

Changes in Saltwater Angling Methods and Gear in California

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Introduction

In California, as in most other coastal states, saltwater recreational fishing has increased rapidly over the years, and is likely to continue to increase. Recreational fish stocks, however, only have the capacity to yield a limited sustained catch.

To manage a recreational fish stock rationally, its relative abundance must be monitored over a period of time. One method widely used in assessing relative abundance is the collection and analysis of catch per unit of effort data (i.e., catch per angler hour, catch per angler day). Researchers recognize, however, that there are other factors to consider when assessing abundance by this technique. One such factor is the change in efficiency of fishing gear and methods over a period of time. Actual reduction of fish stocks, if measured by catch-per-effort alone, may be masked by increased efficiency in gear and/or methods, so that there would appear to be little, if any, decline in the stock (Gulland, 1968).

One of the first steps in approaching and understanding this problem is to document important changes in angling techniques and tackle, and the approximate times these changes have taken place. Descriptions of commercial fishing gear and methods have been documented by Scofield (1929, 1947, 1948, 1951a, 1951b, 1956), Fry

(1931), Whitehead (1931), Croker (1938a), and others. Information on commercial gear and techniques has also been gathered by the State of California since 1916. This type of information is not available for California's marine recreational fisheries, except in scattered reports in the scientific literature and in popular articles.

This report traces developments in saltwater angling equipment from just before the turn of the century to the present. It also presents some examples of California fisheries that have been affected by developments in sportfishing methods and equipment, and documents current methods and tackle used in these fisheries.

General Developments

California saltwater recreational fishing had its beginnings during the last decades of the 19th century. In the early days of the sport, it appears that most offshore fishing was conducted with handlines, except for a select group of big game anglers who fished for bluefin tuna off Catalina Island and a few salmon trollers in Monterey Bay (Collins, 1892; Holder, 1914; French, 1916). No doubt some people used fly-fishing and freshwater baitcasting tackle for some of the smaller inshore and anadromous species around river mouths and in creeks and bays, but there is little specific information of the type of tackle used in these areas.

Hexagonal split bamboo rods had been introduced in the United States around 1870 (Marden, 1965), and rods made of plain bamboo (Calcutta type) were also available before the turn of

the century, as were a variety of hardwood rods made of Cuban lancewood, hickory, South American greenheart, and bethabera. Multiplying baitcasting reels¹ were in use, but only a few were designed for saltwater fishing. Because these early multipliers did not have an internal drag or free-spool mechanism, the reel handles would spin wildly when casting or when a fish ran with the line. For this reason they were coined "knucklebusters." Pressure was applied to the outgoing line by a leather thumb brake.

Fishing line was usually tarred cotton or twisted linen. The last, called "cuttyhunk," became the most popular for saltwater use and consisted of strands of Irish linen. Each strand or ply of the most common type (25-lea²) had a breaking strength of about 3 pounds per strand dry, and 5 pounds wet; a more specialized line (50-lea) tested at 2 pounds per strand when dry and 3 pounds when wet (A. W. Agnew, Sunset Line and Twine, Petaluma, Calif., pers. commun.). Cuttyhunk became the standard in ocean angling until supplanted by nylon and Dacron³ after the second World War. Linen line was combined with a variety of leader materials, usually gut or wire.

¹Multiplying reels, as opposed to single-action types, are geared to give increased retrieving speed, the spool revolving several times with each turn of the handle.

²A unit of measurement (300 yards per pound) indicating the degree of fineness of the yarn from which the threads of the line were made.

³Reference to trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

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During the mid-1890's, gasoline boat engines were developed (Scofield, 1956), which would have a profound effect on the expansion of ocean sport fishing on the west coast. After the turn of the century a steadily increasing number of boats began to shift from sail and oar power to gasoline engine power.

One of the most important developments in ocean fishing tackle was the invention of the star-drag reel. The first reel (Fig. 1) of this type with slipping clutch (internal drag) and irreversible handle was patented by Edward Vom Hofe and Co. in 1902 for big game fishing off Catalina (Major, 1948; Melner and Kessler, 1972). After about 1913, the Vom Hofe star drag and other similar reels began to replace the early knucklebusters (Major, 1948; Reiger, 1973), but apparently they were mostly used by big game fish anglers and still quite expensive. In a 1919 catalogue, prices for the Universal Star (Vom Hofe) in sizes 2/0 to 9/0 ranged from \$57.50 to \$75.50 each (Melner and Kessler, 1972).

The 1920's marked a turning point in ocean fishing with the introduction of public sportfishing boats and fishing barges in southern California (Major, 1948; Van Deventer, 1926; Sadler, 1928). In general, a sportfishing boat or party boat⁴ provides fishing space to the public for a fee and operates on a scheduled basis as opposed to charters and rentals where the boat itself is hired for the exclusive use of one or more anglers. Barges are essentially immobile sportfishing boats reached by shuttle launches from shore. With these new facilities, open ocean fishing became available to the general public.

In the 1930's, live-bait fishing and public sportfishing (Fig. 2) became established in southern California, while ocean pleasure fishing was just beginning or already underway in

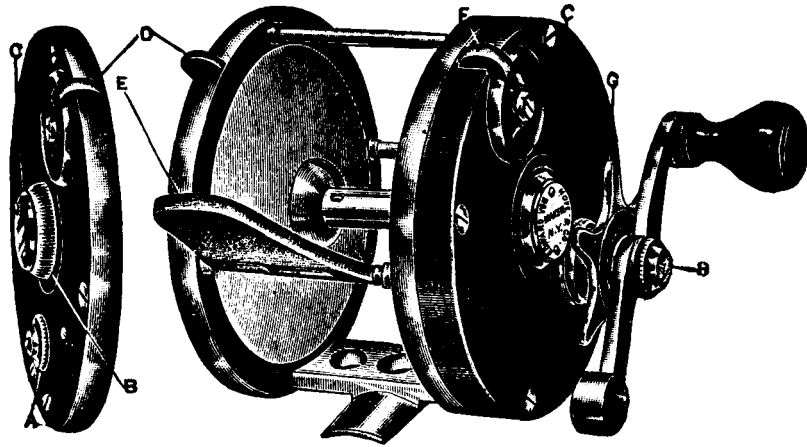


Figure 1.—Vom Hofe & Company's "Universal Star," forerunner of today's star-drag reel design, as it appeared in a 1919 catalog (E=removable leather thumb pad, F=free-spool lever, G=star drag). Taken from *Great Fishing Tackle Catalogs* edited by Samuel Melner and Hermann Kessler. Commentary by Sparse Grey Hackle. ©1972 by Samuel Melner and Hermann Kessler. Introduction and commentary ©1972 by Alfred W. Miller. Used by permission of Crown Publishers, Inc.



Figure 2.—Pierfishing for mackerel at Monterey, Calif., in 1931. Note long bamboo poles (no reels) and thick lines. Mass-produced, low-cost star-drag reels came on the market about 4 years after this photo was taken. (Photo courtesy of California Department of Fish and Game.)

⁴In this report the term "sport fishing boat" has been substituted for, and is synonymous with, "partyboat." Use of the latter term has been discouraged by members of the recreational fishing industry.

northern California (Croker, 1938b; Davis, 1949). Starting in 1935, California boat operators who carried anglers for hire were required by law to keep daily records of their catch.

