# EXPERIMENTAL SABLEFISH FISHING OFF SAN DIEGO, CALIFORNIA

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We feel that our results showing such high sablefish populations in the deep waters off this area are well worthy of the commercial fisherman's attention. Much interest in this work has been shown here, not only by oceanographers at Scripps and at the Bureau of Commercial Fisheries, but by a number of commercial fishermen on the coast.

We have found free-vehicle gear to be remarkably successful in fishing these deep bottom fish. We feel that commercial fishermen everywhere should be aware of its usefulness. The technique allows great flexibility. It can be used to catch deep-water fish anywhere in the world.

Free-vehicle fishing techniques have been modified and tested successfully in a survey of the benthopelagic sablefish, Anoplopoma fimbria, off San Diego and the offshore islands. Plastic elliptical traps have been placed in series on vertical set lines with or without hooks. Short-term releases (3-4 hours) can be as effective as longer-term releases (8-14 hours) in areas with high populations of fish. Sablefish numbers were extensive in almost all areas monitored between depths of 250 and 500 fathoms; maximum yields were obtained at 500 fathoms. The average hookline yield from all stations was 0.24 fish per hook (range: 0.00-0.75 fish per hook); the average trap yield from all stations was 4.4 fish per trap (range: 0-12 fish per trap).

Our results provide evidence that sablefish populations are extensive off San Diego and the offshore islands. These fish represent an underfished resource in this area. We feel that they can be fished economically through some form of free-vehicle technique.

The sablefish (or black cod, seatrout, skilfish, beshow, coalfish, butterfish, candlefish), Anoplopoma fimbria, has been fished commercially by civilized man on the western coast of North America since the middle of the nineteenth century (Pacific Marine Fisheries Commission, 1954). The fishery, extending from Southern California (Newport Beach) to Alaska, has mostly been a secondary product of the Pacific coast halibut fishery, along with ling cod (Ophiodon elongatus) and red cod (Sebastodes ruberrimus). It is of special importance during the winter closed season for halibut (Thompson, 1941). It is fished by longline gear and otter or balloon trawls (Phillips, 1958).

The sablefish market is mostly for fish in the smoked or kippered form. The market for fresh fish is limited because the flesh is quite oily. According to Dolev and Olcutt (1965), sablefish oil is highly stable (no detectable rancidity at 50° C. over five months). The triglycerides are characterized by less polyunsaturated fatty acids than most marine

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oils. Smaller sablefish often are filleted and sold fresh; larger ones are frozen and smoked. As early as 1910, the smoked form of these fish was marketed as barbecued Alaska black cod, a very popular restaurant item. Sablefish was the most important smoked fish product prepared in California in the 1930s; all of it was produced in San Francisco (Croker, 1936). The salted product was especially useful in the sale of beer in saloons.

## Collected In 100-800 Fathoms

Sablefish are most commonly collected by Scripps Institution of Oceanography ichthyologists off San Diego between depths of 100 and 800 fathoms. They are a common benthopelagic fish in this area (Marine Vertebrate Cruise Data, Scripps Institution of Oceanography). They have been photographed as deep as 656 fathoms by the Marine Life Research Group at Scripps (Walter Schmidt, personal communication) on the San Clemente rift slope. Phillips (1958) gives 200-400 fathoms as the depth range during winter and early spring spawning season. After spawning, the fish are found in shallower depths, about 100-175 fathoms. The most extensive surface run of these deep-dwelling fish occurred in the region of the municipal pier in Monterey, California, where fishermen landed about 110 tons from the pier during 15 days (Cox, 1948). Sablefish eggs are pelagic and free floating and have been collected near the surface (Clemens and Wilby, 1946). The larvae and young are also collected near the surface as well as farther out to sea than is expected from the adult distribution. Brock (1940) describes morphological differences between the young and adults. He speculates that the large pectoral fins in the young (about one-third the body length) might aid in flotation. They reduce to one-tenth the body length in the adult.

Extensive intermingling of sablefish stock off North America does not occur (Pacific Marine Fisheries Commission, 1954). Tagging data demonstrate that most fish do not migrate more than 30 miles from the point of release. There are at least four major stocks on the Pacific coast which do not intermingle to any significant extent.

## Sablefish Trawl Landings

According to Orcutt (1969), annual sablefish trawl landings in California of recent years have averaged slightly more than 2,000,000 lbs. Total California landings of sablefish between 1963 and 1967, and the mean price per lb. during these years, are shown in Table 1. Orcutt states that this resource could stand harvest of at least four to five million pounds more each year. Interestingly enough, the fishery has never extended to San Diego; reports often give the southern limit as north of San Diego. Generally, it is thought to extend from northern Baja California to the Bering Sea, with a greater concentration in the northern part of the range. The fish are not abundant south of Monterey, California (Phillips, 1958).

