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Berkeley Scientific Journal

Title

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Permalink

<https://escholarship.org/uc/item/6952232v>

Journal

Berkeley Scientific Journal, 30(1)

ISSN

1097-0967

Author

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Publication Date

2026-10-30

DOI

10.5070/BS3.69972

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We Bare Bears: Evolutionary Origins and Ecological Adaptations of Grizzlies, Polar Bears, and Pandas

United by Chaos, Split by Evolution

Perhaps you have seen Panda, Grizz, and Ice Bear roaming the San Francisco Bay in a stack, integrating themselves into human society, one ill-fated (yet comically disastrous) adventure at a time in the animated sitcom “We Bare Bears.” While this show portrays these furry creatures coexisting in the modern world, their real-life counterparts have followed vastly different evolutionary paths, starting around 55 to 38 million years ago during the Eocene Epoch.¹ From the bamboo forests of China to the tundra of the Arctic, pandas, grizzlies, and polar bears exemplify how a shared ancestry can give rise to remarkably distinct ecological adaptations — each species a product of evolutionary trade-offs between specialization and adaptability.

These three bears, though united by lineage, trace unique evolutionary trajectories that mirror the environments they inhabit. The giant panda (*Ailuropoda melanoleuca*) represents the earliest branch of the Ursidae lineage which is the biological family that includes all modern bears, diverging from the Ursidae’s common ancestor around 19 million years ago and adapting along a uniquely specialized trajectory toward herbivory and a bamboo-exclusive diet.² The grizzly, or brown bear (*Ursus arctos*), evolved later around 1.2 million years ago and remains one of the most evolution-

arily versatile members of the family; its omnivorous diet and broad habitat range, from tundra to temperate forest, reflects the adaptability that helped ancestral ursids endure Pleistocene climate shifts or repeated cycles of cold and warm shifts.³ Meanwhile, the polar bear (*Ursus maritimus*) represents one of the most recent branches of bear evolution, diverging from the grizzlies roughly half a million years ago, with the precise date still widely debated among scientists, and adapting rapidly to an Arctic lifestyle as a hypercarnivorous hunter of seals.⁴

“From the bamboo forests of China to the tundra of the Arctic, pandas, grizzlies, and polar bears exemplify how a shared ancestry can give rise to remarkably distinct ecological adaptations — each species a product of evolutionary trade-offs between specialization and adaptability.”

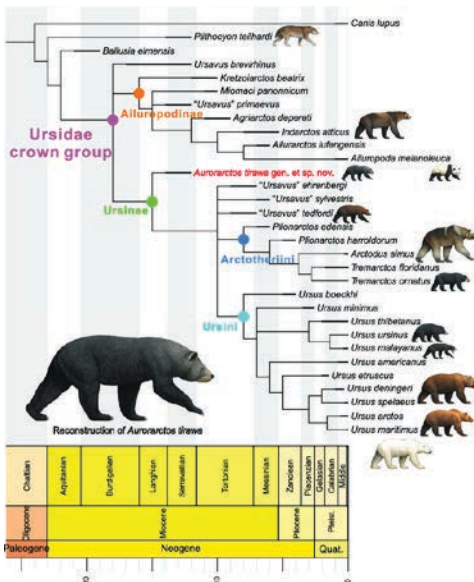


Figure 1. Ursidae phylogenetic tree depicting evolutionary relationships among modern and extinct bear species, illustrating the diversification of the lineage from the early Miocene to the present and the divergence of the giant panda (*Ailuropoda melanoleuca*), brown bear (*Ursus arctos*), and polar bear (*Ursus maritimus*) from shared ancestors within the Ursidae crown group.

From this shared yet fragmented lineage emerges a striking narrative not just of separation, but of adaptation. As each bear species carved out its ecological niche, evolution sculpted them in different directions, refining traits to meet the demands of their environments. To understand how these differences arose, we must look closer at the evolutionary forces that molded their morphologies and behaviors.

Divergent Evolution

Divergent evolution occurs when species evolve from a common ancestor into different forms due to distinct ecological pressures, and this can be seen through the evolution of dietary and ecological specializations in the Ursidae lineage.

