



September 2023

**Early Detection and Rapid Response Plan for  
Invasive European Green Crab (*Carcinus maenus*)  
in Alaska, 2023-2028**

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# Glossary

## Acronyms used in this document:

ADEC — Alaska Department of Environmental Conservation  
ADF&G — Alaska Department of Fish and Game  
ADNR — Alaska Department of Natural Resources  
AKISP — Alaska Invasive Species Partnership  
AIS — Aquatic invasive species  
DFO — Department of Fisheries and Oceans Canada  
DMLW — Division of Mining, Land and Water  
DPOR — Division of Parks and Outdoor Recreation  
EGC — European green crab  
EPA — U.S. Environmental Protection Agency  
ICS — Incident Command System  
IPM — Integrated Pest Management  
KBNERR — Kachemak Bay National Estuarine Research Reserve  
MIC — Metlakatla Indian Community  
MOU — Memorandum of Understanding  
NOAA — National Oceanic and Atmospheric Administration  
USCG — U.S. Coast Guard  
USFWS — U.S. Fish and Wildlife Service

## Definitions

- **Contain**—To prevent an invasive species from spreading outside a designated infested site.
- **Containment**—A tool to prevent further transport of existing invasive species or to reduce the impact of existing invaders. Strategies for containment generally combine tools used in prevention and eradication.
- **Control**—Suppressing, reducing, or managing invasive species populations to a density below their economic and/or ecological thresholds of harm using integrated pest management techniques.
- **Detection**—The verification of an invasive species' presence as determined by the Alaska Department of Fish and Game, the Department of Fisheries and Oceans Canada, tribal sovereign nations, and others within their respective jurisdictions.
- **Early detection**—Invasive species are detected at the earliest point in the invasion process to allow cost effective and environmentally sound decisions to be made to prevent their spread and establishment.
- **Eradicate**—To remove or destroy an entire population of invasive species.
- **Established**—A species having a self-sustaining and reproducing population in a specified geographic area without the need for human intervention (Iannone et al. 2020).
- **Functional eradication**—A strategy that focuses on suppressing populations of invasive species below levels that cause unacceptable negative impacts on conservation targets (Green and Grosholz 2020).

- **Integrated Pest Management**—A sustainable, science-based, decision-making process that combines biological, cultural, physical, and chemical tools to identify, manage and reduce risk from pests, and pest management tools and strategies in a way that minimizes overall economic, health and environmental risks (IPM Institute of North America 2023).
- **Introduced species**—Species that have been transported by human activities, either intentionally or unintentionally, into a region in which they did not occur in historical time and are now reproducing in the wild (Carlton 2001).
- **Invasive Species**—A species that is not native to the ecosystem under consideration and whose introduction does, or is likely to cause, economic or environmental harm, or harm to human health (Executive Order 13112).
- **Management**—To prevent, control, and/or eradicate the introduction or spread of invasive species.
- **Molt**—The shell remaining after a crab sheds its exoskeleton.
- **Monitoring**—The coordinated set of actions to detect presence of aquatic species in an ecosystem to which they are not native or unknown previously to occur.
- **Partners**—Entities who participate in planning, surveillance, response, management, funding, or research at some level.
- **Prevention**—Preventing spread of invasive species from areas where they are present, and taking steps, such as restoration of native species and habitats, to reduce the effects of invasive species and to prevent further invasions (Executive Orders 13112 and 13751).
- **Rapid Assessment**—A large, multi-day intensive trapping, or other surveillance method, across suitable habitat in and around the water body where an observation has occurred.
- **Rapid response**—Expedited management actions triggered when invasive species are detected, for the time-sensitive purpose of containing or eradicating the species before it spreads or becomes further established (RCW 77.135.010).
- **Surveillance**—Activities to detect new introductions of aquatic invasive species.
- **Verification**—The scientifically-based process to confirm the presence and species identity of aquatic invasive species.



Figure 1. Jasmine Maurer of Kachemak Bay National Estuarine Research Reserve instructing Homer EGC exercise participants on invasive crab protocols. Photo credit: George Buckner.

# Executive Summary

The European green crab (EGC) is a global invader that causes significant detrimental environmental, economic, and social effects upon establishment. Identifying, prioritizing, and implementing prevention, early detection and rapid response, control and management, and research actions that address incipient and established populations of EGC are critical to Alaska’s natural resources, economy, and the livelihoods of its residents. The purpose of this plan is to provide guidance to partners and other entities for surveillance, monitoring, suppression, and control of EGC populations along Alaska’s coastline to minimize the detrimental effects of EGC on Alaska’s environment, culture, and economy.

EGC were first detected on the West Coast of North America in 1991. In the 32 years since that initial discovery, EGC have spread north to Washington, British Columbia, and Alaska, likely through planktonic larval dispersal. In July of 2022, the shell of a dead EGC was discovered on a beach in Southeast Alaska within the jurisdiction of the Metlakatla Indian Community (MIC). As of August 2023, the MIC has trapped 2,169 live EGC and have discovered 119 EGC carapaces.

Multiple entities have management responsibility for coastal ecosystems in Alaska. Whereas many entities play a role in EGC research, outreach, and management efforts, the following entities have jurisdictional responsibilities for EGC in Alaska:

Organization	Jurisdictional Role
Alaska Department of Fish and Game (ADF&G)	EGC management authority in all waters owned by the State of Alaska
Alaska Department of Natural Resources – Division of Parks and Outdoor Recreation (DNR)	Other state-owned land outside of generally allowed use for other specific practices
Metlakatla Indian Community (MIC)	EGC management authority within its Annette Islands Reserve lands and waters
U.S. Fish and Wildlife Service (USFWS)	EGC management authority in submerged lands and monuments managed by the USFWS
U.S. Forest Service (USFS)	EGC management authority in waters and coastal areas managed by the USFS
National Park Service (NPS)	EGC management authority in waters and coastal areas managed by the NPS
National Oceanic and Atmospheric Administration (NOAA)	EGC management authority in EEZ waters
Department of Fisheries and Oceans Canada (DFO)	EGC management authority in British Columbia coastal waters

The Incident Command System (ICS) is an effective framework to organize and direct site-specific responses to detections of AIS. The system has been modified and is being used to address the suite of actions associated with detections of high-risk deleterious aquatic invasive species, including species, such as dreissenid mussels and EGC. In Alaska, potential exists for partner organizations to employ a Unified Command, which would allow two or more partner agencies with geographical or functional responsibility for an incident to assign incident commanders from each to a Unified Command organization.

If a EGC carapace or live adult is detected and verified by ADF&G, deliberate actions will be taken to determine the magnitude of the invasion, and appropriate response actions. These steps include: verification of observation, rapid assessment, declaration of emergency, notification communication, delineate scope of response, activate incident command system and response team, implement response actions, and step down ICS to long-term management.

This action plan contains a suite of actions to address existing and new detections of EGC in Alaska in the areas of prevention (two objectives, nine strategies), early detection (one objective, five strategies), rapid response (one objective, seven strategies), and control (one objective two strategies). Performance metrics were developed for each strategy to evaluate success through time.

This plan contains a EGC Community Toolkit that is a guide and resource for Alaskan communities to address EGC. The toolkit contains information on the importance and value of early detection monitoring, surveillance methods and protocols, equipment lists and sources, outreach materials (websites, videos, etc.), information to help identify EGC from other commonly observed crab species, molt walk and other EGC protocols, how to report a sighting of EGC, EGC response steps, EGC publications, and EGC agency and organization contacts.

Appendices included in the plan include information on EGC biology as well as ecological and economic impacts, laws and regulations pertaining to EGC in Alaska, contact information for the Alaska Invasive Species Partnership Marine Committee, an example press release to be used upon detection of EGC, an example of an Emergency Proclamation by the Alaska Governor, draft guidelines for EGC rapid assessment, and an example of a memorandum of understanding with partner organizations in Alaska.

# Plan Purpose, Goal, and Objectives

The European green crab (EGC) is a global invader that causes significant detrimental environmental, economic, and social effects upon establishment. Identifying, prioritizing, and implementing prevention, early detection and rapid response, control and management, and research actions that address incipient and established populations of EGC are critical to Alaska's natural resources, economy, and the livelihoods of its residents.

## Purpose

The purpose of this plan is to provide guidance to partners and other entities for surveillance, monitoring, suppression, and control of EGC populations along Alaska's coastline.

## Goal

This early detection and rapid response plan will minimize the detrimental effects of EGC on Alaska's environment, culture, and economy.

## Objectives

To achieve this goal:

**Objective 1. Prevention** — Outreach and education to increase awareness of EGC and decrease propagule pressure via vector and source population management.

**Objective 2. Early Detection** — Partners and volunteers will implement community-based early detection surveillance and monitoring protocols to detect new or previously unreported EGC populations.

**Objective 3. Rapid Response** — Partners will respond quickly and effectively to new introductions of EGC to eradicate or reduce the population to the maximum extent possible.

**Objective 4. Control** — For those EGC populations that cannot be eradicated, partners will implement actions to minimize the size of and/or area impacted by the population.



Figure 2. European green crab trapped by the Metlakatla Indian Community. Photo credit: Martin Media.

# Introduction

## ■ Status and Distribution of European Green Crab on the West Coast of North America

The European green crab (EGC, *Carcinus maenas*) is native to coastal Europe and North Africa, but is currently established in North America, Australia, Argentina, Japan, and South Africa.

The first records of EGC for the West Coast of North America begin in 1991, when a local fisherman discovered an unidentified crab in bait traps in Drakes Estero, an estuary north of San Francisco. Cohen simultaneously discovered a EGC molt on the East Bay shore (Cohen et al. 1995). In the 32 years since that initial discovery, EGC have spread north to Washington, British Columbia, and Alaska, likely through planktonic larval dispersal (Behrens et al. 2000).

From 2011 to 2021, the Pacific Northwest witnessed rapid EGC population expansion in abundance and distribution. In 2022, Department of Fisheries and Oceans Canada (DFO) staff detected EGC populations at least 100 miles north of Vancouver Island within two embayments along the coastal mainland of Queen Charlotte Sound. In 2012, the DFO documented an EGC population in the Sooke Basin on the Strait of Juan

de Fuca (Drinkwin et al. 2019), a record linear range expansion rate for a marine animal (Kuris et al. 2005). Discovery of EGC in the Washington portion of the Salish Sea occurred in 2016, followed by detections in 2017 and 2018 of small populations in additional Salish Sea locations in Washington. In 2021, more than 70,000 EGC were discovered in a sea pond on the Lummi Reservation. That same year, established populations of adult EGC were found on Haida Gwaii near Queen Charlotte Sound (Figure 1). These populations were about 580 miles from the Alaska border.

In July of 2022, the shell of a dead EGC was discovered on a beach in Southeast Alaska within the jurisdiction of the Metlakatla Indian Community (MIC). The MIC began trapping efforts in hotspot locations, such as Tamgas Harbor on Annette Island, and other locations (Figure 2). As of August 2023, the MIC has trapped 2,169 live EGC and have discovered 119 EGC carapaces (upper shells). For updated numbers and status of efforts by the MIC to minimize EGC populations, visit their website at: <https://www.metlakatla.com/fishwildlife>.



Figure 3 (top). Distribution of EGC - October 2022. Tan dots note trapping locations. Red dots note detections of EGC. Figure 4 (left). EGC collected using shrimp traps from the Metlakatla Tamgas Harbor in October of 2022. Photo courtesy of Dustin Winter.

## ■ Pathways of Introduction and Current Suitability in Alaska

Human-mediated pathways and planktonic dispersal are responsible for the introduction and spread of EGC globally. Human-mediated pathways include ship-ping, recreational and commercial boating, commercial trade of live food and bait, the aquarium and water garden trade, unauthorized introductions, and aquaculture practices (Drinkwin et al. 2019). Perhaps the most probable means by which EGC arrived in Southeast Alaska is favorable ocean conditions and currents that support the natural dispersal of EGC larvae, likely from several different populations on the West Coast (Yamada et al. 2015). Favorable ocean conditions for EGC dispersal include warm winter water temperatures, high Pacific Decadal Oscillation and El Niño Southern Oscillation Indices, and an abundance of southern copepods, which contribute to stronger EGC year classes (Yamada 2020). These same West Coast populations have contributed to the introduction and establishment of EGC populations in the eastern Salish Sea, British Columbia, and elsewhere (Brasseale et al. 2018).

Several research efforts have documented the potential risk of EGC establishment throughout Alaska. Hines et al. (2004) determined several sites within Prince William Sound and elsewhere in Alaska had warm enough water conditions (at that time and not considering changes to water conditions caused by climate change stressors) to support self-sustaining EGC populations, noting that Alaska was at risk to invasion by EGC. De Rivera et al. (2007) forecasted the northward spread of EGC among other marine nonindigenous species using Environmental Niche Modeling. This model predicts that if ocean temperatures increase by 2°C, then EGC could expand as far north and west as Norton Sound, Alaska. Yamada and Gillespie

(2008) predicted EGC would spread to northern British Columbia and Alaska with continued good recruitment and mild winters.

In 2009, Davidson et al. predicted Alaska invasion of EGC from small, ephemeral, and seasonal recruitment events, especially when ocean conditions are favorable. They noted that vigilant monitoring of ocean conditions could predict strong recruitment years (Davidson et al. 2009). Establishment models used in 2009 revealed that EGC could persist in Alaska from southeast Alaska as far north as Cape Romanzof, citing habitats with four characteristics may be especially prone to invasion, including protected, or semi-protected wave exposures; sand and mudflats in low intertidal areas; eelgrass in low intertidal/shallow subtidal areas, and saltmarsh vegetation in the supra-tidal zone (Harney 2008).

Reimer et al. (2017) developed a semi-quantitative ranking system to assess the potential risk of non-native marine species to the Bering Sea based on criteria and characteristics that would facilitate arrival, establishment, expansion, and damage in the Bering Sea. Criteria included current habitat and distribution, biological characteristics, transportation, and establishment associated with anthropogenic activities, and the potential ecological and socioeconomic threat of each of the species considered (Reimer et al. 2017). Of the 46 species investigated, EGC ranked among the top 10 non-native species of concern. The Bering Sea Marine Invasive Species Assessment (Reimer et al. 2017) ranked the EGC 69.5 points out of a total possible 100 points, or highly invasive, based on distribution and habitat, anthropogenic influence, biological characteristics, and impacts (Shaw 2017).



Figure 5. European green crab in seaweed.

# European Green Crab Early Detection and Response Actions: Models of Success

## Seadrift Lagoon, California

EGC were discovered in Bolinas and Seadrift Lagoons in the early 1990s and were speculated to serve as a source of EGC larvae to other sites within Bolinas Lagoon as well as nearby bays and estuaries. Trapping was initiated in 2009, and all crabs removed from the area were composted. Although there were challenges in reducing the population, this project serves as an example of how numerous entities, including academia, volunteers, and homeowners can work together to reduce a EGC population, lessening the effects of EGC on native species and reducing the potential for larval dispersal to other sites.

## Sooke Basin, British Columbia

The detection of EGC in the Sooke Basin on the West Coast in 2012 resulted in a series of response actions that included active trapping, mobilization of volunteers, outreach and education, partner coordination and collaboration, and data collection and sharing that implementers believed would serve as a model for future detections (Drinkwin et al. 2019). As a result of these ongoing activities, it is predicted that natural larval spread of EGC to other areas will be minimal.

## Salish Sea, Washington

European green crab were detected in Westcott Bay and Padilla Bay in 2016, and large-scale trapping efforts were conducted to limit the size of the population and minimize their spread to other areas. In 2017, EGC were detected on Dungeness Spit, and aggressive trapping was initiated to limit the size of the EGC population and minimize their spread. Trapping efforts continue to minimize populations. After EGC were discovered in the Sooke Basin, Washington issued an Emergency Declaration through its Governor's office, and initiated efforts to enhance EGC detections

In January of 2022, Washington Governor Jay Inslee issued an emergency order intended to address the growing EGC population in Lummi Nation's Sea Pond and other coastal areas. The order directed the Washington Department of Fish and Wildlife to implement

eradication and control efforts, and elevated management of this species as a high priority for the Departments of Ecology and Natural Resources as well as the State Parks and Recreation Commission. As of October of 2022, the Washington Department of Fish and Wildlife removed more than 170,000 EGC from Washington waters.

## Pacific Coast, Alaska

Since the early 2000s, numerous communities throughout southern Alaska have been participating in the Alaska Green Crab Monitoring Network to monitor for the presence of EGC. The 2009 Alaska EGC Rapid Response Plan documented the communities from Dutch Harbor to Ketchikan monitoring for EGC invasions.

## Metlakatla Indian Community, Alaska

With funding from National Oceanic and Atmospheric Administration (NOAA), the Metlakatla Indian Community (MIC), located in SE Alaska, initiated an EGC early detection program in 2020. In July of 2022, the MIC detected EGC carapaces during shoreline molt surveys. After this first detection of EGC in Alaska, MIC initiated an intensive trapping effort that led to detection of live EGC in August of 2022. Although the outcomes of their trapping efforts have yet to be realized, the existence of an early detection program has proven to be important.

