Name	**Heavy metals**
DPSIR classe	Impact
ECASA subgroups	Sediment
ECASA code	HEAVYMET
Proposed by participant	1 - SAMS
Definition, computation,	Sediment heavy metal concentrations to characterise impacts
Data required	Actual sediment heavy metal concentrations. Requires ICP-MS analysis of sediment samples
Summary, scientific meaning, implementation	Of the metals present in fish farm sediments, elevated concentrations of copper and zinc have been reported in Scotland and Canada. The principal sources of these metals are antifoulant paints and fish feed. Additionally, cadmium, molybdenum and uranium are enriched in fish farm sediments, and up to 150 m away from farms. Metal concentrations have been shown to increase over the farm growing season. Redox-sensitive metals may be subject to sediment horizon migration due to increased organic enrichment from farm activities. All environments and aquaculture types can be assessed using these indicators. 0.1 m^{-2} van Veen grab or similar taking grabs along an organic gradient with samples taken at reference stations. Possible use of sediment traps in hard substrate areas.
Range of validity	Certain regulators (SEPA) already issue acceptable standards of sediment metal concentrations. A range of theses values up to the EQS can be calculated/tabulated
Species concerned (fishes/molluscs)	All
Related type of aquaculture	All
Relevant environments for this indicator	MOST soft-bottom environments where sediment sampling is easiest, although sediment traps may be deployed in hard substrate areas to at least establish metal concentrations in waste food/faeces
Geographic scale	Local-regional
Direct relevance to objectives	A
Clarity in design.	A - Well established
Realistic collection or development costs	B - Main limitation is the cost of sediment heavy metal analysis.
High quality and reliability	A – These analyses are robust and reliable, subject to quality control between laboratories.
Appropriate spatial and temporal scale	A – Well tested along spatial and temporal gradients, subject to several post-graduate studies.
Obvious significance	B –
advantages	
disadvantages	

references	Ankley, G.T. , DiToro, D.M., Hansen, D.J., & Berry, W.J., 1996. Assessing the ecological risk of metals in sediments. Environmental Toxicology and Chemistry 15, 2053-2055. Brooks, K.M. and Mahnken, C.V.W., 2003. Interactions of Atlantic salmon in the Pacific Northwest environment III. Accumulation of zinc and copper Fisheries Research 62, 295–305. Dean, R.J., 2005. Physical and biogeochemical pathways of metals around fish farms. Ph.D. thesis, UHI Millenium Institute/Scottish Association for Marine Science. Smith, J.N., Yeats, P.A. and Milligan, T.G., in press. Sediment geochronologies for fish farm contaminants in Lime Kiln Bay, Bay of Fundy. In: B.T. Hargrave (ed) Environmental effects of marine finfish aquaculture. The Handbook Of Environmental Chemistry (vol. 5): Water Pollution. Springer Verlag. Yeats, P.A., Milligan, T.G., Sutherland, T.F., Robinson, S.M.C., Smith, J.A., Lawton, P. and Levings, C.D., in press. Lithium normalised zinc and copper concentrations in sediments as measures of trace metal enrichment due to salmon aquaculture. In: B.T. Hargrave (ed) Environmental effects of marine finfish aquaculture. The Handbook Of Environmental Chemistry (vol. 5): Water Pollution. Springer Verlag.
State of validation	Existing datasets from numerous Scottish fish farm studies held at SAMS, and Mediterranean sites investigated during MERAMED
recommendations	