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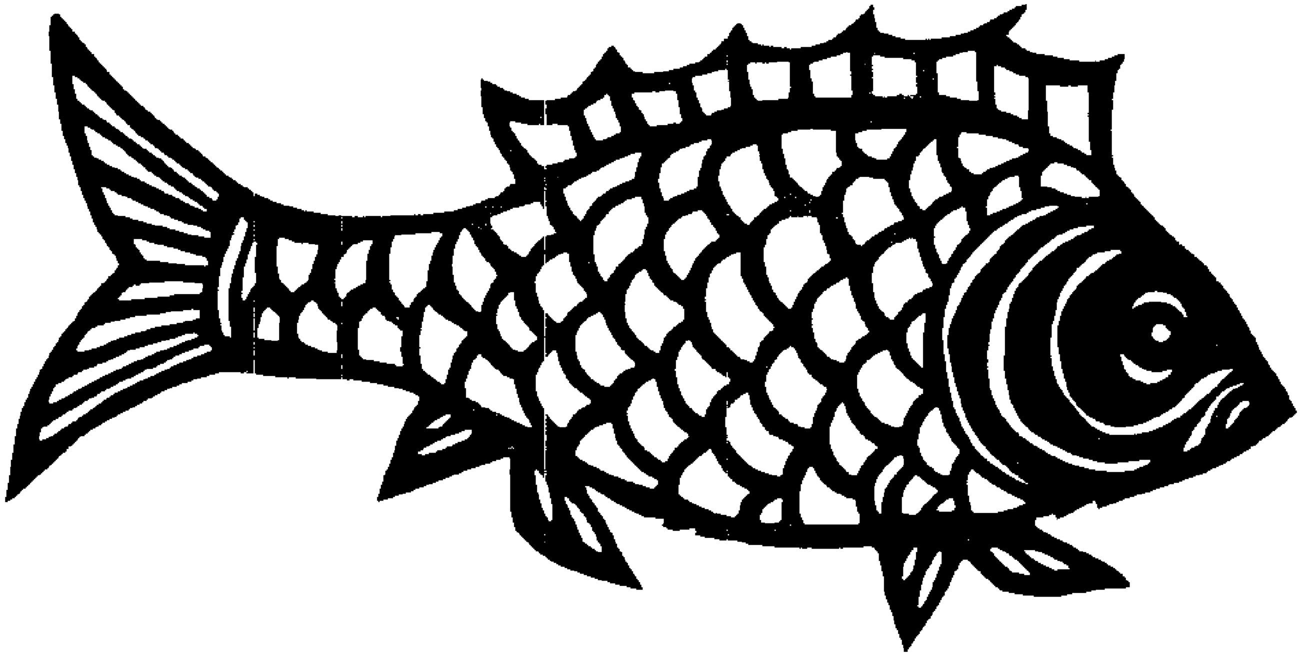

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ECONOMIC POTENTIAL OF NORTH COAST MARINE RESOURCES

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OUR FUTURE FROM THE SEA

a symposium on the ECONOMIC POTENTIAL OF NORTH COAST MARINE RESOURCES

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JUNE 19, 1971

EUREKA, CALIFORNIA

Sponsored jointly by:

*HUMBOLDT DEVELOPMENT ASSOCIATION
the non-profit industrial development arm of the Humboldt Council Chambers of Commerce, representing the 15 Chambers in Humboldt County.*

*MARINE ADVISORY-EXTENSION SERVICE
Humboldt State College, a Sea Grant Project sponsored by the National Oceanic and Atmospheric Administration, U. S. Department of Commerce.*

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PREFACE

This conference was organized jointly by the Humboldt Council Chambers of Commerce and the Sea Grant Program at Humboldt State College for the purpose of exploring better ways to utilize the available marine resources of northern California. Much of the marine resources are presently unused or wasted. Following a review of the available resources, ways to more fully utilize those resources were discussed. The full texts of the papers by the speakers are presented in this report. Also, comments, questions, and answers that followed the presentations are included.

It is hoped that the exchange of information and ideas at this symposium will serve to stimulate further inquiry and investigation that will enable the people of the north coast of California to realize the full potential of their marine resources.

RESOURCES PRESENTLY UTILIZED

Fred Phebus
Secretary-Manager
Fishermens Marketing Association

Having been connected with the fishing industry for a period of slightly over 30 years, I am thoroughly convinced that our scientific community does not know near enough about the abundance of our offshore fishery resources. I say this with all due apologies to the fishery scientists that are present here this morning.

I have been asked to speak on the "Resources Presently Utilized" and this is a subject that maybe many of you know more of than I do. Nevertheless, I will attempt to present some facts and figures that may indicate a potential industrial fishery resource that should be utilized to a better advantage.

Hake is the greatest industrial fishery resource, but it is not utilized now. It was utilized in the past for both human consumption and as mink feed.

At least 65 percent of California bottom fish that is consigned to the fresh fish market is produced in northern California. About 50 percent is processed by Humboldt Bay processing plants. The 1970 total is approximately 27 million pounds in northern California. Sixteen million pounds were processed in the Eureka area. The balance was about equally divided between Fort Bragg and Crescent City. Of this total amount, probably 60 percent is dover sole, the rest being divided among the other soles - rock fish, black cod and several other species. Probably two-thirds of the total bottom fish that reaches the fillet lines of the processing plants is the offal or a waste product. This by-product of the fillet lines is almost totally utilized as mink feed.

Another source of supply is the presently caught, non-marketable species. Drag boat fishermen probably dump back into the sea at least one-third of the fish that comes aboard in each drag. This is small sole, rock fish, black cod, turbot, arrow tooth sole and other species that there is no ready market for. This constitutes an 8 to 9 million pound potential - a good industrial fish potential. Some is utilized now as mink feed.

Other fisheries that have a great potential as a by-product for an industrial fish processing plant are crab and shrimp fisheries. Approximately ten million pounds of Dungeness crab is produced in an average year. Possibly 3 to 4 million pounds will be shell crab. The balance would be meat or picking crab. The average accumulation of waste product from this amount of meat crab would be 1½ to 2 million pounds.

In the case or shrimp, the quantity produced by the fishermen is regulated by a quota that is established by Cal Fish and Game, but will generally average between 3 and 4 million pounds. The waste material from this item would amount to one million to one-and-a-quarter million pounds. Again a source of produce for an industrial fish processing plant.

Oyster shell would contribute another one million pounds of usable by-product. In all, about 14 million pounds of various kinds of fish residue would probably be available for processing in a fish meal plant.

DISCUSSION

Question 1: How can the formation of a harbor district help the fishing industry?

Answer: I don't think I know the answer to that other than we would have an entity that could work within the harbor itself in respect to establishing possibly better mooring facilities and additional food plants. This has been a problem in the past; we have had too many people to work with and they have been at loggerheads.

Question 2: How can fishermen improve their efficiency to provide large quantities of food fish at low prices?

Answer: The American fisherman is very efficient when you consider that he is doing the same type that is done the world over and that is dragging or trolling. The fisherman is always experimenting with new nets trying to do a better job. We are tied to a mesh size limit that does allow for escapement of small fish for reproduction purposes; this only makes sense. But the foreign fishermen are not, consequently they can, even if they were using the same size net as we are, probably double us in productive capability. This doesn't necessarily mean that the fishermen are sitting still and not making the effort to upgrade their efficiency. They are trying out new concepts in fishing all the time and, any time anyone comes up with a new idea, they are always willing to try it. We are tied to a pretty limited market, consequently, we are producing to the limit of that market right now. From that viewpoint, we don't have to do any better, we are doing well enough. I think we could produce industrial fish at a cheaper price simply by doing the same thing they do in that particular type of fishery on the east coast -- such as adapting our vessels by redesigning the holds so that they could be easily unloaded. But we don't have this market so why bother with it at this present time.

RESOURCES AVAILABLE FOR A NORTHERN CALIFORNIA INDUSTRIAL FISHERY

John Radovich
Operations Research Branch
California Department of Fish and Game

Before discussing the potential resources that exist off the coast of California, I would like to point out a few factors which can influence development of an industry, aside from the quantity of fish off the coast. The following example will illustrate some of these factors.

A few years ago, drag fishermen in Oregon were negotiating for a price between 5¢ and 6¢ a pound for fish delivered in the round. Since these fish were always filleted and since the fillets weighed about 28 percent as much as the whole fish, the cost of the fillets was 18½¢ a pound for a 5¢-a-pound fish, and 21½¢ a pound for a 6¢-a-pound fish, not including the cost of butchering or packaging.

Frozen blocks of foreign-caught fish at that time were being delivered to fish brokers in the U. S. for about 22¢ a pound.

The fishermen felt they could not afford to fish at 5¢ a pound while the markets maintained they couldn't afford to pay 6¢ a pound because of foreign competition.

That year, I believe, the price was finally set at 5½¢ a pound, which was too high for the market to compete effectively with the foreign imports and too low to encourage a vigorous fishery by the U. S. fishermen.

In this case, the total supply was not the controlling factor for a viable fishery; however, it was obvious that the density of the fish in the ocean was important.

If, for instance, the fish were more heavily concentrated so that the catch per drag were 50 percent higher, the local fishery could supply the domestic market to the extent of its capacity at slightly less than 5¢ a pound, since the fishermen would more than make up for the low cost by the increased volume. If the fleet could increase its efficiency by 50 percent through development of more efficient gear, the results would be essentially the same. On the other hand, if the average catch per standard drag would decline 25 to 30 percent, the fishery would be in a critical condition

The California anchovy fish meal business is in a similar precarious position. Its existence is dependent on the price of fish meal, which is influenced by the supply of anchovy meal from Peru and the prices of other protein sources such as bone meal, soy bean meal, blood meal, and so forth. The price paid to California fishermen for anchovies has been around $20 a ton, plus or minus a couple of dollars. This comes to about 1¢ per pound.

In order to produce a commercial product such as fish meal or F. P. C. profitably, it is necessary to have a large volume of raw material available, capable of supplying large catches at a very low cost. It must be susceptible to being harvested in large quantity with relatively low manpower, or else it must exist in sufficient quantity as a by-product of another fishery.

Now, considering these constraints, let us look at the marine resource potential off California.

Two very good sources of information on our latent resources are "California's Living Marine Resources and their Utilization", by the California Department of Fish and Game (in response to Assembly Bill 564 of the 1969 Regular Session), and "The Future of the Fishing Industry of the United States", by University of Washington (a collection of papers presented at a conference in 1968). The latter publication contains a paper by Elbert H. Ahlstrom, entitled "An evaluation of the Fishery Resources Available to California Fishermen", which is pertinent to the subject we are discussing.

Dr. Ahlstrom's conclusions are based on egg and larvae surveys in the area of the California current. These surveys follow a basic station plan consisting of lines 120 miles apart, containing stations about 40 miles apart, from British Columbia to the tip of Baja, California. Additional lines and stations have been added to give heavier coverage over the area of greatest interest. In some areas, lines have been as close as 12 miles apart and stations as close as 4 miles apart.

At most of these stations, tows were made with a standard 1 meter plankton net in the upper 100 meters of water. Some of the stations were occupied almost monthly - others less frequently. The CalCOFI surveys have been conducted for the past 20 years and constitute an extensive and continuous index of fish abundance in the region. The amount of eggs and larvae caught in the nets is an indication of the abundance of the larvae of each species caught. If we have additional information on the number of eggs produced by the average adult female, and the sex ratio in the population, the population of a species can be estimated. These surveys provide us with the best estimates available of local population size for a number of species; essentially those whose eggs and larvae are distributed in the upper 100 meters of water.

The major fishery resources off the California coast, as indicated by the CalCOFI egg and larvae surveys, are northern anchovy (Engraulis mordax), Pacific hake (Merluccius productus), rockfish (Sebastodes spp.), jack mackeral (Trachurus symmetricus), Pacific saury (Cololobis saira), and deep sea fishes such as lanternfishes (Myctophidae and Gonostomatidae) and deepsea smelts (Bathylagidae).

NORTHERN ANCHOVY (Engraulis mordax)

Dr. Ahlstrom estimates that the anchovy population off California and Baja California will weigh between 4½ to 5½ million tons, about half of which is off California. The Department of Fish and Game's publication agrees closely with Dr. Ahlstrom's estimate and puts the population between 4 and 6 million tons. The anchovy population is more abundant off southern California than off northern California.

JACK MACKEREL (Trachurus symmetricus)

Dr. Ahlstrom and the Department of Fish and Game publication both estimate the jack mackerel population at between 1.4 and 2.4 million tons in the CalCOFI area, and from 2.1 to 4.8 million tons for the eastern Pacific. Small jack mackerel are vulnerable to purse seines in southern California. Large adult jack mackerel are widely distributed farther offshore and farther north, and are neither densely concentrated nor very vulnerable to present fishing methods.

PACIFIC SAURY (Cololabis saira)

The Pacific saury population for the eastern North Pacific is at least 450,000 tons according to Ahlstrom and the Department's report. It may be several times this large. Soviet research personnel have reported finding heavy concentrations of sauries about 50 miles off the coast of southern Oregon during the fall.

Sauries may be caught easily with a blanket net after first attracting and concentrating them under night lights. This technique is used by the Russians and the Japanese. Recently the Soviets have been using a suction pump in conjunction with night lights to pump the fish directly aboard. The saury population within the CalCOFI region is at least 225,000 tons and it may be several times this large. If we do not utilize the saury resources off our coast, I expect the Japanese will.

PELAGIC RED CRAB (Pleuroncodes planipes)

The pelagic red crab is extremely abundant off Baja California and occasionally off southern California. It can be caught by bottom or mid-depth trawling, or with night light and blanket net. Soviet fishermen took 5,000 tons experimentally in 1967 off Baja California. The species doesn't normally occur north of Point Conception.

SQUID (Loligo opalescens)

Squid are very abundant; during their spawning period they become highly vulnerable to fishing with dip nets or blanket nets under a night light; at other times they may be caught with purse seines. In southern California, they are extremely susceptible when they spawn in January and February. However, they spawn later and consequently become available to the fishery in Monterey Bay in April. Little in known of their habits in the northern California area.

SABLEFISH (Anoplopoma fimbria)

Sablefish are very abundant in deep water, and their range extends into Baja California where they have been caught in depths up to 1100 fathoms. On the basis of deep sea photographs and catches in traps, Prof. John Isaacs (Scripps Institution of Oceanography) estimates the population at over 400,000 tons. They can furnish a steady substantial product for the fresh fish market if a market could be developed. They probably do not school densely enough to supply a reduction fishery.

