

Biomass accumulation across trophic levels: analysis of landings for the Mediterranean Sea

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Supplement. The list of all taxa considered in the analysis and the complete results of the comparison between environmental variables and curve parameters are reported below.

Table S1. Taxa per basin and assigned trophic level (TL). Ae = Aegean Sea, AS = Adriatic Sea, Ba = Balearic Sea, BS = Black Sea, GoL = Gulf of Lion, IS = Ionian Sea, LS = Levant Sea, Sa = Sardinia

| Species | TL | AS | Ae | Ba | BS | GoL | IS | LS | Sa |
|----------------------------------|------|----|----|----|----|-----|----|----|----|
| <i>Acipenser gueldenstaedtii</i> | 3.11 | | | x | x | | | | |
| <i>Acipenser stellatus</i> | 3.10 | | | | x | | | | |
| <i>Acipenseridae</i> | 3.11 | | | | x | | | | |
| <i>Alopias superciliosus</i> | 4.50 | | | x | | | | | |
| <i>Alopias vulpinus</i> | 4.50 | | | x | | x | | | |
| <i>Alosa pontica</i> | 3.93 | | | | x | | | | |
| <i>Alosa</i> spp. | 3.93 | | x | x | x | x | x | x | x |
| <i>Ammodytes</i> spp. | 3.40 | | | x | | x | x | | x |
| <i>Anguilla anguilla</i> | 3.53 | x | x | x | | x | x | x | x |
| <i>Aphia minuta</i> | 3.10 | x | | | | | x | | x |
| <i>Argentina</i> spp. | 3.62 | | | x | | x | | | |
| <i>Argyrosomus regius</i> | 4.29 | | x | x | | | x | x | x |
| <i>Aristeidae</i> | 3.30 | x | | | | | x | | x |
| <i>Aristeus antennatus</i> | 3.30 | | | x | | x | x | | x |
| <i>Aspitrigla cuculus</i> | 3.85 | | | | | x | x | | |
| <i>Atherina boyeri</i> | 2.32 | | | | x | | | | |
| <i>Atherinidae</i> | 2.32 | x | x | x | x | x | x | x | x |
| <i>Balistes carolinensis</i> | 3.55 | | | x | | | x | x | x |
| <i>Belone belone</i> | 4.21 | x | x | x | x | x | x | x | x |
| <i>Beryx</i> spp. | 4.13 | | | | | x | | | |
| <i>Bivalvia</i> | 2.10 | x | | x | | x | | | |
| <i>Boops boops</i> | 2.97 | x | x | x | x | x | x | x | x |
| <i>Brachyura</i> | 2.15 | x | x | x | x | x | x | x | x |
| <i>Brama brama</i> | 4.08 | | | x | | x | | | |
| <i>Callista chione</i> | 2.39 | x | | | | | x | | |
| <i>Carangidae</i> | 3.50 | | | x | | | x | x | |
| <i>Caranx</i> spp. | 3.50 | | | | | | | x | |
| <i>Carcharhinus plumbeus</i> | 4.50 | | | x | | | | | |
| <i>Carcinus aestuarii</i> | 3.40 | | x | x | | x | x | | x |
| <i>Cardiidae</i> | 2.10 | | | | | | x | | x |
| <i>Centrophorus granulosus</i> | 4.13 | | | x | | | | | |
| <i>Centroscymnus coelolepis</i> | 4.35 | | | x | | | | | |

