### Supplement 1

* **Brief interpretation of the table:**

In terms of the species summarized by the spatial indicators, 49 works were focused on fish (31 with one species and 17 with more than two) and only four works focused on invertebrates (cephalopods and crustaceans). Spatial indicators have been used primarily to summarize longer time series, as only 4 works accounted for 1 to 2 years, whereas in 32 works, more than 10 years of data were integrated. In terms of the sampling device used, in 25 works the data was sampled during bottom trawl surveys, in 10 of them, the main data source was based on acoustic sampling and in five, plankton and eggs sampling was carried out. In terms of geographic origin, most works were located on the North-East Atlantic area, including North Sea, Bay of Biscay-North-West Ireland, Iberian coast, English Channel and in the North-West Atlantic, namely Georges Bank, Gulf of Maine, Gulf of St. Lawrence and Newfoundland (9 works). Six works focused on Mediterranean and other 6 on the North Pacific. Only one work integrated data from surveys taken in different parts of the world, but it used a model-based approach to estimate the indicators.

Besides changes in the species spatial-temporal distribution, these indicators have been used to address the effect of climate change, bottom temperature, other oceanographic indices and fishing effort. The spatial indicators have also been used to compare the prey and predator distributions, different life stages of a species (e.g. larval stages, juveniles, adults or different ages/cohorts) and co-existing species (e.g. sardine and anchovy). Often, spatial indicators have been used to explore species density-occupancy relationships, test for MacCall’s hypothesis or for the Ideal Free Distribution Theory. Another common previous application of the spatial indicators has been in model validation (e.g. individual model, ecosystem models, fisheries models), by comparing the spatial distribution of the modelled results with survey data (reality).

