

# **Management of the British Columbia Abalone Fishery**

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## **Abstract**

In 1976, production from the British Columbia commercial dive fishery for abalone increased substantially. For the next 14 years the fishery was relatively active. However, the fishery has not been opened since 1990 due to the depletion of the abalone stocks. Little was known about the stock or its harvestable surplus when the fishery expanded in 1976. Regulations to control effort and production included the introduction of limited entry in 1977 and a total allowable catch, supported by a form of individual quotas, in 1979. This report surveys the history of this fishery after 1976, paying particular attention to the limited entry and the individual quota programs.

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## Introduction<sup>1</sup>

The British Columbia commercial dive abalone fishery took off from relatively low levels of production in 1976, and ended in 1990 due to the depletion of the abalone stocks. It has not been opened since 1990.

Very little was known about the available stock or its harvestable surplus at the time the fishery began. Regulations to control effort and production included the introduction of limited entry in 1977 and a total allowable catch (TAC), supported by a form of individual quotas, in 1979.<sup>2</sup>

The history of this short lived fishery illustrates some of the problems with the management of an emerging fishery and provides a case study of the operation of limited entry (for two years) and of individual quotas (for 12 years).<sup>3</sup>

## B.C.'s Abalone Resource

“Northern” or “pinto” abalone” (*Haliotis kamtschatkana*), are found from Baja California north to Southeast Alaska. The only abalone species in British Columbia, it is found on rocky, kelpy, bottoms, in relatively shallow water from the low tide line out to about 30 to 40 feet.<sup>4</sup> It is found throughout B.C., but particularly in northern and exposed waters.<sup>5</sup> Northern abalone is a type of snail, harvested by scuba divers for the meat in its foot.<sup>6</sup>

Northern abalone grow relatively slowly; it takes six or seven years for them to reach 100 millimeters (about four inches); that was the minimum harvestable length during the fishery. Growth rates can vary depending on conditions. Fishermen refer to “surf” abalone in exposed beds that grow more slowly and never reach their potential maximum lengths. Spawning begins after about three years, or when the abalone are about two inches long. Fertilized eggs hatch quickly and the larvae settle on the bottom within two weeks.<sup>7</sup> Mortality rates for northern abalone may be on the order of 20% per year. Adult predators include the octopus, starfish, and sea otter (although otters were not a serious problem in B.C. during the fishery).<sup>8</sup>

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<sup>1</sup> This report has benefited from comments by Kurt Schelle of the Alaska Commercial Fisheries Entry Commission and Alan Campbell of the Canadian Department of Fisheries and Oceans. Only the author is responsible for any errors in this report.

<sup>2</sup> In much of the Canadian literature the total fishery harvest limit imposed by regulation is called a “quota.” I will refer to it as the “total allowable catch” or TAC in order to avoid confusion with “individual quotas.”

<sup>3</sup> This fishery is managed by the Canadian Federal government through its Department of Fisheries and Oceans (DFO) and not by the Provincial government.

<sup>4</sup> Fedorenko and Sprout, page 4; Campbell, fax.

<sup>5</sup> Campbell, pers. comm.

<sup>6</sup> Talley, page 48.

<sup>7</sup> Fedorenko and Sprout, page 4-6.

<sup>8</sup> Fedorenko and Sprout, page 7.

Although the abalone has a foot, it tends to be relatively immobile. It may drift during its larval stage, and there has been some speculation that younger abalone settle in relatively deeper water and migrate towards shallower water as they grow.

Northern abalone may have high discard mortality rates. When they are damaged and cut during harvesting, they tend to keep bleeding. Discard mortality rates may be between 50% and 100%.<sup>9</sup>

Sea urchins and northern abalone may substitute for each other in the same ecological niche. Areas where abalone have been fished out may be colonized by sea urchins. This may inhibit the recovery of the abalone stocks in those areas.<sup>10</sup>

Harrison notes that “the history of abalone fisheries in Japan, California, Canada, and Mexico show substantial depletion of stocks after heavy fishing.”<sup>11</sup> Northern abalone have a number of characteristics that make them vulnerable to fishing. They are slow growing, relatively immobile animals, often valuable, and relatively easy to harvest.

