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# Underwater World

## The Atlantic Snow Crab



Canada

## The Atlantic Snow Crab

Snow crab (*Chionoecetes opilio*) is the most important commercial crab species in eastern Canada. It ranks sixth in the value order of all commercial species, worth nearly \$20 million to Canadian fishermen in both 1979 and

1980. Its value is much higher when the finished product is sold on the market. Furthermore, its complex processing generates an unusually high number (several thousands) of well-commod jobs.

Since females never exceed the commercially acceptable and legal minimum size, they are not kept by fishermen. Only the males are harvested.

When the fishery for snow crabs was developing in eastern Canada, they were known as spider crabs or queen crabs. These names have since been replaced by snow crab, after a ruling by the American Food and Drug Administration stated that if they are to be marketed in the United States, all species of the genus *Chionoecetes* must bear the earlier established trade name of snow crab.

The snow crab is a crustacean (like lobster and shrimp) with a flat and almost circular body, slightly wider in the back. It has five pairs of long spider-like legs that are somewhat flattened, the first one being equipped with claws. The fully grown male is almost twice as large as the female, reaching (although rarely) a maximum shell width of 16.5 cm, a leg span of over 90 cm and a weight of 1.35 kg. The average size crab in the commercial catch measures approximately 11 cm and weighs 0.5 kg. Females grow to a maximum of only 9.5 cm shell width, with a leg span of 38 cm and weight of 0.45 kg. They have no commercial value. Males have proportionally longer legs and larger claws than females. The abdomen, which is relatively small and folded under the body, is quadrilateral in males but circular in females.

Shell colour varies. Just after shedding (molting), it is reddish on the upper surface and creamy white beneath. The animal is then called a "white crab". As the shell hardens and ages, it changes to a dull greenish brown above and dull yellow beneath. It eventually will become covered with small marine organisms.

