Supplementary Material 1

Relevance of protist functional trait

Marine protists live in a multi-variable world where both the environment and species interactions have shaped distinct ecological strategies (Worden *et al.*, 2015). Here we propose 30 functional traits that describe those strategies, and explain their survival in the environment (Violle *et al.*, 2007). Traits were annotated only when mentioned in the bibliography and generalizable to the taxonomic reference of Operational Taxonomic Units. By choosing to work non-speculatively, mixotrophy, thought to be widespread (Selosse *et al.*, 2016), was probably under-estimated. The final annotated table is public but not finite; it represents a first improvable functional annotation of marine protists (doi: in the course of acquisition via a public portal).

Cell Morphology and Structure

Cell Size (Minimum and maximum): defined as a key trait for phytoplankton in Litchman & Klausmeier (2008). Involved in growth and metabolic rates (Litchman *et al.*, 2007), sinking rates (Smayda, 1969), grazer resistance (Thingstad *et al.*, 2005) and resource acquisition for phototrophs (Grover, 1989; Yoshiyama and Klausmeier, 2008), heterotrophs (Hansen *et al.*, 1994; Naustvoll, 2000) and parasites (Lafferty and Kuris, 2002).

Cell Cover: diminishes palatability for predators (Reynolds, 2006). Can involve an additional nutrient requirement for siliceous, calcite, strontium sulphate covers.

Cell Shape: elongation decreases palatability and shape is also involved in resource acquisition for phototrophs by modifying the surface area/volume ratio of the cell (Grover, 1989; Pahlow *et al.*, 1997; Litchman *et al.*, 2010).

Spicule: diminishes palatability for predators (Hamm, 2005).

Symmetry and *Polarity*: proxies of investment in cell structure, complexity. They also influence *Cell Shape*. Proposed in Litchman *et al.* (2010).

Colony: the colony-forming mode of life is thought to play a role in both predator avoidance (increasing the size and complexity of the structure) and improved resource acquisition by increasing water renewal around the cell (Margalef, 1978). It could also increase buoyancy, which is useful to avoid sinking (Margalef, 1978; Ploug *et al.*, 1999).

Motility: plays a role in survival (predator avoidance), reproduction (mating), and resource acquisition (prey search and capture), even for phototrophic species by increasing the renewal of nutrient-replete water around the cell (Karp-Boss *et al.*, 1996; Ginger *et al.*, 2008; Kiørboe, 2011; Nielsen and Kiørboe, 2015). When motility varied during the life cycle, the motility was annotated according to the trophic stage.

Trophic Strategy

Plastid Origin: plastids are organelles involved in the phototrophic strategy, i.e. the creation of organic matter using energy from light and carbon dioxide (McFadden, 2014). Plastids can be synthesised by the cell but also originate from kleptoplasty or endosymbiosis (Mitra *et al.*, 2016).

Ingestion: highlights the heterotrophic strategy, i.e. the creation of new organic matter from the catabolism of organic matter (Sherr and Sherr, 2000). It is proposed here that the method of ingestion reveals the nature of the prey available for the heterotroph (i.e. osmotrophic: dissolved organic matter; saprotrophic: dissolved, dead and detrital matter; phagotrophic: smaller size than or similar size to the predator; myzocitosis: all living organisms) (Gleason *et al.*, 2008; Jeong *et al.*, 2010; Worden *et al.*, 2015).

Behaviour: describes the feeding processes of the organism (encounter and interception of the resource) (Kiørboe, 2011).

Mutualistic Hosts: hosting of any other organisms, and details on the type and need of the symbiont for the hosts to thrive in the environment (Stachowicz, 2001; Decelle *et al.*, 2015; Stal and Silvia, 2016).

Symbiosis: whether the organism is engaged (i.e. is a guest) in a symbiosis and the effects it has on its hosts (Stachowicz, 2001; Decelle *et al.*, 2015; Stal and Silvia, 2016). Parasitoids were distinguished from parasites as they could have further impact on the host population (Lafferty and Kuris, 2002).

Symbiont Location: endo- or ecto-symbionts have different impacts on the holobionts. It explains distinct parasitic patterns and affects *Specialisation* (see below).

Specialisation: indicates any specialisation in the relationship with another species (predation, guest or host symbiosis). Generalists and specialists have distinct effects on the fitness of other organism populations and possibly on ecosystem dynamics (Lafferty *et al.*, 2008).

Physiology

Mucilage: when synthesised, it negatively influences grazing, allows buffering of osmo-regulation and is involved in the size of mucilaginous colonies (Margalef, 1978; Grattepanche *et al.*, 2011).

Chemical Signal: information on allelopathic, mating and osmolytic composites produced by the species and that could help it to thrive in the environment (Wolfe, 2000; Schwartz *et al.*, 2016).

Niche-related Traits: preferences and tolerance range for influential environmental metrics (i.e. nutrients, dissolved oxygen concentration, depth, light, temperature and salinity) (Brun *et al.*, 2015). Typical "performance traits".

Toxigenicity: Synthesis of toxins harmful at the ecosystem scale (other organism communities) (Heisler *et al.*, 2008; Gu *et al.*, 2013). A performance trait linked to *Chemical Signal*.

<u>Life Cycle</u>

Benthic Phase: if occurring during the life cycle, the complete species fitness is influenced by resuspension and hydro-dynamism (Ohtsuka *et al.*, 2015).

Longevity: could help highlight stress-tolerant species present at low nutrient concentrations (Grime, 1974; Reynolds, 2003).

Resting Stage: represents a competitive advantage during unfavourable environmental conditions (Litchman and Klausmeier, 2008; Lange *et al.*, 2015). Could also be linked to a benthic phase.

Ploidy: the capacity to reproduce enables genetic variations and genetic flexibility could be an adaptive advantage against ecological pressures (Litchman and Klausmeier, 2008).

Genome Size: by reducing genome size, cells can reduce their needs for growth-limiting elements and could present an adaptation to resource scarcity (Pommier *et al.*, 2007; Litchman *et al.*, 2010; Raven *et al.*, 2013).

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