

NORTH AMERICAN CRAB FISHERIES: REGULATIONS AND THEIR RATIONALES

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ABSTRACT

Because of similarities in species' life histories, fishing and processing methods, economics of fishing and processing, and political systems among jurisdictions, managers of North American crab fisheries share many common problems. This review is presented to suggest options to those delegated the responsibility for managing crab fisheries.

The review is organized by fishery and management problems. Six fisheries in 12 government jurisdictions are included. Regulations are grouped into management problems of 1) conservation, 2) allocation of landings among commercial fishermen, 3) stability of landings, 4) conflict over grounds or resource, 5) processing economics, and 6) administration. A final section discusses procedures in eight jurisdictions by which public or government representatives may effect changes in regulations.

If the rationale for each regulation (or at least each new one) and the name of the group requesting it are appended to copies distributed to users, more informed discussion of management problems and more reasoned support for regulations may result.

Problems of managing crab fisheries change as established fisheries develop and new fisheries emerge. Because of similarities in species' life histories, fishing and processing methods, economics of fishing and processing, and political systems within which both government employees and fishing industries must operate, managers of North American crab fisheries share many common problems. This review of North American crab fishery regulations and their rationales is presented to suggest options to those delegated the responsibility for managing crab fisheries. While these regulations may not be optimum according to either biological or economic criteria, they have met the very demanding test of political feasibility.

This review is organized by fishery and management problems. The classification of management problems is necessarily arbitrary. Justifications for a given regulation may make it applicable to more than one problem in the same governmental jurisdiction or applicable to different problems in different jurisdictions. The classification is an attempt to make the presentation more user-oriented, as a search for regulations is commonly prompted by a particular management problem. A final section contains procedures for eight jurisdictions whereby either public or

government representatives may recommend changes in regulations.

METHODS

Information on regulations and their rationales was provided by government biologists and resource managers in interviews on the west coast and in correspondence on the east coast. Table 1 lists these contacts and their agencies.

The regulations are not a complete set for any jurisdiction but do represent a large sample of the types of controls in force. Some regulations are omitted because I judged them not to be of general application or my contacts did not know their rationales; the latter is understandable considering the time period over which most sets of regulations evolved. Sampling was least complete for the blue crab fishery. There are 16 States with regulations governing this fishery and several were not included because of the similarity among their regulations.

I have not commented on the success of enforcement of regulations as this would have required firsthand knowledge of each fishery or extensive field interviews with enforcement officers and fishery participants.

The management problems into which regulations have been grouped are listed and defined below.

Conservation: to prevent resource waste,

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TABLE 1.—Sources of information.

Fishery	Contact	Agency
Alaska king crab	Guy C. Powell	Alaska Dep. Fish and Game
Alaska snow crab	Duane E. Phinney Guy C. Powell	Alaska Dep. Fish and Game
West coast Dungeness crab	Duane E. Phinney T. H. Butler Herb C. Tegelberg C. Dale Snow	Alaska Dep. Fish and Game Canadian Fisheries & Marine Serv. Washington Dep. Fisheries Oregon Fish and Wildlife Commission
Eastern Canada snow crab	Walter Dahlstrom	California Dep. Fish and Game
East coast blue crab	Author (R. J. Miller) Richard W. Cole	Canadian Fisheries & Marine Serv. Delaware Dep. Natural Resources & Environmental Control
Florida stone crab	William A. Outten Dennis L. Spitsbergen Edwin A. Joyce Edgar A. Hughes Terrance R. Leary Edwin A. Joyce	Maryland Dep. Natural Resources North Carolina Dep. Natural and Economic Resources Florida Dep. Natural Resources Alabama Dep. Conservation & Natural Resources Texas Parks and Wildlife Dep. Florida Dep. Natural Resources

principally by fishermen, and to maximize physical yield.

Allocation of landings among commercial fishermen: to partition the annual catch of a single species among participants, usually by area or gear restrictions.

Stability of landings: to even out annual landings over good and bad years of resource recruitment.

Conflict over grounds or resource: to resolve competition among classes of users for fishing grounds or fishery resources. Sport-commercial conflicts over the same species are included in this category.

Processing economics: to limit landings to crabs that can be processed at a profit acceptable to processors.

