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Report of the PSARC Invertebrate Subcommittee Meeting June 7-10, 1999

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INVERTEBRATE

SUMMARY

The PSARC Invertebrate Subcommittee met June 7-11, 1999 at the Pacific Biological Station in Nanaimo. The Subcommittee reviewed eight Working Papers and ten Fishery Updates.

Working Papers I99-9, I99-10, I99-12: Phase 0 Assessments

Three working papers representing Phase 0 assessments were completed for four species: Purple sea urchin (I99-9), box crab (I99-10) and pink and spiny scallops (I99-12). These working papers represent the preliminary phase to assemble all available information on the biology of the target species, and similar species, related to the scientific information requirements for precautionary management strategies (Perry 1996).

The Subcommittee agreed that purple sea urchins are vulnerable to over-exploitation given their biological characteristics: long-lived, slow growth, low abundance, and sporadic recruitment. The Subcommittee recommended continuation of the phased approach in any further development of the purple sea urchin fishery.

The Subcommittee recommended that any further development of the box crab fishery follow the phased approach. The Subcommittee noted that there is very little information available for box crab and that extensive biological information is required in any proposed phase 1 assessment. The Subcommittee recommended that if a phase 1 assessment is undertaken, that bycatch in the prawn fishery be considered as a possible data source.

The Subcommittee recommended that a precautionary approach be applied when considering continuing with the scallop trawl fishery. The trawl fishery should only proceed under the conditions of the phased approach, guided by the policies for new and developing fisheries and in the context of policies presently being developed for selective fishing practices; and that the phased approach be applied to the dive fishery.

Working Paper I99-11: Sea Cucumber phase 1 fishery progress report

This paper was a progress report following the second year of an adaptive management regime in the sea cucumber fishery. The Subcommittee recommended that investigations into alternative methods for sampling contagiously-distributed benthic organisms with patchy distributions be pursued.

Working Paper I99-13: Assessment of bycatch in the 1997 and 1998 shrimp trawl fisheries in British Columbia, with emphasis on eulachons

The Subcommittee recognized this work as being important and an integral part of new selective fishing policies and practices. The Subcommittee recommended that bycatch monitoring be continued and that methodology on estimating bycatch be refined. The Subcommittee recommended that bycatch of eulachon and other species be reduced from the 1997-98 levels. Due to the stock concerns for eulachon, the level of bycatch should be minimized and the stock status of eulachon be reviewed by the Pelagic Subcommittee.

The Subcommittee recommended that a working group of assessment staff and managers from groundfish and invertebrate sections should examine bycatch from the groundfish fisheries and other sources.

Working Paper I99-14: Scientific concepts for ecosystem-based management of marine invertebrates on Canada's Pacific coast

The Subcommittee found this to be a very timely contribution. The Subcommittee recommended that the ecosystem approach be further investigated through application on appropriate test cases, and that ecosystem management considerations be included in Stock Status Reports and Integrated Fisheries Management Plans.

Working Paper I99-15: Discussion on a precautionary approach for management of the red sea urchin fishery in British Columbia

The paper represented the start to a serious evaluation of the red sea urchin fishery.

Working Paper I99-16: Status of the Olympia oyster, *Ostrea conchaphila*, in Canada

This report was prepared as a status report for submission to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The Subcommittee felt the paper represented a thorough review of the scientific information available on Olympia oysters for the COSEWIC's future designation on the status of the species.

Fishery Updates

Fisheries Management staff, in consultation with Conservation and Protection and the Stock Assessment Division, prepare fishery updates. The updates provide summaries of commercial fishery performance, including significant management, enforcement, and stock assessment activities on an annual basis. The updates provide the opportunity to identify high priority issues that affect assessments and conservation concerns.

The following Fishery Updates were presented:

- Sea cucumber
- Squid
- Geoduck
- Green sea urchin
- Scallop
- Octopus
- Horse clam
- Crab
- Intertidal clam
- Razor clam

INTRODUCTION

The Subcommittee Chair opened the meeting welcoming the participants. During the introductory remarks the objectives of the meeting were reviewed, and the Subcommittee accepted the meeting agenda (Appendix 1). The Subcommittee reviewed eight working papers (Appendix 2) and 10 Fishery Updates.

A number of external participants and observers attended: Mike Featherstone, (President, Pacific Urchin Harvesters Association) attended as an external participant for the meeting. Lorne Clayton (facilitator, Pacific Coast Shrimpers' Cooperative Association) attended the presentation of working paper I99-13 as an external participant. The following attended as observers: Walter Carey and Robert Stickney attended for working paper I99-9. Chris Peterson (Box Crab and Whelk Association) attended for working paper I99-10. Debra Logan (B.C. Beam Trawlers Association) attended for working paper I99-13. Scott Wiebe attended for working paper I99-12. A list of meeting participants is included as Appendix 3.

GENERAL SUBCOMMITTEE CONCERNS

The Subcommittee discussed issues of general concern to the management and assessment of shellfish in British Columbia.

The Subcommittee had concerns regarding the quality of data (catch data in particular) for a number of fisheries and recognized the efforts made by the Best Estimate of Catch Subcommittee of the Shellfish Working Group to resolve some of these problems. In many cases however, the lack of resources hampered progress.

The demands for precautionary approach, ecosystem management and selective fishing, combined with the reduction in departmental resources and the lack of priority for invertebrates in the region, has resulted in problems with meeting objectives.

Assessment and management have attempted to implement the phased precautionary approach in dealing with data limited fisheries. Concern was expressed over the lack of strategy to integrate existing data-limited fisheries (i.e. scallop dive, scallop trawl, opal squid, octopus dive) into the phased approach. Conservation concerns have been identified in the scallop fisheries and the lack of effort controls, in general, is a significant concern.

There have been a number of phase 0 reports completed which provide literature reviews and identification of data shortfalls. There is, however, a need to develop a process to prioritize the development of candidate species. Should resources be dedicated to existing data-limited fisheries (i.e. scallop, octopus, squid) prior to developing new fisheries? There is currently no process to prioritize which species should proceed to phase 1 assessments.

Concern was raised that many of the fisheries have access to almost 100% of the coast. A common theme of working papers and fishery updates was the need for refugia (no-harvest areas) and the consideration of rotational fisheries. The need for large experimental management areas (i.e. 25% of the estimated total red sea urchin beds) were also identified. Goals and objectives for refugia are required. These should include ecosystem considerations and multi-species interactions, and should not be exclusive to commercially-harvested invertebrates

Harvest logs need to be geo-referenced in those fisheries where these data are not collected.

WORKING PAPER SUMMARIES, REVIEWS AND DISCUSSION

I99-9 A review of the biology and fisheries for the purple sea urchin (*Stongylocentrotus purpuratus*, Stimpson, 1857) and discussion of the management of a proposed fishery

G. Workman **Accepted subject to revisions**

Summary

This paper has been prepared in accordance with the phased approach to providing scientific advice for new and developing fisheries, as Phase 0. The paper consists of a review of the relevant literature on the biology of *S. purpuratus*, and describes urchin fisheries on the West Coast of North America. Relevant management measures, and their data requirements, that should be applied to any fishery for purple sea urchins are discussed. Interest was first expressed in starting a fishery for this species in the late 1980s. A small experimental fishery ran between 1989 and 1992, when concerns over compliance with the term of the experimental harvest permit and local depletion

led to closure of the fishery. Since 1992, nine proponents have requested a re-opening of the fishery.

Intertidal *S. purpuratus* have been studied extensively in Oregon and California. This species is characterized by long life, (greater than 50 years) patchy distributions, slow and variable growth, low and periodic recruitment, is sedentary and displays density dependant spawning success (Allee Effect). The above characteristics are indicative of a species susceptible to over-exploitation, which in turn dictates a very cautious approach to fisheries development.

Small fisheries for *S. purpuratus* exist in Oregon and California. The fisheries for purple sea urchin are of limited success because of this urchin's small size, variable gonad quality and the harsh conditions under which it must be harvested. Other urchin fisheries on the West Coast of North America include *S. franciscanus*, the giant red sea urchin, which is harvested from South-East Alaska to Baja California, Mexico and *S. droebachiensis*, the green sea urchin, which is harvested from Kodiak, Alaska to Washington state. Red urchin fisheries in Oregon and Northern California have collapsed under excessive fishing pressure, the green sea urchin fishery in British Columbia likewise peaked and declined. These are examples of "Boom and Bust" fisheries where rapid development of a commercial fishery decimates the virgin biomass prior to any assessment of the resource.

Suggested management measures for purple sea urchins include quotas, size limits, seasonal closures, a rotational fishery and limited entry. The data requirement for the first of these measures could be met by an extensive survey and bio-sampling program, the last would be an arbitrary management decision. The data needs identified herein include information on distribution and abundance, as well as, estimates of growth and age for subtidal *S. purpuratus* in B.C. The costs of implementing a survey and bio-sampling program, ongoing enforcement and ongoing management would be substantial and may exceed the landed value of a commercial fishery for purple sea urchins in B.C.

Reviewer #1

Reviewer 1 felt the paper was well organized and addressed all the initial objectives. This reviewer encouraged more discussion on the Allee effects. Reviewer 1 noted that the text was unclear as to whether the management measures proposed were to be initiated concurrently. Potential management measures can now be explored in the Phase 1 collecting new information stage.

