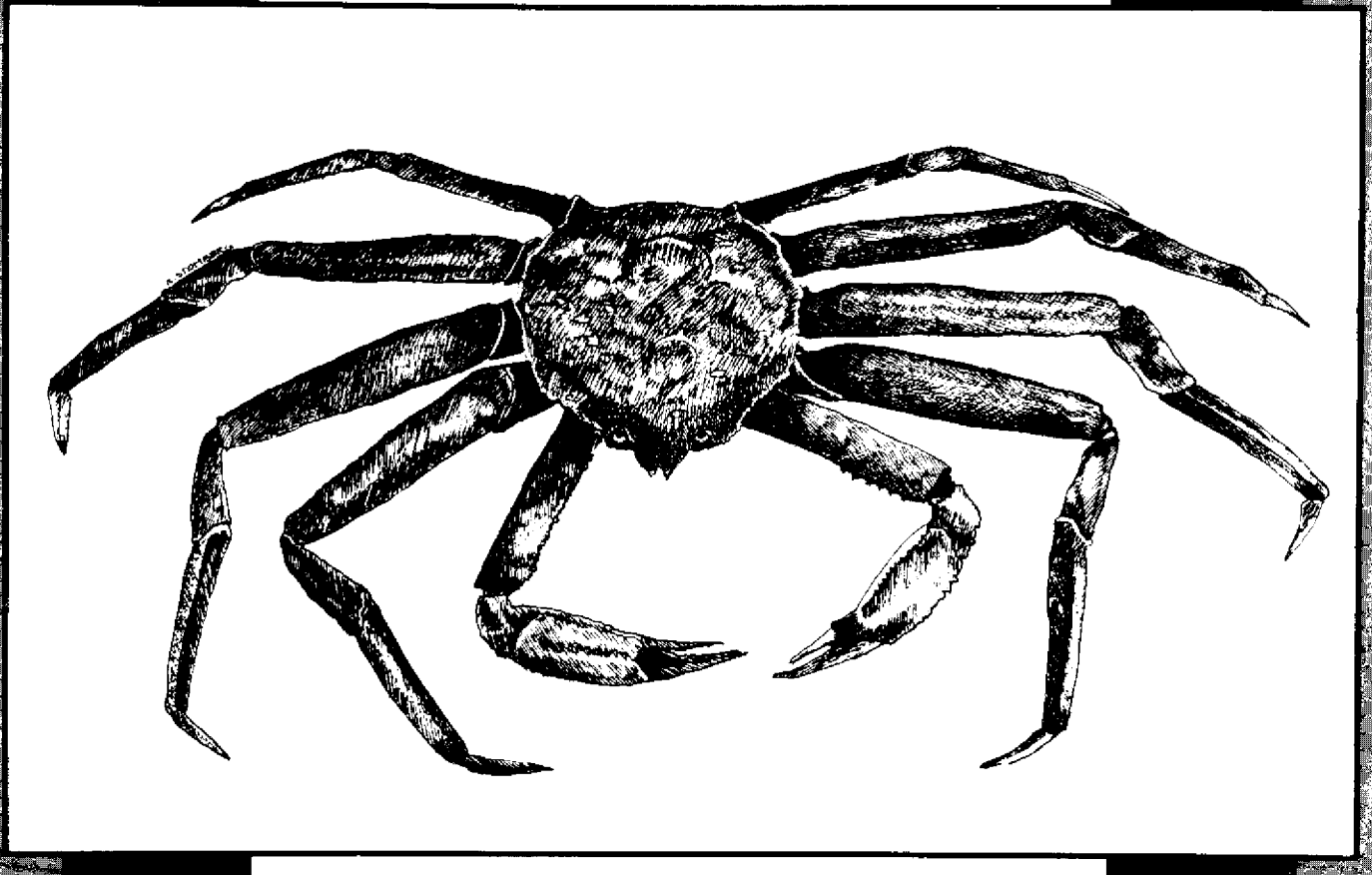
Encrusting Barnacles as Ageable Tags on Gulf of Alaska *Chionoecetes Bairdi* (DECAPODA)



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ENCRUSTING BARNACLES AS AGEABLE TAGS ON GULF OF ALASKA *CHIONOECETES BAIRDI* (DECAPODA)

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Encrusting Balanus hesperius laevidomus Pilsbry and Balanus crenatus Bruguiere on carapaces of Gulf of Alaska Chionoecetes bairdi Rathbun were examined to determine if barnacle age could be used to provide a qualitative estimate of tanner crab intermolt periods. Depending on the geographical site of collection, between 22 and 51 percent of harvested male crabs had barnacles on their carapaces. The age and basal diameter of the largest barnacles on each crab were determined. Barnacles that had survived one, two, and three growing seasons were found on 32, 5, and 1 percent, respectively, of the crabs examined. Barnacles that had survived four or more growing seasons were rarely encountered on crabs.

