Section S1 – Detailed description of the functional groups included in the Bay of Biscay Atlantis model.

Table S1. Description of functional groups composition of the Bay of Biscay Atlantis model.

Code	Group	Species
SBD	Diving and pursuit divers seabirds	Razorbill (*Alca torda*, Linnaeus 1758), Cory's shearwater (*Calonectris diomedea*, Scopoli 1769), Atlantic puffin (*Fratercula arctica*, Linnaeus 1758), European storm-petrel (*Hydrobates pelagicus*, Linnaeus 1758), European shag (*Phalacrocorax aristotelis*, Linnaeus 1761), great cormorant (*Phalacrocorax carbo*, Linnaeus 1758), Manx shearwater (*Puffinus puffinus*, Brunnich 1764), Balearic shearwater (*Puffinus mauretanicus*, Lowe 1921), common murre (*Uria aalge*, Pontoppidan 1763)
SBS	Surface feeding seabirds	Norhern fulmar (*Fulmarus glacialis*, Linnaeus 1761), herring gull (*Larus argentatus*, Pontoppidan 1763), yellow-legged gull (*Larus cachinnans*, *Pallas 1811*), lesser black-backed gull (*Larus fuscus*, Linnaeus 1758), great black-backed gull (*Larus marinus*, Linnaeus 1758), yellow-legged gull (*Larus michahellis*, J.F. Naumann 1840), common black-headed gull (*Larus ridibundus*, Linnaeus 1766), northern gannet (*Morus bassanus*, Linnaeus 1758), black-legged kittiwake (*Rissa tridactyla*, Linnaeus 1758)
BWH	Baleen whales	Minke whale (*Balaenoptera acutorostrata*, Lacépède 1804), sei whale (*Balaenoptera borealis*, Lesson 1828), blue whale (*Balaenoptera musculus*, Linnaeus 1758), fin whale (*Balaenoptera physalus*, Linnaeus 1758), humpback whale (*Megaptera novaeangliae*, Borowski 1781), sperm whale (*Physeter macrocephalus*, Linnaeus 1758)
CET	Toothed cetaceans	Common dolphin (*Delphinus delphis*, Linnaeus 1758), short-finned pilot whale (*Globicephala macrorhynchus*, Gray 1846), long-finned pilot whale (*Globicephala melas*, Traill 1809), Risso's dolphin (*Grampus griseus*, Cuvier 1812), grey seal (*Halichoerus grypus*, Fabricius 1791), Atlantic white-sided dolphin (*Lagenorhynchus acutus*, Gray 1828), white-beaked dolphin (*Lagenorhynchus albirostris*, Gray 1846), pygmy sperm whale (*Kogia breviceps*, de Blainville 1838), Dwarf sperm whale (*Kogia sima*, Owen 1866), Gervais' beaked whale (*Mesoplodon europaeus*, Gervais 1855), True's beaked whale (*Mesoplodon mirus*, True 1913), killer whale (*Orcinus orca*, Linnaeus 1758), harbour seal (*Phoca vitulina*, Linnaeus 1758), harbour porpoise (*Phocoena phocoena*, Linnaeus 1758), false killer whale (*Pseudorca crassidens*, Owen 1846), striped dolphin (*Stenella coeruleoalba*, Meyen 1833), bottlenose dolphin (*Tursiops truncatus*, Montagu 1821), Cuvier's beaked whale (*Ziphius cavirostris*, Cuvier 1823)
SHB	Demersal sharks	Starry smooth-hound (*Mustelus asterias*, Cloquet 1821), smooth-hound (*Mustelus mustelus*, Linnaeus 1758), picked dogfish (*Squalus acanthias*, Linnaeus 1758), longnose spurdog (*Squalus blainville*, Risso 1827), small-spotted catshark (*Scyliorhinus canicula*, Linnaeus 1758), nursehound (*Scyliorhinus stellaris*, Linnaeus 1758)
SHP	Pelagic sharks	Thresher (*Alopias vulpinus*, Bonnaterre 1788), shortfin mako (*Isurus oxyrinchus*, Rafinesque 1810), porbeagle (*Lamna nasus*, Bonnaterre 1788), blue shark (*Prionace glauca*, Linnaeus 1758)
SHD	Deep water sharks	Leafscale gulper shark (*Centrophorus squamosus*, Bonnaterre 1788), Portuguese dogfish (*Centroscymnus coelolepis*, Bocage & Capello 1864), rabbit fish (*Chimaera monstrosa*, Linnaeus 1758), kitefin shark (*Dalatias licha*, Bonnaterre 1788), birdbeak dogfish (*Deania calcea*, Lowe 1839), arrowhead dogfish (*Deania profundorum*, Smith & Radcliffe 1912), velvet belly (*Etmopterus spinax*, Linnaeus 1758), tope shark (*Galeorhinus galeus*, Linnaeus 1758), Atlantic sawtail catshark (*Galeus atlanticus*, Vaillant 1888), blackmouth catshark (*Galeus melastomus*, Rafinesque 1810), bluntnose sixgill shark (*Hexanchus griseus*, Bonnaterre 1788), knifetooth dogfish (*Scymnodon ringens*, Bocage & Capello 1864)

Table S1 (continued)

Code	Group	Species
SSK	Skates and rays	Common stingray (*Dasyatis pastinaca*, Linnaeus 1758), blue skate (*Dipturus batis*, Linnaeus 1758), sandy ray (*Leucoraja circularis*, Couch 1838), shagreen ray (*Leucoraja fullonica*, Linnaeus 1758), cuckoo ray (*Leucoraja naevus*, Müller & Henle 1841), common eagle ray (*Myliobatis aquila*, Linnaeus 1758), thornback ray (*Raja clavata*, Linnaeus 1758), small-eyed ray (*Raja microocellata*, Montagu 1818), spotted ray (*Raja montagui*, Fowler 1910)
BFT	Bluefin tuna	Atlantic bluefin tuna (*Thunnus thynnus*, Linnaeus 1758)
ALB	Albacore	Albacore (*Thunnus alalunga*, Bonnaterre 1788)
OPE	Other large pelagic fishes	Garfish (*Belone belone*, Linnaeus 1761), Atlantis pomfret (*Brama brama*, Bonnaterre 1788), skipjack tuna (*Katsuwonus pelamis*, Linnaeus 1758), bluefish (*Pomatomus saltatrix*, Linnaeus 1766), Atlantic bonito (*Sarda sarda*, Bloch 1793), Atlantic saury (*Scomberesox saurus*, Walbaum 1792), bigeye tuna (*Thunnus obesus*, Lowe 1839)
MAC	Mackerel	Atlantic chub mackerel (*Scomber colias*, Gmelin 1789), Atlantic mackerel (*Scomber scombrus*, Linnaeus 1758)
HOM	Horse mackerel	Mediterranean horse mackerel (*Trachurus mediterraneus*, Steindachner 1868), Atlantic horse mackerel (*Trachurus trachurus*, Linnaeus 1758)
PIL	Sardine	European pilchard (=Sardine) (*Sardina pilchardus*, Walbaum 1792)
ANE	Anchovy	European anchovy (*Engraulis encrasicolus*, Linnaeus 1758)
OPL	Other planktivorous fishes	Allis shad (*Alosa alosa*, Linnaeus 1758), twaite shad (*Alosa fallax*, Lacépède 1803), argentine (*Argentina sphyraena*, Linnaeus 1758), bogue (*Boops boops*, Linnaeus 1758), boarfish (*Capros aper*, Linnaeus 1758), Atlantic herring (*Clupea harengus*, Linnaeus 1758), silvery pout (*Gadiculus argenteus*, Guichenot 1850), longspine snipefish (*Macroramphosus scolopax*, Linnaeus 1758), European smelt (*Osmerus eperlanus*, Linnaeus 1758), Atlantic saury (*Scomberesox saurus*, Walbaum 1792), European sprat (*Sprattus sprattus*, Linnaeus 1758)
FMP	Mesopelagic fishes	Baird's slickhead (*Alepocephalus bairdii*, Goode & Bean 1879), spotted barracudina (*Arctozenus risso*, Bonaparte 1840), half-naked hatchetfish (*Argyropelecus hemigymnus*, Cocco 1829), glacier lantern fish (*Benthosema glaciale*, Reinhardt 1837), Madeira lantern fish (*Ceratoscopelus maderensis*, Lowe 1839), shortnose greeneye (*Chlorophthalmus agassizi*, Bonaparte 1840), jewel lanternfish (*Lampanyctus crocodilus*, Risso 1810), silvery lightfish (*Maurolicus muelleri*, Gmelin 1789), spotted lanternfish (*Myctophum punctatum*, Rafinesque 1810)
ANF	Anglerfish	Blackbellied angler (*Lophius budegassa*, Spinola 1807), angler (=monk) (*Lophius piscatorius*, Linnaeus 1758)
BSS	Seabass	European seabass (*Dicentrarchus labrax*, Linnaeus 1758)
WHB	Blue whiting	Blue whiting (=Poutassou) (*Micromesistius poutassou*, Risso 1827)
HKE	Hake	European hake (*Merluccius merluccius*, Linnaeus 1758)
COD	Cods	Norway pout (*Trisopterus esmarkii*, Nilsson 1855), pouting (=bib) (*Trisopterus luscus*, Linnaeus 1758), poor cod (*Trisopterus minutus*, Linnaeus 1758)
MEG	Megrim	Four-spot megrim (L*epidorhombus boscii*, Risso 1810), megrim (*Lepidorhombus whiffiagonis*, Walbaum 1792)
SOL	Common sole	Common sole (*Solea solea*, Linnaeus 1758)
FFL	Flatfishes	Imperial scaldfish (*Arnoglossus imperialis*, Rafinesque 1810), Mediterranean scaldfish (*Arnoglossus laterna*, Walbaum 1792), Thor's scaldfish (*Arnoglossus thori*, Kyle 1913), deep water sole (*Bathysolea profundicola*, Vaillant 1888), solenette (*Buglossidium luteum*, Risso 1810), spotted flounder (C*itharus linguatula*, Linnaeus 1758), wedge sole (*Dicologlossa cuneata*, Moreau 1881), witch flounder (*Glyptocephalus cynoglossus*, Linnaeus 1758), common dab (*Limanda limanda*, Linnaeus 1758), thickback sole (*Microchirus variegatus*, Donovan 1808), lemon sole (*Microstomus kitt*, Walbaum 1792), sand sole (*Pegusa lascaris*, Ben-Tuvia 1990), European flounder (*Platichthys flesus*, Linnaeus 1758), European plaice (*Pleuronectes platessa*, Linnaeus 1758), turbot (*Scophthalmus maximus*, Linnaeus 1758), brill (*Scophthalmus rhombus*, Linnaeus 1758)
MUL	Mullets	Red mullet (*Mullus barbatus*, Linnaeus 1758), surmullet (*Mullus surmuletus*, Linnaeus 1758)

Table S1 (continued)

Code	Group	Species
FDL	Large demersal fishes	Meagre (*Argyrosomus regius*, Asso 1801), European conger (*Conger conger*, Linnaeus 1758), Atlantic cod (*Gadus morhua*, Linnaeus 1758), haddock (*Melanogrammus aeglefinus*, Linnaeus 1758), blue ling (*Molva dypterygia*, Pennant 1784), Spanish ling (*Molva macrophthalma*, Rafinesque 1810), ling (*Molva molva*, Linnaeus 1758), forkbeard (*Phycis phycis*, Linnaeus 1766), pollack (*Pollachius pollachius*, Linnaeus 1758), saithe (=pollock) (*Pollachius virens*, Linnaeus 1758), John dory (*Zeus faber*, Linnaeus 1758)
FDM	Medium demersal fishes	Tub gurnard (*Chelidonichthys lucerna*, Linnaeus 1758), blackbelly rosefish (*Helicolenus dactylopterus*, Delaroche 1809), sand steenbras (*Lithognathus mormyrus*, Linnaeus 1758), whiting (*Merlangius merlangus*, Linnaeus 1758), blackspot seabream (*Pagellus bogaraveo*, Brünnich 1768), red porgy (*Pagrus pagrus*, Linnaeus 1758), greater forkbeard (*Phycis blennoides*, Brünnich 1768), red scorpionfish (*Scorpaena scrofa*, Linnaeus 1758), gilthead seabream (*Sparus aurata*, Linnaeus 1758)
FDS	Small demersal fishes	Scale-rayed wrasse (*Acantholabrus palloni*, Valenciennes 1839), small sandeel (*Ammodytes tobianus*, Linnaeus 1758), transparent goby (*Aphia minuta*, Risso 1810), butterfly blenny (*Blennius ocellaris*, Linnaeus 1758), dragonet (*Callionymus lyra*, Linnaeus 1758), spotted dragonet (*Callionymus maculatus*, Rafinesque 1810), reticulated dragonet (*Callionymus reticulatus*, Valenciennes 1837), red gurnard (*Chelidonichthys cuculus*, Linnaeus 1758), streaked gurnard (*Chelidonichthys lastoviza*, Bonnaterre 1788), longfin gurnard (*Chelidonichthys obscurus*, Bloch & Schneider 1801), thicklip grey mullet (*Chelon labrosus*, Risso 1827), goldsinny-wrasse (*Ctenolabrus rupestris*, Linnaeus 1758), four-spotted goby (*Deltentosteus quadrimaculatus*, Valenciennes 1837), white seabream (*Diplodus sargus*, Valenciennes 1830), common two-banded seabream (*Diplodus vulgaris*, Geoffroy St. Hilaire 1817), grey gurnard (*Eutrigla gurnardus*, Linnaeus 1758), bigeye rockling (*Gaidropsarus macrophthalmus*, Günther 1867), three-bearded rockling (*Gaidropsarus vulgaris*, Cloquet 1824), gobies nei (*Gobiidae*), cuckoo wrasse (*Labrus mixtus*, Linnaeus 1758), spiny gurnard (*Lepidotrigla dieuzeidei*, Blanc & Hureau 1973), Fries's goby (*Lesueurigobius friesii*, Malm 1874), thinlip grey mullet (*Liza ramada*, Risso 1810), softhead grenadier (*Malacocephalus laevis*, Lowe 1843), common Atlantic grenadier (*Nezumia aequalis*, Günther 1878), snake blenny (*Ophidion barbatum*, Linnaeus 1758), axillary seabream (*Pagellus acarne*, Risso 1827), common pandora (*Pagellus erythrinus*, Linnaeus 1758), sand goby (*Pomatoschistus minutus*, Pallas 1770), painted goby (*Pomatoschistus pictus*, Malm 1865), cadenat's rockfish (*Scorpaena loppei*, Cadenat 1943), comber (*Serranus cabrilla*, Linnaeus 1758), black seabream (*Spondyliosoma cantharus*, Linnaeus 1758), greater weever (*Trachinus draco*, Linnaeus 1758), piper gurnard (*Trigla lyra*, Linnaeus 1758)
FSD	Deep sea fishes	Alfonsino (*Beryx decadactylus*, Cuvier 1829), red bandfish (*Cepola macrophthalma*, Linnaeus 1758), hollowsnout grenadier (*Coelorinchus caelorhincus*, Risso 1810), Mediterranean slimehead (*Hoplostethus mediterraneus*, Cuvier 1829), Mediterranean codling (*Lepidion lepidion*, Risso 1810), common mora (*Mora moro*, Risso 1810), *Notacanthus bonaparte*, Kaup's arrowtooth eel (*Synaphobranchus kaupii*, Johnson 1862), roughsnout grenadier (*Trachyrincus scabrus*, Rafinesque 1810)
CBE	Benthic cephalopods	Globose octopus (*Bathypolypus sponsalis*, Fischer and Fischer 1892), horned octopus (*Eledone cirrhosa*, Lamarck 1798), spider octopus (*Octopus salutii*, Verany 1837), common octopus (*Octopus vulgaris*, Cuvier 1797), lentil Bay of Biscaytail squid (*Rondeletiola minor*, Naef 1912), elegant cuttlefish (*Sepia elegans*, Blainville 1827), common cuttlefish (*Sepia officinalis*, Linnaeus 1758), pink cuttlefish (*Sepia orbignyana*, Férussac 1826), common Bay of Biscaytail squid (*Sepietta oweniana*, d'Orbigny 1839)

Table S1 (continued)

Code	Group	Species
CBP	Squids	Midsize squid (*Alloteuthis media*, Linnaeus 1758), European common squid (*Alloteuthis subulata*, Lamarck 1798), broadtail shortfin squid (*Illex coindetii*, Verany 1839), Northern shortfin squid (*Illex illecebrosus*, Lesueur 1821), veined squid (*Loligo forbesi*, Steenstrup 1856), European squid (*Loligo vulgaris*, Lamarck 1798), European flying squid (*Todarodes sagittatus*, Lamarck 1798), lesser flying squid (*Todaropsis eblanae*, Ball 1841)
NEP	Norway lobster	Norway lobster (*Nephrops norvegicus*, Linnaeus 1758)
CRP	Pelagic crab	Henslow’s swimming crab (*Polybius henslowii*, *Leach 1820*)
SHR	Zooplankton feeding shrimps	*Acanthephyra pelagica* (Risso 1816), *Acanthephyra purpurea* (A. Milne-Edwards 1881), green shrimp (*Chlorotocus crassicornis*, Costa 1871), *Eusergestes arcticus* (Kroyer 1855), *Gnathophausia zoea* (Willemoes-Suhm 1873), pink glass shrimp (*Pasiphaea multidentata*, Esmark 1866), white glass shrimp (*Pasiphaea sivado*, Risso 1816), lesser striped shrimp (*Plesionika acanthonotus*, S.I. Smith 1882), arrow shrimp (*Plesionika heterocarpus*, Costa 1871), golden shrimp (*Plesionika martia*, A. Milne Edwards 1883), *Sergia robusta* (Smith 1882)
DFB	Benthos-feeders decapods	Red snapping shrimp (*Alpheus glaber*, Olivi 1792), blue and red shrimp (*Aristeus antennatus*, Risso 1816), circular crab (*Atelecyclus rotundatus*, Olivi 1792), *Bathynectes* maravigna (Prestandrea 1839), edible crab (*Cancer pagurus*, Linnaeus 1758), common shrimp (*Crangon crangon*, Linnaeus 1758), whip shrimp (*Dichelopandalus bonnieri*, Caullery 1896), *Galathea dispersa* (Bate 1859), *Geryon trispinosus* (Herbst 1803), European lobster (*Homarus gammarus*, Linnaeus 1758), scorpion spider crab (*Inachus dorsettensis*, Pennant 1777), blue-leg swimcrab (*Liocarcinus depurator*, Linnaeus 1758), knobby swimcrab (*Macropipus tuberculatus*, Roux 1830), *Macropodia longipes* (Milne-Edwards & Bouvier 1899), spinous spider crab (*Maja squinado*, Herbst 1788), common prawn (*Palaemon serratus*, Pennant 1777), pink spiny lobster (*Palinurus mauritanicus*, Gruvel 1911), *Pandalina brevirostris* (Rathke 1843), deep-water rose shrimp (*Parapenaeus longirostris*, Lucas 1846), megalops shrimp (*Penaeopsis serrata*, Bate 1888), caramote prawn (*Penaeus kerathurus*, Forsskål 1775), *Philocheras echinulatus* (M. Sars 1861), *Polycheles typhlops* (Heller 1862), Norwegian shrimp (*Pontophilus norvegicus*, M. Sars 1861), spiny shrimp (*Pontophilus spinosus*, Leach 1815), processa shrimp (*Processa canaliculata*, Leach 1815), *Rissoides desmaresti* (Risso 1816), Atlantic mud shrimp (*Solenocera membranacea*, Risso 1816)
DFD	Detritus-feeders decapods	*Anapagurus laevis* (Bell 1845), angular crab (*Goneplax rhomboides*, Linnaeus 1758), *Munida intermedia* (Milne-Edwards & Bouvier 1899), *Munida iris* (Milne-Edwards 1880), *Munida sarsi* (Huus 1935), *Munida tenuimana* (Sars 1871), American smooth flounder (*Pagurus alatus*, Fabricius 1775), common hermit crab (*Pagurus bernhardus*, Linnaeus 1758), *Pagurus excavatus* (Herbst 1791), Prideaux's hermit crab (*Pagurus prideaux*, Leach 1815), delta prawn (*Palaemon longirostris*, H. Milne Edwards 1837), whiteleg shrimp (*Penaeus vannamei*, Boone 1931)
BIV	Bivalves	
POL	Polychaetes	
SB	Suprabenthos	Mysids, isopods, amphipods, cumaceans and copepods
ECH	Echinoderms	
INV	Other invertebrates	Gastropods, cnidarians and sponges
ZG	Gelatinous zooplankton	Cubozoa, hydrozoa, scyphozoa and tunicata
ZL	Macrozooplankton (> 2000 µm)	
ZM	Mesozooplankton (200-2000 µm)	
ZS	Microzooplankton (< 200 µm)	
PP	Benthic primary producers	Benthic macrophytes and microphytobenthos
PL	Large phytoplankton (> 20 µm)	
PS	Small phytoplankton (< 20µm)	

Table S1 (continued)

Code	Group	Species
PB	Pelagic bacteria	
BB	Sediment bacteria	
DL	Labile detritus	
DR	Refractory detritus	
DC	Carrion	

Carrion

The model was initialized with a biomass of 0.91 t km^{-2} (Corrales et al., 2022).

We assumed that bacteria groups are distributed throughout the whole water column of the model. The vertical and horizontal distribution was based on the proportion of each cell from the total area. Detailed vertical and horizontal distribution can be found in Section S3, Table S6 and Fig. S1, respectively.

Detritus

Labile and refractory detritus have equal initialization estimates. Each of the detritus group was initialized with a biomass of 86.81 t km^{-2} (Corrales et al., 2022).

We assumed that bacteria groups are distributed throughout the whole water column of the model. The vertical and horizontal distribution was based on the proportion of each cell from the total area. Detailed vertical and horizontal distribution can be found in Section S3, Table S6 and Fig. S1, respectively.

Bacteria

Pelagic and benthic bacteria have equal initialization estimates. As a rough estimate for the biomass of each of the bacteria group, a value of $5.50 \cdot 10^{+5}$ cells ml^{-1} from ICES (2012) and the conversion factor from Fukuda et al. (1998) was used to get the initial $6.6 \cdot 10^{-5}$ mg ml^{-1}.

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

We assumed that bacteria groups are distributed throughout the whole water column of the model. The vertical and horizontal distribution was based on the proportion of each cell from the total area. Detailed vertical and horizontal distribution can be found in Section S3, Table S6 and Fig. S1, respectively.

Phytoplankton

The size categories for large and small phytoplankton comes from Marquis et al. (2007): > 20 µm and < 20µm, respectively.

Estimates of phytoplankton biomass were collected from E.U. Copernicus Marine Service Information for the Iberia-Biscay-Ireland (IBI) area (Aznar et al., 2016). These estimates were based on satellite Chl-a data and conversion factors from Jorgensen et al. (1991) and Dalsgaard et al. (1997) were used to convert to t km^{-2}. Large phytoplankton was initialized with a biomass of 4.22 t km^{-2} and small phytoplankton with a biomass of 7.42 t km^{-2}.

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The phytoplankton is most common in the upper 45 m (Liria et al., 2016), but a maximum depth of 100 m was set (pers. comm. Xavier Corrales). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized weighing each of the boxes from the total area of the Bay of Biscay. Detailed horizontal distribution can be found in Section S3, Fig. S1.

Benthic primary producers

The benthic primary producers group includes benthic macrophytes and microphytobenthos. The model was initialized with a biomass of 0.49 t km^{-2} (Guénette and Gascuel, 2009).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Benthic primary producers are mostly common in the first 0-50 m (pers. comm. Xavier Corrales). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized weighing each of the boxes from the total area of the Bay of Biscay. Detailed horizontal distribution can be found in Section S3, Fig. S1.

General zooplankton

The size categories for macrozooplankton, mesozooplankton and microzooplankton are the standard sizes used in the literature: > 2000 µm, 200-2000 µm and < 200 µm, respectively (Poulet et al., 1996).

The zooplankton can be found from the surface up to 2000 m (Albaina and Irigoien, 2007). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized weighing each of the boxes from the total area of the Bay of Biscay. Detailed horizontal distribution can be found in Section S3, Fig. S1.

Microzooplankton

The model was initialized with a biomass of 5.5 t km^{-2} (Corrales et al., 2022).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Their diet consists mainly of the two phytoplankton groups and detritus (Calbet, 2008; Sherr and Sherr, 2007). Detailed diet matrix can be found in Section S4, Table S7.

Mesozooplankton

The model was initialized with a biomass of 7.7 t km^{-2} (Corrales et al., 2022).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The mesozooplankton feeds mainly in microzooplankton, large phytoplankton and small phytoplankton (Calbet, 2001; Calbet et al., 2002; Calbet and Saiz, 2005). Detailed diet matrix can be found in Section S4, Table S7.

Macrozooplankton

The model was initialized with a biomass of 5.1 t km^{-2} (Corrales et al., 2022) .

The growth rate (mgN per day) for this group was assumed to be this set in the SE-Australian Atlantis model (Fulton et al., 2004).

The mortality rate was set very low, 0.000001 per day (Hansen et al., 2016).

Their diet consists of gelatinous zooplankton, macro- and meso-zooplankton, large and small phytoplankton and detritus (Båmstedt and Karlson, 1998; Cleary et al., 2012; Dalpadado et al., 2008). Detailed diet matrix can be found in Section S4, Table S7.

Gelatinous zooplankton

The gelatinous zooplankton group is composed by cubozoas, hydrozoas, scyphozoas and tunicatas. It was initialized with a biomass of 0.81 t km^{-2} (Lamb et al., 2019; Pauly et al., 2008).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The maximum depth of the group was assumed 2000 m (pers. comm. Xavier Corrales). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized weighing each of the boxes from the total area of the Bay of Biscay. Detailed horizontal distribution can be found in Section S3, Fig. S1.

Their diet consist of gelatinous zooplankton, macrozooplankton, mesozooplankton, microzooplankton, large phytoplankton, small phytoplankton and detritus, being mesozooplankton the dominant prey (Granhag and Hosia, 2015; Hansson et al., 2005; Lilley et al., 2009; Martinussen and Båmstedt, 1995). Detailed diet matrix can be found in Section S4, Table S7.

Other invertebrates

The other invertebrates group is composed by gastropods, cnidarians and sponges. This group was initialized with a biomass of 7.23 t km^{-2} (Blanchet et al., 2005; Le Loc'h et al., 2008; Serrano et al., 2006).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Based on the information of depth range gathered in Palomares and Pauly (2021) for the invertebrate species included in DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d), a depth range of 0-2000 m was assumed for the group. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The 85% of the diet corresponds to detritus, the remaining 15% being made up of suprabenthos, the zooplankton groups, benthic primary producers, large and small phytoplankton, and discards. (Bergquist, 2001; Geiger, 2006; Lewis, 1982). Detailed diet matrix can be found in Section S4, Table S7.

Echinoderms

The echinoderms group was initialized with a biomass of 1.12 t km^{-2} (Le Loc'h et al., 2008; Lourido et al., 2014; Serrano et al., 2006).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Based on the information of depth range gathered in Palomares and Pauly (2021) for the echinoderms species included in DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d), a depth range of 0-1500 m was assumed for the group. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet consists of bivalves, polychaetes, other invertebrates, benthic primary producers, detritus and discards, being detritus the dominant prey (90% of the total) (Coulon and Jangoux, 1993; Juan et al., 2007; Rodriguez, 1972). Detailed diet matrix can be found in Section S4, Table S7.

Suprabenthos

The suprabenthos group is composed by mysids, isopods, amphipods, cumaceans and copepods. This group was initialized with a biomass of 2.51 t km^{-2} (Blanchet et al., 2005; Cartes et al., 2001; Frutos and Sorbe, 2017; Le Loc'h et al., 2008; Pérez et al., 2007).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The depth was set at 30-400 m (Sorbe and Elizalde, 2014). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized weighing each of the boxes from the total area of the Bay of Biscay. Detailed horizontal distribution can be found in Section S3, Fig. S1.

The 84% of its diet corresponds to detritus, the remaining 16% being made up of polychaetes, other invertebrates, mesozooplankton, microzooplankton and discards (Cartes et al., 2001). Detailed diet matrix can be found in Section S4, Table S7.

Polychaetes

The group was initialized with a biomass of 0.86 t km^{-2} (Lastra et al., 2006; Le Loc'h et al., 2008; Lourido et al., 2014).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The depth range for the group was assumed to be 0-5000 m (pers. comm. Xavier Corrales). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Polychaetes main source of food are the detritus, being this specie the 94% of its diet (Andresen and Kristensen, 2002; Checon et al., 2016; Dubois et al., 2003; Jumars et al., 2015; Magalhães and Barros, 2011). Detailed diet matrix can be found in Section S4, Table S7.

Bivalves

The group was initialized with a biomass of 0.86 t km^{-2} (Lastra et al., 2006; Le Loc'h et al., 2008; Serrano et al., 2006).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Based on the information of depth range gathered in Palomares and Pauly (2021) for the bivalves species included in DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d), a depth range of 0-200 m was assumed for the group. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of bivalves consists mainly of the phytoplankton and detritus groups, with large phytoplankton being the main source of food (57% of the total diet) (Chauvaud et al., 2001; Heral, 1989; Langdon and Newell, 1990; Lehane and Davenport, 2002; Nerot et al., 2012; Page and Lastra, 2003; Perez et al., 2013). Detailed diet matrix can be found in Section S4, Table S7.

Detritus-feeders decapods

This group was parameterized based upon *Munida sarsi*, the most abundant specie from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 1.57 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Munida sarsi lives abundantly at depths of 700-800 m (Wikipedia, 2018). Other species included in the group, however, have a different depth distribution. Delta prawn (*Palaemon longirostris*), can be found in the surface up to 17 m (Palomares and Pauly, 2021), whilst *munida iris* and *munida tenuimana* can be found at around 1300 m and 1900 m (Palomares and Pauly, 2021), respectively. We therefore assumed a depth range of 0-1300 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

This group feeds in almost all invertebrate groups included in the Bay of Biscay Atlantis model, although detritus is the main resource of food (41% of the total diet) (Ansell et al., 1999; Cartes et al., 2007; Lagardère, 1977). Detailed diet matrix can be found in Section S4, Table S7.

Benthos-feeders decapods

This group is composed by shrimps, lobsters and crabs, although it was parameterized based upon edible crab (*Cancer pagurus*), the most abundant specie from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). This group was initialized with a biomass of 1.81 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The edible crab´s depth range is set at 6-40 m (Palomares and Pauly, 2021). Almost all species included in the group has a shallow distribution (the information for all the species was gathered from Palomares and Pauly (2021)), but *Macropodia longipes* and *Polycheles typhlops*, which are found at depths of 1249 m and 2195 m, respectively (Palomares and Pauly, 2021). We therefore assumed a depth range of 0-1400 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of this group consists mainly of polychaetes, suprabenthos and other detritus (50 % of the diet is made up of these three groups) (Abello, 2008; Allen, 1965; Ansell et al., 1999; Bernárdez et al., 2000; Cartes, 1995; Cartes et al., 2007; Freire, 1996; Lagardère, 1977; Monfort, 1986). Detailed diet matrix can be found in Section S4, Table S7.

Zooplankton feeding shrimps

This group was parameterized based upon arrow shrimp (*Plesionika heterocarpus*), the most abundant specie according to DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). This group was initialized with a biomass of 1.21 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The arrow shrimps maximum depth is considered to be 850 m (Palomares and Pauly, 2021). Pink glass shrimp (*Pasiphaea multidentata*), however, can be found at 2000 m depth (Palomares and Pauly, 2021). We therefore assumed a depth range of 10-2000 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of this group is composed of mesopelagic fish, benthopelagic fish, zooplankton feeding shrimps, benthos- and detritus-feeders decapods, bivalves, polychaetes, suprabenthos, echinoderms, other invertebrates, zooplankton, detritus and discards (Cartes, 1993b, a; Cartes, 1991; Cartes, 1998; Cartes et al., 2007; Fanelli and Cartes, 2004; Lagardère, 1977). Detailed diet matrix can be found in Section S4, Table S7.

Pelagic crab

The pelagic crab group represents the Henslow's swimming crab (*Polybius henslowii*). It was initialized with a biomass of 0.55 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Henslow's swimming crab can be found at depths of 0-500 m (Palomares and Pauly, 2021). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Around 42% of the diet of Henwlow´s swimming consists of discards, being the remaining 58% squids, pelagic crab, zooplankton feeding shrimps, benthos- and detritus-feeders decapods, polychaetes, suprabenthos, other invertebrates, gelatinous zooplankton, macrozooplankton, mesozooplankton and detritus (López López, 2017; Signa et al., 2008). Detailed diet matrix can be found in Section S4, Table S7.

Norway lobster

The Norway lobster was initialized with a biomass of 0.11 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Based on the ICES (2016d) stock annex report, Norway lobster's distribution in the southern Bay of Biscay and northern Galicia is limited to depths ranging from 90-600 m. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The Norway lobster feeds mainly in polychaetes and detritus, and to a lesser extent, in benthic cephalopods, zooplankton feeding shrimps, benthos-feeders decapods, detritus-feeders decapods, bivalves, suprabenthos, echinoderms, other invertebrates, macrozooplankton, mesozooplankton and discards (Cristo and Cartes, 1998; Lagardère, 1977). Detailed diet matrix can be found in Section S4, Table S7.

Squids

The squids group was parameterized based on veined squid (*Loligo forbesi*), the most abundant squid specie of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). The group was initialized with a biomass of 0.28 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Based on Palomares and Pauly (2021), the veined squids maximum depth is established at 431 m. Northern shortfin (*Illex illecebrosus*) squid and European flying squid (*Todarodes sagittatus*), however, can be found deeper, at 1000 m and 2500 m, respectively (Palomares and Pauly, 2021). We therefore assumed a depth range of 0-2000 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The squids feed in almost all the species included in the model, although, anchovy, other planktivorous fishes, mesopelagic fish and zooplankton-feeding shrimps are the main sources of food (Lordan et al., 1998; Lordan et al., 2001; Pierce et al., 1994; Rasero et al., 1996; Rocha et al., 1994; Rosas-Luis and Sánchez, 2015; Rosas-Luis et al., 2014; Valls Mir, 2017). Detailed diet matrix can be found in Section S4, Table S7.

