Squid Fishery in Texas: Biological, Economic, and Market Considerations

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Introduction

Squids are considered to be one of the underdeveloped fishery resources along the Gulf and Atlantic coasts of North America. The recent international implementation of a 200-mile limit, rapidly increasing fuel costs, and a worldwide increase in the demand for squids have provided the impetus to reexamine the squid resources of the U.S. continental shelf. Most of the current activity is centered in the northeastern United States, where stocks of the squids *Loligo pealei* and *Illex illecebrosus* have been exploited for some time, and where both local and overseas markets have been developed (Rathjen, 1973; Serchuk and Rathjen, 1974; Lux et al., 1974; Kolator and Long, 1979).

In contrast, only small amounts of squid have been landed from the Gulf of Mexico, where little market development has occurred. Our purpose is to examine the biological, economic, and marketing constraints that hinder the development of a squid fishery along the Gulf coast of Texas and investigate the concept of squids being a source of income for the existing shrimp fleet. We have chosen this limited geographical area not only because we are familiar with it, but because it typifies the problems faced when introducing an unfamiliar resource to the public.

The concept of utilizing squids as a fishery resource in the Gulf of Mexico is not new. Voss (1960, 1971, 1973) and Rathjen et al. (1977, 1979) stated that squid stocks of unknown size exist in the Gulf of Mexico. Three species occurring over the continental shelf and one species occurring beyond the shelf in deep water have possible commercial potential. These are the loliginid (family Loliginidae) shelf forms: brief squid, *Lolliguncula brevis*; arrow squid, *Loligo plei*; and common or long-finned squid, *Loligo pealei*; and the ommastrephid (family Ommastrephidae) offshore species, the orange-back squid, *Ommastrephes pteropus*. These species can be identified by keys and descriptions presented by Voss (1956), Voss et al. (1973), and Cohen (1976). Presently the only directed fishery for squids in the Gulf of Mexico is a very small-scale fishery that takes place in the fall near Progreso, Mexico, in the state of Yucatan (LaRoe, 1967; Voss, 1971). At night fishermen in small boats use torches and small tethered live fishes (the halfbeak *Hemiramphus* sp.) to attract *L. plei* within range of dipnets. Additionally, all three loliginid squids are taken in bottom trawls as a bycatch of the Gulf shrimp fishery (Hildebrand, 1954, 1955). While most are discarded along with the rest of the bycatch, a small amount is sold at a low price for bait or human consumption.

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ABSTRACT–Presently no major squid fishery exists in the Gulf of Mexico, although the shelf forms Loligo pealei, Loligo plei, *and* Lolliguncula brevis *occur throughout the Gulf. We examined the constraints that hinder the development of the fishery, using Texas as a model. Reported incidental catches of squids in shrimp bottom trawls are low, but if markets were developed shrimpers could reduce their monthly losses in the first 6 months of the year by up to 11 percent. Several biological, economic, and marketing problems were identified that indicate a squid fishery is not viable in Texas at this time, although future potential for one exists.*

Biological Considerations

Our characterization of squid populations along the Texas Gulf coast is derived from three sources. Data on commercial landings of squids in Texas are from annual summaries published by the National Marine Fisheries Service (NMFS) in cooperation with the Texas Parks and Wildlife Department. Additional information on squid population parameters came from a 3-year (1975-77) survey sponsored by the U.S. Bureau of Land Management (BLM)[1] of the south Texas offshore continental shelf from the Mexico-U.S. border to Matagorda Island. Similar data were obtained from 924 stations undertaken by the Marine Biomedical

[1]Environmental studies, South Texas Outer Continental Shelf, Biology and Chemistry. 1979. Reports submitted to the Bureau of Land Management by the University of Texas, Marine Science Institute, Port Aransas Marine Laboratory, Port Aransas, TX 78373.

Institute (MBI)[2] as part of a program to supply live squids for neuroscience research.

The general areal and bathymetric distribution of the four squids was determined by combining the BLM and MBI survey data (Fig. 1). Each species occupies a primary depth range, but these vary both seasonally and from year to year. These ranges overlap, and it is not uncommon to catch the three inshore loliginid squids in a single trawl.