Previous work indicated an intermolt period of approximately 18 months for C. bairdi of harvestable size. The prevalence of newly settled barnacles, and individuals that had settled the previous year, on harvested C. bairdi suggests that most crabs molted within the expected period. Only 1 percent of 2,706 male crabs carried barnacles that had survived three years. The results of this study suggest that for some Gulf of Alaska areas, barnacle age can aid in estimating tanner crab intermolt periods.

INTRODUCTION

One problem in managing tanner crab fisheries is the inability to predict the rate of molting frequency of sublegal and legal size crabs. Because of the molting process, the body of these crabs does not contain structures that are easily aged. The major technique for monitoring growth is observing the external appearance of the carapace. For Chionoecetes bairdi, a system of grading the carapace as new shell, old shell and very old shell is commonly used. However, there is considerable subjectivity involved in carapace grading, and different observers often give conflicting status to a single crab. Thus, any technique that eliminates some of the subjectivity from carapace aging would improve the accuracy of recruitment predictions.

In the northeastern Gulf of Alaska and its embayments, only two species of barnacles, Balanus hesperius and B. crenatus, are commonly found attached to tanner crab carapaces. These two species are easily identified (Cornwall 1975). Sexually mature male tanner crabs, which are either at harvestable size or are recruits to the fishery with their next molt, have a peak molting period in the spring (Colgate 1982). In both barnacle species, larvae are released from early spring through fall (Pyefinch 1948, Barnes and Bagenal 1951, Feder Keiser and Mueller 1979). Thus, for more than half of the year, barnacle larvae are available to settle on newly

molted crabs. It is suggested that aging barnacles on crabs will provide a qualitative estimate of the intermolt period. The technique is well-suited to tanner crab because mature females all reach a terminal molt (Paul 1984), so prevalence and age structure of barnacles on their carapace provides a natural contrast to males, which can potentially molt.

Because of the protracted spawning season, young of the year barnacles have a first growing season that can range from three to ten months. Individuals surviving two, three and four growing seasons would have ages of 15 to 22 months, 27 to 34 months, and 39 to 46 months, respectively. Thus, in this report barnacles are not categorized by age in years. Rather, the number of growing seasons they had survived is noted. Due to the prolonged settlement season the size frequency method of aging these barnacles is unsuitable (Barnes and Bagenal 1951). In the case of these two barnacles, counting annuli is likely to be a more accurate method of aging. Prior to this study, age estimates did not exist for B. hesperius, and age information was available only for Atlantic B. crenatus.

The objective of this study was to examine the age and prevalence of occurrence of these encrusting barnacles on tanner crabs and thus describe their potential as natural ageable tags. This information would be useful in determining the recent molting history of crabs on which these barnacles settled.

MATERIALS AND METHODS

Winter growth rings, called annuli, are formed on the outer surface of several species of Balanus at high latitudes (Kuznetsov and Matveeva 1949, Barnes and Bagenal 1951, Petersen 1966, Rucker 1983). An annulus is a notch or overhang of shell material formed by retreat of the mantle tissue in winter, when conditions no longer favor shell growth. Juveniles in their first season of growth have no winter growth rings, while the second and third year classes possess one and two annuli, respectively (Rucker 1983). In Alaska, intertidal B. balanoides (L.) forms a single annulus for each growing season (Rucker 1983) and we assume this is the case for other Alaskan species. In the study area, marked growth of filter feeders is likely to be restricted to the spring and summer months since this is the period when quantities of phytoplankton and fecal pellets are transported to the bottom (Goering, Shiels and Patton 1973, Chester and Larrance 1981).

In the laboratory, the following measurements were taken on barnacles collected from crabs: maximum basal diameter (carino-rostral length) and maximum shell height; and number of annuli. Annular counts were made under a dissection microscope and barnacle age equated to the annuli count.

Barnacle age was related to crab size to describe the intermolt period of host crabs.

One difficulty with the annuli counting approach is that first year barnacles do not form an annulus (Rucker 1983). To validate our estimates of the size of first year barnacles, specimens known to be first year barnacles were taken from mature female red king crabs, Paralithodes camtschatica. These king crabs were collected in Kachemak Bay, Cook Inlet, during late winter. Mature female king crabs molt annually in spring just prior to breeding and production of new egg clutches (Marukawa 1933). The king crab's eggs are carried until the next spring when hatching occurs, followed by molting, mating and egg extrusion. All female king crabs from which barnacles were taken carried eggs nearly ready to hatch, and thus, had not undergone their annual molt. Therefore, all barnacles attached to these crabs had a maximum age of one growing season. Male tanner crab also have a peak molting period in the spring, but an annual molt is not a prerequisite of their reproductive cycle.

Barnacles were collected from December through March from male tanner crabs delivered by commercial fishermen to processing plants in Seldovia, Kodiak and Sand Point, Alaska (see Figure 1 for collection sites). The male tanner crabs sampled ranged in carapace width from 120 to 180 mm.

One collection of terminal molt egg-bearing C. bairdi was made by trawl during June, 1983, in Kamishak Bay, Cook Inlet. The life span of a multiparous tanner crab, which would affect the age of their encrusting barnacles, is unknown, but they have survived in captivity for four years (Paul 1984) and presumably live longer. Since several year classes would be included in any collection of mature females, the age structure of their encrusting barnacles will be biased by year class strength.

