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## **C S A S**

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**Pacific Region**

**Proceedings of the Centre for Science Advice, Pacific Region - Review of Recovery Potential Assessment – Rocky Mountain Ridged Mussel (*Gonidea Angulata*) in British Columbia**

**February 25, 2011  
Nanaimo, BC**

**Sean MacConnachie  
Chairperson**

## **S C C S**

**Secrétariat canadien de consultation scientifique**

**Compte rendu 2011/072**

**Région du Pacifique**

**Compte rendu du Centre des avis scientifiques de la région du Pacifique – Examen de l'évaluation du potentiel de rétablissement – Gonidée des Rocheuses (*Gonidea Angulata*) en Colombie-Britannique**

**25 Février, 2011  
Nanaimo, C-B**

**Sean MacConnachie,  
président de réunion**

Fisheries and Oceans Canada / Pêches et Océans Canada  
Pacific Biological Station / Station biologique du Pacifique  
3190 Hammond Bay Road  
Nanaimo, BC V9T 6N7

**May 2012**

**Mai 2012**

## **Foreword**

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

## **Avant-propos**

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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## SUMMARY

A review of the Recovery Potential Assessment (RPA) of Rocky Mountain Ridged Mussel (*Gonidea angulata*) was held on February 25<sup>th</sup>, 2011 at the Pacific Biological Station in Nanaimo BC. A RPA is undertaken when COSEWIC designates an aquatic species as Threatened or Endangered. The purpose of the RPA is to provide information that will:

- Inform the decision to list or not to list a species on Schedule 1 of the Species at Risk Act (SARA)
- Support decisions on permitting incidental harm;
- Inform public consultations; and
- Assist the Recovery Team in developing a Recovery Strategy and/or Action Plan for the species if the listing recommendation is accepted.

Participants included DFO staff from Science branch, Oceans, Habitat and Enhancement branch, and Policy branch. Representatives from the province of BC, industry and First Nations also participated.

The meeting rapporteur was Robyn Kenyon.

Additional information on this RPA is available in the CSAS Research Document series and the Science Advisory Report.

## SOMMAIRE

Un examen de l'évaluation du potentiel de rétablissement de la gonidée des Rocheuses (*Gonidea Angulata*) a été conduit le 25 février 2011 à la Station biologique du Pacifique, à Nanaimo, en Colombie-Britannique. Une évaluation du potentiel de rétablissement est entreprise lorsque le COSEPAC désigne qu'une espèce aquatique est menacée ou en voie de disparition. L'objectif d'une telle évaluation est de fournir de l'information visant à servir aux buts suivants :

- Informer en vue de la prise de décision à savoir si l'espèce sera inscrite ou non à la liste de l'annexe 1 de la *Loi sur les espèces en péril* (LEP).
- Soutenir les décisions concernant la permission de dommages fortuits.
- Fournir des renseignements au public, à des fins de consultation.
- Aider l'équipe de rétablissement à développer une stratégie ou un plan d'action en faveur des espèces si celles-ci sont inscrites à la liste.

Parmi les participants à l'examen figuraient des employés de la Direction des sciences, la Direction des océans, de l'habitat et de la mise en valeur et de la Direction des politiques du MPO. Des représentants de la province de la C.-B., de l'industrie et des Premières Nations étaient également présents.

La rapporteure de réunion était Robyn Kenyon.

D'autres renseignements sur l'évaluation du potentiel de rétablissement se trouvent dans la série des documents de recherche et des avis scientifiques du SCCS.

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## INTRODUCTION

A review of the Recovery Potential Assessment (RPA) of Rocky Mountain Ridged Mussel (RMRM) (*Gonidea angulata*) was held on February 25<sup>th</sup>, 2011 at the Pacific Biological Station in Nanaimo BC. A RPA is undertaken when the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates an aquatic species as Threatened or Endangered.

The purpose of the RPA is to provide information that will:

- Inform the decision to list or not to list a species on Schedule 1 of the *Species at Risk Act* (SARA)
- Support decisions on permitting incidental harm;
- Inform public consultations; and
- Assist the Recovery Team in developing a Recovery Strategy and/or Action Plan for the species if the listing recommendation is accepted.