S1 Table : Table of previous works using the spatial indicators (literature review), by subject, with a brief quantittaive description on the indictators used, the inclusion of the areas of influnce in its calculations (if is is mentioned and wether the details for calculation were provided), the species, temporal interval considered, type of sampling and area studied. Spatial indicators: CG: center of gravity; I: inertia; PA: positive area; EA: equivalent area; SA: spreading area; IC: index of collocation (either global or local); SP: spatial patches; G: Gini; MS: microstucture index; IA: index of aggregation; OC: occupied area; Sampling: bts=bottom trawl surveys; as=acoustic surveys; Note that Voronoi was considere to be equivalent to Dirichlet tessellation.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference | Subject | Indicators used | Areas of influence | Species (groups) | Period | Sampling | Area |
| Petitgas (2009) | methods description | CG, I, i, PA, SP, EA, MS | not mentioned | *Gadus morhue* (different ages) | 1985-2005 | bts (DA-TRAS-ICES) | North Sea |
| Woillez, Rivoirard, and Petitgas (2009) | methods description | CG, I, i, IC, PA, SP, EA, MS, SP | Voronoi, but not detailed |  |  |  |  |
| Adams et al. (2018) | spatio-temporal dynamics | CG, I, PA | Voronoi, but not detailed | 9 fish sp | 1963-2016 | bts | Northwest Atlantic |
| Adams(2017) | spatio-temporal dynamics | CG, I, PA | Voronoi, but not detailed | *Peprilus triacanthus (fish)* | 1982-2013 | bts | Northeast US |
| Alvarez et al. (2004) | spatio-temporal dynamics | CG, distribution ellipses | not mentioned | *Merluccius merluccius* (fish eggs and larvae) | 1995-1998 | Bongo (ICES plankton surveys) | Bay of Biscay to the north-west of Ireland. |
| Alvarez et al. (2001) | spatio-temporal dynamics | CG, distribution ellipses | not mentioned | *Merluccius merluccius* (fish eggs and larvae) | 1983-1995 | Bongo (ICES plankton surveys) | Bay of Biscay |
| Atkinson et al. (1997) | spatio-temporal dynamics | statistical ellipses, area occupied | not mentioned | *Gadus morhue* | 1981-1993 | bts | Newfoundland  |
| Barra et al. (2015) | spatio-temporal dynamics | CG, NP, I, i, PA, AS, EA, IC | areas of influence from gridding | *Sardina pilchardus* and E*ngraulis encrasicolus* | 2002-2010/2004-2006 | as (MEDIAS) | Strait of Sicily and North Aegean Sea, |
| Baudron and Fernandes (2015) | spatio-temporal dynamics | CG | not mentioned | *Merluccius merluccius* | 1978-2011 | bts | North Sea, West of Scotland, Celtic Sea, Porcupine bank and Bay of Biscay |
| Bez and Rivoirard (2000) | spatio-temporal dynamics | CG, I | not mentioned | *Scomber scombrus* (eggs/larvae) | 1989 | as (ICES) | North-east Atlantic (Bay of Biscay, Celtic Sea, and west of Ireland). |
| Bitetto et al. (2012) | spatio-temporal dynamics | CG, IC, I, PA SP | not mentioned | *Aristaeomorpha foliacea* (crustacea) | 1994-2010 | bts (MEDITS) | Central-southern Tyrrhenian Sea (GSA) |
| Blanchard et al. (2005) | spatio-temporal dynamics | area occupied (#ices rectangles) with >95% of population | not relevant | *Gadus morhue* (juvenile) | 1977-2012 | bts | North Sea |
| Bonanno et al. (2017) | spatio-temporal dynamics | PA, SA, EA, CG, I, i, SP  | not mentioned | *Engraulis encrasicolus, Sardina pilchardus, Sardinella aurita, Trachurus trachurus* and *Boops boops* | 2006-2015 | as | Central Mediterranean Sea (Sicily) |
| Bourdaud et al. (2017) | spatio-temporal dynamics | IC | not relevant | several sp | 1998-2014 | bts (CGFS)/onboard sampling (OBSMER) | English chanel |
| Boyra et al. (2013) | spatio-temporal dynamics | CG | not mentioned | *Engraulis encrasicolus* (juvenile) | 2003-2010 | as (JUVENA) | Bay of Biscay |
| Bruge et al. (2016) | spatio-temporal dynamics | CG, P5, P95 | not mentioned | *Scomber scombrus* (Pres/Abs data and egg production ) | 1992–2013 | eggs survey | EU North Atlantic coast |
| De Robertis and Cokelet (2012) | spatio-temporal dynamics | CG | not mentioned | *Theragra chalcogramma*/zooplancton | 2007-2008 | as/commertial vessels | Bering Sea |
| Engelhard et al. (2011) | spatio-temporal dynamics | CG, Weighted standard deviations and standard errors of the weighted mean latitudes were calculated | not mentioned (gridded) | *Solea solea; Pleuronectes platessa* | 1913-2007 | catch and effort data for British North Sea trawlers | North Sea |
| Faraj and Bez (2007) | spatio-temporal dynamics | CG, I, i, IA | mentioned but no detail given | *Octopus vulgaris* | 1998-2004 | bts | Atlantic coast of Marrocco |
| Gastauer, et al. (2016) | spatio-temporal dynamics | CG, I, i, PA, EA, G, IC | mentioned but no detail given | *Micromesistius poutassou*  | 2006–2014 | as (IBWSS) | West of British Isles and Ireland |
| Honkalehto et al. (2011) | spatio-temporal dynamics | CG, I, IC | not mentioned | *Theragra chalcogramma* | 2006-2009 | Acoustic-trawl, bottom trawl and acoustic data collected from commercial fishing vessels | Eastern Bering Sea |
| Hughes et al. (2014) | spatio-temporal dynamics | CG, I, i | not mentioned | *Scomber scombrus* (eggs) | 1977-2010 | eggs survey (NEA- WSC; ﻿plankton tows)  | North-west Atlantic |
| Modica et al. (2016) | spatio-temporal dynamics | %presence, CG, I | not mentioned | *Helicolenus dactylopterus*, *Merluccius merluccius* and *Lophius budegassa* | 1983-2010 | bts (DEMERSALES) | southern Bay of Biscay |
| Morfin et al. (2012) | spatio-temporal dynamics | CG, I, presence area | not mentioned | 12 sp | 1994-2010 | bts (MEDITS) | Gulf of Lions |