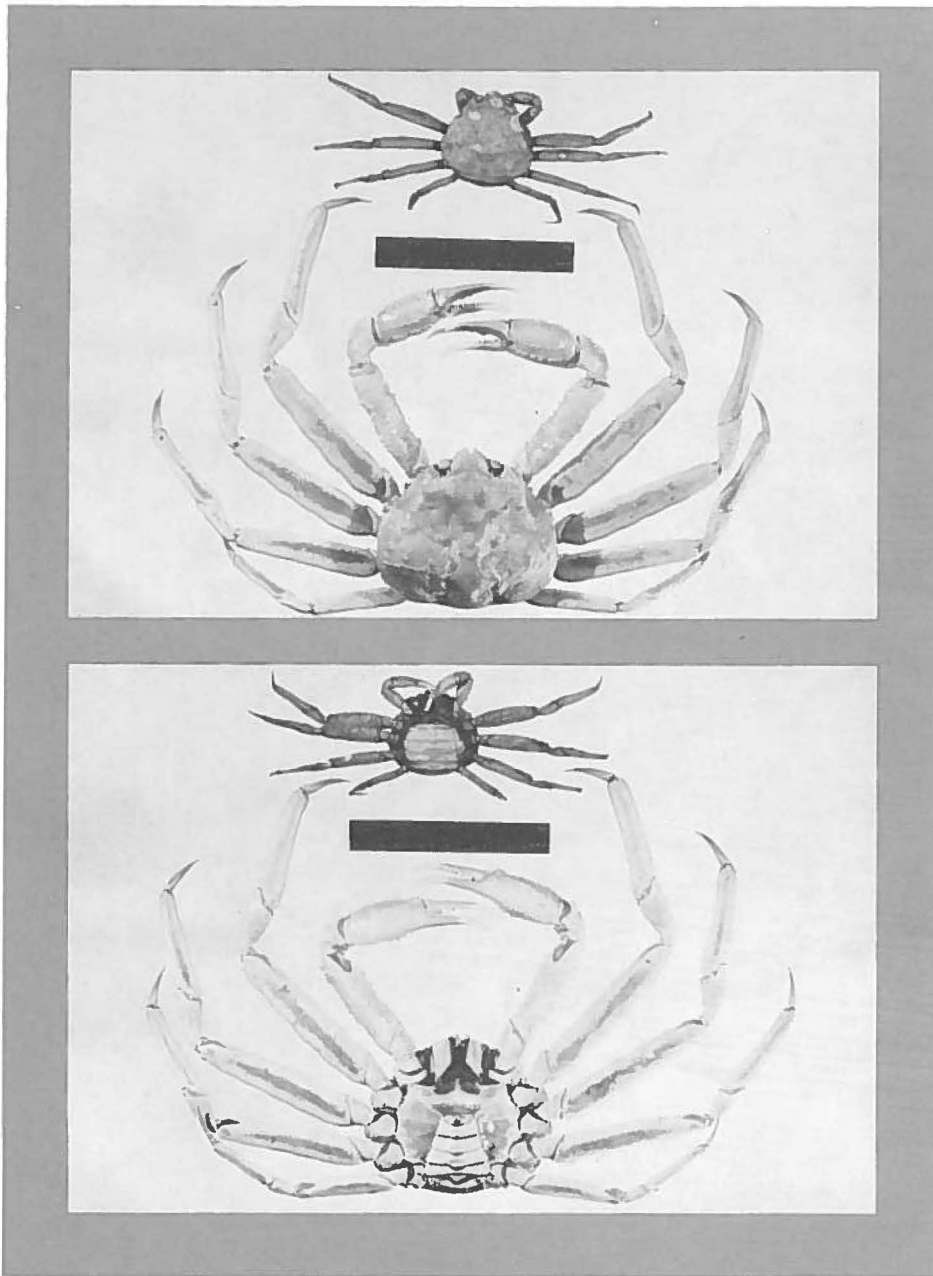


FIG. 1 Back view (top) and underside (bottom) of female and male snow crabs. On the underside, notice the circular abdomen of the female and the quadrilateral abdomen of the male.

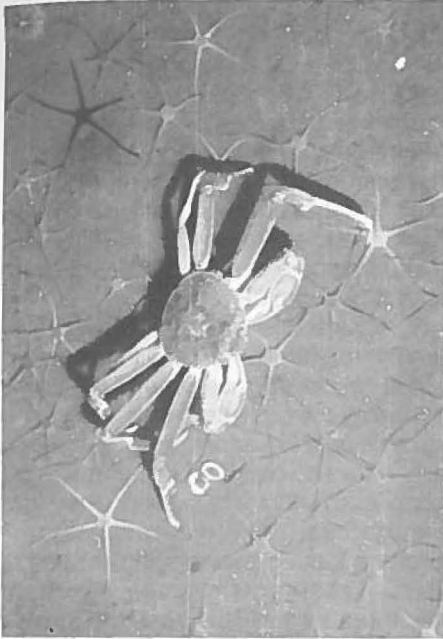


FIG. 2 Male snow crab on a muddy sea bottom covered with brittle stars, its usual habitat.

Toad crabs (*Hyas araneus* and *H. coarctatus*) are other spider-like crabs that are sometimes found in the shallow part of the snow crab habitat. They can be distinguished by their tubular legs, a more elongated body resembling the shape of a violin, and a wider range of colour (from gray to brick red).

#### Distribution and Habitat

In the Pacific, where snow crabs are represented by more than one species, they occur from the Sea of Japan to Alaska, British Columbia, and the States of Washington and Oregon. In the northwest Atlantic, they extend from west Greenland down the Canadian Atlantic coast and into the Gulf of Maine where only a few individuals have been reported. They are totally absent from the northeast Atlantic.

Snow crabs are common in the estuary and the Gulf of St. Lawrence, around Cape Breton Island and in the bays of Newfoundland, from Fortune Bay to White Bay. They are also found near Hamilton Bank off Labrador.

Snow crabs live most commonly on muddy or sand-mud bottoms at temperatures ranging from  $-0.5$  to  $4.5^{\circ}\text{C}$ . In the Gulf of St. Lawrence, they are usually found at depths of 70 to 140 m, while in Cape Breton the depth varies from 45 to 245 m, and from 170 to 380 m off Newfoundland. The distribution of small crabs is not well documented but they are occasionally found with the adults, or on gravelly bottoms at shallower depths. In some areas, there are indications that snow crabs move from gravel bottom to mud bottom, usually in deeper waters, as they reach maturity.

