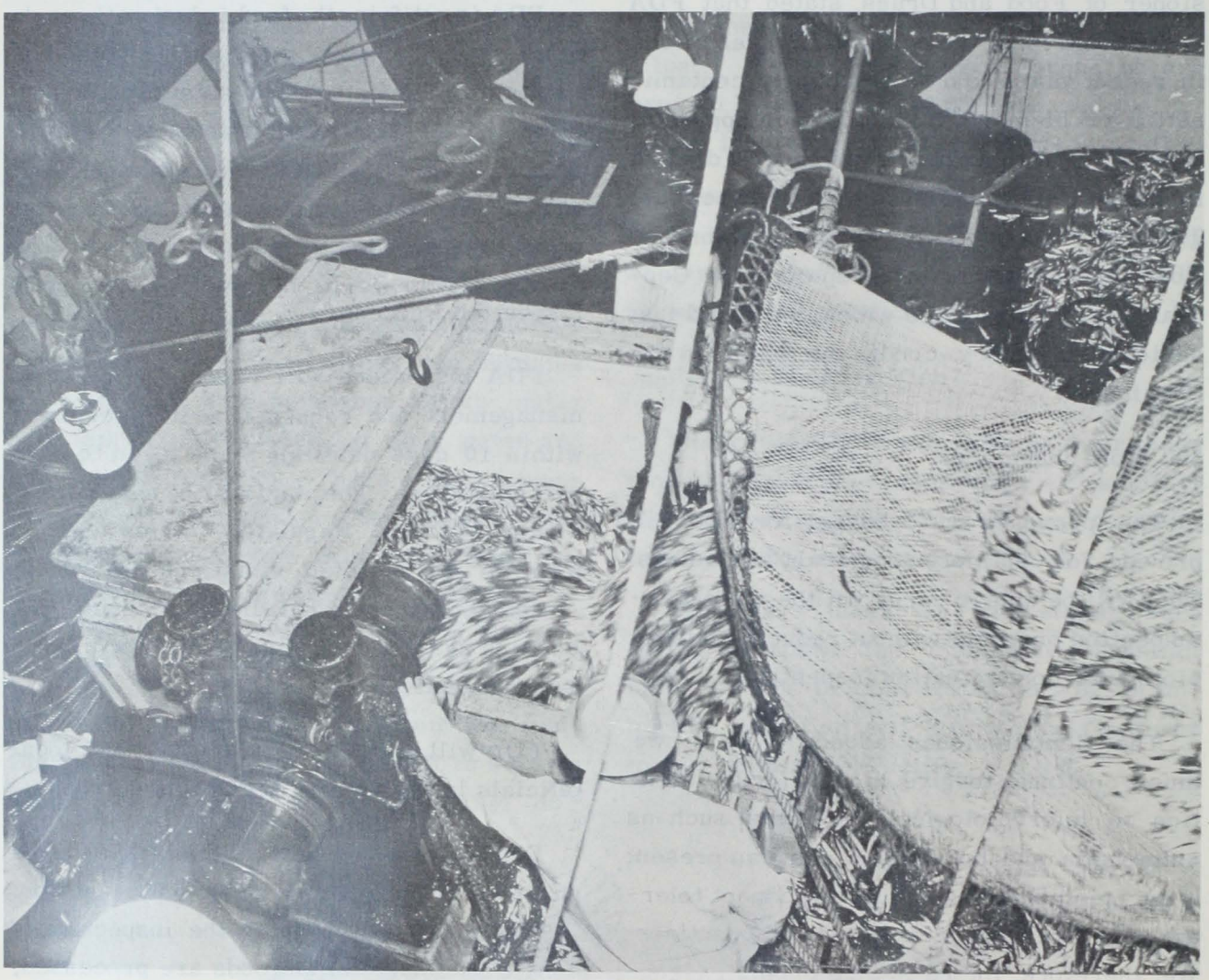

Anchovies being emptied into hold of a purse-seine vessel.

SAN PEDRO WETFISH FLEET:
Major Purse-Seine Gear Changes, 1952-1972

Eric H. Knaggs

In 1952, the San Pedro purse-seine fleet consisted of 161 vessels. It dwindled to 42 by 1972. Very few new vessels have been constructed; all but 4 are 23 years old or older.

Although the fleet has decreased, definite improvements have been made in purse-seine gear and techniques.

The two most important changes are the use of nylon netting (replacing cotton netting) and the Puretic power block.

Twenty-eight other changes in equipment represent successful original developments, improvements, or modifications of existing gear.

The first purse-seine vessel to operate at San Pedro, California, was the 'Alpha', which began fishing in 1894. Purse seining proved a very successful way to capture fish. By 1920, the fleet consisted of about 125 purse seiners (Scofield, 1951). The fleet size always fluctuated with economic conditions and availability of wetfish*.

With the collapse of the sardine fishery in the Northwest in the late 1940s, many boats moved into California waters. The later decline in the early 1950s of the California sardine fishery left a sizable fleet of purse seiners (161 vessels in 1952) seeking other wetfish. Some of these vessels turned to salmon or tropical tuna seining, some converted to trawling, while many left the west coast to become property of foreign fishing companies (Perrin and Noetzel, 1969). By 1972, there were only 42 vessels in the wetfish fleet.

Many gear changes have occurred that increased vessel efficiency during this latest period of fleet decline. Some gear adaptations are from the purse-seine revolution that took place in the west coast tuna fishery (McNeely, 1961). Government programs have helped to stimulate fishermen to use new equipment; other gear changes are typical of the ingenuity of individual fishermen.

This article documents major gear changes during the 21 years prior to March 1, 1972. Information on gear improvements is based on personal observations in the San Pedro area and discussions with many fishermen.

PURSE SEINERS IN THE WETFISH FLEET

Thirty-eight of the 42 purse seiners based in the San Pedro area are 23 or more years old. The other seiners are of wood plank construction and range from 44 to 86 feet. Individual load capacities run from 27 to 160 tons. Construction is along the lines of the west coast sardine purse seiner, figure 1

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*Wetfish are species that, when canned, are placed uncooked in the container before being preserved through sterilization by heat. The species canned as such in California are: northern anchovey, Engraulis mordax Girard; Pacific sardine, Sardinops caeruleus (Girard); Pacific mackerel, Scomber japonicus Houttuyn; jack mackerel, Trachurus symmetricus (Ayres); and squid, Loligo opalescens Berry.

Trade names mentioned in this article do not imply endorsement of commercial products.

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Fig. 1 - Typical west coast "sardine" purse seiner. (J. D. Spratt)

(described by Scofield in 1951 and Daugherty 1952). These vessels have certain common features: a low, flat stern for net storage; one main engine turning a single propeller; a crow's nest on top of a central mast used for fish scouting; a single, large storage area located below ship's deck; and a pursing winch just in front of the hatch.

The 4 newest vessels were built in 1966, 1967, 1969, and 1971. Three of these are steel hulled, while the fourth's hull is fiberglass over plywood.

The 'Veteran' and 'Erm Too' have built-in live-bait wells. These boats have been used very successfully by alternating between live-bait fishing in summer months and mackerel-anchovy fishing in fall and winter months.

The 'Bumble Bee' is the first new boat built since 1949 solely for seining wetfish. It has many features that depart from the typical sardine purse seiner. It has two main engines, the hull is constructed of fiberglass over plywood, refrigeration facilities consist of a spray system and brine tanks, and much equipment is hydraulically run. The vessel has a registered length of 51 feet and carrying capacity of 40 tons. It cruises at 13 to 13.5 knots (3 knots faster than the others) and has a top speed of 18 knots. Bumble Bee has been fished very successfully since its first trip in July 1969.

The 'Teresa T' is a steel-hulled, 50.8-foot (Alaska limit) purse seiner built in 1971. It has a carrying capacity of about 60 tons. The main engine is a Detroit Diesel 12V-71.

The daily load capacity of the San Pedro-based wetfish purse-seine fleet, including old and new vessels, approximates 3,655 tons.

GEAR CHANGES

SYNTHETIC NETTING

DuPont 66 Nylon was first tested experimentally for gill nets in 1939; however, military demand for Nylon during World War II delayed further work in the fishing industry.

The first synthetic fibers to be used by the San Pedro wetfish purse-seine fleet were ropes of Nylon and Dacron. Some difficulty was experienced at first in hanging nets on these ropes. Fishermen learned that synthetic fiber ropes stretch somewhat more than manila ropes, but do not shrink when wet. They modified their hanging techniques to compensate for these differences.

Synthetic polymer netting was first introduced in the 1950s with Marlon in sardine-mackerel seines. Eventually, Nylon replaced all others. In January 1956, the 'Anthony M' carried the first all-Nylon tuna seine (McNeely, 1961); by spring 1959, some boats had tuna or sardine-mackerel purse seines made partly or entirely of Nylon. By 1961, almost all purse seines were made largely or entirely of this fiber. No other type of webbing was being used for repairing nets.

Nylon's Advantages

The advantages of Nylon are: (1) high tensile strength, (2) good elasticity and relatively good recovery, and (3) high resistance to rot and mildew. Formerly, it was necessary to replace half the webbing in a cotton net each year. By comparison, Nylon nets are usually good for 4 or 5 years. In those parts of the net where wear is negligible, Nylon webbing may last 7 or 8 years.

Nylon nets are considerably lighter than cotton nets, and much lighter when compared to wet cotton nets of the same size (approximately half the weight).

To achieve optimum handling characteristics, fishermen dip Nylon purse seines into a stiffening agent, such as an asphalt base tar. It also has been found that a slightly heavier chain lead line must be used to provide desired sinking qualities in the net (National Fisherman, 1957a).

