

Table S1: Characteristics of the fish individuals used in this study

sample_id	Species	Standard length (mm)	Body mass (g)	Gut length (mm)	Relative gut length	Diet category
F_F268	<i>Boops boops</i>	175	98	329	2.14	Selective_plankton_feeding
F_F272	<i>Boops boops</i>	140	27	342	2.44	Selective_plankton_feeding
F_F275	<i>Boops boops</i>	171	48	315	1.84	Selective_plankton_feeding
F_F264	<i>Diplodus annularis</i>	156	160	166	1.02	Hunting_macrofauna
F_F267	<i>Diplodus annularis</i>	160	143	176	1.10	Hunting_macrofauna
F_F319	<i>Diplodus annularis</i>	166	211	155	0.94	Hunting_macrofauna
F_F218	<i>Diplodus puntazzo</i>	238	223	194	0.82	Hunting_macrofauna
F_F298	<i>Diplodus puntazzo</i>	191	254	281	1.47	Hunting_macrofauna
F_F084	<i>Diplodus sargus</i>	200	299	251	1.26	Hunting_macrofauna
F_F214	<i>Diplodus sargus</i>	170	210	141	0.83	Hunting_macrofauna
F_F519	<i>Diplodus sargus</i>	250	469	196	0.80	Hunting_macrofauna
F_F219	<i>Diplodus vulgaris</i>	140	44	197	1.04	Hunting_macrofauna
F_F234	<i>Diplodus vulgaris</i>	174	200	227	1.31	Hunting_macrofauna
F_F266	<i>Diplodus vulgaris</i>	200	293	178	0.89	Hunting_macrofauna
F_F283	<i>Diplodus vulgaris</i>	192	343	238	1.24	Hunting_macrofauna
F_F291	<i>Diplodus vulgaris</i>	212	367	157	0.74	Hunting_macrofauna
F_F293	<i>Diplodus vulgaris</i>	202	334	198	0.98	Hunting_macrofauna
F_F310	<i>Diplodus vulgaris</i>	184	154	205	1.12	Hunting_macrofauna
F_F311	<i>Diplodus vulgaris</i>	171	233	176	1.03	Hunting_macrofauna
F_F316	<i>Lithognathus mormyrus</i>	223	127	120	0.54	Hunting_macrofauna
F_F318	<i>Lithognathus mormyrus</i>	236	335	183	0.78	Hunting_macrofauna
F_F323	<i>Lithognathus mormyrus</i>	282	476	143	0.62	Hunting_macrofauna
F_F468	<i>Lithognathus mormyrus</i>	235	321	124	0.53	Hunting_macrofauna
F_F324	<i>Oblada melanura</i>	236	350	243	1.03	Hunting_macrofauna
F_F520	<i>Oblada melanura</i>	215	251	329	1.53	Hunting_macrofauna
F_F522	<i>Oblada melanura</i>	200	196	286	1.28	Hunting_macrofauna
F_F325	<i>Pagellus acarne</i>	175	135	110	0.63	Hunting_macrofauna
F_F475	<i>Pagellus acarne</i>	185	145	110	0.63	Hunting_macrofauna
F_F476	<i>Pagellus acarne</i>	180	143	110	0.63	Hunting_macrofauna
F_F487	<i>Pagellus acarne</i>	130	54	110	0.63	Hunting_macrofauna
F_F200	<i>Pagellus erythrinus</i>	168	100	107	0.64	Hunting_macrofauna
F_F201	<i>Pagellus erythrinus</i>	185	131	138	0.75	Hunting_macrofauna
F_F202	<i>Pagellus erythrinus</i>	165	100	103	0.59	Hunting_macrofauna
F_F238	<i>Pagellus erythrinus</i>	160	116	64	0.40	Hunting_macrofauna
F_F207	<i>Pagrus pagrus</i>	186	151	180	0.88	Hunting_macrofauna
F_F215	<i>Pagrus pagrus</i>	205	261	180	0.88	Hunting_macrofauna
F_F521	<i>Pagrus pagrus</i>	190	209	180	0.88	Hunting_macrofauna
F_F523	<i>Pagrus pagrus</i>	155	114	180	0.88	Hunting_macrofauna
F_F104	<i>Sarpa salpa</i>	236	431	706	2.99	Grazing_aquatic_plants
F_F116	<i>Sarpa salpa</i>	203	203	554	2.73	Grazing_aquatic_plants
F_F121	<i>Sarpa salpa</i>	246	453	474	1.93	Grazing_aquatic_plants
F_F252	<i>Sarpa salpa</i>	283	523	440	1.56	Grazing_aquatic_plants
F_F256	<i>Sarpa salpa</i>	251	411	783	3.12	Grazing_aquatic_plants
F_F216	<i>Sparus aurata</i>	220	288	125	0.57	Hunting_macrofauna
F_F232	<i>Sparus aurata</i>	213	286	138	0.65	Hunting_macrofauna
F_F309	<i>Sparus aurata</i>	161	102	194	1.21	Hunting_macrofauna
F_F313	<i>Sparus aurata</i>	222	297	201	0.90	Hunting_macrofauna
F_F315	<i>Sparus aurata</i>	195	188	140	0.72	Hunting_macrofauna