## **The Unlimited Fishery, Up to 1977**

Northern abalone were being harvested commercially in B.C. by the early 20th century. Commercial harvests continued intermittently through the first 50 years of the century. The largest harvest during this period, about 31 metric tons, appears to have been made in 1928.<sup>12</sup>

The introduction of scuba gear led to larger and more systematic harvests starting in the 1950s. Between 1950 and 1971 firms appear to have been small, selling to domestic fresh markets. Harvests were generally under 10 tons, although they rose to almost 20 tons in two years, and to over 50 tons in 1964.<sup>13</sup>

From 1972 on, abalone production was much higher than before. From 1972 to 1975 production was around 60 tons a year, and in 1976 it jumped up to 273 tons.<sup>14</sup> While 21 vessels operated in 1975, 40 operated in 1976. Several reasons have been suggested for the production increase. Limited entry in salmon and herring fisheries put investment cash in the hands of license holders and forced persons without licenses to look for new, unlimited, fisheries to enter. New marketing opportunities opened in Japan, and ex-vessel

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<sup>9</sup> Fedorenko and Sprout, pages 7-8.

<sup>10</sup> Fedorenko and Sprout, page 8.

<sup>11</sup> Harrison, page 19.

<sup>12</sup> Sloan and Breen, page 23. All references to “tons” in this report are to metric tons.

<sup>13</sup> Sloan and Breen, page 23.

<sup>14</sup> Many of the numbers cited in this paper are summarized at the end of the paper in the appendix table on annual TACs, landings, and effort.

price rose from \$990 a ton in 1972 to \$3,150 a ton in 1976. Also, new freezing technologies were introduced.<sup>15</sup>

The increased harvests in the mid-seventies were also a northern B.C. phenomenon. Historically (at least since the introduction of scuba gear in the early 50s) harvests had been made in both the north and the south. For long periods of time, the south might dominate landings. But when the large landings began in the mid-seventies, they came from the north, particularly from the eastern side of the Queen Charlotte Islands and from the seaward side of the islands off of the mainland coast opposite the Queen Charlottes.<sup>16</sup> Fedorenko and Sprout argued that,

The major reason for a shift in abalone harvest from the south to the north of B.C. during the mid-1970's, was the introduction of larger, more mobile fishing vessels with freezer capacity. These vessels could travel to more remote areas, cover a larger area under more adverse weather conditions, and harvest more abalone without spoilage. Also, the operators could hire additional scuba divers due to the continuing increases in the price of abalone.<sup>17</sup>

Prior to limited entry, management was minimal. Some areas were closed in the seventies to protect Native and sport fisheries. A size limit of 2.5", in place since 1938, remained in place throughout the period and was the only real tool to control harvest in most areas. Fishermen needed an unlimited fisherman's registration card, and an unlimited "C" vessel license for the vessel, which allowed the vessel to be used in a variety of non-salmon fisheries.<sup>18</sup>

Before 1978, managers had no good estimate of the fishery's sustainable yield. The large landings in 1976, considered to be above the unknown sustainable yield, led to a fishery closure for the first time in November.<sup>19</sup>

## **Limited Entry - 1977 and 1978**

In 1977 the DFO responded to the rapid price, fleet, and production increases, and limited entry in the fishery to 29 persons. It appears that the initial limitation took place in connection with the limitation of the "C" vessel licenses that year; the abalone fishermen were initially limited as a special category of the "C" license.<sup>20</sup> However, from September, 1977 a new category "E" personal limited entry license was issued to persons who operated vessels which landed more than \$2,000 of abalone in 1976 or earlier, and

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<sup>15</sup> Sloan and Breen, page 23; DFO Pacific Coast Licensing Handbook, page 35; All prices and values in this paper are reported in Canadian dollars. These values would be lower if reported in U.S. dollars.

<sup>16</sup> Fedorenko and Sprout, pages 27-35.