Administration: licensing and registration of boats, men, and gear, and collection of statistics.

RESULTS

Alaska King Crabs (*Paralithodes camtschatica*, *P. platypus*, *P. brevipes*, and *Lithodes aequispina*)

Exploitation of American stocks of king crabs was sporadic prior to 1953, but annual landings increased from 5 to 159 million pounds from 1953 to 1966, sharply decreased, then recovered to 90 million pounds in 1974 and 1975 (Rothschild et al. 1970; D. E. Phinney, pers. commun.). The American fishery is pursued along most of the Alaskan coast from the Bering Sea pack ice to the northern end of Vancouver Island over a depth range of 20 to 100 fathoms (Idyll 1971). The catch is

predominately *P. camtschatica*. Although Japanese and Russian fleets formerly took large catches from the Bering Sea, their efforts are now concentrated in the western North Pacific. The following regulations are those of Alaska.

Conservation

Seasons are set to prevent the taking of soft-shelled crabs during and immediately after the molting season. Soft-shelled crabs provide a low meat yield, the quality of meat is poor, and the handling mortality is high.

Harvest levels (i.e., variable catch quotas) and minimum sizes ensure that enough mature males are left on the fishing grounds for breeding. Males are sexually mature for an average of 2 yr before reaching the minimum size. The minimum size also helps maximize yield as determined from growth and mortality rates.

Most females are protected by the minimum size but a separate regulation prevents their being retained to leave them for reproduction.

Gear type is limited to traps, ring nets (a type of baited trap), and diving to prevent use of destructive trawls and tangle nets. The latter two types of gear result in unacceptable levels of mortality of noncommercial crabs returned to the water and of commercial crabs before they reach the processing plant.

One nursery area is always closed to fishing to prevent repeated handling of undersized and female crabs.

To help enforce seasons and harvest levels, tunnel eyes, i.e., entrances of traps, must be at least 5 inches high. This is so that king and snow

crab traps can be distinguished and to prevent king crab fishing in seasons for snow crab fishing only.

A second season in a year in the Kodiak area has a larger minimum crab size than the primary season. This encourages boats to fish areas where catch per trap is lower than in more productive areas but where large, old crabs have accumulated because the areas have been underfished.

A subsistence or sport limit of six crabs per day limits waste that might result from higher catches.

Allocation of Landings Among Commercial Fishermen

There are seven exclusive and two nonexclusive registration areas. A boat may register before the season opens to fish in only one exclusive area but in either or both nonexclusive areas in addition. To enforce this regulation and to prevent fishing before the season opens, a boat must have its hold inspected prior to fishing to verify that no king crabs are on board. If a boat wishes to land its catch outside its registration area, it must report by radio to a designated authority the size of its catch, and it may be required to submit to a hold inspection before leaving its registration area. The boat may at the time of landing have no more or less king crabs on board than were present at the time of reporting or inspection. To revalidate its registration, a boat must be reinspected in its registration area prior to resuming fishing. As the exclusive areas are more accessible to harbors and population centers, they are easier to fish than nonexclusive areas. By limiting boats to one exclusive area the larger, more mobile boats must take part of their catch from more remote areas less accessible to small boats. The small-boat operations are economically viable because of their versatility to participate in other fisheries, e.g., salmon, halibut, and shrimp. A boat operator is limited to operating only one boat in one exclusive area although he may operate the same or additional boats in nonexclusive areas. This excludes one-operator fleets from exclusive areas.

Trap limits per boat in some areas favor small boats because large boats cannot operate as economically if their fishing power is restricted.

Local boats are favored as an ancillary effect of the second season mentioned above. The catch per trap is lower and the weather less favorable than in the primary season, and nonlocal boats are often unwilling to fish for the lower returns.

Stability of Landings

Harvest levels are set to ensure that at least two year-classes are well represented in any year's landings. This helps dampen the effect on landings of uneven annual recruitment to commercial size.

Conflict Over Grounds or Resource

Trap sanctuaries off limits to towed gear have been negotiated with foreign groundfish trawlers. Foreign trawlers have also agreed to area closures and to use rollers on trawls to reduce the catch of king crabs. Domestic shrimp trawlers and scallop draggers are excluded from some prime king crab grounds.