Table 1 - Sablefish landings and shipments, 1963-1967, landings in lbs. round weight. (From California Department of Fish and Game, Bulls. Nos. 129, 132, 135, 138, 144.)

| | | | | | |
|---|---|---|---|---|---|
| Eureka | 637,937 | 1,136,677 | 1,554,968 | 1,588,892 | 2,300,577 |
| San Francisco | 840,564 | 826,330 | 683,292 | 1,031,522 | 474,786 |
| Monterey | 271,226 | 410,717 | 570,905 | 593,831 | 1,021,201 |
| Santa Barbara | 57,436 | 88,215 | 53,140 | 1,658 | 1,610 |
| Los Angeles | 348 | 926 | 1,245 | 16 | -0- |
| San Diego | 1,838 | 587 | -0- | 20 | -0- |
| Total | 1,809,349 | 2,463,452 | 2,863,550 | 3,215,939 | 3,798,493 |
| Mean Price Per lb. | .054 | .066 | .070 | .072 | .083 |

## METHODS AND MATERIALS

The free-vehicle fishing technique that we have used in this study is illustrated in Fig. 1. The term free-vehicle means that the fishing gear is completely released from the fishing vessel, whereupon it sinks and rests upon the bottom to attract fish for a variable length of time. After this time, a release mechanism breaks the connection between the fishing assembly and weights, and the gear floats back to the surface leaving the weights on the bottom. It may be located by a number of techniques, including radios, radar screens, bright flags, and blinking lights.

Launching is best accomplished by trailing the gear out behind the boat, which moves

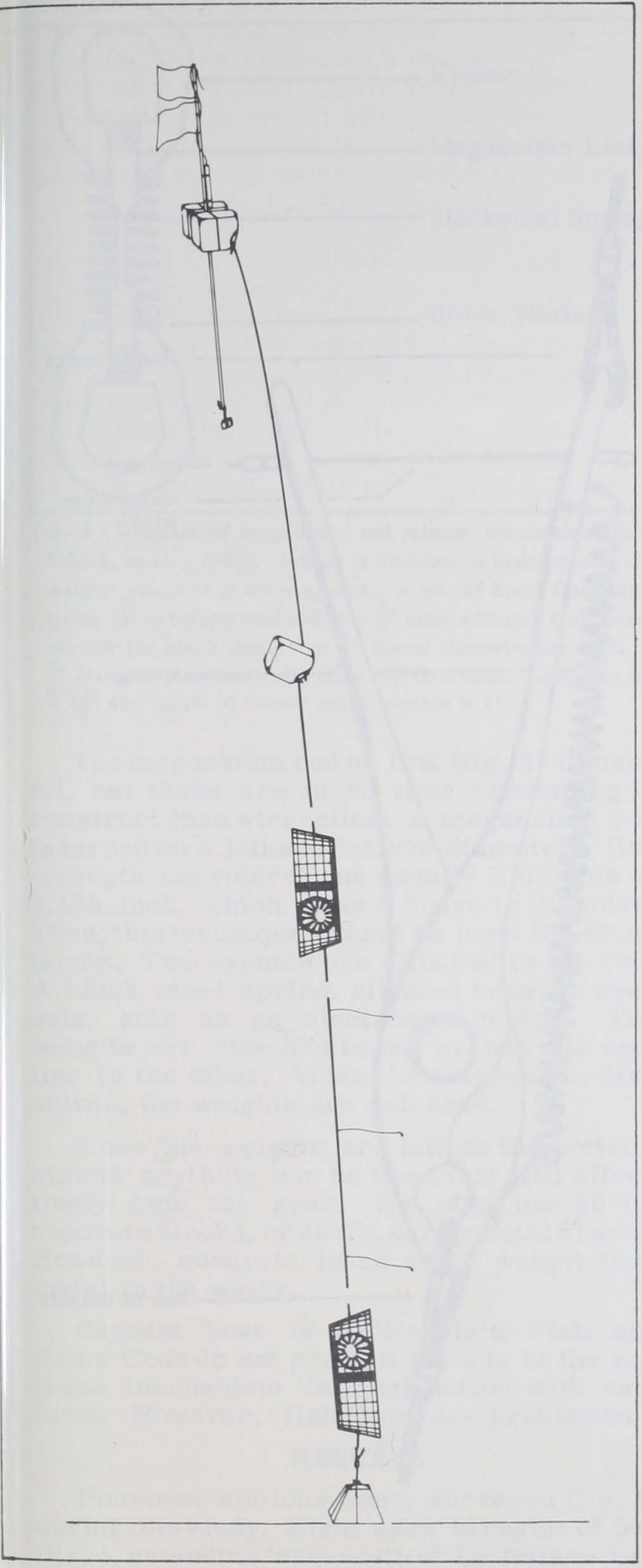


Fig. 1 - Free vehicle fishing gear; schematic diagram. Top shows plastic mast supported by isopar-filled jerry jugs with radio and flags. Fifty feet of handling line connects to secondary float, below which are traps and setline. Free vehicle is held on the bottom by a 60 lb. weight. The release is located between the lower trap and weight.

ahead at a slow speed. Floats and mast are placed in the water first, after which the secondary float, hookline and/or traps are paid out. Finally, the release device and weights are dropped in, and the whole assembly then sinks to the bottom.