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|------------------------------------|-------|---|---|---|---|---|---|---|---|
| <i>Cepola macrophthalma</i> | 3.13 | x | | x | | x | | | |
| <i>Cerastoderma edule</i> | 2.10 | | | x | | | | | |
| <i>Cetorhinus maximus</i> | 3.20 | | | x | | | | | |
| <i>Chamelea gallina</i> | 2.10 | x | x | x | x | x | x | x | x |
| <i>Chelidonichthys lucerna</i> | 3.65 | x | | | | x | | | |
| <i>Clupeonella cultriventris</i> | 3.00 | | | | x | | | | |
| <i>Conger conger</i> | 4.29 | x | x | x | x | x | x | x | x |
| <i>Coryphaena hippurus</i> | 4.37 | | | x | | x | x | | x |
| <i>Crangon crangon</i> | 3.23 | x | x | x | x | x | x | | x |
| <i>Crassostrea gigas</i> | 2.10 | | | x | | x | | | |
| <i>Dactylopterus volitans</i> | 3.64 | | | x | | | | | |
| <i>Dasyatidae</i> | 4.00 | | | x | | | | | |
| <i>Dasyatis pastinaca</i> | 4.05 | | | | x | | | | |
| <i>Dentex dentex</i> | 4.50 | x | x | x | x | x | x | x | x |
| <i>Dentex macrophthalmus</i> | 3.43 | | x | x | | | x | x | |
| <i>Dicentrarchus labrax</i> | 3.80 | x | x | x | x | x | x | x | x |
| <i>Dicentrarchus punctatus</i> | 3.94 | | | x | | | | x | |
| <i>Dicentrarchus spp.</i> | 3.76 | x | x | x | x | | x | x | x |
| <i>Dicologlossa cuneata</i> | 3.32 | | | x | | | | | |
| <i>Diplodus sargus</i> | 3.04 | | x | x | | x | x | x | x |
| <i>Diplodus spp.</i> | 3.500 | x | x | x | x | x | x | x | x |
| <i>Donax spp.</i> | 2.10 | x | | x | | x | x | | x |
| <i>Eledone spp.</i> | 3.65 | x | x | | | | x | | x |
| <i>Engraulis encrasicolus</i> | 3.11 | x | x | x | x | x | x | x | x |
| <i>Epinephelus aeneus</i> | 4.02 | | | x | | | | | |
| <i>Epinephelus caninus</i> | 4.02 | | | x | | | | | |
| <i>Epinephelus marginatus</i> | 3.73 | x | x | x | | x | x | x | x |
| <i>Epinephelus spp.</i> | 3.73 | | x | x | | | x | x | x |
| <i>Etmopterus spinax</i> | 3.82 | | | x | | x | | | |
| <i>Etrumeus teres</i> | 3.49 | | | | | | | x | |
| <i>Eutrigla gurnardus</i> | 3.57 | | | | | x | | x | |
| <i>Gaidropsarus spp.</i> | 3.38 | | | | x | x | | | |
| <i>Galeorhinus galeus</i> | 4.21 | | | x | | | x | | x |
| <i>Galeus melastomus</i> | 4.23 | | | x | | | | | |
| <i>Gasterosteus aculeatus</i> | 3.51 | | | | x | | | | |
| <i>Gobiidae</i> | 3.20 | x | x | x | x | x | x | x | x |
| <i>Gobius niger</i> | 3.20 | x | | | | | | | |
| <i>Helicolenus dactylopterus</i> | 3.81 | | | x | | x | | | |
| <i>Homarus gammarus</i> | 3.26 | x | x | x | x | x | x | x | x |
| <i>Huso huso</i> | 4.06 | | | | x | | | | |
| <i>Illex coindetii</i> | 4.11 | x | | | | x | x | | x |
| <i>Isurus oxyrinchus</i> | 4.50 | | | x | | | | | |
| <i>Lamna nasus</i> | 4.50 | | | x | | | x | | |
| <i>Lepidopus caudatus</i> | 3.85 | x | | x | | x | x | | x |
| <i>Lepidorhombus whiffiagonis</i> | 4.24 | | | x | | x | x | | x |
| <i>Lichia amia</i> | 4.50 | x | x | x | x | x | x | x | x |
| <i>Lithognathus mormyrus</i> | 3.42 | x | | x | | x | x | x | x |
| <i>Littorina littorea</i> | 2.10 | | | x | | | x | | x |
| <i>Liza aurata</i> | 2.76 | | | | x | | | | |
| <i>Liza saliens</i> | 2.76 | | | | x | | | | |
| <i>Loliginidae, Ommastrephidae</i> | 4.50 | | x | x | | x | x | | |
| <i>Loligo spp.</i> | 4.10 | x | x | x | | x | x | x | x |
| <i>Lophius piscatorius</i> | 4.45 | x | x | x | | x | x | x | x |
| <i>Maja squinado</i> | 2.94 | x | | x | | x | | | x |
| <i>Merlangius merlangus</i> | 4.37 | x | x | x | x | x | x | x | x |
| <i>Merluccius merluccius</i> | 4.42 | x | x | x | x | x | x | x | x |
| <i>Metapenaeus monoceros</i> | 2.15 | | | | | | x | | x |
| <i>Microcosmus sulcatus</i> | 2.10 | | | | | x | | | |
| <i>Micromesistius poutassou</i> | 4.01 | x | x | x | x | x | x | x | x |

