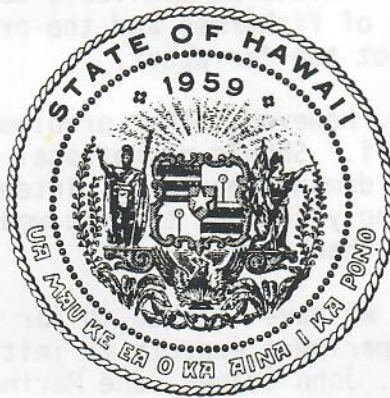


# Potentials for Shark Meat as Food



ECONOMIC DEVELOPMENT DIVISION  
DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

1976

## FOREWORD

Senate Resolution 401 of the Eighth Legislature 1975 requested the Department of Planning and Economic Development to conduct a program to educate consumers on the merits of shark meat as a food.

Prior to undertaking such a program, the Department reviewed the problems associated with the catching of shark, the interest of restaurants and fish markets in shark meat, and the estimated costs of shark meat. The Department has found that because of the necessity for immediately cleaning the shark after catch in order to prevent odor, fishermen demand a relatively high price for shark meat. Our survey has indicated that there is little interest in shark meat on the part of fish markets and fishcake manufacturers but there is some interest on the part of restaurants.

Although the price restaurants are willing to pay is lower than that which would be available to them, the difference in the asking price of fishermen and the price restaurants are willing to pay is not too far apart.

There are, however, other problems in creating a shark meat market in Hawaii. Should promotional efforts and consumer acceptance create a demand for shark, intensive fishing efforts might reduce the supply so much that it would not create a sustainable market for shark meat.

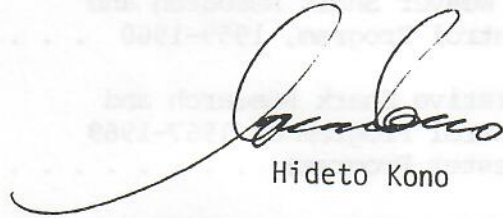
From what we have learned so far regarding the problems noted above, the Department expects to initiate -- through generous collaboration of Dr. John Craven, the Marine Affairs Coordinator and his associates at the University of Hawaii -- a limited program in which the Leeward Community College students would develop techniques for shark capture and on-vessel processing of the meat, and DPED personnel would have restaurateurs to offer the meat in their menus in forms recommended to them as a result of food technology work at the University of Hawaii.

The appendices contain a number of suggested uses of captured shark, including recipes collected from published sources. Perhaps the more adventurous members of the community would help improve upon the recipes and other uses and thereby help increase the demand for captured shark which in turn help enhance the safety



and enjoyment of our beaches by residents and visitors alike.

The study was conducted by Ann Ota under the supervision of the late Arthur Kodama of the Economic Development Division of the Department. I want to express my appreciation to all who assisted Ann and Arthur in the study and in the preparation of the report.

  
Hideto Kono

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## POTENTIALS FOR SHARK MEAT AS FOOD

Report on Senate Resolution 401 - Shark promotion as a valuable seafood/  
shark consumer education program

### Introduction

Through Senate Resolution 401, the Senate of the Eighth Legislature, 1975, State of Hawaii, directed the Department of Planning and Economic Development to "...conduct a program to educate the seafood consumers to the merits of shark meat as a food and low cost protein source...and to include assistance to fishermen and fish markets as necessary to make the catch and sale of shark a profitable undertaking..." However, before pursuing such a program, a preliminary investigation to study questions which seemed crucial to such an effort appeared necessary. The availability of shark meat, the financial return to fishermen for their efforts in catching shark, and the utility of shark meat for human consumption were some of the topics considered.

Through contact with various State agency personnel, fishing industry representatives and restaurateurs, a preliminary assessment of probable supply and marketability of shark meat was made. Information on Hawaii's shark situation and the problems anticipated in shark use was also gathered as part of the study.

Before proceeding with the findings of the study, it may be useful to call attention to other legislative proposals concerned with the shark issue, which have been under consideration in the Eighth Legislature:

S.B. 242: Introduced by Senator Joseph Kuroda, making an appropriation for shark control and research activities.

H.B. 722: Introduction by Representative Oliver Lunasco, making an appropriation for the establishment of a bounty on sharks.

H.B. 1084: Introduction by Representative Oliver Lunasco, making an appropriation for the creation of a shark tournament under the Department of Land and Natural Resources.

### Background and Data

#### 1. Shark species in Hawaiian waters

There are mainly two basic groups of sharks: the "inshore" and "offshore" species. The "inshore" sharks of Hawaii include the sandbar, tiger, galapagos, blacktip, scalloped hammerhead, smooth hammerhead, grey reef, and other less common species. These generally inhabit the shallow water zone from the reef to about 150 fathoms, although some species (e.g., the blacktip) may not go as deep and others (e.g., the tiger) may go deeper. These sharks feed mostly on fish, crabs, mollusks, and other invertebrates which are on or close to the bottom but some, at least, will also feed on prey in mid-water or at the surface. The tiger shark is a notorious scavenger. These sharks rarely penetrate the reef areas. They are seen occasionally by skin and scuba divers in deeper waters just beyond



the reef. The two species regarded as truly dangerous to man are the large and voracious tiger and galapagos sharks, both of which have been implicated in shark attacks. All species, but particularly the abundant sandbar and less abundant galapagos, may destroy gear and eat the catch of longliners, handliners, and trollers. All compete with more desirable food species for food at some level of the food web, and some feed directly on them.

