgens*—44 chromosomes) in that about 99% of their diet is bamboo, but both will eat meat on occasion. Both have backward-facing male genitalia (Lindburg and Baragona, 2004, p. 45), unlike other bears, where male genitalia point forward. The giant and lesser pandas have a radial sesamoid, which is a sixth, "toe-like" structure produced by an enlarged carpel bone. The lesser panda's radial sesamoid is not as prominent

Table I. Ursidae descriptions, ranges, chromosomes, and subspecies.

Descriptor	Sun *Ursus malayanus*	Sloth *Ursus ursinus*	Brown *Ursus arctos*	Polar *Ursus maritimus*	American Black *Ursus americanus*	Asiatic Black *Ursus thibetanus*	Andean (Spectacled) *Tremarctos ornatus*	Giant Panda *Ailuropoda melanoleuca*
Physical Description	**Smallest bear**, short, black fur, light colored crescent on chest, large paws, long claws	Very shaggy black coat with mixed gray/brown hair, light colored "Y" or "U" shape on chest, light colored muzzle, can close nostrils	Dark brown to cream to black, if guard hairs have white tips gives "grizzled" appearance, **shoulder hump, box-shaped nose, dish shaped profile, longer claws on front than back feet**	**Largest bear**, long neck, white fur, triangular profile, no shoulder hump, black skin, very wide paws for paddling, considered a marine mammal	Medium size, found in many different color phases including; black, chocolate, cinnamon, pale blue, and white	Medium sized bear, mostly black but also has a brown phase, muzzles are light colored and all have a cream-colored "V" shaped marking on chest	Small bear with cream colored facial markings around eyes that give it the name "spectacled" bear	Small black and white bear, shortened muzzle, large black eye patches, most of torso and head are white, black "saddle" and fore and hind limbs
Range	Eastern Himalayas, China, Malayan Peninsula	Mostly India, Nepal, Sri Lanka, Bangladesh	Widest distribution of all bears and includes Eurasia & Western NA, 2nd largest home range	Circumpolar Arctic Regions, multi-continental largest home range	USA, Canada, & Northern Mexico	Southern & Eastern Asia Including Pakistan, Korea, Afghanistan	Forested Mountains of South America	Six small regions of southwest China, may have smallest home range
Number of Subspecies	2	2	Variable 5 - 90	0	16	1	0	0
Chromosome Number	74	74	74	74	74	74	52	42

Table II. Ursidae comparative behaviors and conservation status.

Descriptor	Sun Bear	Sloth Bear	Brown Bear	Polar Bear	American Black Bear	Asiatic Black Bear	Andean Bear	Giant Panda
Winter Dormancy Not Obligate	**Yes**	**No**	**Yes**	**Yes** Pregnant Females	**Yes**, body temps. may drop to 31-34 degrees C	**Sometimes**, body temps. may drop 3-7 degrees C	**No**	**No**
Feeding Behavior # of Teeth	Omnivore, mostly frugivorous 42	Omnivore Insect Specialist **40**	Omnivore Mostly Plants Variable 42	95% Carnivore Fruits Kelp 42	Omnivore Mostly Plants Eats A Variety of foods 42	Omnivore Mostly Plants Bamboo 42	Omnivore Mostly Plants Bromeliacea 42	Omnivore 99% Bamboo Eats some meat 42
Delayed Implantation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unique Behaviors & Daytime Activity	Makes nests in trees and sleeps in them Much unknown Variable mostly diurnal & crepuscular	**Slow walking, no upper incisors so they can make a tu**be out of mouth and "vacuum" insects mostly nocturnal & crepuscular	Observed far north riding ice flows, wild hybrids with polar bears, may be heavily carnivorous. Variable, mostly crepuscular	Except for pregnant and nursing mothers, don't hibernate, fasts during summer months Mostly diurnal	Excellent tree climbers, "bear nests" Mostly diurnal but varies with season and life histroy	50% time may be spent in trees, may migrate rather than hibernate "bear nests" Mostly nocturnal but varies by region	Best tree climbers, will make feeding and sleeping platforms in trees Generally nocturnal & crepuscular	Not very active, sleeps most of day, radial sesamoid for eating bamboo, smallest of cubs Generally crepuscular but varies
Conservation Status	**Vulnerable Declining**	**Vulnerable** CITES: Appendix I	**Threatened** CITES Appendix I	U.N **Vulnerable** USA **Threatened** Russia/Canada **Species of Concern**	Estimated 450,000 in North America Game Species	**Vulnerable** CITES Appendix I Sub- species is **Critically Endangered**	**Vulnerable** CITES Appendix I	**Endangered CITES Appendix I Declining**

Table III. Discontinuity matrix for Ursidae.

