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Evaluation of aquaculture system sustainability: A methodology and comparative approaches

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Very little work dealing with the evaluation of aquaculture system sustainability has been undertaken to date on a global and comparative basis. Moreover, the analysis of the main reference frameworks such as codes of conduct, guides of good practice, standards, labels and of initiatives for the construction of sustainable development indicators in aquaculture, show that most of them are based on very unbalanced approaches concerning the dimensions of sustainable development that are taken into account. The approach taken up here is instead designed to cover all the dimensions of sustainability including the traditional pillars (economic, social and environmental) as well as the institutional one (governance). This latter, in particular, gives these approaches its original and innovative nature as well as the role played by aquaculture as a development factor for the sustainability at the territory level. At once multidisciplinary and participatory (co-construction of sustainability indicators), the approach compares several worldwide countries with highly differentiated types of aquaculture system. An original output from this work states that the classification of areas with respect to sustainability obtained from the multicriteria evaluation corresponds, in terms of relative priority, to the classification obtained from the results of the life cycle assessment. Hence, in both cases, the technical model based on intensive farming obtains the best scores whilst more extensive systems, which might have been thought to be closer to natural systems in their environmental dimension and therefore intuitively more "sustainable", score much lower.

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Conserving a threatened endemic, landlocked Atlantic salmon population

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Populations of migratory salmon decline worldwide due to human activities and numerous measures have been undertaken to maintain these populations. The regulated River Klarälven and Lake Vänern host endemic populations of land locked Atlantic salmon (*Salmo salar*). Historically high abundances of the salmonids in Klarälven in the 1800s have decreased dramatically, reaching all-time lows after the completion of nine Swedish hydroelectric plants in the 1960s. After extensive stocking and transportation of wild and hatchery-raised spawners past eight hydroelectric plants catches have again increased. Recently, increases in the proportion of wild salmon returning to river Klarälven have generated interest in establishment of wild salmon throughout the entire river. To obtain information needed to produce a management plan for the salmon, we conducted multiple studies of upstream-migrating spawners and downstream-migrating smolts and kelts. We compared migratory behaviour of wild and hatchery reared salmon. For spawners we found that wild fish swam directly to the spawning grounds, whereas the few hatchery salmon that arrived at the spawning grounds swam considerably more before settling down and they held positions for shorter periods of time. For smolt, only 16-30% passed all eight dams and losses in the dam-free lower 25 km of the river were higher for hatchery-raised smolts than for wild. Moreover, losses of hatchery-raised smolts varied depending on feeding routines in the hatchery. For kelts, only 2% passed all eight dams. Thus, the production of high quality hatchery-raised fish together with remedial measures to increase the number of wild salmon is needed.

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