It should be emphasized at this point that the shark hazard to swimmers in Hawaii, while ever present, is remote. There have been only 11 known fatalities, and perhaps double that number of non-fatal attacks in Hawaii, over the past 90 years. (Tester report, p. 41). The probability of injury or death from shark attack is obviously smaller compared with that from automobiles, yet it still exists. The fear engendered by sighting a shark in inshore recreational areas is real indeed to the swimmer and usually results in widespread publicity that causes apprehension among both local residents and tourists and detracts from the full and pleasurable use of inshore recreational areas. Somewhat more tangible, however, is damage caused by sharks to fishermen's gear and catch, and the role of shark as predators on more desirable marine species.

The "offshore" sharks, including the great white, mako, silky, oceanic white tip and other less dangerous species, inhabit mostly the mixed layer of the ocean, from the surface to 150 fathoms or more. They are widespread in their distribution, occurring throughout the Pacific and other oceans and feed on pelagic fish and invertebrates of the photic zone. They constitute a hazard to man, particularly in the event of airplane or ship disaster at sea. They destroy the gear and gorge on the catch of offshore fisheries such as tuna and billfish caught by longlining and trolling.



In Hawaii, only rarely do the dangerous offshore sharks enter shallow water. Occasionally they will do so, however, as shown by the isolated catches of mako and silky taken during two previous shark research and control programs held in the State. According to the reports of one of the programs, there is little hope of controlling the abundance of the vast and far-reaching populations of offshore sharks but, fortunately, these species rarely enter shallow inshore areas.

## 2. Previous shark studies

There have been three major shark research and control programs conducted in the State within the last 17 years: the Billy Weaver Shark Research and Control Program of 1959-60, (Ikehara, 1961); the Cooperative Shark Research and Control Program of 1967-69, (Tester, 1969); and the 1971 Shark Control and Research Program, (Fujimoto and Sakuda, 1971).

### a. Billy Weaver Shark Research and Control Program, 1959-60:

Following the tragic death of a Lanikai youth, Billy Weaver, in a shark attack in December of 1958, a one-year Shark Research and Control Program was conducted through public subscription and a special State grant by the State Division of Fish and Game from 1959-60. Due to its short duration, few questions were answered concerning the shark situation in Hawaii.

### b. Cooperative Shark Research and Control Program of 1967-69: (Tester Program)

In May 1965, prompted by newspaper accounts of shark sightings which indicated that their abundance had increased to a point of public concern, Governor John A. Burns appointed an ad hoc advisory committee of interested citizens to consider the problem. A Cooperative Shark Research and Control Program was recommended by a technical subcommittee of local fishery scientists as the only feasible method of both assembling scientific



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information needed to properly assess the problem, and at the same time, initiating immediately some measure of control of shark abundance. As a result, a two-year program was launched in April of 1967.

The main objectives and findings of the Tester program were as follows:

Objectives:

To determine the species of sharks present in inshore waters of Oahu, and, as possible, of the other islands, to determine their abundance and distribution; and to determine their life histories, particularly their movements and migrations, growth rate, food, fecundity and reproductive habits, relating these, if possible, to environmental parameters.

Findings:

During the program, 1,727 sharks were caught, with sandbars (789), tiger sharks (280), Reef grey (274) and galapagos (206) being those most often caught. The average total length (in cm) of sharks caught was as follows:

Sandbar	131 cm.
Tiger	262 cm.
Reef grey	(not available)
Galapagos	189 cm.

Descriptions of tagging operations, migration, areas of catch, stomach contents, bait preferences, catching method and number of shark pups, are detailed in the 47-page final report of the program.

Objective:

To determine to what extent abundance is decreased by fishing efforts and to recommend measures for controlling abundance in the future.

Findings:

It was indicated that a significant decline in the total shark population occurred after progressive fishing. (Similar declines in catch rate



were also reported during the Billy Weaver Program.) Although the reduction in catch rates for the various islands differed somewhat, the general trend was one of progressive reduction. Eight circuits or rounds of fishing were conducted on the various islands. The data per island is not directly comparable, however, due to variations in intensity of the fishing effort involved (number of sets of hooks laid per round) and the variation in types of bait and fishing methods. Generally, the results are as follows:

<u>Island</u>	<u>Number of sharks caught per 100 hooks</u>		<u>Overall catch rate</u>
	<u>1st circuit</u>	<u>8th circuit</u>	
Oahu	11.29	- 6.42	5.93
Kauai	13.88	- 2.78	9.95
Niihau	(not given)	- (not given)	10.35
*Maui-Molokai	(not given)	- (not given)	19.90

\*Note: It was concluded by the final report that sharks were particularly abundant in this central island group. However, due to erratic fishing efforts (e.g., certain areas being fished only once; many alternative bait tests being conducted) progressive decrease in abundance during the program could not be assessed.

**Hawaii	2.50	- 2.78	4.01
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\*\*Note: The shark abundance in the area was presumed to have been controlled by continuous fishing efforts conducted by the Oceanic Institute within the previous year. The Institute program results indicated a reduction in catch rate of about 88%, from 34.09 sharks per 100 hooks to 3.12 sharks per 100 hooks during the period from Jan. 1966 to March 1967.