Table S2: Average trait values per species

Species	Gut_length	Relative_gut_length	Diet_category
<i>Boops boops</i>	329	2.14	Selective_plankton_feeding
<i>Diplodus annularis</i>	166	1.02	Hunting_macrofauna
<i>Diplodus puntazzo</i>	238	1.15	Hunting_macrofauna
<i>Diplodus sargus</i>	196	1.04	Hunting_macrofauna
<i>Diplodus vulgaris</i>	197	1.04	Hunting_macrofauna
<i>Lithognathus mormyrus</i>	143	0.61	Hunting_macrofauna
<i>Oblada melanura</i>	286	1.28	Hunting_macrofauna
<i>Pagellus acarne</i>	110	0.63	Hunting_macrofauna
<i>Pagellus erythrinus</i>	103	0.59	Hunting_macrofauna
<i>Pagrus pagrus</i>	180	0.88	Hunting_macrofauna
<i>Sarpa salpa</i>	591	2.46	Grazing_aquatic_plants
<i>Sparus aurata</i>	160	0.81	Hunting_macrofauna

Table S3: Phylogenetic conservatism of morphological traits

Phylogenetic signal was tested using Abouheif test.

Trait	Obs	Std.Obs	p-value
Gut length	0.19	2.25	0.027
Relative gut length	0.34	2.82	0.021

Figure S1: Abundance-occurrence distribution of ASVs and identification of core ASVs

The figure below represents the relationship between occurrence (number of samples in which the ASV occurs) and average abundance of ASVs across samples (%). Green ASVs are core ones.

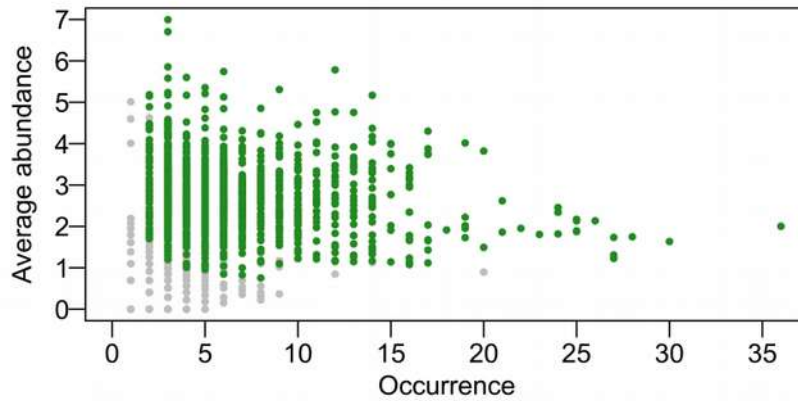


Figure S2: Phylogenetic conservatism of morphological traits

Gut length and relative gut length were significantly related with phylogeny. Trait values were scaled for the representation.