# Monitoring European Green Crab in Alaska

In 2009, the Aquatic BioInvasion Research & Policy Institute produced an Early Detection and Rapid Response Plan for the European Green Crab in Alaska for the Alaska Department of Fish and Game (ADF&G) (Davidson et al. 2009). The plan documented a detection and monitoring protocol for EGC using trapping and shoreline surveys. Protocols used were consistent with Kachemak Bay National Estuarine Research Reserve (KBNERR) and the National Marine Sanctuary Program. The protocol recommended deploying slightly submerged traps at low tides in low-intertidal to shallow subtidal zones of wave-sheltered bays and estuaries (particularly estuaries with low salinity) (Yamada and Gillespie 2008), or habitats known to harbor EGC, as well as shoreline surveys for molts and individuals. The plan noted that if cancrivora crabs (e.g., Dungeness crabs) are present, then EGC may be found in high intertidal to mid-intertidal zones.

Since the early 2000s, numerous organizations have been participating in the EGC Monitoring Program of Alaska in Ketchikan, Juneau, Cordova, Valdez, Tatitlek, Whittier, Chenega Bay, Homer, Seward, Sitka, Petersburg, Kodiak, Cold Bay, King Cove, and Dutch Harbor. The public and members of stakeholder organizations participate in a coordinated community-based early detection network focused on marine invasive species. Interested stakeholders are invited to join the monitoring network. Participants receive sampling protocols, equipment, and, as needed, training to promote success. All early detectors are required to apply for an ADF&G issued Aquatic Resources Permit to handle native and banned invasive species and are asked to collect and share data according to the protocols. ADF&G hosts a toll-free invasive species hotline, 1-877-INVASIV, to receive reports of observations of EGC and other aquatic invasive species from monitors and the public.



Figure 6. Drone footage can be a very useful tool in identifying EGC habitat and access to trapping sites (large photo). A EGC trapped by the Metlakatla Indian Community (upper left photo). Photo credits: Martin Media.

# Management Roles for European Green Crab in Alaska

There are multiple entities with management responsibility for coastal ecosystems in Alaska. Many entities are engaged in early detection of EGC; however, the entity with responsibility for new detections and long-term management of EGC populations will depend upon where in Alaska the invasive crabs occur (Table 1). Entities with key leadership roles are summarized below. Additional opportunities exist for organizations throughout Alaska to engage in early detection activities.

## State Agencies

### Alaska Department of Fish and Game (ADF&G)

The mission of ADF&G is to protect, maintain, and improve the fish, game, and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the sustained yield principle. ADF&G strives to protect native fish and wildlife and the habitats that support them from impacts imposed by invasive species. EGC management is within the Aquatic Invasive Species (AIS) Program of ADF&G. The ADF&G AIS Program is responsible for (a) preventing the introduction of new AIS and (b) controlling or eradicating established AIS populations. Section 5 AAC 41.075 – Classification of banned invasive species (Alaska Administrative Code) classifies EGC as a banned invasive species. Alaska’s Aquatic Nuisance Species Management Plan identifies EGC as a real, or potential, threat to Alaska ecosystems (ADF&G 2022), and the state’s 2015 Wildlife Action Plan identifies EGC as a species that is considered a threat to wildlife and their habitats in Alaska (ADF&G 2015).



The ADF&G commissioner has authority to issue aquatic resource permits to allow possession, collection, and transport of aquatic organisms in marine waters, including banned invasive species.

The Division of Commercial Fisheries, Aquatic Farming Unit implements statutes and regulations associated with aquatic farming in Alaska to ensure the protection of the state’s fish, game, and aquatic plant resources and improve the economy, health, and well-being of the people of the state. ADF&G reviews applications and issues permits for mariculture and transportation of seed stock. The agency also certifies hatcheries and seed distribution facilities.

**Jurisdiction:** ADF&G has invasive EGC management jurisdiction in all waters owned by the State of Alaska.

#### Roles:

- Chairs and facilitates the AKISP Marine Committee
- Lead agency for EGC surveillance and monitoring activities in state waters
- Lead agency on EGC management projects in state water
- Lead agency on EGC suppression projects in state waters
- Partner agency on EGC eradication in non-state waters
- Partner agency on research efforts pertaining to EGC management
- Partner agency on outreach efforts pertaining to EGC management

### Alaska Department of Natural Resources (ADNR)

The Division of Mining, Land and Water (DMLW) manages all state-owned land and tidelands except for trust property and units of the Alaska State Park System. DMLW’s Aquatic Farm Leasing Program implements statutes and regulations associated with aquatic farming in Alaska which grant a property right allowing a lessee to develop the state’s tide and submerged lands into a shellfish or aquatic plant farm. The statewide Aquatic Farm Program is jointly administered by DMLW, ADF&G, and ADEC.



**Jurisdiction:** DMLW could potentially play a role in permitting associated with EGC activities on state-owned land outside of generally allowed uses.

#### Roles:

- Issue permits within state-owned land and tidelands for activities outside of generally allowed uses.
- Partner agency on outreach and education for EGC
- Partner agency on all other EGC efforts.

The Division of Parks and Outdoor Recreation (DPOR) provides outdoor recreation opportunities and conserves and interprets natural, cultural, and historic resources for the use, enjoyment, and welfare of the people.

**Jurisdiction:** DPOR could potentially play a role in permitting associated with EGC activities within Alaska State Park units.

#### Role:

- Issue permits within Alaska State Park units.

### Alaska Department of Environmental Conservation (ADEC)

The mission of ADEC is to conserve, improve, and protect Alaska’s natural resources and environment to enhance the health, safety, economic, and social well-being of Alaskans. The Division of Water and Division of Spill Prevention and Response is housed within ADEC.



Alaska’s ballast water regulation (AS 46.03.750) describes provisions for ballast water discharge. The ADEC shares regulatory responsibility for ballast water activity with federal agencies, the U.S. Coast Guard (USCG), and U.S. Environmental Protection Agency (EPA).

**Jurisdiction:** ADEC has no EGC management jurisdiction in waters owned by the State of Alaska.

#### Roles:

- ADEC assists in the management of aquaculture regulations in the State of Alaska and coordinates with ADF&G on enforcement of aquaculture regulations.
- ADEC regulates ballast water activity in conjunction with USCG and EPA.

### Pacific States Marine Fisheries Commission (PSMFC)

The PSMFC is an interstate compact agency that helps resource agencies and the fishing industry sustainably manage Pacific Ocean resources in a five-state region. Alaska is one of five member compact states.



**Jurisdiction:** PSMFC has no regulatory or management authority.

**Roles:**

- Partner agency on EGC management projects
- Partner agency on research efforts pertaining to EGC management
- Partner agency on outreach efforts pertaining to EGC management

### Tribes and Tribal Organizations

#### Metlakatla Indian Community (MIC)

The Metlakatla Indian Community (MIC) is located on Annette Islands Reserve, and is the only Indian Reserve in the State of Alaska. The community exists by the authority of the Constitution and bylaws of the MIC as approved in 1944 by the Secretary of the Interior and MIC, as an Indian Tribe organized under provisions of the Indian Reorganization Act. The Secretary of Interior has delegated responsibility to MIC to prescribe rules and regulations governing the use of Annette Island Reserve.



**Jurisdiction:** The Metlakatla Indian Community has EGC management authority within its tribal lands and waters.

**Roles:**

- Member of the AKISP Marine Committee
- Lead entity in ensuring management activities on MIC lands and waters
- Lead entity in rapid response for waters under MIC ownership, and partner agency outside of those waters
- Partner entity in early detection for EGC
- Partner agency on outreach and education for EGC
- Partner entity on EGC research
- Partner entity in securing resources for EGC management

#### Other Tribes and Tribal Organizations

Alaska native peoples have been stewards of Alaska's lands and waters for time immemorial. Invasive species threaten to expel culturally important native species used for food and arts. They also threaten to alter historically important locations and native species habitat. Tribes and tribal entities have a stake in protecting these resources and can take an important role in early detection and management of invasive species. Examples include the South East Resource Advisory Council and the Chugach Regional Resources Commission.

**Roles:**

- Partner entities in early detection for EGC



Figure 7. Members of the Metlakatla Indian Community setting EGC traps. Photo credit: Martin Media.

- Partner entities on outreach pertaining to EGC management
- Partner entities for early detection of EGC
- Partner entities on EGC response actions

### Federal Agencies – United States

Ownership of waters within Federal lands is not always clear and may require legal consultation to determine pre-statehood ownership clauses. This clarification will be sought in cases of EGC introductions to National Wildlife Refuges, National Parks, US Department of Agriculture (USDA) Forest Service, or USDA Forest Service lands. Otherwise, all waters in Alaska fall under state management authority except for Metlakatla Indian Community lands.

#### U.S. Fish and Wildlife Service (USFWS)

The USFWS works with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The USFWS engages in habitat conservation and restoration, aquatic invasive species management and outreach, implementation of the Endangered Species Act, injurious wildlife inspections through the Lacey Act, and National Wildlife Refuge management.



**Jurisdiction:** The USFWS implements invasive species management efforts in coordination with partners under multiple Federal Acts, Executive Orders (e.g., 13122 and 13751), and national program policies. These mandates provide the USFWS opportunities to work with others within and outside of National Wildlife Refuges to conserve USFWS trust species and their habitats. USFWS has EGC management jurisdiction in submerged lands and coastal areas managed by the USFWS (e.g., marine monuments and National Wildlife Refuges).

**Roles:**

- Lead agency in ensuring management activities comply with federal regulations (e.g., National Environmental Policy Act, Wilderness Act, Endangered Species Act) when actions occur on USFWS lands or partners using USFWS funds
- Lead agency in rapid response for submerged lands under USFWS management, and partner agency outside of those waters
- Partner agency in early detection
- Partner agency on outreach and education for EGC
- Partner agency on EGC research
- Partner agency in securing resources (e.g., data, funding, etc.) necessary to develop conservation and recovery strategies for native species
- Member of the AKISP Marine Committee

#### U.S. Forest Service (USFS)

The USFS mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. The agency exists within the U.S. Department of Agriculture, which administers 154 national forests; the Tongass and Chugach National Forests are vulnerable to EGC invasions because of their proximity to existing EGC populations in SE Alaska.



**Jurisdiction:** The USFS has EGC management authority in waters and coastal areas managed by the U.S. Forest Service.

**Roles:**

- Lead agency in rapid response for waters under USFS management, and partner agency outside of those waters
- Partner agency in early detection
- Partner agency on outreach and education for EGC
- Partner agency on EGC research
- Partner agency in securing resources (e.g., data, funding, etc.) necessary to develop conservation and recovery strategies for native species
- Member of AKISP Marine Committee

**National Park Service (NPS)**

The mission of the NPS is to preserve unimpaired natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. Glacier Bay, Kenai Fjords, Lake Clark, Wrangell-St. Elias, and Katmai National Parks are vulnerable to EGC invasion because of their proximity to existing EGC populations in SE Alaska.



**Jurisdiction:** The NPS has EGC management authority in waters and coastal areas managed by the NPS.

**Roles:**

- Lead agency in rapid response for waters under NPS management, and partner agency outside of those waters
- Partner agency in early detection
- Partner agency on outreach and education for EGC
- Partner agency on EGC research
- Partner agency in securing resources (e.g., data, funding, etc.) necessary to develop conservation and recovery strategies for native species

**National Oceanic and Atmospheric Administration (NOAA)**

The NOAA seeks to understand and predict changes in climate, weather, ocean, and coasts; to share that knowledge and information with others, and to conserve and manage coastal and marine ecosystems and resources. The agency has the authority to regulate and sustain marine fisheries and their ecosystems, protect endangered marine and anadromous species, protect, and restore habitats and ecosystems, conserve marine sanctuaries and other protected places, respond to environmental emergencies and aid in disaster recovery.



**Jurisdiction:** NOAA implements invasive species management efforts in coordination with partners to conserve marine species and their habitats. NOAA has EGC management authority in waters within the exclusive economic zone (EEZ), the area of the ocean extending 200 nautical miles beyond the nation's territorial sea.

**Roles:**

- Partner agency in early detection for EGC
- Partner agency on outreach and education for EGC
- Partner agency on EGC research
- Partner agency in securing resources (e.g., data, funding, etc.) necessary to develop conservation and recovery strategies for native species
- Member of AKISP Marine Committee

**Federal Agencies - Canada**

**Department of Fisheries and Oceans Canada (DFO)**

In British Columbia, management of EGC falls under the AIS National Core Program, managed by the Ecosystem Management Branch of the DFO. EGC is listed as a control species under the AIS Regulations in the Canadian Fisheries Act. The Science Branch of DFO is also active in informing management of EGC in British Columbia. The Science Branch (a) monitors distribution of EGC along the outer coast, documenting presence/absence and relative abundance, size, and sex to understand different year classes; and (b) maintains this in a database that allows the generation of maps to inform management. DFO has an established AIS rapid response framework to guide development of rapid response plans for specific AIS (Locke et al. 2011).



Fisheries and Oceans Canada  
Pêches et Océans Canada

**Jurisdiction:** DFO implements invasive species management efforts in coordination with partners to conserve marine species and their habitats. DFO has EGC management authority in coastal waters of British Columbia.

**Roles:**

- Partner agency in early detection for EGC
- Partner agency on outreach and education for EGC
- Partner agency on EGC research

**Academia**

**Alaska Sea Grant (ASG)**

The ASG enhances the sustainable use and conservation of Alaska's marine, coastal, and watershed resources through research, education, and extension.



**Jurisdiction:** Alaska Sea Grant does not have EGC management jurisdiction.

**Roles:**

- Partner agency on outreach and education for EGC
- Partner agency for EGC early detection
- Partner agency on EGC research

**Kachemak Bay National Estuarine Research Reserve (KBNERR)**

The KBNERR is located in Homer on Kachemak Bay, and is affiliated with the University of Alaska Anchorage and the NOAA Office of Coastal Management. KBNERR's Harmful Species Program has been monitoring for the early detection of marine invasive species, including EGC, since 2006 through their community monitoring program and outreach activities.



**Jurisdiction:** KBNERR does not have EGC management jurisdiction.

**Roles:**

- Partner agency in early detection for EGC
- Partner agency on outreach and education for EGC
- Partner agency on EGC research
- Partner agency in securing resources (e.g., data, funding, etc.) necessary to develop conservation and recovery strategies for native species

## Local Organizations

### Cooperative Invasive Species Management Areas (CISMA)

The CISMA organizations prevent the introduction and spread of non-native invasive species, reduce the extent and density of newly established invasive species, implement economically effective and safe control methods for priority invasive species, and facilitate cooperation among those working to manage invasive species.



Generally, each CISMA organization has its own geographic jurisdiction. The Kodiak and Kenai Peninsula CISMA's work in geographies vulnerable to EGC.

#### Roles:

- Partner organization on outreach pertaining to EGC management
- Partner organization for early detection of EGC
- Partner organization on EGC response actions

### Prince William Sound Regional Citizens' Advisory Council (PWSRCAC)

The PWSRCAC is an independent nonprofit corporation guided by a mission to promote environmentally safe operation of the Alyeska terminal and associated tankers



#### Roles:

- Co-chair of the AKISP Marine Committee
- Partner organization for early detections of EGC
- Partner organizations for outreach pertaining to EGC management



Figure 8. ADF&G Invasive Species Program Coordinator Tammy Davis providing instruction on setting EGC traps. Photo credit: Martin Media.

**Table 1. Jurisdictions and roles relative to European green crab detection, eradication, suppression, surveillance, monitoring, research, outreach, and resource securing in Alaska.**

Organization	Jurisdiction	Roles					
		AKISP Marine Committee	State Waters [1]	Non-state Waters [2]	EGC Research Efforts	EGC Outreach Efforts	Securing Resources for EGC Management
Alaska Department of Fish and Game (ADF&G)	EGC management authority in all waters owned by the State of Alaska	Chair	Lead	Partner	Partner	Partner	Partner
Alaska Department of Natural Resources	Management authority on all state-owned land and tidelands		Partner	Partner	Partner	Partner	Partner
Metlakatla Indian Community (MIC)	EGC management authority within its Annette Islands Reserve lands and waters	Member	Partner	Lead in waters under MIC ownership	Partner	Partner	Partner
U.S. Fish and Wildlife Service (USFWS)	EGC management authority in submerged lands and monuments managed by the USFWS	Member	Partner	Lead in lands and monuments under USFWS management	Partner	Partner	Partner
U.S. Forest Service (USFS)	EGC management authority in waters and coastal areas managed by the USFS	Member	Partner	Lead in waters under USFS management	Partner	Partner	Partner
National Park Service (NPS)	EGC management authority in waters and coastal areas managed by the NPS	Member		Lead in waters under NPS management	Partner	Partner	Partner
National Oceanic and Atmospheric Administration (NOAA)	EGC management authority in EEZ waters	Member	Partner	Partner	Partner	Partner	Partner
Department of Fisheries and Oceans Canada (DFO)	EGC management authority in British Columbia coastal waters				Partner	Partner	Partner
Alaska Sea Grant (ASG)		Member	Partner	Partner	Partner	Partner	
Kachemak Bay National Estuarine Research Reserve (KBNERR)		Member	Partner	Partner	Partner	Partner	Partner
Cooperative Invasive Species Management Areas (CISMA)			Partner in Kenai Peninsula waters	Partner in Kenai Peninsula waters		Partner	Partner

[1] EGC eradication, suppression, surveillance, and monitoring activities.

[2] Ibid.