RESULTS

The percentage of commercially harvested tanner crabs that had encrusting barnacles of either or both species on their carapaces averaged 39, 51, and 22 percent in Cook Inlet, Kodiak and Sand Point study areas, respectively. Both Balanus hesperius and B. crenatus were found encrusting crabs in all three main study areas. Balanus hesperius occurred on 29 percent of all male tanner crabs examined. In comparison, 9 percent of male crabs had B. crenatus attached to their carapaces (Figures 2 and 3). Approximately 5 percent of all tanner crabs examined had both barnacle species attached to their carapaces.

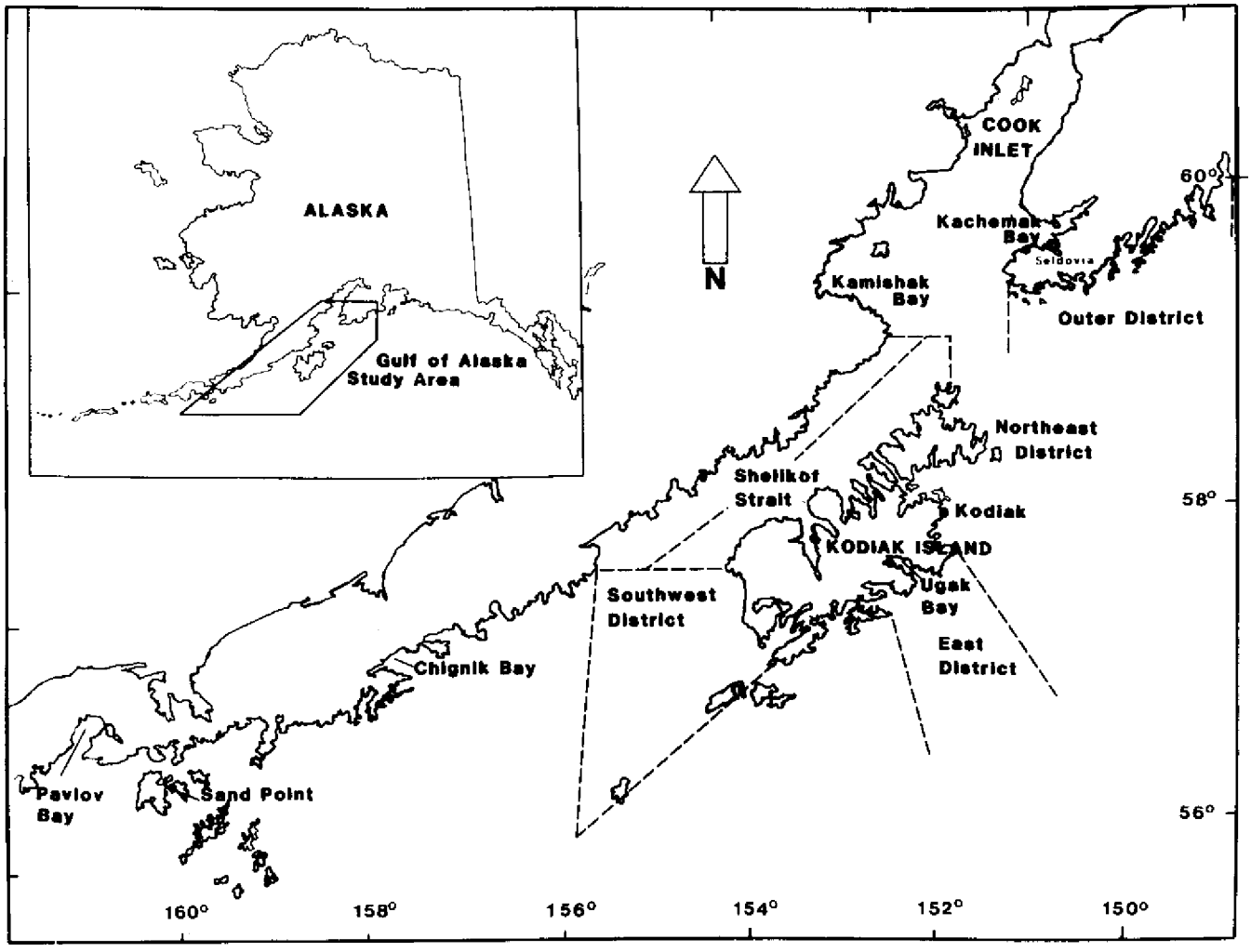

Figure 1. Location of study areas, southcentral Alaska.