Netting

Standard mesh size for Nylon netting is $1\frac{3}{8}$ inches (stretched mesh) in sardine-mackerel nets, and $\frac{11}{16}$ inch for anchovy nets; some $\frac{5}{8}$- and $\frac{3}{4}$-inch anchovy netting has been used. The larger mesh tuna seine ($4\frac{1}{4}$ inch) has been replaced by sardine-mackerel nets, which also are suitable for taking large pelagic fish. In some cases, boats sew extra pieces of webbing (tuna extensions) on their sardine-mackerel nets for the summer tuna season. This provides the additional length sometimes needed for catching fast-swimming tuna.

Knot slippage or loosening in knotted mesh (Figure 2) was a problem in the early days of synthetic netting. This problem was overcome by using special resin-treated twines and special knots, heat-treating finished nets, and using knotless webbing (Figure 3). Knotless webbing is formed by cords woven together. It is easy to handle, easy to patch, and less likely to chafe. However, knotted webbing is still used in most nets today (1972).

NET AND NET DESIGN

Purse seines, lampara, and ringnets are all classified under the general term of roundhaul net. These nets are all large, encircling nets supported by floats at the water's surface, and weighted by chain or lead at the bottom. The two ends of the net are brought together, the opening at the bottom is at least partially closed to impound a school of fish, and then the net is pulled aboard a boat (Scofield, 1951).

The lampara's essential features are: (1) a large central bag (bunt), (2) wings pulled together, (3) graduated mesh sizes, and (4) no purse line or rings.

The purse seine is characterized by: (1) no bunt, (2) one wing pulled, (3) uniform mesh, and (4) use of the purse line with rings.

The ringnet is a hybrid that started as a modified lampara: (1) the two wings are pulled together, (2) it has purse rings, and (3) little or no bunt.

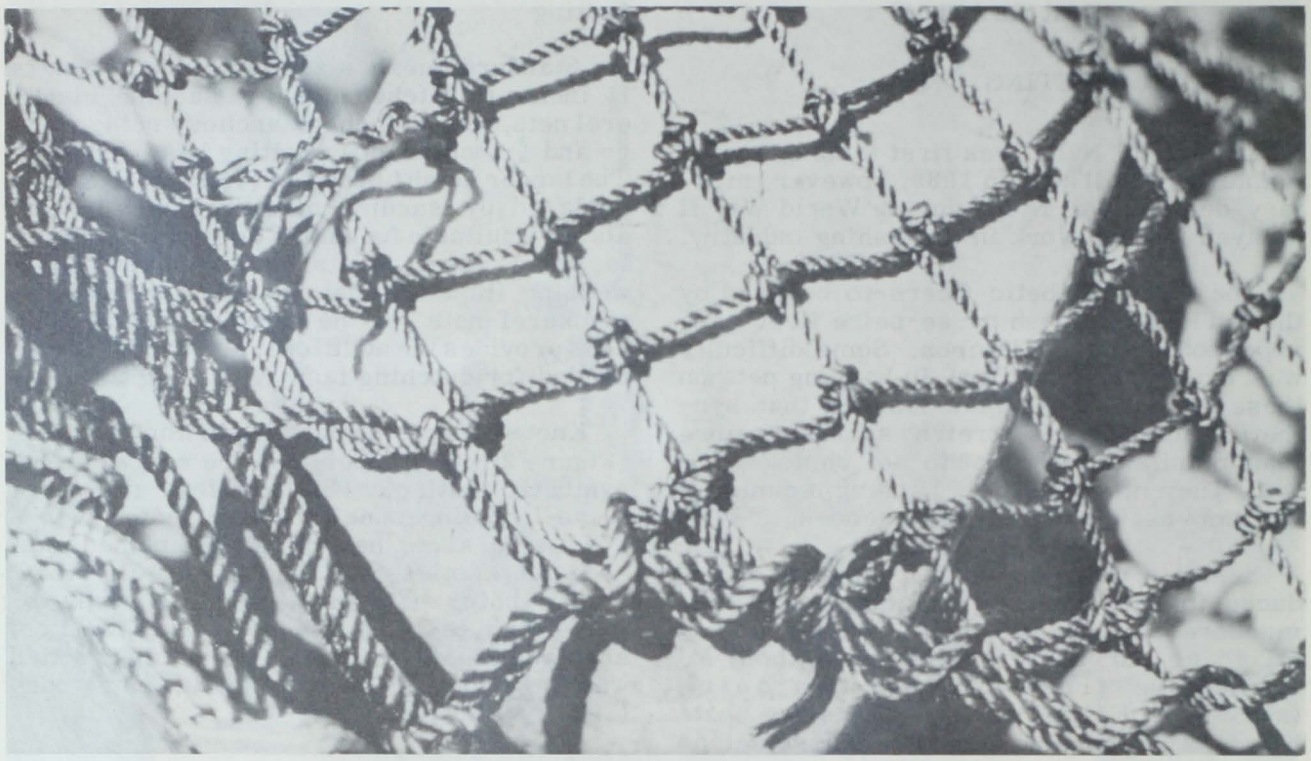

Fig. 2 - Knotted nylon netting.

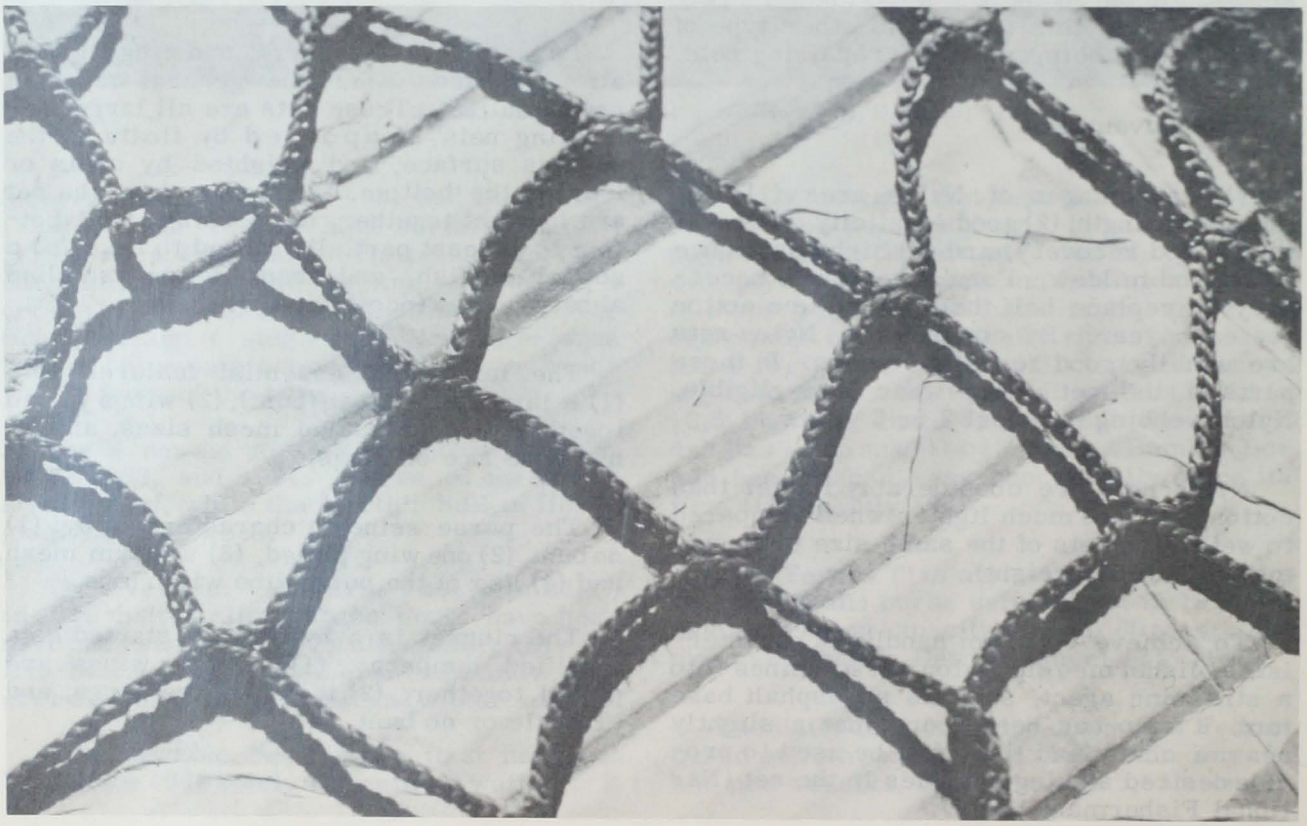

Fig. 3 - Knotless nylon netting. (Photos 2 & 3: Dave Hoopaugh)

Lampara Net Advantages

Each net has been popular with fishermen during various periods of the fishery. Before acceptance of Nylon netting and power block, the lampara net had the advantage of being faster, easier to use, and more efficient than a purse seine; however, with the adoption of these new pieces of equipment, the situation was reversed.

In either the late 1940s or early 1950s, a new-style lampara net, the Porter seine, was developed to catch fish more efficiently under the guidance of an aerial spotter. This adaptation must not have become too popular because it was never mentioned after 1954.

There were still many lampara nets (15) used to fish anchovies in 1966. By early 1967, only four were left; from June 1967 to 1969, only one was used with any regularity. Although lampara nets are no longer used by the wetfish fleet, they still are used by various boats fishing for live bait.

There were never many ringnets used by the wetfish fleet. The last ringnet vanished in 1954 from the San Pedro area.

Each purse-seine net constructed by San Pedro area fishermen has its characteristic design; nevertheless, all are long rectangular walls of webbing. Fishermen are always changing the lengths and depths of their nets. In the early years of the anchovy reduction fishery (1965 and 1966), the average anchovy net was 243 fathoms long by 31 fathoms deep. An average anchovy net in 1972 was 260 fathoms long (range is 190 to 300 fathoms) by 36 fathoms deep (range is 28 to 41 fathoms). An average sardine-mackerel net was 273 fathoms long by 36 fathoms deep.

