Name	**Univariate indices**
DPSIR classe	Impact
ECASA subgroups	Benthos (macrofauna diversity)
ECASA code	UNIVAR
Proposed by participant	1- SAMS
Definition, computation,	S (number of species), A (Abundance), Biomass (B) Also B/A, A/S, Shannon-Wiener H' (diversity), Pielou's (Evenness), Simpson, top 5 most abundant species. Indicators species and families, ratio of biomass retained on 0.5 mm sieve to 1.0 mm sieve (Karakassis and Lampadariou, unpublished).
Data required	Sampling of sediment using grab or corer, sieving and preservation of samples in the field along an organic gradient and reference locations. Laboratory taxonomic identification of samples resulting in abundance and biomass of species (and/or) families.
Summary, scientific meaning, implementation	S, A and B, S/A, B/A are calculated from taxonomic identification species lists. H', Evenness and Simpson can then be subsequently derived. Formulae for these are given in standard benthic ecology text books (e.g. Levinton, 1982), or are calculated by statistical packages, eg. PRIMER. Certain indicator species and families have been shown to indicate impact by their presence/absence (recent example in the Mediterranean - Karakassis and Lampadariou, unpublished). Classic trends of each of indices (S, A, B) are documented in the literature and the range of these indices are site and environment specific. Therefore, it is not appropriate to specify a range for these indices. Disturbance of macrobenthic community results in recognised changes in these indices. Primarily, diversity decreases along an increasing organic gradient, with a corresponding increase in abundance expected. A severely impacted situation may result in abundance tending to zero (azoic). Biomass changes along an organic gradient are typically more complex, with peaks in biomass associated with peaks in opportunistic species and a larger peak in biomass at unimpacted locations.
Range of validity	Wide field of validity for these indicators, except care is required in using some of the derived indices when very low species (S) are present. E.g. a low *S* in itself describes the state of the benthic community and so eliminates the need for derived indices. Computed values site/environment specific and so not specified here. In particular, the indicator species and families identified and tested by Karakassis and Lampadariou in the Eastern Mediterranean will be environment specific. There tends to be more examples of aquaculture impacts and these indices in areas with soft sediments, but the aquaculture industry in some countries is tending to seek more dispersive, offshore sites. As a result, these indices will need to be robust for assessing aquaculture impacts in these environments.

Species concerned (fishes/molluscs)	All
Related type of aquaculture	All
Relevant environments for this indicator	MOST (perhaps excluding environments where aquaculture operations situated above bedrock/coarse sediments where sampling difficult)
Geographic scale	Local to regional
Direct relevance to objectives	– **A** – Most of these indicators are well tested and included as standard in assessment of benthic communities
Clarity in design.	– **A** - Well established
Realistic collection or development costs	– **B** - Main limitation is the cost of macrobenthic surveys and subsequent identification to species level. Some information can be gained by examining the presence of indicator species/families or identifying to a certain level as shown recently in the MERAMED project (Karakassis and Lampadariou). This can result in lower costs in identification. A full cost benefit analysis has also been undertaken by these authors.
High quality and reliability	– **A** – Well established and tested
Appropriate spatial and temporal scale	– **A** – Well tested along spatial and temporal gradients
Obvious significance	**B** – Although these indices give a useful amount of information regarding disturbance of the benthic community, it is often the case that stakeholders prefer a single number contained in an index which describes "impact". Ideally S, A, B and derived useful indices should always be provided alongside such an index of impact.
advantages	
disadvantages	
references	Cromey, C.J., Nickell, T.D. and Black, K.D. (2002). DEPOMOD - modelling the deposition and biological effects of waste solids from marine cage farms. Aquaculture, 214, 211-239. Karakassis, I., Tsapakis, M., Hatziyanni, E., Papadopoulou, K.N. & Plaiti, W. (2000). Impact of cage farming of fish on the seabed in three Mediterranean coastal areas. ICES Journal of Marine Science, 57, 1462-1471. Levinton, J.S. (1982). Marine Ecology, pp. 87-89. Prentice-Hall Inc., New Jersey, US, ISBN 0-13-556852-8. Pearson, T.; Rosenberg, R. (1978). Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanography and Marine Biology Annual Review, 16: 229-311.
State of validation	Biodiversity indices are used to characterize different impacts, in various environments.
recommendations	