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9. ABSTRACT

Technology as knowledge and means for exploitation of the environment has approached in many areas the limits imposed by the finite nature of the environment. The trawlermen's charges against the overkill of the foreign factory fleets are recognized increasingly as being well founded. Their advocacy of a 200-mile limit thus is pointing to an important concomitant of technological innovation; the need for social innovation. Unrestrained use of technology poses many dangers in diverse areas of human life and is being discredited. In fisheries technology, the danger of the unregulated use of the factory fleet technology may be the end of fishing, as maximum sustainable yields are exceeded more readily. The need to restrict all nations in the application of increasingly efficient technologies to conform to the limits of the resource being exploited is exemplified here in the study of several New England fisheries. The relationship between fishing technology and resources has reached the point at which there no longer is the luxury of trial-and-error solutions.

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Luddites and Fishermen: A Note on Response to Technological Change

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**Sociology and Anthropology
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Luddites and Fishermen

A Note on Response to Technological Change

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ONE important companion study to the history of technology is the social history of response to technological change. Men whose customary livelihood and life style are placed in jeopardy by innovations of technology have often spoken out and sometimes acted against the displacement by more effective modes of production of the technology to which they are committed.

In a dream world of unrestrained *laissez-faire* and frictionless labour markets, every technological change would result in automatic and instantaneous adjustment in the division of labour. Practitioners of obsolescent crafts would move promptly and painlessly into new ones. Competition would be on a Hobbesian scale, but the Invisible Hand would assure satisfactory outcomes.

Such a world does not exist and the social costs of technological innovation have been borne by particular groups rather than by the commonwealth. To ward off such contingencies men began early on to form organizations such as guilds, unions, and professional associations. Promulgation and enforcement of rules to protect the practitioners committed to obsolescent technologies against displacement have been a stock-in-trade for such organizations. Organized as well as unorganized protest, machine-breaking, and other forms of resistance are well known. Luddites destroying stocking frames, Swing rioters breaking threshing machines, locomotive firemen clinging to places in the cabs of diesel locomotives, musicians seeking to stem the broadcasting of recorded music, and painters opposing the introduction of spray guns, represent familiar examples of defensive responses to technological change.

In a study of several New England fisheries we have found relevant materials for the history of the responses of fishermen to successive changes in fishing technology. Hook-and-line technology, trap and hand-seine technology, small-trawler fishing, and, finally, the development of large factory ships with fleets of auxiliary vessels emerged in succession from precolonial times to the present, each more productive than its predecessor and each associated with a cost for the practitioners of its predecessor.

Hook-and-line technology is the least productive in general because each hook must be baited and can catch but one fish at a time. The use of traps and seines is more productive because many fish can be caught without use of bait. However, traps are stationary and can be utilized only to catch such fish as happen to swim into them, while haul seines are long nets taken into the water by rowboats and pulled in by men standing on the beach. These are more productive in that they 'go to the fish' rather than waiting for the fish to come.

The introduction of steam-powered vessels (later, diesel engines superseded steam engines) and trawling gear made possible even more extensive pursuit of the prey and rapid marketing of the catch. In the small-trawler fisheries that we have studied it is the vessels with the most powerful engines which have been the most productive.

The most recent stage in technological development in fishing has been the emergence of large factory ships which process and freeze the catch of their auxiliary vessels 'on the spot', thus obviating the need to leave the fishing grounds until the catch is exhausted. The massive scale and sophisticated gear of these operations portend the end of fishing because of their overkill capacity.

This sequence of four stages in fishing technological development can be viewed in terms of successive displacement of fishermen committed to the first three types of gear. To the degree that fishermen have developed a vested interest in a particular mode of production and have been unable to adopt a more productive method, the changing mode of production has been a threat to their livelihood. Thus threatened, some have uttered protests and sought to stem the tide of technological change.

