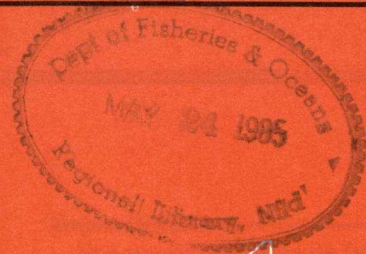


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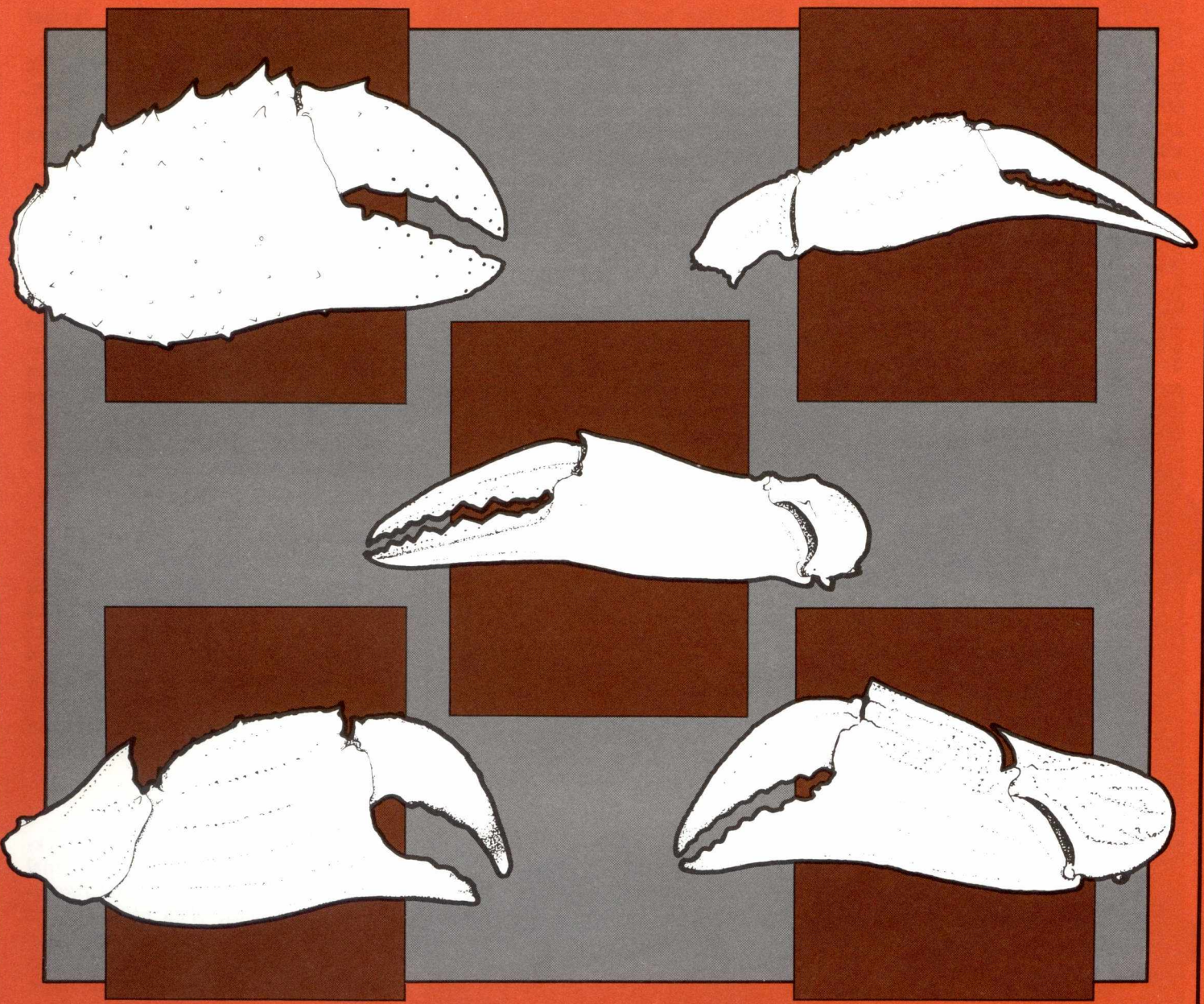