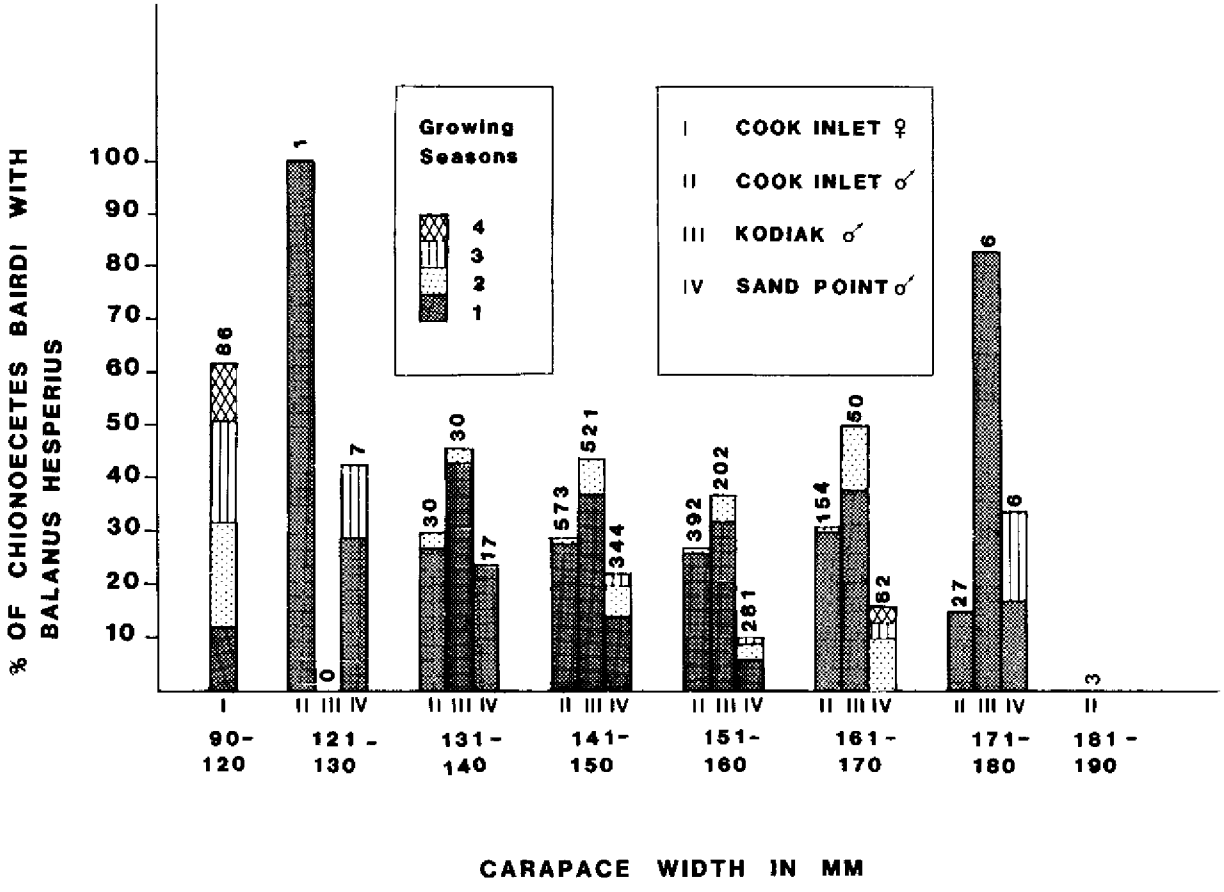

Figure 2. Percent of Cook Inlet, Kodiak and Sand Point Chionoecetes bairdi carrying Balanus hesperius vs carapace width. The number of crab are noted over each histogram bar. The number of growing seasons barnacles had survived are denoted by stipling type.

