(January 2, 2008 Version)

Status of the European Green Crab in Oregon and Washington Estuaries in 2007

by

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Executive Summary

A strong cohort of young European green crabs (*Carcinus maenas*) appeared in North American embayments from Oregon to the west coast of Vancouver Island following the strong *El Niño* of 1997/1998. Unusually strong north-moving coastal currents transported crab larvae from established source populations in California to the Pacific Northwest. Both coastal transport and recruitment of young green crabs have been weaker since. Although it was predicted that green crabs would become extinct in the Pacific Northwest once the original colonists died of senescence at about age six, this has not happened. Age-class analysis and the appearance of young crabs evidence the existence of local recruitment in the Pacific Northwest. Good recruitment in 2003, 2005 and 2006 is linked to warm winters and shore-ward transport in late winter and early spring when larvae are believed to be settling out from the plankton. Recruitment in 2007 was poor but the strong 2005 and 2006 cohorts will assure a larval source until 2012 when the last of these crabs will die of old age.

An extensive survey by Fisheries and Oceans Canada found green crabs in all the major inlets on the west coast of Vancouver Island, but not in the inland sea between Vancouver Island and the mainland. Therefore, outreach efforts should continue to help prevent the establishment of this invader in the latter waters via ballast water or shellfish transport.

Even though green crab abundance in the Pacific Northwest is still low when compared to Europe, eastern North America, Tasmania and California, it is imperative to continue monitoring efforts for two reasons:

1) to elucidate the process of range expansion and population persistence of this model non-indigenous marine species with planktonic larvae and

2) to understand the role of ocean conditions on recruitment strength in order to predict the next strong recruitment event of green crabs.

Professional and Outreach Activities since Fall 2006

Date	Talks / Activities	Location
Dec. 7, 2007	Behrens Yamada, S. and Gillespie, G. E. 2008. Will the European green crab (*Carcinus maenas)* persist in the Pacific Northwest? – paper accepted	International Council for the Exploration of the Sea, Journal of Marine Science, 65: 000–000.
October 23, 2007	***Trapping demonstration and mentor for students of Jane Goodall Environmental Middle School, Salem*.**	Yawina Bay study sites- Monthly green crab sampling over the winter
October 9, 2007	***Status of the European Green Crab in Oregon, Washington and B.C. in 2007*** Yamada, Gillespie, Randall	Pacific Coast Shellfish Growers Associatio/National Shellfish Association, Welches, Oregon
July 26, 2007	***Will the European green crab persist in Pacific Northwest estuaries?*** Talk for a general audience	Hatfield Marine Science Center, **Newport, Oregon**
July 14, 2007	***Green Crab Biology and Invasion History***. Presentation and sampling exercise for Biological Invasion Class	Oregon Institute of Marine Biology**, Charleston, Oregon**
June 19 –July 4	Sampled non-native species, including green crabs, around northern Vancouver Island with ***Fisheries and Oceans Canada*** biologists	Smith Sound, Rivers Inlet and north-west coast of Vancouver Island, British Columbia
May 21-24, 2007	***Will the European green crab persist in Pacific Northwest estuaries? -- talk*** Sylvia Yamada and Graham Gillespie	Fifth International Marine Bioinvasion Conference **Boston, MA**
April 9, 2007	***Green Crab Biology and Invasion History***. Presentation for Marine Biology Class (Bi 450)	Hatfield Marine Science Center, **Newport, Oregon**
February 1, 4 May 17, 20, 2007	***Oregon Field Guide -*** the European Green Crab in Oregon	TV show aired on Oregon Public Broadcasting
February 22-24, 2007	***Will the European green crab persist in Pacific Northwest estuaries? -- talk*** Yamada, Gillespie, Randall ***Sex Pheromones: A new tools for controlling a global invader? -- poster***	Pacific Estuarine Research Society University of Victoria, **Victoria, B.C., Canada**
Oct. 3, 2006	***European Green Crab Status in 2006*** Yamada, Gillespie, Randall ***Sex Pheromones: A new tool for controlling a global invader?***	Pacific Coast Shellfish Growers Association/National Shellfish Association. Hilton Conference Center **Vancouver, Washington**
Sept. 7, 2006	***Assisted Oregon Public Broadcasting crew film green crab story for Oregon Field Guide.***	**Tillamook Bay and Netarts Bay, Oregon**

Introduction

European green crabs (*Carcinus maenas)* were first discovered on the east coast of North America in the early 1800's (Say 1817). These natives of Europe and Northern Africa and were introduced into North America via shipping. Green crabs arrived in California prior to 1990, and by 2000, had dispersed as far north as Port Eliza on the northern coast of Vancouver Island, British Columbia. The potential range of green crab includes Southeast Alaska (Behrens Yamada 2001, Carlton 2003).

The green crab is a voracious predator that feeds on many types of organisms, including commercially valuable bivalve mollusks (e.g., clams, oysters, and mussels), polychaetes, and small crustaceans (Cohen et al. 1995). It also competes with native juvenile Dungeness crabs and shore crabs for food and shelter (McDonald et al. 2001, Jensen et al. 2002). Larger, more aggressive native crab species such as the red rock crab (*Cancer productus*) and the yellow rock crab (*Cancer antennarius*), have been shown to offer biotic resistance to this invader, but only in the cooler and more saline lower parts of estuaries (Hunt and Behrens Yamada 2003; Jensen, McDonald and Armstrong 2007). Scientists, managers and shellfish growers are concerned that increases in the abundance and distribution of this efficient predator and competitor could permanently alter native communities and threaten commercial species such as juvenile Dungeness crab, juvenile flatfish and bivalves (Lafferty and Kuris 1996, Jamieson et al. 1998).

On the West Coast, the northward range expansion of green crabs during the 1990's appears to be linked to favorable ocean conditions for larval transport during El Niño events (Behrens Yamada et al. 2005). Warm temperatures and strong northward moving coastal currents (>50 km/day) during the 1997/1998 El Niño were correlated with the appearance of a strong cohort of young green crabs in Pacific NW estuaries in the summer of 1998 (Behrens Yamada and Hunt 2000, Behrens Yamada et al. 2005). With the loss of this strong cohort to senescence and the absence of favorable currents to transport larvae from California in recent years, it was predicted that green crabs in Northwest estuaries would go extinct. This has not happened. Some localized recruitment has occurred in Oregon estuaries most years. Following the warm winters and springs of 2003, 2005 and 2006 good green crab recruitment occurred in estuaries from Coos Bay to Quatsino Sound, BC on the northern west coast of Vancouver Island (Gillespie et al. 2007).

Goals

The goal of this study is to document the present and predict the future status of the European green crab in the Pacific Northwest. This is accomplished by:

- Estimating the size/age structure and relative density of green crabs in Oregon and Washington estuaries by using baited traps.
- Estimating year-class strength of young-of-the-year green crabs at the end of their first growing season by setting minnow and pit-fall traps in the high intertidal zone.
- Comparing patterns in recruitment strength over time and correlating them to ocean conditions: winter surface temperatures, currents patterns in March and April and date of the spring transition.
- Collaborating with scientists from Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife and Fisheries and Oceans Canada as well as with shellfish growers and sports fishers in order to compile all existing green crab data for the Pacific Northwest.