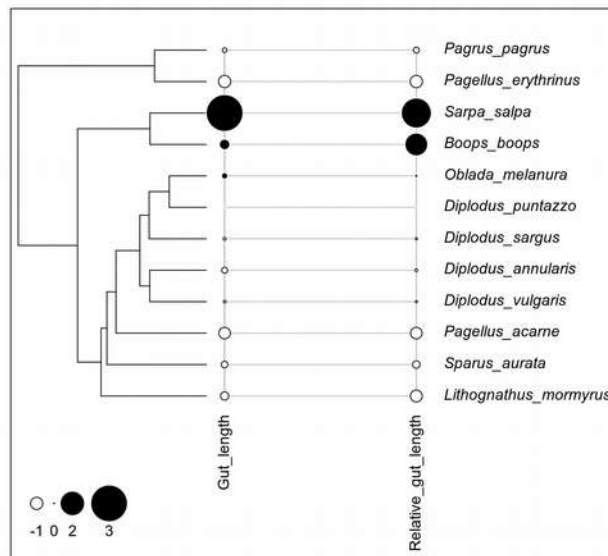


Figure S3: Composition of the core gut microbiome in Mediterranean Sparidae

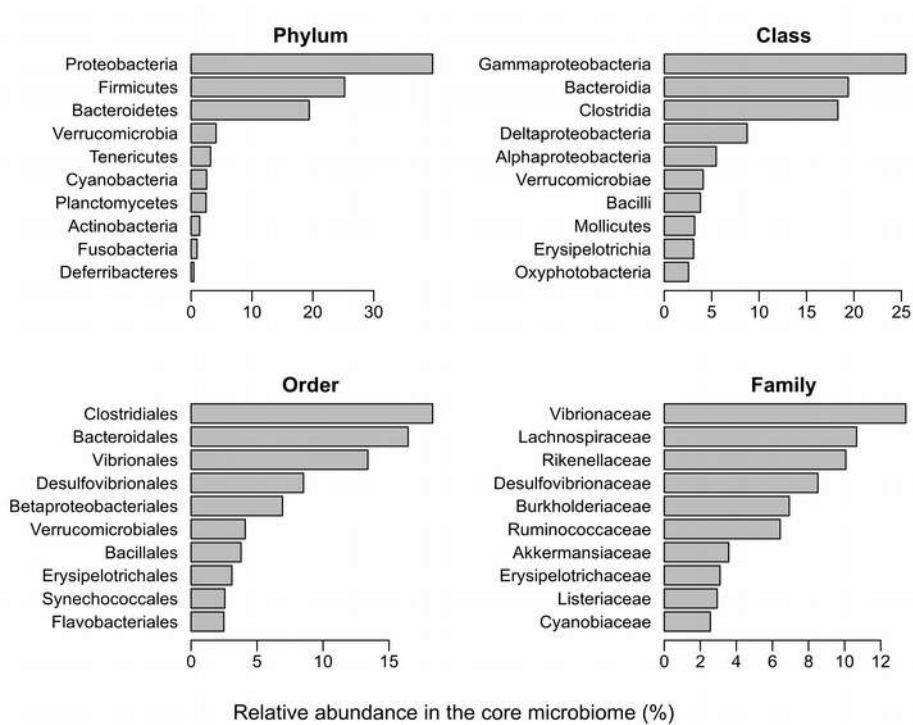


Figure S4: Determinants of gut microbiome structure in Sparidae

Differences in gut microbiome structure between groups were tested using Wd test. Each barplot represents the logged p-values of the test for six different dissimilarity methods (see main text). Blue lines correspond to p-values = 0.05 and red lines to p-values = 0.01. Left plots depict raw p-values and right plots logged p-values.

