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ABSTRACT: Lost and delinquent commercial and sport fishing gear has gained public notoriety recently because of documented waste of fish and shellfish resources. Shellfish and groundfish pots have contributed to the problem. Although escape mechanisms have been developed to allow egress of captured species from pots, imprecise release time of these devices has generated debate exacerbated by inexact estimates of the survival of captured species. To gain information on Tanner crab *Chionoecetes bairdi* survival in pots, we captured large, adult male Tanner crabs and held them in cod pots in the outer portion of Kachemak Bay, Alaska. The pot tunnels were secured shut so the crabs had no chance to escape. No external source of food was provided. The pots were pulled periodically over a 119-d period. A total of 52 (39%) of the original 132 crabs died during the experiment.

INTRODUCTION

Mortality of crabs and groundfish in Alaska resulting from ghost fishing by lost and derelict pots has always been a concern for state and federal managing agencies and the commercial fishing industry. A number of studies have documented aspects of this problem in Alaska and other states: Dungeness crabs *Cancer magister* (High 1976; Hicks et al. 1989), king crabs *Paralithodes camtschaticus* (High et al. 1979; Stevens et al. 1993), Hawaiian spiny lobster *Panulirus marginatus* (Paul 1984; Parrish et al. 1992), Maine lobster *Homarus americanus* (Blott 1978; Pecci et al. 1978), and blue crabs *Callinectes sapidus* (Guillory 1993).

To address the ghost-fishing issue, the legislature adopted a law requiring escape mechanisms in crab pots, and the Alaska Board of Fisheries subsequently adopted a regulation in 1977 that required all crab and groundfish pots have escape panels made of biodegradable twine. The eventual degradation of the twine, in concept, allows for escape of the trapped crabs. However, as more pots were used by the increasingly competitive industry, pot losses increased: reported losses in the Bering Sea alone are in the thousands each year. The importance of this regulation as related to the efficacy of biodegradable escape mechanisms has therefore been magnified (Kimker 1990).

Whether or not untreated cotton twine actually carries out the legislature's intent for escape mechanisms has been questioned since its inception. Dissatisfaction with both the enforceability of the regulation and the varying degradation time of the twine (30-thread cotton) led the Board of Fisheries, the Alaska Department of Fish and Game (ADF&G), and the fishing industry to examine galvanic timed release (GTR) devices in lieu of cotton twine. GTRs are short, metallic rods that restrain opening of the release mechanism until they dissolve, which gradually occurs when immersed in salt water. The rate of disintegration depends on water temperature and salinity.

Commensurate with interest in the effectiveness of GTRs was a practical need to determine longevity of the various commercial crab species when trapped; that is, how long could crabs live in pots before they had to be freed? Although both the regulatory agencies and the commercial fishing industry agree that crabs will eventually die when trapped in lost gear (ghost pots), the longevity of certain Alaskan crab species, such as Tanner crabs *Chionoecetes bairdi,* while in these pots and their ability to survive after release has been a matter of conjecture. Recently, Paul et al. (1994) found that Tanner crabs do not seem to have a capacity for compensatory feeding. In this related study, I examined the biological effects and longevity of Tanner crabs held in commercial pots without food. The fishing industry and the department hoped this pilot project would lead to development of similar studies on other commercial crab species.

