

---

AUDIT AND EVALUATION  
DIRECTORATE

---

DIRECTION GÉNÉRALE  
DE LA VÉRIFICATION  
ET DE L'ÉVALUATION

---

PACIFIC SALMON SELECTIVE FISHING  
PROGRAM  
EVALUATION

PROJECT NUMBER 60278  
FINAL REPORT  
FEBRUARY 11, 2005



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

Canada

# TABLE OF CONTENTS

<b>1.0</b>	<b>EXECUTIVE SUMMARY .....</b>	<b>I</b>
	<b>LESSONS LEARNED.....</b>	<b>II</b>
<b>2.0</b>	<b>INTRODUCTION .....</b>	<b>1</b>
<b>2.1</b>	<b>BACKGROUND .....</b>	<b>1</b>
<b>2.2</b>	<b>OBJECTIVES AND SCOPE .....</b>	<b>1</b>
<b>2.3</b>	<b>PROGRAM DESCRIPTION.....</b>	<b>2</b>
<b>3.0</b>	<b>METHODOLOGY.....</b>	<b>4</b>
<b>4.0</b>	<b>FINDINGS .....</b>	<b>5</b>
<b>4.1</b>	<b>PROGRAM IMPLEMENTATION .....</b>	<b>5</b>
<b>4.2</b>	<b>RELEVANCE .....</b>	<b>6</b>
<b>4.3</b>	<b>SUCCESS.....</b>	<b>7</b>
<b>4.4</b>	<b>COST-EFFECTIVENESS .....</b>	<b>15</b>
<b>5.0</b>	<b>CONCLUSIONS.....</b>	<b>18</b>
	<b>LESSONS LEARNED.....</b>	<b>18</b>

## 1.0 EXECUTIVE SUMMARY

In 1998 the Federal Government announced \$400 million for the Canadian Fisheries Adjustment and Restructuring Program (CFAR), a multi-departmental program designed to address the ground fish problems on the Atlantic coast and the salmon problems on the Pacific coast. The Pacific Salmon Selective Fishing Program (PSSFP) one of the sub programs of CFAR received \$21.5 million of this funding. PSSFP was delivered from 1998-2002 to respond to concerns raised with the low Coho stock returns in the South Thompson and Upper Skeena rivers. Under the Program, commercial and First Nations harvesters and recreational anglers were encouraged to develop selective fishing gear and methods, and participate in experiments and research projects. The PSSFP was comprised of five Program components: Experimental Pilot Projects; First Nations Gear Purchases; Research Projects; Education, Training and Communication; and Compliance.

The evaluation methodology included: literature reviews, 2 surveys for a total of 165 respondents, and 35 key informant interviews. These were the basis for the analysis and evaluation of the relevance, success and cost-effectiveness of the PSSFP.

With regard to Program relevance, it was found that the PSSFP was innovative and ambitious, aiming at implementing selective fishing activities and promoting in Canada internationally compatible policies and regulations for selective fishing. The Program assisted in the implementation of innovative management practices and fishing patterns for commercial, First Nations and recreational harvesters. The Program became the medium in the discrepancy between salmon conservation and the continuous fishing activity of commercial, recreational and First Nations' harvesting, and is still regarded as the most appropriate alternative.

With regard to Program success, there were important areas in which success was achieved, such as the implementation of selective technologies and gear standards into conditions of licences for salmon harvesters. The allocation principle and policy were well thought out and applied successfully to further experimental testing and to encourage selectivity. The Program was successful in terms of maintaining fishing activity under the guidance of Integrated Fisheries Management Plans that contained temporary gear measures and time allocations, which helped sustain the industry through a period of low abundance by offering an innovative management approach. Stock identification research also advanced under the PSSFP. There were Program areas that aimed to achieve long term impact and they did not measure the same degree of success. Such was the aim to develop selective fishing standards for handling fish and changing harvesters' habits, as well as, to analyse and conclude on escapement rate and total mortality rate standards based on the experiments and testing completed at the time. Another essential component was not developed such as the experimental assessment of long term survival and spawning of released Coho by-catch. Researchers and DFO managers observed changes in the behaviour of program participants while working together on projects and program monitoring. The monitoring and enforcement components did not change the habits of all harvesters, pre-existing cultural disposition, and the complexity of survival in the commercial harvesting industry. A number of constraints existent within the Program's environment such as: harvesters long living fishing habits; difficulties in tracking violators; and difficulties in assessing impact on fish stocks limited Program success. A great deal was expected of experiments on the long term survival of by-catch after release as those experiments were to continue to provide data on

spawning. These results were needed to provide a foundation for the development of selective fishing standards. There was also no evidence to suggest the PSSFP had an impact in creating a viable and sustainable fishing industry. While the activities in the PSSFP responded clearly to the Program component objectives there were no measurement indicators or collection of data that would link actual activities to the outcomes and the long term conservation effects of the Program. Accurate implementation measures and selective fishing compliance indicators needed to measure the Program progress were lacking.

Overall, the Program marked a step in the shift of thinking about selective fishing in the changed environment of fisheries in the Pacific. The Program contributed to the development of innovative scientific and management approaches to address new trends observed in the movement of salmon. However, with regard to the most essential long term objectives such as spawning experiments and selective standards developments the Program fell short of its objective. While those harvesters participating on projects indicated behavioural change, changing the behaviour of the harvesting community is a long process and this evaluation can not conclude whether the PSSFP had a lasting impact or not.

With regard to cost-effectiveness, a common creative approach towards Coho preservation was in place. The costs required of harvesters to comply with purchasing the mandatory selective fishing gear were bearable for the majority of harvesters. Resources were allocated to each one of the components and the components were crafted to fit the emerging crisis. The Program presented an alternative to closures of significant areas of the Pacific salmon fishery.

## **LESSONS LEARNED**

Lessons learned to be considered in the development of any program that aims at achieving conservation results and raising protective measures for endangered species while allowing continued harvesting activities are:

- Select carefully the strategies that encourage changes in the behaviours and practices, because those that are implemented through a payment system are likely to disappear when the payments stop.
- Utilise 5% TAC (Total Allowable Catch) to initiate the development and implementation of gear and fishing method and standards for selective fishing in a proactive manner by collaborating with harvesters. Assess the necessity of 5% TAC application on annual basis according to its goals and discontinue the practice when it outlives its purpose.
- Address concerns with monitoring of the pre-existing systems and consider alternative monitoring practices in order to develop monitoring systems that provide reliable data for the fishing plans. Some fishery monitoring practices suggested to us were on-board observers, charter patrol vessels and aerial over flight that can help to determine the degree of fleet compliance with catch reporting, gear and other requirements in the fishery.

