MFR PAPER 1313

The San Diego Tuna Industry and Its Employment Impact on the Local Economy

STEVEN ROCKLAND

Steven Rockland is with the Department of Economics, San Diego State University, San Diego, CA 92182. *This paper is a result of research sponsored by the Office of Sea Grant, NOAA, under Grant No. USDS 04-3-158-22. Opinions expressed are those of the author and do not necessarily represent the views of the Office of Sea Grant or the National Marine Fisheries Service.*

INTRODUCTION

Tuna fishing, like agriculture and manufacturing, is a basic industry rather than a dependent one. It brings new money into the community, provides a source of primary employment, and generates secondary economic activity. Tuna has become a staple of the American diet and its market has expanded rapidly. Canned tuna is the nation's leading fish product, constituting more than one-third of the annual pack of all fish and seafood.

San Diego developed early in the American tuna fishery as the main base of the tuna fleet. Although Terminal Island in the Long Beach-Los Angeles Harbor area has dominated the processing side of tuna, San Diego has had at least one cannery for many years. As a basic industry of some consequence, the fishery is well worth consideration in any analysis of San Diego's economic base.

The purpose of this study is to review the San Diego tuna industry. This will include a sectoral and aggregate analysis of its impact on the local economy. This paper has been completed using data up to 1975. Prior to examining the industry, we will briefly focus on the evolution of the tuna industry and its general characteristics in San Diego. This will include a review of the fish fleet, the catch, and the yellowfin quota.

GENERAL HISTORY

The United States tuna industry can be dated from 1903 when a San Pedro sardine packer turned to canning albacore after the local supplies of sardines dwindled. Consumers' acceptance of canned tuna soon led to the development of fishing fleets in both San Diego and San Pedro. Increased public demand for tuna resulted in a growing fleet that ventured progressively further south over time in search of yellowfin and skipjack to supplement the albacore catch. The growth of the fleet has been accompanied by a gradual expansion of support facilities including tuna processing, vessel contruction and repair, and ship chandlery. Tuna processing facilities came to be concentrated at Terminal Island and, much later, in Puerto Rico. San Diego became the major base for the fleet, a position it continues to hold.

The Fleet

Prior to 1957, the San Diego fleet was largely composed of bait boats that fished for tuna with pole and line. Anchovies were used as bait which the vessels caught in coastal waters near the fishing grounds. The development of nylon netting for the purse seine and the Puretic[1] power-operated hauling block revolutionized the industry (McNeeley, 1961). As a result, between 1957 and 1961, most of the vessels underwent conversion from hook-and-line fishing to mechanized purse seining. This markedly increased vessel productivity and reduced typical voyages of 60-90 days to 30-50 days. Consequently, new tuna boats were constructed for the first time in many years. However, the rate of new boat building was relatively slow—approximately a vessel per year through the 1960's. In 1969, the realization of huge profits to be made in tuna fishing led to rapid expansion of the fleet. Not only were many new vessels constructed, but the boats were larger and faster than their predecessors. Whereas in 1969, the San Diego tuna fleet had a total fishhold capacity of 31,750 tons, by 1974 this figure had grown to 52,840 tons. Table 1 depicts the rapid expansion of the San Diego fleet in the Inter-American Tropical Tuna Commission's (IATTC) Yellowfin Regulatory Area (CYRA). The growth in the fleet is reflected more in increased average capacity than in growth in the absolute number of vessels. For the most part, large, new superseiners have been added to the fleet at a rate closely approximating the number of sunken tuna boats and transfers to foreign flags. Consequently, the average capacity of purse seiners increased from 374 tons to 691 tons between 1969 and 1974. In addition, the

[1]Mention of trade names or commercial products or firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 1.—San Diego-based fleet in CYRA[1].

Year	Gear type[2]	No. of vessels	Total carrying capacity	Average capacity
1969	B.B.	36	3682	102
	P.S.	75	28068	374
1970	B.B.	37	3439	93
	P.S.	77	33112	430
1971	B.B.	38	3142	83
	P.S.	78	39782	510
	J.B.	28	508	18
1972	B.B.	40	3933	98
	P.S.	69	36378	527
	J.B.	23	585	25
1973	B.B.	39	4071	104
	P.S.	75	48575	648
	J.B.	4	85	21
1974	B.B.	41	4355	106
	P.S.	70	48381	691
	J.B.	6	104	17

[1]Data from IATTC Annual Reports, 1969-74, and through consultation with scientists from National Marine Fisheries Service, Southwest Fisheries Center, La Jolla, Calif.
[2]B.B.=Bait boat; P.S.=purse seiner; J.B.=jig boat.

