From:	Levin, Lisa
To:	R9RoseCanyon
Subject:	comments on Rose Canyon Sustainable Aquaculture
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Comments by Lisa Levin, Center for Marine Biodiversity and Conservation, Scripps Institution of Oceanography.

Offshore Aquaculture offers much promise and may eliminate some of the problems characteristic of nearshore/coastal aquaculture. However it raises many new issues as well. Below I have listed some of the key issues that need to be addressed.

I. Direct environmental impacts:

A. Physical impacts on regional flow, turbulence, sedimentation, oxygenation.

B. Biogeochemical and consequences of organic enrichment in the underlying water column and seafloor

C. Ecological consequences of organic enrichment in the underlying water column and seafloor – changes in community composition, diversity, productivity, food webs and other functional attributes.

D. Effects of noise, light, electromagnetic and other non-natural aspects associated with operations. Impacts of boat activity to and from shore.

II. Indirect environmental impacts.

A Reef effects – attraction of fish and invertebrate species to the pen structures, fish aggregations and attraction of the predators of those species.

--[if !supportLists]-->B. <!--[endif]--> B. Are there effects on or attraction of non-native species.

--[if !supportLists]-->C. C. Impacts on long-distance migratory species (marine mammals), or local - vertical migrating plankton.

--[if !supportLists]-->D. D/ <!--[endif]-->Genetic impacts – altered connectivity of the target or affected species. Will the site act as a larval source or sink? Will the farmed population exchange genes with resident populations?

--[if !supportLists]-->E. E. Energy efficiency and use… what is the carbon footprint of the farmed fish.

--[if !supportLists]-->F. <!--[endif]-->

III. Interaction with Climate Change

A. How will environmental changes interact with secular trends in declining oxygen/ intensified CA undercurrent, increased onshore/upwelling events, ENSO, storms etc.

B. Can instrumentation on the pens be used as long-term climate monitoring facilities? Or as early warning to avoid catastrophic results from changes in conditions.

C. Will kelp drifts and other debris released during storms get trapped on the pens? Are the pens stable under storm conditions?

D. Can multitrophic culturing (plants, bivalves in addition to fish) ameliorate some of the potential climate hazards such as ocean acification or hypoxia?

IV. What are the social benefits and disadvantages?

Jobs? Food availability? Competition with wild fisheries or reduced pressure on wild fisheries?