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## An Economic Review of Artificial Salmon Propagation and Management Operations in Japan

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### Abstract

This study investigates the positive economic effects of salmon propagation operations on salmon fishing areas in Japan. The effects of these operations had previously been measured biologically using salmon's returning rates. However, few studies have been conducted from an economic point of view. Iwate Prefecture has one of the most advanced salmon propagation operations in Japan. In this study, we will therefore analyze the fishing area of Miyako Fisheries Cooperative. Miyako typically represents the Iwate Prefectural salmon propagation system where the private sector manages the operation and the number of released fry is relatively very high.

Our findings are: (1) The fisheries cooperative directly manages the fishing operations of the set net fishery. The additional profits from these operations cover the cooperative's management costs. As a result, the necessary contributions to the co-op by members have decreased. (2) The fishermen involved in the set net fishery are cooperative members working as employees. They gain wages and secure a stable income through their co-op wages. (3) Additional profits from the salmon propagation operations are insignificant, but profits from the cooperative managed fishing operations are sufficient to cover the deficit. (4) The changes in the number of returning salmon is strongly dependent on the number of fry released and this in turn has a strong correlation between the propagation costs and the income from returning salmon.

The income from salmon propagation operations is basically composed of prefectural subsidies and fishermen contributions. However, this support is insufficient to cover the operation costs. Therefore, the unification between salmon propagation and fishing operations has been established to achieve the fisheries objectives.

### Introduction

Japanese salmon propagation operations are carried out in most of northern Japan. In 1988, the number of fry released throughout the country was 2.05 billion fry, of which 1.08 billion and 973 million fry were released from Hokkaido and Honshu Island, respectively. On Honshu Island, Iwate Prefecture ranked first among the other prefectures in salmon propagation operations. The number of fry released in 1988 was nearly 443 million fry representing 45.5% from the total number of fry released in Honshu. Among the other prefectures of Honshu, Aomori Prefecture is the only other prefecture which released more than 100 million fry. Therefore, we recognize that Iwate Prefecture has the largest scale salmon propagation operations on Honshu; Japan's main Island (Figure 1).

In 1988, the total number of salmon caught was 51.293 million fish of which,

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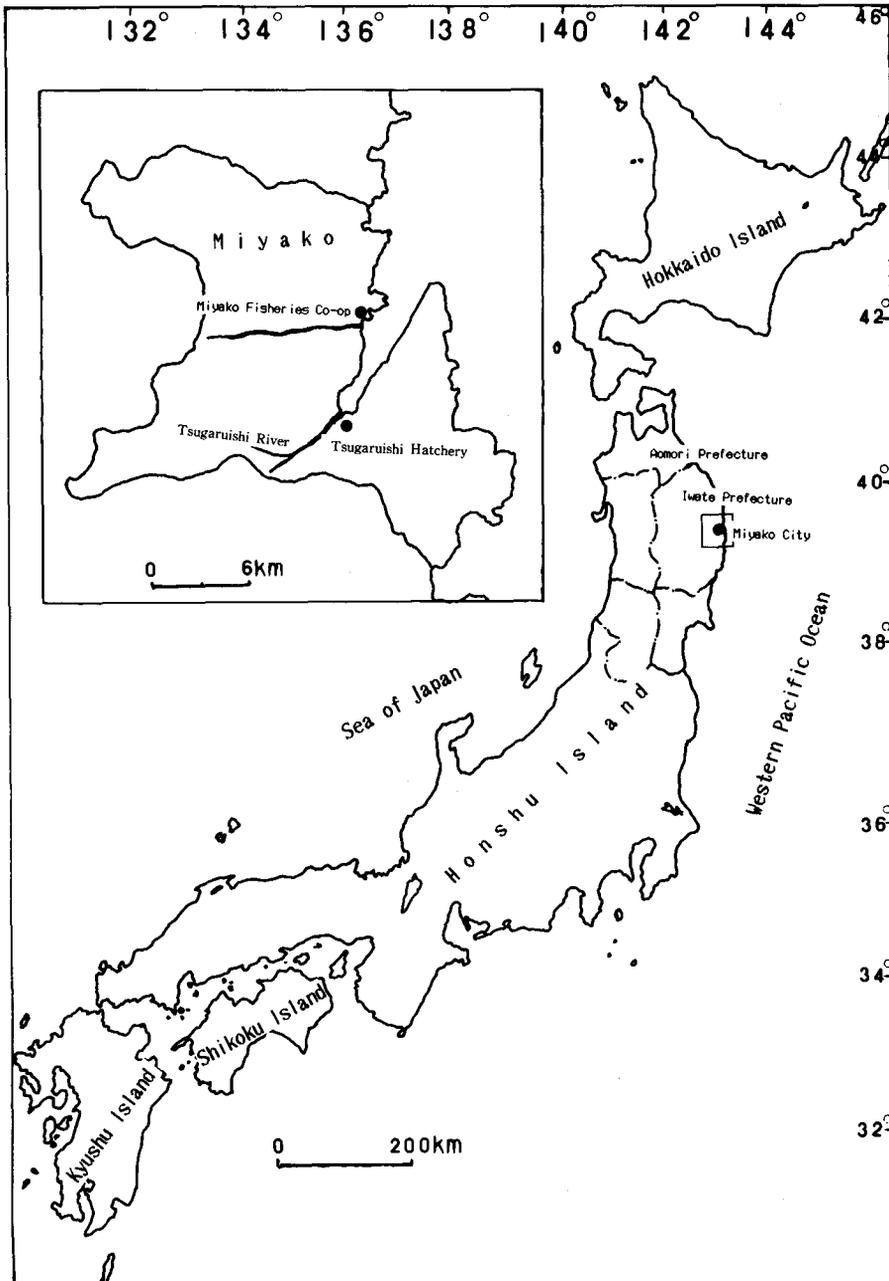


Fig. 1. Diagram of Iwate Prefecture and location of Miyako Fisheries Cooperative.

3.289 million were fresh water catch and 48.004 million were coastal catch. While Hokkaido catch was 2.315 million from rivers and 32.514 million from coastal waters, Honshu's catch was 974,000 from rivers and 15.49 million from its coastal fisheries. In Honshu, Iwate Prefecture ranked first in salmon landings, with river catch at 45% (439,000 fish) and coastal catch at 76% (11.768 million fish) of Honshu's river and coastal catch, respectively (Table 1).

In Hokkaido, government enterprises manage most of the salmon propagation operations and private enterprises manage very few of these operations. In contrast, all salmon propagation operations in Honshu are managed by the private sector. In this case, river fishermen work under the supervision of inland water fisheries cooperatives after receiving fishing rights. Marine fishermen work under the supervision of the coastal fisheries cooperatives for that specific fishing area<sup>1,2)</sup>.

In Iwate Prefecture, all salmon propagation operations, and most salmon fishing operations, are carried out by the regional coastal fisheries cooperatives. Because the total revenue from salmon propagation operations is insufficient to cover its expenses, the profits from the catch of returning salmon of coastal fisheries are transferred to fund the salmon propagation operations. This system of fisheries operations in Iwate Prefecture is reasonable and efficient, and it is typical of Honshu

Table 1. Number of released salmon fry and the corresponding catch in Japan during the period 1970-88.

