

Figure S1. Time-calibrated phylogeny of carangoid fishes modified from Santini & Carnevale [27]. Scale at bottom of page in million years.

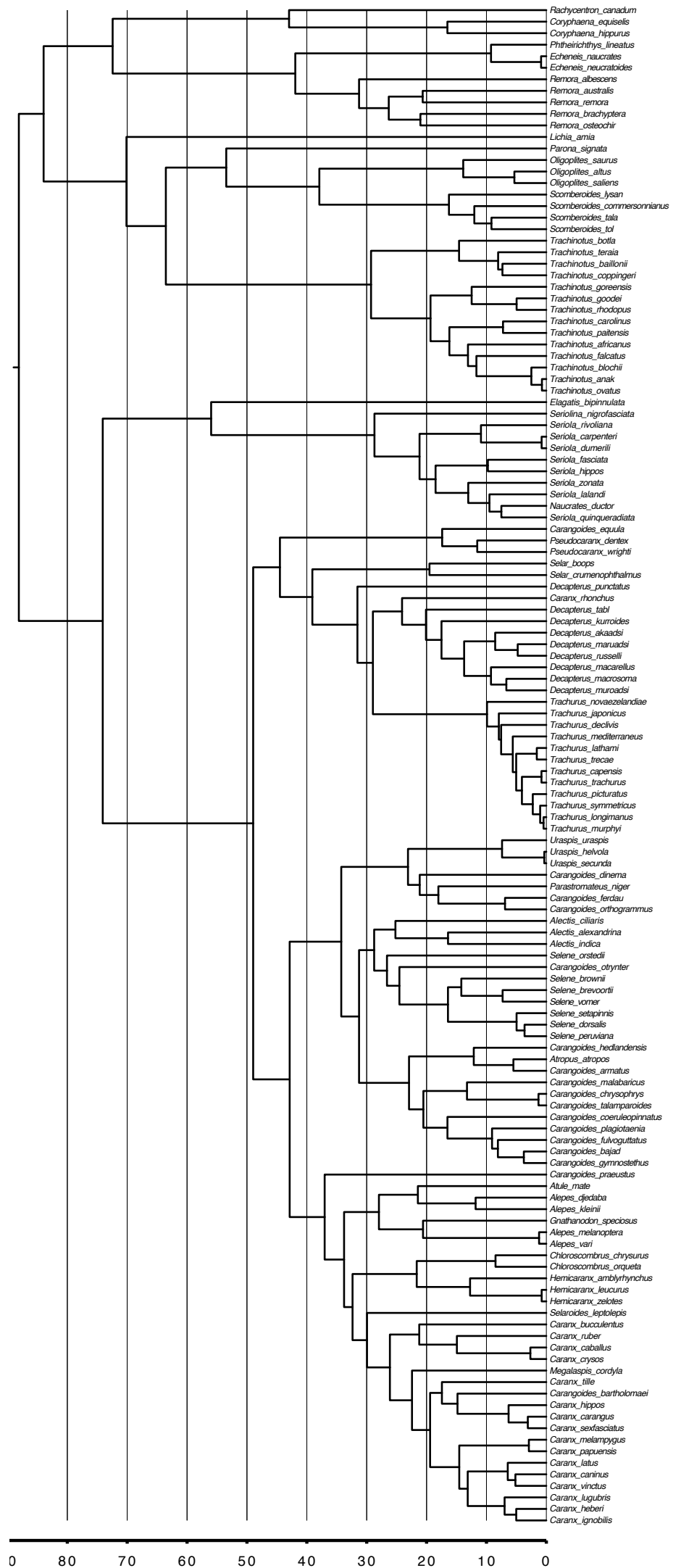


Figure S2. Morphospace of carangoids built on the first two PC axes (with percentage of the relative explained morphological variation between brackets), including all extant and fossil species. Colors are used to illustrate species from the four periods studied: Eocene, Oligocene, Miocene and Extant. Deformation grids illustrate shape variation along the first two PC axes from negative to positive scores (with percentage of the relative explained morphological variation between brackets).