ROCKFISH (Sebastodes)

As a group, the many species which constitute the genus Sebastodes range beyond the areas presently fished. Their potential yield and total population size is unknown. They have been fished heavily by the Soviets, particularly off our northern states. The Soviet rockfish catches off Oregon, Washington, and Alaska consist mostly of Pacific Ocean perch (Sebastodes alutus). Soviet rockfish catches off California have been mainly splitnose rockfish (Sebastodes diploproa). In 1967, the Soviets caught 17,766 metric tons of rockfish; 9,141 metric tons in 1968, and 382 metric tons in 1969. They have agreed to avoid concentrations of rockfish since they maintain they are interested only in catching hake off California.

PACIFIC HAKE (Merluccius productus)

The Soviets' Pacific hake catches were 34,679 metric tons in 1967; 4,075 metric tons in 1968, and 9,337 metric tons in 1969.

SOVIET CATCH OFF CALIFORNIA
(METRIC TONS)

	1967	1968	1969
PACIFIC HAKE	34,679	4,075	9,337
ROCKFISH	17,766	9,141	382
OTHER SPECIES	10,191	1,309	3,960
TOTALS	62,636	14,525	13,679

Dr. Ahlstrom estimates the spawning population of adult hake at 2 to 4 million tons. He indicates the principal hake spawning area is off California despite the fact that heavier catches are generally made off Oregon and Washington. His estimate based on eggs and larvae counts is quite a bit higher than the Soviet and U. S. scientist's estimates of 1.2 million tons and 610,000 tons respectively, based on experimental trawling.

Using the experimental trawling estimates, scientists of the two countries calculated the potential sustained yield to be between 174,000 and 349,000 tons.

MESOPELAGIC FISHES

According to Ahlstrom, perhaps the most underutilized group of fish over the entire world is what he calls the mesopelagic fishes. These are wide ranging mid-depth oceanic species and they include the lanternfishes (Myctophidae and Gonostomatidae) and the deepsea smelts (Bathylagidee). They make up 20 to 30 percent of all the fish larvae taken in the CalCOFI samples. The farther you go offshore, the higher the proportion of these deep sea fishes.

This group makes up 80 percent of the fish larvae in the tropical Pacific and is also very abundant in the Indian Ocean. It probably constitutes a biomass as large as that of the resources which now support the world's fisheries. This group is also abundant off our coast.

However, there are several drawbacks to their commercial utilization:

1. They are small - most adults are from 1¼ to 2 inches long.
2. They are deep - although the larvae occur in the upper mixed layer above a depth of 100 meters, the adults usually live at greater depths.
3. They are not concentrated - although they are extremely widespread and abundant, adults rarely occur in dense schools; and
4. They are offshore - they are most numerous in oceanic waters.

The following table of much underutilized and much overutilized species is modified from Ahlstrom's table 7 and summarizes the subject quite well:

UTILIZATION OF CALIFORNIA FISHERY RESOURCES

Much Overutilized	Much Underutilized
Pacific sardine	Northern anchovy
Pacific mackerel	Hake
	Saury
	Squid
	Mesopelagic fishes
	Sharks and Skates
	Rockfishes
	Sablefish
	Jack mackerel
	Bonito

PACIFIC BONITO (Sarda chiliensis)

The only two much underutilized groups listed on this table that I have not discussed are Bonito, and Sharks and Skates. Bonito are abundant in southern California and northern Baja California, but are rarely taken in any quantity north of Point Conception.

SHARKS AND SKATES

Sharks, skates and rays are greatly underutilized, and some species such as the spiny dogfish (Squalus acanthias) are so numerous that they become a nuisance to drag fishermen. However, one would not expect a sustained high yield from sharks and skates since they tend to be slow growing and have a low reproductive potential.

The soupfin shark (Galeorhinus zyopterus) which was the object of an extensive fishery a number of years ago declined markedly under exploitation despite the fact that it had a relatively high reproductive potential for sharks. The average litter of 35 young was produced with a gestation period of less than a year. By contrast, the dogfish has only 13 to 14 young every two years. Therefore, although sharks and skates might produce considerable raw material initially, it is doubtful that a high production could be sustained.

I have covered the potential resources that exist off our coast, but as you can see, there are problems connected with developing an industry on any one of them. Perhaps some of the other speakers today may be able to develop some novel and creative ideas which will enable a viable industry to develop for the utilization of these resouces.

PELLETIZED FISH HATCHERY FEED

William E. Schafer
Supervisor of Hatcheries
California Department of Fish and Game

I was asked to come here today and discuss fish feed requirements for the California Fish Hatchery system, and the ingredients required to produce an acceptable feed. I will speak about our program, and refer to some of the manufacturer's specifications.

The one important development really responsible for improvement in fish culture in the last ten years was the development of the dry pelleted fish feed. This feed is a complete diet, it contains all of the necessary proteins, carbohydrates, fats and vitamins presently known to be required for fish growth. Most of the formulations are based on work done at the Courtland Laboratories in New York and the Salmon Nutrition Laboratory in Washington. Now there are trout feeds, salmon feeds, and even catfish feeds, commercially available.

The California Department of Fish and Game operates 21 fish hatcheries, 13 trout hatcheries, 6 salmon and steelhead hatcheries and 2 warmwater fish hatcheries. One of the warmwater hatcheries is strictly for rearing channel catfish. During fiscal year 1970 we produced 46½ million fish, weighing 3½ million pounds. Of this total, 32 million were resident fish or trout, and 14 million were anadromous fish (11,900,000 salmon and 2,100,000 steelhead). We spent over $700,000 for fish feed to raise these fish, and I might point out that 95 percent of this money went out of state.

We feed three types of feed - a dry pelleted trout feed, a pelleted catfish feed, and the Oregon pellet which is a moist frozen pelleted diet designed for salmon and steelhead. We feed about 7 million pounds of trout feed, a half million pounds of catfish feed, and one million pounds of the Oregon pellet each year. With our proposed expansion, this will increase by at least 50 percent in the next 10 years. All of the vendors that are selling us feed presently are located out of state. The Oregon pellet is made by two firms, one in Oregon and one in Washington. Of the four bidders on our bidders' list for trout feed, one is located in Idaho, two are located in Utah, and the other is the Ralston Purina Company, who is proposing to start milling their feed in Stockton. We purchase our feed for about 9¢ per pound for the dry feed and about 18¢ a pound for the Oregon pellet. We get conversion ratios between 1.5 and 2 on these diets (that means for every pound and a half of feed, we get a pound of fish).

One thing that I should point out is that governmental agencies whether they are federal, state, county or city, generally must purchase through competitive bids. In general the lowest bidder is awarded the contract if his product meets the specifications. We recently have been able to convince the Office of Procurement that the lowest priced product is not always the cheapest product or the most economical. We are currently running diet tests. Any vendor that has a commercial diet can bring it to us with data showing that it has produced fish for at least a year, then we will test it. We feed it to a small group of fish for another year, come up with a conversion ratio on his feed and then use this ratio, as a factor to interpret bids. This way we feel we are getting the best performing feed for our dollar.

Pelleted fish feeds are all formulations of many ingredients. We refer to two types of formula, the so-called open formula (examples are the Oregon pellets or the Abernathy diet, and PR6 a federal formula) where the ingredients and the amounts are specified to the manufacturer. He puts them together and mills them according to specifications. The closed formula is a manufacturer's own formula, no one but he knows the ingredients of the diet. Generally these are brand name feeds, for example there is Silver Cup which is milled by Murray Elevators in Utah; New Age which is a Moore Clark product from Salt Lake City; Splash, a mid-West feed; and the Ralston Purina chows.

All the pelleted feeds contain a very large amount of fish meal. In some cases even over 50 percent of the total ingredient is fish meal. Most open formulas restrict the type of fish meal to herring meal. Some of them even restrict it to Canadian, Alaskan or domestic herring meals. I don't know what the commercial products are using, but assume they are using herring meal - Canadian herring meal - with a high protein content.

The Oregon pellet also contains a wet mix of fish viscera, it is a combination of dry meals and a mixture of 4 or 6 fish. I have several formulas here that I would like to go through to show you how restrictive they are.

The specifications on the formula put out by the Oregon Fish Commission, for their Oregon pellet, specify herring meal - 28 percent, (Canadian or domestic minimum 70 percent protein; full meal containing the herring solubles) dry whey product - 5 percent; cotton seed meal - 15 percent (with minimum of 50 percent protein) shrimp or crab meal (preferably shrimp - 4 percent (maximum of 3 percent salt, crab meal must contain minimum of 30 percent protein) wheat germ meal - 4 percent (minimum 25 percent protein and 7 percent fat); 4 percent corn distillers dry solubles. Also a vitamin mix is added which contains Absorbic acid, Biotin, B_{12}, E, Folic acid, inositol, menadione, niacin, Pantothenic acid, Pyridoxin, Riboflavin and Thiamine. Added to this dry mixture, the wet mix consists of 2 or more of the following 6 fish products, providing none shall exceed 15 percent of the total fish diet, and the 1/32nd and 3/64 inch pellets shall contain at least 7.5 percent tuna viscera. Fish specified are albacore tuna viscera (without heads and gills, with livers) turbot (whole turbot), salmon viscera (without heads and gills, with livers and pasteurized). The other fish products are herring (whole pasteurized) dogfish (whole with livers), and hake (whole pasteurized). Two percent kelp meal, 6 percent soybean or herring oil. These ingredients are mixed together, milled, frozen and bagged and that is the Oregon pellet.

Three of the specified fish are required to be pasteurized and the temperature has to be raised to 180 degrees held for a half hour and dropped slowly. Thermograph records of all pasteurization of fish products have to be maintained and given to the Commission so that they can determine if the pasteurization process is carried out properly. This is primarily to protect the salmon and steelhead resources because adult fish carcasses do carry diseases and parasites. The practice a few years ago was to grind up the adults and feed them back to the fry. In the Sacramento drainage there is a virus disease that affects our king salmon. Pasteurization, we feel, will eliminate these organisms.

There is an Oregon mash which we use for starting all our fish, trout, salmon and steelhead. It is a mixture of 46 percent herring meal; 10

percent wheat germ meal, 10 percent dried whey products, 4 percent corn distillers dry solubles, and 1.5 percent of the vitamin mix. The wet mix consists of: 8 percent albacore tuna viscera, 8 percent turbot, salmon viscera or herring, 2 percent kelp meal, 10 percent soy bean or herring oil, and 1/2 percent of choline chloride. These are very good feeds, a little expensive but they do provide a return of fish.

Another formula developed at the Salmon Cultural Laboratory, is the Abernathy diet. Its formula is as follows: fish carcass meal, salmon, dogfish hake or turbot - (minimum protein 70 percent maximum fat 12 percent, maximum moisture 7 percent, TBA value not to exceed 40 (TBA is thiobarbituric acid, it's a measure of rancidity in the fish meal) no fillet scrap meal acceptable, meal without solubles preferred) - 41 percent of the diet consists of this fish carcass meal; dried whey, (not less than 15 percent protein) - 23.9 percent; cottonseed meal (minimum protein 50 percent) - 15 percent; wheat germ meal, (minimum protein 25 percent, minimum lipid 8 percent) - 12 percent of the pellet; vitamin mix - 1 percent; soy bean oil - 6 percent. The vitamin package is about the same with some difference in amounts from other diets.

The federal government also has a dry diet open formulation which provides: crude protein - levels of 40 percent and the fish meal specified is again Canadian or Alaskan herring meal (minimum protein 70 percent maximum fat 10.5 percent, maximum salt 2 percent, maximum moisture 10 percent, immediate past season, pepsin digestability not less than 92.5 percent). Approximately 35 percent of this diet is made up of this meal. Corn gluten meal (60 percent protein) - 6 percent of the diet; Wheat middlings (minimum protein 14 percent) - 22 percent of the diet; soy bean oil - 10 percent; (Solvent extracted protein content of 48.5 percent) Corn fermentation extractives 8 percent Dried Brewer's Yeast-4 percent, Delactosed whey - 4 percent, dehydrated alfalfa meal (reground pellets, minimum protein level of 17 percent) - 3 percent of the diet; and so on.

Idaho is developing a test diet very similar to the others. They specify herring meal - 31 percent; blood flour - 10 percent; soybean - 15, Whey-8; Wheat middlings - 19, and so on, herring oil - 2 percent.

We have a diet we feed our catfish. Catfish being a little different from the salmonids have a different digestive tract and can utilize more protein from vegetable origin. It consists of rice bran - 34 percent; soy bean meal (44 percent protein) - 20 percent of the diet; fish meal (65 percent protein) - 12 percent; corn fermentation solubles - 8 percent; ground rice hulls - 9½ percent. Poultry by-products - 7 percent (this is poultry offal); alfalfa meal (15 percent protein) - 4 percent; feather meal - 2.5 percent; Orzan which is a stabilizer to keep the pellet from dissolving in the water - 2.5 percent; and grow-lay premix (a vitamin package) - 1/2 percent.

The catfish industry is a very large industry in the midwest and they have large amounts of waste from their dressed fish, and are trying at present to develop a meal out of the waste to use in the feed.

I gave you the poundage of the Oregon feed pellet that we feed. We feed about 1/11th of the total amount fed in the 3 western states. The Washington Fish Commission uses 4 million pounds of the Oregon pellet, the Oregon Fish Commission uses 3 million pounds, the city of Tacoma feeds 1 million pounds, the Oregon and Washington Game Departments combined feed about 1 million pounds, we feed about a million pounds and the federal government also feeds about a million pounds.

In summary, most of these dry pelleted feeds are very sophisticated diets. They are not the old liver or cod frames, and the fish grow much better. Dry feeds are a lot more economical to feed, they are easier to feed, they have allowed us savings in man power because we can automate with them, and they require high quality ingredients.

DISCUSSION

Question 1: What did you say they use to hold the fish meal together in water?

Answer: Some use ligmin, and the one for catfish is Orzam. It keeps the meal from disseminating in the water.

Question 2: Are any of these pellet formulas patented or are they open for anybody to produce?

Answer: They are open for anyone who wants to produce them, the open formula as such. What I had there actually was a bid request from the Oregon Fish Commission which they send out to people who might want to make the pellet. It spells out what goes in the pellet, how you shall mill it, how you shall take care of your ingredients, what samples you shall send to them, what analyses will be done, and when the deliveries will be made.

Question 3: What machinery have the Oregon pellet makers developed? Is it patented?

Answer: No, I believe it is still the California pellet mill type arrangement, or a different mill that they are pelleted in and then fast frozen. Presently they are frozen, brought to room temperature, bagged and then frozen. One plant is contemplating putting in their line a system whereby after they are pelleted, they will be fast frozen and then bagged similar to the way peas are processed now.

Question 4: I think California has just recently started using the Oregon fish pellet for salmon and steelhead.

