CRABS AND LOBSTERS

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Summary

Crabs and lobsters are edible, highly sought, conspicuous, and distinctive marine crustaceans. We tell you about their general biology and ecology, and the fisheries for them. First we overview the main exploited species and fisheries of crabs, clawed lobsters, spiny lobsters and slipper lobsters. Then we deal with harvesting methods - traps, nets, trawls, diving and hand gathering—and go on to discuss the problem of ghost fishing by lost traps and possible solutions to minimize the impact. The next part is dedicated to the biological features important for resource exploitation, management and sustainability - general ecology, growth, reproduction and migration. The fifth part is a short review of methods used for stock assessment and of management strategies; it includes consideration of the selective impact of fishing. The last part suggests the directions research and management could take in the future.

1. Introduction

Crabs and lobsters are crustaceans, more precisely reptant (creeping) decapods. These often-large invertebrates are found in all the oceans of the world and are exploited in most temperate and tropical waters, from the intertidal zone down to more than 1000 meters. Crabs and lobsters are some of the most sought after and high-priced seafoods. They are also the basis for important recreational fisheries. Owing to their hard shells, they transport well and many species are sold live in national markets or are exported to other countries. Important markets also exist for canned crabs and the frozen tails of spiny and clawed lobsters. Cumulative world landings of these crustaceans in 1996 were approximately 1 428 000 tonnes, worth $US6175 million (FAO statistics): crabs 1 219 000 tonnes, clawed lobsters 133 000 tonnes, spiny lobsters 73 000 tonnes, and slipper lobsters 3000 tonnes.

Vernacular names are often a problem for crabs and lobsters, especially species fished in more than one country or exported to other countries. Some examples: spiny lobsters are just as correctly referred to as rock lobsters, and the clawed lobster *Nephrops norvegicus,* fished by more than 20 countries in Europe and North Africa, is known locally by more than 50 names. To avoid confusion in this document, one common

name for each species will be used, along with the scientific name at each first mention in the text. Thereafter, the common name will be used. Lobster species will be referred to specifically as clawed lobster, spiny lobster, or slipper lobster.

2. Species and Fisheries

2.1 Crabs

Exploited crabs (see Table 1) comprise species which belong to the groupings: 1) Anomura: Lithodidae (e.g. red king crab, *Paralithodes camtschaticus*) and Galatheidae (e.g. munids, or squat lobsters (e.g. *Cervimunida johni* and *Pleuroncodes monodon*)), and 2) Brachyura: Cancridae (e.g. European edible crab, *Cancer pagurus*, and Dungeness crab, *C. magister*), Geryonidae (e.g. Atlantic red crab, *Chaceon quinquedens*), Grapsidae (e.g. Chinese mitten crab, *Eriocheir sinensis*), Majidae (tanner and snow crabs, *Chionoecetes spp*.) and Portunidae (e.g. blue crab, *Callinectes sapidus*, and Gazami crab, *Portunus trituberculatus*).

		Mean 1984–1995	**1996**
Reptantia	Marine crabs	287 716	391 465
Portunus trituberculatus	Gazami crab	148 876	303 170
Callinectes sapidus	Blue crab	103 235	115 584
Chionoecetes spp	Pacific tanner crabs	86 960	34 232
Paralithodes spp	King crabs	50 368	81 338
Portunus pelagicus	Blue swimming crab	49 462	111 615
Chionoecetes opilio	Queen, or snow, crab	40 000	65 920
Cancer pagurus	European edible crab	28 773	29 400
Cancer magister	Dungeness crab	19 275	34 410
Scylla serrata	Indo-Pacific swamp crab	12 996	21 726
Geryon spp	Geryons nei	6015	6127
Maja squinado	Spinous spider crab	5096	5700
Callinectes danae	Dana swim crab	4342	4180
Portunus spp	Swim crabs	3873	2950
Cancer irroratus	Atlantic rock crab	2516	3580
Menippe mercenaria	Black stone crab	2443	3652
Lithodes antarcticus	Southern king crab	2367	1959
Chaceon (= Geryon) quinquedens	Red crab	1491	465
Cancer borealis	Jonah crab	822	334
Carcinus aestuarii	Mediterranean shore crab	799	565
Carcinus maenas	Green crab	708	697

Chaceon (=Geryon) maritae	West African geryon	196	400
Paralomis granulosa	Soft-shell red crab	5	1
	TOTAL CRABS	858 333	1 219 470

Table 1. Mean 1984–1995 and 1996 annual landings (t) of crabs (from FAO statistics).

