

Supplementary Information: Collagen Fingerprinting and the Earliest Marine Mammal Hunting in North America

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Chronology:

The marine mammal samples in this study are from four well dated Paleocoastal sites, with stratified and secure Early Holocene or Terminal Pleistocene deposits and radiocarbon chronologies. Table S1 presents all Paleocoastal ^{14}C dates from each of the cultural components at the four archaeological sites from which our samples were selected. Additional details of the stratigraphic context of the samples and site chronologies are available in Erlandson et al. (1996, 2011) and Watts (2013). All ^{14}C dates were calibrated using CALIB 7.1, with the Marine13 dataset for all shell samples and the INTCAL13 dataset for terrestrial samples (Reimer et al. 2013). A ΔR of 261 ± 21 (Jazwa et al. 2012) was applied to all marine samples.

References

- Erlandson, J. M., D. J. Kennett, B. L. Ingram, D. A. Guthrie, D. P. Morris, M. A. Tveskov, G. J. West, and P. L. Walker. 1996. An archaeological and paleontological chronology for Daisy Cave (CA-SMI-261), San Miguel Island, California. *Radiocarbon* 38:355–373.
- Erlandson, J. M., T. C. Rick, T. J. Braje, M. Casperson, B. Culleton, B. Fulfroost, T. Garcia, D. A. Guthrie, N. Jew, D. J. Kennett, M. L. Moss, L. A. Reeder, C. E. Skinner, J. Watts, and L. Willis. 2011. Paleoindian seafaring, maritime technologies, and coastal foraging on California's Channel Islands. *Science* 331:1181–1185.
- Jazwa, C., D. Kennett, and D. Hanson. 2012. Late Holocene subsistence change and marine productivity on western Santa Rosa Island, Alta California. *California Archaeology* 4:69–98.
- Reimer, P. J., E. Bard, A. Bayliss, J. W. Beck, P. G. Blackwell, C. Bronk Ramsey, C. E. Buck, H. Cheng, R. L. Edwards, M. Friedrich, P. M. Grootes, T. P. Guilderson, H. Haflidason, I. Hajdas, C. Hatté, T. H. Heaton, D. L. Hoffman, A. Hogg, K. A. Hughen, K. F. Kaiser, B. Kromer, S. W. Manning, M. Niu, R. W. Reimer, D. A. Richards, E. M. Scott, J. R. Southon, R. A. Staff, C. S. M. Turney, and J. van der Plicht. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon* 55:1869–1887.
- Watts, J. L. 2013. *The Culture of Santarosae: Subsistence Strategies and Landscape Use in the Northern Channel Islands from the Initial Occupation*. PhD Dissertation, Oxford University.

Table S1. Paleocoastal radiocarbon data from CA-SMI-261, CA-SMI-522, CA-SRI-26 and CA-SRI-512.

Provenience	Lab Number	Material	$^{13}\text{C}/^{12}\text{C}$ Adjusted	Age Range (cal BP, 1σ)
CA-SMI-261				
Col. E6, Str. E1	CAMS-8866	Charred twig	7810 ± 60	8680–8480

Col. E6, Str. E1	CAMS-14379	CA mussel	8380 ± 60	8690-8500
Col. E6, Str. E1	CAMS-14380	CA mussel	8400 ± 60	8710-8520
Col. E6, Str. E1	CAMS-14360	CA mussel	8440 ± 80	8830-8550
Col. E6, Str. E1	Beta-15621	Black abalone	8460 ± 100	8870-8570
Col. E6, Str. E1	CAMS-14361	CA mussel	8500 ± 80	8900-8630
Col. E6, Str. E4	Beta-15622	Black abalone	8730 ± 120	9280-8950
Col. E6, Str. E4	CAMS-8865	Charred twig	8040 ± 60	9020-8780
Col. E6, Str. F1	Beta-15623	CA mussel	8900 ± 120	9430-9150
Col. E6, Str. F1	CAMS-8867	Charred twig	8600 ± 60	9630-9520
Col. E6, Str. F3	Beta-49948	CA mussel	9360 ± 90	10,000-9670
Col. E6, Str. F3	CAMS-8863	Charred twig	8810 ± 80	10,130-9690
Col. E6, Str. F/G	CAMS-33368	Charcoal	8970 ± 60	10,230-9950
Col. E6, Str. F/G	CAMS-33375	Marine shell	9620 ± 70	10,280-10120
Col. E6, Str. G	Beta-52360	Black turban	10,600 ± 70	11,540-11,220
Col. E6, Str. G	Beta-14660	Red abalone	10,700 ± 90	11,750-11,350
Col. E6, Str. G	CAMS-9094	Wood charcoal	10,390 ± 130	12,520-12,050
CA-SMI-522				
1S-III-A	OS-68509	Marine shell	9230 ± 40	9670-9540
1N-7	OS-68511	Marine shell	9240 ± 40	9690-9550
1S-IV	OS-68510	Marine shell	9260 ± 55	9740-9550
IS-A	OS-68512	Marine shell	9300 ± 45	9830-9630
1S Wall-2	OS-68508	Marine shell	9330 ± 45	9880-9680
1S-B, (Notes I)	OS-69026	Charred twig	8780 ± 50	9900-9700
Sea cliff: base of midden	OS-37737	Marine shell	9390 ± 30	9990-9770
Above base	OS-27943	<i>Mytilus californianus</i>	9450 ± 70	10,120-9880
Sea cliff: base of midden	OS-37963	Charred twig	8870 ± 40	10,150-9910
1S-III-B	OS-69027	Charred twig	8940 ± 50	10,190-9940
CA-SRI-26				
Gully, A4 soil, ~2 m below surface	UCI-80937	<i>Mytilus californianus</i>	10,545 ± 30	11,310-11,210
A4 Paleosol	DAMS-8725	<i>Haliotis rufescens</i>	10,700 ± 37	11,690-11,390
A4 Paleosol	OS-96885	Goose bone (uf)	10,150 ± 70	11,980-11,640
CA-SRI-512				
A5 Paleosol	UCIAMS-59871	Goose bone (XAD extract)	10,000 ± 30	11,600-11,360