Benthic cephalopods

The benthic cephalopods group is composed of octopuses, squids and cuttlefishes. However, the group was parameterized based on common octopus (*Octopus vulgaris*), the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). The group was initialized with a biomass of 0.44 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The growth rate (mgN per day) and mortality rate (per day) were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The common octopus is more abundant in the first 100 m (Palomares and Pauly, 2021). Globose octopus (*Bathypolypus sponsalis*), however, can be found up to 700 m (Palomares and Pauly, 2021), whilst spider octopus (*Octopus salutii*) and elegant cuttlefish (*Sepia elegans*) in depths of 500 m (Palomares and Pauly, 2021). We therefore assumed a depth range of 0-700 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized taking into account the information gathered from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet consists mainly of small demersal fishes, benthos- and detritus-feeders decapods and bivalves (Ajana et al., 2018; Alves et al., 2006; Castro and Guerra, 1990; Du Sel et al., 2000; Hernández López, 2000; Neves et al., 2009; Regueira et al., 2017; Valls Mir, 2017). Detailed diet matrix can be found in Section S4, Table S7.

Deep-sea fishes

The deep-sea fishes group was parameterized based upon roughsnout grenadier *(Trachyrincus scabrus)*, the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 0.07 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

Roughsnout grenadier can live up to 11 years and measure 45 cm (Froese and Pauly, 2021). There was not possible to find maturity age information for roughsnout grenadier, but alfonsino (*Beryx decadactylus*) mature at 2.3-4 years (ICES, 2011). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was characterized assuming a linear growth in length and using the general length-weight formula of $W = 0.00129 \cdot L^{3.232}$ from Froese and Pauly (2021). The growth rate for each age class (mgN per day) was estimated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

In the Northeastern Atlantic roughsnout grenadier spawn between February and March (Froese and Pauly, 2021). No information on recruitment was found for this specie, hence, we assumed that the recruitment parameters for this group are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality used was this set for alfonsino, 0.23 per year (ICES, 2011). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $6.301 \cdot 10^{-08}$ and $3.151 \cdot 10^{-12}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

Roughsnout grenadiers are most commonly found at depths from 395 to 1700 m (Froese and Pauly, 2021). Other species included in the group, however, are found in different depths, such as red bandfish (*Cepola macrophthalma*), at 15-400 m (Froese and Pauly, 2021), and Kaup's arrowtooth eel (*Synaphobranchus kaupii*), at 400-2200 m (Froese and Pauly, 2021). We therefore assumed a depth range of 15-2000 m for the group as a whole. The vertical distribution was then defined based on the proportion of each vertical layer to the total depth of the area. Detailed vertical distribution can be found in Section S3, Table S6. No information about swimming speed for roughsnout grenadier was found, but both *Notacanthus Bonaparte* and Kaup's arrowtooth eel have a burst swim speed of between 1-1.5 m s^{-1} (Clough et al., 2004). Therefore, a swimming speed of 1.25 m s^{-1} was assumed for the group. The horizontal distribution was characterized with information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult deep-sea fishes prey on mesopelagic fish, medium and small demersal fishes, cephalopods, Norway lobster, zooplankton feeding shrimps, decapods, polychaetes, suprabenthos, echinoderms, other invertebrates, gelatinous zooplankton, microzooplankton and mesozooplankton (Dürr and González (2002); Modica et al. (2014); Pais (2002); Saldanha et al. (1995) and IEO database). Juveniles, however, feed less on vertebrate fishes and more on invertebrate fishes, mainly on zooplankton feeding shrimps, benthos-feeders decapods and suprabenthos (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Small demersal fishes

This group was parameterized based upon axillary seabream *(Pagellus acarne)*, the most abundant specie from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 0.93 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

Axillary seabreams mature at 2-3 years and can reach a maximum age of 7 years (Froese and Pauly, 2021). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was estimated based on the total length by age for the Gulf of Cadiz and

Alboran Sea from Velasco et al. (2011) and the general length-weight formula of W = $0.00856 \cdot L^{3.131}$ from Froese and Pauly (2021). The growth rate for each age class (mgN per day) was defined based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

In the Eastern Atlantic axillary seabream spawning starts in March and ends in April (Froese and Pauly, 2021). No information on recruitment was found, so we assumed that the recruitment parameters for this group are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

A natural mortality of 0.43 per year is established for axillary seabream (Froese and Pauly, 2021). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $5.89 \cdot 10^{-12}$ and $1.178 \cdot 10\text{-}^{07}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

Axillary seabreams are usually found between 40-100 m depth (Froese and Pauly, 2021). White seabream (*Diplodus sargus*) and common Atlantic grenadier (*Nezumia aequalis*), however, are found in different depths, at 0-50 m and 200-1000 m, respectively (Froese and Pauly, 2021). We therefore assumed a depth range of 0-1000 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. Swimming speed information for red gurnard (*Chelidonichthys cuculus*) and sand goby (*Pomatoschistus minutus*) was found instead of for axillary seabream. Red gurnard swims at a speed of 0.47 m s^{-1} and sand goby at a speed of 0.27 m s^{-1} (Froese and Pauly, 2021). In consequence, a swimming speed of 0.37 m s^{-1} was assumed for the group. The horizontal distribution was characterized using information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult small demersal fishes feed on other planktivorous fishes, blue whiting, common sole, flatfishes, small demersal fishes and all invertebrates fish but Norway lobster (Almeida, 2003; Castro et al., 2013; Gibson and Ezzi, 1987; Gonçalves and Erzini, 1998; Leitao et al., 2007; Leitão et al., 2006; López-López et al., 2011; Morato et al., 2001; O'Connell and Fives, 1995; Pita et al., 2002; Saldanha et al., 1995). Juveniles', however, prey less on vertebrate fish and more on invertebrate fish (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Medium demersal fishes

The medium demersal fishes group was parameterized based upon blackbelly rosefish *(Helicolenus dactylopterus)*, the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 0.22 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

A maximum age of 43 was found for blackbelly rosefish in France (Froese and Pauly, 2021). We therefore assumed a maximum age of 40 for the Bay of Biscay Atlantis model. Blackbelly rosefish mature between 13 and 16 years and with a length of 32 m (Froese and Pauly, 2021). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was characterized based on the mean length by age from White et al. (1998) and the general length-weight formula of $W = 0.01072 \cdot L^{3.08}$ from Froese and Pauly (2021). The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 4 years. Detailed growth rate per age class can be found in Section S2, Table S4.

In the Northeast Atlantic blackbelly rosefish spawn between November and December (Froese and Pauly, 2021). No information about recruitment parameters were found, hence, we assumed that the recruitment parameters for this group are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is fixed at 0.12 per year (Froese and Pauly, 2021). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $1.644 \cdot 10^{-12}$ and $3.288 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

Blackbelly rosefish can be usually found from 150-600 m (Froese and Pauly, 2021). Other species included in the group, such as sand steenbras (*Lithognathus mormyrus*) and whiting (*Merlangius merlangus*) have a shallower distribution, exactly 10-20 m (Froese and Pauly, 2021) and 30-100 m (Froese and Pauly, 2021), respectively. We therefore assumed a depth range of 0-600 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. There was not possible to found swimming speed information for blackbelly rosefish, but whiting swims at a speed of 0.23 m s^{-1} (Froese and Pauly, 2021). The horizontal distribution was characterized using information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult medium demersal fishes prey on anchovy, other planktivorous fishes, mesopelagic fish, blue whiting, flatfishes, large demersal fishes, medium demersal fishes, small demersal fishes, deep sea fishes and almost all invertebrates, mainly decapods (Castro et al. (2013); Gibson and Ezzi (1987); Morato et al. (2001); Neves et al. (2012); Pita et al. (2002); Rault et al. (2017) and IEO database). Juvenile medium demersal fishes, however, do not feed on large, medium and deep-sea fishes and feed more on invertebrate species (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Large demersal fishes

This group was parameterized based upon European conger *(Conger conger),* the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 0.46 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

European conger can reach a maximum age of 11 years for males and 19 years for females (Froese and Pauly, 2021). In consequence, a maximum age of 20 years was assumed for the Bay of Biscay Atlantis model. It matures at the age of 5 years (Froese and Pauly, 2021). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was characterized based on the total length per age by Correia et al. (2009) and the general length-weight formula of $W = 0.000203 \cdot L^{3.4991}$ from Froese and Pauly (2021). The growth rate for each age class (mgN per day) was then calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

Information on spawning for the Bay of Biscay could not be found, but in the Portugal coast, spawning occurs between June and August, with a larval stage duration of 127 days (Froese and Pauly, 2021). We therefore assumed a spawning period of June-August and a larval stage duration of 127 days for the Bay of Biscay Atlantis model. No information about length of time recruits arrive over was found, hence, we assumed that the length of time recruits arrive over for the Bay of Biscay Atlantis model is that set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality was assumed to be 0.2 per year (pers. comm. Cecilie Hansen). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.7395 \cdot 10^{-12}$ and $5.479 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

European conger can be found at a depth range of 0-1000 m (Froese and Pauly, 2021). Detailed vertical distribution can be found in Section S3, Table S6. No swimming speed information was found for European conger, but for Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). Atlantic cod mean speed in a tank is around 0.4 bl s^{-1} (Bjornsson, 1993), meaning bl common length, so with a common length of 1 m (Froese and Pauly, 2021), a speed of 0.4 m s^{-1}. Haddock burst speed is set between 1.83 m s^{-1} and 2.46 m s^{-1} (Froese and Pauly, 2021). We therefore assumed a swimming speed of around 1 m s^{-1} for the group. The horizontal distribution was characterized based on the information from DEMERSALES and EVHOE bottom trawls surveys (ICES, 2017d). Detailed horizontal and vertical distribution can be found in Section S3, Fig. S1.

The adult large demersal fishes feed on demersal and deep-sea sharks and in almost all fish groups, being blue whiting, pouts and small demersal fishes the main source of food (Bergstad (1991); Hubans et al. (2017); Rault et al. (2017) and IEO database). Juvenile large demersal fishes, however, do not prey on sharks and large, medium and deep-sea fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Mullets

The mullets group is composed by surmullet (*Mullus surmuletus*) and red mullet (*Mullus barbatus*). However, it was parameterized based upon surmullet as it is the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). The group was initialized with a biomass of 0.07 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

In the Eastern Channel, a surmullet live a maximum age of 11 years and mature at 1-2 years (ICES, 2015). We therefore assumed a longevity of 11 years and maturity age of 1 year for the Bay of Biscay Atlantis model. The maturity-at-age proportion was defined based on the information from the ICES (2015) report, described in detailed in Section S2, Table S3. The weight distribution was characterized based on the mean length-at-age information from ICES (2015) and the general length-weight formula of $W = 0.00512 \cdot L^{3.2956}$ from Ravard et al. (2014). The growth rate for each age class (mgN per day) was then estimated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

In the Eastern Channel and North Sea spawning occurs between May and August, with a peak in June (ICES, 2015). We therefore assumed a spawning period of May-August for the Bay of Biscay Atlantis mode. No information about recruitment was found for mullets, so we assumed that for this group the recruitment parameters are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality rates were calculated based on the mortality values by age per year from ICES (2015). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.863 \cdot 10^{-07}$ and $1.087 \cdot 10^{-07}$ per day for juveniles and adults, respectively were assumed for the Bay of Biscay Atlantis model.

They can be found around the first 100 m (Mahé et al., 2005), although large surmullets were observed at more than 300 m (Caill-Milly et al., 2017).We therefore assumed a depth range of 0-300 m for the group. Detailed vertical distribution can be found in Section S3, Table S6. Swimming speed for surmullet nor red mullet could be found. Therefore, we assumed that surmullets swim at a same speed as seabass, 0.6 m s^{-1}. The horizontal distribution was determined taking advantage of the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Around 50 % of their diet consists of polyachetes, and the remaining percentage corresponds to small demersal fishes, benthic cephalopods, zooplankton feeding shrimps, decapods, bivalves, suprabenthos, echinoderms, other invertebrates, microzooplankton and benthic primary producers (IEO database). Detailed diet matrix can be found in Section S4, Table S7.

Flatfishes

The flatfishes group was parameterized based upon thickback sole *(Microchirus variegatus),* the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a total biomass of 0.12 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

Thickback sole can live for a maximum of 14 years and measure a maximum length of 21 cm (Froese and Pauly, 2021). It matures at 3 years (Froese and Pauly, 2021). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was estimated using the maximum length above mentioned and the assumption of a linear growth in length together with the general length-weight formula of $W = 0.00137 \cdot L^{3.543}$ from Froese and Pauly (2021). The growth rate for each age class (mgN per day) was then calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

There was no spawning information available for the area, but in the Mediterranean Sea, thickback sole spawns in February (Froese and Pauly, 2021). We therefore assumed that this group spawns in February for the Bay of Biscay Atlantis model. The recruitment parameters were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality was assumed to be 0.2 per year (pers. comm. Cecilie Hansen). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.7395 \cdot 10^{-12}$ and $5.479 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

Thickback sole can be found from 20 to 400 m (Froese and Pauly, 2021). However, other species included in the group can be found in different depth ranges, such as deep water sole (*Bathysolea profundicola*), between 200 and 600 m (Froese and Pauly, 2021), solenette (*Buglossidium luteum*), between 10 and 40 m (Froese and Pauly, 2021) and brill (*Scophthalmus rhombus*), between 5 and 50 m (Froese and Pauly, 2021). We therefore assumed a depth range of 0-600 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. Swimming speed for thickback sole could not be found, but European plaice (*Pleuronectes platessa*) swim at a speed of 0.34 m s^{-1} (Froese and Pauly, 2021). The horizontal distribution was characterized using the information form DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult flatfishes feed mainly on small demersal fishes, polychaetes and suprabenthos (Allen et al., 2004; Cabral et al., 2002; Castro et al., 2013; Cresson et al., 2014; Paulo-Martins et al., 2011; Rodriguez, 1996; Teixeira et al., 2009; Vinagre et al., 2011). The juveniles, however, prey more on zooplankton feeding shrimps, decapods and bivalves (pers. comm. Xavier Corrales). Detailed diet matrix can be found on Section S4, Table S7.

Common sole

The common sole was initialized with a biomass of 0.14 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

They live up to 26 years (Froese and Pauly, 2021) and are fully mature at 3 years (ICES, 2016a). The maturity-at-age proportion was defined based on the information from the ICES (2016a) report, described in detailed in Section S2, Table S3. The weight-at-age distribution was characterized based on information on total length for male and female from Parker-Humphreys (2004) and the general length-weight formula of $W = 0.00475 \cdot L^{3.181}$ from Ravard et al. (2014). Once the weight per age was estimated, growth rate for each age class (mgN per day) were calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 3 years. Detailed growth rate per age class can be found in Section S2, Table S4.

Common sole's spawn between December and May in Cantabrian Sea and Atlantic Iberian waters with a larval stage duration of 35 days (Froese and Pauly, 2021). The length of time recruits arrive over was assumed to be that set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is assumed to be 0.1 for all age groups (ICES, 2016a). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $1.37 \cdot 10^{-12}$ and $2.74 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

In the northern and central Bay of Biscay the common sole can be found at less than 150 m (ICES, 2016a) and in the Cantabrian Sea and Atlantic Iberian waters at around 100-200 m (ICES, 2014c). We therefore assumed a depth range of 0-200 m for the Bay of Biscay Atlantis model. Detailed vertical distribution can be found in Section S3, Table S6. The swimming speed was assumed to be the same as another flatfish species, American plaice (*Hippoglossoides platessoides*). This specie swim at around 1.05 m s^{-1} (Winger et al., 1999). The horizontal distribution was characterized based on the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult common sole's diet is composed by small demersal fishes, zooplankton feeding shrimps, benthos-feeders decapods, detritus-feeders decapods, bivalves, polychaetes, suprabenthos and echinoderms (Cabral, 2000; Rault et al., 2017; Rijnsdorp and Vingerhoed, 2001). The juveniles have the same diet but feed less on benthos-feeders decapods and more on suprabenthos (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Megrim

Four-spot megrim (*Lepidorhombus boscii*) and megrim (*Lepidorhombus whiffiagonis*) species were included in this group. However, it was parameterized based upon megrim as it is the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a total biomass of 0.10 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The maximum age for megrim varies with the ICES subareas. In the southern Bay of Biscay and East Atlantic Iberian waters the maximum age for megrim is considered to be 12 years (ICES, 2014d), whereas in the West and Southwest of Ireland and Bay of Biscay the maximum age is about 14-15 years (ICES, 2018b). In consequence, a maximum age of 15 years was assumed for the Bay of Biscay Atlantis model. 50 % of the individuals mature at about 2.5 year old and 20 cm length (ICES, 2018b). The exact proportion of maturity was estimated based on the mean of the proportion of fish mature at each age for ICES 8 abd (ICES, 2018b) and 8c subareas (ICES, 2014d). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was estimated using mean length-at-age from Landa and Piñeiro (2000) and the general length-weight formula of $W = 0.0065 \cdot L^{3.0114}$ from (ICES, 2014d). The growth rate for each age class (mgN per day) was then calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning period of these species is short. In the ICES 8c and 9a subareas mature males can be found from November to March and mature females from December to March (ICES, 2014d). In the ICES 7 b-k and 8 abd subareas, however, from January to March (ICES, 2018b). We therefore assumed a spawning period from November to March for the Bay of Biscay Atlantis model. No information about recruitment was found for the area, hence, we assumed that the recruitment parameters are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is set to 0.2 and assumed constant over all ages and years (ICES, 2014d, 2018b). Consequently and following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.7395\cdot10^{-12}$ and $5.479\cdot10^{-08}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

There is a certain bathymetric difference between the two species of megrim. Four-spot megrim can be found at depths ranging from 100 to 450 m in the southern Bay of Biscay and Atlantic Iberian waters (ICES 8c and 9a subareas) whereas megrim has a preferential depth range of 50 to 300 m (ICES, 2014d). In the west and southwest of Ireland and the Bay of Biscay (ICES 7b-k and 8abd subareas), four-spot megrim can be found between 200-600 m, whereas megrim between 100-300 m, although can dive up to 800 m (ICES, 2018b). We therefore assumed a depth range of 50-600 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The swimming speed was assumed to be the same as another flatfish species, American plaice (*Hippoglossoides platessoides*). This specie swim at around 1.05 m s^{-1} (Winger et al., 1999). The horizontal distribution was characterized based on the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of megrim is mainly composed by zooplankton feeding shrimps, benthos-feeders decapods and detritus-feeders decapods (IEO database), but juvenile megrim feed less on small pelagic fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Cods

The cods group is composed by Norway pout (*Trisopterus esmarkii*), pouting (*Trisopterus luscus*) and poor cood (*Trisopterus minutus*), although it was parameterized based upon poor cod, the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 0.45 t km^{-2} estimated from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The poor cod is a short-lived specie, living until age 4-6 in Strait of Sicily (Ragonese and Bianchini, 1998) with a maximum length of 24 cm (Froese and Pauly, 2021). We therefore assumed a maximum age of 6 years for the Bay of Biscay Atlantis model. It matures at age 2 (Jennings et al., 1999) with a length of 13.4 cm (Froese and Pauly, 2021). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. These length information together with the general length-weight formula of $W = 0.0086 \cdot L^{2.98}$ from Froese and Pauly (2021) were used to estimate the weight-at-age distribution. The growth rate for each age class (mgN per day) was then calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning season of poor cod in the coast of Spain lasts from December to March (Froese and Pauly, 2021). Information about recruitment was not available, therefore, we assumed that for this groups the recruitment parameters are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

No mortality information for poor cod was found for the area, neither for any other specie included in the group. In consequence, based upon mortality rates for lumpish and Norway pout from the NoBa Atlantis model (Hansen et al., 2016), mortality rates of $1.23 \cdot 10^{-10}$ and $5.21 \cdot 10^{-10}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

Poor cod is mostly found at depths from 50 to 200 m (Ragonese and Bianchini, 1998). Pouting, however, is found at 30-300 m depth range (Spitz, J. et al., 2006). We therefore assumed a depth range of 30-300 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. No swimming speed was found for poor cod, but pouting swim at a speed of 0.55 m s^{-1} (Froese and Pauly, 2021), hence, this swimming speed was assumed for the group. The horizontal distribution was characterized based on the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult cods prey on almost all demersal fishes and invertebrates, being benthos-feeders decapods the main source of food (Castro et al. (2013) and IEO database). Juveniles, however, do not feed on adult deep-sea fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Hake

Although hake was split into two age groups (juvenile and adult) in the calculation of biomass and stomach content, in the Bay of Biscay Atlantis model was included as one age group. It was initialized with a biomass of 0.19 t km^{-2}, calculated summing up the biomass of adult and juvenile hake estimated from DEMERSALES and EVHOE bottom trawls surveys (ICES, 2017d).

The longevity of hake is set at 10 years (ICES, 2016b, 2017b; Korta et al., 2015). The estimated age at which 50 % of individuals mature was considered 2.5 years for males, 4.4 years for females and 3.2 years for the combined sexes (Piñeiro and Sainza, 2003). We therefore assumed a maturity age of 2.5 years for the Bay of Biscay Atlantis model. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was estimated using mean length-at-age for combined sexes from Piñeiro and Sainza (2003) and the general length-weight formula of $W = 0.00513 \cdot L^{3.074}$ from ICES (2016b). The growth rate for each age class (mgN per day) was calculated considering the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning season of hake in the Iberian Atlantic area extends from December to May, with peaks in February (Piñeiro and Sainza, 2003). The duration of the larval period in the Bay of Biscay is estimated to last 39 days (Kacher and Amara, 2005). No information about the length of time recruits arrive over was found, hence, we assumed that for this group this parameter is that set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is determined to be 0.4 per year (ICES, 2016b, 2017b; Korta et al., 2015). Taking into consideration the guidelines from Audzijonyte et al. (2017) mortality rates of $5.48 \cdot 10^{-12}$ and $1.096 \cdot 10^{-07}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

It lives mostly between 70 and 500 m, swimming at a speed of 0.79 m s^{-1} (Froese and Pauly, 2021), although it can be found from 30 m down to depths of 1000 m (Korta et al., 2015). We therefore assumed a depth range of 70-500 m for the Bay of Biscay Atlantis model. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized considering the information from DEMERSALES and EVHOE bottom trawls surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult hake feed mainly on horse mackerel, sardine, anchovy, blue whiting and juvenile hake. Juvenile hake, however, do not prey on some adult species such as horse mackerel, sardine, anchovy and blue whiting (Mahe et al. (2007); Velasco and Olaso (1998) and IEO database). Detailed diet matrix can be found in Section S4, Table S7.

Blue whiting

The model was initialized with a biomass of 1.97 t km^{-2} estimated from the DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

Blue whiting's life expectancy is considered 10 years, whilst maturity age 2-7 years (ICES, 2016c). We assumed a maturity age of 2 years for the Bay of Biscay Atlantis model. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The maturity age of 2 years corresponds to a length of 18.2 cm (Froese and Pauly, 2021) and males can reach a total length of 30-35 cm and females 35-40 cm (Silva et al., 1997) when they are adults. This length information together with the general length-weight formula of $W = 0.00375 \cdot L^{3.082}$ from Froese and Pauly (2021) were used to characterize the weight-at-age distribution. The growth rate for each age class (mgN per day) was then estimated considering the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning season is considered to be from March to April (ICES, 2016c). No information about recruitment was found for blue whiting in the area, hence, we assumed that the recruitment parameters for this group are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Natural mortality for blue whiting is fixed to 0.2 per year for all age groups (ICES, 2016c). Considering the guidelines from (Audzijonyte et al., 2017), we therefore assumed mortality rates of $2.7395 \cdot 10^{-12}$ and $5.479 \cdot 10^{-14}$ per day for juveniles and adults, respectively.

The highest concentration of blue whiting is found at depths ranging between 300-600 m (ICES, 2016c), swimming at a speed of around 0.8 m s^{-1} (Hansen et al., 2016). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized with information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

Macrozooplankton is the main resource of food of both juvenile and adult blue whiting, being this planktonic group around 45 % of the total diet (Cabral and Murta (2002) and IEO database). The adult blue whiting feed on almost all pelagic fishes, whilst juveniles do not feed on large pelagic fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Seabass

The seabass was initialized with a biomass of 0.17 t km^{-2} estimated from the DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The maximum observed age in the northern seabass stock was 26-28 years (ICES, 2018a) and the maturity age around 4-7 years, which corresponds to a 35 cm length for males and 42 cm for females (ICES, 2013), reaching 85 cm in the last age of life (Ravard et al., 2014). We therefore assumed a longevity of 28 years and a maturity age of 4 years. The detailed proportion of mature per age was obtained from (ICES, 2018a), described in detail in Section S2, Table S3. The length information mentioned together with the general length-weight formula of $W = 0.01248 \cdot L^{2.9485}$ from Ravard et al. (2014) were used to determine the weight-at-age distribution, assuming a linear growth in length per age. The growth rate for each age class (mgN per day) was estimated considering the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 3 years. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning season moves later in the year in northern latitudes, being in the Bay of Biscay from January to March (ICES, 2013). Regarding the recruitment information, the larval stage was set at 46 days (Froese and Pauly, 2021) and the length of time recruits arrive over was that set in the SE-Australian Atlantis model (Fulton et al., 2004).

The estimation of the natural mortality was conducted after performing a sensitivity analysis of the effect of different M values on the assessment of the Bay of Biscay seabass stock, finally setting a natural mortality at 0.24 per year (ICES, 2018a). Following the guidelines from Audzijonyte et al. (2017), mortality rates of $6.575 \cdot 10^{-12}$ and $6.575 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

They are found along 10-100 m depth (Froese and Pauly, 2021), swimming at around 0.6 m s^{-1} (Claireaux et al., 2006). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was characterized using the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of the adult seabass is composed by almost all pelagic and demersal groups, and also cephalopods and decapods, although it consists mainly of mackerel and horse mackerel (Spitz et al., 2013). The juveniles, however, do not feed on large and medium demersal fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Anglerfish

The anglerfish group is composed by blackbellied angler (*Lophius budegassa*) and angler (*Lophius piscatorius*). However, the group was parameterized based upon angler (*Lophius piscatorius*) as it is the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). The group was initialized with a biomass of 0.21 t km^{-2} estimated from the DEMERSALES and EVHOE bottom trawl (ICES, 2017d).

The maximum observed age for anglers was 20 years (ICES, 2018c). Based on estimates from Ireland, 100 % of individuals are mature at ages 5 (ICES, 2018c). We therefore assumed a maturity age of % years. The maturity percentage per age was based on Duarte et al. (2001), which can be found in detailed in Section S2, Table S3. The weight distribution was characterized considering the mean length-at-age information for females and males from Landa et al. (2001) and the general length-weight formula of $W = 0.02457 \cdot L^{2.5612}$ from Ravard et al. (2014). The growth rate for each age class (mgN per day) was estimated taking into account the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning occurs between January and June (Duarte et al., 2001). No information on recruitment was available, therefore, we assumed that the recruitment parameters for this group are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Then et al. (2015) estimated a natural mortality of 0.315 per year based on the maximum observed age. However, the observation error around this estimate was considerable (ICES, 2018c). In consequence, after considering the growth, the age-at-first maturity and the lifestyle of the angler, a natural mortality of 0.25 per year was assumed by WKAnglerfish (ICES, 2018d). We therefore assumed a natural mortality of 0.25 per year. Taking into consideration the guidelines from Audzijonyte et al.

(2017) mortality rates of $3.082 \cdot 10^{-09}$ and $6.164 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

Anglers are most abundant at depths of 200-800 m along the southern Celtic Seas and the Bay of Biscay (ICES, 2018c) and from the surface up to at least 1000 m along the Cantabrian Sea and Atlantic Iberian waters (ICES, 2018e). We therefore assumed a depth range of 0-1000 m. Detailed vertical distribution can be found in Section S3, Table S6. The anglers swim at a speed of 0.24BL/s, BL meaning body length (Wikipedia, 2018). Considering the common body length of 100 cm established by Froese and Pauly (2021), we assumed that angler swim at a speed of 0.24 m s^{-1}. The horizontal distribution was characterized based on the information from DEMERSALES and EVHOE bottom trawls surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult anglerfish feed on some elasmobranch groups, other planktivorous fishes, juvenile hake, cods, megrim, large and small demersal fishes, deep-sea fishes, cephalopods, zooplankton feeding shrimps and decapods, but mainly on mackerel, horse mackerel, blue whiting and common sole (Preciado et al. (2006) and IEO database). The juveniles, however, do not prey on elasmobranch nor large demersal and deep-sea fishes, but prey more on invertebrates (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Mesopelagic fishes

The mesopelagic fishes group is composed by different lantern fish, although it was parameterized based upon jewel lanternfish (*Lampanyctus crocodilus*) as it is the most abundant specie of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 1.80 t km^{-2} obtained from EwE (Corrales et al., 2022).

Due to difficulties in gathering information about longevity and maturity age of jewel lanternfish in the Bay of Biscay, other areas or species information were searched. In the Ionian Sea the maximum age identified of jewel lanternfish was 8 years (Sion et al., 2011), so therefore we assumed a longevity of 8 years for the Bay of Biscay Atlantis model. They can reach a length of 30 cm, although the length range in the Balearic Island is established from 9 cm to 21 cm (Froese and Pauly, 2021). The maturity age was assumed to be 1 year, the age at which half-naked hatchetfish (Froese and Pauly, 2021), glacier lanternfish (Froese and Pauly, 2021) and silvery lightfish (Rosland and Giske, 1997) mature. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was characterized using the general length-weight formula of $W = 0.0017 \cdot L^{3.431}$ from Bayhan et al. (2020) and assuming a linear increase in the length per age. The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning of jewel lanternfish occurs in March-August in France, along the Mediterranean Sea, and in September-November in Portugal (Froese and Pauly, 2021), so a spawning period of March-August was assumed. The recruitment parameters were assumed to be those from the SE-Australian Atlantis model (Fulton et al., 2004).

The mortality rates were assumed to be those set in the NoBa Atlantis model (Hansen et al., 2016), $6.25 \cdot 10^{-20}$ and $1 \cdot 10^{-17}$ per day for juveniles and adults, respectively.

Lanternfish are found around 275-1000 m depth (Froese and Pauly, 2021), hence, we assumed a depth range of 200-1000 m. Detailed vertical distribution can be found in Section S3, Table S6. We assumed a swimming speed of 15 m s^{-1}, the swimming speed established for silvery lightfish (*Maurolicus muelleri*) and glacier lantern fish (*Benthosema glaciale*) (Torgersen and Kaartvedt, 2001). The horizontal distribution was characterized according to the information from the DEMERSAL and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult mesopelagic fishes diet consists of mesopelagic fishs, polychaetes, other invertebrates, gelatinous zooplankton, macrozooplankton, mesozooplankton and microzooplankton (Bernal et al., 2013; Bernal et al., 2015; Fanelli et al., 2014; Sever et al., 2013). Juveniles however do not feed on mesopelagic fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Other planktivorous fish

The other planktivorous fish group was parameterized based upon boarfish (*Capros aper*), the most abundant species of the DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). The group was initialized with a total biomass 1.15 t km^{-2} estimated from the PELGAS and PELACUS acoustic surveys (Masse et al., 2018).

Boarfish's maximum age and the age at which 50 % of individuals become mature are considered 31 and 3.5 years, respectively (ICES, 2014b). The proportion of maturity was defined based on the information from the ICES (2014b). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was characterized through the total body weight-at-age from White et al. (2010). The length-weight relationship was defined with the general formula of $W = 0.0305 \cdot L^{2.791}$ from Froese and Pauly (2021). The growth rate for each age class (mgN per day) was then estimated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 3 years. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning occurs between June and July in the Northeast Atlantic (ICES, 2014b). Given that there was no information about recruitment available, we assumed that the recruitment parameters for this group are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is fixed to 0.16 per year (ICES, 2014b). Consequently and following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.192 \cdot 10^{-12}$ and $4.384 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed.

The boarfish are widely distributed from the surface up to 600 m (ICES, 2014b). However, other species included in the group such as argentine (*Argentina sphyraena*) and silvery pout (*Gadiculus argenteus*) are found deeper, at 700 m and 1000 m respectively. We therefore assumed a depth range of 0-1000 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. It was not possible to find swimming speed for boarfish, but for Atlantic herring (*Clupea harengus*) and European sprat (*Sprattus sprattus*), two of the species that compose the planktivorous fishes group. Atlantic herring swim at a speed of around 0.64 m s^{-1} (Røttingen and Røttingen, 1991) and European sprat at 0.63 m s^{-1} (Froese and Pauly, 2021). Therefore, a swimming speed of around 0.64 m s^{-1} was assumed for this group. The DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d) supplied information to characterize the horizontal distribution. Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of planktivorous fishes consists mainly of mesozooplankton (around 70 % of the diet) (Bachiller, 2013; Bachiller and Irigoien, 2015; Doherty and McCarthy, 2004; Lankov et al., 2010; Lopes et al., 2006; Maitland and Lyle, 2005; Rice, 1963; Santos and Borges, 2001; Skóra et al., 2012), although juveniles planktivorous fish do not feed on vertebrates (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Anchovy

The anchovies were initialized with a biomass of 0.51 t km^{-2} estimated from the ICES (2019b) report.

Anchovy's life expectancy hardly exceeds three years. They grow very fast during the first year, doubling its weight from first to second year of life, reaching at the end of his life on average 18 cm (ICES, 2010c). Many authors have suggested that the anchovy matures at age 1 (Cort et al., 1976; Furnestin, 1945; Lucio and Uriarte, 1990) with a size of 11 cm for males and 11.5 cm for females (ICES, 2010c). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was characterized considering the mean weight-at-age in the catches in the ICES 8 subarea (ICES, 2010b). The length-weight relationship was defined with the general formula of $W = 0.007 \cdot L^{3.017}$ from the ICES (2010c) report. The growth rate for each age class (mgN per day) was then calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning season on the Bay of Biscay takes place between April and July (ICES, 2010c), with a larval stage duration of 37 days (Froese and Pauly, 2021). The information about the length of time recruits arrive over was assumed to be this set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is fixed at 1.2 per year, although the working group consider that some results presented about the increase of the mortality with age demand a revision of the natural mortality (ICES, 2010b). We therefore assumed mortality rates of $1.644 \cdot 10^{-11}$ and $3.288 \cdot 10^{-07}$ per day for juveniles and adults, respectively, taking into consideration the guidelines from Audzijonyte et al. (2017).

The juvenile anchovies are located in the first 45 m (Boyra et al., 2013), whereas adults can be found at around 100 m (Massé, 1996). Detailed vertical distribution can be found in Section S3, Table S6. No swimming speed information was found for this group, therefore, we assumed a swimming speed of 1.345 m s^{-1}, the same swimming speed as herrings (Brawn, 1960). The horizontal distribution was characterized based on the egg distribution from the BIOMAN survey for 2018 (pers. comm. Maria Santos). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult anchovies prey on macrozooplankton, mesozooplankton, microzooplankton, large phytoplankton, small phytoplankton (Bachiller, 2013; Bachiller and Irigoien, 2015; Plounevez and Champalbert, 1999), while the juveniles feed less on microzooplankton and more on mesozooplankton and phytoplankton (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Sardine

The sardines were initialized with a biomass 1.72 t km^{-2} biomass estimated from the PELGAS and PELACUS acoustic surveys (Masse et al., 2018).