Note: The US Bureau of Land Management is not included in this table as their only responsibility would be in Whiting Harbor, and this plan recommends they engage with either USFWS or ADF&G using an interagency agreement to address EGC introductions.

# The Incident Command System

The Incident Command System (ICS) is an effective framework to organize and direct site-specific responses to detections of AIS by providing a standardized command structure for coordination, information flow, analysis, decision making, resource allocation, communications, and response actions (Burgiel 2020). Although developed and used primarily for human health and environmental emergency response actions, such as terrorist attacks, oil spills, and wildfires, the system has been modified and is being used to address the suite of actions associated with detections of high-risk deleterious aquatic invasive species, including species, such as dreissenid mussels and EGC.

The ICS is particularly effective because it standardizes command, control, and coordination of on-scene incident management, providing a common hierarchy for numerous organizations to effectively respond (U.S. Department of Homeland Security 2017). Individuals involved in a response know how to function during a response based on ICS standardized roles and responsibilities associated with command, operations, planning, logistics, and finances (Burgiel 2020). The benefits of using ICS include:

- Facilitates the initial identification of overall incident management authority;
- Provides structure for communication, messaging, convening stakeholders, ensuring compliance, and record keeping;
- Creates a framework for establishing and updating situational awareness as the incident progresses;
- Integrates authorities in areas with overlapping management structure;
- Provides legitimacy for response actions;
- Responsive to increasing or decreasing complexity based on incident variables;
- Enhances efficiencies and leverages resources;
- Provides focus for tactical implementation.

The guiding principles for ICS include flexibility (i.e., response tools and guidance are scalable), standardization (i.e., standardized practices foster cohesion among multiple response entities), and unity of effort (i.e., coordination of activities among various organizations to achieve common objectives while recognizing

that organizations with specific jurisdictional responsibilities may need to maintain their respective authorities while supporting the response).

There is also potential for partner organizations to employ a Unified Command, which would allow two or more partner agencies with geographical or functional responsibility for an incident to assign incident commanders from each to a Unified Command organization.

# ICS

## ■ Rapid Response Actions to Address European Green Crab

The rapid response process is initiated when a report of an EGC is received from an area outside of the current known EGC distribution. If a EGC carapace or live adult is detected and verified by ADF&G, deliberate steps will be taken to determine the magnitude of the invasion, and the appropriate response actions (Figure 9). Currently there are multiple entities actively engaged in EGC surveillance and early detection monitoring. It is possible for the report of an observation to be made by multiple entities engaged in early detection activities, and informal reports may be submitted by other entities or individuals. Key activities may occur simultaneously at various stages of response and may be influenced by the nature of the detection.

### Verification of Observation

**Purpose:** Verification of observation

**Lead:** ADF&G; alternative will be determined by the location of observation and fall to jurisdiction of that location

The initial observation may be from routine early detection monitoring, or other surveillance efforts, by ADF&G, partners, or public reporting. Regardless of the nature of the observation, specific steps including documenting basic information on the observation will be followed. ADF&G will confirm the detection once the report is received.

- A detection of a live adult, molt, or carapace can be confirmed visually by ADF&G or an appropriate authority designated by ADF&G. Additional rapid assessment will occur following confirmation.
- ADF&G will confirm any eDNA results.
- Information gathered during the verification of an initial EGC observation will ideally include number of individual crabs observed, dorsal and ventral photos of each crab, carapace width of each crab, location of observations (GPS coordinates, name of specific location, nearest municipality and state), habitat description and photos (substrate, dominant algae or other cover species, approximate tide level) date, and contact information of observer (name, phone(s), email, and mailing address). Information should also include method of detection (established trapping survey, beach walk, sport fishing crab pot, etc.).

### Rapid Assessment

**Purpose:** Attempt to replicate initial verified observation and improve understanding of observation  
**Lead:** ADF&G; alternative will be determined by the location of the observation and may fall to the jurisdiction of that location

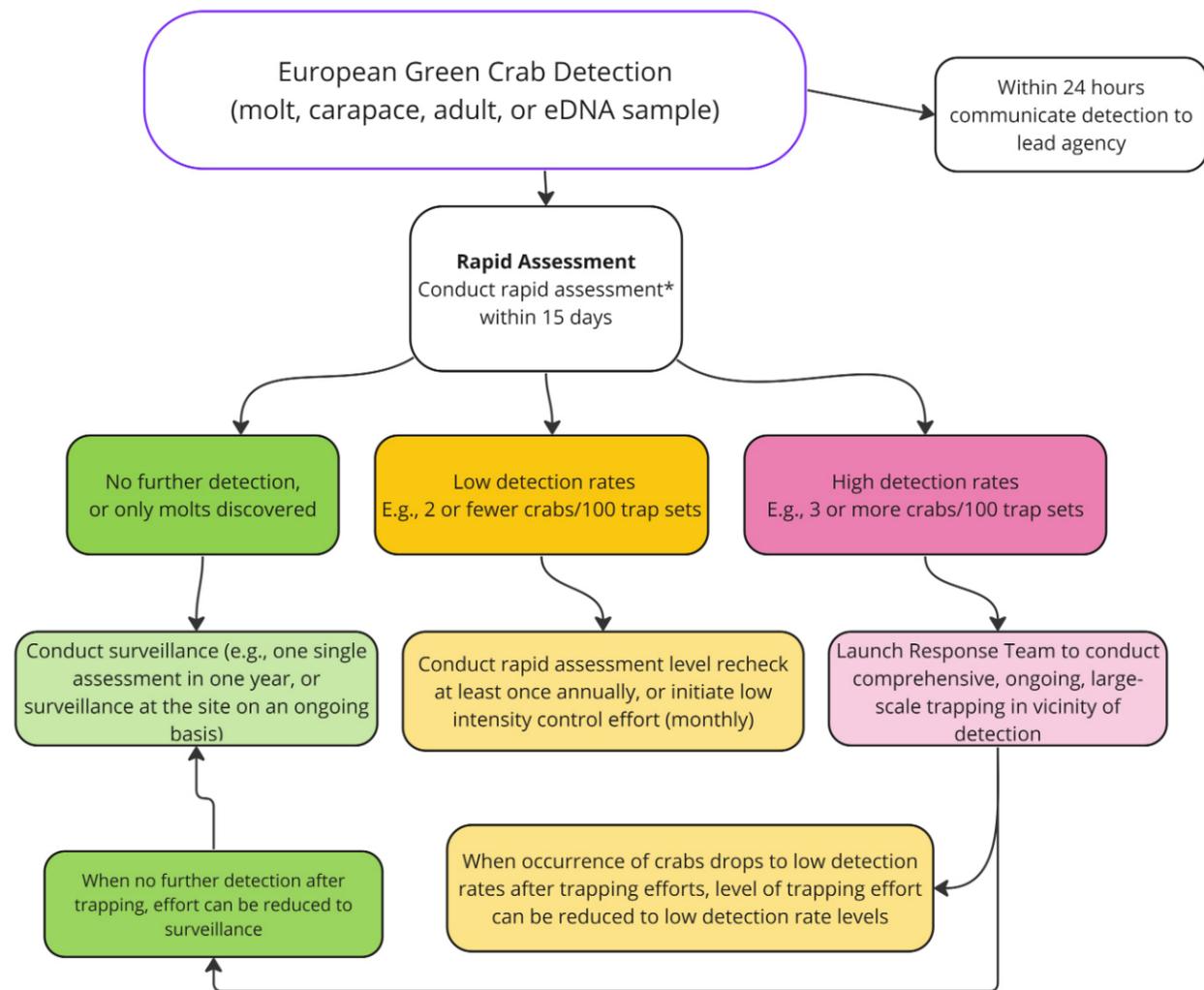
Rapid assessment consists of a localized trapping effort at the observation site. During the rapid assessment (Figure 9), if no further EGC are detected, or if only molts are discovered, surveillance will be conducted annually. If two or fewer crabs per 100 trap sets are detected, a rapid assessment level re-check will be conducted at least once annually, or low intensity control efforts are conducted monthly. If three or more crabs per 100 trap sets are detected, a Response Team is launched to conduct comprehensive, ongoing, large-scale trapping in the vicinity of the detection. When Response Team efforts result in the occurrence of crabs at two or fewer crabs per 100 trap sets, then trapping efforts can be reduced to low detection rate levels. When no EGC are detected during trapping, effort can be reduced to surveillance.

### Declaration of Emergency

**Purpose:** Initiation of statewide scale of response to an EGC detection.

**Lead:** ADF&G

The scope of a EGC situation will influence the level of response and the scale of that response. A Declaration of Emergency (Appendix G), which can only be made by the Governor of Alaska, helps to inform the level of concern of the situation to Alaskans and the State of Alaska, and may be vital for the mobilization of funding to conduct response actions. Communication by ADF&G to the governor's office will be made within 24 hours of verification of the initial detection. ADF&G may proceed with a request for emergency declaration based on the detection of adults or carapace.



\*Rapid assessment is a large, multi-day intensive trapping effort (on the scale of 100 traps for 2-3 trap days) across suitable habitat in and around the water body where detection occurred. If new detection is well beyond the limits of currently established populations and distribution, or if new detection is within habitat or areas deemed critically important, conduct a more aggressive rapid assessment (expand scope, scale and duration) to find edges of population and hotspots.

Figure 9. European Green Crab detection decision tree to inform monitoring effort.

**Notification Communication**

**Purpose:** Ensure that factual and timely information is communicated with appropriate entities.

**Lead:** ADF&G

When the confirmation of detection is complete, multiple notifications will be made to raise awareness and allow area partners to respond (Figure 10). Numerous types of communications may be necessary early in the response process.

- If detection was made by an entity other than ADF&G, then ADF&G will be notified within 24 hours.

- Once confirmation of the detection has been made by ADF&G, then ADF&G will provide information to the USGS Nonindigenous Aquatic Species Database, the Pacific States Marine Fisheries Commission EGC Occurrence database, the AKISP Marine Committee, West Coast EGC managers, aquatic farmers, Chugach Regional Resources Commission, shellfish fishery managers, Alaska Native Tribal Health Consortium, local municipalities and boroughs, and the Indigenous Sentinels Network.

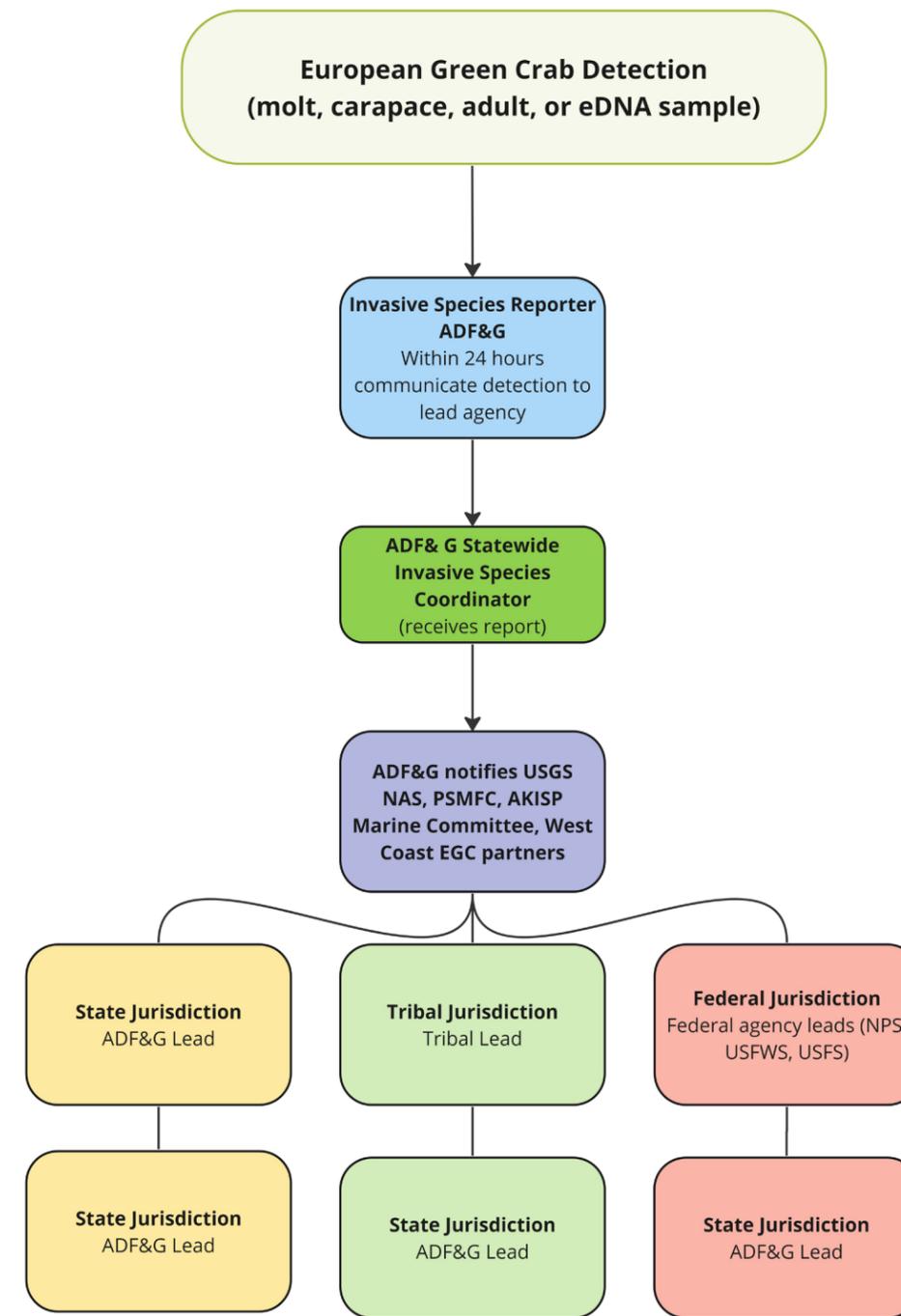


Figure 10. Flow of information from a new EGC detection report to appropriate jurisdiction. This flow chart illustrates coordination and collaboration with ADF&G by ensuring that state, tribal, and federal leads report back to the ADF&G lead for EGC to ensure Alaska's databases and information on EGC are updated and available to all jurisdictions.

**Note:** \* The National Park Service (NPS) has jurisdiction over the marine waters (Supreme Court case in 2006), and all submerged lands to 3 nautical miles from mean high tide or mid channel. NPS regulates uses of fish and wildlife in those areas. NOAA has EGC management authority in EEZ waters. The US Bureau of Land Management is not included in this table as their only responsibility would be in Whiting Harbor, Sitka, and this plan recommends they engage with either USFWS or ADF&G using an interagency agreement to address EGC introductions.

## Delineate Scope of Response

**Purpose:** Determine the scope of the EGC population to inform management response.

**Lead:** Determined by location of detection.

After the rapid assessment, a broader effort to understand and characterize the nature of the detected population (e.g., multiple age classes, multiple locations, or isolated populations, etc.) will be initiated. This may include deliberate searches with the use of trapping and molt walks using targeted habitat assessments, volunteer teams, and potentially eDNA sampling. Multiple techniques may be utilized simultaneously. This coordinated strategy will capture all search information into digital characterization to better visualize the area affected by EGC.

## Activate Incident Command System and Response Team

**Purpose:** Engage in a process to adequately address scale of management situation.

**Lead:** Determined by location of detection jurisdiction.

If it has been determined that the potential exists to implement management options that may minimize the extent of the EGC population, options will be explored via activation of ICS. The ICS structure allows a complex management situation to be addressed efficiently.

The basic ICS structure (Figure 11) illustrates an incident commander that serves as the overall lead in a multiple agency response, directing the work of a public information officer, safety officer, and liaison officer, and overseeing the roles of operations, planning, logistics, and finance.

## Response Actions

**Purpose:** Identify specific actions to address an EGC population that includes public communication, mobilization of agency and volunteer intensive trapping, and documentation.

**Lead:** ICS-structured incident commander with ICS team.

An ICS team will compile information to inform decisions. This information will include a suite of options that should explore how the following factors could influence or be affected by various response actions.

Response factors to be considered include:

1. Distance from nearest existing EGC population.
2. Regional and local distribution
  - a. Proximity to threatened or endangered species or their critical habitats.
  - b. Proximity to leading edge of southernmost EGC population.
3. Regional and local oceanographic influences.
4. Anticipated costs for specific response actions.
5. Available resources, including staff, materials, and equipment.
6. Ability to access habitat.
7. Proximity to significant
  - a. Commercial marine resources.
  - b. Recreational marine resources.
  - c. Ecologically significant marine resources (e.g., Izembek Lagoon)
  - d. Cultural and subsistence marine resources.
  - e. Presence of federally listed species.
8. Impact of no response.

## Stepping Down ICS and Shift to Long-Term Management

**Purpose:** Deactivation of incident command team - shift to long-term management.

**Lead:** Lead action agency.

Understanding when an ICS lead response is complete will be determined by a variety of factors, but ultimately will be at the discretion of the lead action agency. However, there may be valuable indicators that will help determine when an incident has shifted to a long-term management situation, rather than functioning in a response situation. In general, when all actions for monitoring, communication, and coordination have been exhausted, a response team may be terminated. Factors that may indicate there is no longer a need to operate ICS for the incident include:

- An emergency declaration has been rescinded.
- A shift to long-term surveillance strategies to understand EGC population dynamics (e.g., multiple partners have engaged in strategic surveillance north of operational response area) occurs. This shift would be precipitated by reduced numbers of EGC caught/100 traps as well as recognition that established populations require consistent, long-term trapping to maintain low population levels.
- The frequency of communication about the response situation to local stakeholders becomes minimal.

