NOAA WDVCC Fisheries Internship

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Student Name: Antonio Jones

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DATE: 12/5/22
Abstract

The invasive European Green Crab (*Carcinus maenas*) have spread from the Atlantic Ocean to the Pacific Ocean, becoming a matter of concern in waterbodies throughout the Salish Sea. The possible establishment and growth of this invasive species poses risks to the native species, that thousands of people rely on for their livelihood and for the seafood industry in the Pacific Northwest. I completed an internship with the Northwest Straits Commission (NWSC) working in an emergency response trapping effort to trap invasive European Green Crabs (EGC) in Drayton Harbor, WA to help protect and conserve the native species from their devastating impacts. With the NWSC, we set hundreds of different traps to capture EGC, collected the data, and send them off for genetic testing. This effort involved the help of other organizations who also support the project as we responded to the removal of the invasive EGC within intertidal zones and creeks that are their preferred habitat and essential habitat for native species.
Intro

European Green Crab

The European green crab (*Carcinus Maenas*) is an invasive species native to Northern Europe (Mauritania to Norway in Europe) that was initially introduced to the U.S. east coast in the 1800’s and eventually to the U.S. West Coast and surrounding Salish Sea water bodies in 1989 (Young and Elliot, 2020). The European green crab, “is a medium-sized (adults 40-90-mm carapace width, CW) brachyuran crab well adapted as an invasive colonizer worldwide” (McDonald et al, 2000). The European green crab has 5 marginal teeth, 3 rostral bumps, and they can be various colors. The abdomen of the green crab can be red, orange, yellow, or green depending on the age of the crab.

![European green crab](image)

*Figure 1.*) European green crab and its width and the different identifying factors.
The invasive species can wreak havoc on aquatic ecosystems in any area they are established by decimating native habitats and causing the native species to be displaced by outcompeting native species for resources and causing damage to the native shellfish and Dungeness industry. (Drinkwin et al, 2019). The invasive species threaten native species such as the Dungeness crab (*Cancer magister*) as they fight for and compete with habitat that provide shelter for juvenile Dungeness crabs (McDonald et al, 2000). EGC is well documented for its impact on both shellfish and various other invertebrates within invaded areas (Poirier et al, 2017). “This species is a significant predator of small sized cockles (*Katelysia scalarina*), softshell clams (*Mya arenaria*), blue mussels (*Mytilus edulis*), ribbed mussels (*Aulacomya atra*), and American oysters (*Crassostrea virginica*)” (Poirier et al, 2017). The type of habitat the native species must compete for includes estuary areas or areas that provide structure like shells beds, eelgrass, and rocky areas.

The first EGC was discovered within Drayton Harbor in 2019, by a volunteer which initiated a rapid response trapping effort by Washington Department of Fish and Wildlife (WDFW) (QAPP, 2022). During the rapid response trapping effort from September and October 2019, over 100 EGC were captured in Drayton Harbor and within Lummi Bay. In 2020 there were 253 EGC captures and in 2021 that number declined to 146 (QAPP, 2022).

**Organizations**

The Northwest Straits Commission’s (NWSC) focus is on restoring and protecting the health of the Northwest Straits marine ecosystem by bringing together scientists and volunteers. The NWSC supports seven county Marine Resources Committees (MRCs), who are all located within
counties of northern Puget Sound. NWSC, MRC’s and the Northwest Straits Foundation (non-profit partner) make up the Northwest Straits Initiative, which is a special organization that has a community-based approach to marine conservation in the Salish Sea. NWSC operates in the U.S. marine waters spanning along the Strait of Juan de Fuca including the San Juan Islands and North Puget Sound extending to Snohomish and Jefferson Counties at the southern border and north to the Canadian border. Within this operational area and jurisdiction includes 7 counties, 15 tribes, and various other cities and local governments have jurisdiction in this area. NWSC leads MRC-based regional projects and will assist partners on various projects, such as the EGC response with Washington Dept. of Fish and Wildlife (WDFW) and Washington Sea Grant (WSG) (QAPP, 2022).

The Veterans Conservation Corps (VCC) is a sub-program of Washington Conservation Corps (WCC) which provides resources and opportunities for veterans by gaining new skills, certifications, educational internships, and various other programs to support veterans. I was introduced to the internship opportunity with the NWSC by Kim Pham (Veterans Conservation Corps Program Manager), and I applied for it during my studies as an Environmental Studies major at Western Washington University.