During the mid-1930's, American reel manufacturers introduced moderately priced, mass-produced, high quality, revolving spool reels (star-drag type) to middle and low income people, and these reels soon came into widespread use (H. Henze, Penn Reels, Philadelphia, Pa., pers. comun.). Although the first spinning (fixed spool) reel was introduced from France in 1935, by the time a market was developed in 1939, the supply was cut off because of the war (McClane, 1974). Braided nylon fishing line made its appearance around 1939 (samples were exhibited at the San Francisco World's Fair), and it later came into limited use during the war years (A.W. Agnew, Sunset Line and Twine, Petaluma, Calif., pers. commun.). This early nylon line stretched badly, and at the time, no one knew how to eliminate or reduce the stretch factor. In general, bamboo was the most popular rod material, although in 1936, tubular metal rods made of beryllium copper came on the market. These beryllium rods resisted saltwater corrosion better than other metal rods already on the market for freshwater use (Moss, 1976), although corrosion was still a problem.

When the United States entered World War II in December 1941, the U.S. Navy closed all ports to sport-fishing. Later a few boats with special permits were allowed to operate from certain ports, but under strict regulations (Young, 1969).

By the end of the war, most anglers were still using cane rods, star-drag reels, and twisted linen line with gut or wire leaders, but important developments in tackle were already underway. Many reels were now equipped with lightweight plastic spools which made it much easier to cast light lures and live bait using cuttyhunk line. Also, by this time, the gear-in-mesh feature was available on most reels. Prior to this invention it was very easy to strip the gears of a reel if the angler threw it into gear while a fish was running with the line.

An important new product, monofilament nylon line, was introduced in 1946. Although the first monofilament line was waterproof (did not rot) and was lighter than braided nylon or linen line, it was stiff and difficult to use as a main line. It also stretched badly and played havoc with plastic spool reels, bursting them under pressure. Later, many improvements were made that cut down on the stretch, and casting lines were made softer and limper. Soft monofilament was finally introduced to the west coast in the early 1950's, but it did not begin to outsell braided linen line until the early 1960's when spin fishing became popular in salt water. Spinning reels had been reintroduced about the same time as monofilament line (circa 1946), but these were mainly designed for freshwater fishing. The early spinning reels were trouble-prone and did not work well with braided line which was still popular for ocean fishing in the 1940's.

An important advance in rod building occurred in 1948, when fiberglass rods were introduced, and solid, hollow, and wooden core models became available (Major, 1948). The advantage of fiberglass was that it was flexible and tough, excellent for casting, and did not take a permanent bend or "set" after prolonged use as did bamboo or hardwood rods, or rust like metal rods.

Also, in the late 1940's, the first fiberglass boats were made available to the public. Fiberglass enabled boat builders to mass produce one-piece hulls with a minimum of skilled labor, and in following years this material would become a standard in the pleasure boat field (Whittier, 1976). Advancements in welded and riveted aluminum hulls also helped to make aluminum a popular boat-building material. These new materials made fishing skiffs strong yet light and portable, and relatively maintenance free.

Another postwar development was the introduction of outboard engines with forward-neutral-reverse gearshifts. These soon replaced the old direct drive outboards, making small boats more manageable, safer, and simpler to operate. Soon afterward manufacturers offered cable-operated remote-control steering so one could operate

the motor from up forward, giving the boat better stability and the skipper better forward visibility (Whittier, 1976). These developments, as well as the many other improvements in boat and engine designs that followed after the war, including the introduction of electric starters, radio-telephones, fathometers, radar, and other electronic equipment, had a great influence on the expansion of the recreational boat fishery in California.

In 1950, soft monofilament fishing line was introduced on the west coast. Soon most leader materials were discarded in favor of tying the hook directly to the monofilament line. This made casting small baits and lures easier and caused a boom in the lure business (Agnew, Sunset Line and Twine Co., Petaluma, Calif., pers. comun.; Cannon, 1964). Also, during this time, fiberglass rods were quickly replacing the old cane rods. Moderately priced, quality spinning reels were introduced in 1953, and these reels soon became popular in freshwater fishing, and later (the 1960's) in saltwater fishing. The spinning reel, or fixed-spool design, eliminated the main cause of line backlashes, permitted the use of very light lures and baits, and perhaps most important, made the art of casting relatively easy to master for novice anglers.

In the late 1950's, the Coast Guard enforced stringent regulations for passenger boats (Frey, 1971), and the following years would see a marked decrease, followed by a leveling off, in the number of active sportfishing boats (Young, 1969), and a trend, especially in southern California, toward larger, faster, and more comfortable boats designed for offshore and long-range fishing trips. Many of the larger southern California sport boats were built and launched during this period (Young, 1969).

In the 1960's, the combination of spinning reels, fiberglass rods, and monofilament nylon line became established in saltwater fishing in California. On the west coast, monofilament line came into widespread use, outselling braided line (Agnew, Sunset Line and Twine, Petaluma, Calif., pers. comun.). By the mid-1960's, fiberglass had dominated the rod market.

Today, nylon monofilament line is still the most popular line, and is used on both spinning and revolving spool reels. Spinning gear is especially popular for the many small-to-medium-sized game fishes found in California's inshore waters. Revolving spool reels are enjoying renewed popularity largely due to refinements in reel designs. Some of the newer reels have an internal centrifugal brake system as well as an external spool tension control that allows the angler to cast lures and baits with monofilament line without line backlashes—the main drawback of old revolving-spool reels. Spinning tackle is now common on southern California live-bait sportfishing boats, although the combination of conventional (revolving-spool) reels and monofilament line is widely used, and is also preferred for ocean salmon trolling and sturgeon fishing in northern California, and jigging for some of the larger game fish in southern California.

Braided lines (nylon and Dacron) are generally reserved for big-game trolling and offshore bottom fishing where heavy duty conventional reels and rods are used. A new type of small diameter braided Dacron line has recently been introduced and is gaining in popularity in southern California. It has good abrasion resistance and low stretch (7-8 percent as compared with nylon line with 20-25 percent stretch).

The tubular fiberglass rod is still the standard in California sport fishing; however, a new type of rod made from graphite was introduced around 1973. Graphite rods are extremely light and ultrasensitive, yet very strong, though approximately one-third smaller in diameter than comparable fiberglass rods. At this time, however, graphite rods are still quite expensive.