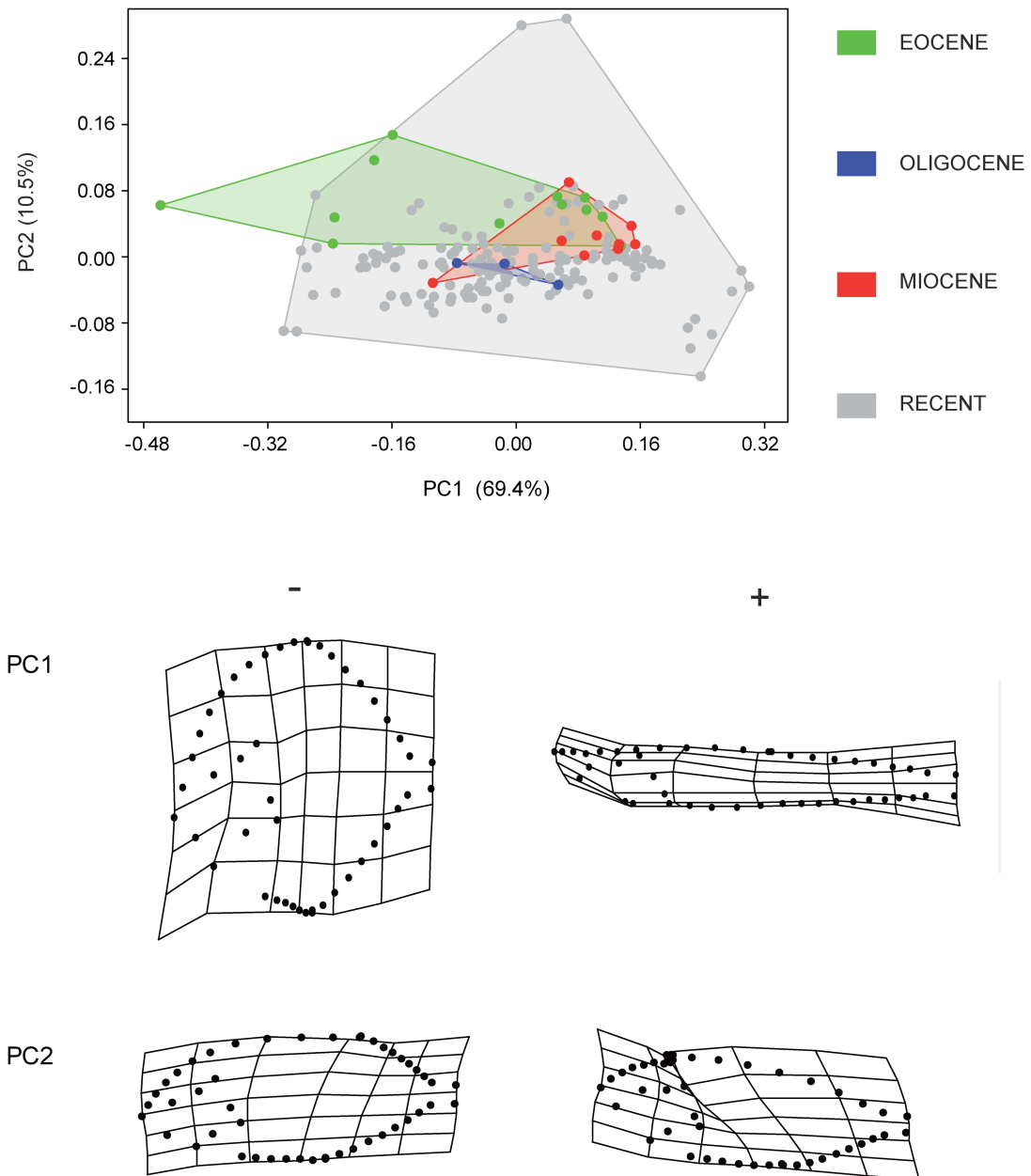


Table S1. Dataset list of studied species, with relative coding based on their habitat and diet. The specimen accession number and source are available from the authors upon request. Accession numbers of museum specimens (NHM London, California Academy of Sciences and LA County NHM) are available from authors upon request. Photographs of specimens were also obtained from online databases:

- Academia Sinica (<http://fishdb.sinica.edu.tw/eng/specimenquer.php>)
- Smithsonian ichthyological collection (<http://collections.nmnh.si.edu/search/fishes/>)
- Museum National d'Histoire Naturelle, Paris (<https://science.mnhn.fr/institution/mnhn/collection/ic/item/search/form>)
- “John E. Randall's Fish Photos” (<http://pbs.bishopmuseum.org/images/JER/>).

