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Consideration of Management Units for Jonah Crab, Cancer borealis

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ABSTRACT

The Jonah crab, Cancer borealis, occurs from from Canso, Nova Scotia to Florida, and is found from the intertidal zone to over 800 m. On the Scotian Shelf and in the Gulf of Maine, the species is the dominant crab away from shore. Although ubiquitous, distribution tends to be contagious with maximum abundances between ~100 to 600 m. Currently, Jonah crab form only a by-catch to the lobster fishery off Nova Scotia and in the Bay of Fundy (total recorded landings were <10 t in 1985); a similar small-scale fishery exists in the Gulf of Maine. A directed Jonah crab fishery in LaHave/Emerald Basins and on the adjacent Shelf Edge achieved catches of 90 t and 149 t in 1983 and 1984, respectively, before failing due to economics. The area of directed fishing was restricted to prevent overlap onto existing commercial lobster grounds. Resource surveys and by-catch data have not revealed any natural stock boundaries although data are scanty. Adult movement patterns have not been investigated. However, with planktonic larval development times of ~40-60 d at 20°C long-distance stock-recruitment relationships are possible. Given the distribution and life-history characteristics of Jonah crab, there appears no discernable intrinsic biological benefit from any particular management-imposed boundary line between fisheries.

RESUME

On trouve le crabe-tourteau boréal, Cancer borealis, de Canso (Nouvelle-Ecosse) jusqu'en Floride et de la zone intertidale jusqu'à plus de 800 m. Sur la plate-forme Scotian et dans le golfe du Maine cette espèce est le crabe dominant loin du rivage. Quoique omniprésent, sa répartition semble non aléatoire et les zones de plus grande abondance se situent entre environ 100 et 600 m. Actuellement, le crabe tourteau ne constitue qu'une prise accessoire de la pêche au homard au large de la Nouvelle-Ecosse et dans la baie de Fundy (les débarquements totaux étaient inférieurs à 10 t en 1985); il existe une pêche analogue à petite échelle dans le golfe du Maine. Une pêche dirigée au crabe-tourteau boréal dans les bassins LaHave et Emerald ainsi que sur le rebord adjacent de la plate-forme a respectivement fourni en 1983 et 1984 des prises de 90 et de 149 t avant d'échouer pour des raisons économiques. La zone de pêche dirigée a été réduite de manière à ne pas chevaucher les zones existantes de pêche commerciale au homard. Les relevés des ressources et les données sur les captures accessoires n'ont pas révélé de limites naturelles des stocks quoique les données sont rares. Les configurations des déplacements des adultes n'ont pas été étudiées. Toutefois, avec des durées de développement des larves planctoniques d'environ 40 à 60 jours à 20°C, des relations de recrutement à partir de stocks éloignés sont possibles. Etant donné la répartition et les caractéristiques de l'histoire naturelle du crabe-tourteau, il semble n'exister aucun avantage biologique intrinsèque perceptible à imposer pour la gestion des limites particulières entre les pêcheries.

INTRODUCTION

The Jonah crab, Cancer borealis, is the larger of the two cancrinid species found in the northwest Atlantic; the congener being the rock crab, Cancer irroratus. The Jonah crab occurs from Canso, Nova Scotia to Florida, and is common from the intertidal zone to over 800 m (Williams, 1984). Haefner (1977) found that maximum abundances in the Mid-Atlantic Bight occurred between 150-400 m depth and 8°-13.9°C. On the Scotian Shelf and in the Gulf of Maine the Jonah crab tends to be the dominant crab species away from shore. Jonah crabs are frequently sympatric with American lobsters, Homarus americanus, and deep-sea red crabs, Geryon quinque-dens, as well as with rock crabs (Caddy et al., 1974; Jeffries, 1966; Elner and Robichaud, 1985). Overall, the distribution of Jonah crab appears ubiquitous having been reported from rocky (Jeffries, 1966), sand and silt-clay bottoms (Musick and McEachern, 1972).

Detailed accounts of Jonah crab biology can be found in Haefner (1977) and Carpenter (1978); however, the following is of interest when assessing stock structure. Male Jonah crabs reach a maximum carapace width (CW) of approximately 180 mm and 0.9 kg; females may attain 174 mm CW and 0.8 kg but they do not commonly exceed 150 mm CW and 0.5 kg (R.W. Elner and J.F. McElman, unpublished reports). Carpenter (1978) determined that most males are mature in the 90-100 mm CW range. Ovigerous females as small as 85 mm CW have been collected on the Scotian Shelf (R.W. Elner and J.F. McElman, unpublished reports). Sastry and McCarthy (1973) and Sastry (1977) described five zoeal stages (larvae) and one megalopa stage; time to complete larval development was between approximately 40 to 60 d at rearing conditions of 20°C and 30‰ salinity.

A. History of Management Area Definition

Jonah crabs in Canadian waters have been subject to sporadic low-level exploitation as trap by-catch to lobsters since the mid-1960's (Caddy et al., 1974). There was a directed Canadian fishery for Jonah crab between May 1983 - August 1984. Occasional landings (<10 mt in 1985) still occur as by-catch to the offshore and inshore lobster fisheries on the Scotian Shelf and in the Bay of Fundy.