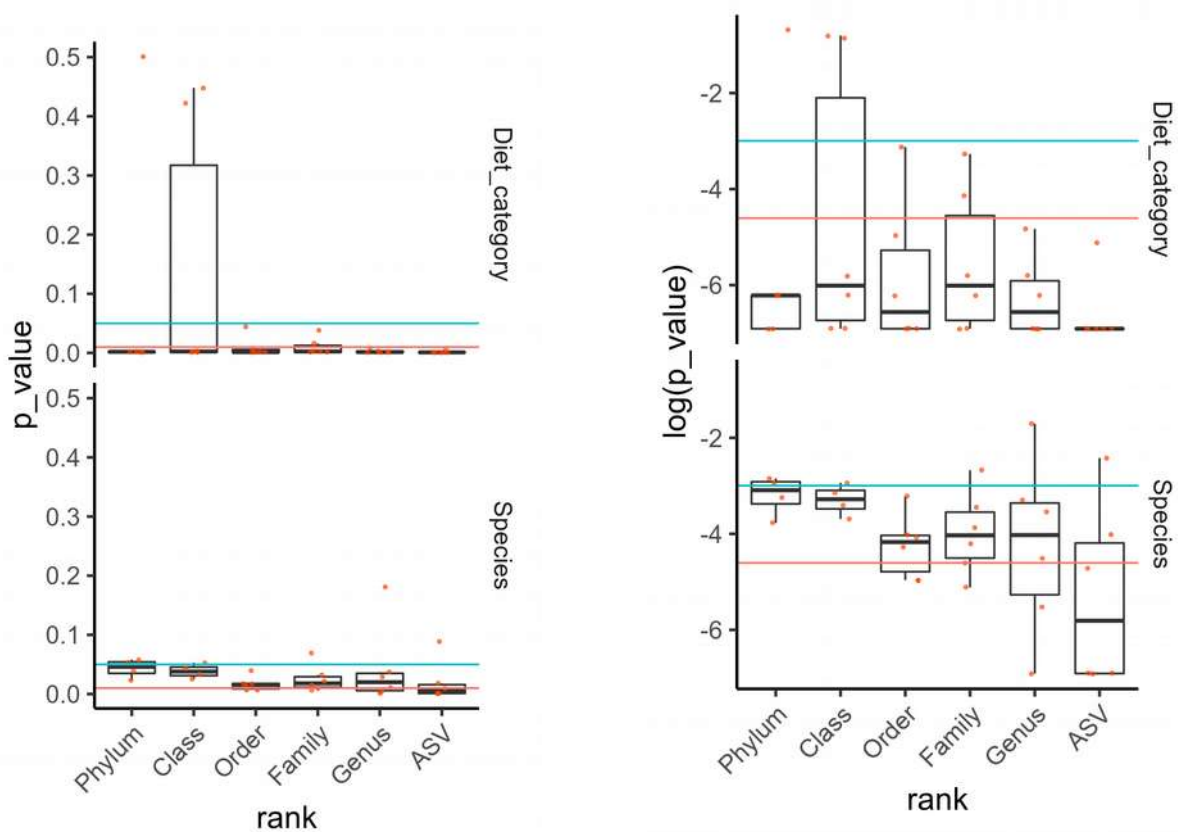


Figure S5: Gut traits explain the differences in phylogenetic structure of the microbiome better than host phylogeny

We tested for relationship between dissimilarity of the gut microbiome for specific bacterial taxa (Y axes) and host dissimilarity (X axis) using Mantel tests (for each subplot: r = correlation between X and Y variables and p-val. = p-value of the Mantel test). Gut microbiome dissimilarity, here estimated using abundance-weighted Hill numbers phylogenetic index with $q = 2$, was computed at six different levels of taxonomic resolution (row names on the right of the figure). Each point represents a pair of fish species. Pairs within the *Diplodus* genus are depicted in blue, pair within the *Pagellus* genus is depicted in pink, pair between *Sarpa salpa* and *Boops boops* is depicted in black and other pairs that included *S. salpa* and *B. boops* are depicted in green and orange, respectively.