Whitin European Atlantic waters, sardine attains age below 10 years and a total length lower than 23 cm (ICES, 2017a). Most sardines are mature by their first year of life (ICES, 2017c, a), and all individuals reach sexual maturity by age 2 (ICES, 2017a). The ICES (2010b) report served to obtain the fraction of maturity per age for the Cantabrian Sea in 2009. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was defined using mean weight-at-age values from (ICES, 2010b). The length-weight relationship was characterized with the general formula of $W = 0.00594 \cdot L^{3.77}$ from Froese and Pauly (2021). The growth rate for each age class (mgN per day) was defined based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The sardine spawns during spring (Certain et al., 2008), more precisely from March to end-April (Froese and Pauly, 2021), with a 40 days larval stage (Froese and Pauly, 2021). Information about length of time recruits arrive over was not available, hence, the recruitment parameters for sardines are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The mortality rate of $2.297 \cdot 10^{-07}$ and $1.142 \cdot 10^{-07}$ for juveniles and adults, respectively, were defined based on age specific natural mortality for ICES 8c (ICES, 2017a) and 8abd (ICES, 2017c) subareas, and following the guidelines from Audzijonyte et al. (2017).

The distribution of this species is restricted to the coastal shelf, mainly at depths up to 150 m (ICES, 2017a). Detailed vertical distribution can be found in Section S3, Table S6. No swimming speed information was found for this group, therefore, we assumed a swimming speed of 1.345 m s^{-1}, the same swimming speed as herrings (Brawn, 1960). The horizontal distribution was characterized based on the egg distribution from the BIOMAN survey for 2018 (pers. comm. Maria Santos). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult sardines feed on gelatinous zooplankton, macrozooplankton, mesozooplankton, large phytoplankton and small phytoplankton (Bachiller, 2013; Bachiller and Irigoien, 2015; Cunha et al., 2005), whereas juveniles prey on less gelatinous zooplankton and large zooplankton, but more mesozooplankton and phytoplankton (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Horse mackerel

The horse mackerel fish group is composed of Mediterranean horse mackerel (*Trachurus mediterraneus*) and Atlantic horse mackerel (*Trachurus trachurus*). However, based on the most abundant horse mackerel specie of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d), the group was parameterized as Atlantic horse mackerel. The model was initialized with a biomass of 2.39 t km^{-2} estimated from the PELGAS and PELACUS acoustic surveys (Masse et al., 2018).

The maximum age and length reported for this species are 20 years (ICES, 2017f) and 50 cm, the maximum length obtained in the EVHOE survey (Ravard et al., 2014). At age 0, Atlantic horse mackerel's length is below 14 cm, and up to 18 cm at age 1 (Villamor et al., 1997). At age 3.5 (ICES, 2017f) and around 21.5 cm (Villamor et al., 1997), 50 % are mature (ICES, 2017f). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age distribution was described taking into consideration the length information mentioned above and the general length-weight formula of $W = 0.00733 \cdot L^{3.02544}$ from Ravard et al. (2014), the weight-at-age distribution was described. The growth rate for each age class (mgN per day) was then defined based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning period in the Bay of Biscay is not clear, different spawning seasons can be found in different publications, but it is known to have a longer spawning period in the Bay of Biscay than in the North Sea (Abaunza et al., 2003). Letaconnoux (1951) mentioned the peak of spawning to be in May-June, whereas Arbault and Lacroix-Boutin (1969) stated that spawning preferentially takes place in the spring. Nazarov and Dobrusin (1977) referred to the spawning period from December to June. Finally, Lucio and Martin (1989) reported that horse mackerel appear in higher frequency between March and August. In the Northern coast of Spain, Letaconnoux (1951) revealed the spawning season to occur between February and April, whereas Anadón (1960) stated to be from February to May, and Solá (1990) between February and December, although this last mentioned the main spawning period from April to June. Considering the different spawning seasons in the Bay of Biscay and in the Northern coast of Spain, a spawning period from February to August was assumed. There was no recruitment information available, hence, the recruitment parameters were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is uncertain, although ICES currently applies a mortality of 0.15 per year (ICES, 2017f). Consequently and following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.055 \cdot 10^{-12}$ and $4.11 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed.

This benthopelagic species is usually found in 100-200 m, although it has been reported 1050 m (Froese and Pauly, 2021). However, as Mediterranean horse mackerel stays in shallower waters (Froese and Pauly, 2021), a depth range of 0-250 m was assumed for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. There was no swimming information available for horse mackerel in the Bay of Biscay, therefore, the same swimming speed as the mackerel group was assumed. The horizontal distribution was characterized based on the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of adult horse mackerel is composed of some pelagic and demersal fishes, and almost all the invertebrate groups, mainly suprabenthos, macrozooplankton and mesozooplankton (Bachiller, 2013; Bachiller and Irigoien, 2015; Garrido and Murta, 2011; Olaso-Toca et al., 1999). The juveniles prey on invertebrates, mostly zooplankton (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Mackerel

In the mackerel fish group, Atlantic chub mackerel (*Scomber colias*) and Atlantic mackerel (*Scomber scombrus*) were included. However, the group was parameterized as Atlantic mackerel, as this is the most abundant species of the DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 2.05 t km^{-2} obtained from the TRIENAL acoustic survey (ICES, 2019a).

The Atlantic mackerel can live for over 20 years, maturing at 2-3 years (Jansen and Gislason, 2013). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight-at-age was defined based on the mean weight-at-age information from ICES (2017e). The general length-weight formula of $W = 0.0032 \cdot L^{3.2695}$ from Costa et al. (2017) was used. The growth rate for each age class (mgN per day) was then calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

In the Northeast Atlantic, mackerel spawning starts in the Iberian Peninsula waters in January/February and ends in the North Sea in July. In the spawning area from Spanish and Portuguese waters, spawning starts in January and ends in March (ICES, 2017g). After spawning, most of them migrate in a northerly direction along the west of Ireland and north of Scotland to feed in autumn in the northern North Sea and Norwegian Sea and overwinter along the north of Ireland and Scotland, coming back towards the spring spawning grounds (Uriarte and Lucio, 2001). Based on this information, mackerel's spawning season was assumed from January to March, starting the migration towards the north in April and coming back to the model domain around December. The larval stage lasts 40 days (Froese and Pauly, 2021), and the length of time recruits arrive over was assumed to be this set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality was set at 0.15 per year, a fixed value for decades (ICES, 2017g). Consequently and following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.055 \cdot 10^{-12}$ and $4.11 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were assumed.

During the 2009 blue whiting spawning stock surveys, large amount of mackerel were observed throughout the spawning ground, ranging from 60 to 300 meters (ICES, 2016c) and swimming at around 2 m s^{-1} (Jansen and Gislason, 2013). Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was defined using the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult mackerel's diet consists mainly of blue whiting, supra benthos and macro zooplankton (Bachiller (2013); Bachiller and Irigoien (2015); Olaso, Ignacio et al. (2005) and IEO database). Juvenile mackerel, has a larger fraction of invertebrates in their diet (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Other large pelagic fishes

The other large pelagic fishes group was parameterized based upon Atlantic bonito (*Sarda sarda*), the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 0.14 t km^{-2} obtained from EwE (Corrales et al., 2022).

The age determination has been studied by means of different methodologies, establishing finally a maximum age of 5 years (ICCAT, 2006-2016a). They mature at age 1, when they have a length of 37 cm (Froese and Pauly, 2021). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. Atlantic bonito is a small tuna specie, with a common fork length of 50 cm and about 2 kg, reaching a maximum fork length of 91.4 cm and 5.4 kg (ICCAT, 2006-2016a). The common weight and the length-at-maturity together with the general length-weight formula of $W = 0.00724 \cdot L^{3.1644}$ from ICCAT (2006-2016a) were used to defined the weight-at-age distribution, assuming a linear increase in weight. The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning season information was found for the Mediterranean, which occurs from May to July (ICCAT, 2006-2016a). The recruitment parameters are those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The Atlantic bonito swims at a speed of 0.35 m s^{-1} along the 80-200 m depth (Froese and Pauly, 2021). To take into consideration the depth distribution of all the species included in the group, a depth range of 0-200 m was assumed for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was defined taking advantage of the information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of the adults of this group consists mainly of horse, sardine, anchovy, other planktivorous fishes and microzooplankton (Dhieb et al., 2001; Dorman, 1988; Navarro et al., 2017; Sever et al., 2009; Varela et al., 2019). Among the changes in the diet of juveniles is the cease of horse mackerel as one of the main sources of food (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Albacore

The albacore was initialized with a biomass of 2.03 t km^{-2} (ICCAT, 2016).

Le Gall (1974) estimates a longevity of 15 years. However, tagging experiments have shown that the oldest albacore ever recovered was less than 10 years old (ICCAT, 2006-2016b). Therefore, a maximum age of 10 years was assumed. Juvenile albacores are found during the summer in tropical surface waters, where they grow very quickly reaching around 20 cm at an age of 6 months (Nikolic et al., 2016). In general, there is a lack of exhaustive studies on Atlantic albacore sexual maturity (ICCAT, 2006-2016b). In the model assumptions, 50 % of north and south albacore are mature at age of 5 years, measuring around 90 cm (ICCAT, 2006-2016b; Nikolic et al., 2016), reaching up to 140 cm and 60 kg in weight as adults (Nikolic et al., 2016). The precise fraction of maturity per age class was defined based on ICCAT (2006-2016b), defined in detailed in Section S2, Table S3. The length information mentioned together with the general length-weight formula of $W = 0.0438 \cdot L^{2.825}$ from Nikolic et al. (2016) were used to defined weight-at-age distribution. The growth rate for each age class (mgN per day) was set based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

In the North Atlantic, spawning takes place between April and September (Nikolic et al., 2016). No information was found on recruitment, therefore the recruitment parameters are from the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality is assumed to be 0.3 per year for all year classes (ICCAT, 2006-2016b). Therefore, for the Bay of Biscay Atlantis model mortality rates of $8.219 \cdot 10^{-08}$ per day for both juveniles and adults, were defined.

Its depth distribution in general is relatively shallow, being 95% of the time within the upper 50 m, although sometimes it can be found within the upper 100 m (Goñi et al., 2011b). For this reason, a depth range of 0-100 m was assumed. Detailed vertical distribution can be found in Section S3, Table S6. Along this depth range, juveniles are known to swim faster than adults, at 0.57 m s^{-1} whereas adults swim at 0.45

cm s^{-1} (ICCAT, 2006-2016b). The horizontal distribution was established based on the box proportion of the total area. Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult albacore feeds on mackerel, horse mackerel, sardine, anchovy, other planktivorous fishes, mesopelagic fishes, blue whiting, squids, pelagic crab, zooplankton feeding shrimps, gelatinous zooplankton, macrozooplankton, mesozooplankton (Goñi et al., 2011a; Pusineri et al., 2005). The juvenile's diet, however, feed less on vertebrates and more on invertebrates (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Juveniles and immature albacore seem to be mostly distributed in the Northeast Atlantic during summer, and in the central and southwest Atlantic during winter (Nikolic et al., 2016). When albacore reach maturity, this pattern changes. After this age, albacore migrate from the northeast of the North Atlantic to tropical waters of the southwest of the North Atlantic, and they remain in this region until they completely mature and then spawn. Then they follow an annual migration following warm water, from the south to the north in January until September, returning to the south (Nikolic et al., 2016). The juveniles were thus assumed to enter the model domain in May and leave in mid-October, whereas adults were assumed to stay outside the model domain the whole year (pers. comm. Eider Andonegi). Taking into account the way migration is defined in Atlantis, adults were specified to come in, spawn and leave the same day (pers. comm. Beth Fulton).

Bluefin tuna

The bluefin tuna was initialized with a biomass of 0.10 t km^{-2} (ICCAT, 2017).

Bluefin tuna's lifespan, maturity age and weight-at-age distribution were defined based on information from ICCAT (2006-2016c). Bluefin tuna adults grow at a slower rate than juveniles, but their weight grows faster. They measure about 30-40 cm long and weight about 1kg when hatching, reaching 60 cm long and about 4kg after one year. The first age-at-maturity is stablished at age 3, weighting 20 kg. Detailed fractions of each age class which is mature can be found in Section S2, Table S3, which were defined based on the values from ICCAT (2017). At 10 years, an individual bluefin tuna measures approximately 200 cm and weighs 150 kg, at 20 years old reaching in average 300 cm and 400 kg. We therefore assumed a maximum lifespan of 20 years and a maturity age of 3 years. The weight-at-age distribution was defined based on the age-weight distribution for East Atlantis published by ICCAT

(2006-2016c). Although length-weight parameters were suggested in the ICCAT manual (ICCAT, 2006-2016c), this parameters were considered low comparing with the length-weight parameters of the fish groups from the SE-Australian Atlantis model (Fulton et al., 2004). We therefore used the length-weight parameters from Froese and Pauly (2021) obtaining the general formula of $W = 0.013 \cdot L^{3.01}$. The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

In east Atlantic and east Mediterranean, bluefin tuna spawn from May to mid-June (ICCAT, 2017), and the larval stage duration is set at 28 days (Froese and Pauly, 2021). The length of time recruits arrive over was assumed to be this set in the SE-Australian Atlantis model (Fulton et al., 2004).

The mortality rates for juveniles and adults were calculated based on mortality-at-age rates from ICCAT (2017), being $9.041 \cdot 10^{-08}$ and $3.79 \cdot 10^{-08}$ the mortality rates for juveniles and adults, respectively.

From June to October bluefin tuna is concentrated between 0-30 m and restricted to 50 m overall, while from December to March, the depth range expand to 100-125 m (Arregui et al., 2018). For this reason, a 0-125 m depth range was assumed. Detailed vertical distribution can be found in Section S3, Table S6. They swim at a speed of around 3 m s^{-1} (Froese and Pauly, 2021). The horizontal distribution was defined based on the box proportion of the total area. Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of adult bluefin tuna consists mainly of horse mackerel, sardine and anchovy (De la Serna et al., 2012; Logan et al., 2011; Varela et al., 2014; Varela et al., 2019). The juveniles, however, do not feed on adult large pelagic fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

The Bay of Biscay has been revealed as important summer feeding area for juveniles, as well as an overwintering area for an unexpected proportion of this population (Arregui et al., 2018). For this reason, juveniles were assumed to enter the Bay of Biscay area in May and leave in October (pers. comm. Eider Andonegi). Among adults, a few were documented to enter the Bay of Biscay during the period after spawning migration out of the Mediterranean (Arregui et al., 2018). In consequence, adults were assumed to stay out the whole year (pers. comm. Eider Andonegi). However, Atlantis is modelled in a way that a species can be sent away for one day (Audzijonyte et al. (2017); pers. comm. Beth Fulton). We therefore assumed that adults come in for spawning and leave the same day.

Skates and rays

Skates and rays was parameterized as thornback ray (*Raja clavata*), as it is the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). It was initialized with a biomass of 0.17 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

Thornback ray's maximum age was set at 10 years and a maturity age at 5.6 years (Garcia et al., 2008). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight distribution was defined based on the general length-weight formula of $W = 0.0045 \cdot L^{3.0686}$ (ICES, 2018f) and the estimates of length-at-age published by Serra-Pereira et al. (2008). Once the weight-at-age distribution was defined, the growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

Since no spawning information was found for Bay of Biscay, spawning information from the Gulf of Gabès, south-central Mediterranean Sea, was used. In Gulf of Gabès, actively spawning females occur throughout the year, although the spawning fraction is highest between May and September (Kadri et al., 2014). We therefore assumed spawning period from May to September for the Bay of Biscay Atlantis model. The recruitment parameters were assumed to be this set in the SE-Australian Atlantis model (Fulton et al., 2004).

Based on Froese and Pauly (2021), a mortality of 0.19 per year is set for thornback ray. Following the guidelines from Audzijonyte et al. (2017), mortality rates of $2.602 \cdot 10^{-11}$ and $5.204 \cdot 10^{-11}$ per day for juveniles and adults, respectively, were assumed for the Bay of Biscay Atlantis model.

Thornback ray is found in Western Galicia at depths ranging from 20 to 400 m, specifically in the sedimentary grounds of the continental shelf, but it is most abundant between 50 and 200 m, particularly near 75 m (ICES, 2014a). Considering the depth ranges of all the skates and rays included in the group, a depth range of 0-300 m was assumed for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. Since no swimming speed information was found for the Bay of Biscay, swimming speed information is those set in the SE-Australian Atlantis model (Fulton et al., 2004).

DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d) served to characterize the horizontal distribution. Detailed horizontal distribution can be found in Section S3, Fig. S1.

Adult skates and rays feed on demersal sharks, skates and rays, and on almost all the fish and invertebrate species, although Norway lobster is the main source of food (Ajayi (1982); Ellis et al. (1996); Morato et al. (2003); Ponte et al. (2016); Valls Mir (2017) and IEO database). Juvenile skates and rays, however, do not eat sharks, skates and rays, adult large and medium demersal fishes, but eat more invertebrate species (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Deep-water sharks

This group was characterized as blackmouth catshark (*Galeus melastomus*), the most abundant species of DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). The group was initialized with a biomass of 0.05 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

The maximum longevity for blackmouth catshark in the Northeast Atlantic is established for males, at age 8 (Froese and Pauly, 2021). The age of maturity was assumed to be at age 3, the age at which the blackmouth catshark mature in the Ionian Sea (Froese and Pauly, 2021). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. Males mature between 34 and 42 cm, reaching at least 61 cm. Females, however, mature between 39 and 45 cm, and can reach a length of 90 cm (Ebert and Stehmann, 2013). Based on this information, a maturity length of 40 cm and a length-at-last age class of 55 cm were assumed. This length information together with the general length-weight formula of $W = 0.00263 \cdot L^{3.03}$ from Froese and Pauly (2021) were used to characterize the weight distribution per age. The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 1 year. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning period was obtained for the Ionian Sea, where the individuals apparently reproduce from the end of February to September (Froese and Pauly, 2021). The recruitment parameters for this group were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

Natural mortality information was obtained for birdbeak shark from Irvine et al. (2012). The natural mortality ranges from 0.061 to 0.191 for males and 0.051 to 0.145 for females, therefore, a natural mortality of 0.1128 per year was assumed. With regard to the need of low natural mortality (Audzijonyte et al., 2017), mortality rates of $1.545 \cdot 10^{-12}$ and $3.09 \cdot 10^{-08}$ per day for juveniles and adults, respectively, were defined.

The blackmouth catshark is found on the outer continental shelves and upper slopes, mainly between 200 to 500 m, although occasionally can be found up to 55 m and down to 2000 m (Ebert and Stehmann, 2013). Other sharks included in the group are found deeper, such as Portuguese dogfish (*Centroscymnus coelolepis*), 270-3675 m (ICES, 2010a), birdbeak dogfish (*Deania calcea*), 60-1490 m (Ebert and Stehmann, 2013), and knifetooth dogfish (*Scymnodon ringens*), 200-1600 m (Ebert and Stehmann, 2013). We therefore assumed a depth range of 0-3600 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. No information on swimming speed for blackmouth catshark was found, so swimming speed for Portuguese dogfish was used to initialize the model, which based on Bagley et al. (1994) is set at 0.1043 m s^{-1}. The horizontal distribution was characterized using information from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

This group feeds on almost all fish groups included in the model, although the primary source of food are the blue whiting, deep-sea fishes, benthic cephalopods, zooplankton feeding shrimps, decapods and suprabenthos (Barría et al. (2015); Ellis et al. (1996); Moura et al. (2005); Navarro et al. (2014); Neiva et al. (2006); Preciado et al. (2009) and IEO database). Detailed diet matrix can be found in Section S4, Table S7.

Pelagic sharks

The pelagic shark group was parameterized as blue shark (*Prionace glauca*), the most abundant species in the area (pers. comm. Guzman Diez). It was initialized with a biomass of 0.06 t km^{-2} obtained from the EwE model (Corrales et al., 2022), that was estimated using a realistic ecotrophic efficiency of the group (EE). This ecotrophic efficiency indicates the proportion of the production or total mortality that is actually explained in the model (Christensen and Walters, 2004).

The maximum estimated age for blue shark is about 20 years whilst the maturity age for females is between 5 and 7 years, and for males between 4 and 5 years (Ebert and Stehmann, 2013). We therefore assumed a maturity age of 4 years. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight for each age class was estimated using the length-weight relationship together with estimates of length-at-age. The general length-weight formula of $W = 0.00437 \cdot L^{3.11}$ from Froese and Pauly (2021) was used, whereas the lengths are based on those reported at Skomal and Natanson (2003). Growth rate for each age class (mgN per day) were calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a given time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

There was no information of spawning, recruitment nor mortality available for this group in the Bay of Biscay. However, in the Indian Ocean, blue shark spawn between March and June (Froese and Pauly, 2021), so a spawning period of March-June was assumed for the Bay of Biscay Atlantis model. The recruitment parameters are those set in the SE-Australian Atlantis model (Fulton et al., 2004). The mortality was assumed to be 0.2 per year (pers. comm. Cecilie Hansen), so as a result, mortality rates of $5.479 \cdot 10^{-08}$ and $2.7395 \cdot 10^{-12}$ per day for juveniles and adults, respectively, was defined in the Bay of Biscay Atlantis model.

Blue sharks can forage up to 600 meters deep (Pusineri et al., 2008) and swim a total of 2 km at a rate of 0.3 to 0.6 m s^{-1} (Klimley et al., 2002). With the aim of taking into consideration the maximum depth of all the sharks included in the group, a depth range of 0-700 m was assumed for the group as a whole. The vertical and horizontal distribution was described based on each layer proportion of the total water column and the box proportion of the total area, respectively. Detailed vertical and horizontal distribution can be found in Section S3, Table S6 and Fig. S1, respectively.

The adult pelagic sharks feed mainly on other large pelagic fishes, mackerel, anchovy, other planktivorous fishes and medium demersal fishes (Clarke et al., 1996; Joyce et al., 2002; Maia et al., 2006; Preti et al., 2008), although in the juvenile pelagic sharks diet, among others, other large pelagic and medium demersal adult fishes cannot be found (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Demersal sharks

This group was parameterized based on the most abundant species from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d), lesser-spotted catshark (*Scyliorhinus canicula*). It was initialized with a biomass of 0.13 t km^{-2} obtained from DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d).

Initially, the maximum age for lesser-spotted catshark was set at 14.6 years, the maximum time achieved at liberty considering results from tag-recapture data (ICES, 2018f). However, according to the tagging length, the estimated life expectancy of this specie could be at least 20 years (ICES, 2018f). As a result, a longevity of 20 years was assumed. Considering the maximum length of 75 cm observed in the annual bottom trawl surveys carried out by the IEO along the Cantabrian Sea and the von Bertalanffy length-at-infinity of 69.3 cm (ICES, 2018f), a 60 cm length-at-last age class was assumed. Rodríguez-Cabello et al. (1998) estimated the maturity age at 7 years from a length-at-maturity of 54.2 cm obtained for this specie and using the von Bertalanffy growth equation derived from tag-recapture data. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. There was no weight information found, so the weight-at-age distribution was characterized using the general length-weight formula of $W = 0.0022 \cdot L^{3.1194}$ from ICES (2018f), and the previous mentioned length-at-maturity and length-at-last age class. The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

The spawning can take place almost all year around (Ellis et al., 2009), although in the Languedian Coast, France, it takes place from October to August (Froese and Pauly, 2021). Therefore, a spawning period from October to August was assumed for the Bay of Biscay Atlantis model. In the North Atlantic, the gestation period was estimated at five to six months, with a fecundity of 29-62 eggs per year (Ellis et al., 2009). In the Atlantis models the total number of new recruits per individual, not per female, must be specified (Audzijonyte et al., 2017). For this reason, we divided by 2 the number of eggs, assuming a fecundity of 15 eggs per individual per year.

No information of mortality was obtained for lesser-spotted catshark. We therefore decided to use mortality rates for picked dogfish defined in NoBa Atlantis model (Hansen et al., 2016), $3.52 \cdot 10^{-09}$ and $5.74 \cdot 10^{-10}$ per day for juveniles and adults, respectively.

The lesser-spotted catshark is particularly abundant over sandy, gravelly and muddy bottom in the Cantabrian Sea, at depths ranging from 50 to 500 m, although primarily at depths from 150-300 m (Rodríguez-Cabello et al., 1998). Picked dogfish (*Squalus acanthias*) and lognose spurdog (*Squalus blainville*) are found at depths of 600 m (Ebert and Stehmann, 2013) and 780 m (Froese and Pauly, 2021). We therefore assumed a depth range of 0-700 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. No information of swimming speed for lesser-spotted catshark was found, but for picked dogfish who swims at a speed of around 2 m s^{-1} (Domenici et al., 2004). The horizontal distribution was described using the information collected from the DEMERSALES and EVHOE bottom trawl surveys (ICES, 2017d). Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult demersal sharks feed on almost all the fish groups included in the model, although the main source of food is blue whiting and decapods (47% of the diet) (Ellis et al. (1996); Olaso, I et al. (2005) and IEO database). Juvenile sharks do not feed on adult sharks and adult medium demersal fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Toothed cetaceans

The toothed cetaceans group was parameterized based on bottlenose dolphin (*Tursiops truncatus*), the most abundant specie based on Laran et al. (2017). It was initialized with 20210 cetaceans, which was calculated using information of individuals per km^2 for 2012 from Pettex et al. (2017) and doing a reconstruction of the time series of the numbers of cetaceans for the period 2004-2016 with Authier et al. (2018); the initial abundance value used corresponded to the year 2004.

The female bottlenose dolphins can live more than 57 years, whereas the males can live up to 48 years, reaching an estimated body weight of around 210 kg (Perrin et al., 2009). Therefore, a maximum longevity of 60 years was assumed. Females reach sexual and physical maturity before males. The age at which they reach sexual maturity varies by region, but females typically reach sexual maturity between the ages of 5 and 13, while male sexual maturity occurs between the ages of 9 and 14 (Perrin et al., 2009).

Consequently, a maturity age of 5 years was assumed. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The estimation of the weight-at-age distribution was based on the information of the estimated body weight mentioned above, and calf and mature adult weight data provided by Perrin et al. (2009), assuming a linear trend on the weight distribution. The length-weight relationship was defined using the general formula of $W = 0.01 \cdot L^3$ from Girardin et al. (2018). The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a time window of 6 years. Detailed growth rate per age class can be found in Section S2, Table S4.

No information on spawning and recruitment was found for the Bay of Biscay, hence, these parameters were assumed to be those set in the SE-Australian Atlantis model (Fulton et al., 2004).

The natural mortality was assumed to be 0.2 per year (pers. comm. Cecilie Hansen). In consequence, converting to daily mortality and implementing the recommendations of Audzijonyte et al. (2017), mortality rates of $5.479 \cdot 10^{-08}$ and $2.7395 \cdot 10^{-12}$ per day for juveniles and adults, respectively, were assumed.

Bottlenose dolphins are found between 100 and 200 m isobaths (Certain et al., 2008), swimming at a speed of around 2 m s^{-1} (FISH and HUI, 1991). Other cetaceans included in the group have deeper vertical distribution, such as long-finned pilot whale (*Globicephala melas*), 0-600 m (Perrin et al., 2009), and striped dolphin (*Stenella coeruleoalba*), 200-700 m (Ringelstein et al., 2006). We therefore assumed a depth range of 0-700 m for the group as a whole. Detailed vertical distribution can be found in Section S3, Table S6. The horizontal distribution was established based on the shelf (depth < 200 m), slope (200 < depth < 2000 m) and oceanic (depth > 2000 m) strata classification of the area from Laran et al. (2017), and assuming a homogeneous distribution upon the boxes of each area. Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of adult toothed cetaceans consists mainly of sardine, blue whiting, medium demersal fishes and cephalopods (De Pierrepont et al., 2005; González et al., 1994; Marçalo et al., 2018; Meynier et al., 2008; Santos and Borges, 2001; Santos et al., 2007; Santos et al., 2013; Santos et al., 2008; Spitz et al., 2011; Spitz, J. et al., 2006; Spitz, Jérôme et al., 2006). Juvenile toothed cetaceans, however, do not feed on medium demersal adult fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Baleen whales

The baleen whales group was parameterized based upon fin whale (*Balaenoptera physalus*), as it is the most abundant specie based on Laran et al. (2017). The initial abundance value was 831 whales, which was calculated using information of individuals per km^2 for 2012 from Pettex et al. (2017) and doing a reconstruction of the time series of the numbers of whales for the period 2004-2016 with Authier et al. (2018); the initial abundance value used corresponded to the year 2004.

Fin whale´s longevity has not been determined, but individuals of up to 80-90 years old have been identified (Perrin et al., 2009). Based on this information, a maximum longevity of 90 years was assumed. In the Northern Hemisphere, the body mass of adults usually ranges from 40000 to 50000 kg, and the calf weight from 1750 to 1850 kg (Perrin et al., 2009). The sexual maturity is reached at a weight of 30000 kg, which corresponds to a length of approximately 17.5 m in males and 18.5 m in females (Perrin et al., 2009). These lengths are typically associated with ages of 6-7 years in males and 7-8 years in females (Perrin et al., 2009). So, therefore, we assumed a maturity age of 6 years. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight information previously mentioned was used to characterize the weight-at-age distribution, and therefore, the growth rate for each age class (mgN per day) calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a time window of 9 years. Detailed growth rate per age class can be found in Section S2, Table S4. The length-weight relationship was estimated with the general formula of $W = 0.0015 \cdot L^{3.46}$ (Perrin et al., 2009).

Fin whales mate in winter, from December through to February, the gestation lasting about 11 months (Norsk Polarinstitutt, 2018). During their first migration, they accompany their mothers to higher latitudes, and they remain with their mother for about 6-7 months (Norsk Polarinstitutt, 2018), so the arrival of recruits to the model was assumed 6.5 months.

No information about mortality was found for the Bay of Biscay, therefore, the mortality rates were those defined in the NoBa Atlantis model (Hansen et al., 2016), $3.04 \cdot 10^{-06}$ and $5.10 \cdot 10^{-08}$ per day for juveniles and adults, respectively.

The vertical distribution was defined considering a dive range of 100-200 m (Perrin et al., 2009). Detailed vertical distribution can be found in Section S3, Table S6. The fin whales dive at around 1 m s^{-}

[1] (Edwards et al., 2015). The horizontal distribution was established based on the shelf (depth < 200 m), slope (200 < depth < 2000 m) and oceanic (depth > 2000 m) strata classification of the area from Laran et al. (2017), and assuming a homogeneous distribution upon the boxes of each area. Detailed horizontal distribution can be found in Section S3, Fig. S1.

The main source of food of baleen whales is macrozooplankton, mackerel, sardine, anchovy, other planktivorous fishes, cods, small demersal fishes, squids and gelatinous zooplankton (Clarke et al., 1993; Giménez et al., 2013; Haug et al., 1995; Pierce et al., 2004; Ryan et al., 2014; Spitz et al., 2011). Detailed diet matrix can be found in Section S4, Table S7.

Surface feeding seabirds

Surface feeding seabirds were parameterized as northern gannet (*Morus bassanus*), as it is the most abundant specie based on Pettex et al. (2017). An initial abundance of 541933 birds was used, which was calculated using information of individuals per km^2 for 2012 from Pettex et al. (2017) and doing a reconstruction of the time series of the numbers of birds for the period 2004-2016 with Authier et al. (2018); the initial abundance value used corresponded to the year 2004.

They live around 16-24 years (Phang, 2017), so a maximum longevity of 20 years was assumed. The fraction of mature per age class was based on the assumption of a total maturity for species at year 3, the age at which northern gannets mature (Winn and Olla, 2012). Detailed fractions of each age class which is mature can be found in Section S2, Table S3. It was not possible to find weight-at-age class, hence, a weight distribution was calculated based upon the general length-weight formula of $W = 0.02 \cdot L^3$ from Girardin et al. (2018) and information of hatching growth and mass range from Animal Diversity Web (2018). Their weight at hatching is about 79.3 gr and they reach a weight between 2.47 and 3.61 kg in the last years of life. The growth rate for each age class (mgN per day) was calculated based on the amount of weight each individual needs to gain to reach the weight of the next age class within a time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

Females lay a single egg from the end of April through mid-June, although they may lay up to 3 replacement eggs if they are lost (Animal Diversity Web, 2018). They need 42 to 46 days to hatch, and 90 days to become independent (Animal Diversity Web, 2018), so the arrival of recruits to the model was assumed 90 days.

The first year after hatching has the highest mortality rate, in particular during the period just after fledging when immature individuals are unable to fly. Approximately 65% of immature northern gannets do not survive to adulthood, and adult mortality rates are expected to be less than 6%. Therefore, a mortality of 0.65 and 0.06 individuals per year for juveniles and adults, respectively, was used. Converting this mortality rates to daily mortality and implementing the recommendations of (Audzijonyte et al., 2017), mortality rates of $1.781e^{-07}$ and $1.644e^{-08}$ per day for juveniles and adults, respectively, were assumed.

The northern gannet dive up to 30 m (Winn and Olla, 2012), and we therefore assumed that they are present down to 30 m depth. Detailed vertical distribution can be found in Section S3, Table S6. Northern gannets travel down the water column at 0.81 m s^{-1} (Ropert-Coudert et al., 2009). As in the other seabirds group, the horizontal distribution was based on the work by Pettex et al. (2017) and assuming a homogeneous distribution upon the boxes of each area. Detailed horizontal distribution can be found in Section S3, Fig. S1.

The adult seabirds feed on almost all pelagic groups, small demersal fishes and discards (Alonso et al., 2015; Furness and Todd, 1984; Hamer et al., 2000; Moreno et al., 2010; Ramos et al., 1998). The juvenile seabirds, however, do not eat adult large fishes (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Based on the work by Pettex et al. (2017), this seabirds can also be considered winter visitors.

Diving and pursuit divers seabirds

This functional group was parameterized based upon data for common murre (*Uria aalge*). Based on Pettex et al. (2017), the common murre is the most abundant specie in the Bay of Biscay. The model was initialized with an abundance of 255653 birds, which was calculated using information of individuals per km^2 for 2012 from Pettex et al. (2017) and doing a reconstruction of the time series of the numbers of birds for the period 2004-2016 with Authier et al. (2018); the initial abundance value used corresponded to the year 2004.