In attempting to document the response to technological change we turn first to the report of a Rhode Island legislative committee charged in 1870 with the duty of investigating the fisheries of Narragansett Bay [1]. The inquiry of this committee elicited responses from 39 fishermen to a series of questions dealing with the state of productivity in various fisheries. Thirty-five of the respondents said that their catch as well as the overall yield had declined, and they attributed this to the depredations of trap and seine fishermen. The remaining 4 witnesses attributed the decline to pollution. Significantly, the latter 4 were all associated with trap and seine technology. The responses of the hook-and-line fishermen were exemplified by the following:

I think if traps were abolished, fish would become numerous again. [2]

All hook and line fish ought to be protected and the only way to do this is to prohibit trapping and heart seining entirely. [3]

I would like to have all kinds of standing traps or seines prohibited by law forever, for if not prohibited by law they will soon depopulate the bay of fish. . . [4]

One witness went so far as to impute infernal origins to the competing technology:

Under the present destructive system of trapping, not only is all our summer supply sent off, but the fish not being allowed to spawn, the natural increase is cut off . . . As to a remedy, prohibit trapping. It is doubtless an invention of the devil to distress the people by increasing the cost of living. [5]

Two of the hook-and-line fishermen stated under oath that they knew of others who refrained from giving testimony for fear of reprisals by trappers and seiners. William Spooner, of Newport, stated:

I think a portion at least of the hook-and-line fishermen are intimidated from testifying before this committee by threats from the owners of heart seines that they should not be supplied with bait for their lobster pots, upon which they have depended. [6]

This is evidence of the conflict which frequently arises between users of different modes of production.

All told, 26 of the witnesses explicitly advocated outright prohibition of various types of traps and seines. In response, the committee drafted the following bill which embodied the wishes of the hook-and-line fishermen:

AN ACT TO PROHIBIT TRAP AND HEART SEINING OF FISH IN THE WATERS OF
NARRAGANSETT BAY

Section 1. No trap, heart seine, or other contrivance of any kind or description other than pike nets, purse seines, shore seines, scoop or hand nets, and hook and line for catching fish shall be set or drawn in any of the waters within the jurisdiction of the State, northerly of a line drawn from the southerly point of the rocks at Brenton's Reef, to the southernmost point of Point Judith, and north of the Stone Bridge at Howland's Ferry.

Section 2. That each and every person who shall be or shall have been engaged in setting or drawing any trap or other contrivance prohibited by the first section, shall be deemed guilty of a misdemeanor, and shall pay a fine of not less than fifty, or more than three hundred dollars for the first offence, and for the second and every subsequent offence, he shall be fined a sum of not less than five hundred, or more than one thousand dollars, and shall be imprisoned for not less than one month, or more than one year [7].

While this proposed legislation was not enacted, a law was passed in 1882 which greatly restricted the application of certain devices in this fishery. For example, the act stipulated that:

Section 18. No person shall, between the fifteenth day of April and the fifteenth day of June, inclusive of both days, or between the fifteenth day of August and the fifteenth day of December, inclusive of both days, commencing at the rising of the sun on both days, erect any wier or set or draw any seine or net for obstructing, catching or hauling of fish within half a mile east from Point Judith ponds breach, meaning the breach for the time being into the sea, or within a point of the west side of said breach four rods distant from Joseph Champlin's fish house, so called, or within said breach or within any channel leading to said ponds or any branch thereof from the sea, or within a quarter of a mile of the entrance of such channel into said ponds or branches of said ponds, and whenever the fifteenth day of December happens on Sunday, this prohibition shall continue to the rising of the sun on the next succeeding day [8].

In addition to a fine of not less than twenty nor more than fifty dollars for any violation, the penalty section provided that the offender 'shall also forfeit the boat, seine net and other apparatus by him used in such violation. . . ' [9].

Despite the restrictions sought by hook-and-line interests, the number of traps continued to increase until 1914. The total number recorded rose from 119 in 1898 to 252 in 1914, and thereafter began to decline [10]. In 1928 a law was enacted in Rhode Island that provided for the licensure of fish traps, which prohibited the erection of any trap within 3000 feet of another.

CHAPTER 1157

AN ACT TO CONSERVE AND PROTECT CERTAIN FISHERIES

It is enacted by the General Assembly as follows:

Section 1. It shall be unlawful for any person, without first obtaining a license as hereinafter provided, to erect or maintain any fish trap of either floating, weir, pound, stub or stake type in those portions of the public waters of the state designated by the engineer's office of the war department of the United States as available areas for the purposes of fishing which are included in the following boundaries, viz.: commencing at Point Judith and thence extending in a northeasterly direction to Sakonnet Point, thence in a northwesterly direction to Sachuest Point, thence following the southerly shore line of the island of Rhode Island to Brenton's Point, thence westerly in a straight line to Beaver Tail Light House, thence in a northwesterly direction to Bonnet Point, thence following the easterly shore line of the town of Narragansett to Point Judith.