The process followed the guidelines of the Government of Canada for producing sound and effective advice and was conducted following specific RPA Guidelines provided by DFO's Canadian Science Advisory Secretariat (CSAS) (DFO 2007).

RMRM was designated as a Species of Special Concern by COSEWIC in November 2003. The species was re-assessed in November 2010 and was designated as Endangered due to reduced abundance and distribution and the potential threat from invasive species. The development of the RPA was in response to this new assessment.

The agenda for the meeting is provided in Appendix A, meeting participants in Appendix B, the terms of reference in Appendix C, and the detailed reviews in Appendix D.

The meeting Chair (Sean MacConnachie) opened the meeting by welcoming participants, describing the SARA recovery planning process, reviewing the agenda and reviewing the terms of reference.

The meeting participants reviewed the following working paper:

- "Recovery Potential Assessment for Rocky Mountain Ridged Mussel (*Gonidea angulata*)" by Ray Lauzier and Lily Stanton

## DISCUSSION

*\*Paper was accepted subject to revisions\*.*

The Rocky Mountain ridged mussel (*Gonidea angulata*) is a freshwater bivalve mollusc that reaches the northern extent of its global distribution in southern British Columbia. It is presently restricted to the Okanagan Basin with small aggregations present in the northeast and southwest areas of Okanagan Lake, in addition to a few individuals encountered in Vaseaux Lake and the Okanagan River. Recent surveys indicate their range and distribution is decreasing and their numbers are in decline. Not enough data is present to quantitatively evaluate any trends or changes in population trajectories. The preponderance of large adult

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mussels and the apparent absence of small and/or young juveniles could indicate a relict or ageing population with limited reproductive potential and recruitment.

Historic, current and potential or known threats and their impacts to habitat such as channelization of the Okanagan River, dams and weirs, development of shoreline and littoral zones, pollutants, and the potential of introduced alien species (e.g. Eurasian watermilfoil and dreissenid mussels), were evaluated and mitigation measures were discussed. Like many fresh water mussel RMRM requires an intermediary fish host to transport the larval stage of the mussel (glochidia). In the Okanagan basin the fish host for RMRM is unknown.

## **REVIEWS**

Two formal reviews were presented. Both reviewers felt that this was a very good RPA and that the authors had done a thorough job even though RMRM is a data limited species. The first reviewer suggested highlighting the uncertainty around lack of comprehensive surveys and the animal's cryptic nature. Also, the lack of evidence for successful recruitment (juveniles) may be more of an issue of inappropriate survey design as opposed to a relic population. Both reviewers suggested further emphasis on the possibility that RMRM populations may be found at greater depths and the SCUBA surveys could be undertaken. The authors responded that if time and resources were available a more comprehensive survey regime should be undertaken.

The first reviewer suggested greater clarity about population structure i.e. are there several populations of RMRM in Okanagan Lake or is it acting as one meta-population. There was also discussion on increasing the clarity on historic (and possibly inaccurate) records of RMRM in the Kootenays, Columbia River and Vancouver Island.

Uncertainty if "residence" applied to RMRM was discussed. The conclusion of the participants is that it did not.

The second reviewer suggested that a method for age determination is needed and it would be critical in addressing if RMRM is a relict population. This reviewer also suggested that further information could be added to the paper including changes to water quality values from pollutants derived from the agriculture industry (excessive nitrogen), road salting in the winter and the effect of creosote from pilings that are prevalent on the numerous docks in the Okanagan basin. The reviewer also asked if information could be provided on these threats from a historic vs. present status. The authors responded that the challenge with this approach is there's very little information on either past RMRM population levels or amount of pollutants that may have entered into the Okanagan Lake.

## **GENERAL DISCUSSION**

Following the oral presentation and the reviews, points of clarification around habitat were raised. Specifically, if there was a relationship between wave action and the distribution pattern of adults – the authors indicated that they have observed RMRM in areas where there is little wave action. A question was raised by the chair about the presence of RMRM in the closed off oxbows of the now straightened Okanagan river? There has not been confirmed evidence of RMRM shell in the oxbows, although a thorough search has not been undertaken.

One participant inquired if RMRM was found in the mainstem of the Columbia River. The authors responded that they found no evidence of RMRM in the Columbia River and when found large rivers basins in the US they are usually in the smaller tributaries.

