Oikos

o20411

Mouchet, M. A., Burns, M. D. M., Garcia, A. M., Vieira, J. P. and Mouillot, D. 2013. Invariant scaling relationship between functional dissimilarity and co-occurrence in fish assemblages of the Patos estuary (Brazil): environmental filtering consistently overshadows competitive exclusion. – Oikos 122: 136–148.

Appendix A1

Characterization of fish functional niche

TableA1.1. List of functional traits. Functional traits are divided into two functions of interest in fish ecology: food acquisition (prey capture, detection and assimilation) and locomotion (position in the water column, hydrodynamism and swimming mode). The functional trait 'M' (i.e. biomass) is included in the characterization of both functions. Thus, food acquisition is characterized by 7 functional traits and locomotion by 10 traits. The quantification of functional traits is based on the ecomorphological traits presented in Fig. A1.1.

Function	Functional trait	Abbreviation	Measure
Food acquisition	oral gape surface	Osf	$\frac{Mw \times Md}{Bw \times Bd}$
	oral gape shape	Osh	$\frac{Md}{Mw}$
	oral gape position	Ops	$\frac{Mo}{Hd}$
	gill raker length	GR	Length of the largest gill raker
	gut length	Glst	$\frac{Gl}{Bl}$
	eye size	Edst	$\frac{Ed}{Hd}$
Locomotion	eye position	Eps	$\frac{Eh}{Hd}$
	body transversal shape	Bsh	$\frac{Bd}{Bw}$

	body transversal surface	Bsf	$\frac{\log\left(\frac{\pi}{4}\times Bw\times Bd\right)+1}{\log(Mass+1)}$
	pectoral fin position	PFps	$\frac{PFi}{PFb}$
	aspect ratio of the pectoral fin	PFar	$\frac{PFl^2}{PFs}$
	caudal peduncle throttling	CPt	$\frac{CFd}{CPd}$
	aspect ratio of the caudal fin	CFar	$\frac{CFd}{CPs}$
	fins surface ratio	Frt	$\frac{(2\times PFs)}{CFs}$
	fins surface to body size ratio	Fsf	$\frac{(2\times PFs)+CFs}{\frac{\pi}{4}\times Bw\times Bd}$
	Biomass	M	log(Mass+1)

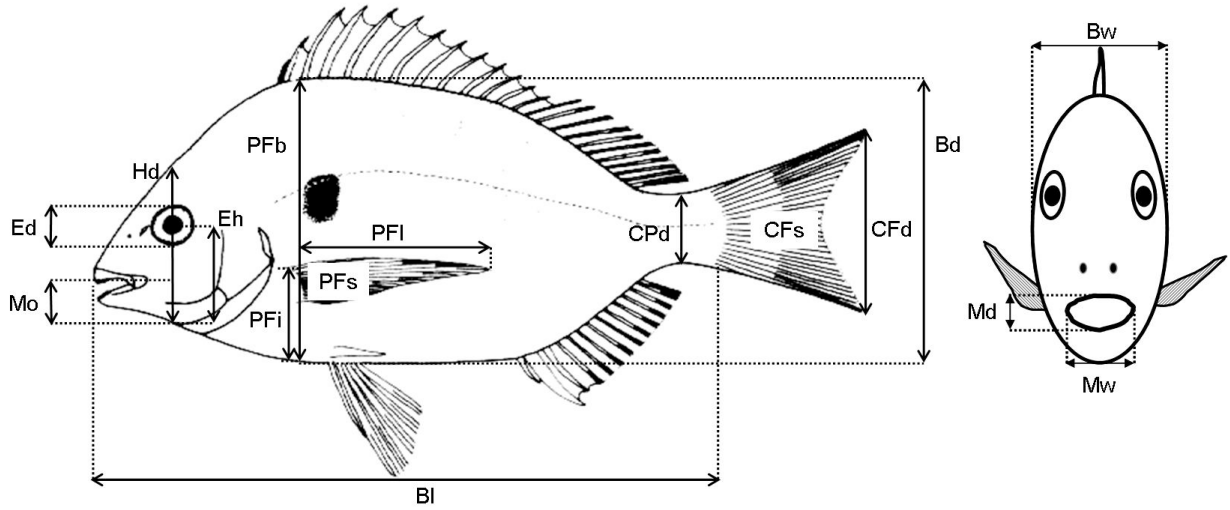


Figure A1.1. Ecomorphological features involved in functional trait calculation.