Reviewer #2

Reviewer 2 noted that the reference for *S. franciscanus* in Japan was probably an error and that the range of *S. purpuratus* from the literature is probably not to Sitka Alaska. Reviewer 2 suggested that purple sea urchins intertidally probably move very little and also noted that purple sea urchins do use the spine canopy

of conspecifics for protection of juveniles.

This reviewer noted that times-to-settlement referenced in the paper are based on lab work and that the time to settlement in the plankton is unknown. Reviewer 2 clarified that estimates of post settlement mortality and other measured estimates for the life cycles of red sea urchins and purple sea urchins are unknown so the reasons for one being more abundant in certain habitats are unknown. Reviewer 2 also noted that survival trends are better in the north and suggests this is because some diseases have a temperature component.

Subcommittee Discussion

The Subcommittee agreed that purple sea urchins are vulnerable to over exploitation given their biological characteristics: long-lived, slow growth, low abundance, and sporadic recruitment. A precautionary approach needs to be taken to fishery development. Any future fishery should be small, with considerable information collected to properly manage the resource.

The Subcommittee noted that the previous fishery for purple sea urchins in B.C. had enforcement concerns, particularly the illegal harvest of other species such as red sea urchins and abalone.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to revisions.

The Subcommittee recommended continuation on the phased approach, should this species be approved for further consideration of an experimental commercial fishery. Consideration of this species for further fishery development (Phase 1) should be based on its likely needs for Fisheries Management and Conservation and Protection resources, and therefore needs to be ranked against other species also recommended for Phase 1 development.

I99-10 A review of the biology and fisheries of the box crab, (*Lopholithodes foraminatus* Stimpson)

Z.Y. Zhang, G. Workman, A.C. Phillips **Accepted subject to revisions**

Summary

Existing biological and fishery information on box crab and similar species relevant to the potential development of a box crab fishery in British Columbia was synthesized. Information was collected from published books and papers, unpublished reports, discussions with experienced fishermen and biologists, DFO's trawl database, Oregon commercial fishery, and experimental fisheries or surveys in California, Oregon, B.C. and Alaska. A management strategy for this potential fishery is provided based on the collected biological information.

Insufficient data are available on box crabs to develop management strategies.

Reviewer #1

Reviewer 1 felt the paper was successful in addressing the stated objectives of collecting and analyzing existing biological and fishery information on box crab, providing biological information to managers relevant to the consideration of a developmental fishery, and identifying lacking or insufficient information. The reviewer questioned the fourth objective stated in the paper, “to recommend possible management strategies for this potential fishery”.

The reviewer noted that significant reference is made to a limited data set of three years of groundfish trawl observer data, but the use of that data includes a troubling assumption that all reported bycatch of *Lopoholithodes* was box crab when it may also have included Puget Sound king crab. This assumption affects the discussion of an abundance index described later in the report. The paper suggests that there are populations of box crab on the West Coast of Vancouver Island occurring at much greater depths than reported in the literature. Reviewer 1 also questioned the reliability of the crab identifications made by groundfish trawl observers.

Reviewer 1 noted that information about box crab habitat and movement is largely anecdotal, as is the information about moulting presented in the report. Information about feeding behaviour and prey items appears to be opinion based without substantiating data. Reviewer 1 felt the discussion about predators was conjectural, depending on co-occurrence of species in groundfish trawl catches.

Reviewer 1 challenged the development of an abundance index without further definition of the true habitat that box crab use.

Reviewer 1 requested further information regarding the fisheries surveys for the commercial fishery in Oregon, the experimental survey in Oregon, the experimental fishery in California, and the two previous experimental fishing attempts in B.C. waters.

Reviewer 1 noted that the summary suggests that the incidence of box crab occurrence appears to be increasing from 1996 to 1998 but felt there was an insufficient time and sample series on which to make this suggestion.

Reviewer 1 suggested that the authors indicate what information needs to be collected in support of various management strategies rather than make recommendations on specific management measures. Reviewer 1 also noted the authors presuppose that there will be a Phase I assessment.

This reviewer felt that the discussion does not satisfactorily describe the data that could be provided by a fishery independent survey.

It was Reviewer 1's closing opinion that there was insufficient discussion on the potential bycatch issues and potential for conflict with other fisheries. There was insufficient discussion of the likely sustainability of a fishery on this species, either based on the fisheries for this species in other jurisdictions, or in comparison to fisheries on other deep water crabs. The Alaska experience with boom and bust fisheries on deepwater crabs may serve as a point of comparison. The absence of age information for box crab is viewed as a serious deficiency that lacks emphasis in the phase 0 paper.

Reviewer #2

Reviewer 2 suggested that the possibility of two box crab populations at different depths may be resolved by using current DNA analytical techniques. Reviewer 2 noted that although we know that male box crabs grow bigger than females, without the means to tag or age box crabs properly we have no way of knowing if they grow faster. The second reviewer also suggested the authors qualify the estimates of fecundity to consider the small sample size (4) and also questioned the use of 80% in developing an estimate of abundance.

Subcommittee Discussion

The author was commended for developing a paper for a species where very little information exists. The Subcommittee noted that requests for box crab fisheries development have been for near shore areas whereas the limited existing catch data in B.C. is almost exclusively from offshore trawl fisheries. The Subcommittee was concerned that the groundfish trawl observer data may be inaccurate for box crab due to problems with species identification and noted that the data should be used with caution. They noted that the range of box crab extends into habitat where trawling does not occur as evident by box crab bycatch in the prawn trap fishery.

The Subcommittee recognized the serious data deficiencies on the distribution and basic biology for the species and noted that any phase 1 work will have to be much more extensive in its scope than for other species. The Subcommittee noted the need to collect and review more information before a particular management strategy can be discussed. For example, size and sex restrictions may not be appropriate for box crab if discard mortalities are as high as in other deepwater crab fisheries.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to revisions.

The Subcommittee recommended that any further development of the fishery follow the phased approach.

The Subcommittee recommended that if a phase 1 assessment is undertaken,

the shrimp (prawn) trap logbook could be modified to collect data on box crabs taken as bycatch.

I99-11 Sea cucumber phase 1 fishery progress report

C.M Hand and J. Rogers **Accepted subject to revisions**

Summary

This paper provides a progress report following the implementation of an adaptive management regime in 1997 in the sea cucumber fishery. The information being collected in this phase 1 fishery includes population abundance estimates from transect surveys, exploitation-rate effects from experimental fisheries, recovery from small-scale depletion from removal experiments, and size distribution from biological samples. Methods and results from programs underway are described.

Density estimates from transect surveys, in number of animals per metre of shoreline, varied from 2.6 in Laredo Inlet (PFMA 6) to 13.6 in the Bella Bella area (PFMA 7). The precision of estimates was also variable, from plus or minus 60% in the Gulf Islands (PFMA 17) to 12% in Tolmie Channel (PFMA 6). Results from repeat surveys were consistent in Jervis Inlet (PFMA 16) but varied by 40% between surveys in both Tolmie Channel and Laredo Inlet.

Aspects of survey and experimental fishery results are discussed in relation to factors, such as spatial variation in sea cucumber productivity and migration behavior, that affect the variability and reliability of the data. Recommendations for further research includes studies to monitor the seasonal distribution of sea cucumber populations, and the development of a time-series of recruitment indices in selected habitats and areas of the coast.

Reviewer #1

Reviewer 1's comments were brief, but included suggestions for discussion of Washington and Alaska findings and a discussion of the scientific literature on sea cucumbers such as migration, life history and patchiness in relation to feeding opportunity.

Reviewer #2

Reviewer 2 agreed that the management parameters which control the sea cucumber fishery in British Columbia are very conservative. This reviewer noted the similarities between management approached in B.C. and Alaska with the observation that the response by cucumber populations to harvest cycles in southeast Alaska was mixed, some increasing, some decreasing and some

showing no change. Like B.C., localized depletions were also a concern in Alaska.

Reviewer 2 suggested using a systematic or random selection of areas to be surveyed so that more areas can be accessed, and a better understanding of the spatial distribution, size composition and abundance in the total area open to harvest could be understood.

Reviewer 2 suspected that the most accurate estimates of abundance are obtained with a systematic sample design and random starting point rather than a two stage random sample design.

Reviewer 2 questioned whether sea cucumbers could migrate or be passively carried from one experimental area to another, noting large and unexplained changes in abundance's in some areas.

Subcommittee Discussion

The Subcommittee commended this as a progress report of phase 1 experimental fishing.

The Subcommittee discussed the survey methodology with respect to sampling aggregated, patchily distributed, benthic organisms. The Subcommittee suggested further documentation of the survey design and the rationale for its use. In addition, the working paper should detail how the current individual quota fishery is modified through the survey results.

The Subcommittee agreed that all survey designs and methodology used in estimating stock abundance are to be reviewed by PSARC prior to utilizing the technique to develop stock estimates, however, there was disagreement on whether biomass estimates or stock density estimates developed for management plans using PSARC approved methods required PSARC review for all subsequent assessments.

The Subcommittee discussed the choice of systematic versus random sampling techniques in comparison to those used in Alaska and supported the approach used in the paper.

The Subcommittee agreed with the recommendations presented in the paper to:

1) Initiate study areas to determine seasonal migration patterns possibly including tagging studies;
2) Develop methods for obtaining indices of larval settlement and juvenile survival, possibly using spat collectors at existing aquaculture sites;
3) Investigate the spatial scale of stocks using DNA studies; and
4) Investigate the potential for localized enhancement of depleted areas.

