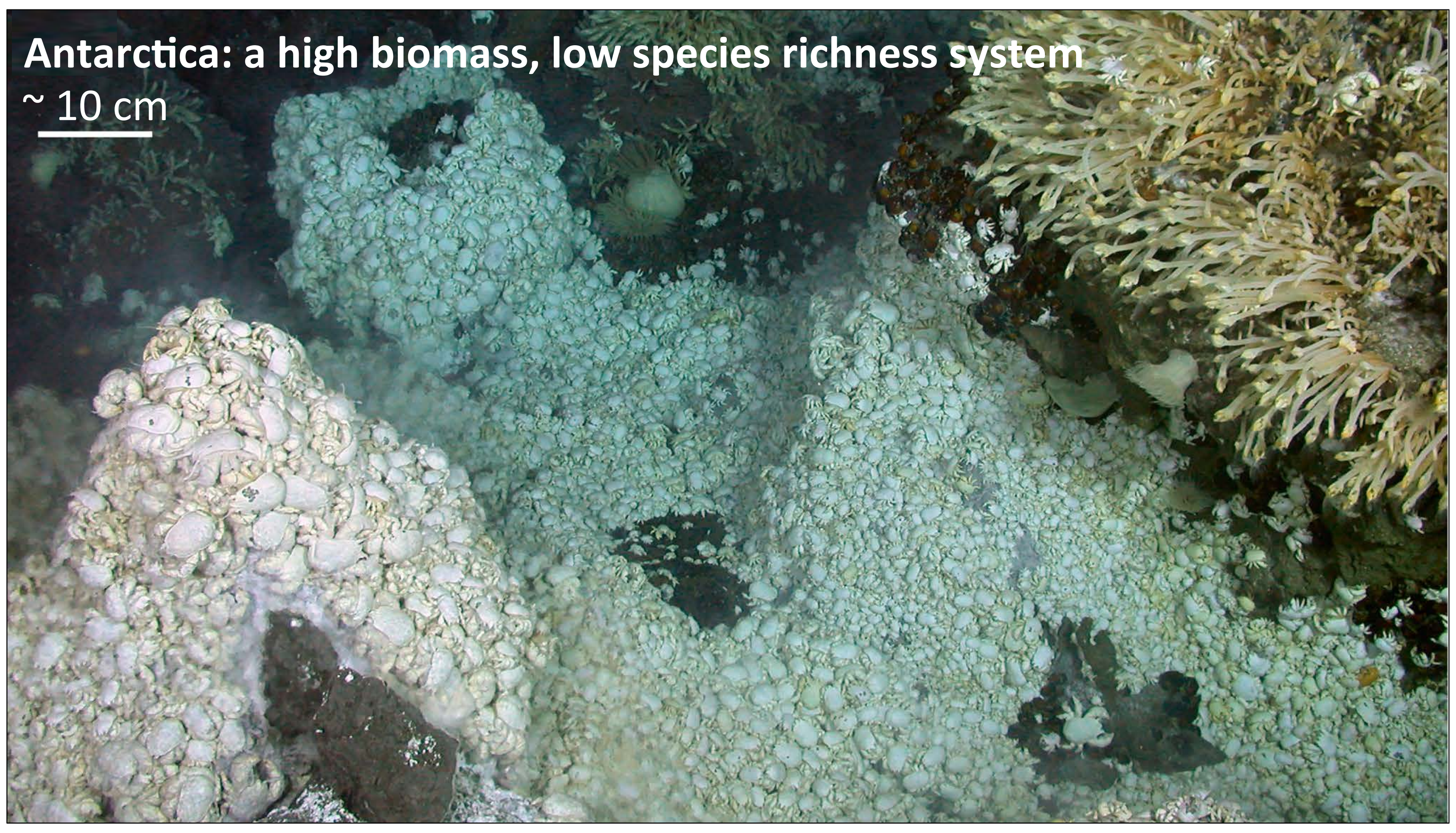
Hydrothermal Vent Biodiversity

A Functional Trait Perspective

Why Study Hydrothermal Vent Biodiversity?

Hydrothermal vents have been explored for decades. Researchers have documented the discovery of uniquely adapted fauna, able to thrive in toxic environments without light, at the bottom of seas around the globe. Work has been carried out to map spatial and temporal distributions of vent fauna, to investigate large scale biogeographic patterns and smaller scale successions. Species richness has been used as a means to compare diversity between sites across the globe.