- Improve the monitoring systems to identify areas of non-compliance with selective fishing standards and practices in a timely manner in order that appropriate enforcement is carried out.
- Find proactive ways of integrating commercial harvesters' input in the development of standards for handling the fish with the use of particular selective fishing gear.
- Identify different ways of encouraging compliance with selective fishing gear measures and standards.
- Develop clear and simple performance measurement indicator by program component to measure the program progress on ongoing basis.
- If such a program is undertaken in the future, it would require stable provisions, clear guidelines, standards and requirements, and a much higher incentive to harvesters to abide by the new norms and requirements.
- As a means to encourage the utilisation of selective fishing practices among commercial harvesters, clarify for stakeholders the implications of failing to meet selective fishing standards. Develop feedback mechanisms that would reflect back to harvesters their performance in accordance to selective fishing regulations.
- Ensure that formal evaluations are conducted to assess the scientific validity of the experiments undertaken under the TAC sharing arrangement and build on that work to develop standards.

## **2.0 INTRODUCTION**

### **2.1 BACKGROUND**

The Pacific Scientific Advice and Review Committee (PSARC) advised the Minister of Fisheries and Oceans in 1998 that Coho stocks in the Upper Skeena and Thompson River system were declining. The two Coho stocks were seen as risking extinction despite fisheries closures and the ban placed on their harvesting. The Minister announced a conservation-based fishing regime for salmon that prohibited the retention of certain salmon stocks and species to promote sustainability. An overarching national Canadian Fisheries Adjustment and Restructuring (CFAR) program was implemented, of which Pacific Fisheries Adjustment and Restructuring Program (PFAR) became the local component in the Pacific. The PFAR was funded at \$400 million to implement the conservation regime in the Pacific and conduct the following initiatives:

- Restructuring the commercial fishing industry by moving to selective harvesting, diversifying fishing opportunities and further reducing the salmon fleet;
- Helping people and communities adjust; and
- Increasing efforts to protect and rebuild salmon habitat.

Other programs under PFAR previously evaluated are: the Vessel Tie Up Program conducted in 1999, and the Licence Retirement Program conducted in 2002.

As part of the restructuring of the commercial fishing industry, the Pacific Salmon Selective Fishing Program (PSSFP) was developed to allow Aboriginal, commercial, and recreational fishing to continue while reducing or eliminating the by-catch of stocks and species that were at very low levels of abundance. The Program was intended to develop and evaluate selective fishing techniques; facilitate the implementation of selective fishing practices; and communicate to participants new fishing methods that would lead to selective fishing. Funding for the Program was approved at \$21.5 million over four years (1998 -2002).

Over the four year duration of the Program DFO funded 256 projects through the fishing sectors for the development and implementation of new gear, such as, revival tanks, brailers, fish wheels, mesh size, barbless hooks etc. at a total cost of \$21.5 million in direct expenditures.

In December 2000, a DFO Exit Strategy for Selective Fisheries was released with a number of recommendations aimed at the continuation of selective fishing after the Program's end.

### **2.2 OBJECTIVES AND SCOPE**

The purpose of this evaluation is to measure the relevance, success, and cost-effectiveness of the PSSFP against the conservation objectives presented in the five Program components. The evaluation covered the four years of the program from 1998-2002. The key issues identified for the evaluation are as follows;

## **Relevance**

- Was PSSFP policy and practice aligned with the international context for selective fishing?
- Was the design and delivery of the PSSFP appropriate to the problems faced by commercial, Aboriginal and recreational fisheries in 1998?

## **Success**

- To what extent did the PSSFP result in the adoption of new technologies and methods,
- To what extent has DFO, working with affected harvesting sectors, developed selective fishing standards,
- To what extent have harvest allocations and access to fisheries been shaped by success at fishing selectively,
- In Pacific fisheries where by-catch is an issue, to what extent are harvesters meeting specified standards of selectivity,
- To what extent did the PSSFP result in the maintenance of commercial and recreational fishing activity,
- To what extent were the PSSFP and its communication/education/training activities successful in altering the attitudes and behaviours of harvesters towards selective fishing techniques and gear,
- Were monitoring and enforcement activities effective,
- To what extent did the PSSFP contribute to the conservation of salmon stocks,
- To what extent was the PSSFP successful in altering the behaviour of harvesters, and
- Did the PSSFP contribute to a more viable and sustainable fishing industry.

## **Cost-Effectiveness**

- Were the resources supporting each component of the PSSFP allocated in a cost effective way?
- Was the PSSFP cost-effective compared to alternatives such as no program at all, a government-imposed program without industry involvement.

## **2.3 PROGRAM DESCRIPTION**

The PSSFP's aim is to convey the practical application of the concept of a selective fishery in commercial, recreational, and Aboriginal harvesting. Selective fishing is a conservation-based management approach, which allows a fishery to proceed in times of estimated decrease in the abundance of certain stocks or species, while aiming to minimize, avoid, or let unwanted by-catch escape and eventually spawn. The Program engaged First Nation groups, commercial harvesters, and recreational anglers to work together with DFO scientists in the development of research projects and experiments to test new gear and methods and determine the effect of it on non-target by-catch. A "Methodology Manual: Measurement of Fishing Gear Selectivity" had been prepared in 1995 to guide technicians, senior fishing crew, scientists, and observers in the planning, execution, and reporting of size and species trials with mobile and fixed gears.

The PSSFP consisted of the following five components:

**Experimental Pilot Project** component: Supported projects assessing new selective harvesting technologies and gear for commercial and aboriginal harvesters, and recreational anglers. The experiments carried out by DFO in partnership with the commercial, Aboriginal and recreational sectors, were reviewed by DFO scientists to ensure that Coho mortality would not exceed the PSSFP conservation objectives. While managers and industry were experimenting with new gear, scientists were observing the impact of the gear on the physiology of the fish. The number of research projects and new gear experiments totalled 256.

**First Nation Gear Purchases** component: Over 60 First Nations selective gear purchases were funded through the Program. Selective fishing equipment was purchased to be applied in fishing for food, social and ceremonial purposes. The purchased fish wheels, traps, weirs, beach seines and dip-nets were seen to meet higher standards of selectivity than in-river gillnets or other gear used previously.