2.1.1 The Dungeness Crab (*Cancer magister*) Fishery

This species is found in the eastern North Pacific from the Aleutian Islands to northern Mexico, and occurs on sandy substrates from the intertidal to a depth of about 180 meters. Adult males, the largest and only exploited sex, can reach 230 mm. CW (excluding the carapace spines) but in exploited populations, few crabs exceed 190 mm. CW. These crabs have a 3–4-mo larval dispersal phase and as adults (older than 2 years), mostly occur near shore. MLS varies slightly by political jurisdiction, but is about 155 mm. CW. Dungeness crabs are taken commercially only by trapping, although, since their distribution can overlap with commercial concentrations of groundfish, crabs can be an accidental bycatch in trawling. Population size is partially determined by available habitat, and since the nearshore is mostly rock and fjord in coastal British Columbia (Canada), and Alaska (USA), crab populations there are typically small and geographically isolated. The largest landings come from Oregon and Washington (USA), where landings peak cyclically, for unknown reasons, every 8 or 9 years. Overall, landings have been relatively constant since most fisheries became fully exploited in the 1960s. Dungeness crabs are mainly sold live or freshly cooked in western North America.

2.1.2 The Blue Crab (*Callinectes sapidus*) Fishery of the USA

Blue crabs are portunid, or swimming crabs, which occur in the western North and South Atlantic Oceans, from Massachusetts (USA) to Uruguay. They mature at 1–1.5-years and live only 1-year more. Landed crabs range in size from 112 to 204 mm. CW, with a MLS in the USA of 127 mm. CW for hard males but no size limit for hard females. There is no size limit for peeler and soft-shell crabs in Virginia, and size limits for these crabs are 75 and 88 mm. CW, respectively, in Maryland and Delaware. Soft-shelled crabs are those which have recently molted and their shells are only just beginning to firm; hard crabs are those which molted well before capture.

Adult males remain in brackish water all their lives, while mated females leave low salinity waters, and migrate to the mouths of bays in spring and fall, where they extrude eggs 2–9 months later. Larvae are pelagic for 1–2 months and are abundant in nearshore waters, but only those that return to estuaries seem to survive.

This crab is fished in both deep channels in estuaries and in the brackish waters of upper estuaries. It is the major benthic crustacean fished in the USA between Cape Cod and Florida, with about 40% of landings coming from Chesapeake Bay. While recent landings have fluctuated, they have always been substantial.

2.1.3 The Snow Crab (*Chionoecetes opilio*) Fishery

Snow crabs are majid crabs, which, in the western North Atlantic, occur only in the Gulf of St. Lawrence and north of mainland Nova Scotia, Canada. In the North Pacific, this species occurs only in the northern part of the Bering Sea. In eastern Canada they are fished at depth ranges of 35–700 meters and can be found from 15–1000 meters. They prefer water temperatures of -2 to 4°C, and mostly occur in deep temperate waters. Males, again the only exploited sex, are much larger than females, and reach a maximum size of about 140 mm. CW. Larvae are pelagic for about 3 months. The biology of majid crabs is unusual in that there is a terminal molt in both sexes (males are distinguished by their disproportionately large chela or nipper). Once individuals reach a certain size no more molting occurs, and the crab lives another 5 years or so at that size. Male terminal molt crabs vary in size from 35 to 140 mm. CW, and appear to do most of the mating. It has been suggested that the proportion of larger terminal molt individuals in the population may influence an individual's molting to the terminal molt state.

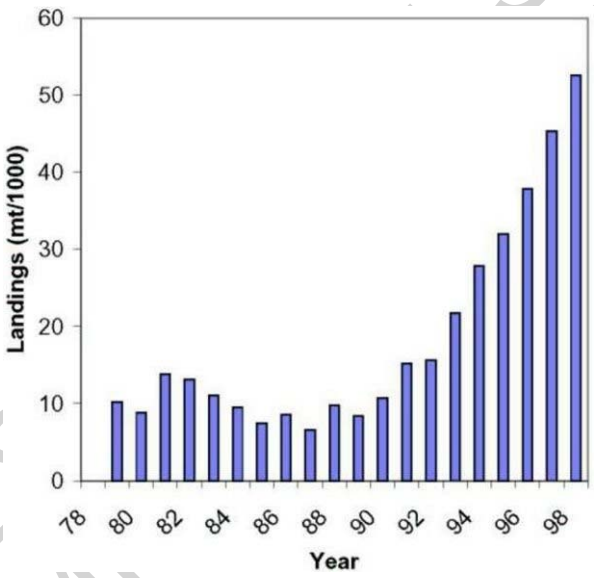

Figure 1. Snow crab landings in Newfoundland and Labrador (NAFO Divisions 3LNO, 3K, 2J, 3PS, and 4R), showing the increase in production following the collapse of groundfish stocks in the late 1980s (Dave Taylor, DFO, St John's, Nfld, Canada, personal communication).

