

## OTHER FISHERY NOTES

## Fish Oils--World Production and Trade ✓

The 1945 world production of fish oils, not including whale, seal, and shark-liver oils, is roughly estimated at 160,000 short tons, which is about half the 1935-39 annual average. The United States produced more than 50 percent of the world output in 1945. By comparison, during the prewar period about 35 percent of the world's total was produced in the United States, around 27 percent was contributed by Japan, and the bulk of the remainder was processed in Norway, Iceland, the United Kingdom, and Germany. (See table 1.)

Table 1 - Fish Oil (excluding whale and shark-liver oils):  
Production by specified countries, averages 1925-29 and 1935-39, annual 1940-45

Country	Average	Average	1940	1941	1942	1943	1944	1945
	1925-29	1935-39						
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	sh. tons	sh. tons	sh. tons	sh. tons	sh. tons	sh. tons	sh. tons	sh. tons
United States .....	42.0	110.0	78.7	102.6	70.6	80.8	100.7	86.1
Japan .....	25.8	1/ 85.0	36.7	25.0	7.9	7.0	1.2	.7
Norway .....	-	2/ 30.0	2/ 20.0	2/ 10.0	2/ 5.0	-	-	5.0
Iceland .....	-	25.0	31.0	34.0	32.0	35.0	33.0	25.0
United Kingdom .....	-	2/ 20.0	-	-	-	-	-	-
Canada <sup>3/</sup> .....	-	1/ 16.4	15.2	11.0	-	-	4/ 9.0	4/ 10.5
Germany .....	-	2/ 15.0	-	-	-	-	-	-
Newfoundland .....	-	-	-	-	-	5/ 4.4	5/ 4.1	-
Italy .....	-	2/ 5.0	-	-	-	-	-	-
Portuguese Angola .....	-	1.1	-	-	-	-	-	3.0
Portugal .....	-	6/ 1.0	-	1.3	1.0	1.3	1.3	-
Argentina .....	-	6/ .2	-	-	1.4	-	-	-
Spain .....	-	-	-	-	.1	-	-	-
Estimated world total ...	-	315.0	225.0	210.0	155.0	165.0	170.0	160.0

<sup>1/</sup>4-year average.

<sup>4/</sup>Pilchard oil only.

<sup>2/</sup>Estimate.

<sup>5/</sup>Year ending October 31.

<sup>3/</sup>British Columbia only.

<sup>6/</sup>1 year only.

Compiled from official and unofficial sources.

Owing to the critical food situation in many countries, preference will undoubtedly be given to direct human consumption rather than to the processing of fish into oil. In addition, several of the European countries and Japan lack adequate fishing craft and supplies. Until equipment is restored, the prewar output of fish is not likely to be reached.

During the war, considerable interest arose over the virtually untapped fishing resources off the coasts of South America. Reports indicate that these waters abound in fish which are important as a source of food and oil. Already several firms have started shark-liver and fish-oil projects, notably in Argentina, Brazil, Chile, and Peru.

Two other potential resources of fish oil in the Western Hemisphere are the anchovies along the California coast and the waste from the Alaskan salmon pack. The total waste of the salmon pack amounts to 75,000 or 100,000 tons a year, of which only a small portion is processed into oil.

<sup>1/</sup>Reprinted from Foreign Agricultural Report No. 11, Fats and Oils--World Production and Trade (U. S. Department of Agriculture, August 1946), written by the staff of the Fats, Oils, and Price Division, International Commodities Branch, Office of Foreign Agricultural Relations, USDA.

The fish oil most universally produced, exclusive of marine-animal and shark-liver oil, is derived from pilchards (sardines). In the United States during the 1920's, menhaden was the largest source of fish oil, but lost its prominence owing to the phenomenal growth of the Pacific coast pilchard- and herring-oil industries.

Fish oils have a wide range of uses and possess a certain degree of interchangeability with animal and vegetable fats and oils. In the United States, approximately 75 percent of the pilchard and herring oil goes into the manufacturing of soap. The second major use for fish oils is in the manufacture of insecticidal sprays, menhaden oil being the principal constituent. The tempering of steel and the manufacturing of linoleum and certain types of paint are other important industrial uses. Cod-liver oil enters largely into medicinal and pharmaceutical products, and inferior grades find a substantial outlet in the leather-processing industry. In Europe, fish oils are used to some extent for edible purposes.