A5 Paleosol	UCIAMS-59872	Goose bone (XAD extract)	10,045 ± 40	11,700-11,400
Below A5	Beta-261353	<i>Ceanothus</i> charcoal	10,090 ± 50	11,810-11,410
A5 Paleosol	UCIAMS-60751	Charred twig	10,160 ± 30	11,950-11,760
A5 Paleosol	OS-68030	Goose bone (ultrafiltration)	10,150 ± 40	11,960-11,720
Below A5	OS-75147	<i>Ceanothus</i> charcoal	10,200 ± 45	12,000-11,811

Table S2. Table of ZooMS markers useful for identifying Marine Mammals.

Common Name	Species name	A	B	C	D	P	ES*	F	G
Southern Elephant seal	<i>Mirounga leonina</i>	1205/1221	1453	1566	2171	2215	2663	2853	2957
Northern Elephant seal	<i>Mirounga angustirostris</i>	1205/1221	1453	1566	2171	2215	2663	2853	2957
Harbor Seal	<i>Phoca vitulina</i>	1205/1221	1453	1566	2171	2215	2705	2853	2957
South American Fur Seal	<i>Arctocephalus australis</i>	1205/1221	1453	1566	2121	2215	2705	2853	2957
Antarctic Fur Seal	<i>Arctocephalus gazella</i>	1205/1221	1453	1566	2121	2215	2705	2853	2957
Stellar's Sea Lion	<i>Eumotopias jubatus</i>	1205/1221	1453	1566	2121	2215	2705	2853	2957
South American Sea Lion	<i>Otaria flavescens</i>	1205/1221	1453	1566	2121	2215	2705	2853	2957
Northern Fur Seal	<i>Callorhinus ursinus</i>	1205/1221	1453	1566	2121	2215	2705	2853	2957
California Sea Lion	<i>Zalophus californianus</i>	1205/1221	1453	1566	2121	2215	2705	2853	2957
Walrus	<i>Odobenus rosmarus</i>	1205/1221	1453	1566	2121	2246	2705	2853	3003
Guadalupe Fur Seal	<i>Arctocephalus townsendi</i>	1205/1221	1453	1566	2121	2246	2705	2853	2957
Sea Otter	<i>Enhydra lutris</i>	2119/1235	1453	1566	2147	2215	2705	2853	2973

*Marker described here as useful for identifying Elephant Seals

Figures S1-S3. Collagen Fingerprint Reference Spectra for Marine Mammal Identification