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|-------------------------------------|------|---|---|---|---|---|---|---|---|
| <i>Molva dypterygia</i> | 4.48 | | | | | x | x | | |
| <i>Mugil cephalus</i> | 2.76 | x | x | | x | | x | x | x |
| <i>Mugil soiuy</i> | 2.73 | | | | x | | | | |
| <i>Mugilidae</i> | 2.76 | x | x | x | x | x | x | x | x |
| <i>Mullus barbatus</i> | 3.15 | x | x | x | x | x | x | x | x |
| <i>Mullus spp.</i> | 3.15 | x | x | x | x | x | x | x | x |
| <i>Mullus surmuletus</i> | 3.42 | x | x | x | x | x | x | x | x |
| <i>Murex spp.</i> | 2.50 | | | x | | x | | | |
| <i>Mustelus mustelus</i> | 3.83 | | | x | | | x | | |
| <i>Mustelus spp.</i> | 3.83 | x | x | x | x | x | x | x | x |
| <i>Myliobatidae</i> | 3.61 | | | x | | | | | |
| <i>Mytilidae</i> | 2.10 | | x | | | | | | |
| <i>Mytilus galloprovincialis</i> | 2.10 | x | x | x | x | x | x | x | x |
| <i>Naucrates ductor</i> | 3.98 | | | | | | x | | x |
| <i>Nephrops norvegicus</i> | 3.15 | x | x | x | | x | x | | x |
| <i>Oblada melanura</i> | 3.03 | x | x | x | x | x | x | x | x |
| <i>Octopodidae</i> | 3.60 | x | x | x | | x | x | x | |
| <i>Octopus vulgaris</i> | 4.10 | x | x | | | x | x | x | x |
| <i>Ostrea edulis</i> | 2.10 | x | x | x | x | x | | x | x |
| <i>Pagellus acarne</i> | 3.48 | | | x | | x | x | x | x |
| <i>Pagellus bogaraveo</i> | 3.73 | | | x | | x | x | | x |
| <i>Pagellus erythrinus</i> | 3.40 | x | x | x | | x | x | x | x |
| <i>Pagellus spp.</i> | 3.50 | x | x | x | | x | x | x | x |
| <i>Pagrus pagrus</i> | 3.65 | | x | x | x | x | x | x | x |
| <i>Pagrus spp.</i> | 3.65 | | x | x | | | x | x | |
| <i>Palaemon serratus</i> | 2.69 | | | x | x | x | | | x |
| <i>Palinurus elephas</i> | 3.34 | x | x | x | | x | x | x | x |
| <i>Palinurus mauritanicus</i> | 3.54 | | | | | x | | | |
| <i>Palinurus spp.</i> | 3.40 | | x | x | | x | x | x | x |
| <i>Parapenaeus longirostris</i> | 3.30 | x | x | x | | x | x | x | x |
| <i>Pecten jacobaeus</i> | 2.10 | x | x | | x | x | | x | |
| <i>Pecten maximus</i> | 2.10 | | | | | x | | | |
| <i>Pectinidae</i> | 2.10 | x | | x | | x | | | |
| <i>Penaeus japonicus</i> | 2.80 | | | | | x | | x | |
| <i>Penaeus kerathurus</i> | 2.80 | x | x | x | | x | x | x | x |
| <i>Perca fluviatilis</i> | 4.35 | | | | x | | | | |
| <i>Phycis blennoides</i> | 3.73 | | x | x | x | x | x | x | x |
| <i>Phycis phycis</i> | 4.26 | x | | x | | | x | | x |
| <i>Platichthys flesus</i> | 3.19 | x | x | x | x | x | x | x | x |
| <i>Plectorhinchus mediterraneus</i> | 3.49 | | x | x | | | x | | |
| <i>Pleuronectes platessa</i> | 3.26 | | | | | x | | | |
| <i>Pleuronectiformes</i> | 3.26 | x | x | x | x | x | x | x | x |
| <i>Polyprion americanus</i> | 4.14 | | x | x | | x | x | | x |
| <i>Pomadasys incisus</i> | 3.80 | | | x | | | | | |
| <i>Pomatomus saltatrix</i> | 4.55 | | x | x | x | | x | x | x |
| <i>Portunus pelagicus</i> | 2.15 | | | | | | | x | |
| <i>Prionace glauca</i> | 4.24 | | | x | | x | x | | |
| <i>Psetta maxima</i> | 3.96 | x | x | x | x | x | x | x | |
| <i>Raja clavata</i> | 3.76 | | x | x | x | x | x | | |
| <i>Raja spp.</i> | 3.76 | | x | x | x | x | x | x | x |
| <i>Rajiformes</i> | 3.76 | x | x | x | x | x | x | x | x |
| <i>Reptantia</i> | 3.15 | | | x | x | x | | x | |
| <i>Ruditapes decussatus</i> | 2.10 | | x | x | | x | x | | x |
| <i>Ruvettus pretiosus</i> | 4.18 | | | x | | | | | |
| <i>Sardina pilchardus</i> | 3.05 | x | x | x | x | x | x | x | x |
| <i>Sardinella aurita</i> | 3.40 | x | | x | | x | x | x | x |
| <i>Sardinella spp.</i> | 3.40 | | x | x | | | x | x | x |
| <i>Sarpa salpa</i> | 2.14 | x | x | x | x | x | x | x | x |
| <i>Saurida undosquamis</i> | 4.48 | | | | | | | x | |

