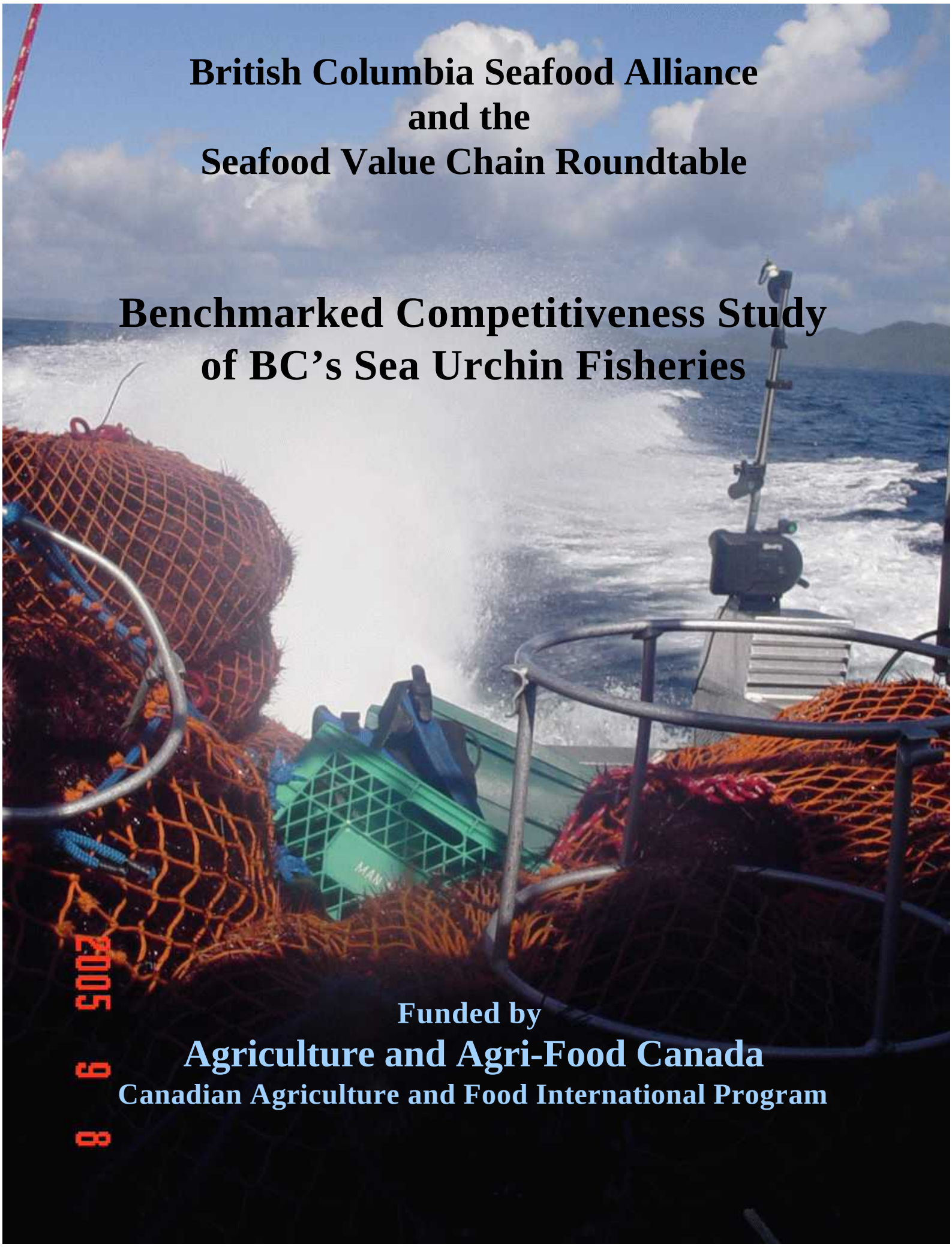


British Columbia Seafood Alliance and the Seafood Value Chain Roundtable

Benchmarked Competitiveness Study of BC's Sea Urchin Fisheries

Funded by

Agriculture and Agri-Food Canada

Canadian Agriculture and Food International Program

British Columbia Seafood Alliance and the
Seafood Value Chain Roundtable

Benchmarked Competitiveness Study of BC's Sea Urchin Fisheries

Funded by
Agriculture and Agri-Food Canada
Canadian Agriculture and Food International Program

Report Prepared by:
Explorations Unlimited Inc.
Brentwood Bay, BC

March 30, 2006

Benchmarked Competitiveness Study of BC's Sea Urchin Fisheries

Executive Summary

Red and Green sea urchins are handpicked by divers in the coastal waters of British Columbia. 110 and 49 active licences are permitted to harvest 4,885 and 186 MT per year in each fishery respectively. Canada's sea urchin fisheries are acknowledged as among the most sustainable in the world but the industry has been experiencing difficulties of late because of deteriorating market conditions. The major market for sea urchin products is Japan, which consumes about 6,000 MT of roe (uni), about 75% of world total, each year.

This study benchmarks British Columbia's Green and Red Sea Urchin fisheries with other prominent urchin fisheries from around the world, including California, Japan, Chile, Maine, Russia, Mexico, China and, of particular concern, an Illegal, Unregulated and Unreported (IUU) Russian sea urchin fishery in the Kurile Islands. The balance between production levels and product quality struck by each fishery influences its economic performance. Sea urchin products from Japan and California obtain the highest quality ratings and prices and are the primary comparisons of interest.

A list of benchmarks for this study was provided by Agriculture and Agri-Food Canada, Fisheries and Oceans Canada and the Canadian Food Inspection Agency. Establishing a consistent basis for comparing industries using these benchmarks required breaking out component parts which were available or could be inferred from other sources. A comprehensive profile of each fishery was developed and mined for trends that could be used as discussion points relevant to the assigned analysis. The synthesized ratings for the primary fisheries of interest in terms of the assigned benchmarks are summarized in the table below.

Executive Summary Table with Benchmark results for BC, California and Japan.

Benchmarks	Ratings			Comments
Government Policies	**BC**	**CA**	**Japan**	
Resource Sustainability	4	2	3	Canada's urchin fisheries seen as very good in this regard
Resource Management	3	3	4	Adopting EVM technology will allow more flexibility
Operations				
Management	2	2	3	Some transparency and coordination concerns
Input Costs	2	2	2	High load factors result in efficient use of capital and labour
Harvesting	3	3	2	Efficient; remote/extensive area raises equip. & flexibility issues
Post-harvest handling	2	3	4	Good awareness of issues and causes, reasonable results
Handling impacts R&D	2	2	2	Lack of empirical data on quality impacts, now based on opinions
Processing	2	3	3	No GSU proc'g or North Coast facilities; room for add'l value added
Logistics/transportation	2	3	3	Remote harvests cause complexities; good fleet support
Quality	2	3	4	Realized recoveries competitive, refrigeration might raise N. Coast bar
Continuity of supply	2	3	3	Weather related delays on north Coast; no summer supply
Marketing				
Market research	3	2	3	Good and increasing sectoral collaboration on market'g
Product development	2	2	2	Standard definitions (Japan); add'l info services in dev't to differentiate
Pricing	2	2	2	Russia, China & Chile are low cost; Russian IUU = market disruptor
Promotion/advertising	2	2	2	Increasing collaboration with Japanese distributors
Market development	2	2	2	Japan represents ~75-80% of world market
Selling methods	2	2	2	Company-based everywhere
Customer service	2	3	4	Direct consumer contact limited; examining internet opportunities
Access	2	3	4	Supermarkets, limited restaurant exposure & co-branded prestige
Packaging	2	3	4	Mainly generic; limited linkage to Canada's favourable reputation
Administration				
Human resources (harv'g)	3	3	2	Highly qualified & knowledgable personnel; some retention concerns
Human resources (proc'g)	3	3	2	Trained and experienced staff aging; recruitment issues rising.
Overhead	2	2	2	SME's with limited administration requirements.
Capitalization	2	2	3	Fleet & plant modernization could be stepped up in some cases

Competitiveness Rating Code: 0 = very low; 1 = inferior ; 2 = mid-range (acceptable); 3 = superior; 4 = very high

BC's sea urchin fisheries are generally well managed from a biological sustainability perspective and the resource management regime appears to be effective and fairly cost efficient in relation to others around the world. Harvesters in Japan, Canada and the US recognize their success ultimately depends on the health of the resource and are willing co-managers of their fisheries.

From the business side, the competitiveness of the industry also compares favourably with other legitimate sea urchin fisheries, including the sector leaders, California and Japan. BC's urchin fisheries are the 4th largest in the world, 5th if the IUU fishery is included, with Chile, Japan and California leading. When landed prices are expressed on a per kilogram of roe basis, BC urchins are generally at par with those from California while Japanese prices are just over double. The same relationships hold for the average wholesale contract sale prices. The Tsukiji auction prices for California uni are often considerably higher that those for Canadian product but this may reflect, at least in part, Canadian processors' reluctance to sell through the auction.

The average catch per diver-day in BC's RSU fisheries is much higher than the other fisheries and high load factors translate into efficient use of capital and labour. This keeps the unit costs manageable even with extra logistical requirements imposed by remote North Coast operations. BC's urchin products industry has demonstrated its ability to thrive in challenging natural and business environments. However, the market for sea urchin products in Japan is in turmoil because of the Russian IUU fishery on the Kurile Islands and virtually all producers are having problems. This fishery produces a very highly regarded product at prices others simply cannot match because normal regulatory limits and costs are simply avoided. It operates with virtually no government or market restraints and in defiance of any environmental sustainability, human safety or economic parity principles.

This is an issue of over-riding importance to both sea urchin fisheries in BC and the first recommendation in the report calls upon the Government of Canada to continue pressing this issue in bilateral or multilateral discussions with Russia and Japan. **All other recommendations in this report are subordinate to resolving this issue.** The report also recommends the suspension of GSU and RSU licence fee payments, without penalty, in those cases where licences remain wholly unfished for a full season for as long as the current crisis continues. The GSU fishery in particular is in crisis and this must recognized by all levels of government.

As noted above, the performance of BC's urchin fisheries is generally rated as acceptable in comparison to California and Japan, even with the influence of geography and circumstance. This study recommends adopting Delivery Time Intervals, Accumulated Heat Absorption Index, Unit Cost Index and Unit Value Estimate as performance metrics. The study has used these to demonstrate the operational performances of BC's south coast urchin fisheries compares favourably with the California fishery, but the remoteness of the North Coast fishery requires extra measures to get the same results.

Defining exactly what measures are most appropriate remains a problem because there are no empirical data charting the quality transitions of urchins held under different conditions and therefore no means to objectively and systematically assess the impacts of various factors and/or practices. This is compounded by ambiguity in the measures of quality used in the fishery, whether it be recoveries, colour or taste, which leaves the basic problem of "how do you manage something you cannot measure?"

There are a series of recommendations following from this. The first of these is to initiate a program to develop and adopt standardized methodologies to collect and categorize objective information on the product quality including:

- ✧ water loss studies correlating water content of the urchin to the time out of water;
- ✧ standardized methodology for calculating product recovery; and
- ✧ standardized 'reference' criteria for product colour, texture and perhaps taste; and
- ✧ heat absorption logs for all post-harvest intervals up to wholesale distribution.

Once these preliminary requirements are met, studies which assess handling impacts and product quality from various areas and at different times of the year can be conducted with some assurance that the analyses and conclusions are based on common reference points. This will allow objective assessments of variables, such as transit times, season, in-water vs. out-of water holding, maximum holding temperature, etc. on any of the defined quality criteria. The benefits will include more effective handling options leading to reduced quality impacts, higher realized recoveries and higher prices. A systematic effort to accumulate this data in a relational data base will provide a whole new dimension for optimizing the use of the resources.

Many of the most productive grounds in BC are on exposed coastlines and continuity of supply is often a problem once the quotas from protected areas are gone. Problems with inconsistent product availability are often mentioned in discussions with Japanese buyers. As a short term measure it may make sense to freeze some of the excess production and/or limit fishing on the South Coast whenever the northern fishing is not held back by weather, effectively extending the South coast season. Over the longer term, establishing a system to inventory live urchins at an interim holding facility might make sense. An objective estimate of fishing opportunities (in pounds/kilograms) lost on the North and Central Coast due to harvest limits from processors is needed to evaluate the potential of either option. Freezing tests are also needed to evaluate costs, effects, market reception and constraints with different types of freezing.

While everyone is generally satisfied with the current fishing and area openings strategy, there have been some comments to the effect that limiting the number of open areas too much concentrates the fleet and reduces the fleet's flexibility to take advantage of local conditions. Harvesters are looking for cost savings and/or efficiency gains wherever they can find them and feel Electronic Vessel Monitoring (EVM) technologies offer considerable potential. An EVM system is currently being piloted on a single RSU dive vessel on the Pacific Coast to get a better idea of its costs and capabilities. This study recommends industry and DFO continue and realize whatever benefits they can from fuller implementation as soon as practicable.

Uni is a traditional product in Japan and presenting it to quality conscious Japanese consumers as a differentiated product requires a completely honest appraisal process to retain that most valuable of supplier attributes, credibility. This is the other reason to develop the objective metrics outlined above: a properly and fully implemented system will be a powerful marketing tool by providing buyers with assurances that they are getting exactly what they want. The idea is that once the program is established, purchases can be traced over the internet and investigated by lot number. This means the industry is providing buyers, including consumers, with a tool that can, in and of itself, become a defining feature of the Canadian product. The Sea Urchins from Canada group is still developing the infrastructure to support this process and continued CAFI funding for this program is critical

Sources for this study include approximately 66 scientific journal articles; 20 periodical and newspaper articles; market, production and industry structure information from Canadian Embassy staff in Tokyo and Santiago; comments and background information from Fisheries and Oceans personnel in BC, Nova Scotia and New Brunswick; meetings with, and comments from, licence holders, processors, divers and skippers in BC's Red and Green Sea urchin fisheries; discussions with an active diver/permit holder in California; meetings with Japanese and Russian processors and buyers; and discussions with a Chinese fisheries research scientist.

Benchmarked Competitiveness of BC's Sea Urchin Fisheries

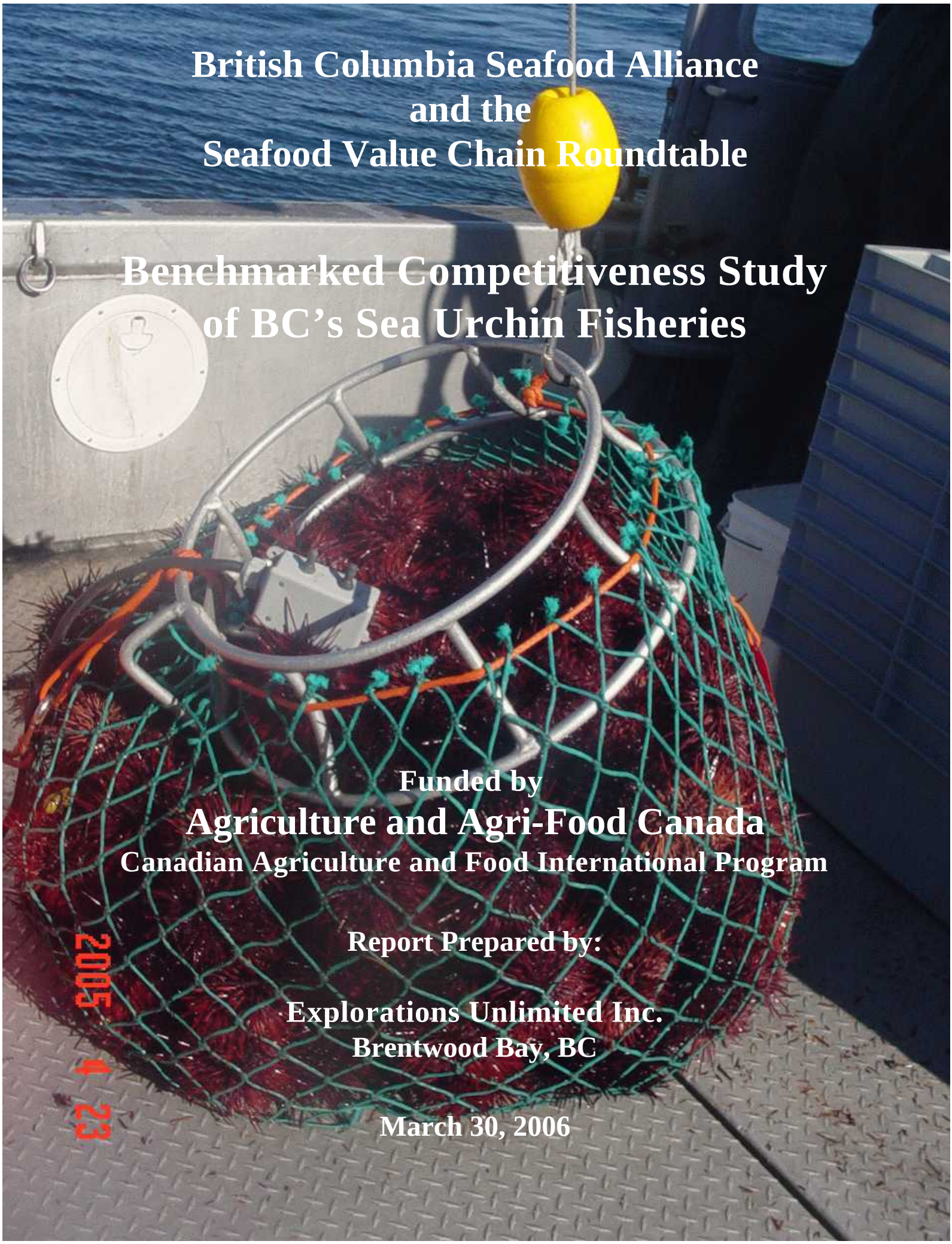
Table of Contents

List of Figures

List of Tables

Acknowledgements

This project was funded through the Canadian Agriculture and Food International Program of Agriculture and Agri-Food Canada and the author and proponents would like to thank Ms. Jane Barnett, Seafood Specialist at the Sectoral Industry Services Division in Mississauga, for her assistance and support over the course of the project. Mr. Tsuneto Sasaki and Ms. Renee Plouffe , Canada's Trade Commissioners in Tokyo, Japan and Santiago, Chile respectively, went above and beyond the call of duty providing background information on the Japanese and Chilean components of the study and deserve special mention. The author would also like to thank Ms. Christina Burridge for her patience and her unflagging pursuit of the highest achievable standard for this work, and Messrs. Michael Callow, Mike Featherstone and Ross Morris for their editorial comments and assistance.



British Columbia Seafood Alliance and the Seafood Value Chain Roundtable

Benchmarked Competitiveness Study of BC's Sea Urchin Fisheries

Funded by

Agriculture and Agri-Food Canada

Canadian Agriculture and Food International Program

Report Prepared by:

Explorations Unlimited Inc.
Brentwood Bay, BC

March 30, 2006

1.0 Introduction

On behalf of its members, the Pacific Urchin Harvesters Association (PUHA) and the West Coast Green Urchin Association (WCGUA), the BC Seafood Alliance is examining market and operational issues to identify competitive strengths and weaknesses and to develop options to ensure the continuing development of a sustainable and profitable sea urchin fishery in BC. The performance of the BC industry is benchmarked to that of other suppliers, each with their unique characteristics, to identify effective practices and possible strategies to improve economic performance.