<sup>17</sup> Fedorenko and Sprout, page 41.

<sup>18</sup> Sloan and Breen, page 28-29; DFO, Pacific Region, Commercial Licensing Handbook, page 33.

<sup>19</sup> Sloan and Breen, page 28-29.

<sup>20</sup> Sloan and Breen, page 29. DFO, Pacific Region, Commercial Licensing Handbook, page 33.

who could document that they had made more than 50% of their fishing income from abalone in any one year before 1977. Not more than one license could be held by a person. An appeals process was available to applicants.<sup>21</sup>

The rights associated with the limited entry permit were fairly restricted. A person could only hold one license which allowed operation of one vessel. License holders were allowed to employ three divers. Divers' names had to be listed on the license, and divers had to be registered with the DFO. Divers were allowed to change license holders during the year.<sup>22</sup>

The license holder had to use the license on a vessel in which he held a majority interest. He could transfer the license from one vessel to another in which he held a majority interest. He could not transfer the license to another person. However, since the license holder did not need to be present with the fishing operation, it was possible for the license holder to lease the license. Apparently leasing took place. If a license holder wanted to renew the license it had to have been used to harvest 2.3 metric tons of abalone during the preceding year. There was a \$200 a year license renewal fee.<sup>23</sup>

Limited entry was introduced along with a variety of other new management measures. The season was shortened to eight months (April through November), a new 4" size limit was introduced, areas were closed, fishermen were required to measure abalone underwater and discard undersized abalone, and detailed logs of daily operations were required.<sup>24</sup>

During this period, managers were attempting to control harvests through controls on fishing effort. Total allowable catches were not introduced.<sup>25</sup>

The minimum harvest rule appears to have led to a reduction in the number of licenses. In 1977, 22 of the available 29 licenses were used to make the minimum level of landings. Eventually 27 licenses survived an appeals process and were issued for 1978. Another vessel lost its license in 1979 because it didn't meet the minimum landings requirement in 1978.<sup>26</sup> This left 26 licenses in the fishery. This number remained constant to the end of harvests in 1990.

Limited entry and the other restrictions did not curtail harvests. Catch rose from 273 tons in 1976 to 428 tons in 1977. The season length was reduced to three months in 1978 in an unsuccessful attempt to limit harvests.<sup>27</sup> Harvests rose to 433 tons in 1978.

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<sup>21</sup> Fedorenko and Sprout, page 19. DFO, Pacific Region. Commercial Licensing Handbook, page 35.

<sup>22</sup> Sloan and Breen, pages 28-29.

<sup>23</sup> Fedorenko and Sprout, pages 19-21; DFO 1994 Licensing Handbook, page 36.

<sup>24</sup> Campbell, fax.

<sup>25</sup> Sloan and Breen, page 28-29.

<sup>26</sup> Fedorenko and Sprout, page 22-23..

<sup>27</sup> Sloan and Breen, page 29.

Harvests rose because the program did not control all the available “margins” along which fishermen could expand their effort. Also the “one-size-fits-all” license and three person diver limit “locked in” a lot of formerly unused effort potential. Breen has described the ways in which effort increased under limited entry:

...effort per licensed entrant increased dramatically in several ways. In 1977 five boats took 66% of the catch, thus many boats were fishing at low efficiency. Licensees who previously fished alone increased their fishing team to three, creating a net increase in the total number of divers. Most diving for *H. kamtschatkana* takes place in shallow water, so divers increased the number of hours dived per day. Licensees moved their licenses to larger boats, which allowed them to spend more time fishing and access to more remote beds.<sup>28</sup>

By 1979 it was clear that the 1977 and 1978 restrictions were not slowing down the harvest. In addition, by the end of 1978 managers had a preliminary estimate of the sustainable yield.<sup>29</sup>

## **TAC Management and Individual Quotas, 1979 to 1990**

In 1979, managers introduced a total allowable catch to this fishery. Managers sought to bring the harvest down gradually, from 1976 levels to the estimated sustainable yield, in two years. The TAC was set at 226.8 tons in 1979 and at 113.4 tons in 1980.<sup>30</sup>

