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Glacial Fjords in Glacier Bay National Park: Nursery Areas for Tanner Crabs?

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Abstract. During summer 2002, the U.S. Geological Survey Glacier Bay Field Station conducted a systematic survey for king and Tanner crab in Glacier Bay. The distribution of Tanner crabs was segregated spatially by size class, with adults predominating in some areas and juveniles in others. Almost half (44 percent) of the juvenile crabs in the survey were caught in Wachusett Inlet and Scidmore-Charpentier Inlet, narrow glacially-influenced fjords where adults were scarce. Where high numbers of juveniles occurred next to high densities of adults in the central bay, juveniles were associated with shallower depths. However, in Wachusett and Scidmore-Charpentier Inlets, where adults were scarce, adults were associated with shallower depths. Because adults prey on or compete with juveniles, the distribution of juveniles could be driven by the distribution of adults. Areas where adults are scarce, such as glacially influenced fjords, could serve as refuges or possibly nursery areas for juvenile Tanner crabs.

Introduction

Tanner crabs *Chionoecetes bairdi* support valuable commercial fisheries in Alaska. However, Tanner crab stocks have experienced dramatic fluctuations in recent years, sometimes resulting in fishery closures. Enhancing our understanding of the spatial processes that influence recruitment should lead to increased understanding of fluctuations in abundance as well as aid in the implementation of spatially explicit fisheries management techniques. Recently developed management tools that have explicit spatial components, such as marine reserves and essential fish habitat designation, require knowledge about how populations are distributed in space as well as the processes that influence distribution.

During summer 2002 the U.S. Geological Survey Glacier Bay Field Station conducted a systematic survey to determine the relative abundance and distribution of Tanner crabs in Glacier Bay. Here we compare the spatial distribution and habitat associations for juvenile and adult female Tanner crabs in a fjord ecosystem and marine reserve.

Methods

During July and August 2002, pots were set at 415 stations on a 1.5 km grid of the entire bay. At each station a commercial Tanner/king crab pot was used to sample adult crabs and a commercial shrimp pot was attached to the adult pot with a 20 m tether specifically to sample juvenile crabs. Crabs were measured with vernier calipers to the nearest mm, and shell condition was determined (Jadamec and others, 1999).

We mapped the spatial distribution of juvenile and adult female Tanner crabs. Our results are presented in terms of female Tanner crabs because only female crabs can be categorized unambiguously as juvenile or adult. In contrast to males, there is an obvious morphological difference between juveniles and adults.

We characterized the distribution of juvenile Tanner crabs with respect to depth (Perry and Smith, 1994; Dionne and others, 2003). For this we compared the cumulative frequency distribution of catch per unit effort (CPUE) for each "age" class with the cumulative frequency of depths sampled using a Kolmogorov-Smirnov two-sample test (Conover, 1999).

Results

Tanner crabs were generally widespread throughout Glacier Bay. However, Tanner crabs were segregated spatially by size class. Specific areas were dominated by either juveniles or adults (fig. 1). Juveniles predominated in Wachusett Inlet and the distal ends of Scidmore-Charpentier Inlet, where almost one-half (44 percent) of the juvenile crabs in the survey were caught. Juveniles also predominated, but at lower densities, in a patch in the central bay that was adjacent to high numbers of adults.

For stations in the central bay, juvenile females were associated with shallower depths and adult females were associated with deeper depths (fig. 2A). In contrast, adults tended to be in shallower depths than juveniles in Wachusett and Scidmore-Charpentier Inlets (fig. 2B).