1.1 BC's Sea Urchin products sector

Red sea urchins (*Strongylocentrotus franciscanus*) and Green sea urchins (*Strongylocentrotus droebachiensis*) are handpicked by divers in the coastal waters of British Columbia to depths of about 20 m. British Columbia's commercial fishery for Red Sea Urchins (RSU) began in the 1970's but did not start growing substantially until the mid 1980's when landings grew to just under 2,000 tons per year. The Green Sea Urchin (GSU) fishery commenced in 1987 and quickly grew to about 550 tons per year. Landings in both fisheries peaked in 1992 at about 12,000 and 1,000 tons respectively, even as Fisheries & Oceans Canada (DFO) took steps to control the harvest. Limited entry policies restricted the number of licences to 110 (RSU) and 49 (GSU) respectively, and fishery independent surveys were initiated to establish sustainable harvest levels. The TAC's have stabilized at around 4,885 and 186 MT per year respectively with quota shares evenly split between the licences. The GSU fishery is restricted to the South Coast while approximately 85% of the RSU are taken on the North/Central Coast - Queen Charlotte Islands.

Grading and packing processes are critically important for these products and considerable skill is required to meet the Japanese standards. Colour and size consistency and stacking pattern are all key indicators of quality to the Japanese consumer. The final package for the product is traditionally a small wooden tray but supermarket sales more often simply use the same shrink-wrapped styrofoam tray seen in North America.

GSU are smaller and more difficult to process than RSU and are commonly shipped live to Hokkaido for processing, grading and packing. RSU are processed to one degree or another by one of nine processors in the Vancouver area before being shipped to Japan. Approximately 35% of the product is packed onto trays which are then generally moved directly to retail outlets once they arrive in Japan. The remaining 65% is more simply bulk packed using less intensive grading in Canada and then shipped to Japan to a re-packer which then grades and packs the product before moving it to a retail outlet or, more rarely, to the Tsukiji auction market.

Canada exports approximately 460 MT of sea urchin products to Japan each year, accounting for approximately 75% of our production. Approximately 10% is consumed domestically each year with the balance going to Hong Kong, the US and China. The wholesale export value was about $25 million in 2002. This declined to about $21.6 M by 2004 because of market impacts from the emergence and rapid growth of an Illegal, Unregulated and Unreported (IUU) Russian fishery in the Kurile Islands.

1.2 Market Synopsis

The major market for sea urchin products is Japan which consumes about 6,000 MT of roe (uni), about 75% of world total, each year. France consumes approximately 1,000 MT of roe each year and is the second largest. Uni is marketed in Japan in several forms: fresh, frozen, steamed, baked & frozen and salted. The most popular and highest value use for the product is chilled fresh uni on sushi. There are two sales routes into Japan. The preferred method for Canadian processors uses contract sales at a set price to Japanese companies. The other route is via consignment on the Tsukiji Seafood Auction in Tokyo but these prices are highly variable.

In Japan sea urchins are esteemed for their highly nutritious gonads, or uni, which is considered one of the most valuable seafoods, in some cases commanding a wholesale value in excess of $C 850 per kg. Imports are not generally accorded the same value, although some 300 gram trays of premium California RSU uni fetch $C 120.00 on Tsukiji, equivalent to about $C 400 per kg. The best price obtained on Tsukiji for Canadian trays over the past couple of years is ¥ 3,000 per 300 g. tray, equivalent to about $C102 per kg. Normal average prices for contract sales of BC and California RSU uni range between ¥ 4, 980 - 5,500/ kg ($C 50 - 55 /kg). The highest contract price for Canadian uni in 2005 was ¥ 5,960 /kg in August, about 20% higher than the average for the year and a little higher than the highest price last year for US uni , ¥ 5,900 in October.

Sea urchins have been fished in Japan for over a thousand years and while production peaked in 1969 at 27,500 MT, the harvest has stabilized at between about 10,000- 13,000 MT per year since 1990. The market is much larger than this and the country now imports about 80-85% of its uni supply. The major importers serving Japan's uni market, the volumes each shipped in 2005 and their respective prices by product type are listed in Table1.

Table 1: Major sea urchin product importers into Japan in 2005 (Canadian Embassy, Tokyo)

	Fresh uni		Frozen uni		Salted uni		Live urchins	
Country	**MT**	**$C/kg**	**MT**	**$C/kg**	**MT**	**$C/kg**	**MT**	**$/kg**
USA	720.2	53.68	34.9	16.73			106.3	9.13
Chile	460.0	40.71	2,088.3	22.45	28.9	24.49		
Canada	340.1	50.66	47.1	6.12	3.2	33.06	35.1	10.79
China	270.2	32.04			9.2	20.71		
North Korea	204.1	34.20	53.0	9.18	112.5	11.22	819.4	5.05
Russia	2.9	41.12					13,825.6	4.56

Live imports from Russia increased from less than 3,500 MT in 1998 to more than 10,000 MT by 2002 and to almost 14,000 MT by 2005, This increase has been ascribed entirely to the Russian IUU fishery. This activity is having major impacts on the market, displacing product from legitimate fisheries and lowering prices for all suppliers. BC's GSU fishery has been one of the most seriously affected with 2005 shipments to Japan declining by 80% from 2004.

1.3 Benchmark elements

The benchmarks established for this study are based on a list drawn up and approved by Agriculture and Agri-Food Canada, Fisheries and Oceans Canada and the Canadian Food Inspection Agency. The benchmark elements can be broken down into four basic categories:

1. Government policies: this category is interpreted to reference the support provided by government policy to the industry's competitive position. This includes subcategories of Resource Management and Sustainability. All the fisheries compared in the study are wild capture fisheries and all importers operate under the same trade rules so the sub-categories of Trade Policies and Animal Welfare were excluded.

2. Operations: this category refers to normal business operating variables. It includes Management, Input Costs, Harvesting, Processing, Logistics/Transportation, Quality Characterizations and Continuity of Supply.

3. Marketing: this category refers to generic marketing initiatives and research undertaken and publicly circulated amongst companies in the various jurisdictions. It includes Market Research, Product Development, Pricing, Promotions/Advertising/ Communication, Market Development, Selling Methods, Customer Service, Product Access and Packaging.

4. Administration: this category refers to the administrative variables affecting the fishery including Human Resources, Overhead and Capitalization.

2.0 Methods

California is the leading supplier of RSU products and Japan's sea urchin product industry sets the quality standards against which all other urchin industries are judged, so these two are the primary regions of interest in this benchmarking study. Other significant players are included: Chile because its sea urchin fishery is the largest in the world, Mexico because it is the only source of RSU other than Canada and the US; and China because of its significance as a current and potential future source of both wild and cultured urchins. The Canadian Maritimes and Maine are significant suppliers of Green Sea Urchin products and provide an important contrast for BC's GSU fishery. Russia's legal and IUU fisheries are also included.

It is difficult to collect comparable data from all these countries as there are no recognized or required standards for data reporting. The data collected by various countries are fairly unique to each and not usefully applicable to cross-jurisdictional comparisons. Even companies operating in the same country collect information, including metrics on such basics as recoveries and grades produced, with unique and undefined assumptions and methods so it is not necessarily transferable or comparable to the information collected by other companies.

Establishing a consistent basis for comparing industries using the approved benchmarks required breaking out component parts which were either directly available or which could be estimated from other data. There is a considerable body of scientific literature on sea urchins which discusses many factors affecting fishery performance in each jurisdiction. It includes some fairly definitive data on absolute production (green weight), numbers of vessels, divers and plants, environmental conditions, sustainability etc. as well as more anecdotal accounts of costs, efficiencies and various other management, harvesting, transport, processing and marketing factors. A comprehensive literature search of sea urchin fisheries in BC, the Canadian Maritimes, Japan, Chile the US, Mexico, China and Russia was used to develop an in-depth profile of the industry in each country.

Comparable data were not always directly available and non-parametric coding methodologies were used to categorize inferred magnitudes for costs and/or other measures. A total of five data coding processes were applied to Resource Management, Operations, Input Costs, Logistics-Transportation, Marketing, Product Differentiation, and Human Resources benchmark categories. The most widely applied method involves a five step graduated scale ranging from Very Low (0) to Very High (4). This use of this is indicated on the charts or tables by the presence of 'code 1' in the title. The other coding systems are not so much graduated as they are categorical, involving, for example in the case of the Resource Management, an indexed categorization of management tool cost as either low (0.5) or high (1.0).

The data were assembled into a series of eight tables so the contributions of the various factors in each category could be easily compared between fisheries. Whenever data from multiple fisheries is aggregated within a table, for example the GSU and RSU fisheries on the South Coast, their contributions are weighted according to their respective production volumes. These tables are attached as Appendix A, but most of the comparisons presented in the Results and Discussion section are accompanied by charts drawn from relevant data. A compound numbering system is used for the charts. The first digit refers to the Table in Appendix A from which the data is obtained while the second is simply a reference count.

3.0 Results and Discussion

3.1 Government Policy

3.1.1 Resource Management

3.1.1.1 Funding Source and Government Involvement

Governments fund the resource management process in Chile, Mexico, Russia and China, and the costs incurred are much lower than in the other jurisdictions where most of the costs are absorbed by the users of the resources. Government involvement is generally collaborative in Canada, the US and Japan, nominal in Chile and Mexico and dominant in the more authoritarian regimes in Russia and China. The Illegal, Unregulated and Unreported (IUU) Russian fishery in

the Kurile Islands is reportedly a venture between the Russian and Japanese mafia with no government involvement.

3.1.1.2 Management Tools and Management Cost Index

The available data for different jurisdictions are not readily comparable so in this instance, season closures, the application of minimum legal size limits, the use of fishing logs and validation are each assigned a cost value of 0.5 while more expensive measures such as on-grounds monitors, independent surveys/research, stock enhancement and habitat enhancement are each assigned a cost value of 1.0. If a given measure is not used in the jurisdiction a value of '0' is used. The cost of management in each area is then simply indexed by totalling the respective values for each area. Management effectiveness, harvester accountability, management credibility and current fishery sustainability indices are indexed according to the Code 1 system.

The management tools used in this analysis include seasonal closures, minimum legal size limits, fishing logs, validation, on-grounds monitoring, fisheries independent research and surveys, seeding (hatcheries) and habitat enhancement (Figure 1-1). Japan uses all of the available tools except for the landings validation and on-grounds monitoring, and is the only jurisdiction in this study using seeding and habitat enhancement, although the costs are mostly absorbed by government. Canada comes in next using all the same measures as the US, including fishery independent surveys and/or research, as well as being the only nation to employ validation and on-grounds monitoring. Minimum legal sizes are used in all the listed fisheries, including the IUU fishery in the Kuriles where it is reportedly included as a condition in the sales contracts. Fishing logs are required in all fisheries, except for Chile's and the Russian IUU fishery. Russia and Chile also both support limited survey /research programs while China and Mexico do not.

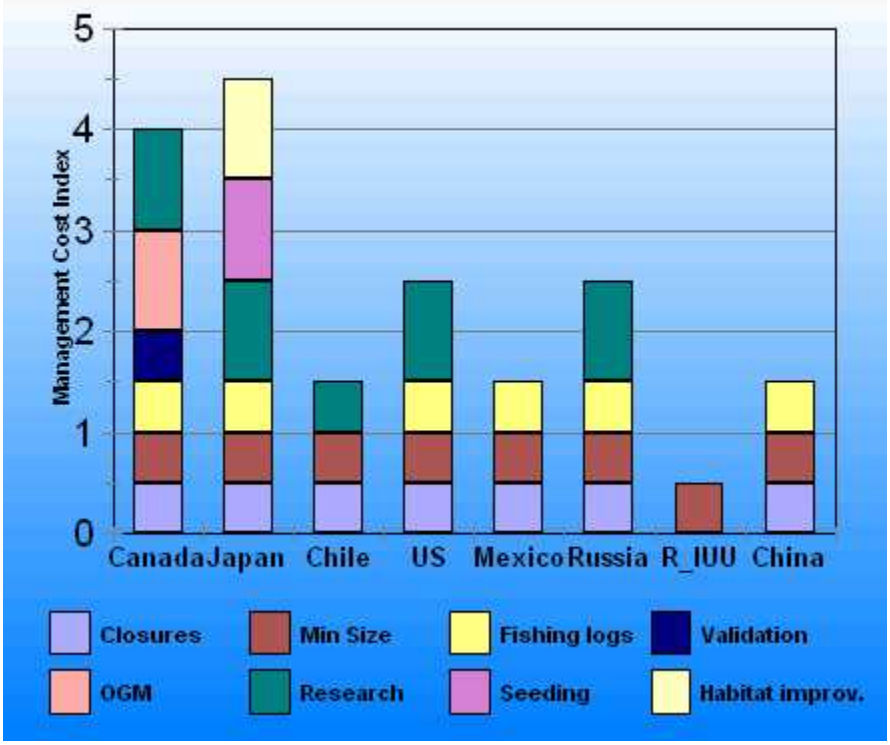


Figure 1-1: Management tools used in various urchin fisheries.

3.1.1.3 Resource Access Control

Individual Fishing Quotas are used to regulate access to urchin resources in BC. Exclusive area rights are used in Japan, part of the Canadian Maritimes fisheries and the Mexican fishery and more limited parts of the Chilean

fishery. The most widespread measure in Chile is simply based on open access for all fishermen registered as of 1998. Harvester permits are required in the other jurisdictions, including the US, Russia and China.

The harvesting sector is independent in the US and processors are not allowed to own or control harvesting permits because of concerns over increasing corporate control of fisheries. This consideration has not affected ownership restrictions in Canada and processors own about 20% of the licences. The interests of processors and harvesters are not always the same and there is generally a striking imbalance in the resources each can bring to the market. Canada has the Competition Act to restrict un-competitive behaviours but the difficulties, costs and time involved in proving a case under this Act limit its effectiveness. Ensuring a level playing field and providing continuing opportunities for independent fishermen requires maintaining a flexible, competitive and transparent market for licences and for the fisheries products.

Red Sea Urchin licences in BC are presently valued at about $150,000, down from about $250,000 over the last 18 months or so, while Green Sea urchin licences are valued at less than $50,000, both because of deteriorating market conditions in Japan. These licence values are still considered too rich by divers and the industry is exploring avenues through which young fishermen can afford to buy an ownership interest. Urchin permits in the California are not currently transferable, and therefore hold no nominal value, although fishermen and regulators are discussing changes so the fishermen can recapture some of the value they have built into their businesses as they retire.

3.1.2 Fishery Sustainability (Figure 1-2)

Fisheries Cooperative Associations (FCA's) in Japan have exclusive area rights for inshore fishery resources and control the product from harvest right up to the wholesale level. FCA's manage their fisheries with advice from Prefectural Fishing Agencies and are completely accountable if the resources under their control are depleted. With hatchery stocks accounting for up to 80% of the harvest, sea urchin fisheries in Japan have recently become dependent on stock enhancement to maintain harvest levels. Natural stock abundance trends are not tracked in Japan, which coupled with the dependence on hatcheries and concerns with genetic dilution and periodic disease outbreaks, marginally reduces the sustainability rating for Japan's fishery.

Harvester accountability levels in Canada and the US lie below that in Japan but harvesters here recognize their revenues depend on the strength of the resource. The sustainability situation in Canada has been acclaimed as one of the best by worldwide authorities, primarily because the harvest rate on mature (legal-sized) is only 2% in BC and 3.5% in the Maritimes. The levels realized in the US are less precautionary at between 20- 30% in California and Maine. Management effectiveness has been compromised in Maine, and to a lesser extent in Northern California, as the biomass and harvests have declined significantly since the late 1990's. In Maine, where mass mortalities reduced the biomass by about 80% in the late 1990's, harvests continue in the face of scientific advice from Federal, State and academic authorities. Industry groups in California are advocating a move to smaller-scale management through fishing co-ops to bolster the effectiveness of the management regime.

In Mexico the situation is considered quite hopeful because of the 'tenure' arrangements used, but a lack of survey information and ongoing problems with corruption are sufficient to cast uncertainty on where things actually stand. In Russia and China, the fishermen more typically simply follow orders, expected in authoritarian societies, and so have only a limited personal stake in the sustainability of the operation or the credibility of the management regime.

Chile is one area where there is widespread acknowledgement of a sustainability problem. About 50% of the harvest comprises urchins smaller than the legally defined minimum, and virtually all sources expect both stock and harvest declines in the near future. Part of the problem is with the number of people involved. With up to 8,000 harvesters involved, each reportedly making less than $C 10 per day, none have a over-riding personal stake in seeing that things work.

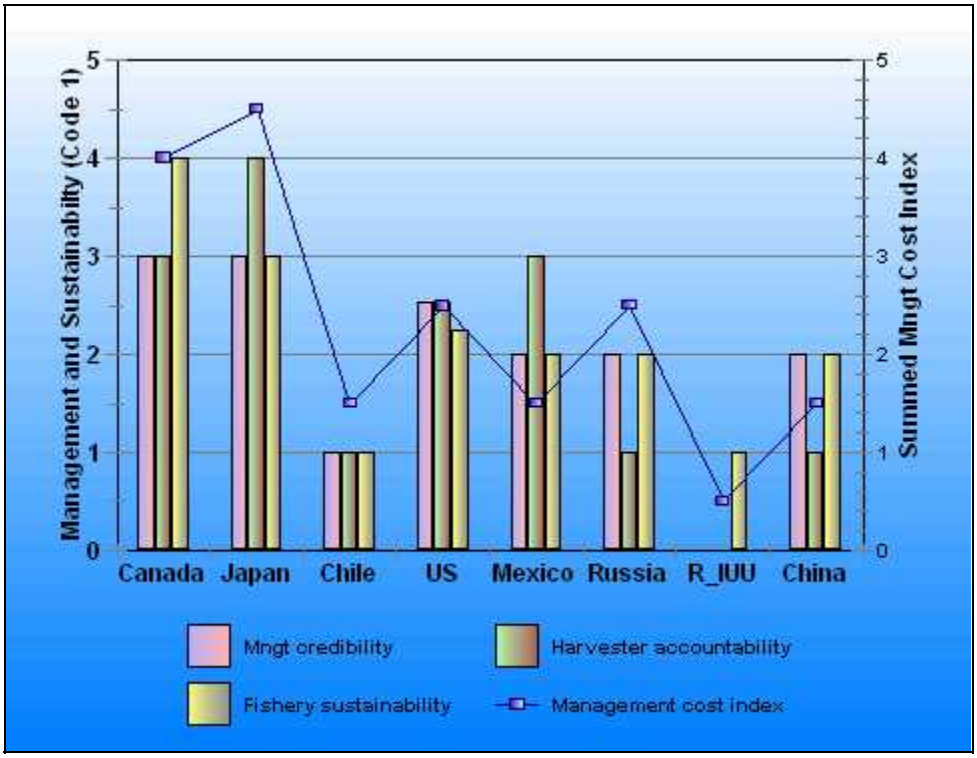


Figure 1-2: Accountability, credibility and sustainability estimates.

Sea otters are a significant threat to the sustainability of the sea urchin fisheries on North America's west coast. These animals are protected under the Species At Risk Act in Canada, and under the Endangered Species Act in the US. At present there are no criteria established to allow their removal from the endangered species list, which would permit management intervention. Sea otter population levels and ranges are rapidly increasing, according to some reports at up to 15 - 20% per year in some areas.

Sea otters compete directly with mankind for shellfish. Once a colony becomes established in an area, shellfish, including sea urchins, geoduck clams, crab, abalone etc, are quickly eaten and any commercial shellfish fishing activity is lost. Sea otter populations are now expanding in SE Alaska, along the North and Central coast of BC and the West Coast of Vancouver Island from Cape Scott down to Tofino, and Central California down into the northern Channel Islands. The economic consequences of continuing unconstrained growth of this species are serious, as shellfish fisheries in the US and Canada are losing significant resources each year.