The report went on to discuss the possibility of a commercial fishing operation as a measure for controlling the shark population in local waters. It pointed out that at first glance, encouragement of a commercial fishery for sharks and the development of markets for shark products might seem to be the best approach to the problem of reducing shark abundance with control and commercial use complementing one another. But there are difficulties involved. For example, it was noted that



the price of sharks paid to the fisherman would be low, but the cost of fishing would be high. Moreover, it appeared that local inshore shark populations were of relatively small size; and that a significant decrease in catch per unit of effort and presumably in abundance had occurred with a one-vessel operation. With more intensive effort the decrease in abundance would be even greater, soon resulting in "scratch" fishing in the intensely fished areas. To be successful, shark fishing vessels would then have to go farther afield for their catches, eventually working non-inhabited coastlines and areas such as the Leeward Islands. For this reason also, the control of sharks by the bounty system was discouraged. The report recognized that commercial shark fishing was only a possibility for the future. It suggested that if continued low abundance of the inshore shark population were desired, it could be achieved only by a continued Shark Research and Control Program, with emphasis on control--with its main objective to reduce the abundance of sharks by at least 50 percent along all populated coastlines used for recreation and on all of the main inshore fishing grounds of all islands. Secondary objectives of such a program could include:

1. To continue research on shark life history and particularly on the effect of fishing on the relative abundance of the various species, and
2. To further investigate the feasibility of establishing a commercial shark fishery.

Objective:

To supply materials for behavioral, physiological and other biological studies of sharks which will contribute to the general knowledge of their life history and behavior.



Action:

Shark specimens and other marine species (e.g., rays, remoras, other fishes) were supplied to the University of Hawaii's Laboratory of Sensory Sciences for study.

c. 1971 Shark Control and Research Program: (Fujimoto and Sakuda).

Act 92 of the 1970 Legislature appropriated \$50,000 to be expended by the Department of Land and Natural Resources for carrying out a shark control and research program in the waters of the State. This 1971 Shark Control and Research Program emphasized shark control, using the knowledge of shark behavior gained from the two previous programs.

This program was much like the Tester program in fishing methods and data gathering techniques, but on a smaller scale and for a shorter duration. A total of 81 fishing sets involving 5,451 hooks were fished during the six-month duration of the program. This resulted in a catch of 238 sharks, giving an average catch rate of about 4.4 sharks per 100 hooks or 22.9 hooks per shark.

The greatest number of shark fishing sets were made around the Island of Oahu (36 sets involving 2,503 hooks) followed by Hawaii (18 sets with 1,053 hooks), Maui (12 sets with 863 hooks), Kauai (8 sets with 576 hooks) and Molokai (7 sets with 456 hooks).

Tiger sharks were caught more frequently than any other sharks on all the islands except Oahu, where more sandbars were taken. Molokai and Maui had highest catch rates of all islands (7.0 and 6.5 sharks per 100 hooks respectively), while Oahu had the lowest, with 3.1 sharks per 100 hooks.

The majority of sharks caught were between 3 and 14 feet in length. The largest caught were tiger sharks, with 81 specimens measuring 8 feet or



longer, and one measuring 15 feet in length. All the sandbar and black-tip sharks were between 3 and 8 feet long.

Data on sex, stomach content, and reproduction were also gathered and presented in the 37-page report of the program.

#### Past Utilization of Shark in Hawaii

The utilization of shark as a commercial product has been experimented with in the past, with descriptions of the taste, texture and quality of shark meat receiving varied and conflicting evaluations. Markets for shark products (livers, fins, skin and meat) presently exist in various parts of the world, but in Hawaii, the limited demand is satisfied by imports.

Shark livers were formerly valued for their oil which is high in Vitamin A. However, not only is this vitamin synthesized artificially but its contents tend to be low in tropical sharks; for these reasons the demand for shark liver oil was not felt to necessitate nor sustain a shark industry in Hawaii.

In the past, there was shark fishing in Hawaii with the catch being marketed largely as an ingredient of fish cakes. Although shark meat is considered a good binder (elastic ingredient that tends to bind the fish cake ingredients together) (Eiichi Tanikawa, Marine Products in Japan, p. 346) very little shark meat reportedly was used. It was used mostly as a "filler" together with other kinds of fish. Also, only certain species of sharks were purchased for fishcake manufacture in the past. Those favored were the mako, thresher, white tip, sandbar, galapagos and hammerhead sharks, while those considered undesirable were the tiger, blue, and any small or uncommon species of sharks. Sharks used for manufacturing fishcakes were dressed by removal of the head, viscera and fins before processing.

The shark fishery, however, suffered a mortal blow when legislation was passed requiring that the ingredients of fish cakes be so listed on the



package, and manufacturers, anticipating consumer rejection, ceased to use shark meat in their product. As a result, Honolulu shark landings fell from an average of 21,000 pounds per year (1944-53), to 200 pounds in 1954 and 12 pounds in 1955. Department of Land and Natural Resources statistics show that for the period between 1948 and 1955, when shark meat had a market in fishcake manufacturing, dressed shark sales averaged an annual value of \$3,087 or \$0.16 per pound.

The resulting demise of the fishery was considered both unnecessary and unfortunate (McCormick, p.173); unnecessary because shark meat was in fact considered highly palatable when properly prepared, and unfortunate because with little doubt the fishery kept the numbers of sharks in Hawaiian coastal waters at a low level. Shark populations are especially vulnerable to fishing, compared to those of most other fishes, as mentioned previously. This is largely because the developing young are carried by the females for a long period, and because only a relatively few young are produced by each female during a breeding season. (Shadows in the Sea, p. 172). In the years following the end of the shark fishery, sightings of these animals increased, and it was the opinion of many experts that the number of sharks in Hawaiian coastal waters was on the upswing.

