

# **Management of the British Columbia Sea Urchin Fisheries**

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## **Abstract:**

The British Columbia commercial dive fishery for red sea urchins began to take off in 1978. Limited entry was introduced in 1991, and a voluntary individual quota program was begun in 1994. In 1996 the Department of Fisheries and Oceans made the individual quota program an official part of the management of the fishery. The commercial dive fishery for green urchins began in 1987, entry was limited in 1991, a voluntary individual quota program was begun in 1994, and the Department of Fisheries and Oceans introduced an official individual quota program in 1995. The management histories of both fisheries are reviewed, with particular attention to the operation of the limited entry and the individual quota programs.

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## Introduction<sup>1</sup>

The commercial dive fishery for red sea urchins began to take off in 1978. Limited entry was introduced in 1991, and a voluntary individual quota program was begun in 1994. In 1996 the Department of Fisheries and Oceans<sup>2</sup> (DFO) made the individual quota program an official part of the management of the fishery.

The commercial dive fishery for green sea urchins began in 1987. Limited entry was started in 1991 when it was introduced in the red urchin fishery. A voluntary individual quota program was started in 1994. In 1995 the DFO made individual quotas an official part of fishery management.

The histories of these fisheries illustrate some of the problems with the management of emerging fisheries and provide case studies of the operation of limited entry and the implementation of individual quotas.

## B.C.'s Red and Green Sea Urchin Resources

B.C. has had commercial harvests for red (*Strongylocentrotus franciscanus*), green (*Strongylocentrotus droebachiensis*), and purple (*Strongylocentrotus purpuratus*) sea urchins. The purple urchin fishery has been extremely limited and is not discussed in this paper<sup>3</sup>

Red urchins can be found all along the British Columbia coast. Red urchins like kelpy areas with moderate currents. Fjord passes (narrow openings with lots of tidal water passing through) are often good locations for red urchins. They can be found down to 100 feet.<sup>4</sup> Green urchins occur in all areas of the B.C. coast, but are very patchy. Although they prefer areas with good sea water circulation, they are not quite as avid as red urchins for high current. They have been found as deep as 90 feet and may be deeper.<sup>5</sup>

Both male and female urchins are harvested for their gonads (frequently referred to as “roe” in a fishery convention). Red urchins may spawn at any time of the year. Since the fishermen are fishing for the sex organs of the urchins managers are flexible with red urchin fishing schedules. Green urchin spawning is concentrated in the spring. Product quality will drop off after January

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<sup>1</sup>The report has benefited from reviews by Kurt Schelle of the Alaska Commercial Fisheries Entry Commission, Shane Neifer of the Canadian Department of Fisheries and Oceans, Dr. Ian Perry of the Canadian Department of Fisheries and Oceans, and Darin Macey of D&D Pacific Fisheries Ltd. Any errors are the responsibility of the author.

<sup>2</sup>The red and green sea urchin dive fisheries are managed by Canada's Federal government, not by the Provincial government.

<sup>3</sup>The purple urchin fishery was an experimental fishery that lasted for two years. There is no commercial purple sea urchin fishery at this time. Neifer, pers. comm.

<sup>4</sup>Neifer, pers. comm.; Parker, pers. comm.

<sup>5</sup>Neifer, pers. comm.; Parker, pers. comm.

31, and spawning will continue to early April. Product quality has improved again by the fall. Managers thus open the green urchin fishery in the fall and early winter.<sup>6</sup>

Urchin larvae can drift for six to eight weeks before settling on the bottom. During this time currents can carry them long distances. Thus bed specific stock-recruitment relationships are probably not strong.<sup>7</sup> Once they settle they retain some mobility. However, since they like areas with moderate tidal currents, they have the capability of attaching themselves tightly to the bottom.

The urchins tend to grow at a slow rate, although the green urchins tend to grow faster than the red urchins. Good urchin aging techniques have not yet been developed. Recent evidence, from California, suggests that red urchins may live well over 100 years, perhaps as long as 200. First spawning takes place when the red urchins are about 65-70 mm long, and, because of a minimum size regulation, the urchins are recruited into the fishery at 100 mm. Green urchins are believed to live to 10 years or somewhat longer; first spawning is believed to take place after two to three years. The current minimum size limit of 55 mm is believed to give the green urchins at least a year of spawning before they can be fished.<sup>8</sup>

An undamaged urchin can be replaced on the ocean floor. However, fishing may destroy some animals. As noted, urchins live in areas where water flows rapidly. Because of this they attach themselves tightly to the bottom. Divers may break the shells, or damage the sucker feet they use to attach themselves to the substrate, as they try to pry them off the bottom. In addition, divers cannot tell the "roe" content by a visual examination of the outside of the shell. Divers may break open the shells of a large number of urchins in an effort to check out the quality levels in a particular harvest area.

Urchins can be involved in a complex ecological interrelationships with sea otters and kelp. Urchins eat kelp and otters eat urchins. Urchins can eat too much kelp and make it impossible for the habitat to continue to sustain them. Otter populations can drive urchins down to very low levels. Urchin populations were probably at or near historic highs at the time the fishery began, due to low otter populations. Currently, however, the BC otter population, although small, is growing rapidly.<sup>9</sup> This may ultimately reduce available urchin stocks substantially.

Large adult red urchins provide protection for smaller, juvenile red urchins, beneath their shells. Because of this relationship, there was a period in the fishery during which managers imposed a 165 mm maximum size limit on red urchin harvests on B.C.'s North Coast. This was designed to increase the level of protection for the smaller urchins. This regulation was dropped with the advent of individual quotas. Since smaller urchins are more desirable to the market divers fishing under individual quotas are much less likely to harvest them.

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<sup>6</sup>Parker, pers. comm.

<sup>7</sup>Parker, pers. comm.

<sup>8</sup>Parker, pers. comm.; Perry, pers. comm.

<sup>9</sup>Neifer, pers. comm.



Red urchin vessels on the North Coast may range up to 40-45 feet; red and green urchin vessels on the South Coast are smaller, ranging up to 30 feet. Crews typically include a tender and two divers. Most red urchin divers have adopted scuba gear, although a significant number (perhaps 30%) continue to use a hose with air pumped from the surface. Green urchin divers use scuba gear because of its mobility since green urchin distribution is patchy. The “tender” is a person designated to monitor the divers on the bottom.<sup>10</sup> Divers harvest the urchins with an aluminum rake. Fishing takes place from five to 60 feet down; 25 to 30 feet is a very common depth.<sup>11</sup>

The Japanese market is the largest market for sea urchins. This market is served by countries from all over the world, including the United States, Canada, South Korea, Chile, North Korea, Peru, and China. Large scale Japanese production began in the 1950s and grew rapidly, running between 22,000 and 27,000 metric tons a year between the late sixties and the early eighties.<sup>12</sup> After about 1987, however, Japanese production began to decline,<sup>13</sup> opening up market opportunities for producers in other countries. Red urchin roe is mainly sold processed while green sea urchins are mainly sold into live, whole markets.<sup>14</sup>

## Red Sea Urchin Management

### *The Unlimited Fishery, Early 1970s-1990*

There is evidence from middens that British Columbian Natives might have used urchins once, but at the time the commercial fishery emerged there was no significant recreational or aboriginal fishery.<sup>15</sup> The first commercial landings began in 1971, but the fishery remained small until 1978.