3.2 Operations

3.2.1 Harvesting

In aggregate, Canada's sea urchin fisheries are the fourth largest in the world, trailing Chile, Japan and the US, If the IUU fishery in the Kuriles is included in the Russian tally, Russia is basically tied with Japan in second position. The landings and landed values of a number of fisheries are presented in Figure 2-1. The Southern California fishery remains the largest source of RSU, and landings are apparently improving as the kelp forests recover from the 1990's when El Nino's were more frequent. The landings for the IUU fishery stand out in relation to the legitimate fishery in Russia as well as the other fisheries included. It is interesting to note that the Maine fishery is still quite substantial, despite a significant reduction in biomass, and is about the same size volume wise as the Chinese fishery although the value is substantially higher.

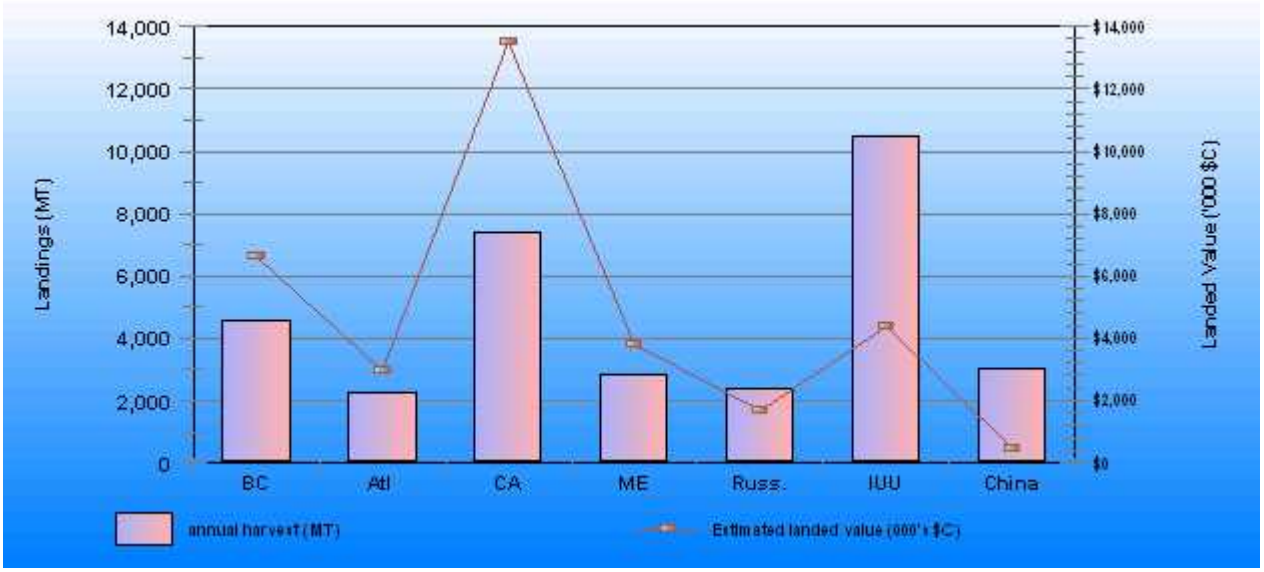


Figure 2-1: Landings and landed value for select urchin fisheries. The landings (value) for Japan and Chile are 13,000 MT ($C124 M) and 50,000 MT ($C 9.26 M) respectively.

Harvesting on the west coast of the Americas and in Russia is by dive only while the GSU fisheries on the Atlantic coast of Canada and Maine (ME) are both trawl and dive. The quality obtained with the trawls is more hit and miss, as the trawl is inherently much less selective than divers, but the unit harvest costs are much lower. The fisheries in Japan and China use similar traditional techniques, including dip nets, free diving and baited traps, as well as scuba.

Fishing operations can also be examined in terms of productivity. In Figure 2-2, the average catch per unit effort is expressed as kg. harvested per diver-day for each of the fisheries. These values are derived from literature, interview sources or deduced from the interplay of factors including the number of active divers, the season length, annual production and harvest techniques used. The number of harvesters in Japan was estimated assuming an average team size of 4 at each of 250 Fishery Cooperative Associations in Japan to produce a total of 1,000 active urchin harvesters.

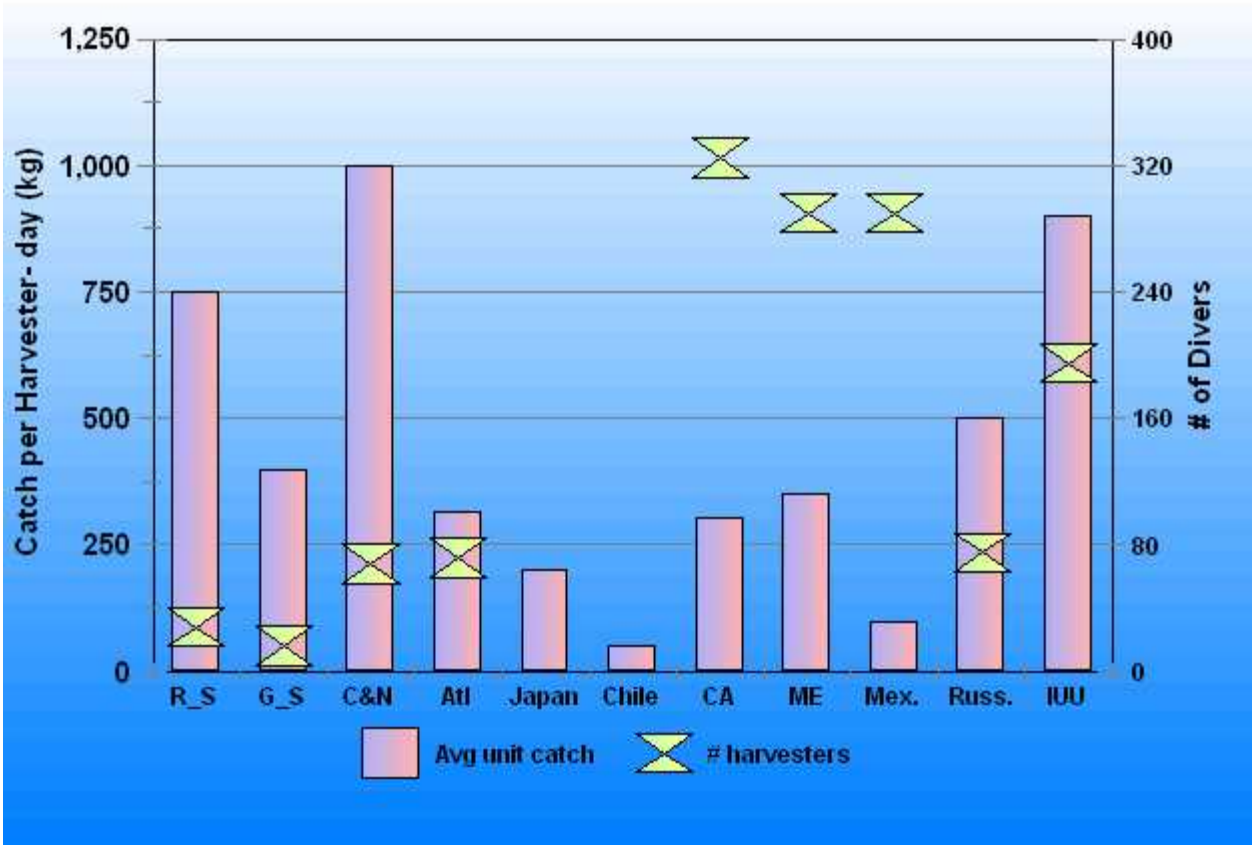


Figure 2-2: Number of harvesters and the average unit productivity for select sea urchin fisheries. Harvester estimates for Japan and Chile are 1,000 and 7,500 respectively.

One thing that stands out about the BC fishery is the relatively low number of divers involved and the high individual harvest rates in comparison to other locations. The catch per diver-day in BC is, for instance, up to 17 times higher than those found in Japan and perhaps 12 times higher than those found in California. This is good in the sense that the number of vessels needed to support the divers is lower, improving the economics of each operation. It is also bad because the product flow is highly variable at times and some buyers and consumers may perceive that less emphasis is placed on quality.

3.2.1.1 Landed Quality

The landed prices paid for sea urchins in the various fisheries appear to fall into three categories: Japan in the highest, Canada and the US in the middle, and less developed countries at a lower level (Figure 2-3). Within these tiers the prices are assumed to fairly represent product quality. In BC, the price for GSU, at about $1.70/lb, is considerably higher than the $0.65 - 0.70/lb paid for RSU. The market, however, is only interested in the roe and once the prices are converted to a per roe weight basis and the different recovery rates are incorporated, the landed prices of urchins in BC and California are fairly consistent with a slight advantage for Southern California. In general, landed prices on a roe weight basis for Canada and the US are about 40 - 50% of Japan's, while in Chile, China, Russia and Mexico, they range between about 5-15%.

Quality in the BC fishery is considered generally good, but it still pales against Japan's where fishermen are probably better described as cultivating, as opposed to harvesting, their product. The Japanese know their grounds intimately, regularly postpone their harvest until the animals are in peak condition and make sure the product arrives at the plant in pristine condition. The situation in other jurisdictions is somewhat more opaque. Landed prices are lower, possibly reducing their potential positive influence on harvester behaviour, particularly in Chile where questions regarding the distribution of wholesale revenues are causing discontent.

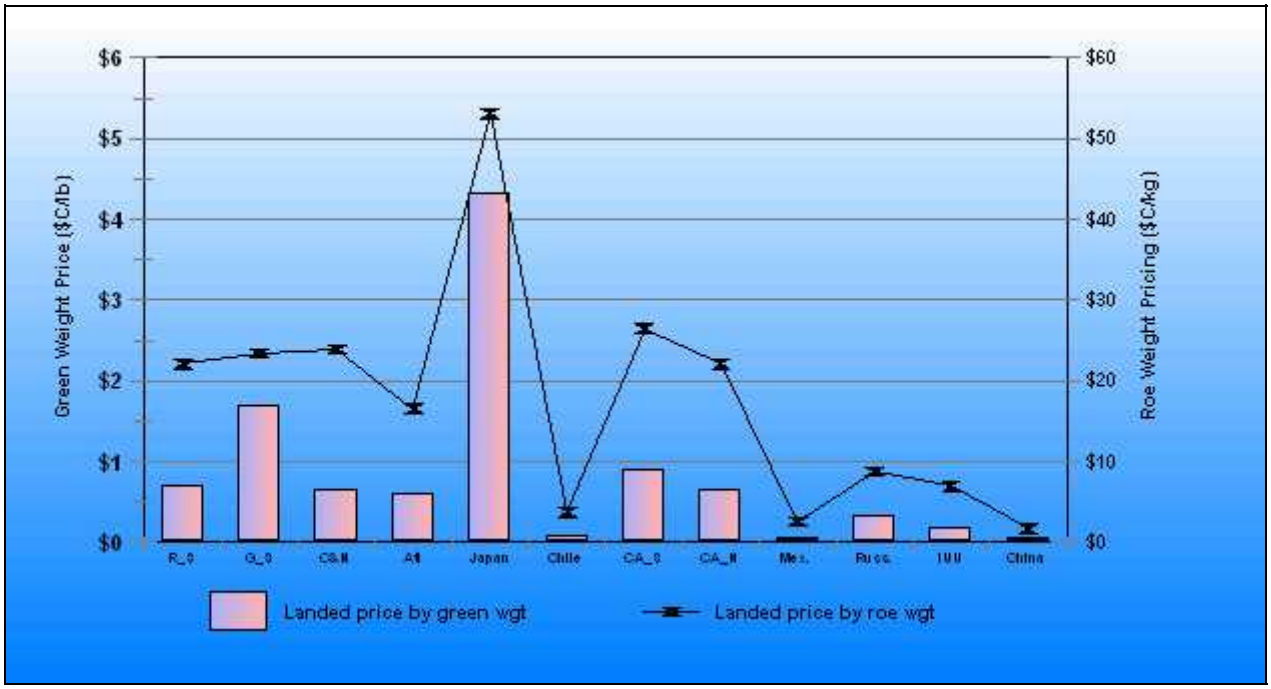


Figure 2-3: Landed prices from various urchin fisheries (R_S; G_S; C&N; Atl.; Japan; Chile; CA_S; CA_N; Mexico; Russia; IUU and China)

In BC, each fisherman (boat) is paid a single price which contains only implicit recognition of the quality of the product. This means boats focussing on volume, as opposed to quality, earn more. According to fishermen, even the almost-daily communications with processors do not include explicit quality ratings for recently delivered product. Up to about 1997 harvesters got daily, full quality breakdown reports on their deliveries and could alter their harvesting patterns accordingly. An independent third party was used to verify the quality breakout but the program was dropped as a cost saving measure. Processors maintain that prices have declined because darker, less attractive roe is a larger portion of the catch now than in the past but, despite this, they continue to fight the re-establishment of a more explicit link between price and quality.

A lack of clarity in communications on quality is apparently a general feature of the urchin trade. Reports from fishermen in Canada and the US describe how feedback from processors on the quality of their catch is seemingly based on mysterious criteria that may change daily. This lack of clarity even extends to the Tsukiji seafood auction reports which include information on high and low prices and the number of trays sold and but provide no means to estimate the average or modal prices.

3.2.2 Processing

The processing average for each fishery is estimated simply as twice the annual harvest divided by number of days in the season. The estimated capacity required for each country parallels the harvest level, but differences in product specifications (e.g. tray vs. bulk, fresh vs. frozen) influence the size of the plants and the economies of scale realized. In all countries except Chile, processing facilities are best described as small to mid-size operations with average processing capacities of perhaps 5-20 MT per day (8 -10 hours) with a comfortable average probably less than10 MT. In Chile, the export market is basically controlled by a few large multinational processors, including many with significant Japanese investment, which are involved in a number of other capture and culture fisheries. These operations reportedly comprise large industrial facilities capable of processing perhaps 100 MT+ per day and freezing the resulting uni using modern and efficient blast, plate or tunnel freezers. In Japan, there are reportedly a couple of large processing operations north of Tokyo but the majority of the processors, including re-packers, are small plants distributed throughout the country.

3.2.3 Management

The market projection period (Figure 2-4) is an important factor affecting the risk for processors and buyers as they are estimating demand in the future for commitments in the present. In more remote areas like BC's North Coast product orders received on day 0 may not be delivered to the market in Japan until perhaps day 4- 5. The time line might include one-half day to aggregate it with other orders and get it out to the grounds, 1.5 - 2.5 days to fish and land, one day for transport to the plant and one day to process and ship to Japan. BC's North Coast and Chile's southern area fisheries are similar in this regard, as operations are quite remote. This contrasts to the situation in Japan, where an order received on day 0 can be fished and delivered for sale on day 1. California can likewise deliver product for sale in Japan on day 2 to 2.5, depending on whether the operation is a day- or overnight fishery.

3.2.4 Continuity of Supply (Figure 2-4)

The RSU (GSU) fishery in BC generally starts sometime in mid to late September (mid November) and extends through to about mid-April (end of February) when the urchins become too mature. The seasonality of BC's fisheries is generally in line with most other jurisdictions, save for Southern California where good quality product is found all year because food availability is consistent and less seasonal. California fishermen consider a constant presence in the market an important contributor to maintaining prices and demand and use this to their advantage to ensure availability in the market at all times of the year. Areas with good quality are also found out of season along the BC coast but the areas have not been adequately defined to support year round operations.

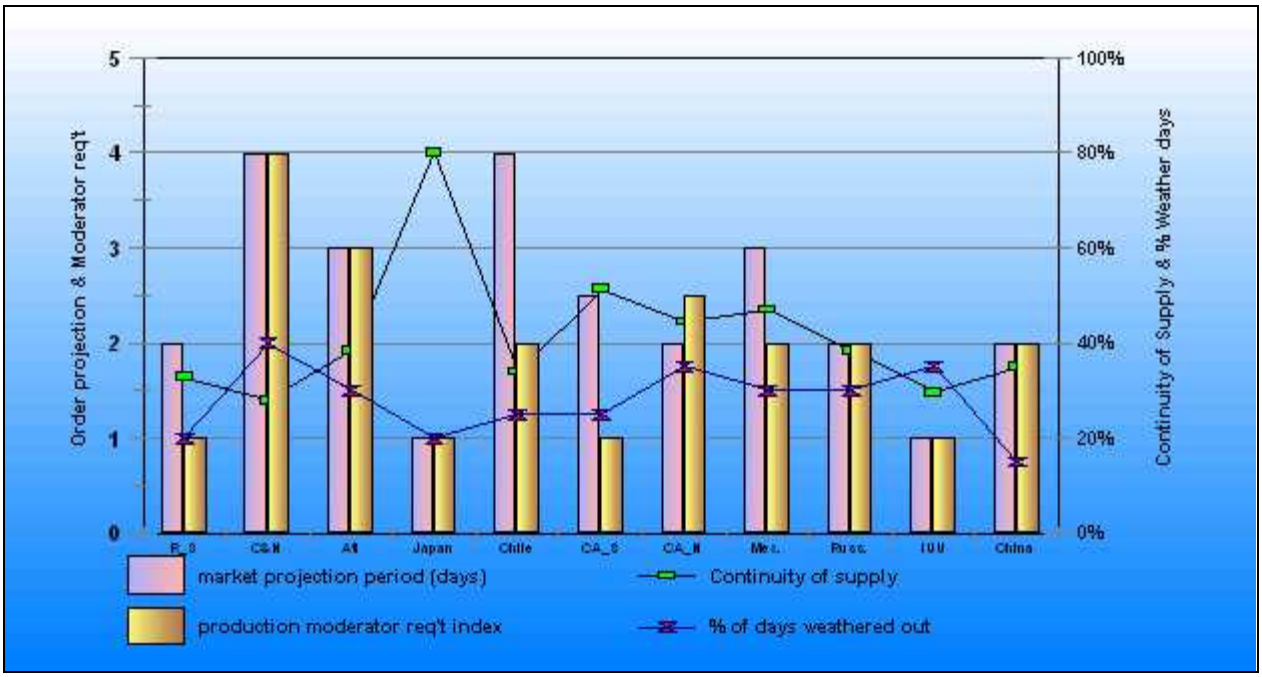


Figure 2-4: Market projection period and continuity of supply in various urchin fisheries (South Coast; C&N; Atl.; Japan; CA_S; CA_N; Mexico; IUU; China)

Urchin fisheries in Japan are closed each year around the spawning period, but taken together there is always domestic product available from somewhere and in this analysis Japan's urchin fishery is considered open all year. As a result, Japan's supply continuity ranks #1 followed by California and Mexico. In contrast, BC's South Coast rank is #10 while the North Coast comes in at #12. Chile is ranked at #9 but they freeze upwards of 80% of their production and can maintain a presence in Japan by drawing on inventory throughout the year.

The majority of BC's urchin harvest comes from the Central and North coast (C&N) during the winter when the harvest operations are vulnerable to weather related disruptions. The weather impacts on the C&N are higher than any other urchin fishery, except perhaps for the Russian IUU winter fishery, and weather-related fishing interruptions have contributed to part of the RSU Total Allowable Catch (TAC) being left in the water each of the last few years. There are defined areas which can be fished in different types of weather on the C&N but their quotas are depleted during the high demand period in mid-December through early January and matching an open area with appropriate weather is difficult in February-March. Fishing opportunities are limited to only 50 - 60 % of the time in this period, and Canadian processors and buyers in Japan alternate between starvation and glut, neither of which is good for market stability. When the supply chain is glutted, prices fall. When product is not available, buyers and consumers move to alternative suppliers. These are the very things California fishermen work to avoid.

The glut- starvation situation in BC highlights the need on the North Coast fishery for some sort of "moderator" so the product flow from the grounds can be evened out. Currently, harvesters are given catch limits and packers are slowed down when the system is becoming glutted. Freezing basically eliminates shelf life worries and could support marketing efforts to establish a year- round 'Brand' presence, but low prices limit much of the appeal.

