

Management and Status of Invasive European Green Crab in the Salish Sea: White Paper



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Executive Summary

This White Paper provides a summary of the problems European green crab (EGC) pose to the Salish Sea, a proposed solution, benefits of that solution, and a call to action. The Salish Sea is at high risk of invasion from EGC, that have caused economic and ecosystem harm in other regions of the world. The proposed solution is implementation of the newly produced *Salish Sea Transboundary Action Plan for Invasive European Green Crab* (Action Plan or Plan). The Plan outlines a clear pathway for effective and efficient management of EGC to prevent their establishment and identifies 63 specific actions within a framework of 18 strategies that address six overarching objectives. In addition, 47 performance measures are identified to ensure the actions taken are meeting objectives. The next steps in the call to action include:

1. Gathering signatures from partners and stakeholders stating that they recognize EGC management is essential for the protection of the Salish Sea;
2. Securing short-term funding to continue current levels of early detection monitoring and rapid response capacity; and
3. Securing long-term funding to ensure effective and efficient EGC management into the future.

Introduction

The Salish Sea is at high risk of invasion from European green crab (EGC). Potential impacts of an EGC invasion in the Salish Sea include degradation and destruction of eelgrass and estuarine marsh habitats, threats to the harvest of wild Salish Sea shellfish and the shellfish aquaculture industry, threats to the Dungeness crab fishery, threats to salmon recovery (and by extension threats to orca recovery), and a complex array of additional ecological impacts to food webs, all of which negatively impact the human uses and cultural resources of the Salish Sea.

Problem Definition

The EGC is included on the International Union for Conservation of Nature's (IUCN) list of 100 of the world's worst alien invasive species (IUCN, 2018), it is classified as a prohibited level 1 species in Washington State, and is classified as a species for control in Canada. EGC devastates aquatic ecosystems, displacing native species, degrading and disturbing native habitats (including eelgrass), and altering food webs (Figure 1). As a voracious consumer of bivalves, it also has caused significant harm to shellfish industries, particularly on the US East Coast. EGC pose serious risks to the economy and ecology of the Salish Sea.

The EGC is a notorious aquatic invasive species, able to survive a wide range of temperatures and salinities. To reproduce, individual EGC are capable of releasing hundreds of thousands of larvae that can live up to 80 days and travel hundreds of kilometers on ocean currents. It is a generalist feeder, digging in the sediment for bivalves and other prey and has been linked to (among other documented impacts globally):

- Massive declines in commercial bivalve crops (reducing softshell clam landings from 15.4 million pounds or 7 million kilos to 2.3 million pounds or 1 million kilos) on the east coast of the U.S., contributing to fishery collapse (Glude 1955);
- Decimation of native clams and shore crabs in at least one California embayment causing alterations of the food web (Grosholz et al. 2000); and

- Substantial reduction (up to 75%) in eelgrass density in Nova Scotia and Newfoundland (Garbary et al. 2014; Matheson et al. 2016).



FIGURE 1. Photos of Maquoit Bay, Maine, before and after dense European green crab populations decimated healthy eelgrass beds and the ecologies they support. Photos by Hillary Neckles/U.S. Geological Survey (Grason et al., 2016). See <https://www.pressherald.com/2015/10/28/invasive-species-exploit-warming-gulf-maine-sometimes-destructive-results/> for interactive photos and full story.

The EGC is native to the western and northern shorelines of Europe. It has spread through various pathways across the globe, establishing on the east coast of the United States more than 200 years ago. The EGC became established on the west coast of the United States prior to 1989 in San Francisco Bay. It has since spread north and south, becoming established in 1998 on the Pacific coasts of Washington State and Vancouver Island in British Columbia (Behrens Yamada et al., 2015; Gillespie et al., 2007).

In 2012 DFO confirmed the first established Salish Sea EGC population in Sooke Basin on the Strait of Juan de Fuca. Since that time both DFO and WSG Crab Team have conducted early detection monitoring widely across the Salish Sea at sites identified as most suitable to EGC survival, but covering only about a quarter of all possible sites (Figure 2). DFO Science has trapped opportunistically along the BC shorelines of the Strait of Juan de Fuca, Southern Gulf Islands, and the Strait of Georgia several times since 2012.

As of October 2018, the EGC has been found at several other Washington State locations, including Dungeness Spit (USFWS Dungeness National Wildlife Refuge), Dungeness Landing River Park, Sequim Bay, Westcott Bay, Padilla Bay, Fidalgo Bay, Lagoon Point, and Kala Point and Scow Bay (collectively labeled as Pt. Townsend; Figure 3). With the exception of Dungeness Spit, only one to six crab have been captured at each location. In British Columbia, the EGC has been collected at Becher Bay, Port Renfrew and Witty's Lagoon, in addition to Sooke (Figure 3).