The first important commercial landings, 75 tons, came in 1978 along the South Coast of British Columbia.<sup>16</sup> Harvests began to take off in the early eighties; production rose more than six times, from 160 to 986 tons, between 1982 and 1983, increased almost 80%, to 1,764 tons, in 1984, and continued to rise into the early 90s. In 1990, the year before limited entry, the fishery produced 3,158 tons.<sup>17</sup>

Landings prices and effort also rose during this period. Landings prices rose in each year, from an average of \$213/ton in 1978 to an average of \$618/ton in 1990.<sup>18</sup> This was a total price increase of 190%. The number of vessels rose from 4 in 1978, to 21 in 1982, to 114 in 1990. The total number of “vessel fishing days” also rose, but less than proportionately. There were 54 vessel

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<sup>10</sup>Neifer, pers. comm.

<sup>11</sup>Harbo, in *Bodega Bay Proceedings*, page 2; Perry, pers. comm.

<sup>12</sup>All references to “tons” in this report are to metric tons.

<sup>13</sup>Wilén and Wessells, Figure 1, page 5.

<sup>14</sup>DFO, 1995/96 Mgt. Plan, page 3.

<sup>15</sup>Neifer, pers. comm.

<sup>16</sup>Most of the red urchin statistics cited in this report are from Canadian fisheries management documents. The appendix to this report has tables summarizing most of these numbers.

<sup>17</sup>DFO, PSARC, 1995, Table 1.

<sup>18</sup>Harbo in *Bodega Bay Proceedings*, Table 1, page 9. The 1990 price estimate is based on data that was still preliminary at the time of publication (1992). All prices and values in this paper are in Canadian dollars. These prices and values will be lower when expressed in nominal U.S. dollars.

fishing days in 1978, 195 in 1982, and 2,651 in 1990.<sup>19</sup> The available data on the numbers of divers shows that there were 152 in 1988 and 149 in 1989, but that their numbers rose to 185 in 1990, about 23% above the 1988-89 average.<sup>20</sup>

The growth in red sea urchin harvests went through two phases during this period. The first, lasting through 1986, was based almost entirely on an expansion of harvests on the South Coast of B.C.<sup>21</sup> South Coast harvests peaked in 1986, and then were relatively stable for several years, finally beginning to drop off in 1990. The second phase involved the expansion of production on the North Coast. In 1987 there were significant harvests on the North Coast for the first time. By 1990 North Coast harvests were about equal to South Coast harvests.<sup>22</sup>

From 1978 to 1982, fishermen needed a “fisherman’s registration card” and a “C” license. The C license was a vessel license that allowed a vessel to fish for “Schedule II” species. These were a wide variety of species including red and green sea urchins, sea cucumbers, and octopus. The registration cards were required for everyone on a commercial fishing boat. The C license had been placed under limited entry in 1977 based on vessel landings in 1975 and 1976. There were, however, so many of these issued that the limitation did not imply an effective limitation on the red sea urchin fishery.

In 1983 a personal “Z” license was introduced. There were several varieties of these, including the “Z-C” for the red sea urchins, and the “Z-A” for the green sea urchins. These were personal licenses, and their numbers were not limited at this time. They allowed persons who held them to use a licensed fishing vessel in the appropriate fishery. They were issued to companies as well as natural persons, and the license holder did not have to be present with the operation for fishing to take place. A license holder could hold more than one Z-C license if he had more than one fishing vessel. A fishing operation had to have “fisherman’s registration cards” for each person, an appropriate vessel license (a C license would do), and a “Z-C” license in order to fish for red sea urchins.

During this time management rules followed somewhat different paths in the South Coast and North Coast fisheries. Management rules on the South Coast were more restrictive than on the North Coast. When the fishery began to take off in 1982, there were already a minimum size limit for red urchins of 100 mm across the shell (excluding the spines), a seasonal summer closure, and some area TACs. Log books became mandatory in 1983. In subsequent years additional area TACs were added and divided by time periods, and limits were imposed on the number of fishing days per week.<sup>23</sup>

Regulation on the North Coast was less restrictive. When the fishery began in the mid-eighties it already had a 100 mm minimum size limit. A 140 mm maximum size was added in 1988. This

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<sup>19</sup>Niefer, email.

<sup>20</sup>Parker, pers. comm.

<sup>21</sup>The South Coast comprises the waters south of Cape Caution (just north of the northern end of Vancouver Island). The North Coast is the waters north of Cape Caution.

<sup>22</sup>Harbo and Hobbs, Figure 4, page 14.

<sup>23</sup>Harbo and Hobbs, Table 3, page 12.

was introduced because large urchins were believed to provide shelter for and to protect juvenile urchins. In 1990 a policy of area rotation was introduced. This was meant to allow an area to be fished, and then to lie fallow for two years.<sup>24</sup> There were no North Coast TACs during this time.

### ***The Limited Fishery, 1991-1993***

In 1991 the number of red urchin “Z-C” licenses was limited. One hundred and two licenses were initially issued but by 1994 another eight licenses were issued following appeals, for an eventual total of 110 licenses.. Since 188 licenses had been issued in 1990, this was a reduction of about 41% in the number of licenses issued.<sup>25</sup>

Limited licenses were issued to license holders with 75,000 lbs. of landings during the three year period from 1987 to 1989, 20 days recorded harvest in any year from 1987 to 1989, or 5,000 lbs., landed in any year in the North Coast areas (1-10) between 1987 and 1989.<sup>26</sup> A person could receive more than one of the limited licenses if they had more than one license in the base years that met the criteria.

The limited licenses could not be transferred. However, since the owner did not need to be on-board, they could be leased. An actual sale could be approximated with a long-term lease contract. This provided a way for license holders to sell or otherwise transfer their license. The limited licenses could be moved from one vessel to another, so long as the new vessel was not longer than the original vessel.

Limited entry didn’t control harvests. Landings skyrocketed in 1991 and 1992. Landings more than doubled from 1990 to 1991, and almost doubled again from 1991 to 1992. Total landings in 1990 were 3,158 tons, and in 1992, the second year of limited entry, they were 12,983 tons.<sup>27</sup> These 1992 landings were very high; they exceeded the landings in the three previous years (one of which was itself a record landings year) taken together. These production increases were all coming on the North Coast. South Coast landings did not change much at this time.<sup>28</sup>

The limits on the numbers of vessels and their lengths did not control all the margins on which an operation could expand effort.<sup>29</sup> The number of vessels accounting for this harvest didn’t increase, and in fact fell substantially in 1991. However both the total number of fishing days, number of divers, and catch per unit of effort rose significantly. The number of vessel fishing days rose by about 46% in 1991 and by about 50% again in 1992.<sup>30</sup> The number of divers rose by 4% in 1991

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<sup>24</sup>Harbo and Hobbs, Table 3, page 12.

<sup>25</sup>DFO, 1997, page 6; PSARC, 1995, page 4.

<sup>26</sup>Parker, email.

<sup>27</sup>DFO, 1995 PSARC, Table 1.

<sup>28</sup>DFO, 1995 PSARC, Tables 2 and 4.

<sup>29</sup>Managers never tried to control the number of divers per vessel because of enforcement problems. Heizer, pers. comm.

