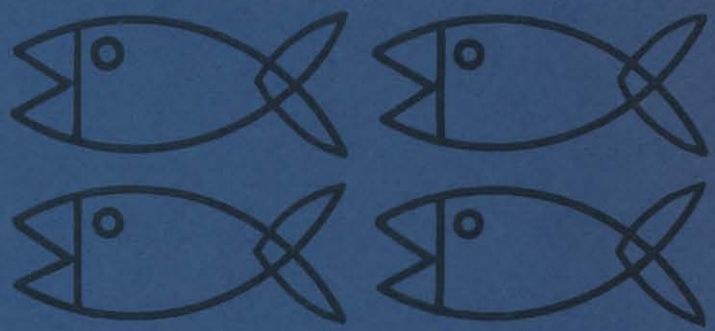
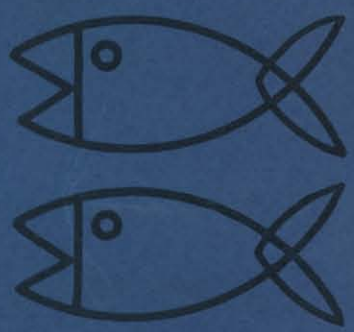
July 1973

Information Series:
Number 3

College of Forestry, Wildlife and Range Sciences



A Survey of Fish Health Management in Idaho



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ACKNOWLEDGEMENTS

Funds for this survey were provided by the Bureau of Sport Fisheries and Wildlife (Contract No. 14-16-0001-4208FS), Idaho Fish and Game Department, College of Forestry, Wildlife and Range Sciences, and the Research Council of the University of Idaho (STAR Program). The Steering Committee for the formation of the Idaho Food Fish Commission assisted greatly in the organization of the survey. Personnel contacted in the federal, state and private fish-raising sectors responded to the survey questions without reservation with one exception. Finally, Kevin Amos, my graduate assistant, contributed immensely to collection and interpretation of information.

To all these agencies and individuals, I say thank you.

A SURVEY OF FISH HEALTH MANAGEMENT IN IDAHO

Introduction

Idaho is rapidly becoming the nation's leading producer of hatchery-raised game and commercial salmonids, if indeed it has not already done so. In the 1971 production year Idaho Fish and Game Department raised 1.824 million pounds of trout and salmon (Idaho Fish and Game, 1973). The National Fish Hatcheries in Idaho during the same period raised 0.645 million pounds of trout and salmon (Bureau of Sport Fisheries and Wildlife, 1972). The commercial trout industry had an estimated production of 10-12 million pounds in 1971 (Araji, 1972). The 1971 commercial catfish production has been estimated at 75,000 pounds (Heffernan, 1972).

This report is a summary of a survey conducted to inventory the status of fish health management in hatchery-raised salmonids and ictalurids in Idaho. The information was gathered by conferring with the manager or, in a few cases, the assistant manager of each fish-raising facility visited (Appendix I). At each site a questionnaire (Appendix II) was completed insofar as possible and a sketch of the facilities was made.

Development of the Study

Since the survey involved asking questions that might have been construed as personal in that the answers concerned production data, we contacted each of the commercial producers of salmonids and ictalurids by letter inviting them to attend an informational meeting at Rangen's Trout Research Farm on 4 November 1972. Of the 30 persons invited, 18 attended and discussed the questionnaire *per se* and its implications. In addition we discussed our future survey and service plans and made alterations as recommended by the industry representatives.

After reviewing the information resulting from the 4 November meeting, a subsequent meeting was held at Rangen's Trout Research Farm on 16 December 1972. Of the 30 persons invited to this meeting, 21 attended. The significant outcome of the meeting was the formation of a Steering Committee to investigate the many aspects of forming an "Idaho Food Fish Commission" to function within the governmental structure of the State of Idaho. Serving on this committee are: Mike Fennen (Snake River Trout Farm, Chairman), Ted Eastman (Clear Springs Trout Company), Bill Jones (Jones and Sandy Livestock), Mike Greene (Blue Lakes Trout Farm), and Porter Houghland (Crystal Springs Trout Company).

After the commercial fish growers had agreed on the nature and scope of the survey, personnel of the Idaho Fish and Game Department and the Hatchery Division, Bureau of Sport Fisheries and Wildlife were consulted for their opinions on the survey protocol. They concurred with all aspects of the proposal.