A modified purse seine, similar to one designed by Ben Yami and Green (1968), was built and used on 'Southern Monarch' by Nick Jurlin in 1969. Basic innovations in this net are longer chain lead line and tapering the net from the center towards the ends. This gives the net a faster sinking rate, and available webbing is used in a more efficient way. This 235 by 31 fathom anchovy net worked very successfully.

PURETIC POWER BLOCK

The first prototype power block was used by Andrew Kuljis on 'Courageous' while fishing for tuna off Mexico in early 1954. Mostly, it was used for small tuna hauls of 10 to 15 tons. The power block kept the net moving and enabled the crew to put the net on the boat faster, thus preventing shark attacks on the catch. By Fall 1960, at least 27 of the 58 large seiners (60 feet or over) fishing for sardines had installed a power block. All purse seiners in the present wetfish fleet are so equipped (Figure 4).

The Puretic power block is an aluminum block with a power-driven sheave. The block is mounted on the boom's tip on most purse seiners.

The first power blocks were powered by the pursing winch. A circular piece of rope, running between a small V sheave on the side of a block and pursing winch, was used as a power belt. Later, a circular piece of $\frac{1}{2}$-inch steel cable was used. After several unsuccessful attempts to mechanize the power block, an integrated hydraulic system was finally perfected. It is the system now in general use. Nevertheless, one boat continues to use the steel cable and pursing winch to rotate the block.

Power Block's Desirable Features

The power block's desirable features are: (1) it reduces manpower requirements; (2) it relieves crew of considerable physical exertion; (3) block can be opened and net placed on the sheave (handy if only half the net is set); and (4) it increases the hauling speed or speed at which a net is put aboard. Vessels utilizing a power block average 25 to 35 minutes in stacking a net; it took 90 minutes with the old method of using a sling and boom hoist.

SPRAY REFRIGERATION SYSTEMS

In recent years (1955-1971), the fleet has seined various pelagic fishes with more regularity and for longer periods. These include jack mackerel, Trachurus symmetricus (Ayres); Pacific bonito, Sarda chiliensis (Cuvier); albacore, Thunnus alalunga (Bonnaterre); bluefin tuna, Thunnus thynnus (Linnaeus); yellowfin tuna, Thunnus albacares

Fig. 4 - Puretic power block being used to stack a net.

(Bonnaterre); and skipjack tuna, Euthynnus pelamis (Linnaeus). It is not unusual for a boat to spend up to 10 days at sea. So spray refrigeration systems have been added to boats' gear.

When purse seiners started making long trips for fish, the boats would be filled with ice. When fish were caught, they were brailed on deck. Then a large part of the crew would go below and break loose the ice carried by the vessel. Then the fish were passed down to the crew. Generally, a layer of fish was stowed and a layer of ice shoveled in on top of them. The process continued until the bin or hold was filled (National Fisherman, 1958a).

Permanent installation of freezing coils in larger tuna purse seiners began about 1945 or before. During 1946, many larger seiners were equipped with refrigeration (Scofield, 1951). This refrigeration coil system did not have the capacity to freeze large amounts of fish without auxiliary ice.

The first spray brine system was used on the 'Jo Ann' in 1957. This system consisted of an ice machine and coils in the ship's hold. Water was circulated and sprayed on refrigeration coils, gradually building up a large mass of ice on them as much as a foot in diameter.

Fish were placed in the hold and brine water released into the compartment. Ice that had built up on the coils would melt, thus cooling the brine water. Then, the brine water was circulated to freeze the fish. Also, more water was sprayed on the coils. This cold

brine dripped on the fish and continued to chill them (National Fisherman, 1958a).

In the early 1960s, Capt. Anthony DiLeva saw a new type of refrigeration system on some visiting Canadian fishing vessels. Aided by Quality Refrigeration Company, Wilmington, California, he modified this new form of spray system and installed it on 'San Antonio IV'. This spray system consists of a refrigeration compressor, an evaporator mounted on deck, and a chiller mounted overhead in the fish hold. The compressor is a Carrier 5H40, driven by a 3-71 GM diesel engine.

The fish hold is lined with fiberglass. Overhead polyvinyl chloride plastic (PVC) spray lines begin at 3 inches in diameter and are gradually reduced to 1 inch to maintain uniform pressure. The actual spray system consists of 13 spray heads and a spray pipe that runs diagonally across the hatch cover. Brine temperature is normally kept at 28 degrees Fahreheit, and the system uses between 1000 and 1200 gallons of sea water.

The spray system operates automatically by means of a control valve built into the compressor. The automatic valve increases or decreases capacity of the system by cutting out one or more cylinders of the 4-cylinder compressor when the desired temperature is reached. Conversely, the valve permits all cylinders to operate when fish are put in the ship's hold (Pacific Fisherman, 1964).

The advantages of this system are: (1) refrigeration of fish is accomplished more efficiently, (2) cooling coils on the bottom of the hold can be eliminated, (3) with the system in operation, the boat can remain at sea until a full load of fish is caught, and (4) this system makes it possible to discharge partial loads when a daily limit is imposed on the vessel.

This newer type of spray system is easily adapted to vessels in the San Pedro wetfish fleet; 11 boats are now so equipped.

FISH PUMP

As early as 1932, attempts were made to use a suction hose to empty the net at sea (Scofield, 1951). In 1955, a suction pump was used on the purse seiner 'Golden West' by John Stanovich (National Fisherman, 1955). The suction pump was 32 inches in diameter, stood 4 feet high, and weighed 700 pounds. This pump sucked 2 tons of water and sardines from the net every minute, rushing the mixture through an 8-inch hose. All these early attempts were impractical or unsuccessful.

In 1968, a commercially built fish pump (Figure 5) and dewatering screen (Figure 6) were installed by John Zankich aboard 'St. Christina' and used successfully in transferring anchovies from net to vessel. This pump was an 8-inch "Capsul-pump" built by Marco of Seattle, Washington. About this same time, the National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries) placed a fish pump aboard 'S.G. Giuseppe' as part of a gear-development program.

The "Capsul-pump" is readily adaptable to purse seiners since it uses hydraulic power that exists already on most boats. Advantages of this lightweight compact pump include: (1) fish transfer from net to boat can begin sooner, (2) "drying up" time is reduced, (3) strain on nets and gear are reduced, and (4) there is less labor involved in handling the catch.

The older method of transferring fish from net to boat is the "stocking" brail (Figure 7). This cumbersome method involves 5 or 6 men who can transfer 1 to 3 tons of fish at a time. In comparison, the fish pump requires only 2 or 3 men and is faster.

Lack of acceptance of the "Capsul-pump" by most fishermen is due to three factors: (1) to most fishermen, the "stocking" brail has proved successful in transferring all types of pelagic fish, (2) transfer of fish can be accomplished in reasonable time by the "stocking" brail even though it is slower, and (3) the pump hasn't been used successfully in transferring pelagic fishes larger than anchovies and mackerel.

At the present time, there are 7 fish pumps on the purse seiners. There is only one 8-inch model, while the rest are 10- or 12-inch models.

Fig. 5 - Capsul-pump attached to "Morgan" boom.

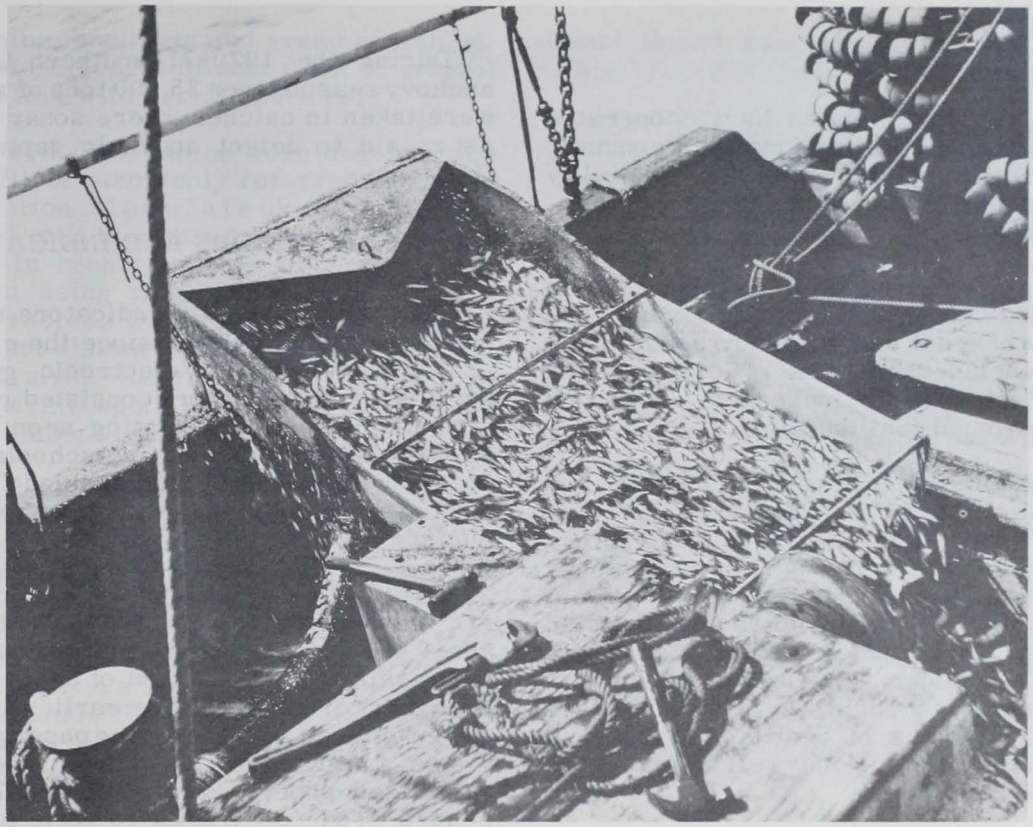

Fig. 6 - Dewatering screen being used on a catch of anchovies. (J. D. Spratt)

Fig. 7 - The stocking brail being used to transfer anchovies from the net to the boat.