The mast assembly includes a mast, bright flags, stabilizing weight, floats, and radio plus antenna. The mast itself consists of a 12-foot length of plastic pipe, one inch in diameter. We have found that plastic is much less subject to breakage than wood, and it is less expensive than hollow metal tubes that have been used. The flags, usually bright yellow or international orange, are attached near the top of the mast. The stabilizing weight, 4 pounds of lead, is attached at the bottom of the mast to help keep it upright while floating at the surface. Two floats are clamped to the mast at its center point. Further stabilization of the mast assembly is achieved by clamping the floats tightly. This aids in equipment recovery since the mast stands erect in the water. Previous experience with loosely attached floats caused problems, despite the pressure of a stabilizing weight, because the mast would not be upright in the water. In strong winds and heavy seas, mast assemblies would lie almost horizontal in the water, making visual sighting nearly impossible.

## The Float

A float consists of a plastic 5-gallon carboy container filled with a lightweight oil. Isopar-M, a vehicle oil manufactured by Humble Oil and Refining Co., has been used successfully. A single 5-gallon container provides 11 lbs. of buoyancy at the surface. It is an odorless, relatively high boiling (172° F.), isoparaffinic solvent, with unusually low skin-irritation effects. Spillage on clothes leaves no stain mark. Compressibility data (tabulated at 32° F.) show a decrease in volume of 1.2% at 2,000 p.s.i. and 5.5% at 10,000 p.s.i. Cost is \$0.23 per gallon from a tank car, and \$0.62 per gallon if ordered in a 55-gallon drum. We feel that Isopar-M is preferable to gasoline as a float material because fammability is reduced. If gasoline is used, occasional leaks in floats while operating in rough seas can be very hazardous.

The return of the free vehicle to the surface is signaled by a one-watt radio transmitter. This radio operating at citizen band frequencies (27 mega-hertz) is able to transmit its signal up to 10 miles. Since the radio is coupled to a pressure-activated switch, battery power is conserved, and the radio may operate for a day or longer. The free vehicle is located with a radio direction finder (RDF). Standard RDF units are not able to sense a direction because of their power and frequency. A high-sensitivity portable unit, or a large directional citizens band antenna, must be used.

A handling line (50 ft. long) is attached to the two floats, with a third float attached to the other end. This expedites hauling the mast assembly aboard before the fishing gear is encountered. The vertical set line is situated below the third float. This can consist of 30-60 hooks (8-0 or 9-0) spaced about 1- or 2-meter intervals on plastic leaders (a foot or 2 long), a hookline with a trap above and below hooks (see fig. 1), or a string of traps in series. We have used successfully 8 traps spaced at intervals of 8-10 feet.

## Elliptical Traps

Elliptical traps have proved excellent for catching fish and bottom creatures. These traps are manufactured by Fathoms Plus, a San Diego company, and have the following advantages over traditional metal lobster traps: (1) they are made of black plastic and so are impervious to water, rust, electrolysis, rot, and marine borers; (2) they can be rested in stable stacks to conserve space aboard boat; and (3) as organisms sense the bait, they constantly move closer to it from any direction. The trap is made from high-density polyethylene and measures 40" by 3" by 14". The bait containers (12" by 4.5") can be removed from traps and stored separately.

A release mechanism is located between bottom hook or trap and weights. We have used 2 types of releases made of magnesium: wire-plier and magnesium-rod.

The wire-plier type is excellent for short-term sets (3 to 5 hours). The pliers are suspended from set line (fig. 2), and a short piece of $\frac{1}{16}$" magnesium wire is clamped between the two handles. This keeps pliers shut, so the weights can be suspended from other end. When the wire dissolves, the pliers spring open--releasing the weights on the bottom. A spring insures that the pliers will open. The pliers are recovered and must be acid soaked or sanded after immersion to clean the metal surface; this acts as an electron acceptor.