Figure S4-S8. Collagen Fingerprint Spectra for Samples in this Study

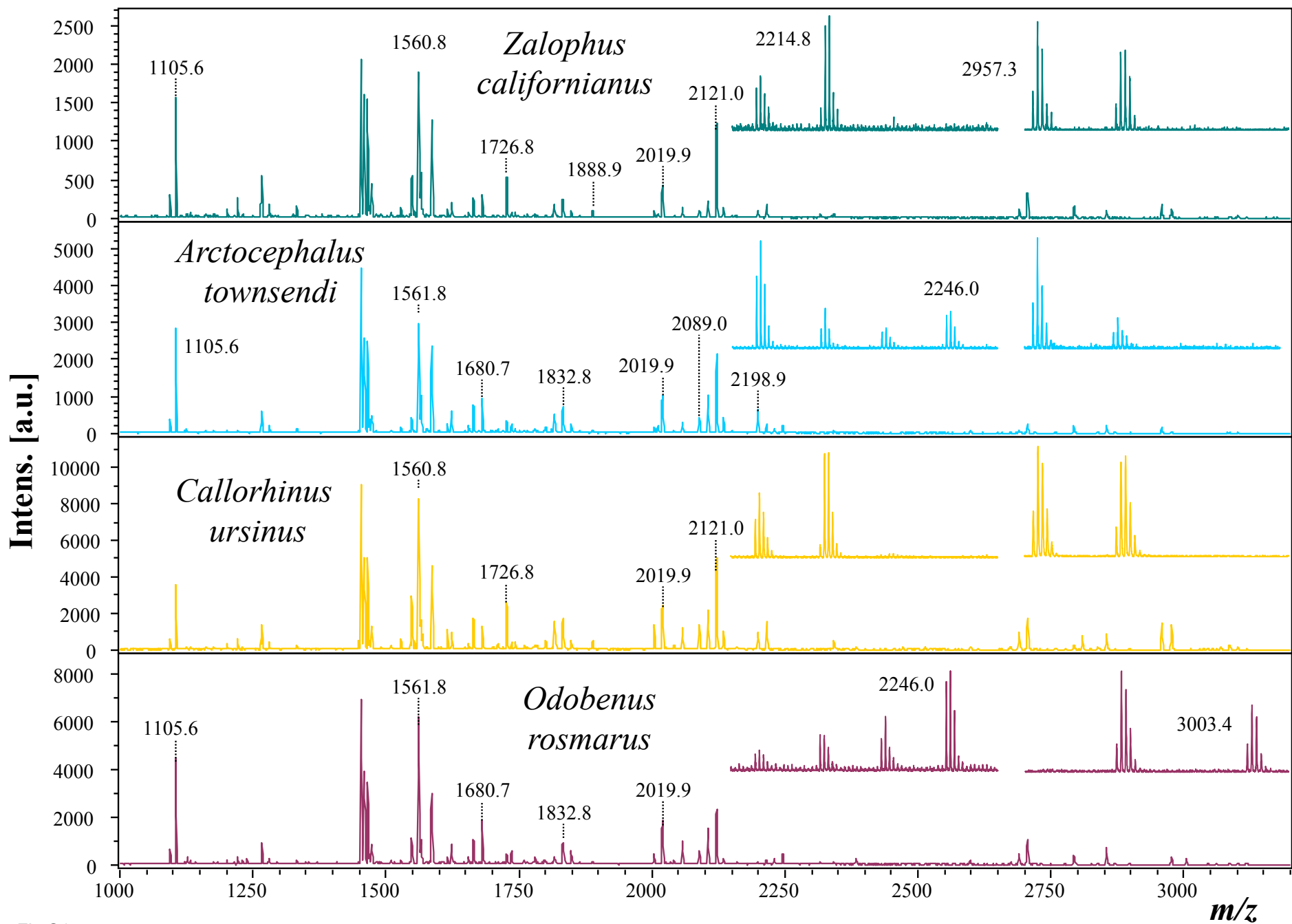