The Subcommittee noted that these recommendations for further study would be subject to funding and logistics. The investigation of migration patterns is the

highest priority, while other recommendations form part of the long-term (10 years) objectives of the phase 1 fishery.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to revisions.

The Subcommittee recommended future work on sampling design for benthic organisms, especially those with patchy distributions.

I99-12 A review of the biology and fisheries of the pink scallop and spiny scallop

R.B. Lauzier and G. Parker **Accepted subject to revisions.**

Summary

A review of the biology of pink and spiny scallops is presented, based on scientific literature, previous surveys and technical reports. There are considerable differences in the growth characteristics, growth rates, maximum size and reproductive characteristics between the two species. Spiny scallops are faster growing and reach a larger maximum size than pink scallops. Spiny scallops also have a considerable higher reproductive effort in comparison to pink scallops. Spawning in each species occurs at different times.

A review of the scallop fisheries in British Columbia is presented. There has been a commercial fishery since 1982. There are two fisheries for pink and spiny scallops in British Columbia, a dive fishery and a small trawl fishery. The dive fishery has landed 85% of the total cumulative landings. There is presently unlimited entry in both fisheries. Over the past six years, there are 2-3 times more licences issued in the dive fishery than there are licences with reported landings, and in the trawl fishery there are 5-10 times more licences issued than there are licences with reported landings. There is evidence of declining effort in the trawl fishery in recent years, with concurrent increasing effort in the dive fishery. There is also evidence of localized stock depletion in some areas, which has resulted in closures.

Present management controls include a minimum size limit of 55 mm shell height for both species, numerous small closures in parks and study areas, and a maximum width of 2 m in the trawl. The two species are being managed as one species, one stock.

Information shortfalls are identified including: trawl effects on co-occurring species, habitat, or bycatch, or size selectivity; stock status and delineation; and basic biological parameters such as biomass, recruitment and mortality. The present management system is not appropriate for this fishery. The only monitoring systems in place are harvest logs and sales slips, with a calculation of

catch per unit effort (CPUE). This is not adequate for stock assessment requirements in order to implement a risk averse management system. Recommendations for additional information requirements for stock assessments and management plans are given.

Reviewer #1

Reviewer 1 complimented the authors on a thorough review of the biology of pink and spiny scallops fisheries in British Columbia. However, this reviewer felt the review of fisheries for the species elsewhere was incomplete and suggested more discussion of related fisheries, experimental fisheries in Washington and their assessment and management. Reviewer 1 noted that a more thorough review might yield information regarding which management tactics have been successful or unsuccessful elsewhere.

Reviewer 1 felt the section on biological objectives was too general and suggested the authors introduce biologically based management objectives for scallops.

Reviewer 1 noted the inherent refuge provided by dive fisheries because of the limited depth that divers could effectively fish. This reviewer also pointed out that the dive fishery is more selective with less risk of overexploitation and no risk of habitat destruction.

This reviewer detailed the numerous concerns with the trawl fishery for scallops with respect to gear selectivity; quantity, identity and fate of bycatch; fate of animals captured but not retained by trawl gear (mesh selectivity); and collateral effects on non-target species and habitat. Reviewer 1 noted that trawls are limited only by bottom configuration, not by depth as with divers and that size limits will be of little use in trawl fisheries unless the fate of discards is known. Reviewer 1 questioned whether it was realistic to expect that the cost of a habitat assessment could be economically supported by the trawl sector of the fishery given it's small value (<$50,000 annually).

Reviewer 1 felt that any assessment of the size limit for scallops should be based on reproductive potential, not size at first maturity, so that a size limit could be selected that only reduces egg production by an acceptable level. The reviewer noted that in most bivalves, fecundity increases with size and recruitment is not constant.

This reviewer also noted that although refugia are an attractive option, it would be expensive to do the required exploratory assessments to ensure that areas of significant abundance are closed. Reviewer 1 clarified that the number, size and arrangement of refuges to adequately protect significant portions of the stock will require better understanding of production, dispersal and recruitment characteristics of scallop stocks. This reviewer also suggested further discussion of the recommendation to limit the fishery to currently exploited area.

Reviewer 1 suggested that initiation of exploratory fishing or assessments to expand the fishery wait the results of experimental management in the core areas of the fishery.

Reviewer 1 noted that repeating market samples collected in 1986 would be a relatively inexpensive way to collect biological information on changes among the areas fished. The use of management areas may not be appropriate for comparing catch and effort since scallops occur in distinct beds.

Reviewer #2

Reviewer 2 felt the document was fairly complete but identified two areas in the paper that required further development: the negative effects of scallop gear on scallops and the environment and the rotational fishery option.

This reviewer noted that the document evaluates the fisheries potential of species after the fishery had begun and that the fishery has no management strategy or targets. Reviewer 2 expressed concern that it may be impossible to reverse the momentum to create short term jobs and that political interference may prevent the establishment of a sustainable fishery that conserves both the immediate resource (scallops) and the habitat that is used by a host of other species. Reviewer 2 pointed out that this paper may be the only chance scientists will have to influence how the fishery develops.

Reviewer 2 noted that several important lessons have been learned (again) in the East Coast scallop fisheries, which are:

1) Effort must be tightly controlled from the beginning.
2) Dredging and bottom trawling for scallops are very destructive to both the habitat and those animals hit by the dredge or trawl (target species and non-target species).
3) Rotating fisheries are likely the only means of sustainably harvesting sessile species such as bivalves.

Reviewer 2 suggested that this document, which represents the first step at preventing the fisheries disasters seen elsewhere, appears to be several years late and noted that this is the first evaluation for a fishery that is 16 years old.

Reviewer 2 contended that the trawl and dredge fisheries for scallops should be discontinued. The reviewer cites the selectivity issues raised by Reviewer 1 above and provided 18 references on dredging and trawling effects with the conclusion that the mobile gear will destroy the fishery and the habitat.

Reviewer 2 agreed that a comprehensive resource survey should be the highest priority for this fishery and concluded that if the resources to properly study and

control the development of the scallop fishery are not present, the fishery should cease.

Subcommittee Discussion

The Subcommittee noted that there is insufficient information about abundance and distribution of pink and spiny scallops in British Columbia.

The Subcommittee felt that although an exhaustive review of the East Coast and American scallop fisheries was not required in the paper, the revisions should include descriptions of how these fisheries and gear types differ from the trawl fishery for pink and spiny scallops and that a review of the management and assessment of these fisheries would be useful. The Subcommittee noted that although West Coast scallop trawl gear is likely less intrusive than dredge and drag gear used on the East Coast of Canada and elsewhere, the habitat impacts, the bycatch characteristics, the size selectivity, and the fate of discards have not been assessed.

The Subcommittee discussed that a habitat assessment of the trawl fishery would likely cost many times the total annual landed value of the trawl fishery, which has been less than $30,000 for the last three years. The Subcommittee felt that it was unlikely that the trawl fishery could meet the requirements for continuation of the fishery either biologically through the phased approach or economically to fund the necessary assessment and management programs.

The Subcommittee noted that the dive fishery has no associated habitat destruction and is size selective but there is evidence of localized stock depletions in the dive fishery. The dive fishery is not species selective as divers find it difficult to sort pink from spiny scallops at depth due to sponge encrustation. Most (80 to 90%) of the harvest is spiny scallops.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to revisions.

The Subcommittee recommended:

1) A precautionary approach be applied in consideration of continuing the trawl fishery. The trawl fishery should only proceed under the conditions of the phased approach, guided by the policies for new and developing fisheries and in the context of policies presently being developed for selective fishing practices;
2) The phased approach be applied to the dive fishery;
3) Georeferencing be introduced as a requirement on harvest logs.

I99-13 Assessment of bycatch in the 1997 and 1998 shrimp trawl fisheries in British Columbia, with emphasis on eulachons

D.E. Hay, R. Harbo, J. Boutillier, E. Wylie, L. Convey, P.B. McCarter
Accepted subject to revisions.

Summary

A coast-wide observer program to determine the composition of catches in shrimp trawls in British Columbia started in 1997. The objective was to sample catches approximately according to the fishing effort, season, area and type of gear. This report presents the results for all bycatch species for both years, 1997 and 1998, but the emphasis is on the bycatch of an anadromous smelt *(Osmeridae*), the eulachon (*Thaleichthys pacificus*), for which there is a potential conservation concern in many areas of the B.C. coast.

There are relatively few eulachon populations, perhaps 15 in B.C. and only 30-40 throughout the entire range, from California to Alaska. Nearly all populations in the south have declined sharply in recent years. The paper describes eulachon bycatch from the two major fishing gears (otter trawl and beam trawl) from different areas of the coast and provides comment on the bycatch of other species.

The paper presents two methods for estimating eulachon bycatch. One is a *catch proportion* or 'CP' method, based on the relative proportion of eulachons to shrimp in the catches. This method is applicable only for eulachons. It was used for in-season monitoring of eulachon catches in 1997 and 1998. In this paper, it was shown that CP estimates based on the means of individual tows (MCP or 'mean catch proportion') overestimates bycatch. CP estimates based on the cumulative total eulachon and shrimp catches (PCP), summed over an aggregate of time or space (i.e. a shrimp management area) are preferable, but still not wholly satisfactory. A better method for estimating bycatch uses *catch rate* data (i.e., kg of catch per hour) multiplied by the number of hours fished. This approach is the main one used for most other bycatch studies. A limitation of this approach for eulachons, however, is that data on total fishing effort (hours fished) are not available or complete until the end of the fishing season.