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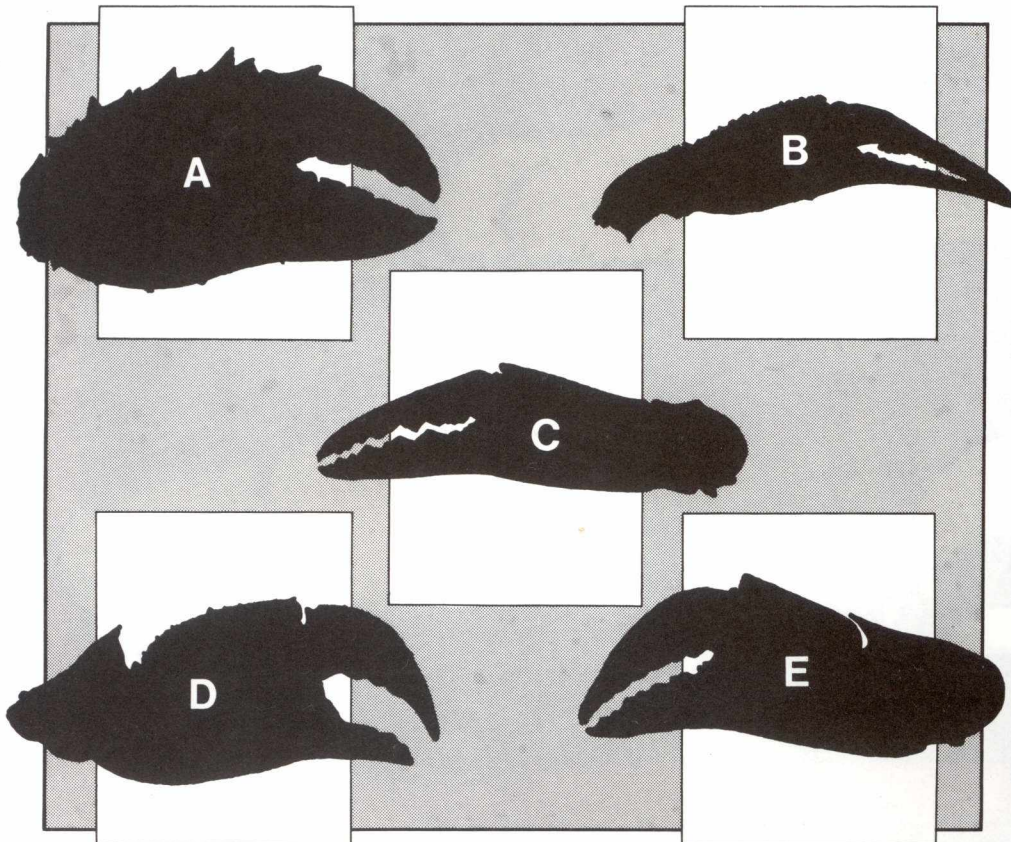
Underwater World

CRABS OF THE ATLANTIC COAST OF CANADA



CRABS OF THE ATLANTIC COAST OF CANADA

Fig. 1 (or Frontispiece). Northwest Atlantic crab claws: form adapted to function. A. northern stone crab: a strong claw with blunt teeth designed for cracking heavily armored prey; B. snow crab: a slender, fine-toothed but powerfully-muscled claw for chipping open mollusc shells and tearing apart brittlestars; C. deep-sea red crab: a fast-action claw with sharp serrated teeth for biting and cutting softer-bodied prey; D. jonah crab: a heavy claw able to exert slow but substantial forces ideal for crushing the shells of molluscs, sea urchins and crustaceans; E. rock crab: a 'generalist' claw, capable of opening shells as well as capturing and tearing apart agile, softer-bodied prey.