Answer: Yes, it has been used about five years now. We feed it exclusively to our salmon and steelhead.

Question 5: Do you see an increased market in California for the Oregon moist pellet food or the frozen pellet? Will there be more hatcheries here for it?

Answer: Essentially there are three in proposal now, one at Warm Springs on the Russian River, an Army Corps of Engineers project which will be on the line probably in 1973 or 1974; Marysville, a dam on the Yuba River which will have a large salmon-steelhead hatchery, it's an authorized but not a funded project; and Butler Valley - if it goes through, there will be another installation up there for mitigation. Talking to people in the area there is a lot of interest in rearing ponds and these will require feed. We will probably, through better techniques over a period of time, increase the poundage produced in our existing hatcheries. Last year, we were given $3.5 million for capital investment for hatchery expansion in conjunction with the State water project, and this will increase our trout production by about 4 million fish. But again these are all projected plans, and I hate to say it but revenue is awful short right now and we may even have to cut back.

Question 6: The conversion ratio right now, isn't it best for the Oregon moist pellet as opposed to dry food? I have heard they are working on a new dry food pellet that might be an improvement.

Answer: The Department has tried to put the burden of development on the manufacturer. We don't feel that we are in a position to put on the people necessary to come up and develop this sort of thing. When we went into using the conversion factor as an adjustment factor on the bid the first year, we got protests from two companies. They went to the Board of Control and we had to back off. So we gave them further notice and told them what we were going to do and how we were going to do it. They all came into the program and are accepting it now. But these two companies were caught with their pants down. Their feed wasn't performing and another company had a great advantage over them. They were just trying to hold things so they could increase their protein level through fish meal and other things and come up to where they were performing in the same ball park.

Question 7: Are there any print outs on FPC formulas?

Answer: Yes, through the Oregon Fish Commission the open formulas are available.

SOIL AMENDMENTS

Fred Smith
Environmental Coordinator
Georgia-Pacific Corporation
Samoa Wood Products Division

I would like to offer soil amendments as one solution to the fishery waste problem. It is obviously not the only solution and probably not the most profitable, but it should be considered.

Soil amendments, as defined by the California Landscape Industry are: "Any material either organic or inorganic that is added to a soil to increase its fertility, modify chemical reactions or improve its mechanical conditions."

This definition is rather broad and could include most anything. Some examples of the more common materials -- peat moss, manure, sawdust and bark, may give you a better idea of what I am talking about. Generally, soil amendments are not fertilizers. Some do have a nutrient value but their primary function is to improve the soil structure by adding organic matter. Once in the soil, organic matter begins to decompose by bacterial action. I won't go into great detail of the process but nitrogen is required for decomposition. If the organic matter does not itself contain enough nitrogen, nitrogen will be removed from the soil.

The problem of nitrogen removal from the soil has caused many people to avoid wood residues as a soil amendment. There are two ways to overcome this problem. A recently developed process of injecting anhydrous ammonia into sawdust and bark is able to add enough nitrogen for complete decomposition. An added benefit from ammoniation is the darkening of the raw material which makes it more "rich" looking.

The second method of offsetting the nitrogen deficiency is by adding a nitrogen rich organic material to sawdust and composting this mixture. The result is a partially decomposed soil amendment that provides intangible growth promoting substances as well as available nutrients and commands a premium price.

Fishery wastes are an ideal nutrient additive because they are generally high in nitrogen and other elements beneficial to plant growth.

The raw material situation in the Eureka area is very promising. Fishery by-products from fish filleting, along with shrimp and crab shells are estimated at 15 million pounds a year. Oyster shells, an ideal source of calcium for composting, are estimated at one million pounds a year. In addition, sewage sludge, animal manures and packing house wastes are also available within a short distance.

I am sure many of you are aware of the wood waste situation in this area. Two pulp mills and a flakeboard plant are running on material that was once burned a few years ago.

Not too long ago, Georgia-Pacific was operating six tepee burners in this area, now we are down to two full time burners and one burner once a week. Although this is an improvement, we still feel this is three burners too many. We would like to see a 100 percent utilization program of converting the remaining wood residue into a useful product. The volume of wood waste available, particularly bark and sawdust in the Humboldt-Del Norte area is about 700,000 dry tons per year. Redwood bark, fir bark, sawdust and shavings are the principle wastes.

Redwood bark and sawdust is presently well accepted by the soil amendment trade because of its darker color and longer life in the soil. Treated redwood sawdust is widely distributed in Southern California and parts of Nevada and Arizona. I would like to briefly outline some of the considerations and advantages for a soil amendment compost operation:

1. Relatively small capital expenditure. The major investments would be material handling equipment such as trucks and front end loaders, a hammer mill or grinder and a bagging machine. Some undeveloped land is also necessary.

2. A product that moves in large volume. The California Landscape Industry estimates over one million cubic yards of wood residue was used in California last year. The wood residue market is growing, particularly in the West by replacing peat moss.

3. A relatively high value product. Organically composted

materials command some of the highest prices in the soil amendment field. This is particularly true with the increased emphasis on organic gardening and public concern over chemical fertilizer problems.

4. Composting reduces the material volume. Bacterial action works on the carbon fraction of wood producing carbon dioxide and water. In this process, the material volume can be reduced as much as one half. Composting also reduces the moisture content which is critical in shipping since rail rates will be a very important factor in a profit picture.

5. Finally, a soil amendment operation is ecologically sound. The nutrients and energy removed from the forests and the sea are returned to the land to stimulate plant growth. A well run composting operation is not offensive and can be non-polluting.

In conclusion, I want to emphasize that I am <u>not</u> suggesting that the commercial fishery industry solve the forest products industry's waste problem. I am offering soil amendments as a solution to a mutual problem and hope it will be considered.

DISCUSSION

Question 1: You said that this was done elsewhere, I'm not sure if you meant specifically that wood waste and fish waste are combined and marketed.

Answer: One example is the Sacramento area, wood waste and chicken offal, processing wastes and bones were composted and sold. On the east coast it is quite common to use fishery by-products, but it is always on a small scale because one problem is that you cannot always depend on your source - things jump around a lot. If you set up for running red snapper and the fishermen are out after something else, you're in trouble -- you have to be flexible. One nice thing about this area is that, with the continued dragfish fishery, shrimp and crab and salmon fishery, it tends to be a year round situation. There are gaps admittedly but it is pretty good from that standpoint.

Question 2: Have you checked into using ocean shipping as a coastal basis for this type of a product. For instance, let's say you tie in at Crescent City, Fort Bragg and Eureka and utilize the mills there, have places where these materials can be mixed and put aboard barges. You would get maybe half a load at Crescent City, and top it off at Eureka and Fort Bragg. At the same time as you top it off you would have the entire thing mixed together and then have a central location, such as Monterey, where you have a bagging center and distribution center.

Answer: We have looked at barges from the standpoint of either bulk or bagged shipping out of here to the Los Angeles area. Presently there is a soil amendment company in Smith River. They are in a good situation for what I'm talking about. There is a problem with wastes in Crescent City and they are in Smith River. Their problem is a rail head, they're stuck. You see trucks going by occasionally with their materials on it, but it costs a lot of money. There are a number of large companies that distribute this material. Our primary interest and your interest is to move a volume. You would rather make a few cents on a lot of bags than a killing on a few bags because you want to get this stuff out. But the distributors are the other way around, they like to mark it up to whatever they can and this causes the problem. The Smith River plant was put in to solve a polution problem. The man that runs the plant feels that the reason he can't move his volume is because they are pricing this stuff out of the market. He knows what it costs him, he knows what he gets for it, and then he sees what it sells for here in town or in Crescent City and he's upset - but he has no control over that. He sells it to the distributor and the distributor takes it from there. The distributor says he can't move this stuff so they have piles of sawdust there that won't quit. All they can do is bag it and pack it. You have to have some kind of control over the price of the end product to keep it low to move a volume.

FISH PROTEIN CONCENTRATE

John A. Dassow
Asst. Laboratory Director
National Marine Fisheries Service

In view of what has happened in the last couple of months, I would like to give you more than a summary of the potential for fish protein concentrates in northern California, including some information on the present status of development for fish protein concentrate (FPC) around the world. The resource base in northern California, as summarized by Fred Phebus and John Radovich, must be related to the requirements of the FPC process methods. I am not going to discuss details of the process at the FPC experiment and demonstration plant, Aberdeen, Washington, since that will be covered in a later talk. However, we should consider the developments on the process methods and the improved protein products under investigation at the Seattle Laboratory of the National Marine Fisheries Service.

First of all, what is FPC? If we take ground whole fish and remove the water and the oil, we will get a stable nutritious material. How stable it is depends on how good a job we do in removing the moisture and the oil. What we have left is a powder that is primarily protein and minerals. How much protein it has depends on how much was in the original material. Obviously, if we start out with shrimp or crab waste we are going to end up with a product that has much less protein than if we started out with a whole fish like hake. FPC is defined as a food additive by the FDA and there are minimum specifications on its composition. Therefore, if we say FPC, one assumes it meets the requirements of the food additive. At present these requirements limit the species that can be used for production of FPC as well as its composition. Hake, herring and menhaden are the main species approved at present, and it is hoped that anchovy will be approved by the FDA in the near future. This doesn't have to limit our horizons for future potentials, however. We are in the process of developing broader perspectives both for the raw materials and the products that might be best developed from the available resources.

Now let us take a quick look at where we stand in the world of FPC. In the U. S. we have two developments. One private firm in New Bedford, Massachusetts, has produced and is marketing an FPC called Instant Protein, which is available in some areas. This FPC product is marketed primarily in the health food stores and is not priced competitively with other protein sources. The second FPC development in the United States is the experiment and demonstration plant for production of FPC at Aberdeen, Washington. Its design, construction and operation were approved by legislation passed by Congress in 1966. The contractor is Ocean Harvesters, Inc., Los Angeles, a joint enterprise of SWECO, Inc., Los Angeles, and Star-Kist Foods, Inc., Terminal Island, California.

This plant is being operated currently under that contract and therefore it is not a commercial plant. The primary purpose is to demonstrate technical and economic feasibility for the FPC process. The product belongs to the government and will be available to the State Department's Agency for International Development for use in overseas feeding programs and to the U. S. food industry for product development research. I have here a sample of the product that was produced the other day and is the first product that meets all the specifications for FPC. In any new plant, especially one with a new process, it takes many weeks for plant startup and operation before a satisfactory product is achieved. As one of our fellows said recently in answer to what the product is worth, the first pound of FPC that came from our plant at Aberdeen was worth $3 million. This, then is where we stand in the U. S. One commercial plant is producing a small output and one experimental government plant is just now underway.

In Canada, Cardinal Protein Ltd. has a plant in Nova Scotia, which produces a high-grade animal feed concentrate but at present FPC is not being produced according to my information. This plant uses an isopropyl alcohol extraction process developed in Canada and has the capability of producing FPC from approved raw material.

In Sweden one company utilizes a different solvent process and produces a small amount of the FPC but mainly produces animal feed protein. Elsewhere in the world there are a number of lesser developments in South Africa, Morocco, Chile and Peru that have pioneered FPC in a different way. Essentially these countries started out with a concept that you produce initially a high-grade fish meal which is then solvent-extracted. This type of product has good nutritional properties but is not acceptable as food in the U. S. and is not legal as FPC under our Food and Drug regulations.

Some years ago, it was believed that the U. S. might produce such an extracted fish meal for shipment to a country suffering a protein shortage even though such a product would not be acceptable for people in the United States. I think we all appreciate today that a hungry person still has his pride and that you injure this pride if you offer him for food something not acceptable to you. For this reason our specifications for FPC are similar for use in the United States and in foreign feeding programs.

The developments in South Africa, Morocco, Chile, and Peru are essentially internal developments and they are responding in different ways. You may have heard one story that illustrates the problem of introducing fish proteins. In South Africa they put the extracted fish meal in bread to improve the protein content; however, the fortified bread was accepted by middle class citizens but rejected by poor citizens who needed the supplement much more. In summary, it is clear that both in respect to process development and product acceptance, FPC still has a long way to go before it is significant commercially.

Turning to the resource available for protein concentrate production, we must consider the resource in relation to the product we want to produce. If we want to produce FPC we must start with hake, menhaden, or herring that are approved by the FDA regulations. Anchovy should be approved soon. If we wish to use shark, fillet waste or shrimp waste, however, we can produce a fine-quality protein concentrate, but such a product can not be sold as FPC. In the future, it does appear that we might accept the idea of producing FPC from any wholesome fish or shellfish material. The technology is largely available including new techniques for separation of flesh from shell, skin or bone. We could have three products from fillet fish in the future. One would be the fillet, second would be an edible protein concentrate, or FPC, and third, the non-edible portion which would go into an animal diet of some sort.

Another consideration in very practical terms is that we must consider the resource in terms of the availability to the plant. I am particularly glad that John Radovich spoke of this relative to some of the problems from the fisherman's view. The point here is that the fisherman must be more productive if we expect him to bring in large amounts of fresh scrap fish suitable for FPC production but at a very low price. Obviously the fisherman not only has to be more efficient to catch this fish, he has to be very efficient to preserve it on the vessel at the food-grade level required for FPC. Yet the price per pound must be sufficiently low to enable the plant to produce the FPC at a price competitive with other proteins such as soy and milk proteins. One answer is to have a very large resource close to the plant, e. g. anchovy or herring.

Another factor in FPC production is the necessity to keep the plant going. It's not like a fillet operation where you can bring in the people and start up your operation very quickly. FPC is a solvent process and a continuous operation in which you start your fish at one end and get products out the other. Such a process like an oil refinery or pulp mill is most efficient if you have long continuous operation. This means that management must be able to contract fish on a firm basis for price and delivery. Otherwise you can't keep the plant operational.

Let's turn to a brief look at the process methods for protein concentrates. First is the Aberdeen plant process in which the raw fish are ground up and extracted with isopropyl alcohol in three or four stages after which we remove the alcohol from the extracted fish and mill it to a fine powder. The isopropyl alcohol is a good solvent to remove the oil and the water from the fish. It is simple in concept but difficult to develop on a large scale with good efficiency. A process which is also approved by the Food and Drug Administration for FPC production is the azeotrope solvent method, also called the Viobin method, in which ethylene dichloride and isopropyl alcohol are the solvents. One method that has great future potential in our opinion is that used in the Swedish development called the Astra process. In this process the first part is production of a press cake in which the whole fresh fish are steam cooked and pressed mechanically to remove a great amount of the water and the oil. This removal is very efficient and involves a considerable reduction in cost of the operation for oil and water removal. Although this can be done in an industrial fish-meal plant, the material for FPC must be handled continuously as a food product; therefore we have to do it better than in a fish-meal plant. No real problems are likely here since it is a matter of sanitation and assurance of food-grade fish for raw material. In the second part of the Astra process, the press cake is solvent extracted to remove the remainder of the oil and water. The product is a high-grade FPC.