The working paper refers to bycatch estimates based on catch rates (in kg/h), as CR estimates. CR estimates can be calculated as the means of individual tows (MCR**)** or for some aggregate of time of space (PCR or 'pooled catch rate') which is the estimate of kg/h based on the sum of cumulative weight of the catch divided by the cumulative fishing time. The analyses indicated that CR estimates are less variable and more consistent than CP estimate, reasons for this are discussed.

There are two main fishing gears used: beam and otter trawls. The numbers of tows examined by year and gear type are as follows:

1997 Beam	332
Otter	366
1998 Beam	248
Otter	432

Estimated eulachon bycatch (to nearest tonnes) calculated from post-season catch rates (MCR) and in-season catch proportion (PCP) are shown below for each year and gear:

	MCR	PCP
1997 Beam	10	18
Otter	76	101
Total for 1997	**86**	**119**
1998 Beam	5	9
Otter	30	50
Total for 1998	**35**	**59**

The MCR (mean catch rate) estimate probably is the most accurate, but may slightly underestimate eulachon bycatch because not all fishing areas were included. Areas where there was no observer data was not included. Of these MCR estimates, three shrimp management areas (Queen Charlotte Sound, 23 inshore, 23 offshore) account for almost 95 % of the eulachon bycatch in 1997 (82 tonnes of the 86 tonne total) and 94% in 1998 (33 tonnes of the 35 tonne total). Further, most eulachon bycatch was taken by otter trawlers and most was in Queen Charlotte Sound (nearly 61 tonnes in 1997, and 20 tonnes in 1998). Eulachon bycatch rates were lower in 1998. In part, the reason for the lower 1998 estimates may have been a lower encounter rate, but it is probable that the fleet took evasive action to lower eulachon bycatch.

The bycatch estimate methods presented for eulachons also are applicable for estimation bycatch of other species. The catch rate of ‘non-target species’ (including eulachons) varied widely among different areas and between gear, but was very high in the Prince Rupert District and the Strait of Georgia. Within some Shrimp Marine Areas, the bycatch rate exceeded 50%. Mainly, these very high bycatch rates were made with beam trawls, and include some commercial species (i.e., flatfish species), but not salmonids or halibut. The paper offers the perspective that although the bycatch of eulachons is highest in otter trawls in Queen Charlotte Sound and on the West Coast of Vancouver Island, the bycatch of other non-target species by this gear, in these areas, is low and the catch rate of target species (i.e. shrimp) approaches 90%. The paper recommends that bycatch monitoring should continue. To assess the significance of bycatch of species other than eulachons, the bycatch in shrimp trawls should be compared and contrasted with that of the groundfish industry.

Reviewer #1

Reviewer 1 felt that the paper did a good job of providing catch and effort data by gear type for 1997 and 1998. This reviewer suggested more specific recommendations with respect to the modifications to the shrimp bycatch program and the management of the fishery. The reviewer suggested a review of the management action levels for eulachon bycatch in the shrimp trawl fishery.

Reviewer 1 noted that since the gear types of beam and otter trawls were significantly different in their bycatch that a breakdown of vessels by gear type was necessary to the document.

Reviewer 1 suggested that while the author does a laudable job of explaining and defending the methods, that further summaries and discussion were required for the results. The reviewer suggested a better description for “hailed” data and noted that further explanation was required to identify the relative amounts of eulachon bycatch by gear and fishing area.

Reviewer #2

Reviewer 2 congratulated the authors for drawing attention to the issues of bycatch estimation in the trawl fisheries and suggests there should be more of these studies.

Reviewer 2 found the paper hard to read and made specific comments.

Reviewer 2’s principal complaint was that the authors state that they are trying to develop an acceptable methodology for estimating bycatch, but have apparently not attempted to use or adapt methodologies developed elsewhere (i.e. using linear models for projecting total bycatch rates for multi-gear, multi-area, multi-season situations and coping with empty cells). The reviewer noted that the relative benefits and statistical properties of CPUE and other ratio estimators are well documented and that the use of ratios is non-trivial and should be approached with caution. Reviewer 2 suggested that the first step is usually to explore the frequency distributions and the underlying relationships between the two variables (eulachon catch to shrimp catch, eulachon catch to hours fished). Then, on the basis of these relationships and the variance of the two variables, the choice among estimators can be determined. This reviewer noted that had the fundamental properties of the variables been examined at the start, an entire part of the analysis could have been avoided. The reviewer provided additional references.

Reviewer 2 noted that MCP and PCP reflect two different weightings of the same data: One weights more heavily the observations of more eulachon or shrimp, the other weights all observations equally. The reviewer recommended that authors note that cumulative ratios are also highly leveraged by large catches or

catch rates.

The reviewer discussed that ratio estimators are biased for small sample sizes (<30) and points out that virtually every line in Table 7 corresponds to fewer than 30 observations, therefore, all these estimates are biased. This reviewer suggested bias-corrected bootstrapping the observations of mean CPUE to calculate confidence limits for cells with small sample sizes and noted that it is possible to estimate the variance of the cumulative catch ratio (PCP) with bootstrapping and with traditional parametric statistics.

Reviewer 2 suggested the authors add a recommendation for an analysis of the relationship of precision, so that observer studies can predict how many observations are required for specific confidence targets.

Subcommittee Discussion

The Subcommittee recognized this work as being important and an integral part of new selective fishing policies and practices. It was noted that much of the program was supported by industry.

Further analyses by gear type were requested. Concern and discussion centered about the eulachon stock status. Although otter trawls had much lower rates of bycatch overall (12% observed in Queen Charlotte Sound and 13% on the WCVI), their rates of eulachon bycatch were the highest and otter trawls appear to have the greatest impact on eulachon stocks. Samples of eulachon from the trawls were collected and this information is being processed.

The Subcommittee expressed concern over the high overall bycatch of beam trawlers. Bycatch rates exceeding 50% occurred in areas of the Strait of Georgia and the Prince Rupert District. It was suggested that estimates of swept volumes could be an improvement over the number of hours towed due to the different gear sizes and tow speeds. Swept volumes would require detailed information on net size and configuration.

An external participant suggested that much of the bycatch in Queen Charlotte Sound in 1997 might have been a result of vessels fishing for volume to record landings in response to rumors that an individual vessel quota system may be implemented in future. The estimates of eulachon bycatch from otter trawls declined significantly from 76 t in 1997 to 30 t in 1998. Most of this bycatch came from Queen Charlotte Sound. Seasonality may also be important. Concerns were expressed about the low number of sets used to estimate bycatch in some areas. This would not reflect the efforts by fishers to avoid bycatch once it has been encountered.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to revisions suggested by the

reviewers and the Subcommittee.

The Subcommittee recommended:

1) Continued monitoring of bycatch and refinement of methodology on estimating bycatch. The program should monitor catch composition and attempt to identify selective fishing practices. Further data on temporal and spatial factors should be collected and analyzed.

2) That the levels of bycatch of eulachon and other species be reduced from the 1997-98 levels. Due to the stock concerns for eulachon, the level of bycatch should be minimized.

3) Further analyses are required to refine in-season estimates of eulachon bycatch. The best estimates appear to come from the use of catch rates but this information is derived from logbooks post-season. The collection of effort data in-season may be useful.

4) A stock status report on eulachons be updated and presented to the Pelagic Subcommittee. Action levels for eulachon bycatch, currently set by managers, should be reviewed.

An ad-hoc committee of assessment staff and managers from groundfish and invertebrate sections should compare and contrast the bycatch from the shrimp trawl and groundfish fisheries.

I99-14 Scientific concepts for ecosystem-based management of marine invertebrates on Canada's Pacific coast

I. Perry **Accepted subject to minor revisions**

Summary

Management to achieve sustainable marine fisheries requires consideration of habitat and multi-species interactions in addition to the present single-species population dynamics approaches. Such "ecosystem" approaches to fisheries management are now common recommendations from advisory bodies, and are becoming part of formal legislation. From a scientific basis, however, it is not clear how to implement or advise upon such ecosystem-based approaches. This paper discusses the scientific concepts and issues necessary to include ecosystem considerations into the management of Canada's Pacific marine invertebrate fisheries resources. The critical concepts are to define the goals for "ecosystem management"; to define the ecosystem (time and space scales); to recognise large uncertainties; to identify appropriate "control levers"; and to go slow (incrementally) but start now. Approaches to applying these concepts are to explicitly include ecosystem thinking in present assessments; to develop indices of ecosystem

status; to reduce destructive fishing practices; to provide an “allocation” for predators; to establish reserve or experimental areas; and to develop models to help focus research. A central point is that “ecosystem management” can not mean the management of ecosystems; rather it means the management of human activities within marine ecosystems.

The paper recommends to:

1) Continue developing “ecosystem thinking” in present stock assessment activities by including a section in each assessment evaluating the habitat and ecosystem roles and relationships for the species being assessed; identify the functional group to which the species belongs and whether it is likely to be a “keystone” component.
2) Develop conceptual models of the potential species and habitat interactions, with the aim of identifying potential “control levers” and predicting directions of impacts (i.e. trophic cascading effects). Use these conceptual models to identify critical but missing information, which should be collected.
3) Develop indices of ecosystem state, starting with data collected during on-going fisheries-independent surveys. This requires collection of adequate information in non-target species observed during the survey, starting with Genus (preferably species) – level taxonomic identifications.
4) Interact with other single species assessments to define the relevant ecosystem boundaries (time and space scales), the appropriate functional group upon which management actions (“control levers”) and monitoring the outcomes of management actions will be based, and the overall goals for ecosystem-based management approaches.