<sup>30</sup>DFO, 1995 PSARC, Table 1.

and by 58% in 1992.<sup>31</sup> Catch per unit of effort rose from 298 kg/diver hour in 1990 to 388 in 1992.<sup>32</sup>

In 1993 North Coast managers responded to these increasing harvests by imposing an area TAC. This TAC was enforced through a system of “timed area openings...in some areas fisheries were pre-empted by managers when large fleets harvested excessive quantities of urchin.”<sup>33</sup>

In spite of efforts by managers, fishermen managed to harvest about 83% of the 1993 North Coast TAC by May. The North Coast fishery was then suspended for the summer and the remainder of the TAC was left for the fall.<sup>34</sup> Managers had problems controlling harvests in the smaller South Coast fishery as well, where the numerous management area TACs were frequently exceeded due to a slow reporting system and inadequate “on-ground enforcement.”<sup>35</sup>

Although the TAC helped to control the harvests, cutting them by about half from the preceding year, it led to a number of problems for the industry. There were many “derby” openings<sup>36</sup> where lots of fishermen would compete for the available product. Fishermen harvested for quantity, not for quality. Lots of product would be placed on the market during brief periods of time, creating gluts, and hurting prices. Fishermen were forced by competitive pressures to operate in poor conditions with insufficient regard for safety.<sup>37</sup> This management approach also made it hard for managers to control the fishery.<sup>38</sup>

In 1994, in an effort to assert more control over the fishery, managers introduced area quotas for the first time in the North Coast.<sup>39</sup> These were based on historical landings. The fishery opened briefly in 1994, but very quickly the fishermen, concerned over the problems posed for them by “derby” fisheries, left the grounds and converged on Prince Rupert where, in a week on intense research and negotiation, they devised a plan for a voluntary individual quota program.<sup>40</sup> This program was run by the license holder’s association, the Pacific Underwater Harvester’s Association (PUHA).<sup>41</sup>

### ***Voluntary Individual Quota Program, 1994-1995***

The voluntary individual vessel quota program designed by the limited “Z-C” license holders divided the remaining 1994 North Coast TAC equally among the licenses (this was not an equal division among the license holders, because persons could hold more than one license). Although

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<sup>31</sup>Parker, pers. comm.

<sup>32</sup>DFO, 1995 PSARC, Table 1.

<sup>33</sup>Neifer, pers. comm. (manuscript).

<sup>34</sup>DFO, PSARC 1995, page 3, Table 4.

<sup>35</sup>DFO, PSARC 1994, page 3.

<sup>36</sup>B.C. fishermen tend to refer to this type of opening as a “shotgun” opening. That term is also applied to openings taking place without prior notice (such as in herring seine). Neifer, pers. comm.

<sup>37</sup>Peters, pers. comm.

<sup>38</sup>DFO, PSARC 1994, page 3.

<sup>39</sup>DFO, PSARC 1994, page 3.

<sup>40</sup>Peters, pers. comm.; Macey, pers. comm.

<sup>41</sup>Macey, page 1.

it was not a formal program the DFO altered the fishing plan to help the program work by making it a condition of license that fishermen use a validation log. The log was only available, for a considerable charge, from a particular validation company. This raised the money to finance private sector validation.<sup>42</sup>

The license holders permitted themselves to lease parts of their quota holdings to each other. Thus, fishermen were able to transfer quota to another vessel if they couldn't harvest it themselves. Processors who owned vessels used the rule to allow them to lease or buy quota and distribute it among their fleets.<sup>43</sup>

In the fall the program was extended to the red sea urchin fishery on the South Coast. The fishermen there divided the remainder of the year's TAC among themselves. Fishermen from the north and the south were largely separate, and a gentlemen's agreement among license holders preserved the separation through the remainder of the voluntary program in 1994 and 1995.<sup>44</sup>

Under this voluntary program, all landings were monitored, or validated, by a company hired by PUHA. D&D Pacific Fisheries Ltd., the company hired to provide these services, had worked with the urchin license holders and buyers before the program to monitor the roe content in urchin deliveries. One of the principals in the company had been a consultant in the negotiations leading up to the decision to use individual vessel quotas.<sup>45</sup>

The validation program was paid for by an assessment of \$0.02 a pound on urchin landings. Buyers were to withhold this from their payments to the fishermen and transfer it to D&D Pacific Fisheries. Fishermen were required to report to D&D Pacific Fisheries before they went fishing and to "hail" the company weekly with catch reports.<sup>46</sup> In 1995, the PUHA also began to pay for an on-ground monitor (OGM) on the North Coast. The South Coast fishery was different, conducted by smaller boats operating closer to port, and an OGM was not felt to be necessary there.<sup>47</sup>

The combination of the two elements of individual quotas and private sector harvest validation in this voluntary program was apparently considered a success by license holders and managers. It is hard to disentangle the influence of the two elements in comments made about the program. The validation services and on-ground monitoring contracted for by the PUHA and provided by D&D Pacific Fisheries meant an important upgrade in fishery information available to DFO managers, to some extent independent of the individual quotas.

The clearest evidence that the program provided benefits to license holders and managers comes from their actions. The North Coast red urchin license holders stuck with it through 1994 and continued it through 1995. On the South Coast the red urchin fishermen adopted a voluntary

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<sup>42</sup>DFO, PSARC, 1994, page 3.

<sup>43</sup>D&D Pacific Fisheries, 1996 Report, page 16, 19.

<sup>44</sup>Neifer, pers. comm.

<sup>45</sup>Peters, pers. comm.

<sup>46</sup>DFO, PSARC, 1995, page 3.

<sup>47</sup>D&D Pacific Fisheries, 1996 Report, page 18; Macey, pers. comm.

individual vessel quota program in the Fall of 1994.<sup>48</sup> During this time license holders requested formal adoption of an individual vessel quota program by the DFO. As noted below, DFO managers adopted one in 1996.

Anecdotal information indicates that the program slowed down the race for the fish with consequent marketing, safety, and management advantages. The price for urchins went up. Fishermen were able to redirect attention towards fishing for quality rather than quantity.<sup>49</sup> In fact, buyers apparently moved from paying fishermen on the basis of a flat poundage rate to paying on the basis of roe recovery.<sup>50</sup> A DFO report notes that in 1994 the program “resulted in improved monitoring of catch and effort and a more orderly fishery.”<sup>51</sup>

Although this was a voluntary system, it was apparently widely seen as a precursor for a more formal DFO program. Anecdotal information suggests that limited entry license prices rose dramatically in response (since the licenses were not formally transferable, the price estimates that follow must be interpreted as the values of long term leases). In December, 1993, limited entry licenses are reported to have been selling for between \$35,000 and \$40,000; by December, 1994 the same respondent reports them at \$350,000. Another respondent places them at about \$35,000 at the start of the program, and at \$200,000 within a few months. A D&D Pacific Fisheries post-season report on the 1996 season, also based on anecdotal information, puts 1995 season prices at \$180,000.<sup>52</sup> DFO price estimates, discussed in the next section of this report, suggest that license prices were \$250,000 in 1994 and \$300,000 in 1996. Without putting too much weight on any of these specific price estimates, it does appear that there was a large increase in license prices with the advent of the voluntary individual quota program.

### ***Mandatory Individual Quotas, 1996-1998***

#### **Nature and allocation of individual quotas**

In 1996 the DFO replaced the voluntary program with a two year “pilot” individual vessel quota program. This decision was announced in the Fall of 1995.<sup>53</sup>

Under the DFO program the coastwide TAC was divided equally among the 110 existing Z-C licenses. The persons who had been receiving quota under PUHA’s voluntary program were the recipients under the DFO program. The equal division of the coastwide TAC in 1996 meant that each license received a quota of 132,763 pounds, whether they fished on the South Coast or on the North Coast.<sup>54</sup> Under this formal DFO program, the quota poundage was a condition of the

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<sup>48</sup>D&D Pacific Fisheries, 1996 Report, page 1.

