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Marine Adaptations  
Exploratory 3  
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*Lophopanopeus bellus*' (Black Clawed Crab) Aggressive Behavior

**Introduction**

Renown for its dark colored chelipeds, *Lophopanopeus bellus* is also known as the black-clawed crab or the black-clawed mud crab. It is commonly found under rocks of the low intertidal zone, in tidepools or among kelp holdfasts. Commonly confused with the red rock crab, it can be distinguished by its 3 lateral spines on the corners of the carapace near the eyes. The carapace can vary in color from a creamy white to a reddish-brown and averaging 3.81 cm wide. This species is omnivorous and feeds on plant material, mussels, barnacles and other crustaceans (beachwatchers). There have also been records of cannibalism to occur (Knudsen, Jens W. 1960). This particular crustacean ranges from the Aleutian Islands, Alaska to San Luis Obispo, California (wallawalla).

Being a member of the Xanthidae family, the black-clawed crab is equipped with excessively large crushing claws and are well known for their insatiable hunger for small invertebrates (Geyer, K., Layman, C., Silliman, B. and J.C. Zieman. 2004). Xanthidae crabs are very alert, quick to detect movement and act swiftly (Knudsen, Jens W. 1960). In attempts to act menacing, the *L. bellus* raises its claws and holds them outward, trying to look large and fierce (beachwatchers). Not only do they look ferocious, they have power to back it up. *L. bellus*' chelipeds are designated as dimorphic, which means that they are designed for both fast and strong movements. Their claws are stout with blunt molar teeth, and sharp tips that overlap in a shearing bill-like fashion. These features help

to specialize the black-clawed crabs as a hard-shell predator (Boulding, Elizabeth G. and Sylvia B. Yamada. 1998).

Living in the rocky intertidal area, *L. bellus* is exposed to a wide variety of crustaceans. Since they are known to have this aggressive behavior, is there a pattern of behavior exhibited when in the presence of different crab species? I hypothesize that the black-clawed crab would display more aggressive behaviors towards smaller rock crab species compared to the larger *Cancer antennarius*, because it is a known predator of the black-clawed crab.

### **Methods**

To test this hypothesis I collected 4 common crab species (excluding the black-clawed crab) from the intertidal area: *Pachycheles rudis* (thick-clawed porcelain crab), *Pugettia producta* (shield-backed kelp crab), *Pachygrapsus crassipes* (striped shore crab) and *Cancer antennarius* (spot bellied rock crab). I designed a series of tests to expose the *L. bellus* to different species and observe its changes in behaviors in response to each. Each test trial was conducted in a watch glass and allowed to run for 10 minutes. For each particular combination of species, the test was run and recorded twice to have more accurate results. A stopwatch was used to keep track of time of behaviors and length of those behaviors exhibited.

The data collected was configured into an ethogram. An ethogram is “a catalog or table of all the different kinds of behavior or activity observed in an animal (Webster’s dictionary).” 6 different behaviors were defined and recorded during the tests.

1) Sitting: No motion is observed, the chelipeds are tucked in close to the body 2)

Walking: Back 4 sets of legs are in motion; walking. Chelipeds are still tucked in close to

the body. 3) Sitting with Aggressive posture: same description as sitting but with chelipeds raised up and out from the body with claws open 4) Walking with Aggressive posture: same as walking behavior but with chelipeds raised up and out from the body with claws open 5) Sitting with Defensive posture: same as sitting behavior but with chelipeds stretched out in front of body, claws closed and tips touching. Chelipeds form a circle in front of them. 6) Walking with Defensive posture: same as walking behavior but with chelipeds stretched out in front of body, claws closed and tips touching. Chelipeds form a circle in front of them.

Fig 1 shows a black-clawed crab exhibiting sitting behavior. Fig 2 shows the defensive behavior and Fig 3 shows the aggressive behavior.

Fig 1



Fig 2

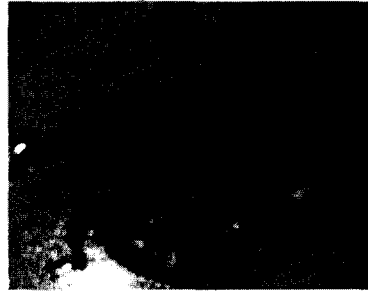


Fig 3



To establish a basic understanding of common black-clawed crab behavior, a designated black-clawed crab's actions (further noted as crab A) were recorded in a set of trial runs in the presence of individuals from its own species. Crab A was exposed to 0, 1, 2 and 5 other crabs (in separate trials) in the same bowl. Due to a small sample size of other species, crab A was exposed only to 1 individual from a different species at a time.

Again, each test was run twice for more accurate data. Tests involving other species were then compared to the 1:1 test with two black-clawed crabs.