Lolliguncula brevis is a small squid with a maximal mantle length (ML) of 90 mm (3.6 inches). Specimens from the BLM study collected with a standard 10.7-m (35-foot) footrope Gulf shrimp trawl (flat net) had a mean mantle length of 42 mm (1.68 inches) and weight of 6.2 g (0.2 ounce). This squid is usually associated with low-salinity water between 17 and 30 ppt and is found primarily in bays and near shore out to a depth of 20 m (65.6 feet). It is periodically excluded from the coastal bays by low temperatures in the winter (Gunter, 1950) and by very low salinities during peak periods of spring and summer freshwater runoff.

Loligo plei and *L. pealei* are larger animals reaching mantle lengths of 250 and 285 mm (10 and 11.4 inches), respectively. Trawl-caught squids are smaller; *L. plei* had a mean mantle length of 66 mm (2.6 inches) and a mean weight of 6.7 g (0.2 ounce), while the average *L. pealei* measured 69 mm (2.76 inches) ML and weighed 14.5 g (0.5 ounce). *Loligo plei* is usually caught between 20 and 75 m (65.6 and 246 feet) where salinities exceed 30 ppt. *Loligo pealei* is primarily found between 40 and 183 m (131 and 600 feet) in salinities above 33 ppt.

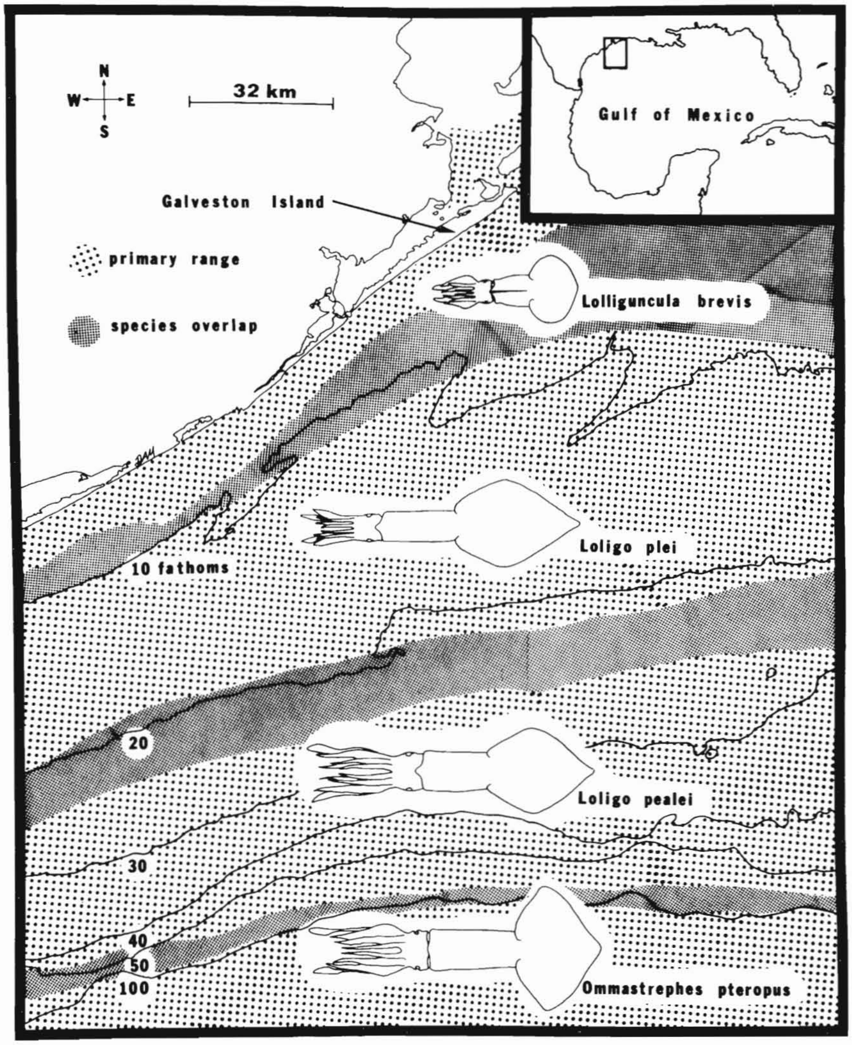

Figure 1.—The approximate areal and bathymetric distribution in summer of four squid species of commercial potential on the Texas continental shelf south of Galveston, Tex.

