# Supplementary Materials

## A Salinity and dissolved oxygen valency groups

Table A.1: Benthodemersal fish taxa were assigned to ecological valency groups based on their tolerance to salinity and dissolved oxygen. Tolerance range values were retrieved from a meta-analysis of fish environmental niches conducted over estuarine and coastal nurseries of the Bay of Biscay. Ecological valency groups were attributed to all fish species using a classification procedure based on three tolerance range categories (wide: eury-, medium: meso-, narrow: steno-) of salinity (-haline) and DO (-oxybiontic).

| Taxon | Salinity tolerance | Salinity valency | Oxygen tolerance | Oxygen valency |
| --- | --- | --- | --- | --- |
| *Abramis brama* | 0.996 | euryhaline | 0.935 | euryoxybiontic |
| *Ammodytes tobianus* | 0.995 | euryhaline | 0.929 | euryoxybiontic |
| *Anguilla anguilla* | 0.998 | euryhaline | 0.990 | euryoxybiontic |
| *Aphia minuta* | 0.988 | euryhaline | 0.984 | euryoxybiontic |
| *Arnoglossus laterna* | 0.927 | euryhaline | 0.921 | euryoxybiontic |
| *Buglossidium luteum* | 0.972 | euryhaline | 0.979 | euryoxybiontic |
| *Callionymus lyra* | 0.994 | euryhaline | 0.987 | euryoxybiontic |
| *Callionymus reticulatus* | 0.176 | stenohaline | 0.161 | stenoxybiontic |
| *Chelidonichthys lucerna* | 0.984 | euryhaline | 0.978 | euryoxybiontic |
| *Chelon labrosus* | 0.776 | euryhaline | 0.233 | stenoxybiontic |
| *Ciliata mustela* | 0.991 | euryhaline | 0.976 | euryoxybiontic |
| *Conger conger* | 0.755 | euryhaline | 0.985 | euryoxybiontic |
| *Ctenolabrus rupestris* | 0.550 | mesohaline | 0.417 | mesoxybiontic |
| *Dicentrarchus labrax* | 0.995 | euryhaline | 0.993 | euryoxybiontic |
| *Dicentrarchus punctatus* | 0.596 | mesohaline | 0.906 | euryoxybiontic |
| *Dicologlossa cuneata* | 0.892 | euryhaline | 0.561 | mesoxybiontic |
| *Echiichthys vipera* | 0.974 | euryhaline | 0.983 | euryoxybiontic |
| *Eutrigla gurnardus* | 0.202 | stenohaline | 0.649 | mesoxybiontic |
| *Gobius niger* | 0.999 | euryhaline | 0.987 | euryoxybiontic |
| *Hippocampus hippocampus* | 0.936 | euryhaline | 0.988 | euryoxybiontic |
| *Hyperoplus lanceolatus* | 0.987 | euryhaline | 0.943 | euryoxybiontic |
| *Lepadogaster candolii* | 0.037 | stenohaline | 0.335 | stenoxybiontic |
| *Limanda limanda* | 0.858 | euryhaline | 0.637 | mesoxybiontic |
| *Merlangius merlangus* | 0.916 | euryhaline | 0.992 | euryoxybiontic |
| *Merluccius merluccius* | 0.273 | stenohaline | 0.517 | mesoxybiontic |
| *Mullus surmuletus* | 0.916 | euryhaline | 0.972 | euryoxybiontic |
| *Osmerus eperlanus* | 0.997 | euryhaline | 0.980 | euryoxybiontic |
| *Pegusa lascaris* | 0.830 | euryhaline | 0.429 | mesoxybiontic |
| *Platichthys flesus* | 0.998 | euryhaline | 0.994 | euryoxybiontic |
| *Pleuronectes platessa* | 0.997 | euryhaline | 0.994 | euryoxybiontic |
| *Pollachius pollachius* | 0.739 | euryhaline | 0.990 | euryoxybiontic |
| *Pomatoschistus spp* | 0.996 | euryhaline | 0.962 | euryoxybiontic |
| *Raja undulata* | 0.412 | mesohaline | 0.345 | stenoxybiontic |
| *Sander lucioperca* | 0.995 | euryhaline | 0.925 | euryoxybiontic |
| *Scophthalmus maximus* | 0.396 | mesohaline | 0.923 | euryoxybiontic |
| *Scophthalmus rhombus* | 0.870 | euryhaline | 0.990 | euryoxybiontic |
| *Silurus glanis* | 0.581 | mesohaline | 0.345 | stenoxybiontic |
| *Solea senegalensis* | 0.971 | euryhaline | 0.686 | mesoxybiontic |
| *Solea solea* | 0.999 | euryhaline | 0.993 | euryoxybiontic |
| *Sparus aurata* | 0.903 | euryhaline | 0.838 | euryoxybiontic |
| *Spinachia spinachia* | 0.820 | euryhaline | 0.978 | euryoxybiontic |
| *Spondyliosoma cantharus* | 0.485 | mesohaline | 0.983 | euryoxybiontic |
| *Syngnathus acus* | 0.988 | euryhaline | 0.986 | euryoxybiontic |
| *Syngnathus rostellatus* | 0.997 | euryhaline | 0.964 | euryoxybiontic |
| *Syngnathus typhle* | 0.956 | euryhaline | 0.496 | mesoxybiontic |
| *Torpedo marmorata* | 0.345 | mesohaline | 0.980 | euryoxybiontic |
| *Trisopterus luscus* | 0.846 | euryhaline | 0.989 | euryoxybiontic |
| *Trisopterus minutus* | 0.711 | mesohaline | 0.520 | mesoxybiontic |
| *Zeugopterus norvegicus* | 0.129 | stenohaline | 0.384 | mesoxybiontic |