Year	No. of fry released (million)		No. of fish catch (1,000)			
			River		Sea	
	Hokkaido	Honshu	Hokkaido	Honshu	Hokkaido	Honshu
1970	442	145	627	149	4,651	425
1971	576	212	846	245	6,806	749
1972	476	225	614	229	6,343	804
1973	446	271	597	238	7,724	710
1974	485	272	601	244	9,026	879
1975	802	344	1,557	362	14,217	1,463
1976	523	287	464	183	3,841	1,362
1977	693	413	741	374	9,466	1,873
1978	779	433	863	394	12,284	2,667
1979	873	590	1,153	608	17,750	4,519
1980	1,146	750	1,660	1,099	13,784	5,873
1981	1,080	738	1,631	727	20,295	7,251
1982	1,113	863	1,770	894	18,270	7,448
1983	1,147	884	1,778	777	21,235	10,052
1984	1,139	894	1,831	895	19,742	15,880
1985	1,131	910	2,413	888	29,461	16,559
1986	1,073	928	1,999	1,201	26,218	19,206
1987	1,053	937	1,567	841	26,560	13,947
1988	1,077	973	2,315	974	32,514	15,490

Source: Fisheries Agency of Japan.

Island salmon propagation operations<sup>3,4,5</sup>).

In this study, we will investigate the following: 1) The framework of salmon propagation operations in Japan, 2) The economic efficiency of salmon propagation operations and salmon fishing operations through the analysis of expenses and income, 3) The economic effects of salmon propagation operations on salmon fisheries. Finally, we will conclude with our suggestions concerning a reasonable and efficient system of salmon propagation and harvest.

This study relied on time series data collected from fisheries propagation operations associations and financial organizations. To study the present circumstances and problems facing the management of fisheries propagation operations, we collected data through interviews with the managers of these operations. Regarding the economic effects, we analyzed salmon propagation operation costs, the relationship between salmon fry and salmon catch, the relationship between costs and income, and then reviewed the framework of salmon fishing operations and its profitability<sup>6,7,8</sup>).

### The Infrastructure Impact of Salmon Propagation Operations in Iwate Prefecture

#### 1. *The framework of salmon propagation operations*

In Honshu, the private sector has been carrying out salmon propagation operations on its own facilities. However, regional prefectures provide these enterprises with the required financing in order to sustain operations. For example, the prefectural government provides necessary equipment. It purchases and transports fish fry from the private hatcheries during releasing operations. In return of these facilities from the prefecture side, the government has been supporting these regional prefectures through paying back its expenses. Regarding the 1988 figures, 189 hatcheries had been established in 20 prefectures of Honshu, of which 3 prefectures have independently carried out its hatching installations. The Japanese government has been increasing its budget for salmon propagation operations from ¥300

Table 2. The levels of the Japanese budget in connection with Chum and Masu Salmon.

	¥ million						
	1960	1965	1970	1975	1980	1985	1987
Hokkaido salmon's hatchery	142	297	380	804	2,200	1,957	2,017
Management costs	134	250	347	657	979	1,186	1,255
Establishment costs	8	47	33	147	1,221	771	762
Subsidies to Honshu	8	22	35	130	1,385	1,178	1,137
Liberation operation's costs	8	17	26	68	325	411	428
Establishment costs	—	5	9	48	786	614	560
Investigation's costs	—	—	—	10	215	108	114
Protection operation's costs	—	—	—	4	59	45	35
Total	150	319	415	934	3,585	3,135	3,154

¥100 = US\$69.14 (1987)

Source: Fisheries Agency of Japan.

Table 3. Classification of the total expenditure on salmon propagation operations in 1986.  
¥ million

Region	Total	National expenditure	Local expenditure	City, town, village	Sea fishermen	Hatchery operators
Hokkaido	6,799	2,097	851	214	1,477	2,160
Honshu	3,815	851	780	129	953	1,102
Iwate	2,067	372	285	20	814	576
Total	10,614	2,948	1,631	343	2,430	3,262

¥100=US\$59.34 (1986)

Source: Fisheries Agency of Japan.

million in the second half of the 1960's to ¥1 billion in the middle of the 1970's and to ¥3 billion by the end of the 1970's. However, in spite of this ¥3 billion budget in the 1980's, there is a decreasing trend. At the end of the 1970's there was a sharp increase due to increasing subsidies of Honshu which represented over 30% of the total salmon budget for Japan (Table 2).

Regarding results of Japanese fisheries investigation by 1986, the salmon propagation operations in Honshu costs about ¥3.815 billion. Of this amount, government and prefectural subsidies were about 42.8% (government-22.3%, prefecture-20.5%). The private sector's share was 57.2% (cities, towns, and villages-3.3%, marine fishermen-25%, and propagation operators-28.9%) (Table 3). Costs of these operations composed 18.9% for fry purchasing (government-7.9%, prefecture-11%), the assistance of establishment cost 12.4% (government-9.2%, prefecture-3.2%), investigation and researches costs 4.7% (government-2.1%, prefecture-2.6%), river environmental maintenance and preservation costs 1.8% (government-0.8%, prefecture-1%) and road equipment and its related equipment costs 5% (government-2.3%, prefecture-2.7%).

Governmental and prefectural subsidies for plant and equipment investments in fish hatcheries for maintenance construction has been reduced. This caused some deficiency in management expenditures for purchasing fish fry. The subsidies of the government and prefectures represent about 40% of the total expenditure of salmon propagation in Japan. The private sector has been finance its requirement expenditure by two ways. The first is by selling the river catch, and the second is through the contributions of marine fishermen (3.5-5% from the total value of fish product). This contribution has been separately organized by Salmon Propagation Organization. This organization collects contributions from fishermen to support the establishment and management of the fish hatcheries. Depending on its income from river and marine fisheries, the private sector has been financing hatching and releasing operations.

The system of salmon propagation of Iwate Prefecture is similar to Honshu's system. However, contributions from marine fishermen in Iwate are more than those from Honshu fishermen. They depend on large revenues from the use of large scale set net fisheries. In addition, Iwate Prefecture's salmon propagation operations are managed by marine fishermen organizations similar in characteristic to fisheries cooperatives.

## 2. The Achievements of Salmon Propagation Operations

According to 1988 figures, 41 hatcheries had executed activities on 46 river banks in Iwate Prefecture. The operations of these hatcheries are: 1) egg removal and egg incubation operations of the adult and mature fish which are caught from rivers, 2) egg removal and egg incubation operations of fish preserved and mature fish which are caught using the set net fisheries, 3) organizing the transplantation and incubation of fish eggs which come from other hatcheries in the same prefecture or from the other prefectures.

First, the total catch of salmon of Iwate Prefecture in 1988 was 439,000 fish. Disregarding that it was 708,000 in 1986, it maintained at a steady level of 500,000 before and after in the first half of the 1980's. Therefore, the salmon catch has recently experienced a decreasing trend. Also the number of removal eggs decreased from 512.06 million eggs in 1984 to 439.8 million in 1988 (Table 4). This decreasing trend results from Iwate Prefectural hatcheries shifting away from large quantity production in favor of fewer but higher quality fry.