The longevity is about 23 years (The Wildlife Trusts, 2018), and adult birds can reach a weight around 1.250 kg (Wikipedia, 2018), while chicks weigh between 55-95 g when they are hatched (Animal Diversity Web, 2018). The common murre mature at 3 years old (Winn and Olla, 2012), so the fraction of each age class that is sexually mature was assumed to be 1 at 3 years old. Detailed fractions of each age class which is mature can be found in Section S2, Table S3. The weight distribution was defined using chicks and adult weight previously mentioned and the general length-weight formula of $W = 0.02 \cdot L^3$ from Girardin et al. (2018). The growth rate for each age class (mgN per day) was calculated based on the weight each individual needs to gain to reach the weight of the next age class within a time window of 2 years. Detailed growth rate per age class can be found in Section S2, Table S4.

They have an average of 1 egg per season (Animal Diversity Web, 2018). The eggs are laid between May and July in populations breeding on the Atlantic coast (Animal Diversity Web, 2018). Both parents participate in the incubation process, which takes between 28 and 34 days divided into 12-24 hour shifts (Animal Diversity Web, 2018). After 18-25 days, chicks leave the nest (Animal Diversity Web, 2018), so the arrival of recruits to the model was assumed 21 days.

With no available information on mortality for our area, mortality rates from the NoBa Atlantis model were used (Hansen et al., 2016), $5.37 \cdot 10^{-9}$ and $2.74 \cdot 10^{-11}$ per day were assumed for juveniles and adults, respectively.

The common murre's mean maximum dive depth is found at 65.65 m (Browning et al., 2018), so a depth range of 0-70 m was assumed. Detailed vertical distribution can be found in Section S3, Table S6. They dive at around 0.9 m s^{-1} (Rory et al., 2002). The horizontal distribution was based on the neritic (depth < 200 m), slope (200 m < depth < 2000 m) and oceanic (> 2000 m) strata classification of the area from Pettex et al. (2017), and assuming a homogeneous distribution upon the boxes of each area. Detailed horizontal distribution can be found in Section S3, Fig. S1.

The diet of adult seabirds consist mainly of sardine, anchovy, other planktivorous fish and discards (Alvarez, 1998; Anderson et al., 2014; Arcos and Oro, 2002; Fortin et al., 2013; Gomes, 2015; Granadeiro et al., 1998; Mirra, 2010). The juveniles, however, do not eat adult large fish due to regurgitation (pers. comm. Xavier Corrales). Detailed diet matrix can be found in Section S4, Table S7.

Most of the seabird groups encountered in the Eastern North Atlantic are more abundant during winter (November-February period) (Pettex et al., 2017), and could therefore be considered winter migrators.

Section S2 – Final parameter values for the Bay of Biscay Atlantis model, after calibration.

Table S2. Initial biomass (t), growth rate (mgN per day) and mortality rates (per day) for invertebrates.

Group	Initial condition	Growth (mgN per day)	Mortality (per day)	
	Biomass (t)		Linear	Quadratic
Benthic cephalopods	63552.8892	0.0014	0	$1 \cdot 10^{-10}$
Squids	41295.6458	0.0006	0	$1 \cdot 10^{-10}$
Norway lobster	16196.8662	0.006	0	0.0000001
Pelagic crab	79601.6974	0.05	0	0.0000001
Zooplankton feeding shrimps	176609.2186	0.0001	0	$1 \cdot 10^{-10}$
Benthos-feeders decapods	264557.8056	0.02	0	0.0000001
Detritus-feeders decapods	229140.5263	0.02	0	0.0000001
Bivalves	125731.1736	0.02	0	0.0000001
Polychaetes	570980.7028	0.02	0	0.0000001
Suprabenthos	366213.6138	0.02	0	0.0000001
Echimoderms	162923.8930	0.005	0	0.0000001
Other invertebrates	1054992.5732	0.04	0	0.0000001
Gelatinous zooplankton	118746.335	0.02	0	0.000005
Macrozooplankton	744449.9483	0.05	0	0.000001
Mesozooplankton	1123973.4514	0.025	0	0
Microzooplankton	802838.1795	0.05	0.0001	0
Primary producers	71293.0813	1	0	0
Large phytoplankton	616278.8765	0.1	0	0
Small phytoplankton	1083370.8592	0.1	0.02	0
Pelagic bacteria	831917.5150	1.2	0	0
Sediment bacteria	831917.5150	1.5	0	0

Table S3. Initial biomass (t), age class structure and reproduction parameters for vertebrates. Two reproduction relationships were used: a modified Beverton-Holt spawn and species biomass dependent recruitment relationship (BH) or a number of recruits per adult.

Group	Initial condition	
	Biomass (t)	Age per class
Diving and pursuit divers' seabirds	169.3699	2
Surface feeding seabirds	999.6767	2
Baleen whales	23231.3078	9
Toothed cetaceans	5611.5053	6
Demersal sharks	19013.6750	2
Pelagic sharks	9267.4457	2
Deep water sharks	7407.7733	1
Skates and rays	25398.8806	1
Bluefin tuna	15099.6053	2
Albacore	296592.8006	1
Other large pelagic fishes	20575.1807	1
Mackerel	299444.7738	2
Horse mackerel	349211.1068	2
Sardine	251321.1936	1
Anchovy	75124.4587	1
Other planktivorous fishes	168586.9675	3
Mesopelagic fishes	262103.4563	1
Anglerfish	30170.4836	2
Seabass	24618.7846	3
Blue whiting	287872.5183	1
Hake	28117.7286	1
Cods	65258.4241	1
Megrim	13966.5248	2
Common sole	19850.0280	3
Flatfishes	16956.3365	1
Mullets	10837.5403	1
Large demersal fishes	67801.7133	2
Medium demersal fishes	31536.7536	4
Small demersal fishes	135260.8628	1
Deep-sea fishes	9488.0876	1

Table S3 (continued)

Group	Initial condition										
	Class at first maturity	Fraction of the age class which is mature									
		Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
Diving and pursuit divers seabirds	2	0	1	1	1	1	1	1	1	1	1
Surface feeding seabirds	2	0	1	1	1	1	1	1	1	1	1
Baleen whales	1	0.75	1	1	1	1	1	1	1	1	1
Toothed cetaceans	1	1	1	1	1	1	1	1	1	1	1
Demersal sharks	4	0	0	0	1	1	1	1	1	1	1
Pelagic sharks	3	0	0	1	1	1	1	1	1	1	1
Deep water sharks	4	0	0	0	1	1	1	1	1	1	1
Skates and rays	6	0	0	0	0	0	1	1	1	1	1
Bluefin tuna	2	0	0.125	0.75	1	1	1	1	1	1	1
Albacore	6	0	0	0	0.1	0.5	1	1	1	1	1
Other large pelagic fishes	2	0	1	1	1	1					
Mackerel	2	0	1	1	1	1	1	1	1	1	1
Horse mackerel	2	0	0.5	1	1	1	1	1	1	1	1
Sardine	2	0	0.47	0.992	0.998	0.999	0.999	1	1	1	1
Anchovy	2	0	0.5	1							
Other planktivorous fishes	2	0.03	0.68	1	1	1	1	1	1	1	1
Mesopelagic fishes	2	0	1	1	1	1	1	1	1		
Anglerfish	3	0	0	0.125	0.31	0.5	0.5	0.56	0.81	1	1
Seabass	2	0	0.067	0.652	0.942	0.993	0.999	1	1	1	1
Blue whiting	3	0	0	1	1	1	1	1	1	1	1
Hake	3	0	0	0.5	1	1	1	1	1	1	1
Cods	3	0	0	1	1	1	1				
Megrim	2	0.25	0.77	0.98	1	1	1	1	1	1	1
Common sole	2	0.44	0.93	1	1	1	1	1	1	1	1
Flatfishes	4	0	0	0	1	1	1	1	1	1	1
Mullets	2	0	0.54	0.65	1	1	1	1	1	1	1
Large demersal fishes	3	0	0	1	1	1	1	1	1	1	1
Medium demersal fishes	4	0	0	0	1	1	1	1	1	1	1
Small demersal fishes	3	0	0	1	1	1	1	1	1	1	1
Deep-sea fishes	3	0	0	1	1	1	1	1	1	1	1

Table S3 (continued)

Group	Recruitment		
	BH α (10^{10})	BH β (10^{10})	# per adult
Diving and pursuit divers seabirds			1
Surface feeding seabirds			0.7
Baleen whales			0.03
Toothed cetaceans			0.04
Demersal sharks			2
Pelagic sharks			0.05
Deep water sharks			0.5
Skates and rays			0.2
Bluefin tuna	0.09	0.1	
Albacore	0.05	3	
Other large pelagic fishes	0.0007	0.8	
Mackerel	0.15	3	
Horse mackerel	0.09	4	
Sardine	0.1	2.5	
Anchovy	2.5	1	
Other planktivorous fishes	0.12	2	
Mesopelagic fishes	0.7	1.5	
Anglerfish	0.001	0.3	
Seabass	0.0001	0.2	
Blue whiting	0.1	2	
Hake	0.001	0.4	
Cods	0.7	0.5	
Megrim	0.0009	0.04	
Common sole	0.008	0.2	
Flatfishes	0.0459	0.1	
Mullets	9	0.08	
Large demersal fishes	0.00009	0.5	
Medium demersal fishes	0.013	0.2	
Small demersal fishes	0.015	1	
Deep-sea fishes	0.0009	0.1	

Table S4. Length-weight relationship and growth rate (mgN per day) per class for vertebrates.

Group	Length/weight	
	a	b
Diving and pursuit divers seabirds	0.02	3
Surface feeding seabirds	0.02	3
Baleen whales	0.0015	3.46
Toothed cetaceans	0.01	3
Demersal sharks	0.0022	3.1194
Pelagic sharks	0.0044	3.11
Deep water sharks	0.0026	3.03
Skates and rays	0.0045	3.0686
Bluefin tuna	0.0126	3.01
Albacore	0.0438	2.825
Other large pelagic fishes	0.0072	3.1644
Mackerel	0.0032	3.2695
Horse mackerel	0.0073	3.0254
Sardine	0.0059	3.077
Anchovy	0.007	3.017
Other planktivorous fishes	0.0305	2.791
Mesopelagic fishes	0.0017	3.431
Anglerfish	0.0246	2.8561
Seabass	0.0125	2.9485
Blue whiting	0.00375	3.082
Hake	0.00513	3.074
Cods	0.0086	2.98
Megrim	0.00649	3.0114
Common sole	0.00475	3.1809
Flatfishes	0.00137	3.543
Mullets	0.00512	3.2956
Large demersal fishes	0.00023	3.4991
Medium demersal fishes	0.01072	3.08
Small demersal fishes	0.00856	3.131
Deep-sea fishes	0.00129	3.232

Table S4 (continued)

Group	Growth per age class (mgN per day)									
	1	2	3	4	5	6	7	8	9	10
Diving and pursuit divers seabirds	1.8025	15.688	24.7003	40.3883	56.0763	71.7643	87.4523	103.1403	118.8283	134.5163
Surface feeding seabirds	0.1906	9.428	11.3338	20.7618	30.1899	39.6179	49.0459	58.4739	67.9019	77.33
Baleen whales	$5.94\ 10^{4}$	$5.01\ 10^{4}$	$3.47\ 10^{5}$	$3.97\ 10^{5}$	$4.47\ 10^{5}$	$4.97\ 10^{5}$	$5.47\ 10^{5}$	$5.97\ 10^{5}$	$6.48\ 10^{5}$	$6.98\ 10^{5}$
Toothed cetaceans	48.8665	1928.439	4371.762	6300.2	8228.64	$1.02\ 10^{4}$	$1.21\ 10^{4}$	$1.40\ 10^{4}$	$1.59\ 10^{4}$	$1.79\ 10^{4}$
Demersal sharks	0.339	1.695	3.39	5.085	6.78	7.2017	7.6234	8.0451	8.4668	8.8885
Pelagic sharks	14.3784	1141.334	1500.795	3108.658	4790.895	6314.149	7589.873	8599.201	9377.049	$1.02\ 10^{4}$
Deep water sharks	0.7531	3.7655	7.5309	11.2964	15.0619	19.14	23.2182	27.2963	31.3745	35.4527
Skates and rays	0.2451	3.4355	4.6611	11.7851	21.5518	32.4667	46.6020	59.5766	80.3888	98.8719
Bluefin tuna	0.0095	0.0477	0.9537	3.4968	7.3116	11.4442	15.8947	20.9809	25.7493	29.8819
Albacore	1.9941	137.6657	369.0905	713.2548	1057.419	1401.583	1745.748	2293.035	2840.323	3387.61
Other large pelagic fishes	1.5957	55.8504	111.7008	186.6198	261.5387					
Mackerel	0.9299	4.6453	6.1964	7.9588	9.1164	10.0076	11.5277	13.247	15.453	17.659
Horse mackerel	0.0946	0.4732	0.9464	1.6021	2.2578	2.9134	3.5691	4.2247	4.8804	5.5361
Sardine	0.2004	0.2535	1.2557	1.6751	1.9358	2.0007	2.0944	2.2507	2.4021	2.4706
Anchovy	0.1332	0.3456	1.0118							
Other planktivorous fishes	0.0051	0.1062	0.1316	0.2734	0.3858	0.4581	0.5038	0.5254	0.5361	0.5446
Mesopelagic fishes	0.0351	0.1757	0.3513	0.527	0.7027	0.8783	1.054	1.2297		
Anglerfish	0.05	29.7381	35.3052	81.9448	156.4855	284.5126	369.919	490.1862	839.1639	992.0211
Seabass	0.4727	4.7268	9.4535	18.4817	27.5099	36.5381	45.5662	54.5944	63.6226	72.6508
Blue whiting	0.0919	0.4595	0.919	1.3785	2.6593	3.94	5.2208	6.5015	7.7823	9.0631
Hake	5.8495	59.4645	88.7118	20.8626	44.0947	82.8911	142.2488	208.4211	337.8097	518.3536
Cods	0.0315	1.1017	2.2033	3.305	5.837	8.369				
Megrim	0.026	2.6229	3.2727	8.1723	14.6614	23.7769	36.0722	49.0821	62.0921	75.102
Common sole	0.0639	0.8205	1.1401	1.6895	1.952	2.0586	2.0712	2.0838	2.0965	2.1091
Flatfishes	0.0184	0.0922	0.1845	0.2767	0.369	0.4612	0.5535	0.6457	0.738	0.8302
Mullets	0.2292	2.0287	3.1748	5.061	6.8812	8.7882	9.2902	9.7923	10.2944	10.7964
Large demersal fishes	0.2449	33.6371	39.7603	112.3663	223.1934	387.7967	584.5923	716.6375	745.4305	775.0265
Medium demersal fishes	0.1728	0.5068	1.3707	1.8774	2.0271	2.4944	3.1486	3.4482	3.6837	3.9192
Small demersal fishes	0.1407	0.8438	1.5474	2.5041	3.3546	4.0373	4.8697	5.7947	6.7196	7.6446
Deep-sea fishes	0.1366	3.4162	6.8324	10.2486	13.6648	17.0811	20.4973	23.9135	27.3297	30.7459

Table S5. Mortality rates (per day) for vertebrates.

Group	Mortality (per day)			
	Linear		Quadratic	
	Juvenile	Adult	Juvenile (10^{-8})	Adult (10^{-8})
Diving and pursuit divers seabirds	0	0	53.7	27.4
Surface feeding seabirds	0	0	17.81	1.644
Baleen whales	0	0	3040	510
Toothed cetaceans	0	0	0.02739	547.9
Demersal sharks	0	0	0.352	0.0574
Pelagic sharks	0	0	0.02739	54.79
Deep water sharks	0	0	0.0001545	3.09
Skates and rays	0	0	0.002602	0.005204
Bluefin tuna	0	0	9.041	3.79
Albacore	0	0	0.08219	8.219
Other large pelagic fishes	0	0	0.001192	0.002384
Mackerel	0	0	$2.055 \cdot 10^{-12}$	$4.11 \cdot 10^{-32}$
Horse mackerel	0	0	0.0002055	0.000411
Sardine	0	0	$2.297 \cdot 10^{-7}$	0.0001142
Anchovy	0	0	0.001644	0.00003288
Other planktivorous fishes	0	0	0.0002192	0.0004384
Mesopelagic fishes	0	0	$6.25 \cdot 10^{-12}$	$1 \cdot 10^{-9}$
Anglerfish	0	0	3.082	0.6164
Seabass	0	0	0.06575	0.006575
Blue whiting	0	0	0.0002739	0.000005479
Hake	0	0	0.548	0.001096
Cods	0	0	0.00123	$5.21 \cdot 10^{-6}$
Megrim	0	0	0.00002739	0.00005479
Common sole	0	0	0.000137	0.000274
Flatfishes	0	0	0.0002739	0.0005479
Mullets	0	0	0.2863	0.01087
Large demersal fishes	0	0	0.0002739	0.05479
Medium demersal fishes	0	0	0.0001644	0.03288
Small demersal fishes	0	0	0.000589	0.001178
Deep-sea fishes	0	0	0.0006301	0.0003151

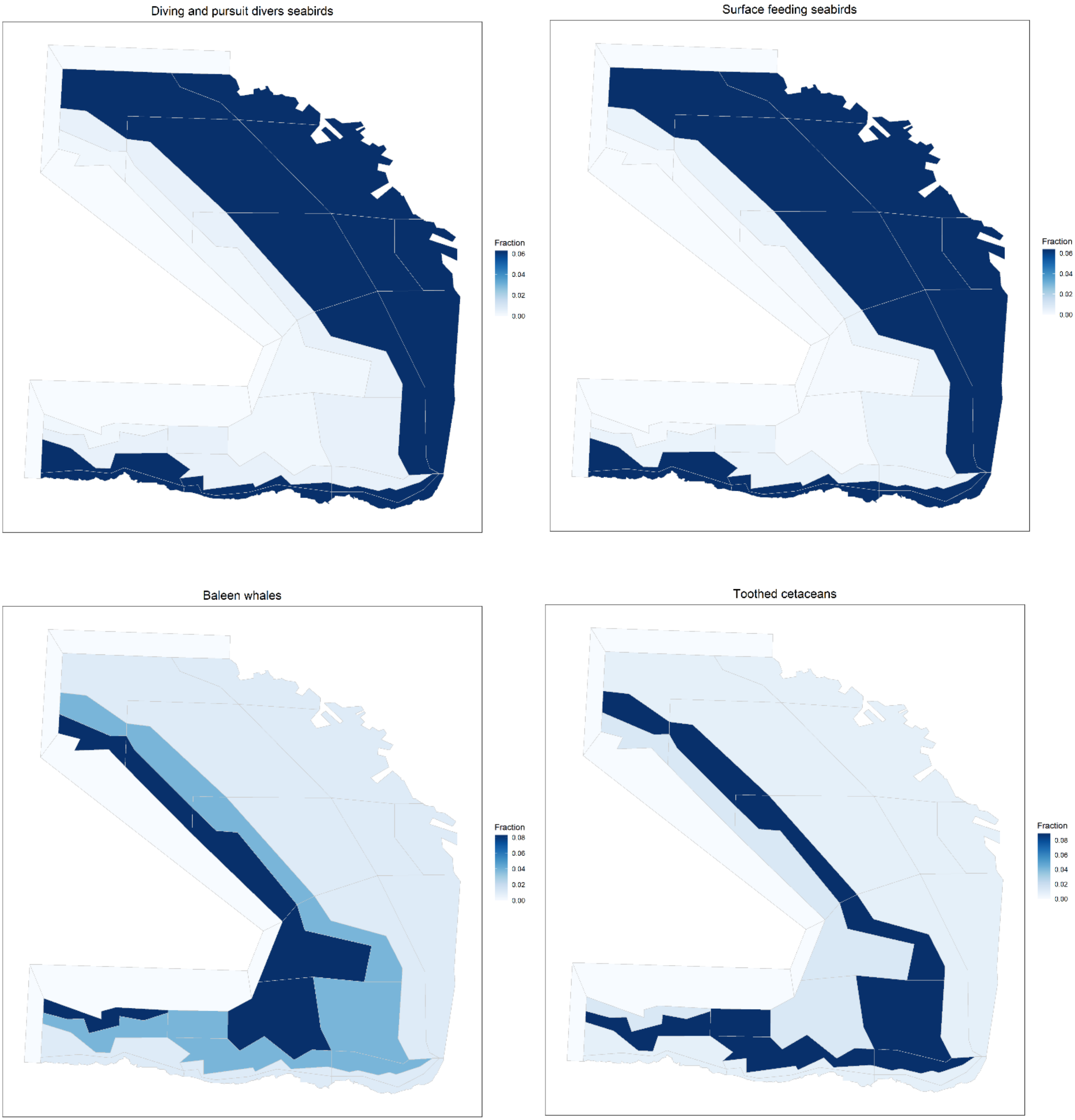
Section S3 – Initial spatial structure of the functional groups included in the Bay of Biscay Atlantis model.

Table S6. Fractions of populations of juveniles and adults at daytime and night-time. L1 is the layer closest to the sediment, while L5 is the surface layer. The fractions must sum up to 1 for each of the groups.

Group	L1	L2	L3	L4	L5
Diving and pursuit divers seabirds	0	0	0	0.29	0.71
Surface feeding seabirds	0	0	0	0	1
Baleen whales	0	0	1	0	0
Toothed cetaceans	0.29	0.43	0.14	0.07	0.07
Demersal sharks	0.29	0.43	0.14	0.07	0.07
Pelagic sharks	0.29	0.43	0.14	0.07	0.07
Deep water sharks	0.861	0.083	0.028	0.014	0.014
Skates and rays	0	0.33	0.33	0.17	0.17
Bluefin tuna	0	0	0.2	0.4	0.4
Albacore	0	0	0	0.5	0.5
Other large pelagic fishes	0	0	0.5	0.25	0.25
Mackerel	0	0.4166667	0.4166667	0.1666667	0
Horse mackerel	0	0.2	0.4	0.2	0.2
Sardine	0	0	0.333333333	0.333333333	0.333333333
Anchovy (juvenile)	0	0	0	0	1
Anchovy (adult)	0	0	0	0.5	0.5
Other planktivorous fishes	0.5	0.3	0.1	0.05	0.05
Mesopelagic fishes	0.625	0.375	0	0	0
Anglerfish	0.5	0.3	0.1	0.05	0.05
Seabass	0	0	0	0.6	0.4
Blue whiting	0.3	0.7	0	0	0
Hake	0	0.7	0.2	0.1	0
Cods	0	0.37	0.37	0.19	0.07
Megrim	0.2	0.5	0.2	0.1	0
Common sole	0	0	0.5	0.25	0.25
Flatfishes	0.17	0.5	0.17	0.08	0.08
Mullets	0	0.3333	0.3333	0.1667	0.1667
Large demersal fishes	0.5	0.3	0.1	0.05	0.05
Medium demersal fishes	0.17	0.5	0.17	0.08	0.08
Small demersal fishes	0.5	0.3	0.1	0.05	0.05
Deep-sea fishes	0.756	0.151	0.05	0.025	0.018
Benthic cephalopods	0.29	0.43	0.14	0.07	0.07
Squids	0.75	0.15	0.05	0.03	0.03
Norway lobster	0.196	0.588	0.196	0.02	0
Pelagic crab	0	0.6	0.2	0.1	0.1
Zooplankton feeding shrimps	0.74	0.15	0.05	0.02	0.04
Benthos-feeders decapods	0.64	0.21	0.07	0.04	0.04
Detritus-feeders decapods	0.62	0.23	0.08	0.04	0.04
Bivalves	0	0	0.5	0.25	0.25
Polychaetes	0.9	0.06	0.02	0.01	0.01
Suprabenthos	0	0.54	0.27	0.14	0.05
Echinoderms	0.67	0.2	0.07	0.03	0.03
Other invertebrates	0.75	0.15	0.05	0.03	0.03

Table S6 (continued)

Group	L1	L2	L3	L4	L5
Gelatinous zooplankton	0.75	0.15	0.05	0.025	0.025
Macrozooplankton	0.75	0.15	0.05	0.025	0.025
Mesozooplankton	0.75	0.15	0.05	0.025	0.025
Microzooplankton	0.75	0.15	0.05	0.025	0.025
Primary producers	0	0	0	0	1
Large phytoplankton	0	0	0	0.5	0.5
Small phytoplankton	0	0	0	0.5	0.5
Pelagic bacteria	0.9	0.1	0	0	0
Sediment bacteria	0.8	0.06	0.02	0.01	0.01
Labile detritus	0.9	0.06	0.02	0.01	0.01
Refractory detritus	0.9	0.06	0.02	0.01	0.01
Carrion	0.9	0.06	0.02	0.01	0.01


Diving and pursuit divers seabirds
Fraction
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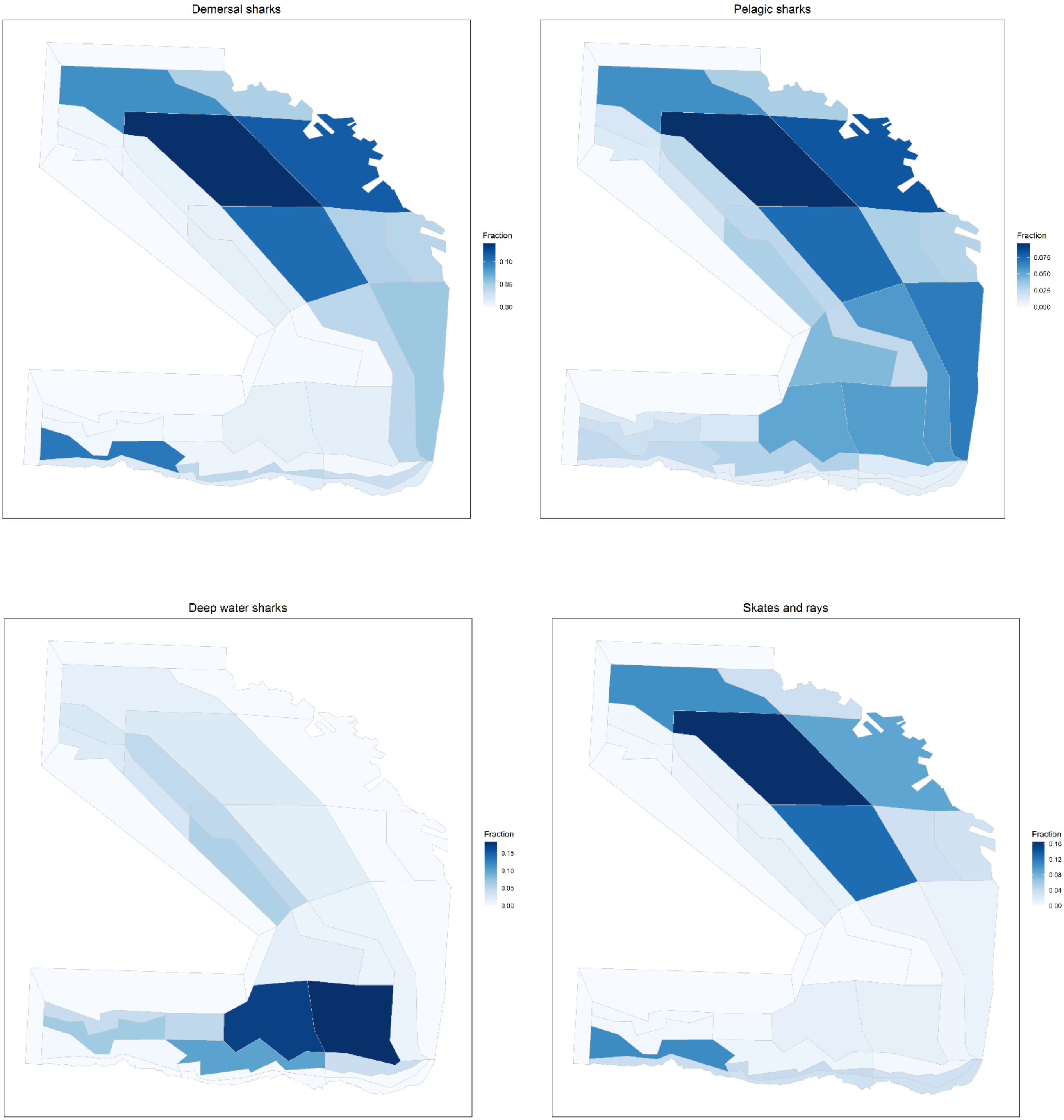
Surface feeding seabirds
Fraction
0.06
0.04
0.02
0.00
Baleen whales
Fraction
0.08
0.06
0.04
0.02
0.00
Toothed cetaceans
Fraction
0.08
0.06
0.04
0.02
0.00


Demersal sharks
Fraction
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0.00
Pelagic sharks
Fraction
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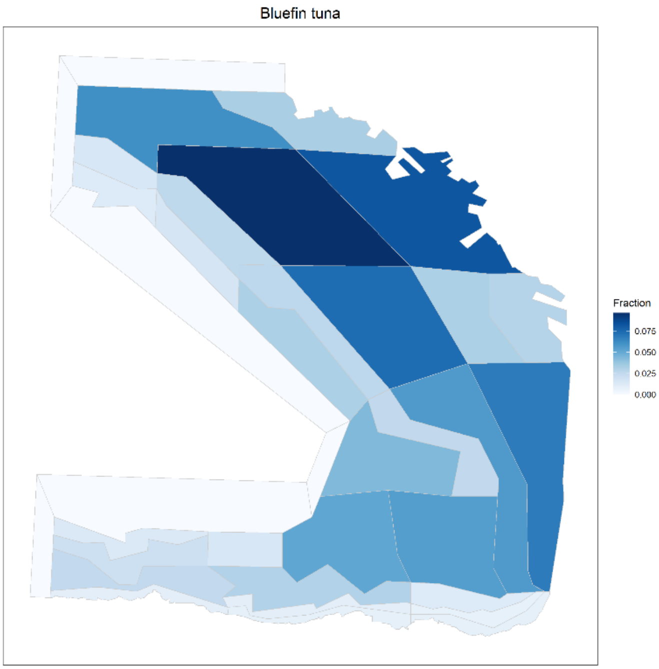
0.050
0.025
0.000
Deep water sharks
Fraction
0.15
0.10
0.05
0.00
Skates and rays
Fraction
0.16
0.12
0.08
0.04
0.00


Bluefin tuna
Fraction
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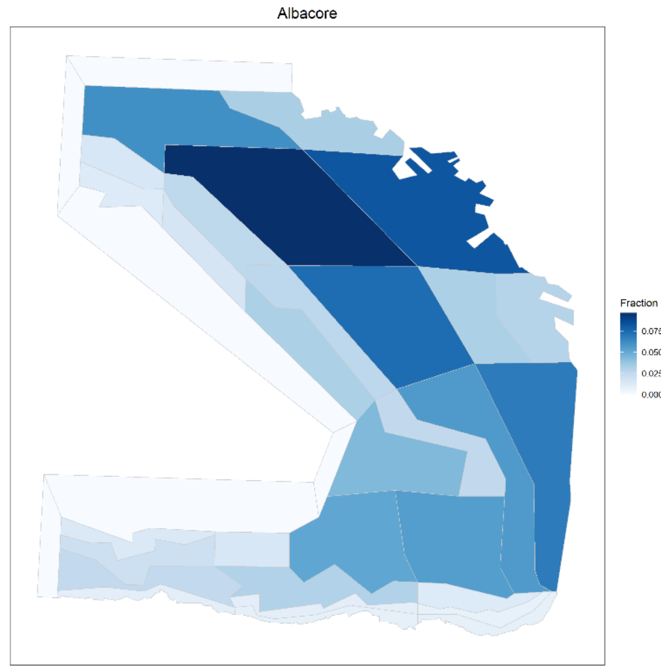
0.025
0.000


Albacore
Fraction
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0.050
0.025
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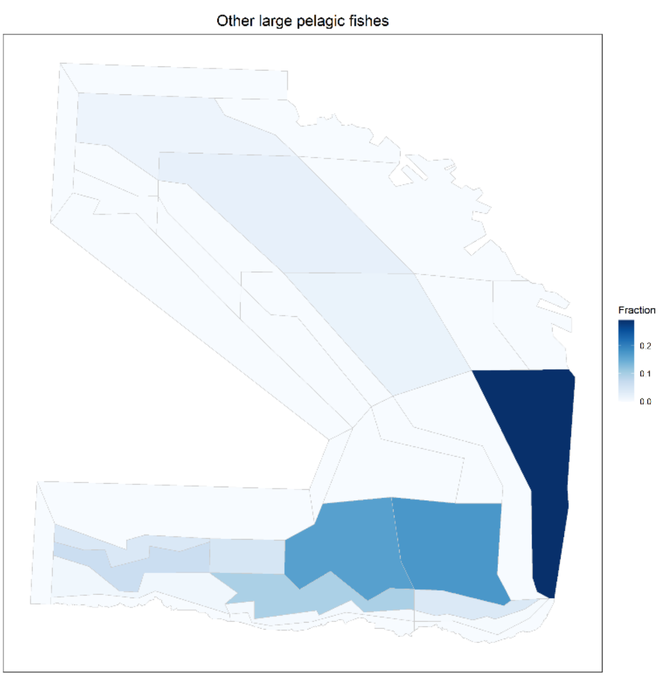
Other large pelagic fishes
Fraction
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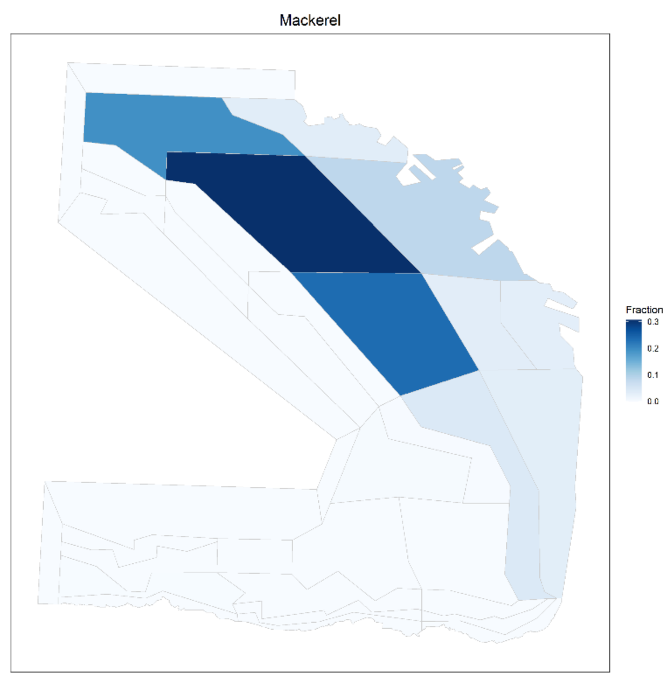
Mackerel
Fraction
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0.2
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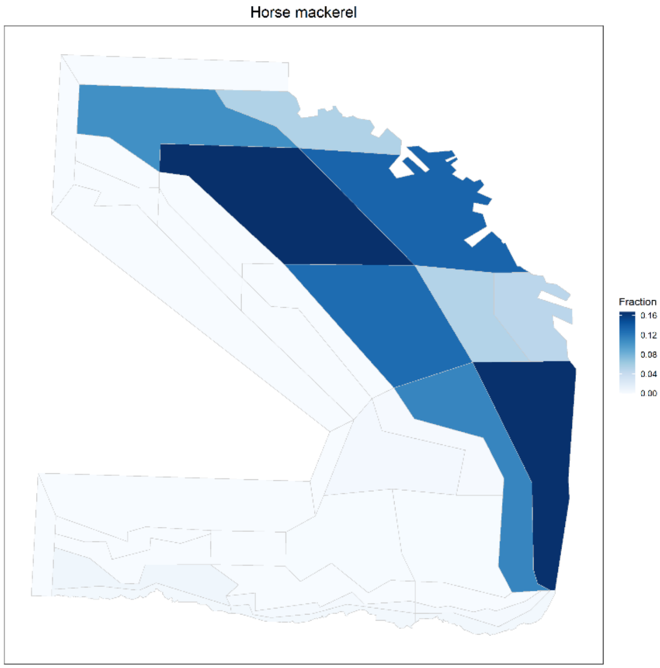
0.0


