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Proceedings of the National Advisory Meeting on Comparison of Trapping Methods for Invasive European Green Crab

Meeting dates: September 28–29, 2021
Location: Virtual Meeting

Chairperson: Sophie Foster
Editors: Sophie Foster, Kyle Matheson, Cynthia McKenzie, Philip Sargent, Nathalie Simard, Thomas Therriault, and Alex Tuen

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Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may 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.

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SUMMARY

European green crab (EGC), *Carcinus maenas*, is a voracious aquatic invasive species (AIS) that poses a serious threat to Canada's marine and estuarine ecosystems on the Pacific and Atlantic coasts. EGC can impact eelgrass, shellfish, predator-prey interactions, outcompete native species, and affect commercial fisheries.

Fisheries and Oceans Canada (DFO), in partnership with stakeholders and Indigenous groups, has developed substantial knowledge of EGC and how to trap them. Trapping has been used for early detection, monitoring, research, and physical removal for control.

DFO's AIS National Core Program has requested science advice because EGC trapping is critical for early detection, determining impacts on native species and habitat, and control efforts to prevent ecosystem degradation and commercial fishery loss.

A Canadian Science Advisory Secretariat (CSAS) Virtual National Advisory Meeting was held September 28–29, 2021 to review the Working Paper which summarized peer-reviewed studies and unpublished projects on EGC trapping. Participants reviewed the information and shared knowledge in order to provide advice on the gear type selection for trapping EGC.

Overall, selecting between trap types depends on management objectives and context. Knowledge gaps and challenges include the lack of information on trapping juvenile EGC and the lack of information on effective threshold levels for functional control to prevent impacts on fisheries and sensitive habitats.

OBJECTIVES OF REVIEW

The objectives of this Canadian Science Advisory Secretariat (CSAS) National Science Advisory Process were to review and characterize gear used for European green crab (EGC) trapping and identified knowledge gaps (Appendix 1 – Terms of Reference).

Specific trapping goals considered included:

- Early detection, rapid response surveys, and monitoring
- Ecosystem impact evaluation
- Population control

The goal of the advice is to provide aquatic invasive species (AIS) program managers with an overview of existing information regarding EGC trapping relevant to their specific objectives. This information could be incorporated by managers into a decision-making tool for guiding action.

PRESENTATION AND DISCUSSION

The Working Paper that was distributed prior to the meeting was divided into sections which were presented and then discussed by the participants (Appendix 2 – Agenda). Participants (Appendix 3) shared their own experiences and contributed to the development of the advice.

TRAP TYPES AND TRAPPING METHOD CONSIDERATIONS

An overview was presented of the various available trap types. There have been a limited number of published and unpublished studies on trap uses in Canada, and very few which provided direct trap comparisons. These experiences were summarized and discussed. Consensus was reached by the participants that the selection of trap type depends on the objectives of trapping. These objectives could include, characterizing population dynamics or targeted control. Logistical constraints such as habitats where trapping is taking place should be considered; for example, traps and nets can be modified to improve Catch Per Unit Effort (CPUE), minimize damage to habitat, or reduce bycatch. In addition, the choice of trap also depends on the trapping method. Considerations include how and when traps are deployed, the environment where traps are deployed, the behaviour of EGC, and information about what is actually being caught in traps. A recommendation was made to specify that the Fukui traps are unmodified. The condition of potential bycatch in traps should be carefully considered. Most bycatch is returned alive at capture sites but there have been incidental reports of mortality of trapped mammals. An additional table will be provided in the revised Research Document which will summarize these factors as requested by the meeting participants.

Participants agreed that the advice should specify geography, given the sources of information originated from both Pacific and Atlantic coasts. Common guidance was developed to be broadly applied across Canada. There may be a need for further nuanced advice tailored to specific coasts or regions.

TRAP COMPARISON AND USAGE

Authors presented a trap comparison and there was a discussion on advantages and disadvantages of different traps and strategies. Trap choice and the deployment method depend on many different factors, such as, but not limited to, time of the year, location, and trap design elements such as mesh size and entrance configuration. A gap in knowledge of trapping

for juvenile EGC was identified, however participants did add some experiences that enriched this section.

Trapping smaller EGC may be improved by:

- Targeting specific locations such as nurseries (vegetation areas with eelgrass beds, clam beds, mussel beds, and seaweed), shale, and mud.
- Using smaller mesh sizes, or retrofitting fly screen or landscape fabric to the traps, to retain small crabs that might otherwise escape traps with larger mesh sizes.