Finally, the downrigger (Fig. 3), used for deep-water trolling, is showing up on an increasing number of private sportfishing boats in California. This device allows the angler to fish at a bait at accurately controlled depths with light or medium tackle and land a fish without the hindrance or loss of the sinker. The downrigger is clamped to the side or stern of the boat and consists of a short rod and hand-

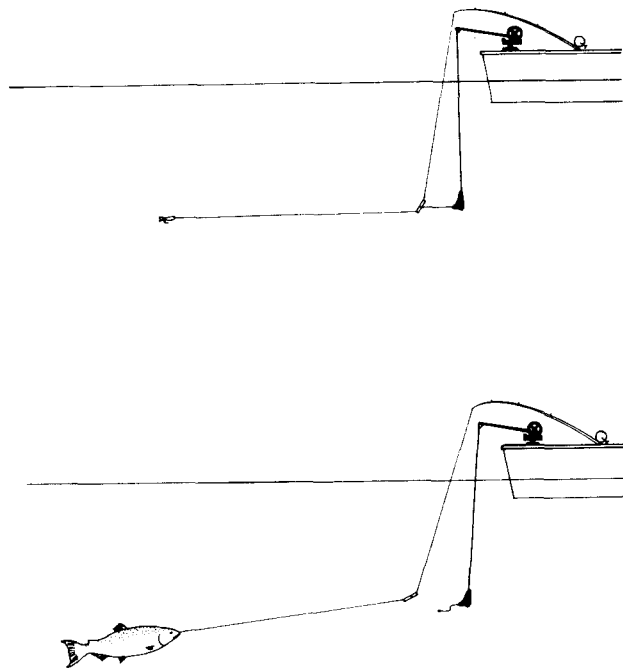


Figure 3.—The downrigger allows an angler to fish a bait or lure at accurately controlled depths using light tackle. When a fish strikes, the angler's line is released from the downrigger sinker and line.

cranked or electrically operated metal drum loaded with stainless steel wire weighted at the end with a heavy cannonball or diving sinker. The angler's unweighted line is attached to the weighted downrigger line by a metal sinker release or release clip, then lowered to the desired depth. When a fish strikes the bait, the angler's line is released, allowing him to fight and land his fish on the free line.

Fishing Technique and Tackle Changes

The following are just a few examples of specific marine recreational fisheries in California that have been affected by developments in sportfishing tackle and fishing methods. No doubt other fisheries have been affected as well. These examples are also used to document present methods and tackle.

San Francisco Area Striped Bass Fishery

Up until the mid-1950's, striped bass, *Morone saxatilis*, fishing methods in San Francisco Bay had remained essentially the same for about half a century—still-fishing with bait and near-surface trolling with artificial lures. But in the summer of 1957, a collapse of the ocean salmon fishery brought salmon sport fishing boats into the bay to fish for striped bass in deep water using the new technique of deep-line trolling with 3-pound (1.4-kg) sinkers and sinker releases (Chadwick, 1962). Many bass were caught, that year off Alcatraz Island, and subsequently in other areas in upper San Francisco Bay. From 1957 to 1959, most fish caught in the upper bay were taken by deep-line trolling. Furthermore, a winter fishery developed around 1958 when anglers discovered

that striped bass could be taken during the herring spawning runs. They used both the new deep-line trolling technique and the standard surface trolling method. Chadwick (1962) concluded that because fishing techniques in upper San Francisco Bay had changed so radically (Fig. 4), the commercial sport fishing boat catch could not be used to measure changes in abundance of striped bass.

From the early to mid-1960's, another major change occurred in striped bass methods with the introduction of live bait drifting with anchovies, *Engraulis mordax*. Only one live-bait sportfishing boat operated in 1962 and 1963, but by 1965, live-bait fishing for striped bass was firmly established (McKechnie and Fenner, 1971; Chadwick and Albrecht, 1965).

Ocean surf-casting methods also changed in the mid-1960's when it was discovered that striped bass gathered in feeding schools at certain areas off ocean beaches, at which time they would readily take artificial lures cast from shore (Miller, 1974). Until then, practically all surf-caught bass were taken with bait, usually clams. According to Frey (1971), by 1966 nearly all striped bass surf anglers had switched to metal and plastic artificial lures. This changeover also affected the catch along ocean beaches of redbait surfperch *Amphistichus rhodoterus*, which previously had been taken incidentally on hooks baited for striped bass. When anglers switched to lures cast out and quickly retrieved, redbait surfperch (which are seldom taken by this method) occurred much less frequently in the catch (Frey, 1971).

Today in San Francisco Bay, live-bait fishing is the primary method used by striped bass sportfishing boats at the height of the summer and fall seasons. Anchovies and shiner perch *Cymatogaster aggregata*, are used as bait. Boats repeatedly drift over areas where an abrupt change in depth occurs and when the current is running swiftest. In early spring, however, some will troll deep, using either single lines rigged with plastic skirt lures ("hoochies") or tandem spreader rigs baited with artificial lures (spoons, plugs, bug-eye

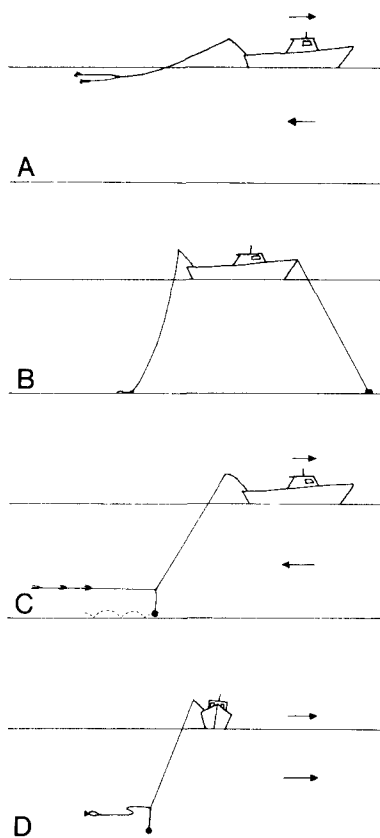


Figure 4.—Over a span of about 8 years, striped bass sport fishing boat methods have changed from (A) near-surface trolling and (B) bottomfishing, to (C) deep trolling and then (D) deep drifting with live bait.

jigs). Among the advantages of live bait fishing on passenger boats, as opposed to deep-line trolling (still a very effective method), are that many lines can be fished at a time, and more anglers can be accommodated per trip. The method is also relatively simple for the novice angler (C. Anfrinson, Captain, fishing vessel *Bass Tub III*, pers. commun.).

In San Pablo Bay and adjacent bays, rivers, and sloughs and up into the Delta, bait fishing remains the most widely used method in fall and winter. Staghorn sculpin *Leptocottus armatus*, mudsuckers *Gillichthys mirabilis*, and bay shrimp *Crangon* sp.,

are used as bait. During the summer, anglers will sometimes troll artificial lures.

Private boat and rental skiff anglers throughout the bay system conduct both surface and deep-line trolling for bass as well as plug casting and bait fishing. Shore anglers cast baits and artificial lures from piers, jetties, banks, and beaches. Some fly-fishing is done in the relatively shallow, quiet waters of the bay.

Boat rods and revolving spool reels are generally used for deep trolling and deep drifting with live bait, while both spinning and conventional tackle are used for surface trolling and casting. Fiberglass surf-casting rods range up to 12 feet (3.7 m) long. Line strengths vary with fishing method, usually anywhere from 12 to 20 pound test monofilament for casting, to 40 pound test or heavier for deep-line trolling where cannonball sinkers (1/2- to 1-pound or 0.2- to 0.5-kg) are used. In deep-line trolling, some sportfishing boats use heavy duty monel wire for the main line, where 2- to 3-pound (0.9 to 1.4-kg) sinkers are needed to carry the long (up to 12 m) monofilament leader to the desired depth.

Sturgeon Fishing in San Francisco Bay

Sturgeon fishing, prohibited by law in 1917, was opened to sportfishing in 1954; the fishery centered in the San Francisco Bay estuary system. The most common species, the white sturgeon, *Acipenser transmontanus*, reaches a length of 20 feet (610 cm) and a weight of 1,800 pounds (816.5 kg) (Squire and Smith, 1977). A size limit of 40 inches (102 cm) was established with a one-fish bag limit. Initially, snagging by trollers seemed to be the only effective method, but trolling for sturgeon was prohibited by law in 1956 (Miller, 1972). Relatively few fish were taken until 1964 when it was discovered that bay shrimp, *Crangon* sp., was a very effective bait (McKechnie and Fenner, 1971). With this discovery, yearly sport fishing boat catches jumped from 3 sturgeon in 1963 to 2,400 in 1967—a striking example of the effect of a new fishing technique on

a fishery. There seems little doubt that angler efficiency increased over this period.