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|--------------------------------------|------|---|---|---|---|---|---|---|---|
| <i>Scaridae (Sparisoma cretense)</i> | 2.86 | | | | | | | | X |
| <i>Sciaena umbra</i> | 3.70 | | X | | X | | | X | X |
| <i>Sciaenidae</i> | 3.70 | X | | X | | | | X | X |
| <i>Sciaenops ocellatus</i> | 4.07 | | | | | | | | X |
| <i>Scomber japonicus</i> | 3.09 | X | X | X | X | X | X | X | X |
| <i>Scomber scombrus</i> | 3.65 | X | X | X | X | X | X | X | X |
| <i>Scomber spp.</i> | 3.37 | X | | X | | X | X | X | X |
| <i>Scomberesox saurus</i> | 3.64 | | | X | | | | | |
| <i>Scombridae</i> | 3.37 | | | X | | X | | X | |
| <i>Scophthalmidae</i> | 3.85 | X | | | | | | X | X |
| <i>Scophthalmus rhombus</i> | 3.76 | | | X | | X | | | |
| <i>Scorpaenidae</i> | 4.20 | X | X | X | X | X | X | X | X |
| <i>Scyliorhinus canicula</i> | 3.69 | | | | | X | | | X |
| <i>Scyliorhinus spp.</i> | 3.60 | | X | X | | X | X | | X |
| <i>Scyllaridae</i> | 3.30 | | | X | | | | | |
| <i>Sepia officinalis</i> | 3.60 | X | X | X | | X | X | X | X |
| <i>Sepiidae, Sepiolidae</i> | 3.56 | X | | X | | X | X | X | X |
| <i>Seriola dumerili</i> | 4.50 | X | X | X | | X | X | X | X |
| <i>Solea solea</i> | 3.13 | X | X | X | X | X | X | X | X |
| <i>Soleidae</i> | 3.13 | X | | | | X | X | | X |
| <i>Solen spp.</i> | 2.10 | | | X | | X | | | |
| <i>Solenidae</i> | 2.10 | X | | | | | X | | X |
| <i>Sparidae</i> | 3.26 | | X | X | X | X | X | X | X |
| <i>Sparus aurata</i> | 3.26 | X | X | X | X | X | X | X | X |
| <i>Sphyrna sphyraena</i> | 4.04 | X | | X | | | X | | X |
| <i>Sphyrna spp.</i> | 4.04 | | X | X | X | X | X | X | X |
| <i>Sphyrna zygaena</i> | 4.50 | | | | | | X | | |
| <i>Spicara maena</i> | 4.15 | | X | X | X | | X | X | X |
| <i>Spicara spp.</i> | 4.15 | X | X | X | X | X | X | X | X |
| <i>Spondyliosoma cantharus</i> | 3.29 | X | X | X | X | X | X | X | X |
| <i>Sprattus sprattus</i> | 3.00 | X | X | X | X | X | X | X | |
| <i>Squalus acanthias</i> | 4.30 | X | | X | X | X | X | | |
| <i>Squalus blainville</i> | 3.97 | | | X | | | X | | |
| <i>Squatina squatina</i> | 4.05 | | | | | | X | | X |
| <i>Squatinae</i> | 4.05 | | X | | X | | X | X | |
| <i>Todarodes sagittatus</i> | 4.01 | X | X | X | | X | X | | X |
| <i>Trachinotus spp.</i> | 4.32 | | | X | | | | | |
| <i>Trachinus draco</i> | 4.18 | X | | X | | X | X | | X |
| <i>Trachinus spp.</i> | 4.18 | | | X | | | | | |
| <i>Trachurus mediterraneus</i> | 3.60 | X | X | | X | | X | X | |
| <i>Trachurus spp.</i> | 3.59 | X | X | X | X | X | X | X | X |
| <i>Trachurus trachurus</i> | 3.64 | X | X | | X | X | X | X | |
| <i>Trichiurus lepturus</i> | 4.45 | | | X | | | | X | |
| <i>Trisopterus luscus</i> | 3.73 | | | X | | X | | | |
| <i>Trisopterus minutus</i> | 3.83 | X | | X | | X | X | | X |
| <i>Umbrina canariensis</i> | 3.37 | | | X | | | | | |
| <i>Umbrina cirrosa</i> | 3.46 | X | X | | X | | X | X | X |
| <i>Uranoscopus scaber</i> | 4.38 | X | | | | | X | | X |
| <i>Veneridae</i> | 2.10 | | | | | X | | | |
| <i>Venerupis pullastra</i> | 2.10 | | X | X | | | | | |
| <i>Xyrichtys novacula</i> | 3.14 | | | | | | X | | X |
| <i>Zeus faber</i> | 4.50 | X | X | X | X | X | X | X | X |