Ommastrephes pteropus attains an adult size of over 350 mm (14 inches) ML but its mean size in our collections is 197 mm (7.9 inches) ML. This squid is an oceanic species that occasionally is taken in depths as shallow as 183 m (600 feet).

Alternate methods of capturing squids other than by bottom trawl have been tested in the MBI study in the western Gulf of Mexico. Other loliginid squids, notably *Loligo opalescens* in California (Kato and Hardwick, 1976), group together in large spawning or feeding congregations and are vulnerable to capture by a lampara net or purse seine. No similar congregations of the three Gulf of Mexico loliginid species have been reported, and our few attempts to capture these species at night with encirclement nets and night lights have had very limited success from a commercial standpoint. However, unpublished data from 24 NMFS-sponsored trials in the northeastern Gulf of Mexico (Wickham, 1971) with purse seines and night lights

[2] Hixon, R. F. 1980. Growth, reproductive biology, distribution and abundance of three loliginid squid species (Myopsida, Cephalopoda) in the Northwest Gulf of Mexico. Doctoral dissert., Univ. Miami, Coral Gables, FL 33149, 92 p.

Table 1.—Location of catch, total catch, value, and price per kilogram of all squids landed in Texas ports between 1961 and 1978. Catch weight in kilograms.

Year	Open Gulf waters	Galveston & Trinity Bays	Other bays	Total catch	$ value	$ Price per kg
1961				5,262	1,128	0.21
1962	12,565			12,565	2,770	0.22
1963	16,965			16,965	3,884	0.23
1964	10,297		363	10,660	2,350	0.22
1965	10,387		454	10,841	2,390	0.22
1966	9,253	544	408	10,206	2,300	0.23
1967	4,445	318	544	5,307	1,019	0.19
1968	4,536	318	227	5,080	1,223	0.24
1969	2,404	318	408	3,130	699	0.22
1970	2,767	1,633		4,400	909	0.21
1971	2,449	1,315	544	4,309	1,508	0.35
1972	1,225	1,089	136	2,449	763	0.31
1973	1,225	816	408	2,449	783	0.32
1974	4,717	1,678	363	6,759	2,676	0.40
1975	1,905	907	136	2,948	1,423	0.48
1976	3,765	5,126	363	9,253	4,595	0.50
1977	3,765	1,542	952	6,260	4,144	0.66
1978				7,025	4,450	0.63

Table 2.—Monthly squid landings (kilograms) reported from all Texas ports between 1962 and 1977.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1962	45	91	136	136	2,177	1,860	4,491	1,860	272	635	816	45
1963	91	45	318	1,724	3,084	3,221	3,493	1,542	2,041	590	499	318
1964	318	454	181	1,225	1,043	862	1,769	1,043	998	1,225	1,089	454
1965	181	136	680	1,633	2,132	3,583	1,270	499		181	318	227
1966	454	227	635	363	1,134	1,179	3,266	1,179	499	408	408	454
1967	272	272	635	181	227	1,361	1,134	544	272	45	318	45
1968		91	91	45	363	272	408	2,223	318	816	408	45
1969	45		91	91	136	408	680	136	227	771	454	91
1970	91	45	45	136	45	318	2,359	272	544	227	272	45
1971		91	45	454	1,270	1,043	363	91	408	272	272	
1972		136	181	45	227	1,134	318	45	181		181	
1973		45		91	1,043	181	408	91	227	136	181	45
1974	454	408	1,588	816	181	1,361	499	544	363	181	181	181
1975		454	136		91	363	771	318	91.	318	272	136
1976		227	862	3,402	3,221	363	318	227	363	181	45	45
1977		45	136	544	590	136	907	953	1,588	726	499	136
Mean	122	173	360	680	1,060	1,103	1,403	723	525	420	388	142

Table 3.—Projected daily catch of each squid species and combined monthly yield of all squids from nine depth strata[1].