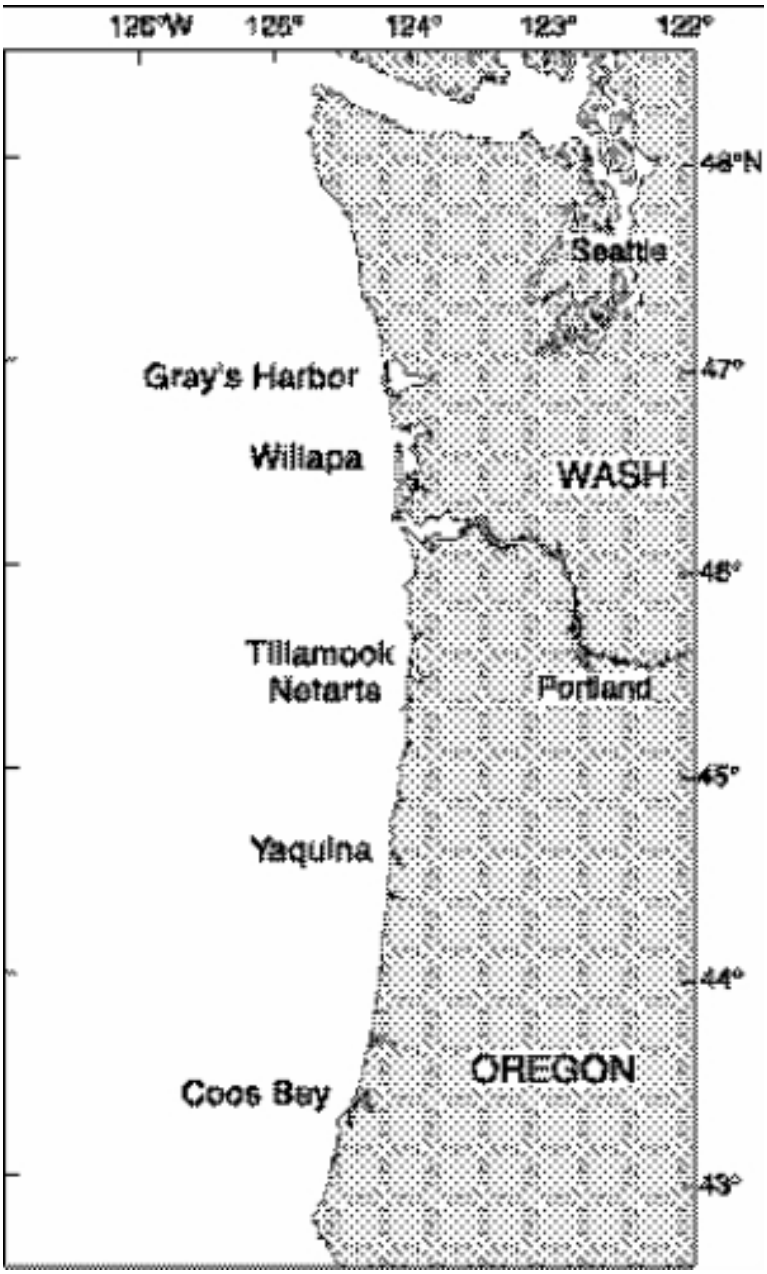

Figure 1. Major sampling sites in Oregon and Washington

Sampling Methods for Green Crabs

Our sampling effort in 2007 focused on four Oregon and one Washington estuaries: Coos, Yaquina, Netarts, Tillamook, Willapa Bay (Figure 1). These estuaries were sampled at least three times during the 2007-trapping season while Grays Harbor, Washington was sampled only once (Appendix 2). In each

estuary, we selected study sites within various habitat types and tidal levels. Since green crabs are rare and patchily distributed, we did not choose our sites randomly. Instead, we preferentially sampled sites that have harbored green crabs in the past such as tidal marshes, gradually sloping mudflats and tidal channels where salinities remain above 15 ‰ and water temperatures range between 12^{o}-22^{o} C in the summer (Behrens Yamada and Davidson 2002). Green crabs are noticeably absent from the cooler, more saline mouths of estuaries, which are dominated by the larger and more aggressive red rock crab, *Cancer productus* (Hunt and Behrens Yamada 2003).

Since *C. maenas* larvae settle high on the shore (Zeng et al. 1999), and crabs move into deeper water as they age (Crothers 1968), we adapted our collecting methods and locations to effectively sample all age classes of *C. maenas.* Since traps differ in their sampling efficiency for different sizes of crabs, we used three trap types (Table 1). Folding fish traps, with their wide slit-like openings, work well for adult crabs larger than 40 mm carapace width (CW); while minnow traps with their small mesh size (0.5 cm) retain young-of–the-year green crabs. Green crabs start entering these baited traps when they are around 30 mm CW. Pitfall traps are water-filled 5-gallon buckets buried into the sediment so that their rims are flush with the surface of the sediment. Thus they trap actively foraging crabs of any size. Pitfall traps were only used at the Stackpole site in Willapa Bay where green crabs have been continually sampled by this method since 1998. Typically, we would trap young-of–the-year green crabs in the high intertidal with minnow and pit fall traps and larger adult crabs in the mid to low intertidal and subtidal zones with folding fish traps (Appendix 2).

Table 1. Types of traps used for sampling *C. maenas* in Oregon and Washington estuaries. Size selectivity is given in carapace width (CW).

Trap Type	Description	Dimensions	Tidal Height	Size Selectivity (CW)
Folding Fukui Fish Trap	Plastic mesh (2 cm) with two slit openings (45 cm)	63 x 46 x 23 cm	Subtidal to lower intertidal	Large >40 mm
Minnow/ Crayfish	Wire mesh (0.5 cm) cylinder with two openings expanded to 5 cm	21 cm diameter 37 cm long	Medium to high	Medium-large 20-70 mm
Pit fall	Water-filled 5-gallon bucket embedded into the sediment	31 cm diameter 37 cm high	High	All sizes

On gravel shores, we added rocks to the minnow and fish traps to weigh them down and to provide shelter for the crabs. On soft sediment, we pinned the traps down with thin metal stakes. We cut fish carcasses into sections and placed them into egg-shaped commercial bait containers (15 x 8 mm). Holes (0.5 cm) in the sides and lids of the containers allow bait odors to diffuse. One bait container with fresh bait was placed in a trap and left for one tidal cycle (typically 24 hours). We retrieved the traps at low tide, identified all crabs and other by-catch to species and noted the sex, carapace widths (CW) and molt stage of all green crabs (Appendix 3). Green crabs were measured between the tips of their fifth anterio-lateral spines using digital calipers. Native crabs and other by-catch were released while green crabs were removed from the ecosystem and destroyed.

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Table 2. Relative Green Crab abundances (# per 100 trap-days) for study sites in Oregon and Washington estuaries. Data for Grays Harbor 2002 and Willapa Bay 2002-2003 were kindly supplied by Washington Department of Fish and Wildlife and those for Willapa Bay 2004, by P. Sean McDonald. Note that in the last five years, green crabs have been most abundant in Netarts Bay, Oregon.

Estuary	Number of crabs trapped divided by (# trap-days)					
	2002	2003	2004	2005	2006	2007
Coos Bay	9 (180)	14 (203)	18 (137)	9 (242)	22 (273)	52 (246)
Yaquina	26 (168)	63 (1084)	12 (461)	39 (290)	48 (211)	48 (231)
Netarts	0 (44)	11 (44)	12 (39)	52 (106)	47 (82)	35 (103)
Tillamook	2 (71)	6 (70)	4 (51)	12 (102)	41 (147)	15 (93)
Willapa	57 (1640)	13 (409)	6 (195)	113 (449)	19 (245)	4 (318)
Grays Harbor	5 (1203)	--	--	2 (94)	3 (175)	0 (30)
Total	99 (3306)	107 (1810)	52 (883)	228 (1283)	180 (1133)	154 (1021)

Estuary	Catch per 100 trap-days					
	2002	2003	2004	2005	2006	2007
Coos Bay	5	7	13	4	8	21
Yaquina	**15**	6	3	13	23	21
Netarts	0	**25**	**31**	**49**	**57**	**34**
Tillamook	3	9	8	11	28	16
Willapa	3.5	3	3	25	8	1
Grays Harbor	0.4	--	--	2	2	0
Total	3	6	6	18	16	15

Table 3. *Carcinus maenas* catch rates (crabs per 100 trap-days) by embayment in the Pacific Northwest, 1997–2007. P indicates confirmed presence from public reports.