On 31 May 1973 we began visiting 2-6 fish-raising facilities each day until 19 June 1973. During this period we visited 3 National Fish Hatcheries, 16 Idaho Fish and Game hatcheries, and 33 commercial fish-raising facilities. The remaining Idaho Fish and Game Department and commercial fish-raising facilities will be visited during July and August, 1973. The results of that portion of the survey will be reported as an amendment to this report.

Description of Fish-Raising Systems in Idaho

Fish are raised in Idaho basically for two purposes; namely, for game or recreational purposes and for commercial sales as live or processed fish. A list of fish species raised in Idaho is presented in Table 1.

Table 1: Species of fish raised for recreational and commercial purposes in Idaho in 1972.

Species	Facility Affiliation
Rainbow trout	Federal, State, Private
Cutthroat trout	Federal, State, Private
Brown trout	State
Steelhead	Federal, State
Golden trout	State, Private
Kamloops trout	State
Makinaw trout	State
Brook trout	State
Chinook salmon	Federal, State
Coho salmon	State, Private
Kokanee	Federal, State
Montana grayling	State
Channel catfish	Private
Blue catfish	Private

The game or recreational fish are produced by the Idaho Fish and Game Department and by the Hatchery Division, Bureau of Sport Fisheries and Wildlife. Both agencies raise large numbers of trout and salmon of fingerling to catchable size for release into public fishing waters of the State of Idaho. Some fish are distributed to surrounding states by the National Fish Hatcheries. During 1972 the three National Fish Hatcheries released more than 16 million fish and the 19 Idaho Fish and Game hatcheries released more than 8 million fish.

The commercial production of trout, salmon, and catfish consists of six basic components:

1) Egg producers - there are seven commercial sources of rainbow trout eggs in Idaho. Of these, four presently use the eggs solely at their facilities. The remaining three have statewide and out-of-state sales.

2) Growers - there are 17 separate companies (24 farms) raising rainbow trout, cutthroat trout, coho salmon, blue catfish and channel catfish. The majority of the fish produced are sold processed with a few sales of live fish to fish-out operations in other states.

3) Grow-out or farm pond operators - there are at least 40 facilities within a 10-15 mile radius of Buhl raising fish for growers. In this type of operation, 6"-8" fish are transferred from a grower's ponds to the farm ponds for rearing to marketable size (approx. 12"-13") with the feed being supplied by the grower. The time required for this is 4-8 months and the farm pond manager is paid on the pounds of fish gained. Many of these facilities do not operate on a year-round basis because of inadequate water quality and quantity.

4) Processors - there are seven trout and catfish processing plants in the Twin Falls-Buhl area. They receive fish from growers and farm pond operators. All but one are associated with a fish-raising facility.

5) Fee fishing or fish-out pond operators - there are several facilities of this type operating in Idaho. None were visited during this segment of the survey because it was thought that their involvement in fish health management in Idaho was minimal. It has been determined subsequently that several facilities receive eyed eggs or fish from out-of-state sources, thereby being potential sources of certain undesired infectious agents for fish.

6) Live-haulers - several fish farms haul live fish to out-of-state distribution points for fee fishing operations. There is at least one individual who contracts to haul live fish and is not associated with any fish farming operation.

During 1972 the commercial production of rainbow trout was 27.4 million pounds. From the survey data it is anticipated that there will be a sizeable increase during 1973. At this time there are nearly 9 million more fish on hand than were marketed the previous year (Table 2). Eleven of the visited commercial facilities are increasing their production capabilities by 25-50% over the 1972 production. These additions should all be in operation by September, 1973. Thus, an industry which had an annual production in 1956 of 0.75 million pounds now ranks economically as the second largest food animal industry in Idaho (Araji, 1972). This phenomenal growth is attributed to the tremendous supply of quality water in which to raise trout and salmon and to the variety of markets available.

Table 2: Summary of production data for federal, state, and private fish-raising facilities in Idaho in 1972

	Federal	State	Private	Total
Number of fish on hand - 1973 (millions)	11.6	17.97	47.75	77.32
Number of fish produced - 1972 (millions)	8.1	16.00	38.65	56.22
Pounds of fish produced in 1972 (millions)	1.04	1.54	27.39	29.97
Food conversion (lbs feed per lb of fish)	1.9	1.9	1.7	
Production cost per pound ($)	0.78*	0.43*	0.37	
Employees (full time)	28	27	159	
(part time)	18	16	13	

*Includes transportation cost for distribution.