Fig S1

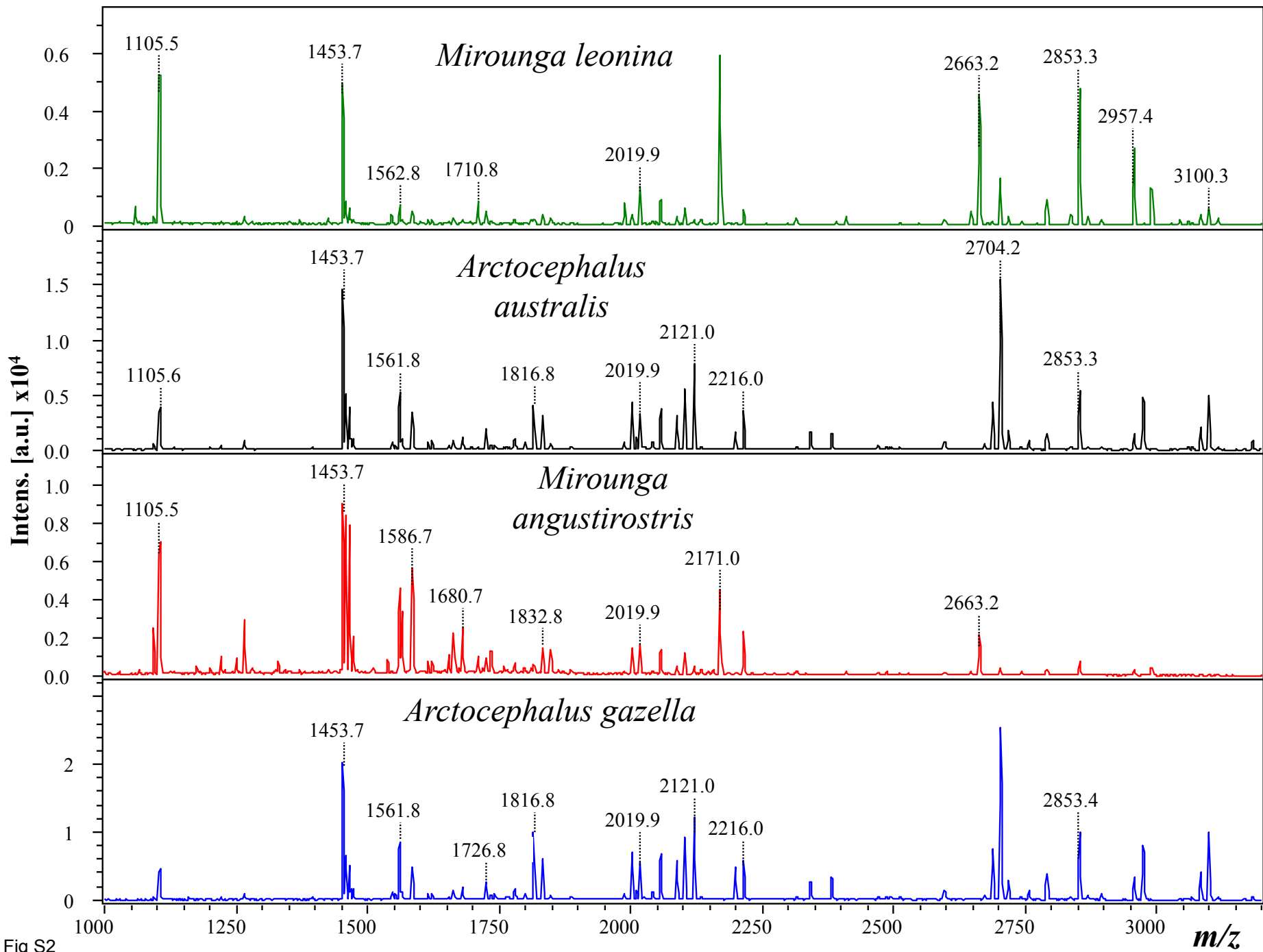
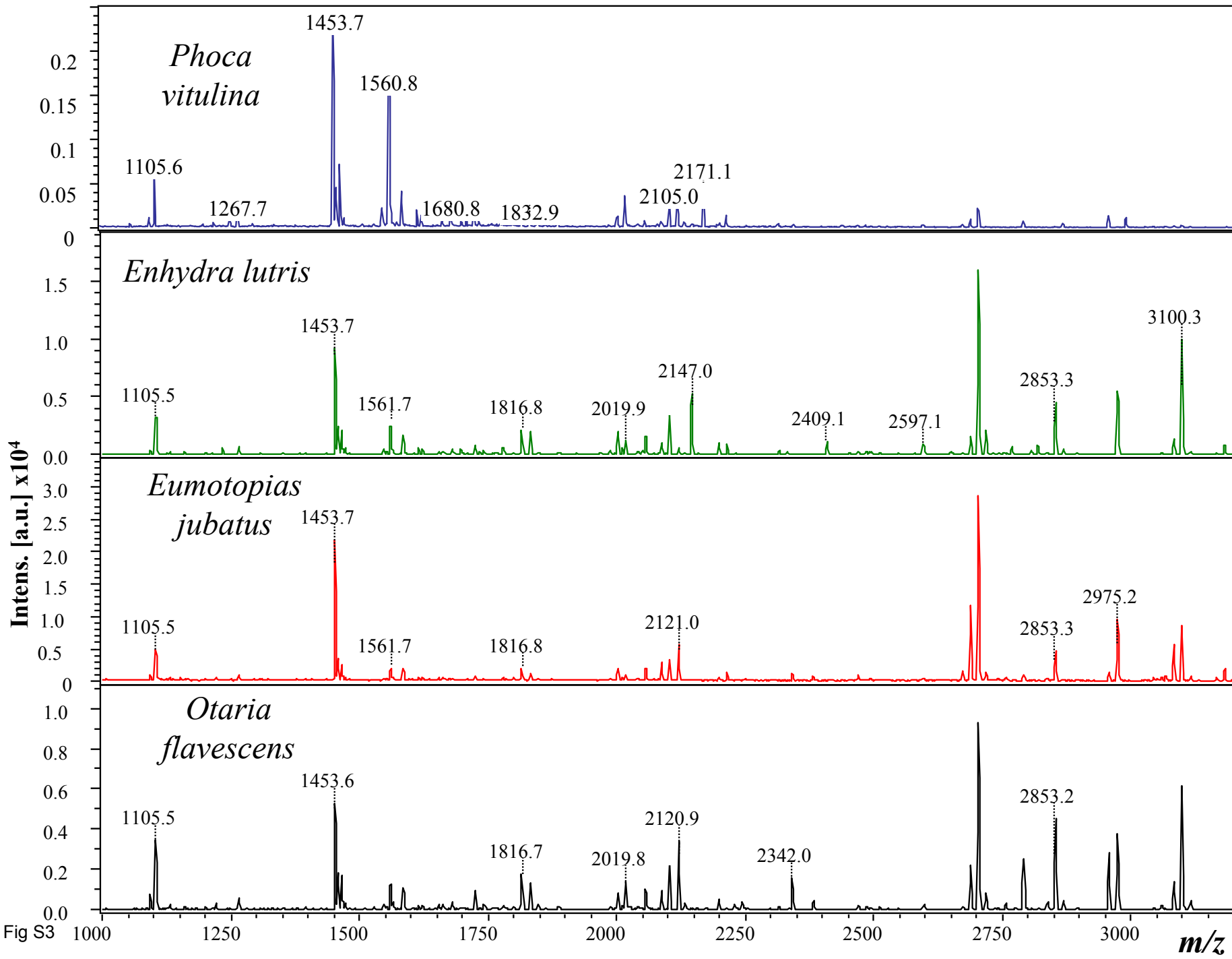