		Number of *Carcinus maenas* per 100 trap-days										
Embayment	**Coordinates**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Quatsino Sound	50°26'N 127°51'W											34
Winter Harbor												1254
Klaskino	50°14'N 127°45'W											183
KyuquotSound, BC	50°04'N 127°13'W						P			P	53	38
Mary Basin												33
Tlupana Inlet	49°43'N 126°29'W											3
Sydney Inlet	49°25'N 126°15'W											150
Esperanza Inlet BC	49°49'N 126°56'W					P	P	P		5	46	
Nootka Sound BC	49°36'N 126°24'W				P						3	
Clayoqout Snd. BC	49°12'N 126°06'W				P						20	
Barkley Sound. BC	48°51'N 125°23'W			P						P	172	
Pipestem Inlet	49°02'N 125°12'W											2202
Esquimalt BC	48°26'N 123°26'W			P								
Grays Harbor, WA	46°52'N 125°05'W		28	3	3	1	0.4			2	2	0
Willapa Bay, WA	46°36'N 134°02'W		35	43	4	3	3.5	3	3	25	8	1
Necanicum, OR	46°00'N 123°55'W											P
Tillamook Bay, OR	45°30'N 123°56'W	P	128	P	P	2	3	9	8	11	28	16
Netarts Bay, OR	45°24'N 123°56'W	P	139			6	0	25	31	49	57	34
Nestucca Bay, OR	46°36'N 124°02'W											P
Yaquina Bay, OR	44°37'N 124°02'W	P	192	69	63	57	15	6	3	13	23	21
Alsea Bay, OR	44°26 'N124°03'W		P				P	P				P
Winchester Bay, OR	43°41'N 124°10'W		P									
Coos Bay, OR	43°25'N 124°14'W	0.2	65	38	P	63	5	7	13	4	8	21
Coquille River, OR	43°08'N 124°23'W		P							5		

Results

Densities in Pacific Northwest

The relative abundances of green crabs trapped in Oregon and Washington estuaries in 2007 are tabulated in Appendix 2 and summarized in Tables 2 and 3. As can be seen from Appendix 2, catch per unit effort (CPUE) is extremely variable. Many factors contribute to this variability, including water temperature, bait type, trap type, tide level, phase in the tidal cycle and the patchy distribution pattern, molt phase, and hunger level of the crabs. Sampling bias also plays a role. For example, when green crabs were rare in Oregon, we focused on known "hot spots" to at least catch a few crabs for age class analysis. One thus must use caution in interpreting differences in CPUE between sites and over time. Minor differences in CPUE are not significant but difference of an order of magnitude would be.

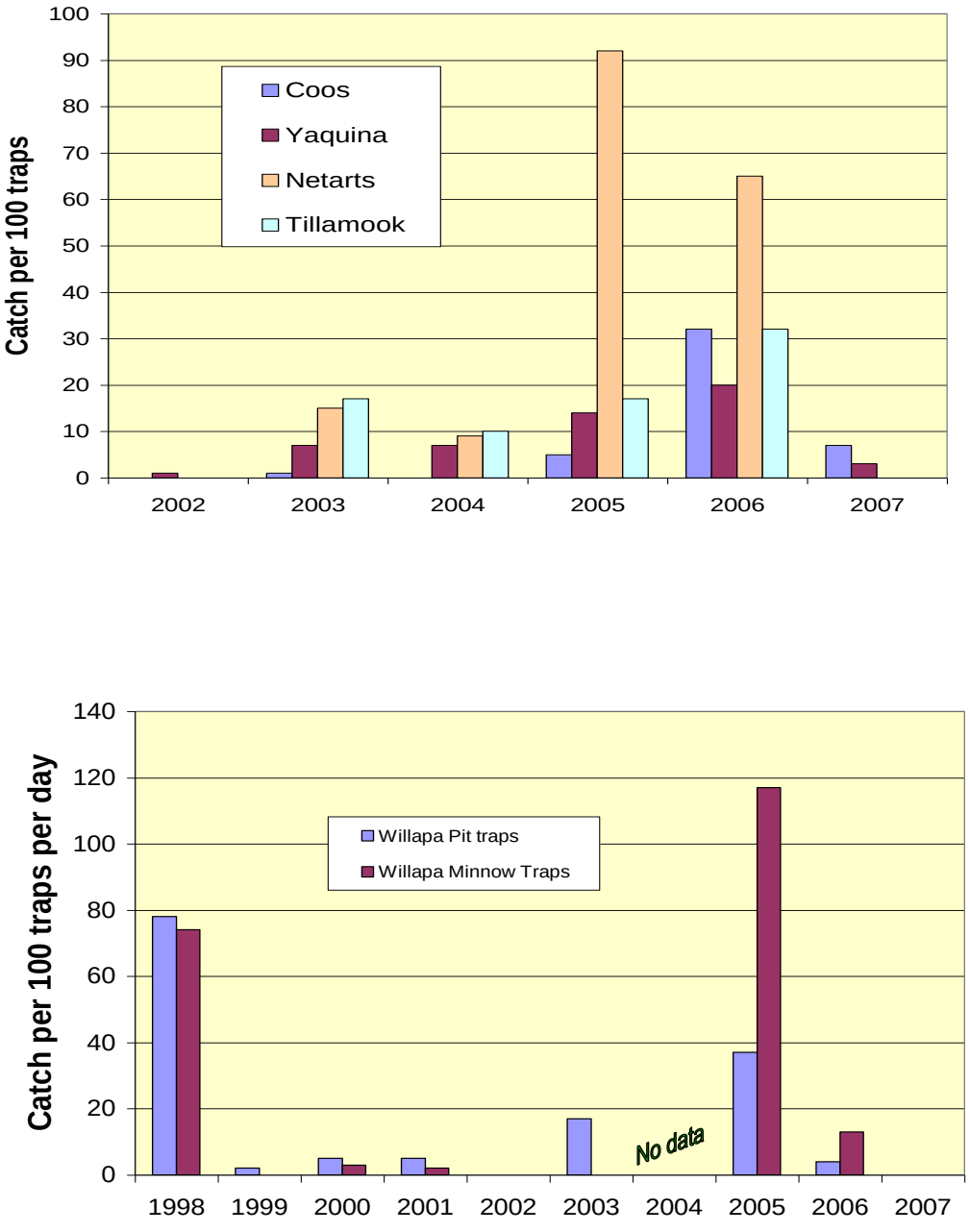
What can be concluded, however, is that catches in Oregon and Washington have decreased an order of magnitude since the 1998 colonization event and have increased slightly after the 2005 recruitment event (Tables 2, 3). While average CPUE per 100 traps ranged from 65 to 192 in 1998, it dropped to 0-15 by 2002. Average catches in both Oregon and Washington averaged less than 7 crabs per 100 traps for 2002, 2003 and 2004. Averages catches in the last three years have roughly doubled due to good recruitment in 2005 and 2006.