Status	Family	Species	N. of specimens	Maximum TL (cm)	Habitat	Piscivory	References
Extant	Carangidae	<i>Alectis alexandrina</i>	1	100	non-reef	yes	1, 2
		<i>Alectis ciliaris</i>	3	150	reef	yes	1, 3
		<i>Alectis indica</i>	3	165	reef	yes	1, 3
		<i>Alepes apercna</i>	1	30	non-reef	no	1, 4
		<i>Alepes djedaba</i>	3	40	reef	no	1, 5
		<i>Alepes kleinii</i>	3	19	reef	no	1, 6
		<i>Alepes melanoptera</i>	3	25	non-reef	no	1, 7
		<i>Alepes vari</i>	4	56	non-reef	yes	1, 3
		<i>Atropus atropus</i>	3	27	non-reef	yes	1, 8
		<i>Atule mate</i>	3	30	reef	no	1, 3
		<i>Campogramma glycos</i>	1	60	non-reef	yes	1, 9
		<i>Carangoides armatus</i>	3	58	reef	yes	1, 7
		<i>Carangoides bajad</i>	3	55	reef	yes	1, 7
		<i>Carangoides bartholomaei</i>	2	100	reef	yes	1, 10
		<i>Carangoides chrysophrys</i>	3	80	reef	yes	1, 3
		<i>Carangoides ciliaris</i>	1	61	non-reef	yes	1, 11
		<i>Carangoides coeruleopinnatus</i>	3	41	reef	yes	1, 3
		<i>Carangoides dinema</i>	3	85	reef	yes	1, 7
		<i>Carangoides equula</i>	3	56	reef	yes	1, 3
		<i>Carangoides ferdau</i>	3	70	reef	yes	1, 3
<i>Carangoides fulvoguttatus</i>	3	135	reef	yes	1, 3		

<i>Carangoides gymnostethus</i>	2	90	reef	yes	1, 3
<i>Carangoides hedlandensis</i>	3	32	reef	yes	1, 3
<i>Carangoides humerosus</i>	1	25	reef	yes	1, 12
<i>Carangoides malabaricus</i>	3	60	reef	yes	1, 13
<i>Carangoides oblongus</i>	2	46	reef	yes	1, 3
<i>Carangoides orthogrammus</i>	2	75	reef	no	1, 3
<i>Carangoides otrynter</i>	3	60	non-reef	yes	1, 14
<i>Carangoides plagiotaenia</i>	2	50	reef	yes	1, 3
<i>Carangoides praeustus</i>	1	25	non-reef	yes	1, 7
<i>Carangoides talamparoides</i>	3	51	reef	yes	1, 3
<i>Caranx bucculentus</i>	1	66	reef	yes	1, 13
<i>Caranx caballus</i>	3	62	non-reef	yes	1, 15
<i>Caranx caninus</i>	3	115	non-reef	yes	1, 15
<i>Caranx crysos</i>	2	70	reef	yes	1, 2
<i>Caranx fischeri</i>	1	53	non-reef	yes	1, 16
<i>Caranx heberi</i>	3	88	reef	yes	1, 17
<i>Caranx hippos</i>	3	124	reef	yes	1, 2
<i>Caranx ignobilis</i>	3	170	reef	yes	1, 3
<i>Caranx latus</i>	3	112	reef	yes	1, 18
<i>Caranx lugubris</i>	3	100	non-reef	yes	1, 3
<i>Caranx melampygius</i>	3	130	reef	yes	1, 3
<i>Caranx papuensis</i>	3	88	reef	yes	1, 3
<i>Caranx rhonchus</i>	2	60	non-reef	yes	1, 2
<i>Caranx ruber</i>	3	69	reef	yes	1, 19
<i>Caranx senegallus</i>	1	100	non-reef	yes	1, 20
<i>Caranx sexfasciatus</i>	3	100	non-reef	yes	1, 3
<i>Caranx tille</i>	2	80	reef	yes	1, 3
<i>Caranx vinctus</i>	3	37	non-reef	yes	1, 14
<i>Chloroscombrus chrysurus</i>	3	65	non-reef	yes	1, 2
<i>Chloroscombrus orqueta</i>	4	30	non-reef	no	1, 15
<i>Decapterus akaadsi</i>	1	35	non-reef	no	1, 8
<i>Decapterus koheru</i>	1	40	non-reef	no	1, 21