## B Monthly variability in environmental conditions in the Loire estuary

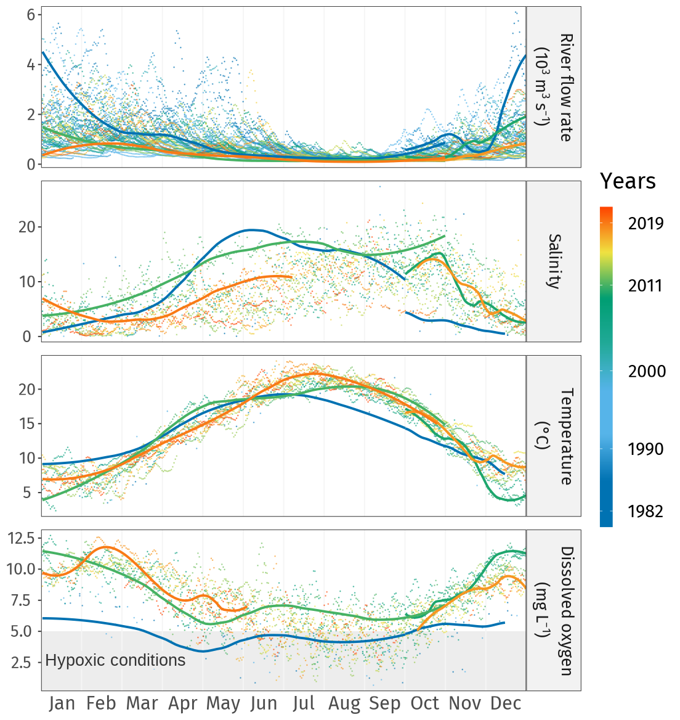


Figure B.1: Daily mean values of abiotic variables measured at Montjean-sur-Loire hydrologic station (flow rate) and Paimbœuf environmental monitoring station (salinity, temperature, and DO), presented with LoESS regression curves associated with the intra-annual surveys (1982, 2011, and 2019).