Table S2. Spearman's correlation coefficients for the set of tested explanatory variables. an = temperature anomaly, bat = mean depth, chla = chlorophyll *a*, latcen = central latitude, latmax = maximum latitude, latmin = minimum latitude, Lindex = L-index, med = median depth, moi1 = Mediterranean Oscillation Index 1, moi2 = Mediterranean Oscillation Index 2, nao = North Atlantic Oscillation, par = photosynthetically active radiation, Psust = probability of being sustainably fished, range = maximum depth, temp = temperature, WeMOi = Western Mediterranean Oscillation, *p < 0.05, **p < 0.01, ***p < 0.001

| | latmin | latcen | latmax | loncen | bat | med | range | area | temp | an | nao | WeMOi | moi1 | moi2 | chla | par | Lindex |
|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|---------|----------|
| latmin | | | | | | | | | | | | | | | | | |
| latcen | 0.96*** | | | | | | | | | | | | | | | | |
| latmax | 0.84*** | 0.94*** | | | | | | | | | | | | | | | |
| loncen | -0.17** | -0.25*** | -0.18** | | | | | | | | | | | | | | |
| bat | 0.48*** | 0.46*** | 0.48*** | 0.17** | | | | | | | | | | | | | |
| med | 0.16** | 0.18** | 0.28*** | 0.22*** | 0.91*** | | | | | | | | | | | | |
| range | -0.74*** | -0.65*** | -0.53*** | -0.06 | -0.76*** | -0.43*** | | | | | | | | | | | |
| area | -0.74*** | -0.59*** | -0.34*** | 0.20*** | -0.47*** | -0.26*** | 0.60*** | | | | | | | | | | |
| temp | -0.83*** | -0.86*** | -0.86*** | -0.01 | -0.22*** | 0.05 | 0.48*** | 0.31*** | | | | | | | | | |
| an | -0.01 | -0.01 | 0 | 0.02 | 0.03 | 0.04 | 0 | 0 | 0.21*** | | | | | | | | |
| nao | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.03 | 0.14* | | | | | | | |
| WeMOi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -0.03 | -0.15** | -0.1 | | | | | | |
| moi1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.20*** | 0.1 | 0.30*** | | | | | |
| moi2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.03 | 0.14* | 0.12* | 0.44*** | 0.87*** | | | | |
| chla | 0.67*** | 0.67*** | 0.68*** | 0.40*** | 0.28** | 0 | -0.57*** | -0.16 | -0.85*** | 0.04 | 0 | 0.06 | -0.01 | 0.02 | | | |
| par | -0.63*** | -0.67*** | -0.66*** | 0.08 | -0.32** | -0.12 | 0.47*** | 0.31** | 0.67*** | 0.31** | -0.29** | 0.19 | 0.46*** | 0.40*** | -0.53*** | | |
| Lindex | 0.60*** | 0.57*** | 0.51*** | -0.21*** | 0.70*** | 0.52*** | -0.71*** | -0.54*** | -0.35*** | 0 | 0.07 | -0.07 | -0.01 | 0.01 | 0.11 | -0.30** | |
| Psust | -0.62*** | -0.60*** | -0.54*** | 0.25*** | -0.68*** | -0.49*** | 0.69*** | 0.54*** | 0.38*** | -0.02 | -0.08 | 0.07 | 0.02 | 0 | -0.12 | 0.36*** | -0.98*** |

