Trapping Crabs in Coos Bay and Winchester Bay

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Introduction

The initial objective of this part of the study was to determine to what extent the European green crab, *Carcinus maenas*, was established along the southern Oregon coast. The first *C. maenas* specimen in Oregon was discovered in Coos Bay in March of 1997. From March to June there had been eight other specimens reported within the Coos system. The discovery of these additional specimens may suggest that *C. maenas* has become established within the Coos system, and has the potential to spread along the Oregon coast. These findings initiated concerns within the Oregon Department of Fish and Wildlife, marine scientists and the Oregon and Washington shellfish industry to asses the density of *C. maenas* and to predict the impact *C. maenas* could have on the Oregon marine ecosystem.

Since *C. maenas* was already discovered in the Coos system it was assumed that it�s next appearance would most likely occur in Winchester Bay, the next port to the north. One assumed mode of transport is via planktonic larvae riding the Davidson current (Hickey 1989). The impact *C. maenas* would have on the shore crab populations was unknown, so this study was broadened to determine size frequency distribution of all shore crabs within Coos and Winchester Bays. By collecting data before and after *C. maenas* becomes established will allow us to draw conclusions about it�s impact on the marine ecosystem.

This study was initiated within the first few weeks of June. Since *C. maenas* was already discovered in the Coos system, the initial search was conducted north in Winchester Bay where it was predicted that *C. maenas* would most likely next appear if transported as larvae. The method I chose to sample crab density is using traps, which was a successful indicator used along the eastern United States, California, South African and Dutch shores.

Materials and Methods

Two sites were selected in each bay. In Coos Bay the trapping sites included Pony Point and the Charleston boat basin (figure 1). The two sites chosen for Winchester Bay were the interior of the south jetty triangle, and the finger jetty which extends near the pier (figure 2). The Coos Bay sites were chosen because *C. maenas* had already been caught at each location. The Winchester Bay sites were chosen because of their similarities with settlement sites of *C. maenas*. The Umpqua triangle is a triangular enclosure made by the south jetty, consisting of very large rip-rap and fed by large tubes through the jetty into both the ocean and the bay. This site appears to be a likely settlement site due to it�s protection from wave action, fairly consistent salinity and the presence of an oyster farm inside the triangle. A fifth site directly across from the Charleston Oregon Department of Fish and Wildlife office was chosen near the conclusion of this study because it possessed a large population of *Pachygrapsus crassipes*, and because it was the location where the only female *C. maenas* was found.

Minnow traps, also known as crayfish traps, were modified so that their openings would have a radius of approximately 60 - 70 mm to allow for sideways entry into the conical opening (figure 3). They were baited with either fish carcasses or chicken, and deployed along edges of rip-rap. For every hour that a trap was deployed it was noted as one trap hour, this allowed for catch per unit effort (CPU) to be determined for each crab species. The goal was to sample as much of the tide range as possible at each site to avoid bias toward any species. So if one trap had been placed at the +1.0 foot level, the next trap may have been placed at a -1.0 foot level, etc.. Trap height at any particular location was varied from + 3.0 feet to - 3.0 feet during each inspection of the traps. This alteration was targeted to maintain a typical tide height of approximately the average low tide level.

As each trap was retrieved the crabs within were identified, sexed and had carapace width measured using vernier calipers. For all crabs the carapace width was measured to the lowest 1 mm. Graphical representation of the size categories for small crabs remained at 1.0 mm intervals, but for larger crabs 5.0 mm intervals were used. This compressed the data allowing year classes of the larger crabs to be detected. The data were then compiled by site, species and date. The data from sampling dates within a six week period were lumped. It was assumed that no significant growth had occurred in this time period.

Results

Tables 1.1, 1.2, 1.3, 1.4, and 1.5 show how many crabs of each species were caught at each location, the average carapace width, standard deviation and catch per unit effort. Table 2 shows the number of trap hours at each site. The most notable observation is that of *P. crassipes* and *C. productus* occur in areas of high salinity, and are absent in nearby locations with fresh water influence. The catch per unit effort of *P. crassipes* in the Charleston boat basin was 0.071 and the CPU for them at Pony Point was 0.029. The CPU for *P. crassipes* in the Umpqua Triangle was 0.112 but up the bay at the finger jetty there were none found (tables 1.2, 1.3). The CPU for *C. productus* in the Umpqua Triangle was 0.022 while there were none caught at the finger jetty site (tables 1.2, 1.3). Along the Umpqua finger jetty *Hemigrapsus oregonensis* had a CPU of 0.178, while in the triangle it had a CPU of 0.006. Since the salinity tolerance of *H. nudus* and *H. oregonensis* are similar to that of *C. maenas*, their presence may indicate how far up an estuary the green crab could penetrate (Dehnel 1962).