Processing Economics

Crabs are hard shelled much longer than the time required for the fishery to take the annual harvest levels. There is, however, a slight improvement in meat yield as the hard-shelled period progresses with the best yield occurring in most areas at times when the weather is unfavorable for fishing. The season opening within the hard-shelled period is a compromise between the respective interests of fishermen and processors.

Administration

Boats are licensed and registered each year and boats and crab-trap buoys must clearly display registration numbers. Plants are obligated to report area of catch, number of trap lifts, and landings by boat. These regulations are necessary to enforce fishing-area and harvest-level restrictions as well as to provide economic and biological data on the fishery.

Alaska Snow Crabs (*Chionoecetes bairdi*, *C. opilio*)

Although *Chionoecetes bairdi*, *C. opilio*, and *C. tanneri* are all referred to as snow crabs, the current domestic fishery consists of about 98% *C. bairdi* and 2% *C. opilio*. Alaskan landings have increased rapidly from 3 million pounds in 1968 to 61 million pounds in 1973. This fishery operates from the Bering Sea to southeastern Alaska over a depth range of 20 to 140 fathoms (Brown²). As in

²Brown, R. B. The development of the Alaskan fishery for tanner crab, *Chionoecetes* species, with particular reference to the Kodiak area. Unpubl. manuscr., 15 p. Alaska Dep. Fish Game, Kodiak.

the king crab fisheries, Japan and the USSR formerly took large quantities from the Bering Sea, but the USSR has not fished since 1971 and the Japanese catch is limited by bilateral treaty to about 22 million pounds per year (D. E. Phinney, pers. commun.). Alaska is the only North American jurisdiction with regulations for this fishery.

Conservation

The following regulations serve the same purpose as in the king crab fishery. Seasons prevent fishing when crabs are soft shelled; fishing gear is limited to traps, ring nets, and diving; harvest levels help ensure enough males are left on the grounds for breeding; females may not be taken; and subsistence fishing is limited to 30 crabs per day. Trap tunnel eyes must be less than 5 inches high when the king crab season is closed to distinguish between snow and king crab traps and to reduce the incidental catch of king crabs.

Cone-shaped traps with a single top entrance may be used for snow crabs in addition to the rectangular king crab trap modified with a smaller tunnel entrance.

Location of Landings Among Commercial Fishermen

As in the king crab fishery, there are exclusive (two) and nonexclusive (three) fishing areas. A boat may register for either one exclusive area or any number of nonexclusive areas. A boat must have its hold inspected to validate its registration and must report prior to landing its catch in an area other than where it is fishing. There are also trap limits for some areas. The rationale for these is the same as in the king crab fishery.

Stability of Landings

Annual harvest levels by area dampen the effect on landings of variable recruitment to commercial size.

Conflict Over Grounds or Resource

As with the king crab fishery, foreign trawlers have agreed to area closures and to use rollers on trawls to restrict the incidental catch of snow crabs. The trap sanctuaries for king crabs also protect the snow crab fishery in many cases.

Processing Economics

The season within the hard-shelled period is set for the convenience of fishermen and processors.

Although there is no minimum size restriction, most immature males are returned to the water on the fishing grounds because they are too small to be processed economically.

Administration

The regulations are similar to those for the king crab fishery.

West Coast Dungeness Crab (*Cancer magister*)

This is an old fishery with commercial exploitation since at least 1917 (Cleaver 1949). Landings are quite variable ranging from 14 to 60 million pounds in the 1970's alone.³ The fishery operates from southwest Alaska to central California over a depth range of 1 to 20 fathoms.⁴ Only United States and Canada fish this species.

Conservation

Closed seasons for the commercial fishery protect soft-shelled crabs in at least some areas of all jurisdictions. Seasons also apply to the sport fishery in California and ocean beaches in Oregon. In addition to a season, Washington specifically prohibits the landings of soft-shelled crabs: "A soft-shelled crab is defined as a crab whose shell, including covering of the legs, is not fully hardened and said shell is flexible and depresses to digital pressure." This regulation has been upheld in Washington courts.

Females may be retained by commercial fishermen only in British Columbia and by sportsmen only in California and British Columbia provided they exceed the minimum legal size. They are protected for breeding purposes (Alaska, Washington, Oregon, California) and because of processing considerations (Washington, Oregon).