The channel catfish industry, on the other hand, is just beginning. There are currently two farms raising channel catfish. In 1972 their combined production was less than 100,000 pounds. However, as more 80°F water becomes available for catfish raising, this segment of the commercial fish industry will increase dramatically. At this time there are more than twice the number of catfish on hand as compared to last year's total production.

Fish Health Management Problems

The following infectious and noninfectious diseases were reported among the fish being raised at the federal, state and private facilities:

1) Fin Rot (fin erosion) is a progressive erosion and disintegration of the fins of hatchery-raised fish. Several species of bacteria have been isolated from outbreaks; but the main contributory causes are thought to be crowding and nutritional imbalances, especially in the vitamins. Treatment and control are effected by external antibacterials, sanitation, and management.

2) Tail erosion is associated with hatchery-raised fish and is characterized by a progressive thickening and subsequent eroding of the caudal fin. The thickening and erosion typically begins on the dorsal portion of the fin. In many cases it occurs concommittantly with fin erosion; however, it occurs also without obvious fin erosion. The main contributory causes of tail erosion are thought to be crowding and nutritional imbalances. In severe cases the processed fish must be sold with the tail removed thus reducing its value. There is no known treatment once the erosion becomes advanced. The best prevention and control is management.

3) Soreback is seen clinically as a clean-looking ulceration of the skin and underlying muscle usually anterior to the dorsal fin. Current theory on its cause is continual nipping by other fish brought on by marginal underfeeding. Fish with advanced soreback are considered unfit for release or marketing. The only treatment is to isolate the affected fish and to increase the feeding level of all lots of fish. It can be prevented by keeping all fish on a high plane of nutrition from the first-feeding fry stage.

4) Strawberry Disease is a sporadic disease in which circumscribed areas of skin become thickened and red. The underlying tissues become filled with fluid. In many cases feeding antibiotics have reduced the incidence thus giving rise to the theory that it has an infectious cause. Another theory on the cause is that it is an allergic reaction to intestinal bacteria. In which case, the antibiotic is reducing the population of gut bacteria thereby reducing the allergic response. Fish with Strawberry Disease are generally not seen until they are on the processing line at which time they are discarded because of their unappetizing appearance.

5) Bacterial Hemorrhagic Septicemia (Aeromonas redmouth disease) is an acute to subacute systemic bacterial disease caused by Aeromonas liquefaciens. All species and ages of fish are susceptible and losses are usually significant. It is traditionally a springtime disease and is effectively controlled by systemic antibacterials.

6) Hagerman Redmouth Disease is an acute to chronic systemic bacterial disease of rainbow trout and is caused by an, as yet, unspecified bacterium. The disease is endemic in the Hagerman Valley of Idaho

and occurs during any season of the year. It is effectively controlled by systemic antibacterials.

7) Furunculosis is a peracute to chronic systemic bacterial disease caused by Aeromonas salmonicida. All species and ages of fish are susceptible with the majority of outbreaks occurring in young-of-the-year fish. Although direct transmission in saltwater has not been adequately proven, marine fish have become infected with the organism and subsequently died of the disease from eating clinically ill salmon smolts following seaward migration. The disease can occur anytime, is stress-mediated, and is effectively controlled by systemic antibacterials.

8) Bacterial Kidney Disease is a chronic, but may be acute, systemic bacterial disease of salmonids caused by a Corynebacterium spp. The disease is widespread and epidemics occur usually in the fall when the water temperatures are declining. This disease is not effectively controlled by the approved systemic antibacterials.

9) Columnaris Disease is an acute systemic and cutaneous disease of freshwater fishes caused by Chondrococcus columnaris. The disease is widespread and occurs most frequently during the summer in young-of-the-year fish. Losses are usually quite high. In warm water fish there is frequently a dual infection with Aeromonas liquefaciens. The disease is effectively controlled by systemic and external antibacterials.

10) Bacterial Gill Disease is a peracute respiratory disease of juvenile hatchery-raised fish (primarily salmonids and ictalurids). A complexity of environmental, physiological and bacterial are involved in causing an outbreak. The disease occurs most frequently in the

springtime when the fish are actively growing and are crowded in low dissolved oxygen-high ammonia water. The bacteria involved are, for the most part, unspecified myxobacteria. Chondrococcus columnaris has been implicated on several occasions. The disease is effectively controlled by reducing the population density and administering external antibacterials.

11) Coldwater Disease (Peduncle Disease) is a chronic external and systemic bacterial disease of juvenile salmonids caused by Cytophaga psychrophila. The disease occurs during the low water temperature months. Outbreaks with catastrophic losses have been reported in yolk sac fry. The disease is controlled by external and systemic antibacterials.