San Diego fleet includes about 240 jig boats, although only a few participate in the yellowfin fishery[2].

The Catch

The San Diego high seas tuna fleet[3] directs its fishing effort to the capture of two tropical tuna species, yellowfin and skipjack tuna. These species, which are essentially identical to each other in taste and flavor, constitute most of the "light meat" pack and are taken off the west coast of Central and South America from Mexico to northern Chile. Skipjack tuna caught in these waters usually range between 4 and 7 pounds and are the least valuable of the tunas. This is because their small size makes them more costly for the canneries to process, resulting in the lowest yield of canned product per ton of raw fish. The yellowfin tuna normally accounts for the greatest tonnage. A large fish may weigh as much as 200 pounds although the average size is 25-35 pounds in most years. Valuewise, the yellowfin tuna ranks second to albacore in per unit value.

Albacore is primarily captured by the smaller bait and jig boats, since it is less a school fish than the tropical tunas and cannot be economically pursued by purse seiners. Albacore are normally caught from July through September by the American fishermen along the Pacific Coast of North America. Although the fishing is limited and seasonal, albacore has the highest unit value of the tunas and is the only one legally packed as the "white meat" variety.

Impact of Quota

In response to a growing demand for tuna products, the fishery expanded to the point where it was confronted by the possibility that the basic resource would not support greater levels of exploitation. In 1961, IATTC[4] scientists first expressed concern that tuna seiners, with their vast fishing capacity, would soon overfish the yellowfin tuna stocks and recommended that regulatory action be considered. In 1966, the first restrictive quota on yellowfin tuna was implemented with each member nation responsible for supervising its own fleet in the CYRA.

While a quota system may lead to the conservation of yellowfin tuna through prohibiting fishing for a period of time, it does not solve the problem of excess capacity and fishing power which may continue to grow at a time when stocks are deemed fully exploited. This phenomenon appears to have occurred in the tuna fishery in that fishing capacity has increased substantially since 1966. Although it is not known to what extent the basic resource has been affected since the implementation of the quota system, no such uncertainty exists with respect to the size and capacity of the international fleet. The total fish-carrying capacity of the international fleet has grown from roughly 62,000 tons in 1969 to over 160,000 tons in 1975, which represents an increase of 158 percent in only 6 years.

The rapid expansion of the fleet raises certain questions concerning the factors underlying the dramatic rise in capacity and fishing power. It may be expected that profits were the primary cause leading to this development. However, it is important to know to what extent, if any, the quota system itself may have affected the operation of the fishery.

The major effect of the quota system has been to shorten the fishing season for yellowfin, which in turn has led to the expansion of the fishery to other grounds. It has also resulted in the construction of larger vessels. This is the direct result of a "first-come, first-served" quota system to provide a solution to the allocation problem. In order to maintain its share of the harvest, each participant has had to fish more intensively during the unrestricted yellowfin season. This competiveness has been a contributing factor in the rapid expansion of fleet capacity, as each nation strives to retain its share of the catch. This overcapitalization could lead to severe economic hardship for both vessel owners and fishermen, especially if prices declined in the short run.

The consequences of continued open access to these common property resources will be economic waste and pressure on conservation (Saila and Norton, 1974). As the open season is shortened, this will further add to the cost of fishing, since the fixed cost component of total costs will be spread over fewer fishing days. The magnitude of these costs will also depend on the degree to which fishing is carried on in other areas during the closed season. Many vessels fish in the less productive but unrestricted waters just west of the regulated area and some of the larger tuna boats move to the eastern Atlantic during this period.

Each nation with vessels fishing in the CYRA is responsible for enforcing its own tuna regulations based on the recommendations of the IATTC. However, the United States is the only nation among the IATTC countries that actually patrols to prohibit their own fleet from fishing inside the line after the season has closed. The other countries have no effective systems for monitoring, regulating, and penalizing their tuna boats for violating the rules. The realization of this condition has been partially responsible for the transfer of a number of U.S. vessels to foreign flags so that they would be able to continue to fish "illegally" during the regulated season[5].

[2]This estimate of the number of San Diego jig boats is from the Western Fish Boat Owners Association. The lack of jig boat participation in the yellowfin fishery is due primarily to the long distance to the fishing grounds relative to their limited fish carrying capacity.