Second, the preservation number of adult fish from marine products in Iwate Prefecture in 1987 was 3,986 fish at 7 stations. This value has more than doubled to 9,144 fish in 11 stations (preservation centers). Also the number of removal eggs has increased sharply from 1.36 million in 1985 to 8.57 million in 1986, 12.32 million in 1987, and then to 22.21 million eggs in 1988. Therefore, we can recognize that there is a decreasing trend of the river total catch which is unbalanced with the

Table 4. Levels of salmon fry released and fish catch in Iwate Prefecture during the period of 1975-88.

Year	Fresh water catch (1,000)	Marine catch (1,000)	Total (1,000)	No. of removal eggs (million)	No. of transplanted eggs (million)	No. of hatching eggs (million)	No. of fry released (million)		
							Rivers	Breeding in the sea	Total
1975	189	779	968	150	-2	159	145	—	145
1976	132	910	1,042	161	-10	154	144	—	144
1977	202	1,114	1,316	230	-11	223	208	—	208
1978	262	1,876	2,138	284	-49	236	214	—	214
1979	377	2,901	3,278	350	-49	303	263	—	263
1980	900	4,715	5,615	389	-53	338	301	—	301
1981	522	5,777	6,299	372	6	367	278	48	326
1982	642	5,974	6,616	480	-35	456	339	60	399
1983	457	8,188	8,645	442	-23	422	309	67	376
1984	544	12,612	13,156	512	-56	457	331	78	409
1985	453	13,406	13,859	472	2	475	325	97	422
1986	708	16,001	16,709	492	7	508	331	106	437
1987	381	10,763	11,144	475	7	495	319	105	424
1988	439	11,768	12,207	440	43	505	344	99	443

¥100=US\$78.03 (1988)

Source: Collected and accounted from Fisheries Agency of Japan.

number of fry released. This is in addition to the problems of transportation and preservation costs and this complementary disposition has been continuing.

Third, the survival number of the transplanted eggs in Iwate Prefecture from Hokkaido has sharply increased from 2.1 million eggs in 1985 to 10.66 million in 1986, 11.5 million in 1987, and 39.07 million in 1988. This increase is due to the increasing returning rates around the month of November of large schools of Hokkaido salmon. As a result in Iwate Prefecture, the total catch of salmon is stable during this fishing period. There are a large number of transplanted eggs in and around Iwate Prefecture. The transplanted eggs in Iwate Prefecture are of a good quality sources.

By this way, salmon eggs are insured through many forms. In 1988, the number of eggs taken from river catch was 439.8 million, 22.21 million were from the marine catch, and transplanted eggs from Hokkaido equaled 39.07 million. The total number of eggs was 501.08 million of which, 5.2 million eggs were transplanted outside Iwate Prefecture. The total number of hatched and transplanted eggs in Iwate Prefecture balanced at 495.88 million eggs.

There was a sharp increase of hatched and released fry. While the release number was approximately 400 million in 1984, thereafter it increased to 442.76 million in 1988. This number has been doubling every few years since the second half of the 1960's. The rearing and releasing of fry into the sea began in 1976 with 8.5 million fry and increased to 99.05 million fry in 1988. This composed about 22% of Iwate's number. Recently, the ratio of fry to eggs taken from spawning salmon was nearly 90 percent (Table 4).

### 3. *The Economic Efficiency of Salmon Propagation Operations*

Rather than review all the fish propagation operations in Iwate Prefecture which have continued to increase over the years, we preferred to study the economic efficiency of one specific operation. We will analyze the revenue and costs of the Tsugaruishi Salmon Hatchery which plays the largest role of salmon propagation operations in Iwate Prefecture.

The Tsugaruishi Salmon Hatchery has an old history, it began in 1905. However, the beginning of its full capacity started after the World War II. From 1968 it proceeded under the administration and supervision of Miyako Fisheries Cooperative.

The total number of Tsugaruishi River's salmon harvest increased from 20,000 fish in the 1960's to 50,000-60,000 in the first half of the 1970's and increased to 100,000 fish in the second half of that decade. However, beginning in the 1980's harvests began to decrease until they reach approximately 40,000 and 50,000 fish in 1987 and 1988, respectively. Tsugaruishi River's salmon catch constitutes approximately 50% of the total salmon harvest from Iwate Prefecture's fresh water catch. There is a possibility to increase this product but, since the 1970's the contributions of the other rivers have increased. Therefore, the relative economic importance of Tsugaruishi River decreased. Its fish catch represented nearly 30% of Iwate Prefecture's river landings at the second half of the 1970's decreased to 10% in the 1980's. The number of released fry was nearly 20 million fry in the 1960's and increased to 70-80 million in 1972-1973. It then stabilized to the level of 40-50 million fry from the second half of the 1970's (Table 5). The rate of fry released

Table 5. The relation between salmon fry released and the corresponding catch according to the catching methods in Miyako Fisheries Co-op fishing area.

Year	No. of Liberation (1,000 fry)	(Tugaruishi)	No. of fish caught						(Tugaruishi) (%)	
			Set net	%	Long line	%	River	%		
1979	52,223	41,767	770,708	85.2				134,097	14.8	125,843 (13.8)
1980	60,539	43,180	851,184	74.7				276,564	25.3	262,392 (24.0)
1981	55,326	40,306	636,451	87.5	31,048	4.3	59,807	8.2	53,456 ( 7.3)	
1982	61,232	42,949	794,237	80.8	59,048	6.0	129,282	13.2	106,135 (10.8)	
1983	58,463	40,383	884,310	81.1	122,436	11.2	83,528	7.7	66,309 ( 6.1)	
1984	70,429	51,367	1,609,703	82.3	231,777	11.8	114,707	5.9	97,215 ( 5.0)	
1985	74,311	56,177	1,298,363	84.7	124,137	8.1	109,880	7.2	90,262 ( 5.9)	
1986	63,000	46,000	1,117,147	72.4	316,322	20.5	109,598	7.1	66,495 ( 4.3)	
1987	62,710	45,727	831,768	77.7	168,076	15.7	70,838	6.6	42,206 ( 3.9)	
1988	69,017	52,117	682,075	66.2	262,199	25.4	86,432	8.4	51,564 ( 5.0)	

Source : Collected and accounted from Miyako Fisheries Cooperative.

and the rate of salmon caught at Tsugaruishi Hatchery was nearly the same and displayed the same trend. The beginning of releasing fry and then rearing them into the sea began in Japan in 1976 at Tsugaruishi Hatchery. In 1976, the number of released fry was 4.5 million and then increased continuously until reaching 12 million fry in 1979. In 1986 the level reached 17 million fry ; representing over 30% of the total number of released fry in Tsugaruishi (Table 5).

