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Report of the PSARC Habitat Subcommittee Meeting, December 12-13, 2000

M. Stocker and J. Pringle (Editors)
Pacific Scientific Advice Review Committee
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

January 2001

Canada

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PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE

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HABITAT

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SUMMARY

The PSARC Habitat Subcommittee met December 12-13, 2000, at the Institute of Ocean Sciences (IOS) in Sidney, B.C. The Subcommittee formally reviewed three Working Papers and one presentation outlining an emerging issue. A list of working paper titles and authors is listed in Appendix 1.

INTRODUCTION

The Subcommittee Chair, Dr. John Pringle, welcomed Subcommittee members, introduced observers and external participants, and explained rules for their participation. During the introductory remarks the objectives of the meeting were reviewed, and the Subcommittee accepted the meeting agenda (Appendix 2). Participants (Appendix 3) were reminded, the meeting deliberations are confidential until publication of the meeting's Advisory Document.

WORKING PAPER SUMMARIES, REVIEWS AND DISCUSSION

H00-04: Cumulative effects assessments: an evaluation of DFO science research options

G.S. Jamieson and L. Chew **Accepted subject to revisions**

Summary

Resource managers are becoming ever more concerned about the cumulative effects arising from different environmental impacts, and how such effects should be considered in a regulatory manner. In this working paper the authors present a literature review of the subject in general, discuss how complex cumulative effects issues are to be adequately assessed, and review how cumulative effect review processes relating to the aquatic and marine environments have been addressed. One generic problem is that although guidelines imposed by agencies often specify that an assessor must consider the cumulative effects of potential impacts, there are no widely accepted methodologies with respect to aquatic and marine environments. In fact, the difficulties in conducting assessments over the spatial and temporal scales involved suggest that developing such methodologies will be years away.

Over a decade ago, it was recognized that social and economic factors are the driving force behind management activities that can cause cumulative effects. In the long term, changing social values and perspectives with regard to the environment will likely be the most effective way to increase public awareness of cumulative effects issues and to minimize their consequences. Therefore, given both that quantitative evaluations of cumulative effects will not readily be

achievable in the near future and the limited resources that are available with DFO for cumulative effects studies, the authors suggest that the most cost-effective short term approach is to model discrete systems in a manner that will show managers and the interested public some of the consequences of accepted minor impacts that are cumulatively expressed. The simple act of constructing such models should also advance our understanding of what research priorities might be for the longer-term development of credible, quantitative cumulative effects evaluation methodologies for aquatic and marine systems. The authors conclude by providing suggestions and recommendations on how such models can best be developed at this time.

Reviewers' Comments

Reviewer 1

This reviewer felt the literature review on approaches to studying this problem was well done as was the proposal to develop a tool to educate the public on the seriousness of cumulative effects. Nevertheless, he felt the recommendations were peculiar and out of place in a PSARC document and the conclusions unsupportable. In addition, the urgent requirements of habitat/ocean managers receive little attention, thus the authors are unable to offer little credible advice to DFO. This reviewer felt the myriad of useful information should be refocused to make this working paper a more useful contribution.

Reviewer 2

This reviewer felt the purpose of the working paper is not clearly stated, and was unsure if the literature review was adequate. He agreed with the authors that cumulative effects is a serious issue, hence the request for advice from PSARC. And that the Department, if it's going to proceed, will have to provide adequate funding. As such, the authors should then have outlined a plan on how to get on with the task, and its cost. He suggested the authors use the literature review to conclude a paucity of tools available to habitat managers, and then to outline research and attendant costs that should be undertaken by the Department to provide such tools. To address this serious issue in an *ad hoc* and opportunistic manner will not solve the problem.

Reviewer 3

This reviewer felt the purpose of the working paper is not clearly stated. He suggested the first part of the manuscript, the literature review, is credible and well done, and agreed with their conclusion that the Department is lacking tools to assess cumulative effects. Though he agreed with the authors that certain new technologies should make cumulative effects problems more tractable, he has not seen evidence of this. He went on to point out that our skills at population modeling of fish were inadequate to tackle the more complex

problems inherent in habitat supply-side dynamics. He disagreed with the recommendations, and suggested that DFO begin to tackle the problem of cumulative effects by developing a sound funding proposal; one that has been developed in concert with the habitat/oceans managers. The proposal suggested in the working paper falls short. In addition, the approach should handle uncertainty, be useful in situations where new data are unavailable, and be useful in whole systems rather than on a site-specific basis. The authors should be encouraged to continue, but with a refined focus, and that the monies required should be made available to carry out long-term mechanistic research, desperately needed to unravel the production/habitat linkage.