Does the Bible claim Discontinuity for bears?		No
Does the Bible infer Discontinuity for bears?	Yes	
Do most of the members of the group exhibit a novel metabolic pathway not found in other groups or only in groups known to be discontinuous? **(Bile Salt Metabolism?, Hibernation Metabolism?)**	Yes	
Is the similarity of ingroup comparisons significantly greater than ingroup vs. outgroup comparisons?	Yes	
Do most members of the group possess novel cell types or structures not possessed by other groups or only in groups known to be discontinuous?		No
Do most members of the group posses novel organs or anatomical structures not possessed by other groups or only in groups known to be discontinuous? **(Dentition, Epipharyngeal pouches)**	Yes	
Is the overall morphological similarity within the group significantly greater than the similarity of the group with other groups?	Yes	
Does the group occupy an environment notably different from other organisms?		No
Are stratomorphic intermediates that would connect the group with other groups mostly absent?	?	?
Is the lowest member of the proposed ancestral group found in a higher layer than the lowest member of the group of interest?		No

Compiled from Wood and Murray, 2003, p. 95

as that of the giant panda. Most bears have the muscles in place for a radial sesamoid, but the carpel extension tends to be small and insignificant. Only in the giant panda is there a sufficient extension to use it as an opposable thumb for holding bamboo while eating.

Biochemically, the giant panda is more like other bears than the red panda (Nash et al., 1998; Lindburg and Baragona, 2004; Yu et al., 2007; Krause et al., 2008). Chromosome banding patterns, serological, immunological, and sequence data classify the giant panda as an ursid and not a procyonid (raccoon) (Lindburg and Baragona, 2004). The morphological, behavioral, and molecular data show that giant pandas are a highly specialized bear that has adapted to an herbivorous diet (Lindburg and Baragona, 2004). This suggests that they diverged very early and are the most basal offshoot of the Ursidae family (Figueirido, 2009; Yu et al., 2007). This conclusion also fits the observation that all ursids, including the giant panda, have carnivore intestines, though longer than the typical meat-eater and containing no known digestive microbes (e.g., Breiter, 2005, pp. 100, 165). Compared to other bears, the panda has the shortest digestive system and can absorb only about 20% of the food it eats. In contrast, typical non-ursid herbivores contain intestinal microbes that allow them to digest about 60% of plant matter (DeBruyn, 1999). The giant panda must eat 12–15% of its body weight daily, for 15 hours per day, and for this reason does not produce the fat reserves required for hibernation. There is no evidence that the giant panda has hybridized with any other bear species.

The Spectacled (Andean) Bear

Subfamily Tremarctinae consists of the only extant member of the *short-faced* bears, the spectacled, or Andean, bear, *Tremarctos ornatus*. The extinct, giant short-faced bear (*Arctodus simus*; Figure 1) is the largest bear that ever lived. It stood 1.2–2 m at the shoulder and could weigh up to a ton or more. Unlike extant bears, which are "pigeon-toed," the giant short-faced bear had long, straight toes. Some have interpreted their long, gangly legs and straight toes as evidence that they were fast runners. They inhabited the land west of the Mississippi River to Alaska (North American Bear Center, 2009), and, until recently, high skeletal N^{14}:N^{15} ratios have suggested that they were mostly carnivorous. Recent data show that this conclusion was premature, an issue discussed later.

Spectacled bears favor forested habitats at elevations between 1800 and 2500 meters, and their diet consists mostly of bromeliads (pineapple family Bromeliaceae) and other fruits (Breiter, 2005). The only bear species inhabiting South America, they are the most arboreal of bears. Much of their time is spent in trees making platforms for eating and sleeping.

The Sun (Malayan) Bear

Subfamily Ursinae comprise the rest of the six species. The smallest of the six is the sun bear (*Ursus malayanus*). A highly arboreal species, it inhabits lowland rainforests of Southeast Asia and, for its size, has one of the largest canine teeth of all known bears (Breiter, 2005). They have a variable birthing season, and cubs tend to be female biased. The sun bear is declining worldwide, now occupying an estimated half of its historical range (Smithsonian National Zoological Park, 2009).