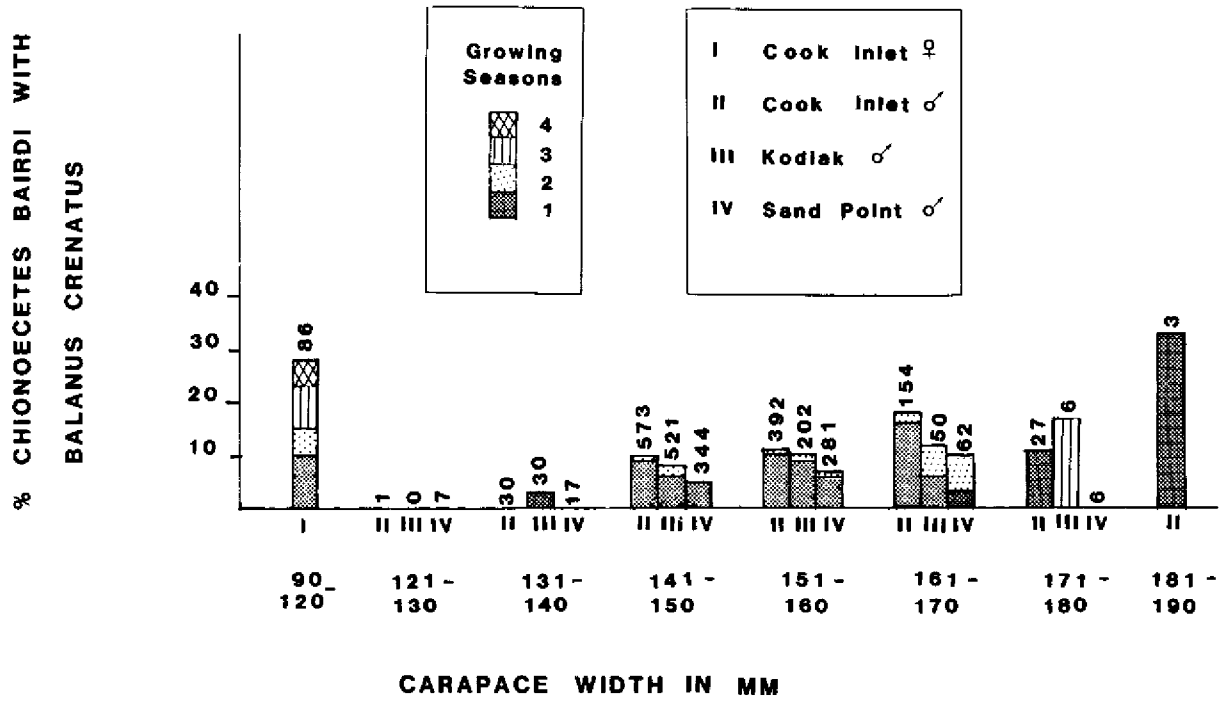

Figure 3. Percent of Cook Inlet, Kodiak and Sand Point Chionoecetes bairdi carrying Balanus crenatus vs carapace width. The number of crab are noted over each histogram bar. The number of growing seasons barnacles had survived are denoted by stipling type.

Specimens of B. hesperius, (n = 37), that had survived a single growing season on the carapace of female red king crabs, ranged from 3.9 to 10.7 mm in basal diameter and from 1.6 to 6.5 mm in height. Balanus crenatus, (n = 80), ranged from 2.7 to 13.7 mm in basal diameter and from 0.9 to 7.1 mm in height.

By geographic area, size versus annular count for B. hesperius on male tanner crabs is presented in Table 1, and for B. crenatus in Table 2. In general, size at age for the two species was similar with little marked variation due to geographic location. Typically, specimens from the settling year class had a basal diameter of 5 mm, increasing to 10 and 13 mm after the next one and two growing seasons, respectively (Tables 1 and 2). First year barnacles on tanner crabs were similar in size to those on female red king crabs. Generally, barnacles with three or more winter growth marks were rare (Figures 2 and 3; Tables 1, 2 and 3). The oldest B. hesperius and B. crenatus attached to male and female Gulf of Alaska tanner crabs had both survived four growing seasons.

Thirty-nine percent of the Cook Inlet male crabs collected carried barnacles that had survived one or two growing seasons. In lower Cook Inlet, none of the 1,180 males examined carried barnacles three or more growing seasons old (Figures 2 and 3). Eighty-seven percent of the terminal molt female crabs from Cook Inlet were carrying barnacles (Figures 2 and 3). Of those females, 42 percent had barnacles that had survived three or four growing seasons (Figures 2 and 3).

In the Kodiak region, 43, 8, and 0.1 percent of the 809 male crabs carried barnacles that had survived one, two and three growing seasons, respectively. Corresponding values in the Sand Point area were 14, 6, and 2 percent of 717 crabs, respectively.

There was no clear relationship between male crab size and the percent of crabs that were encrusted with barnacles (Figures 2 and 3). Likewise, trends relating barnacle age to crab carapace width, over the size range of crab investigated, were not evident (Figures 2 and 3).

The barnacle age data for specific management areas is found in the Appendix, Tables 1 to 8.

DISCUSSION

No previous estimates for growth of B. hesperius exist, however, Barnes and Bagenal (1951) estimated that the carino-rostral length of epizoic B. crenatus that had survived one growing season on Norway lobster to be about 4 to 5 mm. This estimate of growth is similar to that

TABLE 1. Size and relative age of Balanus hesperius on 1,180 male Chionoecetes bairdi from Cook Inlet, 809 from Kodiak and 717 from Sand Point

Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	No. Aged Barnacles
Cook Inlet	1	4.84 1.55 2.1-11.3	1.74 0.84 0.5-6.6	545
	2	10.64 1.72 8.1-14.0	5.16 1.76 3.3-9.2	10
Kodiak	1	4.40 2.05 0.8-11.6	1.44 0.87 0.2-6.8	1117
	2	11.00 1.89 6.6-15.3	4.79 1.25 2.4-7.5	92
	3	17.3	8.1	1
Sand Point	1	4.99 1.39 1.6-9.2	1.81 0.73 0.5-5.1	300
	2	9.23 1.52 6.3-13.9	4.04 1.19 2.0-7.8	130
	3	11.40 1.64 9.2-15.5	5.95 1.33 2.4-7.6	17

[1] Barnacle basal diameter and height values = mean/standard deviation/and range.

[2] No. GS = number of growing seasons.