Various crab species are adapted to a wide range of habitats off Canada's eastern coastline, from the intertidal zone to the deep waters of the continental slope. However, despite their variety and abundance, Atlantic Canadian crabs have hitherto remained largely underutilized. Currently, the snow crab is the sole fully exploited crab species, constituting a major resource in terms of both landings and value. There is only small-scale trapping of the extensive jonah crab and rock crab stocks and essentially no commercial landings of deep-sea red crab, toad crab, northern stone crab, porcupine crab or green crab.

Each of the crab species has its own unique flavor and texture (even the smallest crabs are perfectly edible although somewhat fiddly). Considering that the crabs offer delectable eating experiences as well as being extremely nutritious (the raw white meat contains about 20 per cent protein, 1 to 2 per cent minerals, little fat and hardly any carbohydrate), why are they underutilized?

Certainly, crab species appear more widely harvested in other parts of the

world; even the small and unprepossessing green crab was a favorite in Victorian London a century ago and is still eaten in Spain. One probable answer is that the cost of pioneering a fishery, developing processing techniques and marketing routes for the crabs has appeared commercially unattractive compared to the rewards from other more traditional Atlantic fisheries. Difficulties associated with fishing crab traps in deep, offshore waters, gear conflicts with established fisheries and complications posed by the possibility of by-catches of the more lucrative lobster have presented further problems.

However, with overharvesting in some of the traditional fisheries, industry is being encouraged to diversify and utilize the crab by-catch from existing fisheries as well as start pilot fisheries directed exclusively for crab. An increased world market demand for crab products, created by collapses in the massive Alaskan crab fisheries, has raised crab prices and further heightened the probability of an expanded Canadian crab fishery. Since crabs are likely to increase in commercial importance, it is particularly appropriate to summarize crab biology, ongoing research and the characteristics of the predominant species found in the Canadian Atlantic.

Crab Biology

Crabs are decapod crustaceans (10-legged and having a crust or shell), a wide grouping that includes shrimps and lobsters. Many species of crabs are abundant, grow large and have a high and nutritious meat yield from their body and legs. Such properties have made them a favorite food for man and a target of heavy exploitation.

Moulting and Growth

Being invertebrates (without backbones), crabs rely on a hard external shell for skeletal support and protection. Despite the shell being jointed and somewhat flexible, all crabs must cast off their old shell (a process known as moulting or ecdysis) in order to grow. Once the old shell has been shed, the wrinkled, soft crab takes up

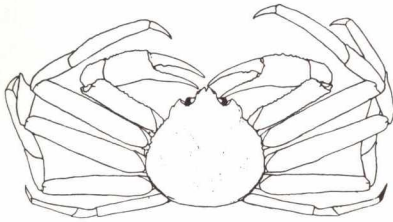


Fig. 2. Snow crab (*Chionoecetes opilio*).

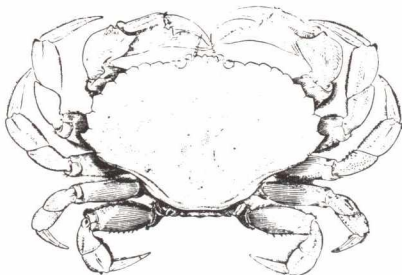
water and swells to its larger size within a few hours. The new shell gradually hardens and more muscles and tissue grow inside, although it may take several months for the crab to regain its former shell hardness and condition. As crabs grow older, they moult less frequently and their percentage growth increment diminishes as well.

Since all the hard parts of the crab, internal as well as external are lost at moulting, no tell-tale indicators (such as scale and otolith rings in fish) remain to accurately age the animal. Hence, the age of a crab of a given size can only be backcalculated from estimates of frequency of moulting and growth per moult. Accurate information on age is basic to much fisheries biology, and the difficulty in obtaining this information for crustaceans remains a fundamental problem.

Life Style

The life style of a crab species is uniquely reflected in the form taken by its 10 legs. The first pair are modified into conspicuous claws which, according to the crab's feeding habits, have evolved as optimal tools for the various crushing, cutting, digging, pinching, rasping and snatching actions required to capture and devour prey. Contrary to popular belief, most northwest Atlantic crabs are not simply "scavengers" but predominantly carnivores with well-defined preferences for prey such as mussels, snails and brittlestars. Claws are also used in burrowing, fighting and, interestingly, signalling. Claw signals are a universal decapod "language" and displays serve variously to ward off rivals for territory, repel would-be predators and attract mates; all without recourse to physical contact. Some crabs have achieved greater flexibility by having one large claw adapted for one major purpose, for example, crushing heavily armored molluscs or display, and the other smaller claw adapted for, say, snatching small agile prey. Although the remaining four pairs of legs are modified most for movement, be it burrowing, climbing, swimming or walking, they can also serve for feeding and grasping.