<i>Decapterus kurroides</i>	2	45	reef	no	1, 3
<i>Decapterus macarellus</i>	3	46	non-reef	no	1, 22
<i>Decapterus macrosoma</i>	3	35	reef	no	1, 3
<i>Decapterus maruadsi</i>	2	28	reef	no	1, 23
<i>Decapterus muroadsi</i>	2	55	non-reef	no	1, 24
<i>Decapterus punctatus</i>	3	35	reef	no	1, 2
<i>Decapterus russelli</i>	3	45	non-reef	no	1, 3
<i>Decapterus tabl</i>	3	50	reef	no	1, 3
<i>Elagatis bipinnulata</i>	3	180	reef	yes	1, 9
<i>Gnathanodon speciosus</i>	3	120	reef	yes	1, 22
<i>Hemicaranx amblyrhynchus</i>	4	50	non-reef	no	1, 18
<i>Hemicaranx bicolor</i>	1	70	non-reef	no	1, 2
<i>Hemicaranx leucurus</i>	3	30	non-reef	no	1, 22
<i>Hemicaranx zelotes</i>	2	35	non-reef	no	1, 22
<i>Lichia amia</i>	3	200	non-reef	yes	1, 9
<i>Megalaspis cordyla</i>	3	80	reef	yes	1, 3
<i>Naucrates ductor</i>	3	70	reef	yes	1, 2
<i>Oligoplites altus</i>	3	62	non-reef	no	1, 22
<i>Oligoplites palometa</i>	1	50	non-reef	yes	1, 10
<i>Oligoplites refulgens</i>	3	25	non-reef	yes	1, 22
<i>Oligoplites saliens</i>	3	50	non-reef	no	1, 10
<i>Oligoplites saurus</i>	3	35	reef	yes	1, 22
<i>Pantolabus radiatus</i>	1	40	reef	no	1, 12
<i>Parastromateus niger</i>	3	75	reef	no	1, 3
<i>Parona signata</i>	3	60	non-reef	no	1, 25
<i>Pseudocaranx cheilio</i>	1	122	reef	no	1, 26
<i>Pseudocaranx dentex</i>	3	122	reef	no	1, 3
<i>Pseudocaranx wrighti</i>	1	78	non-reef	no	1, 3
<i>Scomberoides commersonianus</i>	3	120	reef	yes	1, 3
<i>Scomberoides lysan</i>	3	110	reef	yes	1, 3
<i>Scomberoides tala</i>	2	70	reef	yes	1, 3
<i>Scomberoides tol</i>	3	60	reef	yes	1, 3

