AN ABSTRACT OF THE THESIS OF

ALAN JACKSON BEARDSLEY for the DOCTOR OF PHILOSOPHY
(Name) (Degree)

in FISHERIES presented on March 13, 1969
(Major)

Title: MOVEMENT AND ANGLER USE OF FOUR FOODFISHES IN YAQUINA BAY, OREGON

Abstract approved: Redacted for privacy
Howard F. Horton

A tagging study of starry flounder (Platichtys stellatus), white seaperch (Phanerodon furcatus), pile perch (Rhacochilus vacca) and striped seaperch (Embiotoca lateralis) was conducted in Yaquina Bay, Oregon, from July, 1964, to September, 1967. Recaptures included 469 of 6, 385 flounder (7. 3%) and 55 of 1, 655 surfperch (3. 3%) by November, 1968. A publicity program was used to advertise the tagging study.

The majority of flounder were recaptured in Yaquina Bay by sport fishermen (125) and scientific investigators (256), whereas recaptures outside Yaquina Bay were made by sport fishermen (31) and commercial fishermen (57). Flounder were recaptured as far north as Tatoosh Island, Washington, and south to Winchester Bay, Oregon. The mean total length of flounder recaptured in the ocean (430 mm) was significantly greater than that for flounder recaptured in estuaries (354 mm). Post

mortem shrinkage in commercially landed flounder was 1.5% of the total length. The growth of tagged flounder approximated that of untagged fish. Tag returns and angler surveys revealed that hometowns of anglers were widespread and fishing intensity for flounder was greatest in April.

Length-weight, length-age and age class-frequency relationships were computed for flounder. Evidence is presented that flounder maintain a "homespot" within the bay. Flounder population estimates in King Slough were characterized by a low recovery of tagged fish. Either a large population size (10,000 plus) or a differential capture rate of tagged to untagged fish was indicated. An ambicolored starry flounder from Yaquina Bay is described. Examination of 5,503 flounder revealed that 3,167 (58%) were sinistral. This figure was statistically different from collections made in Japan and Alaska, but did not differ from collections made in Puget Sound, San Francisco Bay or Monterey Bay. Although the commercial fishery appears to have a greater impact (in number and pounds of flounder landed) than the sport fishery on starry flounder populations, neither fishery appears to require restrictive regulations at the present time.

Of all surfperch tagged, only three striped seaperch were recaptured outside Yaquina Bay. A specimen recaptured near Florence, Oregon, represented the only significant longshore migration.

All three surfperch species investigated exhibited seasonal movement as deduced from recapture of tagged fish and catch-per-unit-of-effort data. During winter months pile perch generally leave the estuary, striped seaperch retreat to the lower estuary and white seaperch remain in the middle and lower estuary. Evidence is presented that migrations are triggered by changes in temperature and salinity as well as the reproductive behavior of the species. Among the tags tested, the spaghetti tag proved most suited for surfperch.

Length-weight, length-frequency and length-age relationships were computed for white seaperch. Scarcity of white seaperch in age classes I and II is explained by sampling error and lack of dependence on the estuary as a nursery or reproductive area. The management implications of the apparent segregation of pregnant female surfperch in the upper area of the bay during a period of heavy angling intensity is discussed.

Information on the seasonal distribution of 39 species of fish captured in Yaquina Bay is presented. Mention is made of an additional 61 species reported from the bay.

Movement and Angler Use of Four Foodfishes
in Yaquina Bay, Oregon

by

Alan Jackson Beardsley

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

June 1969

APPROVED:

Redacted for privacy

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in charge of major

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Date thesis is presented March 13, 1969

Typed by Marion F. Palmateer for Alan Jackson Beardsley

ACKNOWLEDGEMENTS

My sincere appreciation goes to Dr. Howard F. Horton, major professor and friend, for his enthusiastic support and helpful advice during the entire study. Generous financial support from the Bureau of Sport Fisheries and Wildlife was conscientiously handled by Mr. Gerald B. Talbot, Chief of the Tiburon Marine Laboratory. To them I am most grateful.

Deserved recognition also belongs to Messrs. Robert Jacobson, Warren Ferris and Pat Keith for assistance in conducting field studies and to Mr. Paul Wares for collaboration in the collecting and analysis of surfperch data. In addition, I would like to thank Mr. Wilbur Breese and Dr. Richard Wydoski and others at the Marine Science Center in Newport for assistance and advice, Drs. Carl E. Bond and William G. Pearcy of Oregon State University for helpful criticism of the manuscript, and Dr. Hugo Krueger for advice in part of the statistical analysis.

The Fish Commission of Oregon cooperated in the study by providing collecting permits and lending the fyke net used to catch surfperch.

Special appreciation goes to my wife Sharon for encouragement and assistance in all portions of the study and to Mia for her extreme patience.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure		Page

MOVEMENT AND ANGLER USE OF FOUR FOODFISHES IN YAQUINA BAY, OREGON

INTRODUCTION[1]

Reported in this thesis are the results of research designed to investigate the population size, movement and angler use of the four most important food fish species in Yaquina Bay, Oregon. These species, in order of total poundage landed in the 1963-1964 sport catch, are the white seaperch (*Phanerodon furcatus*), starry flounder (*Platichthys stellatus*), pile perch (*Rhacochilus vacca*) and striped seaperch (*Embiotoca lateralis*) (Parrish, 1966). Research was conducted from July, 1964, to May, 1968, with the objective of providing additional biological information on these important recreational and food species.

The demand for recreational and commercial use of marine non-game fishes is increasing in Oregon (Oregon State Game Commission, 1966) as well as in the United States (U. S. Fish and Wildlife Service, 1966). Angling activity in the salt waters of the nation was estimated to be increasing at a rate of 7% per year (U. S. Fish and Wildlife

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[1]Supported by a cooperative research agreement between Oregon State University and the Tiburon Marine Laboratory of the Bureau of Sports Fisheries and Wildlife, U.S. Fish and Wildlife Service.

Service, 1962). These increases are due to greater income, mobility, and leisure time of an expanding human population.