Fig. 3. Rock crab (*Cancer irroratus*).



Reproduction

For many crab species in the northwest Atlantic, mating usually takes place between a newly-moulted, soft-shelled, mature female and a larger hard-shelled, mature male. The male carries the female around before her moult and may continue to protect her for several days after copulation. The male's behavior, as well as being of considerable survival value to the vulnerable female, serves to guard his genetic investment against the death of the female and displacement by other males. Subsequently, the female extrudes many thousands of fertilized eggs onto the swimmerets under her abdomen.

Typically, larger females of a crab species carry more eggs than smaller females; a large female rock crab may carry 330,400 eggs. The eggs usually hatch during the warmer months of the year and free-swimming larvae are released. The larvae may spend from one to several months in the plankton and moult through a number of stages before settling down on the sea bed and moulting to the first crab stage. Ocean currents can transport larvae considerable distances from their hatching place. The massive mortalities that occur during the larval stages tend to be compensated for by the vast numbers of larvae produced.

Crab Research

Since the early 1960s, fisheries biologists from provincial and federal governments, as well as from universities, have been carrying out research into crab. The work has been conducted for a variety of purposes, to estimate stock abundance and size composition, growth rate, reproductive pattern, movement, and exploitation rate. However, all the work has a common aim in providing an accurate picture of the crab resources so that they can be properly managed.

Traps, beam trawls and towed underwater camera sledges are used from government research vessels and commercial vessels under charter to assess crab densities on the bottom. Tagging techniques have been refined to produce reliable tags that will be retained

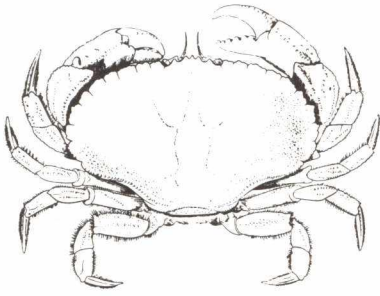


Fig. 4. Jonah crab (*Cancer borealis*).

when a crab moults. Such moult-retainable tags are expected to supply valuable information on stock biomass, exploitation and growth, as well as long-term movements. The ecology and population dynamics of juvenile snow crab are being subjected to special investigation through beam trawl surveys and stomach analyses of the groundfish which feed on crab. Continued research on the larval and juvenile stages of crab remains a priority if the factors influencing growth and recruitment to the fishery are to be understood. If commercial stock size and production could be regularly predicted from larval and juvenile abundances, fishery managers could more effectively optimize exploitation of the resource.

Commercial crab catches are monitored regularly at landing points throughout Atlantic Canada and sales receipts are analyzed. Sampling is also carried out at sea onboard licensed crab vessels and commercial vessels, such as seiners, that have a crab by-catch. Most importantly, data are analyzed from fishermen's logbooks. The logbooks provide critical details such as daily catch weight, number and type of traps hauled, trap location, and soak time. When considered with the commercial catch sampling data, the logbooks provide a vital means of assessing stock size, exploitation rate, and stock dynamics. To this end, the continued cooperation of fishermen in maintaining accurate logbooks is essential.

The following overviews and describes nine species of crabs likely to be encountered in Atlantic Canada.

SNOW CRAB, *Chionoecetes opilio* (spider crab, queen crab, zuwai crab)

The exploitation of snow crab in Atlantic Canada started in 1960 with small incidental by-catches by groundfish dragners off Gaspé, Quebec. However, since the inception of a directed trap fishery in 1966, after exploratory vessels located extensive stocks in the Gulf of St. Lawrence, annual landings have increased rapidly. Peak catches of over 47,000 metric tons (t) in 1982 were worth more than \$43 million to the

fishermen, and placed the species fourth in landed value in the Canadian Atlantic fishery behind cod, lobster and scallop. The 37,255 t of snow crab landed in 1983 had a record value in excess of \$53 million.