Another method that is commercially used is one I have already referred to which is essentially to produce a fish meal and then solvent extract it. This is the way to go if you want to produce meal. This is more expensive than industrial-grade meal but is desirable for pelleted pet and animal feeds in which the high-oil content with the strong odor of rancidity cannot be tolerated.

For the more distant future, there are a number of methods that are still in the laboratory. Our laboratories, as well as others in private industry, are working on new methods with which we hope to reduce the price of production and improve the characteristics of the product. The operating costs of solvent recovery would favor a method in which we could reduce the amount of solvent; therefore we are studying aqueous techniques in which the protein is stabilized and acid washes used to wash most of the oil out of the fish. At present a final alcohol extraction is needed to remove the oil; however we produce a higher quality product. Also such aqueous processes permit production of protein isolates as well as different grades of protein. For such products, it would be better if the plant were to operate in conjunction with an industrial process in order to provide a strong base for diversification into human food and animal feed specialty products. There seems to be a great deal of economic merit to having a diversified product, since we could utilize a wide variety of raw materials and produce products tailored to the expanding protein field.

Finally, I would like to emphasize that the product from our plant in Aberdeen is only the beginning. This product is highly nutritious, but it does not have the functional characteristics desirable for modern processed foods. Presently FPC is nutritious but relatively inert. It does not dissolve or blend with water very well. Improved ability for suspension or solution in water is desirable in many processed foods, e.g., fortified drinks. FPC that is to be used in improved meat or sausage formulations should have good ability to emulsify water and oil. FPC for addition to bread and snack foods must have a desirable affect on texture and mouth feel. We look ahead to protein products in which we will modify the processing methods to produce both a highly nutritious protein concentrate and an additive that is more useful and functional in processed foods. Our food chemists and engineers are optimistic for the future of FPC and fish proteins, but it is probably obvious from these highlights that successful industrial applications await further developments from the laboratory and the pilot plants.

DISCUSSION

Question 1: We all know that the Indians were supposed to have planted fish underneath every hill of corn. We have fish waste, and I think the Lockheed studies said we ought to be moving into row crops. Is there any way we can put the farm land together with the waste fish and fertilize the land to grow better crops?

Answer: I think you would be right, but then you have to look at the soil. Fish, of course, is a soluable element -- they found that you can get nitrogen from fish but if you want a good phosphorous balance you have to bring in phosphates. So, if you have a field and you want to spray fish or dig it in, it would depend on the mineral balance of the soil -- you can overload it.

Question 2: I hate to bring this up, but I think the question is begging in the whole industry - the matter of pollution. I understand the sablefish has just been condemned because of mercury content. I imagine you might have a product involved such as fish concentrate that could be suddenly condemned. I wonder what your attitude is if this pollution keeps increasing?

Answer: Pollution and mercury are such controversial subjects that anything, especially on mercury, is coming out of our office in Washington. Let me tell you what happened with pesticides and DDT. We did a lot of work on pesticides. You remember that there were a lot of chlorinated pesticides left over and a few years ago a lot of mackeral in southern California were found to contain high concentrations of DDT residues. It wasn't very long until we got tired of running DDT residues in fish. In some cases we found none; generally off the north west coast we found none. Off southern California's industrial areas we found quite a lot. Then the next question is, if you did have a lot of fish that are contaminated with DDT, then could you use them for something? And we did research and there are some things you can use if for. DDT is solvent and is extractable. You could take a fish resource that is highly contaminated with DDT and if you wanted to, considering it was commercially feasible, you could make FPC from it, because in the process of solvent extraction you would extract the DDT. You would have a wholesome product. This is not true of mercury and heavy metals because they are attached very closely to the protein portion of the fish. We had a problem with high fluoride in our product. Certain fish like hake have high fluoride and we must debone in order to produce a low fluoride product to meet specifications. Here we are not talking about a contaminant; it just happens that fish accumulate fluoride in their bones - some do more than others. Mercury and some of the other heavy metals are generally the same in regards to ocean fish. This is a natural accumulation and what we don't understand yet is how we are going to utilize the resources in, as you say, the sablefish. I can only say that, in conclusion, after we have a better understanding of the occurrence of these elements in relation to a resource, if we find we have a resource and we end up with something that makes it impractical to use as food, the next thing we would have to do (as we did with pesticides) is find a practical way we can use the resource by removing the metals. There are techniques we could use. Obviously, we would not end up with a fillet, but we are hopeful at the laboratory stage, and this is part of our program at the present time.

Question 3: I understand the protein in the shellfish could be recovered for human use?

Answer: Not under present laws and regulations. You can only make a high quality animal food.

Question 4: I wasn't thinking of producing FPC as defined by FDA but rather to make another high protein product. Would this product still have a nutritious value, in other words, a protein package as good as the protein from the flesh of the fish or shrimp?

Answer: From reports I have read, protein is as good or possibly better because I don't think it has as high a chlorine content. There are other portions in the report where they indicated that right now they are just developing this for non-human consumption as pet food additives. I have heard they would have to develop it for human consumption in the near future to make it profitable. This was thinking of markets in Asia primarily.

Question 5: What could we do to speed acceptance of FPC here in the United States?

Answer: Part of the product from the plant at Aberdeen was made available to the U. S. food industry on an application basis. In the past year, the food processing industry has wanted to try out a small amount of FPC as a protein fortification. They didn't have a very simple way of getting a small amount of it - people in the cereal business, macaroni and noodles. I think this will gain acceptance because, if there is a market, there is more likelyhood of capitalization for it.

Question 6: How do you feel about the one pound package that the FDA has imposed? Do you feel it's only a temporary restraint? Don't you feel that, if it is removed, the market for FPC will be accelerated?

Answer: We have an advisory group through the National Academy of Science Committee which takes a very strong position with the FDA and they think the one pound limitation is very unreasonable, very unfair, and definitely limiting the future of the product. They have recommended that it be eliminated. I would think that, in view of the strength of the position of some of the authorities here, it probably will be changed in the near future. But, here again, I think that pressure from the food industry, once they are really interested in this thing and there is a market for it, could be a very important tool.

Question 8: Can fresh water fish be used for Fish Meal and FPC?

Answer: Yes, if the fish has sufficient protein in it I would say so.

Question 9: Can you use fish carcasses for FPC?

Answer: The Food and Drug Administration doesn't allow us to use just the carcasses. Under Canadian law you can take the fish carcasses and turn them into FPC if everything else comes up to specifications. The idea of the plant is to use an unutilized resource. You have to have a very large amount and this means whole fresh fish. We originally built our whole concept around hake with the potential that we could then go into a fishery like anchovey where you have the potential of bringing in 200 to 300 tons a day for a fairly long period of time.

FISH PROTEIN CONCENTRATE PROCESSING

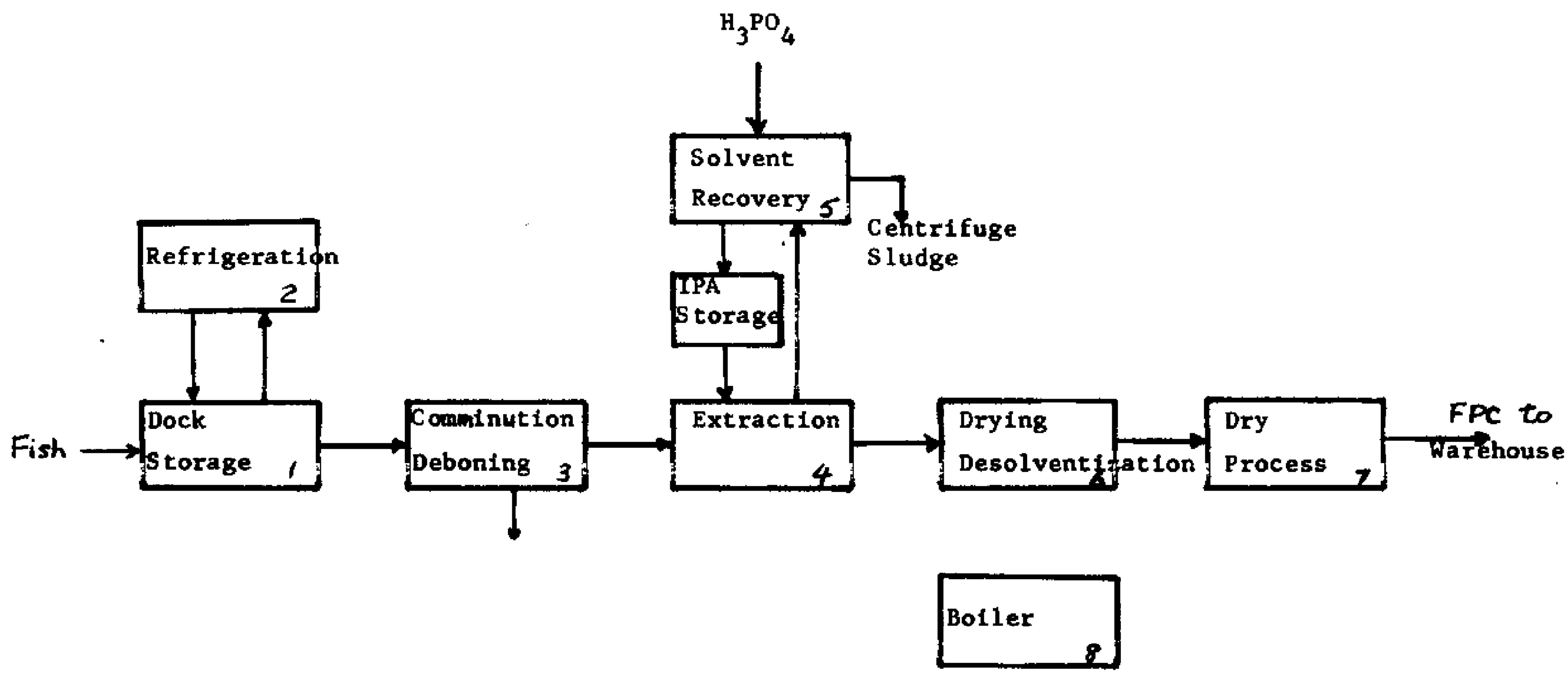
Daniel Lang
Supervisor
Sweco, Incorporated

This afternoon, I would like to describe for you the process we use at Aberdeen, Washington for the manufacture of fish protein concentrate. This plant was built and is now operated by Ocean Harvesters, Inc. under contract to the National Marine Fisheries Service. Ocean Harvesters, Inc. is 50 percent owned by Star-Kist Foods, Inc. and 50 percent by Sweco, Inc., both of Los Angeles. Sweco was responsible for the design, construction and start-up of the plant. On the other hand, Star-Kist is supplying the operation expertise with the assistance of a few Sweco engineers such as myself.

In our process, whole hake fish is extracted with isopropyl alcohol and through a succession of steps the product is converted into a dry, low fat and high protein powder called fish protein concentrate. The FPC Plant in Aberdeen was designed to handle 50 tons of hake-like fish per day (i.e. in 24 hours of operation). Let me show you, using the blackboard, what are the basic components or steps in this plant. In this first box (See Figure 1) we have the dock area with equipment for unloading fish from the boats Also, in this area we have facility to store in chilled brine up to 150 tons of fish in 12 large storage tanks. The adjacent box on the blackboard represents the brine refrigeration unit where recirculating brine from the storage tanks is chilled to about 29 - 30°F before being pumped back into the tanks.

The fish is discharged from the tanks and transported in half ton batches to the receiving area of the main plant. After the fish is weighed and washed it is ground whole into a coarse mix. The ground fish then drops into a deboner unit in which bones and scales are separated from the soft parts of the fish. The latter, we designate as the "flesh" fraction. The flesh then enters the extraction part of the plant (Box #4). We have what is technically known as a four-stage continuous countercurrent solvent extraction process. In this process the fish flesh is extracted by a solvent

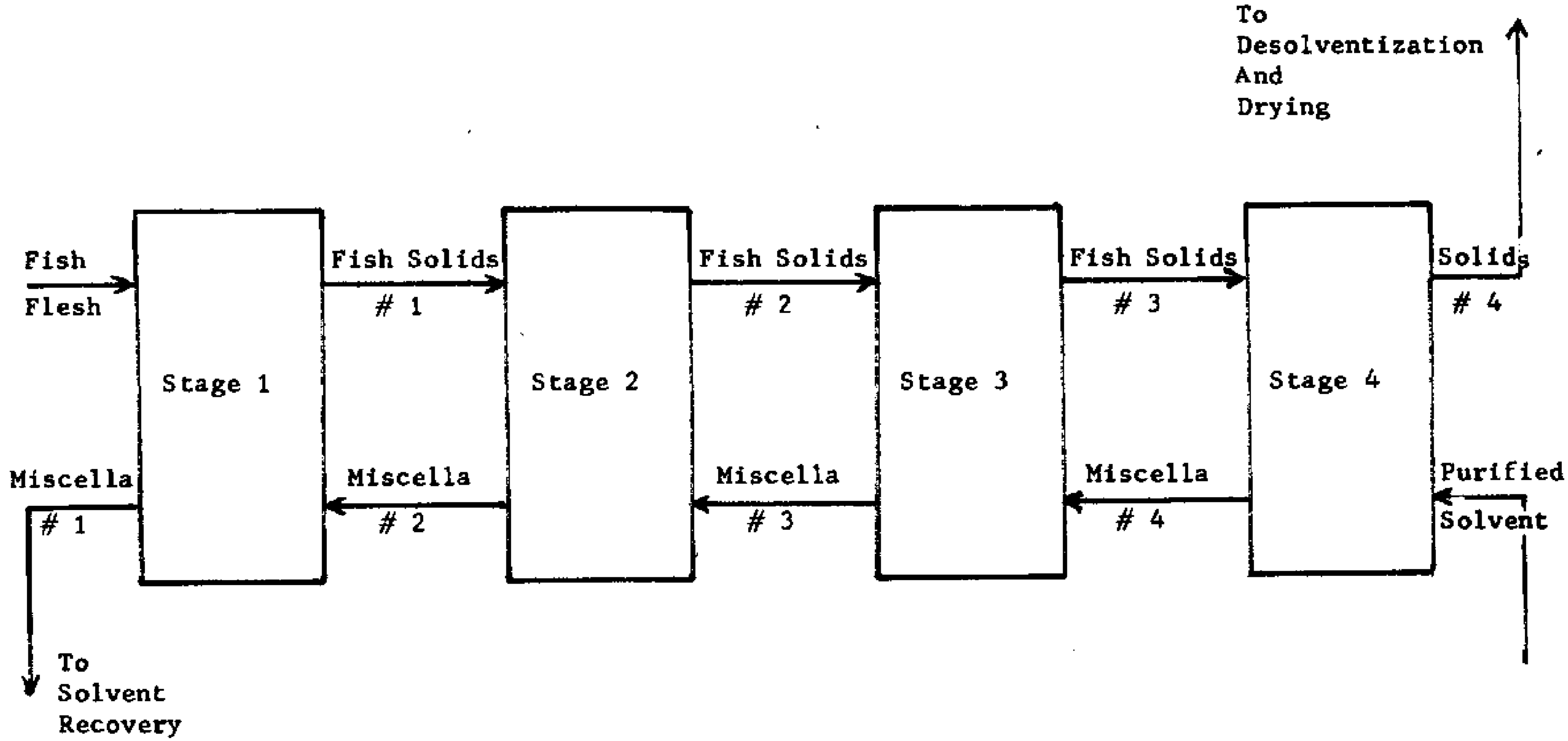
FIGURE 1: FPC Plant Flow Sheet



which removes the water and fat inherently found in the flesh. The removal cannot be economically accomplished in a single step, instead several are required. We are at present set up for four stages of extraction. The extraction is carried out in such a manner that the water and fat concentrations in the fish solids become progressively less in each succeeding stage. Meanwhile, the concentration of protein becomes correspondingly higher. When the solids are discharged from the final stage, they have been in contact with solvent of high purity and by now they have little fat and natural water left in them.