Fig S2



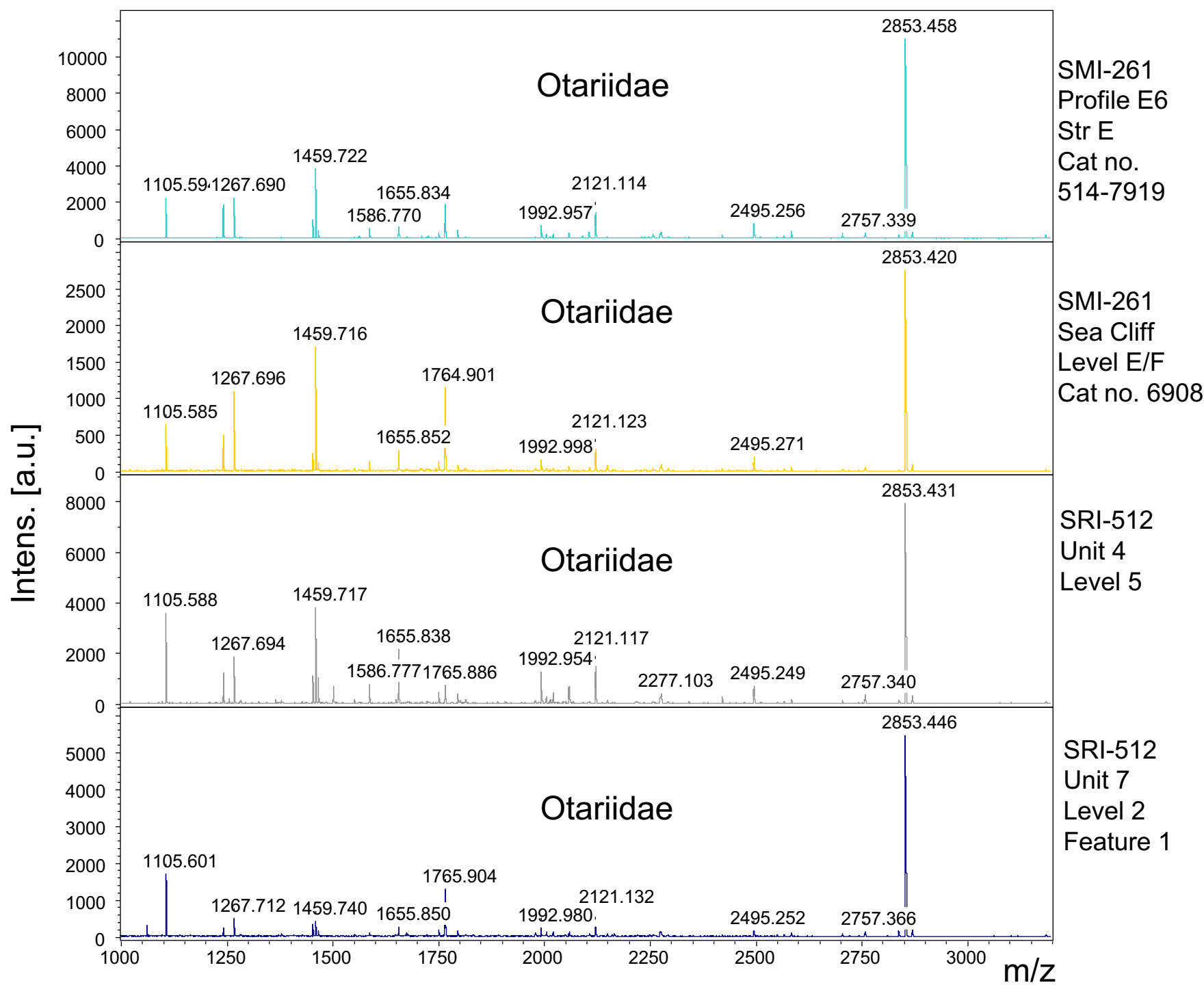