At the same time, Miyako Fisheries Cooperative was carrying out arrangements to increase the hatching and rearing capacity of the facility. The cooperative then moved toward producing a high quality fry rather than increasing its production quantity. With regard to egg-taking at Tsugaruishi Hatchery, it increased until 1985, keeping at a level of 100 million eggs. However, from 1986 and 1987 this number decreased to 60 million and 46 million, respectively. This reduction, in effects, caused the extinction of egg exports from the hatchery.

On the other hand, the number of eggs taken in Hokkaido had increased because of the early migration of salmon schools before November. The number of eggs harvested in Hokkaido rapidly increased 10 times to a level of 20 millions eggs in 1987. As a result, the early return rate included more than 20% in the total number of released fry. The Tsugaruishi Hatchery perfected several techniques to meet its objective of improved fry quality. For example, the hatchery maintains immature salmon that returned prematurely, until they sexually mature, in order to obtain healthy eggs at the optimum time. These fish, as well as returning adult salmon, are selected. Roe is weighted to minimize egg-taking yet still provide the necessary number of quality eggs. In addition, improved return rates and reduced mortality rates have been accomplished by rearing fingerlings in low density conditions to ensure large healthy fry are released.

In this way, we can say that Tsugaruishi Hatchery advanced its position among fish hatcheries, not only in Iwate Prefecture but through out Japan. It has the perfect tools and techniques to lead it to optimal efficiency. This advanced situa-

tion is supported with proof obtained through the results of income-expenses analysis which showed that this hatchery has the standard management of Honshu Island.

The sources of Tsugaruishi Hatchery's income are : (1) selling fish fry to Iwate Prefecture ; the value of released fry, (2) subsidies from Iwate Propagation Association in return of released fry, and (3) other income composed of the value of fertilized eggs, eyed-eggs and selling fry to other cooperatives. The price of fry is determined by two factors ; the total expenditure offered by the Iwate Prefecture Government for a predetermined quantity of fry, and the actual amount of fry produced by the hatchery. Regardless of production quantity, Iwate Prefecture will pay the hatchery the amount allocated within its budget list for purchasing fry. Should the unexpected occur and the hatchery fail to produce the predetermined quantity, it still receives the same income from the government. On the other hand, if it over produces, the government only receives the predetermined quantity of fry and the hatchery uses the excess as it sees fit. In other words, increasing of fish fry production means decreasing price per fry. Decreasing the number of fry released means increasing the price per fry. The number of returning salmon is dependent on the number of fry released. On the other hand, the release number is limiting by the number of returning salmon. Therefore, increasing the number of returns is the first choice. In spite of the fact that the Propagation Association of Iwate Prefecture had been limiting its subsidies, there is a possibility to increase the operation's income because of the increasing demand on fish fry from other cooperatives.

Tsugaruishi Hatchery's income from selling fish fry to Iwate Prefecture accounted for more than ¥40 million in 1980 and 1981. After that it dropped to a level of ¥30 million. Changes in the number of released fry had no effect on income. The financial subsidies from the propagation associations were ¥10 million at the beginning of the 1980's. This was limited compared with the value of

Table 6. The construction of the main costs and the total expenditure on

Year	Income (¥1,000)	Sales to prefectural government (%)	Subsidy by The Association (%)	Other (%)	Cost (¥1,000)	Management expenses of hatching (%) (A)	Wage (%)	Expenses for light, fuel & water (%)
1980	95,559	45.1	23.3	31.6	54,080	71.0	27.8	6.6
1981	64,008	63.4	17.5	19.1	40,329	82.3	36.6	11.4
1982	85,244	35.6	15.3	49.1	47,029	86.1	41.9	10.0
1983	86,763	36.5	18.6	44.9	51,407	88.0	39.6	9.9
1984	164,886	20.2	26.2	53.6	63,480	83.2	46.3	8.3
1985	143,391	23.9	30.1	46.0	78,796	89.0	38.1	12.6
1986	101,411	36.1	32.5	31.4	108,098	82.3	25.7	12.2
1987	113,624	29.7	30.7	39.6	113,262	83.1	25.3	10.6
1988	109,553	35.4	53.4	11.2	109,709	85.1	28.1	11.6

(A) + (B) = 100

Source : Collected and accounted from Miyako Fisheries Cooperative.

prefecture's purchasing. However, in the second half of the 1980's it was much more than the prefecture's purchasing value. This is due to the increase in coastal salmon harvest and in member contributions which lead to the establishment of a basic fund for propagation association operations. As a result, it also lead to an increase of subsidy expenditures (Table 6).

Also, the value of selling fish fry to other cooperatives increased sharply during the mid-1980's where the demand on fish fry increased not only inside Iwate Prefecture but also outside the prefecture. At the present time, in spite of decreasing productivity, there is a possibility to provide other hatcheries with fish fry after self sufficient. Thus, Tsugaruishi Hatchery's income passed ¥100 million in 1984, but after this there was a stagnation in spite of it receiving the same level of ¥100 million annually.

On the other hand, the operation's costs increased steadily with a maintenance level of ¥50 million in the first half of the 1980's with high profits. The profitability corrupted led to a deficit in the second half of the 1980's. This deficit came from decreasing income in front of the continuously increasing costs. Depreciation composed the greatest part within these costs. This is due to the improvement in installations and the increasing of the facilities needed to reduce the rearing density. Expenditures also suffered from the reduction in egg exports and in the selling of perfect fish fry not only inside Iwate Prefecture but also to other prefectures.

Thus, the rearing cost per fry released increased from less than ¥1 during the beginning of the 1980's, to more than ¥1 in the middle of the 1980's. It then increased to over ¥2 in 1987. On the other hand, the rearing cost per fry reared in the sea was ¥0.5 until the middle of the 1980's. It increased gradually until it reached to more than ¥1. It has kept this level since 1986. This increases the installation's investment in addition to depreciation and leads to large increases in

salmon propagation operations in Miyako Fisheries Co-op fishing area.

Feed (%)	Depreciation (%)	Breeding cost in the sea (%) (B)	Wage (%)	Feed (%)	No. of release (1,000 fry)	Number of release breeding fry	Rearing cost per fry released	
							In the river (¥)	In the sea (¥)
5.4	27.8	29.0	4.7	7.0	43,180	13,000	0.89	1.21
7.5	18.2	17.7	6.3	8.9	40,306	13,000	0.82	0.55
6.7	21.4	13.9	5.3	7.7	42,949	13,000	0.94	0.50
6.2	11.7	12.0	3.6	6.2	40,383	13,000	1.12	0.48
12.7	11.7	16.8	2.8	13.2	51,367	13,000	1.03	0.82
9.2	23.2	11.0	3.1	7.6	56,177	18,000	1.25	0.48
4.1	24.7	17.7	3.0	5.8	46,000	17,000	1.93	1.13
6.4	21.5	16.9	2.6	5.5	45,727	17,000	2.06	1.13
5.2	34.8	14.9	1.4	5.6	52,117	17,000	1.79	0.96

propagation costs (Table 6).

In spite of improvements in the hatching and rearing environment, increasing costs in order to produce larger fry, and the policy shift from the increasing fry production quantity to increasing of fry size, there is still a possibility that the operation's income will not increase. This is due to the limiting subsidies and selling salmon fry.