Appendix A2

List of species sampled in Patos-Mirim system

Species with an asterisk, *, were not recorded up the dam, in the area A1, A2 and Up (Fig. 1). Congeneric species are referred as '.spp' in the text.

Order	Family	Genus	Species	Code	
Atheriniforms	*Atherinopsidae*	*Atherinella*	*brasiliensis*	ATB	*
		Odontesthes	*argentinensis*	ODA	
		Odontesthes	*mirinensis*	ODM	
		Odontesthes	*perugiae*	ODP	
		Odontesthes	*spp.*	ODS	
Characiforms	*Characidae*	*Astyanax*	*eigenmanniorum*	ATE	
		Astyanax	*jacuhiensis*	ATJ	
		Astyanax	*fasciatus*	ATF	
		Charax	*stenopterus*	CHA	
		Cheirodon	*ibicuhiensis*	CHB	
		Cheirodon	*interruptus*	CHN	
		Hyphessobrycon	*luetkenii*	HPL	
		Oligosarcus	*jenynsi*	OLJ	
		Oligosarcus	*robustus*	OLR	
		Pseudocorynopoma	*doriae*	PSE	
	Curimatidae	*Cyanocharax*	*alburnus*	CYA	
		Cyphocharax	*voga*	CYP	
	Erythrinidae	*Hoplias*	*malabaricus*	HPM	
Clupeiforms	*Clupeidae*	*Brevoortia*	*pectinata*	BRE	*
		Platanichthys	*platana*	PLA	
		Ramnogaster	*arcuata*	RMC	*
	Engraulidae	*Lycengraulis*	*grossidens*	LYC	
Cyprinodontiforms	*Anablepidae*	*Jenynsia*	*multidentata*	JEN	
Perciforms	*Carangidae*	*Chloroscombrus*	*chrysurus*	CHL	*
		Selene	*setapinnis*	SLS	*
		Selene	*vomer*	SLV	*
		Trachinotus	*marginatus*	TMR	*
	Cichlidae	*Crenicichla*	*punctata*	CRE	
		Geophagus	*brasiliensis*	GEO	
		Gymnogeophagus	*gymnogenys*	GYM	
	Gerreidae	*Eucinostomus*	*melanopterus*	EUC	*
		Eugerres	*brasilianus*	EUG	*
	Mugilidae	*Mugil*	*platanus*	MUG	
	Sciaenidae	*Macrodon*	*ancylodon*	MAC	*
		Menticirrhus	*americanus*	MEN	
		Micropogonias	*furnieri*	MCF	
		Stellifer	*rastrifer*	STE	
	Sphyraenidae	*Sphyraena*	*guachancho*	SPH	*
	Stomateidae	*Peprilus*	*paru*	PEP	*
	Trichiuridae	*Trichiurus*	*lepturus*	TRI	*
	Triglidae	*Prionotus*	*punctatus*	PRI	*

(Continued)