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## C Ecological trajectories and monthly composition of fish populations in the annual cycles

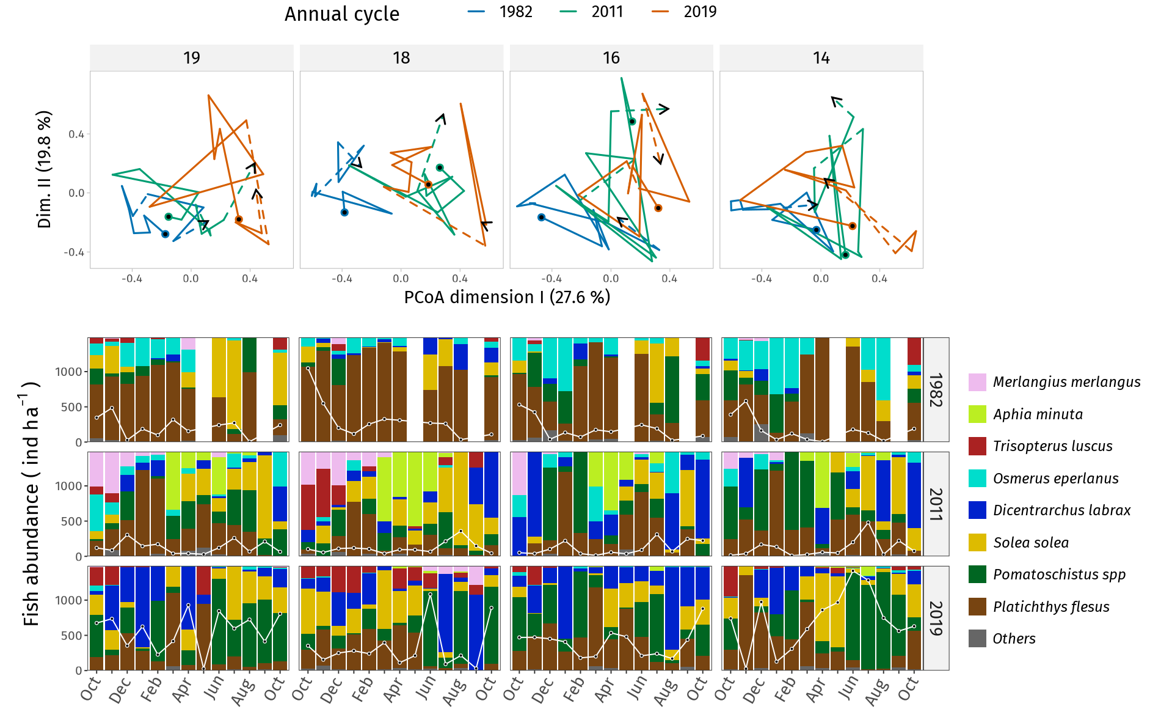


Figure C.1: Above: site-specific ecological trajectories across four sites (kilometer milestones) and over three annual cycles (1982, 2011, 2019). Below: monthly relative abundance data for fish taxa (each column totals 100%). Total fish abundance is superimposed as a white line with black dots associated with the ordinate axis values.