The extraction is perhaps the heart of the entire process, therefore, I would like to elaborate a little more on each of the stages involved. Basically the same equipment and method of operation are found in each stage. [To make description easier, we number each stage according to the direction of flow of the fish solids (See Figure 2). Also the stream leaving a stage has the same number as that of the stage]. If the solvent stream is not pure but contains some fat or oil it is called a "miscella". In each stage the fish solids are continuously mixed with a stream of solvent or miscella in a large agitated tank, approximately 1,000 gallons in capacity. Consider for example Stage #2 (See Figure 3). Here, fish solids from Stage #1 is mixed with miscella from Stage #3 to form a slurry in the agitated tank; because the solvent and solids come from opposite directions, the process is hence known as "countercurrent". A pump constantly takes out a stream of slurry and sends it to a Sweco separator which is in principle a vibrating screen on which the liquid (miscella) is separated from the solids. The solid stream discharged from the screen is further "dried" by a squeezing action in a screw press. The solids from the press is continuously discharged to the tank of the subsequent stage, i. e., #3. Meanwhile, the miscella from the press is combined with miscella from the screen and this total stream is sent to the next stage, i. e., #1. The same process is repeated in this manner in each stage. Except,however, the equipment in Stage #1 consists of three tanks instead of a single one; three are needed to convert a batch process into a continuous one, which is characteristic of the rest of the process downstream. Before leaving extraction, I would like to emphasize the fact that the fish solids come into contact with purer miscella (solvent) at each subsequent stage so that the amount of water and

FIGURE # 2: Extraction Stages



fat, particularly the latter, are progressively reduced. In fact, the solvent entering the fourth and last stage is pure solvent. For those who are familiar with solvent chemistry, we use an azeotropic mixture of IPA and water (i. e., 88 w/w% IPA) which is obtained by simple distillation.

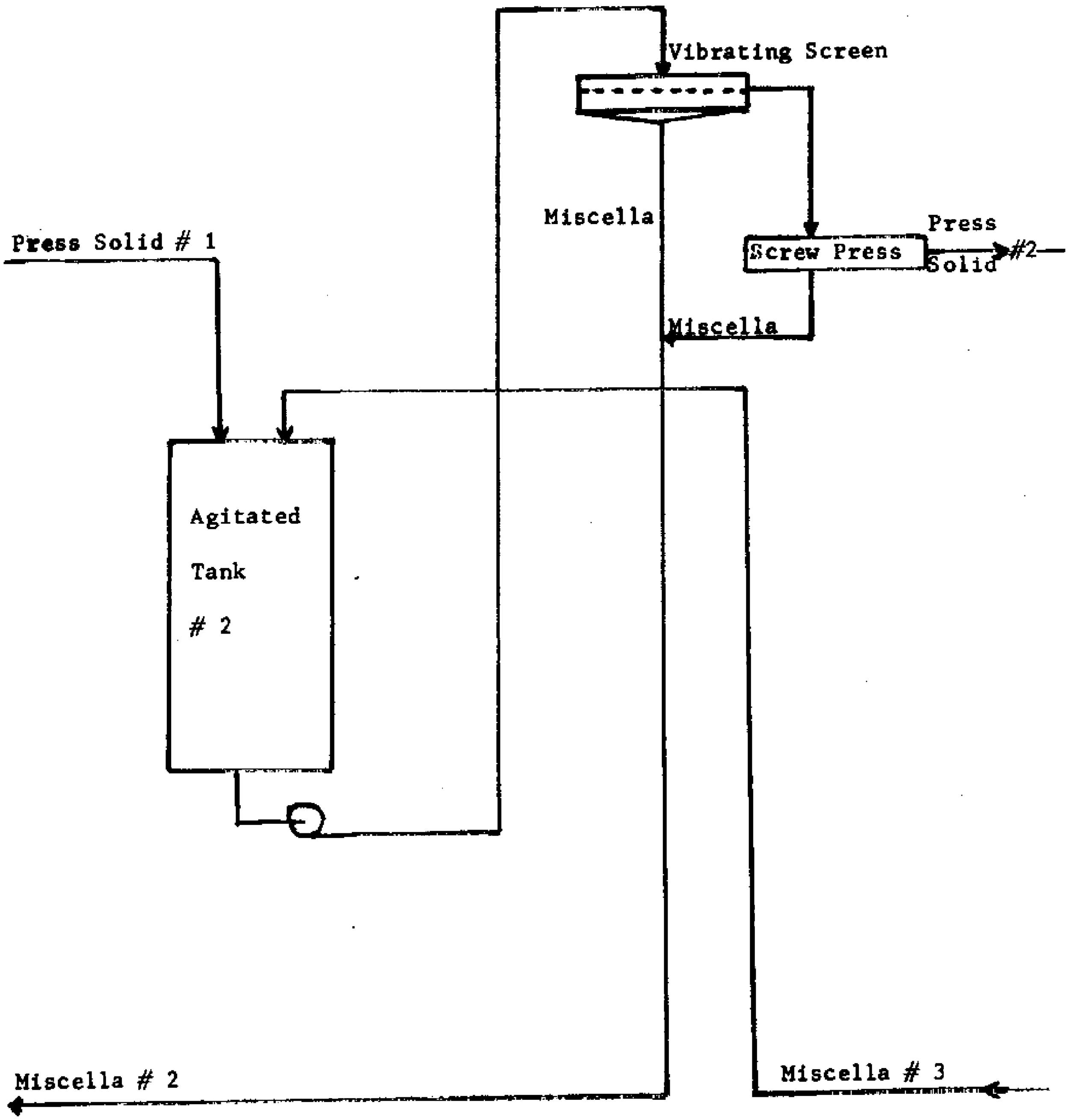
The solvent used in extraction is reused. When it has finally done its job, the solvent has picked up much of the fat and water in the original fish flesh. Entrained unavoidably in this stream (i.e., Miscella #1) is a small but significant percentage of fine fish particles which were too small for the vibrating screen and press to hold back. The water, fat and fines are eliminated in the solvent recovery system which is denoted by Box #5, Figure 1.

The spent miscella or miscella #1, is first acidified with a little phosphoric acid to ph 5.5 and then this stream is clarified in a centrifuge which separates the majority of the free fat and fines from a clarified miscella stream. The latter is sent to a bubble-plate column for continuous distillation, which produces an overhead stream of purified solvent of azeotropic concentration and a watery bottoms rich in fish fat and oil. The recovered solvent is pumped to large underground storage tanks from which a constant supply to the extraction process is drawn. Since some amount of the solvent is irrecoverably lost each time it passes through the system, it is necessary to buy and add some fresh alcohol to the storage tanks from time to time. Azeotropic IPA can be bought by the tank truck load for 45 cents per gallon delivered.

The solids expelled from the press of the last stage contain solvent in approximately a 1:1 ratio of dry solid to solvent and the solvent is removed in the drying and desolventizing process (Box #6 on Figure 1). This is accomplished on a continuous basis by heating the material with both live and jacket steam in long agitated tunnels. The material is further dried in long agitated tunnels by a countercurrent flow of air and heat supplied by jacket steam. There are all told, four such tunnels, joined in series.

The dry fish protein concentrate is conveyed mechanically from the last tunnel to the dry process room where the product is ground to a powder which is 200 mesh or finer. The powder is sealed in 50 pound sacks and these are transferred to the warehouse for storage.

FIGURE # 3: Extraction Stage # 2



The facility at Aberdeen is not a full scale plant; it was build with the purpose of demonstrating the commercial feasibility of manufacturing FPC. We are producing tons of FPC and at the same time we are accumulating data that will be used to guide investors in planning larger plants of this type. From the experience and data we are gathering we hope to modify and amplify the extensive store of knowledge which was previously derived from pilot plant and laboratory work. Also because we are operating under more realistic conditions of manufacture we are improving the reliability of the information useful to FPC production.

How can all this massive amount of information be used? First of all, it can help us improve the accuracy of feasibility studies. In making a feasibility study, one assumes a specific process of manufacture and from that one determines the capital cost, the operating cost for labor, raw materials (such as fish, phosphoric acid, and make-up isopropyl alcohol), maintenance, supplies, etc. The feasibility study, therefore, reveals the cost for manufacturing a single unit of product of a certain purity at a given rate of production. The investor then decides from that if there is enough profit to manufacture and sell the product. However, he needs a certain amount of confidence in the results of the feasibility study.

The plant at Aberdeen represents a basic method of processing, however, it has flexibility for changes, so that related methods of processing may also be set-up and tested. For instance, we can modify the extraction stages so that only three are used instead of four. However, a higher alcohol to fish ratio would be needed. The question arises as to which alternative would be more economical and we are, or will, explore this and other alternatives.

Finally, when an investment is to be made it would be necessary to develop an overall detailed design of the plant and much of the information gathered at this plant and elsewhere will be dependent upon the designer. The demonstration plant and the information it provides represent, to date, some $2,000,000 of initial research and development which a private firm would otherwise have to spend in order to enter the FPC manufacturing business.

I would now like to mention a few design features of the Aberdeen plant. One of the most outstanding aspects of this plant is that equipment is mounted on modules which are box-like frame-work measuring either

10' x 10' x 15' or 10' x 10' x 8' and the frame is welded together from 6 inch square box structural steels. Equipment were installed on the modules in the Los Angeles plant of Sweco, Inc. The utility lines, electrical conduiting and process piping were then fitted and installed. While the modules were being made, the Aberdeen site was being prepared; foundation, utility lines were laid, plant and office buildings were erected. The finished modules with equipment mounted in place were shipped by truck to Aberdeen. The modules were dropped into place in two parallel rows on the floor. A second layer of modules was placed above these. Next the intermodular piping and the connection with the underground pipes were made. The amount of field work needed to build a modular type of plant is greatly reduced, also the expansion of the plant is reduced to the problem of dropping in additional modules of equipment.

The plant has been built for strict sanitary conditions. Much of equipment is made of stainless steel, such as the extraction vessels, the pumps and the internals of the drying units. Also a great deal of sanitary piping has been used, so that they can be disconnected easily for cleaning when necessary. Generally, we have found little microbial growth, except if the product is moist but free of isopropyl alcohol which incidentally is an excellent bacteriocide. In the dry process area where the final grinding and packaging is done, it is necessary to enforce sanitary practices to prevent microbial growth which has been set by FDA at 10,000 total plate counts or less per gram -- a very strict requirement indeed.

When a plant initially goes on-stream many unexpected problems are encountered and I can assure you that we had our share. You may recall a deboning unit is used to reduce the bone content in the feed to the extraction stages. This machine is really quite amazing. A screw feeds comminuted fish to a rotating auger-screen assembly, where high internal pressure causes the soft flesh to squeeze through the perforated screen; whereas bones will not pass through the holes but eventually work their way out to the end of assembly and discharged as a separate stream. The machine is relatively expensive and when the plant was first put into operation, tramp metal from the plant and newly refitted fishing vessels caused the damage of two auger-screen assemblies. For the past two weeks, however, no stoppage has been encountered, apparently, all the tramp metals have finally been "screened" out by the deboner.

The positive displacement rotary screw pumps used for transfer of slurries gave us some trouble. We found the protein slurry is a fairly abrasive substance, a characteristic which becomes apparent under prolonged operation. Further, if boned particules are present, especially those from Puget Sound Hake, the abrasion wear on the pump internals is increased considerably. At first, the rubber lined rotors of the pumps would disintegrate very rapidly and so we decided to switch to stainless steel rotors which are much more wear-resistant, but which are characteristically a little less efficient because of higher clearance between the rotor and the housing.

With regard to the by-products of FPC production, recovered fish oil has a market in the paint manufacturing industry. Also we may have a potential user of by-products in the forestry industry. Some time ago some forestry scientists obtained samples of by-products from our plant for testing it as a deer repellent on seedlings and young trees. The scientists have found that a yet unidentified substance in fish will repel deer, and they suspect that the active agent may be present in our by-product or effluent streams.

DISCUSSION

Question 1: If you can only operate the plant six months out of the year, what are you going to do?

Answer: You could turn to a dual purpose plant or locate your plant where you can get supplies in year round.

John A. Dassow: I think what we have to do is in terms of resource like in northern California; we talk about what we have available. If someone is going to finance a plant like this, he has to come up with amortization. For a plant like this everyone feels 100 days would be too small an amount, 150 days would be much better. It is very difficult to look at the different parts of the world where you can get a large volume of fish for 150 days. Anchovey looks pretty good because you do have a long season for anchovey. In Norway they claim that they can keep their plants going for up to six months a year. It is pretty hard to find anyone who has that much fish that they can keep that size of an operation going for over six months. So, then one of the questions you come up with is, why not put the plant on a barge and then take it to the resource?

Question 2: I was wondering if you have come up with a cost factor of what you could pay the fishermen for the fish?

Answer: A couple of years ago SWECO developed some charts that will give you the gross profit in terms of the operating time in months, the selling price of FPC, and the initial cost of the raw fish. They felt at that time that $20 per ton would be about the lowest we can get for the fishermen and $40 per ton is the maximum price for fish, so it would range between that.

John A. Dassow: At present it is a government plant so the fishermen are under contract and essentially, to get the fish in, the contractors have to make the best deal they can.