Section 2. The harbor commission may issue licenses duly signed and under its seal, to set or erect and maintain fish traps, as provided in this act, to any inhabitants of this state, or to a corporation incorporated in the state [11].

By 1936 trap and seine fishing in Rhode Island had been greatly reduced. The reason for this decline is not attributable to the efforts for protection of a less productive technology—the hook-and-line fishery—but to the development of an even more productive technology—the vessel fishery.

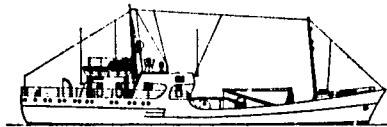
Rhode Island appears to be on the decline from the high position formerly held by those engaged in . . . [trap] fishing. Each year sees less traps set and every year finds it harder for trap fishermen to make both ends meet. While scup, mackerel, butterfish are always fairly abundant in Rhode Island waters during their migration, and we have the equipment, men and boats and experience capable of taking any quantity of these fish, the marketing of these products seems to be the stumbling block between success and failure. This is in large measure due to the competition the trap fishermen in Rhode Island have today, which they did not have years ago, fishermen off southern fishing grounds making early catches of these migratory species and getting them to the market in New York and other big centers before the Rhode Island men begin their catch seems to be the answer [12].

Four years later, a press report on the activities of one of the few remaining trap fishermen was even more explicit about the impact of a superior technology.

But trap fishing is on the way out—so said Capt. J. E. Clark of Snug Harbor yesterday . . . The reason for the decline? Capt. Clark gives that in one word—

THE REASON THE PRICE OF SEAFOOD IS "OUT OF SIGHT" IS BECAUSE THEY'RE CATCHING EVERYTHING IN SIGHT...

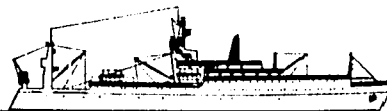
THE SOVIET FISHING FLEET



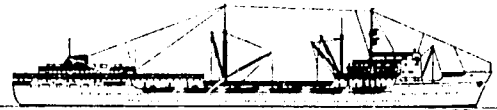
Vessel type: Tuna Long Liner Number in crew: 11
Length overall: 178'. This vessel can carry about 100 tons of frozen fish products.



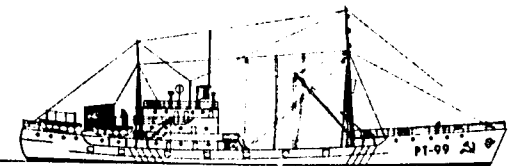
Vessel type: Refrigerated Transport Number in crew: 81
Length overall: 515'. This vessel can carry about 7,250 tons of frozen fish.



Vessel type: Stem Trawler Number in crew: 232
Length overall: 423'. This is the largest stem trawler ever built. Also is a factory ship.



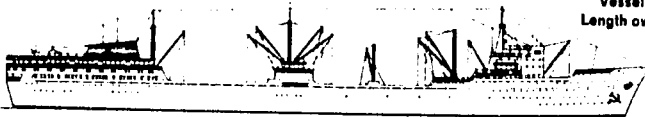
Vessel type: Base Ship Number in crew: 640
Length overall: 532'. Carries 12 boats for pick up of nets and catches. Factory capable of canning, freezing and storage of up to 50,000 cases of fish.



Vessel type: Side Trawler Number in crew: 56
Length overall: 242'. This vessel can carry about 830 tons of fish products.



Vessel type: Mother Ship Number in crew: 183
Length overall: 377'. Six catcher boats are carried on deck. Also serves as factory ship.



Vessel type: Factory Ship Number in crew: 510
Length overall: 715'. No fishing gear, but stern chute to haul whales aboard. World's largest whaling ship. Will carry 18,000 tons of whale oil, 1,800 tons of frozen whale meat. Can handle 65 whales per day.



Vessel type: Research Ship Number in crew: 130
Length overall: 337'. Probably has more oceanographic gear than any ship afloat. Has helicopter landing platform. 16 scientific laboratories.