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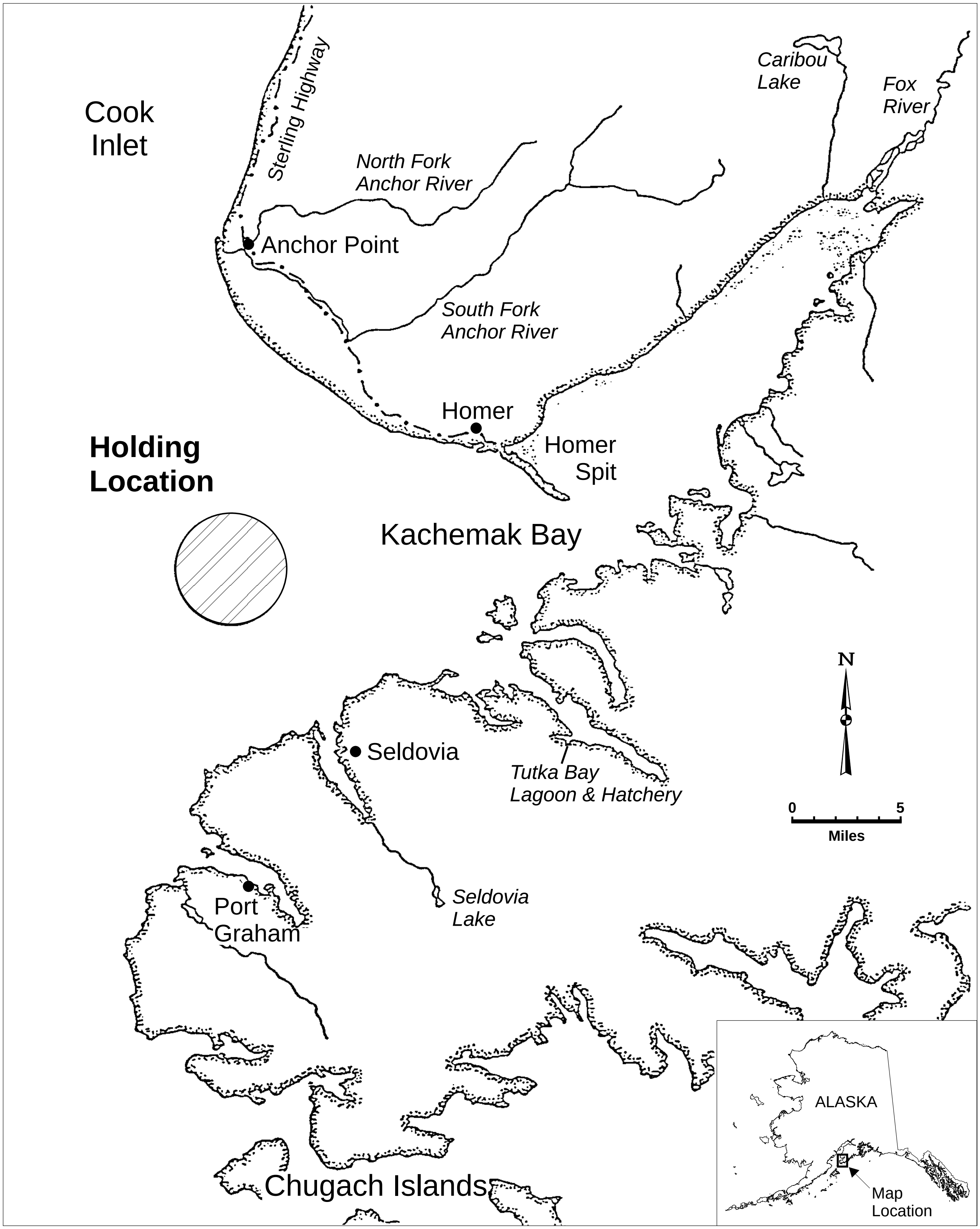

Figure 1. Pot location for Tanner crab survival experiment in the lower Cook Inlet/Kachemak Bay area of Alaska.

METHODS

A commercial fisherman from Cook Inlet volunteered his vessel and gear for the study. His 16-m steel vessel, a combined commercial pot and longline vessel, was used to catch crabs and check pots in which the crabs were being held without food.

Operating out of Homer, Alaska, 132 male Tanner crabs captured on 31 December 1991 in outer Kachemak Bay were used for the experiment. They were all of legal size, ranging from 139 to 179 mm carapace width and averaging 158 mm. None of the crabs selected had missing limbs; 92% were new shells (crabs that had molted within the past year) and the remaining 8% were single skipmolts (i.e., crabs that had not molted within the past year but had molted within the past 2 years).

The crabs were kept in a large plastic container with circulating sea water en route between the capture site and the experimental site. Transit time ranged between 35 and 80 min. Air temperature was 0° C. Wind speed was 15 knots. Crabs captured in pots were sorted, selected, and placed into holding containers within 30–60 s.

Thirty-three crabs per pot were placed in 4 commercial crab pots that had their tunnels covered with webbing. The 127-mm stretch mesh prevented crab escape. The sealed pots with crabs were deployed in central Cook Inlet west of Kachemak Bay between Point Pogibshi and Anchor Point (Figure 1) in depths of 37–74 m (20–40 fathoms). These depths provided modest and infrequent temperature fluctuations during the experimental period. The location was also devoid of gammarid amphipods that can kill a crab within 24 h in a restricted environment, such as a crab pot.