Question 3: How many operators are there in the plant?

Answer: Right now there are ten on a shift, that is seven days a week around the clock, providing we get enough fish to keep us going.

Question 4: If it feasible to mount this type of a plant and operate it out in the ocean?

Answer: I know that ASTRA have embarked on a project similar to that, in that they get the fish and make a meal out of it - a press cake I should say - that is soaked in alcohol so that it will not evaporate quickly then they ship this press cake to a land plant where it is further processed to make FPC.

John A. Dassow: There is a ship in Lake Union, Seattle which has the whole process on board. It has filed bankruptcy with the U. S. government. It was not built as a FPC plant; it was built as a solvent extraction plant. The company had many problems with it and was not able to make a go of it. But I think that a fair answer to your question is that certainly the technology and engineering is there. The question is still one of economic feasibility. There are many problems.

DRY RESOJET PROCESSING

Ben Clayton, Assistant Manager
Fur Breeders Agricultural Cooperative
Midvale, Utah

The last presentation was very interesting to me. I am always looking for new ways of processing. I might mention there has been some talk today of the Fur Breeders Association. To explain our business, we are in the mink raising business in Utah. We supply mink feed to the mink ranchers in Utah, the third largest mink producing State in the Nation. We have been engaged in this area in California for the past eighteen years for the purpose of obtaining fish for part of the mink feed. We also have other operations in California for supply of fish and other products for mink feed.

During the past three years we have purchased and shipped to Utah approximately fourteen million pounds a year of fish from this area. This is both scrap fish and whole fish, the most being scrap fish. Until the past two years we were able to use all the fish it was possible to get and still needed more. Now due to the decline in the mink business, we are able to get all the fish we need.

We are always looking for new and more economical processes to supply our business and this brings me to why I am here. During the past two years we have been working on a Resojet spray drying process. This is a process whereby the product such as fish or poultry is dryed without removing any of the proteins or fats nothing is removed but the moisture. We have one of these processing plants in Turlock, California where we are processing poultry offal. One of the biggest savings we were looking at was freight to Utah. With the product dry instead of frozen we figured in the twenty two million pounds we purchased we could save almost $100,000 a year in freight. Our intentions were, and still are, to build a plant in this area for the processing of fish and other sea products. At this point we still have bugs in the operation. We did take products from here and process them with good results. I have here some of the dry samples which I would like to pass around for you to look at. There are two products which are marked, one poultry offal and the other scrap fish.

This processing plant has been very expensive to build and test. We have had to make numerous changes, and we are still making changes. It is a new process never before used and our funds are about exhausted so we are looking for ways of getting capital to finish the tests and start new plants. To this date we have been interested in producing animal feed, but I am sure there are many other uses for this process. The animal feed has proved to be very good both in nutrition and palatability. We have fed it to mink on the experimental farm with great results. Also we have fed it to dogs and cats. Some dog food manufacturers have been very interested and would be in the market for this product if we could assure them the quantity they need. The test plant we have operating will run about 6,000 pounds per hour of the raw product. It can be operated as many hours a day as necessary.

I will explain a little of how the plant is built and how it operates. First there is a silo 25 feet in diameter and 40 feet high built of 12 inch blocks reinforced with steel and concrete. There is another building adjacent but not attached to this silo. This building is for the purpose of grinding the product in the raw, the control room for operating the equipment and storing the product after it is finished. Inside the silo is a round steel tank 9 feet in diameter and 20 feet high. It has four resojet engines mounted in it. I have here a scale model of the resojet engine for you to look at. We have one jet engine in the center of the bottom and this engine has a 4 million pound thrust. The other three engines are mounted at various angles around the side and they are two million pounds of thrust each. We grind the raw product through a grinder and then through a Reitz mill into a pump. From here it is pumped into the silo through a one inch pipe. The pipe is wrapped around the first, or bottom, jet engine so as to preheat the product. It is then injected into the bottom of the tank along side the jet engine in a manner of spraying in. The other engines keep it in a suspended and circling motion until it is dry and goes out from the top. The secret of the process is not heat so much as it is vibration which shakes out the moisture and keeps all the protein and fat particles in tact. As the product leaves the top of the dryer which only takes a couple of seconds, from the time it enters and is collected in two cyclones. The air that passes through is sent through a scrubber and into the atmosphere. The cyclone collectors discharge the product into a conveyor and it is transferred into the other building.

The whole system is run from a control room in the building and all temperatures and such are recorded on charts. The operator knows at all times exactly what is happening and is able to adjust each phase to keep it functioning at peak. The engines will operate with almost any fuel, such as gas, diesel, natural gas, bottled gas and many others. We are operating these now on a cheap grade of diesel fuel. Each engine is started and controlled from the panel board. It is necessary to keep the temperature to a maximum of 180 degrees for the best results and this is done by the control of the engines.

This is not an operation that employs many people directly, but it has its advantages. It can keep the fishermen working, and help solve a potential pollution problem. We are looking forward to drying the crab shells and finding some kind of a use for this product. We know that getting rid of the crab shells is a big problem. We feel the process is economical enough to do this.and from the experience we have had to this point, it has proven out.

At this time I am unable to give any definite figures as to cost of operation because we are still in the testing stage. Until such time as we are producing, it is hard to get exact figures. However, for our own satisfaction we do know that we are on the right road as far as cost is concerned.

I'll give you some statistics on the samples we passed around. The poultry offal in the raw stage contains approximately 70 percent moisture and 14 percent fat when wet, 48 percent dry. When dried, we get about 28 percent recovery which has from two to five percent moisture and 48 percent fat. The fish will run higher on the moisture and lower on the fat. For example, the fish will run from 72 to 88 percent moisture and 2 to 6 percent fat wet, 6 to 18 percent fat dry. The recovery is less on the fish product because of the moisture content but the dry sample will run equal to the dry sample of the poultry product.

In closing, I would like to thank you for inviting me here, and I will be glad to answer any questions you may wish to ask.

DISCUSSION

Question 1: You said that it would be a one or two man operation to run the plant?

Answer: Right, we have a truck to haul it in and dump it and one man can stand there and operate the controls. If we have to bag it, as we have in the past, then it takes another man. But as far as operation, it won't take very many men.

Question 2: You mentioned that the noise could possibly be eliminated, or the vibration could be isolated. What would you have to do in order to accomplish that?

Answer: Acoustics. Soundproof the silo. You couldn't float the machinery. I have seen these engines operating and split half-inch steel wide open. It takesquite a bit to build the structure. Everything has to be circular; even a flat door will crumble.

Question 3: Are they standard jet engines?

Answer: This engine was designed by a man in France. They have the patent on it. We just have patent rights and have to pay so much per year to use them. They were first built for an airplaine but they wouldn't work so they started looking for other uses.

Question 4: There would be two things you would need for the diversification of an FPC plant. That would be a very economical fish meal plant to work in conjunction with an FPC plant. In addition, it would seem that, although you might not produce FPC, the expertise in solvent extraction would enable you to produce the meal with all the liquid in it, then you could go ahead and plan an extraction. I wonder if you have ever done this in your operation?

Answer: No, we haven't because we have only been interested in the animal feed and we've had no reason to.

Question 5: There are many ways of drying a product that would be much less cumbersome, is this that much more efficient?

Answer: This method doesn't take any of the product out except the moisture, all the fat and protein are maintained. In most drying processes you have to take the oil out first or you can't dry it. That is why this one is so much better.

Question 6: To what temperature do you heat the meal?

Answer: We figure 180 degrees is the outlet temperature at the top. It would be about the same throughout because of the air movement. The material going in is preheated to 170 degrees and it goes through the one-inch tube at 100 pounds per minute, then as it is sprayed in, it is almost dried instantaneously.

Question 7: Have you run any biological tests to determine the efficiency ratios?

Answer: We have done it. In fact, Kelloggs has run samples for us. We have run our own and had samples run by several outfits.

Question 8: How much are the drying costs?

Answer: This is hard to say as we have been running poultry. They tell me we run the fish more economically because we can run it through faster. But on the poultry we were figuring about $30 a ton for the fuel and power that it takes to run it through with one man.

ECONOMIC ISSUES IN ESTABLISHING AN INDUSTRIAL FISHERY

Jack Richards
Regional Economist
National Marine Fisheries Service

I have three major objectives this afternoon. I want to consider, in general terms, some major economic issues relating to establishing an industrial fishery. I will indicate some examples of application of these general concepts and try to answer any specific problems that you may care to raise in your questions. Finally, I will mention some areas where the National Marine Fisheries Service may be able to provide assistance in projects to develop latent or underutulized resources of California's North Coast.

By reviewing the general concepts involved, I hope to point out that characteristics influencing the longer term supply sutuation is likely to be the major factor determining the economic potential of this region. Other factors are also important however. Current market conditions for potential products from this region, factors influencing long-run demand prospects, import policies and similar economic forces also affect the competitive position of this region. Most important, however, are economic forces influencing the production costs of this area.

Why should these issues be considered only by attempting to establish general economic relationships? The major reason for this is the wide range of products that are being considered. We are not looking at just fish meal plants, mariculture or fish protein concentrate, but at any industrial product that might be successfully produced in this region. A wide range of products merit consideration. Thus, I will consider economic issues that may be relevant to any of these products rather than try to analyze the situation for any specific product.

Reviewing some of the specific problems that have come up earlier in the program may help to point out how these general concepts can be applied to indicate the feasibility of a specific product, area or firm. I will also mention examples of important information that might be overlooked in this process of appraising the economic feasibility of a particular situation.

Market Prices -- What Do They Mean?

Although factors influencing production costs in this region need to be our major concern, it is necessary to consider the total economic picture. First of all, I want to look at forces determining market prices and relate these prices to the feasibility of developing new products in this area. Many of the questions that have come up earlier today involved factors influencing the market supply and demand situation and outlook. I will only mention some examples in this area since most of you are probably quite familiar with this topic.

Prices of competing products are a good example of factors that influence the short-run demand situation and outlook. Fish meal production was discussed earlier, so let's use that as an example. We may have a year with a bumper crop of cottonseed or soybean meal production. Government policies may affect both production and use. Farm programs and export policies may influence the amount of soybean meal produced. The market outlook for corn, for example, may influence the amount of acres that eventually are committed to soybean production. Livestock prices may affect protein meal uses and this in turn may be influenced by such developments as consumer income changes. Even poor crops in Europe can encourage imports of fish meals as substitutes for protein for livestock feeds. This can reduce foreign competition for our markets and result in higher U. S. prices, even during a period when domestic production might be expanding and world production might be high.

Short-term supply developments are also important in influencing market prices and quantities purchased. Resource availability, foreign fishing effort, and supplies of imported products are examples of forces that may directly influence the supply of specific products. Fishing success in other fisheries and areas, or changes in market prices for other fish products, are examples of some of the indirect forces that may affect the short-run supply situation.

Market prices and quantities purchased are the result of reconciling the many complex and interacting supply and demand forces. The short-run market outlook, and profit prospects for the individual firm, depend on appropriate response to market conditions. Shorter-term developments are the basic guides for production and marketing decisions. These brief examples should point out the complexity of forces that may affect market prices. Developments that on the surface may seem unrelated to your business may have a significant influence on market prices and quantities purchased. Most individuals and firms have neither access to the wide variety of information needed nor time to analyze these complex market developments. The Division of Current Economic Analysis of the National Marine Fisheries Service has responsibility for analyzing the current market situation and talented individuals to provide their view of likely future developments. Market news and statistics are published to keep you informed on new developments. This material is available to you. I certainly recommend that you obtain these reports to use as a basic guide for business decisions that require responding to new market developments.

Longer Term Economic Forces

While the current situation requires essential responses to assure the best possible earnings, it is not the area that we need devote our major interest today. The economic potential for California's North Coast marine resources depends primarily on longer-term forces. First, I will briefly consider factors affecting the longer-term demand situation. Then, I will devote much of the remainder of my discussion to the economic forces affecting the longer-run supply situation.

The demand for many fish products, measured on a per capita consumption basis, has not been expanding especially when compared to the increased use experienced for products such as beef or broilers. Population growth, however, can add to total demand even if per capita use remains relatively constant or even declines slightly. Another longer-term demand factor is increasing consumer income, particularly in other areas of the world. This can increase the demand for protein foods, including fish meals for livestock feed, and may reduce foreign competition for U. S. markets. Higher incomes and improved opportunities may also increase fishing costs in other nations.

The fundamental issue concerning the economic potential of marine resources of this region is likely to depend on the ability to supply products at competitive prices -- in short, the competitive position of this region compared to other areas that compete for market outlets.

Earlier today the statement was made that fishermen could compete effectively if they had an adequate market. This suggests that the problem is largely one of inadequate demand.

The secret of a large consumer market is low production costs, relative to those of competing areas, both domestic and international, and low prices relative to products that compete for the consumer's retail dollar. One path to increased consumer use is lower product prices. For example, a few years back, the use of broilers expanded rapidly. This resulted mostly from a drop in market prices associated with new cost-reducing production technology which brought about more efficient production methods and lower market prices. Since a large share of the domestic market for fish products is often supplied by imports, an adequate market exists for the domestic fishing industry at present price levels.

For most fish products, current use exceeds domestic supply capacity at existing market prices. This means that we either must reduce imports or achieve greater production efficiency if the domestic fishing industry is to compete more effectively with imports. In short, an adequate market already exists for most fish products -- adequate in the sense that a large share of the market is imported. I will say more about why we import these products in just a few minutes. For now, let's accept the fact that imports exist. Our problem then is one of achieving a long run supply situation that permits this, or any region, to effectively compete for the domestic market.

Competitive Position of This Region

Long-term supply characteristics are likely to be the major factor determining the economic potential of California's North Coast marine resources. Production efficiency compared to other areas and competing products is the fundamental factor determining the competitive advantage of any region as long as production decisions are guided basically by market forces.

It was pointed out in a comment made earlier today that U. S. fishermen are already highly efficient. In general, I agree with that view. But if foreign producers are operating with lower cost inputs (e.g., labor, fishing vessels, gear) then these advantages usually will have to be neutralized by even greater production efficiency by the U. S. fishing industry. Resource availability may also result in unjustified encouragement to develop new fisheries. Undeveloped fishery resources may suggest a tempting means to regional economic expansion.

Our basic purpose today, as I understand it, is to evaluate the economic potential of marine resources in this region. This means indicating latent or underutilized resources that may justify development effort. There are several reasons why market conditions may indicate the need for a regional development effort.