In succeeding years, bottom fishing for sturgeon became increasingly popular in the San Francisco Bay area, with most angling taking place from sportfishing boats and skiffs (private and rented) in San Pablo and Suisun Bays from fall through early spring. In these areas the standard equipment is a 7- to 8-foot (2.1- to 2.4-m) boat rod with a flexible tip, and conventional star-drag reel loaded with about 300 yards (274 m) of 40- to 50-pound test monofilament line. Most anglers use one of the commercially available sturgeon rigs that include a wire or heavy sleeve, and hooks. The bait is usually live or freshly-dead bay shrimp (Fig. 5), although mudsucker, *Gillichthys mirabilis*, and ghost shrimp, *Upogebia pugettensis* and *Callinassa californiensis*, have also been used in recent years. In fact, the use of callinassid bait has increased dramatically since about 1976, and it is possible that ghost shrimp, particularly *C. californiensis*, may be an even more effective bait for sturgeon than bay shrimp.

Sinker weights vary with the strength of the current. The method is to locate a known or suspected sturgeon ground, then anchor. After dropping a baited hook over the side, line is payed out and the rod tip watched closely. After the first light tap, a few more feet of line is payed out. Usually when the second tap is felt, the angler sets the hook. A modest fishery takes place in south San Francisco Bay, where anglers use methods and tackle similar to those in San Pablo and Suisun Bays.

A separate fishery also exists in upper San Francisco Bay during the herring (*Clupea harengus*) spawning runs that occur from about January to March. At this time, sturgeon are known to feed on herring eggs around the Sausalito and Tiburon Peninsulas, where, during the height of the runs, sturgeon are caught by shore and boat anglers (Fig. 6). This fishery developed over the past 8 years, growing from a handful of anglers in 1970, and increasing rapidly since 1974 as more anglers learned of the availability of

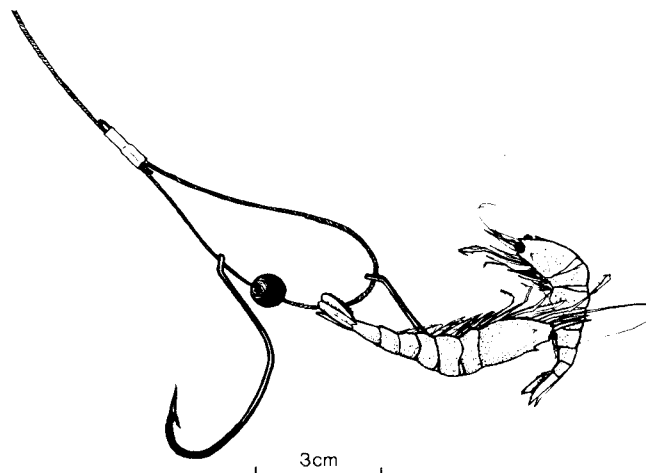


Figure 5.—Discovery in the early 1960's of bay shrimp, *Crangon* sp., for bait revolutionized the sturgeon fishery in San Francisco Bay. The terminal end of a typical rig is shown (one hook left unbaited to show hook type).



Figure 6.—Landing a white sturgeon in San Francisco Bay. In recent years, Bay anglers have developed effective methods for catching sturgeon on the herring spawning grounds near the Golden Gate Bridge.

sturgeon in these areas and the techniques to catch them (L. Green, San Bruno, Calif., pers. commun.). The fish are caught bottom fishing close to shore, often during swift-running incoming tides. Instead of the standard grass shrimp, herring fillets or wads of herring roe are used for bait. In the herring spawning areas, the sliding sinker rig is used over sand or mud bottom, while over rocky bottom the

weight is attached to a short length of lighter line which is tied to a swivel about 60 cm above the hook.

Recently, snagging again became a problem, especially during times when sturgeon would congregate to feed on herring spawn. Reportedly, some anglers were casting out heavy lures and snagging fish on the retrieve. In 1978, this type of snagging became illegal, and anglers are now required to

return to the water all sturgeon not hooked in the mouth.

Ocean Salmon Fishing

Ocean fishing for salmon was started by recreational anglers in Monterey Bay in the early 1880's. According to Scofield (1956), they trolled for salmon from small sailboats using two hand rods and a line over each side equipped with a hook and leader. Some lines were provided with two leaders and hooks. The leader was about 30 feet (9 m) long and carried a lead sinker midway between the main line and lure. Up until this time, salmon had been taken only in rivers and bays by commercial netters and in rivers and streams by anglers using fly-fishing or freshwater baitcasting tackle.

By 1893, the troll-line sport fishery had become well established in the Monterey Bay area. Anglers fished from sailboats or rowboats using "stout lines and hooks attached to flyrods or simply fished by hand . . ." (Smith, 1895). Sardine was the principal bait. In 1893, a writer for *Forest and Stream* (predecessor to today's *Field and Stream* magazine) reported fishing for salmon in Monterey Bay with a trolling rod, multiplying reel, and linen line (cited by Smith, 1895).

By 1902, anglers were trolling for salmon in the ocean just north of San Francisco. According to old newspaper reports, they trolled from launches, fishing the area between Tennessee Cove and Bolinas Bay, Marin County, some using artificial lures (Neal, 1977). Around the same time in Monterey Bay, anglers apparently were still relying on sardines, *Sardinops sagax*, for bait, and spoons were only rarely used (Jordan and Evermann, 1902). They would use a 30-ply line and a 3- to 5-pound (1.4- to 2.3-kg) sinker attached to a lighter 24-ply line, 6 m above the hook. About 150 feet (46 m) of line would be let out and the bait fished 6-15 m below the surface, trolled at about 4 miles per hour (Jordan and Evermann, 1902).

By 1908, ocean salmon anglers in central California were beginning to use lighter, more sporting tackle for salmon. That year, large catches of salmon were reported in Monterey

Bay, landed by anglers using light rods, 9-thread line, and size 7/0 hooks baited with smelt, anchovy, or sardine (Holder, 1908). In 1908, a writer for *Forest and Stream* reported that while "most professional salmon fishermen [off San Francisco] use sardines and a heavy sinker on thick line, the amateurs use a new trolling spoon on a light line, and secure many more strikes" (A.P.B., 1908).

According to Croker (1938b), very little salmon angling took place in the ocean north of Bodega Bay until after World War II, although sometimes north coast commercial trollers would allow anglers on their boats. The technique of "mooching" for salmon was introduced to California at Humboldt Bay in the late 1930's or early 1940's, when there was a great influx of anchovies into the Bay (D. Gotshall, Calif. Dep. Fish Game, Monterey, Calif., pers. commun.). This method apparently originated in the Seattle, Wash., area, developed by Elliot Bay anglers around the turn of the century (Haw et al., 1967).