Based on the Working Paper and experience, participants discussed various considerations in trapping success, including:

- Frequency of trap deployment.
- Local food availability.
- Target population and behavior (for example, male, female, size).
- Bait (how deployed, use of, type).
- Method of deployment (e.g., from shore or from a boat).

Participants discussed trapping objectives, including early detection surveys, rapid response surveys, monitoring, research, and control. A participant noted that it was not clear how to use trapping as a method to prevent establishment. After rapid response trapping is completed to gather initial information on EGC in an area, it was recommended to next evaluate the level of effort required to impact the population. This will inform next steps including decisions related to transition trapping towards control measures, where trapping is sustained and adjusted accordingly at the location. Participants emphasized that it must be made clear that trapping is a tool with limitations and must not be assumed to be the sole solution to an invasion. Discussions provided additional clarity to the information presented and summarized in Table 6 of the Research Document.

Questions arose on the target population and trapping. It was emphasized that it is not always the intent to target large male EGC. However, the same trap deployed at different times of year will trap different demographics, based on the life cycle and seasonality of EGC. For instance, trapping in early June or July generally yields more males in most locations, which can decrease the male proportion of the population. Whereas, waiting to deploy traps until after females have released their eggs can target females when they begin foraging for food. Subsequently, by autumn there are proportionally fewer large males and more females caught. The Working Paper will be revised to clarify that large males are not exclusively targeted and trapped.

Critical questions when making decisions related to trapping include:

1. What is the objective of the trapping? Why is it taking place? These questions are related to the target EGC population.
2. How will the trapping be conducted? Is it shore-based, on small vessels, or on larger vessels? Who will be trapping?
3. What are the potential unexpected consequences? There are additional precautions for vulnerable bycatch mortality, and protected areas.

Fisheries and Oceans Canada (DFO) will continue to work with stakeholders and partners. The advice generated by this CSAS process may be useful to outside organizations who are considering EGC trapping.

KNOWLEDGE GAPS AND OTHER CONSIDERATIONS

There is a lack of information on trapping juvenile EGC. Participants agreed that the definition of juvenile needs to be clarified in the Research Document, whether based on size or reproductive stage, because the usage varied between information sources. Participants discussed how immaturity may be defined differently between the Pacific warm-water strains and the Atlantic hybrid strains of EGC. While reproductive size was acknowledged to be surprisingly small, and EGC with carapace widths of 26–32 millimeters have been found to be berried and therefore reproductive, it is difficult to indicate immature EGC by size alone.

There is a lack of information on effective threshold levels for functional control to prevent impact on fisheries and sensitive habitats. Thresholds based on crab size were discussed as a possible objective.

Other considerations include:

- External factors influencing CPUE of trapping such as local environmental conditions and food competition.
- Due to their cannibalistic behaviour, removal of large EGC allow smaller EGC to thrive, as juveniles escape cannibalistic predation by larger adults.
- Trap modifications to prevent bycatch mortality and ghost fishing.
- It is unlikely that trapping alone will be fully successful to control EGC. It needs to be ongoing, in conjunction with other mitigation measures, e.g., cleaning, draining, and drying gear and vessel tanks to prevent introduction and spread of adult and juvenile EGC. The presence of reintroduction and larval supply must considered for an effective mitigation plan.
- Invasion status or how long the EGC have been established in the area.

Observations from year to year may not have a strong relationship with trapping activity. Generalized instructions to do more trapping may not consider all factors, and conversely, as trapping continues it cannot be certain that EGC numbers or sizes are decreasing. Trapping is most often done in a small system that is not independent of the larger surrounding environment. Trapping may be able to suppress numbers but not completely eliminate them, and the law of diminishing returns results in a plateauing of trapping success unless effort is increased. Regarding larval supply, there is the possibility that different methods can be combined, such as sampling using plankton nets, for larvae in the water column that could be part of early detection or monitoring activity, prior to or in addition to EGC trapping.

DEVELOPMENT OF THE RESEARCH DOCUMENT AND SCIENCE ADVISORY REPORT

The Working Paper received positive feedback from reviewers. Participants were offered a final chance to provide additional editorial comments for two weeks after the conclusion of this National Advisory Meeting. Participants agreed that the Working Paper is approved for publication as a Research Document with the revisions recommended and discussed at the meeting. Volunteer editors will perform a final review, prior to publication.

A reference to Table 5 (revised Table 6) of the Working Paper (covering the applications of the different trap types, and includes important characteristics and deployment logistics) was included in the Summary Bullets of the Science Advisory Report. It was challenging to draft wording that succinctly captured the two knowledge gaps of juvenile trapping and thresholds at the meeting. A final bullet and the revised table was shared with participants. The draft Science Advisory Report was also shared prior to publication.