Historically, the principal barrier to development of a sustained directed Jonah crab fishery has been the poor economic returns on the processed product, due mainly to the high cost of meat extraction. Another problem is the cost of enforcement as Jonah crab and lobster distributions overlap. Therefore, in a directed Jonah crab fishery the lobster by-catch is at risk from poaching and handling-related damage. With the collapse of Alaskan crab stocks in 1982 and the subsequent increase in world market demand and price for crab, the economics of a directed Jonah crab fishery became more viable. The Department of Fisheries and Oceans in October 1982 actively fostered industry interest in a directed fishery for Jonah crab on the Scotian Shelf. The Scotian Shelf Crab Advisory Committee was formed in January, 1983, as "a focal point for federal-provincial, processor-fishermen consultations on matters relating to resource allocation, harvesting and processing." Thirty two (32) Jonah crab permits were released in May 1983. Ultimately, only 10 of the permit holders actively fished for Jonah crab.

To reduce lobster by-catch the area of directed fishing was restricted to 12 or more miles off the coast; north and east of a line which commenced 12 miles off at 65°33' west longitude, proceeded true south to 43° north latitude, then true east to 64°30' west longitude, then true south to the "200-mile" limit (Fig. 1).

The 1983 fishery for Jonah crab was assessed by Elner and Robichaud (1984). The preferred gear was offshore lobster traps with soak times ranging from 1 to 14 d. Traps were set in the LaHave/Emerald Basins and on the Scotian Shelf edge. Landings, as derived from logbooks, totalled 90.3 t after a 4 mo. season. Catch rates fluctuated considerably, but with a slight upward trend between the start and end of the season, and a mean value of 6.6 kg trap haul⁻¹. The fluctuations in the catch rates may, in part, have been due to the exploratory nature of the fishery. Fishing stopped in August 1983 when the principal buyer ceased operations.

In 1984 the three Jonah crab permit holders on the Scotian Shelf landed 148.6 t (Elner and Robichaud, 1985). However, the fishery failed to regain impetus following heavy gear losses in late June and catches effectively ceased in late August. The principal operators re-directed onto red crab, Geryon quinquedens, a deep water species which had previously been a by-catch to Jonah crab.

B. In-depth Review of Biological Basis for Definition of Unit Stocks

Information on Jonah crab population biology and distribution is meager, the most detailed accounts are given by Haefner (1977) for the Mid-Atlantic Bight and Carpenter (1978) for Norfolk Canyon and the adjacent slope. Based on a series of trawl surveys, Haefner (1977) determined that Jonah crab were contagiously distributed and the maximum abundance appeared to be dependent on depth and temperature; there was some evidence for limited seasonal movements.

The most comprehensive data base on Jonah crab stock structure for the Scotian Shelf was collected during trap surveys conducted by the Department of Fisheries and Oceans (D.F.O.) off central and southern Nova Scotia (including Browns Bank) in 1980-81 (R.W. Elner and J.F. McElman, unpublished reports): The overall distribution appears patchy based on catch rates. Traps were set at depths of 26-458 m and maximum relative abundance occurred between 43-293 m. There was a tendency for mean CW to increase with increasing depth, particularly in males; a similar trend was noted by Haefner (1977). These D.F.O. surveys formed part of the impetus for the directed Jonah crab fishery in 1983-84. Most effort by the directed fishery was concentrated at depths of 100-640 m along the Shelf edge between Baccaro Bank and Emerald Bank and in the LaHave and Emerald Basins (Elner and Robichaud, 1984; 1985). Graham et al (1983) summarized Cancer crab by-catch data from lobster trapping in the Bay of Fundy between 1979-82. Jonah crabs appeared relatively more abundant in open, deep waters close to the mouth of the Bay. Similar Jonah crab by-catch data were collected from lobster traps on Browns Bank and Georges Bank in September 1979 (A.B. Stasko, unpublished data). However, such data must be interpreted with caution since traps were set to maximize lobster catches and, therefore, were never directed toward locating

areas of crab abundance. There is no information available on current catches of Jonah crab by U.S. vessels in the Gulf of Maine although both Jonah crabs and rock crabs are probably subject to low-level exploitation, most likely as by-catch to the lobster fishery.

Little is known about Jonah crab movement patterns. There have been neither long-term tagging studies nor attempts to distinguish stocks on the basis of electrophoresis or morphometrics. However, given the ubiquitous distribution of adults and a larval duration in excess of 40 days (Sastry and McCarthy, 1973), there is probably considerable genetic exchange throughout the Gulf of Maine Area. Roff et al (1986) found Jonah crab zoeas (stages I-V) to be common in coastal waters around Nova Scotia, with numbers generally lower at the edge of the Shelf. The megalopas were also abundant beyond the Shelf edge. These could have been derived from adults south of Georges Bank.

In summary, based on available information, there is no biological rationale for discriminating management units for Jonah crab.