Humboldt Bay mooching involves drifting a bait (usually anchovy) close to the bottom on an incoming tide, repeatedly lifting the bait up at an angle, then letting it drop back again. The action is also imparted by varying the boat speed (motor or oar power), to help the drift when the current is running swiftly. Mooching rods are usually longer, lighter, and more limber than conventional rods used in ocean trolling for salmon, and are combined with revolving spool reels. The line (after about 1950, nylon monofilament) is usually weighted with a light, crescent-shaped sinker.

In the San Francisco area in the 1930's, metal sinker releases (the spring-loaded type similar to that used today) had already come into use. It is not known exactly when this device was introduced in California, but apparently it was first used with window sash weights, then cannonball sinkers. It soon became part of standard trolling tackle. During the 1930's, San Francisco salmon trollers would use spoons in spring, then later in the season switch to bait (anchovies, sometimes sardines). They used primi-

tive long-shank commercial salmon hooks with no eye, and these were tied directly to the cuttyhunk line, which anglers would often mark with paint or nailpolish to better gauge the fishing depth (A. W. Agnew, Sunset Line and Twine, Petaluma, Calif., pers. commun.). After the war before monofilament nylon came into use, piano wire was used as leader material (E. Neal, *San Francisco Examiner*, pers. commun.).

During the 1950's, ocean salmon fishing increased phenomenally, and no doubt the development of more powerful and dependable boat engines and improvements in boat design had much to do with the expansion of the sport (Wendler, 1960). Anglers could reach fishing grounds that were previously unsafe or out of reach. Availability of moderately priced, quality fishing tackle—fiberglass rods, monofilament line, and trouble-free fishing reels—also played a part in the expansion of ocean salmon fishing.

Today, sport fishing for salmon is conducted all along the central and northern California coast from Avila Beach to Crescent City. Most fishing north of Fort Bragg is conducted from skiffs, although commercial sport fishing boats are available seasonally at Eureka, Trinidad, and Crescent City. The majority of salmon sport boats operate out of the San Francisco Bay area. Both chinook, *Oncorhynchus tshawytscha*, and coho, *O. kisutch*, salmon are taken, with chinooks dominating the catch south of Fort Bragg and cohos entering the catch more frequently to the north. Although the tackle has changed considerably over the years, the method of fishing is basically the same used back in 1902 at Monterey Bay—trolling whole fish baits from 6 to 18 m below the water's surface, depending on where the fish are feeding.

Offshore of the Golden Gate Bridge, where the most consistent salmon runs occur, the standard tackle consists of a conventional fiberglass boat rod (7-8 feet or 2.1-2.4 m) combined with a medium-sized star-drag reel loaded with about 200-250 yards (183 to 229 m) of 20 to 30 pound test nylon monofilament or Dacron line. Many anglers

use a metal sinker release and cannonball weights of 1-3 pounds (0.5-1.4 kg). Plastic diving planes are sometimes used but as yet are not as common as the sinker release rig. An increasing number of boats are equipped with downriggers to carry the bait to the desired depth. Standard bait is fresh-frozen anchovy, though herring is also used. The bait is usually threaded on one of the commercially available bait holders (crowbars, easy-baiters). A sliding two-hook rig is used along the north coast, as are mooching rigs and the combination of a #2/0 hook and crescent or torpedo-shaped sinker. Some anglers attach a spinning "flasher" or wobbling "herring dodger" (both shiny metal attractors) between the sinker and bait (Fig. 7). Most north coast sport fishing boats use the flasher or dodger rig; it is not as common on San Francisco boats. Artificial lures (particularly spoons) are in use, especially from Monterey south to Avila Beach, but in general these run a distant second to fish bait.

Boats troll over a known fishing ground at about 2 to 5 miles per hour with lines fished at slightly different depths to avoid tangles. Coho salmon are taken nearer the surface than chinooks, with baits fished usually no deeper than 6 or 9 m below the surface.

Southern California Live Bait Fishing

As mentioned earlier, live-bait fishing from public sport fishing vessels was introduced in southern California in the 1920's. Initially, trolling was the principal method, but as early as 1925 some boats were using live bait. These early "live-bait boats" would go out on a scheduled basis every day, but were primitive and offered anglers little in the way of comfort (Davis, 1949). Bait was kept in barrels which had to be replenished every few minutes with buckets of fresh seawater (Hull, 1973). Sardines, the principal live bait, were netted prior to the fishing trip (Fig. 8).

In the 1930's, the use of live bait for both bait and chum became established (Fig. 9). By the mid-1930's, a few boats began to specialize in catching and

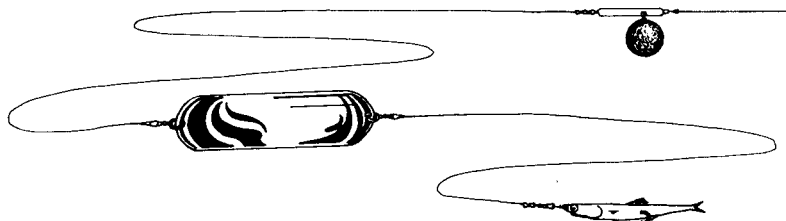


Figure 7.—Salmon trolling rig showing cannonball sinker and release, metal attractor, and rigged anchovy.

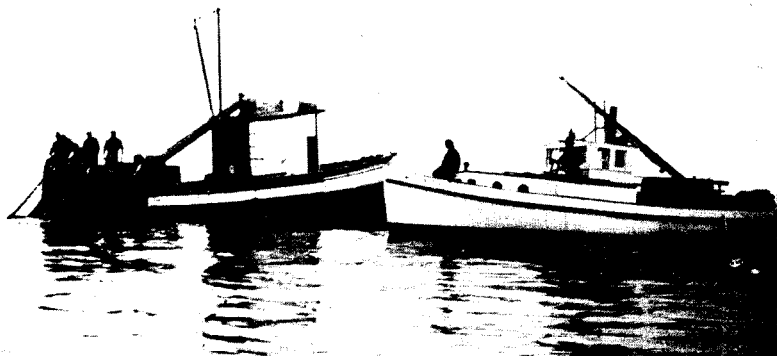


Figure 8.—Sport boat seining for sardines outside Long Beach Harbor, 1928. In the early days of southern California live-bait fishing, sport boats netted their own bait before picking up passengers (long bamboo poles rest against cabin). (Photo courtesy of California Department of Fish and Game.)



Figure 9.—Live-bait fishing off Rocky Point, southern California, 1938. (Photo courtesy of California Department of Fish and Game.)

supplying live bait to others, and the live bait industry was born (Hull, 1974). Also, new live bait tanks were

developed that circulated a continuous flow of pumped water to keep the bait in good condition. Standard tackle was

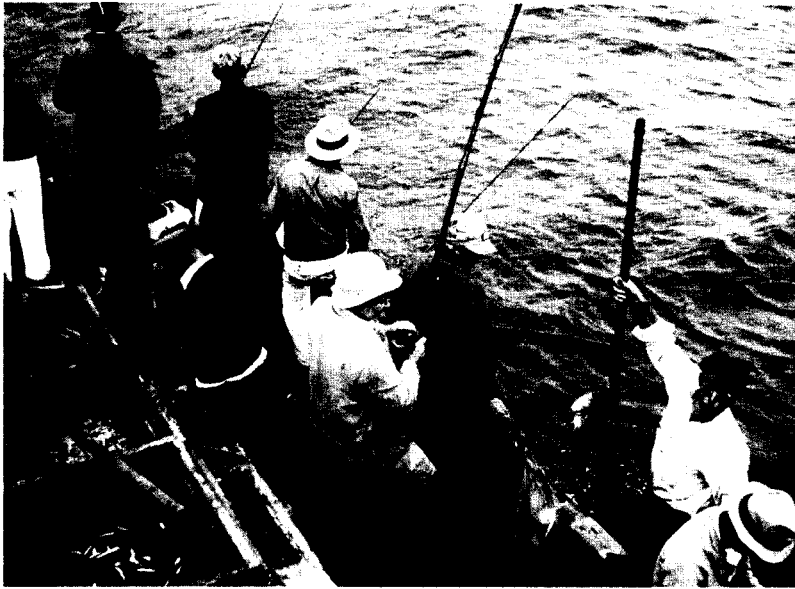


Figure 10.—Deck hand gaffs a bluefin tuna on a 1937 fishing trip off Catalina Island. In the late 1930's, southern California live-bait anglers fished with hefty cane rods, star-drag reels, and linen line using sardine for bait and chum. (Photo courtesy of California Department of Fish and Game.)