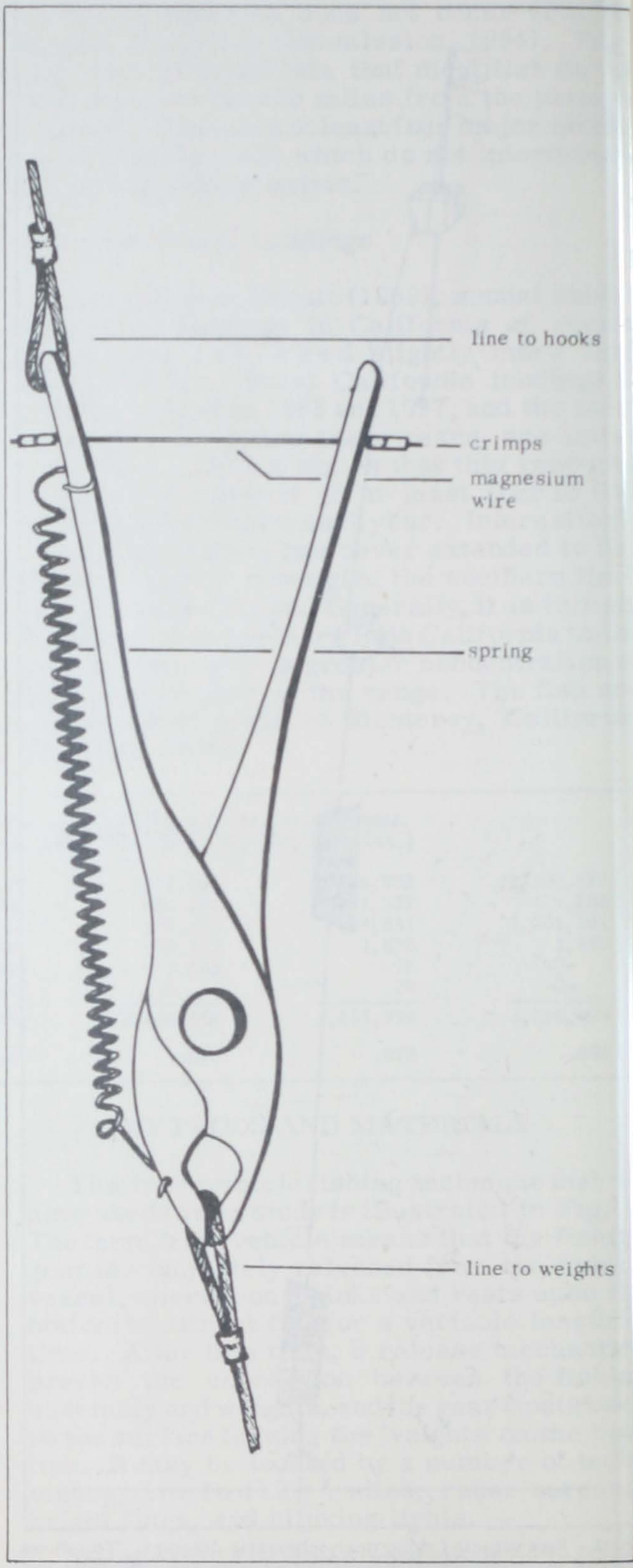



Fig. 2 - Scale diagram of wire-plier release mechanism. Magnesium wire is $\frac{1}{16}$ inch diameter. When it dissolves in seawater, the spring insures that the pliers will snap open to release the weights.

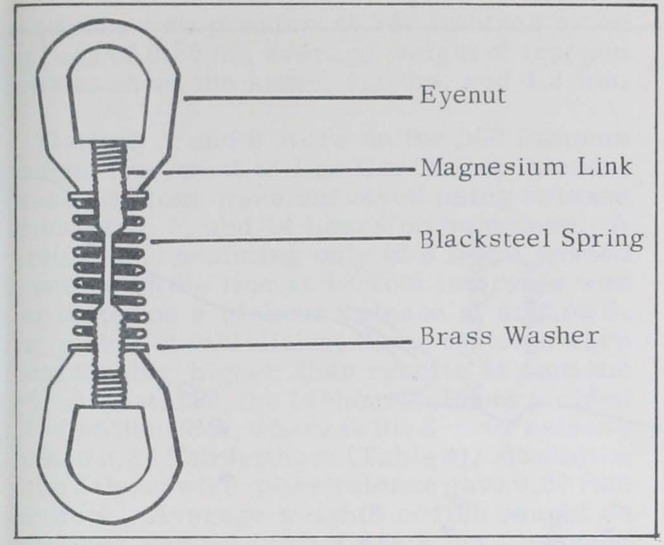



Fig. 3 - Diagram of magnesium rod release mechanism (from Schick, et al., 1968). Setline is attached to upper eyenut and weights attached to lower eyenut. A no. 68 black finish steel spring $1\frac{3}{4}$" length) is used with two $\frac{3}{8}$" brass washers. Galvanized eyenuts (or black steel) with $\frac{3}{8}$" thread diameter are used. A $\frac{3}{8}$" diameter magnesium rod alloy AZ31B is used. Length of rod is $2\frac{1}{2}$" and length of narrow center portion is 1".