12) Infectious Pancreatic Necrosis is a peracute to acute virus disease of juvenile salmonids - particularly the trouts and chars. It is widespread and considered to be egg transmitted. Losses are generally quite high in fish less than 2-inches long. The recommended control methods include chemical disinfection of eggs, elimination of carrier females and depopulation of affected stock.

13) Infectious Hematopoietic Necrosis is an acute virus disease of juvenile salmonids. Until recently this disease was recorded as Oregon Sockeye Disease, Sacramento River Chinook Disease, Columbia River Sockeye Disease, and Leavenworth Sockeye Disease. The primary species affected are chinook salmon, rainbow trout and sockeye salmon. The disease is endemic in the western U.S. with sporadic outbreaks occurring in other parts of the country. The virus is considered to be egg transmitted. Losses are quite high in less than 2-inch fish in water temperatures below 56^{o}F. The recommended

control methods include chemical disinfection of eggs, elimination of carrier females, and depopulation of affected stocks.

14) Ichthyophonus is a chronic systemic mycotic disease of freshwater and marine fish caused by Ichthyophonus hoferi. Losses are generally not very high; however, serious outbreaks have occurred. All ages and species of fish are affected. There is no treatment. The spread has been controlled by feeding cultured fish only inspected and processed marine fish. Rigid sanitation and disposal methods also have decreased the prevalence of this disease.

15) Saprolegniosis and Achylosis are two acute cutaneous mycotic diseases of all fish. The diseases generally arise secondarily to pre-existing bacterial infections or traumatic wounds. Effective treatment and control methods include external disinfectants and strict sanitation practices.

There are several hundred genera of parasites - protozoa, metazoa - which use fish and shellfish as intermediate or definitive hosts. Of these, less than 100 genera have been described as causing primary or secondary disease problems in cultured fish and shellfish. For epidemiological and therapeutic convenience those protozoa and metazoa causing epizootics in salmonids and ictalurids have been categorized by the portion of the host affected; i.e. gills, body surface, and internal. The gill parasites and body surface parasites are effectively controlled by external chemotherapeutics and rigid sanitation practices. The internal parasites are usually controlled by disrupting the life cycle. In some cases, internal chemotherapeutics are effective.

The mortalities in each of the four age groups of fish; i.e. eggs, 1"-3", 3"-6", and 6"-12", varied significantly among the three agencies. However, the overall mortality was quite uniform among the three agencies (Table 3).

Table 3: Percent mortalities from all causes in federal, state, and private fish-raising facilities in Idaho in 1972.

	Federal	State	Private
Egg mortalities	10.0	11.7	16.5
1"-3" fish	10.5	22.6	15.5
3"-6" fish	25.0	8.3	6.5
6"-12" fish	0.1	1.7	6.4
$\bar{x}$	11.4	11.07	11.22

The approximate ratio of infectious disease mortalities to noninfectious disease mortalities were 4:1 overall (Tables 4, 5, 6). Most of the respondents did agree, nonetheless, that many outbreaks of infectious disease were precipitated by handling or crowding stresses.

The major cause of egg mortalities was infertility. Fungus (Saprolegnia sp.) and silting were minor causes of egg loss.

The most frequent cause of mortalities in 1"-3" fish was gill disease. It could not be determined if this was bacterial gill disease or some other form of gill disease. All respondents reporting having severe problems with gill disease stated that outbreaks were abated by using one of the many external antimicrobial drugs. Thus, it could be assumed that bacteria were in some way involved with the disease. Infectious pancreatic necrosis and infectious hematopoietic necrosis outbreaks were sporadic in commercial fish farms and the resultant mortalities were usually quite high. The most frequently occurring noninfectious disease problem in this age group was fin erosion, which is considered to be a management problem aggravated by crowding and underfeeding. Although there were no mortalities attributed to fin erosion, the incidence was sufficiently high to reduce productivity of affected lots of fish.

The most frequent causes of mortalities in the 3"-6" fish were gill disease and "redmouth" disease. Again, it could not be determined if this was truly bacterial gill disease; however, treatment with external antibacterial drugs was effective in most cases. The "redmouth" disease mortalities were due to infections of either RM bacterium (the causative agent of Hagerman Redmouth) or Aeromonas liquefaciens (the causative agent for Bacterial Hemorrhagic Septicemia). Either type was controlled by feeding systemic antibacterial drugs. There were many cases in which the incidence of the disease

Table 4a: Percent mortalities in four age groups by major cause in 23 private fish-raising facilities in Idaho in 1972.

