

Supplementary Materials

Article

Fish Beta Diversity Patterns Across Environmental Gradients in 63 European Shallow Lakes: Effects of Turbidity, Nutrient Enrichment, and Exotic Species

Rosemberg Fernandes Menezes ^{1,2,*}, Jens-Christian Svenning ³, Hui Fu ⁴, Luc De Meester ^{5,6,7,8}, Torben Linding Lauridsen ^{2,9}, Martin Søndergaard ^{2,9}, José María Conde-Porcuna ¹⁰ and Erik Jeppesen ^{2,9,11,12,13}

¹ Departamento de Fitotecnia e Ciências Ambientais, Centro de Ciências Agrárias, Universidade Federal da Paraíba, Areia 58395-000, Brazil

² Department of Ecoscience, Center for Water Technology (WATEC), Aarhus University, DK-6000 Aarhus, Denmark; ms@ecos.au.dk (M.S.); ej@ecos.au.dk (E.J.)

³ Center for Ecological Dynamics in a Novel Biosphere (ECONOVO) & Center for Biodiversity Dynamics in a Changing World (BIOCHANGE), Department of Biology, Aarhus University, Ny Munkegade 114, DK-8000 Aarhus, Denmark; svenning@bio.au.dk

⁴ Department of Ecology, College of Environment & Ecology, Hunan Provincial Key Laboratory of Rural Ecosystem Health in Dongting Lake Area, Hunan Agricultural University, Changsha 410128, China; huifu367@163.com

⁵ Freshwater Ecology, Evolution and Biodiversity Conservation, University of Leuven, Debériotstraat 32, 3000 Leuven, Belgium; luc.demeester@igb-berlin.de

⁶ Leibniz-Institute of Freshwater Ecology and Inland Fisheries, 12587 Berlin, Germany

⁷ Institute of Biology, Freie Universität Berlin, Königin-Luise-Strasse 1-3, 14195, Berlin, Germany

⁸ Berlin-Brandenburg Institute of Advanced Biodiversity Research (BBIB), Altensteinstr. 6, 14195 Berlin, Germany

⁹ University of Chinese Academy of Sciences, Sino-Danish Centre for Education and Research (SDC), Beijing 100049, China

¹⁰ Institute of Water Research, University of Granada, Ramón y Cajal 4, 18071 Granada, Spain; jmconde@ugr.es

¹¹ Limnology Laboratory, Department of Biological Sciences, Centre for Ecosystem Research and Implementation, Middle East Technical University, Ankara 06800, Turkey

¹² Institute of Marine Sciences, Middle East Technical University, Mersin 33731, Turkey

¹³ Institute for Ecological Research and Pollution Control of Plateau Lakes, School of Ecology and Environmental Science, Yunnan University, Kunming 650091, China

* Correspondence: rosembergmenezes@gmail.com; Tel.: +55-83-3362-1726

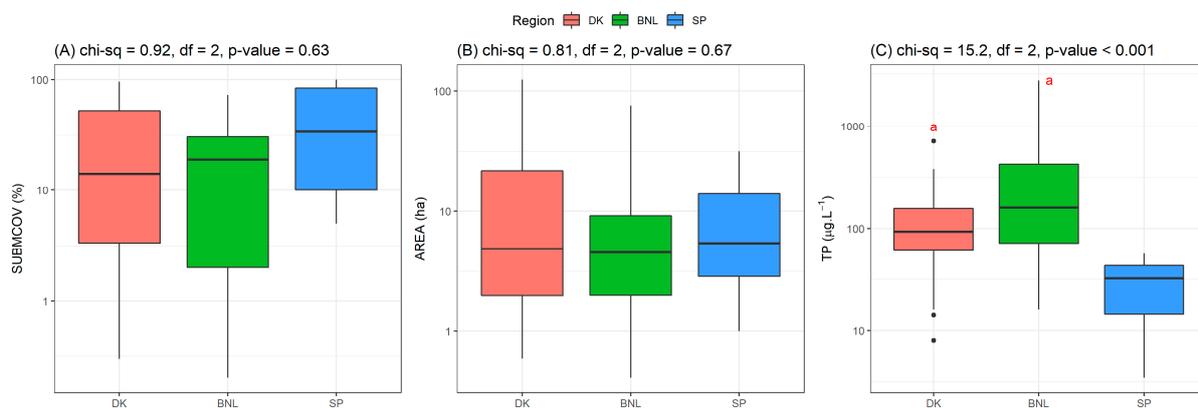


Figure S1. Kruskal-Wallis tests comparing the means among regions for submerged macrophyte coverage (SUBMCOV %), lakes size (AREA), and total phosphorus (TP). The box and whisker plots show the median and range of each environmental gradient. Similar letters at the top of the bar graphs indicate that the medians of the groups compared are similar according to the Dunn's test of multiple comparisons.