The Sloth Bear

The shaggy sloth bear (*U. ursinus*) is an unusual bear of the grasslands and lower woodlands of Southern Asia. With its upper incisors absent, naked lips, and ability to close its nostrils, it is an insectivore. Their "vacuum cleaning" feeding behavior can be heard 90 meters away "vacuuming" termites and ants out of their nests. Also, mother bears often let the cubs ride on their backs.

The Asiatic Black Bear

In southern and eastern Asia, the Asiatic black bear (*U. thibetanus*) is also known as the "moon" bear. The Asiatic black bear is considered the American black bear's closest cousin and can be sympatric with the giant panda and brown bear. *U. thibetanus* is found in temperate mountain forests at elevations as high as 3000 m, and it is estimated that they spend about half their time in trees. Like the spectacled bear, they also make tree platforms for feeding and resting. There is one small area in India where the sun, sloth, and Asiatic black bears are sympatric with one another.

The Brown Bear

The variable brown bears (*U. arctos*), along with polar bears, are the only bears ranging over more than one continent. They are believed to be endemic to Eurasia, later dispersing to North America and becoming sympatric with American black bears in the west. The largest numbers of brown bears are found in Russia. A female brown bear had her last litter at 42 years of age and lived to a record age of 47 years in captivity before she had to be euthanized (Breiter 2005, p. 140). Habitat and phenological events allow the brown bear a high degree of flexibility in their trophic ecology, which is true for most bears. Grizzlies have been observed on sea ice hunting seals 60 miles from land (Doupé et al, 2007; Breiter, 2005).

Depending on the source, subspecies range from five to ninety and include the grizzly bear (*U. a. horriblis*), Eurasia's brown bear (*U. a. arctos*), and the Kodiak brown bear (*U. a. middendorffi*). The Bible has 14 references to bears and refers to the smallest brown bear subspecies, the Syrian brown bear (*U. a. syriacus*). It no longer inhabits the wilds of Israel because it was extirpated in the early twentieth century. Some wild populations may still be found in western Asia, but the numbers are declining.

The Polar Bear

The carnivorous polar bears (*U. maritimus*), on average, are the biggest extant bears, reaching weights of 450 kg or more (American Zoo and Aquarium's Bear Taxon Advisory Group, 2009). Compared with most other bears, they occupy a habitat of low food diversity and are the most restricted carnivorous bear. Having the largest canine teeth, their diet consists of about 95% meat, but they also eat fruit and kelp. Polar bear hair is not white but made of transparent hollow tubes that reflect and scatter light to produce the white effect (Polar Bears International, 2009). These hollow hairs also provide the conditions for algal growth in zoo bears, turning them green. When photographed with ultraviolet sensitive film, the bear looks black. This led researchers to hypothesize that the hollow hairs functioned as optical fibers that conduct light to their black skin. It was assumed that the black skin absorbed the light, producing increased warmth in their bitterly cold environment. Beside the fact that polar bears are most active during the time of year when there is little or no light, this theory was disproven in 1988. Physicist Daniel W. Koon realized that the keratin makeup of hair, not the skin, was probably absorbing the light (Koon, 2009). In fact, the polar bear is so well insulated with guard hairs, thick fur, and about 12cm of blubber that infrared photography reveals no detectable heat loss on a healthy bear (Breiter, 2005 p. 97; Polar Bears International, 2009).

In 2006, a wild grizzly/polar hybrid was shot in northern Canada. DNA results determined that the father was a grizzly and the mother was a polar bear (Lamb, 2006; Doupé et al., 2007; Hennigan, 2009b). Captive polar bears have produced fertile hybrid offspring with brown bears (Table III), and hybrid traits between the two species tend to be intermediate with exceptions (Table V).

The American Black Bear

The variably colored American black bear (*U. americanus*) is considered the only endemic North American bear species. The American black bear is actually found in a range of colors, usually based on region, including black, blue-gray, cinnamon, and white. The white allele expressed in the "Spirit" or "Kermode" bear is rare. Normally it occurs along the British Columbia coast and the southeast panhandle of Alaska (Breiter, 2005, p. 95).

Favored foods of the American black bear include jack-in-the-pulpit (*Arisaema sp.*), wild calla (*Calla palustris*), and skunk cabbage (*Symplocarpus foetidus*), which contain calcium oxalate, a compound harmful to humans when ingested but not deleterious to black bears (DeBruyn, 1999, p. 110). If humans were to ingest these plants, calcium oxalate would cause potassium and phosphate to diffuse out of the blood, resulting in tissue shrinkage, throat constriction, and possible death.