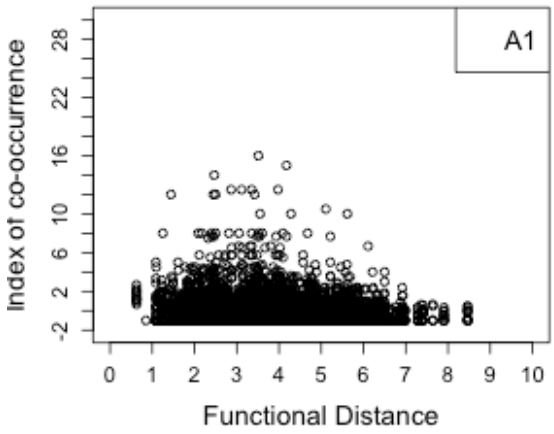
Order	Family	Genus	Species	Code	
Pleuronectiforms	*Achiridae*	*Catathyridium*	*garmani*	CAT	*
	Cynoglossidae	*Symphurus*	*jenynsi*	SYM	*
	Paralichthyidae	*Citharichthys*	*spilopetrus*	CIT	*
		Paralichthys	*orbignyanus*	PRB	*
Siluriforms	*Ariidae*	*Genidens*	*barbus*	GNB	
		Genidens	*genidens*	GNG	
	Aspredinidae	*Bunocephalus*	*iheringii*	BUN	
	Auchenipteridae	*Trachelyopterus*	*lucenai*	TLC	
	Callichthyidae	*Corydoras*	*paleatus*	COR	
	Heptapteridae	*Pimelodella*	*australis*	PMS	
		Rhamdia	*quelen*	RHA	
	Loricariidae	*Hypostomus*	*commersoni*	HPC	
		Loricariichthys	*anus*	LOR	
		Rineloricaria	*longicauda*	RNL	
		Rineloricaria	*microlepidogaster*	RNM	
		Rineloricaria	*strigilata*	RNS	
	Pimelodidae	*Parapimelodus*	*nigribarbis*	PNG	
		Pimelodus	*maculatus*	PMC	
	Pseudopimelodidae	*Microglanis*	*cottoides*	MCT	

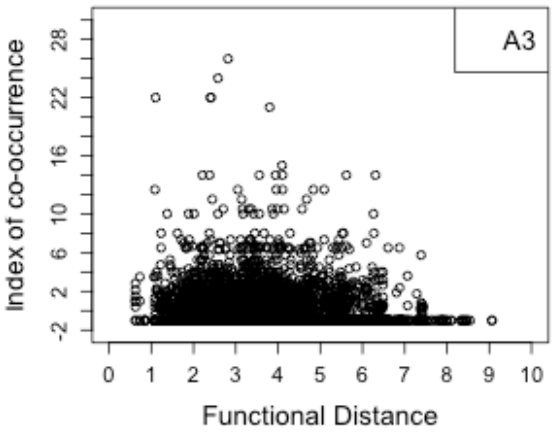
Appendix A3

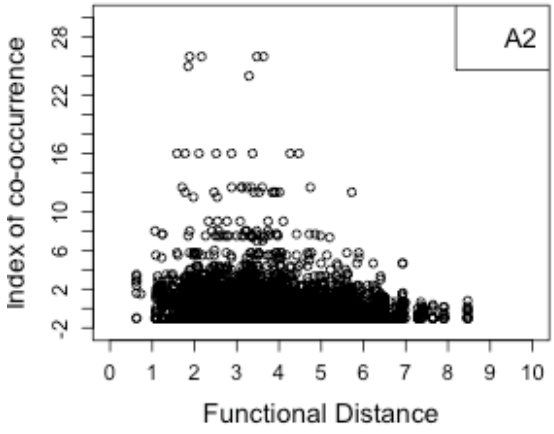
Observed co-occurrence – functional dissimilarities relationships.

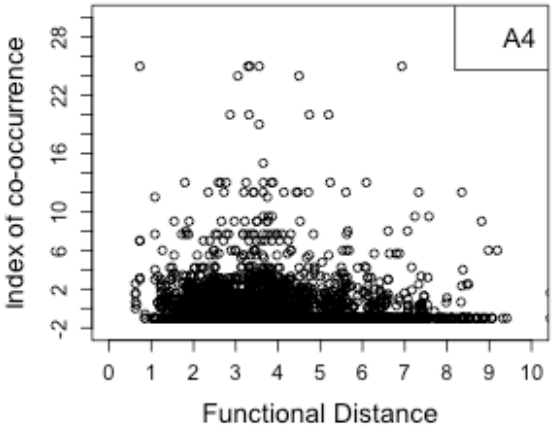
FigureA.3.1. Observed co-occurrences – pair-wise functional dissimilarities relationships at the chosen scales. Functional dissimilarities (or distances) are based on (a) locomotion traits or (b) food acquisition traits. Each point represents a couple of species. The overall relationship at each scale is illustrated by drawing the monthly samples together in order to limit the number of figures. 'Reg' stands for 'regional pool of species'. 'Up' and 'Down' depict upstream and downstream areas (Fig. 1). 'A1/A2' and 'A3/A4' areas are respectively located up and down the dam (Fig. 1).