<sup>49</sup>Peters, pers. comm.; Neifer, pers. comm.; Macey, pers. comm.; although fishing for quality could mean more discard mortality if fishermen crack more shells on the bottom to check for roe quality. This is discussed more in the section on the mandatory program.

<sup>50</sup>D&D Pacific Fisheries, 1996 Report, page 17.

<sup>51</sup>DFO, PSARC 1994, page 3.

<sup>52</sup>Peters, pers. comm., Macey, pers. comm.; D&D Pacific Fisheries 1996 Report.

<sup>53</sup>DFO, 1996 Mgt. Plan, page 4.

<sup>54</sup>DFO, 1996 Mgt. Plan, page 6.

license.<sup>55</sup> This equal division was a change from the way the program had operated in 1995 when individual quotas were smaller on the South Coast.

The introduction of the mandatory program was associated with changes in the rights associated with licenses and individual quotas. When DFO took over the program, it changed the rules on quota transferability. Quota could no longer be transferred independently of the license (as noted later, small transfers to cover harvests slightly over quota were an exception). This restricted the flexibility of the license holders quite a bit, but made monitoring of quotas by D&D Pacific Fisheries easier.<sup>56</sup> However, licenses were now made permanently transferable, they could be “stacked” up to three on a single vessel,<sup>57</sup> and they could be transferred onto a longer fishing vessel.

Although fishermen got the same quotas, whether they fished on the North or on the South Coasts, the separation of the North and South fisheries was preserved. The coastwide TAC was subdivided between the North Coast and the South Coast. The TAC for the North Coast was set high enough to accommodate 89 license holders and the TAC for the South Coast was set high enough to accommodate 21 license holders.

License holders registered for one of these areas. If too many fishermen signed up for one of the areas, a lottery was to be held to decide which license holders would be given a license quota in that area. License holders were free to exchange North Coast and South Coast licenses and associated quotas after the allocation was completed.<sup>58</sup>

In late January, after the start of the 1996 season, South Coast fishermen agreed to split their quotas between the Gulf and the west coast of Vancouver Island. This was a “gentlemen’s agreement” mediated by PUHA. This split reflected concerns by South Coast fishermen that declining production from the west coast of Vancouver Island would lead to DFO closure of those fishing areas. Quotas had gone unfished on the west coast during the voluntary program.<sup>59</sup>

These North Coast and South Coast TACs were divided between a number of management areas within these larger regions. On the North Coast, these management areas subject to “rolling openings” over the course of the year. At intervals of about a month, a new group of management areas is opened. Each new group of monthly openings made between 850,000 and 1,150,000 additional pounds of red sea urchins available to the license holders. This procedure was adopted to spread the fishery out over the year “in order to meet market demands.”<sup>60</sup> It also reduced monitoring costs by geographically restricting production during any time period.

The management areas in the South Coast were also subject to a system of “rolling openings.” In this case some openings were scheduled for specific dates, some were contingent on closings in

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<sup>55</sup>Neifer, pers. comm.

<sup>56</sup>D&D Pacific Fisheries, 1996 Report, page 16.

<sup>57</sup>D&D Pacific Fisheries, 1996 Report, page 19.

<sup>58</sup>DFO, 1996 Mgt. Plan, page 6.

<sup>59</sup>Neifer, pers. comm.; D&D, 1996 Report, page 19-20.

<sup>60</sup>DFO, 1996 Mgt. Plan, page 8,10.

previously opened management areas, and some opening dates were left “to be announced” at the start of the season. In the South Coast, moreover, no area would actually be opened until at least four vessels had notified the firm that had been contracted to conduct landings validation that they intended to fish in that area.<sup>61</sup>

Although areas are opened sequentially throughout the year, fishing in an area will often be closed because of poor weather, poor roe quality, or because the quota will be taken. If one area is closed before another area is scheduled to open, the fishermen might often go back to an area that had been closed prematurely for a “clean-up” fishery. These closures and “clean-up” openings are made by DFO in close consultation with the fishermen and D&D Pacific Fisheries.

## **Enforcement**

Under the DFO program the key to the enforcement of the quotas continued to be the “observing, recording, and reporting” activities of D&D Pacific Fisheries, the private firm hired by PUHA. All landings had to be monitored by a dockside observer from D&D Pacific Fisheries. Fishermen had to notify a red sea urchin observer with D&D Pacific Fisheries at least 24 hours before fishing, within 24 hours of finishing fishing, at least 24 hours before moving to a new Quota Area, and at least 24 hours before delivering product.<sup>62</sup> All landings had to be made at a designated landings port. There were seven of these for the Northern Region and 12 for the Southern Region.<sup>63</sup> All landings information had to be recorded in a red sea urchin “validation log” supplied with the license. These log books contained a running tally of the license holder’s remaining quota and had to be consulted before fishing.<sup>64</sup>

On the North Coast many fishermen deliver their product to packers (tenders) on the grounds for delivery to the shore. Cargo bags or totes of urchins delivered to packers are weighed and marked with the fishermen’s’ license information. Formal validation takes place when the urchins are delivered to shore by the packer.<sup>65</sup>

In addition, D&D Pacific Fisheries continued to provide an OGM in the north during times of peak urchin fishing activity. This monitor is on the grounds for about eight months a year. He is not on the grounds during the summer when he works on salmon, but effort tends to be less in the summer as well so there is not as much to watch. Like the port validators, the observer’s job is to “observe, record, and report.” The on-grounds observer is in almost daily communication with the DFO red urchin manager when the fishery is active, and his reports are a helpful source of information.<sup>66</sup>

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<sup>61</sup>DFO, 1996 Mgt. Plan, page 11.

<sup>62</sup>DFO, 1996 Mgt. Plan, page 17-18.

<sup>63</sup>DFO, 1996 Mgt. Plan, page 17.

<sup>64</sup>DFO, 1996 Mgt. Plan, page 18.

<sup>65</sup>Macey, pers. comm.

<sup>66</sup>Neifer, pers. comm.; Macey, pers. comm.; The on-grounds observer has been a big help to the fishermen, helping them with many small services. His presence has also saved lives. He plays an important role in coordinating fishermen and DFO managers when decisions are being made on early closure of management areas and openings of “clean-up” areas.



Fishermen who went over the quota associated with a license could cover the harvest with unused quota associated with another license in use on the vessel. The only limit on this was the amount of unused quota available on another license (up to three licenses could be stacked on a vessel). If there was no other license on the vessel, fishermen who harvested up to 150 pounds of urchins over their quotas could transfer these urchins to another license holder on another vessel who had not completely fished his quota. This other vessel had to be fishing where the overage was taken. Overages above this level had to be “relinquished” to the government. That is, the income from the sale had to be turned over to the government.<sup>67</sup>

The 1996 program was carried over substantially intact to 1997-98.<sup>68</sup> The amount of an overage that could be transferred was raised from 150 to 200 pounds.<sup>69</sup> In addition, the penalties for overages were stiffened. In 1996 a license holder who was over quota by more than 150 pounds had to relinquish the proceeds from the overage to the government. In 1997-98, in addition to the relinquishment, the license holder would also have the amount of the overage deducted from the 1998-99 quota for that license.<sup>70</sup>

With the 1997-98 program extension there were also adjustments in North and South Coast management area TACs. In order to give each license an equal share of the coastwide TAC it became necessary to change the license numbers on the North and South Coasts. This made it necessary to The North Coast received 91 of the 1997-98 licenses, while the South Coast received 19. The South Coast Gulf and West Coast of Vancouver Island individual quota split was written into the management plan this year as well. As noted above, this was a voluntary arrangement among the fishermen in 1996.<sup>71</sup>

### **User pays**

Red urchin license holders are paying for a large part of the cost of red urchin management under the current system. On both the North and South Coasts landings are monitored by a private firm acting under contract to, and paid by, the license holders. The actual arrangements are made through the license holder association, PUHA. Likewise, on the North Coast PUHA has hired on-grounds monitor who is active much of the year. PUHA also pays for some research into BC red sea urchin biology.