[3]The high seas fleet includes those vessels designated as such by the American Tunaboat Association that are over 100 tons in fish carrying capacity and which fish for the tropical tunas in the CYRA.

[4]The Inter-American Tropical Tuna Commission was established for two purposes: 1) To review the biological, ecological, and population dynamics of the tunas and bait species used to catch them in the eastern tropical Pacific in order to ascertain the effects that fishing and natural factors have on their abundance, and 2) to recommend appropriate conservation measures so that fish stocks can be maintained at levels which will afford maximum sustainable yields. While this convention was originally entered into by the United States and Costa Rica in 1950, the commission has since added Panama, Mexico, Canada, Japan, France, Nicaragua, and Ecuador (which withdrew in 1968).

[5]Another factor responsible for flag transfers is the unused special allocations of member IATTC countries, in which additional legal fishing could take place.

SECTOR ANALYSIS

Following a historical perspective of the San Diego tuna industry, we are ready to examine its various components. This analysis will involve a review of each sector and the role it performs in the industry. In analyzing the impact of an industry on a local economy, employment is used as an indicator of growth.

Each sector will be analyzed in terms of employment which is in some way related to tuna. In those cases in which the company is engaged in pursuits besides tuna, only that portion of employment which can be attributed to the existence of the tuna industry will be included. Estimates on tuna-related employment have been made as a result of extensive interviews with various firms, fishermen, union representatives, research institutes and industry spokesmen. This project includes those firms that are directly involved in the accumulation and processing of the commodity, as well as the numerous businesses that participate through manufacturing, supplying and servicing the industry.

Fishermen

Fishermen comprise a significant share of the tuna industry's employment. It is difficult to get an accurate assessment of the number of tuna fishermen in San Diego. This is due in part to the employment practices of some of the vessels who are hiring some resident aliens. In addition, it is usually more profitable for bait boats to pick up crew members from Mexico while enroute to the fishing grounds, since they are paid on a per ton rather than a share basis. Consequently, aspiring local fishermen are having an increasingly difficult time securing employment aboard San Diego based tuna vessels. Such has not been the case for the key men, who are crucial determinants of how successful tuna boats will fare during their fishing expeditions. Since the fishing fleet has been expanding faster than the key personnel, there has developed a shortage of qualified captains, mates, masters, and engineers to fill these important positions.

Another variant inducing fluctuations in fishermen employment is the tuna boats' operating schedules. During the latter part of the year most tuna vessels return to base in order to get refurbished in preparation for the beginning of the open season in January.

Detailed statistical information on the number of commercial fishermen operating out of San Diego County is not available, since some are self-employed and others come into the area only on a seasonal basis. However, it is possible to closely estimate the number of fishermen covered by unemployment insurance[6]. This adjusted figure[7] includes those San Diegans employed on seiners and bait boats, although primarily on the former. A large majority of the fishermen on bait boats are from Mexico. A recently enacted Mexican law stipulates that at least 50 percent of the crew must be of native origin to fish in local waters, which is where the bait boats catch their bait for fishing.

The general industry consensus is that there are about 300 self-employed fishermen who are involved with the jig boat fleet. In addition, there is a fairly large contingent of San Diego fishermen who are employed on Puerto Rico-based vessels, and who are not included in the local unemployment insurance statistics. As the Puerto Rican fleet has expanded rapidly in recent years, so has the number of fishermen (primarily key men) hired from San Diego. A conservative estimate indicates the employment of San Diego resident fishermen aboard Puerto Rican vessels has risen from 250 persons in 1970 to 500 in 1975.

Canneries

There are two major canneries operating in San Diego: Sun Harbor Industries (SHI) and Van Camp. Van Camp's plant is relatively new, whereas SHI (formerly Westgate-California Foods, Inc.) has been operating for a number of years.

Sun Harbor Industries has the capacity to process 275 tons of medium size tuna per day. Unlike other southern California canneries, SHI has relied relatively little on imported tuna. Through 1969, more than 95 percent of her processing included tuna caught by U.S. flag vessels. This figure has recently fallen to between 70 and 80 percent, as the domestic fleet has been unable to fully supply her needs. In 1973, the cannery processed 53,000 tons of tuna of which 17,000 tons were supplied by foreign flag vessels.