Excellent tree climbers, black bears often climb a tree, find a fixed position, and pull fruit and mast-laden branches toward them, consuming the mast and fruit as they go. When they are finished, the bent branches look like giant nests; hence they are locally referred to as "bear nests."

Conservation Status

Humanity has been entrusted with the stewardship of God's creation (Genesis 1 and 2). As His ambassadors and stewards, our task is to represent the Creator to our fellow man and the created order. This stewardship involves managing ecosystems and creatures by exercising a benevolent dominion that balances the use of land for the well-being of people, while maintaining optimum wildlife habitat and long-term ecological sustainability (Hennigan, 2009c). Therefore, it is important to understand the current status of bear conservation to better steward these creatures. Their response to anthropogenic and environmental changes also will lead to questions concerning how God designed genetic mechanisms that enable them to respond to ecosystem instability and allow both their persistence and seemingly rapid diversification after the Flood.

Bears are probably the most studied carnivore because of international conservation concerns (Table I) outlined by the International Union for Conservation of Nature and Natural Resources (IUCN, 2009). The IUCN publishes the Red List, which is a comprehensive inventory of threatened plants and animals. An international agreement called the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and signed by the United States in 1973 purposed to ensure that international trade did not affect the survival of threatened plants and animals around the world. That same year the United States passed the Endangered Species Act and implemented CITES under Section 8 (Abhat, 2008). Different magnitudes of extinction threat exist, for example, both the giant panda and the Baluchistan subspecies of the Asiatic black bear (*U. thibetanus gedrosianus*) are red listed as *Endangered* and *Critically Endangered* because their numbers suggest that, unless action is taken, they will go extinct (IUCN, 2009). The sun, sloth, Asiatic black, Andean, polar, and brown bears are red listed *Vulnerable* because there is great concern that they are likely to become endangered. Except for the American black bear, all the rest are listed in CITES and cannot be commercially traded.

Russia and Canada classify polar bears as a *Species of Concern* because both countries view the data as insufficient to warrant listing them as endangered or vulnerable (Polar Bears International, 2009). Those who believe in anthropogenic climate change have stressed possible polar bear extinction due to melting ice. The ice is important for breeding, hunting, and sometimes denning. At the most recent IUCN meeting (2009), in Copenhagen, the polar bear specialist group determined that out of the 19 subpopulations, eight are declining, three are stable, one is increasing, and there is not enough data to draw conclusions about the other seven (Polar Bears International, 2009). These issues are important to clarify within a Biblical worldview because the question becomes whether it is more important to focus on the stewardship of the individual species or the created "kind." It has been argued, consistent with God's desire for the persistence of His creatures, that to finance extraordinary measures in order to protect species and subspecies is unjustified because if the baramin persists, the potential for continued speciation also exists (Wood, 2005).

The Case For Apobaraminic Status in Ursidae

The key for determining an apobaraminic relationship is to look for holistic character sets that bind taxa together, making them discontinuous with other taxa, without taking into account their continuity. If ursids are an apobaramin, holistic suites of morphological, biochemical, and behavioral traits would be evident and unique only to them. In order to guide this research, a discontinuity matrix (Table IV) was prepared to highlight the organization of criteria that may shed light on an ursid apobaramin (Wood and Murray, 2003). The case for these criteria is discussed below and will be analyzed for their value in using them as evidence for apobaraminic status in family Ursidae.

Gross Morphology, Dentition, and Heterotrophic Flexibility

Common traits in bears that represent gross morphology include size, brain morphology, auditory region with ossicles, ridges on hard palate, and hair structure (Lindburg and Baragona, 2004). Though the dentition varies between species, specific dental traits set bears apart from other carnivores, including more elongated M2 molars and premolars with broad enamel platforms and underdeveloped carnassials (NHC, 2009; Lindburg and Baragona, 2004). Carnassial teeth consist of the last upper premolar and the first lower

Table IV. Ursid hybrids.