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The interaction between alien invasive species (AIS) and RMRM and their subsequent management was discussed at length. It would appear that RMRM has specific micro-habitat needs. The introduction of Eurasian milfoil may not only be covering up these habitats and interfering with successful recruitment of RMRM, but that various management practices may be damaging suitable habitat. Participants discussed issues around rotor-tilling, the use of herbicides (copper sulphate) and geo-textile fabric to manage milfoil. All of these practices may affect RMRM.

The other AIS threat that was discussed at length was the introduction of dreissenid mussels (Zebra and quagga mussels) and the potential impacts that they may have. Participants expressed concern that the government agencies were not doing enough to monitor invasive spread or to mitigate against this threat. The authors noted that in Lake Mead Nevada, significant resources were put in place to prevent the introduction of Zebra mussels including the development of a management plan, restricted access and enforcement. Unfortunately these actions did not prevent the introduction of the mussels into the waterways.

The participants discussed at length the probability of recovery and allowable harm. Due to the data-limited nature of RMRM no quantitative values could be provided. Key life history parameters need to be determined e.g. natural mortality, recruitment rate, population age structure etc. Until these values are assessed allowable harm should be applied with precaution.

The participants discussed the probability of recovery by relocating or transplanting individuals to increase the likelihood of successful fertilization. If the species were to be listed and the recovery strategy recommended this approach, studies would need to be undertaken to determine the potential impacts to genetic heterogeneity.

One participant asked if the stage height of individual beds could be added to the RPA as this would be helpful in responding to future habitat related issues. There were further discussions about describing the microhabitats of individual bed features for the future identification of critical habitat, as defined in SARA. The RPA does capture some general information about individual bed characteristics but does not go into the detail required for current critical habitat policies. The authors agreed to use some of the language in critical habitat policies and that existing beds may be considered critical habitat in the future but further refinement will be required. Schedule of studies for critical habitat should be developed.

## **RECOMMENDATIONS**

- Research should be undertaken to determine the fish host of the glochidia stage.
- Delineation of adult and juvenile microhabitat preferences should be undertaken.
- Surveys to determine distribution of RMRM at different depth should be undertaken.
- Genetic analysis could be pursued to compare against U.S. populations to see if recovery would be feasible *via* transfers from southern populations.
- If possible riverine habitats could be restored.
- Age determination studies could be undertaken.
- Highlight the uncertainty around why species had apparently declined in abundance and distribution.
- Include rationale for COSEWIC designation in the RPA.

- 
- Improve invasive species awareness and monitoring activities

### **ACKNOWLEDGEMENTS**

Thank you to the authors for the hard work and the participants for a constructive review.  
Thanks to Janeane MacGillivray for administrating the webinar and arranging meeting logistics.

### **REFERENCES**

DFO. 2007. Revised Protocol for Conducting Recovery Potential Assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/039.

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## APPENDIX A: AGENDA

### Agenda

Recovery Potential Assessment for the  
Rocky Mountain Ridged Mussel (*Gonidea angulata*)  
in British Columbia

Pacific Regional Science Advisory Process

February 25, 2011  
Nanaimo, British Columbia

Chairperson: Sean MacConnachie

Working Paper to be reviewed:

Lauzier, R. Recovery Potential Assessment of the Rocky Mountain ridged mussel (*Gonidea angulata*) in British Columbia. CSAP (Centre for Science Advice Pacific) Working Paper 2011/P31.

9:00	Introductions	Sean MacConnachie
9:10	Review Agenda & Housekeeping	Sean MacConnachie
9:20	CSAS Overview & Procedures	Sean MacConnachie
9:30	Review of Terms of Reference as pertains to research document	Sean MacConnachie & RAP Participants
9: 40	Presentation of Working Paper	Ray Lauzier
<b>10:30</b>		<b>Break</b>
10:50	Questions of Clarification	RAP Participants
11:15	Presentation of Reviews & Authors' Responses	Reviewers & Author(s)
<b>12:00</b>		<b>Lunch Break</b>
1:00	Discussion and Building Agreement on Conclusions, Recommendations, Advice and Future Work	RAP Participants
<b>3:00</b>		<b>Adjournment</b>