Notably, pandas demonstrate extreme dietary specialization. Approximately 7 million years ago, ancestral pandas transitioned from a carnivorous diet of small mammals to a nearly exclusive reliance on bamboo, likely driven by ecological pressures such as competition for animal prey and the abundant availability of bamboo. This shift necessitated significant morphological and physiological adaptations. The most prominent adaptation is the evolution

of a ‘pseudo-thumb’, which is an enlarged radial sesamoid bone that functions analogously to a thumb, enabling the panda to grasp bamboo stalks effectively.⁵ Moreover, pandas developed powerful jaw muscles and broad molars to process the tough, fibrous plant material. Interestingly, despite their herbivorous diet, pandas retain a carnivorous digestive system, lacking the specialized gut flora typically associated with herbivores.⁶



Figure 3. Grizzly bears hunting for food.

In stark contrast, the brown bear maintains a primarily omnivorous diet, consuming berries, roots, fish, and small mammals. This dietary strategy arises from a combination of ancestral traits and ecological opportunity. As generalists, grizzlies can exploit whatever food sources are available in a given season or region. This flexibility allows them to survive in highly variable environments, from dense forests to open tundra. Their digestive physiology, jaw structure, and dentition — broad molars for grinding plant material, sharp canines for capturing prey, and a flexible gut capable of processing both meat and vegetation — equip them to adapt efficiently as resources fluctuate.

Unlike pandas, whose shift to bamboo required extensive morphological adaptations, grizzlies retained a flexible digestive system capable of efficiently processing



Figure 2. Giant pandas feeding on bamboo stalks.

both plant and animal matter. Their versatility illustrates divergent evolution in action: from a shared ursid ancestor, pandas and grizzlies followed radically different ecological paths — one toward extreme specialization, the other toward broad generalism — highlighting how distinct environmental pressures can shape species’ dietary strategies in contrasting ways.

Meanwhile, polar bears have evolved a suite of specialized adaptations for life in the Arctic, reflecting a dramatic shift from the generalist diet of their brown bear ancestors. As hypercarnivores, they rely almost exclusively on seals, and their morphology and physiology reflect this dietary specialization: large, partially webbed paws aid in swimming and traversing sea ice, powerful jaws and sharp canines allow them to catch and consume prey efficiently, and a thick layer of blubber, combined with dense, water-repellent fur, provides insulation against extreme cold. Additionally, their keen sense of smell enables them to detect seal breathing holes from over a kilometer away, highlighting a finely tuned predatory strategy.⁸



Figure 4. Polar bear mother catching a seal for her cubs.

Ecological Niches and Adaptation

Giant pandas occupy temperate bamboo forests in the mountainous regions of central China, habitats that impose both opportunities and constraints on their behavior and physiology. These forests are highly fragmented, which has shaped pandas’ movement patterns: individuals maintain relatively large, overlapping home ranges and follow seasonal altitudinal migrations to track the availability of bamboo shoots and leaves.⁹ Their largely solitary nature reduces competition within these constrained habitats, while vocalizations, scent marking, through depositing chem-

ical signals to indicate territory or reproductive status, and other forms of chemical communication allow them to maintain territories and locate mates across rugged terrain. Physiologically, pandas are adapted to conserve energy in a low-calorie environment, as they have a reduced basal metabolic rate and spend much of their day resting when not actively foraging.¹⁰

Grizzly bears exemplify, not only ecological flexibility, but also behavioral and physiological adaptability. Beyond their varied diet, grizzlies exhibit remarkable seasonal and regional behavioral shifts, such as salmon foraging, seed dispersal, and extensive hibernation cycles, reflecting their ability to fine-tune energy use across changing environments.¹¹ Their hibernation strategy, for example, involves entering a state of deep metabolic suppression during winter months, lowering heart rate and body temperature while relying entirely on stored fat reserves for energy. During this period, they neither eat, drink, nor excrete waste; instead, they recycle nitrogen and urea to preserve muscle and organ tissue — a physiological feat unmatched by most mammals of their size. This adaptation allows grizzlies to endure long periods of food scarcity in harsh climates, emerging in spring with minimal loss of strength or mobility.¹² In ecosystems where they coexist with other large carnivores, grizzlies also demonstrate competitive versatility, meaning they may act as apex predators, scavengers, or even ecosystem engineers, redistributing nutrients through carcass remains and soil disturbance.