Hybrid Pairing	Wild or Captive	Fertility	References
U. malayanus (♀) x *M. ursinus* (♂) Sun Bear x Sloth Bear	Captive	Unknown	Asakura, 1969 Scherren, 1907
Tremarctos ornatus ♂ x *U. thibetanus* ♀	Captive	Fertile	McLellan & Reiner, 1994 Torres, D.E.., 2009
U. malayanus x *U. thibetanus* Sun Bear x Asiatic Black Bear	Wild	Probable	Galbreath et al. 2008
U. thibetanus (♀) x *U. arctos* (♂) Asiatic Black Bear x Brown Bear	Captive	Unknown	Gray, 1972
U. americanus x *U. thibetanus* American Black Bear x Asiatic Black ?	Wild ?	Unknown	Hybrid Bears, 2009
U. americanus (♀) x *U. arctos* (♂) American Black Bear x Brown Bear	Captive	Unknown 3 cubs	Gray, 1972
U. arctos (♀) x *U. maritimus* (♂) *Brown Bear x Polar Bear*	Captive	Fertile	Kowalska,1962,1965,1969 Martin, 1876, 1882
U. maritimus (♀) x *U. arctos* (♂) Polar Bear x Brown Bear	Captive	Fertile	Gray, 1972
U. maritimus (♀) x *U. arctos* (♂) Polar Bear x Brown Bear	Wild	Fertile	Hybrid Bears, 2009 Doupé et al., 2007

Table V. Example trait comparisons between brown/polar hybrid offspring and parents.

Traits	Brown Bear	Polar Bear	Hybrid Offspring
Overall Size	Slightly smaller than polar bear	Largest bear	Intermediate
Neck	Short	Long	Long
Shoulder Hump	Large	No Shoulder Hump	Small
Head Size/Shape	Thick set	Slender	Intermediate
Tail	Barely visible	Visible	Visible
Soles of Feet	Hairless	Covered with hair to insulate against ice	Partially covered with hair
Body Hair Structure in Cross Section	Solid or full of small hollow regions, depending on location	Almost completely hollow	A blend of both
Behavior	Do not pounce with two front feet and do not pick up bags and hurl them. Neither behavior has been observed in wild like it has with polar bears.	Pounce on toys with both feet like they do when breaking into seal dens. Use teeth to pick up and throw bags from left to right like they hurl prey in the wild.	Pounce on toys with both feet. Pick up bags with teeth and throw them from left to right.

Source: Walker, 2009

molar used in cutting. They are the classic dental trait of carnivores but are not as developed in bears. This character is consistent with their general hypo-carnivorous behavior and is a key trait used when classifying fossil specimens within Ursidae (Lindburg and Baragona, 2004).

Figueirido et al. (2009) suggest reasons for the variable dentition and skull morphology in bears. They compared and contrasted 157 skull morphologies of herbivorous, faunivorous, and omnivorous extant bears with fossil specimens of the giant short-faced bear (*Arctodus simus*) and the European cave bear (*Ursus spelaeus*). Through statistical analysis they concluded that, rather than trying to determine skull morphology as a function of ancestor-descendent relations, the data suggests that these differences are due to trophic ecology.

For example, herbivorous bears tend to have skull morphologies that include long cheek teeth, short, vault-shaped skulls with well-developed zygomatic arches, and small canines. Faunivorous bears tend to have shorter cheek teeth, long skulls, small zygomatic arches, and well-developed canines. Omnivorous bears share morphological traits intermediate between the two. The giant short-faced bear was assumed to be hyper-carnivorous (North American Bear Center, 2009), and the European cave bear more herbivorous. However, upon closer examination, skull morphology in the extinct specimens was not statistically different from skulls of extant bears, and both extinct specimens were probably more omnivorous than once thought. These findings, along with the ability for seven of the eight extant species to hybridize, have implications for designed genetic mechanisms that respond to environmental disturbances affecting both morphological traits and the flexibility to alternate between carnivory and herbivory. These flexible traits are unique to bears and not observed in other carnivores.

It is evident that God wants His creatures to persist. Rather than recreating adaptations to withstand changing environments, God designed genetic mechanisms that respond to environmental cues. Mechanisms, such as transposons (altruistic genetic elements) and epigenetics, should be areas of fruitful research to determine how bears might rapidly adapt in response to changing environments (Lightner, 2009; Wood, 2003; Wood, 2002) and has potential for shedding light on the origin of bear carnivory.