Traps left unattended for over 2 wk must have bait removed and doors secured open as protection against ghost fishing (Alaska).

³Anon. 1974. Crab review. Fisheries and Fish Prod. Div., Fisheries and Food Prod. Br., Dep. Industry, Trade, and Commerce, Ottawa, 83 p.

⁴Anon. 1972. Pacific edible crab. Fishery Fact Sheet, 2 p. Dep. Environ., Ottawa.

Types of gear are regulated by stating either what may or what may not be used. The effect is to limit the commercial fishery to traps and ring nets, and the sport fishery to traps, ring nets, dip nets, handlines, and diving. Sharp instruments, tangle nets, and usually trawls are excluded to avoid unacceptable levels of crab mortality. To allow escapement of subcommercial-sized crabs, one or two rings of at least 4-inch diameter must be set in the trap mesh in all jurisdictions. This is usually required to be in the upper half of the trap to reduce the chance of openings being covered by drifting sand.

The minimum size is regulated in all jurisdictions. It allows males to mate at least once before reaching legal size although opinions among jurisdictions differ as to whether their respective minimum sizes are biologically optimum. To help enforce size regulations, crabs must be landed whole.

Allocation of Landings Among Commercial Fishermen

Alaska has trap limits which vary considerably among areas. The low limits discourage participation of large boats and reserve the resource for small and local boats. British Columbia limits commercial gear in one area to ring nets or dip nets and traps are excluded in five bays in Oregon to eliminate large commercial operators.

Alaska has both exclusive and nonexclusive fishing areas as in the king and snow crab fisheries, for the same reasons and with the same supporting regulations. As in the snow crab fishery, a boat may not be registered in both exclusive and nonexclusive areas whereas in the king crab fishery a boat may register in one exclusive plus nonexclusive areas.

Conflict Over Grounds or Resource

All jurisdictions have a small catch quota for sport fishermen, ranging from 20 crabs per day in Alaska to 6 per day in British Columbia and Washington. Sport fishermen are limited to three traps or three ring nets in Oregon and two traps or two ring nets in Washington. These regulations serve to differentiate between sport and commercial fishermen and, in some areas, to divide the available catch among many sport fishermen.

There are a number of concessions to sport fishermen in British Columbia, Washington,

Oregon, and California for this very accessible species. The fishery is open to only sport fishermen in a marine park in British Columbia, in Hood Canal in western Puget Sound in Washington, and in bays, harbors, and near jetties in California. A 20-trap commercial limit imposed in Dungeness Bay, Wash., controls competition with sport fishermen. A slightly smaller minimum crab size is applied to sport than to commercial catches in Washington and Oregon to increase the sport share of the catch. This size difference is significant because in areas available to the commercial fishery over 80% of the legal-sized crabs are generally caught in the first few months of the season.

Salmon troller operators and crab fishermen in Oregon have an informal agreement to divide the grounds at the 15-fathom contour to resolve incompatible use of the fishing grounds. California trawlers are permitted to land up to 500 pounds of legal-sized male crabs per trip during the crab season. This discourages trawling directed at Dungeness crabs but allows them to retain incidental catches.

Processing Economics

In addition to protection of their reproductive role, females may not be retained in Washington and Oregon because the meat yield and quality are lower than for males.

Some areas near the City of Vancouver, B.C., are closed to both commercial and sport crab fishing because of polluted water.

Administration

A commercial fishing license specifically for crabs is required in Alaska and Washington, while only a general commercial license is required in British Columbia, Oregon, and California. Although this provides a small amount of revenue, it is primarily for records on participants.

Eastern Canada Snow Crab (*Chionoectes opilio*)

This fishery has two centers of operation, the western Gulf of St. Lawrence and eastern Newfoundland. The first significant commercial landings were taken in the Gulf of St. Lawrence in 1967 and in Newfoundland in 1969. Landings from both areas totaled 23 million pounds in 1974 with

further expansion expected only in Newfoundland. The fishery operates in depths of 40 to 70 fathoms in the Gulf of St. Lawrence and 90 to 200 fathoms in Newfoundland. Only Canada is engaged in this fishery and there is no sport fishery.

Regulations for this fishery have only recently been implemented, so, although they have cleared public service and political hurdles, they have yet to be tested by performance.