	Depth (m)								
Item	0-10	11-20	21-30	31-40	41-50	51-75	76-100	101-125	126-250
No. of daytime tows	6	18	18	18	18	18	18	12	18
Lolliguncula brevis									
Mean no./tow[2]	49.2	60.1	13.4	4.0	0.1				
No. squid/day[3]	1,575	1,923	429	128	3				
Yield in kg/day (6.2 g/squid)	9.8	11.9	2.7	0.8					
Loligo plei									
Mean no./tow[2]	3.3	7.2	45.5	57.2	32.7	23.6	6.9	0.7	0.1
No. squid/day[3]	106	230	1,456	1,830	1,046	755	221	22	3
Yield in kg/day (6.7 g/squid)	0.7	1.5	9.7	12.3	7.0	5.0	1.5	0.1	
Loligo pealei									
Mean no./tow[2]			2.2	2.4	13.1	7.0	15.1	8.5	8.7
No. squid/day[3]			70.4	76.8	419	224	483	272	278
Yield in kg/day (14.5 g/squid)			1.0	1.1	6.1	3.2	7.0	3.0	4.0
Total daily yield (kg)	10.5	13.4	13.4	14.2	13.1	8.2	8.5	4.0	4.0
Monthly yield (kg)[4]	210	268	268	284	262	164	170	80	80

[1]Mean catch based on data for entire year
[2]Each tow was 15 minutes.
[3]Calculated by extrapolating mean catch in 15 minute tow to 8 hours.
[4]Based on 20 days of trawling per month.

show that up to 15 percent of the catch was squids[3].

Another possible capture method for *Ommastrephes pteropus* and both species of *Loligo* is to attract them to lights at night and capture them with squid jigs. Our experience on both research and exploratory fishing vessels with hand-held jigs and squid jig machines has indicated that only *Ommastrephes pteropus* might eventually be taken in commercial quantities with jigs.

A third alternative is the introduction of large high-speed midwater trawling gear similar to that which is presently producing high squid catches in the U.S. east coast offshore squid fishery. Our conclusion is that the three loliginid squids currently would best be caught by using existing commercial shrimp trawling gear. Catches would be higher during daytime because squid undergo a vertical diurnal migration (Summers, 1969; Serchuk and Rathjen, 1974; Rathjen et al., 1979). They are near the bottom during the day and up in the water column at night.

Squid landings statistics reported by NMFS show when and where squids are caught, but the records are incomplete because an unknown amount of squid is not reported, and they do not differentiate the catch into species. Total reported squid landings in Texas between 1961 and 1978 averaged 6,931 kg (15,248 pounds) per year and ranged from 2,449 kg (5,388 pounds) in 1972 and 1973 to 16,965 kg (37,323 pounds) in 1963 (Table 1). The highest monthly mean catches, 680-1,403 kg (1,496-3,087 pounds), are recorded between April and August and the lowest mean catches, 122-173 kg (268-381 pounds), occur between December and February (Table 2).

High catches during the spring and early summer partially reflect increased effort of the shrimp fleet during this time, but similar trends in squid abundance are also found in the BLM and

[3]Wickham, D. A. 1979, Office of Policy and Planning, National Marine Fisheries Service, NOAA, Washington, DC 20235. Personal commun.

Table 4.—1978 monthly and annual costs and returns[1] for an average owner-operated Gulf shrimp trawler in Texas. Source: Tydlacka, 1979.

Item	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Returns													
Kilograms[2]	1,187	1,236	1,093	962	1,370	1,896	3,292	3,640	2,706	2,718	2,462	2,173	24,735
$ Price/kilogram[2]	5.91	5.91	5.84	6.21	4.67	3.26	4.08	5.44	7.16	7.34	8.95	8.47	6.15
$ Gross revenue	7,011	7,300	6,387	5,981	6,402	6,186	13,427	19,819	19,393	19,953	22,038	18,397	152,294
$ Costs													
Variable costs													
Supplies & repairs[3]	3,352	3,212	3,619	3,967	3,789	4,821	5,797	5,263	5,834	5,948	4,857	6,031	56,490
Crew shares[4]	1,402	1,460	1,277	1,196	1,280	1,237	2,685	3,984	3,879	3,991	4,408	3,679	30,458
Packing[5]	195	203	179	158	225	311	540	597	444	446	404	356	4,058
Total variable costs	4,949	4,875	5,075	5,321	5,294	6,369	9,022	9,824	10,157	10,385	9,669	10,066	91,006
Total fixed costs[6]	2,397	2,367	2,375	2,467	2,460	2,412	2,480	2,562	2,496	2,416	2,426	2,552	29,410
Total costs of operations	7,346	7,242	7,450	7,788	7,754	8,781	11,502	12,386	12,653	12,801	12,095	12,618	120,416
Total $ profit or $ loss from operations	−335	58	−1,063	−1,807	−1,352	−2,595	1,925	7,433	6,740	7,152	9,943	5,779	31,878

