Appendix

Isotopic life-history signatures are retained in modern and ancient Atlantic bluefin tuna vertebrae

Adam J. Andrews[*1], David Orton[2], Vedat Onar[3], Piero Addis[4], Fausto Tinti[1], Michelle Alexander[*2]

1Department of Biological, Geological and Environmental Sciences, University of Bologna, Campus of Ravenna, Ravenna, Italy
2BioArCh, Department of Archaeology, University of York, York, U.K.
3Osteoarchaeology Practice and Research Centre and Faculty of Veterinary Medicine, Istanbul University-Cerrahpaşa, Istanbul, Turkey
4Department of Life and Environmental Sciences, University of Cagliari, Cagliari, Sardinia, Italy

*Corresponding authors: adam@palaeome.org, michelle.alexander@york.ac.uk

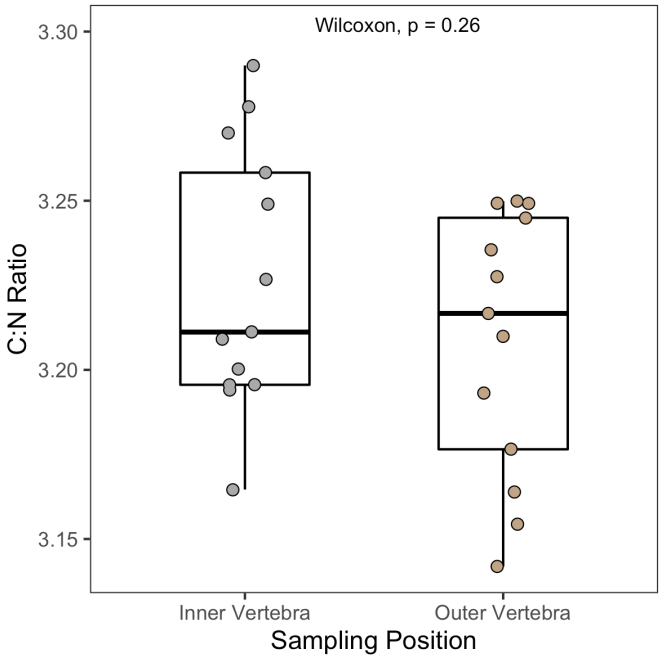

Figure S1. Boxplots showing non-significant differences in C:N ratios of inner vertebrae and outer vertebrae samples from thirteen archaeological Atlantic bluefin tuna (*Thunnus thynnus*) specimens, dated to between the 9-13th c. CE from the site of Yenikapi, Istanbul, Turkey. The significance (p) of a paired Wilcoxon test was tested in R.

Calibration and Analytical Uncertainty for Isotopic Measurements

Stable carbon, nitrogen isotope compositions were calibrated relative to VPDB ($\delta^{13}C$), AIR ($\delta^{15}N$) using IAEA-600, IAEA-N-2, IA-R006. Sulfur ($\delta^{34}S$) was calibrated relative to VCDT using internal standards GS2 and GAS2 (themselves calibrated to IAEA-S-2, silver sulfide, δ 34 S VCTD = 22.62 ± 0.08 ‰ and IAEA-S-3, silver sulfide, δ 34 S VCTD = –32.49 ± 0.08 ‰) (Table S3).

Table S3. Standard reference materials used for calibration of $\delta^{13}C$ relative to VPDB, $\delta^{15}N$ relative to AIR and $\delta^{34}S$ relative to VCDT.

Standard	Material	Accepted $\delta^{13}C$ (‰, VPDB)	Accepted $\delta^{15}N$ (‰, AIR)	Accepted $\delta^{34}S$ (‰, VCDT)
IAEA-600	Caffeine	-27.771	+1.0	
IAEA-N-2	Ammonium Sulfate		+20.41	
IA-R006	Cane Sugar	-11.64		
GS2	Gelatine, sulfanilamide, 13C-glycine			-10.28 ± 0.18
GAS2	Gelatine, acetanilide, sulfanilamide,15N-glycine			18.56 ± 0.10

The following standard was used to monitor analytical uncertainty (Table S4). The isotopic compositions reported here for internal standards represent long term averages calibrated to VPDB and AIR with IAEA-600, IAEA-N-2, and IA-R006.

Table S4. Standard reference materials used to monitor internal accuracy and precision.

Standard	Material	Mean $\delta^{13}C$ (‰, VPDB)	Mean $\delta^{15}N$ (‰, AIR)	Mean $\delta^{34}S$ (‰, VCDT)
ISO_12	SIGMA Fish Gelatine	-15.29±0.11	+15.23±0.28	
USGS88	Marine Collagen			+17.10±0.44
USGS89	Porcine Collagen			+3.86±0.56
B2215	IRMS Fish Gelatine			+1.21±0.24

Table S5 presents the means and standard deviations of the $\delta^{13}C$ and $\delta^{15}N$ values for the check and calibration standards, as well as the number of standards included in each analytical session. Of the basis of the check and calibration standards, measurement precision (the pooled standard deviation of the check and calibration standards) was ±0.08 ‰ for $\delta^{13}C$, ±0.23 ‰ for $\delta^{15}N$ (n=13) and ±0.38 ‰ for $\delta^{34}S$ (n=9). Measurement accuracy (bias) was evaluated by comparing the known and measured $\delta^{13}C$ and $\delta^{15}N$ values for ISO_12 and factoring in the long-term uncertainty in these known measurements. Measurement bias due to systematic error (accuracy) was determined to be ±0.11 ‰ for $\delta^{13}C$, ±0.28 ‰ for $\delta^{15}N$ and ±0.41 ‰ for $\delta^{34}S$.

Table S5. Mean and/or standard deviation of all check and calibration standards for all analytical sessions containing data presented in this paper.

Session ID	Standard	n	$\delta^{13}C$ (‰, VPDB)	$\delta^{15}N$ (‰, AIR)	$\delta^{34}S$ (‰, VCDT)
Session 1	ISO_12	5	-15.18±0.12	15.15±0.13	
Session 1	IA-R006	5	±0.11		
Session 1	IAEA-600	5	±0.06	±0.06	
Session 1	IAEA-N-2	5		±0.25	
Session 2	ISO_12	5	-15.42±0.06	15.23±0.15	
Session 2	IA-R006	5	±0.10		
Session 2	IAEA-600	5	±0.10	±0.10	
Session 2	IAEA-N-2	5		±0.11	
Session 3	ISO_12	3	-15.40±0.11	14.99±0.17	
Session 3	IA-R006	3	±0.04		
Session 3	IAEA-600	3	±0.07	±0.07	
Session 3	IAEA-N-2	3		±0.13	
Session 4	ISO_12	5	-15.25±0.07	15.03±0.20	
Session 4	IA-R006	5	±0.08		
Session 4	IAEA-600	5	±0.05	±0.13	
Session 4	IAEA-N-2	5		±0.10	
Session 5	USGS88	6			16.96±0.37
Session 5	USGS89	7			4.92±0.64
Session 5	B2215	4			1.26±0.21
Session 6	USGS88	5			17.02±0.34
Session 6	USGS89	4			4.28±0.38
Session 6	B2215	4			0.96±0.40
Session 6	B2215	4			0.78±0.29