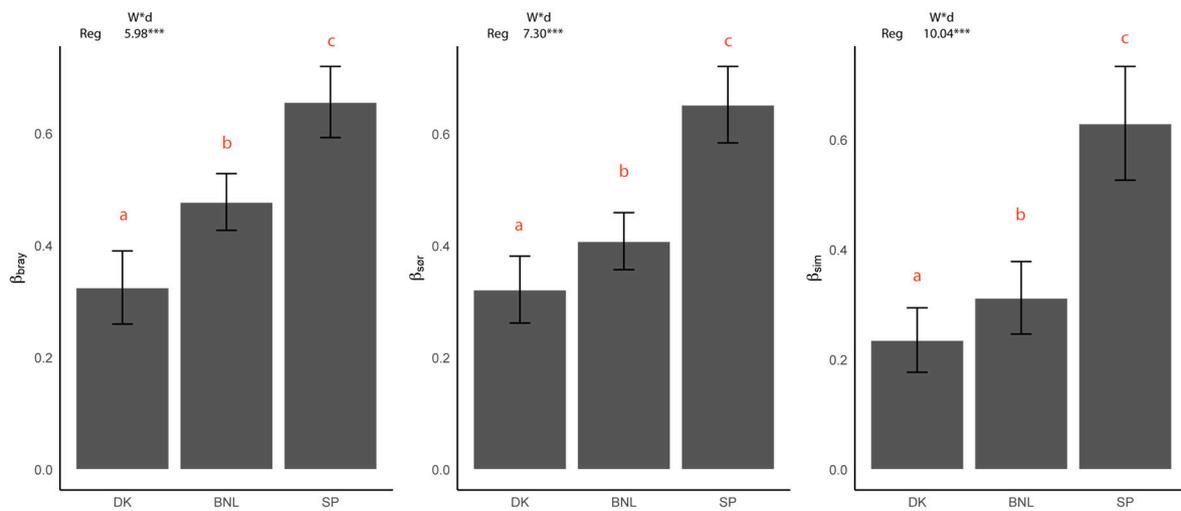


Figure S2. Results of W^*_d -test to assess the effect of geographical region (DK = Denmark, BNL = Belgium and The Netherlands, SP = Spain) on fish beta diversity (β_{bray} and β_{sor}) and turnover (β_{sim}). A pairwise comparison among regions was also performed. The error bars denote the confidence intervals and different letters indicate significant differences, based on pairwise comparisons using the function *Tw2.posthoc.tests* in Hamadi et al. (2019). Average distances to centroids were used to estimate fish β -diversity along a latitudinal gradient from northern Europe to southern Spain. The asterisks in the W^*_d values refer to the permutation test significance level (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; n.s = non-significant).