Sun Harbor Industries' employment has been remarkably stable. The work force has fluctuated between 650 and 750 while averaging 700 employees over a 200-day annual production schedule that hasn't varied over 10 days in the past 10 years. The cannery's growth is reflected in terms of man-hours per worker. Whereas in 1965 the average employee worked a 6-hour day, this figure increased to 6.5 hours in 1970 and rose to 7.5 hours in 1975[8].

SHI's gradual growth and stability has been augmented by a quintupling of her refrigeration capacity. Since 1973, the cannery's cold storage capacity has increased from 800 to 4,000 tons. This has made it possible for greater stabilization of production schedules along with a reduction in time lost by tuna boats waiting to unload.

Van Camp, a subsidiary of Ralston Purina, completed a $25 million cannery which became operational in June 1976. Due to the magnitude of such a facility, it is pertinent to analyze its economic impact and the reasons for its relocation.

First, we will explore why Van Camp decided to partially abandon its Terminal Island plant in favor of constructing a brand new cannery in San Diego. In order to discover some of the factors involved in this move, interviews were conducted with people from

[6]Preliminary figures are from California Employment Payrolls, Employment Data and Research, Employment Development Department, San Diego, Calif. These figures do not include the self-employed.

[7]Unemployment insurance data were adjusted to account for reporting differences, since a number of tuna boats report employment only when they return with the catch. This tends to distort the annual figures, since in certain months (particularly January and February) the reported employment data considerably understate the number of fishermen who are actually employed.

[8]Sun Harbor Industries' employment trends are analyzed in this study using 7.5 hours as a full working day.

all facets of the industry. Some of the reasons given for Van Camp relocating to San Diego include the following:

1) Present facility very old and in need of extensive refurbishing, 2) very costly to meet Terminal Island's environmental pollution standards, 3) crowded harbor conditions in San Pedro, 4) Terminal Island's lack of space for cannery expansion, 5) majority of fleet based in San Diego, 6) San Diego somewhat closer to fishing grounds, 7) favorable price break on new cannery lease arrangements, 8) less expensive water and utility charges in San Diego, and 9) closer proximity to potentially large supply of tuna from Mexico.

Van Camp's plant has the capacity to process approximately 500 tons of raw tuna daily. Future expansion is possible and its processing capability could be increased to 675 tons per day, which is more than twice the production capacity of Sun Harbor Industries. Like its smaller competitor, the Van Camp facility also produces canned pet food, fish meal, oil, and solubles as by-products. The cannery has cold storage capacity of about 7,000 tons, which should help stabilize production.

It is estimated that upwards of 1,600 persons will be employed in two shifts when the cannery reaches full production. This would include 1,525 employees directly involved in tuna processing along with 75 administrative and office staff positions. In addition, about 100 people are employed in their can manufacturing plant (Daniel, Mann, Johnson, & Mendenhall, 1973).

Although we can closely approximate the number of employees at Van Camp, it is important to estimate the number of jobs that will be created for persons currently residing in San Diego. The number of Van Camp employees who transferred from the Terminal Island facility to the San Diego plant included 164 production workers in addition to 25 administrative and office personnel. This leaves approximately 1,500 positions to be filled by the domestic population including green card workers. The latter presently account for 122 of the 867 current employees. In addition, a number of new service industry jobs will develop in San Diego as a result of the increase in personal income generated by the Van Camp positions.

There is also a small noncommercial processing plant operated by the Mormon church. However, this facility does not sell tuna publicly; it distributes canned tuna to church members who are in need. The cannery "employs" anywhere from 40 to 100 workers who produce between 3,000 and 10,000 cans of tuna daily. The plant's employees who work here in addition to their regular jobs are paid in terms of work receipts, which entitles them to receive free tuna along with other food items from the church if they ever become sick or needy (Anonymous, 1975).

Tuna Boat Building and Repair

The construction and repair of tuna boats is a major component of the tuna industry. Campbell Industries and its subsidiary, San Diego Marine Construction, are recognized for their tuna seiners as well as for their vessel repair and maintenance facilities. In 1970, these two companies entered the superseiner market in earnest when the advantages of fast, efficient, large capacity tuna vessels became apparent. The trend has been toward increasingly larger boats in excess of 1,100 tons capacity with speeds of over 16 knots that are capable of traveling anywhere in the world.