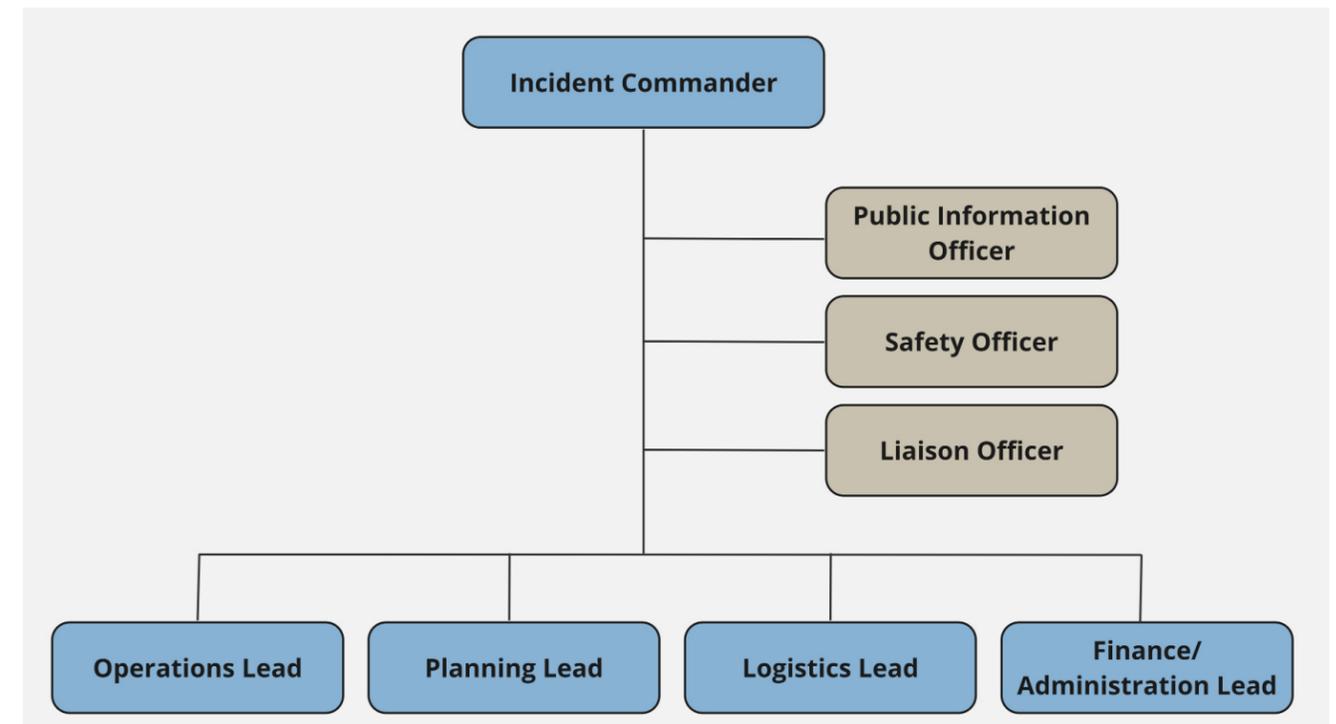


Figure 11. Basic ICS structure of a single incident, illustrating the four core areas of operations, planning, logistics, and finance as well as the public information, safety, and liaison roles.

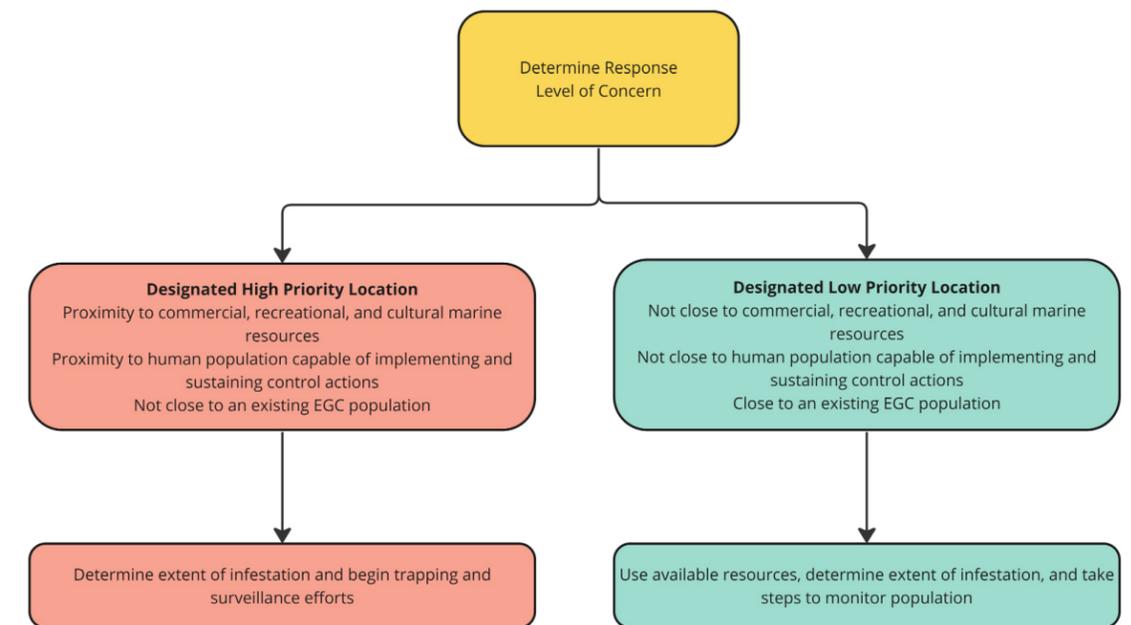


Figure 12. Decision guidance for implementing EGC control actions.

**Table 2. Actions to address new and existing populations of EGC in Alaska.**

Objective	Strategy	Actions	Performance Metrics	Status
<b>PREVENTION</b>				
<b>1. Work collaboratively across Alaska and with jurisdictions in British Columbia, Alaska, and Washington state to plan for and manage responses to EGC on a continual basis.</b>	A. Alaska Department of Fish and Game (ADF&G) leads EGC administration and coordination efforts in Alaska.	1. All partners seek funding, on an ongoing basis, to administer and coordinate implementation of the Early Detection and Rapid Response Plan for Invasive European Green Crab in Alaska.	a. ADF&G dedicates sufficient time and resources to implement the Early Detection and Rapid Response Plan for Invasive European Green Crab in Alaska. b. The status and distribution of EGC is well understood in Alaska, British Columbia, Washington and among Alaska state legislators. c. The Metlakatla Indian Community is consulted on a regular and as needed basis. d. A database that tracks surveillance and monitoring efforts as well as the current distribution of EGC in Alaska is maintained and publicly available by January 2024. Consider use of Non-indigenous Aquatic Species Clearinghouse (ANASC) to house data.	
	B. U.S. Fish and Wildlife Service (USFWS) leads EGC administration and coordination efforts on coastal National Wildlife Refuges in Alaska.	2. USFWS seeks funding, on an ongoing basis, to implement surveillance, control, and monitoring actions on Alaska coastal National Wildlife Refuges and adjacent areas.	a. USFWS coastal National Wildlife Refuges have adequate resources to implement and support early detections of EGC introductions, implement control actions, and monitor populations post-control.	
	C. Ensure implementation of the Early Detection and Rapid Response Plan for Invasive European Green Crab in Alaska is coordinated and that actions across jurisdictions are complementary.	3. Alaska partners review the Early Detection and Rapid Response Plan for Invasive European Green Crab in Alaska on a quarterly basis to ensure coordination and complementary actions are taken. 4. AKISP EGC Committee produces annual report documenting implementation of Early Detection and Rapid Response Plan for Invasive European Green Crab in Alaska. 5. AKISP EGC Committee coordinates with the Transboundary EGC Working Group <sup>1</sup> to monitor EGC population status and management activities. 6. AKISP EGC Committee maintains and shares an updated EGC toolkit for EGC monitoring, trapping (including resources available), data collection, QA/QC, field gear decontamination, reporting, training. 7. AKISP EGC Committee promotes standard data collection, record keeping and use of the EGC toolkit.	a. Early Detection and Rapid Response Plan for Invasive European Green Crab in Alaska is reviewed on a quarterly basis, and amendments to address status of EGC are suggested based on best available science. b. Annual report produced by AKISP marine committee documenting implementation of Early Detection and Rapid Response Plan for Invasive European Green Crab in Alaska is produced. c. The Transboundary EGC Working Group is well informed about Alaska EGC efforts. d. The EGC toolkit is maintained and updated, available publicly, and implemented by entities that seek to manage EGC along the coast of Alaska. e. Information on new detections is shared within one week of reported detection to ADF&G invasives hotline.	
	D. Conduct risk assessments to identify key potential EGC effects on resources (cultural, subsistence, commercial, recreational, etc.)	8. AKISP Marine Committee conducts risk assessments to identify key potential EGC effects on cultural, subsistence, commercial, recreational, and other values.	f. Risk assessments are conducted to develop a shared understanding of the threat of EGC to Alaska's economy, environment, and quality of life.	
	E. Clarify roles and responsibilities of partner organizations.	9. Develop a Memorandum of Understanding (MOU) among partner organizations to clarify roles and responsibilities relative to contributions entities will make to minimize detrimental effects of EGC to Alaska's economy, environment, and quality of life.	g. An MOU is signed by all existing and prospective partner organizations to develop a shared understanding of the contributions each entity is willing and able to make toward EGC monitoring, surveillance, control, outreach, and other efforts.	
<b>2. Prevent human-mediated introductions and the spread of EGC in Alaska.</b>	A. Share information about EGC and ways to prevent its spread.	1. AKISP EGC Committee describes, distributes, and promotes best management practices to prevent EGC (and other AIS) spread (e.g., shellfish movement regulations, purchase of permitted seed, shellfish storage, shell disposal).	a. The AKISP promotes best management practices (BMPs) to prevent EGC (and other AIS) spread.	
		2. AKISP EGC Committee shares information on their respective websites and outreach materials re: EGC threats, population status, pathways, and preventive actions.	b. EGC information is shared on all strategic partner websites.	
	B. Prevent the introduction and spread of EGC from aquaculture operations..	3.1. Partners inform shellfish growers about EGC pathways and steps that can be taken to minimize risk.	b. Alaska shellfish grower associations share information about preventing the introduction and spread of EGC in grower materials and on their respective websites.	
		3.2. ADF&G, ADNDR, and Alaska Department of Environmental Conservation (ADEC) enforce aquaculture regulations.	c. All aquaculture transport complies with regulations to prevent the introduction and spread of EGC in Alaska.	
C. Prevent the introduction and spread of EGC in ballast water in Alaska.	4. AKISP EGC Committee supports the review of Alaska's ballast water regulations to incorporate adoption of a formal program for the management of EGC and other AIS in ballast water discharges.	d. ADEC takes the lead in reviewing Title 46, AS 46.03.750 and recommending changes to address EGC and other AIS by 2025. e. Outreach to harbormasters and other relevant personnel in port communities.		
D. Prevent the introduction and spread of EGC via hull fouling and movement of fouled marine infrastructure, such as docks and net pens.	5. Clarify Alaska statutes regarding which agency (ADEC or ADF&G) has responsibility for hull fouling because crabs can be translocated short distances on heavily fouled vessels. Clarify which agency has responsibility for mitigating EGC (and other AIS) spread through movement of fouled marine infrastructure such as docks and net pens.	f. Alaska clarifies in statute which agency is responsible for hull fouling. g. New laws are adopted regulating hull husbandry practices, and transport and management of biofouling on vessels and in-water infrastructure to prevent the spread of EGC.		

<sup>1</sup> The Transboundary EGC Working Group includes representatives from the Washington Department of Fish and Wildlife, Department of Fisheries and Oceans Canada, Washington Sea Grant, University of Washington, and the Puget Sound Partnership. The group developed the *Salish Sea Transboundary Action Plan for Invasive European Green Crab* (2019).

Objective	Strategy	Actions	Performance Metrics	Status
<b>EARLY DETECTION</b>				
<b>3. Quickly and efficiently detect EGC presence.</b>	A. Identify, categorize, and prioritize potential sites for EGC introductions.	1. Develop habitat suitability assessments to identify and prioritize EGC early detection surveillance in Alaska. 2. Develop models to identify and prioritize locations for early detection and surveillance using best available habitat and oceanographic (current, water temperature, etc.) data to determine larval distribution.	a. Partners develop prioritized habitat suitability assessments. b. EGC detections are mapped and compared to habitat suitability assessments, and refinements are made, if necessary, to improve future surveillance, assessments, and prioritization.	
	B. Partners develop, implement, and refine a EGC toolkit in Alaska to detect new introductions of EGC using a tiered approach based on local resources and capacity, and the level of confidence in the detection report.	3. EGC Rapid Response Plan is developed and refined on a regular basis to incorporate new science and information, and address the needs of local communities conducting surveillance, trapping, and monitoring efforts.	c. Partners develop, use, and improve, on a continual basis, the EGC toolkit. d. Partners in locations of high habitat suitability for EGC have a standard protocol and funding to annually survey for EGC.	
	C. Partners recruit and support training to networks of individuals along the Alaska coast at strategic locations to conduct effective and efficient EGC surveillance using the EGC toolkit.	4. Identify organizations, individuals, and communities for appropriate training, and deliver outreach for prevention training and resources to support surveillance networks. Note: Alaska has numerous excellent examples of these types of networks in operation, e.g., Elodea, Harmful Algal Blooms).	e. All partners recruit, train, and maintain EGC-focused volunteers using consistent protocols and methodologies described in EGC toolkit in locations defined as high priority for potential introductions of EGC. f. ADF&G, AK Sea Grant, and University of Alaska works with shellfish growers and others to develop EGC monitoring networks and reporting requirements among growers.	
	D. Surveil sites regularly (when water temperatures are suitable for EGC survival and spread) for presence of EGC using toolkit methodologies and share information about surveillance results in publicly available database.	5. ADF&G and University of Alaska oversee surveillance networks in locations identified priority sites for EGC surveillance using habitat suitability and oceanography assessment tools.	g. Priority sites are surveilled on an annual seasonal basis for EGC presence.	
	E. Submit surveillance data to ADF&G and make that data publicly available.	6. All surveillance data collected by any party is submitted directly to ADF&G. 7. Publicly available database is available for surveillance networks to share results of data collection.	h. ADF&G receives all EGC surveillance data in Alaska in a timely annual basis. i. Results from surveillance efforts are publicly available within one month of data collection.	
<b>RAPID RESPONSE</b>				
<b>4. Respond quickly and effectively to new populations of EGC to eradicate or reduce the population.</b>	A. Verification – EGC is detected and verified.	1. EGC is detected, verified, and reported to publicly available database.	a. Within 7 days of initial detection, EGC is verified, and information is uploaded to publicly available database.	
	B. Notification – Partners and the public are notified.	2. Within 2 weeks of initial detection, Alaska Partners, British Columbia and Washington leads, local communities, and legislators are notified of new detections.	b. Partners, local entities, and legislators are informed and aware of new detections within 2 weeks of initial detection.	
	C. Activate Response Team – Incident Command System (ICS) Team is activated to initiate response to EGC detection.	3. ICS team is formed, and roles and responsibilities are assigned. 4. Cooperative agreements (if necessary) are developed and a process to obtain permits for trapping is initiated. 5. Personnel and equipment resource needs are defined.	c. ICS team is formed within one month of EGC detection. d. Cooperative agreements are developed (if needed) and permits for trapping are obtained. e. Local entities understand the resource needs to achieve control/eradication goals. f. Delineate strategically located teams available to take control and monitoring actions when detections occur.	
	D. Risk reduction actions are taken, and extent of infestation is defined.	6. Surveillance methods are enhanced (e.g., eDNA, trapping) to detect scope and extent of infestation.	g. Surveillance methods detect scope and extent of infestation.	
	E. External communications are enhanced.	7. A press release is issued, coordination with interagency public information officers occurs, a point of contact for the media is established, and online communication resources are developed and available to enhance public understanding of the detection and control actions. 8. A rapid response listserv is created of potential entities that could participate in trapping efforts.	h. The public is aware of an EGC detection and actions being taken to address the detection.	
	F. Control measures are activated.	9. Control efforts are initiated. 10. A plan for long-term monitoring is developed.	i. Control actions are taken to reduce/eradicate existing EGC populations while minimizing risk to native fish and wildlife and their habitats.	
	G. Long-term monitoring and communication needs are identified.	11. A long-term monitoring plan and communication needs associated with long-term monitoring efforts is developed.	j. A long-term monitoring plan is implemented to assess changes in EGC population status through time.	

Objective	Strategy	Actions	Performance Metrics	Status
<b>CONTROL</b>				
<b>5. Minimize risk to native species and their habitats by implementing functional eradication of EGC populations that cannot be eradicated.</b>	A. Develop process to manage persistent EGC populations.	1. Incorporate into EGC Toolkit options available to manage persistent EGC populations.	a. Approaches to managing persistent EGC populations are understood, documented, and implemented on a case-by-case basis.	
	B. Collaborate with experts to determine EGC population thresholds required to protect high value coastal resources and habitats.	2. Implement intensive trapping of all age classes of EGC to reduce the population below the identified threshold.	b. Functional eradication is implemented by ADF&G and partners overtime in areas of high value ecosystems. c. EGC populations are monitored at functional eradication sites to determine effectiveness and inform management decisions.	