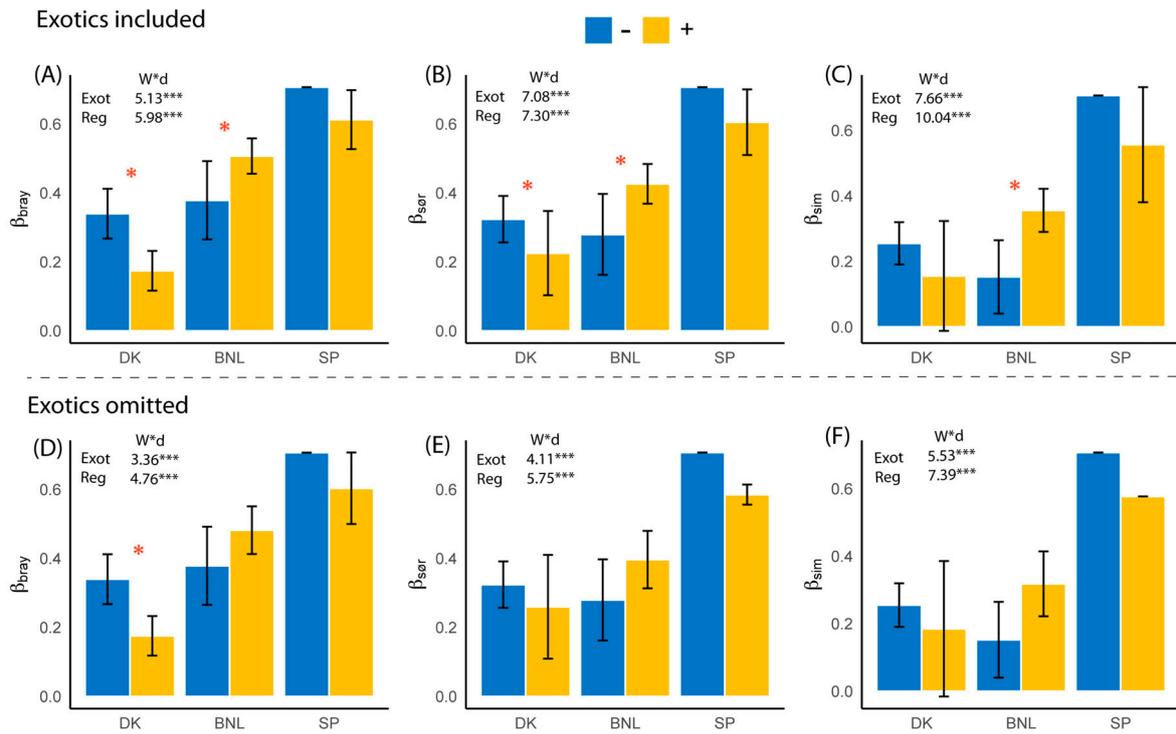


Figure S3. Results of W^*_d -test to elucidate the effect of presence of exotic (Exot) fish species (+ vs. - exotics) and region (Reg) on fish beta diversity (β_{bray} and β_{ser}) and turnover (β_{sim}). A pairwise comparison among the groups was also performed. Average distances to centroids were used to estimate fish β -diversity along a latitudinal gradient from northern Europe to southern Spain (DK = Denmark, BNL = Belgium and The Netherlands, SP = Spain). Beta diversity and turnover were calculated for lakes with presence (+) and absence (-) of exotic fish species. The effects of exotics fish were also tested including and omitting exotics species from the data sets. The error bars denote the confidence intervals and the red asterisks above the bars show that beta diversity (β_{bray} , β_{ser} and β_{sim}) is different between lakes with and without exotics within the corresponding group region.