In Oregon there is a substantial, year around sport fishery for marine non-game fishes.[2] For example, Parrish (1966) and Stevens (1966) estimated that in one 12-month period in Yaquina Bay, Oregon, 89,582 angler hours were spent catching 66,508 pounds of food fishes. At present, no license is required to angle for these species and virtually no major management practices are employed for their benefit by either the Oregon State Game Commission or the Fish Commission of Oregon. Recently, Administrative Order FO 162 of the Fish Commission of Oregon (amending OAR 625-10-355 and enacting OAR 625-20-035) established a commercial hook and line season for ocean food fish (i. e., non-game fishes). Regarding marine food fish that frequently enter the sports catch, this administrative order contained the stipulations that:

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[2] Some 33 species have been defined as game fishes in Oregon (Oregon State Game Commission, 1965). Of this total, those commonly inhabiting marine and brackish waters include: cutthroat trout (*Salmo clarki*); rainbow trout (*Salmo gairdneri*); striped bass (*Roccus saxatilis*); shad (*Alosa sapidissima*); green sturgeon (*Acipenser medirostris*); white sturgeon (*Acipenser transmontanus*); sockeye salmon (*Oncorhynchus nerka*); chinook salmon (*Oncorhynchus tshawytscha*); coho salmon (*Oncorhynchus kisutch*); and chum salmon (*Oncorhynchus keta*). Hereafter, non-game marine sport fishes will be referred to as food fish.

> (1) it is unlawful to commercially take surfperch between May 1 and July 15 of any year, and (2) it is lawful to take ocean food fish, except salmon, striped bass, sturgeon or trout for commercial purposes by means of a hand line, pole-and-line, or pole-reel-and-line, provided the line has not less than four (4) separate fish hooks attached.

Thus, management decisions are being made on species about which we have little biological knowledge. Therefore, studies of important recreational and food fishes are needed to provide biological information upon which future management decisions may be based.

The starry flounder is a member of the family Pleuronectidae (right eye flounders) (American Fisheries Society, 1960). This fish is easily distinguished by the numerous, spinous, stellate plates (cycloid scales) and the dark brown to nearly black coloration on the eyed side of the body, the creamy white color on the blind side; and by the alternating black and yellowish brown bands in the dorsal, anal and caudal fins (Clemens and Wilby, 1961). Although included in the family of right eyed flatfish, this flounder commonly possesses both eyes on either side of the head.

Orcutt (1950) reported the southern limit of distribution of this species in the Eastern Pacific Ocean as the mouth of the Santa Ynez River at Surf, Santa Barbara County, California (Figure 1). Starry flounders become more numerous northward and are found along the entire Pacific Coast of North America north of the Santa Ynez River. They occur along the Aleutian Island chain westward

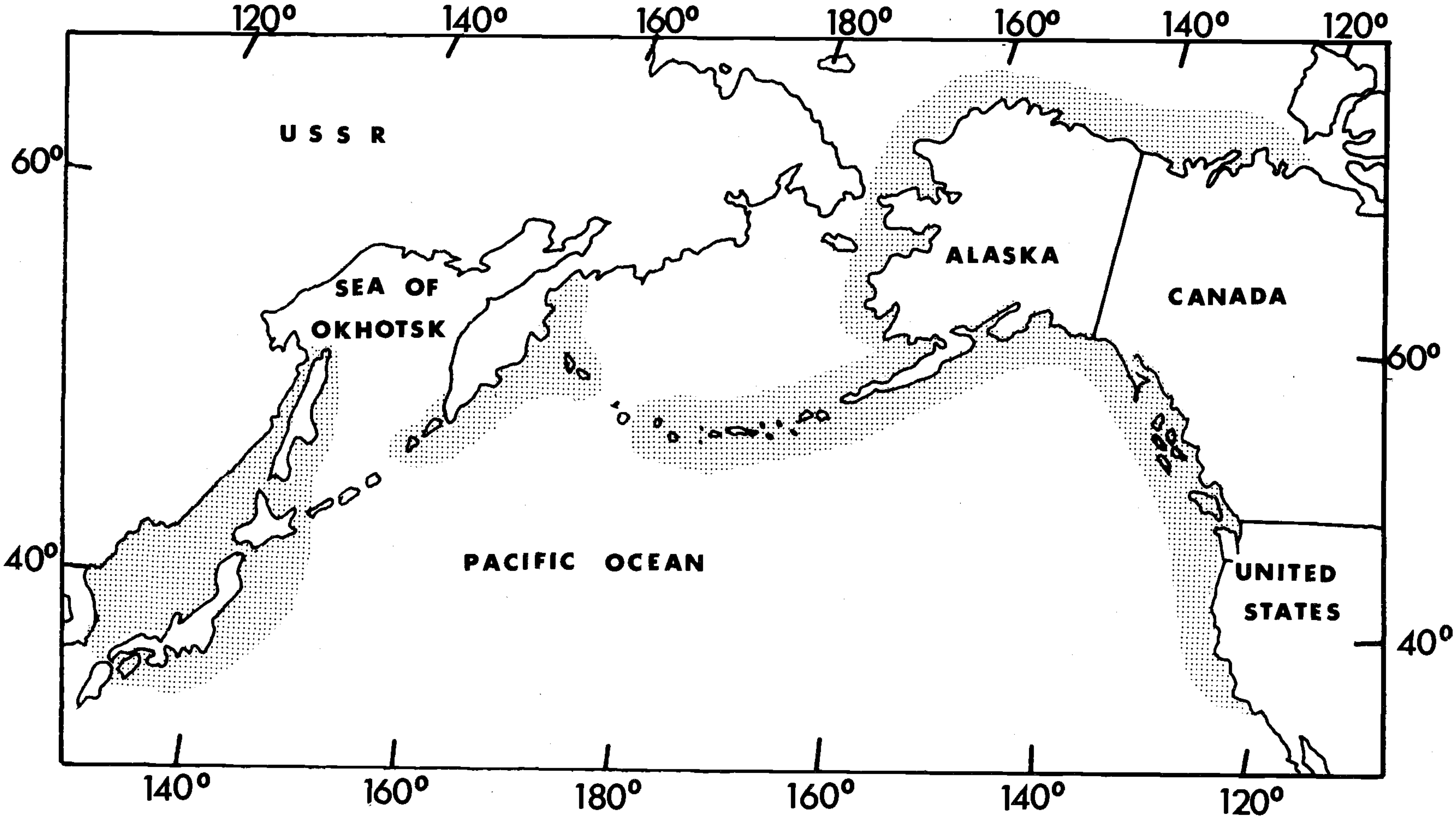


Figure 1. Geographic distribution of the starry flounder, Platichthys stellatus, indicated by the stippled areas.