Horse mackerel
Fraction
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0.12
0.08
0.04
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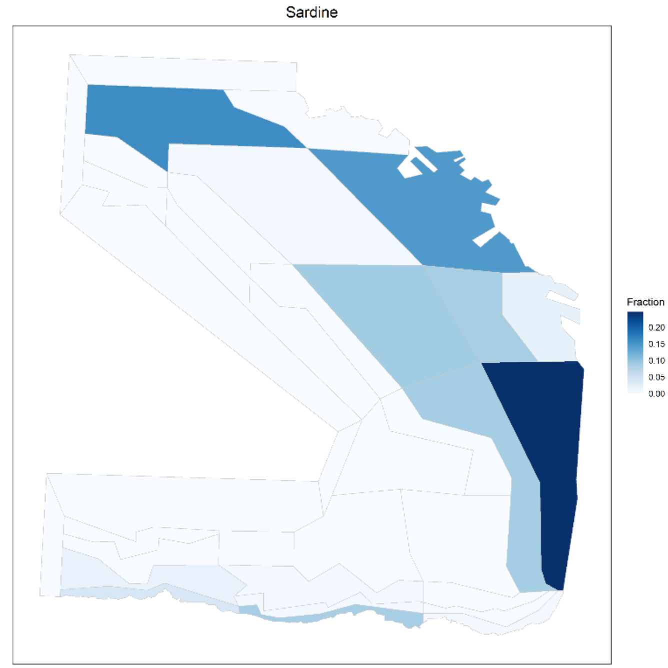
Sardine
Fraction
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0.15
0.10
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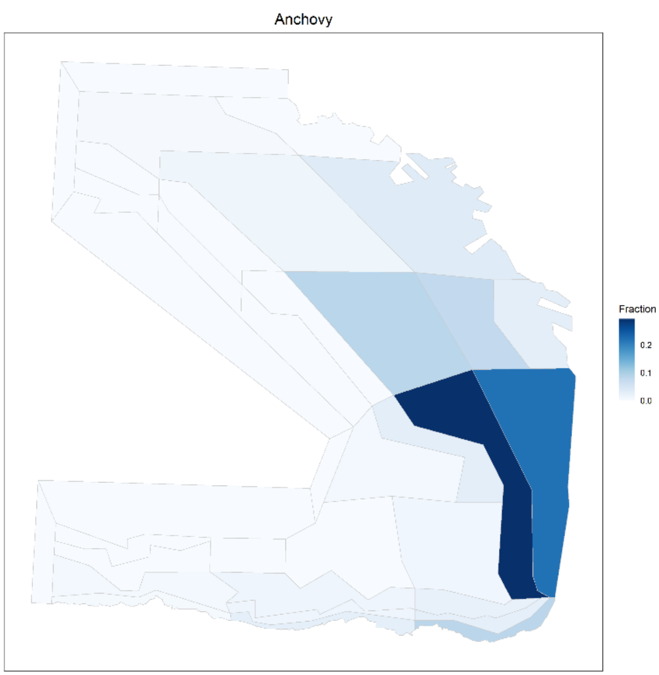
Anchovy
Fraction
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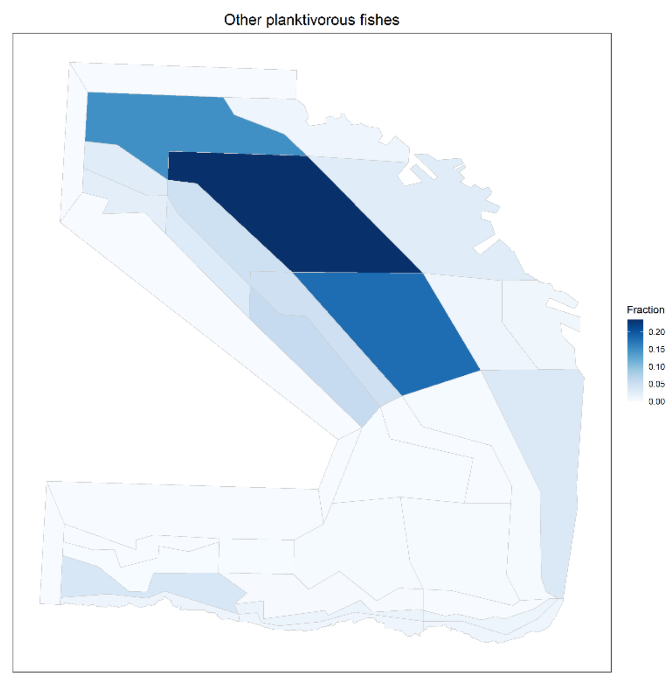
Other planktivorous fishes
Fraction
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0.10
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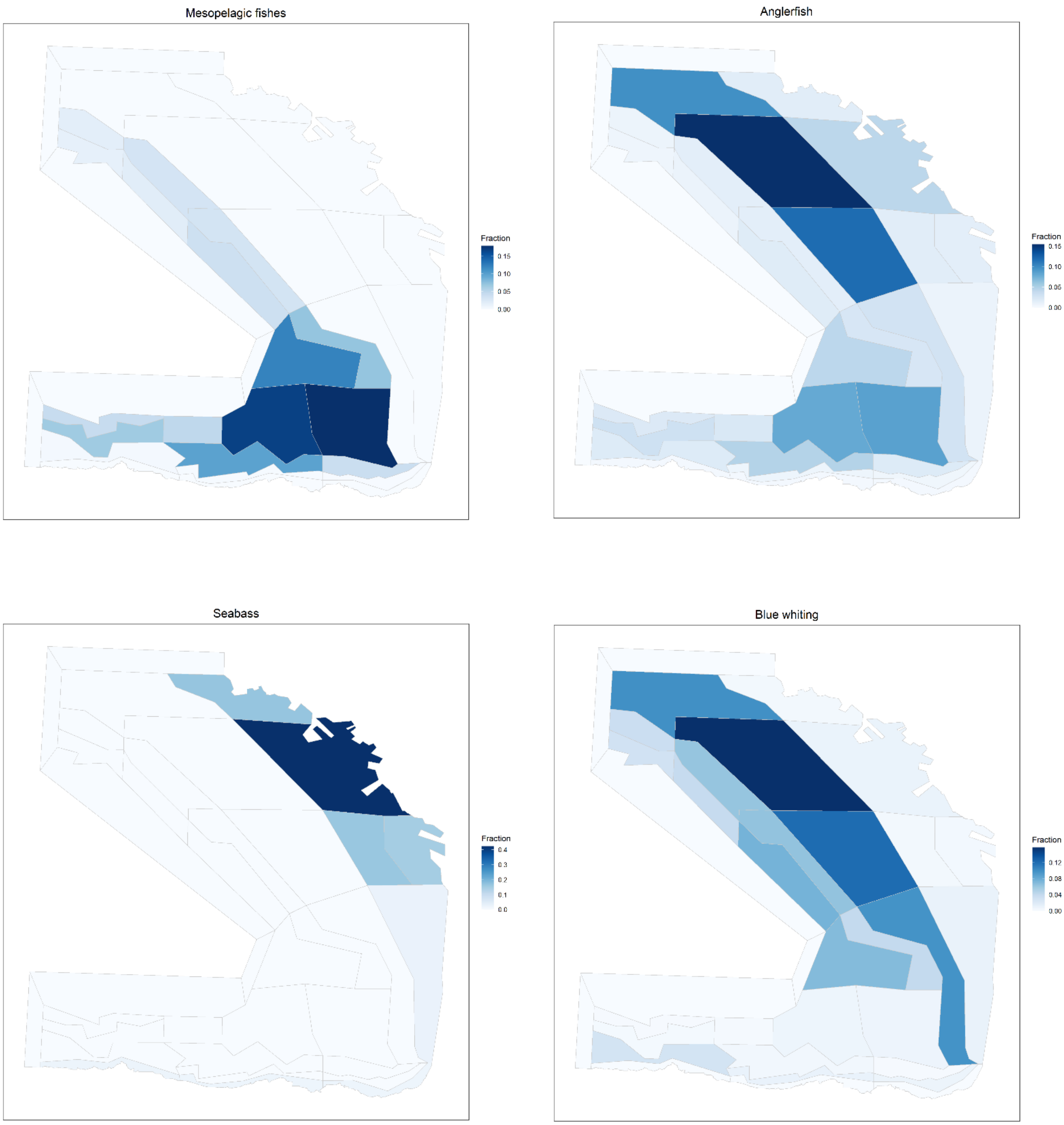
0.00


Mesopelagic fishes
Fraction
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Anglerfish
Fraction
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0.10
0.05
0.00
Seabass
Fraction
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0.0
Blue whiting
Fraction
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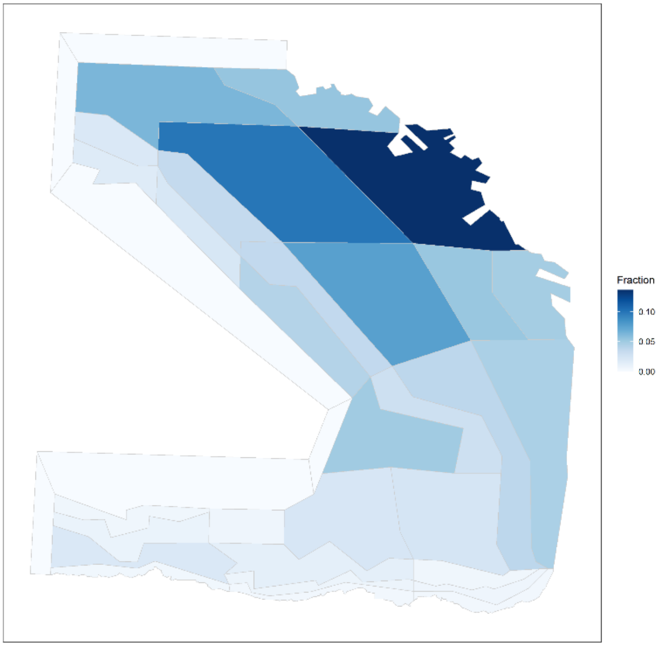
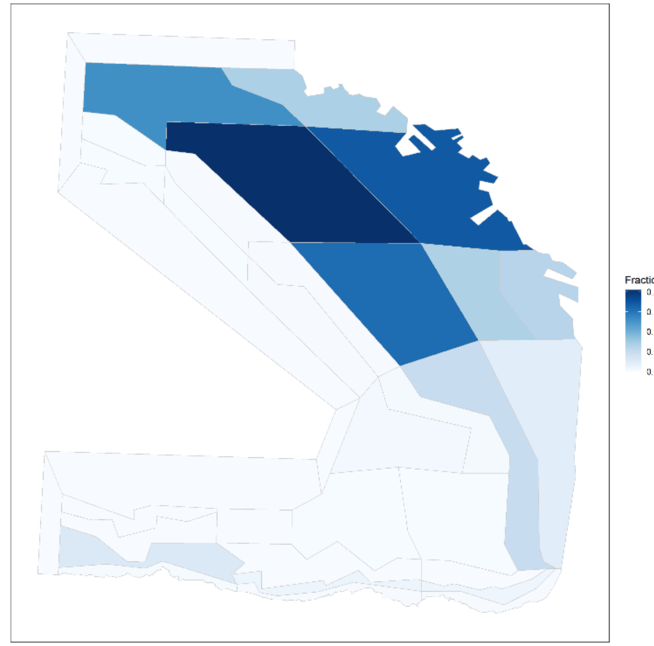
0.04
0.00

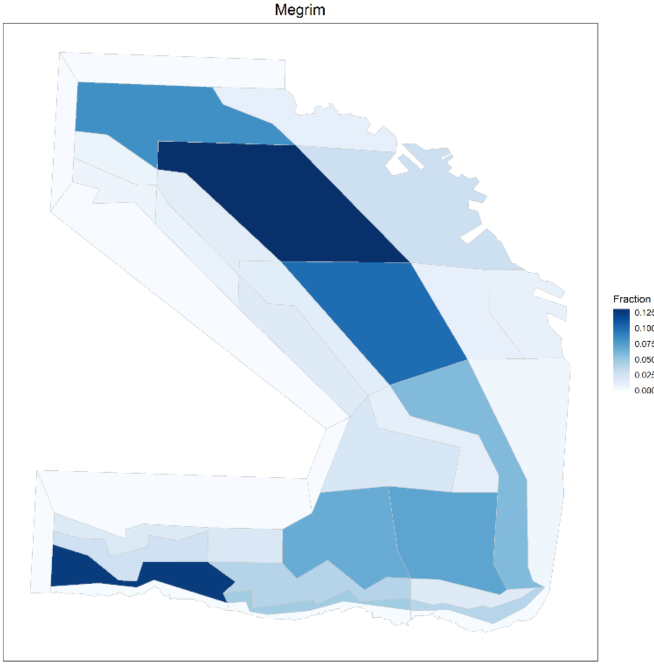
Hake



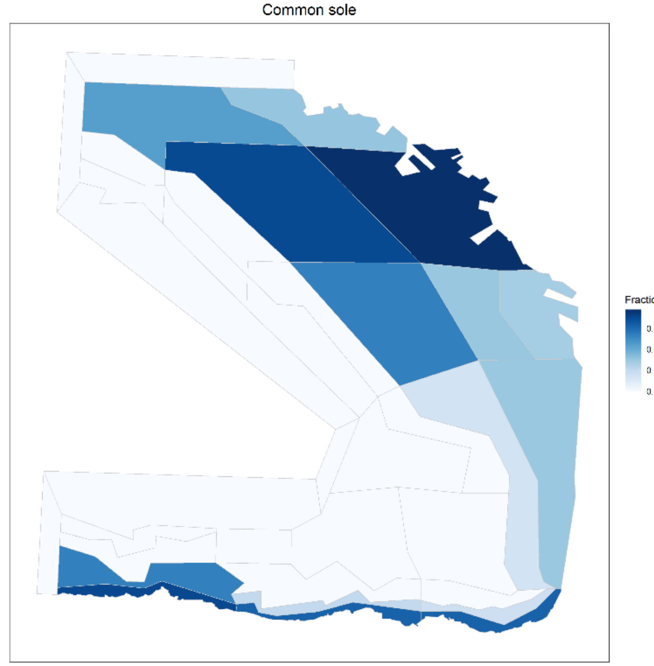
Cods

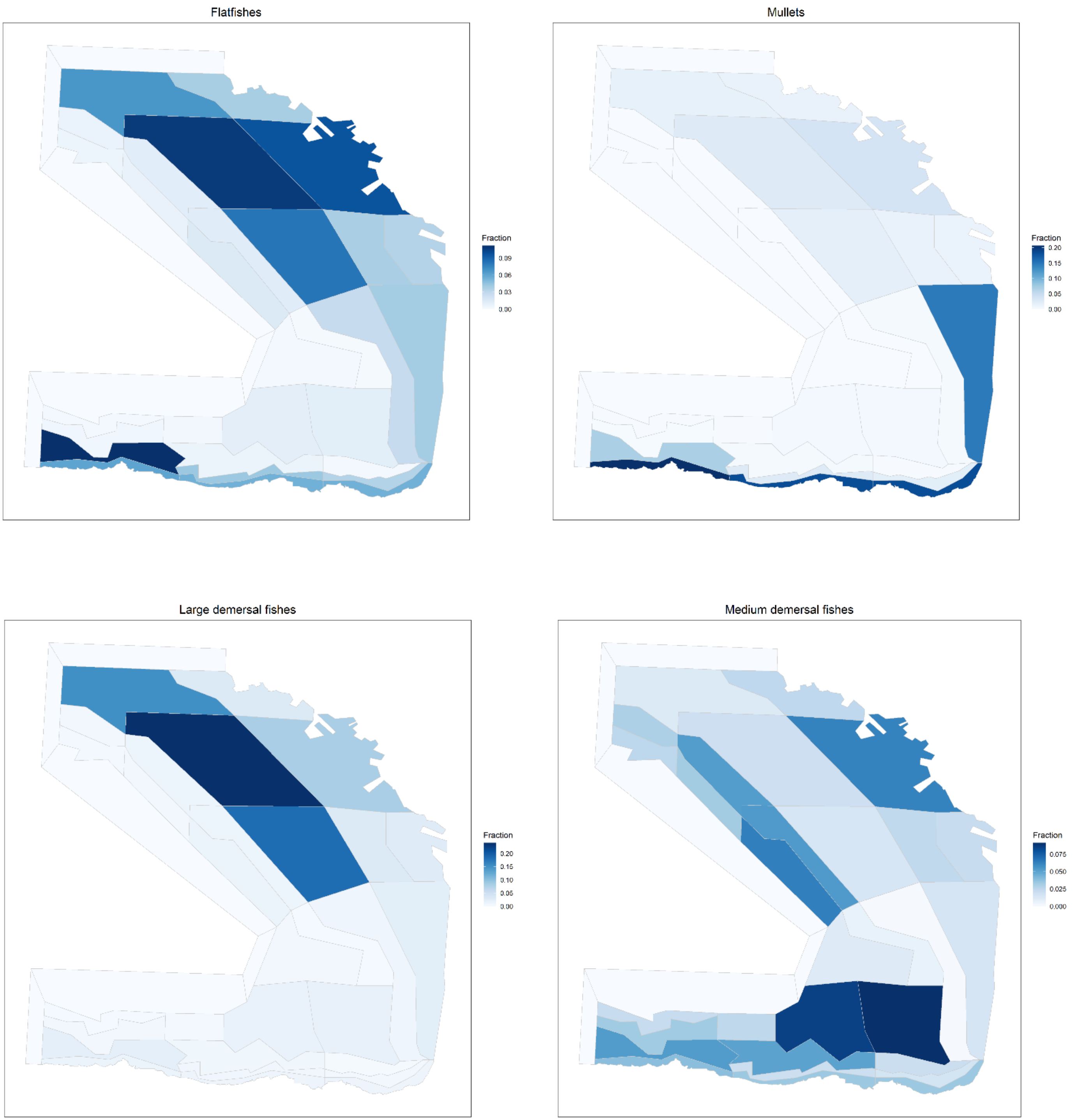


Megrim



Common sole




Flatfishes
Fraction
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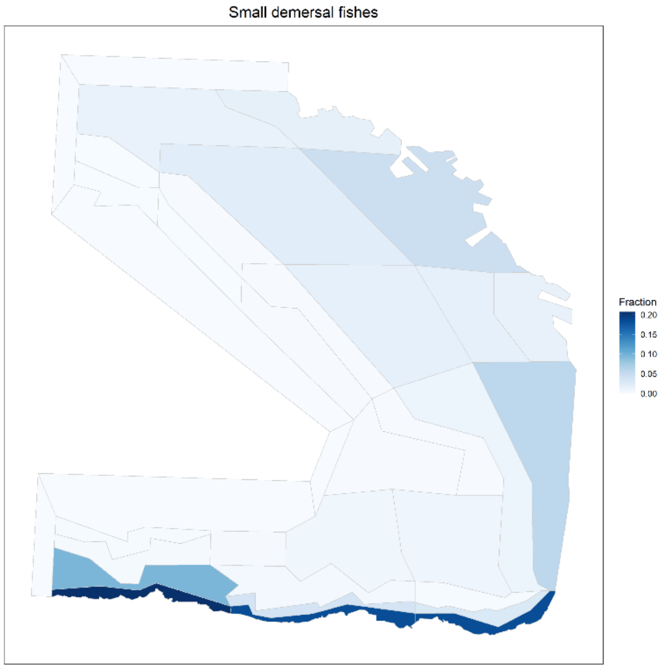
0.03
0.00
Mullets
Fraction
0.20
0.15
0.10
0.05
0.00
Large demersal fishes
Fraction
0.20
0.15
0.10
0.05
0.00
Medium demersal fishes
Fraction
0.075
0.050
0.025
0.000


Small demersal fishes
Fraction
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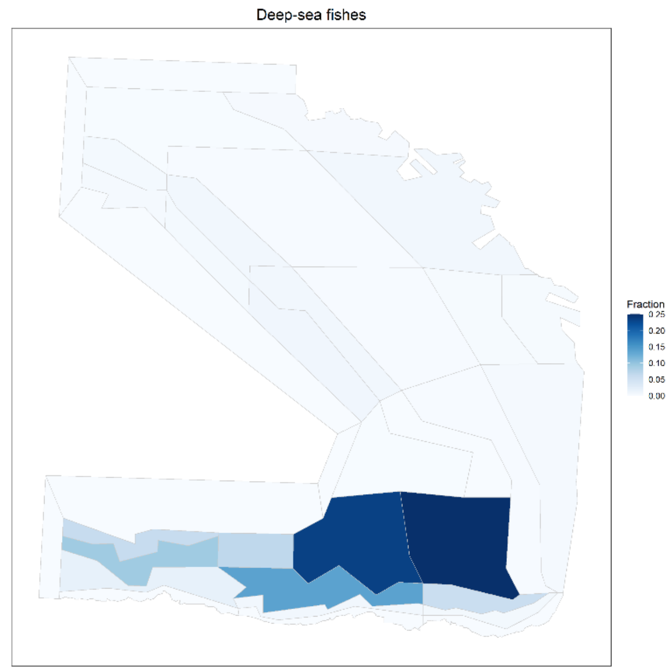
Deep-sea fishes
Fraction
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0.10
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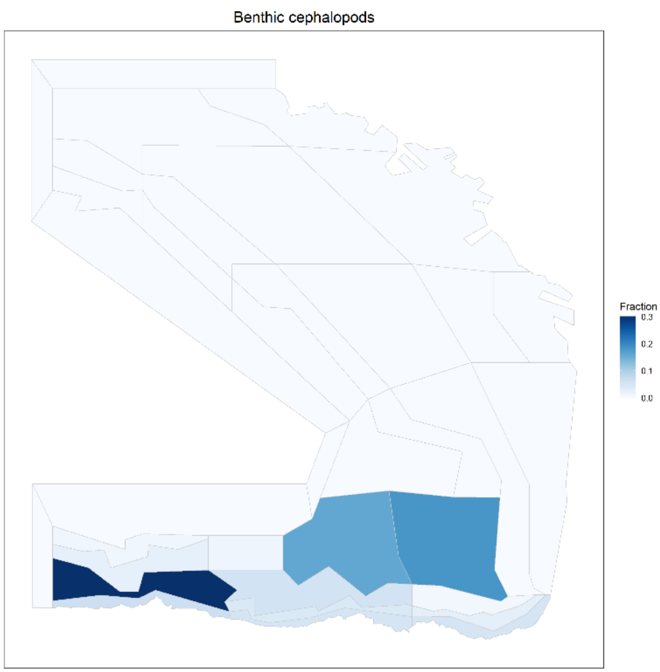
0.00


Benthic cephalopods
Fraction
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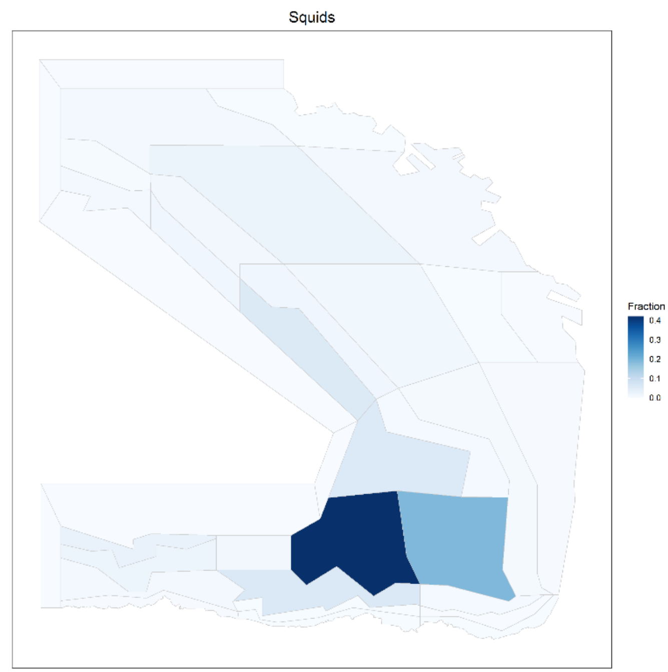
Squids
Fraction
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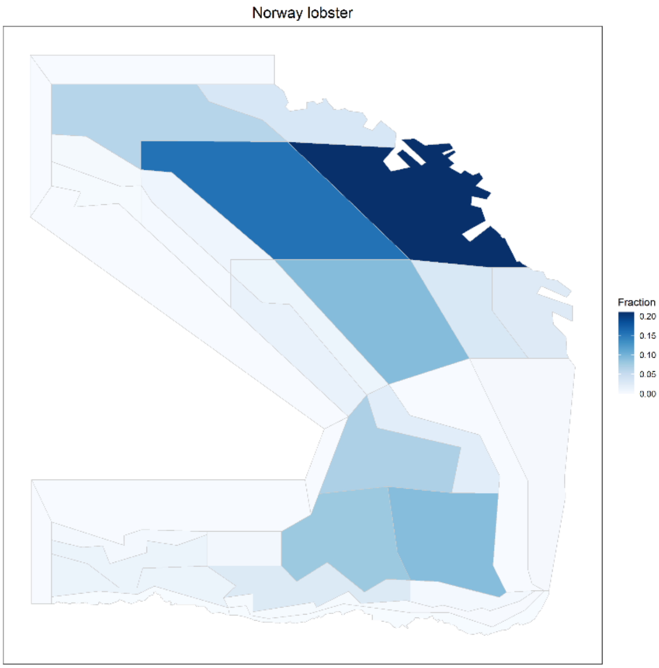
Norway lobster
Fraction
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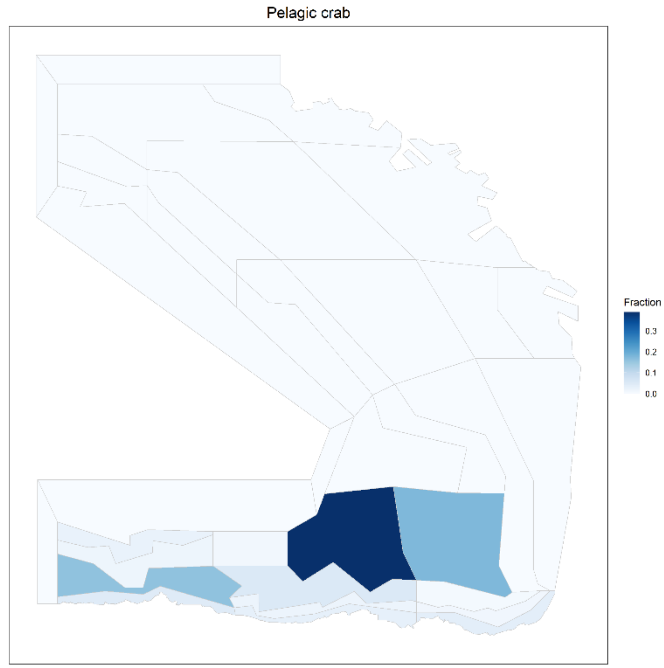
Pelagic crab
Fraction
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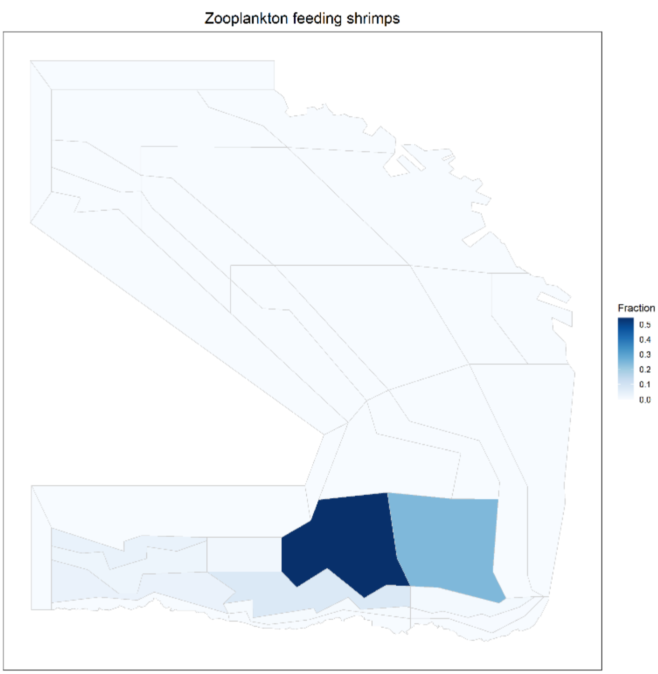
Zooplankton feeding shrimps
Fraction
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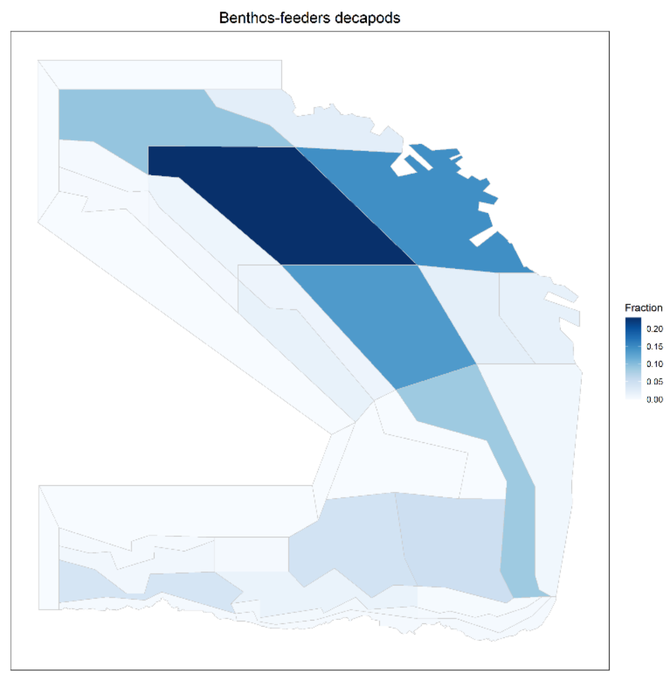
0.0


Benthos-feeders decapods
Fraction
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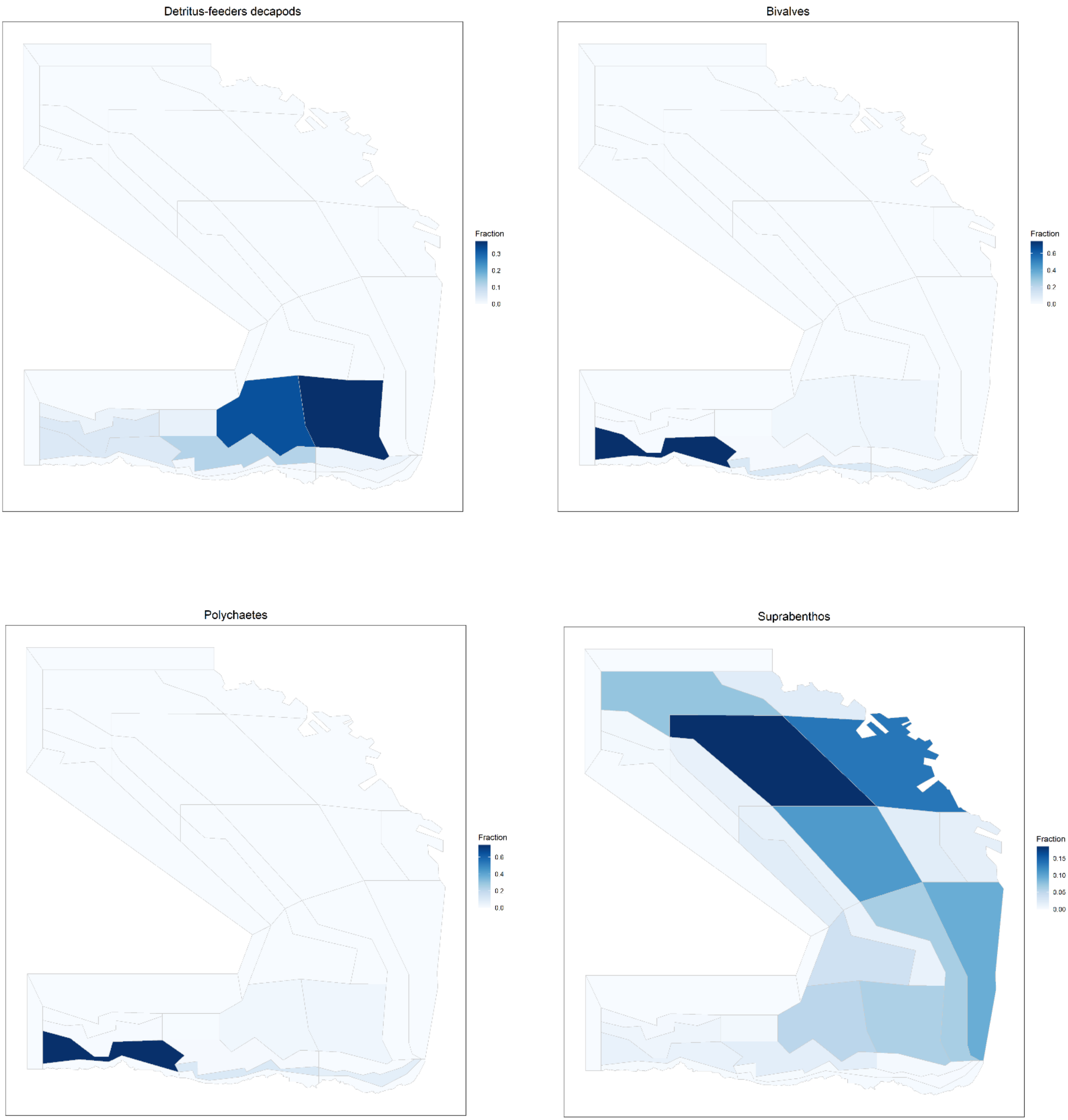
Detritus-feeders decapods
Fraction
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Bivalves
Fraction
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0.0
Polychaetes
Fraction
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Suprabenthos
Fraction
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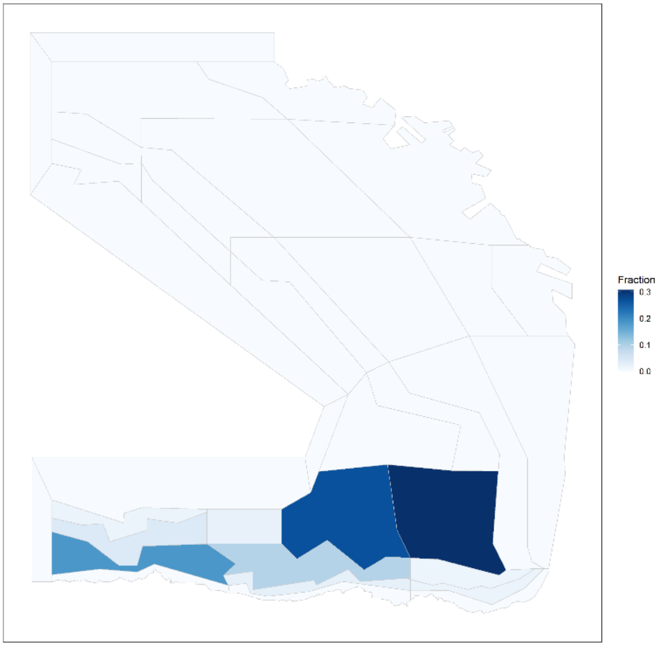
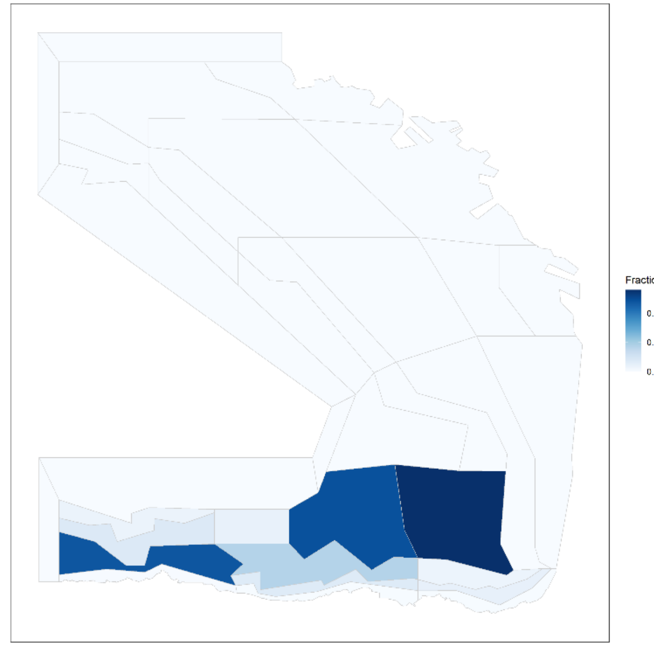
0.05
0.00