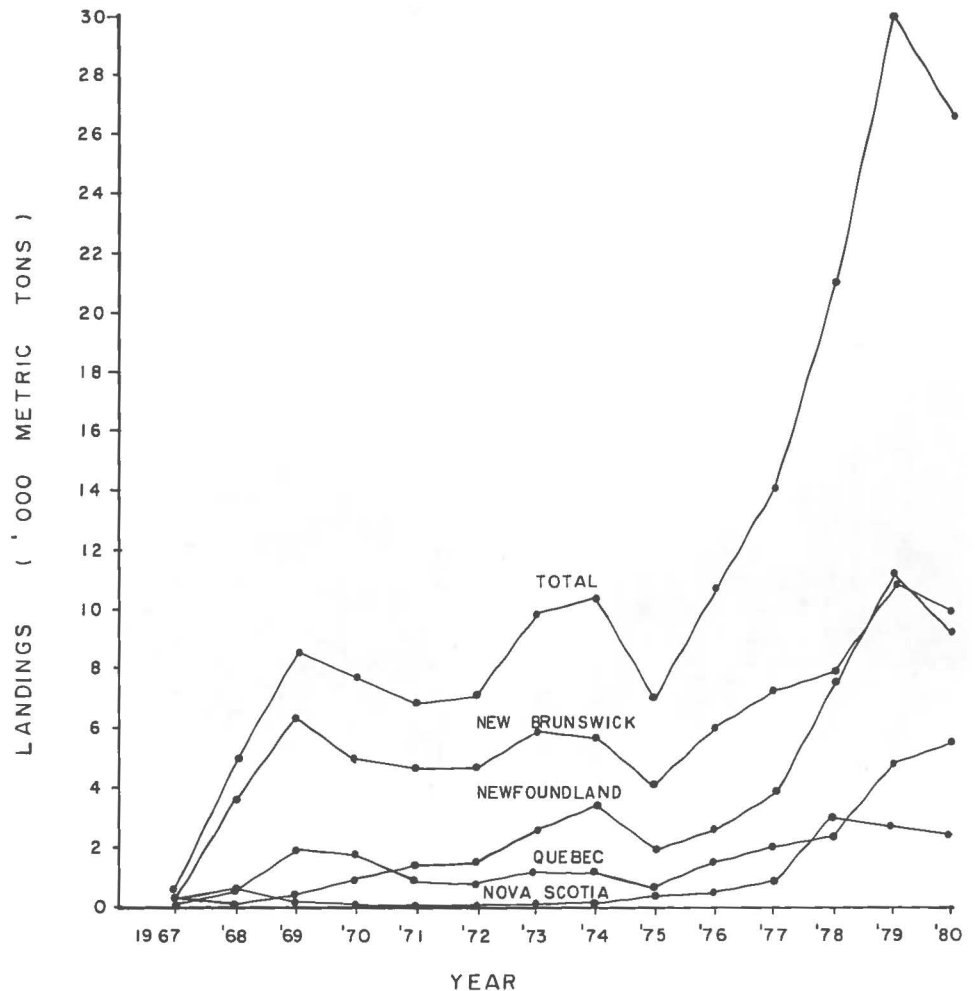


FIG. 3 Annual landings of snow crab in eastern Canada.

Photographs of snow crabs in nature show that they are frequently found along with brittlestars, which are one of their food items. They also show that females tend to stay together in large groups, while males are distributed more randomly. In some instances, crabs were seen partially buried in the mud, probably as a means for protection.

Tagging experiments carried out in the Gulf of St. Lawrence did not indicate any clear pattern of seasonal movements by the male snow crabs, which had travelled in many directions before recapture. Most of them (80 to 90 per cent) were caught within 25 km from the point of release, but a few had travelled up to 50 km in less than a year, indicating that snow crab is not at all a sedentary species.

#### Life History

Mating is thought to occur at the end of the winter or in the spring. During the mating period, the male holds the female with his claws until she molts. He may even help her out of her old shell. Soon after, sperm is deposited into the openings of the female's sperm sacs located underneath her abdomen. Depending on her size, she then lays 20,000 to 150,000 eggs over a

period of a few days. A female can lay and fertilize more than one annual batch of eggs without further mating, since she can store spermatophores for long periods. The eggs are deposited on hairy appendages, located under her abdomen, where they are carried until the following year. During this period, the eggs change colour from bright orange to dark purple or black. In the southern Gulf of St. Lawrence, hatching starts in May and is generally completed by July.