## Production by Regions

### Western Hemisphere

UNITED STATES: The United States is the largest producer of fish oil in the world and is a leading exporter and importer of this product. The 1945 output of fish oil, excluding marine-animal and fish-liver oils, was estimated at 86,100 short tons. About 50 percent of the production was pilchard (sardine) oil; menhaden oil comprised around 33 percent; and herring, tuna, and mackerel made up the remainder (table 2).

Table 2 - Production of Fish Oil in the U. S. by kinds, average 1935-39, annual 1940-45

Product	Average	1940	1941	1942	1943	1944	1945
	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons
Pilchard .....	75.7	47.2	67.8	47.0	52.2	67.8	44.1
Menhaden .....	16.8	21.6	22.6	19.2	21.5	22.7	28.5
Herring:							
Alaska .....	16.5	7.8	10.8	3.1	6.0	8.6	10.6
Maine .....	.9	.5	.5	.5	.3	.4	.3
Tuna and mackerel .....	1.1	1.6	.9	.8	.8	1.2	1.0
Total .....	111.0	78.7	102.6	70.6	80.8	100.7	1/86.1

1/Approximately 750 tons of groundfish oil and 850 tons of miscellaneous oils included.

United States consumption of cod-liver and cod oil rose from around 7,500 tons in 1921 to nearly 34,000 in 1937. It fell sharply during the war, however, as a result of reduced imports. United States production of these oils is small compared with that of Norway, Iceland, and Newfoundland, which normally export a large part of their cod-liver oil production to the United States.

NEWFOUNDLAND: The Grand Bank off the coast of Newfoundland is the most important source of cod. Virtually the entire production of fish oil in Newfoundland is exported, since domestic consumption is insignificant. Common cod oil usually makes up more than 50 percent of the fish-oil exports, cod-liver oil about one-

third, and herring and miscellaneous oils the remainder. The United States and Canada are leading purchasers of Newfoundland fish oils.

**CANADA:** Approximately half of Canada's output of fishery products comes from British Columbia, where herring and pilchards (sardines) are the mainstay of the fish-oil industries. In addition, considerable quantities of oil are derived from salmon waste, grayfish, and anchovies. In 1940, approximately 50 percent of the total oil output, amounting to about 15,200 tons, was from herring. Pilchard-oil production was about 25 percent, and salmon oil, 5 percent. On the Atlantic side of the Dominion, cod is the leading catch, and its output ranks second among all fish caught in Canada.

**OTHER WESTERN HEMISPHERE COUNTRIES:** Argentina is regarded as the largest fish-oil producer in South America, although its output, when compared with that of the major producing nations, appears insignificant. A river fish, known locally as sabalo, is the principal source of fish oil other than shark-liver oil in Argentina. Other important varieties used for oil are hake, conger, anchovy, and weakfish. The 1942 production of fish oil was estimated at 1,400 short tons, which was more than 5 times the 1939 output. Exports of fish oil are comparatively small.

In Brazil the only fish-oil industry of importance is the production of shark-liver oil used for medicinal purposes. The small amount of fish oil consumed domestically, primarily cod-liver oil, is imported chiefly from Canada and the United States.

The countries along the west coast of South America--Chile, Peru, Ecuador, and Colombia--do not have important fishing industries. Although definite information is not available, their output of fish oil is considered insignificant. However, with the recent establishment of several new fisheries, fish-oil production may soon become more important. In many Caribbean islands, commercial fishing is a comparatively undeveloped industry. Most islands do not have a catch large enough to supply their needs. Little, if any, fish oil is produced.

## Europe

**NORWAY:** Norway, a leading fishing nation of the world, had a prewar 1934-38 average annual catch of over 1 million short tons of fish, of which around 70 percent were herring and brisling and about 20 percent were cod. About 45 percent of the total catch during this period went into the production of oil and meal. The annual fish-oil production, principally from cod liver, and herring, probably averaged around 30,000 tons in 1934-38, in comparison with around 15,000 tons in 1945. Norway is normally a leading exporter of fish oil, although during the war years shipments were reduced to insignificant amounts, which went to Germany. Small amounts of herring and sardine oil, primarily from Iceland and Japan, were imported before the war.