Subcommittee Discussion

The Subcommittee felt the purpose of the working paper is not clearly stated. The reviewer urged stronger linkages between science personnel and habitat/ocean managers in order to get the latter's requirements prior to embarking on proposal writing. An iterative process is required in order to develop a tractable problem along with the environmental variables to be assessed. There is an urgent need for a solution; a methodology that will provide the best scientific advice possible to the resource managers for this complex problem area. The Subcommittee agreed that cumulative effects is a complex problem and long-standing issue, and that net loss of habitat is occurring when site-specific, single development projects only are considered by ocean/habitat managers. It is imperative that DFO consider the cumulative effects of all developments and works in aquatic ecosystems.

The authors were commended on a solid literature review. Though a variety of approaches were identified (emphasis was placed on freshwater urban and forestry issues), it was obvious scientists and habitat/ocean managers collectively must put boundaries on the problem.

Subcommittee Recommendations

1. The Subcommittee recommended the paper be accepted subject to revision.

2. The Subcommittee recommended that a cross-sectoral team, or task force, is required to set boundaries on the problem, give guidance on the approach to be employed, identify resources required and the sort of tools expected, and evaluate their effectiveness. Science, habitat, and oceans management staff would be the key members of the Task Force.

H00-05: Salmon farm – pinniped interactions in British Columbia: an analysis of predator control, its justification and alternative approaches

G.S. Jamieson and P.F. Olesiuk **Accepted subject to revisions**

Summary

Predator control is widely practiced in most forms of agriculture and aquaculture, including salmonid fish farming. Canada has a process whereby fish farmers can obtain authorization to kill predators, particularly pinnipeds (seals and sea lions), but to date, the details of this process, how it is being used by industry, and alternative measures to minimize the need for such killing have not been scientifically assessed. The authors describe existing Fisheries and Oceans Canada (DFO) policy and culling permit requirements associated with predator control; the impacts marine mammals are having on cultured fish production; the annual, seasonal and spatial pattern of kills; how this pattern is related to the abundance, distribution of haulouts and seasonal movements of pinnipeds; and the availability, effectiveness and use of alternate methodologies to deter pinniped impacts on fish farms. Establishment of Canada's Oceans Act in 1997 gave DFO the mandate for marine ecosystem management. With the recent growth in the coastal eco-tourism industry and the economic value and public interest now associated with pinnipeds, there is a current need for this information. Pinnipeds are near the top of the marine food chain, and although they are not commercially exploited, their continued presence and occurrence in natural ecosystems, at appropriate levels of abundance, are important resource management considerations.

Reviewers' Comments

Reviewer 1

This reviewer felt that the working paper is a detailed, robust and important manuscript, documenting well the state of existing knowledge on marine mammal predation of net pen-farmed salmon. He claimed it provides a balance between industrial economic concerns and the increasing value of the non-consumptive pinniped resource. It is, on the one hand, highly critical of the current state of affairs, while on the other it provides sound research priorities and recommendations to resource managers. It is useful, relevant and comprehensive, though at times long-winded and rambling and thus, polishing and focusing is strongly recommended. He urged the authors to consolidate the biology of all species considered (harbour seals, Steller and California sea lions and salmonids) in the Introduction. The positive role predators play in maintaining biological diversity and productivity in marine ecosystems should be highlighted.

The draft Marine Mammal Regulations will likely have a bearing on this working paper, and if possible, should be reflected in the manuscript.

Finally, the reviewer suggested the environmental impact of Flex Guard (a copper based paint used as a net stiffener, thereby reducing pinniped predation success) be reviewed.

Reviewer 2

This reviewer felt that the working paper should be concerned with only the impact of pinniped culling on their respective population dynamics, not with ethics or morality of killing problem seals/sea lions. Population dynamics represented only a small portion of the assessment and indeed, the authors "…tailored their observations to support this ethical position." Later in the review, this reviewer claimed that non-science information should be deleted, as it was only included to "…fit an agenda."