My role as an intern

The contract was created between the Northwest Straits Commission (NWSC) and the Veterans Conservation Corps (VCC) and approved. This internship started on 6/22/22 and ended 11/15/2022. I was accepted to the internship for both 2021 and 2022 European green
crab seasons with a total of 15 internship credits applying towards my bachelor's degree in the Fall quarter of 2022. I was an intern with the NWSC working as part of the emergency response trapping effort within Drayton Harbor to help protect and conserve the native species from the devastating impacts of the invasive European Green Crab (EGC). I worked with the entire NWSC staff and volunteers consisting of Lucas Hart (Director), Sasha Horst (Operations Manager), Dana Oster (Marine Program Manager), Leah Robison (Ecosystem Project Assistant), Allie Simpson (Ecosystem Project Coordinator), and Jeff Whitty (Project Coordinator).

I was a Marine and Near shore Project technician intern who assisted Leah Robison (Ecosystem Project Assistant) with EGC project processes setting hundreds of traps in Drayton Harbor and surrounding areas. I have learned about various processes of the project that shaped my education in the conservation of marine and nearshore ecosystems. I also have spent a significant amount of my time working with Allie Simpson (Ecosystem Project Coordinator) both in the field learning about the related processes and the office environment learning about data, research, and guidance with my internship report. I also helped planning for field work, data collection and entry, providing updates at weekly meetings, and collaborating with experts and volunteers associated with the NWSC and the European Green Crab project.

**Methods**

**Sites Description**

The specific area where most of my field work was conducted is Drayton Harbor, located in Blaine WA just south the Canadian border and directly across from White Rock Canada. It is
one of two EGC Action areas NWSC works in (QAPP, 2022). The other Action Area is Samish Bay. These two areas are tasked by the NWSC as part of a routine intensive European Green Crab removal effort. The goal of the project in this location was to “prevent and reduce environmental harm of self-sustaining invasive EGC populations in Whatcom and Skagit County, outside of tribal jurisdiction, through intensive removal efforts in order to maintain habitat complexity and species diversity” (QAPP, 2022).

There are 3 core sites within Drayton Harbor: Pillars, California Creek, and Dakota Creek (Table 1 and Figure 1). Within Drayton Harbor are tidally influenced freshwater creeks, Dakota Creek, and California Creek. Dakota flows into Drayton Harbor and varies from a narrow (at low tide) to a very wide (at high tide) creek depending on the tide. The mouth of Dakota Creek, where the core site is established, provides structure including a single dock, eelgrass present throughout, and a shallower depth than the subtidal zone. California Creek is a bendy creek consisting of muddy terrain, eelgrass, and rocks along the creek which also leads out into Drayton Harbor’s subtidal zone. California Creek is very similar to Dakota Creek as it also gets very narrow (during low tides) and expands to be very wide (at high tides) depending on the tide. Pillars is also another core site within Drayton Harbor’s intertidal zone where some of the first European Green crabs were discovered within Drayton Harbor. Pillars provide a very different habitat that has structure for various species such as rocks, bricks, eelgrass, derelict pilings, and an intertidal zone. These areas can provide habitat for the Invasive European Green crab and other species despite not being a creek like the other core sites. No Name Creek is where we have spent some time during the year as well and this creek also flows into Drayton Harbor and is part of our prospecting efforts within the harbor.
These were the main areas of focus during the internship as they are nearshore habitats and creeks where the preferred habitats exist for the European Green Crab and other native species. The three core sites are where we put forth most of our trapping effort, most of the crabs have been caught in these areas specifically.

**Field Processes**

In preparation for field work one of the most important steps before going out the following week is to check the tide’s levels on the tide forecasts website (NOAA Tides and Currents). Since accessibility in the intertidal zones are tide dependent, I gathered tide predictions prior to the upcoming week of trapping to analyze the best possible time to set traps at the core sites in Drayton Harbor. The sites are only accessible and safe up to these tide levels in the different core site locations: Pillars at + 3.5ft., Dakota Creek +.5ft., and California Creek +1ft. Any tide level lower than these limits are acceptable levels and are safe to access the core sites under those conditions.
Table 1: Drayton Harbor Core Sites: This table describes the requirements for setting traps at each of the specific core sites. Some of the specifics include Access information, Number of traps, placement, starting points, order of the traps and other trapping specifications.