to the Commander Islands and the Kamchatka Peninsula, then southward along the east coast of Kamchatka to the Kurile Islands. The southerly limit in the Western Pacific Ocean is Tokyo Bay on Honshu Island (Orcutt, 1950).

The white seaperch (Phanerodon furcatus), pile perch (Rhacochilus vacca), and striped seaperch (Embiotoca lateralis) belong to the family Embiotocidae (surfperches). One of the distinguishing characteristics of this family is the viviparous development of young. According to the American Fisheries Society (1960), the family Embiotocidae is represented by ten genera and 19 species in the marine waters of the United States and Canada, as well as by one fresh water species. The center of dispersal of North American embiotocids is central and southern California (Gnose, 1968) with individual species radiating north and south to southern Alaska and central Baja California, respectively (Tarp, 1952).

White seaperch have a silvery body coloration which is frequently accented by a yellowish tinge on the fins and a dark blotch on the anterior portion of the anal fin. The smooth continuous low margin of the dorsal fin easily distinguishes this species from the pile perch. Large specimens may reach 350 mm (TL). White seaperch occur from San Diego northward to Vancouver Island, Canada. They have the most limited distribution of the four species investigated.

Difference in height of the spinous and soft-rayed portions of the dorsal fin distinguishes the pile perch from other embiotocids. Generally the last spine is slightly more than half of the length of the first ray. Body coloration varies from a dusky grey on breeding males to silver in young fish. Most often a dusky vertical band is found between the base of the dorsal fin and the anterior portion of the base of the anal fin. Posterior to the mouth, a black spot frequently occurs on the preopercle. Wares (1968), using a Walford line, predicted maximum attainable total lengths of 432 mm for male and 490 mm for female pile perch. Squire (1964) reported that pile perch inhabit marine waters from northern Baja California to Port Wrangel, Alaska.

Striped seaperch are readily distinguished from other embiotocids by the colorful orange and blue longitudinal stripes on the sides of the head and body. The dorsal fin, in addition, has a low spinous portion with the last spine about three-quarters of the length of the first ray. Large specimens in Yaquina Bay reach 350 mm (TL) (Gnose, 1968). This species is found in marine waters from central Baja California to Port Wrangel, Alaska (Squire, 1964).

Yaquina Bay, Oregon, was selected as the study area because of its nearness to the Oregon State University campus in Corvallis, and the associated Marine Science Center in Newport. In addition, the existence of an established sport fishery and the availability of published hydrographical and biological material on the bay (i. e., Burt and McAlister, 1959; Dimick and Long, 1941; Frolander, 1964; Gnose, 1968; Kulm, 1965; Parrish, 1966; Stevens, 1966; Swedberg, 1965; and Snow and Demory, 1961) made it an excellent choice for my study.

Yaquina Bay is located on the central Oregon coast near the town of Newport, Oregon (Figure 2). This estuary is formed by the confluence of the Pacific Ocean and the Yaquina River, a small stream with headwaters in the Coast Range of mountains in Lincoln County, Oregon. Tidal influence extends 23 miles inland to Elk City, but the freshwater head of the bay lies approximately 15 miles east of Newport. The freshness of the water above Toledo severely limits the upstream movement of marine fishes so only that portion of the bay below Toledo was investigated.

Yaquina Bay varies in width from about two miles in the Sally's and King Slough area to about 400 feet near the town of Toledo. The lower estuary is characterized by numerous sloughs and tidal flats. Sediments range from clean sand in the lower bay to silty mud flats in the middle and upper regions. Barnacle- and algae-encrusted rocks extend into the water at many points, particularly near Yaquina, the perch hole, and the fyke net site (Figure 2).

Dredging, associated with industrial development, has greatly altered the bathymetry of the bay. Presently a channel 40 feet deep