[1]Based on budgets of vessels from 20 to 29 m in overall length.
[2]Recalculation from original pounds to kilograms resulted in slight rounding differences.
[3]Includes fuel, nets, groceries, repairs, ice, miscellaneous supplies, and maintenance.
[4]Based on share agreement of 20 percent.
[5]Based on $2.05/kg.
[6]Includes insurance, interest, overhead, and depreciation. Based on vessel cost of $166,000.

MBI data. Over 80 percent of the reported squid catch is taken on the continental shelf in the open Gulf of Mexico. The remainder is taken in coastal bays, the most important of which are Galveston and Trinity Bays (Table 1).

Presently it is not possible to make statistically defensible estimates of the squid resources of the Texas Gulf Coast. The best information available comes from the BLM trawling survey (footnote 1) that adopted a nonrandom sampling scheme. The object of the extensive BLM study was to determine which species were present within the survey area and the relative abundance of these species between sampling stations. With these limitations in mind, we used the BLM data (footnote 1) to estimate a catch rate for squids with commercial shrimp trawl gear at various depths (Table 3). This estimate was made from 144 daytime trawls taken in three seasons (winter, spring-summer, and fall) in 1976 and 1977 from 24 fixed stations arranged on four inshore-to-offshore transects. Each sample consisted of a 15-minute bottom tow with a standard 10.7-m Gulf shrimp trawl. To summarize, the data in Table 3 indicate that projected catches are low (current maximal estimates of 284 kg (625 pounds) per month) and that the greatest amounts are caught between shore and a depth of 50 m (164 feet).

Table 5.—Break-even yield at alternative prices for squid for an average Gulf shrimp trawler in Texas between January and June in 1978 dollars.

Squid price	Jan.	Feb.	March	April	May	June	Total
$0.66/kg							
Kilograms	16,021	15,555	16,692	17,897	17,390	20,086	103,642
$ Value	10,574	10,266	11,017	11,812	11,477	13,257	68,403
$2.20/kg							
Kilograms	2,188	2,082	2,342	2,564	2,446	3,104	14,727
$ Value	4,813	4,580	5,152	5,641	5,381	6,829	32,399
$4.40/kg							
Kilograms	913	869	977	1,070	1,020	1,295	6,143
$ Value	4,017	3,824	4,299	4,708	4,488	5,698	27,029

Economic Considerations

What conditions in terms of price, catch rates, and fishing season would induce a typical Gulf shrimper to fish for squid? We analyzed these questions by considering squids either the subject of a directed fishery or as part of an incidental fishery. Table 4 shows the 1978 monthly and annual costs and returns for an average owner-operator Gulf shrimp trawler of 20-29 m (65.6-95 feet) overall length.

Over the calendar year 1978 the owner-operator earned an accounting profit from the shrimp fishery of $31,878. Notice, however, that total profit from operations is negative for the first 6 months of the year (except February) and positive for the last 6 months of the year. Based solely upon economic considerations, we estimated how much squid an owner-operator would have to land to just break even if he fished exclusively for squids for the first 6 months of the year. Break-even yield is defined here as the yield that just covers the total costs of operations, so that total profit equals zero. It will be assumed that variable costs remain the same.

Table 5 gives the break-even yield and gross value of the hypothetical total squid landings under alternative price conditions from January through June. For convenience we chose values of $0.66, $2.20, and $4.40 per kilogram of squid ($0.30, $1.00, and $2.00 per pound). The lower price of $0.66/kg is the recent average price of squid along the Texas coast (Table 2), whereas the $4.40/kg is the approximate price received by trawlers off the northwest coast of Africa (Griffin et al., 1979). At a price of $0.66/kg, the catch just to break even for each trawler must average over 17,000 kg (37,400 pounds) of squid per month, or total over 100,000 kg (220,000 pounds) for the entire 6-month period. As the price moves up to $2.20/kg, the break-even quantity of squids drops considerably to a 6-month total of 14,727 kg (32,400 pounds). At $4.40/kg, the 6-month break-even quantity would be reduced to 6,143 kg (13,515 pounds). Our biological estimates indicate that even at a price of $4.40/kg the break-even quantity is higher than our estimated monthly catch rate.