**Research Projects** component: Evaluated the effects of catch and release; the selectivity of traditional and new technologies or approaches; the overall impact of selective fishing in terms of its effect on aggregate escapement levels; and to provide scientific support to the development of new gear and fishing methods.

**Education, Training and Communication** component: Designed to enhance communication on findings of research and pilot experiments; consultation with stakeholders on project selection criteria and process; support programs for training harvesters in fish identification and fish handling; facilitate effective live releases; and consult on selective fishing policies.

**Compliance** component: Ensured all projects and selective fisheries met conservation objectives by thorough catch monitoring/observer and compliance monitoring programs.



### **3.0 METHODOLOGY**

To ensure the validity and reliability of our findings, in the conduct of this evaluation, multiple lines of inquiry were used to conduct the data gathering and analysis. The evaluation team reviewed the relevant documentation, which included the Selective Fishing Policy and Framework; the PSSFP Final Report; statistical data reports; scientific studies and project reports; technical reports and evaluations; summary records of catch data; program call up documents; Newsletter information; and financial documents and records.

Two surveys were conducted by the evaluation team. One involved project participants from the commercial, recreational and First Nations fishery. A random sample of 44 program participants was surveyed out of the total population of 80 program participants. The other was a general survey of randomly selected licence holders from the commercial, recreational and First Nations fishery. A sample of 60 commercial and First Nations licence holders was surveyed from a total population of 1417. For this same survey of recreational anglers, we interviewed 53 out of the total population of 200,000. A total of 165 individuals were interviewed for the two surveys. We stratified the total harvesting population into categories according to gear type in order to select a sample that would represent each category. Then we applied a randomised sampling technique to each of the gear categories to select the sample.

A total of 35 key informant interviews were conducted: DFO employees: 5 senior managers, 13 managers, chiefs, and coordinators; 1 Chief Conservation and Protection; 2 dockside monitoring staff; and 6 scientists and biologists. Interviews with external participants in the PSSFP included: 3 Simon Fraser University (SFU) scientists; 2 B.C. provincial government representatives; 1 representative from the Aboriginal Fisheries Commission; and 2 Pacific Resource Conservation Council representatives. The interviewees were selected to provide a source of information according to each evaluation issues as explained in the methodology plan outlined in the Terms of Reference for this evaluation project.

## **4.0 FINDINGS**

### **4.1 PROGRAM IMPLEMENTATION**

Low abundance levels in salmon stock in the first three years of PSSFP did not allow fully the testing of proposed selective gears and methods. This was particularly the case with trap nets in the Fraser River where sockeye returns were low. Thus the program, initially designed to last three years, was extended one extra year to allow for further development and testing of new technology for implementation in salmon fishing.

To initiate the Program, two multi-stakeholder workshops were held and a number of intensive consultations were carried out by the Industry Technical Committee on Selective Harvesting of Salmon, which included First Nations and other stakeholders in the industry. Stakeholder groups and Departmental representatives agreed on the funding mechanisms, the project selection strategy, and the criteria to evaluate project proposals. The PSSFP drew on the experience of harvesters in the three major fishing sectors; commercial, Aboriginal, and recreational. Input was also gathered from fisheries managers, scientists from DFO and Simon Fraser University (SFU), provincial government representatives, Non-Governmental Organisation (NGO) representatives, and conservation groups.

As the Program aimed to impact the management of the Pacific Salmon Fishery, new mandatory measures were introduced in licence conditions. Revival tanks became a legal requirement on board all commercial fishing vessels; barbless hooks were obligatory for recreational and troll harvesters; brailing and sorting of fish became mandatory for seine net harvesters; and net specifications and 'daylight fishing only' was required for gillnet harvesters. Salmon catch targets were estimated based on perceived exploitation rates for stocks of concern. Harvesters in Thompson River and Upper Skeena River were required to release all of their Coho by-catch. To estimate the chances for survival and spawning of the released Coho scientists developed a scale to measure the degree of mortality to assess the frequency of Coho encounters and the degree of post-release mortality of Coho. Catch-monitoring observers were placed on board fishing vessels to observe the volume of by-catch and encourage compliance with new gear use.

Managing the fishery under PSSFP also involved changing the behaviour of harvesters. One of the main aims of the PSSFP was to educate harvesters to apply selective fishing methods and to handle fish in a way that is least harmful. This change in harvester's behaviour was expected to become a standard and to bring about and multiply the effectiveness of the selective gear. DFO developed a communication strategy which was delivered through workshops, by fishing sector, and through booklets and educational video series. Program participants from different fishing sectors were involved in the preparation of the workshops where harvesters were invited to exchange information and experience. The workshops also provided an important medium for informing harvesters from different areas on the results of scientific research projects and experiments on selective fishing. The educational video series presented the goals of the PSSFP and what they meant for harvesters. They introduced avoidance strategies, selective fishing gear application, a new vessel set up plan, new technology for fish handling on board the vessel, education on stock and species identification, and categorisation of fishing mortality.

The Department called for proposals from commercial and Aboriginal groups of harvesters for the experiments with new selective fishing gear and methods. Questions were raised by members of the commercial fishing community regarding the fairness of the selection process. We found that the selection process was applied to administer the funding, licensing, and reporting of the selected projects and that the accepted proposals were the ones that were best developed and clearly put together. In 1998/99 DFO staff evaluated sixty proposals for experimental projects, as there was not yet a formal selection committee in place 1998/99. A formal selection committee was created, and included representatives of the B.C. Provincial Government and DFO members for the next selection process in the years 1999/2000. In year 2000/2001 the committee consisted of recreational, Aboriginal, commercial, B.C. Provincial Government, and DFO representatives. Throughout the lifespan of the program, proposals were sent to all representatives for comments before the review and ranking process began.

## **4.2 RELEVANCE**

### **Was the Selective Fishing Program, policy and practice aligned with the international context for selective fishing?**

From our literature reviews we found that the Program initiatives were aligned with international direction for selective fishing practices. The problem with by-catch, recognised internationally in 1999 at the annual Food and Agriculture Organisation FAO conference in Rome, sparked interest in Canada to explore selective fishing practices. Through the PSSFP, Canada became one of the most prominent supporters of the international sustainable fishery strategy, and contributed in the development of the United Nation's Code of Conduct for Responsible Fisheries at FAO. As a signatory of the Code, Canada was among the first countries to prepare a national plan for reduction of the capacity of the fishing fleet. Indirectly the Selective Fishing Program became a model that the United States was closely monitoring, thus contributing towards improving relationships with the U.S. and Federal fisheries agencies.