### **Impacts on license holders**

“Z-C” license holders have apparently received a large wealth increase through the increase in the market value of their licenses. Since the license market is thin, DFO has prepared price estimates

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<sup>67</sup>DFO, 1996 Mgt. Plan, page 7.

<sup>68</sup>In 1997 the DFO changed the license renewal periods for the red sea urchin licenses to a July 1 to June 30 license year. To facilitate the changeover, the 1997 license was actually an 18 month 1997-98 license and expiring on June 30, 1998. The management plan that followed the 1996 plan was therefor an 18 month plan covering the period through June 30, 1998. DFO, 1997, page 9

<sup>69</sup>DFO, 1997, page 9.

<sup>70</sup>DFO, 1997, page 9.

<sup>71</sup>DFO, 1997, page 8, 20.

based on interviews with brokers and fishermen. These price estimates must be used with considerable caution, in part because before 1996 they must be prices for long term leases, while in 1996 and 1997 they refer to permanent transfers. The price estimates were \$42,500 in 1991, \$250,000 in 1994, \$300,000 in 1995, \$400,000 in 1996, and \$350,000 in 1997.<sup>72</sup>

The DFO encourages cautious use of these estimates, describing them as “suspect” because of their basis in what fishermen say they would buy or sell for rather than on market prices.<sup>73</sup> A separate report by D&D Pacific Fisheries Ltd, the firm providing the landings validation services, estimates, on the basis of personal communications from persons in the industry, that the price to purchase a license in 1995 was \$180,000 and the price to purchase a license in 1996 was \$250,000.<sup>74</sup> A fishery manager has likewise suggested that the prices might have been somewhat lower than reported in 1996 and 1997. He suggested a value of \$350,000 in 1996 and \$250,000 in 1997.<sup>75</sup>

“Z-C” License holders also appear to be less likely to be present with their fishing operations. The license does not require that the license holder be present to fish. Several sources indicated that there was an increased tendency for license holders to remain on shore instead of going out with the operation. The estimates of the numbers of license holders who were actually fishing were between 10% and 20%. These estimates were felt to be below the percentages of license holders with the operations before individual quotas.<sup>76</sup>

The D&D Pacific Fisheries Ltd. report mentioned above provides some information on the lease payments accruing to license holders. These were estimated to be \$35,000 a year or \$0.25 a pound in 1995, when ex-vessel prices were estimated to average \$0.75 a pound, and \$65,000, or \$0.45 a pound in 1996, when ex-vessel prices were estimated to average \$0.90 a pound.<sup>77</sup> These estimates imply that 30% of the ex-vessel value went for lease payments in 1995 and 50% in 1996. Anecdotal information on lease rates before individual quotas ranged from lease rates of 20% to 35%, while the evidence on lease rates after individual quotas ranged from 30% to 50% or even 60%. Without putting too heavy a reliance on any particular value, it appears that the cost of leases has risen.<sup>78</sup>

If lease payments were actually \$35,000 a license in 1995, when there were 110 licenses available, the implied 1995 resource rents associated with the entire suite of management arrangements (including individual quotas, the landings validation service, and DFO management) would be about \$3,850,000. The 1996 resource rents would be about \$7,150,000. Under the arrangements in the fishery these fishery rents, the payments to operations over and above the payments necessary to actually bring forth the effort needed to harvest the fish, would accrue primarily to the license holders, and through Canadian income and capital gains taxation, to society.

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<sup>72</sup>Mylchreest, fax.

<sup>73</sup>Mylchreest, faxed table.

<sup>74</sup>Macey, pers. comm.

<sup>75</sup>Neifer, pers. comm.

<sup>76</sup>Peters, pers. comm.; Kensall, pers. comm.; Neifer, pers. comm.

<sup>77</sup>Macey, pers. comm.

<sup>78</sup>Neifer, pers. comm.; Peters, pers. comm.; Kensall, pers. comm.

## **Impacts on crew**

Crews have typically included the tender and two or more divers. Information on average total crew sizes is not available, but information on the total numbers of active divers is available from log books for 1994 to 1996. The number of divers dropped in each year of the individual quota program. There were 258 divers in 1993; this dropped to 241 in 1994, the first year of the individual quota program, 208 in 1995, and 177 in 1996. In all, this was a 32% drop in the number of divers.

Care must be taken in ascribing the entire drop to the individual quota program. The decline in the number of divers actually began a year before the individual quota program. There were 303 divers in 1992, but only 258 in 1993. This was about a 15% drop. The declines under individual quotas continued this trend.<sup>79</sup> Total harvests were extremely high in 1992. Management measures in 1993 led to a reduction in harvests and may have been partly responsible for the decline in numbers of divers in 1993 and after.

Without good information on possible changes in share systems it is hard to say what the impact has been on diving wages. A reduction in employed divers may have led to excess supply of diver labor and a reduction in diver wages. Additionally, during this period changes in management in related dive fisheries were also reducing the number of dive jobs in those fisheries. This might have increased the number of divers willing to work in red urchins at any wage and tended to reduce wages. Alternatively, improved marketing opportunities may have led to higher red urchin prices than there might otherwise have been; if share systems change with a lag, divers may have enjoyed some short run rents from this. Improvements in general working conditions, such as comfort, safety, or the likelihood of harvesting the quota, would tend to reduce shares and actual cash income from the fishery. These factors would increase the attractiveness of diving and increase the expected value of the income from any given share arrangement, reducing the size of the shares operators would have to offer to attract divers.

A significant complaint about this program is that it has increased the proportion of revenues that must be spent to lease a license. The Canadian personal licenses give the license holder the right to operate a vessel, but the license holder does not have to be present with the vessel while it is operating. License holders often lease their licenses or employ hired skippers to operate their vessels. As noted earlier, under the individual vessel quota program, these lease charges have apparently risen. This increase in the “license” share is apparently the source of hard feelings among persons who lease licenses from others in order to fish.<sup>80</sup>

## **Impacts on fishing effort**

Resources used to produce the fishing effort have declined since individual quotas were introduced.<sup>81</sup> In the first year, the number of vessels with landings only dropped from 101 in 1993

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<sup>79</sup>Parker, pers. comm.

<sup>80</sup>Neifer, pers. comm.; Peters, pers. comm.; Macey, pers. comm.

<sup>81</sup>The effort data available to me covers the three years 1994 to 1996. The first two years were managed under the voluntary program, and the last year was the first year of the mandatory program.

to 98 in 1994. However between 1995 and 1997 the number of vessel active in the fishery dropped by 22% to 76. The total number of vessel fishing days actually rose by 24% in the first year of the program and by 4% in the second year, before declining somewhat, by about 9% in 1996.<sup>82</sup>

As noted earlier, however, the number of divers declined in each year of the program. They declined by about 6% from 258 to 241 in 1994, and by 14% in 1995 and 15% in 1996. To put these declines in perspective, however, note that the number of divers had also declined from 1992 to 1993, before individual quotas were introduced. The number of divers appears to have peaked at 303 in 1992, and to have been declining thereafter. The decline in 1993 was about 15% of the total.<sup>83</sup>

The downward trend in the number of divers began before individual quotas. In 1992, when there were 303 divers, coastwide landings were about twice what they were in the next highest year in the fishery. New management measures were introduced in 1993, including TAC management on the North Coast, which led to a considerable reduction in harvests in 1993 and thereafter. These measures, as well as the introduction of individual quotas, may have helped account for the declines in the numbers of divers.