Therefore, in Tsugaruishi Hatchery the increasing trend of fixed costs is causing an increasing trend in the cost per fry. This is occurring in spite of reductions in labor wages, feeding, water expenses, fuel and lighting costs. Therefore, there is only one way to reduce these costs by fixing the number of released fry and the total revenue. However, the running cost is essential to rearing health fry. As a result, cost reductions will generate imperfect rearing conditions. Therefore, to reduce operation costs, we must conduct a plan to stabilize and reduce the future investments.

## **The Infrastructure Impact of Iwate Prefecture's Salmon Fishery**

### *1. The Framework of Iwate Salmon Fisheries*

Recently, the set net fishery is used as the main fishing method for harvesting salmon in Iwate Prefecture. Drift-net and long-line fisheries are also primary methods in the coastal areas. In Iwate Prefecture the governor has the authority to issue licenses for entering the set net fishery. In addition, since 1981, he also has the authority to issue long-line fishery licenses. Regarding 1989 figures of salmon long-line fisheries, the governor permitted the use of power fishing vessels of less than 10 tons for a fishing period from October 16, 1989 to January 31, 1990 within a short distance and limited area of 3-6 sea miles. In 1988, the number of vessels licensed for the long-line fisheries were 4,083 boats. Of these vessels 3,325 were less than 3 tons, 499 vessels of 3-5 tons and 259 vessels of the 5-10 tons size.

The governor also issued fishing licenses for 99 fishing units for the large scale set net fisheries. Fisheries cooperatives recognized 64 units of small scale set net fisheries. The total number of approved set net fisheries were 163 units of which 153 were used mainly for harvesting salmon. Only 10 units targeted other fish groups. These large scale set net fisheries have many forms of fisheries management. The fisheries cooperatives managed 42 sets, fisheries cooperatives and private sectors managed 22 sets, the Fishermen Production Association managed 14 sets, the private sector managed 6 sets, private cooperatives managed 13 sets, and independent companies managed 2 sets. The fisheries cooperatives are managing over 60% of the total number of fishing sets.

The management of salmon set net fisheries through fisheries cooperatives has increased in response to the strong role of these cooperatives in salmon propagation operations which has caused high return rates of salmon to the coastal fisheries which in turn increased the hatching and the number of released fry. The fisheries co-ops are distributing profits gained from the value of adults caught among all co-op members. The co-op profits from the administration of other types of fisheries are reverted directly back to fisheries management. However, in case of management through fisheries cooperatives, part of the profits gained from the set net fishery is given to cover cooperative operation costs. At the same time, part of these profits

are invested to support the cooperative members.

Japanese fisheries law has determined the location and the area of fishing ground in addition to developing an exclusive monopoly in fisheries management<sup>9)</sup>. In respect to the large scale set net fishery, any fisherman intends to have a fishery right created shall file an application for the grant with the local authorities; the governor of this prefecture and the local fisheries cooperatives. According to the applicant condition, he may have a priority preference to receive this right if he is presently a fishery operator or fishery employee. The governor shall, in granting fishery rights, take into consideration the following matters relating to the fishery applied for: (1) the labor conditions thereof; (2) the degree of employment of fishermen residing within the local district. (3) the degree of participation in the management of that fishery by local fishermen. (4) the degree of experience in that fishery, capital reserves and other management capabilities. (5) the degree of their economical dependency upon that fishery; (6) the degree of cooperation with other fisheries operating within the sea area in which the fishing ground of that fishery is located and that of other considerations relating to the over all exploitation of such waters.

There is also a fishery right system for salmon long-line fisheries. In the case of an increasing salmon return rate, the cooperative can allow the use of long-line fisheries based to a request from the long-line fishermen. At the same time, if profits coming from the set net fisheries increase, the cooperatives distribute some of these profits among other members whom can not participate in set net fisheries in order to provide for their welfare.

## 2. *The achievements of Iwate salmon fisheries operations*

Regarding the 1960's figures of Iwate Prefecture, the total amount of salmon caught from rivers and marine fisheries was nearly 1,000 tons. This catch increased sharply to about 2,000 tons during the beginning of the 1970's. It increased to 5,000 tons by the middle of the 1970's then went up to 10,000 tons at the end of that decade. In the 1980's landings increased twice every 3 years until it reached nearly 50,000 tons in the middle of the 1980's. At the same time, the total number of individual salmon caught experienced the same increasing trend (Table 4). While this number was 1 million fish in the second half of the 1970's, it increased to 12 million fish by the middle of the 1980's. This is an increase of about 100 times compared with the salmon catch level during the end of the 1960's.

In respect to the number of individual salmon caught in fresh water, it was about 50,000 fish on the 1960's, and about 100,000 fish in the 1970's. It increased sharply to 300,000 fish at the end of the 1970's and then rose to 900,000 in 1980. It stabilized at 500,000-600,000 fish in the 1980's. Therefore, this stability of harvesting mature salmon in fresh water sustained the salmon hatching operations. The fresh water fishery indirectly contributed to increasing the coastal fisheries harvest because by sustaining the hatchery, an increased salmon return rate was made possible. In this way both the total number of individual salmon and total weight had rapidly increased. However, from the second half of the 1980's salmon catch decreased in total weight but increased in the number of individual fish. The result was a decreasing trend of individual fish weight (Table 7).

Regarding 1986 figures, the total number of coastal salmon caught by set net

Table 7. The classification of salmon catch according to the harvesting methods and the corresponding value in Iwate Prefecture.

Fish catch methods			1984	1985	1986	1987	1988
Set net	No. of fish	(1,000)	10,909	12,048	12,892	9,169	9,530
	Weight	(t)	34,352	43,638	38,239	30,942	27,414
	Value	(¥ million)	19,322	17,793	14,044	18,968	18,154
Long line	No. of fish	(1,000)	1,492	1,087	2,867	1,434	2,116
	Weight	(t)	4,659	3,909	8,594	4,684	6,188
	Value	(¥ million)	2,691	1,738	3,454	2,936	4,259
Others	No. of fish	(1,000)	211	271	242	160	120
	Weight	(t)	653	903	655	484	330
	Value	(¥ million)	416	346	181	254	200
Total	No. of fish	(1,000)	12,612	13,406	16,001	10,763	11,768
	Weight	(t)	39,664	48,450	47,488	36,110	33,932
	Value	(¥ million)	22,429	19,877	17,679	22,158	22,613

Source : Iwate Prefecture Fisheries Department.

fisheries went up to its highest level, but the total weight landed decreased. On the other hand, there were large changes in salmon long-line fisheries of both quantity and numbers of fish caught. While these fisheries occupied a range of 10–20% from the total catch, the general trend of catch quantity didn't take the same fluctuations. This was due to: (1) water temperature and ocean current conditions. (2) the instability of salmon migration routes and their staying period, and (3) the annual changes in fishing ground area which is relatively inconsistent with the area of returning salmon (Table 7).