Local fishcake manufacturers turned to the use of marlin, mixed with various other species such as oio, etc., for their product, when the Hawaii State Board of Health passed the food-labelling regulation. But when the "mercury scare" hit the U.S., marlin quickly went out of style. The principal ingredients presently used are imported from the West Coast and Japan. Approximately 1/2 million pounds of processed fish is imported annually by the State's largest fishcake manufacturer.



Potential Utilization of Shark in Hawaii

The Department of Land and Natural Resources recently surveyed longline fishermen to determine a current price that would be sufficient incentive for landing sharks. The majority of prices quoted indicated a price between 35 cents and 50 cents per pound as an acceptable price, although the range of prices spanned between 25 cents and \$1. As a standard of comparison, the average price per pound for aku in 1974 was 36 cents (DLNR Commercial Fish Landings Report, 1974). Some fishermen further indicated that they would accept about 5 cents less per pound provided that limitations were not imposed on size, amount and species of sharks landed.

Since there can be no practical value to landed shark flesh unless a market is available, fishcake industry representatives were also contacted by DLNR personnel. Although interested, they were not very enthusiastic about using shark. Some of the reasons given for not purchasing shark since 1955 were:

- 1) Supplies of shark were inconsistent and often inadequate to fill needs, resulting in unpleasant disagreements between the suppliers and purchasers;
- 2) Increased costs of processing shark flesh;
- 3) Labeling laws;
- 4) Less costly and readily available stocks of imported fishes, such as codfish.

Further discussions with the manufacturers revealed that current prices quoted by fishermen for shark are too high in relation to the present wholesale price of fishcake, due to the amount of processing required before shark flesh can be used. Thus, unless the price differences can be settled, it is very unlikely that the industry would return to the use of shark meat.

Should shark be promoted as a seafood, the greatest utilization of the fish, aside its use in fishcakes, would be as fish fillets. As previously mentioned, shark meat has received a range of evaluations from "quite delicious and tasty" to "terrible" and "not very good". In general, results of interviews and research indicate that although certain species of sharks are edible, other fish are definitely preferable for eating. Shark meat has a pungent odor due to its retention of urea in the blood; the flesh has a tendency to produce an ammonia odor when not properly processed before packaging and/or canning. The special handling and preparation required, as well as the questionable availability of a sustainable supply of sharks to be fished at a reasonable price, work against recommending total feasibility of a shark industry.

Shark fishing is said to be tedious and frustrating. Because shark meat spoils so quickly, cleaning and dressing of the shark meat must be done immediately after the catch. After a day or night of fishing, fishermen are usually too



tired to put in another day's work immediately, so they may hire a work crew, thus driving up expenses. Additionally, the meat needs to be cut and soaked in brine to rid it of its urea odor and taste, and then immediately placed on ice. All this coupled with the fact that shark meat sells for a low market price compared to that of other fish, makes the returns less attractive to the fishermen.

Some local shark fanciers do find shark meat quite palatable, however. Included in the appendix are some of their tested recipes.

Another proposed use of sharks is for their fins, which are the main ingredient of shark fin soup, a local delicacy. However, the cost incurred by the extensive processing required for shark fins for sale as a marketable product mitigates against its profitability for local operations. Presently, shark fins are imported from Japan and Hong Kong, where their processing and packaging have been perfected.

Other market potentials for shark use have not been thoroughly investigated, but perhaps a small local market could be developed for tiger shark teeth for jewelry and souvenirs. Also, the skin, suitably removed, scraped and salted, might be sold to Mainland or Hong Kong firms specializing in shark leather products, although the purchase price (about \$10 per hide) seems small compared with the labor involved in preparing the skin and the cost of shipment.

Hawaii's experience in promoting shark as a commercial venture, outside of its brief association with fishcake manufacturing, has been limited. The most encouraging participation in an independent project has been the following:

In December of 1967, as part of the University of Hawaii's Cooperative-Shark Research and Control Program, a trial shipment of 100 pounds of frozen sandbar shark fillets was sent to Australia. The sandbar shark, the most abundant shark in Hawaiian waters, resembles the school shark of Australia which is fished commercially and utilized as the fish in their "fish and chips" industry. The fillets were prepared and tested as food under the direction of Mr. Norman Lewis, head of the East Melbourne Fishing Company. Mr. Lewis reported that the fillets were quite acceptable as food, and were just about the same as those of the local sharks. The report concluded that the results of much experimentation in preparing and packaging shark fillets suggest that with due care in handling, shark fillets can be prepared as an attractive product. **The big obstacle would be public prejudice against eating sharks.**

4 In another marketing venture undertaken as part of the 1971 Shark Control and Research Program (DLNR), seven oriental-food dealers in Honolulu were interviewed to determine the marketing potentials of shark fins produced locally. Unfortunately, none of these stores would handle



the "raw dried" shark fins that were collected during the program.

It was learned that the shark fins sold here are processed in Japan or Hong Kong. Processing involves cooking in broth, skinning and removing the flesh, leaving only the fin cartilage. This cartilage is then shredded and either canned in sauce or re-dried and packaged for sale. The finished product retails for about \$12 per pound.

It is estimated that the fins from a 10-foot shark would yield about one-half pound of the finished product. In view of the low yield per shark, extensive processing involved, and the relatively small volume sold in the local markets, the profit realizable from shark fins are not large enough to encourage the local processing of fins taken from sharks caught in Hawaii waters.