Clearly, a directed fishery for squids is not feasible at this time along the Texas coast using bottom trawls. It may be possible, however, for squids to be an incidental fishery, especially during the first half of the year when shrimping alone does not provide a profit margin.

Since squid catches are highest between April and August (Table 2), we have made some estimates of how much the average owner-operator might reduce his losses during this period by selling squids that are caught during daytime shrimp trawling. Using a value of $0.66/kg and a projected catch rate of 284 kg (625 pounds) per month, the owner-operator pulling one trawl would receive $187 per month for whole, unprocessed squids. Assuming crew shares and packing charges are the same as for shrimp, the owner-operator would clear only $103.

Some boats pull two trawls and their take would be about $206 per month. While these figures are low, they can reduce the monthly loss. In April, for instance, $206 per month for squids would reduce the $1,807 loss by 11 percent. Losses would be further reduced if markets and products for other incidental finfishes could be simultaneously developed (Juhl and Drummond, 1976; Blomo and Nichols, 1974; Nichols et al., 1975).

Market Considerations

From all the foregoing information it is obvious that for squids to be an alternative fishery in Texas the highest price possible should be attained. The marketing task required is formidable and touches three areas of consumer acceptance criteria: 1) Perceptual appearance, 2) physical attributes, and 3) buying decision perspectives. Many of our observations are based on an analysis of seafood consumption and product perceptions in Texas (Gillespie and Houston, 1975).

In terms of perceptual appearance, domestic consumers hold a strong bias against both the name "squid" and the traditional retail merchandising method of marketing squids in the whole, unprocessed form (Kalikstein, 1974). Most consumers do not want to eviscerate and dress animals for meal preparation. On the positive side, processed squid that has been eviscerated and skinned has a preferred white-colored flesh. Its appearance is further enhanced when the mantle is split, resulting in an appealing fillet-like form (Berk, 1974). An alternative name such as "calamari" (Italian for squid) would seem to make the product more appealing for the uninformed user[4].

The physical attributes of preferred seafoods are that they be tender and mild-tasting. In spite of favorable taste qualities, squid flesh tends to be tough or rubbery when it is improperly cooked, due to the presence of several layers of connective tissue in the muscle (Otwell and Hamann, 1979a) that are absent in finfish.

Based upon current technology, neither pounding nor mechanical tenderizing equipment can achieve the degree of tenderness of most other cooked seafood. However, Otwell and Hamann (1979b) concluded that to insure tender cooked squid, mantle meat should be cut into longitudinal strips which have less muscle fiber resistance, and boiled for less than 5 minutes to avoid excessive mantle dehydration. If further tenderization is desired, boiling squid meat 40-60 minutes will tenderize it very well, although at some sacrifice of moisture content.

An additional consideration is that larger squids (e.g., *Loligo pealei* or *Ommastrephes pteropus*), which cost less to process and prepare, are usually tougher than the smaller squids (*Lolliguncula brevis*). If the goal is to produce a squid product with acceptable taste and texture, it may be more advantageous to develop a market using smaller squids. This would be beneficial since trawls generally select for smaller squids.

From a buying decision perspective squid must be economical, nutritious, and easy to prepare. The retail price of whole squid is attractive relative to other seafood; however, the market price increases significantly after processing. Currently, squids must be hand-processed[5], and they have between one-third and two-thirds yield; therefore, a dealer price of $0.66/kg (Table 1) to a processor becomes a conservative yield price of $1.98/kg. When the processor's costs for labor, packaging, and profits are added, the price of processed squid easily exceeds $2.20/kg. The pricing mechanisms of the distribution channel through frozen food brokers, distributors, and wholesalers results in a retail price of $3.50-$4.15/kg ($1.59 to $1.89/pound). At these prices squid competes with finfish fillets, and it is more likely that the consumer will choose the more familiar fish instead of squid.