Regarding the total value of salmon product, there was stability with respect to salmon set net fisheries and an increasing trend with respect to long-line fisheries. In 1988, the total weight of salmon harvested from the set net fishery displayed a large decrease but the total number of individual fish caught significantly increased. Therefore, the total value was at the same level as the previous year. However, in the long-line fishery there was an increasing level of both quantity and number of fish landed. Therefore, the total revenue had sharply increased. The average weight per fish was more in the case of the long-line fisheries when compared with salmon caught by the set net fishery. Therefore, the price of a kilogram of long-line caught fish was more than those caught by the set net fishery. This was due to its high quality, in spite of the fact that the set net caught salmon displayed better maturity than the long-line caught fish (Table 8).

Looking at salmon coastal fisheries during the second half of the 1980's, the total catch in both quantity and numbers has increased but, the total value decreased in 1985–1986. From 1987 the total catch stabilized at more than 30,000 tons causing stability in the total value of fish product (Table 7). Coastal fisheries salmon trends have largely been affected by changes in fish catch quantity, reduced landings from the northern-sea, and changes in fish imports and fish prices.

Table 8. The classification of salmon catch according to the catching methods and the corresponding value in Miyako Fisheries Co-op fishing area.

Year	Fishing method	No. of set nets or vessels	No. of fish catch (1,000) (A)	fish catch (ton) (B)	Value of catch (¥ million) (C)	B/A (kg)	C/B (¥)	Price of Miyako market (¥)
1981	Set net	9	815	4,117	1,325	5.05	322	633
	Long-line	472	31	101	58	3.24	575	
1982	Set net	9	636	4,243	1,723	6.67	406	676
	Long-line	327	59	196	134	3.33	684	
1983	Set net	9	884	4,706	1,027	5.32	218	348
	Long-line	354	122	436	169	3.56	388	
1984	Set net	9	1,610	6,682	2,624	4.15	393	555
	Long-line	320	232	763	436	3.29	571	
1985	Set net	9	1,298	4,749	1,777	3.66	371	407
	Long-line	345	124	460	212	3.70	460	
1986	Set net	9	1,117	4,393	1,074	3.93	244	357
	Long-line	356	316	936	394	2.96	421	
1987	Set net	9	832	3,578	1,627	4.30	455	615
	Long-line	351	168	578	380	3.44	656	
1988	Set net	9	683	2,736	1,412	4.25	516	673
	Long-line	361	262	752	523	2.67	696	

Source : Collected and accounted from Miyako Fisheries Cooperative.

### 3. *The Economic Efficiency of Salmon Set Net Fishery*

To study the economic efficiency of salmon fisheries, we must analyze the costs and income of salmon set net fisheries. These fisheries are managed through Miyako Fisheries Cooperative which Tsugaruishi Hatchery is a member (Figure 1). In this case, we must take the long-line fishery into consideration. In Miyako Fisheries Cooperative, fishing areas include 5 large-scale set net fisheries with a main net height greater than or equal to 27 m and 4 small-scale set nets with a main net height less than 27 m. There are 123 employees that work in these 9 set net fisheries. The salmon fishing period for the area extends from September to February every year.

Regarding the total catch of salmon over the past 10 years, we observed significant fluctuations. While landings were nearly 4,100 tons in 1979, they increased to 6,680 tons in 1984 and then decreased to 2,736 tons in 1988. This cycle repeated every 4 years. The number of individual fish harvested reached its peak of 1.6 million fish in 1984 when the catch quantity also peaked. This was twice its previous level of 700,000-800,000. After 1984 the number of salmon caught decreased continuously. Also, in 1986 the average weight per fish decreased. In 1987-1988 both, the number of fish caught and the weight per fish decreased (Table 8).

This decreasing trend is due to changes in ocean current, water temperature and

other environmental factors. The fisheries income differed with changes in average fish price. During the past 10 years, the set net fishery's income experienced a minimum level of ¥1 billion and a maximum of about ¥2.6 billion with an average income of ¥1.45 billion. In Miyako market the price of salmon was ¥475/kg in 1980, it steadily increased to ¥676 by 1982 and then decreased to ¥348 in 1983. From 1984 price again began to increase to ¥357 in 1986 and ¥673 in 1988 (Table 8).

The supply of Japanese salmon in the 1980's was between 200,000 and 300,000 tons. This supply was composed of northern-sea harvests from spring to summer, coastal fisheries during autumn fishing, as well as imports from North America. While salmon supplied from the north-sea were greatly decreasing due to the onset of 200-mile Exclusive Economic Zones, fish imports from North America were increasing. The price level of salmon caught from coastal fisheries were affected by the quantity supplied from these same areas in addition to changes in quantity supplied from America and northern-sea that were caught in response to domestic demand.

The reduction in the price of salmon in 1983 was due to a sharp increase of domestic supply which amounted to 260,000 tons. Domestic supply averaged between 220,000-230,000 tons prior to 1982. The reduction in the price of salmon in 1986 was due to an increased supply of coastal landings equaling 100,000 tons. This occurred in spite of a reduced northern-sea supply and an unchanged quantity imported from North America. Therefore, we can say that the salmon prices depended on the relationship between its supply and demand. At the beginning, price increased in response to the increasing demand which was more than the increase in quantity supplied. However, price decreased when the increasing rate of supply was more than the increasing rate in quantity demanded. Therefore, we can say that the income from salmon fisheries changed in relationship with national

Table 9. The construction of the main costs and the total expenditure of salmon set net fisheries in Miyako Fisheries Co-op fishing area.

Year	Income	Cost	%					Earned surplus	rate of return %
			Materials	Wage	Administrative	(Contribution)	(Depreciation)		
1979	1,730	990	3.7	59.7	36.6	7.9	4.1	740	42.8
1980	1,446	667	5.2	55.0	40.8	7.2	5.7	779	53.9
1981	1,330	631	4.9	54.2	40.9	8.0	6.6	699	52.6
1982	1,797	816	4.1	56.4	39.5	8.3	4.2	981	54.6
1983	1,037	563	5.1	54.9	40.0	8.2	3.9	474	45.7
1984	2,630	1,134	2.9	65.7	31.4	13.8	1.2	1,496	56.9
1985	1,787	842	3.7	59.6	36.7	13.8	1.1	945	52.9
1986	1,100	577	4.5	52.9	42.6	11.2	0.7	523	47.5
1987	1,650	768	3.6	57.4	39.0	14.3	0.1	882	53.5
1988	1,443	682	4.4	56.9	38.7	13.4	0.0	761	52.7

Source: Collected and accounted from Miyako Fisheries Cooperative.

supply and demand, not only in Iwate Prefecture.

The ratio between costs and income was approximately 50%, but this ratio was inversely related with changes in income. In 1983, income decreased and the cost ratio grew to 54.3%. In 1984 income increased and the cost ratio decreased to 43.5%. This is due to changes in income which depends on changes in costs. Labor wages represent the largest percentage of costs. Labor wages composed more than 50% of total costs. Management expenses was a fixed rate of the fishing income. In addition, there was an increasing trend in propagation operations costs as well as a growing market commission (Table 9).