**ICELAND:** The banks off the coast of Iceland are one of the richest fishing regions of the world. The waters south and southwest of the island furnish cod, and herring comes principally from north of the island. In addition, other important varieties of fish caught in these general areas are haddock, pollock, halibut, and flounders. Prior to the war, it was estimated that the waters around Iceland produced from 17 to 21 percent of the total European output of fish. Britain, Germany, Scotland, and Norway were the most important foreign competitors prior to the war, although at least 11 foreign nations fished in these waters.

The majority of fish caught are processed or canned for sale abroad; only comparatively small amounts go into the fish-oil industry. Herring and cod are the principal source of oil. During the war, the herring-oil output was increased, whereas barreled-herring production fell off because of the higher profits gained from the sale of oil to the United Kingdom. The production of cod-liver oil was maintained at steady levels during the war. The principal purchasers of cod-liver oil in 1945 were the United States, the United Kingdom, Sweden, and France. The output of cod-liver oil during 1945 is estimated at 10,000 tons, and of herring oil, 15,000 tons. During the 1946 season, production of both oils may reach 40,000 tons.

**UNITED KINGDOM:** Prior to the war, the United Kingdom was the leading producer of cod-liver oil, having an annual production of around 18,000 short tons, or about half the world production. Germany, Norway, Iceland, and Newfoundland were the other important world producers of this oil. At the outbreak of war, a large part of the British fishing fleet was requisitioned by the Government, which resulted in a drastic drop in the cod-fish supply and cod-liver-oil production. Exports of cod-liver oil practically ceased during the war.

The United Kingdom has always been a leading importer of fish oils. During the war, purchases, principally from Iceland, the United States, Canada, and Newfoundland, were maintained at relatively high levels. Prewar imports were derived primarily from Japan and Norway and, to a lesser extent, from Newfoundland and the United States.

**GERMANY:** Prior to 1940, Germany, a leading producer of cod-liver oil, was surpassed only by the United Kingdom. Of the estimated annual world production in prewar years of around 40,000 short tons of cod-liver oil, Germany is credited with around 10,000 tons. Although herring from the North Sea comprised the greater part of the German fish catch, the oil output, mainly from herring scraps and wastes, was not large enough to fulfill German requirements. Prewar imports of fish oils normally exceeded domestic production.

**OTHER EUROPEAN COUNTRIES:** In Spain and Portugal, fishing is one of the most important industries. Fish-oil production is small, however, and almost the entire output is consumed domestically. Sardines comprise the largest and most important catch. Both exports and imports of fish oil have been negligible.

In the Netherlands and Belgium, the principal catch is herring. Oil production has always been small. Before the war, both countries depended on outside sources for the bulk of their oil requirements. Nearly all the imported fish oil was edible, and only small amounts were for industrial purposes. The usual practice was to re-export part of the imported oil to other European countries.

In Sweden and Denmark, cod and herring have always been the principal catches, and they increased during the war. The fish-oil industry in both countries, however, remained relatively unimportant. Denmark was one of the leading prewar importers of fish oil in Europe.

The Italian fishing industry expanded rapidly before the war, although high levels of fish-oil production were never reached. During 1935-39 an annual average of around 5,000 tons of sardine oil were produced.

The French output of fish includes mainly cod and herring and some sardines and mackerel. Although information is not available regarding production, most



prewar fish-oil requirements were derived from imports, mainly cod-liver oil from Norway.

### Asia

**JAPAN:** During prewar years, Japan occupied first place among the fishing countries of the world. The annual fishery output in 1936 was around 4 million short tons. Sardines accounted for around 75 percent of the total catch, and herring ranked second in quantity. Other fish were cod, mackerel, salmon, tuna, and bonito. Of all these, tuna and bonito were regarded as the most valuable.

Japan ranked second only to the United States in fish-oil production. Of the total output, which averaged about 85,000 tons in 1935-39, sardines supplied about 80 percent. Almost all the hardened oil used in Japan came from sardines. With the outbreak of war, shortage of labor, lack of fuel, and restrictions in fishing caused fish-oil production to dwindle to approximately 700 tons in 1945.

Japan has always been a leading importer as well as an exporter of fish oils. Prewar exports, almost exclusively of sardine oil, went mainly to Europe, with Germany taking the largest part.