C. Implications of Conclusions on Stock Structure to Definition of Optimal Boundaries for Statistical and Managerial Purposes

Given that there is presently no biological basis for separating unit stocks of Jonah crab in the Gulf of Maine Area (as covered in sections A and B, above) it follows that there is no discernable intrinsic potential benefit from any particular boundary line. However, as Jonah crab are usually caught as by-catch to the lobster fishery it appears reasonable that the stock boundary eventually chosen should be the same as that decided for lobster.

D. Recommendations for Future Research

The major questions regarding Jonah crab stock structure in the Gulf of Maine Area pertain to resolving: 1) the movements of benthic life history stages on the Continental Slope; and 2) the transport patterns of pelagic larvae. The first question could be addressed by long-term tagging and field surveys. Resolution of the second question demands laboratory studies into Jonah crab larval behaviour which would have to be "married" to larval survey and hydrographic data. Given the distribution of the resource, the actual research would seem to require joint Canada:U.S. involvement.

In general, these same research questions are unanswered for most commercial invertebrates, although they appear fundamental to effective fisheries management.

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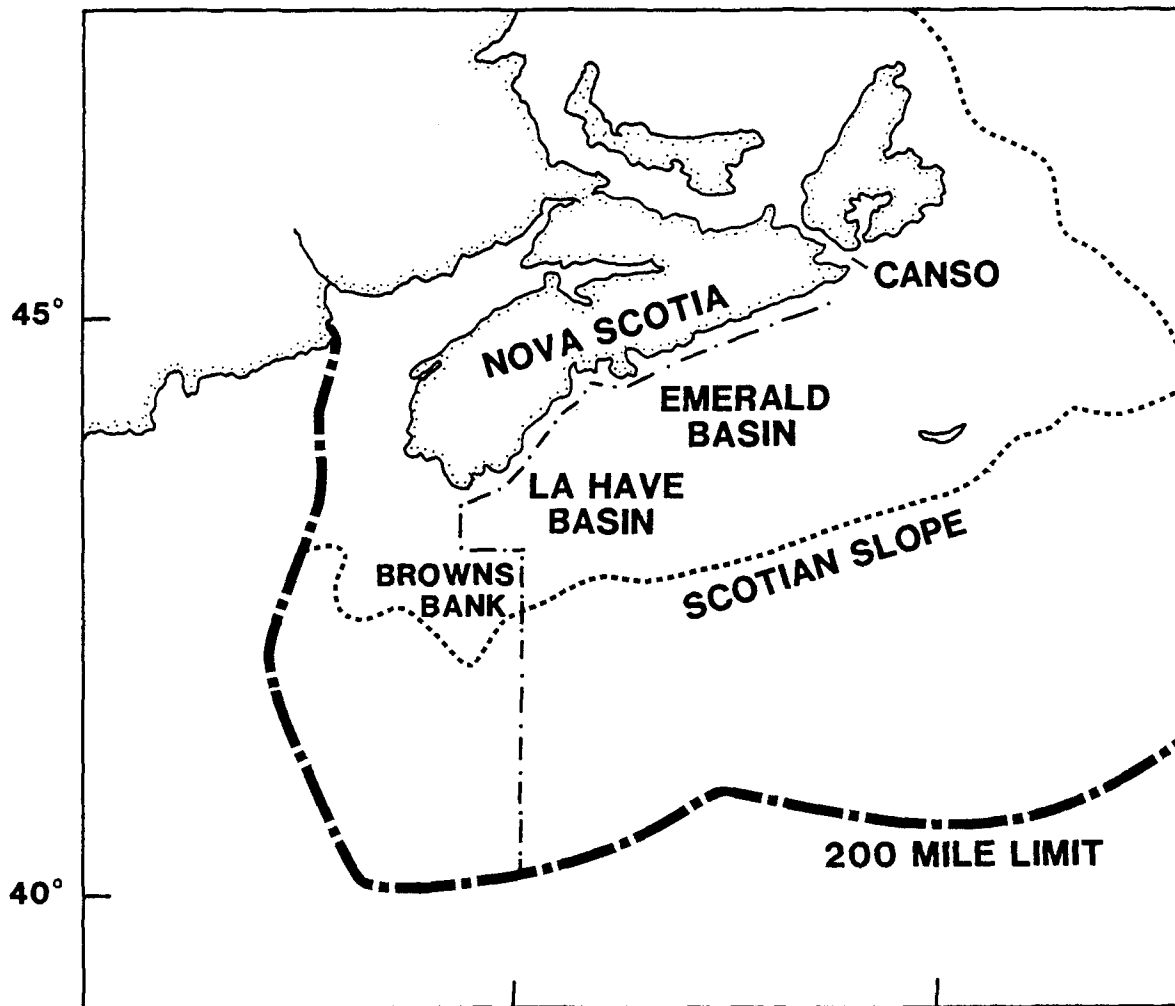


Figure 1. The area defined for the directed Jonah crab fishery in 1983 and 1984; fishing was restricted to at least 12 miles off the coast and then north and east of the boundary line (-.-.-.-) up to the 200 mile limit (---).