So far, it has been found that vent systems are low in species richness, but high in biomass. Hydrothermal vents are now targets for deep-sea polymetallic sulphide mining, which is a destructive process that will reduce biomass and may cause species loss. With low species richness, what impact would the loss of even one species have? We have the opportunity to quantify vent biodiversity patterns and drivers, to identify the best means of management, before policies and guidelines are finalised for industry.



'Oases of life like no other on Earth.'

(WWF, 2015)

A Functional Trait Perspective

A functional trait is any feature of an organism that can affect its performance or role within an ecosystem, as well as its influence on the ecosystem itself. A trait is a feature of an individual, not a community (i.e. body mass is a trait but biomass is not).

A functional approach will enable us to tackle questions about vent ecosystem vulnerability and function in a new way. It is expected that vents will be low species richness, high functional diversity systems (Fig. 1). At vents, low functional redundancy (animals sharing a functional role with other animals, rendering them 'redundant' to the system) is likely because vent species are likely to play unique functional roles in their communities. The functional approach is outlined in Figure 2.

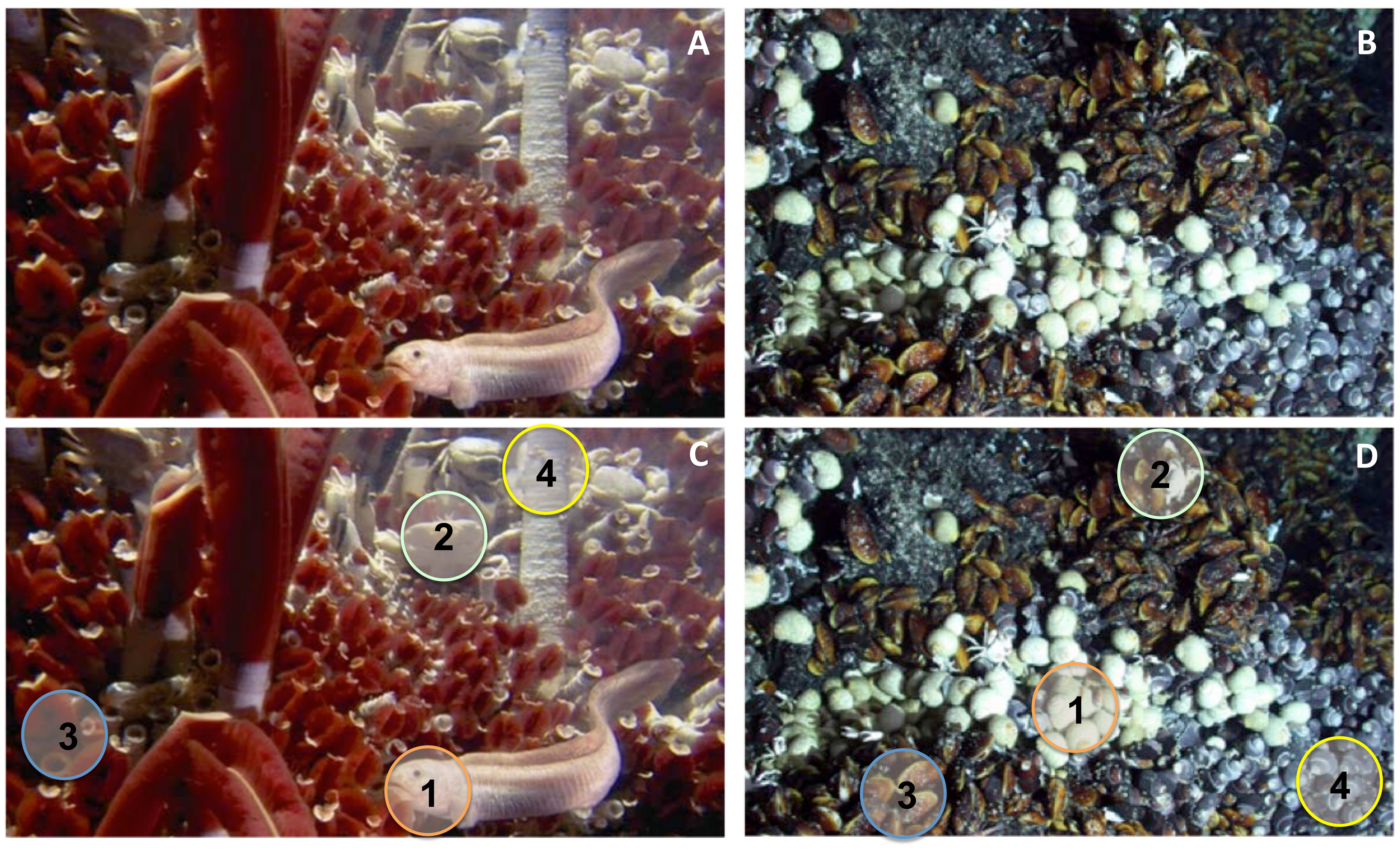
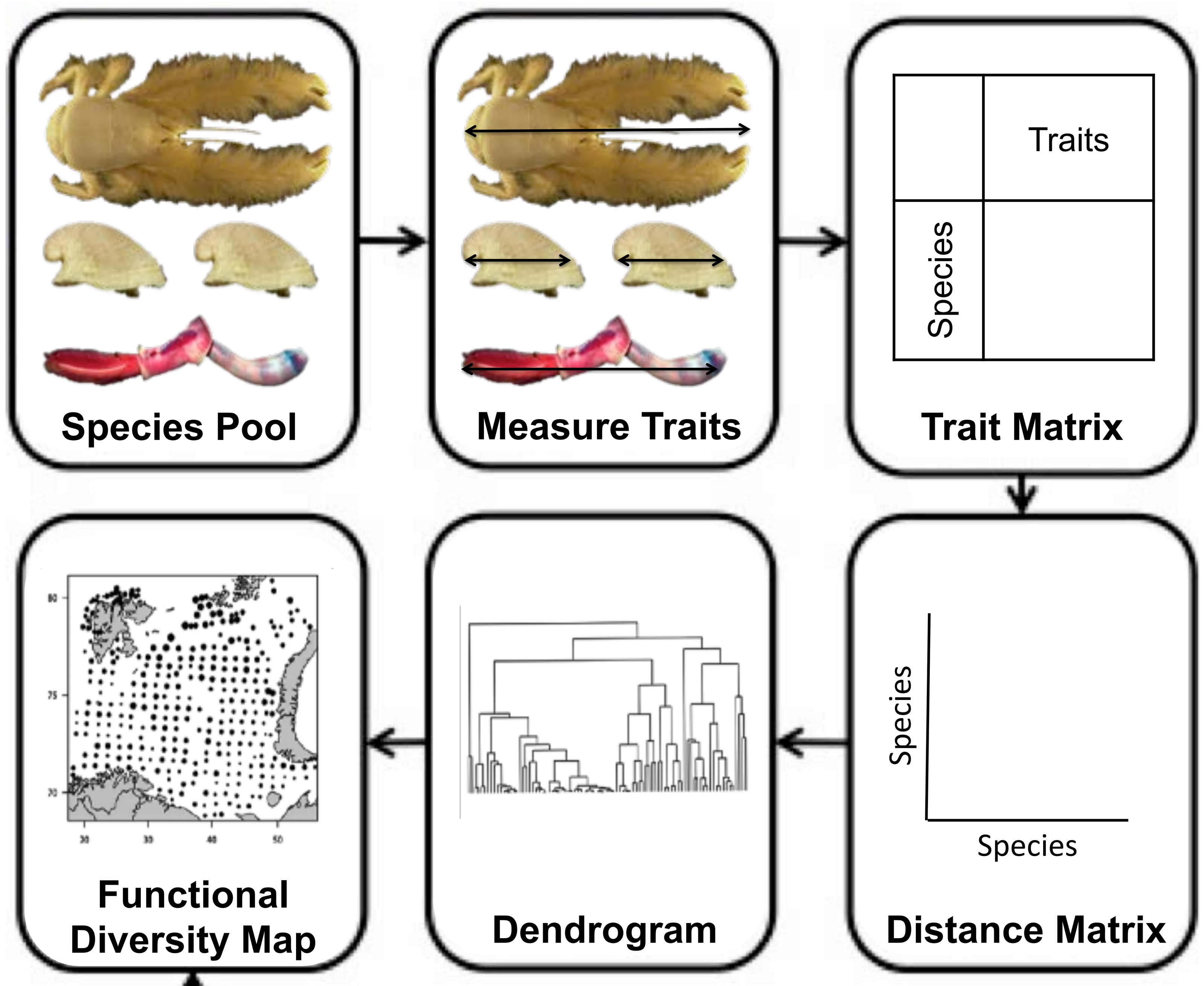