The reviewer agreed with the authors that harbour seal abundance peaked at historic highs in the 1980s in B.C. waters, which was concurrent with the development of the salmonid farming industry. The reviewer then claimed the authors resorted, incorrectly, to describing local population declines e.g. Broughton Archipelago, to support their concerns regarding the impact of culling. He then suggested the authors misrepresent earlier PSARC data on population abundance figures, and that their observations on population structure do not match the current accepted theory that, "It is unrealistic to expect local population differentiation on a geographic basis the size of the Broughton Archipelago."

Regarding California sea lions, the animals in B.C. are non-breeding males and thus, their removal through culling would only marginally impact the reproductive potential of the population. The reviewer agreed with the working paper authors that the abundance of B.C.-occurring Stellar sea lions has been increasing, therefore, fish farm culling appears not to have seriously impacted population dynamics.

The reviewer took exception to one conclusion that, "There is insufficient scientific evidence to justify the current killing of pinnipeds by fish farmers in British Columbia". He suggested a more scientifically defensible conclusion would be that, "There is no scientific evidence to indicate that killing of pinnipeds by fish farmers in British Columbia has any demonstrable impact on population dynamics of pinnipeds." In addition, he provided a critical overview of each of the working paper Recommendations.

Reviewer 3

This reviewer, a manager directly concerned with pinniped management issues, commended the authors on a timely and well written working paper that provides a most useful set of recommendations for management. He fully supported the manuscript and was most pleased it had been prepared. He pointed out that non-

consumptive aspects of pinniped management such as, eco-tourism, were increasingly becoming more important. He felt the data-gaps were well described and he fully agreed with the suggested need for new and better data. The reviewer agreed with the Chair's suggestion that he work with the authors to remove policy-related material from the manuscript. The reviewer also suggested the title did not match the content of the paper, a concern raised by several Subcommittee members. The authors agreed to develop a new title.

Subcommittee Discussion

Considerable time was spent in addressing the extensive concerns of Reviewer 2. The Subcommittee was satisfied the working paper authors did not have "an agenda" beyond bringing sound science to a review of the Department's current policy of permitting the culling of marine mammals around salmon net pen farms. Members agreed pinniped culling should be assessed in the context of bycatch issues.

The Subcommittee supported the authors contention that harbour seal population numbers had plateaued over the past two decades; the period when salmon farmers were culling seals. The spatial scale of seal population management units relative to their population genetics was extensively discussed. The authors exhibited data showing harbour seal populations with genetic differentiation over a small spatial scale: animals on a small island off Kodiak Island, Alaska, were genetically different to those from areas around Kodiak Island. As well, the authors, using PSARC-reviewed data, showed evidence of a decrease, between 1989 and 1996, in harbour seal abundance estimates (down 16 % of baseline) in B.C.'s Broughton Archipelago. This brackets the expansion period for fish farming in the Archipelago. The Subcommittee agreed, there was an unresolved problem, that of reconciling pinniped management units with sampling scales and population genetics. More research is needed on these topics.

The Subcommittee was satisfied the authors' estimates of the number of salmon taken from the farms by pinnipeds was appropriate given the ambiquous data in the literature i.e. 1 % from one source; 6 % from another, all of which had large error terms. The Subcommittee agreed, more work will be required to develop a precise estimate.

The Subcommittee noted the authors' rebuttal that only non-breeding male California sea lions were present in B.C. waters (about 3,000 arrive and depart annually), and hence were not significant to the west coast of North America's population of ~200,000 animals. The authors used a scientifically accepted method (published in the US literature) on estimating population impact. They also pointed out that this transboundary, migratory species should be managed in the same manner as other such species; i.e. crabs, salmon, hake, etc; that is, on their own ecological merit, using the precautionary principle.

While ecosystem management and pinniped ecology was a major conceptual thrust by the authors, they had not provided the appropriate context for it. Several Subcommittee members agreed, and also pointed out that pinniped management should also be viewed in an Integrated Management context vis-a-vis Oceans Act concerns.

It was agreed, the text and the attendant recommendations pertaining to policy be deleted from the manuscript, and that improved data collection procedures and audit processes be implemented, along with a predation control plan for each farm. More serious efforts are also needed to collect biological data from all culled animals, and that analysis of the sample backlog be undertaken.