In 1979 this new TAC was divided into two parts. One half of it was set aside for a short open access fishery in the spring (April 15 to May 3). The other half was set aside for an individual quota fishery during a season meant to last from May 8 to November 30.<sup>31</sup>

Managers were concerned that fishermen, competing under the new TAC limit on harvest would reduce the length of the fishing season in their race for the fish. Larger vessels with freezer capabilities were expected to be placed at a competitive advantage with respect to smaller operations under these conditions. The individual quotas were meant to provide supplies for fresh markets over a long period of time, and to help smaller vessels without freezers compete.<sup>32</sup>

Thus, individual quotas were introduced to solve social and economic problems associated with the introduction of TAC management in the fishery. The primary management tool was the TAC which was designed to control harvest. Individual quotas were, in this case, primarily a conservation tool since their role was to buttress and support a regulation which was conservation oriented.

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<sup>28</sup> Breen, page 310.

<sup>29</sup> Fedorenko and Sprout, page 47.

<sup>30</sup> Sloan and Breen, page 29.

<sup>31</sup> Fedorenko and Sprout, page 22.

<sup>32</sup> Fedorenko and Sprout, page 23.

The actual distribution of individual fishing rights was very egalitarian - each license holder could harvest 4.5 metric tons of abalone. This distribution of rights was very different from the uneven distribution of harvests in preceding years. In 1977, in the first year of limited entry, ten vessels landed 87% of the catch and in 1978 seven vessels landed 68% of the catch.<sup>33</sup> Thus with the TAC allocated equally among the license holders, former highliners who adhered to the quota limits would be constrained relative to the other fishermen.

The following year, in 1980, the TAC was cut in half and the entire TAC was divided equally as individual quotas among the license holders in the fishery. As in 1979, the season was open from April 15 to November 30, but in 1980 none of the TAC was set aside for an open access fishery.<sup>34</sup> The TAC continued to decline over the period from 1980 to 1985, eventually reaching 47.2 tons a year from 1985 to 1990. After 1990 the fishery was closed.<sup>35</sup>

During the years of the fishery the TAC continued to be divided equally among 26 limited entry license holders. While neither the quota nor the license could be sold, the license and associated quota were apparently leased. The license holder did not have to personally fish. Up to four of the licenses (or about 15% of the TAC) could be fished by divers operating off of a single boat.<sup>36</sup> The three diver per boat restriction was retained in 1979, but was dropped afterward.<sup>37</sup>

Licensed fishermen had to notify the government when and where they intended to fish, and when and where they planned to land their catch, when they left port. Logs were to be kept and landings were supposed to be made at designated ports under the supervision of a DFO fishery officer.<sup>38</sup>

Despite these rules, poaching was a serious problem due to the high price of abalone and a difficult enforcement environment.<sup>39</sup> The fishing season was long, abalone could often be found in relatively shallow water, the open areas were large, and abalone fishermen were often active in remote areas. The Department of Fisheries and Oceans (DFO) had limited resources to devote to enforcement. These limited resources were stretched particularly thinly during the salmon fishing season. There were also concurrent recreational and Native fisheries for abalone. Recreational fishermen sometimes sold significant amounts of abalone.<sup>40</sup>

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<sup>33</sup> Fedorenko and Sprout, page 36.

<sup>34</sup> Fedorenko and Sprout, page 23.

<sup>35</sup> Sporer, fax.

<sup>36</sup> Dickson, pers. comm.; My sources aren't clear about when this stacking provision was introduced. The large drop in the number of vessels between 1983 and 1984 (see the appendix table) suggests it may have been introduced for the 1984 fishery but I haven't been able to confirm this.

<sup>37</sup> Breen, page 301.

<sup>38</sup> Fedorenko and Sprout, page 23.

<sup>39</sup> Dickson, pers. comm.

<sup>40</sup> Fedorenko and Sprout, page 47.