<table>
<thead>
<tr>
<th>Access Information</th>
<th>Pillars</th>
<th>Dakota</th>
<th>California</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking at the Public boat launch at the Blaine Marina. Trapping permission and communication with City of Blaine prior to season</td>
<td>Dakota Creek kayak launch and parking lot on Runge Ave. (Public access)</td>
<td>Parking in lot along Drayton Rd. Permission and communication with Birch Bay-Blaine Parks and Recreation District prior to season.</td>
<td></td>
</tr>
<tr>
<td>Number of traps</td>
<td>30 (15 F, 15 M)</td>
<td>30 (15 F, 15 M)</td>
<td>30 (15 F, 15 M)</td>
</tr>
<tr>
<td>Paces</td>
<td>Placed at PVC pipes</td>
<td>20 paces apart (~15 m)</td>
<td>10 paces apart (~7.5 m)</td>
</tr>
<tr>
<td>Starting spot</td>
<td>Any order. See map for trap placement.</td>
<td>Upstream from kayak launch at white pipe on opposite bank just past the derelict dock.</td>
<td>Telephone pole near the bridge.</td>
</tr>
<tr>
<td>Trap order</td>
<td>See map for trap placement.</td>
<td>Trap 1 – Minnow Trap 30 – Fukui</td>
<td>Trap 1 – Fukui Trap 30 – Minnow</td>
</tr>
<tr>
<td>GPS points</td>
<td>None needed</td>
<td>None needed</td>
<td>None needed</td>
</tr>
<tr>
<td>Example trap ID</td>
<td>C.P. 21</td>
<td>C.DC. 10</td>
<td>C.CC.04</td>
</tr>
</tbody>
</table>
Figure 1: These maps show the specific map placement and location of Dakota and California Creeks. The orange represents the Fukui traps, and the blue are minnow trap placements.

Trap Types

![Minnow trap type with orange bait jar and stake to secure it.](image)

Figure 2: This is a Minnow trap type with orange bait jar and stake to secure it.

There are two different types of traps that we utilized specifically for the core sites, Minnow, and Fukui traps, while Shrimp traps are dedicated primarily for prospecting in and around the core sites. The Minnow traps (Figure 2.) are made with galvanized steel with the mesh ¼” (6mm). These traps are smaller than any of the other traps and the opening is approximately 2 inches (modified) which is big enough to allow smaller European Green Crab (EGC) to enter while it is still small enough to prevent larger animals from entering the trap (QAPP, 2022). The minnow is easy to stack and transport and is very effective at catching various types of smaller by-catch. The Minnow requires only one metal stake when placed in a creek or a medium sized rock can also hold the trap in a fixed place.
The Fukui traps are medium sized with large openings and the mesh is ½” (12mm) with zip ties that limit the size of the opening (QAPP, 2022). Although the trap opening is much larger than the Minnow traps the opening is modified small enough to prevent larger mammals from entering but allows larger European Green Crab and other species to enter the trap. The trap is very light weight, easy to carry throughout the core sites and has an opening with clips on the top used to record the different species. This trap type is used in conjunction with the Minnow traps at all core sites as a standard for trapping invasive European Green Crab. The Fukui mostly only requires a single metal stake unless conditions are rougher in certain areas where it may need an additional stake or rocks to secure the position.
Figure 4: This is a shrimp trap with 4 entrances and bait section in the middle.

Lastly, the very reliable and durable Shrimp traps are made of a very rigid metal cage covered in a softer material (Figure 4.). This trap type is used mostly in prospecting methods or subtidal areas which require a more durable and larger trap for the tougher conditions. The shrimp traps are very large and bulky, providing 4 entry points for species to enter and a large bait section. Since they are bulky at most one person can usually only carry on average 2 to 3 shrimp traps on moderate terrain. The rougher the terrain or deeper the mud it became more challenging to carry these large shrimp traps. The shrimp traps can be secured using two metal stakes in the creeks or shallow water or weighed with two pieces of rebar (zip tied) and a buoy if placed in the subtidal zone.
Data Collection

We recorded data of all species captured to see the growth of European Green Crab along with other native species to help implement future and current management efforts within Drayton Harbor. When at a core site or prospecting site the data sheet is the same consisting of information such as weather, start / end time, deployment date, personnel, site information, trap location and type, trap tag number, and columns for various species types. This data sheet was an essential part of the effort and it’s where all the information is tracked and later stored in a meta database for other organizations to view.