**NOTES:**

# Alaska EGC Community Toolkit

## A guide and resource for communities to address European Green Crab

If your community is interested in monitoring for, or responding to an introduction of European Green Crab, the first step is to: **Contact the Alaska Invasive Species Partnership European Green Crab Subcommittee** (<https://alaskainvasives.org>). Your key contact will be helpful and supportive as you consider implementing a EGC monitoring program in your community.

### Why we do early detection and monitoring?

The European green crab (EGC; *Carcinus maenas*) is one of the most successful and damaging invasive species in the world. Its recent arrival along Alaska's shorelines poses a threat to critically important estuarine ecosystems, including native species and shellfish resources, as well as critical wildlife habitat.

We monitor for populations of EGC because if they can be detected early, steps can be taken to minimize the size of their population, thus reducing environmental and economic damages (Figure 1). Although eradicating EGC is a goal, no entity has successfully eradicated EGC once they have become established.

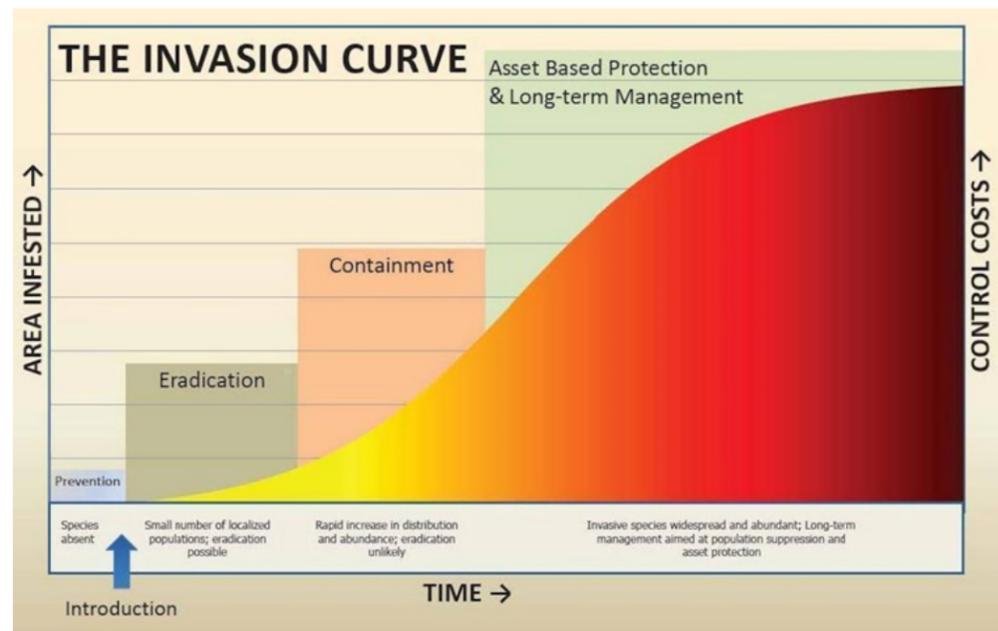


Figure 1. The invasion curve illustrates that eradication is potentially possible when small numbers of localized populations exist. Upon rapid increase in distribution and abundance, eradication becomes unlikely. The most cost-effective approaches to invasive species management are eradication, when possible, or maintaining small, localized populations when eradication is not possible. Graphic credit: US Army Corps of Engineers.

### How to use this guide

This guide can help communities across Alaska address EGC. Information provided here includes:

- 1) Outreach – resources to learn about EGC, how to identify EGC identification, impacts, and more.
- 2) EGC Websites – links to agencies and partners that are actively working on EGC
- 3) EGC Response Steps – State of Alaska guidelines for steps to take if your community detects a EGC
- 4) Publications – there are many scientific papers that provide extensive information on the biology and management of EGC
- 5) Contacts – if you need assistance or need to report the detection of a EGC, all contact information is provided.

Criteria you should consider before creating a EGC monitoring program in your community:

- The size of your community
- Potential EGC habitats in your community (e.g., eelgrass, low-energy beaches, low sloping, sandy and gravelly areas)
- Financial resources
- Site access (is boat operation needed, or does road access exist?)
- Interested volunteers
- The time investment needed to adequately trap, monitor traps, and process species found in traps
- Ability to train and manage a group of volunteers that can be convened at least once annually (to review protocols/training)
- The potential to integrate EGC monitoring while doing other activities in your community
- Reporting mechanisms to share monitoring results
- Permit requirements to legally trap for and possess EGC (ADF&G has an Aquatic Resource Permit for scientific collection and monitoring purposes)



This permit authorizes: **The General Public** (whose signature is required on page 2 for permit validation) of **Anywhere**

to conduct the following activities from **June 29, 2023** to **December 31, 2023** in accordance with AS 16.05.930, AS 16.05.340(b) and 5 AAC 41.600.

**Purpose:** Due to the following regulations, the public cannot retain any part of a European green crab, including any molts or carapaces.  
**5 AAC 41.070. Prohibitions on importation and release of live fish (f)** Except as otherwise provided in this chapter, a person may not possess, import, propagate, transport, release, purchase, or sell within this state a banned invasive species classified under 5 AAC 41.075.  
**5 AAC 41.075** Classification of banned invasive species, includes European green crab (*Carcinus maenas*) as a banned invasive species which includes any part of an organism, including reproductive or genetic material, at any life stage.

This permit would allow members of the public to temporarily collect/possess European green crab carapaces for the purpose of enumerating them as part of a community-based early detection monitoring program.

**Location:** Statewide shoreline.

**Species:** Only carapaces of European green crab (*Carcinus maenas*) may be temporarily retained.

**Method of Collection:** Hand collection.

**Authorized Personnel:** Any member of the general public may participate in collected activities authorized under the terms of this permit.

**Disposition & Reporting:** Any carapaces retained must be reported to the Invasive Species Coordinator and disposed of as directed. **Tammy Davis** (ADF&G Invasive Species Project Leader, Juneau, 1-877-INVASIV (1-877-468-2749), [tda@adfg.alaska.gov](mailto:tda@adfg.alaska.gov)) should be contacted within 24 hours should you find any species suspected to be European green crabs (including larvae). Please take a photo of the organism, as well as a photo of the organism in the environment in which it was observed and note the location with a GPS or by describing it on a map with landmarks. A specimen of a suspected European green crab may be collected in a container and transported to an ADF&G office for the purpose of identification and reporting per 5 AAC 41.075. **Submit the attached datasheet with carapace counts to the email above.**

#### GENERAL CONDITIONS, EXCEPTIONS AND RESTRICTIONS

1. No specimens taken under authority hereof may be sold, bartered, traded or consumed.
2. Specimens collected under the authority of this permit are ONLY to be used for the purposes outlined in this permit.
3. UNLESS SPECIFICALLY STATED HEREIN, THIS PERMIT DOES NOT AUTHORIZE the exportation of specimens or the taking of specimens in areas otherwise closed to hunting and fishing, without appropriate licenses required by state regulations, during closed seasons, or in any manner, by any means, at any time not permitted by those regulations.
4. Issuance of this permit does not absolve the permittee from compliance in full with any and all other applicable federal, state, or local laws, regulations, or ordinances.

*Forrest Bowers* 6/29/2023  
 Deputy Director  
 Division of Commercial Fisheries

## Surveillance Methods and Protocols

- Prior to beginning an EGC monitoring program, your community should:
- Identify potential EGC habitats that exist in your area of interest
- Identify and prioritize the areas of greatest concern, e.g., which habitats you would sample at low tide with teams
- Secure resources to conduct surveillance (people and materials)
- Develop and implement a trap setting tutorial
- Ensure your protocols have been reviewed by the AKISP Marine Committee

## Equipment Lists and Sources

- Molt walks
- Trapping

## Outreach materials

### Printable materials

- [EGC Printable Fact Sheet](#) (8.5 x 11) (Washington Sea Grant)
- [Invasive European Green Crab: A Threat to Washington's Shellfish Industry](#) (poster) (US Geological Survey)
- [Identification Guide: Selected crabs of Oregon, Washington, Alaska, and British Columbia](#) (Oregon Sea Grant)

### Interactive Story Maps

- [The EGC crab in Puget Sound](#) (Encyclopedia of Puget Sound, Puget Sound Institute, and Washington Sea Grant Crab Team)
- [Invasive European Green Crab in British Columbia](#) (Strait of George Data Centre)

### Webinars and Videos

- Washington Recreation and Conservation Office - [First Detector](#) (webinar – 1 hour)
- [European Green Crab Stakeholder/Partner Meeting](#) (Salish Sea), Feb. 15, 2022
- [European Green Crab Stakeholder/Partner Meeting](#) (Outer Coast), Feb. 17, 2022
- Business Insider – [The True Cost of the Green Crab Invasion, and How Whiskey Can Help](#) (video – 10 minutes)
- Outdoor Chef Life – [Deliciously Invasive: European Green Crab as a Sustainable Food Source](#) (video – 16 minutes)
- Coastal Restoration Society – [European Green Crab: The Biggest Threat to Wild Salmon You've Never Heard Of](#) (video – 6 minutes)
- New Hampshire Sea Grant – [Harvesting Invasive Green Crabs](#)
- University of Washington – [UW Research on European Green Crabs](#) (video – 2 minutes)
- UW Environment – [Preventing a Green Crab Invasion](#) (video – 3 minutes)
- CBC Vancouver – [Invasive Crabs Threaten B.C.'s Marine Habitat](#) (video – 2 minutes)
- Chronicle 5 WCVB – [Invading Green Crabs Take Maine's Coast](#) (video – 4.5 minutes)
- Fox 13 Seattle – [Invasive Green Crabs in Lummi Nation](#) (video – 3.5 minutes)
- Fisheries and Oceans Canada – [Invasive European Green Crab in Canadian Waters](#) (video – 2 minutes)
- Maria Mitchell Association – [The Green Crab Problem](#) (video – 5 minutes)
- South Slough National Estuarine Research Reserve – [How to Trap European Green Crabs Using a Modified Minnow Trap](#) (video – 3 minutes)
- WCVB Channel 5 Boston – [Disruptive "Green Crab" Population Exploding in New England](#) (video – 3 minutes)
- SeaDoc Society – [Early Detection and Prevention of Invasive European Green Crab](#) (video – 5 minutes)
- Bamfield Marine Sciences Centre – [The Perils of the Plundering, Invasive, European Green Crab!](#) (video – 10 minutes)
- Invasive Species Council of BC – [Impacts of European Green Crab in British Columbia](#) (webinar – 55 minutes)

utes)

- Pacific County Marine Resources Committee – [European Green Crab](#) (webinar – 35 minutes)
- [European Green Crabs in Oregon: are they now established?](#) (Yamada et al. 2021) (webinar – 52 minutes)

## Identifying EGC

- <https://wsg.washington.edu/crabteam/getinvolved/toolbox/#1520753363092-03b91410-0003>
- [European green crab identification graphic, 2023](#)
- [European green crab identification poster/flier, 2023](#)
- [European green crab in Washington Plain Language Talking Points, 2023](#)
- [European green crab identification image with labels, 2022](#)
- [European green crab identification and reporting sign 2022](#)
- [European green crab identification and reporting sticker, 2022](#)
- [Washington Sea Grant European green crab identification guides](#)
- [Washington Sea Grant European green crab Informational Handout](#)
- [USGS Invasive European Green Crabs: A threat to Washington's shellfish industry infographic](#)
- [ADFG European green crab identification guide](#)

### Invasive European Green Crab (EGC) Beach Walk Crab Molt Monitoring

**For each crab molt seen** use tally marks under the carapace shape to count the number observed, write the total in the table on the back.

Observer(s): \_\_\_\_\_ Date: \_\_\_\_\_

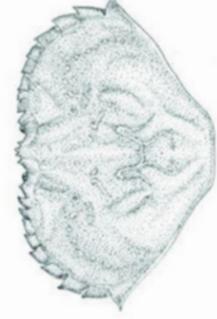
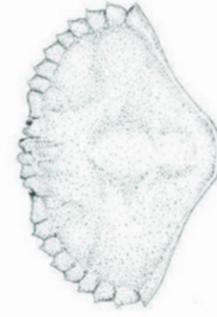
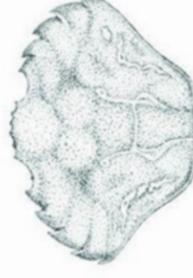
Location started (description or GPS): \_\_\_\_\_

Location ended: (description or GPS): \_\_\_\_\_

Distance walked: \_\_\_\_\_ Beach Habitat (wrack line, driftwood etc.): \_\_\_\_\_

Time started: \_\_\_\_\_ Time ended: \_\_\_\_\_

**Invasive EGC (five spines):** \_\_\_\_\_

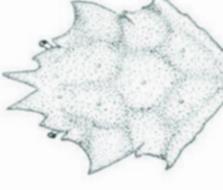
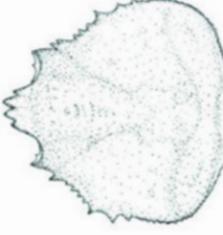
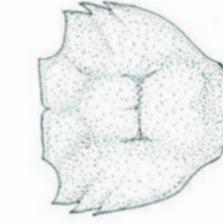
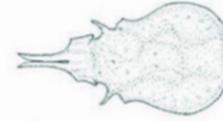


Red Rock: \_\_\_\_\_

Helmet: \_\_\_\_\_

Dungeness: \_\_\_\_\_

Pygmy rock: \_\_\_\_\_



Decorator: \_\_\_\_\_

Shore: \_\_\_\_\_

Tanner: \_\_\_\_\_

Kelp: \_\_\_\_\_

You can share additional observations on the back as needed. Take pictures of any carapace you can't identify, take pictures of any suspected EGC. Please return datasheet to:



Scan the QR code or call 1-877-INVASIV to report observations of any invasive species or unusual plants or animals.

Date: \_\_\_\_\_

Location: \_\_\_\_\_

Carapace Type	Total collected	Additional Comments
Decorator Crab		
Dungeness Crab		
Helmet Crab		
Hermit Crab		
Kelp Crab		
Pygmy Rock Crab		
Red Rock Crab		
Shore Crab		
Tanner Crab		
Other Crab		
<b>European green crab</b>		

**\*\*After counting all the carapaces collected be sure to smash them into small pieces so they are not counted the next time you return to the site for a molt walk survey.\*\***

Recording the location and distance covered is an important piece of early detection for invasive European green crab. The number of molts found over a known distance can be used to compare across different sites or regions and provide some insight into changes over time or impacts. There are several ways you could determine the distance walked during your 20-minute molt walk survey:

1. GPS coordinates from an InReach or Smart phone
2. Use a free phone app such as: Mapmywalk, Fitbit, Go Jauntly, Walkmeter GPS, Nike Run Club
3. Use Google Maps or equivalent after your survey to measure the distance covered.

Look back over your datasheet and check that **all** the information for location, date, molt type and number collected is filled in and legible. Thank you!



## Molt Walk Protocols

### Molt Walk Survey

All crabs must molt to grow, and the molted exoskeletons are often deposited by the high tide onto the upper beach with seaweed and other beach wrack and debris (Figure 1). In addition to live trapping, searching for molts provides another modality by which volunteers look for evidence of EGC in nearby waters. Indeed, several range expansions of this species have been identified first through molts versus through capture of live crabs.

**Protocol:** Volunteers begin at the established site marker, then have 20 total person minutes (20 minutes for one molt collector, 10 minutes for each of two molt collectors, etc.) to collect as many molts and carapaces as possible. Record the start and stop locations on the datasheet as well as the distance walked while collecting molts and carapaces. Distance walked can be determined using an app on a smartphone, such as Mapmywalk, Fitbit, Go Jauntly, Walkmeter GPS, or Nike Run Club. GPS coordinates can be recorded from smartphone maps or Google Maps. Description of the start and stop location and place name can be included as well. Recording the distance walked during the survey is important information that can be used to compare sites and indicate possible changes through time or impacts. Volunteers are instructed to target the highest concentrations of molts and carapaces in the general area and pick up any observed. Record on the datasheet the habitat where most of the molts and carapaces collected are found (wrack, driftwood, upper beach vegetation etc.). Once the time has lapsed, volunteers meet at a location where they can comfortably identify, count, and record the species of all the individual molts and carapaces collected. Count all the carapaces and the molts that have carapaces. Do not count molted legs. Volunteers can keep track of the count of each molt collected using the space provided under the carapace shape on the front of the datasheet. The total number of molts and carapaces collected of each species should be written clearly on the back of the datasheet. Take pictures of any carapaces that cannot be identified. **Important**—Ensure all carapaces are smashed into small pieces after completing the counting and recording the totals. This will prevent recounting the same carapaces again during the next molt walk survey.

Any suspected European green crab molts should be photographed and reported as soon as possible to the Alaska Invasive Species Hotline, 1-877-INVASIV.



Figure 2. Crab molts, including green crab carapace (top left) in beach wrack. Photo: WASG, Jeff Adams.