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## APPENDIX B: ATTENDEES

Martel	Guy	BC Hydro
Brown	Tom	DFO
Kenyon	Robyn	DFO
Lauzier	Raymond	DFO
MacConnachie	Sean	DFO
Magnusson	Gisele	DFO
Nantel	Martin	DFO
Schweigert	Jake	DFO
Stalberg	Heather	DFO
Street	Sheila	Fortis BC
Biffard	Doug	Ministry of Environment
Pollard	Sue	Ministry of Environment
Friesen	Alexis	ONA
Eneas	Brody	ONA Fisheries
Simmons	Ellen	ONA Fisheries/En'owkin
Duncan	Bill	Teck Cominco
Stanton	Lily	

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## APPENDIX C: TERMS OF REFERENCE

### Terms of Reference Recovery Potential Assessment – Rocky Mountain Ridged Mussel (*Gonidea Angulata*) in British Columbia

#### Pacific Regional Advisory Process

February 25, 2011

Nanaimo, B.C.

Chairperson: Sean MacConnachie

#### Context

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates aquatic species as threatened or endangered, Fisheries and Oceans Canada (DFO), as the responsible jurisdiction under the Species at Risk Act (SARA), is required to undertake a number of actions. Many of these actions require scientific information on the current status of the species, population or designable unit (DU), threats to its survival and recovery, and the feasibility of its recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

Rocky Mountain Ridged Mussel was designated by COSEWIC as Endangered in November 2010. DFO Science has been asked to undertake an RPA, based on the National Frameworks (DFO 2007a and b) developed for this purpose. The information and advice in the RPA may be used to inform both scientific and socio-economic elements that are considered by the Minister of Fisheries and Oceans Canada in recommending whether a species is listed as threatened or Endangered under the Species at Risk Act, as well as development of a recovery strategy and action plan, and to support decision-making with regards to the issuance of permits, agreements and related conditions, as per section 73, 74, 75, 77 and 78 of SARA.

#### Objective

Taking into consideration available information, and accounting for uncertainties, provide information and advice respecting the potential for Rocky Mountain Ridged Mussel recovery. The following working paper will be reviewed in support of this objective.

*Lauzier, R. Recovery Potential Assessment of the Rocky Mountain ridged mussel (Gonidea angulata) in British Columbia. CSAP (Centre for Science Advice Pacific) Working Paper 2011/P31.*

The provision of recovery potential information and advice is guided by the DFO National Framework (DFO 2007a and b) developed for this purpose. The frameworks outline the following specific elements for the provision of RPA information and advice, and will be used to guide this review.

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#### A. Population status, trends and trajectories

1. Evaluate present Rocky Mountain Ridged Mussel status for abundance and range and number of populations.
2. Evaluate recent species trajectory for abundance (i.e., numbers and biomass focusing on matures) and range and number of populations.
3. Estimate, to the extent that information allows, the current or recent life-history parameters for Rocky Mountain Ridged Mussel (total mortality, natural mortality, fecundity, maturity, recruitment, etc.) or reasonable surrogates; and associated uncertainties for all parameters.
4. Estimate expected population and distribution targets for recovery, according to DFO guidelines (DFO 2005).
5. Project expected Rocky Mountain Ridged Mussel population trajectories over three generations (or other biologically reasonable time), and trajectories over time to the recovery target (if possible to achieve), given current population dynamics parameters and associated uncertainties using DFO guidelines on long-term projections (Shelton *et al.* 2007).

#### B. Species Residence

6. Evaluate residence requirements for the species, if any.

#### C. Habitat Use of Rocky Mountain Ridged Mussel

7. Provide functional descriptions (as defined in DFO 2007b) of the properties of the aquatic habitat that Rocky Mountain Ridged Mussel needs for successful completion of all life-history stages.
8. Provide information on the spatial extent of the areas in Rocky Mountain Ridged Mussel range that are likely to have these habitat properties.
9. Identify the activities most likely to threaten the habitat properties that give the sites their value, and provide information on the extent and consequences of these activities.
10. Quantify how the biological function(s) that specific habitat feature(s) provide to the species varies with the state or amount of the habitat, including carrying capacity limits, if any.
11. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.
12. Provide advice on how much habitat of various qualities / properties exists at present.
13. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery targets for abundance and range and number of populations.
14. Provide advice on feasibility of restoring habitat to higher values, if supply may not meet demand by the time recovery targets would be reached, in the context of all available options for achieving recovery targets for population size and range.
15. Provide advice on risks associated with habitat "allocation" decisions, if any options would be available at the time when specific areas are designated as Critical Habitat.
16. Provide advice on the extent to which various threats can alter the quality and/or quantity of habitat that is available.