SONAR

In 1944, the United States Navy cooperated with the Fish and Wildlife Service in conducting experiments to determine the feasibility of using sonar to locate sardine schools off San Francisco.

The tests demonstrated that fish schools could be located with sonar. However, when all aspects of sonar scouting were considered, it was concluded that the efficiency of the sardine fleet was not increased. The work was discontinued (Smith, 1947).

Sonar was installed aboard 'Sea Pride' and 'West Point' in 1961 (Pacific Fisherman, 1961a); however, it did not prove satisfactory and eventually was removed. In 1969, sonar was installed aboard 'Diana' by Mike Trama; by March 1970, 6 other boats had installed sonar. By March 1972, 15 boats were operating with a sonar. Fourteen of these units were Wesmar SS 150's, built by Western Marine Electronics of Seattle, Washington, while the other was a Honeywell Scanar-11F, Seattle, Washington.

The equipment used is simplified sonar: it is only a scope presentation. The two types of sonar used basically are constructed of two units: a 10-inch display unit, and a transducer. The sonars normally operate on 12, 24, or 32V dc.

The Honeywell Scanar-11F sonar has manual control through 300 degrees, but has automatic sweep through the 180 degrees ahead of the vessel. Also, it can be put on automatic sweep for a selected arc from 30 degrees to 180 degrees. The transducer can be tilted from 10 degrees above horizontal down to 90 degrees. This sonar has a range of 1200 yards and the ranges are marked off on the screen to as close as 40 yards.

The Wesmar SS 150 has a full sweep through 360 degrees. Manual control is available for the whole sweep, or there are a number of programmed search patterns available for varying sectors of the sweep. The transducer can be tilted from 4 degrees above horizontal down to 90 degrees. The range selection is from 100 to 1600 feet.

Fishermen are using sonar very successfully in finding anchovy schools in deep open water. But, in shallow-water areas (under 30 fathoms), the success of finding fish is limited due to bottom interference.

During the 1970-71 southern California anchovy season, over 25,000 tons of anchovies were taken in catches where sonar was used as an aid to detect and help capture these fish.

DEPTH RECORDERS AND INDICATORS

Depth recorders and indicators have been improved in many ways since the early days of finding fish with electronic gear. The earliest depth indicators consisted of a neon-tube display with a rotating neon light that showed the depth on any fish schools between boat and ocean floor. This enabled fishermen to locate schools that did not show on the surface.

The first installations on California seiners were made in late 1944. Within 2 or 3 years of its introduction into the fleet, almost every seiner had some kind of depth indicator (Daugherty, 1952). These earlier indicators were replaced with recording paper sounders, where a moving stylus passed over moving sensitized paper. Electrical impulses from echoes produced traces to form permanent records.

Later, more sophisticated sounders with "white line" presentation for detecting fish within a few feet of the seabed were installed. This new concept was developed because of color tones that can be produced on recording paper are limited and fish images may merge with that of the bottom. To correct this, a gating circuit used for a fraction of a second produces a white line that divides the bottom contour from fish echoes (Haines, 1959). For the San Pedro wetfish fleet, the white-line depth recorder is very useful when fish are deep, over rough irregular bottom, or next to kelp, Macrocystis.

The boats have been equipped with many types of depth recorders and indicators. Some of these depth indicators are still the neon-tube type.

RADIO TELEPHONES

The first reported California trial of a radiotelephone on a fishing boat was in February 1935 on a Monterey purse seiner (Scofield, 1951). The radio telephone was standard equipment in the purse seine fleet by 1940. The two-way communications equipment enabled skippers to inform each other

about fishing conditions and areas of fishing, contact canneries to inform them of arrival time, and talk with aerial spotters.

The first marine radios were double side-band (DSB) or commonly referred to as AM (Amplification Modulated) radio. These radios are still being used on purse seiners; however, in recent years, fishermen also have been using more frequently citizens band (CB) radios. Since citizens band radios are for short distances and generally limited to line of sight, fishermen are able to talk with an aerial spotter or other fishermen close to fishing areas.

The Federal Communications Commission has changed some rules and regulations covering marine communications. A double side-band radio could not be licensed after Jan. 1, 1972, and may not be used at all after Jan. 1, 1977. In its place a very high frequency-modulated (VHF-FM) radio will be used for short-range communications, and single side band (SSB) radios will be used for long-distance transmissions. Citizens band radios may still be used; however, the U.S. Coast Guard does not monitor CB channels, while VHF-FM Channel 16 is monitored.

The radio is indispensable every day to wetfish-fleet fishermen.

NET SKIFF

The net skiff was first used on one end of the net and served as initial drag in pulling the net off the purse seiner when a set was made around a school of fish (Figure 8). The net skiff also was used in pursing the corks and to hold up the net's outer edge (cork line) when fish were brailed onto the vessel (Figure 9). The skiff developed into a heavy and wide "pumpkin seed" craft (Scofield, 1951); the early models had no motors.

The first seiners to have skiffs with motors were 'Ronnie M' and 'Delores M' in 1944. By winter 1950-51, motorized skiffs were observed on at least 46 of the 232 seiners delivering sardines to the Port Hueneme or Los Angeles regions. At present, all purse seiners have motorized skiffs.

Fig. 8 - Net skiff being used at the start of a set.

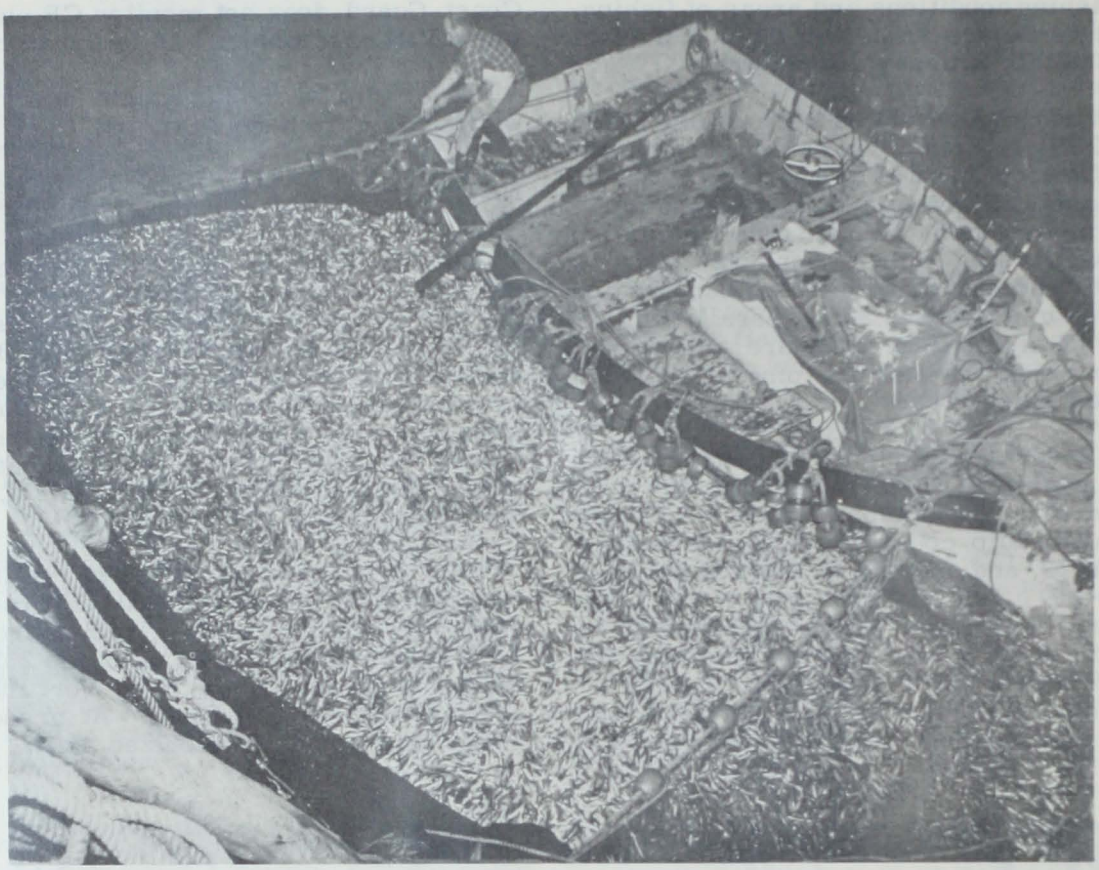

Fig. 9 - Net skiff holding up outer edge of net.