We found that the PSSFP presented an innovative plan to implement selective fishing activities and to develop policies and regulations related to selective fishing in Canada. Program activities supported the implementation of innovative approach for fisheries management for DFO managers and new fishing patterns for commercial, First Nations and recreational harvesters, which was in line with internationally acclaimed selective fishing practices. Experimentation with selective fishing gear and methods is still continuing through the utilisation of 5% TAC set aside.

### **Was the design and delivery of the Selective Fishing Program appropriate to the problems faced by the Commercial and Aboriginal Harvesters and the Recreational Anglers in 1998?**

The PSSFP was designed to address problems faced by the commercial and Aboriginal Harvesters and recreational anglers. DFO emphasised and outlined the conservation objectives of the federal *Oceans Act* in this Program and developed a selective fishery to enhance salmon conservation while allowing a continuation of the fishing activity. Circumstances in 1999 were such that the entire salmon fishery was threatened with a closure, but with the introduction of the PSSFP, fishing was maintained, although, at a much lower level than it was in previous years. The Program delivery, guided by internationally acclaimed practices for selective fishing,

presented a high degree of innovation, and incorporated at each step the input of industry, science, and management. The Program was seen as the most appropriate alternative and its delivery necessary considering the complex circumstances.

To conclude, the Program was relevant to offer its innovative planning and ambitious aims to implement selective fishing activities by introducing in Canada internationally compatible Policies and regulations for selective fishery. The way the Program was designed and delivered it revealed the best solution under the complex circumstances to support the implementation of innovative management practices and fishing patterns for commercial, First Nations and recreational harvesters. The Program became the necessary medium in the created discrepancy between salmon conservation and commercial salmon harvesting activity.

### **4.3 SUCCESS**

#### **To what extent did the PSSFP result in adoption of new technologies and methods?**

The Program encouraged the adoption of new gear and methods by helping to change the conditions of licences to include using the new selective gear in the commercial, Aboriginal, and recreational fishery a compulsory requirement. 81% of surveyed program participants agreed that the new gear was highly selective compared to gear used previously. Based on our interviews regarding the adoption of new technologies, we found that many of the new conditions of licence can be directly attributed to the results of the PSSFP experiments.

Key informants stated that commercial harvesters adopted some of the technologies and methods. For example, conditions for Seine net harvesters required harvesters to use a brailer and a dip net to release fish from the nets while the fish are still in the water. This selective fishing technique causes minimum harm to the fish and its practice has been observed as a result of licence requirements. Another practice on board the vessel is the use of sorting boxes to contain by-catch until these are placed in the revival tank. All commercial harvesters were required to have a revival tank on board their vessels and use it according to the conditions of licences. Mesh size requirements became compulsory under the PSSFP for seine and gillnet harvesters and the use of Alaska twist or a multistrand net was added to licence conditions for gillnet harvesters, as were the requirements for short sets placed in water for a shorter soaking time. Troll line harvesters were expected under the new conditions to use barbless hooks.

The licence conditions specified for commercial harvesters applied to Aboriginal commercial harvesters. One of the program components, First Nations Gear Purchases, funded the purchase of fish wheels and other equipment. It was observed that gear provided to the Aboriginal harvesters in some cases was not being used and one reason given for this was that it is difficult to break with native tradition. Other projects with the use of new gear such as fish wheels achieved successful results, yet they were seen as too expensive and were not adopted. We also found that while gear was purchased, its use was not regulated.

The implementation of selective fishing gear was more successful with recreational anglers for whom the major change in fishing gear was the use of barbless hooks and this change required minimal individual costs.

**To what extent has DFO, working with affected harvesting sectors, developed selective fishing standards?**

**In pacific fisheries where by-catch is an issue, to what extent harvesters are meeting specified standards of selectivity?**

In our evaluation we assessed two types of standards: the standards for selective gear and the standards for selective fishing such as handling of by-catch, encounter rate limits for by-catch, and total mortality limits for non-target by-catch in the fisheries. Developing standards was necessary to establish universally reliable ways for consistent selectivity in the fisheries. They were also important to prolong the impact of the program through the standards it left behind.

The B.C. fishery is managed through Integrated Fisheries Management Plans (IFMP) one for Southern B.C. and another for Northern B.C. These were implemented to outline a new management approach in the Pacific salmon fishery. There was a shift in the management focus: once being on the individual harvester it now moved to the group of harvesters. This was a necessary shift to promote peer concern, because the use of the new gear required team effort; and because allocations made by area and between sub-sector (seine, gillnet, troll) were to be made according to the degree of commitment of each sub-sector to selective fishing. Recently there were concerns expressed that the harvesters are lacking feedback information on their degree of their compliance.

General standards with respect to encounter rates and total mortality have not been developed and implemented across all salmon fisheries as expected in the Program; however progress has been made with respect to stocks of significant conservation concern. For example, exploitation rate limits for Thompson and WCVI Chinook salmon were developed and have been prominent features of the IFMPs in the salmon fishery for several years. More recently, temporary exploitation rate limits have also been developed for late run Fraser sockeye and have been applied in the development of Fraser sockeye fishing plans.

In March 2002, the Selective Fisheries Standards and Action Plans Workshop was expected to set into motion actions guided by the Policy for Selective Fishing (2001). Selective fishing standards and action plans were to be completed by January 2003; however, at the time of this evaluation these were not brought to completion.

The PSSFP was mainly successful in establishing and enforcing standards with regard to gear. Fisheries management guidance, available in the IFMPs provides reference to managers for decisions related to selective fishing implementations. Gear standards required by fishing area, sector and gear type is also available. As discussed earlier, some selective gear and techniques became mandatory in 1998 and were implemented, while other experiments were carried out that did not produce gear standards. For example: selective grid nets for seine vessels and fish wheels were regarded as highly selective and least harmful to the fish, yet there was not enough testing and analysis done; and as their maintenance was considered expensive they were not completed. Some testing supported by the 5% TAC of gear and its effect over non-target salmon species is continuing. Some interviewees stated that an anticipated effect of the short lived well funded PSSFP was to convince industry to commit to future costs of selective fishing.