Another possible option might involve using a live- hold inventory system, whereby specially-handled portions of each landing are set aside in special holding facilities to provide a live inventory which could then be drawn on during weather-induced harvest disruptions. This is known to be quite expensive, but it could also tie in with the planned development of a shellfish culture capacity in Coastal Communities along the North and Central coast with leveraged advantages for all involved.

3.2.5 Input Costs

Wage rates, numbers of personnel on the harvest vessels, load factors for the vessels and factories and processing complexity indices resulting from the unique product mixes etc. are calculated for each country. The Input costs have presented problems because of difficulties in calibrating the costs attributable to the different sets of activities in each jurisdiction. However a consistent arithmetic methodology is used for all areas and the estimated costs of each activity are logically at least roughly comparable between jurisdictions. The results for the different activities are totalled to provide a relative, as opposed to an absolute $/kg of production estimate (because of the calibration issues), aggregated 'Unit Cost index' for each country.

The unit input costs (Figure 3-1), or the costs incurred per unit of production, in each fishery reflect the relative remoteness of the fishing activity, the distances to the processing facilities and distance to market. They do not include the fishery management costs. The respective economic rating for the country (advanced vs. developing) is incorporated because of the general influence this has on the equipment cost and wage levels. A number of operational load factors are key determinants behind the efficiencies and economies of scale realized. For example, the higher cost vessels in BC harvest a higher average weight each day than their Chilean counterparts. This lowers the vessel cost per kg of production so the BC estimate is only about 50% higher than Chile's, despite the larger differences that would expected from each country's economic rating.

The lowest unit costs are associated with the IUU fishery, in part because of the excessive and unregulated harvest rates. The proximity of the fishery to Japan and the developing economic status of Russia also contribute to the low costs. The legitimate fishery in Russia and the fisheries in China, Mexico and Chile all share the relatively low unit cost structures typical of developing economies while those in Japan, the US and Canada are on another level simply because of the countries' higher developed status. The production from the Maritimes is directly exported live to the US and the low unit cost index reflects the absence of any processing costs. The unit costs are highest on BC's North Coast, again because of the remoteness of the areas involved and the associated extra expenses required to get the product to the Lower Mainland.

If the Unit Cost index for each fishery is multiplied by its respective harvest, the total costs are logically related to the overall output of the fishery and to the numbers of boats, fishermen and plants involved. Chile has the highest overall fishing costs in this regard simply because it is so much larger than all of the others. Japan's fishery ranks as the second costliest, although the differing economic status influences the ratio between the two countries. Japan's fishery is about one quarter of the size of Chile's, but its costs are estimated to come in at about 1/3 of Chile's.

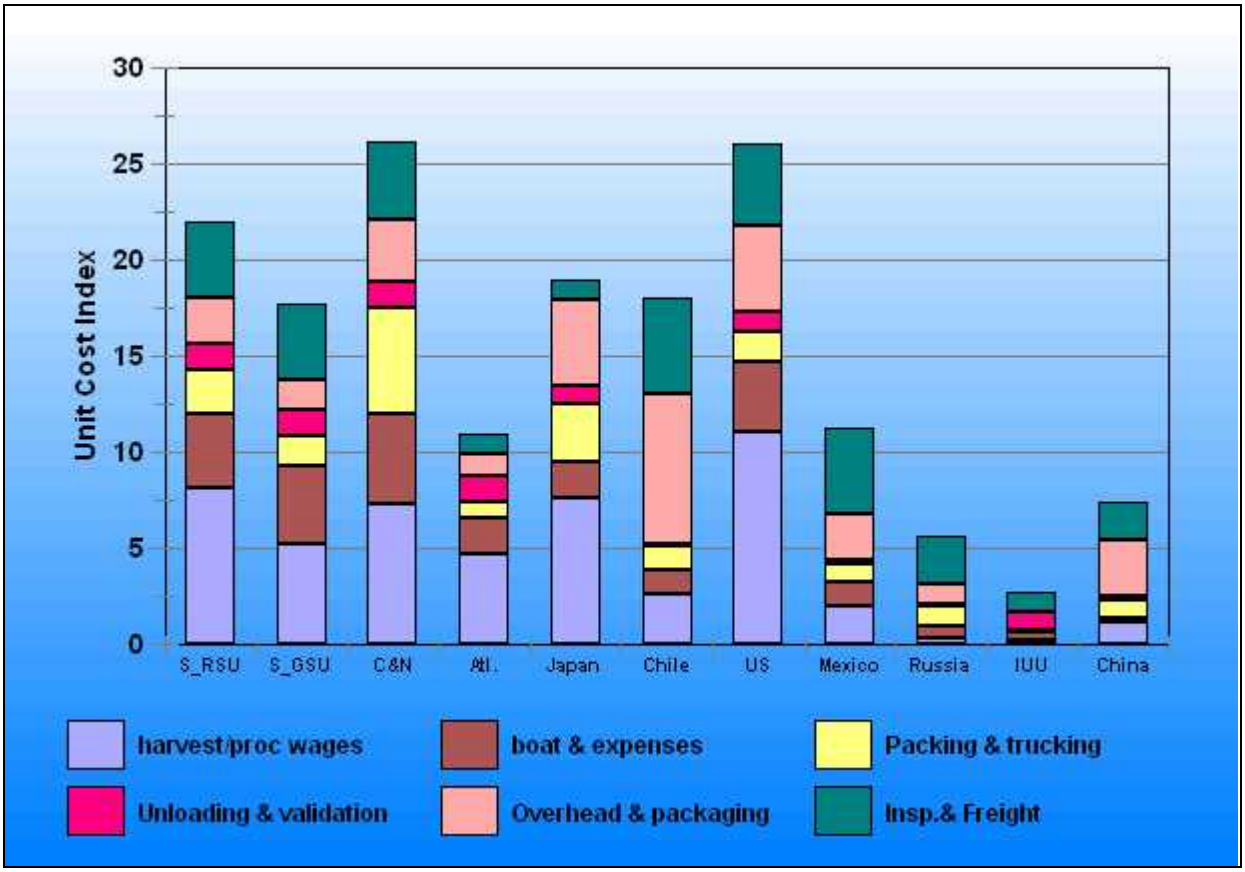


Figure 3-1: Coded Unit Costs for various urchin fisheries.

3.2.6 Logistics/Transportation

Operationally, the fisheries in Southern Chile and on the North and Central Coasts of BC bear a close resemblance because of the remoteness of the fishing activities. The processing facilities are more dispersed through Southern Chile and processing is generally undertaken in the landing ports whereas BC's processing capacity is centralized in the Lower Mainland. Japan, California, Maine, Mexico and the Maritimes have more intensively developed coastlines and transportation infrastructures, and these reduce many of the costs and complexities involved with fishing and transferring the product.

These differences are reflected in the delivery times to the plant for each of the fisheries (Figure 4-1). For example, an estimated 1.8 to 2.8 days are required from harvest to get the product to market in Japan from the South Coast fishery in BC while 3.5 to upwards of 6.2 days are generally expected from the North Coast or Chilean fisheries. This compares to about 1 day for Japan and 1.5 - 2.5 days for California, Mexico, China and both the regulated and IUU Russian fisheries.

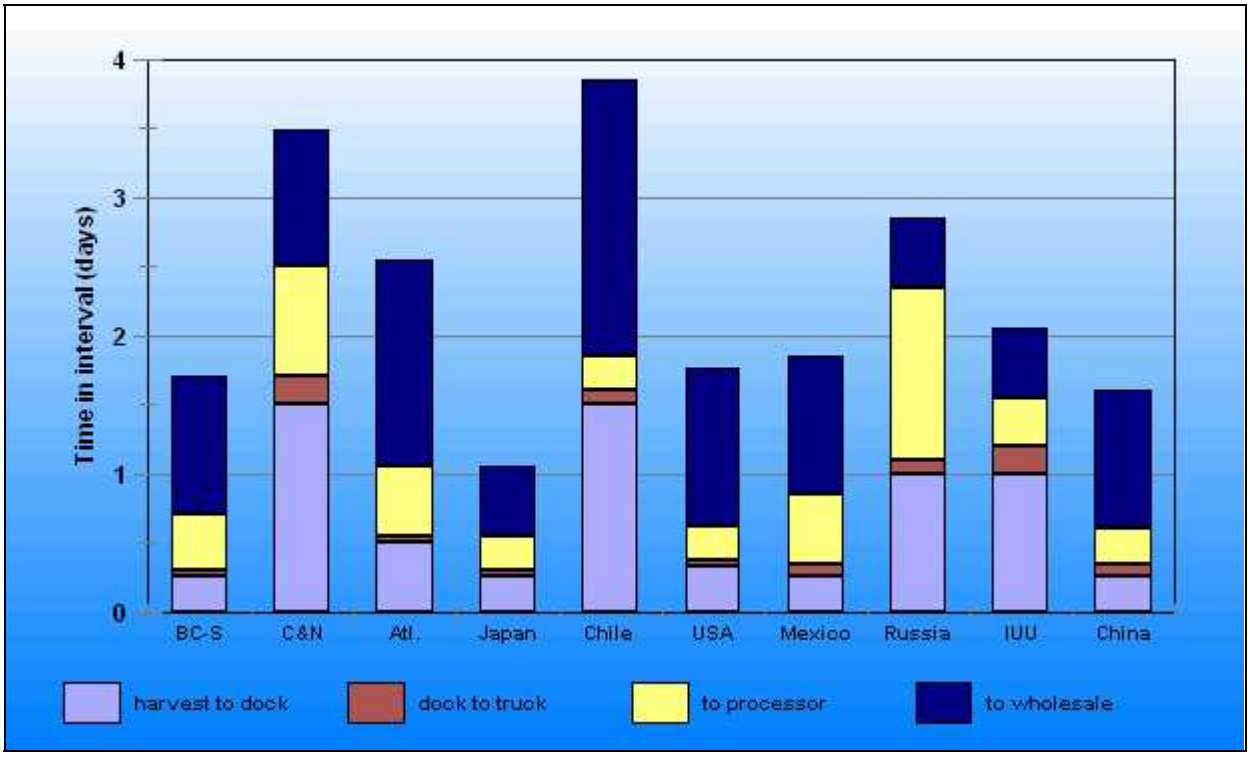


Figure 4-1: Delivery time intervals between harvest and wholesale for various urchin fisheries.

3.2.6.1 Accumulated Heat Absorption (AHA) Index

A more informative measure of quality impacts faced by sea urchins as they move through the supply chain called the Accumulated Heat Absorption index is proposed. This index looks at the logistical differences for different fisheries and is basically the urchin temperature multiplied by the number of hours at that temperature totalled over all time intervals of interest. For example, product on a packer at 10° C for 5 hours and then on a dock at 5° C for 1 hour would have an AHA index of 50 + 5 = 55 C°-hours. Delivery times are estimated as a function of the respective distances involved and the infrastructure in place. The temperatures comprise averages obtained from global atlas sources and in the case of Japan, were those listed for Hokkaido.

The use of this measure assumes that the impact on quality of holding the harvested urchins is directly proportional to both the interval and the temperature at which they are held. The value of this as a measure of freshness is simply demonstrated by, for example, comparing two litres of cream which have been stored for four days. Judging them with a simple time interval metric provides no clues as to any difference between them. However, including the detail that one of them has been in a refrigerator while one has been on the counter for that period and the difference between them is known immediately.

In this analysis (Figure 4-2), Japan, or more precisely in this instance Hokkaido, comes out with the lowest AHA index. This fishery is a day fishery, the distances are short and the fisheries sector infrastructure is intensively developed, all of which contribute to shorter delivery times. The fisheries in California and BC's South Coast also rank highly while BC's North Coast and

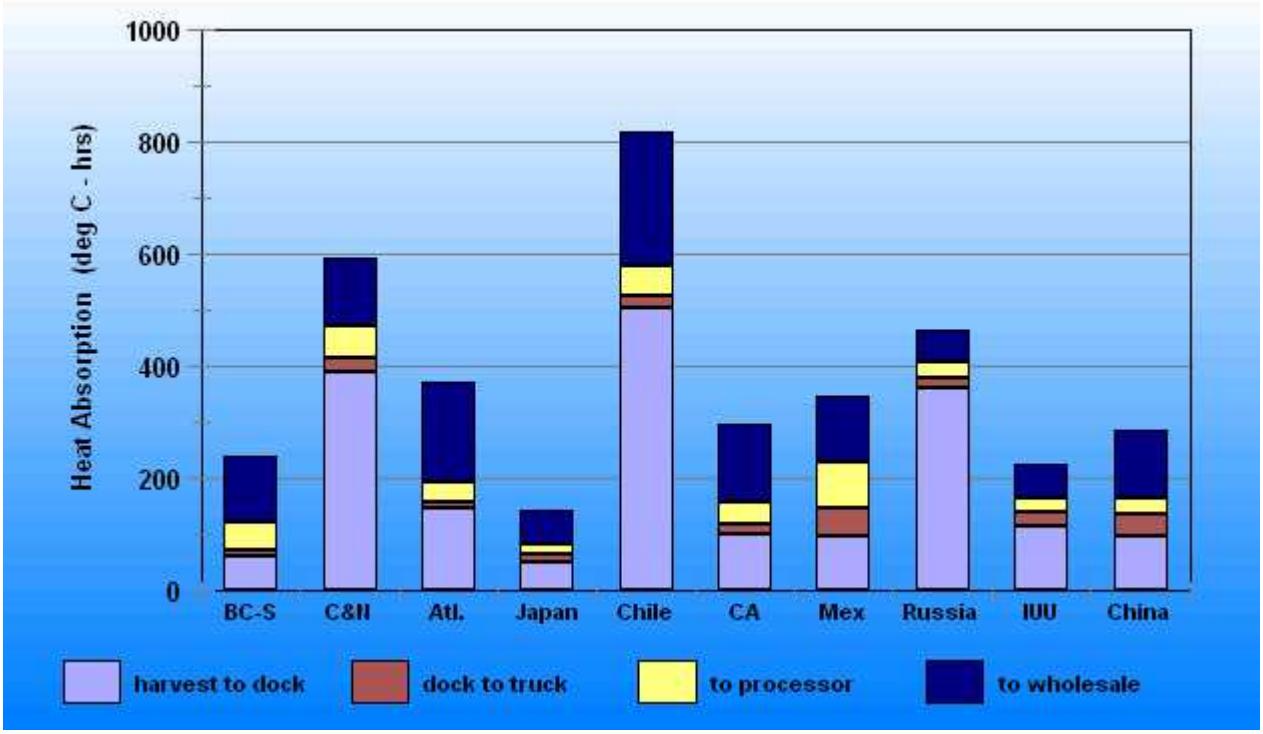


Figure 4-2: Accumulated Heat Absorption estimates (by interval) in select urchin fisheries.

Chile's southern fisheries rank lower because of the remoteness of the operations. The greatest contribution to, and the variation within, this interval is attributed to the at-sea transport of the live urchins to the dock. BC, and presumably Chilean, packers are not equipped with refrigeration at this point and ambient heat warms the urchins while they are in transit, especially on longer runs.

3.3 Marketing

Marketing's aim is to create genuine customer value by offering superior solutions - using the touchstones of quality, service and price, to establish and support a mutually beneficial long-term relationship with its customers. Marketing has long been recognized by companies as integral to business success but the same theme has only recently been picked up by countries and non-business entities. The international sea urchin trade is very competitive, perhaps because of the limited number of companies importing urchin products into Japan, and companies are reluctant to share market intelligence with others for fear of losing an edge. The Sea Urchins from Canada group has been working on a generic marketing initiative for the past three years and the companies involved have developed good working relationships. This initiative has been instrumental in bolstering trust and collaboration amongst companies in BC to the point where the industry now speaks with a single voice at international gatherings.

The Sea Urchin Harvesters Association of California (SUHAC) appears to be the only other group in the sea urchin industry to engage in any generic marketing activities for their product.

In both cases, the Associations are focussed on providing interested consumers, domestically and in Japan, with information on the fishery as opposed to highlighting any brands derived from the fishery. The latter functions remain the responsibility of the processing companies and their Japanese buyers. Some companies from the US have offices in Japan to support their product(s) but the size and number of these has not been determined. Information on similar joint actions in other producing nations could not be found.

3.3.1 Market Research

In 2003, the Sea Urchins from Canada group produced a comprehensive sea urchin market study with funding assistance from AAFC's Agri-Food Trade Program. This study formed the basis for an on-going CAFI-supported Sea Urchin Marketing initiative focussed primarily on Japan, but also including an exploration of European, Chinese and other opportunities. Alaska is the only other confirmed jurisdiction undertaking a market study of Japan, but given the generally progressive stance of SUHAC, it is probably safe to assume California produces relevant market research on an on-going basis. No evidence of Sea Urchin market research was found from other jurisdictions.

3.3.2 Market Development

The market for sea urchin products is growing around the world as the popularity of Japanese food increases. However, Japan, accounting for about 75-80% of total consumption, remains the world's pre-eminent market for these products. The market in France is marginally larger than the US market but currently both are more or less supplied domestically. Domestic sales now represent about 30% of the sales volume and 45% of the sales value for the California fishery. California reserves the majority of its highest grade product for domestic use and generally restricts exports to less-than-premium grades. In Canada, domestic sales account for about 10% of both volumes and revenues. Not all plants are willing to serve this market because they find small orders of little interest.

3.3.3 Product Forms and Product Development

The highest value form in Japan is trays but many suppliers have trouble satisfying the stringent Japanese grading and packing standards and a large proportion of the uni sold on trays in Japan is imported in bulk and then re-graded and re-packed by Japanese companies. The balance between production levels and product quality struck by each fishery influences its economic performance and, because they all sell into Japan, standardized market pricing calibrates quality comparisons between them. Each country supplies a fairly unique combination of products to Japan (Figure 5-1), but these forms are more or less defined by tradition. Opportunities to develop and sell new, innovative sea urchin products are limited . New product forms, and sometimes new suppliers, are viewed with considerable suspicion.

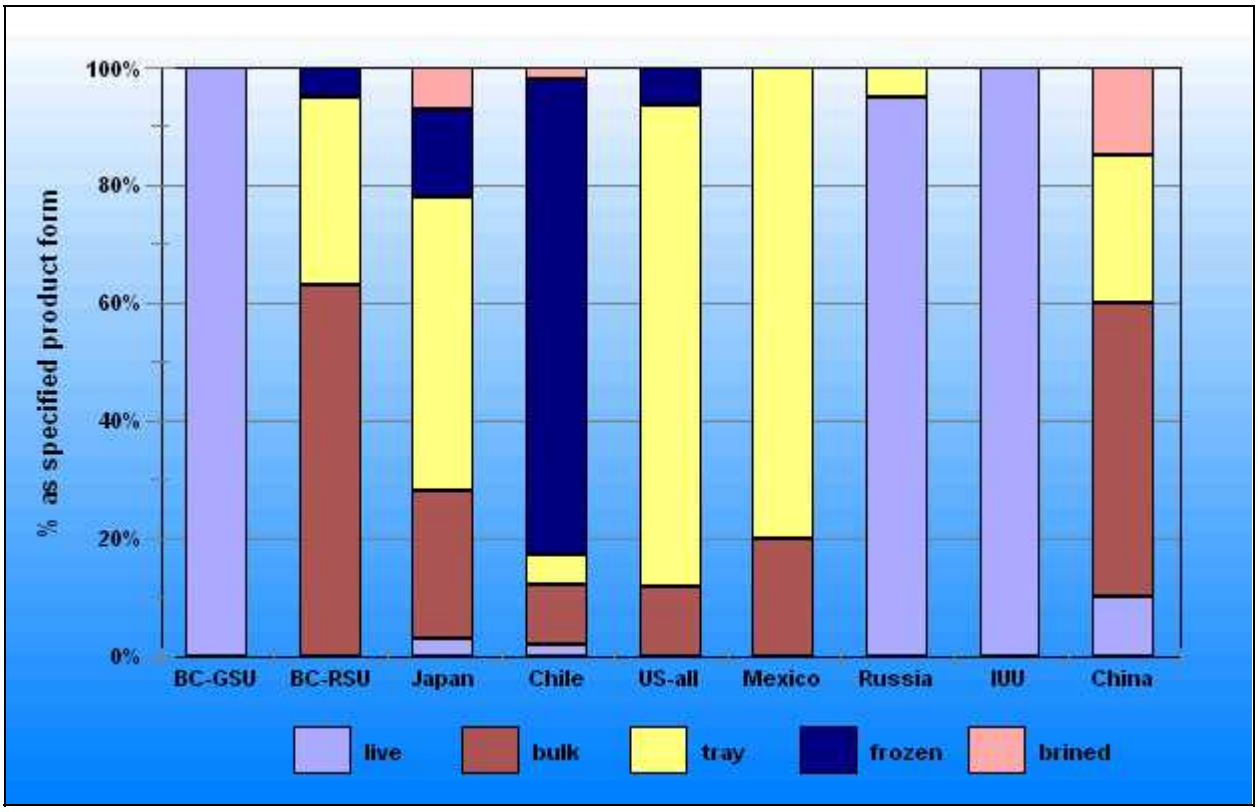


Figure 5-1: Product profiles for various sea urchin fisheries.

