Yesterday is gone, tomorrow has not yet come: Compound-specific stable isotopes of polar bear bone collagen over 2000 years

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Polar bears (*Ursus maritimus*) are the internationally recognized face of Arctic climate change and sea ice related habitat loss. In Alaska, two polar bear stocks are recognized, the Southern Beaufort Sea (SBS) and the Chukchi Sea stock. The SBS stock is currently in decline, and poor body condition, reduced fecundity, and survival have all been noted. Sea ice loss, population recruitment, and increased land use by bears in response to the rapidly changing Arctic are ongoing management concerns. We analyzed bone collagen of SBS polar bears obtained from subsistence harvests (2006-2016; *n*=14), University of Alaska Museum (1906-1971; *n*=7), and archeological digs (1850BP-1180BP; *n*=4) for bulk stable isotopes (SI) and compound specific SI (CSI) of 12 individual amino acids (AA). δ^{15}N of bulk collagen did not differ among present-day, historic, and ancient bears (*P*=0.08), while ^{13}C was significantly depleted in modern bears compared with historic and ancient bears (*P*<0.0001, after Suess correction). This phenomenon has also been observed in other Arctic marine mammals, e.g., pinnipeds, and may suggest an increased sourcing of carbon from open-water phytoplankton over ice-associated primary production. δ^{15}N of essential "source" AA (e.g., phenylalanine that change only minimally in trophic transfer) did not differ among bears of the three gross time groupings (*P*=0.60) indicating that baseline δ^{15}N values in the Arctic food web have remained virtually unchanged. Threonine is a unique AA in its δ^{15}N systematics. Alone among protein AA, threonine deamination involves an enzyme system, where the catabolism leads to depletion rather than enrichment of ^{15}N. This effect is more pronounced in marine than terrestrial food webs. Interestingly, threonine was significantly enriched in ^{15}N of modern bears over historic and ancient animals (*P*=0.008). There could be three reasons: 1) modern bears are in better body condition than in the past; 2) the modern food web is shorter leading to less reworking of nitrogen; and 3) modern bears rely more heavily on terrestrial food webs.