[4]Such a strategy has proved beneficial in the promotion of squids in the northeast United States. The New England Fisheries Development Program published a consumer-oriented squid preparation and cooking pamphlet with recipes entitled "Squid (calamari): the versatile shellfish." (U.S. Gov. Print. Off.:1975-601-510/20, Region No. 1). Forty-six other calamari recipes are found in "Let's cook squid the European way" by K. Hryniewiecka, published in 1976 by the University of California Sea Grant Marine Advisory Program and the California Department of Fish and Game, Long Beach, CA 90802.

[5]Recently, several innovative processing machines have appeared on the market. One example is the Steen III skinning machine (Skinning Machines, Inc., Stonington, CT 06378) that can quickly skin squids. (Personal commun., 1979, with W. S. Otwell, Department Food Science, University of Florida, Gainesville, FL 32611.) Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

Nutritionally, squid meat has a high value (Varela et al., 1962) because of its low fat but high protein content (Matsumoto, 1958; Kahn et al., 1974). Concerning preparation, no widely acceptable processed precooked squid product has yet been developed. Consumers currently must use squid in raw form and must take cooking steps (see above) that require about the same amount of time as preparing other meats.

There are two domestic marketing approaches to be considered at this time. One is through the larger-scale consumer and restaurant trade route, and the other is to introduce the product on a small scale as a specialty item in local seafood or ethnic restaurants. The first approach requires relatively complex and extensive channels of distribution that must first be developed within Texas to insure wide market acceptance. To overcome consumer unfamiliarity with squid and gain mass market acceptance, a well-coordinated promotion program by large seafood processors or a restaurant chain must be instituted[6]. To introduce squid to a regional market area the size of Texas is expensive (estimates exceed $200,000) and the outcome is uncertain.

The second marketing approach seems more appropriate at this time. Small-scale introduction seems best done initially by small Texas processors who could introduce processed squid speciality items such as stuffed squid or breaded squid rings and strips to local small markets, including certain urban ethnic populations which are familiar with squid, and coastal areas or seafood restaurants where one might expect to find squid as a menu item. Such ethnic communities exist in many Texas cities, including a large Vietnamese community that has recently relocated on the Texas coast. Once squid gains public awareness and acceptance on this small scale, steps may be taken toward the development of mass market acceptance.

[6]An example of such a successful program was that for the common Gulf croaker, *Micropogon undulatus*, in which the Texas A&M Sea Grant Program, Texas Parks and Wildlife Service, Handy Andy grocery chain, and Pat Pace Fisheries combined to successfully promote consumer awareness of this product in San Antonio, Tex. (Personal commun., 1979, with J. P. Nichols, Department of Agriculture Economics and Rural Sociology, Texas A&M University, College Station, TX 77843.)

Summary

Several major problems have been identified that indicate a squid fishery is not a viable alternative in Texas at present. Stocks of three loliginid squid species are present in the northwestern Gulf of Mexico, but reliable biological estimates of squid population size must first be made. Squids would be best fished initially by the existing shrimp trawler fleet as an incidental catch and not as a directed fishery. Eventually, fishing methods conducive to capturing the fast-moving schooling squids must be employed for optimal catches. For squids to become an attractive resource, fishermen and processors must be able to receive much higher prices than those now available. Such increases can only be attained when sufficient demand exists either from domestic or overseas markets. Because significant obstacles in terms of product name, texture, and marketable form now exist in the domestic market, either overseas or small-scale domestic markets with squid specialty items should be established first. The decision to expand to wider domestic markets should be postponed until the question of the size of the squid resource, the marketing obstacles pointed out previously, and sufficient economic return to the fishermen and processors can be answered.

While these conclusions are generally negative, it must be pointed out that with changing conditions squid could eventually be fished commercially on the Texas coast. As an example, estimates 15 years ago for the potential of a New England squid fishery were low. Since that time landings by both foreign and domestic fishermen have increased dramatically as new fishing grounds, more advanced capture methods, and overseas and domestic markets have been developed.

A similar course of events could transpire in the northwestern Gulf of Mexico. As the economic situation changes, the Gulf shrimp industry may find it necessary to utilize the bycatch and begin to slowly alter fishing and processing methods to include the more efficient harvest of specific bycatch organisms, including squids.

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