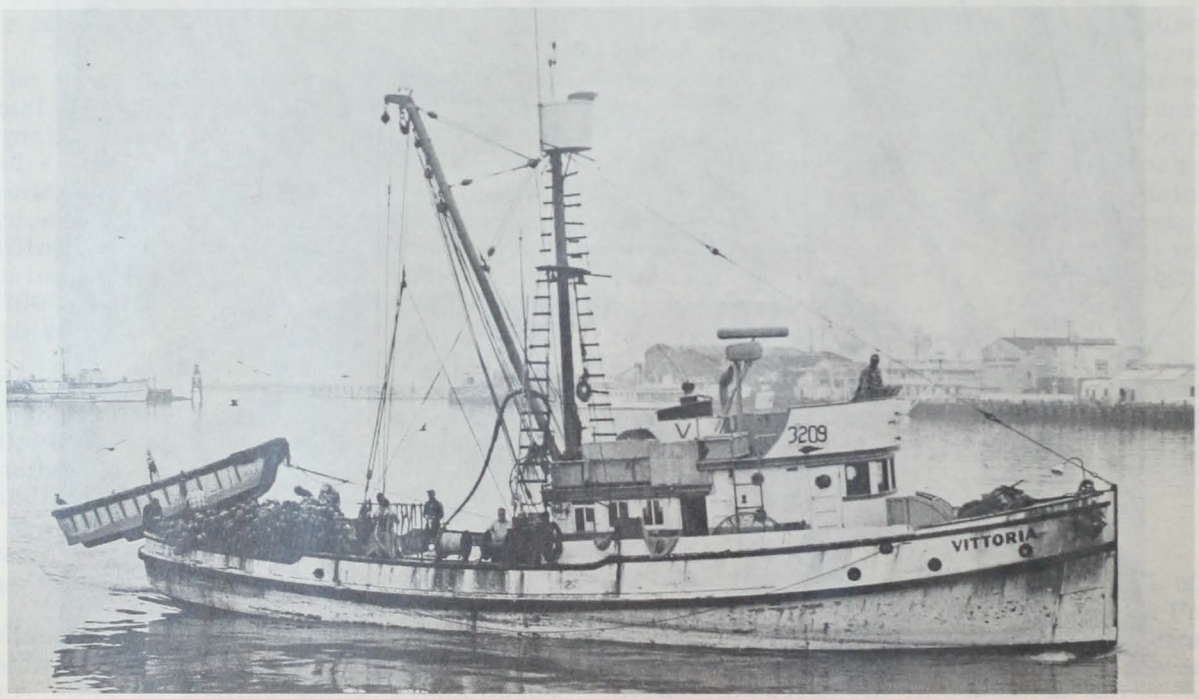

Fig. 10 - Skiff being carried piggyback.

There are two types of skiff engines. The first is a gasoline or diesel inboard engine. A good example is Detroit Diesel Model 2-71 or 3-71. The other type is an outboard motor. Outboards generally range from 35 to 50 horsepower and propel the skiffs on smaller purse seiners.

PIGGYBACKING

A recent development is piggybacking the net skiff. This feature was first used on the west coast tuna seiner 'American Beauty' in 1961 (Pacific Fisherman, 1961b).

Before piggybacking, the skiff was carried atop the net when the vessel was cruising and towed astern when scouting for fish. When the skiff was being towed, it slowed the vessel when speed was essential.

In piggybacking, the skiff is carried on the stern of the purse seiner at such an angle (Figure 10) that if falls directly into the water when a set is made. When the vessel is cruising or scouting for fish, the skiff is held by a cable attached to the pursing winch. The cable is held by a pelican hook, and when a set is made a hammer is used to strike the retaining ring, the pelican hook opens, and the skiff drops into the water.

Since its introduction, piggybacking the net skiff has been widely accepted. There are only two boats that do not have their skiffs riding piggyback.

BALLAST BARRELS

Ballast barrels are 55-gallon oil drums carried in the net skiff. When a large school of fish is netted, the drums are hung outside the skiff and immediately filled with water to stabilize it. This keeps the skiff from tipping over when large amounts of fish sink in the net. Most seiners use one or two ballast barrels in their net skiff.

RADAR

In 1951, only 3 seiners were equipped with radar; the rest did not have great interest in it (Daugherty, 1952). In 1972, only 5 boats are not equipped with radar. Fishermen have purchased radars, not for navigation purposes, but for determining fishing zones open to them during the anchovy reduction season.

CORKS

The first corks were Spanish or Portuguese corks. A later invention was "black cork," which was a cork, tar, and carbon mixture. In the 1950s, synthetic corks first appeared on nets. Spongex corks made by B. F. Goodrich became standard on purse seines. These corks are lightweight, tough, resist crumbling, and absorb little or no water. The plastic reinforcing grommet in the middle of the cork was a later development. This prevents the rope from wearing through the cork.

STEEL CABLE PURSE LINE

Jack Berntsen on the 'Mabel' was first to use steel cable as a purse line in 1927 (Scofield, 1951, Daugherty, 1952). Today, all purse seiners, except one, have steel-cable purse lines.

Most purse cables are spliced together in 3 sections; the center section is constructed of heavier wire. The purse line is commonly $\frac{9}{16}$-inch wire with a $\frac{5}{8}$-inch center piece. The purse cable is $\frac{7}{16}$-inch on smaller seines.

The pursing gypsies on the seine winch had to be enlarged when steel cable was used (Figure 11). The gypsies were surfaced with hardened steel and water cooled to retard wear caused by the steel cable (Philips, 1971).

Steel-cable purse lines couldn't be coiled, so a hand-cranked spool was added to the gear. The purse line was stored on this spool as it was wound off the gypsy.

AERIAL SCOUTING

The first aerial-scouting trials were conducted at San Diego in about 1918. Extensive trials were made in Washington, Oregon, and California from 1930 to 1938, but results were discouraging.

In 1946, aerial spotters were scouting for fish during daylight hours in the Port Hueneme-Santa Barbara area. There were 8

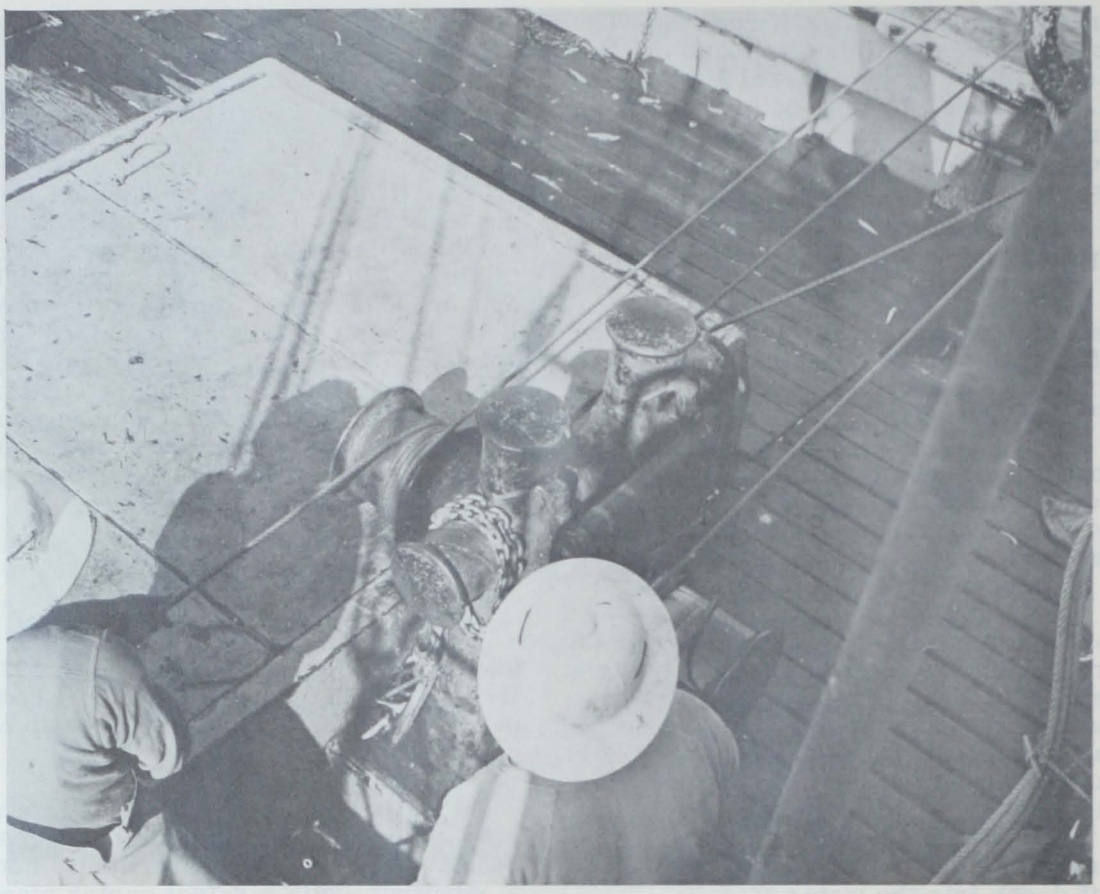

Fig. 11 - Steel-cable purse line wound around the gypsy while the net is being pursed.

aerial observers operating in southern California by 1954 (National Fisherman, 1957b). Aerial spotters were not only locating schools of fish, but guiding boats in a set. Sardine schools were visible from altitudes of 500 to 1000 feet. In 1956, 3 planes were operating out of San Pedro. Pilots worked on a share basis of 5% of the gross catch. These aerial spotters worked day and night hours.

Plane spotters were independent contractors hired by the vessels (National Fisherman, 1958b). They received 7.5% of the gross from catches the vessel made as a direct result of the spotter setting them on fish; otherwise, they received 5% of the gross of all fish taken by the boat, whether or not the aerial spotter was responsible for the catch.

In 1958, there were 8 pilots operating out of San Pedro; during the sardine season, as many as 15 spotters flew. The planes were Pipers or Cessnas equipped with 2-way radio. Aerial spotters operated day or night, up to 16 hours a day. Plane operations generally ranged from Point Conception to San Diego, and covered all islands and fishing banks as far as 90 miles offshore.

Now 6 airplane spotters scout for the San Pedro wetfish fleet. All planes are land based and have a single engine and flying time of over 15 hours. The only modification of the planes is the addition of "crop-dusting tanks" for extra fuel capacity. The aerial spotter receives 5% of the gross from catches the vessel makes as a result of his setting the vessel on the fish, or if he just finds an area of fish and the fishermen catch the fish themselves.

Airplanes are a great advantage in scouting for fish. They cover a greater ocean area and have a much better vantage point in locating fish schools and guiding the direction of a set.

During the 1970-71 anchovy season, aerial spotters helped detect and guide fishermen aboard 13 boats in capturing over 30,000 tons of anchovies.