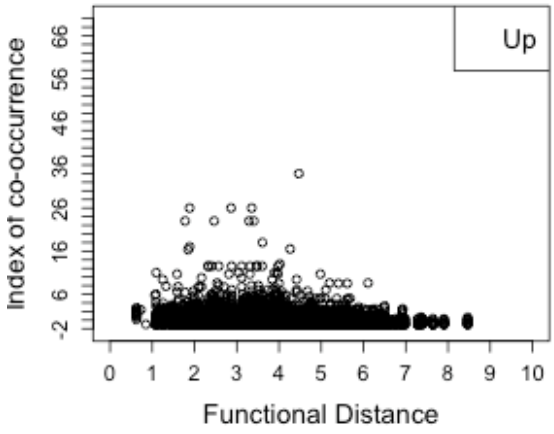
(a)

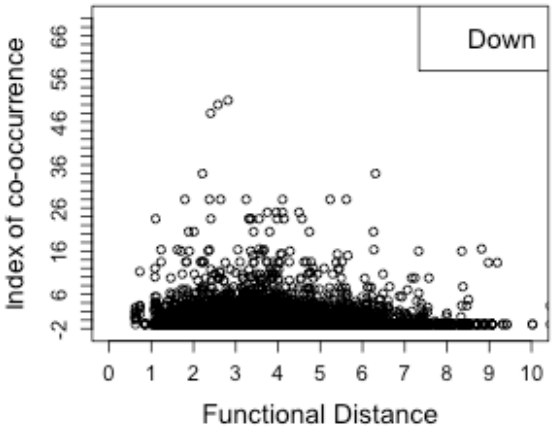

A1
Index of co-occurrence
-2 2 6 10 16 22 28
0 1 2 3 4 5 6 7 8 9 10
Functional Distance

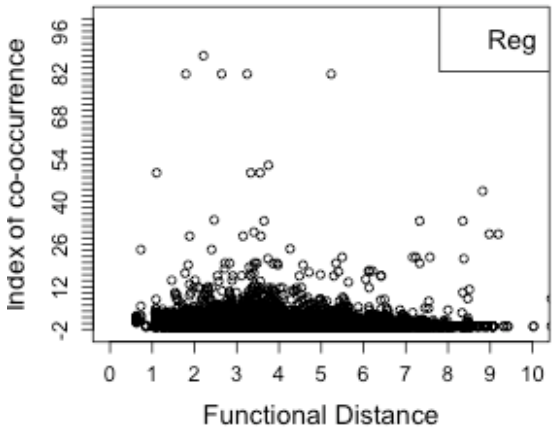

A3
Index of co-occurrence
-2 2 6 10 16 22 28
0 1 2 3 4 5 6 7 8 9 10
Functional Distance


A2
Index of co-occurrence
-2 2 6 10 16 22 28
0 1 2 3 4 5 6 7 8 9 10
Functional Distance