200 MILE LIMIT NOW...

THE SOVIET FISHING FLEET IS 12 miles off our coast and sucking up everything that swims, crawls, or hides in the sand....They leave nothing....They put back nothing....We must have legislation now to control our Continental Shelf and regulate foreign fishing fleet catches. We must start by pushing our present 12 mile limit to 200 miles, which will take the great pressure off of our most valuable marine resources, our fish. If we do not act now, in the very near future we can all forget fish...

Please write today for Fish Tomorrow.

**Write your Senator
and Congressman today
and ask them to support
200 mile legislation...**

200 MILE LIMIT NOW

FIG. 1.

'draggers'. 'Big draggers', he said, 'can get so much fish at once that it pulls the price down and when that happens we suffer' [13].

Draggers, of course, are small trawlers that return to port after short trips to off-shore fishing grounds. Their advantage lies in pursuit of prey as opposed to waiting for migrating fish to come to the traps and seining points of the earlier form of fishing. The growing use of steam- and diesel-powered vessels did to the trap and seine fishery what no amount of protest from hook-and-line fishermen could do.

The small-trawler fisheries were in ascendancy from the time when steam and internal combustion engines came into use to power fishing vessels until the 1960s. Then the small-vessel technology with its inherent limitation on catch and need for frequent return to port began to suffer the same fate as predecessor technologies. This fate came about because of the introduction of highly productive fleets of large factory ships and auxiliary vessels. These fleets represent not only costly capital investments beyond the means of the entrepreneurs engaged in New England fisheries but also a massive technological capacity for the overkill of fish stocks. Unregulated utilization of this technology has already greatly diminished a number of important species and some are threatened with extinction.

The scope of this new departure in fishing effort is exemplified by one recent sighting from a U.S. Coast Guard patrol plane of a veritable armada consisting of 52 Soviet ships 'including 36 side trawlers, 9 stern freezer trawlers, 5 factory ships, and 2 refrigerated transports' [14]. The refrigerated transports have a capacity of over 7000 tons of frozen fish. The factory ships can process about 400 tons of fish per day and '... small side trawlers ... often unload their nets directly aboard the factory ships and the larger stern freezer trawlers freeze their own catch and then unload it in barrels aboard the factory ships' [15].

This fleet also includes a mother ship with a complement of 6 catcher boats carried on deck. The mother ship also serves as a factory ship for processing the fish brought in by the catcher boats. There is also a research ship with a helicopter landing platform and 16 scientific laboratories.

The application of this modern technology in the realm of hunting and gathering is highly systematic and devastatingly effective.

Hunting in packs (search vessels find the fish and call in the fleet) they soon commenced what has come to be known as 'pulse' fishing. This consists of directing intense effort to a particular fishery until it is no longer feasible to continue. At that point the fleet merely switches to another species and proceeds again. The sad story of pulse fishing is best illustrated by the haddock fishery. Traditionally the haddock had been our most valuable groundfish—usually the main ingredient in fish sandwiches and fish-and-chips. It supported a very consistent fishery on Georges Bank. However, in 1965 the Russians moved into Georges with their small-mesh nets and took 283,000,000 pounds of mostly small haddock. This incredible abuse of the fishery, coupled with a succession of poor spawning years, has so reduced the haddock population that some biologists fear that it is a candidate for extinction [16].

Table 1.—FOREIGN FISHERIES CATCH OFF THE U.S. ATLANTIC COAST
BY NEW LIVE SPECIES COMPARED WITH U.S. CATCH; 1971
(In metric tons)