HYDRAULIC CHOKER WINCH

The hydraulic choker winch is another piece of equipment first used by tuna purse seiners in the late 1950s. Before its invention, the net had to be strapped aboard--using the boat's boom and pursing winch--after the power block had been used to pull in most of the net. Then the net was raised out of the water and on to the boat's deck in sections. This process was repeated until fish in the net were concentrated enough to be brailed. If the catch was large, this process was repeated several times until all fish were brailed aboard.

Choker winches make it easier and faster to bring the net aboard. The most noticeable difference is during brailing. Instead of everybody stopping work to strap net aboard, the choker winch is engaged, which pulls more of the net aboard, and brailing continues.

The winch consists of a drive motor, worm gear, and line spool. While several commercial models are available, some boat owners either have made their own or have had them made locally.

SNAP RINGS

Pietro Maiorana first used snap rings on the 'Diana' in the Monterey area. The snap ring (Figures 12 and 13) is a purse ring with a snap fastener. It is made from hard steel, which is galvanized, and has a safe working load of 2,000 pounds. The working parts are stainless steel to prevent corrosion (Pacific Fisherman, 1959).

The old-type purse rings had to be hoisted on deck after net was pursed and before they could be taken off purse line (Figure 14). This could be extremely dangerous in rough weather.

The newer snap rings are left at the side of the boat after the net is pursed, and the lead line stays in the water. A fisherman then unsnaps the rings from the purse line as

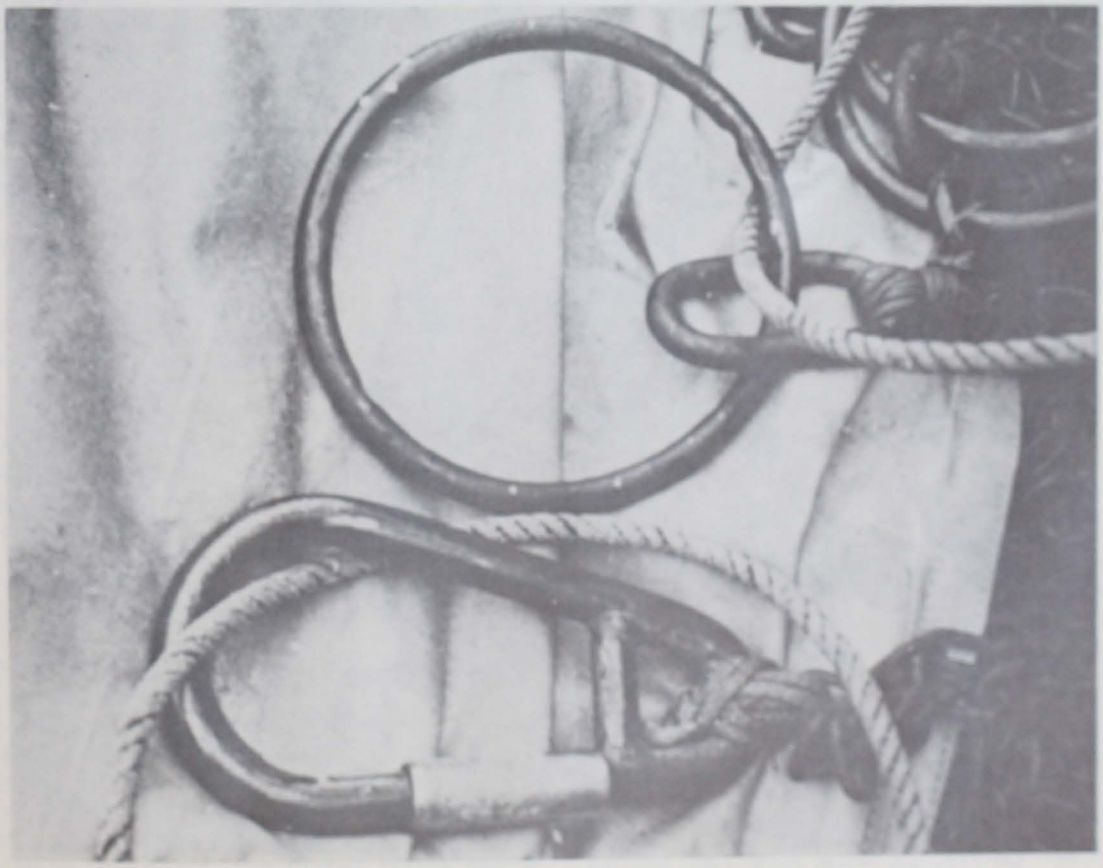

Fig. 12 - Older type purse ring (top) and snap ring (bottom).

Fig. 13 - Snap ring in open position.

Fig. 14 - Purse rings being hoisted on deck.

the net is being put on board. The snap ring not only makes handling the net safer, it cuts handling time by about 30% (Pacific Fisherman, 1959).

AUTOMATIC DIRECTION FINDER

An automatic direction finder (ADF) is a radio-receiving device for determining direction of incoming radio waves. It was first used in the wetfish fleet around 1958. ADF is used for taking bearings on spotter aircraft or on other vessels. Although receivers can be set for several broadcasting bands, purse-seine fishermen generally use citizens band radios during fishing. Because of the limited broadcast range of these radios, ADF has been less effective in finding other boats.

There are presently two models of automatic direction finders used on the boats. One is Bendix ADF 100, the other is Raytheon 358A.

AUTOMATIC PILOT

Automatic pilots are self-regulating mechanisms used in steering the boat. It keeps the purse seiner on a predetermined course in most sea conditions--and saves the man on watch from having to tend the ship's wheel constantly. Most boats are equipped with models of automatic pilots made by Wood Freeman.

RING STACKER

The ring stacker is a horizontal bar used to carry purse rings on small seiners. It is built on the port rail opposite the net.

Larger seiners hang their purse rings over the port rail. If the purse rings were carried in a similar manner on smaller seiners, the rings would either hang in the water or near it. The boat's roll and motion would cause water to sweep and tangle the purse rings. To prevent this, purse rings are stowed on the ring stacker.

KINGPOST

The kingpost is a power-block-carrying davit placed several feet astern the mast and near the starboard side of a purse seiner. The first kingpost was used aboard 'Diana' by Pietro Maiorana (Pacific Fisherman, 1959). With this davit, the power block stays at the top of the boom and doesn't have to be raised and lowered during or after a set has been made. It is a safety factor and eliminates hazards of a wide-swinging boom. The net is a little more difficult to stack when using a kingpost. Six boats have used the kingpost, but fishermen have converted 5 of these back to using a boom to carry the power block. The one exception is 'Erm Too', which still uses a kingpost; this has been moved to the center of the deck behind the hatches. This modification makes the net extremely easy to handle.

DRUM SEINE

Nick Kelly developed the drum seine right after World War II. A large part of handling previously done by crewmen is done automatically with the reel. The net can be set and retrieved more quickly than a regular purse seine. These two advantages make the drum seine ideal for "scratch" fishing where many sets are required to produce a profitable catch (Philips, 1971).

The system consists of a hydraulically driven drum that extends across the vessel's stern. The drum rotates in both forward or reverse for setting or retrieving the net.

The net is retrieved over the stern through a level wind which moves back and forth across the deck on a track. The level wind consists of two parallel upright rollers that are tipped down when the net is set. A free-wheeling mechanism allows the drum to run free when the net is being set, and a brake is used to control the drum to prevent backlashes.

A ring stripper is an accessory piece of equipment used with the drum seine (Figure 15). This steel rod holds all purse rings. It allows the purse line to run freely through them while feeding off one ring at a time as net is retrieved (Hester, Aasted, and Green, 1972).

The 'Sunset', captained by Nick Jurlin and David Masura, was equipped with a drum seine in 1970 (Figure 16). The drum is 14 feet wide with an 8-foot diameter. The drum costs about $17,000, complete with motor and hydraulic equipment (Bunker, 1971; Hester, and Green, 1972).

A purse seine used with a net drum is similar to a regular purse seine, except the cork line and lead line are of equal length so the net will wind up evenly on the reel. The net used on 'Sunset' is 290 fathoms long by 42 fathoms deep.