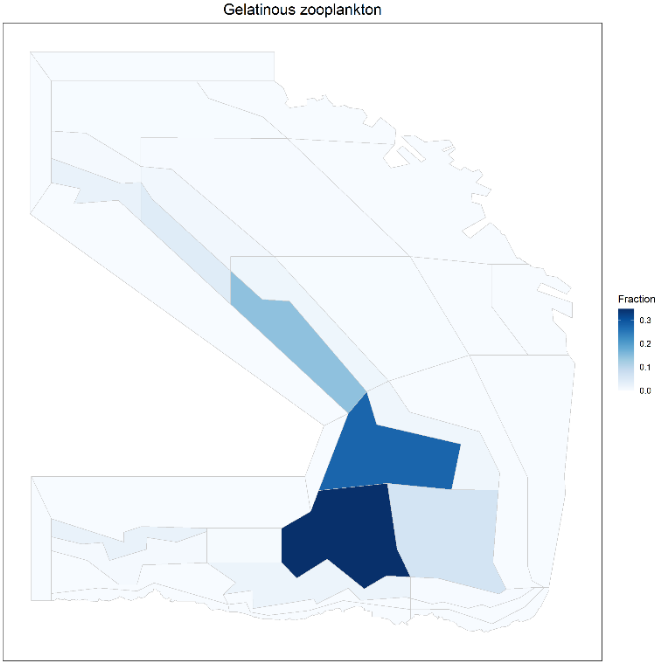
Echinoderms



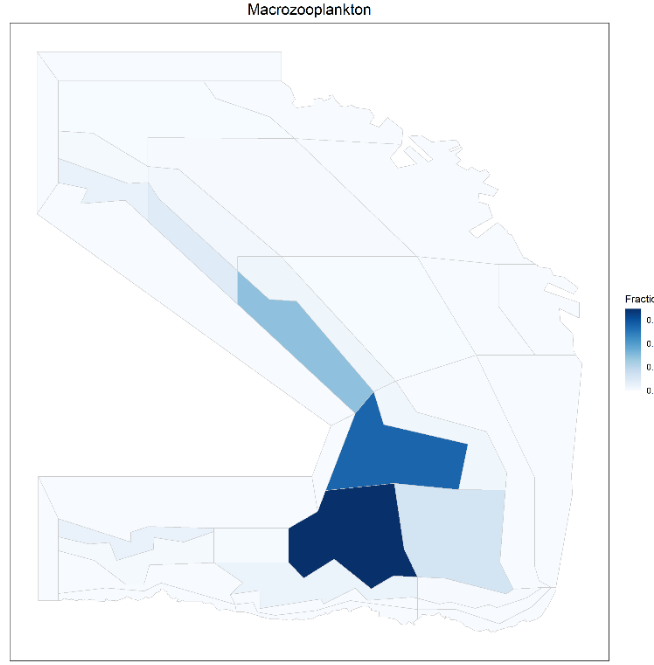
Other invertebrates

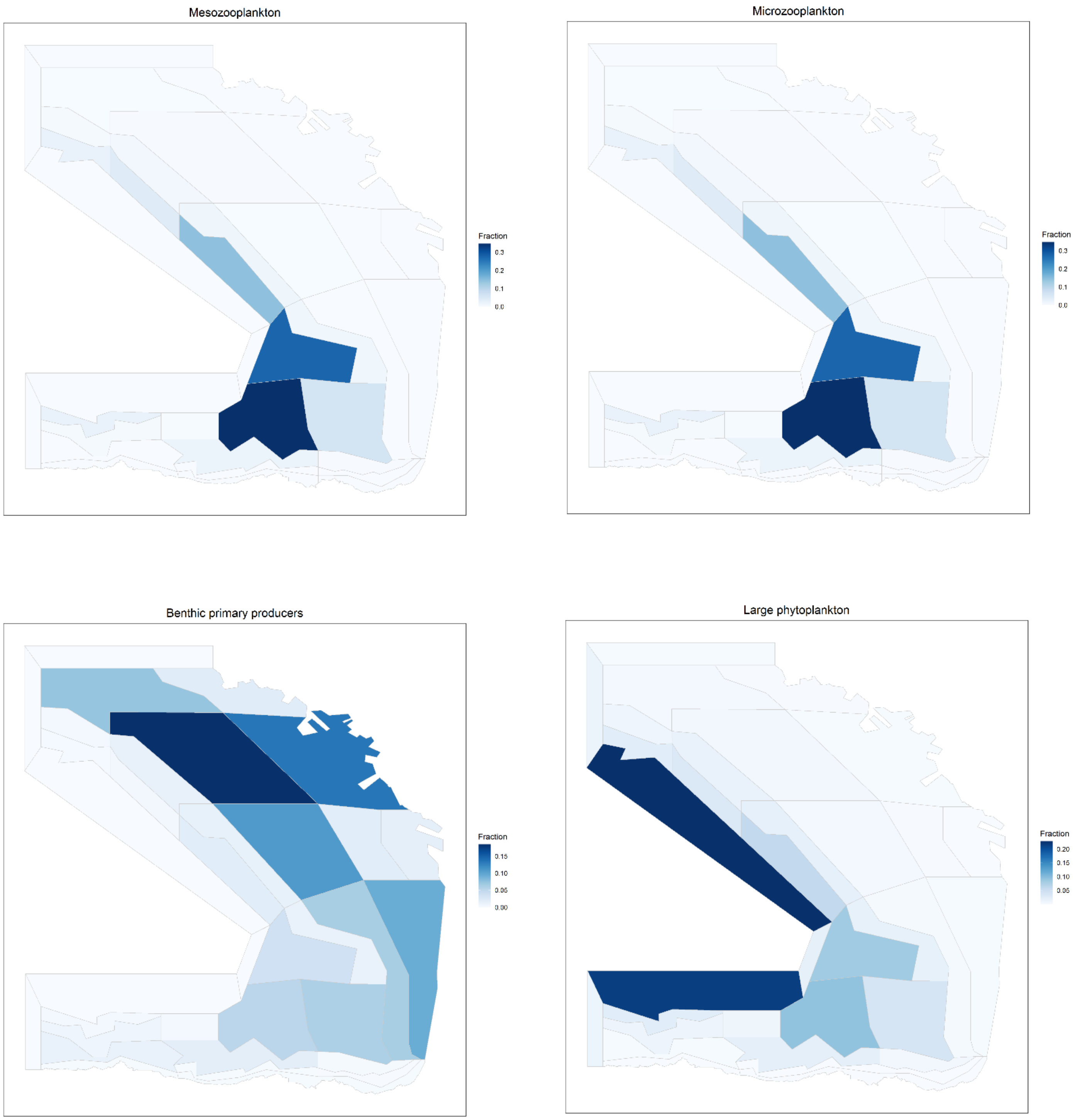


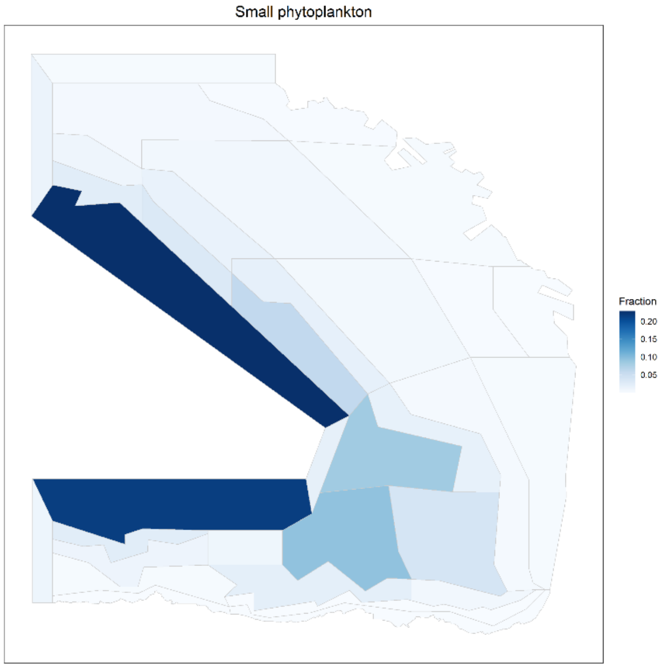
Gelatinous zooplankton

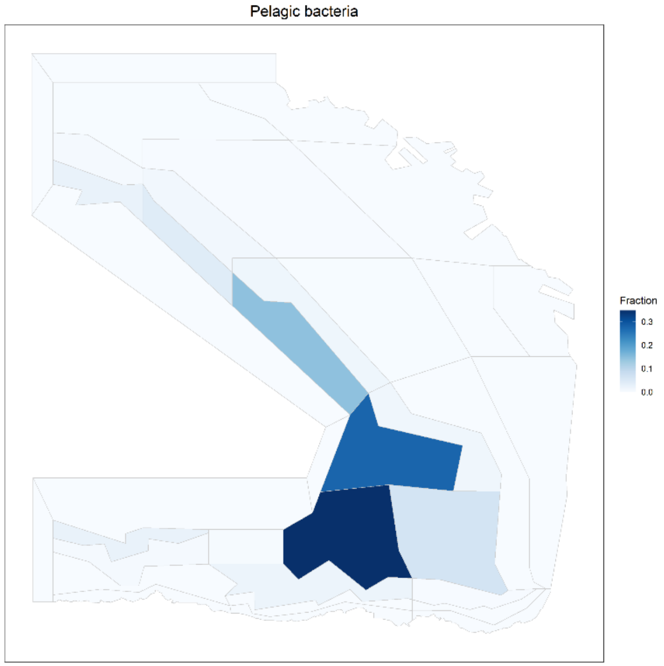


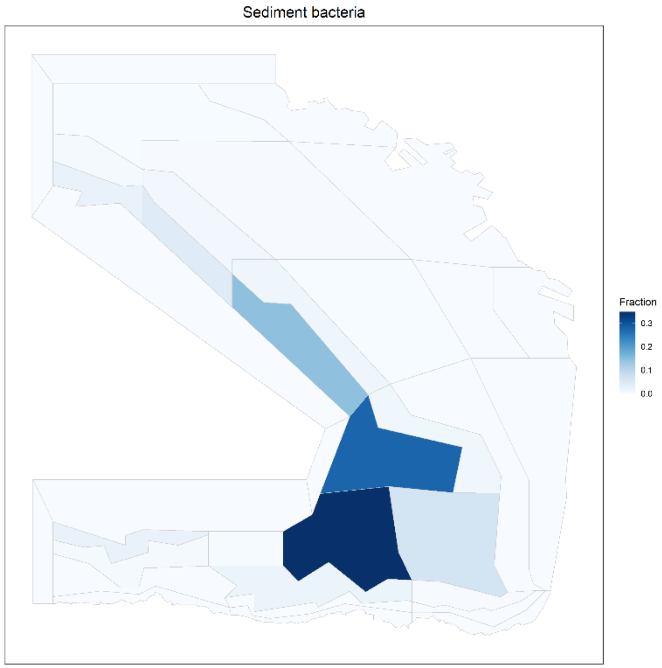
Macrozooplankton

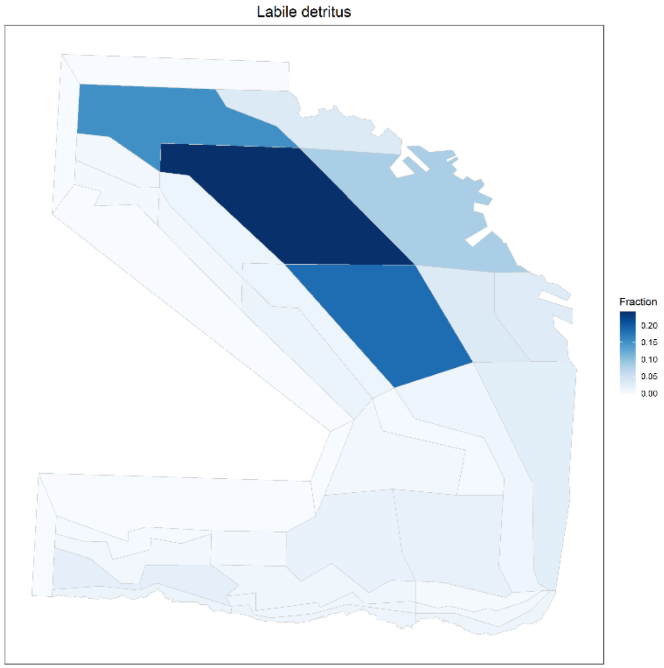



Mesozooplankton
Fraction
0.3
0.2
0.1
0.0
Microzooplankton
Fraction
0.3
0.2
0.1
0.0
Benthic primary producers
Fraction
0.15
0.10
0.05
0.00
Large phytoplankton
Fraction
0.20
0.15
0.10
0.05


Small phytoplankton
Fraction
0.20
0.15
0.10
0.05


Pelagic bacteria
Fraction
0.3
0.2
0.1
0.0


Sediment bacteria
Fraction
0.3
0.2
0.1
0.0


Labile detritus
Fraction
0.20
0.15
0.10
0.05
0.00

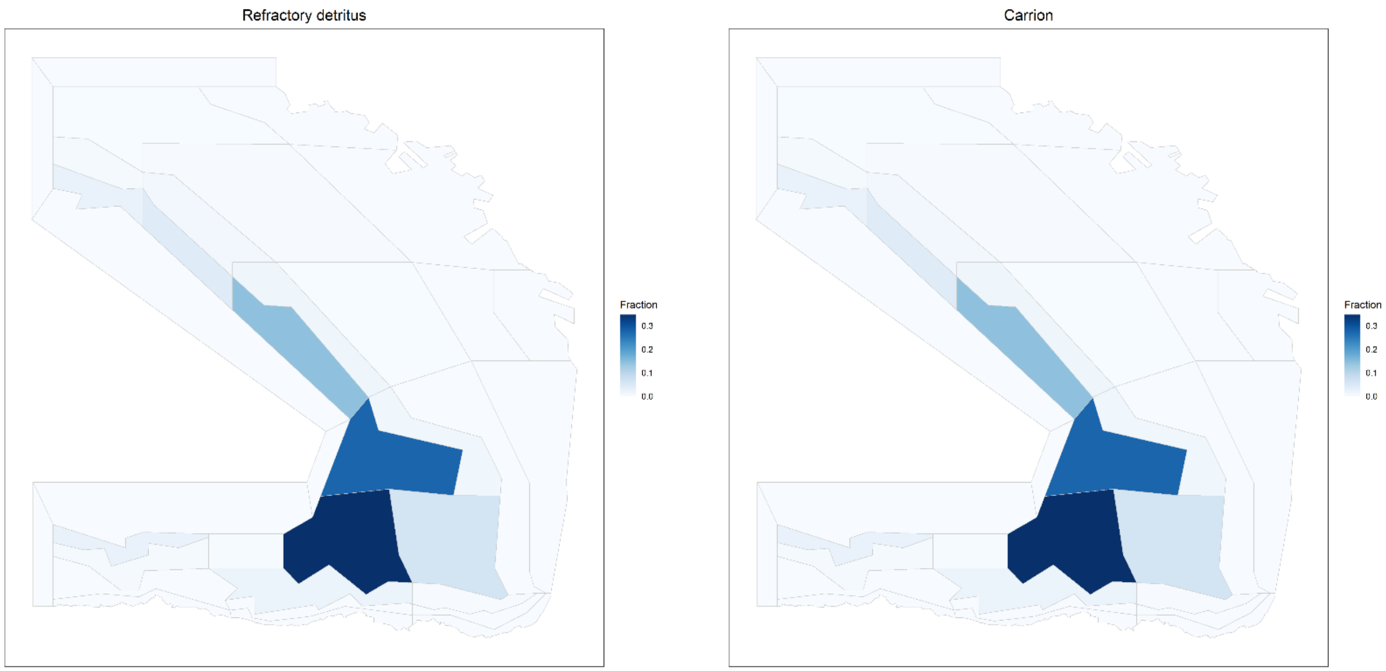


Figure S1. Fractions of populations per box of functional groups included in the Bay of Biscay Atlantis model. Same horizontal distribution was defined for juveniles and adults and each quarter of the year.

Section S4 – Food web structure

Table S7. Availability matrix (ranging from 0 to 1). For vertebrates, juveniles (juv) and adults (ad) were separated if the parameters were different. Groups code can be found in Table S1.

		pred	1		2		3	4		5		6		7		8	
	prey	stage	ad	juv	ad	juv		ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
1	SBD		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	SBS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	BWH		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	CET		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	SHB	ad	0	0	0	0	0	0	0	0.0028	0	0.0093	0	0.0013	0	0.0014	0
		juv	0	0	0	0	0	0	0	0.0028	0.0028	0.0093	0.0093	0.0013	0.0013	0.0014	0
6	SHP		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	SHD	ad	0	0	0	0	0	0	0	0	0	0	0	0.0007	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0.0007	0.0007	0	0
8	SSK	ad	0	0	0	0	0	0	0	0	0	0.0175	0.0018	0.0016	0	$2.98\cdot10^{-06}$	0
		juv	0	0	0	0	0	0	0	0	0	0.0175	0.0175	0.0016	0.0016	$2.98\cdot10^{-06}$	0
9	BFT		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	ALB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	OPE	ad	0.0001	0	0.003	0	0	0.0008	0	0.0728	0.04	0.2189	0.05	0.0472	0	0	0
		juv	0.0001	0.0001	0.003	0.003	0	0.0008	0.0008	0.0728	0.0728	0.2189	0.2189	0.0472	0.0472	0	0
12	MAC	ad	0.0003	0.0003	0.002	0.002	$2.89\cdot10^{-05}$	0.0004	0.0002	0.0003	0.0001	0.0009	0.0008	0.0003	0.0001	0	0
		juv	0.03	0.03	0.2	0.2	0.00289	0.04	0. 04	0.03	0.03	0.09	0.09	0.03	0.03	0	0
13	HOM	ad	0.01	0.01	0.01	0.01	0	0.0651	0.04	0.0081	0.006	0.0583	0.05	0.0016	0.0009	0.0116	0.0116
		juv	0.01	0.01	0.01	0.01	0	0.0651	0.0651	0.0081	0.0081	0.0583	0.0583	0.0016	0.0016	0.0116	0.0116
14	PIL	ad	0.1	0.1	0.12	0.12	0.0106	0.0955	0.15	0.0215	0.04	0.0412	0.06	0	0.02	0.0151	0.0151
		juv	0.1	0.1	0.12	0.12	0.0106	0.0955	0.0955	0.0215	0.0215	0.0412	0.0412	0	0	0.0151	0.0151
15	ANE	ad	0.08	0.08	0.135	0.135	0.0402	0.0172	0.03	0.0092	0.015	0.1143	0.2	0.0243	0.04	0.0009	0.0009
		juv	0.08	0.08	0.135	0.135	0.0402	0.0172	0.0172	0.0092	0.0092	0.1143	0.1143	0.0243	0.0243	0.0009	0.0009
16	OPL	ad	0.2	0.2	0.25	0.25	0.15	0.0206	0.0206	0.017	0.017	0.1456	0.15	0.0026	0.0026	0.0315	0.0315
		juv	0.2	0.2	0.25	0.25	0.15	0.0206	0.0206	0.017	0.017	0.1456	0.1456	0.0026	0.0026	0.0315	0.0315
17	FMP	ad	0	0	0	0	0	0.0025	0.0025	0	0	0.0414	0.05	0.0203	0.03	0.0352	0.0352
		juv	0	0	0	0	0	0.0025	0.0025	0	0	0.0414	0.0414	0.0203	0.0203	0.0352	0.0352

Table S7 (continued)

		pred	1		2		3	4		5		6		7		8	
	prey	stage	ad	juv	ad	juv		ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
18	ANF		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	BSS		0	0	0	0	0	0.0081	0.0081	0	0	0	0	0	0	0	0
20	WHB	ad	0.004	0.004	0	0	0	0.1318	0.1318	0.1732	0.1732	0	0	0.1359	0.1359	0.0415	0.0415
		juv	0.004	0.004	0	0	0	0.1318	0.1318	0.1732	0.1732	0	0	0.1359	0.1359	0.0415	0.0415
21	HKE	ad	0	0	0	0	0	0.0076	0.0076	0	0	0.0076	0	0	0	0	0
		juv	0	0	0	0	0	0.0253	0.0253	0.004	0.004	0.0197	0.0197	0.0016	0.0016	0.0067	0.0067
22	COD		0.001	0.001	0	0	$4.95\cdot10^{-05}$	0.0495	0.0495	0.0148	0.0148	0	0	0.0375	0.0375	0.0002	0.0002
23	MEG		0	0	0	0	0	0	0	0.0059	0.0059	0	0	0.0131	0.0131	$1.1\cdot10^{-05}$	$1.1\cdot10^{-05}$
24	SOL		0	0	0	0	0	0.0033	0.0033	0.0013	0.0013	0	0	0.0131	0.0131	$1.52\cdot10^{-05}$	$1.52\cdot10^{-05}$
25	FFL		0.0002	0.0002	0.003	0.003	0	0.003	0.003	0.0199	0.0199	0	0	0.0339	0.0339	0.0036	0.0036
26	MUL		0	0	0	0	0	0	0	0	0	0	0	0.0131	0.0131	$3.31\cdot10^{-05}$	$3.31\cdot10^{-05}$
27	FDL	ad	0	0	0	0	0	0.0112	0	0.0181	0	0.0332	0	0.0105	0	0.0001	0
		juv	0	0	0	0		0.0112	0.0112	0.0181	0.0181	0.0332	0.0332	0.0105	0.0105	0.0001	0.0001
28	FDM	ad	0.01	0	0.003	0	0	0.1192	0	0.014	0	0.0802	0	0.0125	0	0.0001	0
		juv	0.01	0.01	0.003	0.003	0	0.1192	0.1192	0.014	0.014	0.0802	0.0802	0.0125	0.0125	0.0001	0.0001
29	FDS	ad	0.145	0.145	0.13	0.13	0.0306	0.0661	0.06612	0.03	0.04	0.0406	0.0406	0.0365	0.03	0.0048	0.008
		juv	0.145	0.145	0.13	0.13	0.0306	0.0661	0.06612	0.03	0.03	0.0406	0.0406	0.0365	0.0365	0.0048	0.0048
30	FSD	ad	0	0	0	0	0	0.0001	0.0001	0.0208	0	0.0588	0.0059	0.0718	0.03	0.0353	0.005
		juv	0	0	0	0	0	0.0001	0.0001	0.0208	0.0208	0.0588	0.0588	0.0718	0.0718	0.0353	0.0353
31	CBE		0	0	0	0	0	0.1279	0.1279	0.0277	0.02	0.0005	0.0005	0.0554	0.03	0.0135	0.01
32	CBP		0.02	0.02	0.014	0.014	0.0522	0.1931	0.1931	0.0057	0.005	0.0239	0.0239	0.0282	0.02	0.016	0.016
33	NEP		0	0	0.0001	0.0001	0	0	0	0.0011	0.002	0	0	0.0009	0.002	0.5171	0.5171
34	CRP		0	0	0	0	0	0	0	0.0784	0.0784	0.0003	0.0003	0.0198	0.0198	0.1236	0.1236
35	SHR		0	0	0.0001	0.0001	0	0	0	0.0385	0.045	0.0009	0.0009	0.0584	0.06	0.0795	0.1
36	DFB		0	0	0.0001	0.0001	0	0	0	0.1537	0.17	0	0	0.0546	0.08	0.0341	0.08
37	DFD		0	0	0.0004	0.0004	0	0	0	0.15	0.17	0	0	0.0646	0.09	0.0018	0.01
38	BIV		0	0	0	0	0	0	0	0.0013	0.005	0.0003	0.0003	0.0049	0.005	0.0075	0.01
39	POL		0	0	0	0	0	0	0	0.02	0.04	0.0003	0.0003	0.0278	0.03	0.0171	0.03

Table S7 (continued)

		pred	1		2		3	4		5		6		7		8	
	prey	stage	ad	juv	ad	juv		ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
40	SB		0	0	0	0	0	0	0	0.005	0.005	0	0	0.075	0.09	0	0
41	ECH		0	0	0	0	0	0	0	0.0037	0.0037	0	0	0.0096	0.0096	0	0
42	INV		0	0	0	0	0	0	0	0.0071	0.01	0.0008	0.0008	0.0089	0.0089	0	0
43	ZG		0	0	0	0	0.0141	0.0097	0.0097	0.0131	0.0131	0.0003	0.0003	0	0	0	0
44	ZL		0.04	0.04	0.01	0.01	0.6994	$4.46\cdot10^{-05}$	$4.46\cdot10^{-05}$	0.0321	0.0321	0.0003	0.0003	0.0775	0.0775	0.0011	0.0011
45	ZM		0.03	0.03	0.003	0.003	0	0	0	0	0	0.0003	0.0003	0.0023	0.0023	0.0001	0.0001
46	ZS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	PP		0	0	0	0	0	0	0	0.0009	0.0009	0	0	0	0	0	0
48	PL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	PS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	PB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	BB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	DL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	DR		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	DC		0.1351	0.1351	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0

Table S7 (continued)

		pred	9		10		11		12		13		14		15		16	
	prey	stage	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
1	SBD		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	SBS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	BWH		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	CET		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	SHB	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	SHP		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	SHD	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	SSK	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	BFT		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	ALB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	OPE	ad	0.014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0.014	0.014	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MAC	ad	0.0002	0.0001	0.0005	0.0001	0.0005	0.0003	0	0	0	0	0	0	0	0	0	0
		juv	0.02	0.02	0.05	0.05	0.05	0.05	0	0	0	0	0	0	0	0	0	0
13	HOM	ad	0.155	0.1	0.052	0.02	0.131	0.08	0.0026	0	0	0	0	0	0	0	0	0
		juv	0.155	0.155	0.052	0.052	0.131	0.131	0.0026	0	0	0	0	0	0	0	0	0
14	PIL	ad	0.235	0.16	0.1	0.05	0.155	0.1	0	0	0.008	0	0	0	0	0	0	0
		juv	0.235	0.235	0.1	0.1	0.155	0.155	0	0	0.008	0	0	0	0	0	0	0
15	ANE	ad	0.236	0.17	0.1327	0.07	0.166	0.11	0.008	0	0.0107	0	0	0	0	0	0.002	0
		juv	0.236	0.236	0.1327	0.1327	0.166	0.166	0.008	0	0.0107	0	0	0	0	0	0.002	0
16	OPL	ad	0.075	0.09	0.128	0.09	0.185	0.13	0.0023	0	0.0179	0	0	0	0	0	0.037	0
		juv	0.075	0.075	0.128	0.128	0.185	0.185	0.0023	0	0.0179	0	0	0	0	0	0.037	0
17	FMP	ad	0.024	0.024	0.0547	0.09	0.005	0.005	0	0	0.005	0	0	0	0	0	0.015	0
		juv	0.024	0.024	0.0547	0.0547	0.005	0.005	0	0	0.005	0	0	0	0	0	0.015	0

Table S7 (continued)

	prey	pred stage	9 ad	9 juv	10 ad	10 juv	11 ad	11 juv	12 ad	12 juv	13 ad	13 juv	14 ad	14 juv	15 ad	15 juv	16 ad	16 juv
18	ANF		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	BSS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	WHB	ad	0.005	0.01	0.1473	0.05	0	0	0.2739	0	0.06	0	0	0	0	0	0	0
		juv	0.005	0.005	0.1473	0.1473	0	0	0.2739	0	0.06	0	0	0	0	0	0	0
21	HKE	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	COD		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MEG		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	SOL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	FFL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	MUL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	FDL	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	FDM	ad	0	0	0	0	0.011	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0.011	0.011	0	0	0	0	0	0	0	0	0	0
29	FDS	ad	0.017	0.017	0	0	0.058	0.058	0	0	0.0023	0	0	0	0	0	0	0
		juv	0.017	0.017	0	0	0.058	0.058	0	0	0.0023	0.0023	0	0	0	0	0	0
30	FSD	ad	0.008	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0.008	0.008	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	CBE		0.003	0.002	0	0	0	0	0.0001	0	0	0	0	0	0	0	0	0
32	CBP		0.07	0.05	0.1267	0.15	0.016	0.016	0.0009	0.0009	0.0027	0.0027	0	0	0	0	0.011	0.01
33	NEP		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	CRP		0.02	0.04	0.0007	0.001	0.03	0.05	0	0	0.006	0.01	0	0	0	0	0	0
35	SHR		0.07	0.09	0.0247	0.03	0.03	0.08	0.0174	0.03	0.03	0.04	0	0	0	0	0.005	0.01
36	DFB		0	0	0	0	0	0	0.0075	0.01	0.0014	0.0014	0	0	0	0	0.014	0.02
37	DFD		0	0	0	0	0	0	0.0076	0.015	0.0014	0.0014	0	0	0	0	0	0
38	BIV		0	0	0	0	0	0	0	0	0.0028	0.0028	0	0	0	0	0.0003	0.0003
39	POL		0	0	0	0	0.011	0.02	0	0	0.0061	0.0061	0	0	0	0	0.0003	0.0003

Table S7 (continued)

		pred	9		10		11		12		13		14		15		16	
	prey	stage	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
40	SB		0	0	0	0	0	0	0.0068	0.01	0.2154	0.2154	0	0	0	0	0	0
41	ECH		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	INV		0	0	0	0	0	0	0.0013	0.0013	0	0	0	0	0	0	0.0009	0.0009
43	ZG		0.003	0.005	0.0447	0.05	0.03	0.03	0.095	0.12	0.05	0.06	0.04	0.02	0	0	0.015	0.015
44	ZL		0.039	0.012	0.112	0.18	0.061	0.14	0.3778	0.41	0.41	0.46	0.13	0.09	0.1	0.05	0.132	0.15
45	ZM		0.002	0.008	0.0267	0.04	0.06	0.1	0.1938	0.32	0.17	0.23	0.75	0.79	0.64	0.65	0.669	0.7
46	ZS		0	0	0	0	0	0	0.005	0.015	0	0	0	0	0.2	0.25	0.085	0.09
47	PP		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.009	0.009
48	PL		0	0	0	0	0	0	0	0	0	0	0.03	0.04	0.02	0.03	0.0015	0.002
49	PS		0	0	0	0	0	0	0	0	0	0	0.05	0.06	0.04	0.05	0.003	0.006
50	PB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	PS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	DL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	DR		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	DC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table S7 (continued)

		pred	17		18		19		20		21		22		23		24	
	prey	stage	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
1	SBD		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	SBS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	BWH		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	CET		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	SHB	ad	0	0	0.0012	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0.0012	0.0012	0	0	0	0	0	0	0	0	0	0	0	0
6	SHP		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	SHD	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	SSK	ad	0	0	0.0017	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0.0017	0.0017	0	0	0	0	0	0	0	0	0	0	0	0
9	BFT		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	ALB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	OPE	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MAC	ad	0	0	0.0015	0.0005	$8.02 \cdot 10^{-05}$	$4 \cdot 10^{-05}$	$2.13 \cdot 10^{-05}$	0	0	0	0	0	0	0	0	0
		juv	0	0	0. 15	0.15	0.802	0.802	0.00213	0.00213	0	0	0	0	0	0	0	0
13	HOM	ad	0	0	0.0287	0.005	0.402	0.2	0.0016	0	0.0158	0.035	0	0	0.003	0	0	0
		juv	0	0	0.0287	0.0287	0.402	0.402	0.0016	0.0016	0.0158	0.035	0	0	0.003	0.003	0	0
14	PIL	ad	0	0	0	0	0.148	0.148	0	0	0.197	0	0	0	0	0	0	0
		juv	0	0	0	0	0.148	0.148	0	0	0.197	0	0	0	0	0	0	0
15	ANE	ad	0	0	0	0	0.204	0.204	0	0	0.1385	0	0	0	0.002	0.001	0	0
		juv	0	0	0	0	0.204	0.204	0	0	0.1385	0	0	0	0.002	0.002	0	0
16	OPL	ad	0	0	0.031	0.02	0.042	0.1	0.0458	0.001	0.0167	0	0.0225	0.01	0.06	0.005	0	0
		juv	0	0	0.031	0.031	0.042	0.042	0.0458	0.0458	0.0167	0	0.0225	0.0225	0.06	0.06	0	0
17	FMP	ad	0.05	0	0	0	0	0	0.0399	0.004	0	0	0	0	0.001	0.0001	0	0
		juv	0.05	0.05	0	0	0	0	0.0399	0.0399	0	0	0	0	0.001	0.001	0	0