To find other possible uses for sharks caught in the program, about 47 pounds of tiger and galapagos shark flesh were fed to approximately 600 pounds of fresh water prawns (*Macrobrachium rosenbergii*) that were being cultured experimentally in a one-half acre pond. Observations of the feeding trial showed that the chopped shark flesh was completely eaten by the prawns within 24 hours. In another trial, a smaller amount of chopped shark liver was rejected by the prawns.

Results of a Survey of Restaurants, Fishmarkets and Fishing Associations

In order to ascertain the potential marketability of shark meat, a survey was conducted of various possible retail outlets for shark meat--restaurants and fishmarkets. Fishing associations were also surveyed to determine the willingness of fishermen to fish for shark commercially. The results of the surveys conducted are as follows:

Restaurant Survey:

Of the eleven seafood restaurants surveyed, seven questionnaires were returned. Most responding restaurant managers were aware that shark meat was a high protein fish eaten in many foreign countries, as well as in parts of the Mainland. However, they were divided in their interest in including shark on their menus, as well as to whether it would be a saleable item. Four of the respondents indicated a possibility of selling shark as a regular item on the menu.

Of those who expressed an interest in the shark product, the price they were willing to pay for dressed shark meat ranged from 50 cents to 95 cents per pound.

Fishmarket Survey:

Surveys were sent to 25 fishmarkets on Oahu and the Neighbor Islands with nine responding (33 percent of Oahu markets and 38 percent of Neighbor Island markets.) Only two markets indicated they would be interested in the product. Seven of



the nine responding owners felt shark meat could be utilized best as an ingredient for fish cake.

None of the markets was presently selling any shark and six of the nine owners expressed skepticism as to whether their customers would buy the raw product.

At least half of the responding market owners had tasted shark before, with the majority indicating that it was average in taste and that it wasn't bad dried and smoked.

The two markets which expressed the greatest interest in selling shark meat indicated that they would be willing to pay 25 cents and 60 cents respectively for the raw meat and would sell it for 50 cents and \$1.00 respectively. Fish they presently sold comparable in price to what they would ask for shark meat included rockfish, kaku, kala, awa and baitfish.

Fishing Association Survey:

Five fishing associations were surveyed with four responding. All responding associations indicated that many shark catches are made by members of their association, although no sharks are presently sold commercially. Indication was made by one association representative that commercial fishermen would be willing to fish for sharks if the fillets could be sold for an estimated \$1.00 per pound, with another indicating they would consider selling it for 30 cents for dressed meat.

Spokemen for the associations reported some of their members have tasted shark meat, describing it as average to tasty. They felt shark meat could be a saleable item if properly advertised and if the price were right.

A concern for cultural taboos (Hawaiian shark gods) was expressed by one association as a possible impediment to fishing interests and efforts by some local fishermen.

### Conclusion

No doubt there is utility for shark meat, as noted by its widespread use throughout Europe, the Mainland and Japan, but fishing costs, shark supply and particularly, marketability to local consumers are problems of considerable concern. Obviously, maximum returns could be realized with the total utilization of the shark. This would suggest that all parts of the shark-e.g., fins, skin, teeth(jewelry), meat, etc. be marketed. However, such an undertaking would be tremendously costly (as previously discussed) and would no doubt necessitate considerable State subsidy and private investment.

In marketing shark meat, either as a fresh product or as an ingredient in fishcakes, the supply of sharks is a crucial consideration. According to a DLNR study, the sustained annual yield of inshore and offshore sharks (dressed shark meat) would be somewhere in the vicinity of 230,000 pounds to 325,000 pounds, respectively. It was noted, however, that this yield would be obtained only after considerable effort, which would be extremely costly.



Another problem related to the sustained supply of shark is their susceptibility to intensive fishing efforts. Owing to the shark's lengthy reproductive cycle, replenishment of supply is slow and may cause a strain on total supply. (Since expected volume of demand for shark was not determined, an estimation of the adequacy or inadequacy of this volume of supply was questionable.)

As to the marketing of sharks, data gathered indicate a discrepancy between prices at which the fishermen are willing to fish for the product, and the fishmarkets and restaurants willingness to buy the product. Through the DLNR survey of longliners and a preliminary survey of fishing associations, 50 cents a pound for landed shark and \$1 a pound for dressed shark were prices quoted at which fishermen would be willing to fish for shark. A survey of fishmarkets indicated that they would be willing to pay between 25 and 60 cents per pound for dressed shark meat and would sell the fillets for 50 cents to \$1 per pound. Restaurant owners indicated they would pay between 50 cents and 95 cents per pound for dressed shark meat (or approximately 25 cents to 48 cents per pound for landed, whole sharks). A slight discrepancy exists between asking prices of fishermen and restaurant owners, but a larger gap exists between fishermen and fishmarket prices, with fishermen asking for a much higher selling price for dressed meat than fishmarkets are willing to pay.

the



Fishcake manufacturers and fishmarkets have not indicated very much enthusiasm for using shark meat at the present time, due to the availability of alternative fish supplies to fulfill their needs. One local fishcake manufacturer indicated that imported processed fish from the Mainland and Japan costs approximately 80 cents a pound for a landed shipment in the freezer at his manufacturing plant. This imported fish is ready to be ground into fishcake batter. Local fishermen however, are asking for up to \$1 per pound for a comparable shark product (dressed shark meat ready for fishcake manufacture), not to mention the attendant consumer prejudice involved.

In conclusion, present data suggest that due to the discrepancy between what fishmarkets and fishcake industry people will pay for shark meat and what fishermen will be asking for shark meat, neither fishmarkets nor fishcake manufacturers are presently interested retail outlets for shark meat. The best outlet for shark meat appears to be restaurants, and undoubtedly, there will be a need to establish a promotion program at considerable cost to properly publicize the product to the consumer. Such a program expense does not appear to be merited in light of the relatively small benefits which could be achieved.