<u>Reviewer #1</u>

Reviewer 1 found the paper to be a very useful contribution to the emerging discussion on how Canada incorporates ecosystem objectives in fisheries management.

This reviewer felt that rather than waste a lot of time trying to define an ecosystem, it may be better to define geographic areas based on human management criteria for oceans management, and accept that no geographic area will be useful for evaluation of the range of species of interest.

Reviewer 1 suggested that rather than use the term “ecosystem management” we should incorporate some ecosystem objectives with the package of conservation objectives for fisheries management plans, and manage the human activities to try to meet such ecosystem objectives without a full understanding of ecosystem structure and function. The precautionary approach can be used, as well as some form of adaptive management.

This reviewer also felt that fisheries management is in the best position to shift to ecosystem objectives compared to other ocean industries noting that they already have the framework for conservation objectives, performance measures

and decision rules. This reviewer suggested the shift could be fairly easy and will help the fishing industry deal in a structured way with criticism of other segments of society.

Reviewer #2

Reviewer 2 felt the paper was a valuable contribution and a welcome, balanced and scholarly compilation of theory put into a management framework. Reviewer 2 noted that despite the conceptual nature of the paper, the action steps are realistic suggestions:

1) Putting ecosystem considerations into the assessments.
2) Indexing ecosystem status.
3) Rating and reducing the destructiveness of harvest methods.
4) Allocating mortality to predators.
5) Descriptive modeling.

Reviewer 2 suggested the key points discussed in the paper of establishing reserves and the precautionary approach could be stated with explicit recommendations.

Reviewer 2 also noted that the urchin example needs further discussion as to what would actually be indexed and what the explicit goal might be for the maintenance of species diversity.

Subcommittee Discussion

The author was commended by the Subcommittee for preparing a useful and timely paper on an important initiative. The need for this paper was identified based on recent initiatives of the Oceans Directorate and in response to the results of the phase 0 papers on California mussels and goose barnacles. The Subcommittee endorsed incorporating ecosystem thinking into current stock assessment work. A concern expressed by the Subcommittee was regarding the ability of current resources to meet the challenges of applying the ecosystem approach.

The Subcommittee recognized that recommendations one and four from the paper should be incorporated immediately while recommendations two and three are more conceptual in nature and will require more effort and perhaps resources to implement.

The Subcommittee felt that providing an example application of ecosystem approach, urchins in this paper, was very useful, as this is how the details of applying the approach will be learned. Further test applications are recommended.

The Subcommittee suggested discussion of the document should be widened to include other groups within Fisheries and Oceans Canada.

The Subcommittee stressed the difficulty of defining an ecosystem. An important aspect will be how to produce appropriate indices of ecosystem health. The Subcommittee noted that an element missing from the discussion in the paper were physical components, such as El Nino effects, those affect ecosystems.

The Subcommittee agreed that predation needs to be factored into assessments but noted that historical information has only been collected on species of commercial value so information on non-commercial species is lacking.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to minor revisions.

The Subcommittee recommended:
1) The ecosystem approach be further investigated through application on appropriate test cases;
2) Ecosystem management considerations be included in PSARC Working papers, Stock Status Reports and Integrated Fisheries Management Plans.
3) This working paper be considered by the Habitat Subcommittee.

I99-15 Discussion on a precautionary approach for management of the red sea urchin fishery in British Columbia

A. Campbell, J. Boutillier, J. Rogers **Accepted subject to revisions**

Summary

The red sea urchin has been fished commercially in British Columbia since 1977. The total landed value has generally increased throughout the red sea urchin fishery to nearly Can. $14 million by 1997/98. In 1996, there were 109 licensed vessels with a coastwide quota of 6,625 t, 19.1% allocated to the South Coast and 80.9% allocated to the North Coast of B.C. Currently the main management tools of the red sea urchin fishery include: 1) a minimum size limit of 100 mm TD (test diameter, mm) to allow about three spawning years for red sea urchin prior to harvest, 2) a quota system to provide a conservative fixed exploitation rate of approximately 2%, 3) limited licence entry, and 4) an Individual Quota (IQ) program.

Commercial fishers and fish processors have been requesting reductions in the minimum legal size limit to better meet market demands for the best quality gonad (roe) product which is extracted from red sea urchins. Fisheries Managers have requested that a long term strategy be developed that incorporates adaptive management methods for optimal harvest of red sea urchins while maintaining a precautionary approach to the management of this valuable resource.

The objectives of this paper are to review the history of the commercial fishery, data collection programs, the biological features of red sea urchins, and discuss fishery management goals, the problems and concerns and possible future strategies.

Taking into account the biological characteristics of red sea urchins (which are slow growth, long life, and sporadic recruitment) and the uncertainty of biomass and natural mortality estimates, the following are some of the management strategies that are suggested for consideration: 1) Reductions in the minimum size limit such as to 90 mm test diameter (TD) should be accompanied by reductions of exploitation rate to ensure sufficient brood stock reproduction; 2) large experimental management areas (EMA), 25% of the estimated total red sea urchin beds on the B.C coast, could be used to test the efficacy of the present management system and address issues as they relate to the appropriateness of different exploitation rates, change in size limit to 90 mm TD or limit thresholds and 3) monitoring programs would be needed to obtain changes in size composition and gonad quality of commercially harvested populations and fishery independent abundance/biomass indices.

Reviewer #1

Reviewer 1 considered the paper a much-needed beginning to a serious evaluation of the red sea urchin fishery. The reviewer noted that the paper draws attention to the difficulties and shortcomings of red sea urchin management and provides suggestions for how to move ahead and suggested such an evaluation for all of the established shellfish fisheries.

This reviewer felt that the document needs to be more focused as to what the priority actions and approaches should be, rather than presenting long lists of suggestions for it to achieve it's promise as a "strategy plan" for management of red urchins in B.C.

Reviewer 1 questioned that if there is little relationship between the number of transects and subareas, on what basis were the areas surveyed selected, and is there now a plan to increase surveys in subareas with more beds?

The reviewer felt the biological goals presented were too vague and suggested the authors define research and management information needs and approaches if these "goals" were sharpened. Being clear (and specific) as to the biological goals will help define the fishery information needs and management strategies, even if the goals change over a period of time.

Reviewer 1 suggested the authors clarify what is wrong with the current management system. The description of 'major problems with the present quota system are the uncertainties associated with M, exploitation rates, and biomass estimates' lead this reviewer to question what else is left?

This reviewer noted that while losses of fishing opportunities are a consideration, they do not present a valid concern here. The very fact of “precautionary” or “conservative” management approaches already indicates a loss of fishing.

Reviewer 1 suggested that the authors justify their contention that present size limit does not appear to be achieving the goals of preventing recruitment overfishing as it represents a significant concern.

Reviewer 1 also noted that the final list of recommendations needs to be broken down into management and assessment section and prioritized.

Reviewer #2

Reviewer 2 commended the authors for their work in summarizing the current status of the commercial fishery for red sea urchins and noted that the paper outlines the information shortfalls in the present management scheme.

Reviewer 2 also noted that the recommendations in the paper fall short of a strategic plan and echo’s Reviewer 1’s comments on prioritizing the list. Reviewer 2 suggested breaking the list into short term and long term goals. This reviewer provided several editorial suggestions.

Subcommittee Discussion

The authors were complimented on their attempted efforts to review the state of the stocks and the red sea urchin fishery management. The paper was recognized as a discussion paper and the Subcommittee suggested that more evaluation and discussions were needed to develop specific management actions.

The authors presented new information at the meeting (addenda). They cautioned that the management of the fishery might not be as conservative as the current belief. Concerns about the status of red urchin stocks arose from trends in CPUE data: declines in CPUE from combined logbook data for the whole of B.C. and a significant decline in central coast. The Subcommittee discussed and questioned whether declines in CPUE were a reflection of stock abundance or as a result of management actions and industry’s efforts to fish for quality sea urchins (at a higher economic return) as opposed to fishing for quantity (at a lower unit economic return)? In many areas, fishers were forced by managers to move and spread their fishing efforts over a large area rather than select sites. It was concluded that further evaluation of CPUE might be undertaken on beds rather than large general areas.

The Subcommittee discussed further data collection and analyses in progress: Some local beds have been closed for three to four years in the central coast and have been surveyed and re-opened. Other sites have been closed in the past few years. The survey information has not been analyzed to date. It was noted

that processors have important data on what areas have high recoveries and quality “roe” at different times of the year.

It was pointed out that industry was funding hatchery and enhancement studies and that new biological information may be available on growth rates and size at spawning.

Analyses and a report were requested for studies on-going at various experimental sites. The specific study objectives need to be identified. It was believed that these sites have had different harvest regimes that will assist in the evaluation of the size limit. These sites, however, will not provide critical recruitment data, i.e. the source of the recruitment.

The Subcommittee noted that a stock status paper and a working paper presenting quota options is scheduled to be presented in December, 1999, prior to the development of the next Integrated Fisheries Management Plan for red sea urchins.

The Subcommittee discussed the list of 14 recommendations for biological strategies which included reducing the size limit with an appropriate reduction in exploitation rates, taking more conservative estimates from surveys to apply to areas without survey data, options for rotational fisheries and continued collection of fishery independent data (surveys and research sites) and fishery data. Reserve areas were also recommended, with the possibility of pilot studies taking place in these reserves. The authors agreed to revise this section to “Considerations for Biological Strategies”, as additional assessment information was required to measure the efficacy of each of the options.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to revisions.