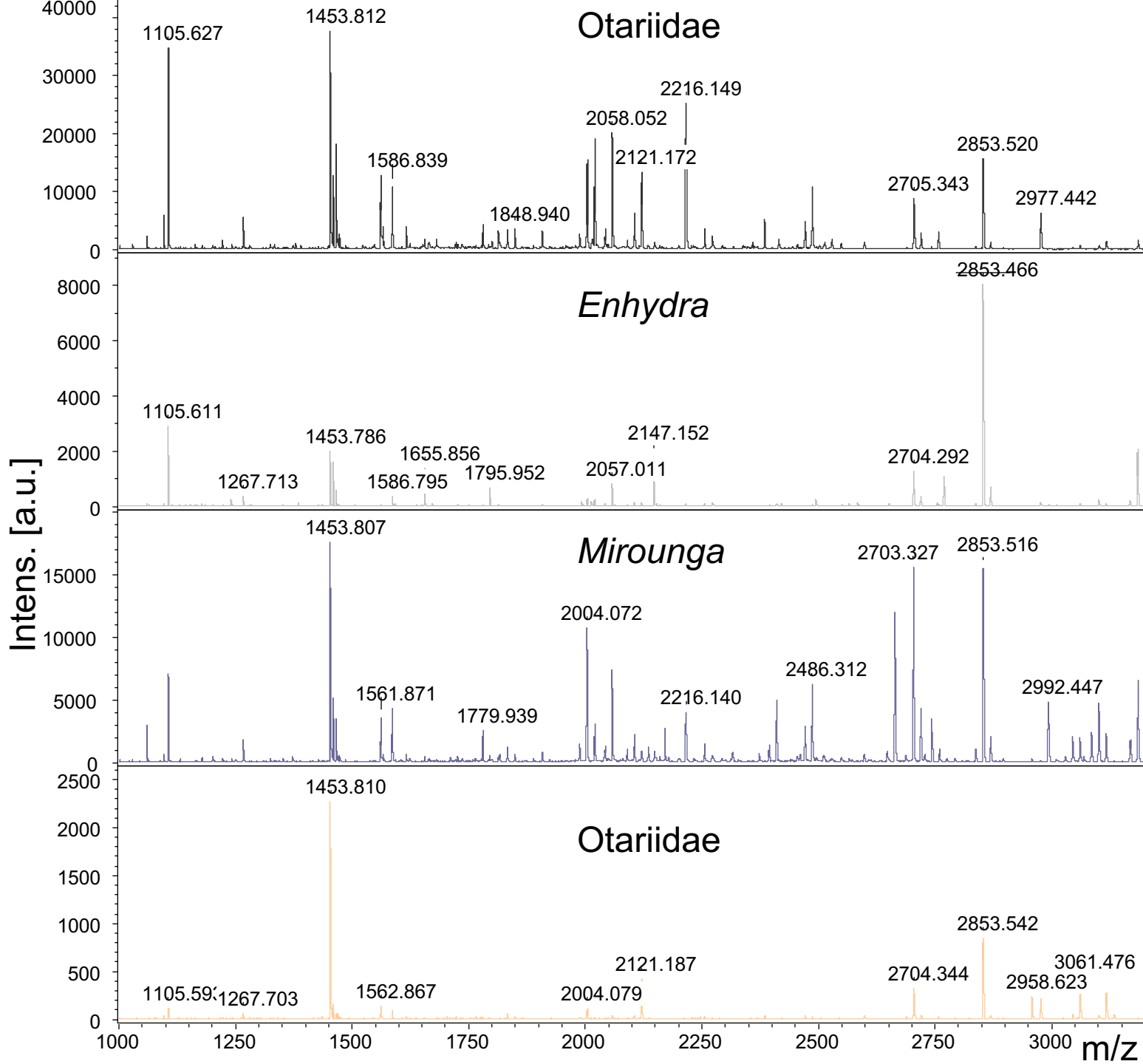