#### D. Assess the Scope for Recovery of Rocky Mountain Ridged Mussel

17. Assess the probability that the recovery targets can be achieved under current rates of Rocky Mountain Ridged Mussel population dynamics parameters, and how that probability would vary with different mortality (especially lower) and productivity (especially higher) parameters.



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18. Quantify to the extent possible the magnitude of each major potential source of mortality identified in the pre-COSEWIC assessment, the COSEWIC Status Report, information from DFO sectors, and other sources.
  19. Quantify to the extent possible the likelihood that the current quantity and quality of habitat is sufficient to allow population increase, and would be sufficient to support a population that has reached its recovery targets.
  20. Assess to the extent possible the magnitude by which current threats to habitats have reduced habitat quantity and quality.

#### E. Scenarios for Threats Mitigation and and/or Recovery

21. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all feasible measures to minimize/mitigate the impacts of activities that are threats to the species and its habitat (Steps 18 and 20).
22. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all reasonable alternatives to the activities that are threats to the species and its habitat (Steps 18 and 20).
23. Using input from all DFO sectors and other sources as appropriate, develop an inventory of activities that could increase the productivity or survivorship parameters (Steps 3 and 17).
24. Estimate, to the extent possible, the reduction in mortality rate expected by each of the mitigation measures in step 21 or alternatives in step 22 and the increase in productivity or survivorship associated with each measure in step 23.
25. Project expected population trajectory (and uncertainties) over three generations (or other biologically reasonable time), and to the time of reaching recovery targets when recovery is feasible; given mortality rates and productivities associated with specific scenarios identified for exploration (as above). Include scenarios which provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.
26. Recommend parameter values for population productivity and starting mortality rates, and where necessary, specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts of listing the species.

#### F. Allowable Harm

27. Evaluate maximum human-induced mortality which the species can sustain and not jeopardize survival or recovery of the species.

#### **Expected Publications**

- CSAS Science Advisory Report
- CSAS Proceedings of meeting
- CSAS Research Document

#### **Participation**

DFO Science, Oceans, Habitat and Species at Risk, Policy and Economics, Aboriginal Communities, Province of BC, External Reviewers, Industry, Non-governmental organizations and Other Stakeholders will be invited to participate in this meeting.

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## References Cited

- COSEWIC. 2010 COSEWIC assessment and update status report on the Rocky Mountain Ridged Mussel in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.
- DFO. 2005. A framework for developing science advice on recovery targets for aquatic species in the context of the Species at Risk Act. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/054.
- DFO. 2007a. Revised Protocol for Conducting Recovery Potential Assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/039.
- DFO. 2007b. Documenting habitat use of species at risk and quantifying habitat quality. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/038.
- Shelton, P.A., B. Best, A. Cass, C. Cyr, D. Duplisea, J. Gibson, M. Hammill, S. Khwaja, M. Koops, K. Martin, B. O'Boyle, J. Rice, A. Sinclair, K. Smedbol, D. Swain, L. Velez-Espino, and C. Wood. 2007. Assessing recovery potential: long-term projections and their implications for socio-economic analysis. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/045.

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## APPENDIX D: REVIEWS

### REVIEW OF: DRAFT RPA FOR ROCKY MOUNTAIN RIDGED MUSSEL (GONIDEA ANGULATA)

#### Reviewer: Sue Pollard, BC Ministry of Environment, Victoria, BC

Overall, the document provides a well written comprehensive and fairly complete overview of the state of information regarding the biology and threats to the species. There are a few areas where a particular conclusion might be overstated given the level of uncertainty, and a few instances where some clarity is required. These specific points are summarized below.

Specific comments and suggestions:

#### Species Biology

- Pg. 2 reference to puerile conglutinates while this is definitely a possibility, it appears, based on limited visual analysis of preserved conglutinates that some samples collected from Dog Beach in 2010 contained mature glochidia with fully developed valves were present suggesting normal conglutinates.