3.3.4 Pricing

The prices paid in Japan for California trays are higher than those paid for Canadian product according to the import (wholesale) values collected by the Japanese government (Figure 5-2). California producers generally limit their production to trays, the most valuable product form, while Canadian sales include less valuable bulk packs. 95% of the sales volume and about 98% of the sales value of California product reside with the trays, vs. a little over 30% in each case respectively in BC. California targets the restaurant trade in Japan, whereas Canadian uni is primarily retailed through supermarkets and department stores.

The prices for fresh, live and brine-canned products from Canada lie in the top tier of all the imports to Japan but the price for frozen material, at just over $C6.00/kg, is right at the bottom. The US and Chile receive almost 3 and 4 times that amount respectively, so there would seem to be considerable upside potential in this regard. To be fair, the price difference is due in no small part to the fact that the product frozen in other jurisdictions is a full cross-section of the material obtained by their fishery while in Canada it is more accurately typified as simply unfit for use in bulk packs or trays. Frozen product dominates the product mix from Chile, representing 81% and 67% of the production volume and value respectively. Frozen product from Chile is first steamed to provide additional protection from a complete melt-down as it thaws.

The majority of the harvest from the Maritimes is shipped live to processors in Maine which

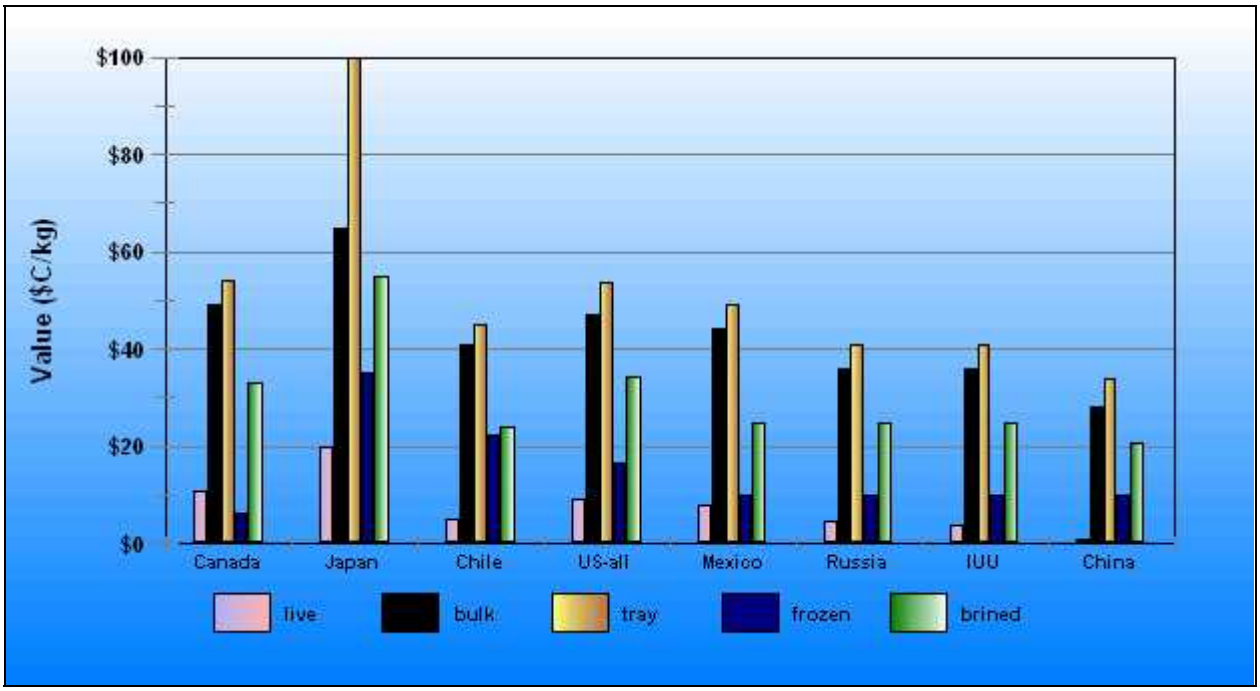


Figure 5-2: Wholesale prices for sea urchin products from various suppliers to Japan.

then process and export it, again primarily to Japan. The Russian harvest is likewise shipped live for processing in Hokkaido. This was the prime market for Canadian green sea urchins until just a few years ago, but demand for Canadian GSU has virtually collapsed because the Russian IUU volumes available eclipse those from Canada while CIF prices are much lower.

A buyers market for sea urchin products prevails in Japan at this point almost entirely because of the Russian IUU fishery. This fishery is strictly supply driven and is pushing so much product onto the market that suppliers have very limited leverage on prices. Canada is further disadvantaged at this time by currency movements which over the past few years have seen the Canadian dollar appreciate by over 30% against the US dollar and the Japanese yen, putting extra pressure on margins. There is little relief on the horizon in either regard.

3.3.4.1 Unit Value Estimate

The Unit Value Estimate (UVE) is proposed to index the value of each kilogram of sea urchin landed as a measure of the resource utilization efficiency. The UVE is generated by multiplying the volume % for each product with its respective wholesale price and totalling the results for all products to obtain a single estimated value for each kilogram of sea urchin harvested. In this case, the volume proportions and wholesale prices for the product forms are from Japan's import data provided by the Canadian Embassy in Tokyo. For a simple example with the Canadian Maritimes, multiplying the live production and bulk volume proportions (95% and 5% respectively) with their respective prices ($C 1.32/kg and $C 49.08/kg) and realized recoveries (100% and 8%) yields $1.254/kg and $ 0.196/kg which add up to a UVE of $C 1.45/ kg.

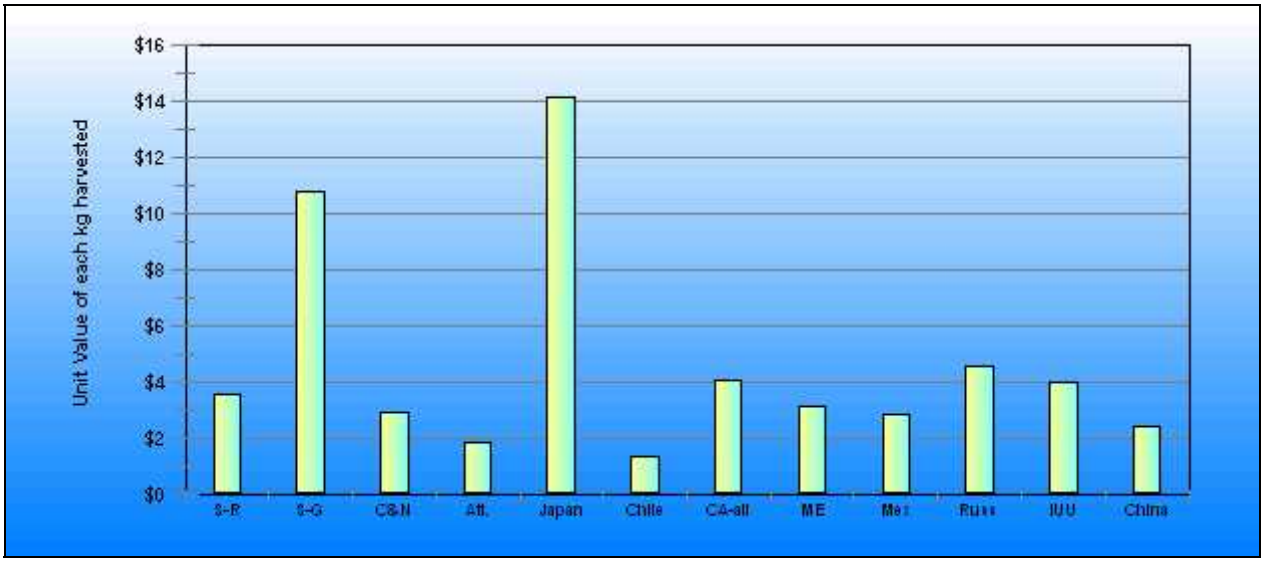


Figure 5-3: UVE for each kg of sea urchin harvested in the various fisheries.

The $C 14.16/kg value registered by Japan (Figure 5-3) is higher than the others because consumers trust and are willing to support domestic producers, and their way of life, with higher prices, much the same as they pay extra to support Japanese rice farmers. BC's Green Sea Urchin fishery comes in second while the legitimate and IUU Russian fisheries follow in 3rd and 5th position respectively. Interestingly all urchins from the latter three fisheries are processed in Japan. The achievement of the BC GSU fishery is tempered by the fact that only 45% of the TAC, or about 103.4 MT, was landed in 2004/05. The proportion of the TAC fished declined further to below 20% during the 2005/06 season, again highlighting the devastating impact of the Russian IUU fishery on this otherwise model fishery.

The California fisheries, with a UVE of $C 4.06/kg, come in 4th while BC's South and North Coast RSU fisheries come in 7th and 9th respectively. The South Coast RSU fishery, with an UVE of $3.53 /kg., comes in higher than the $2.91/kg UVE registered by the North Coast fishery primarily because most of the South Coast fishing occurs when demand and prices are higher but also because the recoveries from the South Coast are marginally higher. The Maritimes fishery comes in 13th with a UVE of $C 1.45/ kg because the product is shipped live to the US at the landed price of about $C 0.70 per lb. and there is no Japanese price to apply. Chile comes in 14th with a UVE of $C 1.35/kg, primarily a reflection of prices for frozen product which are generally less than about 50% of the fresh prices.

3.3.4.2 Gross Value (GV) Estimate

Multiplying the UVE by the production from each fishery provides an estimate of the overall value of each fishery. Unsurprisingly, the rank order of the countries changes so that, for example, whereas Chile ranks 14th on the AUV index it ranks 2nd on the GV index because of the volumes produced in the fishery. Japan retains the top spot in both because of the relatively high production volumes and the very high prices. The North and South Coast fisheries in BC came in at 7th and 11th, reversing their order which again reflects the volumes landed in each.

3.3.5 Promotion/Advertising/Communication

The Sea Urchins from Canada group has participated in the Brussels Sea Food Show for the past two years and in a joint promotional campaign with a Japanese company at the Tokyo Seafood Show. These efforts are being expanded as part of the ongoing CAFI project and will now also include additional promotions in supermarkets in Tokyo. Uni from a Chilean company was similarly promoted but again, this was a company-based effort as opposed to national initiative. No evidence of promotions by other jurisdictions has been found.

Establishing a dialogue with customers is increasingly recognized as an essential element of effective marketing. Customer-initiated communications are especially empowering but there are as yet no means for direct communication between Japanese consumers, our ultimate customer, and Canadian industry. Brochures, videos and a fairly elaborate website provide the public with opportunities, in English and Japanese, to explore the BC industry. The website is regularly updated to include additional product, fishing and promotional information to consumers and more advanced communication capabilities through the website are planned. SUHAC was the only other association found with even the basic information services.

3.3.6 Product Differentiation

The values presented in the Product Differentiation are derived from literature sources and discussions with industry representatives in Japan and Canada. The Reputation Elements use the Code 1 system to characterize contributing elements. BC's urchin products industry is perceived to operate a sustainable fishery in a clean environment (pristine waters) to produce a hygienic, good tasting product with a demonstrated dedication to high quality, honesty etc (Figure 6-1). However our scores on innovation and grading consistency and perhaps on the perceived value score, are weaker.

A "reputation index" for the various suppliers is created by summing the values of the various elements. Japanese suppliers have the best ranked reputation while US West Coast ranks marginally better than BC although it is probably more realistic to say the fisheries in the US, Canada and Mexico are equally ranked behind Japan. Chile comes in just below this group, running into problems with taste, innovation, grading consistency and most tangibly with sustainability. The reputations of Russia and China are ranked lowest although they and Chile are perceived as good value because of the low prices.

A previous survey commissioned by Agriculture and Agri-Food Canada on Japanese consumers identified "product management and quality" as the primary reason behind consumer perceptions of superior agricultural and fisheries products. This was found to be twice as influential as next most important factor which is in fact the Standards, Regulations and Quality Control regime. Canada's system was found a bit wanting in the former, but this was attributed to a general lack of familiarity with Canadian food suppliers.

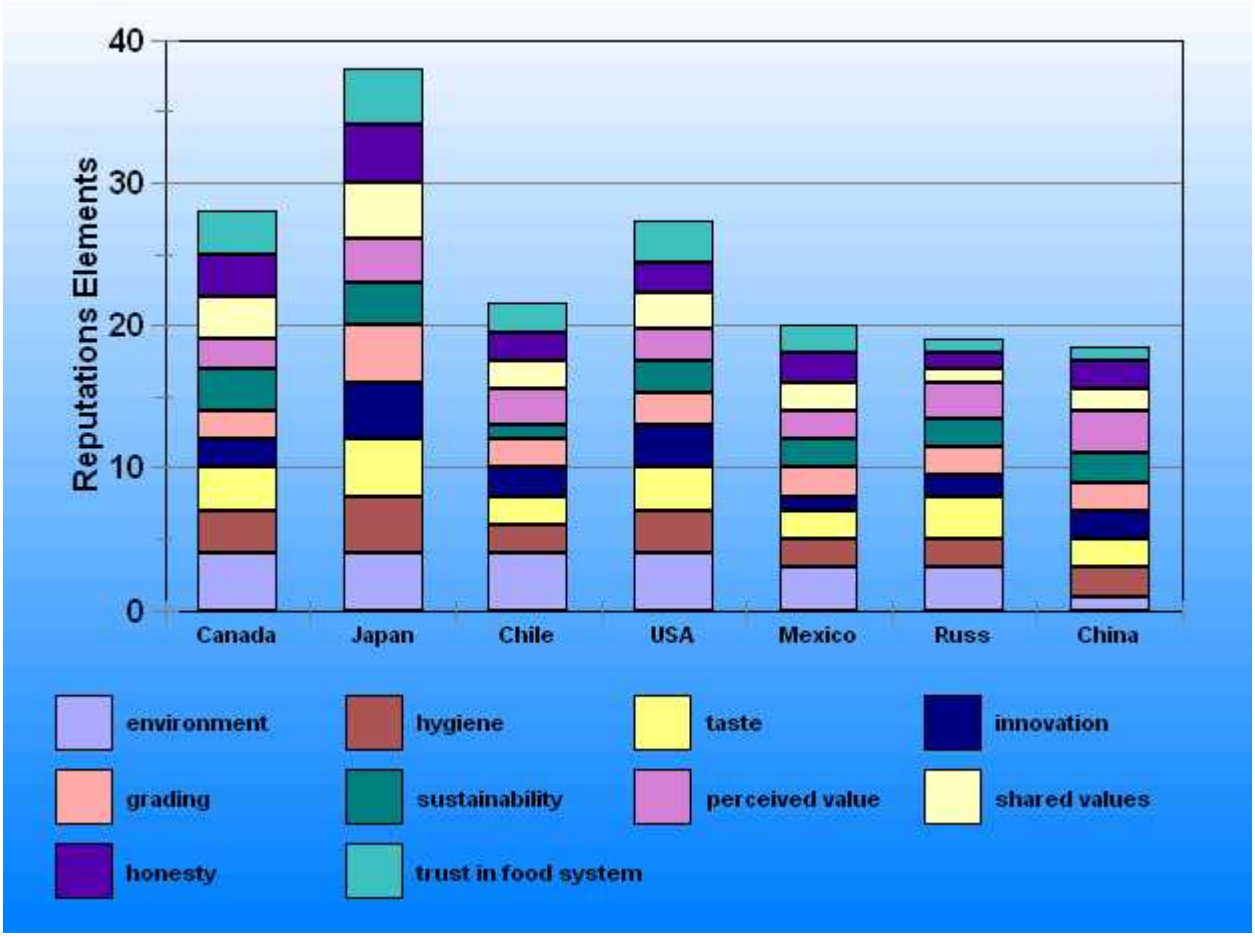


Figure 6-1: Reputation elements in Japan for various nations supplying sea urchin products

3.3.7 Retail Packaging

Companies generally win by building and profiting from a relevant competitive advantage but in today's dynamic market, technical features can be quickly copied. A more successful and lasting strategy works on building a relationship with the consumer which is based on trust and familiarity. Canada and Japan are both lively advanced democracies with similar foreign policy values and views of the world, including common positions on promoting multilateral actions and institutions, human security, global environmental treaties and human rights. These present a foundation upon which to identify common ground and perhaps become better known to one another as friends. These similarities have not, however, raised Canada's profile and recognition by consumers as a significant supplier of high quality food in Japan.

Gaining recognition from consumers comes in no small part from presenting a memorable identity on the store shelf. Even with that, the modern reality is that many people now base their purchases almost solely on price and often do not carefully inspect labels for details that might otherwise interest them. Labels must now identify the source country as part of new traceability regulations, but this information is often fairly discreet on generic packaging. BC producers are not making a very big impression on consumers through packaging in part because the product's

Canadian origin on the package as sold in Japan is understated. Only about 35% of the Canadian uni is packaged in the final retail pack by a primary processor in Canada (Figure 6-2) while in the majority of cases it is added as part of the secondary re-packing operation. This presents most of the Canadian product in a generic package which is categorized as commoditized uni in the mind of the consumer, albeit perhaps as an alternative to the assumed sector leader for this particular product.

This contrasts with the situation in California where more of the uni remains on the original trays and the processors retain much more complete control of the final design elements. California producers also target sushi restaurants where the chefs may identify the California uni as a characteristic of the restaurant so the branded source effectively lends prestige to the outlets handling them. Independent promotions from credible sources, such as respected sushi chefs, provide additional support for the image of California uni as a unique and trusted brand.