The most interesting development over the last two years has been the extensive sampling program for non-native species around Vancouver Island by Fisheries and Oceans Canada. (Gillespie et al. 2006, 2007). While no green crabs were trapped on the east side of Vancouver island nor on the mainland (Rivers Inlet, Smith Sound, Johnstone Strait, Desolation Sound and Discovery Passage), all the inlets sampled on the west coast of Vancouver Island between Quatsino Sound and Barkley Sound yielded green crabs. Densities in many sites were comparable, to those measured in Oregon and Washington however, catches in Pipestem Inlet in Barkley Sound averaged 22 per trap, and Winter Harbor in Quatsino Sound 12 per trap. These densities are much higher than those measured in Oregon right after the 1997/98 El Niño (Table 3).

Recruitment

Late-stage young-of-the-year (YOTY) green crabs typically enter traps once they reach 30 mm in carapace, most years at the end of August. Since green crabs live up to 6 years, one good recruitment event is needed at least once every 5 years to keep the population from going extinct. When the last crabs of the 98-cohort died of senescence in the summer of 2004, the 2003 year class became the dominant one in Oregon and Washington estuaries. Even though the 2003 cohort was less abundant than the 1998 one, it produced enough larvae in 2005 to adequately "seed" Oregon and Washington estuaries to keep the population from going extinct. In Willapa Bay, the 2005 recruitment event was the strongest since 1998 (Figure 2; Appendix 4). While recruitment in Oregon estuaries was good in 2006, Washington estuaries showed a decline. In 2007 we trapped less than 8 YOTY per 100 in Coos and Yaquina Bay and none in the four northern estuaries (Figure 2, Appendix 4).

Figure 2. Recruitment strength of young-of-the-year green crabs in four Oregon estuaries and in Willapa Bay, Washington. For average sizes of recruits, see Appendix 4.



Age Structure of Green Crabs in Oregon and Washington Estuaries

From previous mark and recapture studies and from shifts in size frequency distributions over time (Behrens Yamada et al. 2005,) we estimated the age of green crabs retrieved from Oregon and Washington estuaries in 2007. We assigned crabs to age classes based on their size and coloration (Table 4; Appendix 3). For example, during the summer crabs between 50 and 70 mm, with green or yellow carapaces would represent the 2006 year class. Larger crabs, would mainly belong to the 2005 year class. At the end of 2007, 91% of the green crabs in Oregon and Washington estuaries belonged to the 2005 and 2006 year classes. These two age groups comprise the majority of the breeding population, and would be able to seed Oregon and Washington estuaries until 2012.

Table 4. Estimated age structure of *Carcinus maenas* retrieved from Oregon and Washington estuaries in 2007. Total crabs include trapped crabs recorded in Table 1, those caught in pheromone trials, sports catchescrabs and molts found on the shore. "Older" crabs most likely represent the 2003 year class.

Estuary	2007	2006	2005	"older"	Total
Coos Bay	8	37	14		59
Yaquina	3	28	18	4	53
Netarts	0	15	20	1	36
Tillamook	0	6	7		13
Willapa	0	8	19	1	28
Grays Harbor	0	0	0	0	0
Total	11	94	78	6	189

Conclusions

Population densities of green crabs in Washington estuaries averaged less than 1 per 100 traps and ranged from 16 to 34 per 100 traps in Oregon estuaries. Lower densities in Washington are attributable to poor recruitment in 2006 and a lack of recruitment in 2007.

While green crabs in Oregon and Washington are rare, they are thriving in some inlets on the west coast of Vancouver between Quatsino Sound and Barkley Sound (Behrens and Gillespie 2008 and Gillespie 2006, 2007). Two hot spots were found on our recent cruise around Vancouver Island: Winter Harbor in Quatsino Sound with an average of 12 green crabs per trap and Pipestem Inlet in Barkley Sound with 22 per trap. One trap in Pipestem Inlet yielded 135 green crabs. While these densities are surprisingly high, it should be noted that these hot spots are confined to wave-protected shellfish beaches with freshwater outfall. Hunt and Yamada (2003) and Jensen, McDonald and Armstrong (2007) found that high densities of green crabs occur primarily in microhabits where larger native crabs are rare or absent. In these two studies

and our recent survey around Vancouver Island, green crabs occur higher on the shore and in more marginal habitat than larger natvive crabs: *Cancer magister* (Dungeness), *Cancer productus* (red rock), *Cancer antennarius* (brown rock crab) and *Cancer gracilis* (graceful crab). These larger native crabs are less tolerant of low salinity and high temperatures than green crabs and thus avoid these shallow, warm, low saline microhabitats. In the absence of competition and predation by these larger crabs, green appear to flourish.

Outreach efforts to educate the general public, including boaters and shellfish growers, not to transport non-native Aquatic Nuisance Species (ANS) should continue. Such efforts could delay the spread of ANS in general, and could prevent the establishment of the green crab in the inland sea between Vancouver Island and the mainland, including Puget Sound and Hood Canal. Once green crabs get established in the inland sea, they would spread very quickly as many suitable habitats, devoid of larger crabs and other predators, exist in shallow, warm bays near freshwater outfall. Other non-native species such as the Japanese oyster, the manila clam and the purple varnish clam spread rapidly throughout the inland sea as their larvae are retained and not carried out to sea.

Acknowledgements

P. Sean McDonald of the University of Washington, Bruce Kauffman of Washington Department of Fish and Wildlife and Scott Groth of Oregon Department of Fish and Wildlife provided us with additional data. We thank the staff and faculty of the Oregon Institute of Marine Biology for their hospitality while sampling in Coos Bay. We are especially grateful for the first green crab sighting for the Necanicum and Nestuacca estuaries by Joshua Leighton and Slam Dunkin respectively. Data from the recent surveys around Vancouver Island by Fisheries and Oceans Canada were kindly provided by Graham Gillespie. Harry and Annette's Fresh Fish of Corvallis, Oregon provided most of the bait.

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Appendix 1. Physical data for *Carcinus maenas* sampling sites in Oregon and Washington estuaries. Range of values observed includes sampling times from 2002 to 2005.

Site	Date	Location Description	S ‰	Water Temp.	Air Temp.	Green Crabs Found?
COOS BAY						
Jordan Cove		***Range of values observed***	***5-34***	***14-22***	***14-24***	
	9/24/07				17	Yes
Russell Point		***Range of values observed***	***22-33***	***11-20***	***9-28***	
N 43° 25.974'	5/27/07		28	18.3	16	**yes**
W 124° 13.252'	7/13/07		30	16	18	yes
	9/15/07		32	12.5	9	yes
Trans Pacific Br.	5/25/07		25-38	18	16-21	no
N 43° 26.222'	9/25/07		33	15	16.5	no
W 124° 14.155'						
Trans Pacific Ln.		***Range of values observed***	***22-33***	***11-18***	***10-27***	
N 43° 26.571'	5/25/07		27	16	17	**yes**
W 124° 13.388'	7/14/07		28	19	20	**yes**
	9/26/07		31	13	10	no
North Slough	5/25/07		8-27	19-24.5	15-19	no
Haynes Inlet	9/26/07				13	
N 43° 27.003'						
W 124° 13.478'						
Clausen's Oysters	5/27/07		24	17.6	16	
N 43° 26.911'	7/13/07		28	20.5	19.3	
W 124° 12.209'						