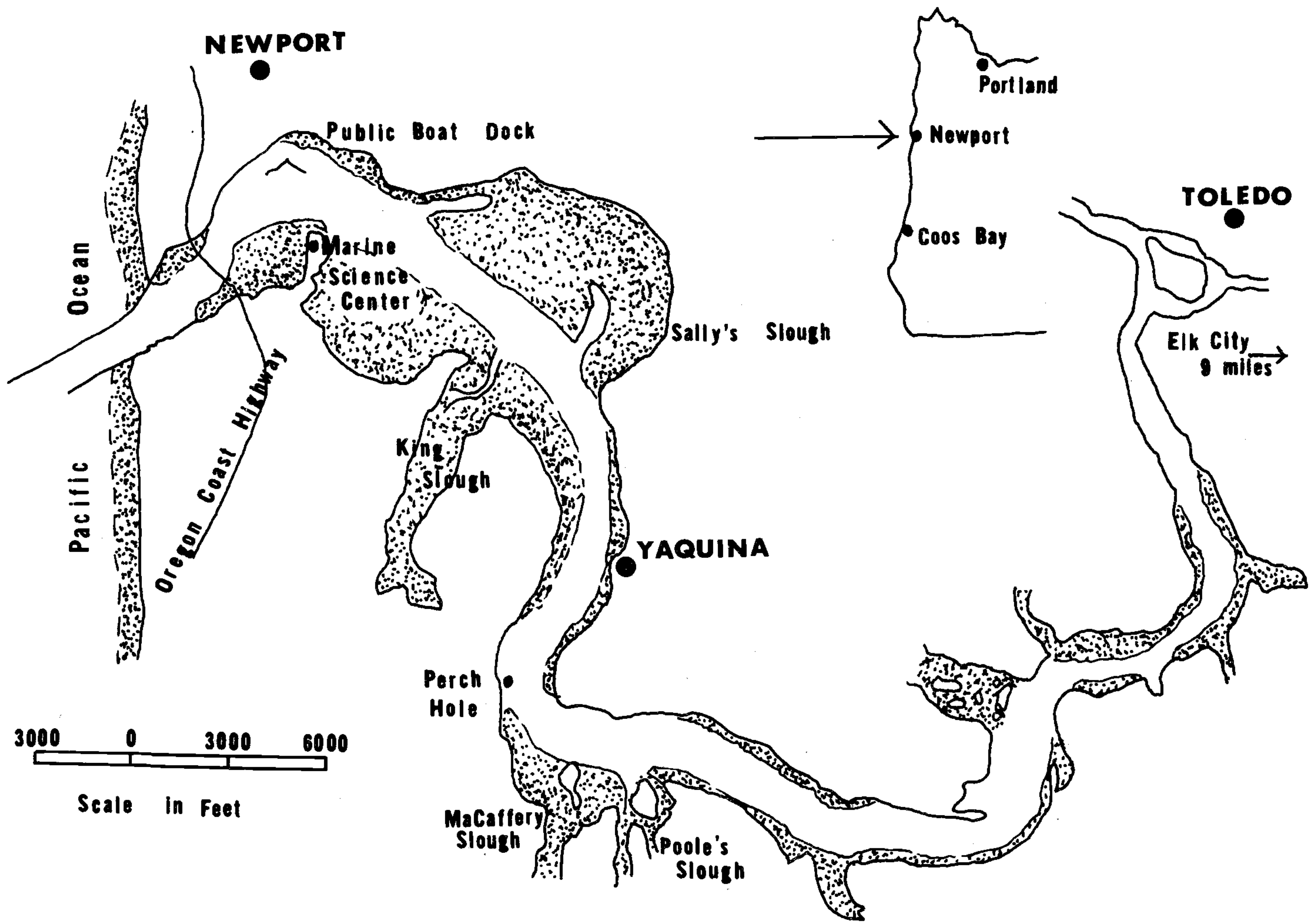


Figure 2. Yaquina Bay and River.

is maintained from the bay entrance to the freighter turnaround off McLean Point. From McLean Point to Toledo, mean low tide depth is about 12 feet.

As is characteristic of other estuaries, Yaquina Bay undergoes a semi-diurnal tidal mixing. These changes in tidal height are directly responsible for sudden changes in temperature, salinity, dissolved oxygen and turbidity, among others, which render the estuary a dynamic environment.

Burt and McAlister (1959) classified Oregon's estuaries on the basis of salinity changes from top to bottom: 20‰ or over, Type A; between 4 and 19‰, Type B; and 3‰ or less, Type D. A Type C estuary (no salinity gradient from top to bottom) has not been found in Oregon and was not considered in their paper. The salinity change used in classification was measured at high water at the station nearest to where mean salinity was 17‰ or half fresh and half salt water. From their data, one might conclude that Yaquina Bay is partly mixed (Type B) in the winter and spring and is well mixed (Type D) in the summer and fall. Reduced fresh water inflow in the summer and fall causes a salt water wedge to extend considerably further up the bay than in the spring and winter months. In addition, surface temperatures in the upper bay may exceed 20 C during the summer months, whereas upwelling along the open coast reduces summer water temperatures in the lower bay to nearly the minimum levels of the year (about 10 C). Gnose (1968) presented average monthly salinities and temperatures from four stations in Yaquina Bay. Unfortunately, tidal fluctuations were not considered during the sampling, so the data at best present only a generalized picture of temperature and salinity patterns during the year.

The volume of literature concerning the life history and biology of the starry flounder, white seaperch, pile perch, and striped seaperch is not large. Even more scarce are reports on the angler use of these fishes.

Orcutt (1950) studied the starry flounder in Monterey Bay, California (Figure 3), and wrote a comprehensive report on their systematic position, commercial catch, geographical variations, hybridization, food habits, parasites, and life history. In addition, he cited most of the previously published material pertinent to his study.

The migration of starry flounder tagged in the lower Columbia River, Oregon, was investigated by Westrheim (1955). Of the 1, 846 starry flounder tagged from 1951 to 1953, 111 (6%) were recaptured by December 31, 1954. The majority (85) were recovered in the Columbia River, but several (26) were captured in the Pacific Ocean. The southernmost recapture occurred in Yaquina Bay, approximately 125 miles from the tagging site. The northernmost recapture occurred near the Umatilla Lightship (Figure 3) on the northern

