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Assessing and Managing Environmental Risks Associated with Marine Finfish Aquaculture

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Abstract Environmental Risk Analysis (ERA) consisting of risk assessment, management and communication can be applied to assess ecological and environmental changes associated with industrial-scale marine finfish aquaculture development. Physical, chemical, and biological variables are identified that may be used to detect thresholds for changes in ecosystem structure and function in order to apply ERA. Changes due to predictable or unpredictable effects may be local or far field. Predictable effects such as reduced dissolved oxygen, increased nutrients and organic matter, or lower diversity of benthic fauna in the vicinity of net-pens can be modeled to quantify local impacts on water column and

sediment variables. Far-field and long-term risks such as interactions of escapees with natural stocks and effects of fishing to obtain food for cultured fish are more difficult to predict and quantify. Despite this, scoring methods using single or multiple indicators may be applied to determine the degree of risk associated with all identified potentially negative effects. ERA should be part of an integrated planning approach where aquaculture development occurs within a broad framework to include all development and user groups within the coastal zone. Environmental observations and models can then be combined with effective aquaculture husbandry practices to manage environmental risks from all sources.

Keywords Environmental monitoring · Risk assessment · Salmon aquaculture · Sustainable development

1 Introduction

Government agencies often have the dual responsibility of increasing economic development while at the same time ensuring environmental protection. In many cases formal policies are needed to ensure reasonable and equitable management decisions. However, in the case of aquaculture development there can be fundamental differences in the interpretation of risks among various stakeholders [1]. Risk, the exposure to a chance of loss or damage, has two components—the probability of an event occurring times the magnitude of the effect. Industry proponents give priority to minimizing risks of economic loss, while opponents may emphasize the potential for negative environmental impacts and effects on traditional fisheries. In some jurisdictions, views on the issues have become so polarized that conflict resolution approaches have been proposed in an attempt to find a balance between the benefits of economic development and environmental sustainability [2].

There are many positive effects from aquaculture development. In addition to obvious economic benefits, there may be positive environmental changes. In marine coastal areas, moderate discharges of particulate organic matter from finfish culture sites may stimulate growth of benthic fauna if organic supplies from natural sources are limiting production. Removal of nutrients through harvesting of cultured shellfish may counteract eutrophication.

Despite these potential benefits, there is widespread perception that marine aquaculture has negative environmental effects and the potential to disrupt and/or displace other activities in the coastal zone. While establishing new aquaculture sites may create employment, those involved with traditional harvest fisheries may feel that their livelihood is threatened if the location or expansion of existing aquaculture sites reduces access to historic fishing grounds or is perceived as causing a reduction in biomass of harvested species. Recently, the scope of concern has expanded to the possibility of