Once a trap was located, the stake was pulled to unsecure the trap from below the water, perform pre-checks for EGC, Open the trap, and begin sorting and counting the variety of by-catch. The most common types of by-catch are Hairy Shore Crab – HEOR (Hemigrapsus oregonensis), Purple Shore Crab – HENU (Hemigrapsus nudus), Dungeness Crab – MEMA (Metacarcinus magister), Red Rock Crab – CAPR (Cancer Productus), Hairy Helmet Crab – PAHI (Pagurus hirsutiusculus), Asian Mud Snail – BAAT (Batillaria attramentaria), Nassa Snail – NASS (Nassarius mendicus n. Fraterculus), Staghorn Sculpin – LEAR (Leptocottus armatus), Shiner Perch – CYAG (Cymatogaster aggregata), Three – Spined Stickleback – GAAC (Gasterosteus aculeatus), and Eel- Like Fishes.

The process for removing an EGC consisted of a very specific process. Once identified, the EGC was removed from the trap, a photo is taken with the trap number of its abdomen and carapace sides, an identification tag is filled out (waterbody, site, trap type and number, Sex,
Size, # EGC it is, condition, eggs y/n, color, date etc.), placed into a plastic zip lock bag with the tag, and eventually sent off for genetic testing. This process can be quite challenging especially when there are more than one EGC captures at once in addition to tough field conditions. The data sheet information was the same except for checking yes for EGC which makes it easier for the meta data process.

MAP. 1 This is a map of the core sites created for my final in GIS 2
**Results**

*European Green Crab Captures*

During the 2022 trapping season there were a total of 313 EGC captured within Drayton harbor. This number has increased from 146 captured in 2021 making a 167 difference. In No Name creek there were a total of 58 EGC caught. 46 of those EGC were caught using a Minnow trap type and 12 EGC caught with Shrimp traps. At California creek there were a total of 25 EGC. At California creek 13 of those EGC were caught with a Shrimp trap and the other 12 were with a Minnow. At Dakota creek there were 132 EGC caught in total. At Dakota creek 116 EGC were caught with the Shrimp trap, 1 with a Fukui, and 15 were captured using Minnows. Lastly, there were 98 total EGC caught at Pillars. At Pillars, 18 EGC were caught with Fukui traps, 25 using Minnow, and 55 with Shrimp traps. The percentages for the total EGC captures based on trap types are Fukui 6%, Shrimp 62%, and Minnow type 32%.

Throughout the duration of the 2022 trapping effort, I have observed the effectiveness between the three different trap types EGC were captured. After analyzing the data, I have concluded that the Shrimp traps are much more effective at capturing Larger EGC compared to the Fukui and Minno traps within Dakota creek, California creek, and Pillars. Although the Minnows weren’t as effective at capturing larger EGC they began exponentially capturing smaller EGC starting at the end of September 2022 to November 4th, 2022, which was the final day of the effort. Some explanations for the preference of Shrimp traps may be the EGC prefers a more solid material to enter, the amount of bait used is more attractive, and the overall size of the entry points and trap in general all could be advantageous factors.
Discussions

Educational Connections

This internship has contributed largely to my educational journey at Western Washington University. I have learned a huge amount about various things related to my education in Environmental Studies such as conservation practices, species identification, research methods, fields observations, ecosystems, and functions, collaborating with marine biologists (NWSC, WDFW, DNR, WA Sea Grant, Local Volunteers, and MRC members.), and learning about environmental ethics. This experience helps bridge the academic connection from my undergraduate program as environmental studies major to hands on work in an environmental / conservation project. I have learned how the importance of conservation and the impacts Invasive species can have on ecosystems. EGC specifically wreak habit on native species habitat and outcompete with the juvenile Dungeness crabs. I have witnessed the urgency to intervene and implement projects or processes to help shift the negative effects on an environment.