Figure 5. Grizzly bear in peaceful hibernation under a cave.

Polar bears inhabit the circumpolar Arctic, a harsh environment defined by sea ice, frigid temperatures, and seasonal variability in prey availability. These bears rely on sea ice platforms to hunt seals and demonstrate remarkable swimming en-

durance, with some covering several kilometers daily in search of prey. Solitary and highly mobile, they maintain vast home ranges that fluctuate with ice coverage and prey density, using scent detection and stealth to locate seals in breathing holes. Physiologically, polar bears are insulated by dense fur and a thick layer of blubber, adaptations that conserve heat and allow energy-efficient movement across icy terrain.¹³ They also exhibit seasonal shifts in activity, increasing hunting efforts during periods when seals are abundant and reducing energy expenditure when food is scarce.¹⁴

These bears illustrate how ecological niches shape both opportunity and constraint. Grizzlies, as generalists with broad niche breadth, can exploit diverse habitats and food sources, giving them high adaptability in the face of environmental change. In contrast, pandas and polar bears occupy narrow, specialized niches, making them highly efficient within their respective habitats, but more vulnerable to disturbances such as habitat loss or prey scarcity.

Case Study: Climate Change as a Selective Pressure

Current global environmental change — driven primarily by climate warming, habitat fragmentation, and shifting food availability — is testing the evolutionary strategies of bears, revealing how specialization and flexibility influence survival under rapidly shifting conditions. For instance, polar bears face dramatic habitat loss due to melting sea ice. With hunting platforms disappearing, they must swim longer distances to find seals, depleting energy reserves and threatening reproductive success. In some regions, reduced ice coverage has led to increased encounters and occasional hybridization with grizzlies, producing “pizzlies”. Such hybridization can dilute polar bear genetic adaptations for Arctic survival, potentially reducing their fitness in an already rapidly changing environment.¹⁸

Similarly, giant pandas are constrained by fragmented bamboo forests. Their survival depends not only on the availability of bamboo, but also on human-managed conservation efforts such as habitat corridors and reforestation programs. Even slight disruptions in bamboo growth due to climate



Figure 6. Hybridization between a polar bear and grizzly bear, sometimes informally called a “pizzly” or “grolar” bear.

variability can impact foraging efficiency and reproduction.¹⁹

In contrast, grizzlies illustrate the advantages of ecological flexibility. As generalists, they are shifting their ranges northward in response to warming temperatures, modifying foraging behavior and exploring new habitats. Their broad diet and behavioral plasticity provide a buffer against ecological disruptions, though they remain vulnerable to climate-driven challenges such as altered prey distributions, reduced availability of key food sources like salmon, and increased encounters with humans as warming temperatures push them into new or more populated areas.²⁰

Beary Adaptive: Lessons of Evolution and Survival in a Changing World

Pandas, grizzlies, and polar bears exemplify how a single ancestral lineage can follow radically different evolutionary paths to meet the same fundamental challenge of survival in a changing world. Therefore, evolution is not linear or inherently “progressive” but rather it is context-dependent. Specialized strategies can yield remarkable efficiency within stable niches yet increase vulnerability under rapid environmental change, as seen in pandas and polar bears. Generalist strategies, like those of grizzlies, may sacrifice peak efficiency yet provide resilience through dietary and behavioral flexibility. Evidence from habitat fragmentation, climate-driven range shifts, and hybridization highlights that adaptability often outweighs specialization when selective pressures fluctuate.

Maybe next time when you see a lazy,

stationary Panda doomscrolling on social media while lounging in bed, an endlessly snack-seeking Grizz foraging the refrigerator for anything edible, or an unflinching Ice Bear silently mastering the cold of the freezer, perhaps the underlying cause is attributed to millions of years of evolution at play.

And in other cases, it is pure tomfoolery.

ACKNOWLEDGEMENTS

A very special thank you to Izzac Wilkinson, junior specialist/lab manager (and the best lab mentor) in the Koskella Lab at UC Berkeley, for providing valuable feedback for improvement on my article.

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Figure 7. Ice Bear, Panda, and Grizz ride a scooter down a steep San Francisco hill as a cable car passes behind them.

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