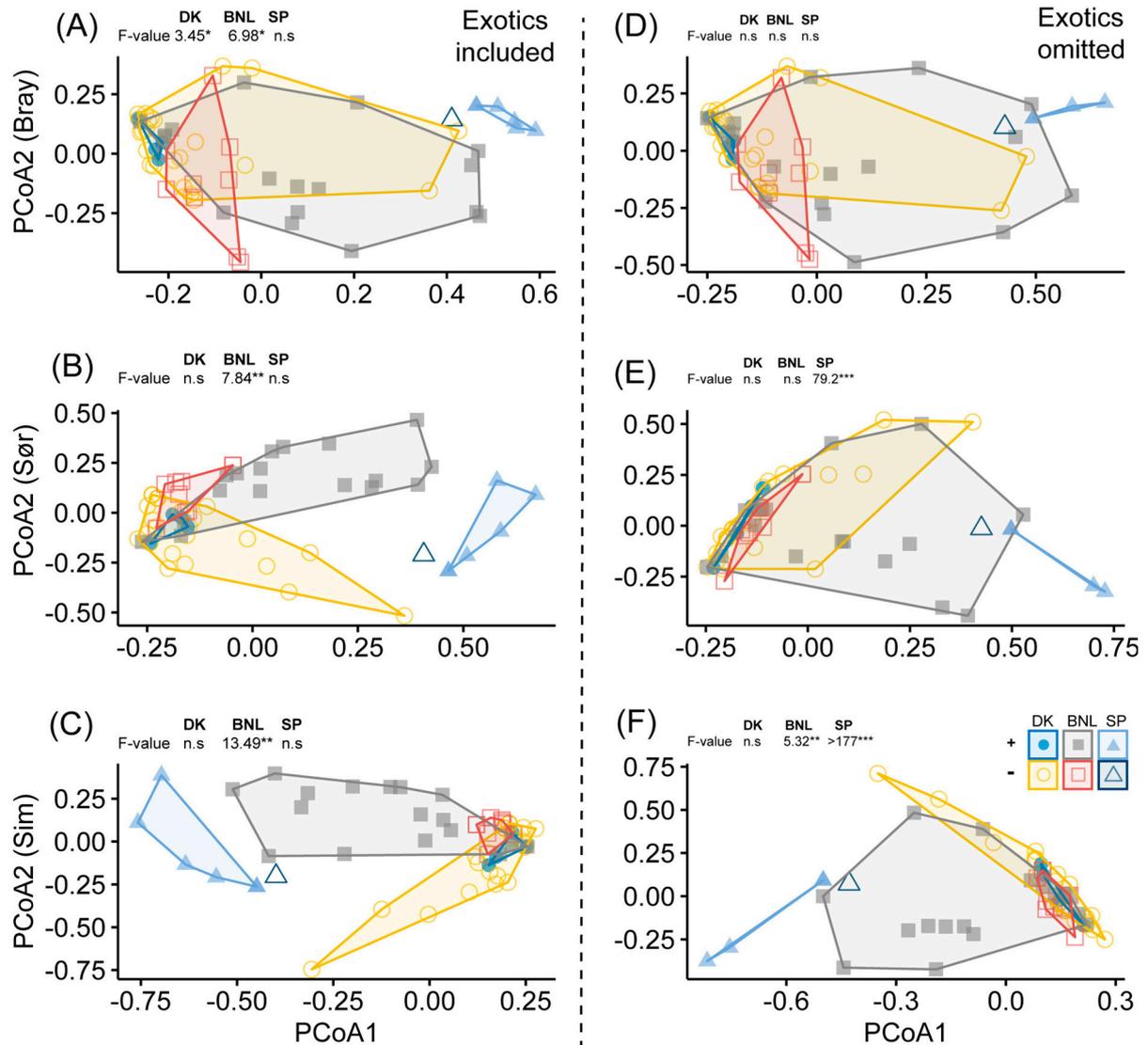


Figure S4. Results of principal coordinate (PCoA) and PERMDISP analyses assessing the effects of presence of exotic fish on group dispersion (variances) within each region (DK = Denmark, BNL = Belgium and The Netherlands, SP = Spain). To test if the dispersions between groups within region differed, the distances of group members to the group centroid were subject to ANOVA analysis. The multivariate dispersions were computed using Bray-Curtis (A-D), Sørensen (B-E), and Simpson (C-F) dissimilarity indices for lakes with (+) and without (-) exotic fish species. The effects of exotics fish were also tested including and omitting exotics species from the data sets. The asterisks in the F-values refer to the permutation test significance level (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; n.s = non-significant).

Table S1. Environmental variables and environmental heterogeneity components (EH) used as predictors in the general dissimilarity models (GDMs). The climate variables used for EH_{clim} were averages for the years 1970-2000 and were obtained from *WorldClim* [44].

Environmental heterogeneity components	Environmental variables
Geographic distance (GD)	Latitude and longitude coordinates
Water quality characteristics (EH_{lim})	Water temperature ($^{\circ}\text{C}$), conductivity ($\mu\text{S cm}^{-1}$), pH, Secchi depth (m), total suspended matter (mg L^{-1}), suspended matter inorganic fraction (mg L^{-1}), total nitrogen (mg L^{-1}) and phosphorus ($\mu\text{g L}^{-1}$), silicate (mg L^{-1}), and orthophosphate ($\mu\text{g L}^{-1}$)
Physical variables (EH_{phy})	Lake surface area (ha) and lake depth (m)
Biological resources (EH_{res})	Chlorophyll a ($\mu\text{g L}^{-1}$), the biomasses of cyanobacteria ($\mu\text{gC L}^{-1}$), cryptophytes ($\mu\text{gC L}^{-1}$), chlorococcales ($\mu\text{gC.L}^{-1}$), phytoplankton < 20 μm , 20-40 μm and > 40 μm ($\mu\text{gC L}^{-1}$), total phytoplankton ($\mu\text{gC L}^{-1}$), mixotrophic species ($\mu\text{gC L}^{-1}$), rotifers ($\mu\text{g L}^{-1}$), cladocerans ($\mu\text{g L}^{-1}$), cyclopoids ($\mu\text{g L}^{-1}$), calanoids ($\mu\text{g L}^{-1}$), oligotrichs, grazable and total ciliates (% in total biomass), densities of bacterial and heterotrophic nanoflagelates (cells mL^{-1}), % coverage of submerged, floating, and emergent macrophytes, and % infestation of submerged macrophytes.
Climatic variables (EH_{clim})	Annual mean temperature ($^{\circ}\text{C}$), temperature seasonality (standard deviation \times 100), annual precipitation (mm), and precipitation seasonality (coefficient of variation).

Table S2. Product-moment correlation coefficients (r) and associated P values between gradient variables in each of the three regions.

Region	N	SUBMCOV - TP		SUBMCOV - AREA		TP - AREA	
		r	P	R	P	r	P
DK	29	-0.33	0.08	0.10	0.60	-0.16	0.40
BNL	26	-0.18	0.37	0.05	0.80	-0.06	0.77
SP	8	-0.60	0.12	-0.29	0.49	0.26	0.54

Note: SUBMCOV: submerged macrophyte coverage; TP: total phosphorus; AREA: lake size; DK: Denmark; BNL: Belgium/The Netherlands; SP: Spain.

Table S3. Summary statistics of gradient variables for each of the studied geographic regions.

For the analyses, we used data from 63 shallow lakes sampled from northern Europe to southern Spain (Denmark = 29; Belgium/The Netherlands = 26; Spain = 8).