Kentuck inlet A	5/27/07		5	17.5	18.2	no
N 43° 25.299'	9/27/07				13	yes
W 124° 11.522'						
Empire Dock	9/27/07		33	12	13	no
N 43° 23.833'						
W 124° 16.596'						
Pony Point			***17-32***	***11-17***	***11.5-18***	
N. Bend Airport	5/26/07	Mudflat near rip rap, *Zostera marina* zone	26	17	15.5	yes
N 43° 25.403'	7/13/07		29	17.4	19.3	yes
W 124° 14.369'	9/25/07		32	12.5	9	yes
YAQUINA BAY						
Johnson Slough	***Range of values observed***		***4-32***	***15-20***	***16-22***	
N 44° 34.692'	4/20/07	Below bridge/along creek bank , *Salicornia* patches	4	17.2	19.5	no
W123° 59.333'	9/17/07		30	16	17	yes
Sawyers Landing						
	4/20/07		12	14.9	13.4	no
Sally's Bend A	below intersection		***22-33***	***12-23***	***12-26***	
N 44° 37.699'	4/20/07	*Scirpus* patches	18	12.8	18.9	no
W124° 01.482'	8/29/07		30	23	18	no
	9/29/07		31	11.5	16	no
Sally's Bend B	George Street		***29-33***	***12-19***	***12-24***	
N 44° 37.640'	4/20/07	*Scirpus* patches	18	12.8	18.5	yes
W124° 00.790'	8/29/07		30	23	18	no
	9/29/07		31	11	16	yes

Sally's Bend D	John Nye Road					
N 44° 37.561'	4/20/07	*Scirpus* patches				
W124° 00.537'	9/29/07		31	11	16	yes
	10/23/07		30	11	15	no
Sally's Bend C	*Zostera marina* zone from gate to Fishing platform		***19-32***	***10-19***	***9-22***	
N 44° 37.419'	4/20/07		18	12.8	18.9	yes
W124° 01.463'	8/29/07		30	23	18	Yes
	9/17/07		32	14	15	yes
	10/23/07		31	12.5	15	yes
	11/20/07		20	11	10	yes
	12/7/07			11	10	yes
Hatfield Marine		***Range of values observed***	***22-34***	***11-21.5***	***12-23***	
Science Center	4/8/07	Rip rap/ boulders/sandy mudflat/ *Zostera marina*	24	12.5	14.8	yes
Pump house						
N 44° 37.408'						
W124° 02.576'						
Oregon Coast			***19-34***	***9-25***	***8-23***	
Aquarium	5/11/07	Tidal channel draining mudflat, along nature trail	28	16.4-20	17.2	no
N 44° 37.108'	8/31/07		32	16	30	yes
W124° 02.165'						
Idaho Point		***Range of values observed***	***19-35***	***12-27.5***	***12-23***	
N 44° 36.818'	5/10/07		26	17	18.8	yes
W 124° 01.582'						
TILLAMOOK BAY						

Tillamook Spit A			***0-30***	***13-19***	***13-27***	
N 45° 30.843'	5/18/07	mudflat- eelgrass zone below rip rap and in *Scirpus*			15.3	no
W 123° 56.738'	7/18/07		0	17.4	18	yes
	9/12/07		30	16	15.5	no
	9/13/07		30	16	15.5	yes
Tillamook Spit B	7/18/07		14	18.2	18	yes
N 45° 30.456'	9/13/07		30	16	19	no
W 123° 56.615'	9/28/07		32	13.5	17	no
Pitcher Point	9/28/07	South of Spit B – mudflat in Japanese eelgrass zone	31	13.5	17.5	no
N 45° 30.365'						
W 123° 56.508'						
NETARTS BAY						
RV Park	9/11/07	mud flat east of bridge	37	15.9	20.6	**yes**
N 45° 25.___'	9/12/07			14.3		Yes
W 123° 56___	9/13/07		33	12.6	15	yes
Whiskey Creek Salmon hatchery	***Range of values observed***		***0-34***	***13-20***	***14.5-21***	
N 45° 23.670'	5/18/07	On mudflat and in creek				
W 123° 56.214'	7/18/07		0	16.3	16.2	
N 45° 23.652'						
W 123° 56.234'						
Intersection of Whiskey Creek & Netarts Bay Roads	***Range of values observed***		***0-34***	***13.5-20***	***15-23***	
	5/18/07	Pool below culvert draining Freshwater marsh			15.5	**yes**
	7/18/07		21	18	17	**yes**
	9/10/07		35	16.3	14	**Yes**
N 45° 24.865'	9/11/07		33	14.8	13	**yes**
W 123° 56.064'						

	9/12/07		33	14.7	15	**no**
WILLAPA BAY						
Stackpole		***Range of Values observed***	***14-28***	***11-19***	***9-28***	
Leadbetter Pt.	3/20/07	Pit traps in Spartina field	20	6	8	**yes**
Sate Park	4/17/07		17	11	11	**yes**
N 46° 35.848’	5/16/07		25	13	11	**yes**
W 124° 02.195’	6/19/07		27	18	19	no
	8/28/07		-	-	-	no
	9/28/07		30	15	14	yes
Tokeland	10/13/07	Upper tideland	29			yes
GRAYS HARBOR						
Lila St. Refuge	10/13/07	Upper tideland	24			no
N 46° 52.480’						
W 124° 05.904’						
Brady’s Oysters	10/13/07	Mouth of Elk River, Upper tideland	20			no
N 46° 51.723’		Vegetated area below store				
W 124° 04.333’						

Appendix 2. Relative abundance of crab species and sculpins (Numbers/trap/day) in Oregon and Washington estuaries during 2006. An asterisk beside trap number indicates that other traps were either opened or were stolen.

Coos Bay

Site		Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpin	Number Traps
Russell Point	5/27/07	Fish	Pools by bridge	0.17	0	0	2.33	0.5	0	0.5	6
	7/13/07	Fish	*Zoster marina*	0.50	0	0	4.00	0	0	2.75	4
Pony Point/Airport	5/26/07	Fish	*Zostera marina*	0.20	0	0	2.2	0	0.5	0.5	10
	7/12/07	Fish		0.45	0	0	2.80	6.25	0.15	3.2	20
	9/25/07	Fish		0.7	0	0	6.9	0	4.4	0.1	10
	5/26/07	Minnow		0	0.2	0	0	0	0	0.7	10
Airport Marsh	9/25/07	minnow	*Scirpus*	0	0.2	0	0	0	0	1.2	5
Haynes Inlet	9/26/07	Minnow	*Scirpus*	0	0	0	0.75	0	0	0.08	12
Clausen's Oysters	5/26/07	Fish	*Mid*	0.38	1.88	0	6.88	0	0	0.25	8
	7/13/07	Fish	*Mid*	0.50	0.83	0	8.67	0.33	0	1.06	4
Kentuck A	5/27/070	Fish	*Low*	0	0.06	0	0.94	0	0	1.00	16
	9/27/07	Minnow		0.09	0.18	0	0.36	0.59	0	0.41	22
North Slough	5/25/07	Fish	*High*	0	0.33	0	6.67	0	0	0.50	6
TransPacific Ln. N	5/25/07	Fish	*Mid*	0.50	0.2	0	1.0	0.1	0	0.8	10
	7/14/07	Fish		0.40	1.47	0	23.53	0	0	0.20	15
	9/26/07	Fish		0	0	0	4.75	0	0	0	8
TransPacific Ln. S	5/25/07	Fish	*Mid*	0.09	0	0	0.82	0	0	0.36	11

	7/14/07	Fish		0.27	0.07	0	9.00	0	0.07	1.00	15
	9/26/07	Fish		0	0	0	2.71	0	0	0.14	7
TransPacific Bridge	5/25/07	Fish	*Mid*	0	0	0	1.33	0	0	0	6
	9/25/07	minnow	*Scirpus*	0	0	0	1.6	0	0	0.4	5
Jordan Cove	9/25/07	minnow	*Scirpus*	0.21	0	0	0.21	0	0	0.01	19
	9/26/07	Minnow		0.4	0	0	0.3	0	0	0.3	10
Empire Docks	9/27/07	Fish	*Mid*	0	0	0	8.28	0	4.43	0.14	7
Total Number				52							246

Yaquina Bay

Mean CPUE (Catch/trap/day)