APPENDIX 1: TERMS OF REFERENCE

COMPARISON OF TRAPPING METHODS FOR INVASIVE EUROPEAN GREEN CRAB

National Advisory Meeting – National Capital Region

September 28-29, 2021
Virtual Meeting

Chairperson: Sophie Foster

Context

European green crab (*Carcinus maenas*) is a voracious aquatic invasive species (AIS) that poses a serious threat to Canada's marine and estuarine ecosystems on the Pacific and Atlantic coasts. They prey on commercial and recreational shellfish, compete with commercial fisheries, and destroy ecologically and biologically-significant habitat, including eelgrass beds, for native species.

Fisheries and Oceans Canada (DFO) has acquired substantial knowledge on European green crab, particularly regarding trapping as a form of physical removal to control their spread. Knowledge acquired includes information on species life history and biology, population dynamics, gear types, and, in some cases, Catch per Unit Effort (CPUE) of trapping gear (e.g., Fukui traps, fyke nets), as well as bycatch, control measures, and mitigation strategies. However, much of this knowledge has yet to be captured formally in a comprehensive review that can be applied to AIS management.

DFO's AIS National Core Program has requested science advice because trapping of European green crab is critical for early detection, determining impacts on native species and habitat, and control efforts to prevent ecosystem degradation and commercial fishery loss. In order to translate DFO's scientific knowledge into management action, information on various removal techniques and strategies must be incorporated into decision-making and be adaptable to different situations, such as variation in habitat, gear type, and trapping goals, balanced with operational capacity.

Objectives

1. Review and characterize gear that has been used for trapping European green crab on Canada's Atlantic and Pacific coasts, considering specific trapping goals (e.g., early detection, ecosystem impact evaluation, population control) and how technologies vary by habitat, organism life stage, by-catch, and catch per unit effort (CPUE).
2. Based on this review, provide recommendations on gear type for trapping European green crab, considering feasibility and logistics.
3. Identify knowledge gaps regarding trapping methods.

The goal of this advice is to provide AIS managers with an overview of existing relevant information regarding European green crab trapping relevant to their trapping objectives. This information could be incorporated by managers into a decision-making tool for guiding action.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Expected Participation

- Fisheries and Oceans Canada (DFO)
- Provinces and Territories
- Indigenous Peoples
- Parks Canada
- Academia

APPENDIX 2: AGENDA

Day 1: September 28, 2021

Time (EST)	Topic	Lead(s)
11:00 – 11:10	Welcome and Introductions	Chair
11:10 – 11:20	Overview of National CSAS Peer Review Process and Terms or Reference	Chair
11:20 – 11:30	Request for Advice and Context	AIS NCP
11:30 – 11:45	Objectives, Scope, European Green Crab Trapping in Canada	Cynthia
11:45 – 12:15	Sources of Information Methodology for Review	Michael
12:15 – 1:00	Results: Trapping Methods – Trap Types	Philip
1:00 – 2:00	Break	
2:00 – 2:30	Results: Trapping Method Considerations Deployment, Environment, Behaviour, Catch	Cynthia
2:30 – 3:00	Discussion: Trap Comparison and Usage Early Detection, Rapid Response, Monitoring, Research and Control	Kyle
3:00 – 3:30	Knowledge Gaps, Other Considerations and Conclusions	Cynthia
3:30 – 4:00	Outstanding Items, Day 1 Recap	Chair

Day 2: September 29, 2021

Time	Topic	Lead(s)
11:00 – 11:05	Brief Welcome - Roll Call	Chair
11:05 – 11:30	Review and Discussion of Day 1	Chair/All
11:30 – 12:00	Additional Reviewers Comments	Chair/Cynthia

Time	Topic	Lead(s)
12:00 – 12:30	Feasibility, Limitations, and Sources of Uncertainty related to EGC Trapping and Client Advice Needs	Cynthia
12:30-1:00	Review of Conclusions and Recommendations	Chair/All
1:00 – 2:00	Break	
2:00 – 2:45	Science Advisory Report Discussion - Summary Bullets - Terms of Reference Objectives Review	Chair/All
2:45 – 3:30	Science Advisory Report Discussion - Knowledge Gaps, Other Considerations Conclusions and Recommendations	Chair/All
3:30 – 4:00	Outstanding Items, Closing Remarks	Chair

APPENDIX 3: LIST OF PARTICIPANTS

Name	Affiliation
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