As a final note, serious consideration should be given to how much current interest is a result of a "craze"

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or "fad" due to the popularity of the movie, "Jaws", and just how much the passing of the fad will affect this interest.

Consideration should also be given to the possibility of undertaking shark fishing within the present fishing industry as a tertiary or supplemental activity. Commercial outlets for sharks caught could be interested restaurants and fishmarkets, who may sell the product when available.

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SHARK USE IN OTHER AREAS:

Let us take a look at the use of shark in other areas. For many years, Italian and Chinese immigrants and their descendants have for all practical purposes been keeping the United States shark market alive. Of the 70,000 to 80,000 pounds of dogfish sold each year in New York City's sprawling Fulton Fish Market, the largest wholesale fish market on the Atlantic coast, almost all are sold to customers of Italian extraction. On both the Atlantic and the Pacific coast, customers of Chinese extraction support a shark market with their demands for fins for their cherished shark fin soup. The six-gill shark is sold as food in California, but is eaten in Germany not so much as food but as a strong purgative. It has also been reported by the Texas Fish and Game Commission that sharks and rays are regularly caught and eaten in Texas.

The camouflaging of shark with another name is a ruse that has been used and is still being used in many parts of the world. The British have been eating shark and skate for centuries, at times under disguised names.

Meat is not the only shark product Kenyans are using; they have learned to use other products from sharks. Oil, used for leather tanning and wood preservation, is extracted from the sharks' livers; fins are exported for shark fin soup fanciers; from the gelatinous fibers in the fins comes an ingredient for luxury soap; the skin is shipped off to European tanneries to be made into leather; the teeth are sold for novelties, and



fertilizer is made out of virtually all that is left.

United Nations sponsored research has also found another use for meal made from shark meat: flour. Actually, fish flour is so nutritious compared to wheat flour that its developers feel "flour" is an inferior word to describe it. Flour produced from fish meal contains 85 percent animal protein as compared with 15 percent protein found in fresh meat and fish. This is one of the highest concentrated protein substances yet developed by man. No mention, however, was made of the manufacturing process involved or the cost of manufacturing operations needed to produce the "flour":

Shark meat is also sold for human consumption in Australia, as fillets, under the name "flake fish" and is the major component of Australia's "fish and chips" market. Health regulations do not permit sharks longer than four feet to be sold for human consumption due to the excess concentration of mercury found in larger sharks.

Finally, from an interview with DLNR personnel, it was learned that sharks are readily sold and consumed in Japan markets. This is perhaps necessitated by the great demand for fish by the Japanese consumer. Shark fins are also processed and sold in Japan and elsewhere in the Orient.

MERCURY CONTENT IN SHARKS:

There are no present Federal Food and Drug Administration restrictions on shark meat as a food product. The same standards apply to sharks as to other fish. The FDA recommended highest "safe-level" for mercury in fish is 0.05ppm. (parts per million), with the State's allowable content level being slightly higher at 1 ppm., restricting fish sales to within the State.

An indication of the mercury content in sharks can be ascertained through data compiled by the 1971 Shark Control and Research Program (DLNR). Of the 22 readings taken from four species caught during the program, the average total mercury content was 0.06. The highest reading of 0.27ppm. was obtained from a six-foot blacktip shark (an inshore species). However, a 15-foot tiger shark, the largest shark caught during the program, registered only 0.07 ppm. Although the sample was small, there was felt to be no indication of a relationship between mercury level and the size of the shark. (See following table)



Mercury analysis of flesh of sharks caught during  
the 1971 Shark Control and Research Program

SPECIES	DATE	AREA	TOTAL LENGTH	MERCURY IN FLESH (ppm)
Tiger	6/4/71	3	6' 3"	.02
Tiger	6/5/71	4	4' 0"	.01
Tiger	7/2/71	21	11' 0"	.09
Tiger	6/6/71	25	14' 6"	.06
Tiger	7/6/71	25	14' 6"	.03
Tiger	7/6/71	25	9' 9"	.07
Tiger	7/6/71	25	10' 4"	.05
Tiger	7/6/71	25	10' 0"	.03
Tiger	7/6/71	25	10' 0"	.03
Tiger	7/8/71	27	9' 6"	.05
Tiger	7/8/71	27	8' 0"	.04
Tiger	7/8/71	27	8' 6"	.03
Tiger	7/8/71	27	14' 6"	.06
Tiger	7/8/71	27	15' 0"	.07
Tiger	7/8/71	27	12' 6"	.02
Blacktip	7/6/71	25	6' 11"	.27
Blacktip	7/6/71	25	6' 7"	.14
Blacktip	7/8/71	27	6' 11"	.06
Blacktip	7/8/71	27	6' 9"	.07
Sandbar	6/6/71	5	5' 3"	.05
Sandbar	7/8/71	27	5' 5"	.10
Galapagos	6/6/71	5	7' 1"	.05

Tester, Albert L., Cooperative Shark Research and Control Program, Final Report 1967-69, University of Hawaii, Honolulu, December 31, 1969, page 26.