1. It is currently economically feasible to develop the resource, but this has not occurred due to lack of information, inadequate financing, or similar problems.
2. New market developments, particularly expanded demand, results in higher market prices and consequently it is possible to compete effectively.
3. Production costs in other regions will likely advance improving the capability to compete with existing supply sources.
4. New technology is possible that favors this region and improves the competitive advantage permitting economically feasible production at existing prices.

The speaker, Fred Smith, representing the Georgia-Pacific Corporation said his firm wanted to stop burning wastes resulting from their industrial activity. Suppose this industry was required to stop burning entirely and do this immediately. It might actually be less expensive to produce a by-product to recycle industrial wastes than to develop an alternative method to destroy these items. A similar situation could develop for fishery production. With the present interest in pollution control, it is not impossible that we might see a situation develop where waste products might be moved into a by-product such as fish meal even if this involved increased production costs of other fishery items. This could provide the basis for economically feasible production. Expansion might also be encouraged. For example, increased production might be needed to provide adequate capacity for maximum efficiency. The purpose of this example is to indicate that conditions to change and opportunities develop.

New technology may also result in improved competitive conditions. Earlier discussions related to the possible use of mariculture to expand production in this region. One advantage of mariculture is the potential to reap the benefits of investment in production facilities due to exclusive use of fishery resources.

New technology in the fishing industry usually does not provide exclusive benefits to a particular region and often tends to benefit all production regions similarly. This is not always the case however. New technology often involves more capital investment which could benefit our fishing industry more than foreign fleets if they have a current advantage due to methods basically utilizing high labor inputs.

Conditions do change. With new developments it may be economically feasible to develop latent or underutilized resources of this region. This may be possible five years from now, one year from now, perhaps at the present time; possibly this has been feasible for some time and the potential overlooked. I have attempted to point out general areas where market developments may affect the feasibility of developing additional production from marine resources. Before summarizing these points, I want to turn to the areas of government policies, particularly import policies, and discuss these issues at least briefly.

Non-market Developments

We are experiencing growing interest in limited entry for fishery resources This is not unrelated to market forces. In fact, it can provide an important basis for market activity. Limited entry and expanded international agreements may provide the basis for significant improvement for many marine resources -- particularly in terms of capability to compete with foreign fishing. If this is the case, it might provide important benefits in developing latent or underutilized fishery resources.

If a substantial portion of the benefits that may be possible with new fishery management proposals remain in the fishing industry, this may provide the needed stimulus for significant improvements in our fishing industry.

There has been considerable discussion earlier today relative to import competition. I have already stated that with a large share of our total use of fish products supplied by foreign competition, our basic problem is on the supply side of the market; that is, in improving our ability to compete with foreign competition for domestic markets. It is tempting to consider eliminating foreign competition which would, of course, provide additional demand for domestic production.

In the first place, the expansion in demand for domestic production would be less than total present use. The higher prices that would result would in turn encourage consumers to purchase competing products. In a sense, we would be shifting emphasis from competing with other world production regions to products competing with fish for the consumer's dollar. Nonetheless, some benefits to the domestic fishing industry would result -- perhaps substantial gains.

What quality of fish should we import? Should we import any? Evaluation of this issue is likely to depend mostly on the point of view from which it is judged. We are all consumers; and as consumers, we want the lowest possible prices. Let's use an example that is unrelated to fishing to demonstrate this. Why do we have import quotas on oil? Our gasoline prices would be lower if we did not -- perhaps as consumers you and I would be able to buy gasoline two or three cants a gallon less than we do with import quotas. Do you, as a consumer, want to limit imports of this product? The oil industry benefits from quotas. Perhaps there are also other factors, such as national defense, that need to be considered. As a consumer of oil products, do you want quotas? Most U. S. industries would like to be protected from foreign competition. Competition is fine -- for the other guy. We seldom welcome competition for ourselves. As a nation we need both competition and international trade. We are better off due to both. Both provide a major contribution to our high standard of living.

If international markets functioned perfectly, we would expect each product to be produced by these nations enjoying the greatest comparative advantage. International markets do not function perfectly. There are some valid reasons for restricting imports. This gets us into a very complex area. In general, however, international trade provides immense national benefits and is clearly to our advantage. The most promising solution for improving our fishing industry, consequently, is likely to result from more effectively competing with imports. This means increased production efficiency is the major issue involved even though there are some changes in international and other policies that may be needed.

Review of General Concepts

I will now summarize the major points that I have tried to present in order to review the general concepts involved. Market prices are important but the current situation and short-term outlook affect mostly production and marketing decisions. Appropriate response to these indicators is the key to profit for individual fishing, processing, and marketing firms. Longer term elements are more critical in guiding investment decisions and resource development. Appraisal of the economic feasibility of developing marine resources in this region needs to consider the total situation, but greatest emphasis should be given to longer term characteristics that affect production costs.

In the short run, fishermen, processors, and market firms compete with each other -- and sometimes this causes serious disagreements among different sectors of the industry. The processor needs to buy the raw product at the lowest possible prices. Fishermen, of course need the best possible price from their product. Most market firms probably try to maintain an adequate margin to assure a reasonable profit. With long-term inflationary pressure, wage pressures, higher taxes, and similar developments, however, many market firms may tend to be more responsive to price advances than to forces such as excess supplies that result in downward price pressure.

If an industrial fishery of any type is to succeed in this or any other region through market developments, a successful business operation must be possible for all necessary successive stages of production. The final product that reaches the retail market must be priced competitively with similar products for other areas, including imports. The price of the final product must also be competitive with other products that compete for the consumer's retail dollar. At the same time, this price must provide a reasonable return for all essential stages of production.

What appears to be a highly competitive situation for firms dealing in day-to-day transactions, actually involves considerable mutual interest if viewed over a longer time period. I have tried to emphasize these longer term characteristics this afternoon. Longer-term expected earnings must be the basis for judging the feasibility of programs to develop latent or underutilized marine resources.

This longer-term outlook will be influenced by both demand and supply developments and both may be beneficial to improving the competitive potential of this region. If demand increases over time for the product under consideration, this will tend to lead to upward price pressure. With much of the products of fishery resources supplied by imports, ability to compete with other production regions may be the critical elements. Even if demand increases in the longer term, it is possible that foreign fleets may operate close to our coasts and absorb much of the raw resource if they can produce this product more efficiently. We need to emphasize long-run production costs and capability to compete with imports as the basic element in judging the economic feasibility of developing latent or underutilized marine resources. Other factors are also important, but only if longer-term production costs indicate a competitive advantage will it be practical to initiate development programs.

Application to Specific Situations

One advantage of appearing later on the program is the opportunity to comment on some of the issues that have come up earlier. I will not attempt to apply the general concepts that I have discussed to determine the feasibility of a specific product, in a particular region, produced by some firm or group of firms. This is a difficult process, and not in keeping with my intention to try to discuss general issues that relate to development of any latent or underutilized resource. I do, however, want to mention how these general concepts relate to specific problems that have been mentioned earlier today or that I think might be overlooked in evaluating the situation faced by a particular firm.

The variation in business objectives that can exist is a major reason that I have considered only general concepts involved. One firm may want minimum per-unit production costs and believe that long-term investments in highly specialized production facilities are justified to achieve this. Another may place a higher value on flexibility to adjust to market developments or new technology and be willing to accept somewhat higher per-unit production costs in order to depreciate their investment in a relatively short time or to have a flexible production facility.

An example may help to demonstrate this point from the livestock feeding industry. My objective is not to expand our area of interest into another field, but the relationships involved may be somewhat clearer if I use examples mostly outside the fishing industry where special interests are less involved.

Several years ago, in connection with a research project evaluating the feasibility of developing a livestock feedlot to expand a local economy, I tried to determine the most efficient facility. If I could do this, I would use it as a standard to compare the maximum efficiency that could be achieved in the local area with production costs in other feeding areas. However, this turned out to be most difficult since efficiency is related to business objectives.

A feedlot can be designed that is highly specialized and must be depreciated for 20 years or more to be practical. It may have mostly cement components, a quarter-million dollar feed mill, and large feed storage capabilities. A feedlot might also be designed with considerable flexibility so that it could be fully depreciated within a few years to avoid risk associated with the rapid rate that technology has been introduced in this industry. This flexibility might also reduce risk resulting from declining profits in livestock feeding or improved opportunities in alternative investments. A feedlot might also be designed to be integrated with another business. For example, a firm that already owns a feed mill might want to utilize this facility more fully and want to design a feedlot that accomplished this.

Minimum per-unit production costs may be possible only in a highly specialized, high capital facilities and firms may be subjected to excessive risk due to future developments. It is possible, therefore, that minimum short-run production costs may not always result in maximum long-run earnings. In order to appraise the feasibility of a particular situation, it is important to keep in mind the range of business objectives that may exist and the need to consider longer-run conditions.

It is necessary to anticipate change and try to judge if a reasonable profit is possible. By profit, I mean a return to investment,labor and management ability of the firm's owner -- in short, the return to the owner's resources. Unless such a profit can be maintained, the firm will not remain in business. It is also essential to consider factors such as size, resource cost, and production efficiency compared to competing firms. For example, how much more efficient will a large firm (say with $1 million to invest) be than a small firm (with perhaps only $50,000 to invest . Capital and other resources may cost less for large firms and they may have more resources to absorb.

For the individual firm, it is important to remember that an appropriate return on the owner's capital is needed. Since equity capital bears a greater risk than debt capital, a good guideline in this case is to use total capital costs that have an interest rate that exceeds the level used for borrowed capital.

The economic feasibility of any particular situation should also be judged on a present value basis. It is important to discount expected returns and costs in order to accurately estimate expected net earnings. In order to accomplish this with minimum difficulty, assistance can be obtained from state universities, finance firms, or others who have access to discount tables.

I also want to mention some special applications of the general principles that I have covered in relation to specific products that have been considered by previous speakers.

We have talked about the feasibility of mariculture. In this case either high productivity or products with high value will be required. Efficient production of low value products may be misleading due to the inability to generate adequate total earnings. This apparently is also true for fish protein concentrate. A substantial market for this product seems likely to depend on its use to complement manufacture of higher value products rather than as a very inexpensive source of protein for the world's poor. If adequate demand develops, production in this region would have to compete with other areas. Production efficiency would be a critical factor.

Pacific saury has been mentioned as possibly a feasible resource for development. In this case, there is a very large market and prices have been good. A large bait market exists, and while there may be some limitations imposed by other nations on imports as a food fish, these might be eliminated or reduced if an alternative supply was available at significantly lower prices. Foreign consumers want products at lowest possible costs also. For this product, the principal problem is determining the stock of resource that actually exists and if it is adequately concentrated to support harvesting efficiently.

<u>Initiating Development Programs</u>

I have indicated that important, numerous, and complex issues exist in evaluating the economic feasibility of development projects of the nature considered by this symposium. Assistance from different sections of the National Marine Fisheries Service may be useful to help solve some of these problems. I have mentioned the publications of the Branch of Current Economic Analysis and market news in connection with evaluating the short-term production and marketing decisions. Statistical data is tabulated and is available to indicate trends and comparisons. The Branch of Economic Research studies important issues facing the fishing industry. Other types of research, such as development of new gear, new food technology and mariculture practices, is supported by public programs through NMFS, and state government agencies and universities. Privately supported studies also provide important contributions in many areas of fishery research. Marketing research needs financial requirements, and similar problems can sometimes be solved with assistance of public agencies or public-originated institutions.

Appraising the economic feasibility of any particular situation is complex and requires all the information that can be developed. This is a difficult process. Implementing development programs where these appear to be adequately justified may be even more difficult. But there is no alternative to evaluating opportunities, setting priorities, and proceeding where this seems feasible.

DISCUSSION

Question 1: Fishermen are not subsidized in the United States. Should we do this or are there alternatives?

Answer: Actually we do subsidize fishing in the United States to some extend because we do make available industrial programs such as grants and aid in terms of financing vessels. We do a basic amount of research in terms of gear research and technology and things of this nature. The plant at Aberdeen is a good example of how government subsidies are helping the fishing industry. You don't like to call them a subsidy, and you could make it more direct such as something like we see in the nature of agriculture, but we do have some public funds. I think the question is, are we subsidizing to the extent to which other nations are? This is something that you have to compare with an individual nation.

Question 2: Lake Erie salmon are doing well in pollution. How does one know how to harvest before pollution will kill off all that have been planted?

Answer: Actually, the pollution problem in Lake Erie is not one that is hurting the fish, it is one that is hurting the product for its use as a food product. I believe the problem there is a heavy metal problem. In this case, then, what you have is a fish product that is not being affected by the contaminant but we would have to use the product for a non-food use. The question is, if pollution is going to ruin that as a food product, how far would you let the resource develop before you would just go in there and take it to beat the pollution. And, in that case, of course, if you know the pollution is going to take it, you might as well go and take the whole thing because it's not going to be worth anything unless you can control the pollution.

Question 3: Are there any instruments or devices that we could use to indicate the amount of pollution so that by testing the waters, oceans, lakes or whatever, we could know when to go out and harvest the resource before it is too contaminated?

Answer: You are getting into an area that, as an economist, I don't know a great deal about, but I would guess that this is probably possible for many of the types of pollutants. Our objective, of course, is to control the pollution and this is what we must move towards. Only by controlling pollutants will we maintain resources such as these. Short of that, you are going to have to move to some other type of fish product that you can utilize, as I mentioned, in terms of recycling what you could utilize with the pollutant already being there. But your principal objective, and I think the one we are going to move to first, is to actually control the pollution.

Question 4: One thing occurred to me on your talk on mariculture. Isn't this one incentive to go into aquaculture, because you mentioned the fact that nobody, either an individual or nation, wants to put an investment into something whose destiny can't be controlled. You wouldn't want to develop a fishery in a lake today and have a pulp plant or something louse it up for you in ten years you are stuck with a fishery investment and you are broke.

Answer: This could be the major incentive. It has been suggested that in ten years or so there will be enough pollution in many of our industrial fisheries that we will simply be doing away with many of our traditional types of fish products because of concern over these heavy metals and we would consider an aquaculturally produced product. Personally, I think that's very far out. We really know very little at the present time and I think we have to learn a lot more about the heavy metals before we can really look that far down the road. Any investment that you are going to make has a certain amount of unknowns. When you are sure the market is going a certain direction, it is almost always too late to take advantage of it. Investment in aquaculture may come because of something far out like this. It certainly could be extremely important but we don't know enough right now to say how important it will be.

Question 5: Let's say that a group of fishermen's organizations were to build a fish processing plant and the world market were to cause it to be not profitable. Don't you think the plant could still draw a profit by being worked on a lease basis to other nations that would be fishing just off our waters?