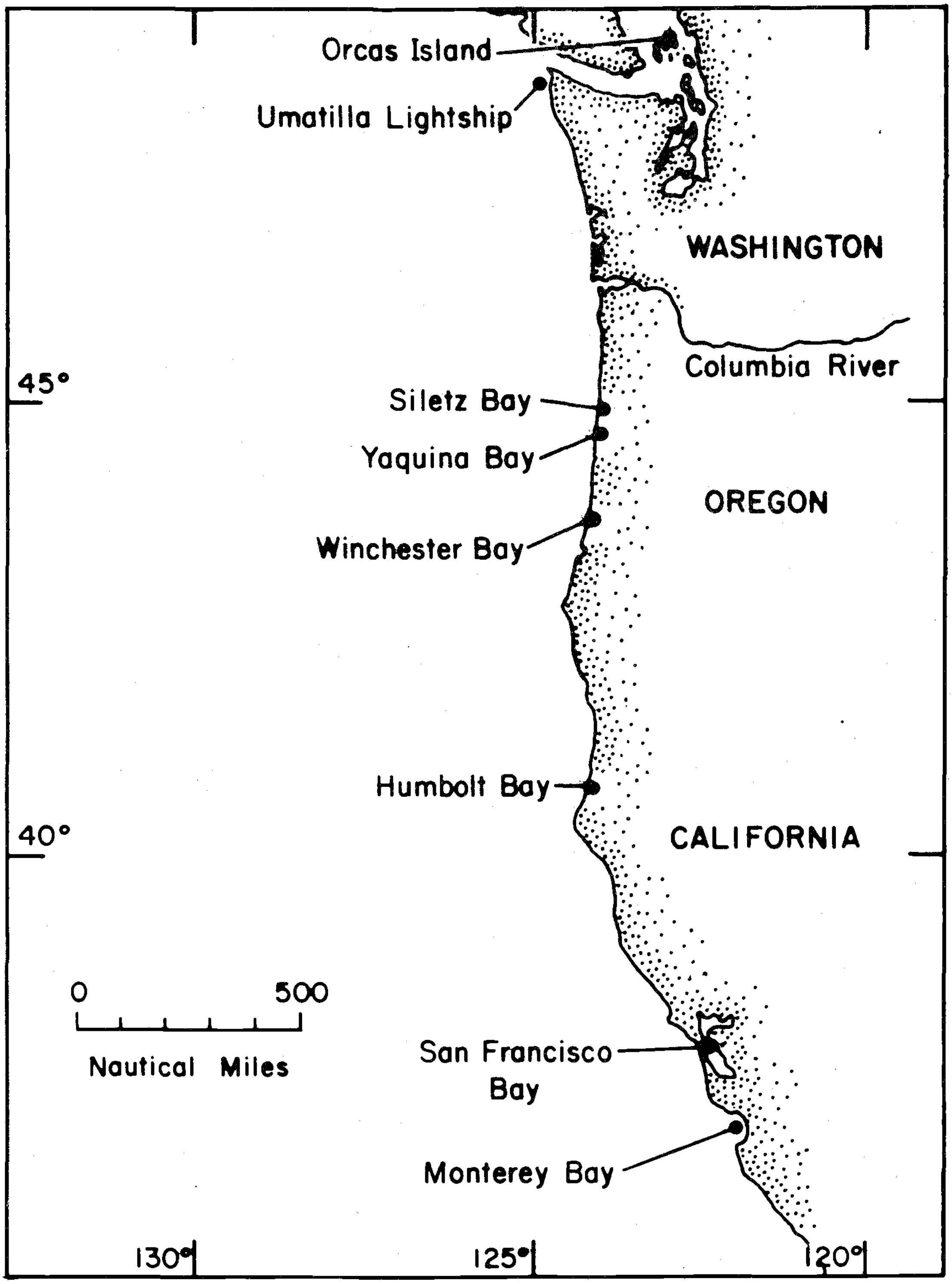


Figure 3. Coastal locations of past studies on the starry flounder and surfperches.

Washington coast, 130 miles from the tagging site.

The food habits of adult starry flounder captured near Orcas Island, Washington, were investigated by Miller (1967). He reported that flounder fed mainly on priapulids, nemerteans, polychaetes, and lamellibranchs. Feeding ceased during the months of lowest water temperature (winter) bringing about a generally poor physical condition.

Tarp (1952) published a taxonomic revision of the surfperches in which 23 species were described. Descriptions of adults and juveniles, geographical distribution, general life histories, and evolution of the species were emphasized. Many meristic counts were included.

In Siletz Bay, Oregon (Figure 3), Morgan (1961) used fyke nets to capture surfperch for tagging. A total of 1,409 pile perch, 397 striped perch, and 81 walleye perch (Hyperprosopon argenteum) were tagged. Recoveries were confined to Siletz Bay and to an area three miles north of the bay.

Several student theses focused research on the life history or biology of embiotocids. Gordon (1965) and Suomela (1931) studied age and growth relationships of the shiner seaperch (Cymatogaster aggregata) collected in British Columbia and Puget Sound, Washington. Sivalingham (1953), Swedberg (1965), and Gnose (1968) studied the general biology of the striped seaperch collected from Puget

Sound and Yaquina Bay, respectively. Wares (1968) investigated the biology of the pile perch in Yaquina Bay, Oregon. Parrish (1966) considered the predicted influence of Kraft mill effluent on the distribution of sportfishes (including several embiotocids and the starry flounder) in Yaquina Bay, Oregon. Smith (1967) studied population dynamics and ecology of the embiotocids of Humboldt Bay, California.

METHODS

Study Zones in Yaquina Bay

Yaquina Bay was divided into ten geographic study zones of nearly equal length (Figure 4). Essentially this division permitted greater accuracy in recording the location of tagged and recaptured fishes. Frequently the study zones were further divided, allowing even greater precision in the recording of sampling locations. Smaller divisions were particularly useful in plotting brief intra-estuarine movements of tagged fish. Boundaries for the study zones were:

Zone 1 - imaginary line drawn from west end of north and south Yaquina Bay jetties to highway bridge crossing the bay (U. S. 101 or Oregon Coast Highway).

Zone 2 - highway bridge up bay to imaginary line drawn between mill burner on NE side of bay (Lincoln Lumber Co.) and mill burner on SW side of bay (Triangle Pacific Lumber).

Zone 3 - line drawn from two mill burners up bay to imaginary line from Coquille Point to point on south side of King Slough.

Zone 4 - King Slough.

Zone 5 - imaginary line drawn between Coquille Point and point on south side of King Slough up bay to overhead powerlines north of Riverbend Marina.

Zone 6 - overhead power lines up bay to imaginary line drawn from mouth of Poole Slough to white navigation marker 25 on edge of Yaquina Bay Road.

Zone 7 - imaginary line drawn between Poole Slough and navigation marker 25 up bay to imaginary line between Flesher Slough, navigation buoy 28 and Yaquina Bay Road.

Zone 8 - imaginary line from Flesher Slough, navigation buoy 28 and Yaquina Bay Road up bay to imaginary line drawn between up bay end of log rafts (or pilings), navigation buoy 36, and Yaquina Bay Road,

Zone 9 - upper end log rafts, navigation buoy 36, and Yaquina Bay Road to imaginary line drawn from Jack's Sport Dock to navigation buoy 47 to Yaquina Bay Road on west side of bay.