Harvest reporting was a problem in this fishery before limited entry in 1977; Fedorenko and Sprout suggest that landings may have been underestimated by up to 20% before 1977. The magnitude of actual poaching during the individual quota fishery is unknown but appears to have been large. In 1982 Fedorenko and Sprout suggested that recent harvests were underestimated by up to 10%.<sup>41</sup> Parsons reports on an internal DFO study that apparently indicated that illegal fishing due to poaching and to overharvests by licensed divers was about equal to legal production, at least at some time after the TAC was allocated among the licenses.<sup>42</sup> About the time the fishery was shut down, DFO documents referred to “anecdotal information and license holders’ estimates” that “levels of illegal landings may be as high as twice to four times the quota.”<sup>43</sup>

With individual quotas and the introduction and steady decrease in TACs, the number of vessels in the legal fishery was reduced, as was the amount of diver activity. In 1977 and 1978, just before individual quotas, there were 22 and 25 vessels operating. The number of vessels remained at these levels through 1983, and then fluctuated between 14 and 18 vessels for the remainder of the fishery. Measures of actual diver activity started to decline almost immediately after TACs and individual quotas were introduced. Over 2,000 diver days were reported in 1977 and 1978, but this dropped to about 1,300 in 1979, when half the TAC was under individual quotas, and then to 789 in 1980, when the entire TAC was under individual quotas. Diver days declined in five of the eight years from 1979 to 1988.<sup>44</sup>

These effort reductions in the legal fishery occurred despite rising ex-vessel prices throughout almost all of this period. Except for some softness in 1982 and 1983, ex-vessel prices appear to have risen in almost every year during this period. DFO reports indicate that ex-vessel prices were \$3,150 per metric ton in 1976, and \$26,940 per ton in 1990, a 755% increase in 15 years.

DFO reports suggest that licenses were trading for about \$90,000 in 1990 (this would be a price for a long term lease) The DFO notes that this estimate must be used with caution. It is based on interviews with fishermen and brokers and reflects their estimates of the value - not actual market prices.<sup>45</sup>

Because of the large declines in the TAC that took place after the individual quotas were introduced, it is hard to know the extent to which effort reductions reflect efficiencies introduced through individual quotas. The effort is also complicated by the widespread cheating which makes it is hard to know what the actual harvests were or how much effort was actually used in the fishery and by the declines in CPUE taking place during the period.

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<sup>41</sup> Fedorenko and Sprout, page 47-48.

<sup>42</sup> Parsons, page 210.

<sup>43</sup> Farlinger, page 43.

<sup>44</sup> Sporer, fax.; Mylchreest, fax.

<sup>45</sup> Mylchreest, fax.

The individual quotas did appear to have lengthened the fishing season. As noted, during the first year, half the quota was harvested in an open access fishery and the other half was harvested in an individual quota fishery. The open access harvest was taken in 18 days, while the individual quota fishery lasted seven months.<sup>46</sup> However, the long, spread out season may have increased enforcement problems.

Poor stock conditions led the government to shut the fishery down in November, 1990. The exact reasons for the stock decline are unclear. Much of the decline probably reflected the “mining” of a largely unexploited stock of slow-growing, relatively sedentary abalone during years of legal and illegal fishing. Breen argued that it was also possible that, for unknown environmental reasons stock recruitment was not keeping pace with natural mortality in the northern abalone stocks. He argued that there was evidence of recruitment problems at the start of the fishery. His calculations suggested that even without fishing mortality, the stock size would have declined substantially over that period “of its own accord.”<sup>47</sup>

In 1991 the commercial total allowable catch was set to zero and the licenses for this fishery, and their associated quotas, were not renewed.<sup>48</sup> Illegal harvests apparently continued after the closure of the legal fishery.<sup>49</sup> In 1998, this fishery was still closed, and although stock reviews were ongoing, there was little chance it would be opened soon.<sup>50</sup>

## Discussion

The commercial abalone fishery started off in B.C. at a time when fishery managers knew very little about the extent and potential productivity of the resource. Within a very short time fishermen had harvested the stock down to low levels. There is also some evidence that the fishery began at a time when natural recruitment was at low levels.