Newly hatched crabs (larvae) are about three mm long. They immediately rise to the surface where they are carried by the currents before they settle back on the bottom, most probably at a different place than where they hatched. During this period, they go through three different larval stages before adopting the regular shape of crabs. These young crabs are then only three mm wide across the shell.

Since their shell is hard, crabs, like lobsters and other crustaceans, must molt to grow. Molting (ecdysis or shedding) is a process by which an animal gets rid of an old shell in order to grow in size. This process is repeated less and less frequently as an individual gets older and larger.

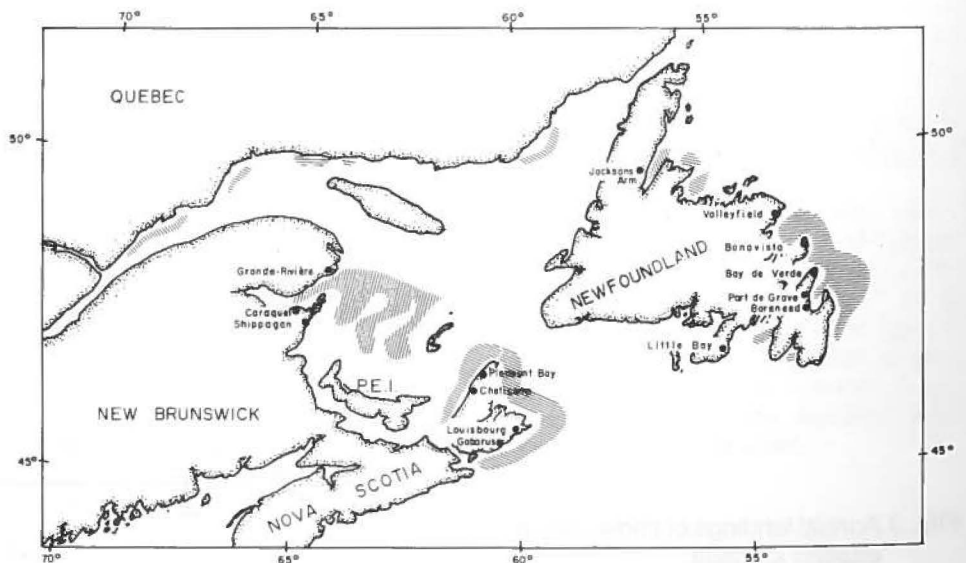


FIG. 4 Distribution of snow stocks (hatched zones) exploited in eastern Canada.

Between molts, the crab builds more organic tissues and prepares a new shell under the old one. When this process is completed and the conditions are suitable, the body shell splits at the back and the crab molts by backing slowly out of the old shell. Large crabs may take up to 10 hours to emerge from the old shell. Immediately after molting, the wrinkled, soft crab takes up water and swells to its new size in a few hours. The soft shell, covering all the body and the legs, gradually hardens and again, more muscles and other tissues grow inside, replacing the water that was absorbed at molting. It may take two months for a commercial-size crab to lose its soft-shell condition and possibly more before it is at its best for harvesting.

At each molt, mature males grow about 20 per cent in width and 60 per cent in weight. Since the frequency of molting is not well known, age and growth are very difficult to determine. Very approximately, crabs of the minimum legal size (9.5 cm) are thought to be at least six years old.

For protection against enemies, each leg of the crab has a small circular groove at its base, which allows the crab to snap off the leg should it become entangled or held by a predator. A valve at this point prevents major blood loss and a healing scar is quickly formed. A leg bud begins to grow from the scar and at the next molt a small new leg is formed. Normally, it takes three molts for the leg to grow back to normal size.

At a shell width of 6.5 cm in the Gulf, and 6.0 cm off Newfoundland, most males are mature and can mate successfully. At maturity, the claws of males become proportionally larger than those of females or immature males. In mature females, the abdomen increases proportionally in size and the small appendages under the abdomen become large and branched with many fine hairs upon which the eggs are eventually deposited. Size at maturity for females can be as small as five cm in shell width.



FIG. 5 Conical trap commonly used in Newfoundland.