Table S7 (continued)

		pred	17		18		19		20		21		22		23		24	
	prey	stage	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
18	ANF		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	BSS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	WHB	ad	0	0	0.1161	0.06	0.066	0.066	0.0693	0	0.188	0	0.0271	0.01	0.05	0	0	0
		juv	0	0	0.1161	0.1161	0.066	0.066	0.0693	0.0693	0.188	0	0.0271	0.0271	0.05	0.05	0	0
21	HKE	ad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0.0866	0.0866	0.026	0.026	0.0073	0.0073	0.1955	0.095	0.0058	0.0058	0	0	0	0
22	COD	ad	0	0	0.053	0.03	0.046	0.046	0	0	0.0307	0	0	0	0	0	0	0
		juv	0	0	0.053	0.053												
23	MEG	ad	0	0	0.0265	0.01	0	0	0.0035	0	0	0	0	0	0.006	0	0	0
		juv	0	0	0.0265	0.0265												
24	SOL	ad	0	0	0.1104	0.05	0.006	0.006	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0.1104	0.1104												
25	FFL		0	0	0	0	0	0	0	0	0	0	0.0152	0.005	0.01	0.005	0	0
26	MUL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	FDL	ad	0	0	0.024	0	0.032	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0.024	0.024	0.032	0.032	0	0	0	0	0	0	0	0	0	0
28	FDM	ad	0	0	0	0	0.036	0	0	0	0.0352	0	0	0	0	0	0	0
		juv	0	0	0	0	0.036	0.036	0	0	0.0352	0	0	0	0	0	0	0
29	FDS	ad	0	0	0.062	0.07	0.1	0.14	0.0056	0.002	0.0022	0.149	0.1258	0.1258	0.15	0.1	0.002	0.002
		juv	0	0	0.062	0.062	0.1	0.1	0.0056	0.0056	0.0022	0.149	0.1258	0.1258	0.15	0.15	0.002	0.002
30	FSD	ad	0	0	0.0206	0	0	0	0.0013	0	0	0	0.0004	0	0.0104	0	0	0
		juv	0	0	0.0206	0.0206	0	0	0.0013	0.0013	0	0	0.0004	0.0004	0.0104	0.0104	0	0
31	CBE		0	0	0.0226	0.01	0.048	0.048	0.0031	0.0031	0.001	0.041	0.0178	0.01	0.0057	0.0057	0	0
32	CBP		0	0	0.0008	0.0008	0.004	0.004	0.0026	0.0026	0	0	0.0068	0.0068	0.0065	0.0065	0	0
33	NEP		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	CRP		0	0	0	0	0	0	0	0	0	0	0.0232	0.03	0.0002	0.001	0	0
35	SHR		0	0	0.001	0.01	0	0	0.1515	0.1515	0.0252	0.19	0.1663	0.18	0.0993	0.0993	0.0129	0.0129
36	DFB		0	0	0.0005	0.03	0.019	0.1	0.022	0.022	0.002	0.15	0.3211	0.33	0.1739	0.1739	0.0769	0.05
37	DFD		0	0	0.0002	0.03	0.019	0.14	0.0238	0.0238	0.002	0.022	0.176	0.18	0.0801	0.0801	0.0129	0.0129
38	BIV		0	0	0	0	0	0	0.0005	0.0005	0	0.002	0.0048	0.0048	0.03	0.03	0.105	0.105
39	POL		0.05	0.05	0	0.03	0	0	0	0	0.0061	0	0.0152	0.0152	0.05	0.05	0.6328	0.6328

Table S7 (continued)

	prey	pred stage	17 ad	17 juv	18 ad	18 juv	19 ad	19 juv	20 ad	20 juv	21 ad	21 juv	22 ad	22 juv	23 ad	23 juv	24 ad	24 juv
40	SB		0	0	0	0	0	0	0.071	0.11	0	0	0.0394	0.0394	0.05	0.05	0.095	0.0625
41	ECH		0	0	0	0	0	0	0	0	0	0	0.0014	0.0014	0.04	0.04	0.0625	0
42	INV		0.05	0.05	0	0	0	0	0.0016	0.0016	0	0	0.0016	0.0016	0.047	0.047	0	0
43	ZG		0.07	0.07	0	0	0	0	0.0001	0.0001	0	0	0	0	0	0	0	0
44	ZL		0.102	0.11	0	0	0	0	0.43	0.47	0.0077	0	0.025	0.055	0.065	0.065	0	0
45	ZM		0.567	0.6	0	0	0	0	0.0691	0.09	0	0	0.0021	0.01	0	0	0	0
46	ZS		0.111	0.15	0	0	0	0	0.048	0.068	0	0	0	0.005	0	0	0	0
47	PP		0	0	0	0	0	0	0	0	0	0	0.0019	0.0019	0	0	0	0
48	PL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	PS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	PB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	BB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	DL		0	0	0	0	0	0	0	0	0	0	0	0	0.03	0.04	0	0
53	DR		0	0	0	0	0	0	0	0	0	0	0	0	0.03	0.04	0	0
54	DC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table S7 (continued)

		pred	25		26		27		28		29		30	
	prey	stage	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
1	SBD		0	0	0	0	0	0	0	0	0	0	0	0
2	SBS		0	0	0	0	0	0	0	0	0	0	0	0
3	BWH		0	0	0	0	0	0	0	0	0	0	0	0
4	CET		0	0	0	0	0	0	0	0	0	0	0	0
5	SHB	ad	0	0	0	0	0.002	0	0	0	0	0	0	0
		juv	0	0	0	0	0.002	0.002	0	0	0	0	0	0
6	SHP		0	0	0	0	0	0	0	0	0	0	0	0
7	SHD	ad	0	0	0	0	0.0002	0	0	0	0	0	0	0
		juv	0	0	0	0	0.0002	0.0002	0	0	0	0	0	0
8	SSK	ad	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0
9	BFT		0	0	0	0	0	0	0	0	0	0	0	0
10	ALB		0	0	0	0	0	0	0	0	0	0	0	0
11	OPE	ad	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0
12	MAC	ad	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0	0	0	0	0	0	0	0
13	HOM	ad	0	0	0	0	0.0368	0.02	0	0	0	0	0	0
		juv	0	0	0	0	0.0368	0.0368	0	0	0	0	0	0
14	PIL	ad	0.0068	0.003	0	0	0.0381	0.02	0	0	0	0	0	0
		juv	0.0068	0.0068	0	0	0.0381	0.0381	0	0	0	0	0	0
15	ANE	ad	0	0	0	0	0.0352	0.01	0.004	0.001	0	0	0	0
		juv	0	0	0	0	0.0352	0.0352	0.004	0.004	0	0	0	0
16	OPL	ad	0.002	0.001	0	0	0.0925	0.08	0.055	0.03	0.0256	0.001	0	0
		juv	0.002	0.002	0	0	0.0925	0.0925	0.055	0.055	0.0256	0.0256	0	0
17	FMP	ad	0	0	0	0	0.0376	0.03	0.005	0.003	0	0	0.0675	0.06
		juv	0	0	0	0	0.0376	0.0376	0.005	0.005	0	0	0.0675	0.0675

Table S7 (continued)

		pred	25		26		27		28		29		30	
	prey	stage	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv	ad	juv
18	ANF		0	0	0	0	0	0	0	0	0	0	0	0
19	BSS		0.0057	0	0	0	0	0	0	0	0	0	0	0
20	WHB	ad	0	0	0	0	0.2111	0.1	0.078	0.03	0.0009	0.0001	0	0
		juv	0	0	0	0	0.2111	0.2111	0.078	0.078	0.0009	0.0009	0	0
21	HKE	ad	0	0	0	0	0	0	0	0	0	0	0	0
		juv	0	0	0	0	0.019	0.019	0	0	0	0	0	0
22	COD		0	0	0	0	0.1072	0.05	0	0	0	0	0	0
23	MEG		0	0	0	0	0.0032	0.002	0	0	0	0	0	0
24	SOL		0.0097	0	0	0	0	0	0	0	0	0	0	0
25	FFL		0	0	0	0	0.0162	0.01	0.0041	0.004	0.0077	0.0008	0	0
26	MUL		0	0	0	0	0	0	0	0	0	0	0	0
27	FDL	ad	0	0	0	0	0.0093	0	0.0016	0	0	0	0	0
		juv	0	0	0	0	0.0093	0.0093	0.0016	0.0016	0	0	0	0
28	FDM	ad	0.0031	0	0	0	0.012	0	0.0161	0	0	0	0.01	0.0001
		juv	0.0031	0.0031	0	0	0.012	0.012	0.0161	0.0161	0	0	0.01	0.01
29	FDS	ad	0.1624	0.1	0.0038	0.0038	0.1319	0.12	0.1054	0.07	0.0143	0.005	0.02	0.01
		juv	0.1624	0.1624	0.0038	0.0038	0.1319	0.1319	0.1054	0.1054	0.0143	0.0143	0.02	0.02
30	FSD	ad	0	0	0	0	0.056	0	0.0022	0	0	0	0	0
		juv	0	0	0	0	0.056	0.056	0.0022	0.0022	0	0	0	0
31	CBE		0.0372	0.0372	0.0095	0.0095	0.0063	0.0063	0.0088	0.0088	0.0157	0.01	0.02	0.02
32	CBP		0.035	0.035	0	0	0.0147	0.0147	0.007	0.007	0.0291	0.02	0.016	0.016
33	NEP		0	0	0	0	0.0005	0.0005	0	0	0	0	0.014	0.014
34	CRP		0	0	0	0	0.0051	0.01	0.086	0.09	0.108	0.08	0	0
35	SHR		0.0694	0.07	0.1429	0.1429	0.0897	0.1	0.0662	0.11	0.0285	0.04	0.2327	0.25
36	DFB		0.0642	0.08	0.1497	0.08	0.03	0.04	0.1763	0.21	0.0815	0.07	0.1842	0.19
37	DFD		0.0671	0.09	0.0252	0.0252	0.0238	0.05	0.1562	0.2	0.0996	0.09	0.0935	0.11
38	BIV		0.0613	0.07	0.0248	0.0248	0.0001	0.005	0.0454	0.06	0.0377	0.04	0	0
39	POL		0.1851	0.1851	0.4975	0.4975	0.0121	0.04	0.0243	0.04	0.1117	0.16	0.0307	0.14

Table S7 (continued)

	prey	pred stage	25 ad	25 juv	26 ad	26 juv	27 ad	27 juv	28 ad	28 juv	29 ad	29 juv	30 ad	30 juv
40	SB		0.2239	0.2239	0.1018	0.2	0.0014	0.02	0.0651	0.09	0.0437	0.11	0.109	0.19
41	ECH		0.0443	0.0443	0.033	0.033	0	0	0.0152	0.03	0.0796	0.06	0.01	0.01
42	INV		0.0088	0.0088	0.009	0.009	0	0	0.0359	0.06	0.0392	0.05	0.0279	0.04
43	ZG		0	0	0	0	0	0	0.0174	0.0174	0.0064	0.0064	0.0734	0.0734
44	ZL		0.0065	0.0065	0.0013	0.0013	0.0007	0.007	0.0097	0.011	0.0184	0.03	0.0721	0.08
45	ZM		0.0065	0.0065	0	0	0.0071	0.01	0.0059	0.007	0.0214	0.034	0.0189	0.03
46	ZS		0	0	0	0	0	0	0.0073	0.009	0.0036	0.01	0	0
47	PP		0	0	0.0018	0.0018	0	0	0.002	0.002	0.004	0.01	0	0
48	PL		0	0	0	0	0	0	0	0	0.0884	0.0884	0	0
49	PS		0	0	0	0	0	0	0	0	0.0442	0.0442	0	0
50	PB		0	0	0	0	0	0	0	0	0	0	0	0
51	BB		0	0	0	0	0	0	0	0	0	0	0	0
52	DL		0.0004	0.0004	0	0	0	0	$9.08\cdot10^{-05}$	$9.08\cdot10^{-05}$	0.0454	0.055	0	0
53	DR		0.0004	0.0004	0	0	0	0	$9.08\cdot10^{-05}$	$9.08\cdot10^{-05}$	0.0454	0.055	0	0
54	DC		0	0	0	0	0	0	0	0	0	0	0	0

Table S7 (continued)

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
1	SBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	SBS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	BWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	CET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	SHB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	SHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	SHD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	SSK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	BFT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	ALB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	BFT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MAC	0	0.0002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	HOM	0	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	PIL	0.0007	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	ANE	0.039	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	OPL	0.0007	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	FMP	0.0022	0.2	0	0	0.0087	0	0	0	0	0	0	0	0	0	0	0
18	ANF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	BSS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	WHB	0	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	HKE	0	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	COD	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MEG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	SOL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	FFL	0.0293	0.004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	MUL	0.0674	0.003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	FDL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	FDM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	FDS	0.1765	0.2	0	0	0	0.0076	0	0	0	0	0	0	0	0	0	0

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Table S7 (continued)

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
30	FSD	0.0081	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	CBE	$5.67\cdot10^{-07}$	0.00011	0.0035	0	0	0.0028	0	0	0	0	0	0	0	0	0	0
32	CBP	0.0002	$5\cdot10^{-07}$	0	0.0169	0.0069	0.0007	0	0	0	0	0	0	0	0	0	0
33	NEP	0.0128	0.004	0.0005	0	0	0	0	0	0	0	0	0	0	0	0	0
34	CRP	0.0128	0.07	0	0.0581	0	0	0	0	0	0	0	0	0	0	0	0
35	SHR	0.0357	0.2	0.0822	0.0199	0.0451	0.0365	0.039	0	0	0	0	0	0	0	0	0
36	DFB	0.1419	0.02	0.0691	0.028	0.0432	0.035	0.0382	0	0	0	0	0	0	0	0	0
37	DFD	0.1107	0.02	0.0478	0.0056	0.0044	0.0311	0.0372	0	0	0	0	0	0	0	0	0
38	BIV	0.2321	0	0.057	0	0.0439	0.0791	0.0152	0	0	0	0.01	0	0	0	0	0
39	POL	0.0266	0.04	0.2035	0.0901	0.0977	0.2541	0.0726	0	0.03	0.02	0.005	0	0	0	0	0
40	SB	0.0172	0.04	0.0506	0.0439	0.1995	0.1019	0.0724	0	0.01	0.03	0	0.01	0	0	0	0
41	ECH	0.00007	0	0.0439	0	0.0233	0.0606	0.027	0	0.005	0	0	0	0	0	0	0
42	INV	0.0063	0.006	0.0581	0.0015	0.0598	0.1355	0.0302	0	0.015	0.03	0.04	0.03	0	0	0	0
43	ZG	0	0	0	0.1126	0.0605	0.0293	0.0418	0.02	0	0	0	0	$1\cdot10^{-07}$	0.02	0	0
44	ZL	0.0059	0.03	0.1285	0.0582	0.0474	0.0463	0.02	0.02	0	0	0	0.01	0.07	$3\cdot10^{-07}$	0	0
45	ZM	0	0.03	0.034	0.0604	0.1039	0.0293	0.022	0.03	0	0.04	0	0.03	0.52	0.0006	$2\cdot10^{-07}$	0
46	ZS	0	0	0	0	0.0052	0	0	0.03	0	0.03	0	0.03	0.2	0.0006	0.25	$2\cdot10^{-07}$
47	PP	0	0	0	0	0	0.0357	0.0147	0	0	0	0.035	0.005	0	0	0	0
48	PL	0	0	0	0	0	0	0	0.57	0	0	0	0.02	0.1	0.1	0.37	0.34
49	PS	0	0	0	0	0	0	0	0.18	0	0	0	0.01	0.05	0.05	0.21	0.005
50	PB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.065
51	BB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.065
52	DL	0	0.0005	0.0868	0.041	0.1023	0.0303	0.2064	0.075	0.47	0.42	0.4525	0.425	0.025	0.025	0.075	0.165
53	DR	0	0.0005	0.0868	0.041	0.1023	0.0303	0.2064	0.075	0.47	0.42	0.4525	0.425	0.025	0.025	0.075	0.165
54	DC	0	0	0.048	0.423	0.0461	0.0539	0.1567	0	0	0.01	0.005	0.005	0	0	0	0

Section S5 – Calibration process related figures and tables of the Bay of Biscay Atlantis model.

Table S8. Overview of runs during the calibration process of the Bay of Biscay Atlantis model. Column description: 1) Parameter pert.: perturbed parameter in the simulation: KWSR_XXX: recruits structural weight (mgN) of XXX, KWRR_XXX: recruits reserve weight (mgN) of XXX, mum_XXX: maximum growth rate (mgN) gained per day of XXX, C_XXX: clearance rate of XXX; BHalpha_XXX: Beverton-Holt recruitment function alpha parameter; pPREYYYY_XXX: maximum availability of prey YYY to a predator XXX; XXX_mL: linear mortality term of XXX, jmQ_XXX: quadratic mortality term of juvenile XXX, mQ_XXX: quadratic mortality term of adult XXX; 2) Original value: parameter value in the non-calibrated model; 3) Final value: parameter value in the calibrated model.

Sim. name	Description	Parameter pert.	Original value	Final value
Run 00	Non calibrated model	-		
Run 01	Adjusted NH3 intial values	NH3	-	NO3 value
Run 02	Increased NO3 inital values	NO3	-	Original value * 9
Run 03	Same small phytoplankton initial values per box and layer	SmallPhyto_N	0-0.00496	0.1
Run 04	Same large phytoplankton initial values per box and layer	LargePhyto_N	0-0.0044	0.1
Run 05	Added linear mortality for small phytoplankton	PS_mL	0	0.02
Run 06	Decreased microzooplankton-small phytoplankton diet link	pPREYPS-ZS	0.31	0.005
Run 07	Added linear mortality for microzooplankton	ZS_mL	0	0.0001
Run 08	Decreased cannibalism value in the diet for microzooplankton	pPREYZS-ZS	0.02	$2{\cdot}10^{-07}$
Run 09	Decreased cannibalism value in the diet for mesozooplankton	pPREYZM-ZM	0.02	$2{\cdot}10^{-07}$
Run 10	Decreased cannibalism value in the diet for macrozooplankton	pPREYZL-ZL	0.03	$3{\cdot}10^{-07}$
Run 11	Decreased macrozooplankton-mesozooplankton diet link	pPREYZM-ZL	0.6	0.0006
Run 12	Added macrozooplankton-microzooplankton diet link	pPREYZS-ZL	0	0.0006
Run 13	Increased growth rate for gelatinous zooplankton	mum_ZG	0.008	0.02
Run 14	Decreased cannibalism value in the diet for gelatinous zooplankton	pPREYZG-ZG	0.01	$1{\cdot}10^{-07}$
Run 15	Increased growth rate for other invertebrates	mum_INV	0.02	0.04
Run 16	Decreased growth rate for echinoderms	mum_ECH	0.02	0.005
Run 17	Increased growth rate for zooplankton feeding shrimps	mum_SHR	0.0000001	0.0001

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 18	Decreased growth rate for Norway lobster	mum_NEP	0.05	0.006
Run 19	Decreased growth rate for squids	mum_CBP	0.01	0.0006
Run 20	Decreased squids-benthic cephalopods diet link	pPREYCBE-CBP	0.011	0.00011
Run 21	Decreased cannibalism value in the diet for squids	pPREYCBP-CBP	0.05	$5\cdot10^{-07}$
Run 22	Increased diet values for squids	pPREYCBP	-	Round up to the next number
Run 23	Decreased benthic cephalopods-squids diet link	pPREYCBP-CBE	0.0174	0.0002
Run 24	Decreased cannibalism value in the diet for squids	pPREYCBE-CBE	0.0567	$5.67\cdot10^{-07}$
Run 25	Decreased deep-sea fishes recruits' structural and reserve weight	KWSR_FSD, KWRR_FSD	66.9578, 177.4381	60, 170
Run 26	Increased growth rate for deep-sea fishes	mum_FSD	0.1366 0.6832 1.3665 2.0497 2.733 3.4164 4.0995 4.7827 5.4659 6.1492	0.1366 3.4162 6.8324 10.2486 13.6648 17.0811 20.4973 23.9135 27.3297 30.7459
Run 27	Increased consumption rate for deep-sea fishes	C_FSD	0.0137 0.0683 0.1366 0.205 0.2733 0.3416 0.4099 0.4783 0.5466 0.6149	0.0137 0.3416 0.6832 .0249 1.3665 1.7081 2.0497 2.3913 2.733 3.0746
Run 28	Increased recruitment for deep-sea fishes	BHalpha_FSD	$6\cdot10^{05}$	$9\cdot10^{06}$
Run 29	Decreased mortality for juvenile deep-sea fishes	jmQ_FSD	$6.301\ 10^{-08}$	$6.301\cdot10^{-12}$
Run 30	Decreased small demersal fishes recruits' structural and reserve weight	KWSR_FDS, KWRR_FDS	82.8861, 219.6481	65, 180
Run 31	Increased recruitment for small demersal fishes	BHalpha_FDS	$1.5\cdot10^{07}$	$1.5\cdot10^{08}$
Run 32	Decreased mortality for adult small demersal fishes	mQ_FDS	$1.178\cdot10^{-07}$	$1.178\cdot10^{-11}$
Run 33	Increased medium demersal fishes recruits' structural and reserve weight	KWSR_FDM, KWRR_FDM	54.4312, 144.2426	250, 840
Run 34	Increased recruitment for medium demersal fishes	BHalpha_FDM	$4\cdot10^{06}$	$1.3\cdot10^{08}$
Run 35	Decreased mortality for adult medium demersal fishes	mQ_FDM	$3.288\cdot10^{-08}$	$3.288\cdot10^{-10}$
Run 36	Decreased large demersal fishes recruits' structural and reserve weight	KWSR_FDL, KWRR_FDL	3106.7989, 8233.0172	145, 500

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 37	Increased growth rate for large demersal fishes	mum_FDL	0.2449 6.7274 7.9521 22.4733 44.6387 77.5593 116.9185 143.3275 149.0861 155.0053	0.2449 33.6371 39.7603 112.3663 223.1934 387.7967 584.5923 716.6375 745.4305 775.0265
Run 38	Increased consumption rate for large demersal fishes	C_FDL	0.0245 0.6727 0.7952 2.2473 4.4639 7.7559 11.6918 14.3328 14.9086 15.5005	0.0245 3.3637 3.976 11.2366 22.3193 38.7797 58.4592 71.6638 74.5431 77.5026
Run 39	Decreased recruitment for large demersal fishes	BHalpha_FDL	$2.5\ 10^{08}$	$9\ 10^{05}$
Run 40	Decreased mortality for adult large demersal fishes	mQ_FDL	$5.479\cdot10^{-08}$	$5.479\cdot10^{-10}$
Run 41	Increased recruitment for mullets	BHalpha_MUL	$9\cdot10^{05}$	$9\cdot10^{10}$
Run 42	Decreased mortality for mullets	jmQ_MUL, mQ_MUL	$2.863\cdot10^{-07}$, $1.087\cdot10^{-07}$	$2.863\cdot10^{-09}$, $1.087\cdot10^{-10}$
Run 43	Increased recruitment for flatfishes	BHalpha_FFL	$1.4\cdot10^{05}$	$4.59\cdot10^{08}$
Run 44	Decreased mortality for adult flatfishes	mQ_FFL	$5.479\cdot10^{-08}$	$5.479\cdot10^{-12}$
Run 45	Increased recruitment for common sole	BHalpha_SOL	$1.9\cdot10^{06}$	$8\cdot10^{07}$
Run 46	Decreased mortality for adult common sole	mQ_SOL	$2.74\cdot10^{-08}$	$2.74\cdot10^{-12}$
Run 47	Decreased megrim recruits' structural and reserve weight	KWSR_MEG, KWRR_MEG	344.0352, 911.6933	20, 60
Run 48	Increased growth rate for megrim	mum_MEG	0.026 0.5246 0.6545 1.6345 2.9323 4.7554 7.2144 9.8164 12.4184 15.0204	0.026 2.6229 3.2727 8.1723 14.6614 23.7769 36.0722 49.0821 62.0921 75.102
Run 49	Increased consumption rate for megrim	C_MEG	0.0026 0.0525 0.0655 0.1634 0.2932 0.4755 0.7214 0.9816 1.2418 1.502	0.0026 0.2623 0.3273 0.8172 1.4661 2.3777 3.6072 4.9082 6.2092 7.5102
Run 50	Decreased recruitment for megrim	BHalpha_MEG	$7\cdot10^{07}$	$9\cdot10^{06}$
Run 51	Decreased mortality for megrim	jmQ_MEG, mQ_MEG	$2.7395\cdot10^{-12}$, $5.479\cdot10^{-08}$	$2.7395\cdot10^{-13}$, $5.479\cdot10^{-13}$
Run 52	Decreased cods recruits' structural and reserve weight	KWSR_COD, KWRR_COD	25.4303, 67.3902	10, 30
Run 53	Increased growth rate for cods	mum_COD	0.0315 0.1574 0.3148 0.4721 0.8339 1.1956	0.0315 1.1017 2.2033 3.305 5.837 8.369
Run 54	Increased consumption rate for cods	C_COD	0.0031 0.0157 0.0315 0.0472 0.0834 0.1196	0.0031 0.1102 0.2203 0.3305 0.5837 0.8369
Run 55	Increased recruitment for cods	BHalpha_COD	$4\cdot10^{06}$	$7\cdot10^{09}$

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 56	Decreased mortality for cods	jmQ_COD, mQ_COD	$1.23\cdot10^{-10}$, $5.21\cdot10^{-10}$	$1.23\cdot10^{-11}$, $5.21\cdot10^{-14}$
Run 57	Decreased hake recruits' structural and reserve weight	KWSR_HKE, KWRR_HKE	1048.4444, 2778.3775	55, 150
Run 58	Increased growth rate for hake	mum_HKE	0.0585 0.5946 0.8871 2.0864 4.4095 8.2891 14.2249 20.8421 33.781 51.8354	5.8495 59.4645 88.7118 20.8636 44.0947 82.8911 142.2488 208.4211 337.8097 518.3536
Run 59	Increased consumption rate for hake	C_HKE	0.0058 0.0595 0.0887 0.2086 0.4409 0.8289 1.4225 2.0842 3.3781 5.1835	58.4945 5946.4511 8871.1771 208.6357 440.9473 828.9111 1422.4875 2084.2113 3378.0965 5183.5364
Run 60	Decreased recruitment for hake	BHalpha_HKE	$3.5\cdot10^{07}$	$1\cdot10^{07}$
Run 61	Decreased mortality for hake	jmQ_HKE, mQ_HKE	$5.48\cdot10^{-12}$, $1.096\cdot10^{-07}$	$5.48\cdot10^{-09}$, $1.096\cdot10^{-11}$
Run 62	Increased upper gape size for hake	KUP_HKE	0.4	0.8
Run 63	Decreased blue whiting recruits' structural and reserve weight	KWSR_WHB, KWRR_WHB	51.2596, 135.838	10, 50
Run 64	Increased growth rate for blue whiting	mum_WHB	0.0459 0.2297 0.4595 0.6892 1.3296 1.97 2.6104 3.2508 3.8912 4.5315	0.0919 0.4595 0.919 1.3785 2.6593 3.94 5.2208 6.5015 7.7823 9.0631
Run 65	Increased consumption rate for blue whiting	C_WHB	0.0046 0.023 0.0459 0.0689 0.133 0.197 0.261 0.3251 0.3891 0.4532	0.0092 0.0459 0.0919 0.1378 0.2659 0.394 0.5221 0.6502 0.7782 0.9063
Run 66	Increased recruitment for blue whiting	BHalpha_WHB	$4\cdot10^{08}$	$1\cdot10^{09}$
Run 67	Decreased seabass recruits' structural and reserve weight	KWSR_BSS, KWRR_BSS	1211.0045, 3209.1618	600, 1000
Run 68	Increased growth rate for seabass	mum_BSS	0.4727 2.3634 4.7268 9.2408 13.7549 18.269 22.7831 27.2972 31.8113 36.3254	0.4727 4.7268 9.4535 18.4817 27.5099 36.5381 45.5662 54.5944 63.6226 72.6508
Run 69	Increased consumption rate for seabass	C_BSS	0.0473 0.2363 0.4727 0.9241 1.3755 1.8269 2.2783 2.7297 3.1811 3.6325	4.7268 47.2676 94.5351 184.817 275.0988 365.3806 455.6625 545.9443 636.2261 726.508
Run 70	Decreased recruitment for seabass	BHalpha_BSS	$3.9\cdot10^{07}$	$1\cdot10^{06}$
Run 71	Increased mortality for juvenile seabass and decreased mortality for adult seabass	jmQ_BSS, mQ_BSS	$6.575\cdot10^{-12}$, $6.575\cdot10^{-08}$	$6.575\cdot10^{-10}$, $6.575\cdot10^{-11}$

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 72	Increased diet for seabass	pPREY1BSS1, pPREY2BSS1, pPREY1BSS2, pPREY2BSS2	-	Original value * 2
Run 73	Decreased anglerfish recruits' structural and reserve weight	KWSR_ANF, KWRR_ANF	2424.2946, 6424.3808	100, 200
Run 74	Increased growth rate for anglerfish	mum_ANF	0.1113 0.9738 1.5305 6.1945 13.6485 26.4513 34.9919 47.0186 81.9164 97.2021	0.05 29.7381 35.3052 81.9448 156.4855 284.5126 369.919 490.1862 839.1639 992.0211
Run 75	Increased consumption rate for anglerfish	C_ANF	0.0111 0.0974 0.1531 0.6194 1.3649 2.6451 3.4992 4.7019 8.1916 9.7202	0.5 297.3813 353.0518 819.4481 1564.8548 2845.1262 3699.1905 4901.862 8391.6391 9920.2109
Run 76	Decreased recruitment for anglerfish	BHalpha_ANF	$9\cdot10^{07}$	$1\cdot10^{07}$
Run 77	Increased mortality for juvenile anglerfish and decreased mortality for adult anglerfish	jmQ_ANF, mQ_ANF	$3.4245\cdot10^{-09}$, $6.849\cdot10^{-08}$	$3.082\cdot10^{-08}$, $6.164\cdot10^{-09}$
Run 78	Increased recruitment for mesopelagic fishes	BHalpha_FMP	$7\cdot10^{06}$	$7\cdot10^{09}$
Run 79	Decreased other planktivorous recruits' structural and reserve weight	KWSR_OPL, KWRR_OPL	13.7987, 36.5666	6.5, 10
Run 80	Increased recruitment for other planktivorous	BHalpha_OPL	$1.2\cdot10^{07}$	$1.2\cdot10^{09}$
Run 81	Decreased mortality for adult other planktivorous	mQ_OPL	$4.384\cdot10^{-08}$	$4.384\cdot10^{-12}$
Run 82	Increased growth rate for anchovy	mum_ANE	0.0666 0.1728 0.5059	0.1332 0.3456 1.0118
Run 83	Increased consumption rate for anchovy	C_ANE	0.0067 0.0173 0.0506	0.0133 0.0346 0.1012
Run 84	Increased recruitment for anchovy	BHalpha_ANE	$2.5\cdot10^{07}$	$2.5\cdot10^{10}$
Run 85	Decreased mortality for adult anchovy	mQ_ANE	$3.288\cdot10^{-07}$	$3.288\cdot10^{-13}$
Run 86	Increased recruitment for sardine	BHalpha_PIL	$1\cdot10^{07}$	$1\cdot10^{09}$
Run 87	Decreased mortality for sardine	jmQ_PIL, mQ_PIL	$2.178\cdot10^{-11}$, $1.038\cdot10^{-07}$	$2.297\cdot10^{-15}$, $1.142\cdot10^{-12}$
Run 88	Decreased adult hake-sardine diet links	pPREYPIL1HKE2, pPREYPIL2HKE2	-	Original value * 0.01
Run 89	Decreased horse mackerel recruits' structural and reserve weight	KWSR_HOM, KWRR_HOM	121.9419, 323.1461	80, 150
Run 90	Increased recruitment for horse mackerel	BHalpha_HOM	$9\cdot10^{07}$	$9\cdot10^{08}$
Run 91	Decreased mortality for adult horse mackerel	mQ_HOM	$4.11\cdot10^{-08}$	$4.11\cdot10^{-12}$

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 92	Decreased anglerfish-horse mackerel and hake-horse mackerel diet links	pPREYHOM1ANF1, pPREYHOM2ANF1, pPREYHOM1ANF2, pPREYHOM2ANF2, pPREYHOM1HKE1, pPREYHOM2HKE1, pPREYHOM1HKE2, pPREYHOM2HKE2	-	Original value * 0.01
Run 93	Increased mackerel recruits' structural and reserve weight	KWSR_MAC, KWRR_MAC	192.4778, 510.0661	270, 725
Run 94	Increased growth rate for mackerel	mum_MAC	0.31 1.5484 3.0982 3.9794 4.5582 5.0038 5.7638 6.6235 7.7265 8.8295	0.9299 4.6453 6.1964 7.9588 9.1164 10.0076 11.5277 13.247 15.453 17.659
Run 95	Increased consumption rate for mackerel	C_MAC	0.031 0.1548 0.3098 0.3979 0.4558 0.5004 0.5764 0.6624 0.7727 0.883	0.093 0.4645 0.6196 0.7959 0.9116 1.0008 1.1528 1.3247 1.5453 1.7659
Run 96	Increased recruitment for mackerel	BHalpha_MAC	$6 \cdot 10^{07}$	$1.5 \cdot 10^{09}$
Run 97	Decreased mortality for mackerel	jmQ_MAC, mQ_MAC	$2.055 \cdot 10^{-12}$, $4.11 \cdot 10^{-10}$	$2.055 \cdot 10^{-20}$, $4.11 \cdot 10^{-40}$
Run 98	Decreased diet links on adult mackerel prey	pPREY2MACXXX1, pPREY2MACXXX2	-	Original value * 0.001
Run 99	Decreased other large pelagic fishes recruits' structural and reserve weight	KWSR_OPE, KWRR_OPE	929.3929, 2462.8911	700, 1800
Run 100	Increased growth rate for adult other large pelagic fishes	mum_OPE	1.5957 7.9786 15.9573 26.66 37.3627	1.5957 55.8504 111.7008 186.6198 261.5387
Run 101	Increased consumption rate for adult other large pelagic fishes	C_OPE	0.1596 0.7979 1.5957 2.666 3.7363	0.1596 5.585 11.1701 18.662 26.1539
Run 102	Decreased recruitment for other large pelagic fishes	BHalpha_OPE	$2 \cdot 10^{07}$	$7 \cdot 10^{06}$
Run 103	Decreased mortality for adult other large pelagic fishes	mQ_OPE	$2.384 \cdot 10^{-07}$	$2.384 \cdot 10^{-11}$
Run 104	Decreased albacore recruits' structural and reserve weight	KWSR_ALB, KWRR_ALB	7221.3482, 19136.5728	400, 800
Run 105	Increased growth rate for albacore	mum_ALB	0.997 68.8329 73.8181 142.651 211.4838 280.3167 349.1495 458.607 568.0645 677.522	1.9941 137.6657 369.0905 713.2548 1057.4191 1401.5834 1745.7477 2293.0352 2840.3226 3387.61