The two types of standards were intended to prolong the effect of the Program. The gear standards became part of the conditions of licences and harvesters are required to meet these gear standards. Instructions for selective gear requirements and fishing time openings were placed in the IFMPs for the Southern B.C. and the Northern B.C. for the year 2003.

The selective fishing standards were intended to determine acceptable encounter rates, limits for the total allowable mortality, and definitions for the type of care needed in handling by-catch; however, there was a limited progress made in the way these goals were achieved. Towards the end of the PSSFP, the Selective (Salmon) Fishing Program: Final Report was produced providing an overview and a summary of activities, and achievements up to 2001. The policy for selective fishing in Canada's Pacific Fisheries was also released in 2001, to integrate issues raised in documents and workshop discussions and to set next steps and target dates for the development of selective fishing standards. The standards for selective fishing with regard to encounter rates have been expressed on a short term basis in IFMPs; long term fishing limitations according to by-catch mortality rate, as well as, standards for the fish handling have not been developed.

**To what extent have harvest allocations and access to fisheries been shaped by success at fishing selectively?**

The Allocation Policy for Pacific Salmon (1999) introduces seven allocation principles. Regarding the commercial sector allocations, selective fishing is allocation principle #6 and is defined as follows:

- a portion of the Total Available commercial Catch (TAC) will be set aside for existing commercial licence holders to test alternative, more selective harvesting gear and technology; and
- overtime commercial allocations will favour those that can demonstrate their ability to fish selectively.

This principle, perpetuated in the Selective Fishing Policy in 2001, provided the rationale for continuous testing after the PSSFP ended. A short term aspect of this principle is TAC, which was set at 5% allocated to fund testing of equipment. In general, interviewees welcomed the TAC allocation because it provided an incentive to investigate selective fishing opportunities. Information was provided that after the first year of the Program, fewer than five vessel owners continued to receive TAC under this arrangement. No evidence was found that formal evaluations were conducted to assess the scientific validity of the experiments undertaken under the TAC sharing arrangement.

The principle also provided for the potential long term reallocation of the TAC shares established in the allocation policy to those sectors that can demonstrate their ability to fish more selectively. While no long term reallocation of TAC shares between gear types has been initiated to date, the actual allocations achieved by the different commercial fleet sectors in the short term have reflected considerations of selectivity. The annual target allocations documented in annual Integrated Fisheries Management Plans take into account pre-season estimates of abundance and projections of the effectiveness of the different gears in achieving their TAC share given the fishing constraints required for conservation reasons. This has meant that in the short term the different gear types have under or over-achieved, relative to the sharing arrangements established

in the allocation policy, depending on their ability to fish selectively. This has directly encouraged project participants representing the gill net fleet, which was the under-achieving fleet, to develop more selective gear or modify its existing gear to decrease the capture of depressed stocks and thereby allow for that gear type to access the full allocation that would be provided if no depressed stocks were implicated. Fish harvesters interviewed stated that the high commitment of the gillnet fleet to apply new technology and modify their gear according to experimental requirements allowed them to have similar access to allocations as seine net and troll harvesters.

Commercial harvesters strongly support the use of part of the allocations to test selective fishing and support avoidance of by-catch. Strategies focused on the release of caught fish alive and unharmed. Conflicting opinions between DFO and industry were expressed about the merits of allocating the 5% by area, gear, and species considering that nothing will be done in Northern B.C. if an area-gear-species approach is taken. The allocation principle was regarded by interviewees as effective in initially promoting selective fishing strategies; managing the fishery in its new legal environment; enhancing the cooperation of industry; and in general, interviewees observed a commitment displayed by the harvesters participating in the collaborative projects.

### **To what extent did the PSSFP result in the maintenance of commercial harvesters and recreational anglers fishing activity?**

DFO managers and program participants believe that if the PSSFP had not been introduced an important component of Pacific salmon fishery would have been forced to close. The Program offered subsidies for the development of new technologies for selective fishing, new gear for harvesters and new management tools to manage the changing industry. The salmon fishery season reopened at a capacity much lower than before the closure in 1998; however, under the PSSFP approach to fishery management, fishing continued for all sectors and gear types.

An important element to maintaining fishing activity was allocation. Small portions of the fishing activity went towards conducting scientific experiments for the development of gear standards and selective fishing standards. Managing the allocations between sectors and among gear types became a management tool to reward harvesters for their commitment to selective fishing. After the Program was completed in 2002, the IFMPs guided the changes in the management approach which maintained the industry.

On the part of harvesters, commitment to gear modifications and innovation required by the PSSFP provided another reason for fishing activity to be maintained. The PSSFP studies were done to improve fishing gear selectivity in all gear types and sectors and to enable greater escapement of the non-target species. Many of the experiments with selective fishing gear produced mandatory licence conditions and found a place in the IFMP pre-season area specifications. This enhanced the implementation of selective gear in some sectors as harvesters were provided with a chance to continue and even increase their fishing activity if they could demonstrate commitment to fishing selectively.

The PSSFP had an impact in prolonging fisheries while managing it to prevent the decline of certain stocks and species caused by fishing. The PSSFP introduced, in theory and practice, a change in the way the industry was managed, constructed educational plans for harvesters and

introduced gear modifications for selective fishing. Those plans were introduced to minimize the effect of the fishery over endangered salmon stocks and the Program thus maintained the Pacific salmon fishery for all sectors in a period of low abundance.

**To what extent were the PSSFP and communications/education/training activities successful in altering the attitudes and behaviours of harvesters towards selective fishing techniques and gear?**

One of the first steps of the PSSFP was to communicate Program goals. Workshops were held to create a forum for the exchange of experience and views. Through our surveys we estimated that the majority of harvesters of all sectors were clear on the goals of the PSSFP. Another step was to exchange experiences between Atlantic and Pacific salmon harvesters. In January 2000 a team representing the B.C fishery visited the Atlantic Provinces to exchange experiences on selective fishing. The team consisted of seine, gillnet, and troll salmon harvesters, the Native Brotherhood, and DFO. They visited New Brunswick and Newfoundland to learn from the East Coast Commercial Fishery Training Program and try to apply it in the Pacific. A report of this visit was produced in May 2000, called "Industry & Departmental Responsible and Selective Salmon Fishing Training Program Development: The East Coast Experience."