Zone 10 - imaginary line from Jack's Sport Dock, navigation buoy 47, Yaquina Bay Road up bay to Georgia Pacific Mill in Toledo.

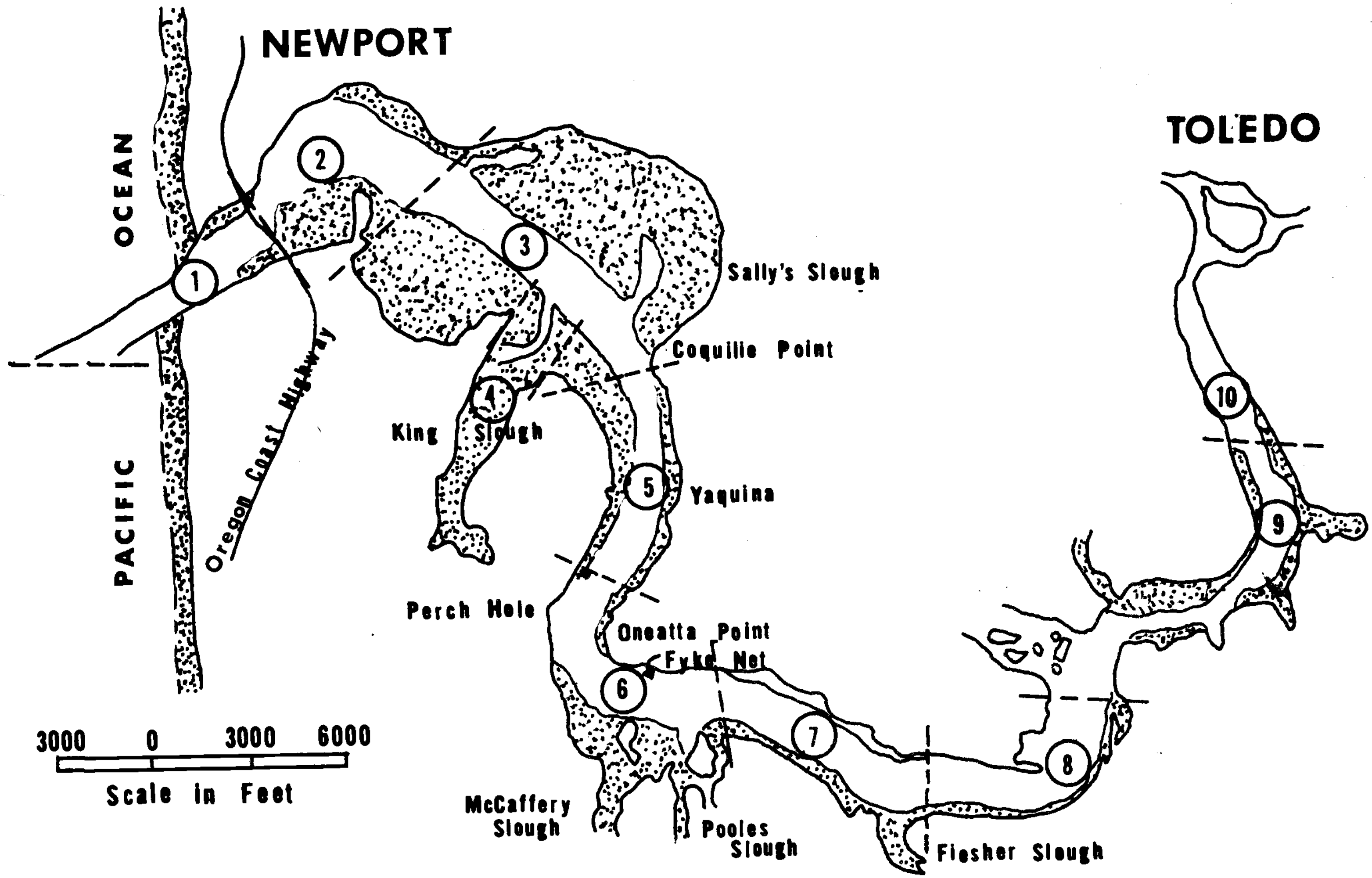


Figure 4. Location of the 10 study zones in Yaquina Bay, Oregon.

Sampling Gear

The five principal types of gear used to collect fish for tagging and study were gill nets, otter trawl, fyke net, beach seine, and hook and line. Work on the bay was conducted from an open boat powered by an 18 hp outboard motor.

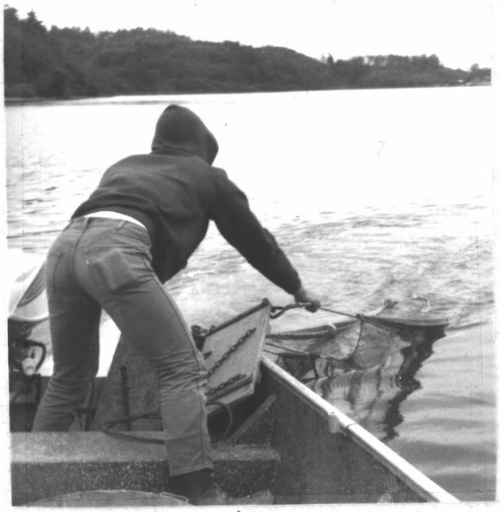
Gill nets were used to collect surfperch in all areas of the bay. Both monofilament and multifilament nylon nets were employed with the monofilament being more effective in numbers of fish caught. The monofilament nets were 100 feet long by 5 feet deep and contained four panels with stretched mesh sizes of 2, 3, 3 1/2, and 4 1/2 inches, respectively. This variation in mesh size ensured a more random sample of perch. The multifilament net was composed of five-inch stretch mesh and measured 300 feet long by 12 feet deep. The relative inefficiency of this net was probably due to the large mesh diameter and the conspicuous nature of the multifilament white thread used in its construction.