Variable	Region	Min	1 st Quart	Median	Mean	3 rd Quart	Max	SD
SUBMCOV (%)	DK	0.00	0.00	4.00	21.74	34.00	96.00	32.20
	BNL	0.00	0.00	1.20	12.53	25.50	73.00	18.42
	SP	0.00	0.00	7.50	29.12	46.50	100.00	40.62
Area (ha)	DK	0.60	2.00	4.90	19.60	21.80	124.00	30.12
	BNL	0.41	2.01	4.56	11.72	9.22	76.25	19.07
	SP	1.00	2.88	6.10	11.09	15.10	31.60	11.83
TP ($\mu\text{g/L}$)	DK	8.00	61.00	93.00	131.80	155.00	708.00	135.92
	BNL	15.97	72.79	158.27	388.63	422.05	2752.92	685.56
	SP	3.46	14.29	32.62	30.19	43.47	56.66	18.51

Note: SUBMCOV: submerged macrophyte coverage; TP: total phosphorus; AREA: lake size; Min.: minimum record; Max: maximum record; 1st Quart: 1st Quartile; 3rd Quart.: 3rd Quartile; SD: standard deviation; DK: Denmark; BNL: Belgium/The Netherlands; SP: Spain.

Table S4. Number of lakes in the five dichotomous categories of environmental effects: water turbidity (clear or turbid), total phosphorus (low and high), lake surface area (small and large), connectivity (connected and isolated), and lakes with and without exotic fish species.

Gradients	DK	BNL	SP
<i>Turbidity</i>			
Clear	15	13	5
Turbid	14	13	3
<i>Total phosphorus</i>			
Low	16	9	8
High	13	17	0
<i>Lake size</i>			
Small	15	14	4
Large	14	12	4
<i>Connectivity</i>			
Connected	14	14	4
Isolated	15	12	4
<i>Exotic fish</i>			
Without	25	9	2
With	4	17	6

Notes: DK: Denmark; BNL: Belgium/The Netherlands; SP: Spain.

Table S5. Lakes names, lake codes, lake regions, coordinates (decimals) and categories of environmental effects: water turbidity (clear or turbid), total phosphorus (low and high), lake surface area (small and large), connectivity (connected and isolated), and lakes with and without exotic fish species

Lake Names	Lake Codes	Regions	Lake Connectivity	Turbidity Classes	Total P Classes	Lake Size Classes	Exotic fish Classes	Lat (N)	Lon (W)
Avn soe	AVNS	DK	Connected	Turbid	Low	Small	With	56.142	9.575
Doej soe	DOJS	DK	Connected	Clear	Low	Small	With	56.029	9.907
Dystrup soe	DYST	DK	Connected	Clear	Low	Large	Without	56.451	10.628
Egeholt soe	EGEH	DK	Isolated	Turbid	High	Small	Without	56.111	9.531
Elle soe	ELLE	DK	Isolated	Turbid	Low	Large	With	56.130	9.574
Engetved soe	ENGE	DK	Isolated	Clear	Low	Small	Without	56.058	9.556
Ensoe	ENSO	DK	Connected	Clear	Low	Large	With	55.940	9.299
Gammelose	GLMO	DK	Isolated	Clear	High	Small	With	56.151	9.889
Hinge soe	HING	DK	Connected	Turbid	High	Large	Without	56.256	9.490
Hulsoe	HULS	DK	Connected	Clear	Low	Small	Without	56.058	9.622
Kvind soe	KVIN	DK	Connected	Turbid	High	Large	Without	56.025	9.498
Lading soe	LADI	DK	Isolated	Clear	High	Large	Without	56.216	9.963
Nedersoe	NEDE	DK	Connected	Turbid	High	Large	Without	55.931	9.333
Poet soe	POET	DK	Connected	Turbid	High	Small	Without	56.156	9.524
Ring soe	RING	DK	Isolated	Clear	High	Large	Without	55.965	9.595
Schousbye soe	SCHO	DK	Isolated	Clear	Low	Small	With	56.168	9.617
Silkeborg Langsoe	SILK	DK	Connected	Turbid	Low	Large	With	56.166	9.519
Soelvsten damme	SLST	DK	Isolated	Turbid	High	Small	With	56.274	9.937
Soeby soe	SOBY	DK	Isolated	Clear	Low	Large	Without	56.049	9.069
Sorte soe	SORT	DK	Connected	Clear	High	Small	With	56.035	9.914
Soebygaard soe	SOSO	DK	Isolated	Turbid	High	Large	With	56.256	9.807
Sunds soe	SUND	DK	Isolated	Clear	Low	Large	Without	56.214	9.021
Torring (soe v.)	TORR	DK	Connected	Clear	High	Small	Without	55.848	9.510