## D Classification of inter-annual samples and species association with clusters

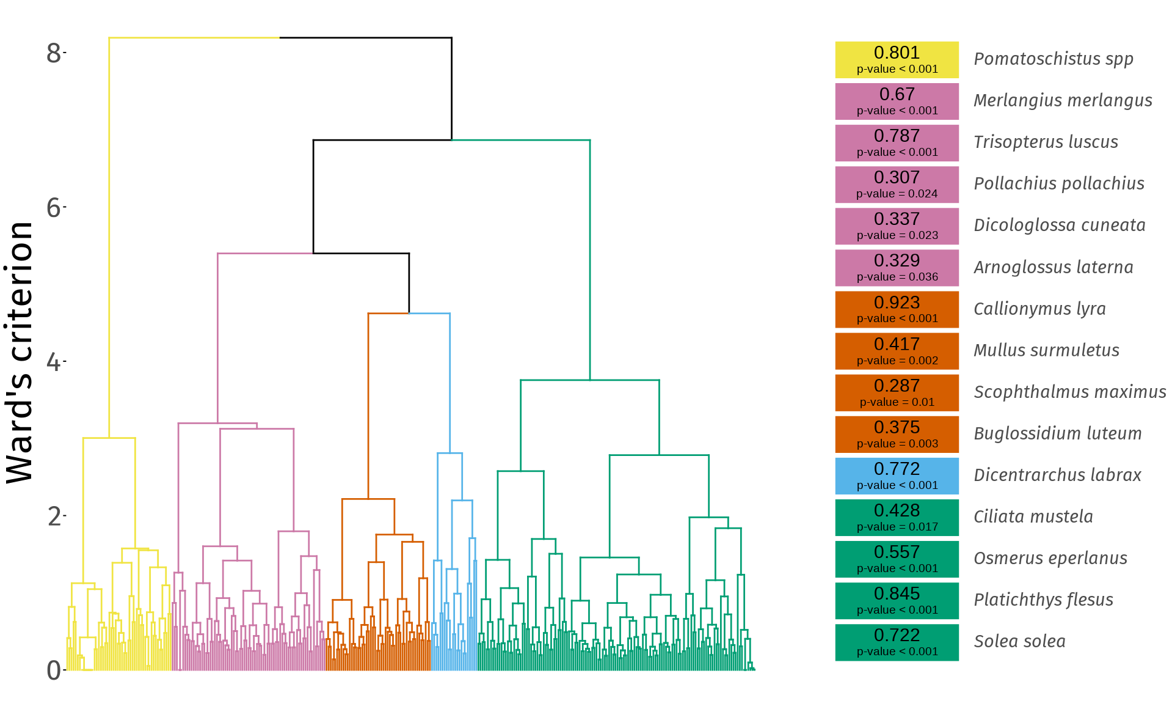


Figure D.1: Hierarchical clustering analysis (Ward’s method) of inter-annual samples identified five well-differentiated clusters of samples visible on the associated dendrogram. The Dufrêne-Legendre association index (IndVal) was computed for each taxon identified at the inter-annual scale and significant associations are presented in the rightmost part of the figure (Dufrêne & Legendre 1997).

## E Partitioning of spatio-temporal variation

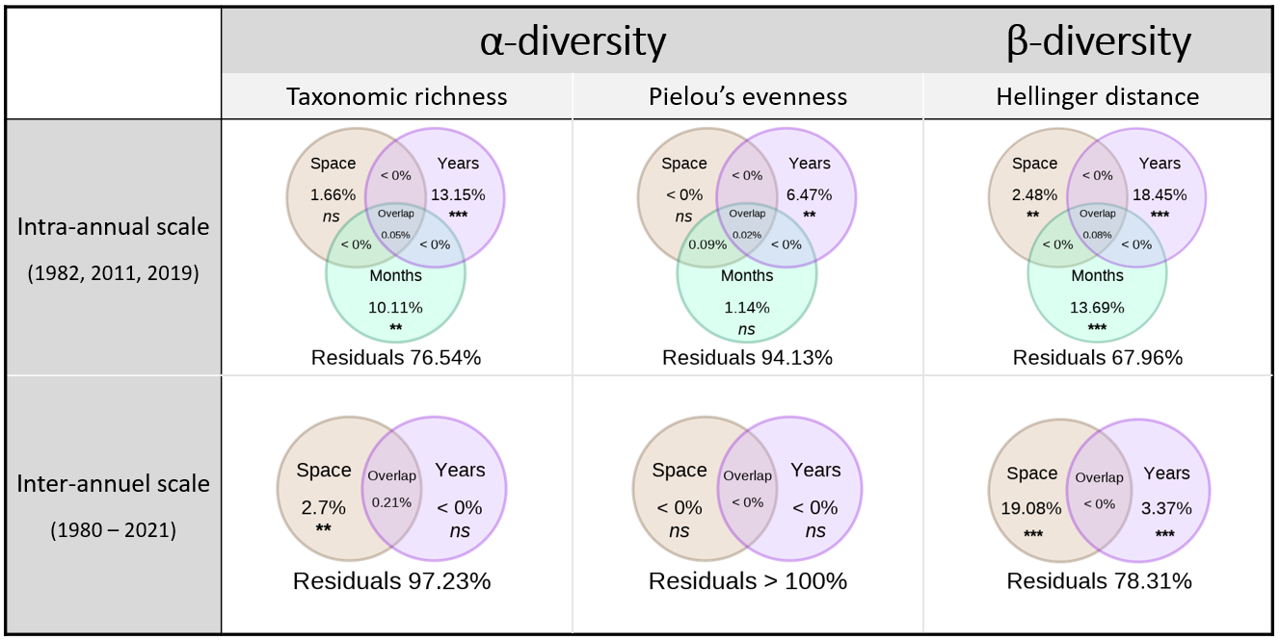


Figure E.1: Summary table of the partitioning of variability (Venn diagrams) in -diversity, -diversity, and dissimilarity among fish communities assessed at both intra-annual and inter-annual scales.