**OTHER ASIATIC COUNTRIES:** Apart from Japan, only comparatively insignificant quantities of fish oil are produced in Asiatic countries. Korea is the only other exporter of fish oil, mainly sardine oil, which was normally shipped to Japan.

### Africa

Portuguese Angola is the most important producer of fish oil in Africa. Her annual production during 1937-39 averaged about 1,100 short tons, and exports amounted to around 900 tons. During the war, the fish-oil output increased.

In the Union of South Africa, fish-oil production, excluding whale oil, is mainly confined to vitamin-liver oils. Before the war, the Union of South Africa was the leading importer of fish oil in Africa, although, on an average, only 300 tons were brought in each year.

### Oceania

Little attempt has been made to establish a fish-oil industry in Australia, mainly because the Commonwealth is an extensive producer of animal fats and oils. In addition, Australia is near the tropical Pacific Islands, where vegetable oils were readily available before the war.

Fishing in the South Seas has been important mainly as a source of food to the inhabitants of that region. Bonito and tuna appear to be the most important catch. Little, if any, fish oil is believed to be produced in these islands.

### Soviet Union

Although little information is available regarding the Soviet fishing industry, official figures show that fish production increased steadily from 1929 through 1936, reaching nearly 2 million tons in the latter year. The Caspian

Sea and the Far Eastern waters off Siberia supply most of the Soviet fish output. Production and trade figures for fish oil are not available.

## World Trade

Approximately half the prewar 1935-39 production of fish oils, estimated at 315,000 tons, entered world trade. Such leading producing nations as Norway, Iceland, and Newfoundland exported a large portion of their output (table 3).

Table 3 - Fish Oils (excluding whale and shark-liver oils):  
Exports by specified countries, average 1937-39, annual 1940-45

Country	Average	1940	1941	1942	1943	1944	1945
	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons
Norway .....	40.4	17.6	8.0	4.1	2.8	1/	1/
Iceland .....	28.0	28.0	33.2	32.0	35.4	32.0	24.5
Japan .....	25.0	4.0	2.0	.4	-	-	-
Canada .....	2/ 13.8	2/ 7.3	-	-	-	-	20.0
United Kingdom .....	10.0	2.5	.7	.1	.3	-	-
Newfoundland .....	3.7	4.0	4.2	3.2	2.6	3/4.8	3/3.9
United States <sup>4/</sup> .....	1.1	2.1	1.3	4.1	7.1	5.4	10.3
Portuguese Angola .....	.9	-	-	-	-	-	-
Belgium .....	.5	-	-	-	-	-	-
Argentina .....	.3	.3	1/	.2	.3	-	-
France .....	.2	-	-	-	-	-	-

1/ Less than 50 short tons.

2/ Excluding liver oils.

3/ Year ended October 31.

4/ Including fish-liver-oil concentrates,

averaging about 25 percent of the total.

Compiled from official and trade sources.

The principal consuming nations were the United Kingdom, Germany, Japan, and the United States, although fish oils were imported to some extent by practically every nation of the world (table 4). During the war, international trade in fish

Table 4 - Fish Oils (excluding whale and shark-liver oils):  
Imports by specified countries, average 1937-39, annual 1940-45

Country	Average	1940	1941	1942	1943	1944	1945
	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons	1,000 sh. tons
Japan .....	44.0	43.0	30.0	13.8	.2	1/	1/
Germany .....	45.0	-	-	-	-	-	-
United States .....	32.9	9.8	12.7	8.3	16.1	14.7	15.4
United Kingdom .....	28.8	53.0	49.6	44.2	34.0	2/ 36.7	2/ 17.8
Norway .....	16.5	3.9	1/	1/	1/	1/	1/
Denmark .....	11.6	1.0	-	-	-	-	-
Belgium .....	8.0	-	-	-	-	-	-
Netherlands .....	7.0	5.0	-	-	-	-	-
France .....	4.1	2.0	-	-	-	-	-
Italy .....	2.0	-	-	-	-	-	-
Canada .....	1.7	1.6	-	-	-	-	-
Greece .....	1.7	-	-	-	-	-	-
Yugoslavia .....	1.0	-	-	-	-	-	-
India .....	1.0	.7	.4	.3	.1	-	-
Australia and New Zealand .....	.6	.6	.3	.1	.1	-	-
Spain .....	.5	-	-	-	-	-	-

1/ Less than 50 short tons.