Fishing, which targets the larger males (the MLS is 95 mm. CW in eastern Canada) and reduces their proportion may tend to decrease the size at which males molt to a terminal molt, which in turn may decrease the number of males above a specified MLS. Fisheries are managed with quotas, which means stock assessment data must be interpreted with care, as it can be difficult to estimate the annual recruitment to the exploitable portion of the population, a value which must be known if the resource is to be harvested in a sustainable manner.

In contrast to the North Pacific, snow crab abundance and range has increased dramatically off eastern Canada in recent years, coincident with the collapse of

groundfish fisheries there around 1990. The groundfish fishery collapse was at least partially the result of overfishing, but there was also a change in ocean climate at that time, with much colder waters moving into fishing locations. Whether environmental change or a reduction in predator abundance most favored crab survival is uncertain, but regardless, crab and shrimp fisheries have expanded spectacularly over the past few years (see Figure 1) and are now the region's major fishery resources.

2.1.4 Other Crab Fisheries

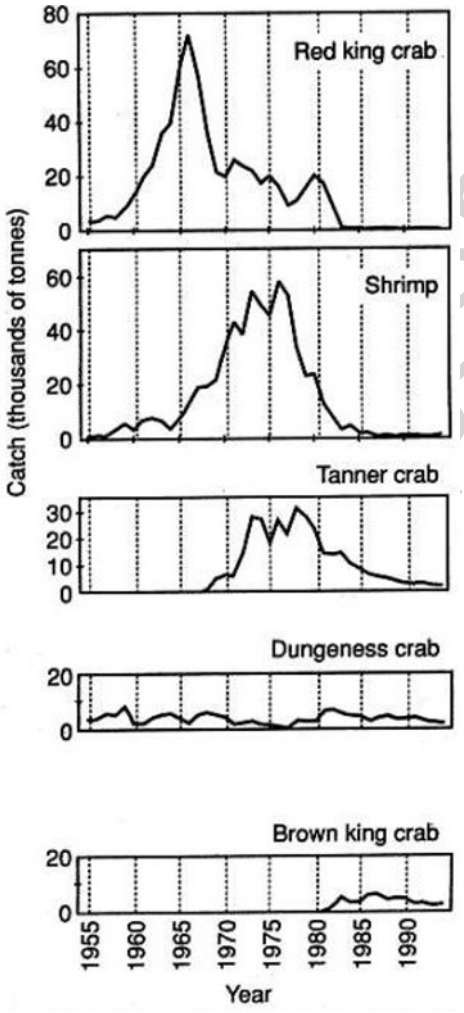

Figure 2. Historical trends of landings of major crustacean resources from the Greater Gulf of Alaska, showing serial depletion of crustacean resources (modified from Oresanz et al. 1998).

Although most near shore crab populations worldwide have been relatively consistent in production under quite high levels of exploitation, there have been significant declines among the deepwater stocks. This is somewhat paradoxical, because most effort has gone into management of the deeper-water stocks—specifically to avoid such problems of stock decline. Causes of substantial fishery reduction, or in some cases collapse, appear to have been the result of either or both natural and fishery causes. For example, the serial depletion of crab stocks through fishing is well documented for the Greater

Gulf of Alaska (see Figure 2), but in some other populations, dramatic decline may have been brought about more by natural factors. With Bering Sea red king crabs, which recruit at 6–7 years, juveniles up to about age 5 were abundant before the mid-1980s collapse, when they, and smaller juveniles, suddenly became much more scarce, for reasons unknown. This resulted in fishery closures in 1983, and more recently, from 1994 to the present. Annual landings from 1984 to 1993 ranged from 1900 to 9200 tonnes, well down from the 59 000 tonnes landed in 1980.

2.2 Lobsters

Among the approximately 170 marine species commonly referred to as "lobsters," those of commercial interest fall into three families (see Figure 3).