These detections confirm that there is high risk of EGC expanding into the Salish Sea, that early detection has been successful, that corresponding rapid response efforts have shown EGC continue to be rare at most

locations where they were detected, and that management actions are necessary to prevent them becoming established in either Washington State or British Columbia waters of the interior Salish Sea.

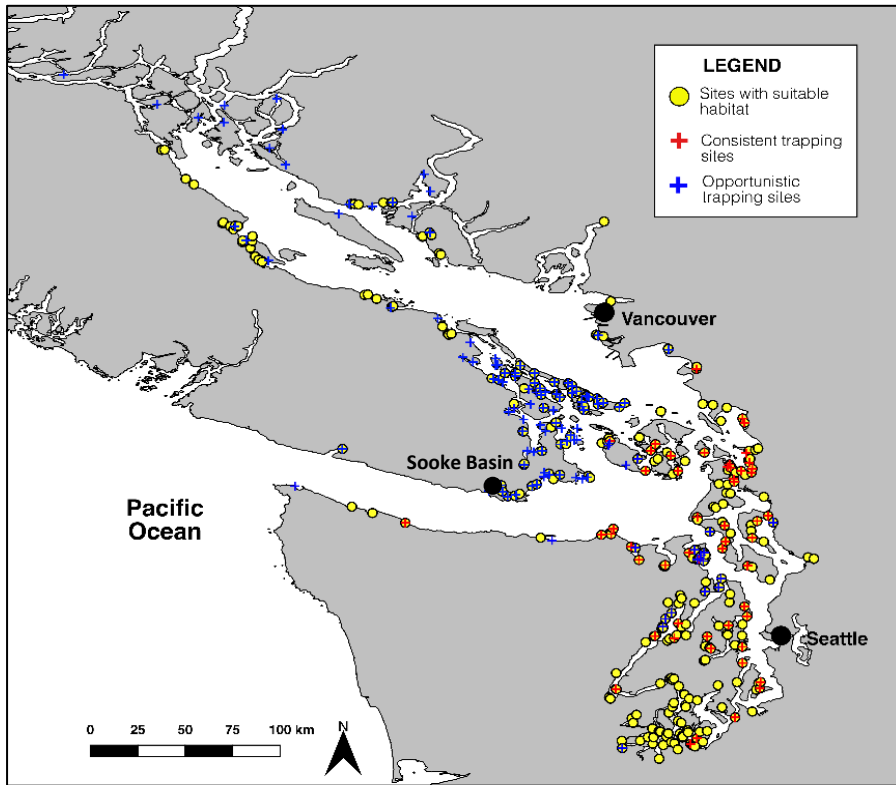


FIGURE 2. Map of European green crab suitable habitat and trapping in the Salish Sea. Suitable habitats indicate sites with medium to high suitability for European green crab based on semi-quantitative algorithm developed by WSG (Grason et al. 2016), but note that assessment of suitable habitat for Canadian shorelines is incomplete. Sites with consistent trapping indicate WSG Crab Team monitoring sites currently trapped each month (April - September) as part of Washington's early detection program. Sites identified as opportunistic trapping sites have had at least one monitoring effort since 2012, but are not regularly trapped. Map data current as of 10/15/18.)

