Status of the
European Green Crab in Oregon and Washington Estuaries

Progress Report

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by

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Executive Summary

The invasion of Pacific Northwest estuaries by the European green crab, *Carcinus maenas*, caused much initial alarm. Following the last El Niño of 1997-98, a strong cohort of young green crabs appeared in estuaries along the coasts of Oregon, Washington, and as far north as Port Eliza on the west coast of Vancouver Island, British Columbia. Unusually strong northward-moving coastal currents (up to 50 km/day from September 1997 to April 1998) must have transported green crab larvae from more established source populations in California to the Northwest. Coastal transport events and recruitment of young green crabs have been much weaker in recent years.

It was hoped that green crabs would go extinct in the Pacific Northwest once the original colonists reached the end of their life span of 4-6 years and no new larvae arrived from California. This has not happened. Local recruitment has occurred most years since 1998. Recruitment strength is linked to winter temperatures: cold winters (2002) are followed by poor recruitment and warm winters (2003 and 2005), by good recruitment. ***The 2005 year-class is now the dominant cohort in the Pacific Northwest, thus assuring a larval source until 2011 when the last of these crabs will die of old age.***

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 in order to predict the next strong recruitment event of green crabs.

Efforts to educate the general public, including boaters and shellfish growers, not to transport non-native Aquatic Nuisance Species (ANS) from one area to another should continue. Such efforts could delay the spread of ANS and prevent the establishment of the green crab in the inland sea between Vancouver Island and the mainland.

Introduction

The goal of this study is to determine 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 density of green crabs in Oregon and Washington estuaries by using baited traps,
- Estimating the year-class strength of young-of-the-year green crabs.
- Comparing patterns in recruitment strength over time and correlating them to ocean conditions.

Sampling Methods for Green Crabs

Sampling effort in the spring of 2006 focused on four Oregon estuaries: Coos, Yaquina, Netarts and Tillamook and two Washington estuaries: Willapa and Grays Harbor. In each estuary, we sampled at least 2 different sites. For a detailed description of sampling methods see previous status reports.

Results

Catches

The relative abundances of green crabs trapped in Oregon and Washington estuaries in early 2006 are tabulated in Appendix 2 and summarized in Tables 1 and 2. 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, and the patchy distribution pattern, molt phase, and hunger level of the crabs. Sampling bias also plays a big role. For example, when green crabs are rare, one tends to focus 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.

What can be concluded, however, is that catches in Oregon have decreased an order of magnitude since 1998 (Table 2). While average CPUE per 100 traps ranged from 65 to 192 in 1998, it dropped to 0-15 by 2002. Catches have increased slightly in recent years due to the appearance strong year classes in 2003 and 2005. While Yaquina, Netarts and Willapa Bay have seen good recruitment in 2005, Grays Harbor and Coos Bay (at the extreme of our sampling range) have not.

Table 1. Relative Green Crab abundances for study sites in Oregon and Washington estuaries. Data for Willapa Bay for 2004 were kindly supplied by P. Sean McDonald. Note

that in the last three years, green crabs have been most abundant in Netarts Bay, Oregon and decreased in abundance in Coos Bay.

Estuary	Number of crabs trapped dived by (# trap-days)				
	2002	2003	2004	2005	Early 2006
Coquille				1 (22)	
Coos Bay	9 (180)	14 (203)	18 (137)	9 (242)	2 (167)
Yaquina	26 (168)	63 (1084)	12 (461)	39 (290)	17 (56)
Netarts	0 (44)	11 (44)	12 (39)	52 (106)	9 (33)
Tillamook	2 (71)	6 (70)	4 (51)	12 (102)	1 (23)
Willapa		13 (409)	6 (195)	113 (449)	4 (54)
Grays Harbor				2 (94)	0 (30)
Total	37 (463)	109 (1810)	52 (883)	230 (1365)	33 (263)

Estuary	Catch per 100 trap-days				
	2002	2003	2004	2005	Early 2006
Coquille				5	
Coos Bay	5	7	13	4	1
Yaquina	15	6	3	13	37
Netarts	0	**25**	**31**	**49**	**27**
Tillamook	3	9	8	11	4
Willapa		3	3	25	7
Grays Harbor				2	0
Total	8	6	6	17	13

Table 2. Green crab annual catch data for estuaries and inlets in the Pacific Northwest. "WDFW" indicates that catch data are in the process of being converted to # crabs/trap-day. "P" indicates that green crabs were present. Note that catches in Oregon were high in 1998, right after the 1997/98 El Nino. The colonists that had arrived during that event have now died of old-age (4-6 years). However, local recruitment in recent years (especially in 2003 and 2005) was high enough to keep the Oregon and Washington population of green crabs from going extinct. Asterisk indicates that fewer than 50 traps were deployed.