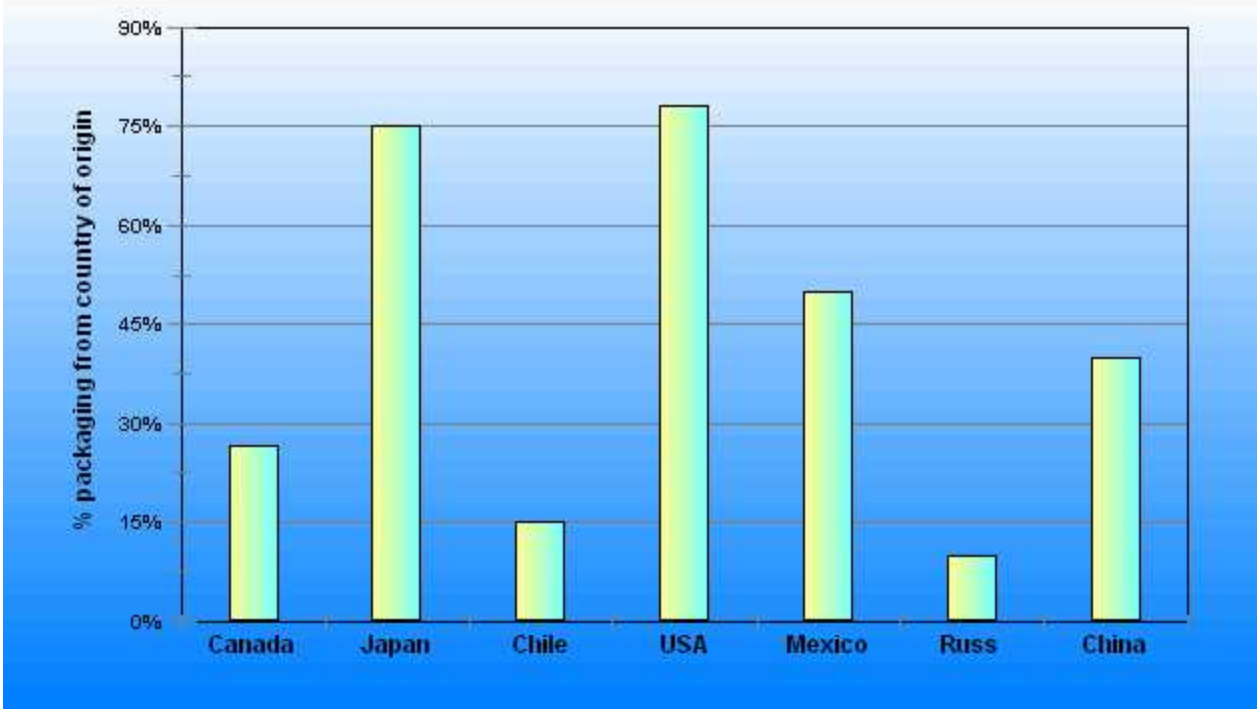


Figure 6-2: Proportion of retail packaging applied by primary processor in source country.

3.4 Administration

3.4.1 Human Resources

3.4.1.1 Country Demographics

All the countries in the developed world are facing personnel and/or skills shortage issues. Japan's population is now declining and its workforce is projected to shrink by 16% over the next 25 years. In the seafood sector, companies have been reporting difficulties recruiting

younger staff and have been using migrant workers from China for some years now. In Russia, the situation seems to be hinging more on decreasing life expectancies, particularly for men, and the Russian population is likewise expected to decline over the next few decades.

In Canada and the US, the situation is similar but populations are not expected to fall because of immigration from areas like Chile and Mexico where the populations are still young and growing. The continuing availability of workers for the processing and harvesting industries, including skilled and highly trained process technicians, vessel officers and engineers is, however, a concern because training programs have only recently started expanding in response to the imminent retirement of the baby boomers. The approach of the Canadian government of increasingly limiting immigration to highly skilled and educated people is also impacting the pool of less skilled workers, particularly in the processing sector. Current staff are getting older and there seems to be a rising shortage of younger people willing to work in these positions, much as has been the case in Japan.

3.4.1.2 Harvest Personnel and Skills

The pool of active urchin fishermen is for the most part generally assumed to parallel the size of the urchin fishery in each nation. This is taken to the extreme in Chile, where the number of participants dilutes the income to the extent that the economic stake for the individual in the fishery is very small. The sea urchin fishery workforce in Chile is estimated to comprise about 7,500 divers, 1,200 skippers and another 1,500 crewmen working on 1,200 dive boats with perhaps another 100 men working on 35 packers. Working this back through the total harvest, this yields a rough productivity estimate of about 4.9 MT of urchins over the season, worth about $C 865.00 before expenses, for each fisherman in the fishery.

The sea urchin workforce in Japan is the next largest, although in this case the estimate is quite rough. Using the assumptions that about 250 Fishery Production Associations have urchin operations in Japan, and that each of these has a team of four to take care of the urchin fisheries, there will be about 1,000 urchin fishers in Japan. Working this back through to the annual harvest provides an annual per-fisher productivity measure of 13 MT, which in turn implies 65 harvest days per fisher (@ 200 kg./day). Additional time is dedicated to site preparation and premium urchin handling protocols to support the high prices accorded to the Japanese product.

There are increasing reports of difficulties in finding divers in the BC's urchin fisheries. The reasons reported include the work is too difficult and/or does not pay enough, WCB certification requirements are a barrier and/or isolation from friends and family, particularly on the C&N RSU fishery, makes other jobs look more attractive. A diver can make about the same wage on an annual basis working at a more local job and not have to spend 60 - 90 days at a time living on a small boat.

BC's South Coast fishery is similar to the fisheries in the Maritimes and California in that they all yield about 14 - 15 MT per person-year. The unit catch index for the North and Central Coast fishery is significantly higher at about 33.5 MT per person-year allowing the provision of what are only fair compensation levels when the remoteness and other associated hardships are

considered. The urchin fisheries in California do not involve the same degree of isolation but as permit owners approach retirement in California, there is no way for them to transfer their permits or apprentice new operators to take over their business. This issue is now a priority with the industry in California.

All maritime industries in BC are facing a shortage of qualified vessel operators. This is a consequence of the imminent retirement of baby boomers, and the limited opportunities that have been available in fisheries over the past 15 years since difficulties in the salmon fishery precipitated an exodus of workers from the industry. The urchin fishery in Maine has been declining over the past 10 years or so, so while there may be more fishermen looking for something to keep them busy, many of them are also likely moving along to different industries, resulting in a dwindling pool of qualified talent.

3.4.1.3 Processing and Skills

In Canada, the critical processing skill requirement focuses on the graders and packers needed to put together trays to the standards required by the Japanese market. The amount of BC product shipped as bulk clearly shows that there is a shortage of people who can meet those requirements. This is most apparent in Northern BC where at least one attempt to develop processing capacity was made, but local labour expectations and low productivity made the prospect uneconomic.

The availability of graders and packers is not as critical in California where companies have access to a larger Asian community and skilled grading and packing staff are more plentiful. It is, however, projected as an issue in Alaska, China and Chile. In the latter case the packing skills are not as important because the vast majority of their production is graded (by colour, size etc as with trays), vacuum packed and frozen. Process managers are required to assure smooth running in all plants and, in Chile's case, the need for skilled and well trained refrigeration technicians etc. is likely ongoing.

3.4.2 Overhead and Capitalization

The number of processors varies from an estimated high of about 100 in Japan to a more typical 7- 12 range in most other locales. In Japan's case, each processor would have an average capacity of about 130 MT of green weight (live) urchins per year while at the other end of the scale in Chile, where the estimated number of processors is 25, the average capacity is about 2,500 MT per year. In BC the respective numbers and capacities are 9 and 496 MT while in California they are 8 and 908 MT.

Assessing the capitalization and overhead levels is complicated by the structural differences in the various industries. For example, urchin fisheries in Japan are a small part of a constellation of fishing activities, which may include crab, scallop, abalone and clam capture and culture, sea weed, groundfish, etc., sharing the same harbour, harvest and processing facilities and equipment. Processing facilities range from numerous dedicated and small urchin processors,

some of which serve individual restaurants, to large vertically integrated players which pull in any number of products from domestic and import suppliers. In Chile, the harvesting depends on artisanal fishers but the processing facilities are more generally characterized as very large and diversified industrial complexes. In Canada, many fishermen and processors are active in two, three or more other fisheries while others are totally dependent on urchins. In short, the complexities of developing meaningful and comparable pro-rated estimates of the capital dedicated to the urchin industry in each country are substantial.

4.0 Conclusions and Recommendations

The ratings for the sea urchin fisheries in British Columbia, California, Japan, Chile and the IUU fishery in the Kuriles for each of the assigned benchmarks are summarized in Table 2.

BC's sea urchin fisheries are generally well managed from a biological sustainability perspective and Canada's resource management regime appears to be effective and fairly cost efficient in relation to other sea urchin fisheries around the world. The fisheries in BC, like those in California and Japan, are co-managed by government and industry and the precautionary stance taken by Fisheries and Oceans Canada, strongly supported by industry, virtually assures the fishery as it is currently prosecuted will remain environmentally sustainable.

From the business side, the competitiveness of the industry also compares favourably with other legitimate sea urchin fisheries around the world, including those from California and Japan which are seen as the sector leaders. Japan represents the largest single market for seafood in the world and remains the focus of the world's sea urchin production industries, BC's included. Japanese consumers have consistently demonstrated a willingness to support attractive prices for superior quality products. However, the fact that average uni prices have been in general decline for the past few years and that virtually all suppliers in that market are having problems is signalling that something is not as it should be.

In fact, a buyers market for sea urchin products prevails in Japan at this point because the Russian IUU fishery is pushing so many urchins onto the market that suppliers have very limited leverage on prices. Reports from Japan consistently highlight the deleterious impact of landing 300 - 350 MT from this fishery each week on the Japanese market. Demand and prices rebound when no Russian packers from the Kuriles are in port, but as soon as another load is reported, prices, and orders, for legitimate supplies wither.

This fishery produces a very highly regarded product, albeit generally with low recoveries, at prices that others just cannot match because most of the costs responsible operators assume are simply avoided. It operates with virtually no restraints from either the Russian or Japanese governments in defiance of any environmental sustainability, human safety or economic parity principles. This is leading some to question the integrity of the systems these governments have in place and their real commitment to the political assumptions underlying the international trading system. This situation is putting undue pressure on other suppliers, jeopardizing legitimate urchin fisheries around the world, including Japan's, and threatening their viability as environmentally and economically responsible enterprises.

Table 2: Benchmark rankings for sea urchin fisheries in this study.

		Ratings				
Government Policies		BC	CA	Japan	Chile	IUU
	Resource Sustainability	4	2	3	1	n/a
	Resource Management	3	3	4	1	n/a
Operations						
	Management	2	2	3	1	n/a
	Input Costs	2	2	2	3	4
	Harvesting	3	3	2	1	4
	Post-harvest handling	2	3	4	1	3
	Handling impacts R&D	2	2	2	1	n/a
	Processing	2	3	3	2	n/a
	Logistics/transportation	2	3	3	2	3
	Quality	2	3	4	2	3
	Continuity of supply	2	3	3	2	2
Marketing						
	Market research	3	2	3	1	n/a
	Product development	2	2	2	1	n/a
	Pricing	2	2	2	2	4
	Promotion/advertising	2	2	2	1	n/a
	Market development	2	2	2	2	n/a
	Selling methods	2	2	2	2	n/a
	Customer service	2	3	4	1	n/a
	Access	2	3	4	2	n/a
	Packaging	2	3	4	2	n/a
Administration						
	Human resources (harv'g)	3	3	2	2	3
	Human resources (proc'g)	3	3	2	2	n/a
	Overhead	2	2	2	3	4
	Capitalization	2	2	3	3	3
Rating Codes: 0 = very low; 1 = inferior ; 2 = mid-range (acceptable); 3 = superior; 4 = very high						

The IUU fishing has been continuing unabated for the past 3-4 years despite widespread expectations that the stocks would have crashed, eliminating the fishery as a factor in the market, some years ago. A characterization of this fishery developed as part of this project suggests that its collapse may not be as imminent as hoped. The urchins targeted by this fishery, *Strongylocentrotus intermedius*, reach a harvestable size (TD = 40 mm.) after only 2-3 years, as opposed to the 6 - 8 years expected in most other sea urchin fisheries. Combining this high growth rate with the high natural productivity in the area, the rich sources of larvae from the east and north coasts of Honshu and the south coast of Hokkaido and the ongoing removals of other 'predatory' species from the area may effectively counter the otherwise unsustainable urchin removals, allowing it to continue indefinitely.

Recommendation: The Government of Canada continue insisting Russia and Japan get this situation under control, reminding them of their obligations to support sustainable fishing and fair trading practices as part of the international trading system. Trust is a key element underlying our willingness to trade and we all benefit by using these resources sustainably. Russia is apparently acting to increase transparency and reduce the influence of

crime in the fishing industry, but Japan's continuing acquiescence to this situation can only inhibit the process. This issue is of such critical importance to the industry that the other recommendations in this report will remain largely academic until the IUU fishery is brought under control.

The IUU fishery is impacting the live market for BC's GSU fishery particularly hard and demand for the product has evaporated. Hokkaido processors are purchasing IUU sea urchins to the exclusion of BC's GSU's and the resource is now seriously underutilized. Sales of processed East Coast GSU products continue to support harvesters in that region but British Columbia does not process GSU. The result of this is that, through no fault of their own, GSU harvesters cannot sell their production at all and RSU producers have seen prices and demand limited by the IUU production. In this light, the ruling by Fisheries and Oceans Canada that harvesters risk losing their licences if they do not pay their licence fees each year is not equitable.

Recommendation: Fisheries and Oceans Canada set aside, without penalty, the requirement to pay the annual sea urchin harvest licence fees for unused licences until the IUU issues are resolved or market prospects otherwise see improvement.

Recommendation: Industry and Government work together to establish a Green Sea Urchin processing capacity in the Province.

BC's urchin products industry has demonstrated its ability to grow and thrive in a challenging business environment. As noted in Table 2 above, its performance is generally rated as acceptable in all the benchmark categories although there is room for improvement. In many cases, California and Japan realize better outcomes in the operations category simply as a matter of circumstance because their fishing areas are more easily accessible. The operational performances of both the Red and Green sea urchin fisheries on the South coast compare very favourably with the California fishery but complications imposed by the remoteness of the North Coast fishery mean extra measures are required to simply get the same results as the others.

Defining exactly what measures are most appropriate remains a problem because of shortcomings in the metrics available to evaluate the effect(s) changes may be having on the quality outcomes. There are no empirical data charting the quality transitions of urchins held under different conditions and therefore no means to objectively and systematically assess the impacts of various factors and/or practices. Basically the problem is that "if you can't measure something, you can't manage it".

The issue revolves primarily around ambiguity in the measures of quality used in the fishery, whether it be recoveries, colour or taste etc., and how these are influenced by handling, geographic and/or seasonal variables. The criteria used by the processors are characterized as unreliable and/or inconsistent as regards objective guidance or advice by fishermen.

Recommendation to industry: initiate a program to develop and adopt standardized methodologies to collect and categorize objective information on the product quality. Suggested elements of this program include:

1. completing a study profiling the water loss rates from urchins to develop coefficients correlating the water content of the urchin to the amount of time it has been out of water. A series of these studies will be required as the rates may vary with the maturity of the gonad and the temperature(s) the urchins are held at.

2. developing a standardized methodology for calculating product recovery based on fully drained weight, and which incorporates the above water loss coefficients, so recoveries obtained in different situations and locations are comparable;

3. developing standardized 'reference' criteria for product colour, texture and perhaps taste so product quality criteria obtained in different situations and locations are comparable. Software systems which provide numeric breakouts of the contributions from component colours in digital photos are common and reference cards could be used to ensure consistent application of the colour and texture criteria in the field.

4. collecting and archiving temperature profiles of sea urchins in transit from the fishing grounds right through to wholesale distribution. Preliminary temperature profiling studies on packers suggest the urchins warm up in the holds to the point where quality impacts are likely. This issue should be first investigated using temperature loggers placed with sea urchin loads in the holds and/or on the decks of the packers throughout 2006/07 season.

Recommendation for industry: Once these methodologies are in place, studies to assess handling impacts and product quality from various areas and at different times of the year should be initiated. The methodologies must come first so the studies can be conducted with some assurance that the analyses and conclusions are based on common reference points. Variables such as transit times, season, harvest location, Accumulated Heat Absorption (° C -hours), in-water vs. out-of water holding, maximum post-harvest holding temperature, etc. can then be objectively assessed for their impact(s) on any of the defined quality criteria. The benefits might include objective assessments of the effects of different handling options on quality leading to reduced quality impacts, higher realized recoveries and higher prices. These studies, for example, are recommended to evaluate the effect of refrigeration in the packing fleet on product quality using pilot scale studies before committing significant investment into the systems.

A systematic program to collect and accumulate this data in a relational data base, where it can, for example, be cross-referenced by subarea and date, will provide a whole new dimension for evaluating investments and allow better use of the resources based on equipment availability, seasonal quality and weather-related accessibility trends. This sort of data will be needed to optimize the harvest schedule and track changes that might be occurring because of changing oceanographic conditions. It is possible that the BC coast could see some exposed areas fished in summer months when conditions are more predictable, to say nothing of more pleasant.

One of the larger problems facing BC's RSU fishery is the inconsistent product availability, even when only considering in-season periods. The main problem is related to weather-related harvest interruptions on exposed fishing areas on the North and Central Coast and the West Coast of Vancouver Island. This is particularly evident after Christmas when most of the South Coast

quota is gone. Canadian processors remain focussed on the fresh and tray markets as the best use for the product and therefore remain dependent on the fresh market to absorb all production before it spoils. This reduces the flexibility available to the industry and may be unnecessarily limiting fishing opportunities in the winter when the fleet must be able to 'make hay while the sun shines' to fully access the quotas.

Processors in BC feel the price impact from freezing is so severe that it can only be rationally considered when there are no other options available. However, the application of appropriate freezing for some North Coast product as an interim measure could provide a net benefit to the industry as worries about spoilage of unsold product disappear. This would allow harvest operations to proceed at full speed whenever weather permits instead of being limited because of the market's inability to absorb fresh product fast enough. It is worth keeping in mind that between 500 - 1,000 MT of the RSU TAC has been left in the water for the past couple years for this very reason. Frozen product could also be held over for the summer market to maintain a presence in Japan throughout to sustain consumer loyalty, at least until specialized niche fishing in the summer develops further.

In the short term, it may make sense to limit fishing on the South Coast whenever the northern fishing is not held back by weather. This will effectively extend the season in the South meaning BC product can still be available when the weather shuts down the north. Over the longer term, establishing a system to inventory live urchins at an interim holding facility where they can be accessed when regular harvest operations cannot should be considered.

Recommendation to industry: Fishermen start estimating and recording fishing opportunities sacrificed (in pounds/kilograms) on the North and Central Coast due to harvest limits from processors. These records should include an indication of whether the South Coast is or is not active. This will permit more objective evaluations of the potentials of South Coast restraint and freezing as options to get more product into the market.

Recommendation to industry: Processors partition some higher grade product for freezing tests to evaluate market reception, costs, operational requirements and constraints, including price issues with harvesters for partitioned product.

There have been some comments that limiting the number of open areas on the North and Central Coast too much concentrates the fleet and limits the fleet's flexibility to take advantage of local weather conditions. When the whole northern fleet is in a single area, the boats work in a more concentrated fashion and the good areas are just fished out that much faster. This means that some vessels fish marginal quality, because that is all they have to work with, and the fleet tends to move along more quickly even though they might be missing or even abandoning a number of limited spots with good product, in effect unnecessarily increasing costs. These compound the difficulties fishermen face because of escalating fuel costs and the rising Canadian dollar and reduce the net benefits realized from the fishery. The adoption of Electronic Vessel Monitoring (EVM) technologies have the potential to provide substantial cost savings while still ensuring the fishery is controlled. PUHA and D&D Pacific Fisheries Ltd. are piloting the technology on a single RSU dive vessel on the Pacific Coast to get a better idea of its costs and capabilities. That report should be ready for general review at the end of this season.

Recommendation: Assuming successful completion of the pilot study, industry and DFO should accelerate the process which will allow industry and government to realize the full benefits from the adoption of satellite-based EVM systems as soon as practicable. The fishing associations and DFO are looking for cost savings wherever possible.