Answer: This depends on the types of restrictions that other nations have on capital flows. There is a great deal of capital flow between countries. We own a great deal of investments in other nations, and unknown to many Americans, a lot of foreign capital is also involved in this country. I don't know if you could handle it on a lease arrangement or if it would be more likely on a purchase arrangement. But certainly foreign capital could be invested in the fisheries. It is my understanding we already have considerable Japanese capital in Alaska.

Question 6: How can fishermen improve their efficiency to provide large quantities of food fish at low prices?

Answer: This is a very competitive industry and it does not have the ability to improve its own efficiency. This is the basic reason why we so heavily subsidize research in agriculture. One of the main reasons for the establishment of our land grant colleges was to establish experiment stations to provide the technology to make our agriculture highly competitive. Justification for this is, and it is a very good justification, that once you have a competitive industry, it does not have the ability to do that itself. Now an industry that can monopolize its product, such as a drug industry, has a degree of monopoly attached to it so that it can capitalize on it. You will then get a lot of funding from private sources going into research and I think this type of research is very important in the long run for a good healthy American industry. Now it might not seem so right today, but if you look at our agriculture, the only thing that has kept us competitive on a world basis is that we have come up with some new ideas. So there may be more potential to this question than there seems on the surface.

POTENTIAL CAPITAL
FOR INDUSTRIAL FISH DEVELOPMENT

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As we have heard today, there are many different sources and uses for industrial fish. But, like most innovative ideas, capital is required for research, feasibility studies and on-line construction. This is the topic of my talk. I would like to point out at this time all the means of financing mentioned today can only be considered potential sources. No commitment was asked of or made by any source. Depending on the source of raw materials and products of fish resource recovery plants, different types of financing are available. I shall first discuss some forms of private investment potential. The next avenue explored will be that of Federal financing.

In the private sector of financing I shall discuss the potential of a bank, mortgage broker and a venture capital firm. As with most situations, there are exceptions to the rules. What I will discuss today are the rules, not the exceptions.

One hundred percent bank financing is not possible. An average business loan is about 50 percent of the total capital required. Industrial loans are similar, but could run as high as 70-80 percent. However, this much financing would only be possible for a strong company or large, nation-wide firm. The length of these loans are 15 years, with 20-25 years for those deemed a good risk. A bank loan of this type would run 8-9 percent with a one percent loan fee.

However, bank requirements for loans are quite strict. They undertake no high risk or speculative ventures. It's doubtful that a bank would consider a loan for financing a project as this. In any event a detailed feasibility study would have to be made providing an economic analysis of the whole project, with a strong emphasis on market research. Even then a bank would probably be a source only if the loan were guaranteed by an individual, a strong firm or by the government as in an SBA loan.

A project with no available background information, at least in the United States could probably not depend on bank financing.

An alternative to bank financing would be financing from a mortgage broker. These firms handle money for insurance companies, mortgage companies, and possible union pension money. Since these firms look for a higher return on their investment, they charge higher interest rates and take corresponding high risks. Interest rates for this would run 9 to 9 3/4 percent, also with a one percent loan fee. However, due to the speculative nature of such a venture and the fact that much money would be required for working capital and process equipment, this type of firm would probably not attempt to finance this type of undertaking.

The final potential source of private investment capital are venture capital firms. These types of firms are quite interesting. They invest money with the expectation of a ten to one return within a 3 to 5 year period. For starting businesses, which this would be considered, a higher return is expected. Venture capital can come from various sources. Some of these are:

1. Small business investment companies.
2. Individuals.
3. Venture capital companies.
4. And some investment bankers.

Some industrial firms provide money for this type of venture as a normal part of their aquisition and expansion program. Dow Chemical and Corning Glass are examples of such companies. Because of the high risk that these firms take, a quite extensive study on all facets of the new business must be presented. Such a report would be more thorough and detailed than similar back-up documentation for a bank loan. Their money is used to buy stock in the company and the high rate of return is realized when the business goes public. The venture capital firm would decide when the business would go public.

Sources of federal financing can vary according to the source of the raw material to be processed. For example, when we are talking about unused resources within the fish industry, the shellfish industry comes to mind. This example should be quite interesting to those present because of the large shellfish industry in the Eureka area. As a matter of fact, my firm made the suggestion that the type of waste shellfish plant I shall describe, be included as the third tenant in the local industrial park project. Approximately 65 percent of each shellfish caught is discarded as waste. If this discharge is to the harbor or to the sewage treatment plant, the shellfish wastes contribute to water pollution. If they are disposed on land, they are a solid waste problem. This dubious distinction as a dual pollution has a type of advantage. The main components of shellfish waste are protein, chitin and $CaCO_3$ and fat of approximately equal composition. These wastes can be processed to provide usable end products. The list is extensive with protein being the most economic to produce and sell. The other products depend primarily on the marketing capacity in a particular area. The other by-products produced involve chitin and some representative ones are:

1. A polymer for coagulation in a waste water treatment,
2. sizes for paper or textile,
3. thickening agents in food processing, and
4. encapsulating agents for pharmaceuticals.

Although there is not at present a process plant that produces these products, pilot plant research has been done to show its feasibility. This has been done by a firm in Seattle, Washington for the problem as it relates to Kodiak, Alaska.

If there is a limited market for the chitin derived products, the protein alone can be extracted and the chitin calcium carbonate residue can be used as a fertilizer, soil liming agent or it can be shipped elsewhere where processing or marketing is more feasible. This background on the pollution aspect of the shellfish industry and the possible cure will be beneficial in considering the following aspects of financing such a waste processing plant.

The potential source of financing for the project just discussed would be the EPA, Environmental Protection Agency. Within this agency two possible types of demonstration grants are available. The first is from the Water Quality Administration.

A grant of this type would be considered a Class V Project. This is a project for the prevention of pollution of waters by industry. It is interesting to note that the FWCA funded the research grants for this shellfish by-product study for a period of 2 to 3 years. It would seem obvious that a demonstration grant should logically follow to show the true applicability of the research results.

The basic requirements for a Class V Project is that it must demonstrate new and improved methods for preventing pollution and shall have industry wide application. This it already has done. The financing under this project would be for $1,000,000 or 75 percent of the project, whichever is smaller.

Because of the dual nature of the waste involved it might also be possible to receive a demonstration grant from the Bureau of Solid Waste Management. This is not as far-fetched as it might seem. A similar demonstration grant has been awarded to the Delaware Board of Health to study a better way of disposing of clam shells.

Solid waste is garbage, refuse and other discarded solid material, including solid waste materials resulting from industrial, commercial, and agricultural operations. Under this definition, shellfish wastes certainly qualify.

Applicants must be a public agency or private non-profit organization. Applications must also be made at least 6 months ahead of anticipated start of the project.

Funds available are available under the Resources Recovery Act, PL 91-512. The share of funds available depends on the number of communities involved. For a single community the Federal Government will finance two-thirds of the project. For a project that would involve the wastes of two or more communities, and thereby solve a regional problem the government share increases to 75 percent and the maximum individual community share would be 12½ percent. Unfortunately the BSWN has little money (only $5,000,000 last year) and many projects to fund.

Other government organizations that would be more directly suited to industrial fish per se are the SBA, NOAA, and EDA, all under the Department of Commerce.

Although we have heard about the SBA as it relates to the Land Development Corporation there are other facets of the SBA that can be touched upon in this talk. One of the basic objectives of the SBA is to stimulate small business in economically deprived areas. If private financing is not available, as would probably be the case for a project such as this, the SBA would be a logical place to start. Basically the SBA will either guarantee a loan or provide direct participation when a guaranteed loan is not available. For a new project such as this, the borrower would probably have to provide or be able to provide approximately 50 percent of the financing. Another requirement of SBA financing is that the borrower "show that prospects of the firm indicate ability to repay the loan out of profits". This indicates a feasibility study primarily to determine the marketing possibility and profitability of such a venture. With the application for such a loan the borrower is required to "prepare a detailed projection of earnings for the first year the business will operate". Again a requirement for a feasibility study.

In addition, the SBA pool loans to groups of small businesses for the purpose of obtaining the benefits of research and development or to establish facilities for these purposes. Thus it appears that some research or facilities for research can be obtained under the SBA. This would allow funding of further research into the processing, product development, or marketing of industrial fish.

Another SBA program provides money for firms affected by "Product Disaster". This would be for small firms who have suffered economic injury due to inability to process and market a product for human consumption because of disease or toxicity to the product. It is conceivable that small fish canneries forced out of business due to mercury or pesticide poisoning could qualify for this type of loan to invest in industrial fish processing.

Another facet of SBA is the small business investment companies. These are SBA licensed private corporations that provide capital for new business. These were mentioned previously as sources of venture capital.

Lastly, the SBA has organizations of executives that will provide managerial expertise and allow a new business to take advantage of their experience in business management, personnel activities, marketing and all other facets of business life. This would allow a new business such as this to receive valuable information in making a research certainty into an economic reality.

The National Oceanic and Atmospheric Administration has two organizations that could be of assistance as potential sources of research funds. The first is Sea Grant, which is a granting agency of NOAA. As I understand it, Humboldt State College is already the recipient of some Sea Grant money, for a grant project. Another type of grant within this program is an institution grant such as given to USC and Scripps Institute. This type of grant allows greater latitude in spending the money and presumably more freedom in choosing programs to investigate.

The National Marine Fisheries also has a grant and loan program. Although the loan program is for fishing vessels and not land based projects, some research money is available from that organization for projects they deem worthy. They have funded some research in the area of industrial fish and they seemed receptive to future projects.

Both of these sources are available for the further investigation of product processes and uses.

The last Federal Agency to be considered is the EDA. I understand that there are some individuals in the area who are quite knowledgeable about the EDA funding, so I will only touch on some of the general programs available. The first to be considered would be those grants authorized under Title III of the Public Works Section of the Act passed in 1965. This would provide 75 percent of staff and administrative costs for technical assistance to provide information needed for economic development programs. Additional technical information needed to make industrial fish a profitable venture could possibly be obtained under this grant program. The remaining 25 percent of the cost must be non-government money. This need not be cash but could be considered as materials and supplies or personnel for the project. The only requirement for a grant is that the area has a substantial need for the assistance requested. This program could provide the necessary technical knowledge to make the project economically feasible. To actually finance the project there are other programs within the EDA.

Under Title I programs, additional financing is available to political entities, non-profit organizations or an EDC. It is primarily for supporting facilities for industrial developments and industrial parks. Under this category such facilities as pollution control plants for industrial wastes and certain research facilities can be funded.

Therefore, something such as the waste shellfish processing plant could be financed.

Another facet of the EDA program is the business development loan. In all EDA qualified areas, public agencies as well as businessmen are eligible to apply for a loan to establish a new business. The main criteria, as with other projects, is that the money is not available from private sources on reasonable terms. If such money is not available EDA will loan up to 65 percent of the capital required for the cost of land, buildings, and equipment for an industrial enterprise. The life of the loan depends on the life of the fixed assets, which are also used as collateral. As with all other sources, the EDA must be assured there is a reasonable assurance the loan will be repaid.

Each of these EDA programs is a potential source for one or another of the many facets involved in the inception of the industrial fish industry.

In summary, we have seen that there are sources of financing for further research into this field of untapped resources as well as for the construction and operation of such a processing plant. Research and Development funds available are from the:

1. Sea Grant and National Marine Fisheries Service.
2. EDA - Title 1 and Technical Assistance Loans.
3. SBA - Pool loans.

Construction and Project funds are available from the:

1. EDA - Title III and Business Development loans
2. SBA - Various Programs
3. EPA - WQA and BSWM demonstration grants
4. Venture capital sources.

Of all the potential sources we discussed the only ones that would seem to be improbable are unassisted bank loans and mortgage broker investments.

However, regardless of the type of financing to be obtained for plant construction, a thorough and careful research of the availability of the resources, the economics of the plant processing and the existence of suitable markets for the end product must be presented. After all, if you were to invest your money, you would want some reasonable assurance of turning a profit.

LOCAL DEVELOPMENT CORPORATION FUNDING

M. Ren Cancellier
President
Greater Eureka Development Corporation

When it comes to loaning money, everyone shies away. If you have plenty of money and assets, the banks are willing to give you more. If you don't have assets, you will have a hard time trying to find someone who is interested in making you a loan.

In 1968, February, a group of individuals in Eureka decided that it would be a good idea if they formed a Development Corporation of some type, whereby monies could be obtained from SBA and EDA to start new businesses in the County. The formation of the "Greater Eureka Development Corporation" was completed February 5, 1968. It was formed with the idea to further the economic development of the Greater Eureka Area, including Humboldt County as a whole. The Corporation is set up in such a manner that it can become involved and interested in projects within Del Norte and Mendocino Counties as well as Humboldt. However, we have been concentrating on the Greater Eureka Area.

The Development Corporation was basically formed to help start new businesses in the area, which in turn would add to the area's payrolls with new jobs. It was felt that by being able to help new companies develop in this area, that over a period of time there would be a broader base in which ten to fifteen percent more jobs would be made available. Business volume is an important thing and any kind of new business is certainly something in which the Corporation has interest.

The type of help that can be offered is loans for capital investments, such as buildings, land, machinery, etc. and is usually handled on a joint venture type of project. We cannot set up loans for operating capital, or to increase a company's cash position. We are interested in helping industry, with the idea of making new jobs and employing more people in the area.

In the past months, we have investigated some thirty different

Corporations, Companies or individuals who have already asked for help (our Secretary, Dean Elliott, has done most of the work). At the moment, we have been successful in putting one Company together. The Company is working fine and has increased its payroll about half, which means that they have been able to make new jobs for twenty more people.

The Greater Eureka Development Corporation is a Stock Corporation. Stock has been sold to the local people who have an interest in seeing Eureka and Humboldt grow. We intend to continue the sale of stock which gives the Corporation a base to negotiate with Federal and State lending agencies.

GEDCO is not interested in a fly-by-night deal, but be assured that it is a concrete venture that will benefit the area with more permanent jobs. GEDCO is interested in people who are really sincere about settling in the Eureka Area, building a business or industry and helping our base product. To explain how it works would take quite awhile. It is just a matter of coming up with a plan, presenting to our people, and within a short time you'll have a yes or no answer.

DISCUSSION

Question 1: You mentioned that thirty applications have been received for assistance, but only one has been approved. What is the greatest stumbling block in this area?

Answer: I think that when we started this thing and advertised it, everybody jumped onto the band wagon. When we reviewed these applications with respect to the assets of the people, it didn't warrant us to do anything about them at that time. The SBA wouldn't accept them because of the qualifications necessary to be eligible. Another thing was that our primary aim was to decrease unemployment and almost all of the applications we received were from men having a small operation going in their garages. They wanted to buy some more machinery. We would ask " How many people are you going to employ?" and they would say, " Well, we can handle it."