(Preliminary data for the west coast of Vancouver Island were kindly provided by Fisheries and Oceans Canada scientists. Their final report will become public in the fall of 2006, after they finish their survey of invasive species around Vancouver Island. We thank the following for providing catch data: Neil Richmond, John Schafer, Todd Miller, Chris Hunt, Ron Figlar-Barnes, Erik Hanson, Sean McDonald and, Hauck 2000 and Hunt and Behrens Yamada 2003).

Number of Green Crab per 100 trap-days									
Estuary/ Site	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**Early 2006**
Port Eliza, BC					P			P	
Esperanza Inlet BC				P				5	P
Nootka Snd BC			P						
Clayoqout Snd. BC			P						P
Barkley Snd. BC		P							P
Esquimalt BC		P							
GraysHbr, WA	WDFW	WDFW	WDFW	WDFW	WDFW			2	0*
Willapa, WA	WDFW	WDFW	WDFW	WDRW	WDFW	3	3	25	7
Tillamook, OR	128	P	P	2*	3	6	8	11	4
Netarts, OR	139			6*	0	25	31	49	27
Yaquina, OR	192	69	63	57	15	6	3	13	37
Alsea Bay, OR	P				P	P			
Winchester Bay OR	P								
Coos Bay, OR	65	38	P	58*	5	7	13	4	1
Coquille, OR	P							5*	

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 early 2006 (Appendix 3). We assigned crabs to age classes based on their size and coloration (Appendix 3, Table 2). For example, crabs between 40 and 70 mm with green or yellow carapaces would represent the 2005 year class. Larger crabs, most likely belonged to thee 2003 year class as recruitment was poor in 2002 and 2004..

Table 3. Estimated age structure of *Carcinus maenas* trapped and retrieved from Oregon and Washington estuaries in the spring of 2006. Total crabs include trapped crabs recorded in Table 1, plus crabs and molts found on the shore or in sports catches.

Estuary	Year Class				
	2006	2005	2004	2003	Total
Coos Bay		1		2	3
Yaquina		11		13	24
Netarts		15		2	17
Tillamook		1			1
Willapa		20			20
Grays Harbor					
Total		48		17	65

Conclusions

In the spring of 2006, green crabs were present in all four Oregon estuaries and Willapa Bay. Catches were high in Netarts, Yaquina and Willapa Bay, extremely poor in Coos Bay and absent in Grays Harbor. The most dominant cohort in Pacific Northwest estuaries is the 2005 year class. Given a longevity of 6 years, this strong cohort will provide a source of larvae until 2011.

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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***	***14-22***	
	4/4/06		20		14.5	no
Russell Point	***Range of values observed***		***22-33***	***11-20***	***10.5-28***	
	4/4/06		20	10.5	9.5	yes
Trans Pacific Causeway		***Range of values observed***	***22-32***	***11-18***	***10.5-16***	
	6/7/06		26	18.6	15	no
Charleston Boat Basin	6/7/06		30	17.7	19.3	no
Pony Point North Bend Airport	***Range of values observed***		***17-32***	***11-17***	***11.5-17***	
	4/4/06	Mudflat near rip rap, *Zostera marina*	20	10.8	11.0	**yes**
	6/10/06		24	15	14.2	**No**
YAQUINA BAY						
Johnson Slough	***Range of values observed***		***23-32***	***15-20***	***16-22***	
		Below bridge, dry mudflat around creek, *Salicornia* patches				
	4/25/06		10	13.4	13.2	**NO**
Sawyers		***Range of values observed***	***6-30***	***11-19***	***9-14***	