#### Ecosystem Role

- Pg. 2 RMRM appears to have a higher tolerance to siltation than Western Pearlshell based on a study in the states indicating greater mobility (Vannote and Minshell 1982), and indeed we saw very few pearlshells in Okanagan Lake. However, there were plenty of floater species in the vicinity of RMRM and I suspect they are much more tolerant of sedimentation given that they are much more common in lake habitats.

#### Assessment

- Pg. 3 (also pg. 6) Park Rill Creek reference we've tried repeatedly to verify this record. I don't believe it is a valid record as the originator of this record Lionel Dallas had no recollection of the record. Efforts since this time have not turned up RMRM either.
- Pg. 4 I think the Vernon site probably contains 100s of mussels based on the two limited surveys to date. In one survey (2009) 50 mussels were observed; in Sept. 2010, a consulting company captured and relocated 77 adults during a salvage for moorage development
- Pg. 4 I found 3 live RMRM in Skaha Lake in 2008. Lora Nield found 1 live RMRM in the north basin of Osooyos Lake in 2010. While these don't represent significant numbers, they are similar to what has been noted for Vaseaux and Okanagan River (i.e. 12 live RMRM total in natural section). I also am not convinced that their range has decreased from previous years surveyed. We really haven't done a thorough job at surveying these locations.
- Pg. 5 Similarly, 'As described above recent surveys SUGGEST (not indicate)...'
- Pg. 5 the large proportion of dead shell compared to live shell could be normal for this species. Some freshwater mussels only come to the surface of the substrate to reproduced and 90% of population remains buried in the substrate. We really don't know the life history of this species enough to conclude that lots of dead shell:live shell is an indication of declining populations or not. We also don't know how long shells remain intact in the environment; depends on chemistry and abrasive movement. There are lots of empty shells at Dog Beach is this healthy or not? Having said that, the situation in Osooyos, Okanagan River and Vaseaux is a concern. Also, repeatedly this document indicates that there have been very few small or medium sized live mussels observed. While this is true, again, we haven't done an adequate surveying job to confirm that this is the case. The substrate at Dog Beach is difficult to dig but we haven't undertaken alternative sampling options that might uncover a juvenile stage that remains buried

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in the substrate for protection. Again, the uncertainty needs to be highlighted more. I believe this is a potential concern but one that needs verification.

- Pg. 6 First line not sure if the range from 10 to 18,000 individuals is survival of offspring per adult or what needs clarification
- Not sure how high glochidial mortality results in extremely low fecundity fecundity is number of eggs per female.
- Pg. 10 Top paragraph again, uncertainty regarding the presence of a normal age structure (i.e. with successful recruitment and numerous age/size classes) in view of our limited efforts to date to sample full y should be discussed not just extinction dept and relict populations.
- Pg. 11 the lake is currently considered ultraoligotrophic because inlet dams capture nutrients I don't think there is any concern in the near future the elevated nutrient levels could alter the status of the lake (Dale Sebastian, pers. comm.).
- Pg. 14 typo 2nd par from top, 2nd line from bottom.
- Pg. 14 it should be noted that while Okanagan Lake has seen the introduction of several nonnative fish species, it has retained the original native species as well. What is more difficult to assess is whether or not native species have changed in terms of distribution or abundance in the lake in response to nonnative species or other factors. The original presence of salmon in Okanagan Lake proper is highly debated; I've never heard of steelhead being in the lake proper.
- Pg. 16 again, reference to recruitment failure suggests a certainty we just don't have around this issue.
- Pg. 17 Other mitigation measures include shoreline development guidelines for salvaging RMRM
- Pg. 17 I believe Lora Nield has replaced Kristina Robbins.
- Pg. 20 I'm not sure how we can talk about 'enhanced habitat protection measures' when we don't know specific habitat needs. We can take some general obvious measures but that is about it. Again, there is a certainty around recruitment failure discussed which we don't have.
- Pg. 21 Research/Monitoring needs must include some confirmation of recruitment failure based on development and application of appropriate survey methodologies
- Pg. 22 I'm not convinced genetic analysis is a real need at this point. Quite possibly the lake sites in BC share similar microhabitat characteristics with the riverine sites in the US. We don't know.
- Table 1. Clarity needed regarding the top two entry numbers.
- Table 1. I've attached a couple of additional sites that are relevant and don't appear to be captured. It should be clear that this table does not capture all survey efforts.