TABLE 2. Size and relative age of Balanus crenatus on 1,180 Male Chionoecetes bairdi from Cook Inlet, 809 from Kodiak and 717 from Sand Point

Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	No. Aged Barnacles
Cook Inlet	1	5.84 1.89 2.2-11.5	2.12 0.98 0.6-5.7	545
	2	9.05 2.31 5.8-14.8	3.78 1.76 1.4-6.7	13
Kodiak	1	5.27 1.56 2.0-10.7	1.79 0.79 0.5-3.9	117
	2	11.11 1.79 6.6-14.2	4.71 1.23 1.8-6.6	33
	3	12.8	6.4	1
Sand Point	1	5.40 1.16 1.8-7.7	1.92 0.55 0.8-3.4	145
	2	7.97 1.47 5.4-11.6	3.18 1.05 1.7-7.1	75
	3	12.37 2.54 9.7-16.6	6.65 0.87 5.3-7.4	6
	4	14.7	8.7	1

[1] Barnacle basal diameter and height values = mean/standard deviation/and range.

[2] No. GS = number of growing seasons.

TABLE 3. Size and relative age of Balanus hesperius and B. crenatus on 86 mature female Chionoecetes bairdi from Cook Inlet, Alaska, collected in June 1983

Barnacle Species	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	No. Aged Barnacles
Balanus hesperius	1	7.82 2.96 0.4-13.2	4.19 1.98 0.2-8.8	80
	2	12.31 1.97 8.2-17.1	6.79 1.43 4.1-11.7	80
	3	14.80 1.55 10.9-17.9	8.85 1.37 6.7-11.8	45
	4	16.33 1.55 13.4-18.7	10.45 2.14 8.2-14.7	12
Balanus crenatus	1	6.38 2.58 1.4-12.1	3.00 1.81 0.4-9.2	94
	2	13.18 1.77 9.8-15.3	7.49 1.53 4.5-9.1	18
	3	15.97 2.09 13.2-20.8	8.96 2.88 5.2-13.7	15
	4	17.78 1.00 16.3-18.9	11.36 2.25 9.1-15.1	5

[1] Diameter and Height values = mean/standard deviation/and range.

[2] No. GS = number of growing seasons.

observed in the northeast Gulf of Alaska (Table 2). Balanus balanoides (L.) from Port Valdez, whose larvae settle from April through June, is the only other Gulf of Alaska barnacle for which age-size data exists. These B. balanoides have carino-rostral diameters of approximately 6, 9, and 11 mm for year classes one, two, and three, respectively (Rucker 1983), similar to those of the two study species. No other reports on using epizoic species to estimate crab or other crustaceans' intermolt periods were discovered during the literature search.

The only known previous estimate of the intermolt period for Gulf of Alaska male C. bairdi is 18 months (Donaldson, Hilsinger and Cooney 1980). With an 18 month intermolt period, crabs carrying barnacles surviving two growing seasons should be nearing a molt. Those crabs carrying barnacles surviving three growing seasons would have had minimum intermolt periods of approximately 27 months. Only 0.6 percent of the males examined carried barnacles that had survived three or more growing seasons suggesting that most of them had molted within a period similar to that expected.

The percentage of crabs having barnacles attached to their carapace varied with geographic location. Thus, the utility of barnacles as ageable tags on crab will vary for different areas. Examination of barnacle encrustations on terminal molt female C. bairdi would indicate how prevalent barnacles are on non-molting crabs from a specific location, as well as providing information on interannual variations in barnacle sets. Currently, there is no information on interannual differences in barnacle sets for the two study species.

In this preliminary study, 38 percent of all male C. bairdi carried barnacles (Figures 2 and 3). It is likely that there are several Gulf of Alaska management areas where barnacle age could be used to estimate intermolt periods of tanner crabs. In using the technique it must be remembered that the period between the crabs' last molt and barnacle settlement is unknown. Thus, using barnacle age to determine the intermolt period may underestimate the intermolt period. However, where barnacles are common, aging them would eliminate some of the subjectivity inherent in methods now used to estimate the number of crabs that did not molt.

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APPENDIX

APPENDIX TABLE 1. Size and age of Balanus hesperius encrusting male Chionoecetes bairdi from Cook Inlet, Alaska

Harvest Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Cook Inlet					
Kachemak Bay December 1982 n=571	1	4.65 1.49 2.2-11.1	1.57 1.70 0.5-6.6	457	40.3
	2	10.41 1.70 8.1-14.0	5.26 1.98 3.3-9.2	8	1.4
Kamishak Bay March 1983 n=384	1	5.02 1.64 2.1-10.4	1.77 0.83 0.5-4.8	96	24.0
	2	11.55 2.05 10.1-13.0	4.75 0.07 4.7-4.8	2	0.5
Outer District March 1983 n=225	no barnacles found				

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 2. Size and age of Balanus hesperius encrusting male Chionoecetes bairdi from Kodiak, Alaska