Beginning 7 January 1992 and concluding 28 April 1992, the pots were pulled 8 times on an irregular basis depending on temperature, wind conditions, and vessel availability. The frequency of observations — pulling the gear and evaluating crab condition — was restricted because continued exposures could have confounded the results. Carls and O'Clair (1989) indicated that exposure of Tanner crabs to cold temperature will have both immediate and long-term effects. Live and dead crabs were counted as quickly as possible; qualitative comments, such as crab vigor and limb loss, were noted. Specific limbs lost were not documented because this would have required additional time on deck. Exposure time, temperature, wind conditions, and bycatch of fish and shellfish that entered through the webbing were also recorded.

Table 1. Numbers of adult male Tanner crabs surviving in 4 closed pots on 8 examination dates during a 119-d period without feeding.

	Pot[a]				Cumulative No. of:	
Date	A	B	C	D	Mortalities	Days
12/31/91[b]	33	33	33	33	0	0
01/07/92	33	33	33	33	0	7
01/14/92	33	32	33	32	2	14
01/28/92	33	32	32	32	3	28
02/25/92	25	27	30	27	23	56
03/10/92	24	26	28	27	27	70
03/17/92	24	25	28	27	28	77
04/10/92	20	21	23	23	45	101
04/28/92[c]	19	16	22	23	52	119

[a] For historical reference, pots A, B, C, and D were actually pots 120, CC, 171, and 55, respectively.

[b] Initial capture and beginning of experiment.

[c] Experiment terminated.

RESULTS

The experiment was concluded on 28 April 1992, after a period of 119 d, at which time the fishing vessel was no longer available. The average time between lifts was 14.9 d, ranging from 7 to 28 d. Fifty-two (39%) of the original 132 crabs died during the experiment. Deaths in individual pots ranged from 30% to 52%. No mortalities were identified until 14 January, 14 d after the experiment began, when 2 crabs in 1 pot had died. Crab mortalities were noted on all subsequent lifts, the final mortality appearing on the last day the pots were pulled (Table 1). Figure 2 shows that mortalities began to increase after 30 d in the pot.

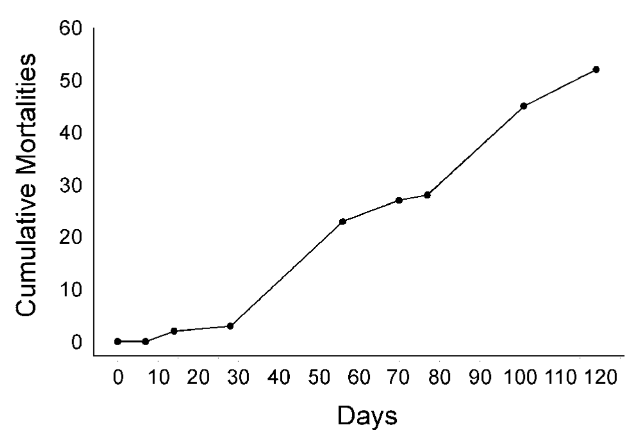

Figure 2. Cumulative Tanner crab mortalities per lift period.

Table 2. Temperature, wind, and mean air exposure time of crabs on each date the pots were examined.

Date	Air temp. (°C)	Water temp. (°C)	Wind speed (knots)	Average exposure time
12/31/91[a]	0		15–20	
01/07/92	2		0	4 min 22 s
01/14/92	4	5[b]	10	4 min 30 s
01/28/92	-4	4[c]	20	4 min 31 s
02/25/92	1		25	3 min 17 s
03/10/92	0	3[c]	15–20	5 min 47 s
03/17/92	1		10–15	3 min 41 s
04/10/92	2		10–15	2 min 25 s
04/28/92[d]			20–25	

[a] Date of capture and beginning of experiment.
[b] Surface.
[c] Taken at 3 m below the surface.
[d] Termination of experiment.

Average exposure time per observation ranged from 2.75 min on 10 April to 5.75 min on 10 March. Overall mean exposure time was 4.1 min. Exposure temperature ranged from -4° to 4° C. Wind speed varied between 10 and 25 knots (Table 2).