Site	Date	Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpins	Number Traps
Johnson Slough	4/21/07	Fish	Below Bridge	0	0	0	0	0.5	0	0.5	2
	9/17/07	Fish		1.5	0	0	12	0	0	0	2
	9/17/07	Minnow	Marsh	0.08	0	0	0	0	0	0.17	12
Sawyers Landing	4/20/07	Fish	Low tide	0	0.20	0	1.40	0.40	0.20	0	5
Sally's Bend A	4/20/07	Minnow	*Scirpus*	0	0.2	0.1	0	0	0	1.2	10
	8/30/07	Minnow		0	1.53	0	0	0.13	0	1.13	15
	9/17/07	Minnow		0	0.5	0	0	0	0	0.44	16
	8/30/07	Pit-trap		0.25	1.2						4
	9/29/07	Minnow		0	0.6	0.13	0	0	0	0.4	15
Sally's Bend B	4/20/07	Minnow	*Scipus*	0	0	0	0	0	0	5.33	6
	8/30/07	Minnow		0	0.60	0	0	0	0	1.60	5
	9/29/07	Minnow		0.1	0.3	0	0	0	0	0	10

Sally's Bend C Fishing Platform	4/20/07	Fish	*Zostera marina*	0.13	0.25	0	0.8	0	0	0	8
	8/30/07	Fish	*Zostera japonica*	0.75	2.75	0	7.0	0	0	5.25	4
	9/17/07	Fish		0.9	0.5	0	0.9	0	0	0.8	10
	10/23/07	Fish		0.6	0.4	0	0.2	0	0	0	10
	11/12/07	Fish		0.4	0.2	0	0.3	0	0	0	10
	12/7/07	Fish		0.1	0.9	0	0	0	0	0	10
Sally's Bend D	9/29/07	Minnow	*Scirpus*	0.1	0.1	0	0	0	0	0	10
	10/23/07	Minnow		0	0.3	0	0	0	0	0	10
HMSC Pump house	4/08/07	Fish	*Zostera marina*	0.17	0.08	0	0.42	0.17	0.83	0	12
Oregon Coast Aquarium	5/11/07	Fish	pools	0	1.5	0	1.80	0	0	2.3	10
	8/31/07	Fish	pools	0.6	1.20	0	0	60.2	0	2.8	5
	8/31/07	Minnow	*Scirpus*	0	0.18	0.12	0	2.18	0	0.18	17
Idaho Point	5/10/07	Fish	Low	0.92	0.31	0	1.08	0	0.08	3.92	13
Total Number				48							231

Tillamook Bay

Mean CPUE (Catch/trap/day)

Site		Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpin	Number Traps
Tillamook Spit A	5/18/07	Fish	*Scirpus*	0	0.08	0	0	0	0	0.58	12
	8/18/07	Fish		0.77	5.61	0	5.77	0	0	1.23	13
	9/13/07	Fish		0.05	0.15	0	0	0	0	3.45	20
	9/12/07	Minnow	*Scirpus*	0	0.3	0	0	0	0	3	10
Tillamook Spit B	7/18/07	Fish	*Zostera japonica*	1.33	1.33	0	3.33	2.00	0	1.66	3

	9/13/07	Minnow	*Scirpus*	0	0.7	0	0	0	0	1.45	15
	9/28/07	Minnow		0	0.1	0	0	0	0	0.4	10
Pitcher Point	9/28/07	Minnow	*Scirpus*	0	0.6	0	0	0	0	0.4	10
Total Number				15							93

Netarts Bay **Mean CPUE (Catch/trap/day)**

Site		Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpin	Number Traps
RV Park	7/18/07	Fish	creek /mudflat	2	0	5	7	0	2	4	1
	9/10/07	Fish		0.75	0.375	0.125	0.375	0	0	1.25	8
	9/11/07	Fish		0.25	0	0	0	0	0	0	8
	9/12/07	Fish		0.17	0.17	0.17	0.17	0	0	2.17	6
Intersection	5/18/07	Fish	pools	2.50	0	0	0	0	0	0.5	4
	7/18/07	Fish		1.00	9.4	0	11.4	0	0	1.2	5
	9/11/07	Fish		1.00	0.5	0	6.5	0	0	2.75	4
	9/12/07	Fish		0	0.2	0	0.8	0	0	0.2	5
Whiskey Creek Salmon Hatchery	5/18/07	Fish	Creek/mudflat	0.33	0	0	0.67	0	0	0.67	6
	7/18/07	Fish		0	9.6	1.4	7.8			0.2	5
	9/11/07	Fish		0.33	4	0	16.5	1.17	0	0.83	6
	5/18/07	Minnow	*Fucus*/mudflat	0	1.75	0.63	0	0	0	3.5	8
	7/18/07	Minnow		0	0.25	0.63	0	0	0	0	8
	9/11/07	Minnow		0	0.37	0.5	0.07	0	0	0.28	14
	9/28/07	Minnow		0.07	1.93	0.07	0	0	0	0.07	15
Total Number				35							103

Willapa Bay				**Mean CPUE (Catch/trap/day)**							
Site		Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpin	Number Traps
Stackpole	3/21/07	Pit-fall	Tide flat	0	0	0	0.16	0	0	0	12
	3/22/07	Pit-fall		0	0	0	0.08	0	0	0	12
	5/16/07	Pit-fall		0.07	0.07	0	0.53	0	0	0	13
	5/17/07	Pit-fall		0	0	0	0.38	0	0	0	13
	6/19/07	Pit-fall		0	0	0	0	0	0	0	12
	8/28/07	Pit-fall		0	0	0	0.83	0	0	0	12
	8/29/07	Pit-fall		0	0	0	0.5	0	0	0	12
	9/28/97	Pit-fall		0	0	0	1.08	0	0	1	12
	10/30/07	Pit-fall		0	0	0	0	0	0	0	12
	3/21/07	Minnow	*Spartina* patch	0	0	0	0.10	0	0	0	10
	3/22/07	Minnow		0	0	0	0	0	0	0.10	10
	5/16/07	minnow		0	0	0	2.30	0.10	0	2.8	10
	5/17/07	minnow		0	0	0.10	1.9	0	0	1.6	10
	6/19/07	minnow		0	0	0	0	0	0	0.27	10
	8/28/07	minnow		0	0	0	3.8	0	0	0.3	10
	8/29/07	minnow		0	0	0	2.6	0	0	0.2	10
	9/28/07	minnow		0.1	0	0.2	2.9	0	0	0	10
	10/30/07	minnow		0	0	0	0.1	0	0	0	10
	5/6/07	Fish	*Spartina*	0	0	0	0	0	0	0	12
Stackpole-shell bag site	4/18/07	Minnow		0	0	0	1.8	0.2	0	1.80	5
	4/19/07	Minnow		0	0	0	1.70	0.40	0	0.40	10
	4/19/07	Pitfall		0	0		0	0	0	0	2
Taylor Hatchery	9/11/07	Pit-fall	Spartina edge	0	0	0	0.4	0	0	2	10
	9/11/07	Minnow	Spartina edge	0	0	0	2.0	0	0	0	10

Nacotta Lab	5/04/07	Fish	Spartina edge	0	0	0	0	0	0	0	30
Tokeland	5/04/07	Fish		0.03							29
	10/13/07	minnow	Upper Tideland	0.1	0	0	0	0	0	0	10
Total Number				4							318

Grays Harbor **Mean CPUE (Catch/trap/day)**

Site		Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpin	Number Traps
Lila Street-refuge	10/13/07	Minnow	Native vegetation	0	0.1	0.05	0	0	0	0.35	20
Brady's Oysters	10/13/07	Minnow	Native vegetation	0	0	0	0	0	0	0.9	10
Total Number				0							30

Appendix 3. *Carcinus maenas* Catches and Sightings from Oregon and Washington Estuaries in 2007. Crabs were assigned to year classes based on the size and condition attained by tagged crabs of known age (Behrens Yamada et al. 2005). Crabs that are green have molted recently, while red crabs have not molted for a long time, in some case well over a year. Missing limbs are numbered in sequence: 1= Right claw; 5= last leg on right side, 6= left claw, 10=last leg on left side.