<i>Selar boops</i>	3	28	reef	no	1, 3
<i>Selar crumenophthalmus</i>	3	70	reef	no	1, 22
<i>Selaroides leptolepis</i>	3	22	reef	no	1, 3
<i>Selene brevoortii</i>	3	43	non-reef	yes	1, 22
<i>Selene brownii</i>	1	29	non-reef	yes	1, 27
<i>Selene dorsalis</i>	2	38	non-reef	yes	1, 9
<i>Selene orstedii</i>	3	33	non-reef	yes	1, 22
<i>Selene peruviana</i>	4	40	non-reef	yes	1, 15
<i>Selene setapinnis</i>	3	60	non-reef	yes	1, 10
<i>Selene vomer</i>	3	48	non-reef	yes	1, 18
<i>Seriola carpenteri</i>	2	73	non-reef	yes	1, 9
<i>Seriola dumerili</i>	3	190	reef	yes	1, 3
<i>Seriola fasciata</i>	3	68	non-reef	yes	1, 2
<i>Seriola hippos</i>	2	150	non-reef	yes	1, 3
<i>Seriola lalandi</i>	3	250	non-reef	yes	1, 3
<i>Seriola peruana</i>	1	40	non-reef	yes	1, 22
<i>Seriola quinqueradiata</i>	3	150	non-reef	yes	1, 25
<i>Seriola rivoliana</i>	3	180	non-reef	yes	1, 23
<i>Seriola zonata</i>	1	75	non-reef	yes	1, 18
<i>Seriolina nigrofasciata</i>	3	70	reef	yes	1, 3
<i>Trachinotus africanus</i>	2	92	reef	no	1, 7
<i>Trachinotus anak</i>	1	100	non-reef	no	1, 3
<i>Trachinotus baillonii</i>	3	60	reef	yes	1, 3
<i>Trachinotus blochii</i>	3	110	reef	no	1, 3
<i>Trachinotus botla</i>	3	75	reef	no	1, 3
<i>Trachinotus carolinus</i>	1	64	non-reef	yes	1, 18
<i>Trachinotus coppingeri</i>	1	30	non-reef	no	1, 3
<i>Trachinotus falcatus</i>	3	138	reef	yes	1, 18
<i>Trachinotus goodei</i>	1	50	reef	yes	1, 18
<i>Trachinotus goreensis</i>	1	100	non-reef	yes	1, 20
<i>Trachinotus kennedyi</i>	1	90	non-reef	yes	1, 22
<i>Trachinotus marginatus</i>	2	45	non-reef	yes	1, 25

	<i>Trachinotus maxillosus</i>	1	80	non-reef	yes	1, 2
	<i>Trachinotus mookalee</i>	3	90	non-reef	yes	1, 7
	<i>Trachinotus ovatus</i>	3	70	non-reef	yes	1, 9
	<i>Trachinotus paitensis</i>	3	51	non-reef	yes	1, 15
	<i>Trachinotus rhodopus</i>	3	61	reef	yes	1, 15
	<i>Trachinotus stilbe</i>	1	34	non-reef	yes	1, 22
	<i>Trachinotus teraia</i>	1	68	non-reef	yes	1, 28
	<i>Trachurus capensis</i>	2	67	non-reef	yes	1, 2
	<i>Trachurus declivis</i>	2	72	non-reef	yes	1, 3
	<i>Trachurus delagoa</i>	3	35	non-reef	no	1, 9
	<i>Trachurus indicus</i>	1	35	reef	no	1, 7
	<i>Trachurus japonicus</i>	3	50	non-reef	no	1, 8
	<i>Trachurus lathami</i>	1	40	reef	no	1, 18
	<i>Trachurus longimanus</i>	1	25	non-reef	no	1, 22
	<i>Trachurus mediterraneus</i>	3	67	non-reef	yes	1, 9
	<i>Trachurus murphyi</i>	2	70	non-reef	no	1, 22
	<i>Trachurus novaezelandiae</i>	1	55	non-reef	no	1, 3
	<i>Trachurus picturatus</i>	2	60	non-reef	no	1, 9
	<i>Trachurus symmetricus</i>	2	81	non-reef	no	1, 15
	<i>Trachurus trachurus</i>	2	70	non-reef	yes	1, 9
	<i>Trachurus trecae</i>	1	39	non-reef	no	1, 9
	<i>Ulua aurochs</i>	1	50	non-reef	no	1, 12
	<i>Ulua mentalis</i>	1	100	reef	yes	1, 3
	<i>Uraspis helvola</i>	2	58	non-reef	no	1, 7
	<i>Uraspis secunda</i>	2	50	non-reef	no	1, 2
	<i>Uraspis uraspis</i>	1	31	reef	no	1, 3
Coryphaenidae	<i>Coryphaena equiselis</i>	1	127	non-reef	yes	1, 29
	<i>Coryphaena hippurus</i>	3	210	non-reef	yes	1, 29
Echeneidae	<i>Echeneis naucrates</i>	2	110	reef	no	1, 3
	<i>Echeneis neucratoides</i>	1	75	reef	no	1, 18
	<i>Phtheichthys lineatus</i>	2	76	non-reef	no	1, 30
	<i>Remora albescens</i>	1	35	non-reef	no	1, 31