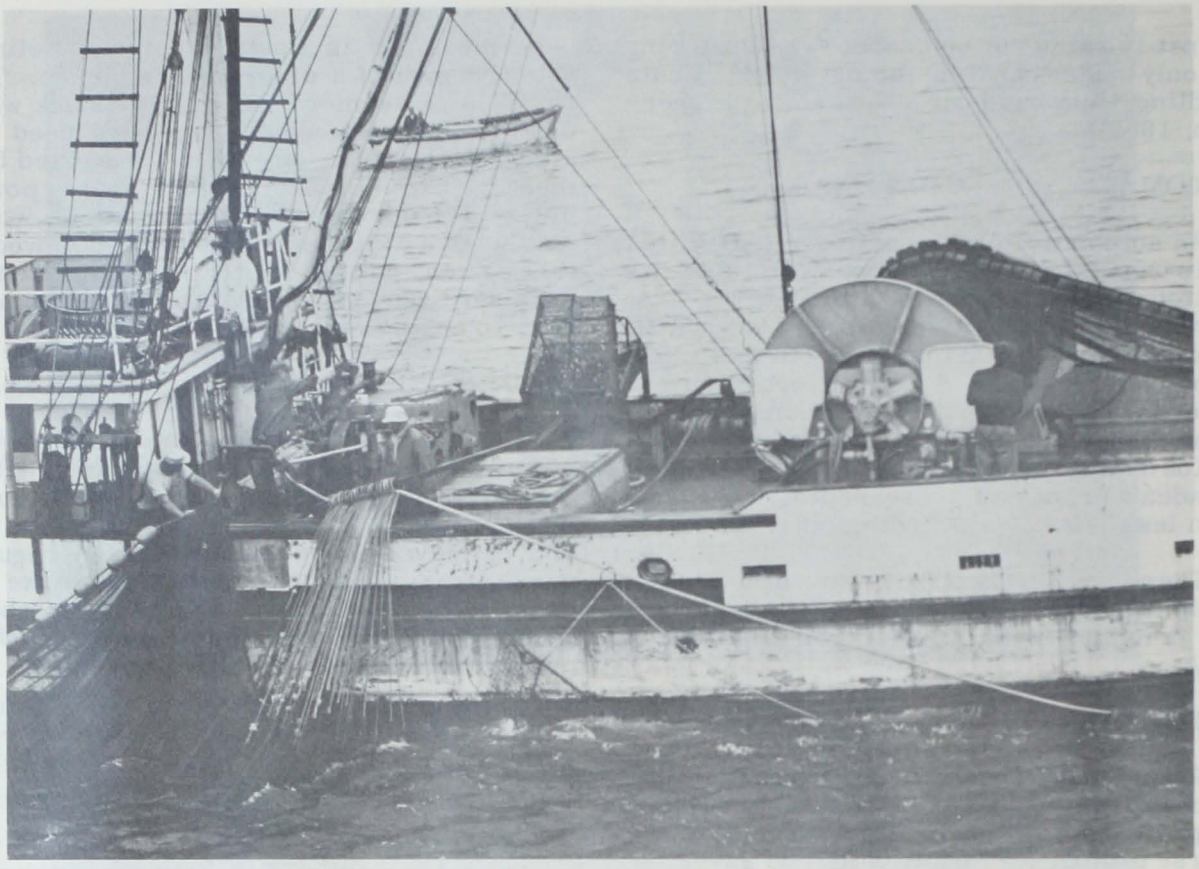

Fig. 15 - Purse rings on ring stripper while net is being retrieved on the drum.

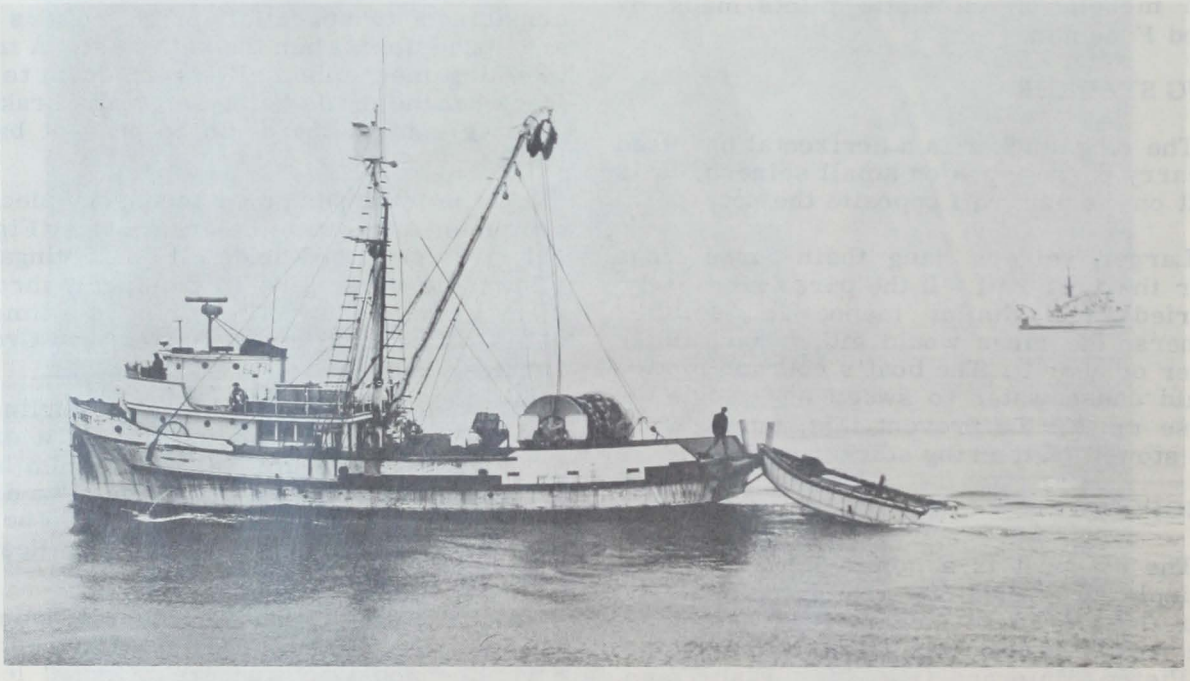

Fig. 16 - The 'Sunset' with a drum seine. (Photos 15 & 16: Roger Green, NMFS)

Drum seining may be one of the least exploited of modern seining techniques. It was obscured before it reached its full development by the Puretic power block. Most wetfish fishermen are impressed by the drum seine's operation, but cost, agreements with local unions, and the impracticability of setting the net with rope suspenders are some present disadvantages.

TURNTABLE

The turntable is a platform on the vessel's stern upon which the net is stacked. The table can be rotated, which permits easier net stacking (Scofield, 1951). In recent years, the turntable has been removed from all but 3 boats; only on one is the turntable operational.

This was a very practical piece of equipment when nets were being strapped aboard before the invention of the Peurtic power block. There was less need for a turntable when fishermen adopted the power block to retrieve their nets.

A net stacked on a boat without a turntable is twisted a half turn as it is rolled through the power block. This twist makes stacking the net a little more difficult; nevertheless, stacking is safer because fish caught in the net more often fall directly to the deck rather than on crew members.

OUTRIGGER POLE

The outrigger pole or "stick" is used when large concentrations of fish are caught. Its main function is to give fish in the net more room to swim by keeping the net away form the boat. This reduces the chance of the cork line being pulled under by fish sounding--and ripping the net or escaping over the sunken cork line. The stick is used rarely today because the power block has reduced the time needed to complete a set. The time fish are crowded at the brailing strip of a purse seine is shortened. Nylon netting also plays a role since it is stronger than cotton netting and less likely to rip if fish sound.

BOOMS

A new concept of the "stick" is the cargo boom and the "Morgan" boom. These are accessory booms in addition to the main boom. These booms, especially the "Morgan", are becoming popular with fishermen using fish pumps. These two booms are used when the catch is "dried up." The cork line of the brailing strip is attached to the boom, which frees the skiff from the "drying up" process and brailing function. This permits the skiff to continue to keep the net free from the purse seiner.

The "Morgan" boom (Figure 5) is a right-angle steel boom mounted on the port rail. It is equipped with a hydraulic ram to keep it in place or pull it in out of the way. Frank Iacono first thought of and installed the "Morgan" boom aboard 'Frankie Boy II'. It works extremely well and many of the vessels with fish pumps are installing it.

CORK PURSE LINE

The cork purse line is a rope strung through a series of small rings along the cork line (Figure 17). It is used to group the corks so there is more support in those areas where a large catch is apt to sink part of the net. The cork purse line has been modified: reduced in length to about 20 to 40 fathoms, compared to old cork purse lines that practically encompassed the entire net. Although there is little need for a cork purse line when catching Pacific mackerel, there is a definite need for it when catching larger pelagic fishes, such as tuna and bonito.

NEW ZIPPER

The zipper is a rope running through a vertical series of rings extending the depth of a purse seine net (Daugherty, 1952). It is used to divide ("cut") the net into smaller parts when a large school of fish has been captured. This division reduces the strain placed on the net by a large catch.

Japanese seine fishermen, working out of San Pedro, developed the net zipper concept in the early 1930s (Scofield, 1951); by 1950, many nets were equipped with zippers. At present, either the zipper has been completely removed or, in a few cases, a narrow strip of large webbing is sewn into a net. This large webbing not only stops tears, but provides a handy marker if the net is divided by hand. Experienced fishermen can divide a wetfish net by hand merely by following the mesh vertically in a straight line.

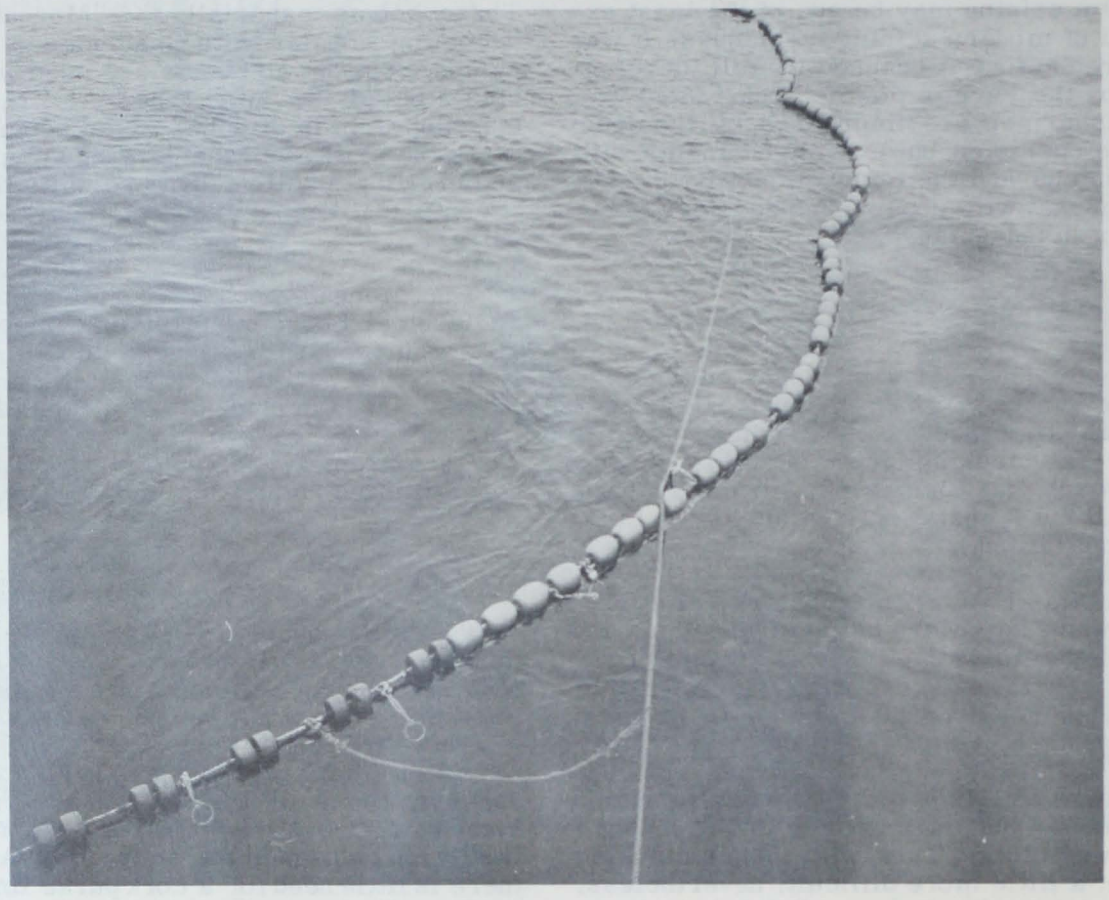

Fig. 17 - Cork purse line.