Campbell Industries and San Diego Marine began building superseiners at an increasingly rapid pace between 1970 and 1975. During this period these companies completed 30 tuna vessels, which added 36,400 tons of fish-carrying capacity to fishing fleets in the CYRA. Although the local shipyards were involved in considerable tuna boat building during this period, it was followed by a sharp curtailment in such activity. The slowdown in tuna seiner construction could be attributed to several factors: 1) Realization of overcapacity of the fleet; 2) mounting costs of vessel construction; 3) increased operating costs, especially fuel; and 4) potential cost impact with implementation of 200 mile limit.

It is difficult to assess accurately the employment breakdown between vessel construction and repair. This is due to the high degree of overlap in manpower between these two operations. It is apparent that the emphasis on tuna boat repair and maintenance is greatest during the last 2-3 months of the year, when the boats are preparing for the start of the open season. The initial 9 months of the year would tend to emphasize vessel construction, especially during the beginning of the year when the open season is in progress.

National Steel & Shipbuilding Company (NASSCO) and Harbor Boat & Yacht Company are also involved in the construction and repair of tuna vessels. In recent years, their operations have emphasized the repair and maintenance of seiners and bait boats. The participation of NASSCO and Harbor Boat in this phase of the tuna industry is relatively insignificant compared to that of Campbell Industries and San Diego Marine.

Ship Chandlery

The chandlery phase of the tuna industry supplies the domestic as well as foreign tuna fleets with a broad array of merchandise ranging from paper goods and hardware to netting and compressors. With the exception of locally manufactured fiberglass chase boats and a metal lubricant (WD-40), the numerous chandlery items are produced elsewhere. The three primary ship chandlery firms include: Nuttall-Styris, San Diego Marine Hardware, and Kettenburg Marine. The latter primarily serves the jig and bait boats, while the others supply more than 95 percent of the high-seas tuna fleet.

Ship chandlery activity in San Diego has grown steadily in recent years, due in part to the rapid growth of the tuna fleet. Because of the slowdown in fleet expansion, the chandlery business has leveled off in employment and revenue. The present fleet will likely require sufficient service so as not to warrant a reduction in employment.

Seine Skiffs

The seine skiff, which rests on the stern of the seiner, is used to set the ¾-mile-long purse seine. Mauricio & Sons of San Diego is recognized worldwide for their manufacture of

these skiffs. More than 270 of the craft are being used by foreign tuna fleets. Approximately half of the company's employment involves the building and repair of seine skiffs.

Electronic Equipment

The electronics field has had a major impact on the tuna industry since innovations have accompanied the rapid expansion of the fleet. Improved radio comminications equipment, radar, and depth sounders have done much to increase the efficiency of tuna vessels through enhancing inter-vessel communication and in locating schools of fish. Satellite navigation receivers integrated with on-board computers is the latest electronic device utilized in improving the efficiency of purse seiners.

There are approximately 12 firms involved in this sector of the industry. Marine Electric, the largest company, engages in the sales, installation, and repair of electronic equipment for about 95 percent of the superseiners and a few of the bait boats. The firm's employment has increased steadily with the tremendous expansion in fleet capacity, since each new purse seiner utilizes about $150,000 worth of electronic equipment.

Customhouse Brokers

Shreve and Hayes was the only customhouse broker in the San Diego area until Barbara Olson, Inc. recently entered the field. The broker's duties involve vessel documentation and the preparation of custom papers for tuna boats upon returning to port. In addition, Shreve and Hayes supplies the fleet with tax-free cigarettes and liquor. The whole operation includes only a small contingent of workers who handle steamers and freighters as well as tuna boats.

Marine Insurance

The marine underwriter's insurance business has been a declining segment of the industry. This is due in large measure to the recent consolidation in the ownership of the fleet. Increased cannery control of the tuna boats has resulted in a gradual decline in the number of insurance brokers needed to service the fleet.

Food

The local tuna fleet secures its food products from a number of different sources. The major supplier of food items is San Diego Famous Market, which serves approximately 60 percent of the high seas fleet. This firm deals exclusively with tuna boats and provides them with a wide array of food and meat products. The average purse seiner requires about $8,000 worth of food items for a 50-day trip. The food supply business is another area utilizing relatively few personnel.

Fuel

Fuel represents the tuna boats' highest operating expense aside from the crew members. Fuel, which more than doubled in price between 1973 and 1975, is supplied by the major oil companies that have set up distribution terminals in and around the Embarcadero and Shelter Island. In addition to supplying tuna vessels, these distributorships supply pleasure craft and commercial boats. Fuel delivery is a highly capital intensive business which requires little in the way of manpower. Only a few office staff, drivers, and personnel to operate the pumps are involved.