Tranevig	TRAN	DK	Isolated	Clear	Low	Small	Without	56.146	9.513
Vallum soe	VALL	DK	Isolated	Turbid	Low	Large	Without	56.384	10.530
Vaeng soe	VANG	DK	Isolated	Turbid	High	Large	Without	56.035	9.653
Vestermose	VSMO	DK	Connected	Turbid	Low	Small	Without	56.034	9.887
Ny Vissing soe	NYVI	DK	Connected	Turbid	Low	Small	Without	56.047	9.693
Gub soe	GUBS	DK	Isolated	Clear	Low	Small	With	56.202	9.529
Berlare Broek	BB	BNL	Connected	Turbid	Low	Large	Without	51.035	4.005
Blokkersdijk	BD	BNL	Isolated	Clear	High	Large	With	51.233	4.347
Blankaartvijver	BLV	BNL	Connected	Turbid	High	Large	Without	51.072	4.461
Breeven	BV	BNL	Isolated	Turbid	High	Large	With	51.091	4.239
Fort Oelegem	FO	BNL	Isolated	Turbid	Low	Small	Without	51.227	4.614
Gavers	GAV	BNL	Isolated	Clear	Low	Large	Without	50.844	3.324
Goor	GOOR	BNL	Connected	Turbid	High	Small	With	51.061	4.706
Kleiputten	KP	BNL	Isolated	Clear	High	Small	Without	50.919	3.138
Maten 12	M12	BNL	Connected	Turbid	High	Small	With	50.944	5.441
Maten 13	M13	BNL	Connected	Clear	Low	Small	With	50.941	5.436
Nieuwkoopse Plassen	NKPL	BNL	Connected	Clear	Low	Large	With	52.153	4.798
Oud Heverlee Helder	OHH	BNL	Connected	Clear	High	Large	With	50.845	4.661
Oud Heverlee Troebel	OHT	BNL	Connected	Turbid	High	Large	With	50.829	4.639
Oude Meren 4	OM4	BNL	Connected	Turbid	High	Small	With	51.148	5.015
Oude Maasmeander Maasveld	OMMV	BNL	Isolated	Clear	High	Large	With	51.033	5.420
Plas Astrid	PA	BNL	Isolated	Turbid	High	Small	With	51.182	3.216
Platweyers	PW	BNL	Connected	Clear	High	Large	With	50.969	5.341
Schulensmeer	SM	BNL	Isolated	Turbid	High	Large	With	50.959	5.144
Uitbergen	UITB	BNL	Isolated	Turbid	High	Small	Without	51.035	3.975
Vinderhoutte	VB	BNL	Isolated	Clear	Low	Small	With	51.088	3.622
Voortmangelbeek	VM	BNL	Isolated	Clear	High	Large	With	51.068	4.383
Vloethenveld 11	VV11	BNL	Connected	Clear	Low	Small	Without	51.147	3.099
Vloethenveld 12	VV12	BNL	Connected	Clear	Low	Small	Without	51.148	3.097

Wik 1	WIK1	BNL	Connected	Turbid	High	Small	With	51.221	2.926
Wik2	WIK2	BNL	Connected	Clear	High	Small	With	51.220	2.921
Zavelput	ZP	BNL	Isolated	Turbid	Low	Small	With	51.053	3.808
Archidona-chica	ARCH	SP	Isolated	Clear	Low	Small	With	37.109	-4.303
Archidona-grande	ARGR	SP	Isolated	Clear	Low	Small	Without	37.098	-4.309
Morenilla	MOR	SP	Isolated	Turbid	Low	Large	With	38.985	-2.900
Tinaja	TIN	SP	Connected	Clear	Low	Large	With	38.933	-2.839
Zoñar-chica	ZOCH	SP	Connected	Turbid	Low	Small	With	37.483	-4.691
Zoñar-grande	ZOGR	SP	Isolated	Turbid	Low	Large	With	37.355	-4.684
Nueva	NUE	SP	Connected	Clear	Low	Large	Without	36.752	-2.950
Padul-1	PA1	SP	Connected	Clear	Low	Small	With	37.015	-3.603

Table S6. Fish occurrence in the different regions and number of lakes in which species appear in the Danish (DK), Belgian/Dutch (BNL), and Spanish lakes (SP). Exotic species refers to non-native fish species either within the study's region (SP, BNL and DK) or Europe. The asterisks after the specific epithet denote exotic species. The literature sources for exotics fish species is given below the table.