On the other hand, the profits from set net fisheries are relatively high. Miyako Fisheries Cooperative uses part of these profits to cover costs. It divides the remaining profits among their members. The profits from set net fishery operations represent a minimum of 60% and a maximum of 80% in the total profits of Miyako Fisheries Cooperative. The management of Miyako Fisheries Co-op plays the greatest role in salmon fisheries operations in Iwate Prefecture. Every year it divides its surplus of ¥30 million among 2,800 co-op members (regular members are 1,400 members). This surplus is insufficient when considering the number of the cooperative members.

There are 123 co-op members working as set net fishery employees and receiving wages income from the co-op. The amount of these wages depends on the quantity of salmon harvested. Per capita income from these landings averages between ¥3-4 million for each fishing period lasting between 6-9 months. The minimum income for this same period is ¥2.4 million when the catch quantity is very low and its maximum is ¥6 million when the total catch is very high. This wage income is satisfactory when compared with the wage level in the other industries. This income is considered as direct income for set net fishermen. However, in the case of other fisheries, like long-lining, the cooperative may allow fishermen to use their long-line gear to earn such high levels of income if the salmon return rate is high.

There are approximately 350 salmon long-line vessels in the co-op. This

Table 10. Annual cost and price of Miyako salmon

year	Cost per fish		Price per fish (¥)
	propagation cost (¥)	fishing cost (¥)	
1980	66	808	1,757
1981	63	980	2,083
1982	59	1,008	2,170
1983	58	627	1,162
1984	39	698	1,630
1985	61	641	1,369
1986	97	508	962
1987	136	911	1,956
1988	161	982	2,070

Source : Accounted from Tables 5, 6, 8, 9.

number has changed only slightly in the last few years. Their annual salmon landings range between 400 and 900 tons. Landings were approximately 580 tons in 1987 and 750 tons in 1988, but it has fluctuated seasonally every year. Annual landing number displayed changes similar to the catch quantity, it displayed a range between 122,000 to 316,000 fish. It was 262,000 fish in 1988 (Table 8). The total catch per fishing vessel was between 1-2 tons, and the average annual income was ¥1.5 million. However, in the case of fishing vessels 3 tons and over, the average income was about ¥5 million; the highest income among Iwate Prefecture.

Table 8 shows the average annual salmon price/kg and weight per fish in the Miyako fish market. Using this table we accounted the price and cost per fish. It was found that the lowest price per fish was ¥1,162 in 1983 and ¥962 in 1986. However, during other years price was approximately ¥2,000 per fish (Table 10). On the other hand, the changes in salmon costs were the same as in salmon price. The cost per fish represented about 50% of the price with an average of ¥1,000.

On the other hand, the total number of salmon caught in the Miyako area was over 1 million fish in 1988, of which 944,000 fish were caught from marine fisheries and 86,000 fish caught from rivers (Table 5). The set net fisheries catch represented the majority of income and profits. According to Miyako Fisheries Cooperative figures, the profits from set net fisheries was sufficient to cover most of the cooperative operation costs and resulted in decreasing the necessary contributions by members. Moreover, the co-op members who work directly in the set net fishery received high wages resulting from stability in their fishing operations. Also, the co-op propagation operations caused an increase in salmon resources of the area and this in turn created continuous benefits, not only in the set net fisheries but also in the long-line fisheries of Iwate.

### Discussion

Now, we can arrange the foregoing review of the economic effects of salmon propagation operations in the following points. First, there is a large increase in salmon resources and their returning rate due to the number of fry released. Second, according to the coastal returning salmon, total landings increased and the number of salmon fishermen increased. Third, the stable increase in migrating salmon caused a possibility of planning for the use of fishing grounds and the resulting fisheries production. Forth, the realization of salmon fisheries planning generated stability in management and in the livelihood of fishermen.

In the Miyako Fisheries Cooperative, propagation operation costs are about ¥150 million. On the other hand, the total revenue of salmon fisheries has gone up to about ¥2 billion. At the present time, the individual cost per fish is less than ¥2,000. Of this amount, ¥150 or less is the cost of the propagation operations, ¥1,000 or less is the set net fishing costs. The remaining costs are the management and other operation costs. Therefore, there are profits if the price per fish is equal to or more than ¥2,000. The annual profit in Miyako Fisheries Cooperative are sufficient to cover co-op costs and fishermen wages. These wages accounted for ¥550 per fish caught. These wages were considered to be the members primary income and determined significant enough to stabilize their livelihoods.

Presently, the targeted fisheries problems include the improvement of salmon

Table 11. The relation between the salmon fry and returning salmon according to the returning age during 1971-1988

year	liberation fry number (million)	The total number of returning salmon at age of						Total (thousand)
		2 years	3 years	4 years	5 years	6 years	7 years	
1971	97.3	42.0	152.8	474.3	191.0	0.2	—	860.3
1972	120.3	112.4	443.2	558.0	71.1	0.2	—	1184.9
1973	137.7	12.4	244.5	763.0	136.0	3.3	—	1159.2
1974	127.6	48.5	443.0	1141.9	150.8	11.2	—	1795.4
1975	144.7	15.2	671.0	2052.0	898.6	12.6	0.3	3649.7
1976	144.4	178.7	996.5	3352.8	900.8	44.2	—	5473.0
1977	207.9	75.4	1274.9	3452.0	1097.4	17.3	0.0	5917.0
1978	213.6	78.6	1789.0	3532.2	933.7	26.2	0.1	6359.8
1979	263.4	144.9	1604.2	4694.2	1264.8	75.6	0.8	7784.5
1980	301.3	337.5	2922.0	10418.2	7769.3	885.5	7.3	22339.8
1981	326.2	77.8	1335.0	4599.1	3249.9	160.9	11.0	9433.7
1982	398.7	111.3	1366.1	11516.1	5569.9	433.2	—	18996.6
1983	376.3	49.3	999.1	4228.6	2796.7	—	—	8073.7
1984	408.6	57.4	1051.3	7641.8	—	—	—	8750.5
1985	421.2	125.2	1255.0	—	—	—	—	1380.2
1986	437.0	64.7	—	—	—	—	—	64.7

Source : Japan, Department of Forests and Fisheries, Iwate Prefecture, Salmon fisheries data.

propagation techniques and increasing stability in the salmon return rate. In order to study the relation between salmon fry release and salmon harvest, we analyzed this relationship using to linear regression analysis. It was found that there is a strong correlation between salmon fish fry and salmon catch, especially after four years from the time of release. Linear regression analysis indicated that for every 1,000 fish fry released about 26 adult salmon returned four years later. However, this number decreased to approximately 18 fish after five years from release. The coefficient of determination was 67.5% in the first case. This means that 67.5% of the changes in salmon catch is due to changes in the number of fry released and only about 32.5% of these changes is due to other factors. The coefficient of determination in the case of five years after release was 59.3%. In other words 59.3% of the changes in salmon harvested after five years is due to the changes in the release number and 40.7% is due to other factors (Table 11 & Figure 2). Therefore, the fluctuating number of returning salmon depended not only on fluctuations in the number of released fry, but also on the fluctuations in other factors. It was also found that total salmon landings four and five years after release represented between 70% to 80% of the total catch in all salmon age classes. Therefore, we can say that the number of returning salmon was strongly affected by not only the number of released fry but also by other factors such as, fish fry quality, the release site environment, and other biological factors<sup>10)</sup>.