Under quotas there is still some gold rush. The first divers on an area can get the urchins along the “feed line.” The urchins move in mass through the kelp. The best quality of the urchins are those within three feet of the front of the lines. Divers can compete to go there and pick well-fed, relatively high quality, urchins.<sup>84</sup>

### **Impacts on management**

The individual quota program and the associated validation and at-sea monitoring programs have helped improve management considerably. The fishery is slower paced, there is more accurate information on harvest times, locations, harvests, and landings. The charting of the beds has been improved. There is money from the fishermen for enhanced management including the log books, keypunching, and validation. Managers can sometimes manage an area’s TAC to within 50 to 100 pounds.<sup>85</sup>

Communications with the fishermen have been improved. These are facilitated by the central role played by the validation company.<sup>86</sup> It is a company hired by the license holders to collect data from them and pass it on to the DFO. As such it forms a useful channel for communication. The on-grounds monitor on the North Coast has been especially effective. In addition to his monitoring work he has established a good relationship with the fishermen by providing them

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<sup>82</sup>PSARC, Table 3.1.2.

<sup>83</sup>Based on diver numbers supplied by Parker, pers. comm.

<sup>84</sup>Neifer, pers. comm.

<sup>85</sup>Parker, pers. comm.

<sup>86</sup>As noted earlier, D&D Pacific Fisheries.

various services. From his vantage point he can keep a good eye on the fishery and he reports on conditions frequently to DFO managers.<sup>87</sup>

The ability of license holders to lease out their licenses and earn income without fishing has affected communication in interesting ways. One manager has noted that license holders who lease out their licenses may be out of touch with actual conditions in the fishery. License holders and leasees may also have different points of view. License holders may be more concerned about stocks, to the point of suggesting conservation measures that may go against their short term interests. This manager noted the importance of keeping in touch with license leasees as well as license leasors.<sup>88</sup>

Management benefits cannot be ascribed entirely to the individual quotas. To a great extent they are due to the program of license holder funding for management services and the private validation program that were brought in when individual quotas were introduced.

Before individual quotas were started fishermen tended to harvest larger animals because they were paid by the pound and the bigger urchins allowed them to bring in a given poundage for less work.<sup>89</sup> For several years prior to individual quotas there was a maximum size limit for red urchins on the North Coast. This was designed to allow adult husbandry of smaller juvenile urchins. This maximum size limit was abandoned in 1994 when the individual quotas were started in on the assumption that no one would harvest 165 mm urchins if they could help it since the market preferred the smaller urchins.<sup>90</sup>

In 1994 there was a problem with TAC underages due to the novelty of the new system and the learning curve required by the fishermen before they could completely harvest their quotas effectively. This problem was apparently exacerbated in 1994 by a slow geoduck fishery in which many of these fishermen were involved. Some persons evidently “abandoned” their red urchin quotas late in the season to fish geoducks instead. The underage problem did not recur as severely in 1995<sup>91</sup>

### **Enforcement effectiveness**

Harvest of undersized urchins is a problem. The smaller sex organs or “roe” found in smaller urchins is apparently more attractive to the markets than relatively larger roe. Industry sources have indicated to managers that the 100 mm minimum size limit on red urchins is too large since the market would prefer urchins in the 85 to 100 mm range.<sup>92</sup>

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<sup>87</sup>Parker, pers. comm.; Neifer, pers. comm.

<sup>88</sup>Parker, pers. comm.

<sup>89</sup>Neifer, pers. comm.

<sup>90</sup>Neifer, pers. comm.

<sup>91</sup>DFO, PSARC 1995, page 4.

<sup>92</sup>Neifer, draft 1997 PSARC, page 5.

Highgrading on the bottom is a problem. Divers can select by size easily, but they can't check for roe without breaking urchins open. One fishery manager believes that, in some areas where quality is questionable, this breakage can approach 30%.<sup>93</sup>

Even without checking for roe, breakage is probably about 10% or more. In high currents the urchins hold tightly to the rocks and many can be broken as they are pried loose. Others are broken as they are put in bags, and bags are hoisted aboard boats, or as bags are transferred from boats to tenders or docks. With each urchin that breaks some water may be lost from the load. When the load is finally weighed at the docks its weight does not reflect the loss of volume, but this weight is used for calculating the percentage of the individual quota that has been used up. This produces the same result as discard mortality.<sup>94</sup>

Highgrading has led to a shift in the type of gear used in the fishery. With the increased concern over product quality, fishermen are increasingly interested in harvesting urchins on the "feed line." This is the leading edge of a group of urchins, feeding on kelp that is relatively high quality. This approach apparently requires more mobility for divers than is provided by traditional air hose "hookah" systems. Some divers have been converting to scuba gear.<sup>95</sup>

## **Green Sea Urchin Management**

### ***The Unlimited Fishery, 1987-1990***

This fishery began with the issuance of experimental permits to 38 vessels in 1987. Of these, 20 made landings of about 120 tons from the east coast of Vancouver Island. At the time the fishery began very little was known about the extent of the green urchin resource or about its biology.

Managers limited effort to January to February and October to December, the months with the highest market demand. Minor area closures protected some parks and study areas, and fishermen were limited by a minimum size of 40 mm.<sup>96</sup>

The permit fishery continued through January and February of 1988. However, before the fall season started in October 1988 a new "Z-A" license was introduced.<sup>97</sup> This was not a limited license, it was available to any purchaser. The license allowed the license holder to operate a vessel with appropriate vessel licenses to fish for green urchins. The license holder could be a company or a person and the license holder did not need to be physically present with the operation. A single person or company could hold more than one license if it was operating more than one vessel.

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<sup>93</sup>Neifer, pers. comm.

<sup>94</sup>Neifer, pers. comm.

<sup>95</sup>D&D Pacific Fisheries, 1996 Report, page 18.

<sup>96</sup>Harbo and Hobbs, PSARC 1994, Table 2.

<sup>97</sup>Parker, Table 3.2.2, page 13.

Industry effort, measured in the numbers of licenses, the numbers of vessels operating, and in the number of vessel fishing days, rose rapidly between 1987 and 1989, before falling somewhat in 1990. Effort measured in the number of divers and numbers of diver hours rose throughout the period. The number of licenses issued rose from 89 in 1988 to 191 in 1989, before falling to 155 in 1990. The number of vessels with landings were substantially less than the number of licenses, but followed the same time trend, rising from 20 in 1987 to 110 in 1989, before falling back to 90 in 1990. The number of vessel fishing days likewise rose from 248 in 1987 to 1,394 in 1989, before falling slightly to 1,352 in 1990. However, the number of divers and the number of diver hours both rose in each year. The number of divers rose from 29 in 1987 to 158 in 1990 and the number of diver hours rose from 729 in 1987 to 3,568 in 1990.