Harvest Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Kodiak					
Northeast and East side March 1984 n=103	1	3.87 1.61 1.7-9.2	1.21 0.65 0.2-3.9	143	27.2
	2	10.38 1.81 6.6-12.9	4.89 1.24 2.7-6.9	12	3.9
East side offshore March 1984 n=101	1	3.58 1.93 1.4-11.6	1.70 0.82 0.4-5.0	232	58.4
	2	11.41 1.80 8.7-15.3	4.78 1.34 2.5-7.5	17	11.9
Ugak Bay East side nearshore March 1984 n=101	1	3.58 1.27 1.5-7.8	1.06 0.48 0.4-2.9	166	52.5
	2	8.8	7.2	1	1.0
Southwest District School 20 March 1984 n=100	1	4.32 2.16 2.2-9.9	1.43 0.97 0.7-3.9	29	16.0

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 2. Continued

Harvest Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Kodiak cont.					
Southwest District School 21 March 1984 n=105	1	6.69 1.86 0.8-10.5	2.28 0.83 0.5-6.8	216	58.1
	2	10.73 1.71 7.2-14.1	4.39 0.95 2.4-6.9	51	23.8
Shelikof Strait East side March 1984 n=200	1	3.02 1.47 1.5-10.2	0.96 0.59 0.3-5.5	180	39.5
	2	12.45 2.29 8.8-14.5	6.31 1.13 4.2-7.6	11	3.0
	3	17.3	8.1	1	0.5
Kodiak Processing Plants March 1984 n=99	1	3.62 1.23 1.0-9.7	1.16 0.49 0.4-3.4	151	42.4

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 3. Size and age of Balanus hesperius encrusting male Chionoecetes bairdi from Sand Point, Alaska

Harvest Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Sand Point					
Chignik	1	5.12	1.95	12	2.5
March 1984		1.68	0.83		
n=198		3.6-7.5	1.2-2.2		
	2	9.54	3.97	18	1.0
		1.59	0.88		
		7.2-11.6	2.7-5.2		
	3	11.3	6.70	2	0.1
		0.28	0.57		
		11.1-11.5	6.3-7.1		
Pavlof Bay	1	5.00	1.78	49	12.2
March 1984		1.34	0.69		
n=115		1.6-7.8	0.5-4.0		
	2	9.22	4.24	24	5.2
		1.40	1.39		
		7.1-13.9	2.4-7.4		
	3	12.5	7.0	1	0.9
Sand Point	1	5.00	1.81	242	21.0
Processing		1.44	0.74		
Plant		2.4-9.2	0.6-5.1		
February 1984					
n=404	2	9.18	4.00	88	7.2
		1.55	1.19		
		6.3-12.5	2.0-7.8		
	3	11.75	5.76	14	2.7
		1.80	1.39		
		9.2-15.5	2.4-7.6		

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 4. Size and age of Balanus crenatus encrusting male Chionoecetes bairdi from Cook Inlet, Alaska

Harvest Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Cook Inlet					
Kachemak Bay December 1982 n=571	1	5.20 1.87 2.2-10.4	1.81 0.92 0.7-4.5	72	6.8
	2	9.32 2.64 5.8-14.8	4.14 1.93 1.4-6.7	9	1.2
Kamishak Bay March 1983 n=384	1	6.40 1.72 2.6-11.5	2.40 0.96 0.6-5.7	82	23.4
	2	8.43 1.44 6.3-9.4	2.95 1.03 1.6-4.1	4	0.8
Outer District March 1983 n=225	no barnacles found				

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 5. Size and age of *Balanus crenatus* encrusting male *Chionoecetes bairdi* from Kodiak, Alaska

Harvest Area	No GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Kodiak					
Northeast and East side March 1984 n=103	1	5.16 1.37 2.1-8.5	1.79 0.78 0.5-3.3	64	17.5
	2	10.10 3.06 6.6-13.5	3.70 1.68 1.8-6.0	5	3.9
East side offshore March 1984	1	5.60 2.00 2.0-10.7	1.93 0.92 0.6-3.8	31	16.2
	2	11.15 1.01 9.7-13.0	4.99 0.93 3.4-6.6	12	4.0
	3	12.8	6.4	1	1.0
Ugak Bay East side nearshore March 1984 n=101	1	4.10 0.14 4.0-4.2	1.15 0.07 1.1-1.2	2	2.0
Southwest District School 20 March 1984 n=100	1	4.05 1.14 2.3-5.6	1.25 0.47 0.7-1.9	6	5.0

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 5. Continued

Harvest Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Kodiak cont.					
Southwest District n=105	1	6.50 1.51 3.1-7.9	1.97 0.61 0.9-2.5	4	13.3
	2	11.18 1.73 8.4-14.2	4.71 1.19 2.7-6.5	14	9.5
Shelikof Strait n=200	1	4.88 1.55 2.9-9.1	1.64 0.78 0.6-3.9	14	7.0
	2	14.1	6.4	1	0.5
Kodiak Processing Plant March 1984 n=99	1	5.63 1.10 4.4-6.5	1.97 0.71 1.2-2.6	3	3.0

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 6. Size and age of Balanus crenatus encrusting male Chionoecetes bairdi from Sand Point, Alaska