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## REVIEW OF THE ROCKY MTN RIDGED MUSSEL RPA FEB22/2011

### Reviewed by Tom G. Brown, Department of Fisheries and Oceans, Pacific Biological Station, Science, Conservation Group, SARA

This is a well-written and comprehensive report that outlines the best available information about the Rocky Mountain Ridged Mussels (*Gonidea angulata*) in B.C. Where species-specific information isn't available, the authors provide good background information on freshwater mussels generally or on similar species to validate habitat use, potential threats and recovery potential. The authors have followed the guidelines on production of RPA reports. Most of the comments are minor, but might require some clarification.

- 1) What is a "broad brush survey??"
- 2) I was surprised that the survey included Vancouver Island –Page 4 top?
- 3) If the last remaining areas are some of the most disturbed can we conclude that sand deposition etc is responsible for the decline? Page 12 bottom.
- 4) I don't believe that RMRM has a residence Page 9. They occupy habitat, but do not expend energy to create a structure or home. I am not sure if a depositional component applies. This section deals with differences in habitat types, gregarious nature etc, but does not satisfy me that there are residences.
- 5) Can RMRM be recovered – Page 8-9? This is the question that will be asked. Clearly state in the first sentence yes, no or can't be answered; then develop your arguments. I don't think this section truly answers this question.
- 6) I would like to get a better feel for allowable harm for permitting; maybe I missed this somewhere but think it should have its own heading and a clear statement.
- 6) Historic changes vs. threats or current conditions? Page 10 "Channelization of the Okanagan River" – This section gives the impression the entire river is currently in a state of disrepair. In fact the upper 5 km of river below McIntyre dam is natural and a further 10-15km has not been channelized since 1957. The river in this reach is "semi-natural", the river has established vegetation on each side and pool and riffle structure is great. Salmon (chinook, steelhead, and sockeye) spawn here. This section should be rewritten to reflect the current state. The statement that only 4km remains in a natural or semi-natural state is wrong. Remember much of the basin was not naturally treed, and fire return intervals are less than 50 years. Also some of the dykes had a minor setback.
- Page 16 – "current threats" -- most of the impacts are in the past. This is a minor point but is important.
- 7) Uncertainty in age (cohorts) determination appears to be a large gap in knowledge and might have to be given more prominence in the suggested studies. This may be critical for narrowing down the threats.
- 8) Is nitrogen loading good or bad? What is the history of sewage treatment –improvements? I would like to see some trend data if you feel this is important.
- 9) Are there any RMRM on the American side of Osoyoos Lake? Page 5 mid.
- 10) Pollutants – Forestry uses more pesticides (wood preservatives than agriculture) the most used pesticide in B.C. is creosote (was about 2/3 by volume). Its impact of the ecosystem is argued but it does appear to have some impacts to freshwater species. Also think you should examine road salt use and types. No discussion of sewage (treatment) and changes over time.
- 11) Page 15 --- There is a 3rd method of milfoil removal – diver operated dredge, not sure if this was ever used in the OK.
- 12) Page 16 – Should add that DFO has chosen not to participate in rapid response teams or to coordinated activities with the USA in regards to invasive dresenids.

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13) I suspect that fish are found in greater densities in milfoil, how does milfoil reduce larval transport by potential fish hosts?

13) Very minor comment. "Expected population trajectories – Page 20" I think this section needs some if statements. i.e If we don't do anything the population is likely to be extirpated within 10 years. If the population can be stabilized and recruitment occurs evidence of stable age structure still requires 20-30 years. If enhanced habitat protection .... Etc.

14) Minor comment -- "Suggested research activities ... host determination – Page 21--" I agree host determination must be a major research activity as it should give clarification of limiting factors, possible reasons for recruitment failure, etc. But, how does the research actually benefit the species or how likely are the findings to provide a benefit option? Are we likely to change the abundance and distribution of fish or biodiversity in the lakes which are currently filled with Y. Perch and Bass and rivers full of Carp?

Grammar and Wording:

Page 6 bottom --- what is "substantial flow"

Page 19 bottom --- allowable harm levels

Page 20 top --- As better more comprehensive

Review submitted by Tom G. Brown,

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