Distribution — West Greenland to Maine and from Alaska to Siberia; from 20 to 700 m. Commercial concentrations occur on soft bottom around Cape Breton, Newfoundland and in the western Gulf of St. Lawrence, especially from 70 to 280 m. Occasionally found in the Bay of Fundy.

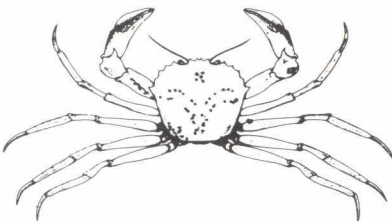
Description — Somewhat flattened walking legs that are two to three times as long as carapace; almost circular carapace; pale brownish above, yellowish below. Males reach a maximum carapace width of 150 mm, a leg spread of approximately 0.9 m and a weight of 2.0 kg; females are not commercially fished as they attain a maximum carapace width of only 47 to 95 mm.

ROCK CRAB, *Cancer irroratus* (sand crab, purple crab)

Where there has been a market, Canadian lobster fishermen have been landing rock crab by-catches for decades, although landings hardly exceeded 230 t per annum prior to 1973. However, with greater demand and occasional directed fisheries for rock crab, landings have since risen; in 1983 approximately 500 t of rock crab were caught (valued at about \$111,000) principally from the Northumberland Strait. The sustainable annual rock crab yield from the southern Gulf of St. Lawrence has been estimated at 1360 to 2270 t. Nevertheless, despite effective crab traps having been developed to exclude a lobster by-catch, the relatively small size of this crab, its low meat yield and high processing costs have so far hindered development of a wide-spread directed fishery.

Distribution — Labrador to South Carolina. Found from low water to 600 m; commonest in shallow water, especially in bays. Highly abundant in the southern Gulf of St. Lawrence, although plentiful along the coastline of Newfoundland, Nova Scotia and in the Bay of Fundy. Most frequently

Fig. 5. Deep-sea red crab (*Geryon quinquedens*.)



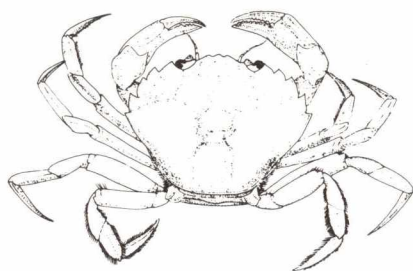


Fig. 6. Green crab (*Carcinus maenas*).

encountered on open sand or sand-mud bottoms.

Description — Nine, shallow, smooth-edged marginal teeth along each side of the front edge of the carapace; marginal teeth pointed at widest part of carapace; surface of claws and carapace relatively smooth (compared to jonah crab); background colour variable above, generally yellow-brown, with overlay of minute purple or crimson spots; pale yellow underneath; up to approximately 140 mm carapace width and 0.25 kg in weight.

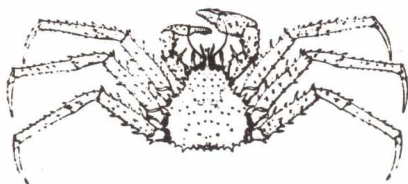
JONAH CRAB, *Cancer borealis*
(white crab)

There have been intermittent small landings of jonah crab by-catches by lobster fishermen in the Bay of Fundy and off southern Nova Scotia since the mid 1960s. Canadian jonah crab landings in 1983 amounted to approximately 204 t, with 90 t being accounted for by a newly-instigated directed pilot fishery on the Scotian Shelf. With high catch rates by the directed fishery in 1984 and processing difficulties (due to the jonah crab's hard brittle shell) being overcome, the commercial forecast for this fine-flavored crab appears promising.

Distribution — Occurs from Nova Scotia to South Carolina; from low water to over 800 m. Dominant crab species at intermediate depths away from shore off Nova Scotia; present in the Bay of Fundy. Not recorded from Gulf of St. Lawrence.