Fig S4



SRI-26
Unit 2
Level 5

SMI-261
Unit D5
Str E2
Cat no. 514-
5710

SMI-261
Unit D5/6
Str E2b
Cat no. 514-
7631

SMI-522
Unit 25
Level 2
Cat no. 247b

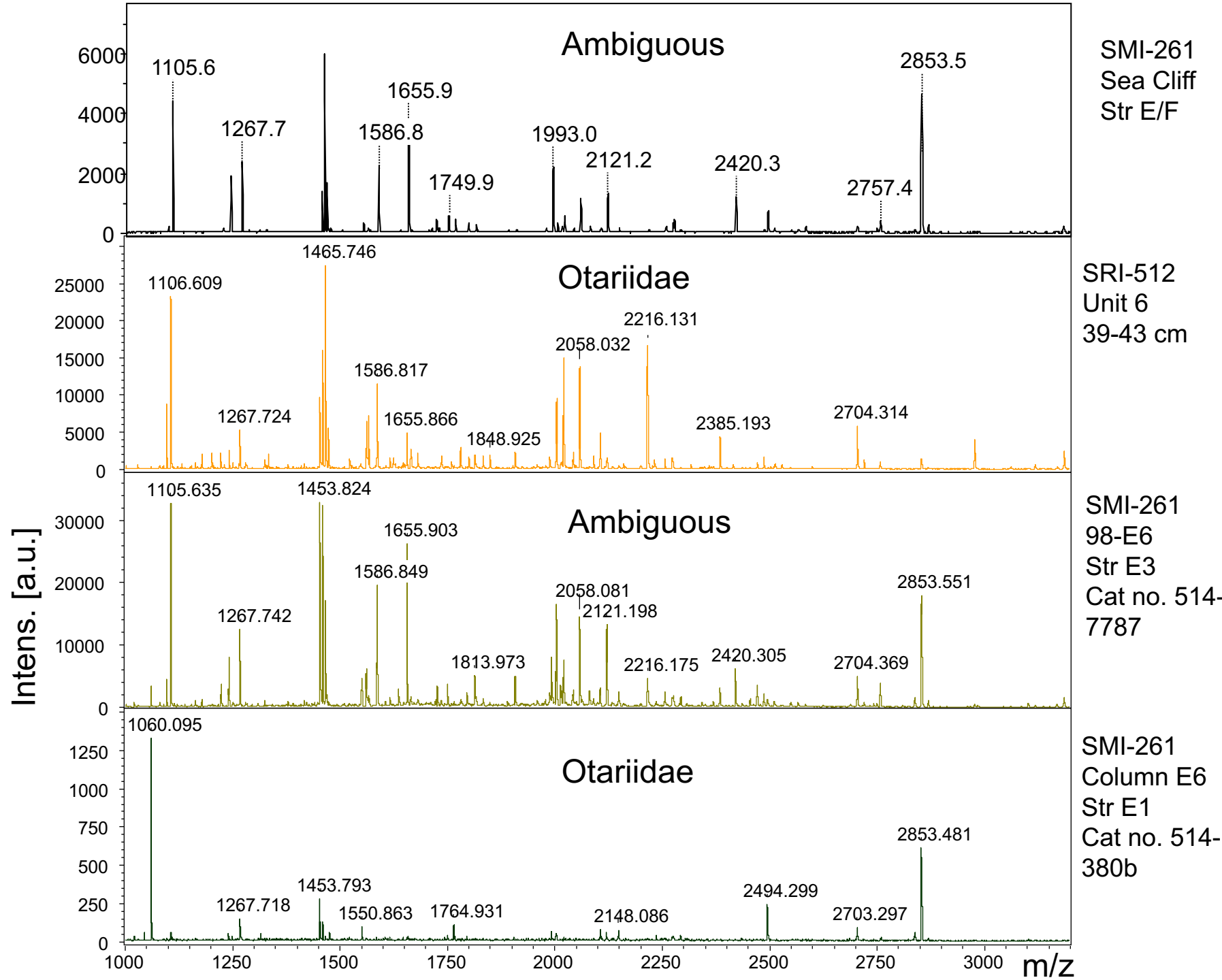


Fig S6

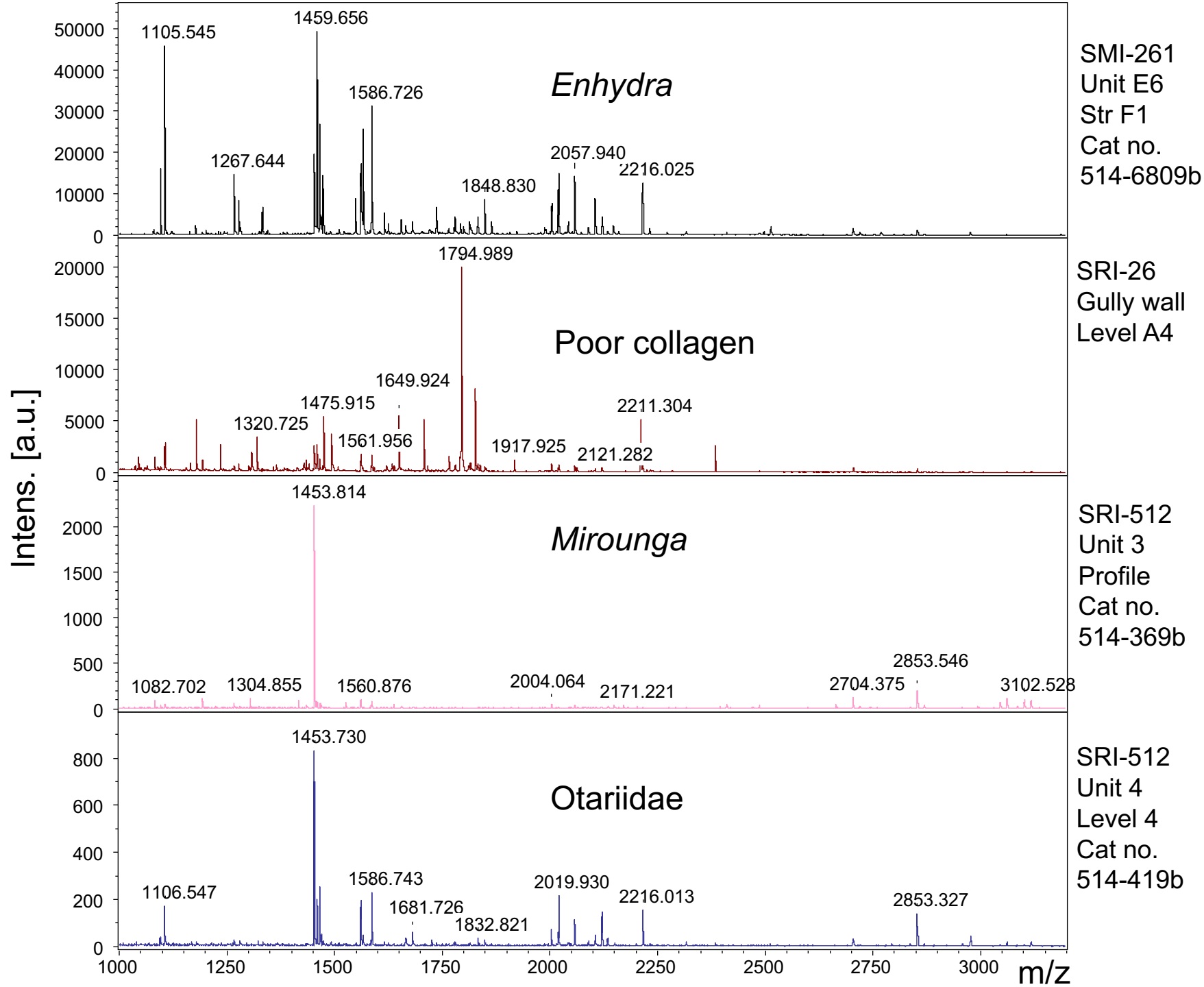