Landings prices increased throughout this period, rising from an average of \$1,058 per ton in 1987 to an average of \$1,977 a ton in 1990. Harvests apparently responded, rising from 120 tons in 1987 to 611 tons in 1989, before falling to 475 tons in 1990.<sup>98</sup>

These harvest increases appear to have been due to increasing effort overcoming declining catch per unit of effort (CPUE). During this period, CPUE tended to drop. Measured in tons per vessel day it rose from 1987 to 1988 but then dropped in 1989 and 1990. Measured in kilograms per diver hour it dropped from 1987 to 1988, rose from 1988 to 1989, and then fell again in 1990. Both measures ended in 1990 below their starting point in 1987. The drop measured in kilograms per diver hour was a striking 42%.<sup>99</sup>

Almost all the green sea urchin harvest activity took place on the South Coast of B.C. There were some North Coast harvests, but these were small. North Coast harvests were largest in 1989 when 13 tons were landed on the North Coast compared to 611 tons landed coastwide.<sup>100</sup>

Managers initially responded to the increasing effort and harvests, and decreasing CPUE, by increasing the minimum size limit from 40 mm to 55 mm and by restricting the time that could be spent fishing and the areas where fishing could take place. In 1990, with the high effort levels of 1989 in mind, managers moved to introduce limited entry in 1991. Limited entry was also introduced into the red sea urchin fishery this year as well.

### ***The Limited Fishery, 1991-1994***

“Z-A” licenses were issued to fishermen who harvested 20,000 pounds over the two year period 1988-1989. Managers expected that at least thirty-three vessels would qualify for licenses.<sup>101</sup> In the actual limitation forty-seven vessels received licenses. This number rose to 49 by 1993 as two additional vessels received licenses following appeals.<sup>102</sup>

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<sup>98</sup>Harbo and Hobbs, PSARC 1994, Table 1.

<sup>99</sup>The CPUE estimates are in the table at the end of the paper.

<sup>100</sup>Parker, Tables 3.2.1 and 3.2.5, pages 12 and 18.

<sup>101</sup>Harbo and Hobbs, PSARC 1994, Table 2.

<sup>102</sup>Harbo and Hobbs, PSARC 1994, Table 2.

These licenses continued to be the “Z-A” licenses, however, instead of issuing new licenses to all comers, the DFO would only renew existing licenses. These licenses were not transferable, but since the license holder did not have to be present when it was used, the license could be leased for long periods of time. Licenses did carry a vessel length restriction. A license holder could transfer the license to another vessel, but the new vessel could be no longer than the vessel for which the license had originally been issued. Licenses could be held by companies or natural persons, and a license holder could hold more than one license in order to operate more than one vessel.

Limited entry did not successfully control effort. In the first year of the program the number of licenses did drop from 155 to 47, the number of vessels with landings from 90 to 47, and the number of divers from 158 to 133. However, the number of actual vessel fishing days barely changed, the number of diver hours shot up from 3,568 to 5,972, and the harvest rose from 475 tons to 607. These effort increases were presumably in response to landings prices which rose by about 50% this year.

In 1992, the year after the number of licenses was limited, ex-vessel prices increased by 44% over 1991 prices. Fishing effort and production also jumped up. The number of active vessels was limited but the number of fishing days rose by 55% over 1991, the number of divers rose by 50%, and the number of diver hours rose by 91%. In response, landings rose by 72%.<sup>103</sup>

Managers reacted in 1992 and 1993 by restricting available fishing time. Fishing seasons were shortened and weekly fishing periods were introduced.<sup>104</sup> These measures may have helped control effort: fishing days, numbers of divers, and total diver hours all fell off considerably in 1993.

During this period CPUE measured in kilograms per diver hour appears to have continued falling. Divers took an average of 93 kg. per diver hour in 1991, but only 64 kg per hour in 1993. CPUE dropped in each year. In response to the apparent conservation problem reflected in the declining CPUE, DFO managers began adding “precautionary” management area TACs to the regulatory mix in 1994.<sup>105</sup> There had been no fishery TACs before this time.<sup>106</sup>

### ***Individual Quotas, 1994-1998***

In the fall of 1994 the green sea urchin fishermen implemented a voluntary individual quota program similar to that then operating in the red sea urchin fishery.<sup>107</sup> This voluntary program ended in December 1994, since the normal January-February fishery did not take place in 1995. This program was similar to that in the red urchin fishery. The year’s remaining TAC was divided equally among the licenses. Individual quotas were 15,700 pounds per license. License holders

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<sup>103</sup>Parker, Table 3.2.1, page 12.

<sup>104</sup>Parker, Table 3.2.2, page 13.

<sup>105</sup>Harbo and Hobbs, page 6.

<sup>106</sup>Parker, Table 3.2.2, page 13.

<sup>107</sup>The January-February fishery this year took place without individual quotas. It was during that period that they were introduced in the North Coast red urchin fishery.



were allowed to transfer parts of their individual quotas to other licenses.<sup>108</sup> Quota could thus be transferred between license holders, or between the vessels in one license holder's fleet.

Validation services were entrusted to a private firm, Archipelago Marine Resources (Archipelago).<sup>109</sup> The DFO helped the program by imposing requirements that license holders report to Archipelago 24 hours before fishing and before landing green urchins. Not all green sea urchin fishermen participated in this voluntary program, but even those that didn't were required to comply with the reporting requirements.<sup>110</sup>

As it happened, the fleet did not take the entire TAC in 1994. The management review of the season provides several possible reasons. First, prices are highest at the end of the year and fishermen may have deferred their harvests to take advantage of the high prices. Those who did so then were then unable to harvest their quotas because of bad weather. Some license holders may have spent their time on red urchins and geoducks rather than green urchins. Finally, fishermen may have underestimated the time it would take to harvest their individual quotas.<sup>111</sup> Fishermen reported investing more time in producing quality urchins.<sup>112</sup>

In the fall of 1995 the Department of Fisheries and Oceans substituted a mandatory two year pilot individual quota program for the voluntary one on the South Coast.<sup>113</sup> The relatively small North Coast fishery was left as a competitive fishery in 1995 and made an "exploratory" fishery in 1996.<sup>114</sup> In many respects, the mandatory individual quota program adopted in green sea urchins was similar to that in the red urchin fishery.

Under the pilot program the South Coast TAC was to be allocated evenly among all the licenses. Transfer of individual quotas between licenses was prohibited, but fishermen were allowed to stack up to three licenses on a single vessel. During the period of the pilot, fishermen were also allowed to transfer licenses to vessels of greater length (although program rules stipulated that if the program was ended after the trial, the pre-program vessel length restrictions would become effective again).<sup>115</sup>

Program enforcement revolved around a port validation program run by Archipelago, and subsequently by D&D Pacific Fisheries Ltd. Fishermen had to notify the validation firm 24 hours before beginning to fish in an area, within 24 hours of finishing fishing, and 24 hours before landing the urchins. Urchins had to be landed at one of several designated landings ports. All landings were to be validated by a contracted port observer. Fishermen were required to keep dive logs, and these were to be submitted to the port observers.<sup>116</sup>

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<sup>108</sup>Heizer and Hobbs, page 6.

<sup>109</sup>Heizer, pers. comm.

<sup>110</sup>Heizer and Hobbs, pages 3-4.

<sup>111</sup>Hobbs and Heizer, page 4.

<sup>112</sup>Heizer and Hobbs, page 6.

<sup>113</sup>In 1996 the management year was changed from a calendar year to run from June 1 to May 31. The 1995 year was extended to a year and five months and ran through May 31, 1996. DFO, 1995/96 Mgt. Plan, page 12.

<sup>114</sup>DFO, 1995/96 Mgt. Plan, page 4.

<sup>115</sup>DFO, 1995/96 Mgt. Plan, page 6.

<sup>116</sup>DFO, 1995/96 Mgt. Plan, pages 6-7.