Subcommittee Recommendations

1. That the Working Paper be accepted subject to revisions.

2. That pinniped population estimates of abundance and distribution be developed prior to farms being located in an area, and that farm siting guidelines, relative to pinniped haul out locations, be reviewed.

3. That the extent of salmon losses attributable to pinnipeds be documented, including geographic location of farm site, and date of losses along with circumstances related to losses

4. That the ecological impact of Flex Guard (a copper-based paint used to stiffen salmon farm nets in an attempt to reduce pinniped predation) be assessed.

H00-06: Structure of yelloweye rockfish (*Sebastes ruberrimus*) populations in British Columbia

K.L. Yamanaka, R.E. Withler and K.M. Miller **Accepted subject to revisions**

Summary

Yelloweye rockfish in British Columbia from northern Vancouver Island to the Queen Charlotte Islands and Bowie Seamount form a genetically homogeneous population or metapopulation that could be considered a single evolutionary significant unit (ESU). Although genetic population analyses of yelloweye rockfish indicate a spatial scale that covers the entire coast of B.C., management strategy should focus on mitigating harvest impacts on a local population scale.

Bowie Seamount most likely receives coastally derived yelloweye rockfish larvae through ocean transport mechanisms such as the Haida Eddy. The relative importance of larval immigration and local reproduction and recruitment to yelloweye population biomass on Bowie is not known, but sufficient larval immigration occurs to prevent genetic differentiation between the yelloweye at

Bowie Seamount and coastal regions.

Past harvests are detectable in spatially discrete yelloweye rockfish populations. Local populations of yelloweye rockfish will declined under fishing pressure when total mortality Z (F+M) is not balanced by recruitment. Bowie Seamount has proved invaluable for scientific study of yelloweye rockfish as these populations have seen little fishing pressure. Population parameters determined from these rockfish provide important unfished reference points with which the fished coastal populations can be compared.

Reviewers' Comments

Reviewer 1

This reviewer, a geneticist, felt this analysis of yelloweye rockfish genetic variation, along with life history and ecological data from most of coastal B.C. and offshore, including Bowie Seamount, to be very well written, presented in a clear fashion and with appropriate Tables, Figures and References: In short, an excellent working paper. The major conclusion that this species in B.C. waters belongs to a panmictic population is striking. It provides a significant contribution to our understanding of rockfish populations in particular, and marine fish population dynamics in general. If, as suggested, Bowie Seamount fish are recruited by larval drift via the Haida Eddy from coastal broodstock, then caution should be used in using Bowie Seamount fish as a "pristine" reference population. Work is required to confirm source of recruitment at Bowie Seamount. A more ideal reference group would be one that is a "source" rather than a "sink ", but it may be difficult to locate in heavily fished coastal areas. Of importance is the observation that though heavily fished, the coastal genetic structure appears not to have been altered. This reviewer urged further studies in areas such as Georgia Basin where population differentiation may have occurred due to different larval dispersal/recruitment patterns. The color morphs discovered on Bowie Seamount require further work to discern if it is a phenecotype or genoecotype.

The reviewer noted that though the chances are slight, the fish at both Bowie and the other collection sights could be distinct populations despite genetic evidence to the contrary. This is based on the potential for the forces that generated and subsequently maintained the observed genetic variation to have been initially partitioned into each population.

The advice to fish managers, that management be done at the local geographic level, is sound if indeed this is one population. This is based on the hypothesis that refugia stocks will provide recruits if recruitment overharvesting occurs locally. If certain local groups are intensively fished, the refugia stock numbers may be indirectly affected, however.

Reviewer 2

This reviewer, a groundfish fisheries biologist, note the working paper authors' conclude that yelloweye rockfish from the Queen Charlotte Islands south to northern Vancouver Island and Bowie Seamount form a genetically homogenous population, and that their recommendations following from this conclusion are as follows:

1. That fisheries managers focus on mitigating local depletions of yelloweye;
2. That Bowie Seamount stock be preserved as a "pristine" reference population for ecosystem and habitat work; and that
3. This same stock serve as a "control" to permit an understanding of fishery and environmental effects that occur in more coastal stocks.