Hibernation Metabolism

Historically, *hibernation* has been a slippery term and has caused confusion. Some researchers did not believe bears hibernated because they did not undergo large body temperature reductions, such as observed in ground squirrels and bats. Therefore, they used terms such as *winter torpor*, *carnivorean lethargy*, and *winter sleep*. The confusion was a definitional problem. Today, the leading physiologists simply use the word "hibernate" when discussing the physiological processes that occur when bears retire to dens when food is no longer available (North American Bear Center, 2009).

The fact that bear hibernation metabolism is very different from other creatures makes them unique. Other taxa that hibernate, such as the eastern chipmunk (*Tamias striatus*) and the little brown bat (*Myotis lucifugus)*, have the genetic capability of reducing their body temperature very near an ambient temperature of 0^{o} C, resulting in nearly no detectable heart rate or respiration (Heinrich, 2003; Boyles et al., 2007). However, these creatures periodically raise their body temperatures, wake up, and proceed to eat, drink, urinate, and defecate.

Hibernating bears periodically wake, but generally do not eat, urinate, drink, and deficate except under unique conditions such as prolonged dormant periods (North American Bear Center, 2009). Some bears are not just hibernators but super hibernators (Rogers, 1999). Five of the eight extant bear species (sun, brown, American black, Asiatic black, and polar bears) are non-obligate hibernators and only hibernate under specific environmental or reproductive conditions. Evidence exists that extinct species such as A. *simus* and U. *spelaeus* also hibernated. The giant panda, sloth, and spectacled bears do not hibernate. The giant panda's poor diet and inability to accumulate needed fat reserves are reasons why. The sloth bear may enter a period of lethargy late in the year. When it is cold, both pandas and spectacled bears may migrate to warmer climes. The question remains as to whether these bears have the latent ability to express metabolic, hibernative processes if food availability and/or climate changed drastically.

By mid to late summer, hibernating bears start the process of hyperphagia (Nelson et al., 1983). They put hundreds of pounds of body fat on their frames, a designed feat that causes no deleterious cholesterol effects. Pregnant bears give birth during hibernation, and births are well timed because of delayed implantation. All eight bear species, along with many other mammal taxa from mustelids to roe deer, have delayed implantation. Mating generally takes place in spring and early summer, and gestation occurs in two stages. The fertilized ovum divides for about a week into a 1–2 mm blastula and then stops when the material in the ovum is depleted. In stage two the blastocyst implants in the uterine wall, and it is thought that implantation is triggered when the bears go into hibernation (see Breiter, 2005 p. 39). It takes two months or less from the time of hibernation to birth.

The data suggests that as winter approaches, the lack of food causes bears to den (Breiter, 2005). The environment also seems to be involved with another phenomenon known as "walking hibernation" (Nelson et al., 1983), caused when bears lower their metabolism to conserve energy in the absence of available food. In summer polar bears are landlocked and food is scarce. They may revert to walking hibernation and fast for several months (Breiter, 2005). Bears have control over this metabolism, so as various foods become available they will raise their metabolism and resume normal feeding activity until the food is gone.

Denning time depends on environment and stage of life. Pregnant females tend to be the first to den, then the subadults and nonpregnant females, followed by dominant males (Breiter, 2005). If food is plentiful, males and nonpregnant females may not hibernate at all. However, pregnant females, including polar bears, will hibernate. Once retired to a den consisting of an enlarged hole, the cavity under tree roots or below a brush pile, metabolic rate slows by half and their normal body temperature (38^{o} C) drops with decreasing ambient temperatures. The body temperature continues to decrease to within 12^{o} of normal but no farther (Rogers, 1999). The heart rate may decrease from 50 to 10 beats per minute, and pregnant females may burn 4000 cal/day (Breiter, 2005). In pregnant bears, unlike other hibernators, the minimal body temperature decrease is critical because high body temperatures are needed for fetal development.

These metabolic processes are unique to bears. A unique metabolic system is required to keep bears healthy during long bouts of inactivity, and many of these metabolic processes remain a mystery. The longest documented hibernative period was a female grizzly on the North Slope of Alaska who averaged eight months in hibernation per year (Breiter, 2005). The huge amounts of fat the bears accumulate sustain them. Cholesterol levels are more than twice the summer levels, yet they experience no cholesterol gallstones or hardening of the arteries (Rogers, 1999). All bears but the giant panda produce a unique bile acid called ursodeoxycholic acid, which is thought to prevent gallstones during hibernation (Rogers, 1999). Kidney function is reduced, and the bears do not need to drink because water is recycled in their bodies. Toxins, like urea, do not build up because urea is hydrolyzed. The nitrogen released combines with glycerol, which is used to synthesize amino acids, and these enter into protein synthesis pathways (Nelson, 1980). The protein is used to rebuild and maintain muscle and organ tissue.