Buyers and consumers from around the world expect, and are increasingly demanding, consistency, innovation, sustainability, and traceability at competitive prices from their food suppliers. Uni is a traditional product in Japan and presenting it to quality conscious Japanese consumers as a differentiated product requires a completely honest appraisal process to retain that most valuable of supplier attributes, credibility. The key steps in marketing are determining what the customer wants, providing it to them and then letting them know that you can and are providing it. This is the another reason to develop the objective metrics outlined above: they are potentially a powerful marketing tool providing buyers with assurances that they are getting exactly what they want. The idea is that once the program is established, purchases can be traced over the internet and investigated by lot number, providing buyers, including consumers, with a tool that can become a defining feature of the product in and of itself.

The Sea Urchins from Canada group is still developing the infrastructure to support this process and has introduced some of the ideas to buyers in Japan. The buyers expressed approval, providing some encouragement that this path is worth pursuing. The dialogue between the harvesters, processors and Japanese buyers has moved beyond the preliminary stage and all parties are considering what they can contribute to a growing list of marketing initiatives. The Group is currently working with Japanese buyers on joint promotions in Japan in July at the Tokyo Seafood Show and later in August in some Tokyo supermarkets before the start of next year's season.

Recommendation to Government: Continued CAFI funding for the Sea Urchins From Canada Marketing program is critical and the proposal submitted for the 2006/07 and 2007/08 seasons should be provided full and fair consideration. The program has established a solid foundation for continuing progress but government support is required if industry is to maintain a credible presence as a marketing partner in Japan.

Appendix A: Detailed Comparison Tables

Table 1:		Canada		Japan	Chile	USA				Mexico	Russia		China
Resource Management		BC	Atlantic			California		Alaska	Maine		Regulated	IUU	
						South	North						
Financing source		licence owners		FCA's	gov't	harvesters	harvesters	harvesters	harvesters	gov't	gov't	Mafia(?)	gov't
Government involvement		collabab. with industr		assisting	nominal	collab.	collab.	collab.	collab.	nominal	dominant	none	dominant
Management tools													
	Closures (spawning or otherwise)	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0	0.5
	days fishing 'closed'	120	120	150	210	125	125	0	270	120	150	0	150
	Minimum Legal Size	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Fishing logs	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5
	Validation	0.5	0.5	0	0	0	0	0	0	0	0	0	0
	On-grounds monitoring	1	0	0	0	0	0	0	0	0	0	0	0
	Independent surveys/research	1	1	1	0.5	1	1	1	1	0	1	0	0
	Seeding	0	0	1	0	0	0	0	0	0	0	0	0
	Habitat enhancement	0	0	1	0	0	0	0	0	0	0	0	0
Management cost index		4	3	4.5	1.5	2.5	2.5	2	2.5	1.5	2.5	0.5	1.5
Access control method		IQ	varied	excl area	open to re	permit	permit	permit	permit	excl area	licence	nothing	licence
	Access control effectiveness (code 1)	4	4	4	1	4	2	4	1	2	3	0	3
Harvester accountability (code 1)		3	3	4	1	3	2	2	2	3	1	0	1
Management credibility/effectiveness (code 1)		3	3	3	1	3	2	2	2	2	2	0	2
Estimate harvest as % of Legal biomass		2%	3.5%	50%	150%	20%	30%	0%	30%	50%	10%	100%	50%
Sea Urchin Type (Red or Green equivalents)			GSU	GE	R/G E	RSU	RSU	RSU	GSU	RSU	GE	GE	GE
Est. age at legal size (years)		8	6	3	5	7	7	8	8	6	7	3	3	2
Current fishery sustainability (code 1)		4	4	3	1	3	2	2	1	2	2	1	2

Notes 1: Japan: 50-80% of harvest dependant on hatchery output Chile: data limited; low mngt. credibility; poor compliance
S. CA: fishing on annual recruitment causing concern Maine: harvest down significantly; transformed ecosystem from urchin abundance decline
N. California: declining production Mexico: ongoing enforcement and corruption concerns; FTA with Japan effective Apr 2005 China: aquaculture ready
RSU = Red Sea Urchin (S. fransiscanus) GSU = Green Sea U GE = Green Sea Urchin Equivalent R/G E = intermediate Red and Green Sea Urchin Equivalent

Table 2: Operations		Canada				Japan	Chile	USA				Mexico	Russia		China
		BC			Atlantic			California		Alaska	Maine		Regulated	IUU	
		South	South	C & N				South	North						
Landings		RSU	GSU	RSU	GSU	GE	R/GE	RSU	RSU	RSU	GSU	RSU&PSU	GE	GE	GE
	annual harvest (MT)	775	103	3,685	2,250	13,000	50,000	5,450	1,815	115	2,857	1,000	2,400	10,500	3,050
	Landed price ($C/lb)	$0.70	$1.70	$0.65	$0.70	$4.33	$0.08	$0.90	$0.80	$0.35	$0.60	$0.07	$0.32	$0.19	$0.07
	Landed price per kg of roe	$22.05	$26.78	$23.89	$19.29	$53.11	$3.70	$26.46	$27.14	$11.52	$16.54	$2.57	$8.82	$6.98	$1.72
	Estimated landed value (000's $C)	1,196	388	5,282	3,473	124,280	9,261	10,816	3,202	89	3,780	154	1,693	4,399	471
Harvest operations															
	% harvested by divers	100%	100%	100%	40%	35%	100%	100%	100%	100%	50%	100%	100%	100%	35%
	% harvested by trawl	0%	0%	0%	60%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%
	% harvested by other (dip nets etc)	0%	0%	0%	0%	65%	0%	0%	0%	0%	0%	0%	0%	0%	65%
	number of divers (harvesters) working	28	16	68	72	1,000	7,500	250	75	40	290	290	75	195	720
	estimated season length (days)	150	120	170	200	350	165	250	250	125	94	245	200	180	150
	Avg unit catch (kg/diver-working day)	750	325	1,000	315	250	50	300	300	600	350	100	500	900	250
	Max unit catch	3,000	750	3,500	900	350	125	400	500	2,000	550	150	800	1,200	500
	diver (harvester)-days req'd for catch	1,033	318	3,685	7,143	52,000	1,000,000	18,167	6,050	192	8,163	10,000	4,800	11,667	12,200
	# harvesters (divers) per boat	2	2	2	3	1	6	2	2	2	3	2	3	3	9
	# of harvest boat days required	517	159	1,843	2,381	52,000	160,000	10,900	3,227	96	2,512	4,138	1,600	3,889	1,356
	# of active boats	14	8	34	41	1,000	1,200	150	40	20	120	120	25	65	80
	# days fishing per boat	37	20	54	58	52	133	73	81	5	21	34	64	60	17
	total days incl. inactive/travel days	46	25	90	83	65	178	97	124	8	23	49	91	92	20
Processing average (MT/day estimated)		10	2	43	3	74	606	44	15	2	61	8	24	0	41
Management (Sectoral Coordination)															
	market projection period (days)	2	2	4	3	1	4	2.5	2	3	3	3	2	1	2
	Info feedback (to harvesters) (note 2)	1	1	1	2	3	1	2	2	1	1	2	2	2	1
	Harvest Order contents (note 3)	3	3	3	2	3	1	3	3	3	2	2	2	2	2
	Volume : quality selectivity (note 4)	3	3	2	1.5	4	1	3	3	3	1.5	2	2	2	2
Continuity of supply															
	Annual (season as % of full year)	41%	33%	47%	55%	100%	45%	68%	68%	34%	26%	67%	55%	49%	41%
	in-season (est. % days fishing)	80%	80%	60%	70%	80%	75%	75%	65%	60%	90%	70%	70%	65%	85%
	compound index for full year	33%	26%	28%	38%	80%	34%	51%	45%	21%	23%	47%	38%	32%	35%
	rank (1 = highest)	9	12	11	5	1	8	2	4	14	13	3	5	10	7
Harvest constraints (inferred)															
	Resource limits- biomass	5%	5%	0%	5%	10%	40%	15%	25%	5%	50%	25%	5%	25%	35%
	Resource limits- seasonaility	10%	10%	10%	15%	10%	15%	0%	15%	15%	15%	5%	15%	10%	0%
	harvest capacity/success	15%	5%	5%	20%	15%	10%	10%	10%	10%	15%	30%	25%	20%	20%
	weather	25%	25%	40%	25%	15%	20%	10%	20%	30%	10%	10%	25%	40%	10%
	market	35%	50%	30%	35%	50%	15%	50%	30%	35%	10%	20%	25%	5%	30%
	processing capacity	10%	5%	15%	0%	0%	0%	15%	0%	5%	0%	10%	5%	0%	5%
	production moderator req't index	1	1	4	3	1	2	1	2.5	4	2	2	2	1	2

Note 2: 0=none; 1= implicit; 2= frequent update; 3 = more explicit/frequent 4= complete

Note 3: 0= implicit volume and zero quality; 1= implicit volume and quality; 2= explicit volume and zero quality; 3=explicit volume and implicit quality; 4= explicit volume and quality

Note 4: 0 = all volume; 4 = all quality

Table 3: Input Costs (relative 'unit' index cost)			Canada				Japan	Chile	USA				Mexico	Russia		China
			BC			Atlantic			California		Alaska	Maine		Regulated	IUU	
			S-RSU	S-GSU	C & N				South	North						
Average Wage Rates (USD)			$18.47	$18.47	$18.47	$18.47	$20.49	$2.04	$21.83	$21.83	$21.83	$21.83	$1.68	$1.00	$1.00	$2.04
Index to US (incl. productivity corr'n factor)			0.85	0.85	0.85	0.85	0.94	0.14	1.00	1.00	1.00	1.00	0.15	0.07	0.07	0.16
Harvest																
	Fishing															
		Divers, harvesters and crew	3.38	4.39	2.54	3.36	1.88	1.78	4.83	4.67	3.75	3.52	1.01	0.29	0.22	0.34
		Boat cost index (code 1)	3	3	3	2	1	1	3	3	3	2	1	1	1	0.5
		Value & load factor corrected	1.50	2.31	1.13	1.06	1.00	0.80	3.00	2.67	1.88	0.88	1.03	0.50	0.28	0.06
		Remoteness index (code 1)	1.50	1.50	3.00	1.00	1.00	3.00	1.50	1.00	1.50	1.00	1.00	1.00	1.00	1.00
		Expenses	1.27	1.27	2.54	0.85	0.94	0.43	1.50	1.00	1.50	1.00	0.15	0.07	0.07	0.16
	Lease		1.00	0.50	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Landing																
	Packing req't index		1	0	3	1	1	2	1	0	0	0	0	1	2	0
	Packing cost index		0.85	0.00	2.54	0.85	0.94	0.29	1.00	0.00	0.00	0.00	0.00	0.07	0.13	0.00
	Unloading		0.85	0.85	0.85	0.85	0.94	0.14	1.00	1.00	1.00	1.00	0.15	0.07	0.94	0.16
	Validation		0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Processing																
	Transport to plant (code 1)		1.50	1.50	3.00	0.00	2.00	1.00	1.00	1.00	4.00	1.00	1.00	1.00	0.00	1.00
	Processing wage rate index		0.85	0.85	0.85	0.85	0.94	0.14	1.00	1.00	1.00	1.00	0.15	0.07	0.07	0.16
	Processing complexity corrector (*)		5.68	1.00	5.69	1.60	6.10	5.85	6.95	6.95	5.85	6.10	6.60	1.30	1.00	5.25
	Processing Wages (correction est.)		4.81	0.85	4.81	1.35	5.73	0.84	6.95	6.95	5.85	6.10	1.02	0.09	0.07	0.82
	Plant load factor		2.067	0.144	4.817	0.975	0.726	23.879	7.267	3.630	1.840	5.066	2.721	1.380	n/a	9.404
	Overhead index (incl corr'n factor 1/10		1.000	0.600	1.800	0.025	2.500	5.000	2.400	1.200	0.200	3.600	0.600	1.000	0.000	1.200
	Packaging		1.39	1.00	1.42	1.10	2.01	2.73	2.05	2.05	1.50	1.70	1.80	0.10	0.00	1.70
Shipping																
	Freight to market index		2	2	2	1	1	4	2	2	2.5	3	2.5	1.5	0	1
	Inspection cost index		2	2	2	0	0	1	2	2	2	2	2	1	1	1
Summation as CIF index																
	harvest & proc wages		8.19	5.24	7.35	4.71	7.60	2.62	11.78	11.62	9.60	9.62	2.02	0.38	0.28	1.16
	boat, expenses and lease		3.77	4.08	4.66	1.90	1.94	1.23	4.50	3.67	3.38	1.88	1.19	0.57	0.34	0.21
	Packing & trucking		2.35	1.50	5.54	0.85	2.94	1.29	2.00	1.00	4.00	1.00	1.00	1.07	0.13	1.00
	Unloading, validation		1.35	1.35	1.35	1.35	0.94	0.14	1.00	1.00	1.00	1.00	0.15	0.07	0.94	0.16
	Overhead, packaging		2.39	1.60	3.22	1.13	4.51	7.73	4.45	3.25	1.70	5.30	2.40	1.10	0.00	2.90
	Insp. Freight		4.00	4.00	4.00	1.00	1.00	5.00	4.00	4.00	4.50	5.00	4.50	2.50	1.00	2.00
	Unit cost index		22.04	17.76	26.12	10.93	18.93	18.02	27.73	24.53	24.18	23.80	11.27	5.68	2.70	7.42
		Rank (1=lowest)	10	6	15	4	8	7	20	13	12	11	5	2	1	3
	Gross Cost Index		17,082	1,837	96,252	24,598	246,072	900,819	151,147	44,528	2,780	67,984	11,267	13,622	28,311	22,638
		Rank (1=lowest)	5	1	11	7	13	14	12	9	2	10	3	4	8	6

Note (*): processing complexity corrector is based on the relative # of man-hours needed: currently set at 1 man-hr for live; 5 for bulk; 7 for tray; 6 for freeze; and 6 for brine

Table 4: Logistics/Transportation		Canada				Japan	Chile	USA				Mexico	Russia		China
		BC			Atlantic			California		Alaska	Maine		Regulated	IUU	
		Overall	South	C & N				South	North						
Delivery times (days)															
	harvest to dock (minimum)	0.22	0.1	0.25	0.1	0.1	0.25	0.1	0.1	0.5	0.15	0.15	0.25	0.35	0.25
	(maximum)	3.40	0.9	4	1	0.35	4	1	0.5	2	1	0.5	3	1.5	0.5
	on dock	0.17	0.05	0.2	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.1	0.1	0.2	0.1
	dock to processor	0.72	0.4	0.8	0.5	0.25	0.25	0.25	0.25	0.05	0.25	0.5	0.4	0.35	0.25
	processor to wholesale	1.00	1	1	1.5	0.5	2	1	1	1.5	1.5	1	0.5	0.5	1
Temperatures (degrees C)															
	water	9.0	9	9	8	6	7	12.5	10	9	8	16	6	6	16
	transporter (incl. packer hold)	12.4	10	13	12	8	14	13	13	12	13	16	10	8	16
	air (on dock)	5.8	9	5	9	12	9	15	11	5	10	20	7	5	16
	truck	3.4	5	3	3	3	9	8	7	3	5	7	3	3	5
Accumulated Heat Absorption index (degree C - hours)															
	high	1217.4	396.2	1449.6	514.8	159.6	1659.6	498.0	331.2	765.6	534.0	444.0	825.6	397.2	380.4
	low	268.4	202.8	279.6	255.6	111.6	399.6	217.2	206.4	333.6	268.8	309.6	165.6	176.4	284.4
	Average	742.9	299.5	864.6	385.2	135.6	1029.6	357.6	268.8	549.6	401.4	376.8	495.6	286.8	332.4
	Rank (1 = lowest)	12	4	13	8	1	14	6	2	11	9	7	10	3	5
	Consistancy (ratio- hi:low)	4.5	2.0	5.2	2.0	1.4	4.2	2.3	1.6	2.3	2.0	1.4	5.0	2.3	1.3
	Rank (1 = lowest)	12	5	14	7	2	11	9	4	10	6	3	13	8	1
Potential recoveries		14%	16%	14%	16%	24%	13%	16%	14%	14%	16%	16%	20%	14%	18%
Realized recoveries average		6.4%	8.1%	6.0%	8.0%	18.0%	5.0%	7.5%	6.5%	6.7%	8.0%	6.0%	8.0%	6.0%	9.0%
Absolute recovery 'sacrifice'		7.9%	7.5%	8.0%	8.0%	6.0%	8.0%	8.5%	7.5%	7.3%	8.0%	10.0%	8.0%	8.0%	9.0%
Sacrificed to realized recovery (STRR) ratio		123.7%	93.4%	133.3%	100.0%	33.3%	160.0%	113.3%	115.4%	109.0%	100.0%	166.7%	100.0%	133.3%	100.0%
	Rank (1 = lowest)	10	2	11	3	1	13	8	9	7	3	14	3	11	3

Table 5: Marketing		Canada				Japan	Chile	USA				Mexico	Russia		China
		BC			Atlantic			California		Alaska	Maine		Regulated	IUU	
		S-RSU	S-GSU	C & N				South	North						
Domestic Markets															
	sales (% volume)	15%	15%	10%	5%	100%	5%	30%	30%	15%	15%	10%	10%	0%	10%
	price (code 1)	2	3	2	2	4	2	3	3	3	3	2	1	0	1
	contribution to revenues	15%	15%	10%	5%	100%	10%	39%	39%	21%	21%	10%	5%	0%	5%
	Main product form	fresh	live	fresh	fresh	fresh	live	fresh	fresh	fresh	fresh	fresh	fresh	n/a	live
Export Markets															
	sales (% volume)	85%	85%	90%	95%	0%	95%	70%	70%	85%	85%	90%	90%	100%	90%
	price (code 1)	2	3	2	2	4	1	2	2	2	2	2	2	1	2
	contribution to revenues	85%	85%	90%	95%	0%	90%	61%	61%	79%	79%	90%	95%	100%	95%
Product forms															
	Volume %														
	live	0%	100%	0%	90%	3%	2%	0%	0%	0%	0%	0%	95%	100%	10%
	bulk	65%	0%	63%	0%	25%	10%	0%	0%	55%	40%	20%	0%	0%	50%
	tray	33%	0%	32%	10%	50%	5%	95%	95%	40%	50%	80%	5%	0%	25%
	frozen	0%	0%	5%	0%	15%	81%	5%	5%	5%	10%	0%	0%	0%	0%
	brined	2%	0%	0%	0%	7%	2%	0%	0%	0%	0%	0%	0%	0%	15%
	Wholesale prices ($C/kg)														
	live	10.79	10.79	10.79	1.54	20.00	5.00	9.13	9.13	9.13	9.13	8.00	4.60	4.00	1.00
	bulk	49.08	49.08	49.08	49.08	65.00	40.71	50.00	50.00	25.00	40.00	44.10	36.00	36.00	28.25
	tray	54.00	54.00	54.00	54.00	100.00	45.00	58.00	58.00	28.50	43.00	49.00	41.12	41.12	34.00
	frozen	6.12	6.12	6.12	6.12	35.00	22.45	16.73	16.73	12.00	16.75	10.00	10.00	10.00	10.00
	brined	33.06	33.06	33.06	33.06	55.00	24.09	35.00	35.00	30.00	33.00	25.00	25.00	25.00	20.71
Contribution to revenue by product type															
	live	0.0%	100.0%	0.0%	76.3%	4.2%	7.4%	0.0%	0.0%	0.0%	0.0%	0.0%	96.4%	100.0%	4.1%
	bulk	63.3%	0.0%	63.7%	0.0%	20.7%	15.1%	0.0%	0.0%	53.4%	40.8%	18.4%	0.0%	0.0%	52.6%
	tray	35.4%	0.0%	35.6%	23.7%	63.5%	8.3%	98.5%	98.5%	44.3%	54.9%	81.6%	3.6%	0.0%	31.7%
	frozen	0.0%	0.0%	0.6%	0.0%	6.7%	67.4%	1.5%	1.5%	2.3%	4.3%	0.0%	0.0%	0.0%	0.0%
	brined	1.3%	0.0%	0.0%	0.0%	4.9%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.6%
Unit Vale Estimate (UVE)		3.53	10.79	2.91	1.82	14.16	1.35	4.20	3.64	1.73	3.13	2.88	4.53	4.00	2.42
	Rank (by UVE) (1 = highest)	7	2	9	12	1	14	4	6	13	8	10	3	5	11
Production (MT)		775	103	3,685	2,250	13,000	50,000	5,450	1,815	115	2,857	1,000	2,400	10,500	3,050
Gross Value Estimate ($C 000's)		2,733	1,116	10,725	4,098	184,119	67,468	22,864	6,599	198	8,954	2,881	10,883	42,000	7,368
	Rank (by GVE) (1 = highest)	12	13	6	10	1	2	4	9	14	7	11	5	3	8
Revenues distribution															
	Landed value estimate ($C 000's)	$1,196	$388	$5,282	$3,473	$124,280	$9,261	$10,816	$3,202	$89	$3,780	$154	$1,693	$4,399	$471
	Residual from wholesale ($C 000's)	$1,537	$728	$5,443	$625	$59,839	$58,207	$12,049	$3,397	$110	$5,174	$2,727	$9,189	$37,601	$6,898
	Estimated % to harvesters	44%	35%	49%	85%	67%	14%	47%	49%	45%	42%	5%	16%	10%	6%
	Estimated % to processors (incl. costs)	56%	65%	51%	15%	33%	86%	53%	51%	55%	58%	95%	84%	90%	94%