		<i>Remora australis</i>	1	76	non-reef	no	1, 3
		<i>Remora brachyptera</i>	1	50	non-reef	no	1, 3
		<i>Remora osteochir</i>	2	44	non-reef	no	1, 3
		<i>Remora remora</i>	1	70	reef	no	1, 32
	Rachycentridae	<i>Rachycentron canadum</i>	3	200	reef	yes	1, 33
Eocene	Carangidae	<i>Archaeus oblongus</i>	1	16	non-reef	?	34
		<i>Ceratoichthys pinnatiformis</i>	3	23	reef	?	35, 36
		<i>Eastmanalepes primaevus</i>	1	20	reef	?	35, 37
		<i>Lichia veronensis</i>	1	29	reef	?	35, 38
		<i>Paratrachinotus tenuiceps</i>	2	19	reef	?	35, 36
		<i>Quasioligoplites mirus</i>	1	13	non-reef	?	39
		<i>Seriola fragosa</i>	1	20	non-reef	?	40
		<i>Seriola natgeosoc</i>	1	51	non-reef	?	40
		<i>Seriola prisca</i>	3	80	reef	?	35, 36
		<i>Trachicaranx pleuronectiformis</i>	1	27	reef	?	35, 36
		<i>Trachicaranx tersus</i>	1	23	non-reef	?	34
		<i>Vomeropsis triurus</i>	3	12	reef	?	35, 36
Oligocene	Carangidae	<i>Caranx daniltschenkoi</i>	1	40	non-reef	?	38
		<i>Caranx glarisianus</i>	1	70	non-reef	?	41
		<i>Selar quassus</i>	1	14	non-reef	?	38
Miocene	Carangidae	<i>Alepes pin</i>	1	5	non-reef	?	42
		<i>Caranx quietus</i>	1	10	non-reef	?	38
		<i>Decapterus abbreviatus</i>	1	10	non-reef	?	43
		<i>Decapterus fusiformis</i>	1	7	non-reef	?	44
		<i>Decapterus praegracilis</i>	1	10	non-reef	?	44
		<i>Scomberoides spinosus</i>	1	12	non-reef	?	38
		<i>Selar fedotovi</i>	1	13	non-reef	?	38
		<i>Selar weileri</i>	1	12	non-reef	?	38
		<i>Seriola smithvanizi</i>	1	13	non-reef	?	44

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Table S2. Principal component analysis on shape variables: eigenvalue and values of the variance explained by the first ten PC axes.

Principal Component (PC)	Eigenvalue	% variance
1	0.018077	70.855
2	0.002789	10.932
3	0.002087	8.1817
4	0.000670	2.6265
5	0.000525	2.0566
6	0.000336	1.3181
7	0.000173	0.67675
8	0.000155	0.60564
9	0.000123	0.48363
10	0.000009	0.37006

Table S3. Model specific parameters for best-fitting models to each morphological trait. In cases where there were multiple best-fitting models ($\Delta AIC < 4$), parameters for all models are given.

			Brownian rate parameter (σ^2)			
			Reef	Non-Reef	Piscivory	Non-Piscivory
Body length	logTL	BMS_habitat	2.70E-03 \pm 5.00E-04	7.80E-03 \pm 6.00E-04		
Body shape	PC1	BMS_habitat	1.80E-04 \pm 4E-05	5.80E-03 \pm 3.94E-05		
	PC2	BMS_habitat	3.88E-05 \pm 8.30E-06	9.47E-05 \pm 7.51E-06		
		BMS_diet			3.88E-05 \pm 6.07E-06	1.00E-04 \pm 6.44E-06
	PC3	BMS_habitat	2.69E-05 \pm 6.93E-06	1.27E-04 \pm 8.73E-06		