Conservation

Any specified area may be closed to the fishery at any time for conservation reasons. Justifications could be an abundance of soft-shelled or sublegal-sized crabs in the catches. Periodicity of soft-shelled abundance is not predictable enough to set annual seasons.

Fishing is permitted only by traps to exclude the wasteful bottom trawl and tangle net gears. A minimum mesh-size regulation allows escapement and eliminates handling of a large portion of the sublegal-sized crabs. A minimum crab size is set (Newfoundland only) in hope of maximizing the yield per recruit, to ensure the presence of enough mature males for mating success, and to satisfy processing requirements. The minimum size excludes all females.

A regulation requires that soft-shelled crabs be returned to the water on the fishing ground. They are unacceptable for processing because of low meat yield, poor quality meat, and poor survival while being held for processing. If landed, they are discarded by processors.

Allocation of Landings Among Commercial Fishermen

Trap limits in the Gulf of St. Lawrence limit the fishing effort per boat.

Any new boats entering the fishery after 1974 must be recommended by a crab management committee composed of representatives from fishermen, processors, Provincial governments, and the Federal government, and approved by a Regional Director of Fisheries. New entrants are considered for underexploited areas only.

Stability of Landings

A single quota for all of Newfoundland is intended to dampen the effects on landings of variable recruitment to commercial size.

Processing Economics

With present technology and product prices, crabs smaller than the legal minimum cannot be processed economically.

Administration

Crab boats must be licensed specifically for crab fishing to control entry and to provide economic data on the fishery. In Newfoundland, boats must report their fishing area to provide a history of yields by area.

East Coast Blue Crab (*Callinectes sapidus*)

This species has supported a commercial fishery since at least 1890 (Newcombe 1945). Landings have been about 140 million pounds annually in the 1970's (footnote 3). The fishery operates along most of the U.S. Atlantic coast and all of the Gulf of Mexico coast, but the bulk of the landings and the most extensive fishery regulations are from the mid-Atlantic States. The depth range of the fishery is between less than 1 to 10 fathoms and the fishery is prosecuted entirely from the United States.

Conservation

Generally, egg-bearing females must be returned to the water to allow them to release their progeny. This is requested by the fishing industry (Delaware, Maryland, Florida, Texas) although there may be no biological evidence establishing a relationship between the size of the parent stock and strength of the resulting year-classes (Delaware, Florida, Texas).

To allow escapement of small crabs, Maryland requires that the wire mesh covering traps be a minimum of 1 by 1 inch, Florida requires that an escape hole near the bottom of traps be a minimum of 2 by 2 inches, and Texas requires that crab trawls have a minimum mesh size of 5 inches (stretch measure).

Seines must be hauled up in the water rather than on shore in Maryland to help ensure that unwanted animals such as small crabs and fish are returned to the water rather than left on the beach.

Hard-shelled crabs must be a minimum of 5-inch

width in Delaware, Maryland, and one county in Florida. This is slightly over the average size at maturity and allows crabs to spawn at least once before being subject to depletion by the fishery. One bushel of undersized crabs is permitted in a daily catch in Delaware.

A 150-trap limit is enforced in small bays just inland from Maryland's ocean beaches as the peeler-crab (crab about to molt) fishery has recently become intensive on the small populations in these bays. Baiting traps with live males ensures a high proportion of females in the catch which molt, then copulate. Effort control through trap limits is an attempt to prevent rates of female removal that would affect the ability of the population to replace itself.

Allocation of Landings Among Commercial Fishermen

A 150-trap limit for some areas in Delaware is near the maximum most boats can fish per day and controls the fishing power of the few fishermen who would choose to fish more traps.

North Carolina prevents the use of dredges operated by power winches in one area. This controls the fishing power of boats using dredges for any species but was aimed primarily at the oyster fishery.

Conflict Over Grounds or Resource

Sport fishermen have gear and catch limits to control their competition with commercial fishermen and to distribute the available landings among many sport fishermen. Limits are two traps, four handlines, and one-bushel catch per day in Delaware; one-bushel catch per day in Maryland; one trap which may not be fished from a boat in North Carolina; and five traps in Florida.