Though this reviewer suggested the prime conclusion is likely sound based on complex genetic analysis, he confessed to having had difficulty understanding the genetic analyses, and therefore recommended the authors develop a "microsatellite DNA guide for non-specialists". As well, he had trouble discerning which data were subjected to statistical procedures in Section 4.1 of the working paper and thus, was left wondering if the statistical methodologies used were appropriate. For example, he pleaded for a mathematical definition of both "Nei's distance" and "F_{ST}". He pointed out that in Section 7 of the working paper, the genetic homogeneity conclusion be restricted to areas sampled (see above) and not extrapolate to Queen Charlotte Sound, Strait of Georgia and SW Vancouver Island; areas not sampled nor included in the analysis. In addition, the fishing history of the Bowie Seamount yelloweye stock along with local habitat conditions be provided to allow the reader to critically assess the correctness of the third recommendation above.

The reviewer recommended that if the working paper is to be revised that it concentrate on the stock assessment/fisheries management aspects and leave the issue of Bowie Seamount stock conservation and specifically the Oceans Strategy and "No Take" MPAs Sections to a future working paper.

Subcommittee Discussion

The Subcommittee agreed with the authors' prime conclusion that within the geographic area sampled there is but a single population, though they agreed with the authors that further studies are required to differentiate between larval "source" and "sink" stocks. Physical oceanographic data are insufficient to conclude retention for Bowie Seamount pelagic larvae as is present around the Bermuda Seamount. The authors, despite inconclusive evidence, urged for protection of Bowie Seamount stock. She noted the minimum age of fish sampled is 20 year, thus loss of genetic diversity may not be detected in time to allow for its conservation. She also agreed, the stock may not be "pristine" (there may have been significant fishing pressure in the distant past from foreign fleets),

but, based on fishing mortality data from most B.C. waters, the Seamount stock is the closest to pristine that exists. There was concern expressed that preserving Bowie Seamount stock to assist with interpretation of coastal stocks may be inappropriate because Seamount and coastal ecological conditions are likely quite different. In addition, might there not be a panmictic North American population from Mexico to Alaska? If this were this the case, would there not be need for coast-long corridor? There was some debate regarding the strategy Pacific Region might take regarding yelloweye rockfish; if the goal is to merely conserve the population it was suggested that a fishing closure would be simpler and more efficient to implement than a marine protected area (MPA), particularly a MPA the size of Bowie Seamount.

The Subcommittee agreed with Reviewer 2 that exploitation data are required before it can be concluded that fishing pressure is indeed low on Bowie Seamount. The catch curve analysis suggests a low exploitation rate, but a direct estimate of exploitation rate is difficult without abundance/biomass data. Given that the dark/bright phenotypes are believed to be an age elicited response, active management would be required to preserve the two phenotypes.

The authors agreed to clarify, within an appendix, the genetic and statistical techniques employed as well as adding a paragraph in the text on "…average migrants per generation."

The bimodal distribution of Bowie Seamount yelloweye rockfish recruitment pulses should be compared with temporal aspects of the Haida Eddy with the view of nullifying the hypothesis that the Eddy is the recruitment source.

The Subcommittee concluded that: 1) the Bowie Seamount yelloweye rockfish population is not genetically unique; 2) we do not yet know if the Seamount stock is a larval "source" or "sink" (likely a sink) and 3) that without biomass data it is premature to advise on whether current exploitation rates are sustainable.

Subcommittee Recommendations

1. The paper be accepted, subject to minor revisions.

2. That fishery managers take note that yelloweye rockfish in the study area (from the Queen Charlotte Islands south to northern Vancouver Island) can be considered a single genetic population, with the caveate that we do not understand whether individual stocks are larval "sources" or "sinks".

3. That Bowie Seamount, as a proposed MPA, would be an excellent location to study a near-pristine (lightly exploited) yelloweye rockfish stock .

Emerging Issue: Critical size and critical period an emerging issue in the management of Pacific salmon.

R. Beamish and C. Mahnken

Summary

A presentation was made to raise awareness of the importance of considering ocean habitat in the management of Pacific salmon. A theory on the natural regulation of Pacific salmon abundance was proposed. It is hypothesized that two stages of early marine mortality determine brood year strength. The first is the well-know predation-based mortality, while the second, the critical-size-critical-period mortality, that is related to the amount of first-summer/fall growth. Specifically, if salmon do not attain a particular size going into their first oceanic winter, they will die. If this hypothesis is correct, it means the numbers of hatchery and wild salmon entering the ocean need to be balanced with the marine habitat carrying capacity. The fisheries management implications are that the state of the ocean habitat affects total returns through intra- and inter-specific competition. The state-of-the-ocean habitat is related to atmospheric and ocean processes that can usually be indexed on decadal scales.