Snow crabs feed on a variety of food. Their stomachs may contain remains of different kinds of shellfishes, worms, sea urchins, brittlestars and detritus. They can crush hardshelled animals with their strong claws and mouthparts. Feeding activity is apparently higher at night.

#### Commercial Exploitation

The commercial fishery for snow crabs on the Canadian Atlantic coast began in 1967 after exploratory surveys had located abundant stocks in the Gulf of St. Lawrence. Since then, new stocks have been located almost every year. In 1967, a total of 616 tons (t) were caught in the Gulf waters. It reached 4 919 t in the following year and fluctuated between 5 000 and 8 000 t until 1976. Since then, the annual landings reported in the Gulf have been increasing steadily to reach a peak of roughly 18 000 t in 1979, almost equalled in 1980. In Newfoundland, the landings also followed a fairly constant increase, which was more important in the last three years. In 1978, eastern Canada produced 20 per cent of the world catches of snow crab, with total landings of 21 000 t.

The main fishing grounds in the Gulf are located between Gaspé Peninsula and the Magdalen Islands, and around Cape Breton Island. The main ports of landings are Caraquet, Shippegan and Lamèque in New Brunswick, Grande-Rivière and Ste-Thérèse in Québec, and Pleasant Bay in Cape Breton. In Newfoundland, most of the commercial catch is made in the Conception Bay and Bonavista Bay areas.

Bad weather and ice-cover in the winter prevents fishing from November to April in the Gulf, so the fishing season generally lasts less than six months. In Cape Breton, it is restricted by regulation to about two months. In some areas off Newfoundland, where the ice conditions are favorable, crab fishing may continue all year-round, except for a legal closure in January.

Fishing trips are usually one or two days long, depending on weather, number of traps to haul, and distance from port. Boats are generally 12 to 20 m long. Traps used in the Gulf are the big square ones, 1.5 X 1.5 X 0.6 m in size, made of welded steel rods and covered with polypropylene netting.



FIG. 6 Examining Snow Crab at Dockside.

They have two entrances placed on opposite sides. Fresh or frozen herring is the usual bait. In Newfoundland, conical traps are used exclusively; they are 120 cm across the base and 65 cm high, covered with polypropylene netting and have a plastic entrance at the top. They are generally set in strings of 35-60 pots, baited with frozen squid and are better adapted to fishing in greater depths (over 180 m, as compared to 70-125 m in the Gulf).

After their capture, the crabs are held live on ice in the hold of the fishing boat. They are usually butchered within a few hours of delivery to the plant. The leg sections are washed, cooked in the shell and cooled. Meat is shaken out mostly by hand but some producers are developing mechanical processing. For instance, the leg tips are generally processed by squeezing rollers. Nevertheless, the hand method has so far proved to be most efficient for obtaining good, high quality meat yields of approximately 20 to 25 per cent of live weight. When the meat has been cleaned, it is either quickly frozen or processed in cans. Most of the production is exported to the United States and Europe. A new quality control program, implemented by the federal government, requires that every producer meets a minimum standard of quality before being permitted to export its production. This program should ensure that the buyers obtain a product of reliable quality.

#### **Management and Research**

There are various regulations and management controls applying to the snow crab fisheries. They deal with the number of licenses issued each year, the allowed number of traps per boat, the mesh size in the traps, the quotas, the fishing zones and seasons and the minimum legal size of crabs.

From year to year, various information is collected on the biology of the crabs and on the fisheries throughout the fishing season. Biologists sample crabs in port and on board vessels for size, maturity, shell hardness and weight. They also gather information on distribution and intensity of the fishing effort from log books that fishermen keep on their fishing activities. This helps to monitor and understand how the fishery influences the crab population.

Specific areas of research concern the evaluation of abundance of the crabs, the recruitment of young crabs to the commercial stocks, and the estimation of growth and mortality rates. A tag that would remain on the crab despite its molting has yet to be developed but such a tag would be very useful in the study of growth. Methods to evaluate the abundance, such as the use of bottom photography and submersibles, is being considered in future projects. The relationship with cod, which feeds heavily on juvenile crabs, is another important subject of investigation. The results of these biological studies will enable the managers to select the most appropriate management policies for resource conservation and optimal exploitation.

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