Landing						
Sally's Bend A	***Range of values observed***		***22-33***	***12-19***	***12-26***	
N 44^{o} 37.699'	4/28/06		20	14.9	13.3	NO
W124^{o} 01.482'	6/14/06			15.9		
Sally's Bend B	***Range of values observed***		***29-32***	***12-19***	***12-24***	
Sally's Bend C	***Range of values observed***		***19-32***	***10-19***	***9-22***	
N 44^{o} 37.419'	4/28/06	Eel grass from gate to Fishing platform	21	14.9	13.6	NO
W124^{o} 01.463'	6/14/06		26	15.9	16.5	no
	6/23/06		31	21	19.0	yes
Hatfield Marine Science Center Pump house		***Range of values observed***	***22-34***	***11-21.5***	***12-23***	
	6/14/06	Rip rap/ boulders/sandy mudflat/ *Zostera marina*	32	15.3	16.5	yes
Oregon Coast Aquarium	***Range of values observed***		***19-34***	***9-25***	***8-23***	
N 44^{o} 37.108'	4/28/06	Tidal channel draining mudflat, along nature trail	24-27	15	16.5	YES
W124^{o} 02.165'						
Idaho Point		***Range of values observed***	***19-35***	***12-27.5***	***12-23***	
N 44^{o} 36.818'	6/15/06		30	16.7	17.8	**yes**
W 124^{o} 01.582'						
Neohla Pt.	6/15/06	Tidal reek near Spencer care center on Idaho Pt. Road		16		**yes**
N 44^{o} 36.751'						
W 124^{o} 02.517						

TILLAMOOK BAY

Tillamook Spit A	***Range of values observed***		***0-30***	***13-19***	***13-27***	
	4/25/06	mudflat- eelgrass zone below rip rap and in *Scirpus*	11	12.7	17.4	yes
Tillamook Spit B						
Pitcher Point		South of Spit B – mudflat in Japanese eelgrass zone				
Hayes oyster flat		Mudflat in native eelgrass zone				
Bay City		Low level, on either side of causeway				

NETARTS BAY

Whiskey Creek Salmon hatchery	***Range of values observed***		***0-34***	***13-20***	***14.5-21***	
	4/25/06	On mudflat and in creek		13.7		yes
RV Park						
		Sand flat below riprap in native eelgrass zone				
Intersection of Whiskey Creek & Netarts Bay Roads	***Range of values observed***		***0-34***	***13.5-20***	***15s-23***	
	4/25/06	Pool below culvert draining Freshwater marsh	33	13.7	17.5	**yes**

WILLAPA BAY

Stackpole		***Range of Values observed***	***14-28***	***11-19***	***9-28***	

Leadbetter Pt. Sate Park						
	4/1/06	Shellbags onTide flats outside spartina field	23	11	10	**Yes**
	4/17/06	Shellbags	23	11	9	**Yes**
	4/28/06	Shellbags	23	13	11	**Yes**
	5/16/06	Shellbags	23	19	18	No
	5/31/06	Shellbags	26	20	16	No
	5/31/06	Pit traps in Spartina field	25	16	18	**Yes**
Nahcotta Lab		WDFW Office, Nahcotta, edge of Spartina and tideflat				
Taylor Resources		Bay Ave./Sandridge Rd, edge of Spartina field				
		Bay Ave./Sandridge Rd, Spartina field				
Boat Ramp by Refuge		Highway 101. Either side of boat ramp used by old cable ferry				
Pickerrell Creek		Highway 101. Near channel and on mudflat				
Palix River		Off Bay Center Dike Road				

GRAYS HARBOR

Grassy Island	6/28/06	marsh at end of Park Street across from Frank L Hotel				no
		Wildlife sanctuary, in front of Grassy Island				
Brady's Oysters	6/28/06	Mouth of Elk River				no

Appendix 2. Relative abundance of crab species and sculpins (Numbers/trap/day) in Oregon and Washington estuaries during 2003. An asterisk beside trap number indicates that other traps were either opened or were stolen.