Workshops were held regularly throughout the 4 years of the Program. Participants and DFO managers agreed that the communication strategies were successful in terms of reaching and informing the intended public about Program goals. This was supported by our surveys where harvesters indicated a high degree of awareness about the goals of the PSSFP and the directions of the experimental projects. Harvesters of all three sectors understood the PSSFP requirements in their sector and agreed that selective fishing was important. Scientists observed attitude changes while working with harvesters participating in projects, who were willing to change and apply new fishing techniques.

The threat of closures by sub-sectors motivated strong commitment to the Program goals. Commercial harvesters were concerned about the potential reallocation of salmon to other gears and aimed to demonstrate their ability to fish selectively. Such was the case with gillnet harvesters who were aware that their gear type allowed the highest mortality rate. Under highly controlled experimental conditions salmon gillnet harvesters were able to demonstrate a decrease in the short-term, post release mortality of Coho. Some gillnet vessel owners became personally committed to the development of selective fishing gear for gillnets vessels and pioneered the revival box. Their commitment was acknowledged in the making of the reallocation decisions.

The management of selective fishing is very complex and different fishing sectors often require a different management approach. For example, Aboriginal harvesters, have the right to fish for ceremonial purposes and retain some non-target species. They can delegate this right to commercial harvesters who in turn harvest under the agreements of fishing for ceremonial purposes on behalf of the Aboriginal community. In such cases, commercial harvesters handle fish differently than when they fish under their own commercial licence agreement and do not apply selective fishing methods. This could be perceived as a management inconsistency and results in a lack of commitment and failure to ensure long term behavioural changes.



In conclusion, although harvesters understand the importance of selective fishing, to change the harvester's behaviour is a long term commitment and further steps need to be taken in developing consistent standards and educating harvesters on how to apply them. The perceived threat from closures coupled with increased funding for the development of selective gear and methods provided the first step in the shift from traditional fishing to selective fishing. With decreased funding for enforcement activity it is important to implement a fair and consistent management approach as well as to develop conservation standards to promote the achievement of long term Program goals.

### **Were monitoring and enforcement activities effective?**

Monitoring was not sufficient to identify in a timely manner where there were compliance problems and as a result of that, enforcement may not have been applied as effectively as possible.

In the scope of this evaluation we looked at the impact monitoring and catch reporting had with regard to harvesters' compliance with selective fishing strategies. Monitoring and catch reporting were needed to form information base accumulating data on salmon movement and abundance by area. This data was necessary for planning and determining quotas, fishing times and proper allocations for the IFMPs. The Pacific Region's Fishery Monitoring and Catch Reporting Framework defines fishery monitoring as observing of the fishery and what is caught based on checking, observing and examining the catching and landing of fish and any related activities including the sampling of any fish caught. The Observer Program monitored salmon catch and release; conducted mortality experiments on captured Coho; and collected biological data. Designated observers included DFO staff or 3rd parties designated by the Minister. They were contracted and trained to monitor, collect and report catch data. Observer coverage was compared with other reports to validate the reliability of their data.

Catch reporting Means providing information, either orally, in writing or electronically, on what is caught whether retained or released. Catch reporting is done by harvesters, by fish buyers and off-loaders or contracted third party service providers on behalf of harvesters. The catch reporting program was expected to be more thorough than previous programs because, it received catch data from phone-in reports within 24 hours of a fishing trip; log book reports mailed at the end of a fishing season; and observer reports on a limited number of boats. While the observer data was reliable it was also expensive, and the percentage of observer coverage were diminishing from 10 % to 2% in the final years of the PSSFP. The majority of catch reporting was still coming from harvesters. Log book practices were successfully promoted only in some areas in Southern B.C.. Interviewees also added that log book data was incomplete and often came after the deadlines, and thus it did not provide reliable reporting for fisheries management purposes.

Log-books were made mandatory for all commercial harvesters, and voluntary for recreational and First Nation harvesters. However, log book and phone-in records were successfully implemented only in some areas in the Southern B.C. Erroneous loggings were also suspected as the catch numbers, first scribed on a piece of paper throughout the day, were entered in the log book at the end of a fishing trip. 100% reporting of hailing catch data was necessary to reflect instantly the state of salmon stocks in different fishing areas and to feed the fisheries allocation

system. However, reports were incomplete and due to the electronic transporting of data, harvesters were not held accountable for its accuracy. Fish slips, an other existent reporting system were also utilised. In the highest reporting areas accurate reports came in at 95% at best. In Northern B.C. managers continued to rely on fish slips and traditional methods to collect data on by-catch. A report in 2002 compared the monitoring systems and recommended improvements to the log-book program. We did not find out whether these recommendations were implemented.

There were contradicting opinions about the success of the catch reporting program with regard to compliance with selective fishing strategies. Observer coverage can provide an estimate of the accuracy of the information being reported by those vessels that report their landings, but observer information can not express how many vessels did not report. It has been suggested that charter patrols or aerial over flights are needed to do that. The sectors monitored most frequently were the recreational, next being the commercial, and least of all monitored were the First Nations harvesters.

The Program provided little funding for enforcement. Very few reports of violations were produced, yet in the opinion of the interviewees it was difficult to capture selective fishing violators. New gear and techniques for sorting and reviving became the norm, yet the practicality of their implementation is not fully examined. A cross-section of interviewees stated that it takes an extra step for harvesters to apply the gear in the proper way and they most often would not go out of their habitual handling to ensure selectivity.

Proper monitoring was expected to focus on where there are likely problems and then regulation and enforcement were to be applied accordingly to where problems were indicated. This cycle was not completed and there was not enough existing evidence to conclude whether or not monitoring and regulatory activities were effective towards increasing harvesters' compliance with selective fishing methods and techniques.

### **To what extent did the PSSFP contribute to the conservation of salmon stocks?**

The PSSFP was a constructive part of the plan to promote two conservation objectives announced in 1998:

- Fisheries will be conducted to achieve a zero fishing mortality for Coho stocks from the Upper Skeena and South Thompson rivers; and
- Where these Upper Skeena and Thompson Coho stocks are not prevalent, fisheries must be selective and demonstrate that the risk of by-catch mortality on Coho will be minimal.