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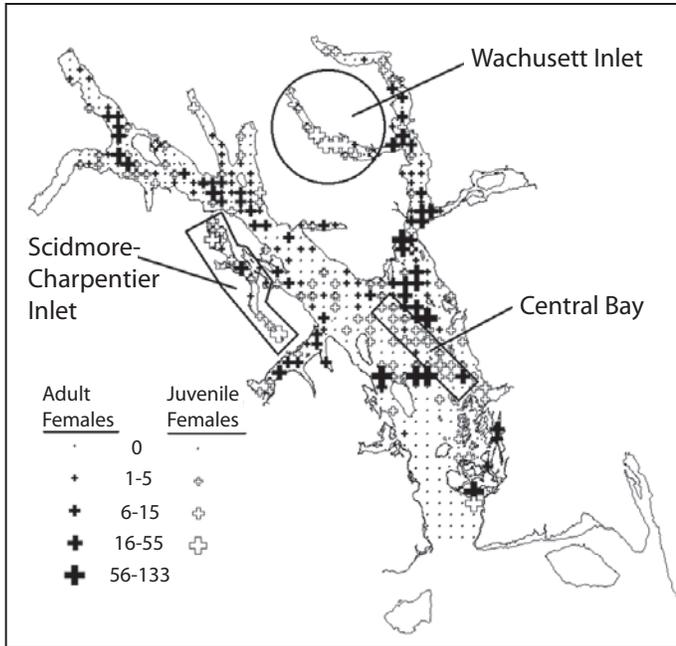


Figure 1. Distribution of juvenile and adult female Tanner crabs in Glacier Bay, Alaska.

Discussion And Conclusions

The pattern of segregated spatial distributions for juvenile and adult females combined with different habitat associations in areas where adults are dense suggests that the distribution of juveniles could be influenced by the distribution of adults. Adults have similar diets to juveniles, and also prey on juveniles (Jewett and Feder, 1983). Thus, high numbers of adults could adversely affect the survival of juveniles. Given that the highest densities of juveniles were in the narrow glacial fjords where adults were scarce, juvenile survival in these areas might be greater as a result of decreased competition with adults for food or space or decreased adult predation.

Management Implications

Both Wachusett Inlet and Scidmore-Charpentier Inlet are located in the marine reserve network of Glacier Bay. If juvenile crabs have higher survival in these areas and leave to join adjacent adult populations, these areas could be thought of as nursery areas. Nursery areas are an important component of marine reserve design, and knowledge about where they occur will be important in designing efficient marine reserves.

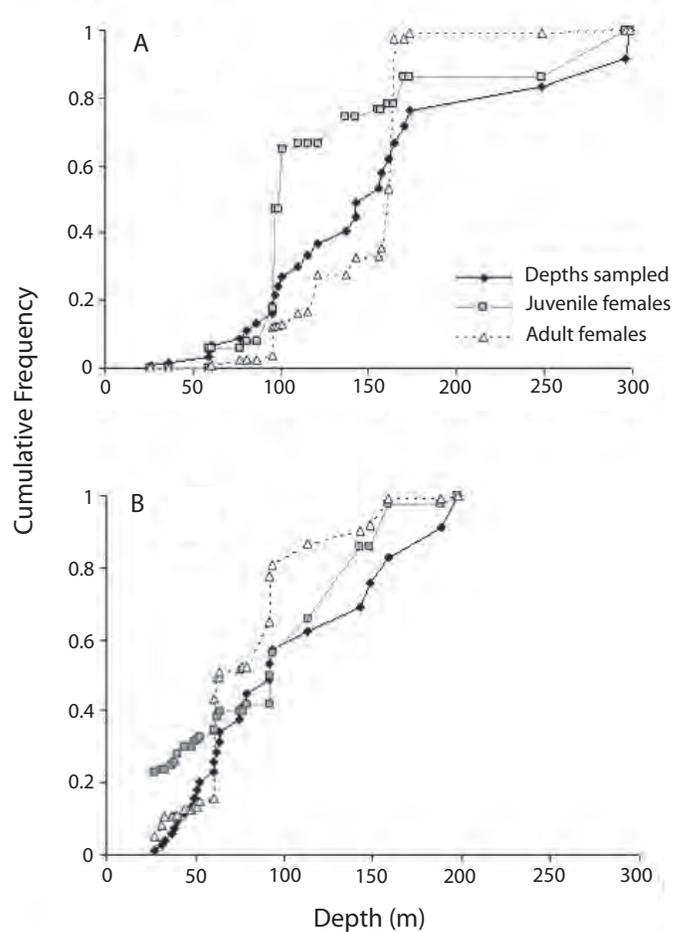


Figure 2. Cumulative frequency distributions of Tanner crabs for depths sampled in (A) Wachusett and Scidmore-Charpentier Inlets that contain high densities of juveniles, but few adults; and (B) central bay that contains high densities of both juveniles and adult females.

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A winter view of pan ice at the head of Geike Inlet. (Photograph by Bill Eichenlaub, National Park Service.)