Most Maryland streams emptying into Chesapeake Bay are off limits to traps to reserve the areas for crab fishermen using trot lines. In North Carolina, crab traps are excluded from some areas from 1 April through 30 November to reserve the areas for haul seines and shrimp trawls. Other areas in North Carolina are designated for fixed gears only, however, to protect them from towed gears.

Traps may not be set in marked navigation channels (Delaware, Maryland, North Carolina), may not be set in water shallower than 4 feet at mean low tide (Maryland), or may not be larger

than 24 inches on a side (Maryland) because of the hazard to navigation. Traps may not be set near bathing beaches in Maryland because the presence of fishing boats, discarded bait, and discarded dead crabs interfere with the recreational use of the beaches.

Crab dredges (also rakes and scrapes) may not be used on bottom leased for oyster propagation except by the lease holder (Delaware) or on public oyster grounds where oysters or shells have been planted by the State (North Carolina). Dredging is not permitted from 16 March to 15 December (Delaware) or 1 April to 30 November (North Carolina) since crabs are not buried in the bottom during this time, and dredging is destructive to both commercial molluscs and noncommercial benthos. Maximum dredge weight is 100 pounds in North Carolina and 40 pounds in Maryland to limit destruction of bottom organisms by the gear.

North Carolina and Texas restrict crab trawling because of possible damage to shrimp stocks. Some shrimp nursery areas are closed to crab trawling since the resulting turbidity may be lethal to shrimp (North Carolina). Mesh size on trawls may not be smaller than 3-inch stretch measure when used for hard-shelled crabs nor smaller than 2-inch stretch measure when used for soft-shelled crabs to allow shrimp to escape (North Carolina). The 5-inch minimum mentioned earlier serves the same purpose in Texas. Trawls used for soft-shelled and peeler crabs are limited to 25 feet in width (float line length) to control damage to sea grass beds where most of this fishing occurs (North Carolina).

Crab trawling is prohibited from 2000 h on Saturday to 2000 h on Sunday to eliminate the time conflict with fishers of men (North Carolina).

Processing Economics

Processors have requested that egg-bearing females not be landed because of their low meat yield (Texas). North Carolina prohibits trawling in ocean inlets to interior bays from 1 April to 31 August because females incubating eggs are concentrated in these areas: females are uneconomical to process.

Minimum shell width for hard-shelled crabs is 4 inches (Alabama) or 5 inches (Maryland, North Carolina—10% undersized permitted). This protects the processor from pressure to accept small crabs which are unprofitable to process.

Soft-shelled crabs and peelers have legal minima of 3½ inches and 3 inches, respectively, in Delaware and Maryland compared to a 5-inch minimum for hard-shelled crabs. Because of the greater molting frequency of smaller crabs, the smaller size limit permits a greater volume of this relatively high-priced product. Soft-shelled crabs are sold and eaten whole so the economics of meat extraction is not a consideration. Crabs with a shell just starting to harden (paper shell) may not be landed as they are not suitable for the soft-shell market and the meat yield is too low for processing as hard-shelled crabs (Maryland).

In Maryland, dredges are permitted only from 15 April to 31 October (compare with summer closure in Delaware and North Carolina in the previous section). The crabs are not buried in the sediment in this period and have had time to clean themselves of attached mud making them a more desirable product.

Administration

A commercial license is required specifically for blue crab in Delaware and Maryland, while a general commercial license will suffice in North Carolina and Texas. No license is required in Alabama and only a permit number is required in Florida. Traps are generally required to be buoyed and must have the boat permit or license number displayed on buoys in Florida, Maryland, and Delaware. This is to reduce the navigation hazard of traps and to help enforce seasons and registration requirements.

Florida Stone Crab (*Menippe mercenaria*)

This species has supported a commercial fishery in Florida for approximately 25 yr. Landings have recently increased from 1 million pounds in 1965 to 2.1 million pounds in 1973. The fishery operates around most of Florida's coast over less than 1 to 8 fathoms depth, but 80% of the landings are taken from the Keys and the southwest coast. The fishery does not exist in other areas of the United States but does extend into the Caribbean.

Conservation

This fishery has a unique regulation requiring that only the claw may be retained. The remainder of the crab must be returned live to the water. The crab market accepts only the claw. A small per-

centage of declawed animals survive to spawn and a small percentage regenerate the claw to commercial size. The minimum size for propodus length of the claw is 2¼ inches. Data on growth and natural mortality indicate that this is near the optimum size for maximum yield per recruit.