Description — Similar to rock crab, but carapace outline more rounded, legs relatively shorter but claws more massive than rock crab; nine, rectangular, rough-edged marginal teeth on each side of the front edge of the carapace; surface of claws and carapace rough; background colour variable but generally yellow-brown above and yellowish below. Up to approximately 180 mm carapace width and 0.4 kg in weight.

Fig. 7. Northern stone crab (*Lithodes maja*).



DEEP-SEA RED CRAB, *Geryon quinquedens*

There are presently no Canadian landings of deep-sea red crab although

a small-scale pilot fishery existed on the Scotian Shelf edge in the early 1970s. However, fisheries have been established for this large attractive crab along the Atlantic coast of the United States and off the west coast of Africa since 1973. Recent exploratory surveys indicate a trappable resource in excess of 2700 t of large male crabs along the Scotian Shelf edge from the Fundian Channel to Sable Island. The flavor and texture of deep-sea red crab meat is excellent and the species shows real commercial potential, particularly in conjunction with the directed trap fishery for jonah crab.

Distribution — Nova Scotia to Cuba; commonly from 40 to 2000 m. Very abundant in patches along edge of the continental slope from western Scotian Shelf to Georges Bank at depths of 180 to 550 m. Occurs in the Bay of Fundy. Found on mud, sand or hard bottoms.

Description — Carapace squarish; usually deep orange or red; five marginal teeth along each side of the carapace; walking legs long and slender; males reach a maximum carapace width of approximately 180 mm and a weight of nearly 1.4 kg.

GREEN CRAB, *Carcinus maenas*
(shore crab, harbor crab, japanese crab)

The green crab, in addition to offering some limited opportunities for exploitation, is particularly renowned as a serious pest of other shellfisheries. Probably introduced from Europe in ships' bilges, the green crab was restricted to shores south of Cape Cod until the late 1800s. Aided by general warming trends, the species has slowly spread northwards until its present day distribution extends into the Bay of Fundy and along the Atlantic coast of mainland Nova Scotia. A rapacious predator of clams, mussels and oysters on both sides of the north Atlantic, the green crab is also a pugnacious competitor with lobsters and other crab species for prey and space. The green crab's small size probably precludes anything other than localized, casual harvesting of the largest individuals for food; however, it is of minor commercial importance as a bait for sport fishermen in the United States and Europe.

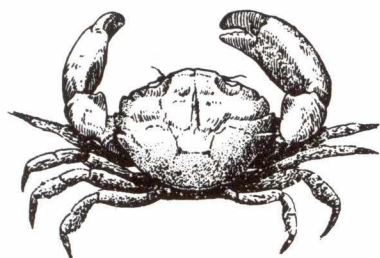


Fig. 8. Mud crab (*Neopanope sayi*).

Distribution — Abundant along the Atlantic coast of Nova Scotia to Bay of Fundy to New Jersey. Commonest crab on rocky shores, occurs intertidally and subtidally to about 10 m.

Description — Carapace colour dark green to brown, sometimes with white or black patches; five prominent marginal teeth along each side of carapace. Claws usually unequal; posterior pair of legs compressed with marginal hairs. Males reach a maximum carapace width of about 85 mm and weight of 0.2 kg.

NORTHERN STONE CRAB,

Lithodes maja (spider crab)

Concentrations of the northern stone crab on the southern Scotian Shelf have occasionally been subject to small-scale exploratory trapping by offshore lobster and Jonah crab vessels. Although meat from these striking crabs is apparently delicious, the shells are reported to be extremely hard. The overall distribution of high concentrations of northern stone crab appears so limited as to preclude either a long-term directed fishery or a by-catch fishery; however, the species might be a target for periodic pulse fishing by crab and lobster vessels when catches of more traditional crustaceans are low.

Distribution — Newfoundland to New Jersey and northwestern Europe; from 65 to 800 m. In the Gulf of St. Lawrence it appears to live in deeper, warmer water than the snow crab. Occurs in Bay of Fundy and on the Scotian Shelf. Very abundant in patches at intermediate depths.