Species name	Family	DK Lakes	BNL Lakes	SP Lakes	Species frequency	Exotic to Europe	Exotic to the region	Often used for stocking (now/historically)	Small range endemics	Literature sources
<i>Ameiurus nebulosus</i> *	Ictaluridae	-	6	-	6	Yes	Yes	Yes	No	[106]
<i>Alburnus alburnus</i>	Cyprinidae	2	-	-	2	No	No	No	No	
<i>Blicca bjoerkna</i>	Cyprinidae	-	5	-	5	No	No	No	No	
<i>Abramis brama</i>	Cyprinidae	17	11	-	28	No	No	No	No	
<i>Carassius carassius</i>	Cyprinidae	8	3	-	11	No	No	Yes	No	
<i>Carassius gibelio</i> *	Cyprinidae	-	7	-	7	Yes	Yes	Yes	No	[107]
<i>Cyprinus carpio</i> *	Cyprinidae	-	8	2	10	Yes	Yes	Yes	No	[108]
<i>Coregonus lavaretus</i>	Coregonidae	2	-	-	2	No	No	No	No	
<i>Gobio gobio</i>	Cyprinidae	3	5	-	8	No	No	No	No	
<i>Umbra pygmaea</i> *	Umbridae	-	2	-	2	Yes	Yes	No	No	[105]
<i>Lepomis gibbosus</i> *	Centrarchidae	-	8	2	10	Yes	Yes	Yes	No	[107]

<i>Leucaspius deliniatus*</i>	Cyprinidae	-	1	-	1	No	Yes	No	No	[108]
<i>Leuciscus idus</i>	Cyprinidae	-	3	-	3	No	No	No	No	
<i>Osmerus eperlanus</i>	Osmeridae	1	-	-	1	No	No	No	No	
<i>Esox lucius</i>	Esocidae	16	5	-	21	No	No	Yes	No	
<i>Perca fluviatilis</i>	Percidae	26	19	-	45	No	No	Yes	No	
<i>Pseudorasbora parva*</i>	Cyprinidae	-	6	-	6	Yes	Yes	Yes	No	[107]
<i>Rhodeus sericeus amarus</i>	Cyprinidae	-	5	-	5	No	No	No	No	
<i>Rutilus rutilus</i>	Cyprinidae	25	20	-	45	No	No	No	No	
<i>Scardinius erythrothalmus</i>	Cyprinidae	15	20	-	35	No	No	No	No	
<i>Gymnocephalus cernua</i>	Percidae	12	7	-	19	No	No	No	No	
<i>Tinca tinca</i>	Cyprinidae	9	2	-	11	No	No	Yes	No	
<i>Sander lucioperca*</i>	Percidae	4	4	-	8	No	Yes	Yes	No	[103,108]
<i>Barbus sp.</i>	Cyprinidae	-	-	1	1	No	No	No	Yes	
<i>Micropterus salmoides*</i>	Cyprinidae	-	-	2	2	Yes	Yes	Yes	No	[105]
<i>Phoxinellus hispanicus</i>	Cyprinidae	-	-	2	2	No	No	No	Yes	
<i>Leuciscus sp.</i>	Cyprinidae	-	-	1	1	No	No	No	No	

<i>Atherina sp.</i>	Atherinidae	-	-	1	1	No	No	No	Yes	
<i>Aphanius iberus</i>	Cyprinodontidae	-	-	1	1	No	No	No	Yes	
<i>Carassius auratus</i> *	Cyprinidae	-	-	2	2	Yes	Yes	Yes	No	[105]
<i>Scardinius sp.</i> *	Cyprinidae	-	-	3	3	No	Yes	No	No	[104]
Exotic to Europe	-	1	7	4	-	9	-	-	-	
Exotic to the region	-	1	9	5	-	-	12	-	-	
Used for stocking	-	5	10	4	-	-	-	12	-	
Small range endemics	-	0	1	4	-	-	-	-	4	
Endemic species	-	11	11	5	-	-	-	-	-	
Total number of species	-	13	20	10	-	-	-	-	-	
Mean species number per lake	-	4.8	5.7	2.1	-	-	-	-	-	
Total number of species ever recorded (source: Fish Base)	-	65	70	101	-	-	-	-	-	

Table S7. Permutation test for homogeneity of multivariate dispersions (PERMDISP) and W*d analyses assessing the effects of turbidity, total phosphorus, lake size, lake connectivity, and presence of exotic fish on group dispersion and on group location between environmental categories within each region (DK = Denmark, BNL = Belgium and The Netherlands, SP = Spain). To test if the dispersions between environmental groups within region differed (e.g. DK clear x DK turbid lakes), the distances of group members to the group centroid were subject to ANOVA analysis, whereas W*d analyses were performed to test differences in location between environmental groups. The multivariate dispersions were computed using Bray-Curtis, Sørensen, and Simpson dissimilarity indices for clear and turbid (> or < 20% of the lake surface area covered by macrophytes), low and high nutrient-enriched (> or < 100 µg l⁻¹ TP), large and small lakes (lake surface > or < 5 ha), connected and isolated lakes, and for lakes with (+) and without (-) exotic fish species. The permutation test was also performed after removing (AR) exotics species from the data.