The gill nets were set perpendicular to the tidal current during slack water. A set during low tide was preferred due to the tendency of the net to fill with debris during ebbing tide. The nets were heavily anchored at both ends to ensure as great a netting surface as possible. Sets were limited to six hours since Dungeness crabs (*Cancer magister*) severely damaged the net and its contents over a longer period of time. Fish caught in gill nets were rarely tagged and released due to the high incidence of net-caused injury.

The semi-balloon otter trawl (Figure 5C), frequently referred to as a shrimp try-net, contained a 16-foot headrope and a 19-foot footrope. The body of the net was constructed of No. 9 thread (1 1/2-inch stretch mesh), while the cod end was composed of No. 15 thread (1 1/4-inch stretch mesh). A quick release knot around the cod end of the net permitted prompt removal of fish (Figure 5B). The otter trawl, towed predominantly in the channels at low tide (Figure 6), was effective in catching most bottom fauna, including crabs, shrimps, sculpins, flatfishes, blennies, cods, and young surfperches. The otter trawl was towed as rapidly as possible, and was the principal means of collecting starry flounder.

The fyke net (Figure 7), 10 feet in diameter and 18 feet long, was borrowed from the Fish Commission of Oregon to aid in the collection of surfperch. Basically a fyke net is composed of a series of cones which progressively decrease in diameter of the opening from the entrance to the cod end. The net was positioned near navigation buoy number 25 on the Yaquina Bay Road (Figure 4).

Placed on a sloping bank, the fyke net rolled into the channel of the estuary due to its own weight. A stainless steel cable was wrapped over the center of the net so that as the net rolled, the cable was wrapped around the net. The cable was passed through a block



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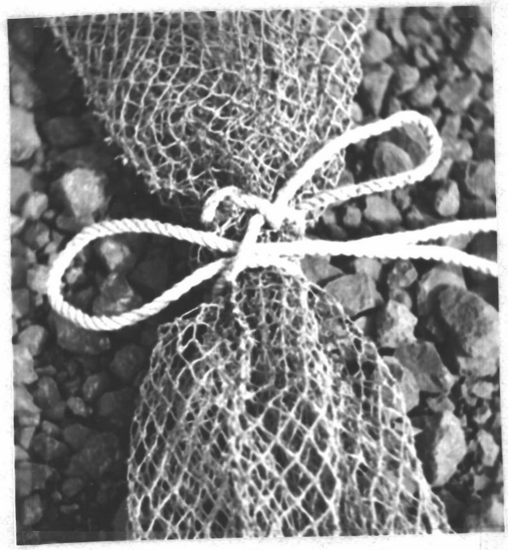

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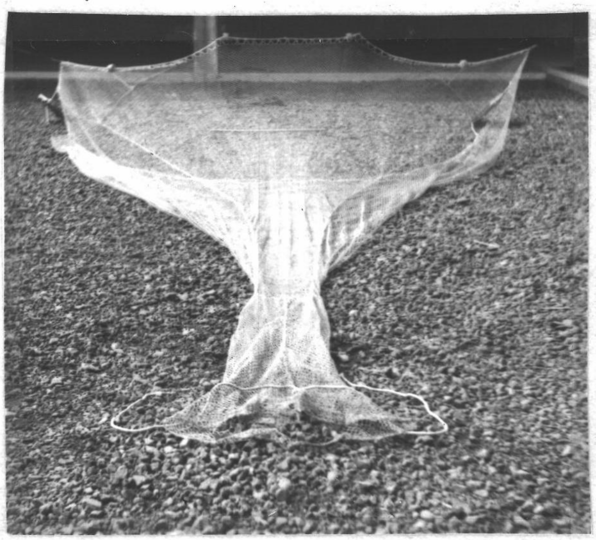

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Figure 5. Use of the otter trawl. (A) setting or retrieving the net while the boat is circling to the port (B) quick release knot tied on the cod end (C) overall view of the net (a yardstick has been placed at the mouth).