The magnesium rod or link (fig. 3) is useful, but these are more time consuming to construct than wire-plier. A magnesium rod is turned on a lathe to desired diameter. Rod strength considerations usually limit this to 0.125 inch, which takes 8 hours to dissolve. Thus, this technique cannot be used for short terms. Two eyenuts are attached to the rod. A black steel spring, situated between eyenuts, acts as an electron acceptor. The weights are attached to one eyenut, the setline to the other. When the magnesium dissolves, the weights are released.

Since the weights are left on the bottom, almost anything can be used that will effectively sink the gear. We often use 80-lb. concrete blocks, or 40-lb. scrap metal blocks. However, concrete loses more weight than metal in the water.

Current laws of California's Fish and Game Code do not prohibit the use of the release mechanism in conjunction with setlines. However, fish traps are prohibited.

## RESULTS

Fourteen stations were surveyed (fig. 4) during this study. Eight were in region of San Diego, extending from north of La Jolla to Los Coronados Islands. Stations 9-11 were east of San Clemente Island; station 12 south of Santa Catalina Island; station 13 on San Juan seamount, about 200 miles west of San Diego; and station 14 was one-half mile east of north end of Guadalupe Island, Mexico. Three free vehicles were lowered at each station with varying amounts of hooks, traps, and bottom times. The depths surveyed ranged from 290 to 500 fathoms. Excepting San Juan seamount and Guadalupe Island, the only fish caught at all stations were sablefish.

Stations 1-4 were at 350 fathoms; no traps were used. The vertical set-lines (30 hooks per line) yielded more fish per hook the farther south the station was. The northernmost station (1) yielded 0.03 fish per hook; the southernmost station (4) 0.26 fish per hook (Table 2). The average weight also increased from north to south--from 2.5 lbs. to 4.4 lbs.--as did average standard length, 478 mm. to 600 mm.

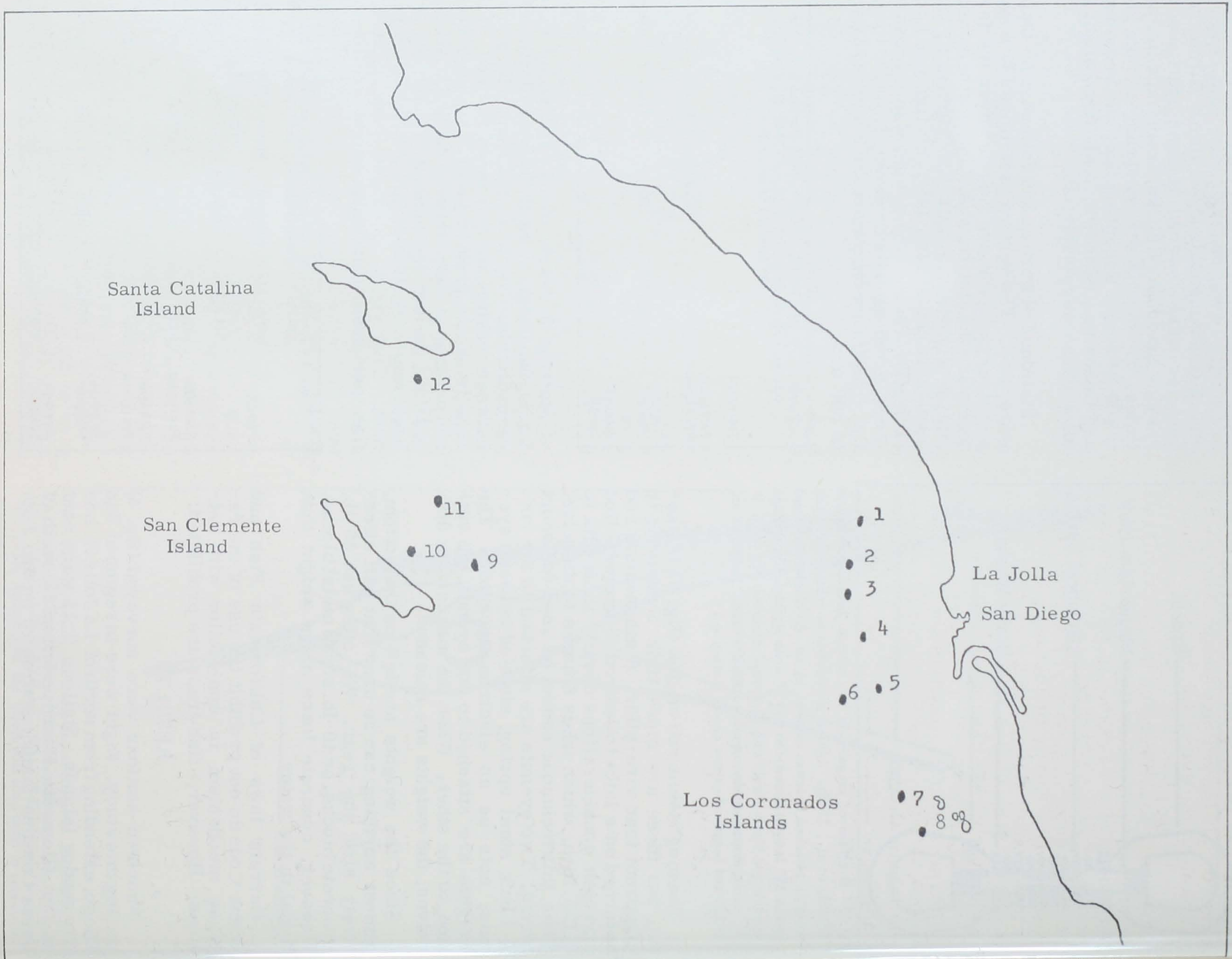
Table 2 - Vertical set line results from stations 1-4. These stations extend from 32°59' NL to 32°49' NL along the 350 fathoms contour line.