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 106	Increased consumption rate for albacore	C_ALB	0.0997 6.8833 7.3818 14.2651 21.1484 28.0317 34.915 45.8607 56.8065 67.7522	0.1994 13.7666 36.9091 71.3255 105.7419 140.1583 174.5748 229.3035 284.0323 338.761
Run 107	Decreased recruitment for albacore	BHalpha_ALB	$3.5\cdot10^{09}$	$5\cdot10^{08}$
Run 108	Decreased mortality for juvenile albacore	jmQ_ALB	$8.219\cdot10^{-08}$	$8.219\cdot10^{-10}$
Run 109	Increased bluefin tuna recruits’ structural and reserve weight	KWSR_BFT, KWRR_BFT	67.2025, 178.0868	6000, 8500
Run 110	Increased growth rate for age classes 3 to 10 for bluefin tuna	mum_BFT	0.0095 0.0477 0.0954 0.3497 0.7312 1.1444 1.5895 2.0981 2.5749 2.9882	0.0095 0.0477 0.9537 3.4968 7.3116 11.4442 15.8947 20.9809 25.7493 29.8819
Run 111	Increased consumption rate for age classes 3 to 10 for bluefin tuna	C_BFT	0.001 0.0048 0.0095 0.035 0.0731 0.1144 0.1589 0.2098 0.2575 0.2988	0.001 0.0048 0.0954 0.3497 0.7312 1.1444 1.5895 2.0981 2.5749 2.9882
Run 112	Increased recruitment for bluefin tuna	BHalpha_BFT	$9\cdot10^{05}$	$9\cdot10^{08}$
Run 113	Decreased skates and rays recruits’ structural and reserve weight	KWSR_SSK, KWRR_SSK	1102.1053, 2920.5791	100, 200
Run 114	Decreased recruitment for skates and rays	KDENR_SSK	1.5	0.2
Run 115	Decreased deep water sharks recruits’ structural and reserve weight	KWSR_SHD, KWRR_SHD	116.3332, 308.2829	110, 280
Run 116	Increased growth rate for deep water sharks	mum_SHD	0.0753 0.3765 0.7531 1.1296 1.5062 1.914 2.3218 2.7296 3.1374 3.5453	0.7531 3.7655 7.5309 11.2964 15.0619 19.14 3.2182 27.2963 31.3745 35.4527
Run 117	Increased consumption rate for deep water sharks	C_SHD	0.0075 0.0377 0.0753 0.113 0.1506 0.1914 0.2322 0.273 0.3137 0.3545	0.0753 0.3765 0.7531 1.1296 1.5062 1.914 2.3218 2.7296 3.1374 3.5453
Run 118	Decreased pelagic sharks recruits’ structural and reserve weight	KWSR_SHP, KWRR_SHP	40315.9198, 106837.1875	14000, 37000
Run 119	Increased growth rate for age classes 2 to 10 for pelagic sharks	mum_SHP	14.3784 228.2669 300.159 621.7315 958.179 1262.83 1517.975 1719.84 1875.41 2030.98	14.3784 1141.3344 1500.795 3108.6576 4790.8952 6314.1485 7589.8727 8599.2013 9377.0495 10154.9

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 120	Increased consumption rate for pelagic sharks	C_SHP	1.4378 22.8267 30.0159 62.1732 95.8179 126.283 151.7975 171.984 187.541 203.098	143.7843 11413.3436 15007.9501 31086.5756 47908.9516 63141.4853 75898.7269 85992.0131 93770.4947 101548.9764
Run 121	Decreased recruitment for pelagic sharks	KDENR_SHP	1.5	0.05
Run 122	Increased mortality for pelagic sharks	jmQ_SHP, mQ_SHP	$2.7395\cdot10^{-12}$, $5.479\cdot10^{-08}$	$2.7395\cdot10^{-10}$, $5.479\cdot10^{-07}$
Run 123	Increased growth rate for adult toothed cetaceans	mum_CET	48.8665 192.8439 437.1762 630.0201 822.8639 1015.708 1208.552 1401.396 1594.239 1787.083	48.8665 1928.4388 4371.7617 6300.2005 8228.6393 10157.0782 12085.517 14013.9558 15942.3946 17870.8334
Run 124	Increased consumption rate for toothed cetaceans	C_CET	4.8866 19.2844 43.7176 63.002 82.2864 101.5708 120.8552 140.1396 159.4239 178.7083	488.6646 19284.3881 43717.6173 63002.0054 82286.3935 101570.7816 120855.1697 140139.5578 159423.9459 178708.334
Run 125	Decreased recruitment for toothed cetaceans	KDENR_CET	0.05	0.04
Run 126	Increased mortality for toothed cetaceans	jmQ_CET, mQ_CET	$2.7395\cdot10^{-12}$, $5.479\cdot10^{-08}$	$2.7395\cdot10^{-10}$, $5.479\cdot10^{-06}$
Run 127	Increased growth rate for baleen whales	mum_BWH	8484.8728 7154.1741 49578.5379 56732.712 63886.8862 71041.0603 78195.2344 85349.4085 92503.5827 99657.7568	59394.1093 50079.2188 347049.7655 397128.9843 447208.2032 497287.422 547366.6409 597445.8597 647525.0786 697604.2974
Run 128	Increased consumption rate for baleen whales	C_BWH	848.4873 715.4174 4957.8538 5673.2712 6388.68862 7104.106 7819.5234 8534.9409 9250.3583 9965.7757	5939.4109 5007.9219 34704.9765 39712.8984 44720.8203 49728.7422 54736.6641 59744.586 64752.5079 69760.4297
Run 129	Decreased recruitment for baleen whales	KDENR_BWH	0.3	0.03
Run 130	Increased mortality for baleen whales	jmQ_BWH, mQ_BWH	$3.04\cdot10^{-06}$, $5.1\cdot10^{-08}$	$3.04\cdot10^{-05}$, $5.1\cdot10^{-06}$
Run 131	Decreased surface feeding seabirds recruits' structural and reserve weight	KWWR_SBS, KWRR_SBS	788.546, 2089.647	150, 450

Table S8 (continued)

Sim. name	Description	Parameter pert.	Original value	Final value
Run 132	Increased growth rate for adult surface feeding seabirds	mum_SBS	0.1906 4.714 5.6669 10.3809 15.0949 19.8089 24.523 29.237 33.951 38.665	0.1906 9.428 11.3338 20.7618 30.1899 39.6179 49.0459 58.4739 67.9019 77.33
Run 133	Increased consumption rate for adult surface feeding seabirds	C_SBS	0.0191 0.4714 0.5667 1.0381 1.5095 1.9809 2.4523 2.9237 3.3951 3.8665	0.0191 94.2802 113.3381 207.6184 301.8986 396.1788 490.459 584.7392 679.0195 773.2997
Run 134	Increased recruitment for Surface feeding seabirds	KDENR_SBS	0.3	0.7
Run 135	Decreased diving and pursuit divers seabirds recruits' structural and reserve weight	KWSR_SBD, KWRR_SBD	283.4522, 751.1482	100, 400
Run 136	Increased growth rate for diving and pursuit divers seabirds	mum_SBD	0.1802 1.5688 2.47 4.0388 5.6076 7.1764 8.7452 10.314 11.8828 13.4516	1.8025 15.688 24.7003 40.3883 56.0763 71.7643 87.4523 103.1403 118.8283 134.5163
Run 137	Increased consumption rate for diving and pursuit divers seabirds	C_SBD	0.018 0.1569 0.247 0.4039 0.5608 0.7176 0.8745 1.0314 1.1883 1.3452	0.1802 1.5688 2.47 4.0388 5.6076 7.1764 8.7452 10.314 11.8828 13.4516
Run 138	Increased recruitment for diving and pursuit divers seabirds	KDENR_SBD	0.3	1
Run 139	Increased mortality for diving and pursuit divers seabirds	jmQ_SBD, mQ_SBD	$5.37\cdot10^{-09}$, $2.74\cdot10^{-11}$	$5.37\cdot10^{-07}$, $2.74\cdot10^{-07}$

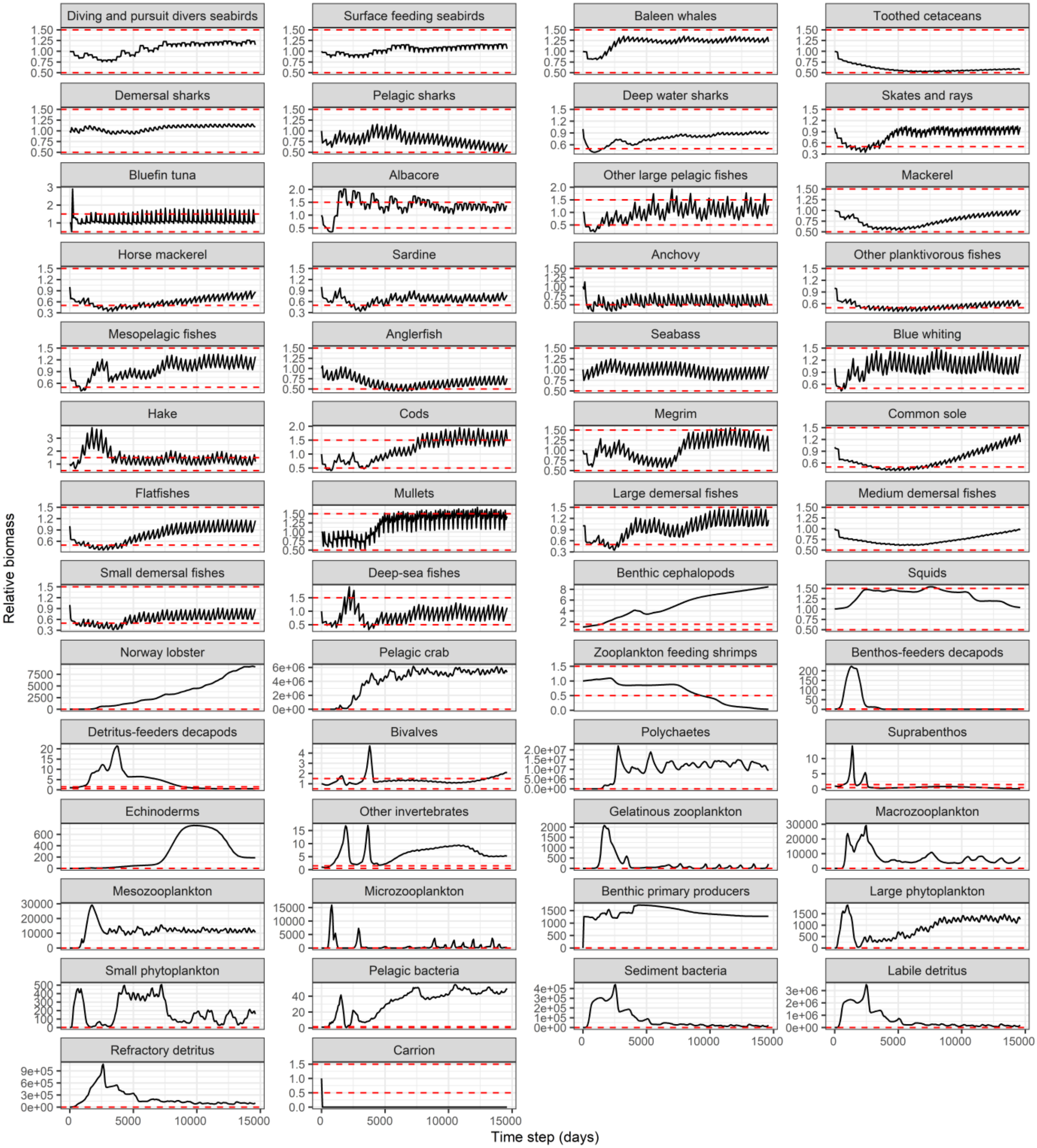
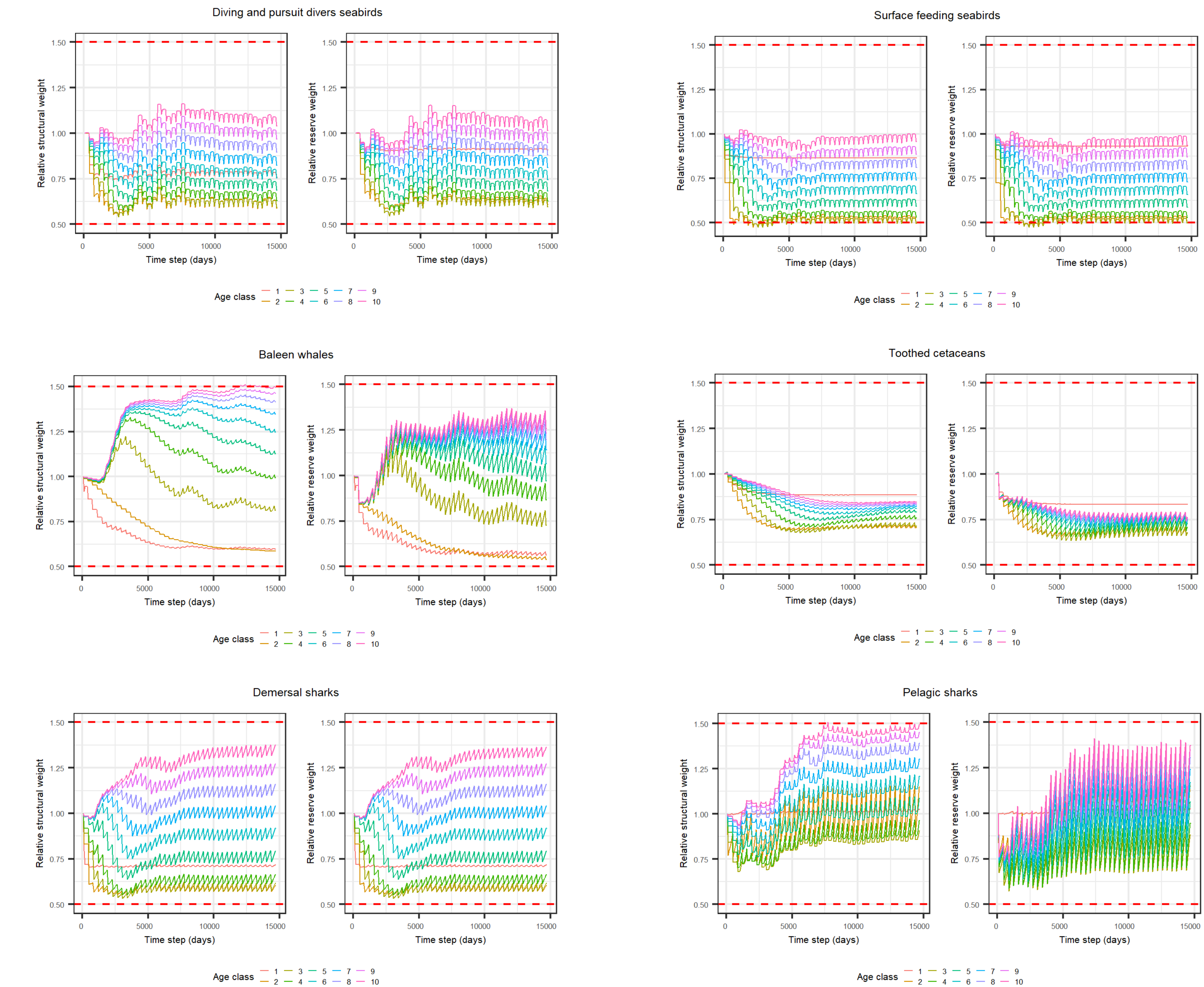
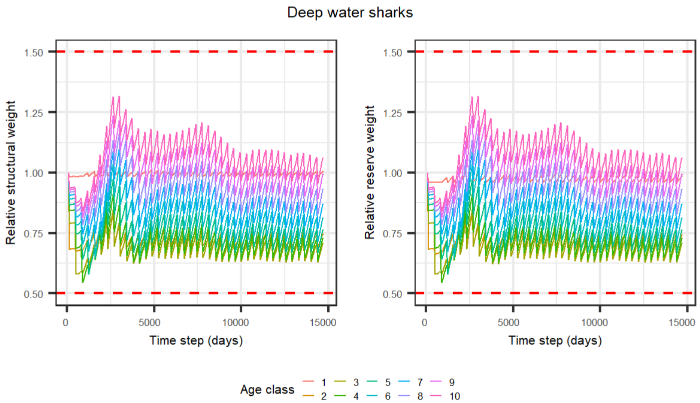
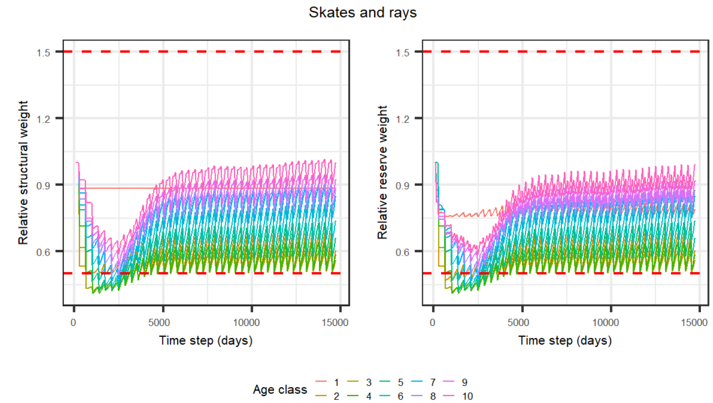
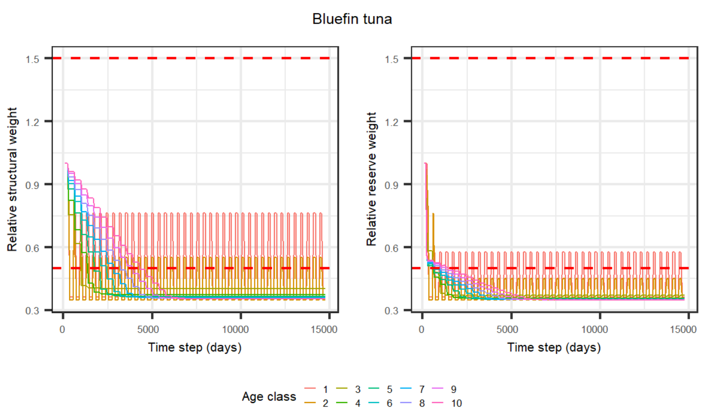


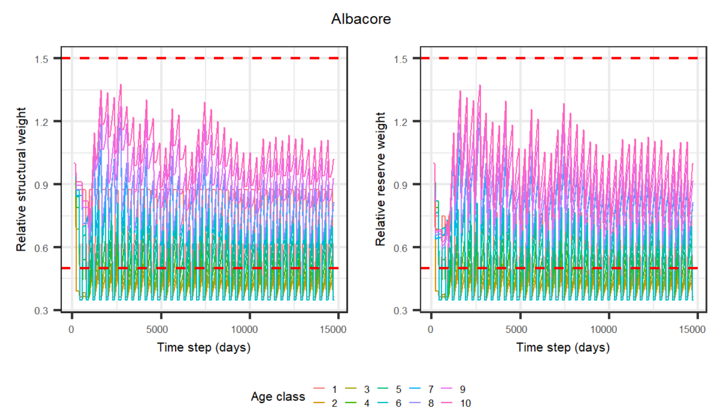
Figure S2. Time series of relative biomass of the functional groups across the entire model domain in the 40-year calibration. Dashed red line corresponds to the intial value ±50 % line.

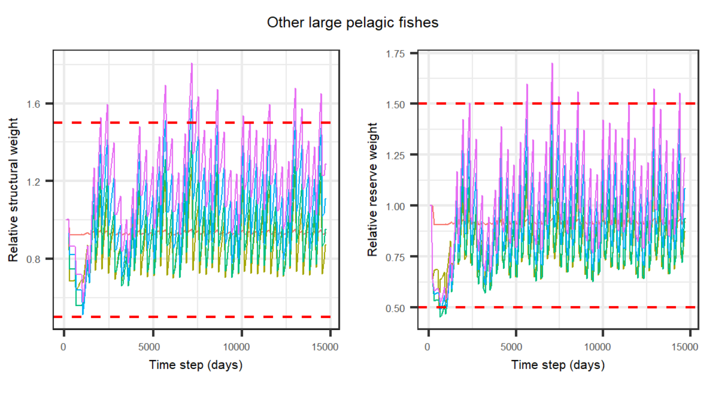

Diving and pursuit divers seabirds
Surface feeding seabirds
Baleen whales
Toothed cetaceans
Demersal sharks
Pelagic sharks
Relative structural weight
Relative reserve weight
Time step (days)
0
5000
10000
15000
0.50
0.75
1.00
1.25
1.50
Age class
1
2
3
4
5
6
7
8
9
10

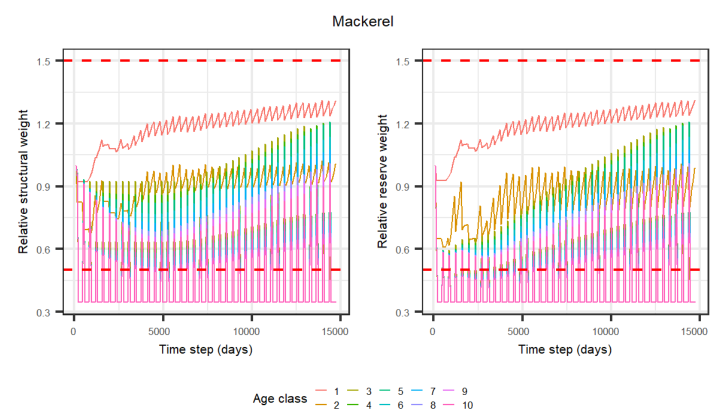

Deep water sharks
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10

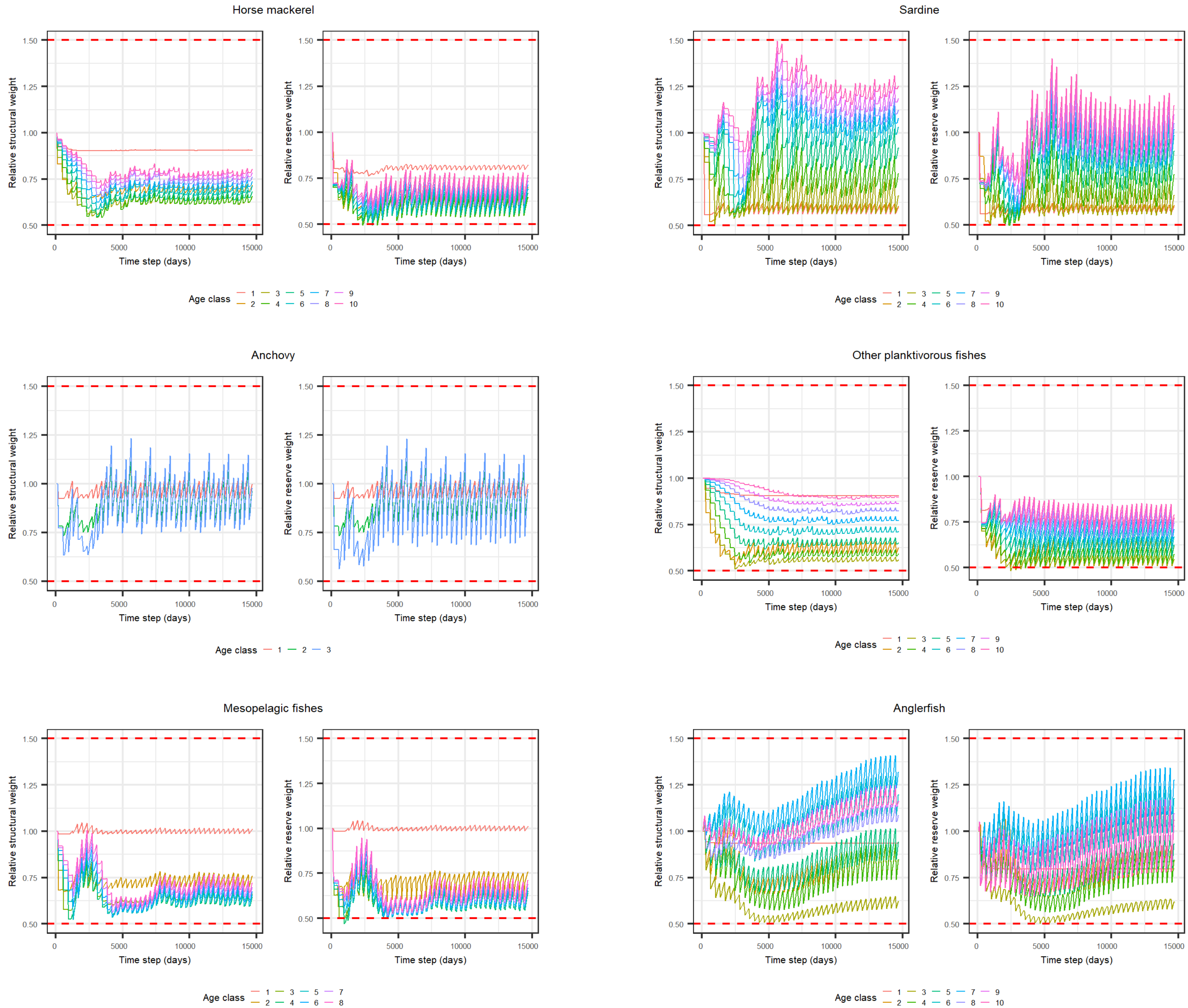

Skates and rays
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10

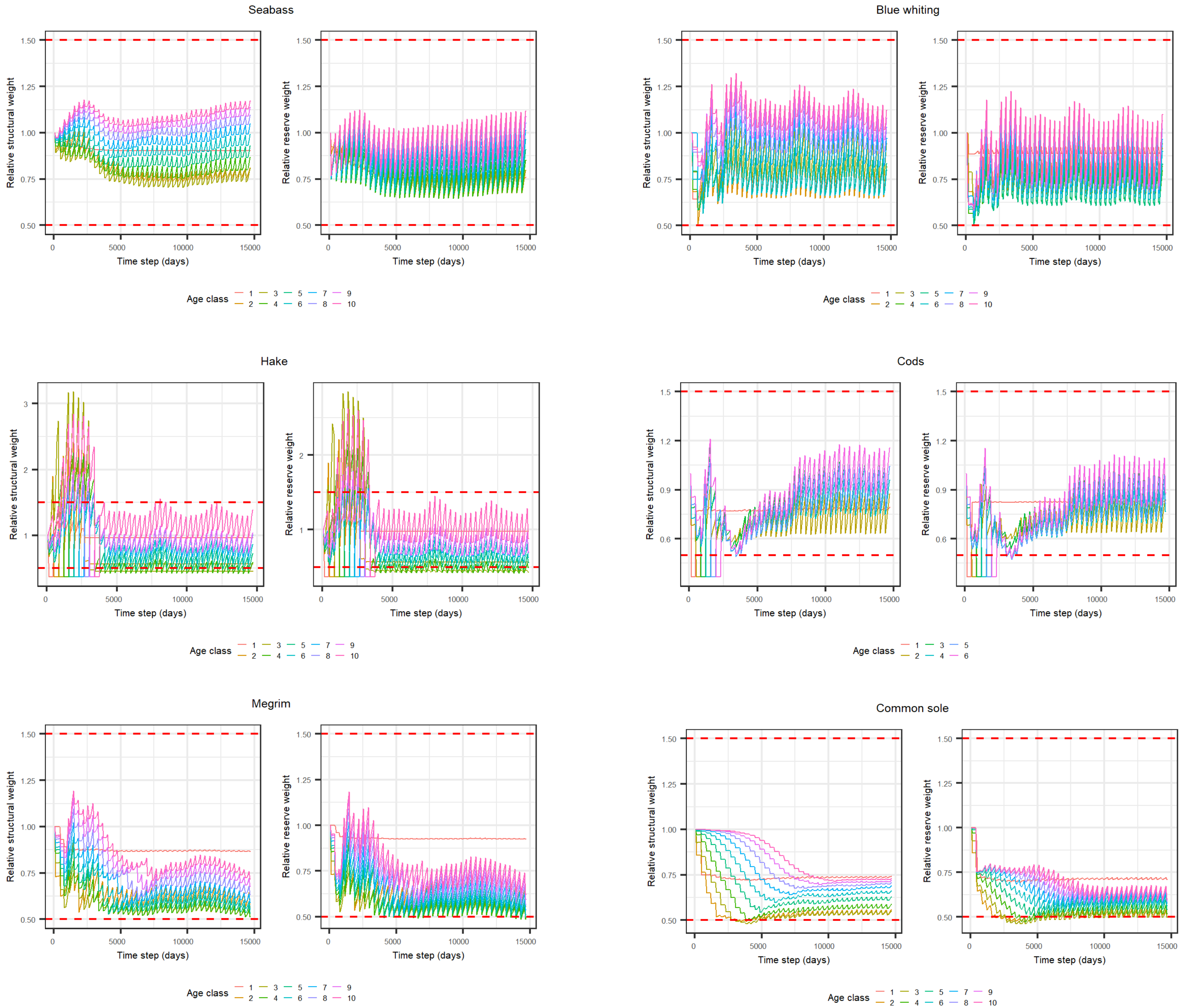

Bluefin tuna
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10


Albacore
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10


Other large pelagic fishes
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5


Mackerel
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10


Horse mackerel
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10
Sardine
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10
Anchovy
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3
Other planktivorous fishes
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10
Mesopelagic fishes
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8
Anglerfish
Relative structural weight
Relative reserve weight
Time step (days)
Age class 1 2 3 4 5 6 7 8 9 10
0.50
0.75
1.00
1.25
1.50
0
5000
10000
15000


Seabass
Blue whiting
Hake
Cods
Megrim
Common sole
Relative structural weight
Relative reserve weight
Time step (days)
Age class

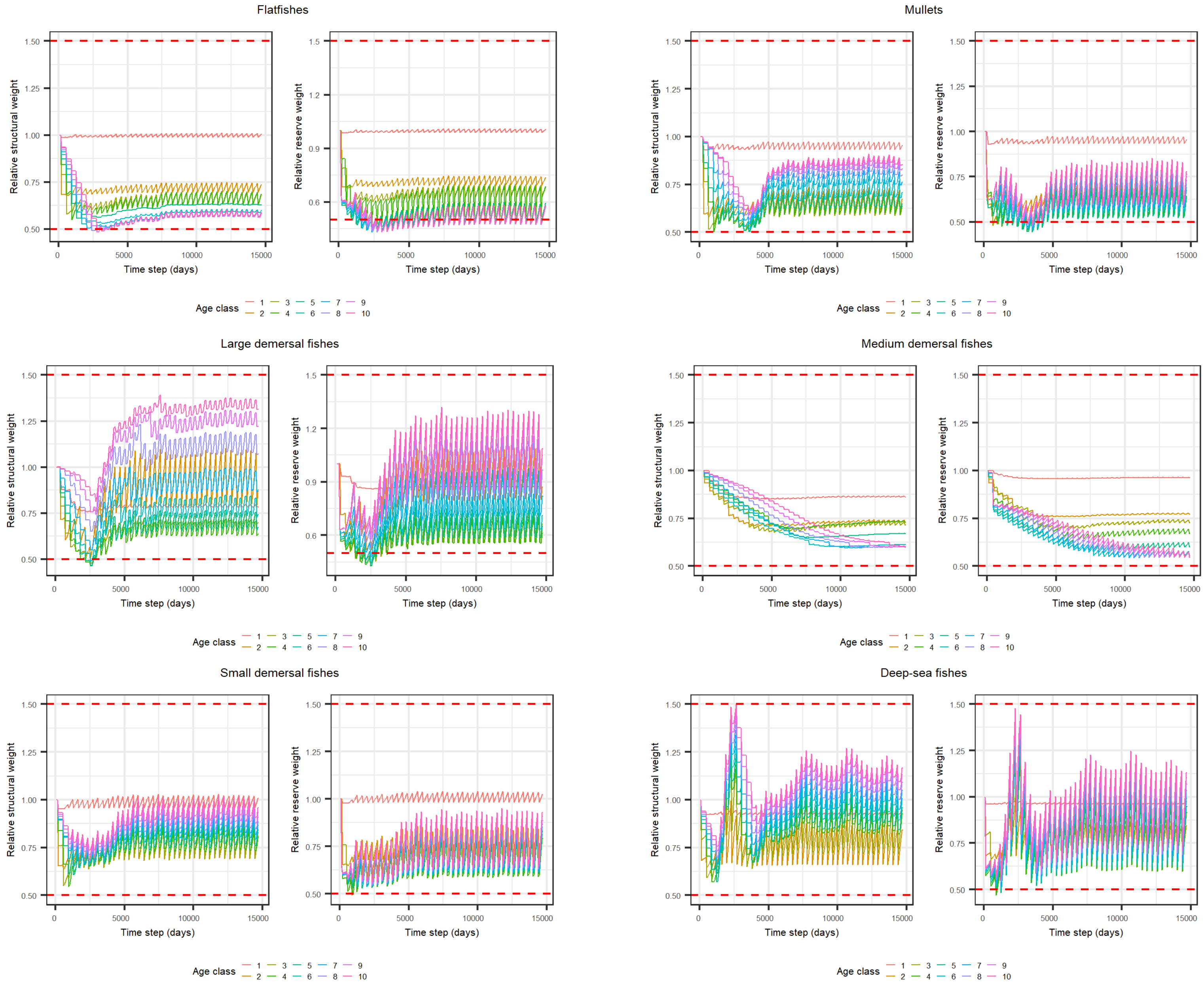


Figure S3. Time series of relative weight per age class (structural and reserve weight) of the functional groups across the entire model domain in the 40-year calibration. Dashed red line corresponds to the ± 0.5 line.

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