Disease	Egg		1"-3"		3"-6"		6"-12"	
	%	No. Farms	%	No. Farms	%	No. Farms	%	No. Farms
Gill disease			5-35	13	1-10	10	1-3	9
Hagerman redmouth			20	1	1-10	10	1-5	9
Aeromonas redmouth					2-10	6	1-7	7
Furunculosis			5	1	1	1	3-5	2
Columnaris							NE	4
Bacterial kidney disease					2	1	1	1
Saprolegnia sp.	NE	4			NE	4	NE	5
Ichthyophonus					NS	6	NS	7
Protozoa					NE	12		
Metazoa					NE	12		
Infectious pancreatic necrosis			5-60	4	30	1		
Infecious hematopoietic necrosis			10-50	2	30	1		

NE - Not Estimated
NS - Not Significant

Table 4b: Incidence of major noninfectious diseases in four age groups in 23 private fish-raising facilities in 1972.

Disease	Egg		1"-3"		3"-6"		6"-12"	
	%	No. Farms	%	No. Farms	%	No. Farms	%	No. Farms
Fin erosion			1-50	10	1-80	20	1-80	20
Tail erosion					1-50	13	1-50	14
Soreback					2-5	10	2-5	12
Strawberry disease							1-2	4
Low dissolved oxygen	10	2	2-10	7	2-10	7	NE	6
Ammonia			NE	6	NE	6	NE	6
Crowding			10-20	2	0.5-2	8	0.5-3	5

Table 5a: Percent mortalities in four age groups by cause in 13 Idaho Fish and Game Department hatcheries in 1972.

Disease	Egg		1"-3"		3"-6"		6"-12"	
	%	No. Units	%	No. Units	%	No. Units	%	No. Units
Gill disease			1-40	10	1-6	8		
Hagerman redmouth			1-3	2	2-5	3	1-3	4
Aeromonas redmouth			1-2	3	1-2	5	1-2	5
Furunculosis							2	1
Columnaris			5-8	2	5-8	2	1-2	2
Coldwater disease			NS	1	NS	1	NS	1
Bacterial kidney disease			25	1				
Saprolegnia sp.			0	0	0	0	0	0
Ichthyophonus					NS	1	NS	1
Protozoa			NS	4	NS	4	NS	3
Metazoa			NS	4	NS	5	NS	2
Infectious pancreatic necrosis			1-30	2				
Infectious hematopoietic necrosis			NR		NR			

NE - Not Estimated
NS - Not Significant
NR - Not Recorded
Units - Hatcheries

Table 5b: Incidence of major noninfectious diseases in four age groups in 13 Idaho Fish and Game Department hatcheries in 1972.

Disease	Egg		1"-3"		3"-6"		6"-12"	
	%	No. Units	%	No. Units	%	No. Units	%	No. Units
Fin erosion			5-20	1	25-40	3	25-40	3
Tail erosion					5-20	3	5-20	3
Soreback					1-5	5	1-5	6
Strawberry disease			NR		NR		NR	
Low dissolved oxygen	NE	1	NE	2	NE	2	NE	2
Ammonia			NE	1	NE	1	NE	1

Table 6a: Percent mortalities in four age groups by cause in three National Fish Hatcheries in Idaho during 1972.

Disease	Egg		1"-3"		3"-6"		6"-12"	
	%	No. Units	%	No. Units	%	No. Units	%	No. Units
Gill disease			10	2	10	2	NS	1
Hagerman redmouth			NR		NR		NR	
Aeromonas redmouth					NE	1		
Furunculosis					NE	1		
Columnaris			NE	1	NE	2		
Coldwater disease			NR		NR		NR	
Bacterial kidney disease			NR		NR		NR	
Saprolegnia sp.	NR		NR		NR		NR	
Ichthyophonus			NR		NR		NR	
Protozoa			1-50	2	2	2	2	2
Metazoa			NR		NR		NR	
Infectious pancreatic necrosis			NR		NR		NR	
Infectious hematopoietic necrosis			NR		NR		NR	

NE - Not Estimated
NR - Not Recorded
Units - Hatcheries

Table 6b: Incidence of major noninfectious diseases in four age groups in three National Fish Hatcheries in Idaho during 1972.