I99-16 Status of the Olympia oyster, *Ostrea conchaphila*, in Canada

G. E Gillespie **Accepted subject to minor revisions**

Summary

The Olympia oyster, *Ostrea conchaphila* (= *Ostrea lurida*), is the native oyster of the West Coast of North America. They are relatively small oysters, generally found attached to hard substrate or loose on soft substrate in singles or small groups. They are generally distributed from southeast Alaska to Panama, discontinuously distributed in appropriate habitats such as estuaries, lagoons, bays, tidal flats or attached to pilings or floating structures. Maximum reported size is 90 mm diameter, although most individuals are less than 60 mm. Maximum age is unknown, but could be > 10 years. In British Columbia, first maturity is generally achieved one year after settlement. Olympias are

larviparous, protandrous, alternating hermaphrodites. Individuals mature first as males, then alternate between male and female phases throughout their lifetime. Fecundity is approximately 250,000-300,000 larvae per spawning. Larvae are retained in the parental mantle cavity for approximately two weeks, then are planktonic for two to four more weeks. Larvae settle preferentially on the undersurface of hard substrates. In British Columbia, brooding occurs from mid-May to July and settlement occurs from July to September. Dispersal is limited to the planktonic larval phase, once set the adults are sessile. Three to four years growth are required to reach 35-45 mm in size, and little growth occurs after five years.

Olympia oysters were commercially fished in British Columbia, Washington, Oregon and California beginning in the mid-1800s. Natural aggregations were over harvested, and largely depleted by the 1930s. The west coast oyster industry unsuccessfully attempted introduction of Atlantic oysters, *Crassostrea virginica*, and is currently dependent on introduced Pacific oysters, *Crassostrea gigas*. Olympia oysters are not commercially fished in British Columbia, and likely hold little recreational value because of their small size.

Olympia oyster distribution is limited by specialized habitat requirements, and relatively low fecundity and dispersal. Olympias are vulnerable to temperature extremes, and are not resistant to harvests ion a commercial scale. Habitats which once supported large aggregations in Georgia Strait no longer do, in part due to historic over harvests and environmental stresses, and because development of large oyster reefs may require centuries without disturbance. Small relict populations survive at low tide levels and under floating structures. Olympias are locally common at sites on the West Coast of Vancouver Island, and little information exists on populations in Johnstone Strait or in the Central Coast. They do not occur in the Queen Charlotte Islands.

Olympia oysters are not likely facing imminent danger of extinction or extirpation in Canada. Limiting factors have led to significant reductions to population levels in the past. From the limited data currently available, the author recommends a status of Special Concern is appropriate.

<u>Reviewer #1</u>

Reviewer 1 found the paper to provide a good summary of what is known about Olympia oysters, particularly in Canada.

Reviewer 1 felt that, overall, it seems that the Olympia oyster have some life history characteristics which would make it somewhat vulnerable to threats or to increased mortality (limited dispersal ability in particular), and it would appear that they are toward the northern limit of their capabilities in B.C. as they don't tolerate freezing. The reviewer noted that the species has other life history characteristics that would make them resilient to threats: high fecundity, early maturation and frequent reproduction. However, total abundance has declined

over the entire range, as has the number of places where this species occurs, and it has been extirpated or greatly reduced in parts of its range. Reviewer 1 noted that abundance and occurrence appear to be stable now and there are no particular reasons to expect a further decline.

Reviewer 1 discussed the COSEWIC designations and suggested arguments for and against any of those designations.

Reviewer #2

Reviewer 2 commended the author in preparing this summary and suggested that this paper and others like it should not remain as a PSARC document but should be published in a recognized and widely read publication so that it can be used and cited.

This reviewer does not believe that Olympia oysters have suffered from competition with other introduced species and suggested the effects of disease be further discussed.

Reviewer 2 noted that Olympia oysters may be more common than believed because few people actually look for them. This reviewer suggested that since Olympia's breed at lower temperatures than either eastern or Pacific oysters, they could breed successfully over much of the B.C. coast every year.

Subcommittee Discussion

The Subcommittee commended the author on his review of the status of the Olympia oyster in Canada. The Subcommittee discussed the role of PSARC relative to the submissions of papers to COSEWIC and noted that it is PSARC's role to evaluate the science within the paper. The Subcommittee may comment on whether the science in the document supports the recommendation with the knowledge that COSEWIC will review and decide the status.

The Subcommittee and the author agreed with the reviewer that competition may have a smaller influence than suggested by the one reference cited in the paper and disease may have a larger influence than suggested in the paper.

The Subcommittee noted that there have been no surveys of Olympia oyster populations since the 1930's.

The Subcommittee agreed with the recommendations in the paper that:

1) Information on the distribution, abundance and population structure on Olympia oysters in B.C. should be collected and collated, as part of a general approach of utilizing resource inventories and ecosystem-based approaches to resource management.

2) A directed commercial fishery on Olympia oysters that depends only on natural stocks should not be considered.
3) Sites of particular significance to Olympia oysters (i.e. sites which support large populations) should be protected when considering proposals for aquaculture tenures or other intertidal activities.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to minor revisions.

The Subcommittee felt the paper represented a thorough review of the scientific information available on Olympia oysters for the COSEWIC to consider the status of "Special Concern" recommended by the author.

FISHERY UPDATES

Fishery updates are summaries of the performance of commercial fisheries prepared annually by fishery managers in consultation with (C&P) Conservation and Protection and Stock Assessment. The Invertebrate Subcommittee uses fishery updates to identify assessment and conservation concerns in each fishery.

Sea Cucumber Fishery Update

Currently 85 licences are eligible for participation in the commercial fishery. The commercial fishery is managed through area and individual quotas, using a catch validation system funded by the commercial industry. 2% of the commercial TAC is reserved for First Nation's food, social and ceremonial use.

Under the adaptive management plan for this fishery, 25% of the coast is fished under a precautionary coastwide commercial TAC, 25% of the coast is reserved for research and experimental harvest, and 50% of the coast is excluded from any commercial harvest for the foreseeable future in support of the risk averse approach to this data limited fishery.

The harvest of sea cucumber in 1998 was 276 t, split weight (viscera removed and drained). Annual landed value has remained relatively constant over the past several years, at $4.60/kg, ($2.00/lb, split and eviscerated weight) or approximately $1 million total ex-vessel value.

Under the current management regime, the fishery generally lasts three weeks, with most licence holders completing a single IQ in a number of days. In 1998, the fishery in most areas spanned the entire three-week period from October 5th to 26th.

PSARC Working Paper I99-11 reviews the adaptive management strategy and

provides recommendations for the continuation of this approach.

The management plan for sea cucumber in 1999 will be the first shellfish IFMP for the Pacific Region.

Squid Fishery Update

Preliminary reported landings of opal squid squid (*Loligo*) in 1998 were 23 t, significantly less than the previous 10 year average of 63 t but significantly higher than the 6 t catch from 1997. The total landed value of this fishery in 1998 was $44,493. There is no directed enforcement action taken in this fishery and no enforcement concerns have been identified. No assessment activities or research were undertaken for opal squid in 1998. Landings are likely under-reported on logbooks as fishers have little incentive to report catch. Much of the catch is landed for personal use as bait.

Squid licences are unlimited, that is, as many are issued as are requested annually. There is no information on the size of squid stocks on the coast, and accordingly, no estimate of what may constitute a sustainable fishery. There is no information about bycatch from this fishery. Seines may impact and damage the bottom when fishing for squid, particularly if they are targeting on spawning aggregations. This may also remove or damage egg masses deposited by the spawning stock. No habitat assessments have been done for squid seining.

The Subcommittee noted that the fishery is data limited. Entry into the fishery remains unlimited and only 6% of licence holders complied with licence conditions and reported their landings in 1998.

The Subcommittee identified that in 1997 (Canadian Stock Assessment Proceedings Series 97-22) opal squid was a priority for a phase 0 literature review and licence limitation. The Subcommittee reiterates its concern that this fishery needs to be rationalized following the guidelines for a new and developing fishery.

The Subcommittee was concerned that licences are being issued with no biological basis for this fishery. The increase in value of the product and the possible non-reporting of catch highlight the need to proceed with the phased approach in this fishery.

Geoduck Fishery Update

The geoduck dive fishery is prosecuted under authority of the “G” licence. The fishery is limited to 55 licences. In 1999, the second year of the fourth three year rotation, quotas were 72,000 lbs (32,659 kg) per licence as they were in 1997 and 1998, and are intended to be in 2000. There were 31 licences assigned to the North Coast area, nine to the South Coast Inside Waters area, and 15 to the West Coast of Vancouver Island area.

Total validated landings, in 1998, of 3.96 million lbs (1,796 t) were slightly greater than the TAC by 0.02% or 755 lb (342 kg).

Current management issues concern high-grading and poaching. As well, aquaculture and enhancement have become significant activities, and the development of a policy to cover these endeavors is in preparation.

Green Sea Urchin Fishery Update

The 1998/99 green sea urchin fishery ran from November 10 to March 15. There was little fishing activity in the last month of the opening. The total allowable catch (TAC) was 166.1 t. Landings fell short of the TAC with 156 t recorded by dockside validators.