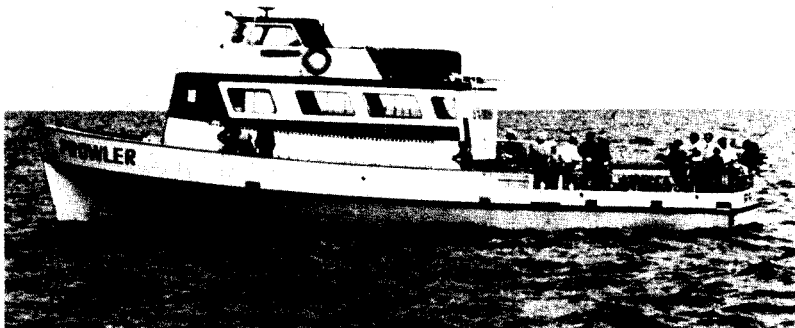


Figure 11.—Live-bait fishing off southern California in the 1970's. Modern sport boats such as this one are faster, safer, and more comfortable than those of prior decades, and are outfitted with sophisticated electronic fish-finding, radio, and navigational equipment to more efficiently locate concentrations of fish.

a bamboo rod, star-drag reel, twisted linen line (cuttyhunk), and a gut or wire leader (Fig. 10).

In the years that immediately followed World War II, most sport

fishing boat anglers were still using medium star-drag reels, Calcutta bamboo poles, twisted linen (and some twisted nylon) line (27- to 30-pound test), and live bait hooks in sizes 1/0

through 4/0, depending on target fish size. Sinkers (most often the torpedo-type), were used for California halibut, *Paralichthys californicus*, and other bottomfishes. Many anglers were now using plastic spools on their reels to make it easier to cast live baits. Leader material was either gut or piano wire. Heavy stainless steel wire was often used for jigging, and some anglers, nicknamed "feather merchants," would bring lighter tackle and fish with feather jigs. By the late 1940's, anchovies had pretty much replaced the hardier sardine as live bait, as the latter were getting too difficult to obtain. Sometimes queenfish, *Seriphys politus*, was used as live bait for kelp bass, *Paralabrax clathratus*, and California halibut.

During the 1950's, soft monofilament nylon line began showing up on sportfishing boats, and fiberglass rods were replacing the old cane rods. New high-speed retrieve reels (star-drag type) were introduced in 1959, and became popular for yellowtail, *Seriola dorsalis*, jigging (H. Heerse, Penn Reels, Philadelphia, Pa., pers. commun.).

In the 1960's and 1970's, fiberglass rods and nylon monofilament line came into widespread use on sportfishing boats (Fig. 11). Today, live bait anglers usually use light to medium action fiberglass rods, generally from 6½ to 7½ feet (2.0 to 2.3 m) long and with a fast taper. These live-bait rods are designed to be strong yet light, with tips flexible enough to cast a small live anchovy on an unweighted line. The choice of medium or light tackle depends on the species sought, and often how crowded the boat is. If many anglers are fishing at close quarters, light tackle is usually discouraged. Open faced spinning or conventional star-drag reels are used, loaded with about 250-300 yards (229-274 m) of 15- to 20-pound test monofilament line. Today, live-bait hooks are much smaller than those used throughout the postwar years and are of the short-shank O'Shaughnessy type with point bent toward the shank (Garrison and Rice, 1972). Generally, hook sizes range from 1 through 6, and the hook is tied directly to the end of

the line. If the fish are not near the surface, a lightweight rubber-cored sinker is attached to the line about 3 feet (91 cm) above the bait (Fig. 12). Live bait is still predominantly anchovy, which is hooked upwards through the gill collar or through the snout. Larger baits and larger hooks (sizes 1/0 to 4/0) are used for bigger game such as large white seabass, *Cynoscion nobilis*, yellowtail, and large kelp bass. Live squid (*Loligo* spp.), hooked through the tip of the mantle, is prime bait for the above species. Pacific mackerel, *Scomber japonicus*, usually hooked through the snout, is also used as live bait for these larger fish. Queenfish, hooked under the breastbone, is still popular for large kelp bass.

A sport boat will arrive at a known fishing spot, such as the seaward side of a kelp bed, and begin to chum slowly with live anchovies, while making a circle about 46 m in diameter. If fish begin to break the surface within the circle, the captain will anchor the boat and continue chumming (Fig. 13). Anglers then cast or ease their baited hooks over the side, set their reels in free spool or open bail, and allow the bait to move relatively free in the water. When a game fish takes the bait, it is permitted to run a short distance before the reel is put in gear and the angler sets the hook.

Offshore Bottomfishing in Northern California

For many years, offshore bottomfish have been an important staple of California marine recreational fishing. Rockfish (*Sebastes* spp.) are the principal species in the bottomfish catch, although others, such as lingcod, *Ophiodon elongatus*, cabezon, *Scorpaenichthys marmoratus*, and flatfishes, also are landed. Approximately 55 species of rockfish occur in California waters, and 29 of these are known to occur in the northern California sport boat catch (Miller and Gotshall, 1965). Since the early 1960's, rockfish have ranked first in numbers of fish taken by sport boat anglers, and between 1972 and 1975 they composed over one-half of the annual statewide

catch (Pinkas, 1977). Rockfish are important in both northern and southern California, and are particularly valuable in areas where other game fishes show up less predictably or only seasonally.

Offshore bottomfishing for sport has been conducted in California since before the turn of this century. According to early newspaper reports, in the late 1870's and 1880's there were sport-fishing excursions during summer out of Humboldt Bay to bottom fishing grounds off False Cape and Cape Mendocino (Wainwright, 1965). Two steam tugs, each accommodating about 30 passengers, operated out of the Eureka area; and tickets for a fishing trip were sold to anglers for \$2.00 each (Wainwright, 1965). Rockfish composed the bulk of the catch, though Pacific halibut *Hippoglossus stenolepis*, and true cod (*Gadus macrocephalus*) also were taken. The reports do not go into detail about tackle, but the anglers apparently used hand-lines, the primary method used for ocean bottomfish in California for about 50 years thereafter.