| Stations: | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Sablefish Per Hook: | 0.03 | 0.00 | 0.10 | 0.26 |
| Average Weight: | 2.5 lbs. | 0.00 | 2.6 | 4.4 |
| Average Length: | 478 mm. | 0 | 523 | 600 |

Stations 5 and 6, at 32° 42' NL off Point Loma, San Diego, were at 290 and 340 fathoms, respectively. Vertical set lines with a trap between hookline and release were used. The results show a greater yield of fish per hook and per trap at 340 fathoms (Table 3). At 290 fathoms, the average number of sablefish per hook was 0.10; at 340 fathoms, 0.37 fish per hook. Trap yields increased from 1.7 to 2.2 fish per trap. Although weight of fish on

Table 3 - Results from stations 5 and 6; both situated at 32°42' NL off Point Loma, San Diego.

| | Station 5 (290 fathoms) | | Station 6 (340 fathoms) | |
|---|---|---|---|---|
| | Vertical Set Lines | Traps | Vertical Set Lines | Traps |
| Sablefish Per Hook: | 0.10 | | 0.37 | |
| Sablefish Per Trap: | | 1.7 | | 2.2 |
| Average Weight: | 3.75 lbs. | 4.3 lbs. | 4.5 lbs. | 4.2 lbs. |
| Average Length: | 489 mm. | 537 mm. | 539 mm. | 538 mm. |




... San Juan Seamount (sta. 13, 500 fathoms) and Guadelupe Island (sta. 14, 500 fathoms).

hooklines was greater at 340 fathoms by an average of 0.25 lb., average weight of trapped fish was about the same, 4.3 lbs. and 4.2 lbs.

Stations 7 and 8 were on the 500 fathoms contour line, west of Los Coronados Islands. These stations were surveyed using release times of 3, 8, and 14 hours on hooklines. A vertical set consisting only of 8 traps spaced in series on the line at 10-foot intervals was also tested on a 14-hour release at station 8. The yields of sablefish at these stations were considerably higher than results at stations 1-6. At station 8, the 14-hour release yielded 0.75 fish per hook, whereas the 8-hour release yielded 0.44 fish per hook (Table 4). At station 7, the 3-hour wire-plier release gave 0.67 fish per hook. Average weights of fish caught on hooklines ranged from 4.4-4.8 lbs., average standard lengths from 531 mm. to 559 mm.

Table 4 - Results from two stations west of the Los Coronados Islands, situated at 500 fathoms. At station 7, eight traps in series were used on a line rather than usual set-line plus combination.

| | Station 7 | Station 8 | | |
|---|---|---|---|---|
| | Vertical Set Lines | Vertical Set Lines | Vertical Set Lines | Traps (8) |
| Release Time: | 3 hrs. | 8 hrs. | 14 hrs. | 14 hrs. |
| Sablefish Per Hook: | 0.67 | 0.44 | 0.75 | |
| Sablefish Per Trap: | | | | 5.3 |
| Average Weight: | 4.8 lbs. | 4.8 | 4.4 | 5.4 |
| Average Length: | 538 mm. | 559 | 531 | 586 |

Fish in the traps had a larger average weight, 5.4 lbs., and average standard length, 586 mm. The average number of fish per trap was 5.3. The distribution of fish in the traps from bottom trap (No. 1) to top trap (No. 8) was: No. 1, 7 fish; No. 2, 11 fish; No. 3, 3 fish; No. 4, 3 fish; No. 5, 6 fish; No. 6, 5 fish; No. 7, 3 fish; No. 8, 4 fish. Although fish entered all traps, the greatest yields were in bottom two traps.