One aspect in the conservation objectives was to minimise Coho by-catch mortality. The distribution of by-catch mortality among commercial harvesters using different gear type is uneven. Based on the short-term mortality experiments, the overall mortality rates of Coho held in a revival tank vary greatly among different gear type vessels. According to log books short term-mortality rates prior to release were estimated at approximately 42% for gillnets; 2% for seine nets; and approximately 8% for troll. Scientists from SFU designed studies to estimate short-term and long-term Coho by-catch mortality under the PSSFP. Five criteria indicating the degree of mortality of captured Coho were developed:

1. Vigorous/Non bleeding
2. Vigorous/Some bleeding
3. Lethargic/Non bleeding
4. Lethargic/Bleeding
5. Dead.

Coho by-catch was placed in the revival tank and soaked (for at least 70 minutes) prior to release. Before placement in the revival tank most of the by-catch (60%) appeared in the first and in the third categories. After soaking, the number of fish in the first category increases with the majority of the fish (up to 70%) of by-catch appearing in the first category. Another SFU short-term mortality study examined the effect of a cage swimming alongside a troll vessel and recorded similar results. Post capture delayed mortality was measured at zero after 24 hours. Those and other gear testing, described in the section “To what extent did the PSSFP result in adoption of new technologies and methods” of this report, were conducted between 1999 and 2001 and indicated beneficial effects with regard to the short-term survival of Coho by-catch. They supported the development of licence conditions.

The 2001 Selective Fishing Policy states that DFO is interested in developing ways of estimating spawning success of released fish. Long-term mortality experiments were conducted to test if released fish lived to reach the spawning grounds and spawn. Studies on post-release survival of Coho were conducted by holding Coho for 24 to 48 hours after capture in a fish holding pen. The fish were tagged and then released to continue their course. The majority of the tags detached from the fish while in the pens and thus long term survival experiments could not be carried out successfully. An attempt made to detect tags at the spawning grounds was also unsuccessful.

In conclusion, the program measured success to complete short-term mortality experiments which amended license conditions to require selective gear. However, long-term mortality experiments did not come up with evidence that released by-catch was able to escape and spawn successfully and thus ensure conservation of salmon stocks.

### **To what extent was the PSSFP successful in altering the behaviour of harvesters?**

The Code of Conduct for Responsible Fishing developed in 1998 represented a positive step in modifying salmon harvester’s value system yet a very minor one. The Code was communicated successfully to commercial and recreational harvesters who voiced their agreement with its provisions. Although the Code was not communicated as well to recreational anglers, promoting selective fishing equipment and practices were seen simpler in this category. Overall, the Code as a symbolic document alone has no binding power to influence changes in the behaviour of harvesters. From interviews we concluded that new gear can only be successfully selective if handled in the proper way; therefore, a thorough change in the attitudes and behaviour of harvesters in all sectors of the salmon fishing industry was essential for the success of the PSSFP.

With regard to selective fishing gear, DFO managers have observed that project participants changed their fishing habits and used the gear. While harvesters in general have altered their vessel set ups and have added to and modified their fishing gear as required. We could not

conclude whether that change spread over to the broader community of harvesters. In addition, we heard from both harvesters and DFO managers that the new equipment and the new settings made it necessary for harvesters to work as a team. This was one intended outcome for the Program which also enhanced greater peer learning. DFO managers suggested that the new licence requirements and the observer coverage on board provided an incentive for the use of the selective gear.

While standards were developed for fishing equipment, standards for the use of the equipment and for handling the fish were not being developed. We were told by project leaders that the new gear is serving selective fishing purpose only if it is applied with the proper care. With regard to handling the fish in the required way, it was observed that the necessary change in the wide majority of harvesters' not participating in the projects did not occur. Selective fishing standards for handling fish had to be clearly identified to elicit such behaviour from harvesters.

There is no conclusive evidence to suggest that harvesters have altered their behaviour to handle fish with care. To change the behaviour of harvesters it was important to develop and finalise the work on standards enforce them and thus prolong the effect of the Program by encouraging long term behavioural change in harvesters.

### **Did the PSSFP contribute to a more viable and sustainable fishing industry?**

It is early to suggest at this time what will be the long term contributions of the Program to a more viable and sustainable fishing industry. We made some preliminary assessment of this issue and asked program participants of which 88% agreed that selective fishing is important to the viability of the resource. Industry, academics, conservation groups, DFO managers and staff interviewed also believe that selective fishing contributed to the viability of the resource. The viability of the industry was at stake and the Program introduced a new management approach and fishing schedules to promote a different type of fishing industry that would do less harm. The Program impact on increased escapement could not be measured since many other factors come into play. Nonetheless, if such a program is undertaken in the future, it would require stable provisions, clear guidelines, standards and requirements, and a much higher incentive to harvesters to abide by the new norms and requirements than was achieved here.

## **4.4 COST-EFFECTIVENESS**

### **Were the resources supporting each component of the PSSFP allocated in a cost-effective way?**

Experiments and research components' activities were merged for reasons of efficiency. Program managers and scientists working on both indicated that a number of duplications and expenses were avoided by conducting experiments along side research activities. The Program's goals have been very well communicated and the support was in place to enable the conduct of planned activities. The 5% TAC provided an extension to the funding of experimental activity.

A small component of monitoring, the Observer Program, was the most reliable and very expensive. As a result the greater number of catch reporting was still coming from the harvesters. Observer coverage was expensive and for this, the levels of the observation initially

at 10% coverage for CFAR monitoring in 1998 had dropped near the end of PSSFP to 2% or lower as funding decreased. Other, more cost effective means of monitoring needed to be considered.

Many interviewees stated that the projects could have been more focused, rather than spread over a wide spectrum of experiments. Some of our interviewees thought that better planning in the first year could have lead to better use of the resources. In terms of Program conduct, the selection of individuals within DFO to coordinate the Program activities was well thought out and that the individuals selected performed their duties well.

Activities were managed within the approved Program budget, however the measurement element to relate the costs to the achievements was missing. It is recommended, however, that in similar programs project financial data and performance information be kept on two parallel tracks and annual summaries be made, in order to trace in detail the program impact.

**Was the PSSFP cost-effective compared to alternatives such as no Program at all, or a government-imposed program without industry involvement?**

From the start, the PSSFP relied on the involvement of industry to carry out projects and monitor tasks. Alternative options, such as delivering the Program without harvesters input or proposing to industry to carry out the Program were not explored. The implementation of the techniques and methods would have been extremely difficult without the commitment of industry and harvesters from different sectors.