By the 1930's, rod and reel was beginning to appear in the ocean bottomfishery, although most fishing was still done with handlines. In 1933, a pleasure fishing trip out of Princeton was described by Buchanan (cited by Young, 1969). According to his report,

14 anglers boarded a 30-foot (9.2-m) long fishing launch and went out one-half to three-quarters of a mile offshore before dropping lines. Only two anglers used poles, the rest used hand-lines with three hooks baited with sardine, the whole rig weighted with a 2-pound (0.9-kg) sinker. Black rock

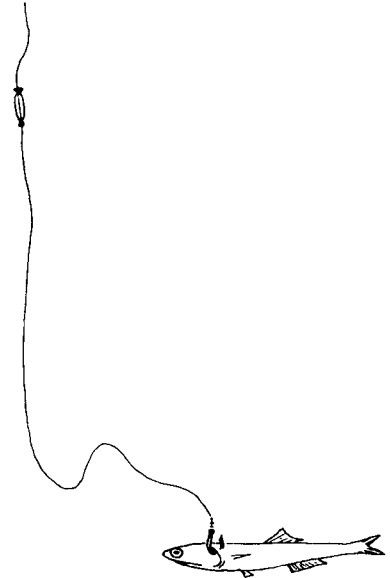


Figure 12.—Southern California live-bait rig. Rubber-cored sinker (above bait) is used if fish are not feeding near the surface.

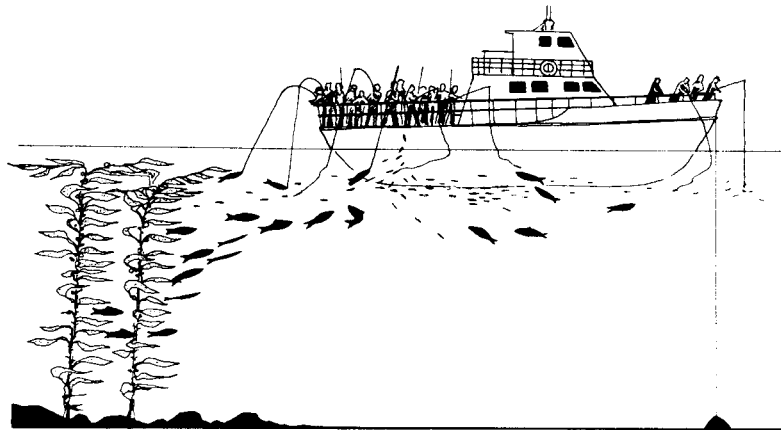


Figure 13.—Live-bait fishing from a southern California sport fishing boat.

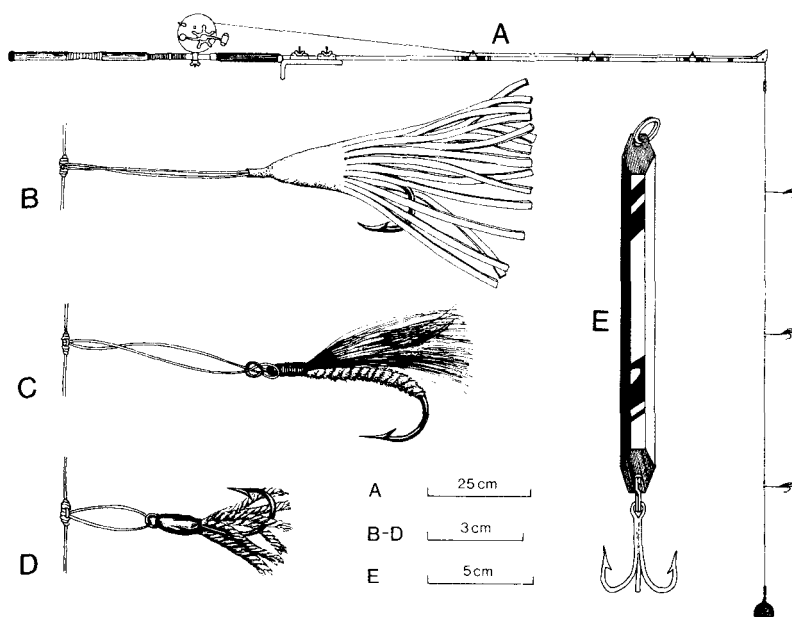


Figure 14.—Northern California bottomfish tackle (1970's): (A) Boat pole with star-drag reel, deck plate, multijig rig, and cannonball sinker; (B-D) variations in rockfish jig designs; (E) chrome "hex" jig used for lingcod and large rockfish.

fish (assume *S. melanops*) dominated the catch, although flatfishes and other species of rockfish were also taken.

In Monterey Bay, offshore bottomfishing up until the early 1940's was done almost exclusively with cotton handlines, which were supplied to anglers at the onset of the trip (F. Arcoleo, retired sport boat captain, Monterey, Calif., pers. commun.). Each handline was about 91 m long, rigged with two dropper lines and 5/0 hooks baited with salted sardine, and weighted with an old railroad spike. Around 1941, Monterey sport boat anglers began using bamboo poles, star-drag reels, and twisted linen (cuttyhunk) line. The standard method was baitfishing with sardine, although some anglers (usually the more experienced ones) used chrome hexagonal jigs for blue, olive, and yellowtail rockfish. These 24-ounce (0.68-kg) "hex" jigs were, and still are, very effective but it takes skill to avoid snagging and losing them on the bottom.

In the late 1940's, fiberglass rods began showing up on the sport boats

and squid was rapidly replacing sardine as bait. The first fathometers also came into use in the late 1940's, but they were generally not accepted until after 1955 when more sensitive models became available. The new monofilament nylon line also took a while to be accepted because even though it was lighter and drifted less than linen line, it stretched badly and damaged plastic reel spools that were used in bottomfishing at the time. About a decade later, when metal spools were used, and line manufacturers were able to cut down on line stretch, nylon monofilament replaced linen line in the Monterey fishery.

Around the time nylon monofilament line was being accepted, an important change in terminal tackle occurred with the introduction of the multiple jig rig for rockfish. These rigs, which vary in design from port to port and are variously called "cod flies," "shrimp flies," "wonderlures," etc., consist of a 5-foot (152-cm) nylon monofilament leader with from three to five hooks on short dropper loops—the hooks decorated with brightly

colored yarn, synthetic fibers, or plastic skirts (Fig. 14). According to sport boat captains in Monterey Bay, when these rigs were introduced in the Monterey area around 1957, the boat that first used them consistently caught more fish than other boats fishing in the same area at the same time. Soon afterward, other sport boat operators in the Monterey Bay area began to use the new multijig rigs. According to Miller (Calif. Dep. Fish and Game, Monterey, Calif., pers. commun.), rockfish landings increased during this period, especially catches of schooling pelagic types such as blue, yellowtail, widow, and olive rockfishes. In this instance, the new type of terminal tackle may not only have affected catch-per-unit-of-effort, but species composition of the catch as well. Also, in the late 1960's and early 1970's spinning gear became available on the Monterey boats so that anglers could fish with feather jigs in case a surface feeding school of blue or yellowtail rockfish was found.

The multijig rockfish lures are now commonly used throughout most of northern California, along with the standard combination of fiberglass boat rods, heavy duty star-drag reels, and nylon monofilament and braided Dacron lines testing at 40-60 pounds. The multijig rigs are fished successfully with or without bait (squid or cut anchovy). Sinker weights vary from 8 ounces to 2 pounds (from 0.2 to 0.9 kg) or more. The hexagonal chrome jigs, in use before World War II, are still commonly used, especially for lingcod, which are also taken with single hook rigs baited with small live rockfish and live squid when available. Recently, other types of jigs, some very similar to the "candy bar" types used on southern California sport boats, have been introduced to central California bottomfishing.