Further reduction in protein loss for pregnant mothers is accomplished through premature birth of babies. Fatty acids are too large to get through the placenta, so the baby is fed by the breakdown of the mother's muscle proteins (Breiter, 2005). If the babies were to go full-term, the mother's muscle mass would dissipate, and she would not be able to move in the spring. This unique hibernation metabolism explains, in part, why the bear cub-to-adult ratio is the largest of any other eutherian and monotreme mammals and is another exclusive bear character. The results of this unique hibernation metabolism include the ability to respond to danger, minimal muscle loss, and strong bone density. Other evidence suggests that unique hormones regulate hibernation physiology, and when injected into other species (hibernators and non-hibernators), these hormones produce hibernation-like effects (Rogers, 1999).

Because food resources seem to be the hibernation trigger, it is unknown whether the sloth bear, spectacled bear, and giant panda have this latent capability. Research into safe ways of triggering hibernation metabolism has potentially fruitful implications for resolving their baraminological status and unlocking latent, directed genetic mechanisms predicted by the creation model. Understanding these metabolic mechanisms also may help us to prevent bedsores, loss of muscle mass, osteoporosis, and heart disease in human patients (Heinrich, 2003).

Unique Bile Acid—Taurousodeoxycholic Acid

Bile is a complex chemical mixture containing water and large amounts of organic molecules critical for digestion, absorption of vitamins and fats, and waste product elimination. Bile is produced by the liver, stored in the gallbladder, and enters the small intestine through the bile duct. Since as early as A.D. 659, bile from bear gallbladders has been used in oriental medicine for ailments such as digestive problems, inflammation, pain, and blood purification (Nette, 2000).

The key ingredient is ursodeoxycholic acid (UDCA), and in recent years this bile chemistry has been clinically shown to have analgesic and anti-inflammatory properties, along with the ability to treat both cirrhosis of the liver and to dissolve gallstones (Li et al., 1995; Nette, 2000). Today, the bile industry is causing a problem for bear populations, as many are poached solely for their gallbladders. It is estimated that China has 7000 captive bears kept in confined conditions and tortured through the "milking" of their bile acids, even though Japanese scientists synthesized the compound in 1955 (Nette, 2000). Some compare the industry to the drug trade. Various laws often are broken, and some estimates of the street value may range from $1 to $9 per gram (Nette, 2000).

UDCA is a unique bile acid produced only by bears. The function of this acid includes dissolving gallstones, making it possible for long-term hibernation. If the bile contains high concentrations of cholesterol and other specific substances, it can harden and block normal bile flow. The effects are possible infection or damage to the gallbladder, liver, and pancreas, which may lead to death. However, the giant panda is the only bear that does not synthesize the compound. This may be another reason, other than available food sources, why they do not, or cannot, hibernate. Some researchers have concluded that the giant panda does not have the enzymes necessary to synthesize UDCA (e.g., Lindburg and Baragona, 2004, pp. 40–41).

The Bear Roundworm *(Baylisascaris transfuga)*

The question of whether or not obligate host/parasite relations may be used as additive or subtractive evidence in determining baraminological relationships may be a worthwhile pursuit. For example *Baylisascaris transfuga*, the bear roundworm can only complete its development in bears and has been identified in all eight species (Schaul, 2006). It is possible that the parasite develops only in bears due to the unique biochemical traits that bears possess. *Baylisascaris* sp. are roundworms that affect a number of mammals, the most important of which is *B. procyonis*, which affects raccoons and causes sickness and even death in humans (Sorvillo et al., 2002; Medpedia, 2009). Other roundworm species of *Baylisascaris* complete their development in other mammals, including the skunk and badger.

Bear roundworm larvae have various intermediate hosts, usually rodents, and bears usually are infected when the cubs ingest eggs, though other infection mechanisms exist. This parasite can be a particular problem in captive bears, and the data suggest that it has potential for causing serious zoonoses with humans and should be monitored (Schaul, 2006). However, before this relationship can conclusively be included in a suite of characteristics that determine an ursid apobaramin, more data are needed to resolve these relationships because *B. transfuga* also has been identified in the red panda, which has now been classified in its own family Ailuridae (Heath and Platnick, 2008).