On each page of ethograms, there are four lines each indicating a separate test. On top left hand corner of each test there are initials of species involved (BCC = Black clawed crab, CA= *Cancer Antennarius*, SSC = Striped shore crab, SBK= Shield back kelp crab, and TCP = Thick clawed porcelain crab) and the ratio of crabs present. An example would be BCC/ TCP 1:1, meaning this test includes 1 black-clawed crab and 1 thick-clawed porcelain crab. An A or B is also located at the top left hand corner indicating test 1, A and test 2, B. Each color is coordinated to a different behavior. Red = Walking, Blue = Sitting, Purple = Walking aggression, Pink = Sitting aggression, Green = Walking defense and Orange = Sitting defense. Above each patch of color is a letting indicating the behavior. Below the patches of color, a number is labeled and indicates the duration of that particular behavior. A colored patch that is outlined in black indicates that in this period an attack occurred.

### Results

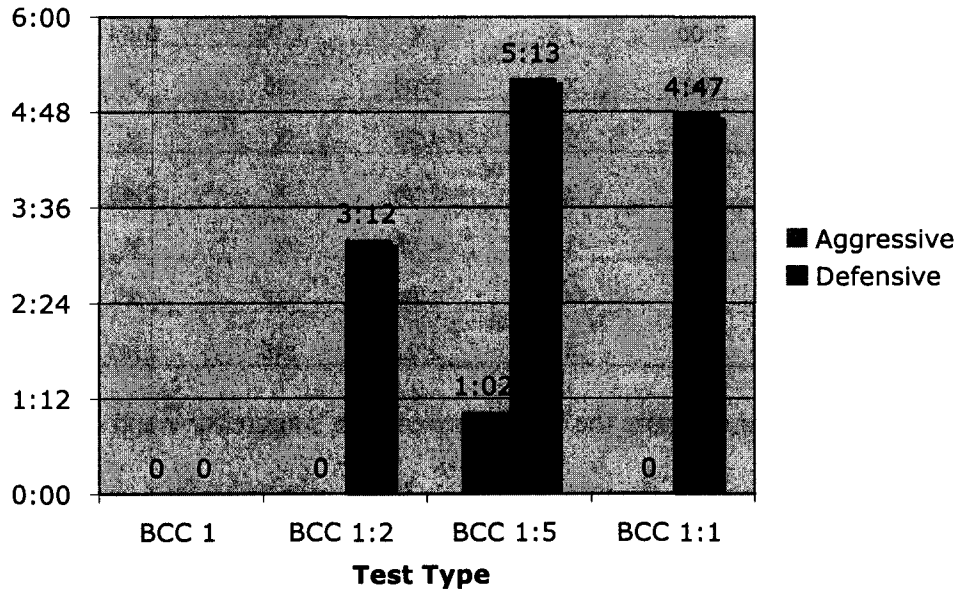
Pages (i-iv) attached show the recorded result from all tests. The times for all 6 behaviors for each test were added up and recorded on Table 1(below). The behaviors as initialed on the 1 row and the test is labeled on the 1 column. All times are recorded in minutes. The last column indicated how many attacks occurred in that particular test trial.

<b>BEHAVIOR</b>	<b>W</b>	<b>S</b>	<b>WA</b>	<b>SA</b>	<b>WD</b>	<b>SD</b>	<b># OF ATTACKS</b>
<b>TEST</b>	-----	-----	-----	-----	-----	-----	-----
BCC 1A	5:37	4:23	X	X	X	X	X
BCC 1B	5:18	3:42	X	X	:30	:30	X
BCC 1:2 A	1:55	6:40	X	X	1:25	X	X
BCC 1:2 B	:46	4:14	X	X	2:39	2:21	X
BCC 1:5 A	:09	X	2:04	X	7:27	:20	X

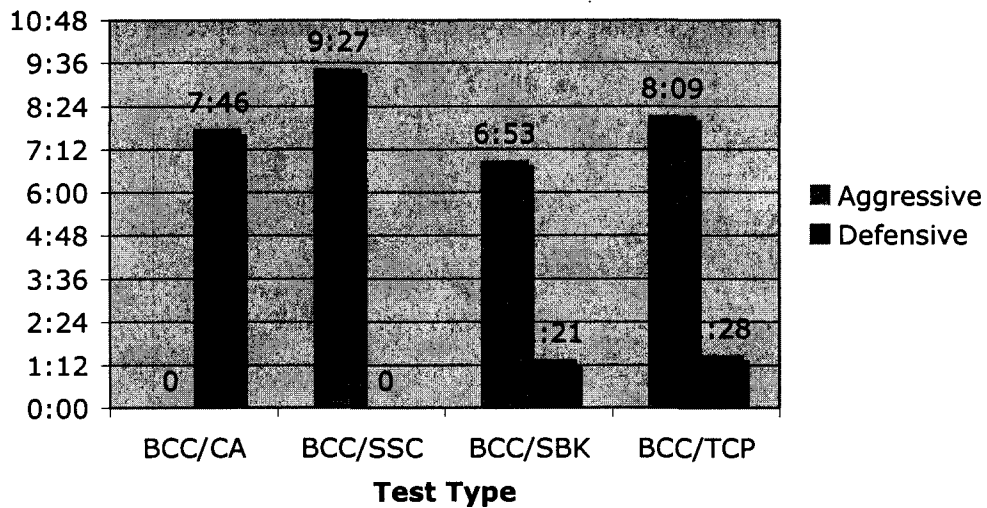
BCC 1:5 B	:55	1:25	3:38	1:19	1:23	1:16	4
BCC 1:1 A	:41	3:26	X	X	4:28	1:25	X
BCC 1:1 B	3:56	1:24	X	X	4:40	X	X
BCC/CA 1:1 A	X	1:05	:24	:59	:20	7:12	X
BCC/CA 1:1 B	X	2:00	X	X	1:06	6:54	X
BCC/SSC 1:1 A	:08	:08	7:04	2:04	:36	X	7
BCC/SSC 1:1 B	X	:13	5:12	4:35	X	X	4
BCC/SBK 1:1 A	:17	:57	3:39	2:24	X	2:43	3
BCC/SBK 1:1 B	:24	1:52	3:39	4:05	X	X	X
BCC/TCP 1:1 A	X	X	7:29	2:04	:27	X	2
BCC/TCP 1:1 B	:19	:24	4:24	2:22	:46	1:43	3