Few enforcement incident reports were filed and passed on to Fisheries and Oceans Canada by the dockside validators and Conservation and Protection. Of these, most were considered of low or medium seriousness, such as incomplete logs prior to landing at the dock and hailing with less than the required 24 hours notice. Mandatory biological sampling and measuring of urchins at each off load by every vessel indicated no problems with harvesting of undersized or illegal product.

The January 1999 PSARC assessment for green sea urchins recommended a small increase to the coastwide TAC based on new surveys and analysis of logbooks. For the 1999-2001 management plan, quotas have been cut in the south gulf areas (due to concerns of low stock abundance, and lack of stock assessment info) and increases in the north island areas. Individual quotas are expected to increase by approximately 440 kg next year. Quotas for the gulf region in 2001 will be based on surveys to be done this year and next. If surveys are not completed, industry has been told these areas will not open.

Surveys area planned for north and south coast areas in 1999 and 2000.

The West Coast Green Urchin Association is interested in pursuing enhancement activities.

Scallop Fishery Update

There were no changes in the management of the commercial scallop fishery in 1998. The scallop dive fishery is open year round and the trawl fishery is open upon request in order to advise trawl harvesters of PSP outbreaks. Landings occurred in all months in 1998, to provide a continuous supply of product to a relatively small market.

Preliminary reports from fish slips indicate that the total landings of scallops were lower in 1998 than in 1997, dropping from 73 t to approximately 54 t. The total

landed value also dropped from $376,000 to $290,000 but the whole landed value per kg increased from $5.15 to $5.37, the highest value per kg recorded.

In 1998, there were twenty dive licences issued and six of these licences recorded landings. Divers harvested 50 t according to fish slips. A relatively small portion of the south coast has supported much of the dive fishery from at least the mid 1980s and this continued in 1998. In 1998, 89% of the dive fishery catch was harvested from Areas 17 and 18. 70% of the total dive catch (from logbooks) was landed from one subarea.

Trawling activity and landings in 1998 have basically stayed the same as in 1997. Thirty-four trawl licences were issued this year, with three recording landings. The total catch of scallop from trawl was 4 t. All of the catch by trawl operations reported on fish slips in 1998 came from Area 14. The trawl landings were also concentrated within one subarea. Using logbooks, 68% of the catch came from one subarea.

Concerns over this fishery continued in 1998. The scallop fishery is an unlimited entry fishery, meaning that anyone with “C” license privileges can obtain a licence to fish for scallops. The potential effort is therefore unlimited. Trawl is not a selective gear. Bycatch from the trawl fishery has not been studied. This is a data limited fishery. A phase 0 paper appears above with Subcommittee discussion and recommendations.

Octopus Fishery Update

Reported landings in 1998 appeared to decline according to the octopus trap and dive logs. Landings for the trawl fisheries were not readily available through Fisheries and Oceans Canada sources, although will be obtained through Archipelago Marine Research. This was a result of groundfish trawl vessels no longer submitting sales slip information to the catch statistic unit. Reported 1998 landings were approximately 129 t from the dive and trap fisheries. Landings in the trap fisheries appeared to remain stable at approximately 72 t, while dive logs indicate a decline in landings to 57 t, down from 111 t in 1997. Area landings appeared relatively stable with the exception of area 19, which saw a decline in 1998. Participation in the dive sector also declined, with only 13 licences reporting landings, down from 27 in 1997. The reported value from the DFO sales slip database was $458,000. This does not include landings from the groundfish trawl fishery.

A Phase 0 report was prepared for the January 1998 PSARC Invertebrate Subcommittee meeting. Recommendations from the paper were to cap effort in the fisheries, develop stock assessment programs to monitor octopus populations, and implement more active management. In 1999, Fisheries and Oceans Canada stopped issuance of the Z(P) trap licence. Prawn and Crab licence holders were issued amended licence conditions to allow retention of octopus as a bycatch species. Fisheries and Oceans Canada will be holding a

meeting on July 5th, 1999 to start implementation of licence limitation for the Z(G) dive fishery. Limitation will become effective in January 2000.

There were no fisheries independent stock assessment activities conducted in 1998. Logs were submitted to and processed by the shellfish data unit for the trap and dive fisheries.

The major enforcement concerns in these fisheries are the use of bleach in the dive fishery to remove animals from their dens, and poor catch reporting practices in the dive, trap, and trawl fisheries. Industry has been notified through the 1999 management plan that Fisheries and Oceans Canada will enforce the prohibition of the use of bleach in the dive fishery beginning in January 2000. Industry will investigate alternatives.

Horse Clam Fishery Update

Horse clams are landed as an incidental catch to the geoduck fishery. There are 55 G license holders that have the authority to dive and harvest geoducks and horse clams. Since 1992, managers have restricted the development of a directed fishery for horse clams until the appropriate stock assessments have been done (phase 1). A phase 0 study, carried out in 1998, identified the need for fishery independent surveys and sampling to determine basic population parameters to develop total allowable catches.

Six vessels landed 1843 lbs (0.84 t) in 33 boat days, largely from Area 24 (Clayoquot Sound). Small amounts were landed in Areas 23, 6 and 7. The price averaged $1.76/lb. The number of sport fishermen and the extent of First Nations participation in horse clam harvesting is unknown.

Crab Fishery Update

Coast wide landings of Dungeness crab have declined since 1993. Recent coast wide trends were driven by the Queen Charlotte Islands fishery which peaked in 1993 at 4,798 t. Landings in the North and Central Coast Mainland Area were down in 1997 and 1998. Landings were above average on the West Coast of Vancouver Island in 1997 and 1998 and catches in Johnstone Strait, Strait of Georgia, and Fraser River areas remain relatively stable.

The total value of the Dungeness crab fishery peaked in 1997 at $28M. Total value was $21 M in 1998. Prices remained high in 1998 at an average of $7.22 per kg. The average annual value of Dungeness crab jumped to a record $7.44 per kg in response to poor fisheries in Washington and Oregon in 1997. Prices were near $8.80 per kg early in 1997 and in January 1998. The poor performance of the American fisheries in 1997 and 1998 was largely due to El Nino storms which kept the fleets from fishing for much of the season.

Crab fishermen were not permitted to change licensed fishing areas between

1997 and 1999. Between 1990 and 1997 annual area selection allowed for fleet movement and there were consistent increases in vessels electing to fish the Queen Charlotte Islands (Area A) in response to increased crab abundance. The numbers of vessels electing the West Coast, Area E, and the North Coast, Area B, declined over the same period. Numbers of vessels operating east of Vancouver Island and in the Fraser delta have remained relatively static. The next area selection will occur prior to the 2000 fishery when fishermen will designate a licence area for the period 2000 to 2003.

Effort in vessel days has declined slightly since a peak in 1996. Effort in vessel days does not consider increases in effort due to larger trap inventories or other changes to fishing power. For example, the amount of gear in Area A continues to increase. A ballot of Area A fishers in 1997 estimated the inventory at 50,000 traps. Harvest logs show a steady increase in trap inventories coast wide with 1998 inventories 2½ times the inventories in 1992. A ballot of fishermen estimated trap loss at 10 to 15 percent annually.

Trap limits have been initiated in the crab fisheries in Tofino, Fraser River, Boundary Bay and the North and Central Coast Mainland. Trap limits are being considered in other areas.

The Subcommittee requested that the catch and effort data be presented by management area.

The Subcommittee expressed concerns about the huge trap inventories in some areas, and the apparent lack of increased catch with the increases in numbers of traps. The Subcommittee did note, however, that work is proceeding to resolve this issue.

The Subcommittee noted that no assessment is conducted to determine the abundance of crabs in this fishery; instead, management is conducted using controls on size, sex and season. Using these controls, the fishery appears to be stable (in terms of landings) over time in most areas. However, it was recommended that the revised update be re-presented at the next Subcommittee meeting to determine if area-specific assessments and analysis of harvest log information is necessary.

Intertidal Clam Fishery Update

The intertidal clam fishery occurs predominately in the south coast. The fishery is actively managed and incorporates advice and recommendations from community clam management boards in select areas. The Clam Reform policy was implemented in 1998 with license limitation and further development of the two clam management boards. Licenses have been limited to 1,160 (subject to appeals) of which 550 are Aboriginal Commercial Licences. This level of effort is approximately 50% of previous years. The manageability of the fishery has improved considerably with the license limitation initiative. The 1998 landings of

manila/littleneck clams are slightly higher than 1997, the average price was higher and individual fishermen realized a significant economic gain from previous years. First Nation's communities are generally well represented in the fishery and many are involved in moving toward pilot projects with a communal management focus. Management of marginally contaminated beaches continues to be supported by a collaborative agreement with the industry under a scientifically supported stock assessment program and conservative harvesting activity.

There is still concern over the expanding number and area of contaminated beaches, which cause potential for enforcement problems, as well as reduced harvest area to all user groups. Provincial programs to increase tenures and thereby alienate vacant crown foreshore may further impact the fishery. Illegal harvesting of clams from contaminated areas and conservation-closed areas continues to be difficult to control with current resource levels.

The recently introduced exotic "varnish clam" (*Nuttalia obscurata*) continues to spread throughout the Strait of Georgia and has now been identified on the southern West Coast of Vancouver Island. Indications from fishermen are that there may be a commercial market for this species. A phased approach to fisheries development is being followed to determine the feasibility of a fishery on this species.

The Subcommittee noted an increasing demand to develop intertidal clam fisheries in the north coast for food, social and ceremonial needs and for economic opportunities.