2/ Excluding liver oils.

Compiled from official and trade sources.

oils was severely reduced when European and Asiatic supplies were completely cut off from the Western Hemisphere. The main trade channels during this period were between the United States and Canada, the United States and Latin America, Norway and Germany, and Iceland and the United Kingdom.



## Hudson River Shad

There were 1,494,000 pounds of shad caught by New York fishermen in the Hudson River in 1946, according to one of the Service's Fishery Marketing Specialists in the Middle Atlantic area. This preliminary total represents a considerable decline from the 1945 catch. The catch was tabulated as follows:

Production of Hudson River Shad by New York Fishermen

Gear	F E M A L E S		M A L E S		Total Pounds
	Number	Pounds	Number	Pounds	
	1 9 4 6				
Drift gill nets	93,291	398,638	122,429	336,598	735,236
Stake gill nets	128,580	524,411	74,890	234,133	758,544
Total, 1946	221,871	923,049	197,319	570,731	1,493,780
	1 9 4 5				
Drift gill nets	132,521	570,008	183,986	510,180	1,080,188
Stake gill nets	188,140	762,294	126,872	325,058	1,087,352
Total, 1945	320,661	1,332,302	310,858	835,238	2,167,540

NOTE: These figures may be changed slightly as additional inspection of them is made, but any possible changes will be very slight and should not materially change this comparison.



## International Fishing Industry Group Planned

During the Food and Agriculture Organization Conference recently concluded in Copenhagen, it was agreed at an unofficial meeting of representatives from 12 countries represented on the Fisheries Committee that an early study should be made of the practicability of bringing about the organization of an International Federation of Commercial Fisheries, according to the Fisheries Council of Canada Bulletin for October 1946. The group requested Messrs. Klaus Sunnanaa, Secretary General of the Norwegian Fishermen's Association; D. J. van Dijk, Chairman and Director of the Marketing Board of Fishery Products in the Netherlands; and Clive Planta, Secretary-Manager of the Fisheries Council of Canada, to act as a standing Committee. Mr. Planta was designated Secretary to carry on correspondence and to coordinate the information to be provided by members of the Fisheries Committee concerning existing organizations of Commercial Fisheries in all producing countries.



## License for the Exportation of Food

The Office of International Trade announced on October 8 the establishment of a consolidated license (CL), effective immediately, for the exportation of all commodities on the Positive List with the processing code "FOOD."

Under this procedure, applicants should submit a single license application for each allocation period covering all proposed exportations to a specific country of each food commodity included in the Positive List. This application, if validated, will constitute a consolidated license for the exportation of the commodity named to the country of destination indicated. However, if more than one license is needed for convenience in export clearance, or if unusual circumstances exist, exporters may submit more than one application during an allocation period for the exportation of the same commodity to a given country. The total amount covered by all applications must not, however, exceed the amount of firm orders on hand when the applications are filed. If additional orders are received for which export authorization is desired during the same allocation period, one or more additional applications may be filed, or licenses already validated may be presented for quantitative amendment.

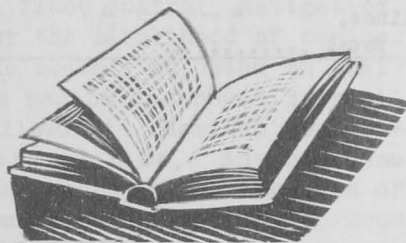
Additional information regarding the consolidated license (CL) for food may be obtained from the Commodities Branch, Office of International Trade, Department of Commerce, Washington 25, D. C., or from any of the Department of Commerce field offices.



## Pacific Coast Operating Costs

From over 200 cost reports from producers and distributors, the Federal Trade Commission has compiled an 82-page publication entitled Cost of Production and Distribution of Fish on the Pacific Coast. This booklet describes halibut, tuna, pilchard, mackerel, shark, otter-trawl, and gill-net fishing, and the distribution of fresh and frozen products. Costs, prices, and profits are covered, as well as marketing organizations and agreements.

This pamphlet is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for 20 cents per copy.



## Salt Fish Exporters Plan Central Office

The International Conference of Salt Fish Exporters, which convened at Bergen, Norway, September 23, at the invitation of Mr. O. Brynjelsen, Director of Fisheries



for Norway, was attended by representatives of exporters from Canada, Denmark, Faroe Islands, France, Newfoundland, Iceland, Great Britain, and Norway, the Fisheries Council of Canada Bulletin (October 1946) reported. Government observers from each of the above countries, and an observer representing the Food and Agriculture Organization also attended the meeting.