Iwate Prefecture has the largest salmon propagation operation on Honshu

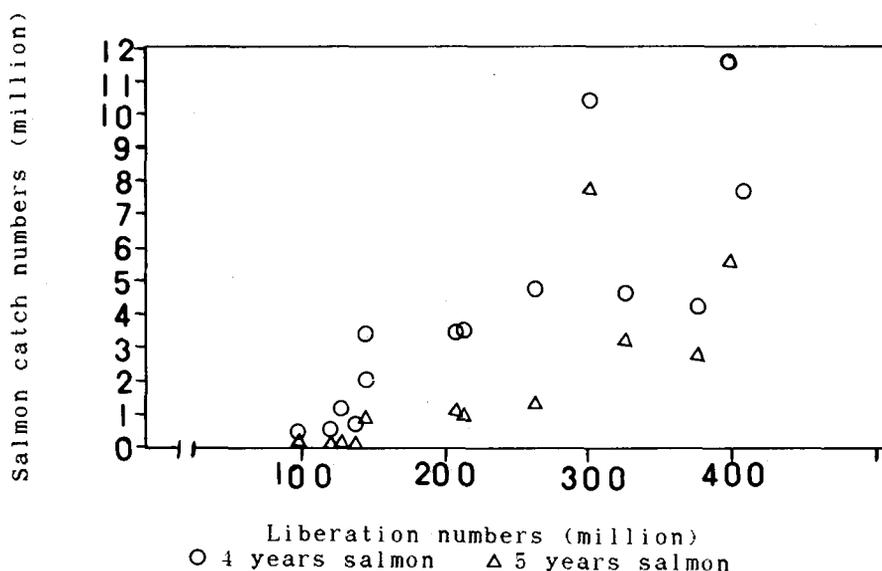


Fig. 2. Iwate salmon catch.

Island. In Iwate Prefecture, the Tsugaruishi River has an old history in salmon propagation. Therefore, the rate of returning fish to both the river and coastal fisheries are increasing. Moreover, the degree of dependence of coastal fishermen on salmon has also been increasing.

Salmon propagation operations have been carried out in order to increase the river salmon harvests in response to river fishermen. Because of the strong positive relationship between propagation operations and the coastal catch, coastal fisheries cooperative operations have been increasing. Therefore, river propagation operations and increased coastal salmon landings have become the targets of coastal fishermen. In Iwate Prefecture, fisheries co-ops have management of the majority of coastal fishing operations. By this system, investments in salmon propagation operations materialize their returns in the form of coastal salmon landings.

The present problems in salmon propagation are in the production of perfect or large size fry in order to increase the return rate. This in turn demanded reproduction on an enlarged scale or a large accommodation area, an increase in feed costs in response to the extended rearing period. Moreover, there resulted an increase demand in new rearing techniques against fish diseases and the like.

In this manner, the number of hatchery workers are on the increase and there is a need for corresponding opportunities for studying the required skills. These in turn causes an increase in costs. Also there is an increasing trend of rearing salmon in the sea. If this were to occur at the same time as rearing in rivers and over an extended period, it is difficult to chose which is the more suitable option. Therefore, fishery operations and measurements of their improvements in techniques are working hand in hand in order to attain a high degree of technological achievement.

According to the advanced position of Iwate Prefecture in salmon propagation, the national and prefectural governments are supporting it through the transferal of

the necessary subsidies for its existence. This is in addition to the revenue obtained from the government by selling fish fry which represent the largest part of these operation's income. Therefore, if propagation operations were transferred to the private sector, the loan costs for the operation would increase. As a result this could negatively influence future salmon harvests due to possibly unstable propagation planning and/or management.

The set net fishery has the largest salmon catches in Iwate Prefecture. All set net fishing operations are under independent management by fisheries cooperatives. Because the fisheries cooperative has the responsibility of salmon propagation operations, it is easy to understand why the propagation operations and the fishing operations are unified. It is easy to secure fish for propagation purposes that are caught among returning salmon or from mature fish through mariculture production. In spite of the independent management of set net fisheries through fisheries cooperatives, they are still coupled with the expenses and returns of their propagation operations. Therefore, the changes in marine landings have little direct effect on propagation operations.

On the other hand, if propagation operations and marine fishermen are separated, each sector will have an independent interest in his fishing operation. There would be no motivation to fill up the deficiencies of other sectors. For example, if the amount of returning salmon decreased simultaneously for both the river and sea fisheries, the number of eggs taken from river caught salmon would be insufficient. There would be no guarantee that the coastal fishermen would fill this deficiency, in spite of the fact that this would affect their landings four or five years later. They would likely look only to their present catch.

Fisheries operators or fishermen can't distinguish between river released salmon and marine released salmon. There are no guideline to know the difference between these two groups of salmon. This is especially true if every body prefers to work separately. On the other hand, marine fishermen will catch some salmon which were released as fry from rivers. For this reason, marine fishermen recognize the importance of salmon propagation operations. However, in all cases, mature salmon will return to any fishing area. There is no guarantee that salmon will return to the same place where they were bread. Therefore, salmon propagation operations and fishing operations are now unified into one body under the supervision of the prefecture fisheries cooperatives.

Many problems could arise for both the prefectural and river fishing sectors if control management of the set net fishery were implemented. The problem for both sectors is that there still would be no easy solution to coordinating among fishermen operating in prefectural rivers. If fishing and releasing operations only occurred in rivers, it would be simpler to determine the cause and affect of egg collection and fry release to the harvest levels of returning salmon. Obviously however, fry release and fishing activity does occur in the marine environment and it is very difficult to specify between river and ocean released salmon. Moreover, if the return time interval is long, there is a possibility that the total catch from distant fisheries will be high. Thus, if there were no agreement among prefectures for using the established fishing grounds, there would be regional dissatisfaction within the fishing community.

Because salmon fishing operations are managed through fisheries cooperatives,

and they implement a principal of equality among members, fishermen are satisfied with the management system. However, if set net fisheries were managed through individuals or private companies problems could emerge regarding how profits would be distributed.

Therefore, the advantage of unifying the operations of harvesting, egg collection, fry production and release have been recognized and implemented. Presently, the unification of the fishing organization and propagation is also under planning elsewhere. Now, the Propagation Association and Council supports this system but the regionalism of financial related cooperation is not occurring. This is due to problems among the fishing regions because the management of hatching eggs for fish propagation and the coordination with fish harvests are still separated.

Should there be, as promised, an execution of a unification plan by the government and prefecture for salmon propagation operations, it is likely to be followed by requests for the establishment of an integrative coordination system for harvesting the returning salmon. According the set net fishing rights, the establishment of regional planning for fishing grounds must be established under the supervision of the local governor. In this manner, unification within a region for the harvesting of salmon has tended to be established in this form of management. We think that the development of salmon propagation will take the first priority.

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