## F Evolution of abundance of major fish taxa over fine and broad temporal scales

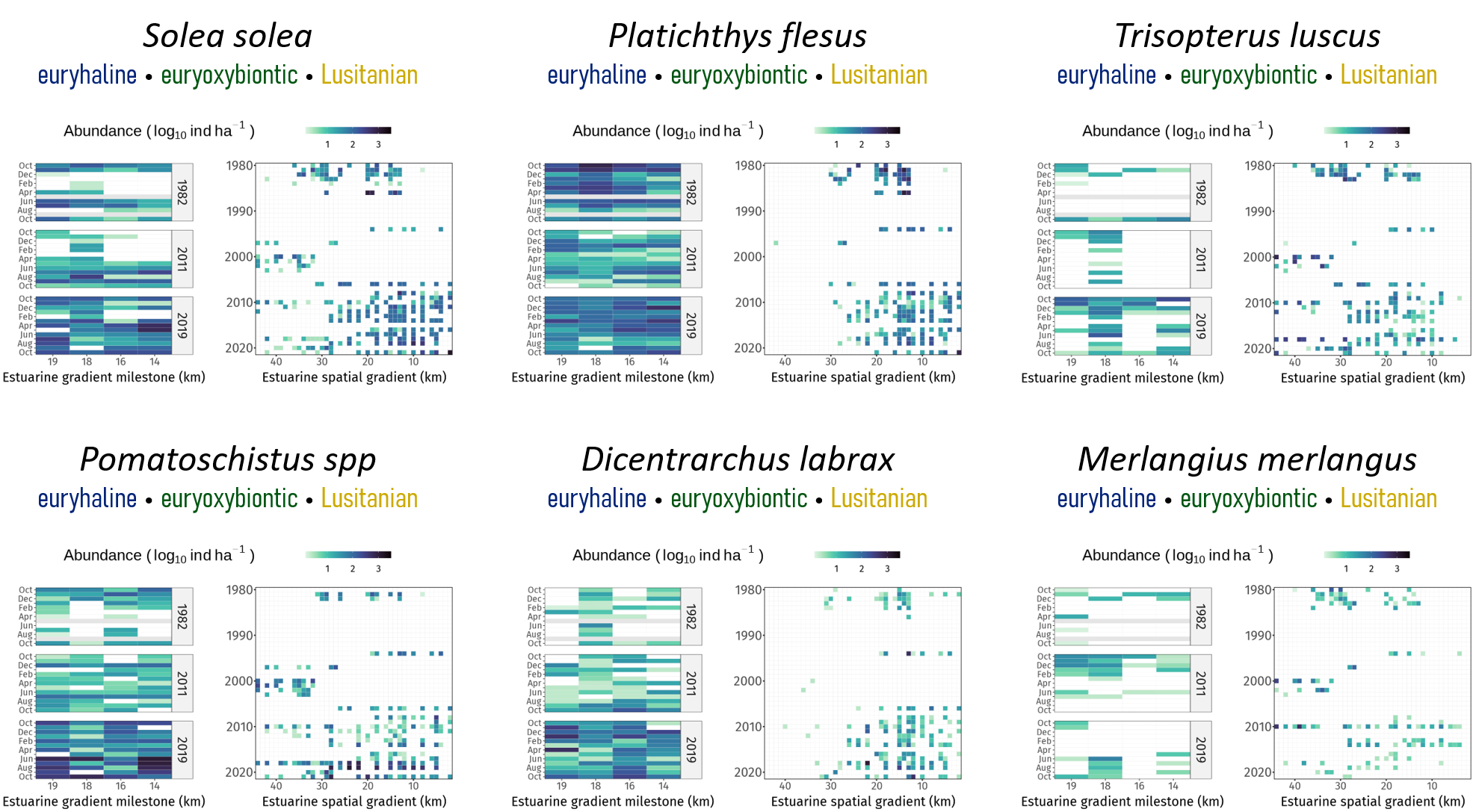


Figure F.1: Evolution of the abundance of major fish taxa over intra-annual (left grids) and inter-annual (right square-shaped grids) temporal scales.