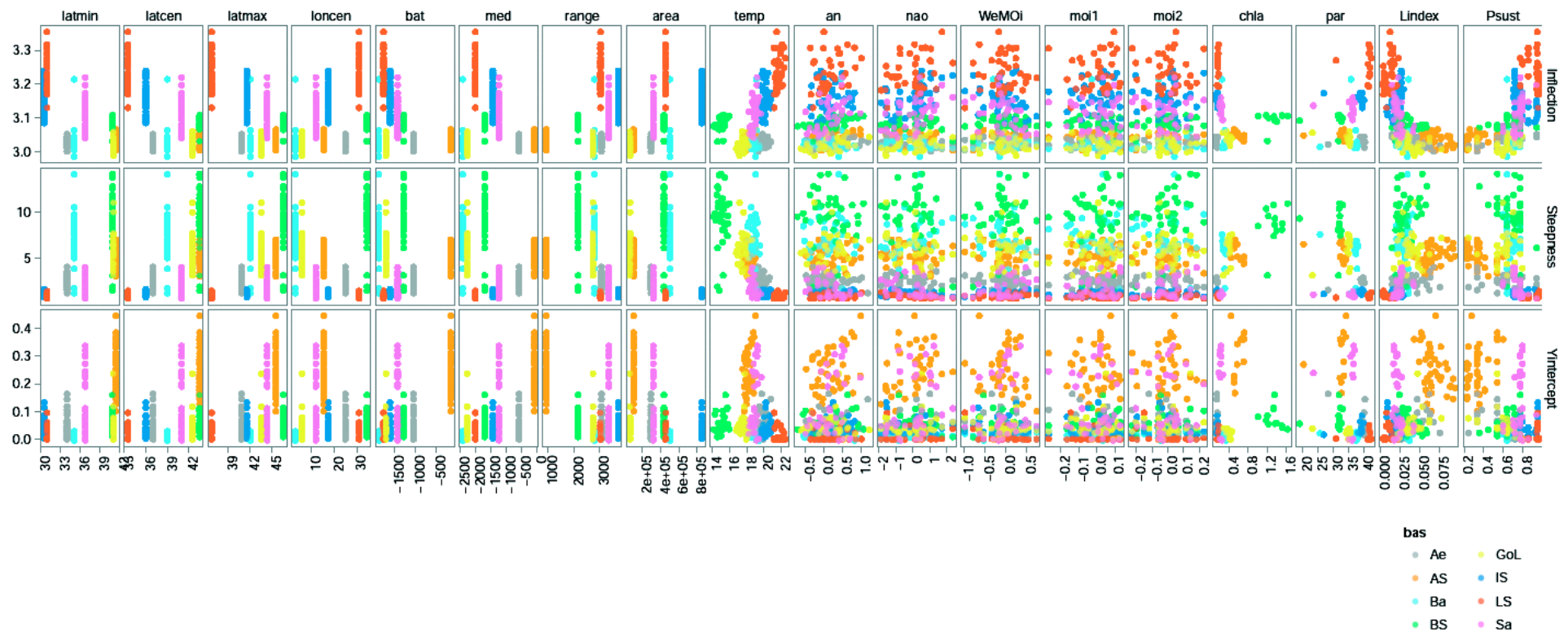


Fig. S1. Relationships between curve parameters and external drivers for all basins grouped together. See Tables S1 & S2 for definitions; bas = basin