Stations 9, 10, and 11 were located east of San Clemente Island at 500 fathoms. These stations were surveyed using 8-, 3-, 3-hour releases, respectively. At the two short-term stations (10 and 11), one trap was between set-line and release. No traps were used on the set lines at station 9, but a string of 8 traps in series was used. At station 9, with 8-hour release, the set-lines yielded 0.64 fish per hook; average weight was 4.8 lbs. and average standard length 537 mm. (Table 5). The set-line yields at stations 10 and 11 with 3-hour releases were 0.13 and 0.07, respectively. The weights and standard lengths were similar to station 9. The bottom traps at stations 10 and 11 proved quite effective, in contrast with low hook line yields, with average of 8 and 5 fish per trap. The 8-trap series at station 9 averaged 3.1 fish per trap. The distribution of fish in traps from bottom (No. 1) to top (No. 8) was: No. 1, 4 fish; No. 2, 8 fish; No. 3, 3 fish; No. 4, 3 fish; No. 5, 4 fish; No. 6, 3 fish; No. 7, 1 fish; No. 8, 1 fish. More fish were caught in lower traps than in higher traps. In contrast to results at Los Coronados Islands, fish in traps did not have greater weight or length. Sixty of the sablefish caught on hooks or in traps were chosen at random for sexing: 19 were males, and 41 females (8 gravid).

Table 5 - Results from 3 stations located east of San Clemente Island at 500 fathoms. At stations 10 and 11, vertical set lines plus one bottom trap were used. At Station 9, an 8-trap combination was used in addition to vertical set lines.

| | Station 9 | | Station 10 | | Station 11 | |
|---|---|---|---|---|---|---|
| | Vertical Set Lines | Traps (8) | Vertical Set Lines | Traps (1) | Vertical Set Lines | Traps (1) |
| Release Time: | 8 hrs. | | 3 hrs. | | 3 hrs. | |
| Sablefish Per Hook: | 0.64 | | 0.13 | | 0.07 | |
| Sablefish Per Trap: | | 3.1 | | 8 | | 5 |
| Average Weight: | 4.8 lbs. | 4.5 lbs. | 5.5 lbs. | 4.5 lbs. | 4.3 lbs. | 4.5 |
| Average Length: | 537 mm. | 535 mm. | 565 mm. | 537 mm. | 514 mm. | 530 mm. |

Two vertical set-lines with 30 hooks--and one trapline with 3 traps spaced 5, 35, and 65 feet from the bottom on the line--were used at station 12, located at 500 fathoms south of Santa Catalina Island. The trap yield (5.7 fish per trap, Table 6) contrasted markedly with set-line yield (0.03 fish per hook). As usual, fewer fish were trapped at top of trap line. Four fish were trapped in lowest trap, 12 in middle trap, and one fish in top trap. At San Juan seamount, a single setline trap combination was used on a 3-hour release, where the trap was between hookline and release mechanism. Only one sablefish was caught on the set-line, while 2 were caught in traps (Table 6). Twelve Pacific rattails (Coryphaenoides acrolepis) were caught on hooks at this station. They were spread evenly between bottom and top hooks. The Guadalupe Island station, sampled at 500 fathoms, yielded one Pacific rattail on a hookline, and no sablefish.

Table 6 - Results from station 12, south of Santa Catalina Island at 500 fathoms, and station 13, on San Juan seamount at 500 fathoms.

| | Santa Catalina Island | | San Juan Seamount | |
|---|---|---|---|---|
| | Vertical Set Lines | Traps (3) | Vertical Set Lines | Trap (1) |
| Release Time: | 8 hrs. | 8 hrs. | 3 hrs. | 3 hrs. |
| Sablefish Per Hook: | 0.03 | | 0.03 | |
| Sablefish Per Trap: | | 5.7 | | 2.0 |
| Average Weight: | 4.5 lbs. | 4.4 lbs. | 9.0 lbs. | 13.0 |
| Average Length | 529 mm. | 535 mm. | 652 mm. | 728 mm. |

## DISCUSSION

A considerable sablefish population exists off San Diego and the offshore islands. It is interesting that only sablefish were caught at depths examined in this study, 290-500 fathoms. No other fish were encountered on the gear used; the exception was Pacific rattails at San Juan seamount and Guadalupe Island, which do not qualify as being anywhere near San Diego. The average yield on all hooklines lowered at stations 1-12 was 0.24 fish per hook. This figure is calculated without consideration of time on bottom, depth of capture, or geographical location. Maximum hook yields were obtained at stations 6-9 (0.37 to 0.75 fish per hook), located at 350 fathoms off Point Loma, San Diego, and at 500 fathoms off Los Coronados and San Clemente Islands. The average trap yield from all stations where traps were tested (stations 5, 6, and 8-12) was 4.4 fish per trap. This figure is calculated without respect to release time, position of traps on line, depth of capture, or geographical location. Maximum trap yields (5-8 fish per trap) were obtained at station 8 and 10-12. The majority of high trap yields did not occur at stations where high hook yields occurred.