The *Cancer magister* and *Cancer productus* trapped at Charleston boat basin were larger than those trapped at Pony Point. *C. magister* from the Charleston boat basin had an average carapace width 118.6 mm, SD= 27.2 mm, compared to the Pony Point site with an average carapace width 55 mm, SD= 9.56 mm (Tables 1.1, 1.5). The difference in carapace width for *C. productus* was 91.5 mm, SD= 24.5 mm at Charleston and 57.7 mm, SD= 11.6 mm, at Pony Point (Tables 1.1, 1.5). The only *C. maenas* caught was a dark green male 86.5 mm at Pony Point and rendered a CPU for that site of 0.002 (Table 1.5). For the total Coos system the CPU for *C. maenas* was 0.001.

Conclusions

The first conclusion to be drawn from this study is that *C. maenas* most likely has not become a strongly established species within the Coos Bay system. With a total CPU of 0.001 for this study and only ten specimens total being reported within the entire system despite ongoing searches by O.D.F.W. personnel, and daily activities of local fishers, would suggest that the local population is very rare. The concern for the spread of this species is warranted since it consumes less algae than other crab species (Griffiths 1992). But it appears that under some conditions the colonization of this species is limited. It appears that a salinity of at least 19 parts per thousand is needed for larval metamorphose into juveniles which may, along with wave action, limit settlement (Dries and Adelung 1982). To understand where these limitations may occur, one could use other species with similar limitations as a model.

In the Umpqua estuary abundance of *C. productus* and *P. crassipes* decrease drastically from the Umpqua triangle to the upper bay. Since both of these crabs are fairly aggressive species, this change is most likely due to physical factors, such as wave action, current, or salinity. The large amount of fresh water flowing through this smaller bay creates a greater salinity range from tide to tide.

The annual flow of fresh water into Coos Bay is 4,370 cfs, and at it�s mouth the bay is 56,500 square feet. Winchester Bay has a flow of 8,120 cfs, with a cross sectional area of 22,000 square feet at the mouth. (Percy, Bella, Sutterlin and Klingeman 1974). These differences in flow rate at the mouth of each bay present very different physical conditions. The strong current and great ranges of salinity within Winchester Bay may be limiting factors for the settlement of *C. maenas* in that system. Varying salinity is known to reduce the survivorship of small *P. crassipes* (Hiatt 1948). The settlement of *C. maenas* is dependent upon the ability of the juveniles to survive the physical and biological demanded by a specific area. Juvenile *C. maenas* are known to prefer shallow waters with high salinities (Dries and Adelung 1982). It also showed that it was unable to colonize wave-swept shores when it was an introduced exotic in South Africa in 1983 (Griffiths 1992). The large current inside the bay, along with the great degree in salinity variation could deter the settlement of *C. maenas* in this system just as it may be the limiting factor for the survival of *P. crassipes*.

There may also be an interesting observation in the time period that *C. maenas* was caught, in relation to the CPU estimate given earlier. Female *C. maenas* are known to molt after fertilization which takes place in August, while males molt between May and June, with juveniles molting under warm conditions. Males are known to molt more often and live up to five years with five larval molts, and fifteen molts for growth occurring (Dries Adelung 1982). Also crabs in pre-molt condition are not known to feed (Crothers 1967, Elner 1980) and these two pieces of information are important since this study is dependent on hungry crabs entering the minnow traps to feed. If there are continual molts for the juveniles throughout the warm water season, and they are known not to eat at pre-molt, this could be an explanation for why we have only seen adults caught. If this is not the case, and we are catching a representative sample of the *C. maenas* population, then they may be limited to a single year class, which is nearing it�s terminal molt stage. A note of importance about the presence of large adult *C. maenas* within the Coos system is that they were probably in Coos Bay 2-4 years before they were brought to the attention of the scientific community.

Some of the problems that arose during the trapping was the interference by the public. Some instances included the stealing of minnow traps, while other instances included the pulling of traps in the absence of the sampler. This led to trapping only being able to take place either in the presence of the sampler, or during hours when the majority of the tourists were not present. Another problem was that some crabs were seen hanging onto the outside of the traps as they were being pulled to the surface. These crabs were not entered into the count because no measurements or accurate count could be taken for each crab that let go of the trap on it�s way to the surface. This occurrence needs to be avoided before the CPU estimates can be considered truly accurate, although this process theoretically can happen to any trap and is therefore possibly eliminated as a constant.

One of the biggest disappointments was the lack of *Cancer oregonensis*, which was observed under rocks at the 2 foot tide level under the Charleston bridge, but was never found inside a minnow trap. This was probably due to it�s risk of predation from the larger species of crab which were present, and that they will rarely leave shelter. The absence of *C. oregonensis* in the traps, although present in the community, may suggest that the minnow traps cannot be depended upon solely as a reliable shore crab density estimator, but can more accurately provide relative size frequency distributions within individual species. To further refine this process would be to mark the carapace of each crab caught with two dots of different colored nail polish to eliminate specific crabs contributing more often to the data. The one certain point of this study is that it is not all inclusive, and needs to be refined, as well as expanded. This would included trapping more sites for more hours, and that the trapping should be year round and not limited to summer and it�s seasonal physical conditions that may be altering the catch rate for species adults and juveniles within the various species.

Appendix -- Size/Frequency graphs

Graphs 1&2

Graphs 3&4

Graphs 5&6

Graphs 7&8