### TRIMBLE'S BAKED SHARK

2 pounds shark steaks or fillets, 2 inches thick  
2 tablespoons lemon juice  
salt and pepper  
2 tablespoons butter  
1 teaspoon chopped parsley  
1 cup creole sauce

#### CREOLE SAUCE:

2 tablespoons chopped onion  
4 tablespoons green pepper, chopped finely  
2 tablespoons butter  
1/2 cup sliced mushrooms  
1 cup brown sauce

Wash steaks and wipe dry. Sprinkle with lemon juice, salt and pepper. Prepare sauce by cooking onion and green pepper with butter 5 minutes. Add tomatoes, mushrooms, olives and cook 2 minutes. Add one cup of your favorite brown sauce and bring to a boil.

Then melt butter in a baking dish and put fish in. Pour sauce over it. Place in preheated, 400 degrees F. oven for about half an hour or until fish flakes easily when tested with fork. Remove fish to a hot serving dish and pour the sauce it was cooked in over it. Sprinkle with chopped parsley and serve. Serves four to five.

### TRIMBLE'S FRIED SHARK

2 pounds shark fillets  
2 eggs  
2 tablespoons soy sauce  
1 teaspoon salt  
1/2 teaspoon pepper  
1 teaspoon garlic salt  
1/2 cup flour  
1/2 cup wheat germ

Wipe fillets dry, slice them into strips and then dip in mixture of lightly beaten egg, soy sauce, salt, pepper and garlic salt. Combine flour and wheat germ and dredge the wet fillets in the mixture. Deep fry in hot oil over medium heat until brown on both sides. Serve with Russian dressing or with lemon wedges.



## SHARK IN TOMATO SAUCE

2 pounds shark fillet  
1 onion, sliced  
1/2 teaspoon salt  
1/2 cup flour  
5 tablespoons butter  
dash of pepper

### TOMATO SAUCE:

1 no. 2 can whole tomatoes  
1 small can tomato paste  
1/2 teaspoon thyme  
1/2 teaspoon rosemary  
1/2 teaspoon salt  
5 teaspoons chopped chives  
1/2 clove garlic, minced  
1/2 tablespoon lemon juice  
1/8 teaspoon pepper  
1 tablespoon cheddar cheese, crumbled  
pinch of red pepper seeds

Prepare the tomato sauce first. Combine in sauce pan all ingredients for the sauce except cheese and lemon juice. Bring to boil. Lower flame and simmer gently for 20 minutes. Add crumbled cheese. Stir well and simmer 5 minutes.

While the sauce is simmering, prepare fish. Wipe fillets with damp cloth and cut into 6 pieces. Blend salt and pepper with flour. Dust each fillet lightly with moisture, and place 1 slice onion in center of fillet. roll fillet around onion and tie with string or skewer with toothpick. Cut two sheets of aluminum foil into sheets the size of baking dish. Line dish with one foil sheet. Arrange rolled fillets on the bottom, and cover fillets with aluminum foil. Bake in preheated oven at 450 degrees F. for about 30 minutes. Arrange fillets on platter and pour spice sauce over them. Serve immediately.

## SHARK IN OLIVES

2 pounds shark steaks or fillets  
2 tablespoons butter  
12 jumbo ripe olives, chopped  
1 small onion, minced  
pinch of rosemary  
1/2 cup dry Sauterne wine  
salt and pepper

Wipe fillets with damp cloth. Salt and pepper lightly to taste, then arrange fillets in well buttered, shallow baking dish. Sprinkle rosemary lightly over fish, and spread olives on top, then minced onions. Dot with lots of butter. Pour Sauterne around fish. Bake in 350 degrees F. oven for about 30 minutes or until fish flakes easily when tested with fork. Serve immediately.



Following recipes from:

McCormick, Harold W. and Tom Allen with  
Capt. William E. Young, Shadows in  
the Sea, The Sharks, Skates and Rays,  
Chilton Book Co., N. Y., 1963

### SHARK PATTIES

- 1 cup ground shark
- 2 cups potato or cornmeal mush
- 1/8 teaspoon pepper
- 1 tablespoon butter
- 1 egg

Wash the fish and shred fine in cold water. Wash, pare, and cut potatoes into pieces of uniform size. Cook fish and potatoes in boiling water for 20 minutes, or until potatoes are soft. Drain, add the butter and the pepper, and mash fine with a fork. As soon as cool, add the egg, well beaten, and salt if necessary. Shape into patties by tablespoonfuls, leaving the outside rough, and fry in deep fat.

### FRIED SHARK, NEW ENGLAND STYLE

- 2 pounds shark
- 1/2 cut fine cornmeal
- 1/2 pound fat salt pork
- Few sprigs parsley
- 1 lemon
- Salt, pepper to taste

Cut the fish as usual, season well with salt and pepper, and roll in the cornmeal. Fry the fat salt pork in a shallow frying pan, and when crisp remove and keep hot. Place the fish in the pan and fry to a nice brown on both sides. Serve on a hot platter, with the salt pork over it, and garnish with parsley and slices of lemon.

### SHARK CUTLETS

1-3/4 cups flaked smoked shark  
1 1/2 tablespoon chopped onion  
2 tablespoons finely chopped red peppers  
3 tablespoons butter  
1/3 cup flour  
3/4 tablespoon salt  
1/2 tablespoon paprika  
1 cup milk  
Sprigs parsley  
Egg-bread crumb mixture

Wash the smoked shark and boil for 20 minutes. Flake it. Cook the onion and the red peppers with butter for 5 minutes, stirring constantly. Add the flour, mixed with salt and paprika, and stir until blended. Add the milk gradually, bring to the boiling point, add the flaked shark, and spread on a platter to cool. Shape, dip in egg and crumbs, and fry in deep fat, then drain on brown paper. Arrange on a serving dish, garnish with sprigs of parsley, and serve with Epicurean Sauce\*

#### (\*Epicurean Sauce)

1 tablespoon tarragon vinegar	Few grains cayenne
2 tablespoons grated horseradish	1 cup whipped cream
1 teaspoon mustard	3 tablespoons mayonnaise
1/2 teaspoon salt	

Mix together the vinegar, horseradish, mustard, salt, and cayenne; add the whipped cream and the mayonnaise dressing. Beat thoroughly.