Crab fishing is closed for 5 mo over the spawning season. Fishermen reason that this closure yields better recruitment to the fishery although this is not supported by present biological data. The effort restriction does produce higher catches per unit effort during the open season, however.

It is unlawful to fish with spears, hooks, or other gear that might kill the crabs.

Administration

Each trap must have a buoy, and traps and boats must be clearly marked with a permit number and color code unique to each boat. These regulations help in enforcement of seasons and boat registration requirements. Traps marked with buoys also reduce their hazards to navigation. Boats must be registered specifically for the stone crab fishery.

PROCEDURES FOR CHANGING LAWS AND REGULATIONS

To this point no distinction has been made between laws and regulations. Laws are passed by an elected legislative body whereas regulations are approved by a department's secretary or minister, or an appointed commission. Recommendations for changes in laws or regulations usually follow the same route whether they originate within the public service or the fishing industry.

Alaska

Regulations are made by a seven-member Board of Fisheries composed of fishermen and businessmen and appointed by the State Governor. Proposed changes for regulations are submitted to the board by the Department of Fish and Game staff and the public at least 60 days before their annual shellfish meeting. Thirty days before the meeting a printed list of all proposals is sent to fishermen, processors, government representatives, and any other interested parties. During its meeting, which is public, the board solicits comments from the public and the staff of the department on each recommendation. Following the

discussion, each recommendation is voted upon by the board in the meeting before proceeding to the next item.

District management officers have authority to adjust seasons and harvest levels and to open and close fishing areas by field announcement.

British Columbia and Eastern Canada

Regulations in these areas, excluding Quebec, are under Federal control. Proposals from any party are submitted to the regional resource management group who drafts regulations. These are forwarded to a resource management group in Ottawa who checks for consistency with existing regulations and considers the justification offered in light of their experience. The Justice Department then checks for contraventions of existing laws, especially the human rights code. It then passes through senior management levels of the Fisheries and Marine Service to the Minister of State for Fisheries. If approval is granted, the Minister finally seeks approval from the Federal Cabinet. Regional Directors of Fisheries have authority to adjust seasons and quotas.

Washington

The Director of the Department of Fisheries has authority to establish many types of fishery regulations, e.g., seasons, gear restrictions, and size limits, after holding public hearings. The State legislature has exclusive authority in setting license fees and can legislate in areas normally the responsibility of the Director.

Oregon

Staff biologists submit proposals to the Marine Fisheries Regional Supervisor who in turn forwards them to the State Fisheries Director. If approved at both these levels, proposals are submitted to a seven-member commission at a public hearing. The commission hears staff and public testimony and accepts, rejects, or modifies the proposal. If accepted, it is registered with the Secretary of State and goes in force. Any citizen of the State may request a public hearing of the commission to consider his views on fisheries regulations. The commissioners are appointed by the Governor and may be any private citizens of the State except an officer in a sportsmen's organization or an affiliate of the commercial fishing industry.

California

A staff biologist submits his proposed law change to his regional manager of the Department of Fish and Game, who in turn submits it to the Department Director. The Director enlists the cooperation of a State senator or representative to sponsor a bill in the legislature where it must be passed by both houses and signed by the Governor. An industry representative may begin at any level in this sequence.

Delaware

The Division of Fish and Game drafts new laws at their own initiative or in response to requests from the public. These drafts of new laws are submitted to a Natural Resources Committee composed of State legislators who in turn brings the recommendations to the legislature for a vote. The laws that have been passed by the legislature are finally signed by the State Governor.

The Division of Fish and Game may also initiate resolutions. These are not enforceable but are desirable policy in the view of the division. Hearings are held by the division to solicit public opinion. Final approval is required from only the Secretary of State.

Maryland

Recommendations for changes in regulations are submitted to a Fisheries Administration staffed by government employees. After the legality of the submission is ensured, public hearings are held by the Fisheries Administration in areas which would be affected by the change. A legislative board of review composed of State legislators must finally approve changes.

Fishery laws are dealt with in the State legislature and are submitted for their consideration by either government or private sources. A legislative committee holds public hearings on proposed changes before they are brought to a vote in the legislature.