Fishery managers responded quickly with regulations designed to reduce the effort, and indirectly the harvest, in the fishery. This included a program of limited entry to control the number of operations, a restriction on the number of divers that could operate in each operation, and various other measures. Given the large number of ways effort could be applied in the fishery, and the extent to which the measures adopted “locked-in” potential effort increases, these measures proved inadequate to control harvests.

When it became evident that these indirect measures were not working, managers again responded promptly and introduced TAC management in the fishery in order to control the actual harvest directly. Individual quotas were introduced in this fishery in 1979, a

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<sup>46</sup> Farlinger, page 43

<sup>47</sup> Breen, pages 306 and 308.

<sup>48</sup> Dickson, pers. comm.; Parsons, page 210. Native and recreational fisheries were also shut down at this time. Campbell, fax.

<sup>49</sup> Heizer, pers. comm.

<sup>50</sup> Adkins, pers. comm.

very early point in time for individual quotas. The quotas were apparently subordinate to a conservation function; they were meant to reduce the social disruption associated with the introduction of the TAC.

These direct controls on harvest failed to preserve the commercial fishery. Much of the harvesting damage had already been done with the high levels of harvest in the earlier years. The government was also, apparently, unable to enforce the TAC effectively. There seems to have been widespread cheating by licensed commercial fishermen and poachers. Exacerbating the problems, there may have been an ongoing recruitment problem in the fishery.

In 1990, the government closed the fishery. It has not been reopened since. However, abalone prices rose after 1990, and there is considerable evidence of a very active illegal abalone fishery continuing in British Columbia's waters.<sup>51</sup>

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<sup>51</sup> Heizer, pers. comm., February, 1998.

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### Appendix: Annual Abalone TAC, Landings, and Effort Information

Year	License Numbers	Limited Entry and Individual Quotas	TAC (tons)	Catch (tons)	Number of vessels	Diver days	CPUE (kg/diver day)	Diver hours	CPUE (kg/diver hour)	Ex-vessel price (\$ per ton)
1975	21	unlimited	none	57	21					2,316
1976	43	unlimited	none	273	40					3,150
1977	29	entry limit	none	428	22	2,356	201.5	12,680	37.4	4,049
1978	27	entry limit	none	433	25	2,169	186.3	11,812	34.2	4,305
1979	26	indiv. quota	226.8	186	25	1,303	151.4	5,816	33.9	5,710
1980	26	indiv. quota	113.4	97	25	789	134.4	3,282	32.3	6,196
1981	26	indiv. quota	94.3	85	24	700	133.8	2,741	34.2	9,353
1982	26	indiv. quota	94.3	54	22	602	136.4	2,587	31.7	8,463
1983	26	indiv. quota	70.6	56	22	415	128.3	1,584	33.6	8,286
1984	26	indiv. quota	58.9	58	16	486	118.3	1,903	30.2	9,138
1985	26	indiv. quota	47.2	42	15	443	98.8	1,367	32.0	10,524
1986	26	indiv. quota	47.2	52	18	477	95.5	1,851	24.6	14,115
1987	26	indiv. quota	47.2	49	15	467	99.4	1,726	25.8	19,857
1988	26	indiv. quota	47.2	49	16	429	106.0	1,750	26.0	22,367
1989	26	indiv. quota	47.2	48	14					23,979
1990	26	indiv. quota	47.2	50	14					26,940

Sources: Most data from Campbell, fax. Data on diver days, hours and CPUE from Farlinger and Campbell, Table 1, page 22. License numbers for 1975 and 1976 are from Breen, Table 1, page 301. Vessels with landings for 1975 and 1976 from the DFO Pacific Region 1994 Commercial Licensing Handbook, page 35. Vessels with landings, 1987-1990 from Mylchreest, fax. In some cases alternative DFO series with slightly different numbers exist. There was heavy illegal fishing during at least some of this time and this can affect the accuracy of many of these numbers.