Disease	Egg		1"-3"		3"-6"		6"-12"	
	%	No. Units	%	No. Units	%	No. Units	%	No. Units
Low dissolved oxygen			NE	1	NE	1	NE	1
Ammonia			NR		NR		NR	
Nitrogen			12	1				
Fin erosion			5-20	1	5-20	2	5-20	2
Tail erosion					5-20	2	5-20	2
Soreback					1-5	1	1-5	1
Strawberry disease			NR		NR		NR	

was quite low and the disease was allowed to run its course without treatment. In these cases, the resulting total mortality was often greater than if treatment were instituted.

The incidence of fin erosion, tail erosion, and "soreback" in the 3"-6" fish was very high in the IFG and commercial facilities. The effect of these diseases was greater in the commercial facilities in that the fish would become esthetically unappealling. The only effective treatment was to reduce the numbers of fish per pond - an impractical measure according to most fish farmers.

The most frequent causes of mortalities in the 6"-12" fish were "redmouth" disease, gill disease, and furunculosis. Most respondents recorded significant problems with handling stresses and low dissolved oxygen. In this size group the chief problem was the high incidences of fin erosion, tail erosion, soreback, and strawberry disease, however, these conditions seldom caused death. Fish with these diseases were withheld from distribution or marketing until the disease signs disappeared with the result that they grew beyond good market size.

Among the "nuisance problems" listed by the respondents were birds, muskrats, frogs, snakes, visitors, and the increasing price of feed. At most of the private fish-raising facilities, fish-eating birds were quite a problem. There were no estimates on the amount of fish the birds consumed during the course of a year. The greatest concern expressed regarding the bird problem was the potential disease transmission - especially the transmission of infectious pancreatic necrosis and infectious hematopoietic necrosis. The viruses causing these diseases have been isolated from the ingesta and feces of certain fish-eating birds (W. Wingfield, California Fish and Game, personal communication, 1973). The remaining nuisance problems were sporadic but

caused concern - especially the price of feed.

The financial loss incurred due to dead fish in the commercial food fish industry was calculated at $557,250 during 1972 (Table 7). This figure was derived on the purchase or production cost of the following:

1) Eggs cost $3.50 per 1000 or 0.35¢ each.
2) 1"-3" fish were worth 0.54¢ each (0.19¢ for feed and labor plus 0.35¢ egg cost).
3) 3"-6" fish were worth 2.1¢ each (1.8¢ for feed and labor plus 0.35¢ egg cost).
4) 6"-12" fish were worth 15.8¢ each (15.5¢ for feed and labor plus 0.35¢ egg cost).

The feed and labor costs were derived from an average production cost of 37¢ per pound exclusive of capital outlay. The average weight per fish in each age group was obtained from the Manual of Fish Culture, Appendix A.1 (Bowen and Studdard, 1970).

Although the financial loss of slightly more than 0.5 million dollars represents 7% of the estimated total production costs ($7.95 million), the loss in the 6"-12" fish represents 75% of the financial loss incurred (Table 7). The egg, 1"-3", and 3"-6" losses constituted only 6%, 8%, and 11% respectively of the monetary loss.

It would be difficult to provide meaningful mortality cost figures for the two game fish-raising agencies since they distribute fish of several size groups. In addition, they raise several species of fish each having different production costs.

Table 7: Production and loss estimates by age group for 23 private fish-raising facilities in Idaho during 1972.

	Production			Loss		
	Nos. (millions)	Cost-$ (thousands)	Cost-¢ (each)	% of prod. nos.	Nos. (millions)	Cost-$ (thousands)
Eggs	62.58	219.0	0.35	16.5	10.32	32.12
1"-3"	52.26	282.2	0.54	15.5	8.1	43.74
3"-6"	44.16	927.3	2.1	6.5	2.87	60.27
6"-12"	41.29	6,523.0	15.8	6.4	2.64	417.12

Summary and Recommendations

This project was initiated with the intent to gather qualitative and quantitative data relative to the significance of infectious and noninfectious diseases in fish-raising facilities in Idaho. These data were to be used to provide factual background information to prepare a proposal to study the cause, prevention and cure for the more significant diseases. What has emerged is a better understanding of a highly complex but integrated industry that has as many unique problems as fish-raising facilities. In addition, it is a rapidly growing industry thus adding to the complexity. The federal and state programs are changing, not quite to the degree that the private sector is, but sufficiently so as to make the data acquired obsolete in a few months.