Harvest Area	No. GS[2]	Diameter (mm)[1]	Height (mm)[1]	Number of Barnacles	Percent of Crab with Barnacles
Sand Point					
Chignik	1	6.10	2.17	44	0.5
March 1984		1.09	0.49		
n=198		3.8-7.7	1.2-3.4		
	2	7.93	2.90	32	0.3
		1.27	0.84		
		6.2-10.9	1.7-4.7		
	3	13.14	6.70	4	0.2
		2.87	0.99		
		9.7-16.6	5.3-7.4		
	4	14.7	8.7	1	0.1
Pavlof Bay	1	5.84	2.17	13	6.1
March 1984		0.74	0.36		
n=115		4.7-7.5	1.4-2.6		
	2	8.41	3.58	8	4.3
		1.31	1.51		
		6.7-10.6	2.1-7.1		
	3	11.2	7.2	1	0.9
Sand Point	1	4.99	1.75	89	7.9
Processing		1.05	0.54		
Plant		1.8-7.7	0.8-3.0		
n=404					
	2	7.91	3.35	35	5.4
		1.68	1.07		
		5.4-11.6	1.8-5.7		
	3	10.4	5.9	1	0.2

[1] Diameter and Height column values equal mean over standard deviation and range in descending order. n = number of crabs.

[2] No. GS = number of growing seasons completed.

APPENDIX TABLE 7. The carapace width of male Chionoecetes bairdi and the oldest Balanus hesperius found on the carapace

Harvest Area	Carapace Width (mm)	Percent Crab* and Barnacle Age 1`	2'	3'	Number of Crab
Cook Inlet					
	120-130	100			1
Kachemak	131-139	44	6		18
Bay	140-150	40	2		313
	151-160	41	1		157
	161-170	38			71
	171-180	40			10
Kamishak	140-150	24			147
Bay	151-160	25	1		147
	161-170	26	1		72
	171-180	13			16
Outer District		no barnacles found			225
Kodiak					
NE & E	131-139	38			8
side	140-150	23	4		83
	151-160	9			11
East	131-139	67			3
side	140-150	45	16		51
offshore	151-160	36	10		39
	161-170	50			6
	171-180	50			2
Ugak Bay	131-139	33			6
East side	140-150	45	1		72
nearshore	151-160	36			16
	161-170	50			6
	171-180	100			1
SW Dist.	140-150	20			55
School 20	151-160	14			36

* rounded to nearest percent
` number of growing seasons the oldest barnacle had survived

APPENDIX TABLE 7. Continued

Harvest Area	Carapace Width (mm)	Percent Crab* and Barnacle Age 1`	2'	3'	Number of Crab
Kodiak cont.					
SW Dist.	131-139	100			1
School 21	140-150	45	27		55
	151-160	57	14		28
	161-170	42	32		19
	171-180	100			2
Shelikof	131-139	43	14		7
Strait	140-150	36	3	1	121
East side	151-160	31	2		61
	161-170	50			10
	171-180	100			1
Kodiak	131-139	75			4
Plants	140-150	40			84
	151-160	18			11
Sand Point					
Chignik	140-150	7	4		57
	151-160	2			106
	161-170	3			33
Pavlof	140-150	8	4		50
	151-160	5	5	2	59
Sand	120-130	29	14		7
Point	131-139	31			13
Plant	140-150	16	7	2	237
	151-160	10	3	2	116
	161-170	19	8	8	26
	171-180	20	20		5

* rounded to nearest percent
` number of growing seasons the oldest barnacle had survived

APPENDIX TABLE 8. The carapace width of male Chionoecetes bairdi and the oldest Balanus crenatus found on the carapace

Harvest Area	Carapace Width (mm)	Percent Crab* and Barnacle Age 1`	2'	3'	Number of Crab
Cook Inlet					
Kachemak	140-150	5	1		313
Bay	151-160	6	1		157
	161-170	9	3		71
	171-180	10			10
Kamishak	140-150	25	1		150
Bay	151-160	22	1		147
	161-170	26	1		72
	171-180	13			16
	181-190	50			2
Outer District		no barnacles found			225
Kodiak					
NE & E	131-139	13			8
side	140-150	13	2		83
	151-160	27			11
East side	140-150	10	2		51
offshore	151-160	13	3		39
	161-170	33	17		6
	171-180		50		2
Ugak Bay	140-150	1			72
East side	151-160	6			16
nearshore					
SW Dist.	140-150	5			55
School 20	151-160	6			36
SW Dist.	140-150	9	11		55
School 21	151-160	11	4		28
	161-170	5	11		19
Shelikof	140-150	4			121
East side	151-160	5			61
Kodiak	140-150	2			84
Plants	151-160	9			11

* rounded to nearest percent
` number of growing seasons the oldest barnacle had survived

APPENDIX TABLE 8. Continued

Harvest Area	Carapace Width (mm)	Percent Crab* and Barnacle Age			Number of Crab
		1`	2'	3'	
Sand Point					
Chignik	161-170	3			33
Pavlof	140-150	4	2		50
	151-160		2	2	59
	161-170		33		3
Sand	140-150	4	3		237
Point	151-160	8	4	1	116
Plant	161-170	4	12		26

* rounded to nearest percent
` number of growing seasons the oldest barnacle had survived