Salt

The Western Salt Company supplies the local fleet with two kinds of salt. Bulk salt is delivered by pneumatic unloading trucks, which deposit the commodity directly into the seiner's wells. Standard sack salt is also distributed to the vessels. While tuna boats constitute a relatively large share of Western Salt's business, the company's employment would vary little if the tuna industry ceased to exist. This is due in part to the production process, whereby manpower varies little with respect to changes in output. In addition, the product's numerous uses result in its distribution to many different consumers.

Unloaders

There has been a growing tendency for boat owners to hire unloaders to manage the relatively arduous task of unloading the catch. In earlier days, the tuna boats relied heavily on crew members for this purpose. The unloaders not only service the local tuna boats, but also those in Terminal Island as well, since a large contingent of them are transported there daily by trucks from San Diego. The employment of unloaders has risen rapidly in recent years.

Netters

The netters are individuals hired on a temporary basis to help repair the purse seines when the tuna boats are in port. The work is seasonal—usually at the end of the year when most of the vessels are in the process of getting refurbished. A fairly large number of people, many of whom are former fishermen, participate in mending nets.

Green Card Workers

Green card workers (GCW) are Mexican aliens who have obtained permits to work in the United States. Evolution of their use came about as a result of shortages of domestic workers in certain occupations. They are presently occupying some industry positions at a time when domestic unemployment is about 10 percent.

Green card workers are most prevalent within the cannery operations, in which they account for approximately 20 percent of the labor force. The participation of GCW as fishermen is limited, although there are a considerable number of Mexican nationals in the bait boat fleet due to the recently enacted Mexican law.

There are few green card workers in tuna boat construction and repair. This is because most of the shipyards' positions require a minimum level of competency which is usually attained through vocational training not available to the GCW. Although GCW involvement in the rest of the tuna industry is only nominal, their presence as cannery workers alone influences the composition of local employment in the industry.

AN INDUSTRY ANALYSIS

Following an analysis of the various sectors of the tuna industry, it is imperative that we examine the industry as a whole. Throughout this study, employment has served as a proxy for

Table 2.—San Diego tuna industry employment estimates, 1965-75[1].

Sector	1965	1970	1971	1972	1973	1974	1975
Cannery	560	607	620	640	660	680	700
Customhouse brokers	5	6	6	6	6	6	7
Electronic equipment	12	17	20	23	28	32	34
Fishermen	1,176	1,360	1,351	1,358	1,545	1,633	1,685
Food	8	8	8	9	9	12	12
Fuel	9	10	11	12	13	14	15
Marine insurance	10	10	9	8	7	6	5
Misc. supplies and services	N.A.	39	40	42	47	49	55
Netters	10	10	11	12	13	14	15
Salt	3	3	3	3	4	4	4
Ship chandlery	N.A.	70	72	75	78	81	83
Skiffs	13	13	14	17	20	23	26
Tuna boat building repair and maintenance	N.A	1,509	1,721	1,303	1,749	1,404	1,619
Unloaders	6	30	40	50	60	70	80
Total tuna-related employment		3,692	4,126	3,558	4,239	4,028	4,351
County employment	272,100	387,100	398,000	421,900	451,400	464,700	469,500
Tuna-related employment / S.D. County employment		0.95%	1.04%	0.84%	0.94%	0.87%	0.93%

[1]Estimates herein on tuna-related employment trends are based on extensive interviews with company representatives and industry spokesmen

Table 3.—Tuna-related employment, tuna landings, and fish carrying capacity[1].

Year	San Diego employment	International fleet capacity (tons)	San Diego fleet capacity (tons)	San Diego tuna landings (tons)
1969	—	62,197	31,750	30,556
1970	3692	72,176	36,551	34,557
1971	4126	95,297	43,432	32,061
1972	3558	115,637	40,886	35,720
1973	4239	136,958	52,731	31,533
1974	4028	152,508	52,840	36,964
1975	4351	—	—	—

[1]Fleet capacity data obtained from scientists of the National Marine Fisheries Service, Southwest Fisheries Center, La Jolla, Calif. San Diego tuna landings data were received through consultation with Leo Pinkas, Department of Fish and Game, Terminal Island, Calif., and from Fish Bulletin 161, The Resources Agency, Department of Fish and Game, California Marine Fish Landings for 1972, Marine Resources Region, 1972.

growth in the tuna business, inasmuch as revenue figures were unavailable. The employment trends in the various phases of the industry are depicted in Table 2. From this table we can make several observations: 1) There was growth in tuna-related employment from 1970 to 1975; 2) approximately 90 percent of the industry's employment is concentrated in three major sectors (tuna boat building and repair, cannery workers, and fishermen); 3) employment has been steadily increasing in all major sectors except vessel construction and repair, which has fluctuated considerably; and 4) while tuna-related employment has been increasing, it remains relatively insignificant compared to total county employment—amounting to slightly less than 1 percent.