SPECIES	COUNTRY		TOTAL FOREIGN CATCH‡	UNITED STATES CATCH	UNITED STATES AS PERCENTAGE OF FOREIGN
	Communist*	Non- communist†			
Mackerel	342,468	3,870	346,338	2,406	0.7
Herring	195,736	87,314	283,050	35,313	12.5
Silver hake	91,435	152	91,587	16,321	17.8
Red hal	36,319	14	36,333	3,604	9.9
Shellfish	814	32,575	33,389	509,358	1,525.5
Alewife	23,027	5,398	23,027	12,804	55.6
Squid	6,228	14,800	21,028	1,182	5.6
Cod	1,542	10,741	12,283	23,558	191.8
Sharks	10,832	140	10,972	102	.9
Pollock	8,013	2,458	10,471	4,732	45.2
Argentine	1,895	—	7,293	—	—
Butterfish	512	5,768	6,280	1,570	25.0
Skates	5,218	2	5,220	900	17.2
Redfish	3,494	273	3,767	16,267	431.8
Ocean pout	3,741	3,065	3,741	4,127	110.3
Haddock	603	5	3,668	8,500	231.7
Angler	3,644	2,890	3,649	88	2.4
Groundfish, n.s.	128	31	3,018	5,032	166.7
Witch	2,838	—	2,869	3,220	112.2
Atlantic saury	2,144	—	2,144	—	—
Yellowtail	2,010	115	2,125	29,208	1,374.5
Winter flounder	2,060	62	2,122	11,841	558.0
Sculpin	1,538	—	1,538	1,156	75.2
Tunas	2	1,114	1,116	2,568	230.1
Scup	1,049	—	1,040	3,157	303.6
Summer flounder	840	42	882	2,470	280.0
American plaice	904	—	904	2,170	240.0
Searobin	792	20	812	110	13.5
Dogfish	754	—	754	—	—
White hake	—	314	314	2,715	864.6
Wolfish	—	98	98	189	192.9
Halibut	—	38	38	81	213.2
Bluefish	23	—	23	1,718	7,469.6
Greenland halibut	22	—	22	—	—
Menhaden	—	—	—	240,751	—
Unspecified	37,467	303	37,770	17,509	215.7
Grand total	788,092	171,602	959,694	964,726	100.5

(Source: I.C.N.A.F. Statistical Bulletin, vol. 21, 1971.)

* Includes Soviet Union, Poland, East Germany, Bulgaria, Cuba, and Romania.

† Includes Canada, Federal Republic of Germany, Japan and Spain.

‡ Does not include catches by Italy and Greece. Their vessels fished off the U.S. Atlantic coasts, but neither country submitted their catch statistics to I.C.N.A.F.

During the first half of the previous decade this technological succession was in the take-off stage. Before 1960 most of the catch off the New England coast was taken by American fishermen, but ' the catch by other countries sky-rocketed from about 108,000 metric tons in 1961 to 580,000 tons in 1965 [17]. By 1971 distant-water fishermen employing the massive factory ship technology were taking the bulk of some species from traditionally American fishing grounds (see Table 1). The continuing rise in the application of this competing technology can be seen in a comparison of vessel sightings between 1972 and 1973 (see Table 2).

Table 2.—FOREIGN STERN FACTORY AND FREEZER TRAWLERS AND MEDIUM SIDE TRAWLERS SIGHTED OFF U.S. ATLANTIC COAST IN MARCH, 1972 AND 1973
(In number of vessels)

NATIONALITY	MARCH, 1973		MARCH, 1972	
	Stern	Medium	Stern	Medium
Soviet	120	52	39	136
Polish	17	16	23	37
East German	9	8	10	15
Bulgarian	8	—	8	—
Romanian	6	—	1	—
Total	160	76	81	188
West German	1	—	—	—
Spanish	14	12	2	6
Japanese	14	—	7	—
Italian	6	1	—	—
Other	—	—	—	—
Total	35	13	9	6
Grand total	195	89	90	194
Estimated fishing effort in units of medium trawlers	1,170	89	540	194
Total	1,259*		734	

* 72 per cent greater than in March, 1972.

In a movement reminiscent of the hook-and-line fishermen's protest of the 1870s, the New England trawler fishing interests of the 1970s have responded to this threat to their accustomed livelihood by seeking to bar the competing technology from the waters they regard as their own. This protest has crystallized around the issue of a 200-mile zone for fishing, or, more precisely, the extension of fisheries jurisdiction 197 miles beyond the territorial waters of the United States.

Both Massachusetts and Rhode Island have enacted legislation that embodies this idea. A Rhode Island legislator, sponsor of that state's 1972 law on Preservation of Marine Fisheries Resources, stated that:

Our local fishing industry has been operating at an unfair disadvantage for years. Government-subsidized boats from other countries which are more modern and better equipped than our own can fish as close to our coast as 12 miles today. Some species of commercial fish have been severely depleted already [18].