One of the primary needs that must be faced before any disease management programs can be implemented is the need for trained fish disease specialists. At this time there is only one state fish pathologist and one federal hatchery management biologist. There are no such persons employed in the private sector. Industry representatives report that they cannot hire any because there are none available.

The Forestry, Wildlife and Range Sciences Experiment Station anticipates providing fish health management services on a limited basis this fiscal year. As more funds become available this program will expand. The long-range goal of the service program is to reduce the mortalities in the 1"-3", 3"-6", and 6"-12" groups by 50%. This is not an unrealistic goal. If realized it could mean that, based on the 1972 figures, an additional 6.75 million fish will be marketed at an increase to the industry of over $8 million plus the loss-savings of $260,000.

Looking down the road, there are several potential problems facing the entire fish-raising sector of Idaho's economy. Among these are: water

discharge quality, change in feed quality, and the pending fish disease legislation. The impact of each is only beginning to be felt this fiscal year.

Of these potential problems perhaps the most serious and most difficult to deal with is the change in feed quality. The Peruvian fish meal industry is unable to meet the demands for their product in manufacturing fish feed. As a substitute for fish meal many vegetable meals are being considered as are other sources of animal protein. None match the nutritional quality of fish meal and as a result will very likely give rise to a myriad of nutritional disease problems that in all probability will lead to a higher degree of infectious disease problems.

There are currently five pieces of proposed enabling legislation regarding fish disease control being considered in this session of Congress. Each private fish-raising facility has received a copy of at least one of these bills. Each respondent was asked during the course of this survey for his opinions on this legislation. The responses varied, as was expected, from being adamantly against it to being moderately for it, provided certain changes were made. All agreed that more in-depth studies must be made on fish diseases before any such legislation could become effective. They also agreed that there could be no blanket policy governing the diseases of fish in all parts of the country. Respondents looked for the proposed "Idaho Food Fish Commission" to carry the responsibility of recommending some sort of restrictions on fish and/or eggs entering the State of Idaho. In this regard, it is interesting to note that several potentially serious fish diseases have not been reported in Idaho; e.g. whirling disease, channel catfish virus disease, Henneguya sp., ulcer disease, vibriosis, and branchiomycosis. Every effort should be made to prevent their occurrence in Idaho.

There are several ways by which the effects of present and potential problems in game and food fish-raising facilities could be at least minimized if not solved. At the top of the list is education in the form of workshops and short courses. Any effective program of disease prevention or control must begin with management. And effective management practices must be implemented by personnel provided with all the techniques available. Week-long short courses have been shown to be an efficient and inexpensive method to update management practices in fish culture.

Next in line of importance in decreasing the disease problems in fish is to give more attention to the disease transmission potential involved in transferring fish and fish handling equipment inter- and intrastate. It would be ideal if fish could be raised from the egg to release or market size in the same watershed as the brood from which the eggs came; but it would be impractical from a management standpoint. Therefore, the alternative is to have a complete disease profile of each fish-raising facility and transfer fish and eggs accordingly. The recent survey is a beginning to achieve this goal.

In summary, this survey has accomplished several things, several of which were not anticipated at the outset. First, a better understanding of fish culture in Idaho and its attendant problems will provide potential applied and basic fish disease researchers a basis from which to work. Second, the commercial fish farmers themselves have a better appreciation of their part in the overall picture. Since the survey was made there have been several reports of more personal communication among fish farmers to discuss their mutual management problems. We would like to speculate that the survey had some part in this. In any event their emerging cooperative concern does

create an air of optimisn that hopefully will culminate on the formation of the "Idaho Food Fish Commission."

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Appendix I: Idaho Fish-Raising Facilities Visited During the Survey.

National Fish Hatcheries:

Dworshak NFH, Ahsahka

Kooskia NFH, Kooskia

Hagerman NFH, Hagerman

Fish and Game Department Hatcheries:

Kamiah

Rapid River

McCall

Eagle

Hagerman

Niagra Springs

Twin Falls

Hayspur

American Falls

Ashton

Grace

Warm River

Henry's Lake

Commercial Facilities:

Blind Canyon Aquaranch, Inc., Hagerman

Rangen's Trout Research Farm, Hagerman

White Water Trout Company, Bliss

Aquaculture Industries, Inc., Hagerman

Crystal Springs Trout Company, Springfield

Royal Catfish Industries, Twin Falls

Appendix I continued:

Snake River Trout Farm, Buhl

Idaho Springs Trout Farm, Hagerman

Papoose Springs Trout Farm, Pocatello

Indian Springs Trout Farm, Blackfoot

Batise Springs Trout Farm, Pocatello

Clear Springs Trout Company, Inc., Buhl

Blue Lakes Trout Farm, Twin Falls

Greene's Trout Farm, Twin Falls

Clear Lakes Trout Farm, Buhl

Rainbow Trout Farms, Buhl

Frame Trout Farms, Twin Falls

Canyon Trout Farm, Twin Falls

Jones and Sandy Livestock, Inc., Hagerman

Rimview Trout Farm, Wendell

Crystal Springs Trout Ranch, Inc., Buhl

Fish Breeders of Idaho, Buhl

Caribou Trout Ranch, Soda Springs

Appendix II: Questionnaire used in the survey of fish-raising facilities in Idaho.

File No. _____

Facility Name: _____

Address: _____

Map Locator: _____

County: _____

Phone No.: _____ Year Started: _____

Manager: _____ Original? (If not-who?) _____

No. Staff: _____ _____

_____

_____

Function:

Brood Stock: In-state sales: _____

Out-of-state sales: _____

States: _____

_____

_____

_____

Fingerlings: Source: _____

In-state sales: _____

States: _____

_____

_____

_____

File No. _____

Catchables: Source: _____

In-state dist.: _____

Out-of-state dist.: _____

States: _____

_____

_____

_____

Processed: Source: _____

Processor: _____

Processor: _____ Supplier: _____

Packaging: _____

_____

_____

No. Employees: _____

PH Insp.: _____

Fish raising units:

	No.	Size	Const.
Raceways			
Ponds			
Vats			
Troughs			
Incubators			

Water Supply:

Source _____

Flow _____

Use _____

File No. _____

Temp. (daily av.) Jan. _____ July _____

Feb. _____ Aug. _____

Mar. _____ Sept. _____

Apr. _____ Oct. _____

May _____ Nov. _____

June _____ Dec. _____

D.O. intake- _____ outfall- _____

NH_3 intake- _____ outfall- _____

NO_2 NO_3 _____ Alkalinity _____

Production:

Species: _____

_____

No. fish on hand: _____

No. fish prod. ann.: _____

Lbs. fish prod. ann.: Less than 100,000 _____
200,000-500,000 _____
500,000-1,000,000 _____
1,000,000-3,000,000 _____
3,000,000-7,000,000 _____
more than 7,000,000 _____

Nutrition:

Brand: _____ Cost: _____

Storage: _____

Feeding techniques: _____

Management:

Temperature records _____

Feed records _____

Mortality records _____

File No. _____

Inventory frequency _____

Production cost/lb to processor: _____

Conversion: _____

Labor cost/lb: _____

Utilities cost/lb: _____

Lbs/produced/man year: _____

Loss-of-production potential:

Fry mortality: _____

3"-6" mortality: _____

6"-12" mortality: _____

Additional comments: _____

File No. _____

Disease History

Most serious problems: (disease, age of fish, % mortality, treatment, time of year)

Viral: _____

_____

_____

_____

Bacterial: _____

_____

_____

_____

_____

_____

Parasitic: _____

_____

_____

_____

_____

_____

Environmental: _____

_____

_____

_____

Nuisance problems: _____

_____

_____

File No. _____

Certification: _____ Dates: _____

Comments: _____ Biologists _____

_____

_____

_____

_____

Fish Examined: Date: _____ Number: _____ Age: _____

External: _____

_____

Internal: _____

_____

Gram stain: _____

_____

Additional comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

File No. _____

Have the following diseases ever occurred in this facility? If so, when, approx. mortality, age of fish, treatment (drug, dosage, efficacy)?

Bacterial Gill Disease _____

_____

Ceratomyxa _____

_____

Channel Catfish Virus Disease _____

_____

Columnaris Disease _____

_____

Furunculosis _____

_____

Henneguya _____

_____

Ichthyophonus _____

_____

IHN _____

_____

IPN _____

_____

Bacterial Kidney Disease _____

_____

Redmouth - Aeromonas _____

_____

- Hagerman _____

_____

File No. _____

Sore Back _____

_____

Strawberry Disease _____

_____

What are your opinions on:

Federal Fish Disease Legislation?

_____

_____

_____

_____

_____

What diseases do you think ought to be checked for in fish and/or eggs entering Idaho?

_____

_____

_____

_____

The formation of a state commission for food fish farmers in Idaho?

_____

_____

_____

_____

_____

_____

_____