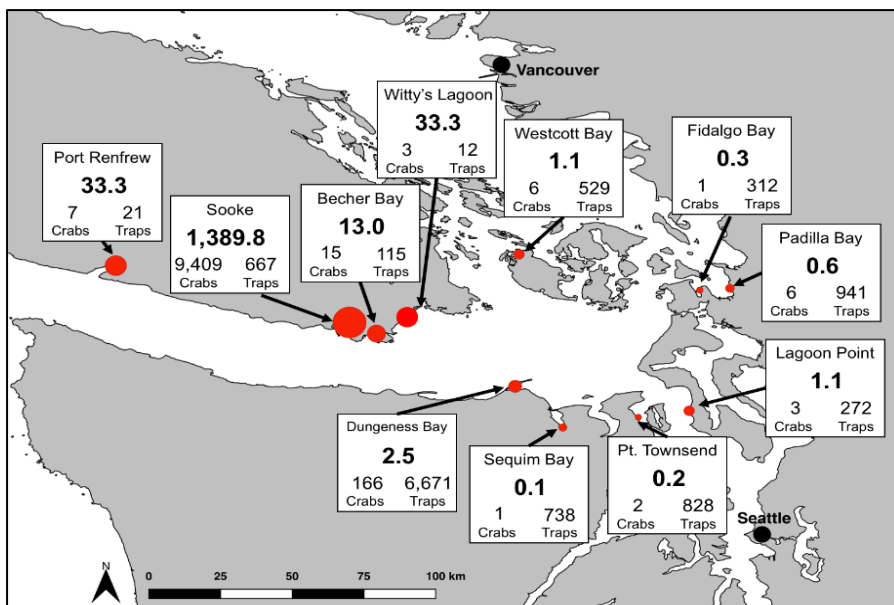


FIGURE 3. European green crab in the Salish Sea. Map of catch per unit effort (CPUE) of European green crab at all detection sites within the Salish Sea. The size of site markers is scaled (logarithmically) with CPUE which is defined as average number of EGC per 100 trap-days, including all trapping effort recorded since 2012. Because effort varies substantially geographically, actual catch (number of crabs) and effort (trap-days) for each location are reported below CPUE. Map data current as of 10/15/18.

Solution Details

The current response to early detections of EGC in the Salish Sea is a success story seldom seen in the world of Aquatic Invasive Species (AIS) management. Rather than playing 'catch up', we are ahead of the curve, acting aggressively to understand, identify and prevent incursions of EGC before they take hold and cause

the dramatic impacts to the Salish Sea ecology and shellfish industry that have been seen on the East Coast of the United States and elsewhere around the globe.

The discovery of EGC in Sooke Basin in 2012 galvanized a forward-thinking management strategy in Washington State, capitalizing on an already active and engaged citizen science community to help detect EGC incursions into the Salish Sea as early as possible. In 2015, in partnership with WDFW, Washington Sea Grant launched Crab Team, a robust citizen science and outreach program to expand the scope of early detection. This strategy paid off when individual EGC were detected in 2016 by Crab Team volunteers in Westcott Bay (San Juan County) and by outreach staff in Padilla Bay (Skagit County). The subsequent rapid response actions, involving large scale trapping efforts designed in coordination by WDFW and WSG Crab Team scientists and implemented by partners, set the model for all rapid responses to follow.

Subsequently, the discovery in 2017 of EGC at Dungeness Spit, part of the Washington Maritime Wildlife Refuge resulted in another successfully coordinated, science-based adaptive management response involving a team of partners executing multi-day trapping efforts at select sites with habitat suitable for EGC. The current site management activities, including active trapping throughout suitable habitats at Dungeness Spit, mobilization of engaged volunteers, education of refuge visitors, coordination of partners, and standardized data collection, are on track to keep this population within a manageable size. This will prevent massive larval spread to other parts of the Salish Sea and local impacts to the ecology of the refuge.

The *Salish Sea Transboundary Action Plan for Invasive European Green Crab* (Action Plan or Plan) was recently developed to guide EGC management for 2019 and beyond. The Action Plan was developed through the expertise of members of the *ad hoc* Transboundary European Green Crab (TEGC) Working Group, comprised of representatives from Washington Department of Fish and Wildlife, Department of Fisheries and Oceans Canada, Washington Sea Grant, University of Washington, and the Puget Sound Partnership. The purpose of the Plan is to establish and implement a coordinated and collaborative response to incursions of EGC that pose a risk of harming or threatening the environmental, economic, or cultural resources within the shared waters of the Salish Sea. The Salish Sea includes Washington State's Puget Sound, the Strait of Juan de Fuca and San Juan Islands and British Columbia's Gulf Islands and Strait of Georgia. The six overarching plan Objectives are:

1. Collaboratively manage the response to EGC.
2. Prevent human-mediated introduction and spread of EGC.
3. Detect EGC presence at earliest invasion stage.
4. Rapidly eradicate or reduce newly detected populations.
5. Control persistent infested site populations to eliminate or minimize environmental, economic and human resource harm.
6. Conduct research to develop increasingly effective adaptive management strategies.

Benefits

It is not too late. There is still opportunity to avoid major impacts from EGC in the Salish Sea by taking decisive and aggressive actions to contain populations and to prevent further introduction and spread to other parts of the Salish Sea. The proposed Action Plan provides a science-based, cost-effective framework to manage EGC thereby preventing the much higher environmental, economic and cultural costs if EGC become established in the Salish Sea. Further, The Plan provides an integrated management approach that relies on a wide range of international partners and stakeholders including citizen science volunteers, shellfish growers, state/ provincial and local governments, Tribes/First Nations, and federal governments/ agencies.

Call to Action

The *Salish Sea Transboundary Action Plan for Invasive European Green Crab* provides a clear pathway for effective and efficient management of EGC to prevent their establishment. The Plan identifies 63 specific actions within a framework of 18 strategies that address the six overarching objectives. In addition, 47 performance measures are identified to ensure the actions taken are meeting objectives. The next steps in the call to action include:

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