| Murawski, Finn and Finn (1988) | spatio-temporal dynamics | CG,Green's index of spatial dispersion;  | not mentioned | 7 fish sp/different ages | 1963-1981 | bts (NEFC-NMFS) | Georges Bank |
| Myers et al. (1995) | spatio-temporal dynamics | G | by strata | *Hippoglossoides platessoides*, *Reinhardtius hipppoglossoidcs*, *Glyptocephalus cynoglossus* and *Lirnanda ferruginea* | 1971-1994 | bts | Newfoundland  |
| Paulino et al. (2017) | spatio-temporal dynamics | CG, I | not mentioned (gridded) | *Dosidicus gigas* (cephalopod) | 2004-2015 | satelite luminosity | Peru |
| Perry et al. (2014) | spatio-temporal dynamics | mean latitude (center of distribution) | not mentioned | 36 fish sp | 1977-2001 | bts | North Sea |
| Persohn, Lorance and Trenkel (2009) | spatio-temporal dynamics | area occupied (adapted spreading area) and occurrence, ﻿cumulative distribution functions (CDFs),  | specific weighting method | 8 fish sp | 1992-2006 | bts (EVHOE) | Bay of Biscay and Celtic Sea, North-East Atlantic |
| Reuchlin-Hugenholtz, Shackell and Hutchings (2015) | spatio-temporal dynamics | D90, G, area occupied, density area | by strata | 9 fish sp | 1970-2011 | bts | Scotian Shelf and Bay of Fundy |
| Rindorf, Lewy and Rose (2012) | spatio-temporal dynamics | Lloyds, I, Ellipses, Gini, D95, ... | not relevant | *Gadus morhue* |  |  | North sea |
| Rindorf and Lewy (2006) | spatio-temporal dynamics | CG (alternative formula) | not mentioned | *Gadus morhue* | 1983-2003 | bts | North Sea |
| Saraux et al. (2014) | spatio-temporal dynamics | *CG, I, IC, SP* | not mentioned | *Sardina pilchardus* and E*ngraulis encrasicolus* | 2003-2012 | as (PELMED) | Gulf of Lions |
| Spedicato, Woillez and Rivoirard (2007) | spatio-temporal dynamics | CG, I, i, IC, SP, PA, AS, EA, MS | mentioned but no detail given | *Mullus barbatus*  | 1994-2004 | bts (GRUND/MEDITS) | **south Tyrrhenian sea**  |
| Swain and Sinclair (1994) | spatio-temporal dynamics | G, D90 | not relevant | *Gadus morhue* |  |  | Gulf of St. Lawrence |
| Vikebø et al. (2005) | spatio-temporal dynamics | CG | not relevant |  |  |  |  |
| Volkenandt et al. (2014) | spatio-temporal dynamics | CG | mentioned but no detail given | *Clupea harengus* | 2005-2012 | as | Celtic sea |
| Woillez et al. (2007) | spatio-temporal dynamics | CG, I, i, IC, PA, SP, EA, MS, SP | mentioned but no detail given | *Merluccius merluccius* | 1987-2004 | bts | Bay of Biscay |
| Brodeur et al. (2014) | spatial overlap | CG, I, IC | not mentioned | *Clupea pallasii, engraulis mordax, Sardinops sagax* and *Chrysaora fuscescens* (medusae) | 1999-2011 | pelagic rope trawl | Washington and Oregon coast |
| Decker et al. (2018) | spatial overlap | CG, I, IC, Cramér-von Mises randomization test | not mentioned | *Gadus chalcogrammus*, *Clupea pallasii, Mallotus villosus* and *Gadus macrocephalus (fish)* and *Chrysaora melanaster* (jellyfish) | 2004-2012 | bts (NMFS AFSC and BASIS) | Bering Sea |
| Marino, Juanes and Stokesbury (2009) | spatial overlap | center of abundance, standard ellipse and 95%, confidence ellipse were Superimposed on the scallop density distribution maps to determine the spatial overlap | not relevant | *Placopecten magellanicus* (bivalve) | 1999-2006 | video surveys | Georges Bank |
| Tableau et al. (2016) | spatial overlap | CG, I, IC | not mentioned | 7 fish | 2008 | beam trawl (NURSE) | Bay of Vilaine (Bay of Biscay) |
| Petitgas et al. (2012) | growth | CG, I |  | *Engraulis encrasicolus*  | 2001-2011 | fish otoliths | Bay of Biscay |
| Doray et al. (2017) | indicators integration | CG, I, i, PA, EA, MS | Voronoi with respective details | multiple (small pelagic fish) | 2000-2015 | as (PELGAS) | Bay of Biscay |
| Guan et al. (2017) | model based | CG, AO | not relevant (model based) | *Gadus morhue* | 1982-2013 | bts | Gulf of Maine |
| Thorson, Pinsky and Ward (2016) | model based | CG, AO | not relevant (model based) | 18 fish sp | 1977-2013 | bts | West coast of the USA |
| Thorson et al. (2016) | model based | CG, AO | not relevant (model based) | 92 sp of fish |  |  | 6 marine regions |
| Thorson (2017) | model based | CG, AO | not relevant (model based) | *Gadus chalcogrammus* | 1982-2017 | bts | Eastern Bering Sea |
| Chust et al. (2013) | model validation | CG | not relevant (model validation) | *Calanus* sp | 1959-2004 | Continuous Plankton Recorder survey coupled with model | North Atlantic Ocean  |
| García-García, Ruiz-Villarreal and Bernal (2016) | model validation | CG, PA, EA, Coeffiicient of variation (PA/EA) | not relevant | *Sardina pilchardus* | 2006-2007 |  | Atlantic Iberian margin |
| Hinckley et al. (2016) | model validation | CG, I, i, Getis-Ord, NDI, Overlap coefficient, Syrjala tests | not relevant (model validation) | *Gadus chalcogrammus* |  |  | Gulf of Alasca |
| Huret, Petitgas and Woillez (Huret, Petitgas, and Woillez 2010) | model validation | CG, I, i, PA, AS, EA and coefficient of variation of positive values of densities | not relevant (model validation) | *Engraulis encrasicolus* (model of larvae dispersal) |  |  | Bay of Biscay |
| Lewy and Kristensen (Lewy and Kristensen 2009) | model validation | CG, concentration, AO | not relevant (model validation) | *Gadus morhue* | 1983-2006 | bts | North Sea |
| Petrik et al. (2015) | model validation | CG, I, IC | not relevant (model validation) |  |  |  |  |
| Pointin et al. (2018) | model validation | CG, I, IC | not mentioned | discards/landings | 2011-2016 | onboard observers (OBSMER) | Celtic Sea and western English Channel  |

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