ROPE SUSPENDERS

The first rope suspenders were used by Tony Mihovilovic on 'Marauder' in November 1956 off Santa Barbara Island.

A rope suspender is a rope run from the cork line in a vertical direction down to the chain lead line. This keeps the net from sinking to its normal fishing depth, and keeps it from snagging on a rough rocky bottom. Several areas where rope suspenders are used are Cortes Bank, when fishing for jack mackerel, and Clarion Island for tuna.

A typical suspender is 17 to 20 fathoms long and can be adjusted to a shorter length. The lines are spaced 15 to 20 fathoms apart along the net. The purse seine tends to sag between suspenders; therefore, 2 to 7 fathoms are allowed for clearance to keep the net off the bottom.

Rope suspenders work very well in combination with a dragger winch. When the net is set, tension is kept on the purse cable and the net can be fished in very shallow water (6-7 fathoms). Rope suspenders have been used for a number of years, but it wasn't until recently that they have been used with any regularity. Most of sardine-mackerel nets are equipped with rope suspenders, while suspenders are not used on anchovy nets.

FLOATING LIGHTS

In 1948 and 1949, high skiffs were used by small boats fishing off San Pedro to attract sardines and live bait (Young, 1950). Small quantities of fish are still caught using this method at various times of the year, but only live-bait lampara fishermen use light skiffs with any regularity at present.

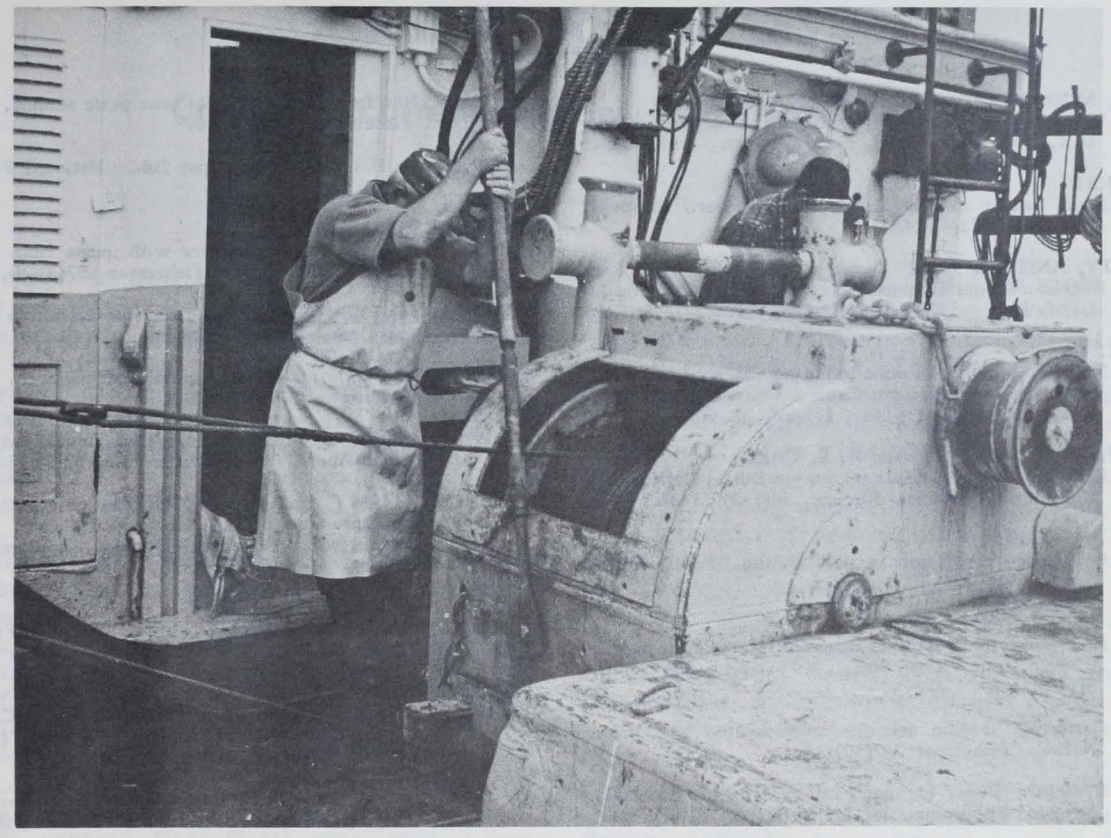

Fig. 18 - Modified dragger winch being used to purse the net.

TRAWL WINCHES

Trawl winches or dragger winches have been modified for seining by being fitted with three drums: two for the purse line and one for the tow line. The 'Fisher Lassie' was equipped with this type of winch in 1944 (Daugherty, 1952). The dragger winch (Figure 18) winds up and holds the purse cable, thereby eliminating hand cranked deck drums. The dragger winch has the advantage, over the standard seine winch, of being able to handle a purse cable with a heavier center piece and there is less tendency for the purse cable to kink. Only nine boats are equipped with modified dragger winches.

SUMMARY

Boats in the San Pedro wetfish fleet range from less than 1 year to 42 years old, with all but four 23 year old or older. All boats have certain common features: a crow's nest on top of a central mast for fish scouting, some form of pursing winch, a low flat stern for net storage, and a relatively large storage area for the catch.

The 'Bumble Bee' is the only boat with many features that depart from the typical sardine purse seiner. This new boat has two engines instead of the usual one. It cruises at 13 to 13.5 knots, 3 knots faster than the others, and has a top speed of 18 knots.

Certainly the two most important gear changes have been adoption of Nylon netting and the Puretic power block. These, along with the other gear changes, have enabled fishermen to remain in business and adjust to the varying availability of several pelagic fishes being sought and taken by the fleet.

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LITERATURE CITED

BEN YAMI, M'NAKHEM, and R. E. GREEN
1968. Designing an improved California tuna purse seine. U.S. Fish Wild. Serv., Fish Ind. Res., 4:183-207.

BUNKER, JOHN
1971. Drum seiner excites Calif. wetfish fleet. National Fisherman, 51(4):14A.

DAUGHERTY, ANITA E.
1952. Recent changes in purse seine gear in California. Calif. Fish and Game, 38(1):125-131.

HAINES, R. G.
1959. The development of echo sounding and echo ranging. :493-498. In Modern Fishing Gear of the World, Fishing News (Books) Ltd., London. p. 607.

HESTER, F. J., D. A. Aasted, and R. E. GREEN
1972. Experimental drum seining for wetfish in California. Commercial Fisheries Review, 34(1-2):23-32.

McNEELY, RICHARD L.
1961. Purse seine revolution in tuna fishing. Pacific Fisherman, 59(7):27-58.

NATIONAL FISHERMAN
1955. New pump sucks sardines from California purse seines without damaging fish. National Fisherman, 36(10):16.

1956. California sardine schools being spotted by planes. National Fisherman, 32(10):33.

1957a. Synthetic fibers for nets and ropes in the fisheries. National Fisherman, 38(11):17, 32.

1957b. California anchovies increase in abundance. National Fisherman, 38(4):15-17.

1958a. New freezing method for tuna purse seiners. National Fisherman, 39(6):9-10.

1958b. California planes spot fish. National Fisherman, 39(6):34.

PACIFIC FISHERMAN
1959. Pete Maiorana pioneers with purse rings and power block davit. Pacific Fisherman, 57(3):20, 23.

1961a. Sea Pride pioneers fish-finder in California tuna fishing fleet. Pacific Fisherman, 59(4):25.

1961b. How American Beauty carries her papoose. Pacific Fisherman, 59(8):19-20.

1964. Brine-spray refrigeration system developed for small tuna seiners. Pacific Fisherman, 62(5):15-16.

PERRIN, WILLIAM F. and B. G. NOETZEL
1969. Economic study of San Pedro wetfish boats. Bureau of Commercial Fisheries, Division of Economic Research. Working Paper 32. 1-81.

PHILIPS, RICHARD H.
1971. The history of western seining. National Fisherman, 52(5):1C-30C.

SCOFIELD, WILLIAM L.
1951. Purse seines and other roundhaul nets in California. Calif. Dept. Fish and Game, Fish Bull., (81):1-83.

SMITH, OSGOOD R.
1947. The location of sardine schools by super-sonic echo ranging. Commercial Fisheries Review, 9(1):1-6.

YOUNG, PARKE H.
1950. Netting bait and cannery fish with the aid of lights. Calif. Fish and Game, 36(4):380-381.