Description — Resembles snow crab in size and general shape but readily identified by the numerous prominent spines on its carapace and legs; carapace slightly longer than wide; long spiny rostrum; orange/red in colour; only 3 pairs of walking legs apparent. Up to approximately 100 mm carapace width with a leg spread of 600 mm and a weight of 1.4 kg.

MUD CRAB, *Neopanope sayi* (Caribbean mud crab)

Too small to command gastronomical interest, the mud crab is never-

theless of concern to shellfish culturists because of its pestiferous nature. In the southern Gulf of St. Lawrence, mud crabs feed on small oysters attached to spat collectors. Although the average predation rate by an individual mud crab is probably no more than one oyster every 2 days, the large numbers of the crabs magnify their impact and make control measures desirable.

Distribution — Gulf of St. Lawrence to Florida; abundant during the summer months in bays around Prince Edward Island, occasionally encountered around Nova Scotia and the Bay of Fundy. Occurs on soft mud bottoms to about 10 m.

Description — Carapace oval shaped, dark reddish-brown in colour. Males have markedly unequal claws with the fingers dark brown or black. A small, stout crab reaching no more than 27 mm across the carapace.

TOAD CRAB, *Hyas sp.* (policeman crab, sea toad, spider crab)

The ubiquitous toad crabs are common by-catch in the existing lobster and snow crab fisheries and could also form an incidental catch to developing crab fisheries. Although unattractive "in-the-shell" and unlikely to warrant directed harvesting, the extracted meat from the by-catch of larger toad crabs might form a worthwhile supplement to lobster and other crab catches.

Distribution — Widespread on both sides of the north Atlantic; from low water to about 1650 m; in the Gulf of St. Lawrence and Bay of Fundy, around Newfoundland and Nova Scotia. Very common in places, mostly at intermediate depths, overlaps rock crab and snow crab zones.

Description — Uneven carapace surface; four pairs of round, tubular walking legs. Carapace approximately 1 1/3 times longer than wide; up to a maximum carapace width of about 100 mm and a spread of 450 mm; maximum weight approximately 0.7 kg.

PORCUPINE CRAB, *Neolithodes grimaldii* (spiny spider crab)

There is so little information on the distribution, abundance and life history of the porcupine crab that

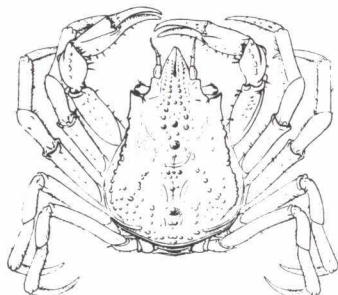


Fig. 9. Toad crab (*Hyas sp.*).

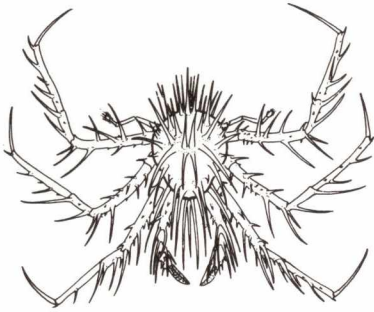


Fig. 10. Porcupine crab (*Neolithodes grimaldii*).

forecasts as to its commercial potential are very tenuous. Concentrations of the porcupine crab are probably so sporadic that it is improbable any long-term directed or by-catch fisheries could develop. However, as for the northern stone crab, it is possible that intermittent landings may occur if crab or lobster fishermen decide to occasionally retarget onto commercial patches of these extraordinary looking beasts.

Distribution — Both sides of the north Atlantic; 100 to 2000 m. Occurs in patches at intermediate depths on the Scotian Shelf. Not recorded from Gulf of St. Lawrence or Bay of Fundy.

Description — Similar to northern stone crab but extremely prominent spines on carapace and appendages. Reaches a maximum carapace width of approximately 100 mm, a leg spread of 760 mm and a weight of 1.4 kg.

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Published By:

Communications Directorate
 Department of Fisheries and Oceans
 Ottawa, Ontario
 K1A 0E6

DFO/1897 UW/43

Minister of Supply and Services
 Canada 1985
 Catalogue Number Fs 41-33/43-1985E
 ISBN 0-662-13648-9

Disponible en français