Estuary	Site	Date	Sex	CW	Color	Year Class	Condition/Comments
COOS	Airport /Pony Pt	5/26/07	M	72.84	Yellow	2005	Limbs 2, 3, 5 missing
			M	80.72	Yellow	2005	Leg # 4 missing
		7/13/07	F	58.67	Yellow green	2006	Good
			M	74.30	Yellow green	2006	Good
			M	74.00	Yellow	2006	Missing 8.9.10
			M	67.05	Yellow	2006	good
			M	76.68	Orange yellow	2005	Missing 2,7,8
			M	78.51	Yellow green	2005	Good
			M	62.42	Orange	2005	2 barnacles on back
			F	62.99	Yellow green	2006	Good
			M	48.66	Green	2006	Good
			M	55.39	green	2006	Good
		9/26/07	F	78.2	Yellow	2005	
			F	59.2	Yellow	**2007**	
			F	70.75	Orange	2006	# 1 regenerating
			F	67.09	Green	2006	Good
			F	66.9	Yellow-orange	2006	# 6 regenerating
			F	76.3	Orange	2005	Missing #6 barnacles on back
			F	75.52	Orange	2005	Good, barnacles
			? molt	38.6		**2007**	New CW = 50
			M molt	48.8	green	**2007**	New CW = 63
	Railroad Bridge	11/?/07	F	67	Orange	2006	Sports catch
	Jordan Cove	9/25/07	M	45.2	Green	**2007**	Good
			F	56.6	Yellow	2006	Good

			F	65.6	Yellow	2006	Good
			F	60.0	Yellow	2006	Good
		9/26/07	M	43.0	Bright green	**2007**	Good
			M	43.3	Yellow green	**2007**	Good
			F	60.0	Green	2006	Good
			M	61.9	Yellow-orange	2906	Good
	Under 101 Bridge	5/26/07	M	68.92	Yellow green	2006	good
		7/13/07	F	57.6	Green	2006	dead
			M	73.88	Yellow-green	2005	Good
			M	77.39	yellow	2005	Good
	Trans Pacific Blvd	5/25/07	M	64.09	Yellow green	2006	Good
			F	49.98	Orange	2006	Good
			M	62.26	Yellow green	2006	Good
			M	64.85	Yellow	2006	Good
			M	75.31	Yellow	2005	Good
			M	85.76	yellow	2005	Good
		7/14/07	F	63.35	green	2006	
			M	66.12	yellow-orange	2006	
			M	67.83	yellow	2006	
			M	74.82	yellow-orange	2005	
			M	73.05	yellow	2006	
			M	75.15	yellow	2006	
			M	74.96	yellow	2006	
			M	70.77	yellow	2006	
			M	73.64	yellow	2006	
			M	78.07	yellow-orange	2005	
	Clausen Oysters	5/27/07	M	47.01	Yellow green	2006	Good
			M	57.20	Yellow green	2006	No # 5
			M	60.56	Yellow green	2006	No # 8,9
		7/13/07	F	51.48	Yellow green	2006	
			M	59.63	Orange yellow	2006	no claws
			M	65.34	Orange yellow	2006	

	Empire	7/15/07	M	~65	Orange red	2006	Scott Groth – no claws
	Kentuck	9/27/07	M	43.2	Green	**2007**	Good
			F	52.48	Green	**2007**	good
ALSEA	Crabbing float	6/19/07	M	80.9		2005	Sports catch– Kelly Corbett
		8/3/07	M	90		2005/2003	Live caught -John Chapman
YAQUINA	Toledo Bridge	7/17/07	?	?	Molt		Tim Davidson
	Johnson Creek	9/17/07	F	36.13	Green	**2007**	Good
			M	87.76	yellow orange	2005	Good
			M	91.2	Orange	2003	Good
			M	89.1	Orange	2003	Missing #1
	Sally's Bend A	7/30/07	M	70.35		2005	Pitfall trap
	Sally's Bend B	9/29/07	F	48	Yellow green	**2007**	
	Sally's Bend C	4/20/07	M	45.2	Yellow green	2006	good
	Fishing platform	8/30/07	M	72.84	Yellow green	2006	
			M	79.17	yellow	2006	
			F	67.38	Red	2006	
		9/17/07	F	61.68	Yellow	2006	Good
			M	74.74	Yellow	2006	# 1 regenerating
			M	77.36	Orange	2006	# 1 missing
			M	73.16	Yellow	2006	Good
			F	59.16	Yellow	2006	Good
			F	63.48	Green	2006	Good
			M	63.48	Orange	2006	Good
			M	73.14	Yellow	2006	# 1 missing
			M	85.77	Yellow	2005	Good
			M	75.80	Yellow	2006	# 1 missing
		10/23/07	M	69.07	Yellow-orange	2006	Good
			F	69.95	Yellow	2006	Good
			M	85.90	Red-orange	2005	Good
			M	81.29	Yellow-green	2005	good

			M	83.51	Red-orange	2005	Barnacles on back
			M	83.12	orange	2005	Missing legs # 7, 9
		11/20/07	M	87.2	yellow	2005	Good
			F	62.35	yellow	2006	Good
			M	80	yellow	2005	No # 4
			F	63	Yellow green	2006	good
		12/07/07	M	71.8	Yellow green	2006	# 1 regenerating
	Sally's Bend D	9/29/07	M	49	Yellow	**2007**	Missing # 6
	HMSC Pump dock beach	4/8/07	M	81.0	Yellow green	2005	Good
			M	87.5	Yellow orange	2005	Good
		6/7/07	M	89.6	Yellow orange joints	2003	No claw #6
	Aquarium mud flat	6/7/07	M	77.87	Yellow, light orange joints	2005	
			M	76.00	Yellow orange	2005	
			M	66.7	yellow	2006	
		8/31/07	M	77.87	Yellow-orange	2005	
			M	76.0	Yellow-orange	2005	
			M	66.7	yellow	2006	
	Idaho Point	5/10/07	M	86.85	Yellow	2005	Missing limb # 7
	(Includes crabs caught from		M	69.78	Yellow	2005	
	pheromone experiment)		M	89.47	Orange	2003	
			M	84.39	Yellow/orange joints	2005	
			M	55.53	Yellow	2006	
			M	64.27	Yellow	2006	
			F	63.5	Yellow green	2006	
			M	63.0	Yellow	2006	Missing claw #1
			F	51.85	Yellow green	2006	
			M	55.70	Yellow	2006	
			M	59.74	Yellow	2006	

