1 Discrepancies of invertebrate trait definitions

Definitions of grouping features and traits varied in their level of detail. The Tachet, Freshwaterecology, and North American (Twardochleb) trait databases provided more detailed descriptions of their trait information compared to the North American (Vieira) and New Zealand databases. An exception is the Australian trait database which is a collection of seven trait datasets (Kefford et al. 2020). Thus, grouping features occur multiple times with varying differentiation into traits. Depending on the dataset trait information is described with more or less detail.

The definition of grouping features varied across databases mainly concerning their differentiation into traits but also in their scope. We provide a summary of discrepancies in trait definitions in the appendix (Table S??). Both, differences in differentiation and scope can lead to discrepancies in trait definitions. For example, for the grouping feature feeding mode discrepancies arise because traits are assigned in different ways. Tachet defines predators as carvers, engulfers and swallowers. By contrast, in the North American (Twardochleb) database predators are defined as engulfers and carnivorous piercers. In turn, in the Tachet database, piercers are defined as a separate trait encompassing herbivorous and carnivorous piercers. Furthermore, the scope in the Freshwaterecology database for feeding mode is primarily on the food source of a species (except for filterers), while the other databases focus on the strategies of food acquisition. Therefore, the Freshwaterecology database defines e.g. predator as "eating from prey", while the other databases use the mouthpart morphology in their definition. The Tachet database captures the food source in an additional grouping feature. Varying levels of differentiation are also present in all other investigated grouping features between the trait databases (see for details Table 1 and Table S??). Locomotion definitions differ also in scope between databases. Freshwaterecology and New Zealand databases describe locomotion as the way of movement of an organism, Tachet as substrate relation, the North American (Vieira) as how organisms deal with flow, Australia as attachment, and the North American (Twardochleb) database includes among the way of movement also the location of movement. Similarly, regarding reproduction trait databases differ in their scope. Reproduction is captured in one grouping feature and defined as location of oviposit clutches and mode of reproduction in the Freshwaterecology and Tachet databases. North America (Vieira) provides information on the oviposition location but not on reproductive behavior. The Australian database report traits for reproductive behavior but also on oviposition site. The New Zealand database distinguishes three grouping features related to reproduction: reproductive technique, oviposition site (e.g. water surface, terrestrial), and egg/egg mass (e.g. free, cemented).

Various codings of traits are used throughout the databases (e.g. binary, fuzzy, continuous). The freshwaterecology and Australian use different codings in their databases. Tachet and the New Zealand database use exclusively fuzzy coding. Both North American trait databases contain categorical grouping features that can be converted into traits using a binary coding (Table 1). Binary coding represents a simple approach in which a taxon either expresses a trait or not. Fuzzy coding characterizes the affinity of an organism to exert a certain trait. It is used to account for plasticity in traits, e.g. taking into account that traits can change over the development time of an organism. Usually, fuzzy coded affinities are converted into proportional values. Continuous coding is used for traits like body size.

Table 1: Number of traits per grouping feature and type of coding of the traits for the respective grouping feature per database.

Database	Feeding Mode	Voltinism	Locomotion	Respiration	Reproduction	Size	Body Form
Freshwater-ecology	10; 10 point assignment system	6; single category assignment system	6; 10 point assignment system	7; presence/absence assignment system	9	-	-
						-	-
Tachet	7; fuzzy [0 − 3]	3; fuzzy [0 − 3]	8; fuzzy [0 − 5]	5	8; fuzzy [0 − 3]	7	-
North America (Twardochleb)	6	3	10	3; binary	10	3	-
North America (Vieira)	8	3	9	8; binary	10	3	5
Australia	16 [a]; binary; proportional [0 − 1]; fuzzy [0 − 3]	7	9; binary; fuzzy [0 − 3]	10; binary; proportional scale [0 − 1]; fuzzy [0 − 3]	13 [b]; categorical	9; binary; continuous; fuzzy [0 − 3]	4; fuzzy codes [0 − 3]
New Zealand	6; fuzzy [0 − 3]	3	4	4	4	5	4

[a] Some of the traits were similar (e.g. trait *Shredder, Shredder, Shredder, Detrivore,* and *Collector, Shredder*).
[b] Many traits were rather comments than traits in the original database and were not considered.