Coquille Estuary **Mean CPUE (Catch/trap/day)**

Site	Date	Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpin	Number Traps

Coos Bay

Site		Trap Type	Zone	*Carcinus maenas*	*Hemigrapsus oregonensis*	*Hemigrapsus nudus*	*Cancer magister*	*Cancer magister* (Recruits)	*Cancer productus*	Sculpin	Number Traps
Russell Point	4/4/06	Fish	Pools by bridge				0.5			0.33	6
	4/5/06	Fish	*Zoster marina*				1.82			0.2	6
	5/16/06	Fish					5.67			0.5	6
	5/17/06	Fish					5.5			1.17	6
	5/18/06	Fish					11.33		0.17	0.67	6
	6/28/06	Fish					11.33		0.17	1	6
	6/29/06	Fish	*Pools*				7.1		0.1	0.1	10
	6/29/06	Fish					10			0.25	4
Pony Point/Airport	4/4/06	Fish	*Zostera marina*	**0.2**	0	0.3	0.3	0.2	0	0	10
	6/8/06	Fish					4.63			0.09	11
	4/4/06	Minnow		**0**	0	0	0.4	0	0	0	10
	6/8/06	minnow		**0**							10
Charleston Boat Basin	6/8/06	Fish	*Zostera marina*				0.6			0.3	10
Trans-Pacific	6/8/06	Fish	*Low*				4.9			2.6	10

	6/8/06	Minnow	*Scirpus*				0.7			2.3	10
Jordan Cove	04/04/06	minnow	*High*	**0**	0	0	0	0	0	1.1	10
	04/5/06	Minnow								0.4	10
	5/16/06	Minnow	*Scirpus*				0.1			0.5	10
	5/17/06	Minnow					0.6			0.6	10

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	4/28/06	Fish	Below Bridge				7.0	0.5		0.5	2
	4/28/06	Minnow	Marsh			1.67	0.33			0.67	3
Sawyers Landing		Fish	Low								
Sally's Bend A	04/28/06	Minnow	*Zostera japonica*		0.67					0.57	3
	6/15/06	Minnow			1.5					5.1	10
Sally's Bend B		Minnow									
Sally's Bend C Fishing Platform	04/28/06	Fish	*Zostera marina*				1.0		5.5		2
	6/15/06	Fish			0.8		5.4			9.8	5
		Fish									
	6/23/06	Fish		0.1	0.5		2.3			3.7	10
HMSC Pump house	**6/15/06**	Fish	*Zostera marina*	0.4	0.1		2.0		0.9	3.5	10
	6/16/06	Fish		0.4			0.6			1	5

Oregon Coast Aquarium	**4/28/06**	Fish	subtidal	0.5			3.5	3.5		0.5	2
	4/28/06	Minnow	*Scirpus*				2	0.66		1.33	3
Idaho Point	6/16/06	Fish	Low	**1.2**			1.0				5
Neohla Point	0/16.06	Fish	*Marsh and creek*	**1.0**						3.75	4

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
Bay City		Fish	*Low, both sides of causeway*								
Tillamook Spit A	4/26/06	Fish	*Zostera japonica*	**0.125**						0.125	8
	4/26/06	Minnow	*Scirpus*		0.125					0.25	8
Tillamook Spit B	4/25/06	Fish	*Zostera japonica*	**0**							1
	4/25/06	Minnow	*Scirpus*	**0**							6
Pitcher Point			*Zostera japonica*								
Hayes Oysters		Fish	*Low*								

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
Intersection	04/26/06	Fish	pools	**2.67**	1		3.33				3

Whiskey Creek Salmon Hatchery	04.26/06	Fish	*Fucus*/mudflat	0.67	1.0						3
	04/26/06	Minnow	*Fucus*/mudflat	**0.08**	0.33	0.33					12

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	5/31/06	Minnow	Spartina	0.12	0.88	0	0	0	0	0	17
Stackpole	5/31/06	Minnow	Spartina	0.1	0.4	0.1	0	0	0	0.3	10
Stackpole	6/1/06	Minnow	Spartina	0.06	1.0	0	0.06	0	0	0	17
Stackpole	6/1/06	Minnow	Spartina	0	0.7	0.1	0	0	0	0.7	10
Long Is.Refuge		Fish	Old ferry ramp								
Pickerrell Creek		Fish	Along creek bank								
Palix River		Minnow	*Spartina*								
Bay Center		Fish	end of School Rd, in *Spartina* patches								

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
Grassy Island Lila Street	6/28/06	Minnow	*Edge of native vegatation*	0							10
Brady's Oysters	6/28/06	Fish	*Low to mid*	0							10
	6/28/06	Minnow	*Mid to high*	0							10