Epipharyngeal Pouches

Weissengruber et al. (2001) noted unique morphological structures in bears known as caudodorsal epipharyngeal pouches. These elongated and tubular blind ending structures are located at the dorsal end of the trachea. The openings of these structures begin in the pharyngeal cavity. The pouch linings have ciliated respiratory epithelia that are involved in moistening and protecting airways to provide a barrier against pathogens, and because of their musculature, are thought to be involved with bear phonation. Structures in similar locations exist in other mammal taxa, but the caudodorsal epipharyngeal pouches on bears (though variable within Ursidae) have large morphological differences and do not suggest phylogenetic relationships between other taxa (Weissengruber et al., 2001). Although identified in all bears, it has not been confidently confirmed in the Asiatic black bear, nor has it been identified in the raccoon and lesser panda. The pouches are currently thought to be unique to ursids.

Conclusions and Further Research

There is much we do not understand, and the role of the seemingly infinite complexity of biomolecular cellular systems is the most important to understanding life and life patterns. As one examines these systems in detail, it appears that a language has been imputed into the system by an Intelligence far beyond our comprehension. For creation biologists this understanding may lead to discoveries that materialists would never consider.

It seems evident that bears have diversified rapidly in less than 4500 years. For this to happen, they must have been designed with biochemical mechanisms that responded to the ecological upheaval produced by the Flood. Genetic drift occurring in small populations immediately after the Flood may explain this. However, biological observations make it clear that it cannot be explained by random mutation and natural selections (Wise, 2009b).

Evidence suggests that bears, including the giant panda, may have come from one "kind," depending on how one defines the term. By human baraminological standards, they are monobaraminic, but the jury is out on their apobaraminic status. The suite of traits that favor an ursid baramin include chromosome banding patterns, serology, immunology, DNA sequence data, hibernation metabolism, gross morphology, bile salts, variation in skull morphology due to diverse trophic ecology, wide-ranging environmental adaptations, largest cub-to-adult ratio of mammals except marsupials, underdeveloped carnassials, roundworm development, and epipharyngeal pouches. However, because of various exceptions, these traits cannot be declared holistically unique within Ursidae, and therefore their apobaraminic status and classification as a holobaramin cannot be determined.

Future research into latent and directed mutations, expressed by specific environmental triggers, may elucidate the origins of carnivory and other latent characters as hibernation and bile metabolisms. Knowledge from this research has potential in the understanding of rapid ursid diversity, discovering God's methods for preserving His creatures, and illuminating relationships that may differentiate God's idea of "kind" with our ideas. Finally, holistic data sets with hundreds of characters analyzed through statistical baraminological methods may produce quantitative measures that shed light on their relationships both within and without the family (Cavanaugh and Wood, 2002).

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Glossary of Baraminological Terms

Apobaramin – A group of known organisms bounded by biologically meaningful differences (discontinuity) without taking into account the biologically meaningful similarities (continuity) within the group

Baramin – From the Hebrew *bara* (create) and *mîn* ("kind"), it refers to the "created kind" and was coined by Frank Marsh in 1941. The word *mîn* is poorly understood, and many Hebrew scholars disagree on its meaning (see Turner, 2009). It may be defined as a region of biological attributes within which any combination of these attributes could produce healthy offspring, at any point or period of history (Wood and Murray, 2003).

Baraminology – a uniquely creationist method of studying the organization of biological diversity.

Continuity – Biologically meaningful similarity between organisms that embrace all types of biological characteristics.

Discontinuity – Biologically meaningful differences between organisms.

Holobaramin – Organisms that share significant biological similarity with at least one other in the group (monobaramin) and are also bounded by biologically meaningful differences with all other taxa (apobaramin). The complete set of known organisms that belong to a single *baramin*.

Hybrid – The offspring produced from the hybridization of different taxa.

Hybridization – The mating of two different taxa. Baraminologists recommend that this be treated as a separate category of meaningful biological similarity. The production of hybrids reveals biologically meaningful similarity at the genetic, developmental, and anatomical levels that would not normally be revealed by biological research (Wood et al., 2003).

Monobaramin – A group of known organisms that share biologically meaningful similarity without considering biologically meaningful differences with other taxa.

Sub-baraminic – Based on a new criterion called the Flood fossil continuity criterion (Wise, 2008; Wise, 2009a), "sub-baraminic" refers to taxa that have diversified well after the Flood, as evidenced by first appearance in the fossil record.

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