The Conference was called for the purpose of resuming discussions held in London in 1939, the recommendations of which did not come to fruition owing to the intervention of war. The objectives set forth in the recommendations made by the London Conference were reviewed, and it was decided to proceed with plans to establish a central office of Salt Fish Exporters at the earliest possible date. The functions of the proposed office, which it was agreed should be located in London, will be to assemble and coordinate statistics covering production, stocks, imports, and exports of salt fish. The office would also assemble and coordinate information generally concerning the industry, and facilitate cooperation between the exporters of the various countries concerned.



## Purchases of Fish by Department of Agriculture

August 1946 purchases of fishery products by the U. S. Department of Agriculture totaled \$113,003, a decline of \$19,259 compared with July. Purchases for the period January 1 to August 31 amounted to \$5,028,432.

Purchases of Fishery Products by USDA

Commodity	Unit	August 1946		January-August 1946	
		Quantity	F.O.B. Cost Dollars	Quantity	F.O.B. Cost Dollars
<u>FISH</u>					
Fish, ground, canned	Cases	-	-	229,000	794,400
Herring,	"	6,596	40,323	12,688	77,565
Mackerel,	"	11,189	72,680	48,117	414,760
Pilchards,	"	-	-	171,207	638,856
Salmon,	"	-	-	277,034	3,029,414
Sardines,	"	-	-	15,929	73,437
Total .....	"	17,785	113,003	753,975	5,028,432



## Wholesale and Retail Prices

Wholesale and retail prices for all foods displayed marked increases from mid-June to mid-July, according to reports from the Bureau of Labor Statistics, Department of Labor. Average retail prices of fresh and canned, and fresh and frozen fish rose 7.1 and 8.1 percent, respectively, during the period and showed substantial rises over prices of July 17, 1945. Prices of pink and red salmon advanced 3.6 and 1.6 percent, respectively, from mid-June to mid-July.

## Wholesale and Retail Prices

Item	Unit	Percentage change from--		
		July 13, 1946	June 15, 1946	July 14, 1945
<b>Wholesale: (1926 = 100)</b>				
All commodities	Index No.	120.7	+ 8.0	+14.3
Foods	do	134.0	+19.9	+26.2
<b>Fish:</b>				
<b>Canned salmon, Seattle:</b>				
Pink, No. 1 Tall	\$ per doz. cans	2.167	+10.0	+10.0
Red, No. 1, Tall	do	4.063	+ 9.9	+ 9.9
<b>Cod, cured, large shore, Gloucester, Mass.</b>				
	\$ per 100 pounds	13.50	0	0
<b>Herring, pickled, N. Y.</b>				
	¢ per pound	12.00	0	0
<b>Salmon, Alaska, smoked, N. Y.</b>				
	do	35.00	0	0
<b>Retail: (1935-39 = 100)</b>				
All foods	Index No.	165.7	+13.8	+16.9
<b>Fish:</b>				
Fresh and canned	do	235.2	+ 7.1	+ 8.2
Fresh and frozen	¢ per pound	39.6	+ 8.1	+ 9.2
<b>Canned salmon:</b>				
Pink	¢ per pound can	25.4	+ 3.6	+ 2.9
Red	do	43.8	+ 1.6	+ 9.0



WATER-UTILIZATION PROJECTS often conflict with the maintenance of fishery resources. The larger and more complicated the engineering devices are for utilizing natural water supplies, whether they be for domestic use, industrial processes, irrigation, flood control, navigation, waste disposal, or simple drainage, the greater the likelihood of serious interference with the fish supply. Fish are delicately adjusted to their environment and an entire population of them can be destroyed by small changes in the water involving any of the following: chemical composition, gas content, temperature, volume, rate of flow. Any of these changes may result from deforestation, from improper cultivation of the land, from irrigation, from mining, from drainage of swamps, from "improvement" of waterways, from a host of manufacturing processes, from simple impoundment for controlling floods or for generating electricity. Thus, land utilization and water utilization are closely related. The maintenance of one of the important water resources; i.e., the aquatic life it contains, is frequently overlooked when water-use projects are planned.