Appendix 3. *Carcinus maenas* catches and sightings in Oregon and Washington Estuaries in 2006. Year Classes are estimates based on crab size, carapace coloration, hardness and presence of large barnacles. 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	4/4/06	M	83.4	Yellow green	2003	Good
			M	79.0	orange	2003	Good
	Jordan Cove						
	Boat Basin	6/5/06	?	23		Small 2005	Molt; crab is now 30 mm
YAQUINA	Johnson Creek						
	Sally's Bend A						
	Sally's Bend C	6/23/06	M	54.4	Yellow green	2005	No #1, 2, 5 6; cracked carapace
			M	49.6	Orange yellow	2005	Good
	HMSC Pump House beach	5/30/06	?	73.2		2003	Molt ; crab is now over 80 mm
		6/14/06	M	73.6	Orange	2003	good
			F	80.5	Orange	2003	No # 5; tips on propal tip worn
			M	91.0	Orange	2003	No # 6, 7, 8, 10
			M	87.9	Yellow	2003	Propal tip on #6 worn
		6/15/06	M	81.8	Yellow orange	2003	Small barnacles; no # 3; worn propal tip
			M	87.7	Yellow orange	2003	8 mm barnacles, no 1, 3, 7
	Hatfield Marine SC						
	Aquarium mud flat	4/29/06	M	54.9	Yellow green	2005	Good
		6/6/06	M	62	Yellow green	2005	Good
		6/14/06	M	62.8	Yellow	2005	good

	Idaho Point	6/16/06	M	89.5	Yellow	2003	Good
			M	92.0	Yellow	2003	Good
			M	86.8	Yellow orange	2003	No # 1; 10 regenerating
			M	76.9	Yellow green	2003	Good
			M	67.0	Yellow green	2005	Good
			F	60.6	Green	2005	Good
		6/23/06	M	89.4	Orange	2003	With barnacles/ good
	Neohla Point/ Spencer Point	06/15/06	M	63.7	Yellow green	2005	Good; # 6 regenerating
			M	64.1	Orange	2005	good
			M	83.55	Yellow orange	2003	Good
			M	58.05	Green	2005	Good
TILLAMOOK	Spit A	4/26/06	48.5	M	Yellow orange	2005	Missing # 4, 6, 7, 8, 9
NETARTS	Intersection of Netarts and Whiskey Creek Roads	4/25/06	M	63	Yellow green	2005	Missing # 2
			M	61	Yellow green	2005	Missing 1 and 6
			M	60.3	Yellow green	2005	Good
		4/26/06	M	41.0	Yellow green	2005	Good
			M	54.5	Yellow green	2005	Good
			M	44,6	Yellow green	2005	Good
			M	63.5	Yellow green	2005	Good
			M	82.2	Red orange	2005	Good
		5/25/06	M	55	Yellow orange	2005	Missing # 1, 2, 3, 6
			M	49.9	Yellow	2005	Missing # 1
		5/26/06	M	72.4	Yellow	2003	# 6 regenerating
			M	61.2	Yellow	2003	Good
			M	57.6	Yellow green	2005	good
	Whiskey Creek Salmon hatchery	4/25/06	M	56.2	Yellow green	2005	Good

			F	45.3	Yellow orange	2005	Missing #1 (right claw)
		4/26/06	M	56.8	Yellow green	2005	Good
		5/25/06	M	58.0	Yellow green	2005	Good
		5/29/06	F	36	Yellow green	2005	Good
WILLAPA	Stackpole	4/1/06	M	49.0	orange	2005	Good
	Stackpole	4/1/06	F	48.0	Orange	2005	w/eggs, Shellbags
	Stackpole	4/1/06	M	50.8	Orange	2005	Missing 2, shellbags
	Stackpole	4/1/06	M	47.4	Yellow/orange	2005	Missing 3 and 6, shellbags
	Stackpole	4/1/06	M	45.1	Orange	2005	Good, shellbags
	Stackpole	4/1/06	M	45.0	Orange	2005	Missning 8, shellbags
	Stackpole	4/1/06	M	44.7	orange	2005	Missing 8, shellbags
	Stackpole	4/17/06	M	45.5	orange	2005	Missing 1, shellbags
	Stackpole	4/28/06	M	48.2	Yellow/orange	2005	Good, shellbags
	Stackpole	5/31/06	M	57.0	Green/yellow	2005	Good, Pit trap
	Stackpole	5/31/06	M	43.2	Green/yellow	2005	Good, Pit trap
	Stackpole	5/31/06	M	57.8	Yellow	2005	Good, Crayfish trap
	Stackpole	6/1/06	M	50.4	Green/yellow	2005	Good, pit trap
	Stony Pt	April	M	52.0	Orange	2005	Missing 1, brought in by Ekone
	Stony Pt	April	F	53.0	Orange	2005	w/eggs, brought in by Ekone
	Stony Pt	April	M	44.0	Orange	2005	Missing 1 and 6, Ekone
	Stony Pt	April	M	44.0	Orange	2005	Missing 8, brought in by Ekone
	Stony Pt	April	M	47.0	orange	2005	Missing 3, brought in by Ekone
	Parcel A, WDFW	5/15/06	M	63.0	Yellow	2005	WDFW moving shellbags
	Parcel A, WDFW	5/16/06	M	49.0	Orange	2005	WDFW moving Shellbags
Grays Harb	Grassy Is./Lila St.						
	Brady's Oysters						