### SHARK À LA NEWBURG

1 pound smoked shark  
1/4 cup butter, melted  
Dash of pepper  
Few gratings of nutmeg  
2 tablespoons lemon juice  
2/3 cup thin cream  
2 egg yolks

Soak the fish in warm water for 1/2 hour, then slowly bring to a boil and boil for 1 minute. Drain and add to the melted butter and cook for 3 minutes. Add the seasonings, lemon juice with cream and yolks stirred into it, and cook until thickened, stirring constantly.



### FRIED FILLETS OF SHARK ORLY

2 pounds shark  
1/2 cup flour  
2 eggs  
Bread crumbs  
Few sprigs parsley  
1 lemon  
Tomato sauce

Cut the fish into fillets, season well, and roll in flour; dip in beaten eggs and roll in bread crumbs. Fry in deep fat to a nice brown color. Drain and serve garnished with parsley and slices of lemon, with a sauce boat of tomato sauce on the side.

### SHARK SAUTÉ MEUNIÈRE

2 pounds shark  
1/2 cup flour  
2 ounces butter  
2 lemons  
Few sprigs parsley  
Salt, pepper to tast

Cut the fish into slices 1/2 inch thick, season well with salt and pepper, roll in flour, and fry in butter. Remove from the pan and place on a hot platter, squeeze the juice of 1 lemon over it, add a little more butter in the pan, and when it stops foaming and is a light brown color, pour over the fish. Sprinkle with chopped parsley and serve very hot with quartered lemon.

### BAKED SMOKED SHARK

2 pounds smoked shark  
2 cups milk  
1 tablespoon flour  
1-1/2 tablespoons butter  
1/8 teaspoon pepper

Wash the smoked shark and soak overnight in cold water. Place in a shallow baking pan, and pour the milk over it. Bake for 20 minutes in moderate oven, stirring into the milk, at the end of 15 minutes, the flour, butter and pepper. When thoroughly done, place the fish on a platter and pour the sauce of choice around it.



SHARK CHOWDER

- 2 pounds shark
- 1/2 pound salt pork
- 2 small onions
- 1 quart sliced raw potatoes
- Few sprigs of parsley
- 1 quart milk
- Salt, pepper to taste

Wash the shark thoroughly, cover with cold water, and boil until tender. Flake the fish or cut it into small pieces. Save the water. Cut the salt pork into small pieces and fry until crisp, then remove the pork scraps. In the fat fry the sliced onions, then add the potatoes and a little parsley and cook until done, adding a little water if necessary. When the potatoes are soft, add the hot milk and the flaked fish, salt and pepper, and heat through. Split Boston crackers or pieces of pilot bread may be placed in the chowder, or served with it.

SHARK MARSEILLAISE

- 2 large onions
- 2 pounds shark
- 2 tablespoons olive oil
- 4 tomatoes
- 1 clove garlic
- 1 pinch saffron
- Salt, pepper to taste
- 1/2 glass water or fish stock

Chop the onions fine and fry in the olive oil. Add the tomatoes cut into small pieces, the garlic, saffron, salt and pepper, and the water or fish stock. Place the fish, cut as usual, in the mixture, and allow to boil fast for 15 to 20 minutes. Keep the kettle covered tightly. Remove the fish and place on some slices of French bread which have been browned in the oven. Boil the liquid down a few minutes so that it will not be watery, correct the seasoning, and pour over the fish.

SHARK SALAD

- 2 cups smoked shark
- 2 cups cooked potatoes
- 1 tablespoon onion
- 1 cup celery
- 2 tablespoons green pepper
- 2 cups mayonnaise
- Salt, pepper to taste

Wash the smoked shark and boil until tender. Shred when cold, and add to the potatoes, which have been diced. Then put in the minced onion, celery, and green pepper. Mix thoroughly and add the mayonnaise, stirring slightly. (The addition of 3 hard-boiled eggs gives an even more nutritious and palatable salad.)

SALT SHARK CHOWDER

- 1/2 pint pickled salt shark
- 1 pint raw potatoes
- 1 large white onion
- Salt and cayenne pepper to taste
- 1 pint milk
- Few tablespoons rich cream

Pare and thinly slice the potatoes and the onion. Place the fish, potatoes, onion, and 1 cracker, crushed fine, in a hot buttered baking dish. Add the seasoning, cover with hot water, and boil gently for 20 minutes. Add the hot milk and cream and let boil up. Serve with crackers or toasted bread.

SALT SHARK AU GRATIN

- 1 pound shark
- 1 tablespoon butter
- 1 tablespoon flour
- 1 cup boiling water
- 2 tablespoons grated cheese
- Bread crumbs

Boil the fish gently for 2 hours, putting it over the fire in tepid water; let cool and mince fine. Make a drawn-butter sauce by cooking together 1 tablespoon each of butter and flour and stirring them into a cup of boiling water until the sauce is thick and smooth. Stir the fish into thi, add pepper to taste, and mix with the cheese. Turn into a baking dish, sprinkle with crumbs, bits of butter, and a little more grated cheese, and brown in the oven.