### Small Fish

Sablefish caught in this study were small fish by comparison with northern populations. The Seattle, Washington, sablefish fishery defines a small fish as average weight of 6.5 lbs., and large fish as average weight of 12 lbs. Average weights of the San Diego sablefish usually were 4 to 5 lbs. At stations 4-12, average weights were 3.75 to 5.5 lbs. from both hooklines and traps. At stations 1-3, the yields were too low (0.03 and 0.10) to attach any significance to smaller average weights (2.5 and 2.6 lbs.). From a marketing standpoint, the fact that these fish are small might be an advantage because small fish can be sold fresh as well as smoked. Large fish usually are sold only in smoked form.

### Depth Important

Depth is probably a very important factor to consider in choosing the best area to fish for sablefish. Philipps (1958) gave the depth range as 200-400 fathoms, when the fish are not spawning, but this is for the northern fishery. We fished between 290 and 500 fathoms and found a maximum yield at 500 fathoms. Data collected off La Jolla and San Diego (Tables 2 and 3) show relatively low yields for 290-350 fathoms (0.00-0.37 fish per hook). The yield increases off San Diego from 290 fathoms (0.10 fish per hook and 1.7 fish per trap) to 340 fathoms (0.37 fish per hook and 2.2 fish per trap). The highest yields were obtained off Los Coronados Islands and San Clemente Island at 500 fathoms (0.64-0.75 fish per hook). These fish must congregate in deeper water the farther south they are found. We fished no deeper than 500 fathoms. Perhaps considerable aggregations will also be common at depths greater than 500 fathoms.

The release time can be varied considerably in free-vehicle fishing. This can be done to suit the fishermen's schedule, or it can be done to maximize yield as a function of time.

Our data from stations 7 and 8 (Table 4) serve to illustrate the latter point. At station 8, the yield was almost doubled with a 14-hour release (0.75 fish per hook) versus an 8-hour release (0.44 fish per hook). At station 7, however, an extremely high fish yield (0.67 fish per hook) was obtained in 3 hours. Three-hour release times did not give such high yields at stations 10 and 11, perhaps due to a more sparsely distributed fish population.

Although we only used 3-14 hour release times, there exist new devices that are quite accurate from 30 minutes to 30 days. An endless amount of flexibility is thus possible to the fisherman with an already tight schedule.

Elliptical Traps

The elliptical traps were built specifically to catch lobsters on the bottom. The fact that they successfully catch sablefish above the bottom proves they also work well as fish traps. At some stations, the traps functioned much better than the hooks. For instance, at station 12, off Santa Catalina Island, the hook yield was 0.03 fish per hook, whereas 3 traps spaced in series at the same station yielded 5.7 fish per trap. Twelve sablefish were caught in middle trap (35 feet off bottom), with an average weight of 4.4 lbs.--revealing the potential of free-vehicle trap fishing.

Traps have additional advantages. They provide a cage to protect the fish from predators. The blue shark (Prionace glanca) often fouls up hooklines at the surface, but it cannot eat fish in the traps. Sealions also enjoy eating sablefish off the hooklines. Traps might be best for especially long release times (greater than one day) because fish seem to live longer in the traps than on the hooks. More living fish are present in the traps than on the hooklines when hauled aboard the ship. For long bottom times, an automatic bait delivery device can be built to provide a continual fish lure, perhaps used together with blinking underwater lights.

Large traps (25' by 25' by 25', or bigger) can be constructed of plastic and left on the bottom for a week or more--or these can be timed to return to surface whenever fisherman is conveniently in area.

Free-Vehicle Fishing

Free-vehicle fishing can be profitable. Hookline and trapline data obtained in this study may be extrapolated to illustrate. At station 7, for instance, 0.67 fish per hook was obtained on a 3-hour release. If two men in a 20-foot skiff were equipped with 8 free vehicles, 60 hooks per line, they would haul in considerable sablefish at this station during an 8-hour work day. It takes 15-20 minutes to pay out a setline, so the lines would start popping up shortly after the men had finished paying them out. At an average of 4.8 lbs. per fish at this station, 16 sets might yield 3,100 lbs. of fish. Before leaving, the 2 men could put down 8 sets on 14-hour releases with 8 traps on each set. At station 8, we obtained 5.3 fish per trap with average weight of 5.4 lbs. These could be retrieved in the morning, yielding 1,800 lbs. of fish. This fishing rate would result in a maximum return of 2,500 lbs. of fish per man per day. Using the prices given in Table 1, the return would be between $125 to $200 per man per day.

Best marketing of sablefish probably can be obtained by smoking these fish. We have tested palatability of smoked San Diego sablefish and found great enthusiasm for the product. Many people consider it superior to smoked salmon. Sample platters of this delicacy disappeared rapidly in local saloons.

Acknowledgments

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