Figure 1 | Images highlighting the differences between perceptions of diversity and species richness. These images illustrate the differences between perceived diversity (where A appears more diverse than B) and species richness (C and D have equal species richness, based on a superficial survey of each image). They illustrate the importance of functional diversity at vent sites, as A and C show fauna of different body sizes, forms, and trophic levels. Meanwhile B and D host mostly hard-shelled grazers of similar size (lower functional diversity). Image sources: A & C – Kristoff (n.d.); B & D – FLEXE (n.d.).



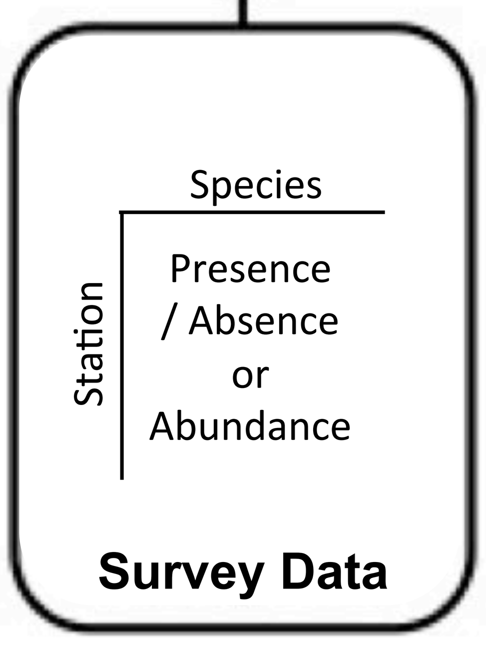


Figure 2 | The functional trait approach to biodiversity research. This schematic illustrates the most commonly used functional trait approach, whereby a species-trait matrix is generated to quantify functional richness and diversity for mapping and hypothesis testing.

This schematic was created using parts of figures provided in Mouillot *et al.* (2013), Wiedmann *et al.* (2014) and Lefcheck *et al.* (2014). Faunal images were sourced from: IFREMER (*Kiwa* crab)· WORMS database (*Lepetodrilus fucensis*), and Batson (*Riftia pachyptila*).

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Sources Cited: **Batson, P. (n.d.)** *Riftia* image, available from: http://www-.arkive.org/giant-tube-worm/riftia-pachyptila/image-G78005.html; **FLEXE (n.d.)** 'Dataset 1L Animal Distribution with Temperature', available from: http://www.flexe.psu.edu/Ecology_Unit/FORUM1/FORUM.cfm; **IFREMER (2005)** *Kiwa* crab image, available from: http://bioweb.uwlax.edu/bio203/s2009/decker_rour; **Kristoff, E. (n.d.)** 'Deep Sea Vents: Science at the Extreme', available from: http://environment.nationalgeographic.com/environment/habitats/deep-sea-vents; **Lefcheck, J.S. *et al.* (2014)** Choosing and using multiple traits in functional diversity research. *Environmental Conservation*, 1-4; **Mouillot, D. *et al.* (2013**) A functional approach reveals community responses to disturbances. *Trends Ecol. Evol.,* 28 (3), 167-177; **NOAA (2011)** *Little Hercules* ROV, available from: http://oceanexplorer.noaa.gov/okeanos/explorations/10index/background/rov/rov.html, courtesy of NOAA Okeanos Explorer Program, INDEX-SATAL; **Rogers, A.D. *et al.* (2012)** The discovery of new deep-sea hydrothermal vent communities in the southern ocean and implications for biogeography. *PLoS Biol.,* 10 (1), e1001234 [also the source of the Antarctic image – top right]; **Wiedmann, M.A. *et al.* (2014)** Functional diversity of the Barents Sea fish community. *Marine Ecology Progress Series,* 495, 205-218; **WoRMS Editorial Board (2015)** World Register of Marine Species, available from://www.marinespecies.org at VLIZ; **WWF (2015)** Deep sea ecology: hydrothermal vents and cold seeps, available from: http://wwf.panda.org/about_our_earth/blue_planet/deep_sea/vents_seeps/ [quoted from article subheadings].