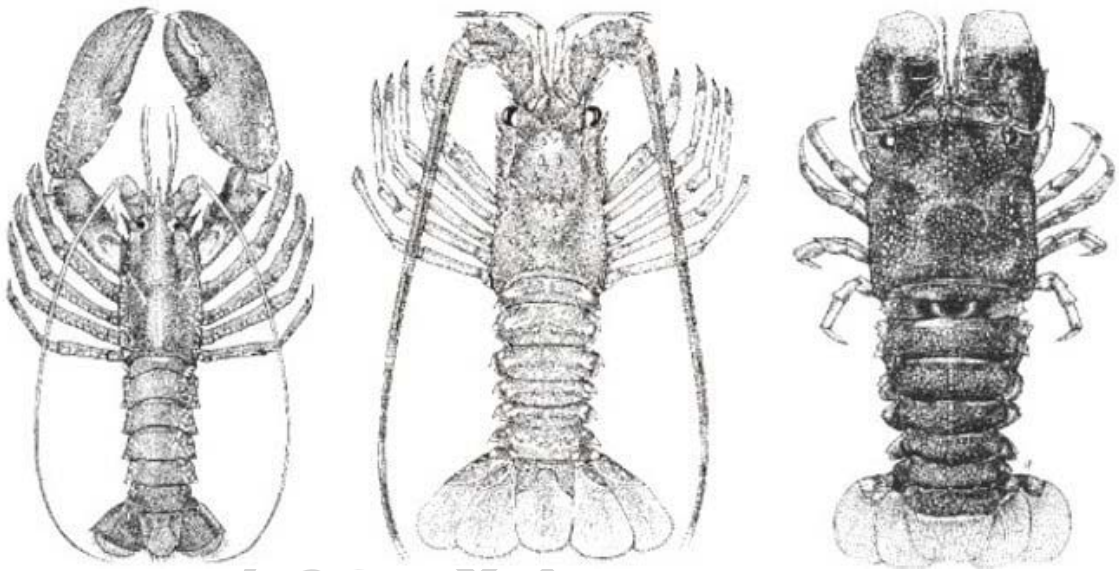

Figure 3. Family Nephropidae: clawed lobsters (left), with sub-cylindrical carapace and a rostrum, and the only lobsters with claws; family Palinuridae: spiny lobsters (center), with sub-cylindrical carapace, whip-like antennae, and horns over the eyes; family Scyllaridae: slipper lobsters (right), with a flattened carapace, antennal plates, and no rostrum or horn.

2.2.1 Clawed Lobster Fisheries

Exploited clawed lobsters belong to the family Nephropidae and include four genera: *Homarus*, *Metanephrops*, *Nephrops* and *Nephropsis*. Although more than 40 species are known, only three support important fisheries, all in the North Atlantic.

		Mean 1984–1995	**1996**
Homarus americanus	American lobster	65 064	71 817
Nephrops norvegicus	Norway lobster	59 086	57 324
Homarus gammarus	European lobster	2596	2577
Metanephrops challengeri	New Zealand scampi	436	670

Metanephrops andamanicus	Andaman lobster	375	132
	Total Clawed Lobsters	127 557	132 520

Table 2. Mean 1984–1995 and 1996 annual landings (t) of clawed lobsters (from FAO statistics).

2.2.2 The Norway Lobster (*Nephrops norvegicus*) Fishery

This species is found in the eastern North Atlantic from Iceland to south of Portugal, in the North Sea, and in the Mediterranean Sea, and occurs from 15 to 800 meters depth on mud or sand-mud bottoms into which it burrows. TL of adults varies from10 to 20 cm. Norway lobsters are caught by trawling, and occasionally by pots or traps, in more than 20 countries. Between 1984 and 1995, annual landings averaged 59 000 tonnes, mainly from the North Atlantic. Production has been fairly stable, with annual variation less than 10% of the average. Major producers over these 12 years period were the UK (averaging 27 700 tonnes per year), France (9300 tonnes), Ireland (4900 tonnes), Italy (4900 tonnes), Denmark (3400 tonnes), Iceland (2000 tonnes), and Greece (1000 tonnes). Despite its vernacular name, the mean annual landing from Norway is less than 200 tonnes. Norway lobsters are sold mainly fresh or frozen, sometimes canned, under the names of Norway lobster, and Dublin Bay prawn in the UK; deep sea lobster, Icelandic baby lobster, deep sea tail- and deep sea dainty in the USA; scampi in Italy and the UK; and langoustine in France.