Even if it is assumed that the fishing power of the terminal tackle itself has not changed, ongoing improvements in electronic equipment and boat and engine design since the 1940's have obviously enabled boats to fish in deeper water and travel to new bottomfish grounds farther from port. Ultra-sensitive fathometers have helped to

locate new reef areas and concentrations of fish with less search time and greater accuracy. The switch from handlines to rod and reel and lighter line also made it easier to fish in deeper water. Today boats are able to fish in water to 183 m deep, whereas handline depth averaged about 37 to 46 m, and early rod and reel depth about 73 to 92 m.

When handlines were used, boats could only fish in shallow water because the heavy lines drifted badly in the current an even with relatively short lengths of line, there was a constant problem with on-deck line tangles between pulls, which cut down on actual fishing time. On some boats, large wooden reels that clamped to the deck rail were used to haul up line, but not all anglers used them, and they were cumbersome and offered little in the way of sport. With rod and reel came lighter line (first linen and then even lighter nylon monofilament and braided Dacron), and soon line drift was no longer much of a problem. Since excess line was retrieved on the reel spool, the major cause of on-deck line tangles was eliminated. Other developments over the past 10 years, such as deck plates³ and reel handle extensions, have also made it easier to crank up fish and heavy sinkers from the depths.

Discussion

It is often said that most of the fish are caught by a small minority of anglers—the ones with the most experience and skill. Although these two factors are obviously important, for every expert there are thousands of average anglers and growing numbers of novice anglers. It is likely that the development of efficient, well-made, yet moderately priced tackle that is simple to operate and maintain has tilted the odds in the average anglers' favor over the years, and will probably continue to do so as new, even

more advanced fishing equipment is developed.

Although there are few quantitative data on the relative efficiency of old versus new gear, it is obvious that saltwater fishing equipment has definitely changed, with the most dramatic developments occurring after World War II. The postwar years were also a time of rapid and tremendous growth in California. Between 1940 and 1970, the State's population tripled and so did the per capita income of its people. More spendable income and more leisure time undoubtedly contributed to the saltwater angling boom in California, and to an increased demand for angling products and services and better dissemination of angling information.

Changes in fishing methods, as well as tackle, also have been observed in saltwater sport fishing in California (Fig. 15). In just 8 years (1957-65), striped bass sportfishing boat methods in San Francisco Bay changed from bait fishing to deep-line trolling to live-bait drifting. Within only a few years, ocean surf casters, who had for years still-fished with bait for striped bass, switched to casting artificial lures. The sturgeon fishery received a tremendous boost when, in the 1960's, grass shrimp was discovered as an effective bait. In the 1970's, the development of successful methods to catch sturgeon on the herring spawning grounds essentially opened up a new fishing area for this species in San Francisco Bay. Multijig terminal tackle has largely replaced the standard bait rig in offshore bottom-fishing in northern California. Development of lightweight synthetic fishing lines, dependable fishing reels and rods, and improvements in boat design and equipment have all changed the style of marine sport fishing in California. No doubt many other California recreational fisheries not mentioned in this report have been similarly affected by changing methods as well as by new kinds of tackle.

Because angler efficiency may also be altered when such changes occur, these factors should be considered when biologists assess relative abundance using catch-per-unit-of-effort data. Changes in methods or tackle

may not only affect the catch of target species, but also that of incidentally caught species.

Ideally, information on relative efficiency should be obtained when a fishery undergoes significant changes in gear or methods, but if this is not possible, these changes should at least be monitored as closely as possible and taken into account when estimating, through effort units, relative abundance of marine game fish populations.

Acknowledgments

Without the cooperation and advice of those I interviewed—veteran anglers, members of the tackle industry, sport boat skippers and others connected with the marine recreational fishing industry—this chronology would not have been possible. I am also grateful to Norm Abramson, Arthur Agnew, Charles Davis, Jr., Roger Green, Daniel Miller, Ed Neal, and George Reiger for reviewing the manuscript and offering many helpful suggestions. Joe Lesh and Dan Gotshall helped by providing needed information on north coast salmon fishing.

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³A plastic or metal plate clamped on the lower part of the rod shaft and rested on the boat railing for better leverage when reeling in.

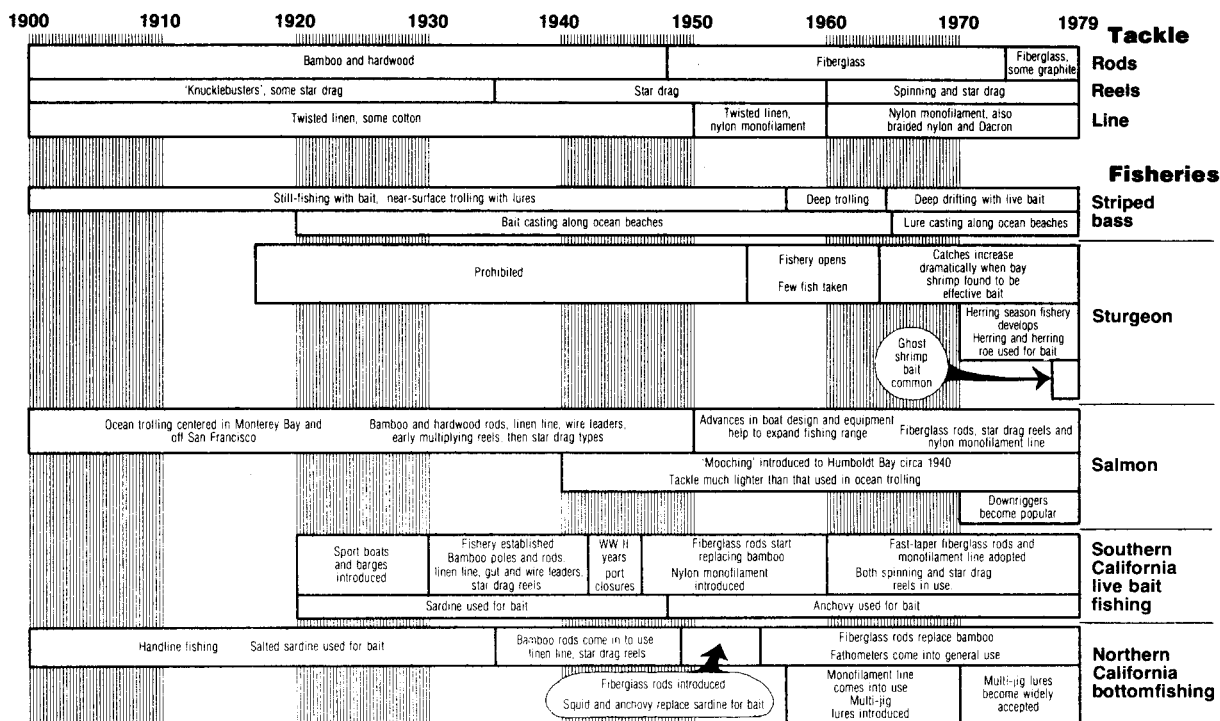


Figure 15.—Chronology of some changes in saltwater angling methods and gear in California. (Demarcation lines for changes are approximate.)

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