Covariate	Region	Dissimilarity indices	PERMDISP			W*d test	
			SS	F-ratio	p values	W*d	p values
Turbidity (clear vs. turbid)	DK	Bray-Curtis	0.15	6.73	0.01	3.97	0.00
	DK	Sørensen	0.04	1.61	0.22	3.21	0.03
	DK	Simpson	0.05	2.25	0.14	5.36	0.03
TP (low vs. high)	DK	Bray-Curtis	0.00	0.01	0.94	0.56	0.74
	DK	Sørensen	0.01	0.28	0.60	0.50	0.70
	DK	Simpson	0.00	0.07	0.79	0.59	0.54
Lake Size (small vs. large)	DK	Bray-Curtis	0.15	6.67	0.01	4.12	0.00
	DK	Sørensen	0.02	0.69	0.42	2.88	0.05
	DK	Simpson	0.10	4.55	0.04	4.34	0.05
Connectivity (connected vs. isolated)	DK	Bray-Curtis	0.16	7.81	0.01	1.50	0.22
	DK	Sørensen	0.20	13.75	0.00	2.73	0.05
	DK	Simpson	0.12	4.95	0.03	2.79	0.13

Exotics (+ vs. -)	DK	Bray-Curtis	0.09	3.46	0.06	3.98	0.01
	DK	Sørensen	0.03	1.38	0.25	4.27	0.03
	DK	Simpson	0.03	1.49	0.22	0.02	NA
Exotics (+ vs. -) (AR)	DK	Bray-Curtis	0.09	3.40	0.08	3.45	0.03
	DK	Sørensen	0.01	0.58	0.45	1.27	0.37
	DK	Simpson	0.02	0.72	0.40	-0.84	NA
Turbidity (clear vs. turbid)	BNL	Bray-Curtis	0.10	8.24	0.01	1.42	0.21
	BNL	Sørensen	0.10	8.12	0.01	2.80	0.02
	BNL	Simpson	0.06	2.74	0.10	2.50	0.10
TP (low vs. high)	BNL	Bray-Curtis	0.00	0.28	0.61	0.56	0.80
	BNL	Sørensen	0.00	0.06	0.80	0.33	0.85
	BNL	Simpson	0.01	0.24	0.63	-0.27	0.92
Lake Size (small vs. large)	BNL	Bray-Curtis	0.07	4.60	0.04	3.00	0.01
	BNL	Sørensen	0.04	2.54	0.12	2.66	0.03
	BNL	Simpson	0.11	3.45	0.07	4.23	0.01
Connectivity (connected vs. isolated)	BNL	Bray-Curtis	0.01	0.38	0.55	0.93	0.48
	BNL	Sørensen	0.00	0.05	0.82	0.82	0.54
	BNL	Simpson	0.02	0.73	0.40	1.02	0.44
Exotics (+ vs. -)	BNL	Bray-Curtis	0.10	6.98	0.02	2.66	0.01
	BNL	Sørensen	0.13	7.84	0.01	5.16	0.00
	BNL	Simpson	0.24	13.49	0.00	6.77	0.00
Exotics (+ vs. -) (AR)	BNL	Bray-Curtis	0.06	3.25	0.08	2.66	0.01

	BNL	Sørensen	0.08	3.19	0.09	5.16	0.00
	BNL	Simpson	0.16	5.32	0.03	6.77	0.00
Turbidity (clear vs. turbid)	SP	Bray-Curtis	0.03	1.35	0.27	1.46	0.21
	SP	Sørensen	0.03	1.08	0.33	1.55	0.14
	SP	Simpson	0.01	0.19	0.68	1.70	NA
TP (low vs. high)	SP	Bray-Curtis	-	-	-	-	-
	SP	Sørensen	-	-	-	-	-
	SP	Simpson	-	-	-	-	-
Lake Size (small vs. large)	SP	Bray-Curtis	0.01	0.90	0.17	0.50	0.89
	SP	Sørensen	0.01	0.96	0.17	0.56	0.83
	SP	Simpson	0.01	0.98	0.18	0.27	1.00
Connectivity (connected vs. isolated)	SP	Bray-Curtis	0.00	0.86	0.17	0.39	1.00
	SP	Sørensen	0.00	0.86	0.17	0.34	1.00
	SP	Simpson	0.01	0.98	0.17	0.27	1.00
Exotics (+ vs. -)	SP	Bray-Curtis	0.01	2.40	0.21	1.38	0.21
	SP	Sørensen	0.02	2.25	0.22	1.41	NA
	SP	Simpson	0.03	1.45	0.25	1.55	NA
Exotics (+ vs. -) (AR)	SP	Bray-Curtis	0.01	4.48	0.10	1.39	0.20
	SP	Sørensen	0.02	79.25	0.00	1.47	NA
	SP	Simpson	0.02	1.77x10 ²⁹	< 0.00001	1.50	NA