			F	48.52	Yellow green	2006	
NESTUCCA		8/6/07	M	86	Yellow/orange joints	2005/2003	barnacles , sports catch - Slam Dunkin
TILLAMOOK	Spit	7/18/07	M	69.87	red	2005	missing a claw
			M	80.69	yellow-green	2005	
			M	63.50	yellow-orange	2006	
			M	69.79	yellow-green	2005	no #5
			M	75.48	yellow	2005	no #9
			M	59.33	yellow-green	2006	
			M	75.99	yellow-orange	2005	no claw # 6
			F	60.88	green	2006	
			M	74.00	orange	2005	
			M	63.95	yellow-orange	2006	claw#6 regenerating
			M	64.75		2006	
			M	68.68	yellow-orange	2005	
		9/13/07	M	58.8	Green	2006	good
NETARTS	RV Park	6/23/07	M	89.5	yellow	2005	below creek bridge
		Summer 07	M	82.5	Red	2005	Sports catch
		9/11/07	F	70.5	Orange	2005	Missing 1,7,8,9,10
			M	78.0	Orange	2005	Missing # 1
			F	75.8	Orange-yellow	2005	
			F	70.5	Red	2005	Missing # 1,2,3
			F	79.6	Yellow	2005	
			M	78	Yellow	2005	Regenerating 1 missing 2
			M	96		2003	
		9/12/07	F	81.2	yellow	2005	
	Intersection	5/18/07	M	79.59	Yellow green	2005	Good
	Netarts Road		M	60.95	Yellow green	2006	No # 4, 5
	Whiskey Creek Rd		M	59.85	Yellow green	2006	Good

			M	82.00	Yellow green	2005	No # 1 claw
			M	66.17	Yellow green	2006	No 8, 9
			M	75.25	Yellow orange	2005	Good
			F	56.69	Orange	2006	Mo # 1 claw
			M	72.31	Yellow orange orange joints	2005	Good
			M	50.85	Green	2006	Good
			M	70.71	Yellow orange orange joints	2005	Good
		7/19/07	M	52.28	yellow	2006	
			M	47.17	yellow	2006	no # 6, 7
			M	66.21	yellow	2006	puncture in gill chamber
			M	72.74	yellow-green	2006	no # 6
			M	80.36	orange	2005	lost propal tip
			M	69.64	yellow-orange	2005	no # 1, 4, 5
			M	68.33	green	2006	
		9/11/07	M	75	Yellow	2006	Good
			M	80	Orange	2005	Good
			M	81	Orange	2005	Good
	Whiskey Creek Salmon hatchery	5/18/07	M	53.42	Green	2006	
			M	73.16	Red orange	2005	No #1 claw, #6 propus tip missing
		9/11/07	M	62	Yellow orange	2006	good
			M	81.4	Orange	2005	
		9/12/07	M	64.9	Orange	2006	good
		9/28/07	M	65.5	Red	2006	good
SEASIDE	Bridge of Necanicum River	9/28/07	M	76	Orange	2006	Good, sports catch Joshua Leighton
			?	?	?		Another crab week before
WILLAPA	Stackpole/shell	3/20/07	M	69.1	Orange	2005	Missing limb #4

	bags site						
			M	68.9	Orange	2005	Good
			M	65.2	Orange	2005	Missing # 4, 7 limbs
			M	67.2	Orange	2005	Missing #6 claw
			M	64.4	Orange	2005	missing #8
			M	70.0	Orange	2005	Missing # 3 limb
			M	49.6	Orange	2006	Good
		5/16/07	F	61.4	orange	2005	Missing #2
			M	49.9	Yellow	2006	good
	Stackpole- pit-fall trap site	9/28/01	M	57.2	Orange	2006	Missing #4,5
	Nahcotta shell bags	3/20/07	M	67.1	Green	2006	
			F	72.3	Red orange	2003	Missing # 1, 2
	Bay Center Mari-culture	1/19/07	F	65	?	2005	Missing 6 legs, including both claws , Dick Wilson
		4/30/07	F	54	?	2006	Dick Wilson
	Goose Point Bay center	12/10/07	F	80	Orange	2005	Dick Wilson One claw regenerating
	Between Bay Ct & Stoney Point	12/31/07	F	78	?	2005	Dick Wilson
	Nemah	5/28/07	F	72	?	2005	Dick Wilson
	Nemah		F	61	?	2005	Dick Wilson
	Nemah	6/25/07	F	63	?	2005	Dick Wilson
			F	70	?	2005	With eggs, Dick Wilson
	Bone River	9/11	F	71	?	2005	Missing 4 legs, Dick Wilson
	Bone River	9/14	M	83	?	2005	Dick Wilson
	Tokeland Kincaid slough	5/4/07	M	85.5	green	2005	
			M	77.9	green	2005	
	Kincaid Slough	5/4/07	M	86.9	Yellow green	2005	

	riprap / hand collected						
			M	56.4*	molt	2006	
			F	34.0*	molt	2006	
	Tokeland	10/13/07	F	56.7	Green/orange	2006	good
GRAYS HRB	Wildlife Sanctuary						No crabs caught in
	Brady's Oysters						30 traps only

Appendix 4. Relative abundance (CPUE) and size of young-of-the-year *Carcinus maenas* at the end of their first growing season in Oregon and Washington estuaries. Crabs were typically caught between mid-August to early October. Catch per unit effort (CPUE) is reported as number of crabs per trap per day. N=number of young crabs sampled; SD=Standard Deviation, Water temperatures for December-March for the Hatfield Marine Science Center Pump Dock in Yaquina Bay were provided by David Specht of the Newport EPA; those for Willapa Bay, by Jan Newton and Judah Goldberg of the DOE.

Year Class	Estuary	# Months <10°C	Mean Winter Temp. °C	N	CPUE Pitfall traps	CPUE Minnow traps	Mean Carapace Width (mm)	SD	Range
2002	Coos			0		0			
2003				1		0.01	59.4		
2004				0		0			
2005				2		0.05	45.0		44-46
2006				17		0.32	43.5	4.6	36-52
2007				**5**		**0.08**	**45.4**	**4.0**	**43-52**
1998	Yaquina	0	10.9	201		**5.0**	46.9	5.0	32-60
1999		4	9.0	13	0.20		38.0	5.0	30-47
2000		3	9.5	14		**0.31**	37.5	5.0	30-45
2001		3	9.5	Not sampled					
2002		4	9.2	1		0.01	38.9		
2003		0	10.5	9		0.07	44.9	5.5	41-59
2004		3	9.9	4		0.07	35.3	5.1	32-43
2005		2	10.3	21	0.75	0.14	41.0	8.4	28-46
2006		3	9.8	18		**0.20**	42.6	5.9	34-51
2007				**3**		**0.03**	**44.4**	**7.0**	**36-49**
2002	Netarts			0		0.0			
2003				6		0.15	49.4	3.7	45-55
2004				0		0			
2005				25		0.92	42.9	5.3	30-53
2006				21		**0.65**	38.6	5.3	29-50
2007				**0**		**0**			
2002	Tillamook			0		0			
2003				5		0.17	50.0	3.1	46-55
2004				2		0.10	41.0		37-45
2005				10		0.17	47.8	4.5	42-56
2006				31		0.32	40.7	4.4	31-51
2007				**0**		**0**			
1998	Willapa	3	8.9	47	0.778	0.74	45.9	4.0	37-55
1999		4	7.6	3	0.023	0.0	38.2	7.5	32-47
2000		4	8.0	9	0.046	0.03	43.4	12.0	19-58
2001		5	8.0	7	0.046	0.02	51.3	2.7	48-56
2002		4	7.6	0	0.0	0.0			

2003		3	9.0	10	0.167	0.0	48.3	5.1	43-59
2004		5	8.6	Not sampled					
2005		3	9.0	106	0.37	1.17	46.1	3.3	34-52
2006				5	0.04	0.13	42.5	5.1	35-49
2007				**0**		**0**			
1998	Grays Harbor			3		1.00	45.3	5.0	40-50
1999				24		0.024	37.4	7.7	34-51
2000				3		0.01	41.3	6.5	35-48
2001				1		0.01	47.9		
2002				0		0			
2003					Not Sampled				
2004					Not Sampled				
2005				2		0.03	47.3		44-50
2006				1		0.02	49.0		
2007				**0**		**0**			