Through workshop discussions, commercial stakeholders agreed that testing of selective fishing gear and methods should focus first on modifications of existing commercial gear, and only when such gears were proven incapable of being more selective would allocations (and funding) be used to test alternate gear and methods. The Program engaged experts and managers to work together with provincial and non-governmental representatives, and the industry in achieving the Program objectives. DFO Program staff and scientists manage the new Program. External participants such as provincial and NGO representatives, industry representatives and scientists from SFU, were identified.

Industry, academia, conservationists, representatives from B.C. government, and DFO managers and staff agreed to participate in helping deliver the PSSFP. No program at all would have meant government imposed salmon fishery closure. Those that were interviewed agreed that the industry had to be involved and thus provided a spirit of collaboration between harvesters and the manager of the Program. This was a valuable step in the design and conduct of Program activities because it allowed harvesters to provide expertise in what they knew best, the capability of their gear, and engage their experience in creating selective fishing gear. This was an intended effect and as expected, it increased the level of commitment among Program participants. This commitment, however, did not spread to the great majority of harvesters, as only a small sample of harvesters were engaged in the Program.

**What (cost) impacts did mandated gear changes have on individual fishers (by sector).**

Information regarding this evaluation question is primarily gathered through our surveys with proponents and licence holders from the recreational, Aboriginal, and commercial fishing sectors. In general, while recreational anglers stated that costs related to their selective gear purchases were insignificant, there were greater expenses related to the purchasing of equipment for the Aboriginal and commercial sectors.

In the case of Aboriginal gear purchases, funding was provided through the Program to local Native communities. There was also a group of commercial harvesters from among the commercial fleet that participated in research and experimental projects who were awarded with funding for gear purchases based on their proposals of projects for the testing of gear selectivity.

We also surveyed a sample of troll, seine, and gillnet vessel owners from the commercial fleet who were not project participants. Overall more than half the vessel owners stated they did not experience any substantial costs (that is costs that exceeded \$1,000) and the majority did not anticipate any additional costs in the near future.

To conclude on the Program's cost-effectiveness, a common creative approach towards Coho preservation was in place and the costs required of harvesters to comply with purchasing the mandatory selective fishing gear were bearable for the majority of harvesters. Resources were allocated to each one of the components, and the components were crafted to fit the emerging crisis. While the activities in the PSSFP responded clearly to the Program component objectives, there were no measurement indicators or collection of data that would link actual activities to the outcomes and the long term conservation effects of the Program. Accurate implementation measures and selective fishing compliance indicators needed to measure the Program progress were lacking and without these the high level conservation objectives of the Program seemed disjointed from the implementation strategies undertaken. The Program presented an alternative to closures of significant areas of the Pacific salmon fishery.

## 5.0 CONCLUSIONS

Based on the findings expressed above, we conclude that the PSSFP was relevant to DFO and government priorities and welcomed by individuals who represented different interests. The way the Program was designed and delivered revealed it to be the best solution under the complex circumstances to support innovative management practices and fishing technologies for commercial, First Nations and recreational harvesters. The Program became the alternative to closures of significant areas of the Pacific salmon fishery. Success was observed in the implementation of gear requirements, allocation applications, experimental testing, and overall in starting the industry to think in the terms of selectivity. The Program was also successful in managing and maintaining fishing activities and sustaining the industry through a period of low abundance while advancing the area of stock identification research.

Our findings also indicated that the Program had limitations with regard to its design in that it did not take into consideration environmental and other complex factors. The development of a viable and sustainable fisheries industry is very difficult to assess especially because abundance in fish return is not necessarily related to the way the fisheries is managed. Some short term alterations in the behaviour of harvesters participating in the projects were observed but there was no evidence to suggest that the majority of harvesters embraced the new requirement. Standards for handling the fish were lacking and it is not likely that without such standards this requirement will prevail. There were concerns expressed that monitoring with respect to compliance with selective fishing was inadequate and that the resulting lack of regulation may undermine the program's potential long term impact. The aim to develop selective fishing standards, with respect to encounter rates and total mortality for non-target by-catch in the fisheries, and have them in place to prolong the effects of the Program after funding ended was not fully achieved other than in a the scale of temporary area planning. The objectives were lacking a measurable aspect regarding how; for example, observed conservation outcomes (such as the early trend of increase in abundance) would be attributed to selective gear use. Indicators and performance measurement information were needed to provide the data that would link the research and experimental work to the long term effects of the Program.

Overall, the Program contributed to the development of innovative scientific and management approaches to address any new trends observed in the movement of salmon. With regard to the most essential long term outcomes such as spawning experiments and selective standards developments, as well as, changing the harvesters' behaviour, the Program did not measure results.

## LESSONS LEARNED

Lessons learned to be considered in the development of any program that aims at achieving conservation results and raising protective measures for endangered species while allowing continued harvesting activities are:

- Select carefully the strategies that encourage changes in the behaviours and practices, because those that are implemented through a payment system are likely to disappear when the payments stop.

- Utilise 5% TAC (Total Allowable Catch) to initiate the development and implementation of gear and fishing method and standards for selective fishing in a proactive manner by collaborating with harvesters. Assess the necessity of 5% TAC application on annual bases according to its goals and discontinue the practice when it outlives its purpose.
- Address concerns with monitoring of the pre-existing systems and consider alternative monitoring practices in order to develop monitoring systems that provide reliable data for the fishing plans. Some fishery monitoring practices suggested to us were on-board observers, charter patrol vessels and aerial over flight that can help to determine the degree of fleet compliance with catch reporting, gear and other requirements in the fishery.
- Improve the monitoring systems to identify areas of non-compliance with selective fishing standards and practices in a timely manner in order that appropriate enforcement is carried out.
- Find proactive ways of integrating commercial harvesters' input in the development of standards for handling the fish with the use of particular selective fishing gear.
- Identify different ways of encouraging compliance with selective fishing gear measures and standards.
- Develop clear and simple performance measurement indicator by program component to measure the program progress on ongoing bases.
- If such a program is undertaken in the future, it would require stable provisions, clear guidelines, standards and requirements, and a much higher incentive to harvesters to abide by the new norms and requirements.
- As a mean to encourage the utilisation of selective fishing practice among commercial harvesters, clarify for stakeholders the implications of failing to meet selective fishing standards. Develop feedback mechanisms that would reflect back to harvesters their performance in accordance to selective fishing regulations.
- Ensure that formal evaluations are conducted to assess the scientific validity of the experiments undertaken under the TAC sharing arrangement and build on that work to develop standards. Once standards are developed add to the requirements.