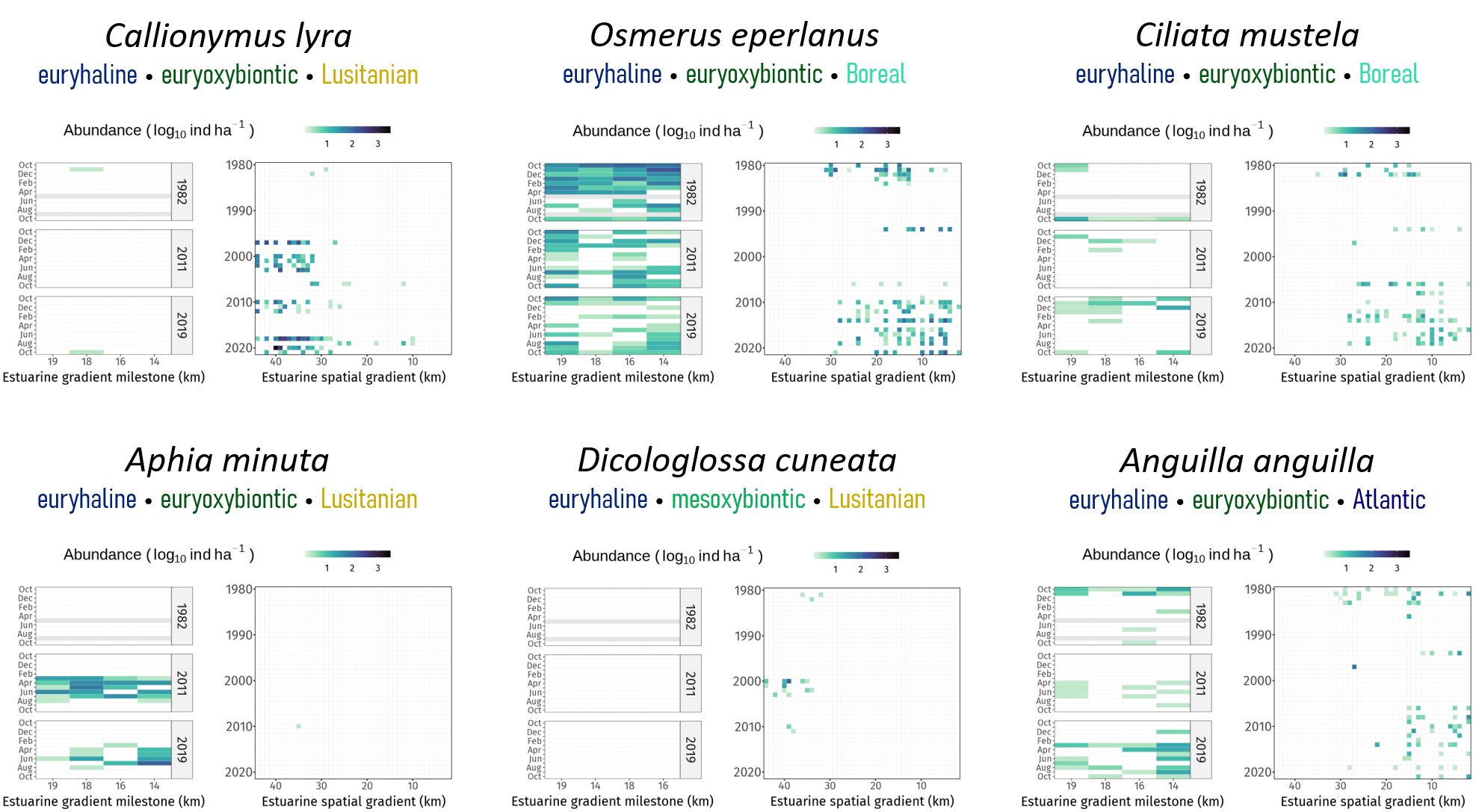


Figure F.1: Continued.