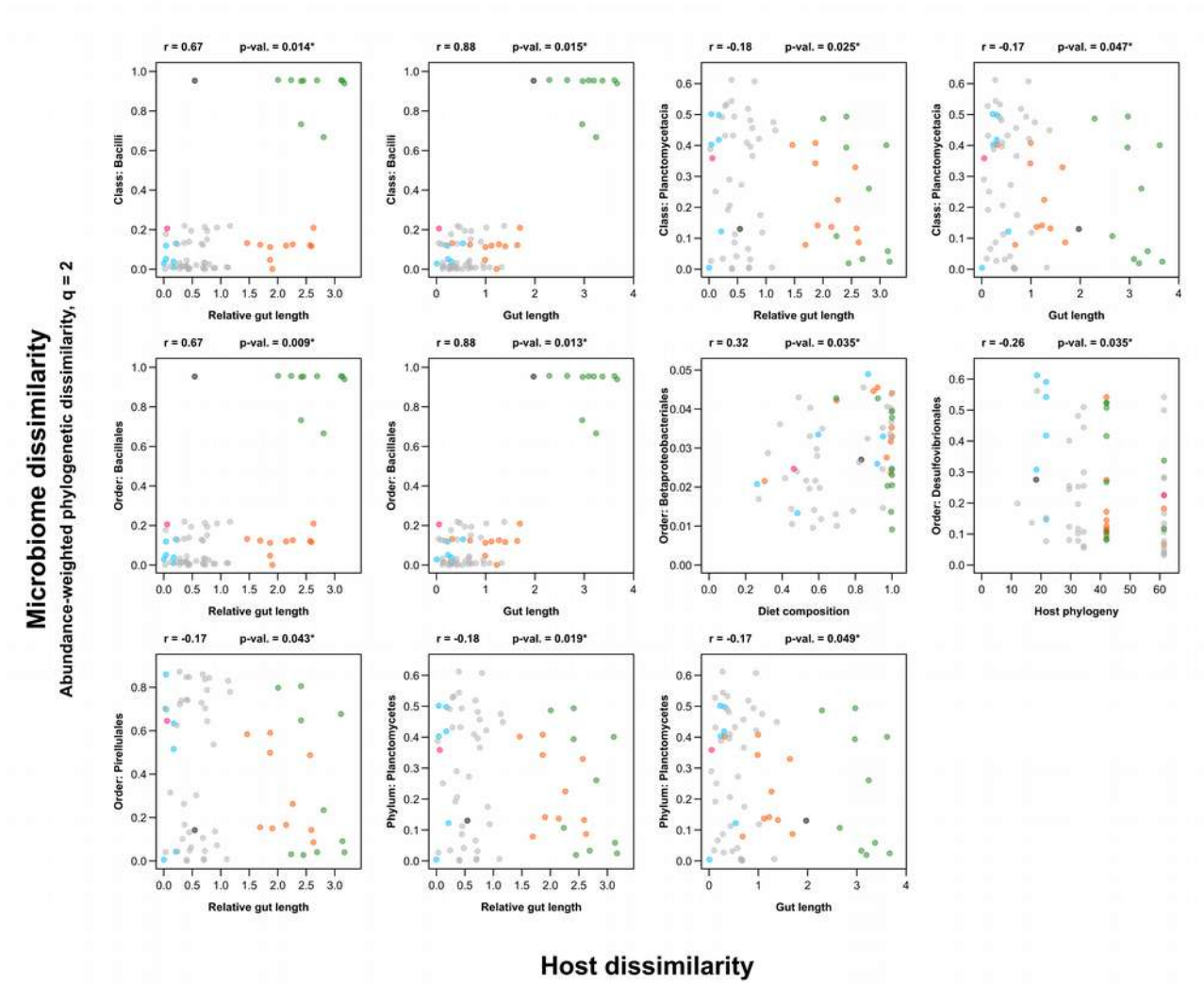


Table S4: Importance of morphological traits and diet items in differentiating Sparidae gut microbiome

This table summarizes the number of time each variable was determined as a significant contributor to the dissimilarity of the gut microbiome composition across the 36 CAP analysis models tested (*i.e.* 6 dissimilarity indices times 6 bacterial taxonomic ranks). Average F values were computed using only the models in which the variables were significant.

Explanatory variable	% significant tests	F values
Gut length	53	4.9 ± 2.3
Echinoderms	8	2.2 ± 0.1
Mollusks	8	1.8 ± 0.2
Relative gut length	8	1.8 ± 0.2

Figure S6: Association between microbiome, gut morphological traits and diet items in Sparidae

Ordinations showing the results of a Constrained Analysis on Principal coordinates (CAP). Fish individuals are represented by big dots colored according to the species (legend as in Figure 2 in main text), explaining variables are represented by italicized labels and arrows, bacterial taxa are represented by grey squares. Microbial data were agglomerated at the taxonomic level serving as title of each plot and dissimilarity between fish microbiome composition was estimated using Hill' numbers abundance-weighted taxonomic dissimilarity ($q = 1$). Only the traits that were identified as explaining a significant proportion of total microbiome variation are depicted (ANOVA.CCA, p -value < 0.05).