Summary
of
Green Crab Pheromone Study:

Feasibility of using sex pheromones in controlling the European Green Crab.

July 3, 2006

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We tested the effectiveness of green crab female sex pheromone in attracting male green crabs in a field setting. Traps were deployed using synthetic female sex pheromone (10^{-4} or 10^{-3}M) in a slow-release gel matrix, fish bait (control) or no attractant (control). For a detailed description of methods, see student report. We found the following:

1. Male crabs were only receptive to female pheromone when water temperatures were above 15^{o}C.
2. Traps baited with fish attracted more male green crabs than traps baited with female pheromone.
3. There was no difference in the number of green crabs entering empty and pheromone traps. This suggests that green crabs are attracted to the shelter feature of the traps.

In July 2006 we will do the following tests:

1. Combine a slow-release with a fast-release gel to increase the pheromone concentration in the traps, and thus increase the chances of attracting males.
2. Do pilot tests on the effectiveness of male sex pheromone in attracting receptive female green crabs. Ralf Bublitz isolated male green crab sex pheromone from the urine of male crabs. We will deploy male pheromone gels inside circular traps that are

Date	Estuary/ Site	Water Temp ^{o}C	Trap type	Fish Bait control	Pheromone (10^{-4} M)	Comments
9/18-20/05	Tillamook/ spit	15.5	Minnow	4/12	0/12	Bait works better
9/18-20/05	Netarts/ Salmon hatchery	13-18	minnow	18/16	3/16 M 42.9 mm M 43.4 mm M 53.8 mm	Bait works better
9/18-20/05	Netarts/ Intersection	14	Fish	0/6	0/6	

Date	Estuary/ Site	Water Temp ^{o}C	Trap type	Empty Control	Pheromone (10^{-3} M)	Comments
9/22/05	Yaquina/ Johnson Slough	Tide was out – Not taken	minnow	None	0/4	
9/22/05	Yaquina/ Sally's Bend	19.5	minnow	None	2/6 M 43.4 mm F 37.2 mm in separate traps	Was female attracted to pheromone or shelter?
9/22/05	Yaquina/ OCA	16.8	minnow	None	0/10	

Date	Estuary/ Site	Water Temp ^{o}C	Trap type	Empty Control	Pheromone (10^{-3} M)	Comments
5/20/06	Yaquina/ OCA	12.0	Minnow	0/18	0/18	
5/22/06	Yaquina/ Idaho Pt.	12.0(check)	Minnow	0/12	0/12	
5/25-26/-6	Netarts/ Salmon Hatchery	16.3	Assorted	1/18	1/22	Were crabs attracted to shelter?
5/25-26/06	Netarts/ Intersection	16.0(check)	Fish	3/4	2/4	Attracted to shelter?
6/14-15/06	Yaquina/ OCA	15.4-16.5	Fish	1/3	0/3	Attracted to shelter?
6/23/06	Yaquina/ OCA	20.6	Minnow	0/4	0/4	
6/23/06	Yaquina/ Idaho Pt.	20.5	Fish	0/3	1/3	89.4 mm male

accessible from all directions (360^{o} traps). Traps will be set in know green crabs "hot spots" and the hypothesis that male pheromone attracts more female than male green crabs will be tested.

Table 1. Number *of Carcinus maenas* caught per # of traps. Traps were deployed using female sex pheromone (10^{-4} or 10^{-3}M) in a slow-release gel matrix, fish bait (control) or no attractant (control).