DISCUSSION

Although higher mortality rates had been anticipated, the 39% crab mortality rate for the 119-d period was not trivial. Paul et al. (1994) found only a 10% mortality rate in Tanner crabs during a 90-d starvation period in laboratory conditions, but they found 100% mortality of those crabs during the 140-d post-starvation period when crabs were offered unlimited food.

In my experiment, no external sources of food were apparent, such as fish carcasses or mollusk shells. It is doubtful, however, that the observed limb loss was a natural occurrence; more likely it was a function of cannibalism (J. M. Paul, University of Alaska Fairbanks, personal communication). Cannibalism, if it occurred, would have mitigated the effects of starvation among the crabs that cannibalized their cohorts.

Limb loss in the living crabs increased over time. At the beginning of the experiment, the crabs had all their appendages intact. On the final day, virtually all of the crabs were missing limbs; in some cases 3 or 4 legs were gone. Limb loss was not quantified during the experiment because it would have required additional exposure time for the crabs. Limited staff and sea conditions prohibited anything but counting the crabs and decking the gear during the final day.

It was rare that an entire crab exoskeleton was found in the pots. Mortality other than external predation was assumed when either a crab was missing or only a carapace was found in the pot. Cannibalism by the living crabs on dead or moribund crabs probably broke up the exoskeleton so that the remains flushed out of the pot, aided by the extreme movement of water in Cook Inlet. The carapaces found in the pots were characteristically paper thin and fragile; there is no obvious explanation for this phenomenon other than the natural decay process.

There was no evidence of octopus predation, at least no octopi were captured in the pots. Although there is some octopus bycatch from the pot cod fishery in this area, it is not substantial, and department pot and trawl surveys in these waters rarely catch octopi.

LITERATURE CITED

Blott, A. J. 1978. A preliminary study of timed release mechanisms for lobster traps. Marine Fisheries Review 40(5–6):44–49.

Carls, M. G., and C. E. O'Clair. 1989. Influence of cold air exposures on ovigerous red king crab (*Paralithodes camtschaticus*) and Tanner crabs (*Chionoecetes bairdi*) and their offspring. Pages 329–343 *in* Proceedings of the international symposium on king and Tanner crabs. University of Alaska Fairbanks, Alaska Sea Grant Program Report 90-04.

Guillory, V. 1993. Ghost fishing by blue crab traps. North American Journal of Fisheries Management 13:459–466.

Hicks, D., and M. Murphy. 1989. A handling study of Dungeness crab at varying exposure intervals and shell-hardness levels. Alaska Department of Fish and Game, Division of Commercial Fisheries, Fishery Research Bulletin 89-01, Juneau.

High, W. L. 1976. Escape of Dungeness crabs from pots. Marine Fisheries Review 38(4):19–23.

High, W. L., and D. D. Worlund. 1979. Escape of king crab (*Paralithodes camtschatica*) from derelict pots. NOAA Technical Report NMFS SSRF-734:1–11.

Kimker, A. T. 1990. Biodegradable twine report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2H90-05, Anchorage.

Parrish, F. A., and T. K. Kazama. 1992. Evaluation of ghost fishing in the Hawaiian lobster fishery. Fishery Bulletin 90:720–725.

Paul, J. M., A. J. Paul, and A. T. Kimker. 1994. Compensatory feeding capacity of 2 brachyuran crabs, Tanner and Dungeness, after starvation periods like those encountered in pots. Alaska Fishery Research Bulletin 1(2):184–187.

Paul, L. M. B. 1984. Investigations into escape vent effectiveness and ghost fishing in captive populations of the spiny lobster (*Panulirus marginatus*). Northwest Hawaiian Islands, University of Hawaii, Sea Grant Manuscript 84-01:283–295.

Pecci, K. J., R. A. Cooper, C. D. Newell, R. A. Clifford, and R. J. Smolowitz. 1978. Ghost fishing of vented and unvented lobster (*Homarus americanus*) traps. Marine Fisheries Review 40(5–6):9–43.

Stevens, B. G., J. A. Haaga, and W. E. Donaldson. 1993. Underwater observations on behavior of king crabs escaping from crab pots. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fishery Science Center Processed Report 93-06, Kodiak, Alaska.