It is important to examine those factors which may have contributed to employment growth in the tuna industry. Table 3 includes annual data in tuna-related employment, tuna landings, and the fish carrying capacities of the San Diego and International fleets within the CYRA.

The regression of employment (E) on tuna landings (TL), lagged one year, yields the following linear equation which is depicted in Figure 1:

$$E_t = 536 + 0.103\ TL_{t-1} \quad (3.158)$$

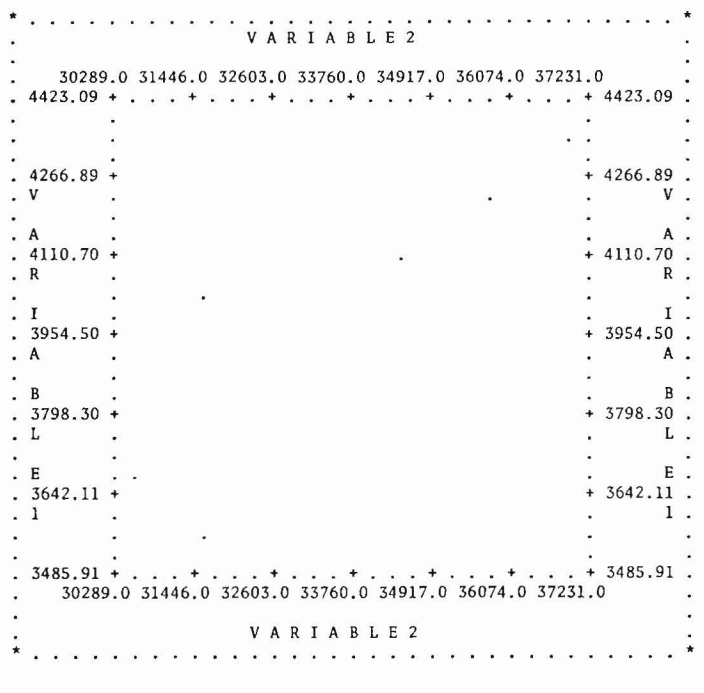
$$SEE = 86.74$$

$$R = 0.845$$

$$R^2 = 0.714$$

The results indicate that the correlation is significant at 5 percent but not at the 2 percent level. Therefore, tuna landings have some impact on tuna-related employment. The equation indicates that if tuna landings increase by 10 tons then employment will rise by an average of one person. Consequently, employment in the San Diego tuna industry stands to benefit from an increase in tuna landings through adding more cannery facilities, such as the new Van Camp plant. However, since the yellowfin catch has reached the estimated maximum sustainable yield in the CYRA, the need for additional cannery facilities in the industry as a whole will depend largely on increases in the

Figure 1.—Employment (Variable 1) and tuna landings (Variable 2).



skipjack catch. Therefore, employment gains in the local economy due to additional processing capacity may be partially offset by losses in other regions.

It is pertinent to measure the tuna industry's ability to generate employment or growth in other sectors of the economy. Using a San Diego County input-output model, employment multipliers were derived to estimate the number of jobs created in other sectors of the economy due to the existence of the local fishing industry (Copely International Corporation, 1976).

The employment multipliers of the major components of the fishing industry are as follows: Vessel construction, 1.206; canneries, 1.391; fisherman, 1.594. For the remaining sectors an employment multiplier of 1.4 is used as an estimate. The direct and indirect employment generated by the San Diego tuna industry is approximately 8,260. This estimated employment figure includes the 1,511 positions created by the Van Camp cannery as well as 665 additional jobs generated in other industries by the new facility.

FLEET CAPACITY

The rapid expansion of the international fleet in the CYRA in recent years has reduced the length of the open season, since the quota has been reached earlier despite its gradual increase. Table 4 manifests the relationship between international fleet capacity, the quota, and the length of the open season.