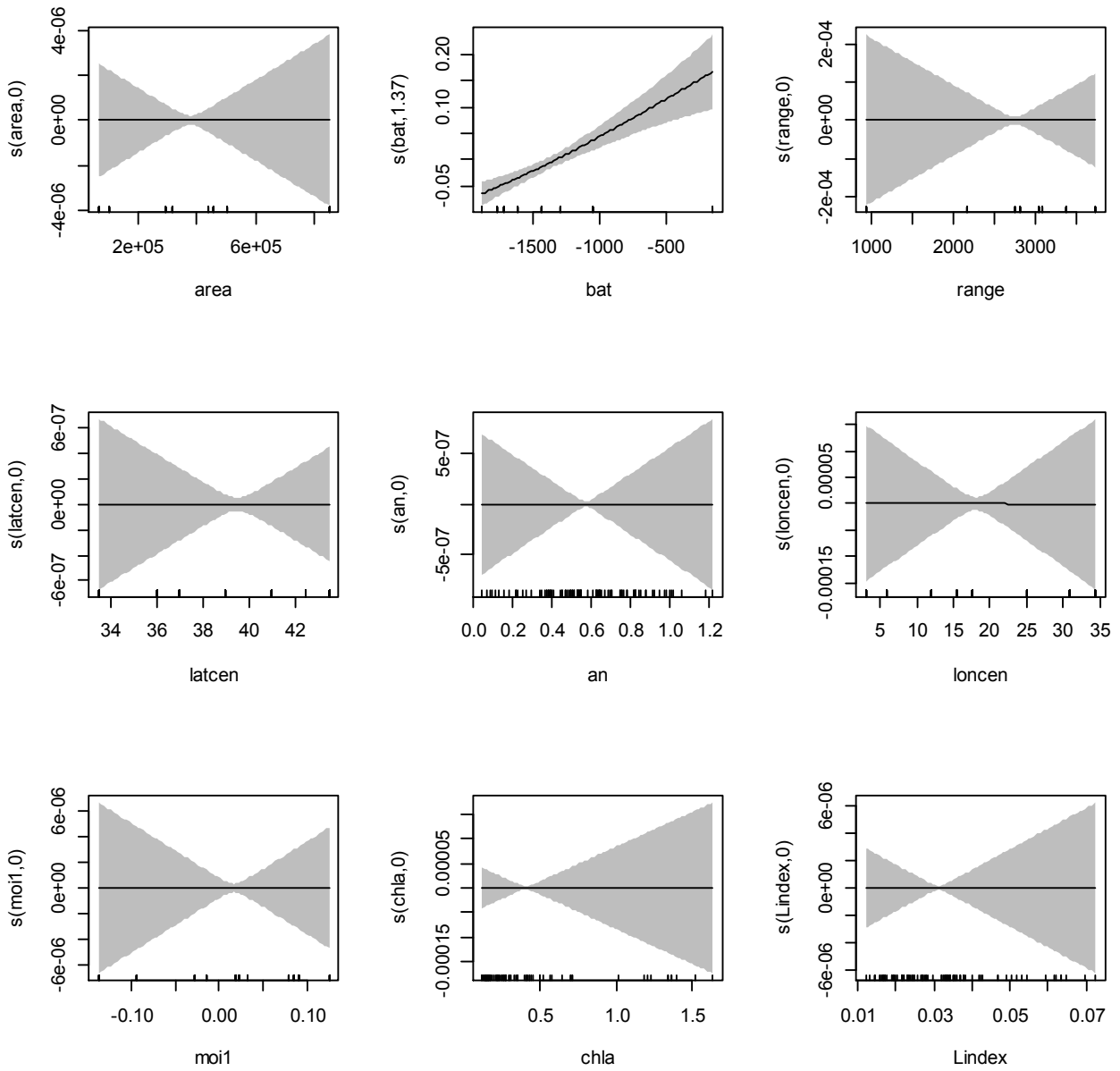


Fig. S2. Smoothers included in the fixed part of the generalized additive mixed models between the y -axis intercept and environmental variables (thin-plate smoothing spline) short time series (1997 to 2008). Shaded area represents 95% confidence intervals; y -axis label shows effective degrees of freedom. See Table S2 for definitions

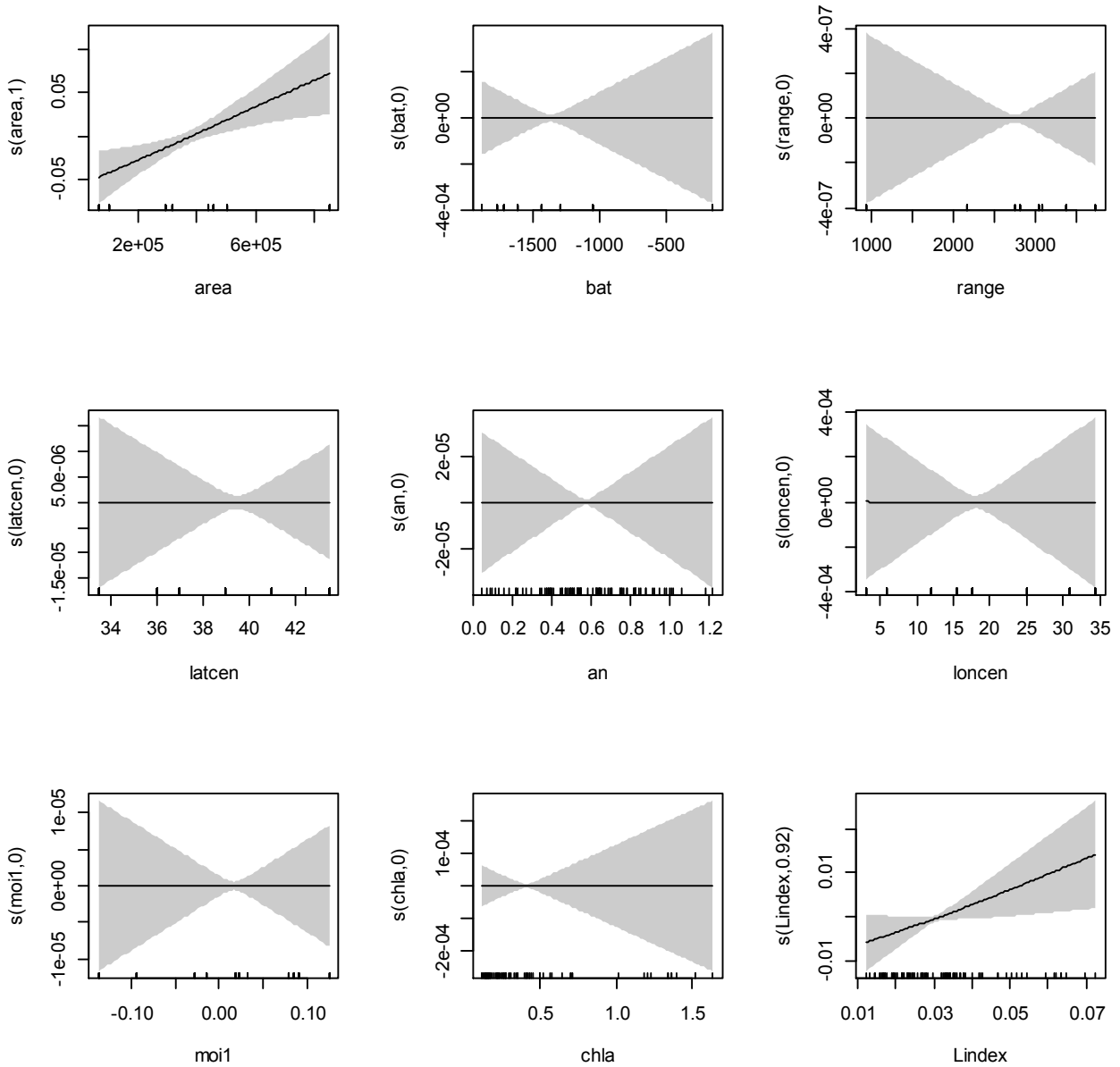


Fig. S3. Smoother included in the fixed part of the generalized additive mixed models between the inflection point (trophic level) and environmental variables (thin-plate smoothing spline) short time series (1997 to 2008). Shaded area represents 95% confidence intervals; y-axis label shows effective degrees of freedom. See Table S2 for definitions