To make it easier to compare the black-clawed crab's aggressive and defensive behavior with other crab species, the two behavior's times were presented in a graph. For each test, the times for aggressive behavior for both trial A and B were added together and averaged; the same was done for defensive behaviors. The first graph (graph 1) shows the levels of aggressive and defensive behaviors exhibited when crab A was exposed to differing number of crabs of its own species. Graph 2 shows the totaled time of the two behaviors when the sampled crab A is exposed to other species of crabs.

**Black Clawed Crab  
(Intra-Species Behavioral Response)  
Graph 1**



**Black Clawed Crab  
(Inter-Species Behavioral Response)  
Graph 2**



Graph 1 shows that a black-clawed crab exposed only to its self for a 10:00 minute period, on average shows no aggressive or defensive behavior. When exposed to two other crabs of its own species, its defensive behavior increased to ~3:12 (min). When exposed to 5 other individuals its defensive behavior increased even further to ~5:13 (min), and its aggressive for ~1:02. When exposed to one-on-one situation, *L. bellus* showed no signs of aggression, yet still had a high level of defensive behavior ~4:47 (min).

When exposed to a single *C. antennarius*, the black clawed crab showed a high level of defensive behavior ~ 7:46 (min) with no signs of aggression. When exposed to the remaining species: striped shore crab, shield backed kelp crab and thick-clawed porcelain crab, the black-clawed crab showed a very high level of aggressive behavior, 9:27 (min), 6:53 (min) and 8:09 (min) respectively. There was no sign of defensive behavior when exposed to the striped shore crab, ~1:21(min) when exposed to the shield-back kelp crab and ~1:28 (min) when in the company of the thick-clawed porcelain crab.

### **Discussion**

The data gathered supports my hypothesis that *L. bellus* will show more aggression towards smaller rock crab species compared to *C. antennarius*, because it is a known predator. There was a significant difference in amount of aggressive behavior present, or lack thereof when comparing *C. antennarius* with all other species used. The trial involving *C. antennarius* was the only test involving another species that showed no aggressive behavior. All other test trials showed *L. bellus* exhibiting a higher level of aggressive behavior towards the other species. All results are as would be expected as per

my hypothesis. In nature the black-clawed crab has been known to prey up on all the species listed above, except for *C. antennarius*. Naturally, a crab would show more signs of aggression towards species it considers prey, in order to achieve a successful hunt. When being approached by a known predator it would be beneficial to maintain a defensive posture to protect oneself. (find a source to support this?)

There are a few sources of error that could have skewed the results. One source of error could be keeping all crabs fed. Feeding the crabs, may have made them more well-mannered. Hunger is one of the factors that drives the aggressive behavior. Another factor that could have affected the results could be the temperature of the water. Being in such a small container, the water temperature could increase and which could affect their behavior.

If this test were to be conducted again, changes should be made. Firstly, the same number of crabs of each species should be collected to see what, if any, changes occur in behaviors when confronted by multiple individuals from different species. Secondly, 2-3 known predators of *Lophopanopeus bellus* should be collected, not just one. The same number of known prey of *L. bellus* should be collected also. Having multiple samples of predators and prey allows a more conclusive result of behavioral reactions. Thirdly, starving the crabs could show more immediate results.



## Work Cited

Boulding, Elizabeth G. and Sylvia B. Yamada. 1998. Claw Morphology, Prey Size Selection and Foraging Efficiency in Generalist and Specialist Shell-Breaking Crabs. *Journal of Experimental Marine Biology and Ecology*. Vol. 220, Issue. 2, pp. 191-211.

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Knudsen, Jens W. 1960. Aspects of the Ecology of the California Pebble Crabs (Crustacea; Xanthidae) *Ecological Society of America*. Vol. 30, No. 2 pp. 165-185.

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