Since catch per standard day's fishing is greatest during the nonregulated season, as the open season is reduced a larger portion of the year involves regulated fishing. During the closed season, fishing is less efficient since operating outside of the line for yellowfin tuna or inside of it for skipjack tuna is more costly in terms of both time and vessel expense.

It is evident that if fleet capacity is reduced, the open season would be lengthened, and the tuna could be captured by a smaller fleet over a greater period of time. This would reduce economic waste manifested through costs incurred in excessive vessel construction and operation. In addition, it would tend to bring the resource to the canneries in a more even fashion, thereby decreasing tuna losses due to refrigeration as well as lessening unloading time. However, as long as a "first-come, first-served" quota system exists, there is little likelihood of a reduction in fleet capacity.

Table 4.—International fleet capacity, the quota, and the length of the open season[1].

Year	International fleet capacity (tons)	Quota (tons)	Length of open season (days)
1966	46,096	79,300	243
1967	45,973	84,500	175
1968	57,787	106,000	170
1969	62,219	120,000	106
1970	72,613	120,000	82
1971	95,229	120,000	99
1972	115,737	140,000	65
1973	138,152	160,000	67
1974	152,618	175,000	77
1975	169,300	175,000	72

[1]IATTC Annual Reports, 1966-74.

SUMMARY

The San Diego tuna industry represents an important entity in the local economy. It provides jobs not only in the catching of fish, but also in tuna boat building and repair, canning, and in the manufacture and distribution of numerous supplies and services.

The local tuna industry has grown steadily in recent years, as manifested by its overall increase in employment. However, when viewed within the context of the local economy, it accounts for a relatively small share of industrial activity. Although its size in terms of employment is insignificant, if revenue data were available, it is likely that the relative importance of the San Diego tuna industry would be somewhat magnified.

In the near future, the tuna industry's employment can be expected to stabilize, as the catch of the tuna resource appears on the verge of reaching its maximum sustainable yield. This study's analytical results indicate that growth in local tuna-related employment would occur through an expansion in tuna landings, which can be brought about by augmenting local processing capacity.

LITERATURE CITED

Anonymous. 1975. The cannery that never sells a tin of tuna. The Fish Boat 20(5):33-34.

Copely International Corporation. 1976. San Diego County input-output models, the Union-Tribune index: a monthly summary of San Diego business activity, December 1976.

Daniel, Mann, Johnson, and Mendenhall. 1973. Final environmental impact statement for the proposed Van Camp tuna cannery at the Tenth Avenue marine terminal, San Diego, California. San Diego Unified Port District, October 1973.

Inter-American Tropical Tuna Commission. 1965-1975. Annual reports of the Inter-American Tropical Tuna Commission, 1964-74. La Jolla, Calif. Various pagination.

McNeely, R. L. 1961. Purse seine revolution in tuna fishing. Pac. Fisherman, June 1961:27-58.

Pinkas, L. 1974. California marine fish landings for 1972. Fish. Bull. 161, Calif. Dep. Fish Game, 53 p.

Saila, S. B., and V. J. Norton. 1974. Tuna: status, trends and alternative management arrangement. Resources for the Future, Wash., D.C. June 1974. Paper 6 in a series prepared for the Program of International Studies of Fishery Arrangements, 59 p.

REFERENCES

Broadhead, G. C., and C. J. Peckham. 1974. The potential economic impact of a 200-mile fishery zone of the United States fisheries for tuna, shrimp and salmon. Living Marine Resources, Inc., June 1974.

Economic Development Research Program. 1969. An updating of original 1966 study —commercial fishery potentials of San Diego County. Economic Research Bureau of San Diego, August 1969.

Forbes, Stevenson, and Baldridge. 1969. Feasibility study: a tuna transhipment plan in San Diego and other ocean-oriented facilities. U.S. Dep. Commer. Prepared for the Economic Development Administration, May 1969.

Forbes, Stevenson & Co. 1966. Economic development research program part II. Commercial fishery potentials of San Diego County. Prepared for the Economic Research Bureau of San Diego, 1966.

Howard, G. V. 1962. Tuna Harvest. Fish. News Int. 1(3):22-29.

MFR Paper 1313. From Marine Fisheries Review, *Vol. 40, No. 7, July 1978. Copies of this paper, in limited numbers, are available from D822, User Services Branch, Environmental Science Information Center, NOAA, Rockville, MD 20852. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*