North Carolina

A nine-member Fisheries Advisory Board appointed by the Governor is staffed by three representatives each from recreational fisheries, commercial fisheries, and the scientific community. This is a source group which advises a seven-member Fisheries Commission. The latter group,

also appointed by the Governor, includes representatives from the tourist industry, seafood processors, sport fishermen, commercial fishermen, and scientists. Recommendations for changes in regulations may be brought to either body although only the Fisheries Commission has authority to make changes. They are obligated to hold public hearings on changes and advertise the hearings in news media a minimum of 10 days before a hearing. Following the hearings, and solicitation of advice from the Fisheries Advisory Board and the Division of Commercial and Sports Fisheries, changes are passed by majority vote.

Texas

The Parks and Wildlife Department accepts recommendations from its staff or the public. Once each year a public hearing is held by the Parks and Wildlife Department in each county affected by suggested changes. A six-man Parks and Wildlife Commission appointed by the Governor then considers staff recommendations and the public reaction at its monthly public meeting when setting regulations. Laws are enacted in the State legislature in response to requests from the government or the public. Fisheries in 15 of 19 coastal counties are controlled by regulations while those in the remaining 4 are controlled by laws.

SUMMARY AND CONCLUSIONS

Management problems and applicable regulations are summarized below.

1. Conservation:
 - a. soft-shelled crabs: season protecting soft shells, taking soft shells prohibited;
 - b. protection of breeding crabs: no females, no egg-bearing females, fishing closed during spawning season, trap limits to control catches of mature females, minimum size which excludes some mature males, catch quotas to leave a significant portion of commercial-sized males, all stone crabs returned live to water;
 - c. ghost fishing: traps must be attended at least every 2 wk;
 - d. handling subcommercial sized crabs: escape holes in trap mesh, minimum mesh size in traps and trawls, fishing excluded in nursery

- areas, seines must be hauled up in water rather than on shore;
 - e. wasteful gear: sharp instruments, tangle nets, and trawls excluded; and
 - f. optimize yield per recruit: minimum crab size, second season with larger minimum size.
 2. Allocation of landings among commercial fishermen: trap limits, trap type (ring nets only), registration area, limited entry of boats.
 3. Stability of landings: catch quotas (harvest levels) by area.
 4. Conflict over grounds or resource: areas reserved for sport fishery; smaller size limit for sport; limits on catch, gear type, and gear quantity for sport; areas for traps only, set gear only (traps or lines), or mobile gear only (trawls or seines); traps may not be set in navigation channels, in less than 4 feet depth, or near beaches; limit on crab catch by groundfish trawlers; weight limit on dredges; seasons and area limits for crab dredging; shrimp nursery areas closed to crab trawling; shrimp trawling; groundfish trawling, and scallop dragging excluded from good crab fishing areas.
 5. Processing economics: minimum crab size, females or egg-bearing females excluded, areas of female concentration closed, soft-shelled crabs excluded, areas of polluted water closed, dredging prohibited when crabs buried in sediment.
 6. Administration: registration of boats, men, and gear; marking boats and gear with registration number; reporting fishing area, number of trap lifts, and quantity of landings.

Many resource managers agree that some regulations are unsupportable on either conservation or economic grounds. This is understandable since there is an inevitable time lag between the collection of information and the updating of regulations, and since groups or individuals are sometimes able to influence regulations by weight of authority without supporting rationale.

I recommend that copies of regulations (or at least each new regulation) provided to enforcement officers, fishermen, processors, etc., have the rationale for each regulation as well as the group requesting it appended. This procedure has the following possible benefits:

1. Fishery participants would be informed as to the benefits of the regulations, i.e., why they are expected to observe them.
2. They could be at least partially educated to the tools and rationale of fisheries management.
3. Providing participants with a background for informed discussion should help to involve them in managing their fishery.
4. Making the concerns of different vested interests public would hopefully provoke the fishing industry, regulatory authorities, and legislators to provide reasoned support for regulations.

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M. C. Mercer, Duane E. Phinney, and R. G. Bug-geln constructively criticized the manuscript.

Considering the amount of detail in the sets of regulations included and the unusual (for someone not trained in the field) legal terminology employed, some errors are inevitable. I accept responsibility for these.

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