License holders who went over their individual quotas could transfer up to 100 pounds of urchins to a license in use in the same area provided it had more than 100 pounds of its quota still to catch (The 100 pound limit did not apply to transfers between licenses in use on the same vessel). This 100 pound limit was raised to 200 pounds in the second year of the program. Larger overages could not be transferred. The revenues from the sale of larger overages had to be turned over to the government; in addition, overruns in one license year could be deducted from quota assignments in the following license year.<sup>117</sup>

DFO estimates of green sea urchin license prices, based on interviews with industry sources, \$35,000 in 1991, \$80,000 in 1994, and between \$70,000 and \$75,000 for 1995 to 1997.<sup>118</sup> The prices before 1995 must be prices for long term leases, since licenses were not permanently transferable at that time. In the 1997-1998 season, it has been estimated that green sea urchin licenses grossed about \$22,000 and leased for about \$7,000.<sup>119</sup> This implies a fishery rental of about \$343,000 in 1997.<sup>120</sup> These fishery rents would have accrued primarily to the license holders and to the Canadian public through income and capital gains taxation.

There is no information on average crew sizes, however, information on the numbers of divers is available from vessel logs. As noted below, these indicate that the number of divers active in the fishery has declined by 43% since individual quotas were introduced. It is likely that part of this decline was due to efficiencies associated with individual quotas, but as noted below, there have also been large declines in the fishery TACs since the start of the program. These may also have contributed to the reduction in the number of crew members. The number of crew members had actually declined in the year before the individual quotas were introduced.

Resources used to produce fishing effort declined considerably during this period. The number of active vessels dropped in each year, falling from 48 in 1994 to 30 in 1996/97, a 38% drop. The number of fishing days dropped by 53%, the number of divers by 43%, and the number of diver hours by 52%.<sup>121</sup>

The South Coast TAC was reduced in each year of the individual quota fishery. It declined from 449 tons in 1994 to about 264 tons in 1995/96 and to about 166 in 1996/97. Landings also fell off in each of these years. The fishery didn't take the actual coastwide TAC in any of them. CPUE actually appeared to stabilize during this period.<sup>122</sup>

## Discussion

These two dive fisheries are related. Many persons participate in both. The two fisheries began about 10 years apart, but from 1991 management initiatives in them were closely tied together.

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<sup>117</sup>DFO, 1995/96 Mgt. Plan, pages 7, 15; DFO, 1996/97 Mgt. Plan, page 17.

<sup>118</sup>Mylchreest, fax.

<sup>119</sup>Kensall, pers. comm.

<sup>120</sup>Assuming \$7,000 for each of 49 licenses.

<sup>121</sup>Parker, Table 3.2.1, page 12.

<sup>122</sup>Parker, Table 3.2.1, page 12.

Entry was limited in both in 1991. Individual quotas were brought into both on a voluntary basis in 1994. Formal DFO individual quotas were brought into both in 1995 and 1996.

Uncontrolled effort increases in these fisheries in the late eighties and early nineties led managers in each fishery to move towards entry limitation. Limited entry did not adequately control effort in either of these fisheries. Although the number and length of the vessels might have been controlled, fishermen could exploit too many uncontrolled margins. Fishing operations appear to have been especially successful in increasing the number of divers that could operate off of each vessel and increasing the number of diver hours in the water.

In each case, after limited entry, managers moved to introduce TAC management into the fishery, but problems with “shotgun” fishing led to diver dissatisfaction with the management regime. These divers had the example of the successful implementation of individual quotas in the geoduck fishery in front of them. Many were geoduck fishermen. In both fisheries the divers took the initiative, with some DFO support, to implement voluntary, private-sector, individual quota programs. These programs had strong similarities to the geoduck programs. The divers moved first in the red urchin fishery on the North Coast, and then, within a year, in the red fishery on the South Coast and the green fishery on the South Coast. In both fisheries the DFO implemented more formal pilot individual quota programs within a couple years of the voluntary programs.

Individual quotas are only one component of the management regimes in these two fisheries. In each case the implementation of the private-sector validation program was another important change in management. The management changes can probably be ascribed as much to the implementation of validation as to the individual quotas. These programs have been in place for a short time. Neither has established the track record of the geoduck program. Both programs appear to have benefited license holders and improved management. These programs do not appear to have benefited the tenders and divers who are not license holders to the same extent. Several of the sources for this report indicated that persons without licenses might even be worse off than they were before. More than one person indicated that they felt that if it could be done again, licenses should be tied to the divers and not the vessel.



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## Annual Red Sea Urchin TAC, Landings, and Effort Information

Year	Limited entry and individual quotas	License numbers	South Coast TAC (tons)	North Coast TAC (tons)	Number of vessels with landings	Total vessel fishing days	Coast-wide landings (tons)	Average Ex-vessel Price (\$/ton)	Number of divers	CPUE (kg/diver hour)
1978	no limitation				4	54	75	213		
1979	no limitation				29	298	317	240		
1980	no limitation				18	331	333	252		
1981	no limitation		136		18	127	116	293		
1982	no limitation				21	195	160	350		
1983	no limitation	64			36	825	986	354		311
1984	no limitation	85			47	1,150	1,764	403		281
1985	no limitation	86	1,803		46	1,086	1,815	419		360
1986	no limitation	103	1,500		67	1,534	2,067	455		363
1987	no limitation	184	1,633		98	1,807	2,118	541		325
1988	no limitation	184	1,678		83	1,249	2,116	587	152	296
1989	no limitation	240	1,644		115	1,542	2,658	614	149	360
1990	no limitation	188	1,668		114	2,651	3,158	618	185	298
1991	limited entry	102	1,531		86	3,862	6,831	613	192	363
1992	limited entry	108	1,554		108	5,789	12,983	616	303	388
1993	limited entry	107	1,401	5,400	101	3,204	6,264	841	258	340
1994	individ. quotas	110	1,543	5,897	98	3,979	5,818	1,349	241	291
1995	individ. quotas	108	1,386.8	5,454.5	89	4,133	6,590	1,710	208	308
1996	individ. quotas	109	1,264.7	5,359.7	77	3,766	6,272	1,974	177	348
1997/98	individ. quotas				76					

Neifer, email, except for data on numbers of vessels after 1985 from Mylchreest, fax and numbers of divers from Parker, email.





### Annual Green Sea Urchin TAC, Landings, and Effort Information

Year	Limited Entry and Individ. Quotas	License numbers	South Coast TAC (tons)	Number of vessels with landings	Total vessel fishing days	Coast-wide landings (tons)	Average Ex-vessel Price (\$/ton)	CPUE (tons/vessel day)	CPUE (kg/diver hour)	Total diver hours	Total number of divers
1987	No limitation	38		20	248	120	1,058	0.48	168	729	29
1988	No limitation	89		68	690	444	1,315	0.64	120	2,544	123
1989	No limitation	191		110	1,394	611	1,669	0.44	137	2,997	153
1990	No limitation	155		90	1,352	475	1,977	0.35	98	3,568	158
1991	Limited entry	47		47	1,348	607	2,957	0.45	93	5,972	133
1992	Limited entry	49		49	2,096	1,042	4,246	0.50	84	11,412	200
1993	Limited entry	49		53	1,631	721	5,239	0.44	64	8,623	190
1994	Individ. quota	49	449	48	969	332	6,392	0.34	61	4,771	136
1995/96	Individ. quota	45	173.4	41	551	157	6,879	0.28	72	2,185	88
1996/97	Individ. quota	49	166.1	30	455	150	5,291	0.33	65	2,305	77

Data are from Parker, Table 3.2.1, page 12.