

# Introduction to Functional Ecology in R

One-day intensive course · Master FBE · EUR TULIP-GS · Université de Toulouse

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## Overview

This one-day course introduces the trait-based approach in ecology: from building a functional space to computing diversity indices and testing assembly rules. All exercises use real freshwater fish morphological data from FishMORPH and GlobalTraits. The afternoon is structured as collaborative group work followed by an in-class written exam.

Learning objectives — by the end of the day students will be able to:

- Explain what functional traits are, their types, and how to choose them
- Build and interpret a functional space (PCA / PCoA) and visualise it with funspace
- Compute CWM and functional diversity indices (FRic, FEve, FDiv, FDis, Rao Q)
- Apply null models and interpret SES as evidence of assembly processes
- Present and critically discuss quantitative results to peers

## Day schedule

Time	Format	Content
09:00–09:15	Introduction	Welcome, objectives, data overview. Why traits? Why fish?
09:15–10:15	Lecture 1	Functional traits and functional space. Trait types (quantitative, ordinal, nominal, fuzzy). Gower distance · PCA vs PCoA · funspace visualisation.
10:15–10:30	Break	
10:30–11:30	Lecture 2	Functional diversity indices. CWM (mass-ratio hypothesis) · FRic · FEve · FDiv · FDis · Rao Q. Interpretation and ecological meaning.
11:30–12:30	Lecture 3	Assembly rules and null models. SES-FRic: overdispersion vs clustering. TPD framework: incorporating intraspecific variability. Case studies from freshwater fish literature.
12:30–13:00	Q&A + wrap-up	Key messages. Review of take-home concepts.
13:00–14:00	Lunch	
14:00–15:30	Group exercise	3 groups · 3 different exercises (see below). R coding + production of 5-slide PPT summary. Instructor circulates; ask questions freely.
15:30–16:00	Group presentation	Each group presents 5 slides (~8 min + 2 min questions). Peers take notes — they may be asked about other groups' results.

16:00–17:00	Written exam	Individual · in-class · 60 min. Notes and exercises allowed (open book). No R coding required.
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## Group exercise structure

Group	Exercise	Focus	Realm subset
A	Exercise 1	Functional space construction + funspace visualisation	Neotropical + Nearctic
B	Exercise 2	FD indices across realms + CWM and trait–env links	Palaearctic + Ethiopian
C	Exercise 3	Null models + SES + assembly rules	Oriental + Australian

Each group must produce a **5-slide PPT** covering: (1) what they did, (2) one key figure, (3) main result, (4) ecological interpretation, (5) one limitation.

## Materials and packages

Item	Details
Data files	fish_traits.csv · fish_communities.csv · env_data.csv
R packages	FD, funspace, ggplot2, dplyr, tidyr, vegan
Slides	data/courses/fullcourse.pptx (course page)
Background PDFs	FBE_basics_R.pdf · FBE_basics_FD.pdf (course page)
Exam	In-class, 60 min, open book

### Install all packages before the course:

```
install.packages(c("FD", "funspace", "ggplot2", "dplyr", "tidyr", "vegan"))
library(FD); library(funspace); library(ggplot2)
cat("Ready!\n")
```

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