### EGC Protocols (note: requires an invitation to access)

[https://docs.google.com/document/d/1TvA5g6Sxp64kRkSmJDD\\_-wWHd9UvQ7Ju/edit?usp=sharing&oid=117605908669843576410&rtpof=true&sd=true](https://docs.google.com/document/d/1TvA5g6Sxp64kRkSmJDD_-wWHd9UvQ7Ju/edit?usp=sharing&oid=117605908669843576410&rtpof=true&sd=true)

[https://drive.google.com/file/d/1loAIPWgL733U8S7S7fmdLWMzjgH\\_EYvH/view?usp=share\\_link](https://drive.google.com/file/d/1loAIPWgL733U8S7S7fmdLWMzjgH_EYvH/view?usp=share_link)

### EGC Websites

#### Tribal websites

- [Lummi Nation](#)

#### Federal agency (Canada and United States) websites

- [National Oceanic and Atmospheric Administration](#)
- [Fisheries and Oceans Canada](#)
- [U.S. Department of Agriculture National Invasive Species Information Center](#)
- [U.S. Fish and Wildlife Service](#)
- [Northwest Straits Commission](#)
- US Geological Survey Nonindigenous Aquatic Species – [Collection information](#), [point map](#), [species profile](#), [animated map](#)
- [NEMESIS](#)

#### State agency websites

- [Alaska Department of Fish and Game](#)
- [Washington Department of Fish and Wildlife](#)
- [Oregon Department of Fish and Wildlife](#)
- [California Department of Fish and Wildlife](#)

#### Sea Grant websites

- [Washington Sea Grant](#)

#### Other websites

- [GreenCrab.org](#)
- Maria Mitchell Association – [The Green Crab](#)
- [Smithsonian: A green crab's super power: eating through its gills](#)
- [Invasive Species Council of British Columbia European Green Crab](#)
- [Seadrift Lagoon Green Crab Project](#)

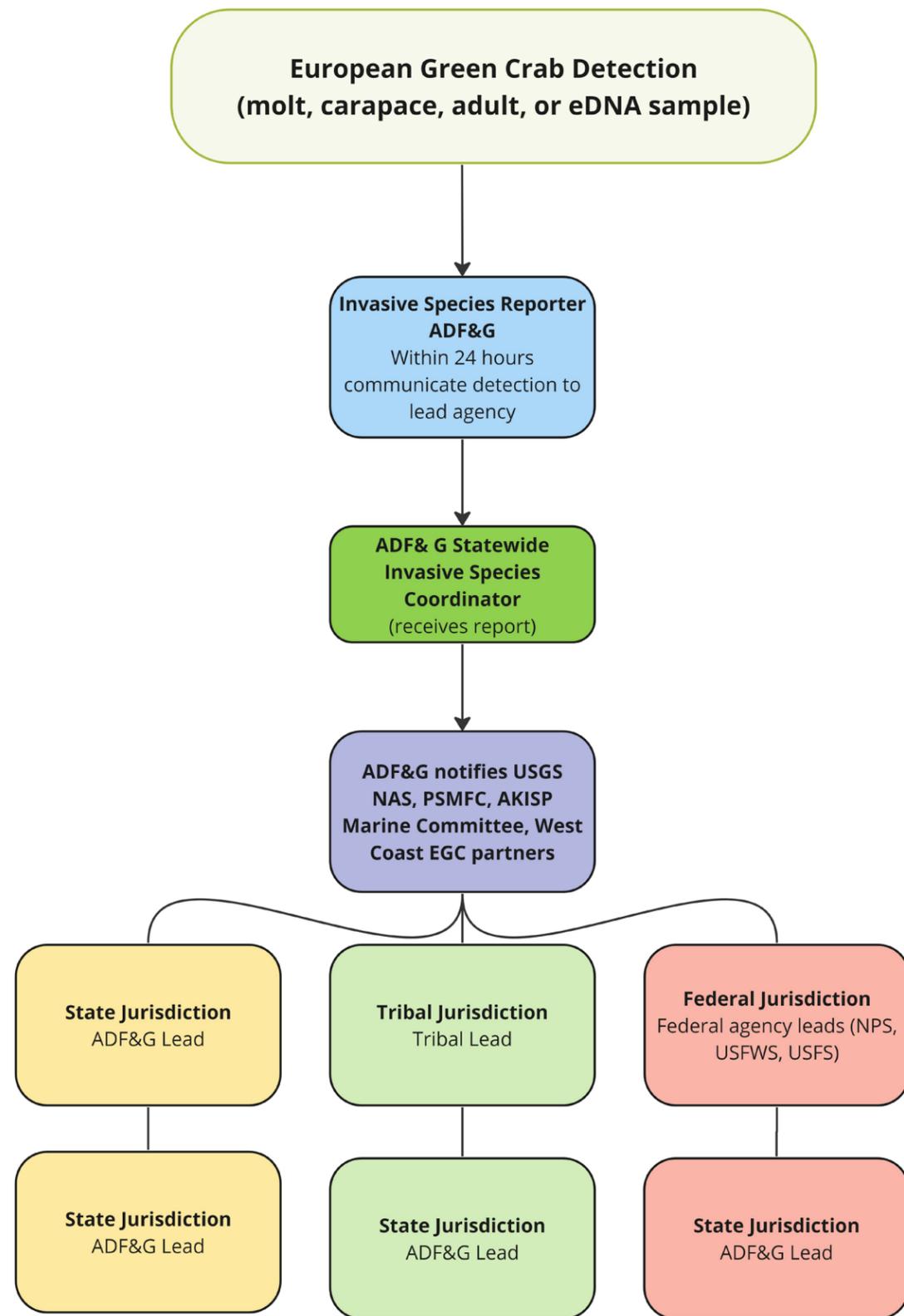
### Report a Sighting in Alaska

Take photos of any suspect crab and call the Alaska Department of Fish and Game Invasive Species Hotline @ 1-877-INVASIV.

### EGC Response Steps in Alaska

If an EGC carapace or live adult is detected, deliberate actions will be taken to determine the magnitude of the detection, and appropriate response actions. These actions are described in detail in *Early Detection and Rapid Response Plan for Invasive European Green Crab (Carcinus maenas) in Alaska, 2023-2028*.

1. Confirmation of Detection
2. Rapid Assessment
3. Declaration of Emergency
4. Notification Communication
5. Delineate Scope of Response
6. Activate Incident Command System (ICS) and Response Team
7. Initiate Response Actions
8. Stepping Down ICS and Shift to Long-Term Management



**Publications (in order of year published)**

- Early Detection and Rapid Response Plan for Invasive European Green Crab (*Carcinus maenas*) in Alaska, 2023-2028 (LINK TO BE ADDED WHEN PLAN IS COMPLETED)
- [The Green Wave: reviewing the environmental impacts of the invasive European green crab \(\*Carcinus maenas\*\) and potential management approaches](#) (Ens et al. 2022)
- [Effect of Predator Exclusion on Softshell Clam \(\*Mya arenaria\* L.\) Recruitment](#) (Young 2022)
- [A pheromone bouquet controls the reproductive behaviour of the male shore crab, \*Carcinus maenas\*](#) (Fletcher et al. 2021)
- [The role of changing pH on olfactory success of predator-prey interactions in green shore crabs, \*Carcinus maenas\*](#) (Richardson et al. 2021)
- [Ocean Indicators Predict Range Expansion of an Introduced Species: Invasion History of the European Green Crab \*Carcinus maenas\* on the North American Pacific Coast](#) (Yamada et al. 2021)
- [Functional eradication as a framework for invasive species control](#) (Green and Grosholz 2021)
- [Engaging the importance of community scientists in the management of an invasive marine pest](#) (Grosholz et al. 2021)
- [Stage-specific overcompensation, the hydra effect, and the failure to eradicate an invasive predator](#) (Grosholz et al. 2021)
- [Status of Green Crabs in Coos Bay: Monitoring Report 2020](#)
- [First detection of the invasive European green crab \*Carcinus maenas\* on Lummi Nation reservation tide-lands](#) (Mueller and Jefferson 2019)
- [Habitat alteration by invasive European green crab \(\*Carcinus maenas\*\) causes eelgrass loss in British Columbia, Canada](#) (Howard et al. 2019)
- [Lifting Barriers to Range Expansion: the European Green Crab \*Carcinus maenas\* Enters the Salish Sea](#) (Yamada et al. 2017)
- [Evaluating trapping as a method to control the European green crab, \*Carcinus maenas\*, population at Pipestem Inlet, British Columbia](#) (Duncombe and Therriault 2017)
- [Citizen science program detects range expansion of the globally invasive European green crab in Washington State](#) (Grason et al. 2017)
- [Effects of spatial resolution on predicting the distribution of aquatic invasive species in nearshore marine environments](#) (Lowen et al. 2016)
- [Maine's Declining Soft-Shell Clam Population Predation by European Green Crabs and Using Eelgrass Loss to Identify At-Risk Zones](#) (Spence 2015)
- [Biological and physical ocean indicators predict the success of an invasive crab, \*Carcinus maenas\*, in the northern California Current](#) (Yamada, Peterson and Kosro 2015)
- [Loss of Eelgrass in Casco Bay, Maine, Linked to Green Crab Disturbance](#) (Neckles 2015)
- [Break-even analysis for a green crab fishery in PEI, Canada](#) (2016)
- [Distribution and Biological Characteristics of European Green Crab, \*Carcinus maenas\*, in British Columbia, 2006-2013](#) (Gillespie et al. 2015)
- [An invasive species facilitates the recovery of salt marsh ecosystems on Cape Cod](#) (Bertness and Cover-

dale 2013)

- [Australian National Control Plan for the European green shore crab \*Carcinus maenas\*](#) (2008)
- [Modeling the impacts of the European green crab on commercial shellfisheries](#) (Grosholz et al. 2011)
- [Will the European green crab \(\*Carcinus maenas\*\) persist in the Pacific Northwest?](#) (Yamada and Gillespie 2008)
- [Northward Spread of Marine Nonindigenous Species Along Western North America: Forecasting Risk of Colonization in Alaskan Waters Using Environmental Niche Modeling](#) (de Rivera et al. 2007)
- [Modeling Economic Impacts of the European Green Crab](#) (Lovell et al. 2007)
- [A Biological Synopsis of the European Green Crab, \*Carcinus maenas\*](#) (Klassen and Locke 2007)
- [Status of the European Green Crab, \*Carcinus maenas\*, in British Columbia – 2006](#) (Gillespie et al. 2007)
- [A global invader at home: population structure of the green crab, \*Carcinus maenas\*, in Europe](#) (Roman and Palumbi 2004)
- [Management Plan for the European Green Crab](#) (Grosholz and Ruiz ed. 2002)
- [Global Invader: The European Green Crab](#) (Behrens Yamada 2001)
- [The Role of Predation by the Red Rock Crab, \*Cancer productus\*, on the Invasive European Green Crab, \*Carcinus maenas\*, in Yaquina Bay, Oregon](#) (Hunt 2001)
- [Predicting the impact of introduced marine species: Lessons from the multiple invasions of the European green crab \*Carcinus maenas\*](#) (Grosholz and Ruiz 1996)
- [Recent Biological Invasion May Hasten Invasional Meltdown by Accelerating Historical Introductions](#) (Grosholz 1995)
- [Introduction, dispersal and potential impacts of the green crab \*Carcinus maenas\* in San Francisco Bay, California](#) (Cohen et al. 1995)
- [Spread and potential impact of the recently introduced European green crab, \*Carcinus maenas\*, in central California](#) (Grosholz and Ruiz 1995)

**Table 3. European Green Crab agency and organization contacts.**

Organization	Title	Geographic Area of Responsibility	Name	Contact Information
Alaska Department of Fish and Game	Invasive Species Program Coordinator	Statewide	Tammy Davis	Office (907) 465-6183 Mobile (907) 209-2492 <a href="mailto:Tammy.davis@alaska.gov">Tammy.davis@alaska.gov</a>
U.S. Fish and Wildlife Service	Regional Invasive Species Program Coordinator	Statewide	Vacant	
U.S. Fish and Wildlife Service	Early Detection and Rapid Response Project Coordinator	Southwest and Southcentral Alaska	Ben Wishnek	Office (907) 260-2819 Mobile (907) 251-0692 <a href="mailto:Benjamin_wishnek@fws.gov">Benjamin_wishnek@fws.gov</a>
Metlakatla Indian Community	Director, Department of Fish and Wildlife	Metlakatla Indian Community	Dustin Winter Genelle Winter	Office (907) 886-3474 Mobile (907) 209-9000 <a href="mailto:dww@aptalaska.net">dww@aptalaska.net</a> (907) 886-1560 <a href="mailto:genelle.winter@gmail.com">genelle.winter@gmail.com</a>
Alaska Sea Grant	Director	Statewide	Ginny Eckert	(907) 796-5450 <a href="mailto:ginny.eckert@alaska.edu">ginny.eckert@alaska.edu</a>
Kenai Watershed Forum	Environmental Scientist	Kenai Peninsula	Maura Schumacher	(907) 260-5449, ext. 1208 <a href="mailto:maura@kenaiwatershed.org">maura@kenaiwatershed.org</a>
Department of Fisheries and Oceans Canada	Research Scientist	British Columbia	Thomas Therriault	(250) 756-7394 <a href="mailto:Thomas.Therriault@dfo-mpo.gc.ca">Thomas.Therriault@dfo-mpo.gc.ca</a>
National Oceanic and Atmospheric Administration	Wildlife Biologist	Alaska Regional Office	Linda Shaw	(907) 586-7510 <a href="mailto:Linda.shaw@noaa.gov">Linda.shaw@noaa.gov</a>
University of Alaska - Alaska Center for Conservation Science - Kachemak Bay National Estuarine Research Reserve	KBNERR Harmful Species Program Specialist		Jasmine Maurer	<a href="mailto:jmaurer@alaska.edu">jmaurer@alaska.edu</a>
Alaska Department of Transportation & Public Facilities	Environmental Impact Analyst III	Statewide	Renee Goentzel	(907) 269-0714 <a href="mailto:renee.goentzel@alaska.gov">renee.goentzel@alaska.gov</a>
University of Alaska Fairbanks Cooperative Extension Service	IPM Instructor	Statewide	Gino Graziano	(907) 786-6314 <a href="mailto:gagraziano@alaska.edu">gagraziano@alaska.edu</a>
United States Forest Service	Invasive Plant and Pesticide Use Coordinator	Statewide	Joni Johnson	(907) 772-5884 <a href="mailto:joni.m.johnson@usda.gov">joni.m.johnson@usda.gov</a>
Salcha-Delta Soil and Water Conservation District	Invasive Plants Program Coordinator	3,762,800 acres in AK interior	Summer Nay	(907) 616-0302 <a href="mailto:summer.nay@salchadeltas-wcd.org">summer.nay@salchadeltas-wcd.org</a>
Tyonek Tribal Conservation District	Habitat Programs Manager	Game Management Unit 16B	Jillian Jablonski	(630) 542-9424 <a href="mailto:jjablonski@ttcd.org">jjablonski@ttcd.org</a>
Homer Soil and Water Conservation District	Invasive Species Program	Homer	Katherine Schake	(907) 235-8177 ext. 5 <a href="mailto:katherine@homerswcd.org">katherine@homerswcd.org</a>
Southeast Alaska Watershed Coalition	Restoration Biologist	SE Alaska	John Hudson	(907) 419-4677 <a href="mailto:john@sawcak.org">john@sawcak.org</a>
Prince William Sound Regional Citizens' Advisory Council	Environmental Monitoring Project Manager	Prince William Sound	Danielle Verna	(907) 834-5090 <a href="mailto:dverna@pwsrccac.org">dverna@pwsrccac.org</a>

# References

- Abt Associates. 2008. Ecological and economic impacts and invasion management strategies for the European Green Crab. Paper # EE-0513.
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# Appendices

- Appendix A. Biology of European Green Crab
- Appendix B. Ecological Impacts of European Green Crab
- Appendix C. Economic Impacts of European Green Crab
- Appendix D. Laws and Regulations Pertaining to European Green Crab in Alaska
- Appendix E. Alaska Invasive Species Partnership Marine Committee
- Appendix F. Example Press Release Upon Detection of EGC
- Appendix G. Example of Emergency Proclamation by Alaska Governor
- Appendix H. Example Memorandum of Understanding with Partner Organization

## ■ Appendix A. Biology of European Green Crab

EGC is a small swimming crustacean identified by five spines on the front lateral edge of the carapace on either side of the eyes and three blunt bumps between the eyes (Davidson et al. 2009). Coloration varies from dark to light mottled green on the dorsal side to bright yellow-green (freshly molted individuals) to dark orange-red (late intermolt crabs). The carapace width of an adult EGC can range up to 6 cm in length and 9 cm wide (Global Invasive Species Database 2022).

EGC is euryhaline, demonstrating wide tolerances to salinity, water temperature, oxygen, and habitat types (Klassen and Locke 2007), and are tolerant to food deprivation (Leignel et al. 2014). EGC are eurythermic and can survive temperatures from freezing to 35 degrees C (Klassen and Locke 2007, Tepolt and Somero 2013). Adult EGC can tolerate temperatures ranging from 0 to 33 °C, salinities from 4 to 54 parts per thousand, starvation for up to three months, and air exposure in damp burrows for up to 10 days (Bravo et al. 2007). Larvae are not as tolerant to temperature, salinity, or starvation as adults which may limit their ability to become established in new habitats (Williams 1984, Dawirs 1985, Klassen and Locke 2007, Global Invasive Species Database 2022).