The two States have enacted provisions that reserve fishing rights 'seaward to a distance of two hundred (200) miles or to a point where the water depth reaches one hundred (100) fathoms, whichever is greater' [19]. Neither Massachusetts nor Rhode Island has naval forces required for enforcement, but passage of this legislation is symbolic of the trawler fishermen's resistance against incursion of a more productive technology into their accustomed fishing grounds.

At the national level, a comparable bill was introduced in June, 1973, by Senator Magnuson and Representative Studts, entitled the 'Interim Fisheries Zone Extension and Management Act of 1973' and captioned as 'A bill to extend on an interim basis the jurisdiction of the United States over certain ocean areas and fish in order to protect the domestic fishing industry, and for other purposes' [20]. Passage of this legislation is made problematic by the fact that a number of conflicting interests, both general and particular, stand in opposition. Among the former are diplomatic interests seeking good relations with distant-water fishing nations, and among the latter are the tuna and shrimp fishing interests that would be excluded from some of their fishing grounds if other nations were to enact similar rules. Nevertheless, from the perspective of the present discussion, the very introduction of this federal legislation dramatizes the response to technological change with which we are concerned here.

Conclusion

While each succeeding stage in technological development elicits complaints from practitioners committed to the previous condition of the 'industrial arts', it has become apparent that this is not an endless process. Technology as knowledge and means for exploitation of the environment has in many areas approached the limits imposed by the finite nature of the environment. While the cry of the hook-and-line fishermen that trappers and seiners would bring about the extinction of various species through overfishing may have been the rhetoric of false alarm, the trawlermen's charges against the overkill of the foreign factory fleets are increasingly recognized as being well founded.

Thus the trawlermen whose advocacy of a 200-mile limit has been documented above are not 'crying wolf' but are pointing to an important concomitant of technological innovation, namely the need for social innovation. Unrestrained *laissez-faire* in utilization of technology poses many dangers in diverse areas of human life, and has been increasingly discredited. In the realm of fisheries technology the danger posed by unregulated use of the factory fleet technology may be the end of fishing, as maximum sustainable yields are more readily exceeded.

The need to restrict the application of increasingly efficient technologies by all nations to conform to the limits of the resource being exploited is well exemplified by this case. We have reached the point in the relationship of fishing technology and resources where there is no longer the luxury of trial-and-error solutions.

Notes

- [1] RHODE ISLAND GENERAL ASSEMBLY (1870), *Report of the Special Joint Committee appointed to examine into the Fisheries of Narragansett Bay*, Pawtucket: Nickerson and Sibley.
- [2] *Ibid*, p. 53.
- [3] *Ibid*, p. 80.
- [4] *Ibid*, p. 128.
- [5] *Ibid*, p. 62.
- [6] *Ibid*, p. 131.
- [7] *Ibid*, pp. 34-35.
- [8] *Rhode Island Public Statutes, 1882*, p. 359.
- [9] *Ibid*, p. 360.
- [10] RHODE ISLAND COMMISSIONERS OF INLAND FISHERIES, *1920 Report*, p. 23.
- [11] *Rhode Island Public Laws, 1927-1928*, p. 546.
- [12] RHODE ISLAND DEPARTMENT OF AGRICULTURE AND CONSERVATION, *1937 Report*, pp. 131-132.
- [13] *Providence Journal*, March 17, 1940, p. 12.
- [14] BRYANT, WILLIAM (1973), 'Soviet Industry floats off Coast', *Providence Journal-Bulletin*, July 21, p. 5.
- [15] *Ibid*.
- [16] RISTORI, AL (1972), 'Twilight for America's Fisheries', *Fishing World*, November-December, p. 45.
- [17] NOETZEL, BRUNO G. (1972), 'New England Trawlermen struggle to survive', *Marine Fisheries Review*, 34, September-October, p. 19.
- [18] RHODE ISLAND HOUSE OF REPRESENTATIVES (1972), 'Statement of Representative Aukerman', January 18 (mimeo), p. 1.
- [19] *Rhode Island Laws, 1972*, 20-36-1.
- [20] UNITED STATES CONGRESS, 93rd Congress, 1st Session, S.1988 A Bill to extend on an interim basis the jurisdiction of the United States over certain ocean areas and fish in order to protect the domestic fishing industry, and for other purposes. By Mr. Magnuson *et al.* an H. R. 8665: identical bill by Mr. Studds.