Razor Clam Fishery Update

The razor clam fishery in Haida Gwaii / Queen Charlotte Islands began in 1923. Since 1994, this fishery has been managed through a co-operative arrangement between Fisheries and Oceans Canada and the Council of Haida Nations (CHN). The authors suggest the fishery be managed by a minimum size limit of 90 mm. Haida diggers fish under a communal licence agreed to by CHN and Fisheries and Oceans Canada, and Fisheries and Oceans Canada issue designation cards to fishery participants. Participation in the last five years has averaged 135 diggers.

The Subcommittee noted that the update does not include a discussion of the estimated portion of the stock available intertidally. Limiting harvest to the intertidal area with the understanding that a relatively small portion of the population was available in the intertidal areas has been considered the major precautionary measure in the past.

The Subcommittee discussed that the 90-mm size limit was developed for market considerations. The Subcommittee noted that if the size limit is to be used as a management tool to protect a portion of the spawning stock it would have to be

larger, taking into consideration the size at first maturity. Since the authors raise this as a priority issue, the Subcommittee questioned whether an assessment of the size limit is being suggested.

The authors raise quotas as a priority issue, citing the estimate of MSY presented by Jones, Schwarz and Lee (1998). The Subcommittee notes that the estimates for MSY provided in the references have been exceeded by the harvest in some years. The Subcommittee is concerned that the authors are suggesting that harvests exceed MSY. This concern is tempered by the fact that the Jones, Schwarz and Lee (1998) paper did not include the subtidal populations. The assessment by Jones, Schwarz and Lee (1998) was not reviewed by PSARC.

The Subcommittee recommended revision of the razor clam fishery update. The Subcommittee recommended an assessment of the razor clam fishery for review at PSARC.

Appendix 1 PSARC Invertebrate Subcommittee Meeting Agenda, 7-10 June, 1999.

PSARC Invertebrate Subcommittee AGENDA	**June 7 to 10, 1999 8:30 AM to 4:30 PM Seminar Room, Pacific Biological Station, Hammond Bay Road, Nanaimo**	
Monday, June 7, 1999		
1. Introductions and Review of Agenda	Ivan Winther	8:30-9:15 AM
2. I99-9 Purple Sea Urchin Phase 0	Greg Workman	9:15-9:45 AM
3. Review of I99-9	Patty Menning	9:45-10:00 AM
• Break		10:00-10:15 AM
4. Review of I99-9	Tom Ebert	10:15-10:30 AM
5. Subcommittee Discussion on I99-9		10:30-11:00 AM
6. I99-10 Box Crab Phase 0	Ziyang Zhang	11:00-11:30 AM
7. Review of I99-10	Abayomi Alabi	11:30-11:45 AM
8. Review of I99-10	Jim Morrison	11:45-12:00 PM
• Lunch		12:00-1:00 PM
9. Subcommittee Discussion on I99-10		1:00-1:30 PM
10. Sea Cucumber Fishery Update	Juanita Rogers	1:30-2:00 PM
11. I99-11 Sea Cucumber Adaptive Management	Claudia Hand	2:00-2:30 PM
• Break		2:30-2:45 PM
12. Review of I99-11	Norm Sloan	2:45-3:00 PM
13. Review of I99-11	John Clark	3:00-3:15 PM
14. Subcommittee Discussion on I99-11		3:15-3:45 PM
15. Squid Fishery Update	Mike Kattilakoski	3:45-4:15 PM
Tuesday, June 8, 1999		
1. Geoduck Fishery Update	Steve Heizer	8:30-9:00 AM
2. I99-15 Red Sea Urchin Management Discussion	Alan Campbell	9:00-9:30 AM
3. Review of I99-15	Guy Parker	9:30-9:45 AM
4. Review of I99-15	Ian Perry	9:45-10:00 AM
• Break		10:00-10:15 AM
5. Subcommittee Discussion on I99-15		10:15-10:45 AM

6. I99-13 Eulachon Bycatch in Shrimp Trawls	Doug Hay	10:45-11:15 AM
7. Review of I99-13	Rick Stanley	11:15-11:30 AM
8. Review of I99-13	Kim West	11:30-11:45 AM
9. Subcommittee Discussion on I99-13		11:45-12:15 PM
• Lunch		12:15-1:15 PM
10. Green Sea Urchin Fishery Update	Guy Parker	1:15-1:45 PM
11. I99-14 Concepts for Ecosystem Approach	Ian Perry	1:45-2:15 PM
• Break		2:15-2:30 PM
12. Review of I99-14	Michael Sinclair	2:30-2:45 PM
13. Review of I99-14	Doug Woodby	2:45-3:00 PM
14. Subcommittee Discussion on I99-14		3:00 – 3:30 PM
15. Review and Finalization of Rapporteur's Reports from Day 1		3:30 – 4:15 PM
Wednesday, June 9, 1999		
1. Scallop Fishery Update	Jim Morrison	8:30-9:00 AM
2. I99-12 Scallop Phase 0	Ray Lauzier	9:00-9:30 AM
3. Review of I99-12	Graham Gillespie	9:30-9:45 AM
4. Review of I99-12	Mark Hanson	9:45-10:00 AM
• Break		10:00-10:15 AM
5. Subcommittee Discussion on I99-12		10:15-10:45 AM
6. Horse Clam Fishery Update	Steve Heizer	10:45-11:15 AM
7. Octopus Fishery Update	Guy Parker	11:15-11:45 AM
• Lunch		11:45-1:00 PM
8. I99-16 Olympia Oyster – COSEWIC	Graham Gillespie	1:00-1:30 PM
9. Review of I99-16	Neil Bourne	1:30-1:45 PM
10. Review of I99-16	Howard Powles	1:45-2:00 PM
11. Subcommittee Discussion on I99-16		2:00-2:30 PM
• Break		2:15-2:30 PM
12. Crab Fishery Update	Ivan Winther	2:30-3:00 PM
13. Intertidal Clam & Razor Clam Fishery Updates	Randy Webb / Juanita Rogers	3:00-3:30 PM

14. Review and Finalization of Rapporteur's Reports from Day 2	3:30 – 4:30 PM
Thursday, June 10, 1999	
1. Review and Finalization of Rapporteur's Reports from Day 3	08:30-10:00 AM
• Break	10:00–10:15 AM
2. General Discussion and Recommendations for the Subcommittee Report	10:15-11:30 AM
3. Date of next meeting and other business	11:30-12:00 PM

Appendix 2: PSARC Invertebrate Working Papers for June 1999.

No.	Title	Authors	Reviewers
I99-9	A review of the biology and fisheries for the purple sea urchin (*Stongylocentrotus purpuratus*, Stimpson, 1857) and discussion of the management of a proposed fishery	G. Workman	P. Menning T. Ebert
I99-10	A review of the biology and fisheries of the box crab, (*Lopholithodes foraminatus* Stimpson)	Z.Y. Zhang G. Workman A.C. Phillips	J. Morrison A. Alabi
I99-11	Sea Cucumber phase 1 fishery progress report	C.M. Hand J. Rogers	N. Sloan J. Clark
I99-12	A review of the biology and fisheries of the pink scallop and spiny scallop	R.B. Lauzier G. Parker	G. Gillespie M. Hanson
I99-13	Assessment of bycatch in the 1997 and 1998 shrimp trawl fisheries in British Columbia, with emphasis on eulachons	D.E. Hay R. Harbo J. Boutillier E. Wylie L. Convey P.B. McCarter	R. Stanley K. West
I99-14	Scientific concepts for ecosystem-based management of marine invertebrates on Canada's Pacific coast	I. Perry	M. Sinclair D. Woodby
I99-15	Discussion on a precautionary approach for management of the red sea urchin fishery in British Columbia	A. Campbell J. Boutillier J. Rogers	I. Perry G. Parker
I99-16	Status of the Olympia oyster, *Ostrea conchaphila*, in Canada	G. E. Gillespie	H. Powles N. Bourne

Appendix 3: Participants at Invertebrate Subcommittee Meeting, June 1999.

Subcommittee Chair: Ivan Winther
PSARC Chair: Max Stocker

DFO Participants	Mon	Tues	Wed
* Subcommittee Members			
G. Parker	✓	✓	✓
B. Adkins*		✓	✓
L. Marshall		✓	
J. Rogers*	✓	✓	✓
R. Harbo*	✓	✓	✓
C. Hand*	✓	✓	✓
L. Barton	✓		
J. Moores*	✓	✓	✓
R. Mylchreest*	✓	✓	✓
K. West*	✓	✓	✓
S. Heizer	✓		
G. Workman	✓		
W. Hajas	✓	✓	✓
D. Clark	✓	✓	✓
Z. Zhang	✓	✓	✓
R. Lauzier*	✓	✓	✓
S. Morin	✓	✓	
L. Convey		✓	
B. Waddell	✓	✓	
D. Hay		✓	
J. Morrison	✓		✓
W. Park	✓	✓	
A. Campbell*	✓		
G. Jamieson*	✓		
I. Perry*	✓	✓	✓
G. Gillespie*			✓
R. Webb			✓

External Participants:

M. Featherstone	✓	✓	
W. Heath*	✓	✓	
L. Clayton		✓	
D. Bureau		✓	

Observers

R. Stickney	✓		
C. Peterson	✓		
Y. Jung	✓		
W. Carey	✓		
C. Slavey			✓
S. Wiebe			✓
D. Logan		✓	
S. Gogin			✓