Table 6: Product Differentiation	Canada				Japan	Chile	USA				Mexico	Russia		China
	BC			Atlantic			California		Alaska	Maine		Regulated	IUU	
	Overall	South	C & N				South	North						
Retail Packaging														
Primary original processor	35%	35%	35%	10%	75%	15%	90%	90%	20%	50%	50%	10%	0%	40%
Secondary repacker	65%	65%	65%	90%	25%	85%	20%	10%	80%	50%	50%	90%	90%	60%
Reputation elements (code 1)														
environment	4	4	4	4	4	4	4	4	4	4	3	3	3	1
hygiene	3	3	3	3	4	2	3	3	3	3	2	2	2	2
taste	3	3	3	3	4	2	3	3	3	3	2	3	3	2
innovation	2	2	2	2	4	2	3	3	3	3	1	1.5	2	2
grading consistancy	2	2	2	2	4	2	2.5	2	2	2	2	2	3	2
sustainable harvest	3	3	3	3	3	1	3	2	3	1	2	2	1	2
price index (Unit Value index)	3.3	4.9	2.9	1.8	14.2	1.3	4.2	3.6	1.7	3.1	2.9	4.5	4.0	2.4
perceived value	2	2	2	2	3	2.5	2.5	2	2	2	2	2.5	3	3
shared values	3	3	3	3	4	2	2.5	2.5	2.5	2.5	2	1	1	1.5
honesty	3	3	3	3	4	2	2	2	2	2	2	1	2	2
trust in food system	3	3	3	3	4	2	3	3	3	3	2	1	2	1
Summed (as index)	31.3	32.9	30.9	29.8	52.2	22.8	32.7	30.1	29.2	28.6	22.9	23.5	26.0	20.9
Rank (1 = best)	4	2	5	7	1	13	3	6	8	9	12	11	10	14

Note: At this point, consumers in Japan do not have any way to discriminate South from Central or North Coast production from BC.

Table 7: Human Resources	Canada				Japan	Chile	USA				Mexico	Russia		China
	BC			Atlantic			California		Alaska	Maine		Regulated	IUU	
	Overall	South	C & N				South	North						
Country demographics (note #5)	2	2	2	2	3	1	2	2	2	2	1	4	4	1
Harvest														
Manpower summary														
Divers/trawlers/pickers	96	44	68	89	1,000	7,500	250	75	40	370	290	75	195	720
Crew (incl. packers)	50	25	45	40	0	2,700	125	50	25	60	210	50	135	
Total (estimated)	146	69	113	129	1,000	10,200	375	125	65	430	500	125	330	720
Catch per man (MT)	31.26	12.73	32.61	17.44	13.00	4.90	14.53	14.52	1.77	6.64	2.00	19.20	31.82	4.24
Gross Value per man ($C)	$47,023	$22,954	$46,739	$26,922	$124,280	$908	$28,841	$25,613	$1,365	$8,790	$309	$13,548	$13,330	$654
Critical Skills 1	divers	divers	divers	divers	harvesters	divers	divers/own	divers/own	divers/ow	fishermer	divers	divers	divers	harvesters
Certification req'ts (code 1)	3	3	3	2	3	1	2	2	2	2	1	2	2	1
Availability trend	lower	lower	lower	stable	lower	increasing	retiring	retiring	stable	declining	rising	declining	declining	rising
Compensation (code 1)	4	4	4	3	3	1	3	3	2	2	1	1	2	1
Satisfaction levels (code 1)	2	3	2	3	3	3	3	3	1	1	3	2	3	2
Isolation (code 1)	3	2	4	1	0	3	1	0	2	0	1	2	4	1
Critical Skills 2	skippers	skippers	skippers	skippers		skippers								
Certification req'ts (code 1)	3	3	3	3		2								
Availability trend	declining	declining	declining	stable		stable								
Compensation (code 1)	3	3	3	3		1								
Satisfaction levels (code 1)	3	3	3	3		2								
Isolation (code 1)	3	2	4	1		3								
Processing														
# of processing companies	9	5	9	1	100	25	6	4	1	12	3	5	0	4
average annual plant capacity (MT)	507.0	175.7	409.4	n/a	130.0	2000.0	908.3	453.8	115.0	238.1	333.3	n/a	n/a	762.5
Critical Skills 1	g/p's			unknown	g/p's	proc mngt	g/p's	g/p's	g/p's	unknown	unknown	g/p's	n/a	proc mngt
Availability trend	stable				declining	stable	stable	stable	rare			rare		rare
Satisfaction levels (code 1)	2				3	3			2			2		3
Critical Skills 2	proc mng					refrig. tech								
Availability trend	stable					stable								
Satisfaction levels (code 1)	3					3								

Note #5: demographic code: 1 = young growing population; 2 stable average age with growing population; 3- old average age, shrinking population; 4- younger avg mortality, shrinking population

Legend: g/p's: graders and/or packers

Appendix B: Information Sources and Literature References

Sources

Industry Contacts

Harvesters

Mike Featherstone	President: Pacific Urchin Harvesters Association
Michael Callow	President: West Coast Green Urchin Association
Dave McRae	RSU Fisherman & Director: Pacific Urchin Harvesters Association
Dave Kensall	Research Director: West Coast Green Urchin Association
Dave Lansdowne	Director: Pacific Urchin Harvesters Association
Bob Hegedus	RSU Diver, RSU Dive boat skipper
Pete Halmay	RSU Diver, California
Will Strong	RSU/GSU Fisherman and urchin marketer
Rick Strong Jr.	RSU/GSU Fisherman
Mike Cotton	Skipper of an RSU packer in BC

plus informal discussions with active divers and skippers in both of BC's sea urchin fisheries

Processors

Francis Cheung	Grand Hale Marine Products Ltd.
Spencer Cheung	Grand Hale Marine Products Ltd.
Paddy Wong	Paladin International Food Sales Ltd.
Peter Choi	Kiku Fisheries Ltd.
William Choi	Kiku Fisheries Ltd.
Mike Crawford	Territory Seafoods

Validators

Darin Macy	D & D Pacific Fisheries Ltd.
Don Christian	D & D Pacific Fisheries Ltd.

Government of Canada Contacts

Tsuneto Sasaki	Canada Trade Commissioner, Tokyo, Japan
Renee Plouffe	Canada Trade Commissioner, Santiago, Chile
Ian Perry	GSU Scientific Authority, Pacific Region, DFO
Robert Miller	GSU Scientific Authority, Nova Scotia, DFO
David Robichaud	GSU Scientific Authority, New Brunswick, DFO
Chris Pearce	Aquaculture Research, Pacific Region, DFO

International Contacts

Masao Hashimoto	Kokusai Boueki Co. Ltd, Sapporo, Japan
Konstantine Tchernychev	Kokusai Boueki Co. Ltd, Sapporo, Japan
Kitaro Endo	Maruki Co. Ltd., Tokyo Japan
Takeyasu Watanabe	Tsukiji Uoichiba Co. Ltd.
John Liuph	Sr. Biologist, Guangdong Dayawan Fishery Dev't Centre, China

Literature

Aas, K. Technology for sea-based farming of sea urchins. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Agatsuma, Y. 2001. Ecology of *Strongylocentrotus intermedius*. In: J.M. Lawrence (ed) Edible Sea Urchins: Biology and Ecology. Elsevier Science.

Agatsuma, Y., Y. Sakai and N.L. Andrew. 2004. Enhancement of Japan's Sea Urchin Fisheries. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Agatsuma, Y. 2001a. Ecology of *Strongylocentrotus nudus*. In: J.M. Lawrence (ed) Edible Sea Urchins: Biology and Ecology. Elsevier Science.

Agatsuma, Y. 2001b. Ecology of *Hemicentrotus pulcherrimus*, *Pseudocentrotus depressus* and *Anthocidaris crassispina* in Southern Japan. In: J.M. Lawrence (ed) Edible Sea Urchins: Biology and Ecology. Elsevier Science.

Andrew, N.L., Y. Agatsuma, C.M. Dewees and W.B. Stotz. State of Sea Urchin Fisheries 2004. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Andrew, N.L., Y. Agatsuma, E. Ballesteros, A.G. Bazhin, E.P. Creaser, D.K.A. Barnes, L.W. Botsford, A. Bradbury, A. Campbell, J.D. Dixon, S. Einarsson, P.K. Gerring, K. Hebert, M. Hunter, S.B. Hur, C.R. Johnson, M.A. Juinio-Menez, P. Kalvass, R.J. Miller, C.A. Moreno, J.S. Palleiro, D. Rivas, S.M.L. Robinson, S.C. Schroeder, R.S. Steneck, R.L. Vadas, D.A. Woodby and Z. Xiaoqi. 1998. Status and management of world sea urchin fisheries. Oceanography and Marine Biology: an Annual Review 2002. 40. pp. 343 - 425.

Ang, A. 2005. Chinese village sealed after protest. G&M Dec. 10, 2005. p. A 24

Anon 1983. Times Atlas of the Ocean. Von Nostrand Reinhold Co. Toronto, ON.

Anon. 2003. Mexico: Fishery Country Profile. Food and Agriculture Organization of the United Nations, NY http://www.fao.org/fi/fcp/en/MEX/profile.htm

Anon 2003a. Fishermen fight Channel Islands Closure. Pacific Fishing Aug. 2003. pp. 14-16.

Anon 2004. Hokkaido Fisheries. Dep't of Fisheries and Forestry, Hokkaido Government.

Anon 2005. More deaths than births expected in Japan. G&M Dec 21, 2005. p. A16

Anon 2005a. Protests in China: The cauldron boils. The Economist. Oct 1, 2005. p. 38.

Anon 2005 b. Corruption in Russia: Blood money. The Economist Oct 22, 2005. p. 53.

Anon 2005 c. How China runs the world economy. The Economist Jul 30, 2005. p. 11.

Anon 2005 d. Special Report China and the world economy. The Economist July 30, 2005 p. 61.

Anon 2005 e. Weather officials warn of future increases in hurricane activity. Sea Technology. Nov 2005. p. 9.

Anon 2005 f. Beyond Siberia. The Economist Sept 3, 2005. p. 45.

Anon 2005 g. The myth of China Inc. The Economist. Sept 3, 2005. p. 53.

Anon 2005 h. Democracy Chinese style. The Economist Oct 15, 2005. p. 45.

Anon 2006. Fujimori's trials. The Economist. January 7, 2006. p. 34.

Anon 2006 a. The casualty report. Pacific Fishing February 2006. p. 23-24.

Barker, M.F. and J. Fell. 2004. Sea Cage experiments on Roe enhancement of New Zealand sea urchin *Evechinus chloroticus*. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Bazhin, A. G. 1998. Sea Urchin (Strongylocentrotus spp.) Fisheries on Kamchatka: current conditions and problems. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and management. Edited by G.S. Jamieson and A. Campbell. Can. Spec. Publ. Fish. Aquat. Sci 125. pp. 423 - 427.

BCSA. 2005. What do we want from BC's commercial fisheries? The case for reform. http://www.bcseafoodalliance.com/BCSA/ReformApril2005.htm

Buschmann, A., C. Garcia and R. Espinoza. 2004. Sea Urchin (*Loxechinus albus*) and kelp (*Macrocystis porifera*) in protected in Southern Chile. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Bustos, R., V. Guerrero , C. Romo, O. Guzman and C. Guisado. 2004. Chemical characterization and sensory evaluation of taste of brown and normal gonads of sea urchin *Loxechinus albus* and its implications for development of artificial feed. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Campbell, A., D. Tzotzos and J. Rogers. 2004. The Red Sea Urchin, *Strongylocentrotus fransicanus*, fishery in British Columbia, Canada. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Carcamo, P.F. 2004. Massive production of larvae and seeds of the sea urchin *Loxechinus albus*. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Castilla, J.C., P. Manriquez, J. Alvarado, A. Robson,, C. Pino, C. Espoo, R. Soto, D. Oliva and O. Defeo. 1998. Artisanal "Caletas" as units of production and co-managers of benthic invertebrates in Chile. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and management. Edited by G.S. Jamieson and A. Campbell. Can. Spec. Publ. Fish. Aquat. Sci 125. pp. 407 - 413.

CDFG 2005. California Sea Urchin Fishery Report: 2004 Wrap up. California Department of Fish and game. Spring 2005.

Chambers, S. 2005. Pacific Urchins. National Fisherman Oct. 2005. p. 16.

Dale, T., S. Siikavuopio and M. Carlhog. 2004. Effects of different diets on sensory quality of gonads. In: Sea Urchins: Fisheries and Ecology proceedings of the international Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

DeWees, C.M. 2004. Sea Urchin Fisheries: A California Perspective. In: Sea Urchins: Fisheries and Ecology proceedings of the international Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Espejo, A., R. Galleguillos and S. Ferrada. 2004. Isozyme analysis in the sea urchin *Loxechinus albus*. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Ess, C. 2006. Market Report: North Pacific Urchins. National Fisherman Feb 2006. p. 18.

Gonzales, S.S. and E. Olguin. 2004. Population Biology of the Sea Urchin *Echinometra vanbrunti* in the Southern Gulf of California, Mexico. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Grimmer, T. 2005 a. Its time to get used to the idea of China as a big player in R&D. G&M Oct 12, 2005. p. B17.

Grimmer, T. 2005 b. In China, people, people everywhere- but few managers to lead.

Grimmer, T. 2005. Capitalist Gini is out of the bottle as rich-poor divide erupts in China. G&M Sept 28, 2005. p. B 18.

Glavin, T. 2006. Russia: land of giant killers. Globe and Mail. February 4, 2006. p. F7.

Guisado, C., F. Buckle, M. Hernandez and B. Baron. 2004. Effect of water flow on the displacement of the *Strongylocentrotus franciscanus* in a controlled environment. In: Sea Urchins: Fisheries and Ecology proceedings of the Int'l Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Hilborn, R. 1998. The economic performance of marine stock enhancement projects. Bull Mar Sci 62(2): 661 - 674.

Ivanov, B.G. 1998. Shell fishery biology in Russia: problems and opportunities. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and management. Edited by G.S. Jamieson and A. Campbell. Can. Spec. Publ. Fish. Aquat. Sci 125. pp. 417-421.

Jaing, W. 2006. The casualties of China's rising tide. G&M Jan. 9, 2006. P. A13

Jimenez, M. 2006. Her victory will be a revolution. G&M Jan 14, 2006. p. F2

Johnson, C. 2006. Biologists advocate end of sea otter relocation. National Fisherman. Jan/2006.

Kajima, K. and J.M. Lawrence. 2001. Disease in edible sea urchins. In: J.M. Lawrence (ed) Edible Sea Urchins: Biology and Ecology. Elsevier Science.

Kalvass, P. 1992. The Northern California Commercial Sea Urchin Fishery: A case study. In: Dewees, C.M. and L.T. Davies (eds). The Management and Enhancement of Sea Urchins and other Kelp Bed Resources: A Pacific Rim Perspective. California Sea Grant College. U of California, La Jolla, CA.

Kato, S. and S.C. Schroeder. 1985. Biology of the Red Sea Urchin, *Strongylocentrotus fransiscanus*, and its fishery in California. Marine Fish. Rev. 47 (3): 1- 18

Lauer, S.R. 2001. Flexible production on the working waterfront: The social origins of the Northwest Atlantic Sea Urchin Industry. Rural Sociology 66(4): 532 - 556.

Martin, R.L. 2005. Competitiveness: A sure way to lose to India and China- assume we have the advantage. Globe and Mail. Dec. 28, 2005. p. B7

Masuda, R. and K. Tsukamoto. 1998. Stock enhancement in Japan: Review and perspective. Bull Mar Sci 62(2):337-358.

Olivarez, I. 2004. Characterization of the gametogenic cycle of the sea urchin *Loxechinus albus*. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Orensanz, J.M. and G.S. Jamieson. 1998. The assessment and management of spatially structured stocks: an overview of the North Pacific Symposium on Invertebrate Stock Assessment and Management. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and management. Edited by G.S. Jamieson and A. Campbell. Can. Spec. Publ. Fish. Aquat. Sci 125. pp. 441- 445.

Rivas, D.A. 2004. Historical Development and Perspectives of the Sea Urchin *Loxechinus albus* Fishery in the Southern and Austral Areas of Chile. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Robinson, S.M. 2004a. A roundtable discussion of the future of aquaculture of sea urchins. In: Sea Urchins: Fisheries and Ecology proceedings of the international Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Robinson, S.M. 2004. The evolving role of aquaculture in the global production of sea urchins. In: Sea Urchins: Fisheries and Ecology proceedings of the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Sakai, Y., K.I. Kajima and Y.Agatsuma. 2004. Mass production of seed of the Japanese edible sea urchins *Strongylocentrotus intermedius* and *Strongylocentrotus nudus* In: Sea Urchins: Fisheries and Ecology proceedings fo the international Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Schei, T. 2004. The failure of establishing a Norwegian sea urchin industry. In: Sea Urchins: Fisheries and Ecology proceedings fo the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Stotz, W. B. 2004. Sea Urchin Fisheries: A Chilean Perspective. In: Sea Urchins: Fisheries and Ecology proceedings fo the International Conference on Sea-Urchin Fisheries and Aquaculture. Puerto Varas, Chile, March 25-27, 2003. DEStech Publications. Lancaster, PA.

Taylor, P.H. 2004. Green Gold: Scientific findings for management of Maine's Green Sea Urchin fishery. Maine Dep't of Marine Resources, Boothbay Harbour, Maine.

Tegner, M. 2001. The ecology of *Strongylocentrotus fransiscanus* and *Strongylocentrotus purpuratus.* In: J.M. Lawrence (ed) Edible Sea Urchins: Biology and Ecology. Elsevier Science.

Vasquez, J.A. 2001. Ecology of *Loxechinus albus.* In: J.M. Lawrence (ed) Edible Sea Urchins: Biology and Ecology. Elsevier Science.

Walker, C.W., T. Unuma, N.A. McGinn, L.M. Harrington and M.P. Lesser. 2001. Reproduction of sea urchins. In: J.M. Lawrence (ed) Edible Sea Urchins: Biology and Ecology. Elsevier Science.

Wilson, C. 2005. Business survivors will be adaptable. Times Colonist. Dec. 1, 2005. p. B2. Victoria, BC.

York, G. 2006. China frets over its expanding income gap. G&M Feb. 9, 2006. p. A1.