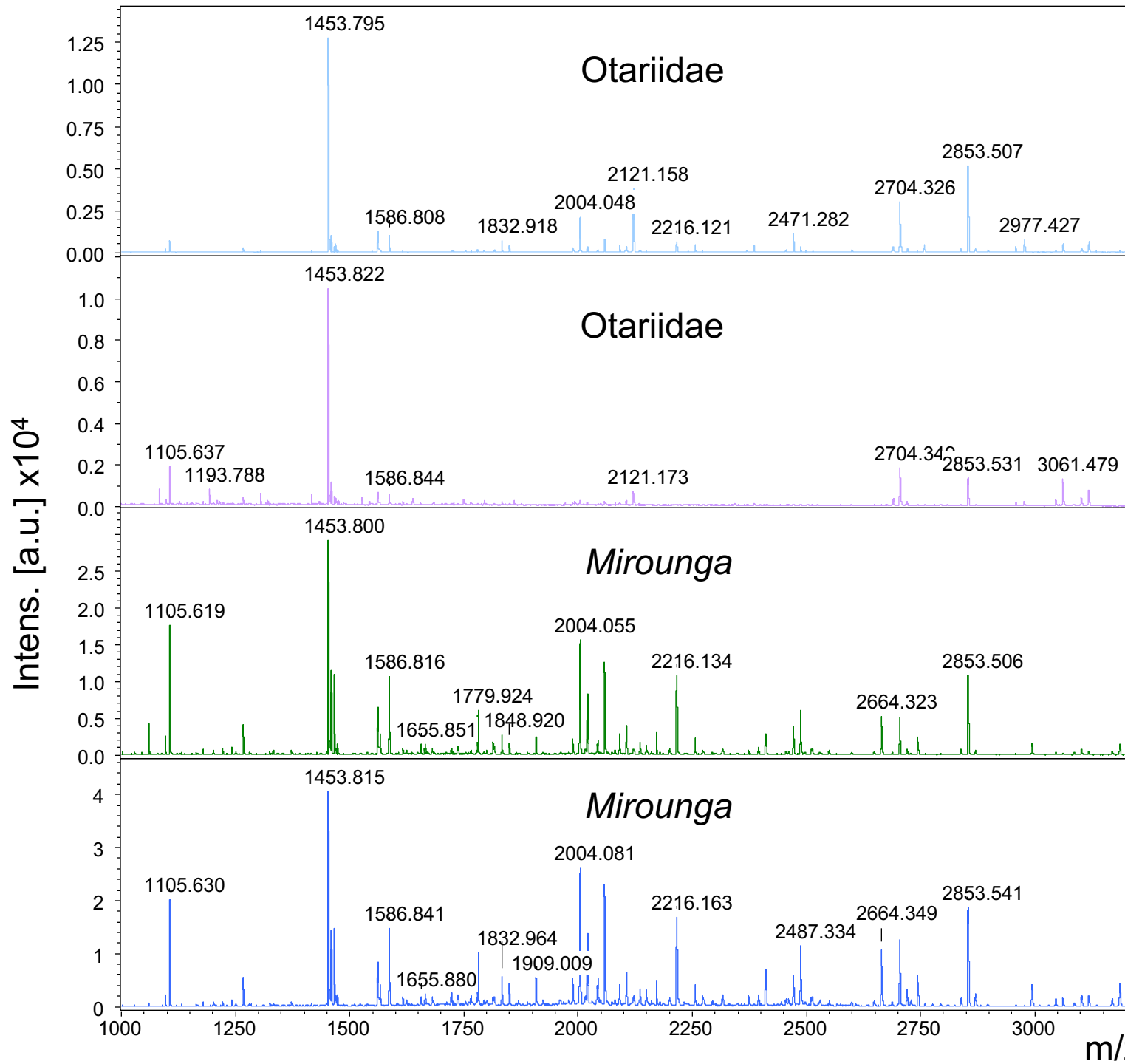


Fig S7



SMI-522
Sea Cliff
Cat no. 522-78b

SMI-261
Column E6
E3
Cat no. 514-7700B

SMI-261
Sea Cliff
G or Below
Cat no. 514-6888b

SMI-261
Sea Cliff
G or Below
Cat no. 514-6888a

Fig S8