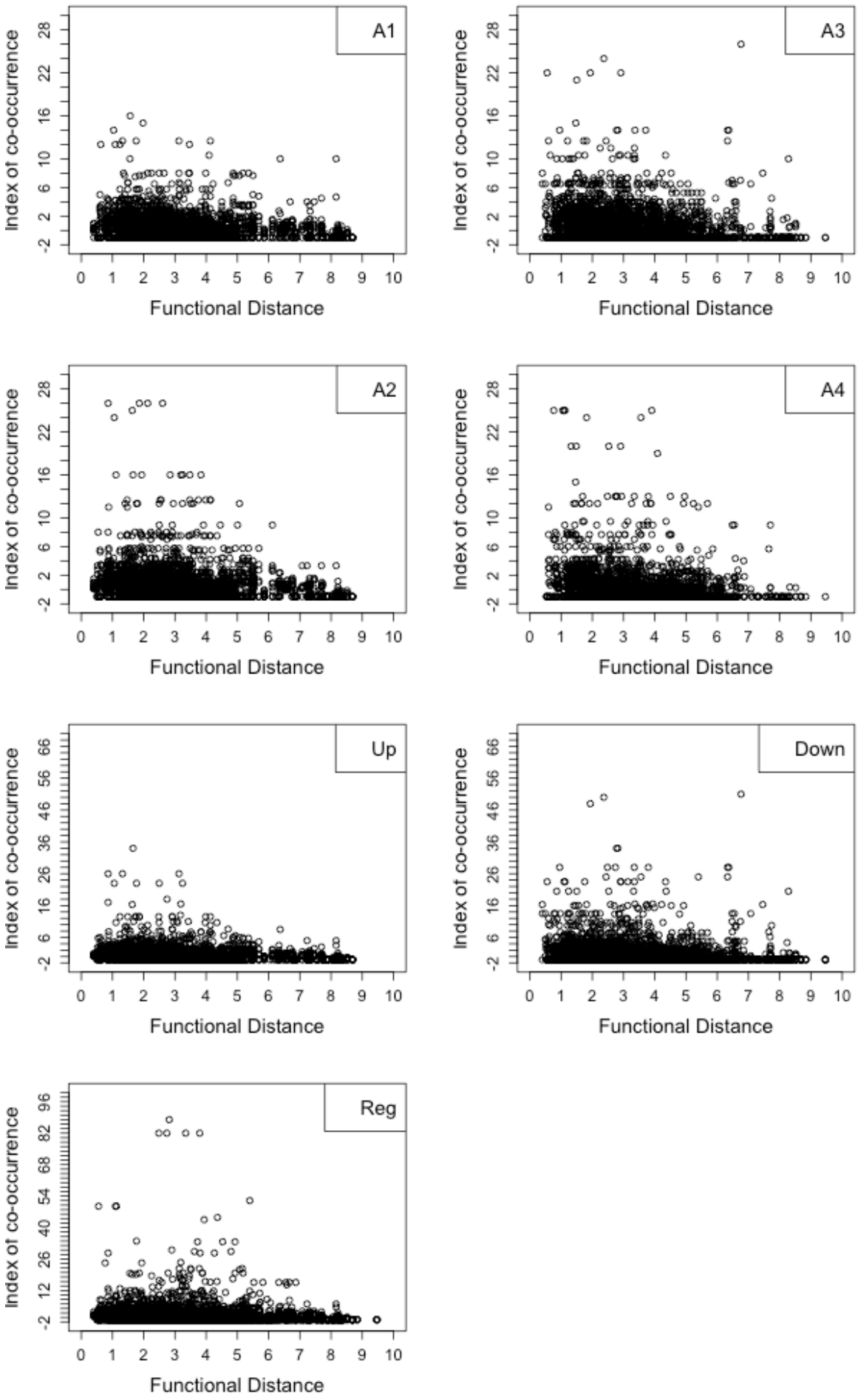

A4
Index of co-occurrence
-2 2 6 10 16 22 28
0 1 2 3 4 5 6 7 8 9 10
Functional Distance


Up
Index of co-occurrence
-2 6 16 26 36 46 56 66
0 1 2 3 4 5 6 7 8 9 10
Functional Distance


Down
Index of co-occurrence
-2 6 16 26 36 46 56 66
0 1 2 3 4 5 6 7 8 9 10
Functional Distance


Reg
Index of co-occurrence
-2 12 26 40 54 68 82 96
0 1 2 3 4 5 6 7 8 9 10
Functional Distance

(b)


A1
A3
A2
A4
Up
Down
Reg
Index of co-occurrence
Functional Distance