Subcommittee Discussion

The Subcommittee noted that at this time, there was no management advice associated with this presentation. The Subcommittee also noted that this is work in progress. The Subcommittee recommended that the authors more fully utilize all available information to test their ideas.

The Subcommittee noted that there are two potential emerging issues. The first is the possibility of providing an additional forecasting tool for predicting adult salmon returns. The second is the possibility that density dependent mortality may occur in the marine environment during unfavourable climate regimes.

Appendix 1: PSARC Habitat Working Papers and Reviewers for December 2000.

No.	Title	Author
H00-04	Cumulative effects assessments: an evaluation of DFO science research options	G.S. Jamieson L. Chew
H00-05	Salmon farm – pinniped interactions in British Columbia: an analysis of predator control, its justification and alternative approaches	G.S. Jamieson P.F. Olesiuk
H00-06	Structure of yelloweye rockfish (*Sebastes ruberrimus*) populations in British Columbia	L. Yamanaka R. Withler K.M. Miller

Reviewers

Reviewers for the PSARC papers presented at this meeting are listed below, in alphabetical order. Their assistance is invaluable in making the PSARC process work.

Reviewers	Association
Beacham, T.	DFO, Science
Devlin, R.	DFO, Science
Holtby, B.	DFO, Science
Kronlund, A.R.	DFO, Science
Lochbaum, E.	DFO, Management
MacDonald, B.	DFO, Habitat and Enhancement
Minns, K.	DFO, Science
Ross, P.	DFO, Science

Appendix 2:PSARC Habitat Subcommittee Meeting Agenda, December 2000

DRAFT PSARC Habitat Agenda
December 12-13, 2000
Institute of Ocean Sciences
Milne Boardroom
09:30 start on Dec 12
09:00 start on Dec 13

1. Review Agenda

2. Review minutes of August meeting

3. "Fisheries management implications of natural regulation of salmon abundance." Richard Beamish and Connie Mahnken

4. Review WP #H00-04, "Cumulative effects assessments: an evaluation of DFO science research options." Glen Jamieson and Luanne Chew

5. Review WP #H00-05, "Salmon farm - pinniped interactions in British Columbia: an analysis of predator control, its justification and alternative approaches." Glen Jamieson and Peter Olesiuk

6. Review WP #H00-06, "Population Structure of Yelloweye Rockfish (*Sebastes ruberrimus*) in British Columbia." Lynne Yamanaka, Ruth Withler and K.M.. Miller

7. Introduce new Subcommittee Chair

8. Tentative agenda for June meeting

Appendix 3: Participants at Habitat Subcommittee Meeting, December 2000.

John Pringle Habitat Subcommittee Chair
Max Stocker PSARC Chair

DFO Participants	Association
*Subcommittee Members	
Beamish, R.	DFO, Science
Chew, L.	DFO, MEHSD
Dixon, S.	DFO, MEHSD
Ennis, G.*	DFO, Habitat and Enhancement Branch
Foreman, M.*	DFO, OSAP
Gallagher, L.	DFO, MEHSD
Hume, J.*	DFO, Science
Jamieson G. *	DFO, MEHSD
Lauzier, R. *	DFO, Stock Assessment Division
Levings, C. *	DFO, MEHSD
Lochbaum, E.	DFO, Fish Management
MacConnachie, S.	DFO, Oceans
Olesiuk, P.	DFO, MEHSD
Samis, S. *	DFO, Habitat and Enhancement Branch
Yeon, I.	DFO, MEHSD

External Participants

Name	Association
Beckman, B.	National Marine Fisheries Service, USA
Dickhoff, W.	National Marine Fisheries Service, USA
Fraker, M.	TerraMar Environment Research Ltd.
Johnston, T.*	B.C. Ministry of Fisheries
Mahnken, C.	National Marine Fisheries Service, USA

Observers

Name	Association
Migneault, J.	Stolt Sea Farm