EGC is an omnivore (Grosholz and Ruiz 1996), thus food is generally not a limiting factor.

On the West Coast of North America, EGC live from four to six years. Under suitable conditions, female EGC are highly fecund, can become mature during their first year, can produce up to 200,000 eggs, and can mate multiple times during a breeding season (Cohen et al. 1995; Grosholz and Ruiz 2022; Behrens Yamada et al. 2005). Breeding season varies, but usually occurs between April to November (WDFW 2008). When eggs hatch, the free-swimming zoeae can travel hundreds of kilometers on ocean currents (Grason et al. 2016).

EGC can disperse long distances as evidenced by the planktonic larval stage that can last up to 80 days in the water column (Darbyson 2006). Rapid spreading of populations can occur once established (Schloemer 2020).

### Habitat Preferences and Home Range

EGC is a generalist that occupies sheltered habitats, such as estuaries, harbors, and other wave-protected

areas but cannot survive open shore wave swept coastlines because of its inability to grip rocky substrates (Behrens 2001; Hampton and Griffiths 2007). Mature EGC lives in rocky and muddy intertidal and subtidal protected bays, estuaries, and saltmarshes.

In the Salish Sea, Howard (2018) predicted EGC may be more prolific in intertidal, marshy habitats where it may avoid predation by larger crabs. EGC can occupy depths ranging from high tide to 6 meters, although it has been recorded occupying habitat to 60 meters (Crothers 1968 et al. 2008).

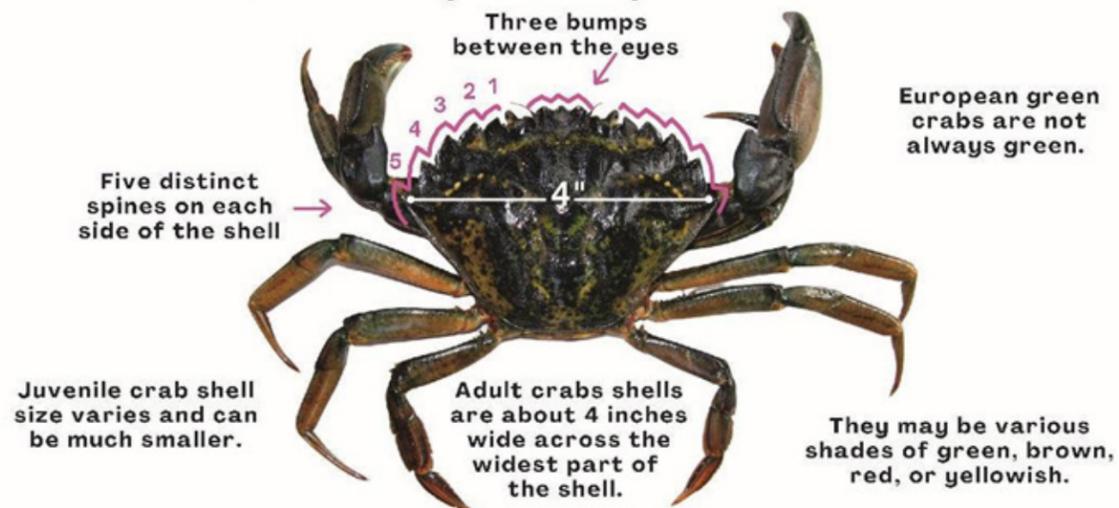
As EGC ages, it occupies a variety of substrates in lower intertidal and subtidal zones, such as mud, sand, rock, and eelgrass, where they can shelter (Young and Elliott 2020). Juvenile crabs prefer gravel or cobble areas, or mussel beds, where they can shelter under rocks and seaweed to avoid predation and cannibalism (Behrens 2001, Almeida et al. 2008). Both juveniles and adults prefer areas with high structural complexity (Amaral et al. 2009) and avoid open sandy areas without refuge, although adults commonly burrow in sandy mud (Young et al. 2017). Thiel and Darnedde (1994) identified mussel beds on mudflats as optimal refuge from predators, e.g., large crabs, fishes, and birds. Adult crabs can travel as much as 2km in 6 hours (Ameyaw-Akumfi and Naylor 1987).

Smith et al. (2022) examined seasonal and daily movements of individual EGC in a Maine estuary, noting individuals remained localized to specific regions (300-600 m linear distance) of the estuary. To take refuge in deeper waters, EGC overwintered in downstream areas when the temperature shifted below 10 degrees C (Smith et al. 2022).

# FOUND IN SOUTHEAST ALASKA INVASIVE EUROPEAN GREEN CRAB

Salmon and shellfish habitat is destroyed by European green crabs.

## How to Identify a European Green Crab



## Spotted a European Green Crab? Now what do you do?

- Take multiple photos of the live crab or the crab shell. Collection and transport is prohibited.
- Note the number of crabs, the location (GPS coordinates or landmarks), and type of habitat.
- Report immediately to the Alaska Department of Fish & Game 1 (877) INVASIV.

### NATIVE CRABS THAT LOOK SIMILAR TO EUROPEAN GREEN CRABS



It is illegal to release nonnative and invasive species into Alaska waters or lands.



Scan the QR Code or call the invasive species hotline at 1-877-INVASIV to report observations of any invasive, nonnative species, or unusual plants or animals.



## Appendix B. Ecological Impacts of European Green Crab

Considered one of the world's 100 worst invaders by the IUCN Species Survival Commission Invasive Species Specialist Group, EGC is considered one of the most ecologically potent and damaging predators in coastal communities (Lowe et al. 2000, Global Invasive Species Database 2022). EGC has the potential for significant impacts on fisheries, aquaculture, and the ecosystem (Global Invasive Species Database 2022) by predation, competition, and habitat modification (Klassen and Locke 2007). In Alaska, Riemer et al. (2017) identified EGC as one of the top ten marine invasive species of greatest concern to the Bering Sea.

### Predation and Competition

Green crabs eat prey from at least 158 genera and decrease the diversity and biomass of estuarine communities (Locke et al. 2007, Cohen et al. 1995, Grosholz and Ruiz 1996) and prey on bivalves and other species (Gillespie et al. 2007), producing significant impacts to wild harvest and culture of shellfish. In both its native range and regions where it has invaded, EGC has had significant impacts on bivalves, other mollusks, and crustaceans, through predation, competition, and burrowing activities (Bravo 2007). EGC competes with other decapods for food or structure (deRivera et al. 2005). EGC contributed significantly to the collapse of the soft-shell clam industries on the East Coast of the United States (Breen and Metaxas 2008). EGC out-compete juvenile Dungeness crab for food and shelter, prey upon Dungeness crab, and displace them from refuge habitats (McDonald et al. 2001). The competitive and predatory effects on the prey base may indirectly impact endangered and threatened species that use similar food resources as EGC, such as Steller's eider (*Polysticta stelleri*; threatened) and Eskimo Curlew (*Numenius borealis*; endangered), or species of cultural importance (Davidson et al. 2009).

### Eelgrass

Seagrass meadows are a key habitat in North American West Coast estuaries and are one of the most biologically productive biomes on Earth (Duarte 2002). Eelgrass (*Zostera* spp.) is the most common and widespread seagrass taxon in estuaries and embayments along the North American West Coast and is found worldwide in temperate zones in soft-bottom habitats within sheltered bays and estuaries (Phillips 1984). Eelgrass supports key ecological functions in coastal and estuarine systems (Nordlund et al. 2016), provid-

ing nursery grounds and habitat for fishes and invertebrates (including Dungeness crab), sediment and shore stabilization, water filtration, and carbon sequestration (Short and Wyllie-Echeverria 1996, Waycott et al. 2009, Sherman and DeBruyckere 2018, Walter et al. 2020).

EGC damages eelgrass beds (Malyshev and Quijon 2011, Garbary et al. 2014), which can both affect survival of Dungeness crab in early life history as well as result in habitat loss that could substantially impact Dungeness crab populations (Drinkwin et al. 2019). On the West Coast, damage to eelgrass could reduce quality and habitat availability for juvenile salmonids, forage fishes, crabs, and other species; impair carbon-storage capacity of tidelands; increase wave exposure and change tideland shape and reduce available foraging area for shorebirds (Drinkwin et al. 2019).

### Other Invasive Species

EGC can facilitate invasions of tunicates, such as *Styela*, by preying on tunicate predators (Locke et al. 2007). In California, predation on native clams by EGC enabled a population explosion of a previously rare invasive clam (Grosholz 2005).

## ■ Appendix C. Economic Impacts of European Green Crab

EGC has caused substantial impacts to commercial and recreational fisheries. New England shellfish, including the softshelled clam (*Mya arenaria*) fishery (Glude 1955), quahogs (*Mercenaria mercenaria*) (Walton and Walton 2001), Manila clams (*Venerupis philippinarum*) (Cohen et al. 1995), and Pacific oysters (*Crassostrea gigas*) have been impacted by EGC. EGC can affect Dungeness crab (*Cancer magister*) (Cohen et al. 1995, Lafferty and Kuris 1996, Jamieson et al. 1998, McDonald et al. 2001), juvenile lobsters (*Homarus americanus*) (Williams et al. 2009), English Sole (*Pleuronectes vetulus*) (Jamieson et al. 1998) and eelgrass (*Zostera marina*; Davis et al. 1998), affecting native oyster restoration (Kimbrow and Grosholz 2006).

European green crabs were estimated to have caused \$18.6 to 22.6 million annually in damage to the East Coast commercial and recreational shellfisheries and eelgrass restoration efforts (Abt Associates 2008).

Seafood is the largest private sector industry in Southeast Alaska, both in terms of workforce size and income, accounting for 15% of regional employment (McKinley Research Group 2022). Key regional ports include Craig, Juneau, Sitka, Excursion Inlet, Ketchikan, Wrangell, Haines, Petersburg, and Yakutat.

EGC in Alaska may have economic, recreational, cultural, and social impacts to commercial and recreational fisheries, including Dungeness crab, Spot shrimp (*Pandalus borealis*), Pacific oyster-aquaculture (*Crassostrea gigas*), Bay mussel (*Mytilus trossulus*), Littleneck clam (*Protothaca staminea*), and Geoduck clam (*Panopea abrupta*) (Davidson et al. 2009).

Although the aquaculture industry is relatively small in Alaska (estimated to have about 82 permitted farms and another 24 permits pending) and the economic value of the industry is \$1.5 million, the Governor's Mariculture Task Force has a goal of developing a \$100 million annual aquaculture industry within the next 20 years (National Marine Fisheries Service 2022). EGC has the potential to negatively impact the aquaculture industry in Alaska.

Mach and Chan (2016) estimate possible Puget Sound, Washington shellfish revenue losses of \$1.03–23.8 million annually, with additional distribution losses up to \$17.6 million and 442 job positions annually because of EGC invasion in the nearshore ecosystem of Puget Sound.

## ■ Appendix D. Laws and Regulations Pertaining to European Green Crab in Alaska

Executive Order 13112 addresses the prevention and introduction of invasive species and provides for their control and minimization of the economical, ecological, and human health impacts the invasive species causes. The order established the Invasive Species Council, which is responsible for preparing and issuing the National Invasive Species Management Plan, which details and recommends performance-oriented goals and objectives and specific measures of success for federal agencies.

Executive Order 13751 was issued in 2016, amended Executive Order 13112, and directed federal agency actions to continue coordinated federal invasive species-related prevention and control efforts.

### USFWS

[USFWS 569 FW1: Integrated Pest Management](#) establishes policy, procedures, and responsibilities for pest management activities on and off USFWS lands consistent with the Department of the Interior Integrated Pest Management policy (517 DM1) and other applicable authorities.

### NOAA

The Nonindigenous Aquatic Nuisance Prevention and Control Act (16 U.S.C. §4701, et seq.) governs NOAA's role in addressing invasive species.

### US Forest Service

Primary laws governing Forest Service programs relating to invasive species include the Organic Administration Act (16 U.S.C. §551), Multiple-Use Sustained-Yield Act (16 U.S.C. §§528-531), Forest and Rangeland Renewable Resources Planning Act (16 U.S.C. §§1671 et seq.), Federal Noxious Weed Act (7 U.S.C. §2814), Public Rangelands Improvement Act (43 U.S.C. §§1901-1908), Federal Land Policy and Management Act (43 U.S.C. §1701), Cooperative Forestry Assistance Act (16 U.S.C. §§2101-2111), among others. Many of these authorities do not focus strictly on invasive species management, but also apply to other Forest Service activities including rangeland management, research, or public use activities.

### National Park Service

The primary laws governing NPS's role in addressing invasive species are the National Park System Organic Act (16 U.S.C. §§1 et seq.; 16 U.S.C. §594), Endangered Species Act (16 U.S.C. §1531 et seq.), Noxious Weed

Control and Eradication Act (7 U.S.C. §§7781-7786), Plant Protection Act (7 U.S.C. §7701 et seq.), National Invasive Species Act (16 U.S.C. 4701), Nonindigenous Aquatic Nuisance Prevention and Control Act (16 U.S.C. §§4701), and Animal Damage Control Act (7 U.S.C. §§426-426c), among other authorities.

### Tribal

#### Metlakatla Indian Community

The Metlakatla Indian Community was recognized by the U.S. federal government as a corporation of the United States via a [charter](#) in 1934 that was amended in 1936. The community has the authority to own, hold, and managed all community property, which includes the 13,200-acre Annette Islands Reserve, and represents the only Indian reservation in Alaska.

### State

[Alaska Stat. § 16.05.251](#)

[Alaska Admin Code Title 5, Part 1, Ch. 1, Art. 1 \(state-wide provisions\); Alaska Admin. Code tit. 5, § 01.010. Methods, means, and general provisions](#)

## ■ E. Alaska Invasive Species Partnership Marine Committee

Tammy Davis	Chair- ADF&G
Danielle Verna	Co-Chair- PWSRCAC
Aaron Martin	USFWS
Alexander Alasin	
Alexandra Davis	University of Alberta
Amanda Kelley	UAF
Amanda Millay	AK DOT&PF - AMHS
Austin Ahmasuk	Kawerak, Inc.
Austin Love	PWSRCAC
Benjamin Pister	NPS
Benyamin Wishnek	USFWS
Bonnie Bernard	UAA- ACCS
Bridget Ferris	NOAA/NMFS
Chandra Poe	Qawalangin Tribe of Unalaska
Christina Kriedeman	NPS
Damian Menning	USGS
Dustin Winter	Metlakatla Indian Community
Gail Ashton	SERC
Gary Freitag	SeaGrant- Retired
Gay Sheffield	AK SeaGrant Marine Advisory- Nome
Genelle Winter	Metlakatla Indian Community
Jasmine Maurer	UAA- ACCS
J Pearce	USGS
Jesse Endert	Seldovia Village Tribe
Joni Johnson	USFS
Julie Matweyou	SeaGrant
Kelsey Morgan	USCG
Kristine Dunker	ADF&G
Linda McCann	SERC
Linda Shaw	NOAA/NMFS
Lynn Wilbur	grad student- JNU
Marnie Chapman	UAS/ Sitka
Matt Van Daele	Sun'aq Tribe of Kodiak
Melissa Good	AK Sea Grant Marine Advisory-Kodiak
Natalie Kiley-Bergen	APU
Nina Chambers	NPS
Ron Britton	USFS- Chugach
Sarah Cohen	SFSU
Stephen Payton	Seldovia Village Tribe
Sunny Rice	AK Sea Grant - Marine Advisory-Petersburg
Tahzay Jones	NPS
Taylor Stumpf	Metlakatla Indian Community
Tim Stallard	Alien Species Control, LLC

## ■ F. Example Press Release Upon Detection of EGC

**LOCATION** – As part of an early-detection surveillance program, the [name, or names, of entities that detected EGC] found evidence of European green crabs (*Carcinus maenas*) in LOCATION during regular surveillance, and then trapped XX green crabs [event following initial detection].

“Finding invasive green crabs in this location area raises serious concern that there may be an established and reproducing population in LOCATION and in nearby locations,” said Tammy Davis, Alaska Department of Fish and Game (ADF&G) Invasive Species Program Coordinator. “We are working with our local partners to conduct additional trapping in the area and will work with local governments, tribes, and other partners to determine the extent of the infestation and plan an appropriate response.”

European green crabs are a globally damaging invasive species that pose a threat to Alaska’s economic, environmental, and cultural resources. Potential impacts include destruction of eelgrass beds and estuarine marsh habitats, threats to the harvest of wild shellfish and the shellfish aquaculture industry, the Dungeness crab fishery, salmon recovery, and a complex array of ecological impacts to food webs, which could negatively impact human uses and the cultural and natural resources of coastal Alaska.

Alaska partners have been working with neighboring agencies, tribes, and organizations in southern Alaska, British Columbia, and Washington to address the northward expansion of invasive green crabs on the West Coast.

“The key to managing this species is surveillance and responding quickly to small populations before they get too big to control, especially in priority locations where there is potential for significant economic, environmental, and cultural loss,” said Aaron Martin, U.S. Fish and Wildlife Service Regional Invasive Species Program Coordinator. “When one invasive green crab is detected, the first step is to quickly conduct trapping to figure out the size and geographic extent of a potential population. Then we have more information to determine the best way to manage them.”