Working with the NWSC as an intern has helped me learn the processes involved with a team who is working on restoring the marine waters. I have experienced collaboration, Leading field days independently with Volunteers and Department of Fish and Wildlife staff, meetings, learning about different organizations and their relationship to the NWSC, and communicating with those organizations on regional projects. This collaboration showed me those processes which are essential to the functioning of organizations working towards conservation. During meetings with the NWSC I had the opportunity to report on field work progress where I shared field plans, observations, and listened to others share about their projects. I was also able to
build my resume, discuss ways to structure the internship report, and reflect on my time as an intern with Alexandra Simpson (Ecosystem Program Coordinator). Lastly, I also met Leah Robison on several occasions to discuss field work plans, discussing tide predictions, working with field data, and learning to build a field plan for independent field work.

I also got opportunities to develop field plans and lead field workdays independently which resulted from the learned experiences as an intern during the 2021 and 2022 with the NWSC. Developing field plans consisted of checking the tides, creating a schedule for the week, communicating with field personnel, and ensuring that I had the essential equipment for field work. I was able to collaborate with Volunteers and DFW to help with field work procedures, teach them the processes, and coordinate the duties in the field to accomplish the tasks. This provided me with a chance to educate others on the project that I’ve learned a measurable amount about the share my knowledge about the project. Leading this was a great accomplishment that I can take with me into my career because now I know what it takes to be in a position where others are counting on you to be trustworthy and educated enough to lead projects.

This internship with the NWSC provided a thorough and knowledgeable learning atmosphere largely contributing to my educational journey and experience. I think the program offered a large variety of resources to help me learn about the Invasive European Green Crab project and the NWSC’s role within the community, volunteers, MRCs, and other organizations.
**Recommendations for future years**

After being an intern for the last 2 seasons of 2021 & 2022 I will give have developed some recommendations for the EGC project. Since Shrimp traps have been shown to outperform the other trap types in capturing EGC, I believe more shrimp traps should be deployed within Drayton Harbor for next season. The only issue with placing more traps is they are bulky and heavy, making them difficult to carry. The type of equipment I would recommend that would benefit from this effort would be an airboat that can maneuver the subtidal and intertidal areas within Drayton harbor and has the capacity to carry shrimp traps and 2-4 personnel as well. This will greatly improve fieldwork efficiency and make access to other areas more easily. The subtidal zone and the conjunction between the subtidal and intertidal area are all places which can be trapped more frequently if there was an easier way to get out there. The other recommendation to improve efficiency is a towing device capable of floating in the water and across the mudflats. This device could be something like a paddle board but capable of carrying multiple trap types, maneuvering over mud, and floating in creeks.

I strongly believe there are other areas that we should assess and monitor in addition to the core sites for prospective reasons that could provide us with more data for the upcoming years. I am curious if the larger EGC’s in addition to the intertidal zones, inhabit the slope areas leading into the subtidal zone or the other areas in the subtidal zone since they are very competitive and are damaged or missing limbs upon capturing them. Since they are sometimes damaged it makes me wonder if they compete with the larger Dungeness crabs resulting in injuries. It may be advantageous to also deploy cameras to monitor the Shrimp traps in the subtidal areas to determine if the EGC are in fact inhabiting those areas and are just hesitant to enter the Shrimp traps because of the much larger and stronger Dungeness crabs going into the traps for the bait because they are more dominant.
The internship program with the NWSC in general is great and there were an outstanding number of opportunities for education and collaboration with various organizations and volunteers. These connections are very important for understanding how communication processes work with regional projects where multiple organizations are involved working on a mission or projects collectively. I was able be a part of EGC projects outside of Drayton Harbor with other organizations in areas such as Chuckanaute Bay, WA and Fidalgo Bay, WA allowing me to apply what I’ve learned in other areas and become involved with people who are also involved in the EGC in other areas. My only recommendation would be is to make those involvement with others slightly more frequent because it only adds to the experience of learning the specific role of the NWSC and other organizations along with the direct hands-on experience working with others from those organizations. This was a great opportunity, and I am beyond thankful for the opportunity as an intern with the NWSC and VCC, Volunteers, MRCs, and other organizations helping shape and connect my educational journey at Western Washington University as an Environmental Studies undergraduate.
References