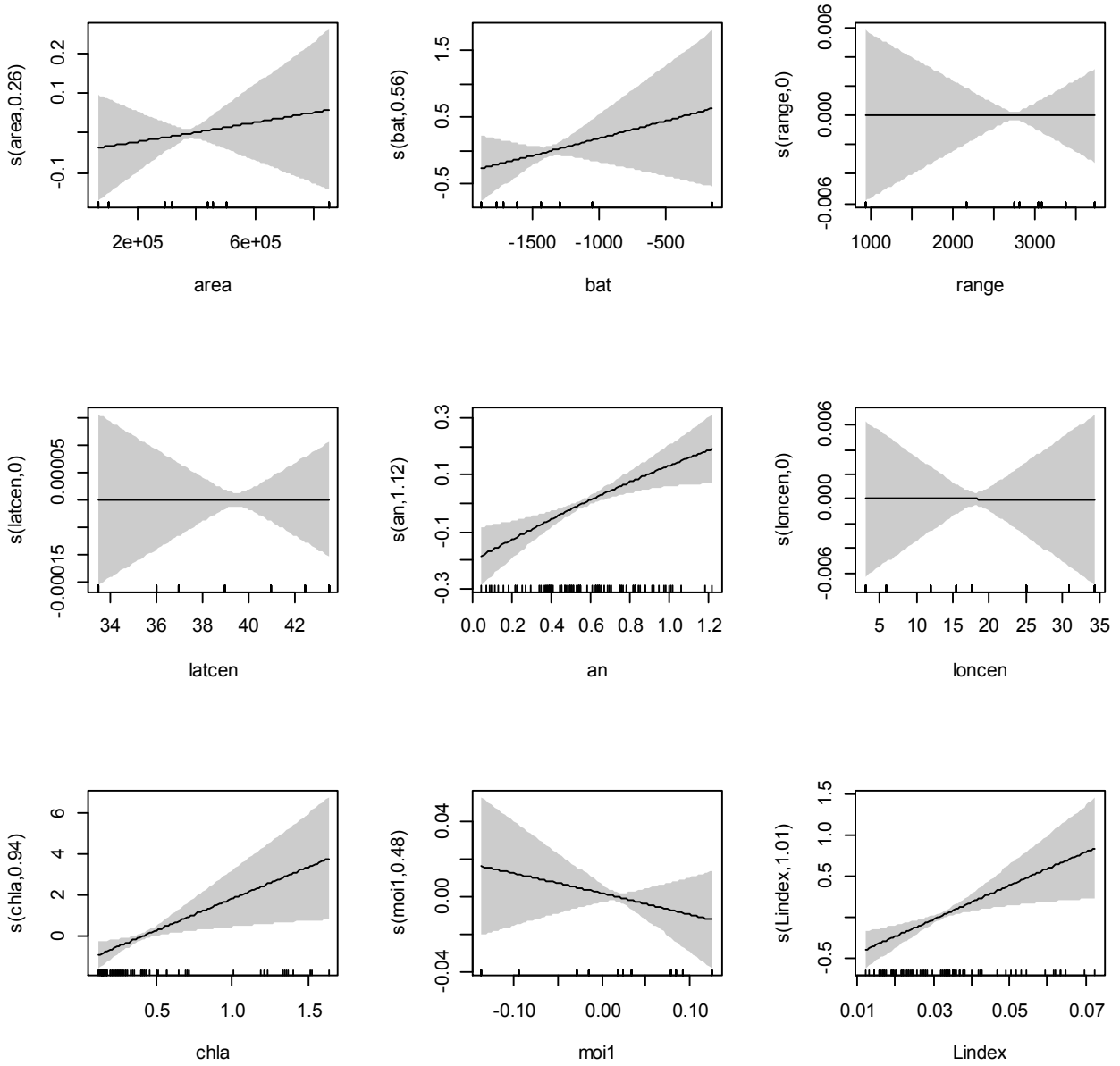


Fig. S4. Smoothers included in the fixed part of the generalized additive mixed models between steepness and environmental variables (thin-plate smoothing spline) short time series (1997 to 2008). Shaded area represents 95% confidence intervals; y-axis label shows effective degrees of freedom. See Table S2 for definitions