The European green crab first became established in the United States in the mid-1800s, arriving by sail or steamships via transatlantic trade routes to the Cape Cod region on the East Coast. In the early 1900s, green crabs spread northwards, where they are believed to have contributed to the dramatic declines in the soft-shell clam industry. In 1989, they were discovered on the West Coast, in San Francisco Bay. They have since been discovered along the coast of Washington, British Columbia, and Southeast Alaska.

Following a discovery of invasive green crab in Southeast Alaska in 2022, the U.S. Fish and Wildlife Service funded an initiative to develop an early detection and rapid response plan for the State of Alaska. The 5-year plan, completed in 2023, included a suite of actions the State of Alaska and its partners should implement to stay ahead of the invasive green crab invasion curve and rapidly respond to new introductions. Numerous federal and state agencies, tribes, non-profit organizations, and academic institutions were involved in the development of the plan. The plan builds on the strengths of the Salish Sea Transboundary Action Plan, a collaborative effort involving Canada, the State of Washington, and others.

### Report your green crab sightings

The best way to tell European green crabs apart from other species is by the number of spines next to the eye (marginal teeth). The green crab is entirely distinct from other native crabs with its five marginal teeth.

The public is encouraged to keep a lookout for European green crabs when visiting any beach or coastline area. People can familiarize themselves with how to identify the species and distinguish it from similar native species on ADF&G’s website.

If you find a live green crab or its shell in Alaska, report it online as soon as possible. Take several pictures from different angles and distances to help confirm the identification. It’s also helpful to include a coin or other object to help show its size.

It is illegal to possess a live invasive green crab in Alaska, so make sure to leave the crab where you found it. This may sound counter intuitive, but this law is designed to protect native crabs from cases of mistaken identity, which is very common. If you find a dead crab or an empty shell, however, you can collect and keep it to help in identification.

■ **G. Example of Emergency Proclamation by Alaska Governor**

**Executive Proclamation by Governor  
Green Crab Infestation**

**WHEREAS**, the Alaska Department of Fish and Game (ADF&G), tribal co-managers, shellfish growers, and other partners have identified an exponential increase in European green crab (*Carcinus maenas*) populations; and

**WHEREAS**, initially native to the northeastern Atlantic Ocean, the European green crab is a globally-damaging invasive species that is able to survive in a wide range of water temperatures and salinities and has become established in many temperate coastal zones in areas around the world; and

**WHEREAS**, where they have become established, European green crabs have disturbed native habitat, displaced, and outcompeted resident native species, altered natural food webs, and decimated shellfish and other aquatic industries; and

**WHEREAS**, if they become permanently established in the coastal waters of Alaska, it is likely that European green crabs will become predators to shellfish and juvenile Dungeness crab, destroy critical habitat such as eel-grass beds and estuarine marshes, disrupt natural food webs, harm overall crab populations, hinder salmon and Southern Resident killer whale recovery efforts, reduce shorebird food supplies, and ultimately affect the overall health and resiliency of Alaskan coast; and

**WHEREAS**, the damage caused by European green crabs, if they become permanently established, will particularly harm endangered species, impact resources that are part of the cultural identity of the tribes and native peoples, and affect small businesses and low-income communities; and

**WHEREAS**, in recognition of the threats posed by the European green crab, the Alaska Department of Fish and Game co-signed the Rapid Response Plan for Invasive European Green Crab (*Carcinus maenas*) introductions in Alaska, 2023–2028, which provides the initial framework for a management response, with Alaska Invasive Species Partnership Marine Committee members and others; and

**WHEREAS**, due to their invasive nature and potential for harm, European green crabs are classified as a high-risk species that seriously threatens the environment, economy, and well-being of the state of Alaska and is a high priority for expedited prevention and rapid response management actions; and

**WHEREAS**, after consultation with necessary parties and co-managers, on DATE, the Director of the ADF&G (1) determined that the ongoing European green crab infestation poses an imminent threat to the environment, economy, and human well-being of Alaska, (2) advised my office that action and funding to counteract the threat cannot wait for the DATE legislative session to meet before action is taken, and (3) requested \$X,XXX,XXX in emergency funding; and

**WHEREAS**, I agree with the Director’s findings, and further find that the ongoing and expanding European green crab infestation poses an imminent danger to Alaska’s marine environment, marine-based economy, and the cultural well-being of both tribes and non-tribal residents, that the costs of a delay in counteracting the infestation are unacceptably high, that the Director of the ADF&G should use immediately-available funding to begin implementation of a coordinated effort to prevent the European green crab from becoming permanently established in Alaska’s coastal waters, and that additional funding from the Legislature is needed to fully implement the necessary measures.

**NOW THEREFORE**, I, XXX XXXXX, Governor of the state of Alaska, by virtue of the authority granted by XXXXXXXX, because of the above-noted situation, and in accordance with Alaska statute XXXXXXXX, do hereby order the ADF&G to begin implementation of emergency measures as necessary to affect the eradication of or to prevent

the permanent establishment and expansion of European green crab.

**FURTHERMORE**, I direct all Alaska state natural resource-related agencies to identify European green crab management as a high priority on their respective state-owned aquatic lands and to facilitate implementing the emergency measures described herein.

**FURTHERMORE**, I urge the Legislature to provide additional emergency funding as requested by the ADF&G as soon as possible.

Signed and sealed with the official seal of the state of Alaska on this XXth day of Month, A.D., Year.

By:

\_\_\_\_\_  
Governor of the State of Alaska

\_\_\_\_\_  
Secretary of State

## ■ Appendix H. Draft Guidelines for EGC Rapid Assessment

After the first observation of EGC in a new location, determining the scale of the invasion is the next step. Rapid assessment surveys through intensive trapping efforts are the best method for determining the density of EGC invasion and informing resource allocation to minimize impacts in critical habitats. There are many factors to consider when implementing a rapid assessment. In some cases, it may be possible to pre-determine rapid assessment survey protocols and identify partners and resources prior to the first observation of invasive EGC. For example, availability and number of traps, the size of the area to be assessed, access to suitable habitat (boat, road), number of people available, tidal cycle, habitat complexity, proximity to other known EGC populations, and modeled larval movement are key pieces of information to inform a rapid assessment.

Rapid assessment is imperative to determine the level of invasion and development of a long-term response and suppression. During the rapid assessment, preferred EGC habitat should be targeted. In the Northeast Pacific, EGC invasions are most abundant in the intertidal area to 20-30 feet. Key habitat features include tidal channels, freshwater inputs, eelgrass beds, soft or sandy bottoms with small cobble, known clam or mussel beds, and low energy bays and inlets. Invasive EGC in the NE Pacific does not commonly establish high densities in rocky intertidal areas. Young of the year and vulnerable females are often found hiding under rocks in the upper intertidal areas and may not enter traps with larger crabs present. Consult with partners, tribal leaders, and local observers to determine the best sites for rapid assessment.

Following standardized methods and data collection will provide critical information long term, such as EGC invasion impacts through time, the health and changes in native crab populations, and comparisons across regions. Standardized methods and protocols should include counting, sexing, and measuring all species present in the traps, or a pre-determined number of individuals when catch rates are high (>50 of a single species per trap). At each site, 5-6 baited traps should be used, 30-50 m apart and soaked for 24 hours. EGC collected during the assessment survey should be removed and transported in sealed containers. EGC should be destroyed either by freezing for seven days or crushing (after all metrics, genetic samples when applicable, maturity assessment have been completed).

Rapid assessment throughout the area of concern will inform targeted removal efforts during repeated monthly trapping, or inform other response plan implementation. In exceptionally large areas, i.e., major bays or inlets, it may take several sampling cycles to thoroughly document the level of invasion to inform response plan development due to distance and/or limited resources (traps or people). It is important to set traps repeatedly (whenever feasible, two days in a row at each site) and regularly at selected sites (monthly) to increase the likelihood of accurately quantifying the initial invasion.

The following is an example of a rapid assessment survey at Padilla Bay NERR. Padilla Bay is eight miles long and 3-4 miles wide (an area of about 20 square miles), and there is about 143 acres of saltmarsh habitat. The rapid response and assessment after the first detection of EGC in Padilla Bay included staff and volunteers from three different groups—Padilla Bay NERR, WA Department of Fish and Wildlife, and Washington Sea Grant Crab Team.

- 31 sites in Padilla Bay
- Average of 6 traps per site
- 2 overnight trap sets
- 182 traps on Day 1
- 186 traps on Day 2
- 368 traps set total
- 13 staff involved: 4 WSG Crab Team; 4 WDFW; 5 PBNERR
- 4 days of field work
- 31 personnel-days total

## ■ Appendix I. Example Memorandum of Understanding with Partner Organization

### INTERAGENCY AGREEMENT

**TITLE:** Alaska Green Crab Management  
**CONTRACTOR:**  
**TYPE:** Payable / Goods and Services / Interagency

**NUMBER:**  
**CONTRACT PERIOD:**  
**CONTRACT VALUE:**

#### A. PARTIES TO THIS CONTRACT

This Contract is entered into between the Alaska Department of Fish and Game (ADF&G), and XXX (Contractor), and shall be binding upon the agents and all persons acting by or through the parties.

#### B. PURPOSE OF CONTRACT

This contract sets out the terms and conditions by which the Contractor shall provide goods and/or services to ADF&G.

#### C. DESCRIPTION OF PROJECT

The Contractor shall perform the project as described in Attachments, which are incorporated herein by this reference:

Attachment "A" General Terms and Conditions

Attachment "B" Contract/Project Summary

Attachment "C" Statement of Work

#### D. PERIOD OF PERFORMANCE

The performance period under this Contract shall commence on XX/XX/XXXX and terminate on XX/XX/XXXX. No expenditures made before or after this period are eligible for reimbursement unless incorporated by written amendment into this Contract. The Contract may be terminated or the performance period extended pursuant to terms set forth in Attachment "A."

#### E. COMPENSATION / PAYMENT

The total dollars provided by ADF&G for this project shall not exceed \$XXX,XXX. The Contractor shall be responsible for all project costs exceeding this amount. Only eligible reimbursement activities that are in direct support of the project deliverables identified in this Contract will be reimbursed. Any additional services provided by the Contractor must have prior written approval of ADF&G.

Compensation for services rendered shall be payable upon receipt of properly completed invoices, which shall be submitted to the Project Manager by the Contractor not more often than monthly. The invoices shall describe and document to ADF&G's satisfaction a description of work performed, activities accomplished, or the progress of the project. The rates shall be in accordance with those herein agreed to.

Payment shall be considered timely if made by ADF&G within 30 days after receipt of properly completed invoices. Payment shall be sent to the address designated by the Contractor. ADF&G may, in its sole discretion, terminate the contract or withhold payments claimed by the Contractor for the services rendered if the Contractor fails to satisfactorily comply with any term or conditions of this contract.

#### F. RIGHTS AND OBLIGATIONS

All rights and obligations of the parties of this Contract are subject to this Contract, including the Attachments, which are incorporated herein by this reference. By signing this contract, the Contractor acknowledges that they have read, fully understand, and agree to be bound by all terms and conditions set forth in this Contract.

#### G. COMPLIANCE WITH APPLICABLE STATUTES, RULES, AND ADF&G POLICIES

The Contractor shall comply with, all applicable state, federal, and local laws and regulations, including published ADF&G policies, while performing this Contract.

**H. ORDER OF PRECEDENCE**

In the event of an inconsistency in this contract, unless otherwise provided herein, the inconsistency shall be resolved by giving precedence in the following order:

- Applicable Federal and State of Alaska statutes and regulations.
- Special Terms and Conditions as contained in this basic contract instrument.
- Attachment A - General Terms and Conditions.
- Any other provision, term or material incorporated herein by reference or otherwise incorporated.

**I. CONTRACT REPRESENTATIVES**

The below named representatives for each of the parties shall be the contact people for all communications and billings regarding the performance of this Contract. All written communications regarding this Contract shall be sent to the designated representatives at the addresses below unless notified in writing of any change.

**Contractor’s Representative/Project Manager**

Name, Address, and contact information

**ADF&G’s Representative/Project Manager**

Name, Address, and contact information

**J. ENTIRE CONTRACT**

This Contract, along with all attachments and exhibits, constitutes the entire agreement of the parties. No other understandings, verbal or otherwise, regarding this Contract shall exist or bind any of the parties.

**K. APPROVAL**

This contract shall be subject to the written approval of ADF&G’S authorized representative and shall not be binding until so approved. This Contract may be altered, amended, or waived only by a written amendment executed by both parties.

**IN WITNESS WHEREOF**, ADF&G and the Contractor have signed this contract.

**Contractor**

**ALASKA DEPARTMENT OF FISH AND GAME**

\_\_\_\_\_  
Signature and Date

\_\_\_\_\_  
Signature and Date

\_\_\_\_\_  
Printed Name and Title

\_\_\_\_\_  
Printed Name and Title

**Attachment A - GENERAL TERMS AND CONDITIONS  
Interagency Agreements**

Insert here standard language used by Alaska Department of Fish and Game in contracts.

**Attachment B - CONTRACT/PROJECT SUMMARY**

**TITLE:** Alaska Green Crab Management

**ADF&G CONTRACT NUMBER:**

**PERIOD:** XX/XX/XXXX to XX/XX/XXXX

**CONTRACTOR:**

**CONTRACTOR CONTACT:**

**CONTRACT TYPE:** Payable / Goods and Services / Interagency

**ADF&G MANAGER:**

**SUMMARY CONTRACT DESCRIPTION:**

Working in coordination with ADF&G, XXX will support green crab management in the XXXX Location.

**Attachment C - STATEMENT OF WORK**

**SCOPE & OBJECTIVES**

The globally invasive European green crab has been on Alaska’s doorstep for two decades, but none were captured from Alaska’s shorelines until 2022. In July of 2022, the shell of a dead EGC was discovered on a beach in Southeast Alaska within the jurisdiction of the Metlakatla Indian Community. Soon after the discovery, the Metlakatla Indian Community began trapping efforts in hotspot locations, such as Tamgas Harbor, and other locations. The discovery increased concern about potential impacts of European green crab on Alaska’s inland marine shorelines and reinvigorated interest in and support for early detection monitoring.

Recent detections of concern within Southeast Alaska and the potential for new populations along Alaska’s coastline have prompted heightened stakeholder concern and expanded the geographic and technical demands on staff. This statement of work outlines how ADF&G support during the period of XX/XX/XXXX to XX/XX/XXXX will be used by Contractor to support assessment, coordination and rapid response efforts along Alaska’s coastline, including;

- coordinating a coastal assessment, focused primarily on Southeast Alaska, to better understand the scope of green crab presence on the coast,
- coordinating monthly trapping at a smaller number of sites on the coast, focused in Southeast Alaska; and
- providing technical and training support to partners and stakeholders.

**TASKS AND DELIVERABLES**

**Task 1: Southeast Alaska Assessment, Coordination and Rapid Response Efforts**

Working in coordination with ADF&G, Contractor will support green crab management in Southeast Alaska. Specifically, Contractor will:

- a) support ADF&G and local response coordinators in identification of high priority sites, development of trapping schedules, and local response logistics (potentially including assistance with landowner access, and recruitment and training of partner and volunteer response teams);
- b) provide scientific advice to inform removal trapping efforts, and review removal trapping data throughout the season to inform real-time adaptive management;
- c) coordinate with ADF&G, the Metlakatla Indian Community, US Fish and Wildlife Service, and other partners

on development and review of specific action area management plans as requested; and

d) provide scientific advice and field staff support, as resources allow, for Southeast Alaska rapid response or other enhanced response actions.

**Deliverable 1.1:** Section of final report detailing Assessment, Coordination and Rapid Response efforts in Southeast Alaska.

**Completion Dates:** XX/XX/XXXX

### **Task 2: Coastal Assessment and Coordination**

Working in coordination with ADF&G and local partners, Contractor will support an assessment of green crab populations in Southeast Alaska. This assessment will include a one-time intensive trapping effort across as much appropriate green crab habitat as possible, to provide a baseline assessment of the extent and relative abundance of green crab populations on the coast. In addition, Contractor will coordinate trapping at about 10 sites monthly to assess seasonal population trajectories (from April – September; likely to include July/Aug/Sept and Apr/May/Jun). Site establishment includes identifying high priority sites, gaining access, and recruiting and training partner and volunteer teams. Contractor may also provide, as resources allow, training, scientific advice and capacity-building for tribes, shellfish growers, and other local partners. The assessment and monthly trapping will fill a knowledge gap critical to effective management of green crab in Alaska.

**Deliverable 2.1:** Data summary from coastal assessment efforts.

**Completion Dates:** XX/XX/XXXX

**Deliverable 2.2:** Site reports for monthly coastal trapping locations.

**Completion Dates:** XX/XX/XXXX

### **Budget/Reimbursement**

This Contract includes a 10% reimbursement “holdback” on all requests for reimbursement until the Contract is fully satisfied. The holdback will be released to the contractor after satisfactory completion of all requirements under the initial statement of work included with this contract. Upon satisfactory completion, the ADF&G Project Manager shall notify the ADF&G Special Accounts Payable office that the contract requirements have been satisfied and they are now directed to release any holdbacks.

<b>Line Item</b>	<b>Description</b>	<b>Est. Amount*</b>
Salaries/Benefits		
Supplies		
Minor Equipment		
Travel		
Office Space (Coastal)		
Total Direct Costs		
Indirect		
<b>TOTAL NOT TO EXCEED</b>		