2.2.3 The American Lobster (*Homarus americanus*) Fishery

This lobster lives in the western North Atlantic along the coasts of Canada and the USA (Newfoundland to North Carolina) on hard mud and rock bottoms from 0 to 500 meters depth, but is most common between 5 and 50 meters. Maximum TL is around 65 cm. but most lobsters caught are 25 cm. TL or less. Baited traps fish them. The 1996 landing was 71 800 tonnes (mean 1984–1995: 65 000 tonnes), 39 300 tonnes from Canada, and 32 500 tonnes from the USA. Canadian landings data, available for more than a century, indicate long term variability in mean recruitment to the stock. Abundance was high 100 years ago, down half over the following 70 years (with minor peaks around 1930 and 1950), and then it has been at a high level for the past 30 years. American lobster is sold live, frozen or canned.

2.2.4 The European Lobster (*Homarus gammarus*) Fishery

This species is similar to the American lobster. It is found at 0–150 meters depth (but usually less than 50 meters) in the eastern North Atlantic from the Arctic Circle south to Morocco, and in the Mediterranean Sea where it is scarce. It is found on hard substrates, rock or hard mud, where it shelters in holes and crevices. Maximum TL is 60 cm. but most lobsters caught are 25–40 cm. TL. Baited traps also fish it. Landings in 1996 were 2580 tonnes (mean 1984–1995: 2600 tonnes): 1050 tonnes from the UK, 570 tonnes from Ireland, 270 tonnes from France, and 260 tonnes from the Channel Islands. Production has been fairly stable. European lobster is nearly always sold live.

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Biographical Sketches

Daniel Latrouite is a French senior research scientist at Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER). He has been for more than 25 years involved in the field of small-scale fisheries at IFREMER Fisheries Department, successively in La Trinité-sur-Mer, Roscoff and Brest. After a seven-year period working on scallops and clams, he shifted to crustacean and is a specialist of crabs and lobsters. His work in this area is currently tended at a complementary approach between Science and requirements of Industry and Administration for fisheries management. Concurrently to his involvement in crustacean and small-scale fisheries, he is heading a laboratory working on Sclerochronology (ageing) of Aquatic Animals.

John Booth is a New Zealand shellfish research scientist whose particular interests are larval, post-larval, and juvenile processes in spiny lobsters. John has published widely in local and international journals, and contributed to several books on lobster fisheries, management, and biology. Palinurid phyllosoma retention and recruitment mechanisms, and factors impacting on puerulus settlement rates, have been a major focus of his work—much of this collaborative with other researchers, particularly from New Zealand, Japan and Australia. He has also reported on juvenile ecology and behavior, the relationship

between puerulus settlement levels and the oceanography and the ocean climate, and juvenile migrations. He has also recently investigated Scyllarid, larval dispersal and recruitment off New Zealand. Addressing survival bottlenecks of spiny lobsters at and soon after settlement, and ways that they might be mitigated in order to increase local production, is an important focus of John's present research. This involves experiments using small, removable, artificial shelters. Dr Booth completed his Ph.D. in 1972, on the morphology and ecology of bivalve larvae. His other research interests in this area involve enhancement of degraded shellfish stocks and bivalve reproduction strategies. John convened the Fifth International Conference and Workshop on Lobster Biology and Management held in Queenstown, New Zealand in February 1997. He is an editor of The Lobster Newsletter. He lives in Wellington and has two sons.

Glen Jamieson has been a research scientist for 23 years with the Canadian Department of Fisheries and Oceans. He spent the first five years in the Maritime Provinces and the past 18 years in British Columbia. While at the Pacific Biological Station, Nanaimo, B.C., he headed the invertebrate stock assessment program from 1981 to 1993. He is now primarily involved with marine ecosystem and protected area studies. He obtained his B.Sc. at McGill University in 1967, and his M.Sc. and Ph.D. at the University of British Columbia in 1970 and 1973, respectively. He has published extensively on exploited invertebrate species and their management, and is now particularly interested in studying range expansions and impacts of exotic marine species. He has previously organized and been senior editor on two North Pacific Invertebrate Stock Assessment and Management Symposia (*Can. Spec. Publ. Fish. Aquat. Sci*. 92 and 125, 1986 and 1998, respectively), and is currently involved in both the ICES (Atlantic) and PICES (Pacific) Working Groups on Crabs. Dr. Jamieson has been on the Editorial Board of the Canadian Journal of Fisheries and Aquatic Sciences since 1993.