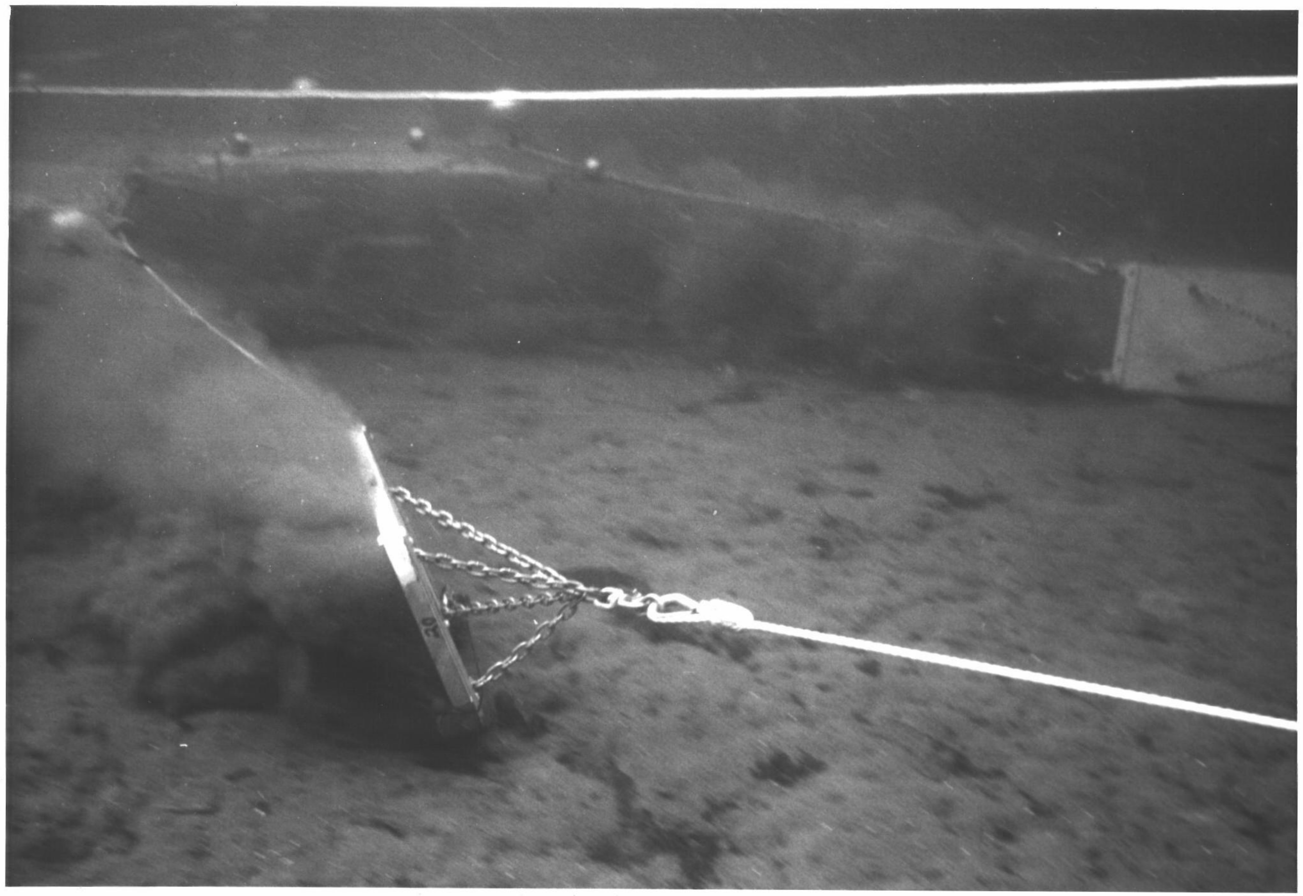


Figure 6. Underwater view of shrimp try-net or otter trawl. (Bill High photo)

Figure 7. Fyke net used to capture surfperches and other estuarine fishes in Yaquina Bay, Oregon.

that acted as a fairlead to keep the net parallel to the shore as it was set. When the free end of the cable was pulled by a truck, the net rolled onto the bank where its contents could be examined. Generally the net was set for a complete tidal cycle; i. e., from low tide to low tide, with the mouth of the net positioned upstream. The fyke net was the most efficient method for collecting surfperch during the summer months. The corrosive action of saltwater on the unprotected steel netting caused numerous holes that necessitated frequent repairs and loss of fishing time. The fyke net was not used during winter months because of stormy weather and poor fishing.

A large beach seine was employed during low tide periods in areas of the bay where mudflats gently sloped into tidal channels. The large size of the available seine; i. e., 200 feet long by 8 feet deep, made it rather cumbersome to set and retrieve. Therefore only two or three sets could be made during one low tide. The 1/2-inch square mesh of the bag was small enough to obtain a random sample of the entire fish population within the confines of the net. The beach seine made possible the rapid capture of a great number of perch with little injury to the fish. Subsequently, many seine-caught surfperch were tagged and released.

Angling with hook and line proved to be a useful technique for sampling surfperch. In rocky areas and around pilings, angling was often the only way to capture numbers of these fishes. During the summer months, when surfperch females were pregnant, angling allowed collection of fish with little or no damage to the adults and embryos. Little information on the size, age class, and sex of surfperch entering the sport catch could be derived from the infrequent returns of tags by sportfishermen. Angling, however, yielded samples of the surfperch populations in a manner identical to that used by sportfishermen, and provided some insight into the sizes and kinds of fish captured by anglers.

In open water areas of the bay, mud shrimp (Upogebia) or ghost shrimp (Callianassa) were used as bait. Whole barnacles (Balanus) were productive bait when fished from docks or near pilings. Owing to the excellent condition of hook and line caught surfperch, many were tagged and released into the bay.

Species Composition

Since an estuary undergoes seasonal as well as tidal changes in temperature and salinity, these changes could possibly account for the seasonal abundance and distribution of various estuarine fishes. A sampling program was conducted in all ten areas of the bay to see if other fish, in addition to those investigated, showed seasonal variations in abundance. The investigation was conducted during two successive days having relatively low tides during daylight hours. Three five-minute otter trawl tows were made per zone and five zones were sampled per day. The exact position and direction of the five-minute tows were indicated on a map. Tidal state, temperature, and salinity of the water were generally recorded for each zone. All organisms captured were placed in a large washtub and counted by species. Relative sizes of the fish were recorded. Ideally such an investigation requires equal effort throughout the year. Unfortunately, inclement weather and lack of daylight low tides limited sampling during the winter months.

The species composition of all gill net sets, seine hauls, and fyke net sets were also recorded.

Age Determination

Frequency polygons depicting the number of flounder in a sample at a particular length were not satisfactory for estimating the age of flounder. Only the first age class was distinct, with age classes of older fish overlapping in length.

The superficial scales of the starry flounder are frequently covered with spinous, stellate plates which obscure the scale circuli. In addition, the small naked cycloid scales are commonly imbedded in the skin. Because these small scales are difficult to handle and read, I elected to use otoliths as a means of determining age in starry flounder. Otoliths were removed from fish of known length, weight, and sex and placed in a one to one mixture of glycerin and water for two weeks before they were examined. The otolith rings were most easily read at the anterior end with the concave surface upward. Orcutt (1950) found in all cases that the translucent, dark concentric rings of the otolith agreed in number to the annuli on scales from the same fish. This was verified with Yaquina Bay flounder.

Scales were collected from all surfperch at the time of tagging. Gnose (1968) and Wares (1968) investigated age and growth in the striped and pile perch in Yaquina Bay; I did not duplicate their work. Scales from recaptured fish of all three species and all scales from the white seaperch were mounted on gummed tape and impressed on acetate cards. A scale press with heated platens was used to make the impressions. Best impressions were made at 6, 700 psi of pressure at 100 C for five minutes. Scales were examined on an Eberbach scale projector for age determination.

Tagging Procedure

The minimum total lengths of fish tagged were arbitrarily set at 20 cm for starry flounder and 26 cm for surfperch since placement of tags on smaller fish could impair their mobility and subsequent survival. All fish were tagged and released at the position of capture. Tags were consecutively numbered so information at the time of tagging could be correlated with fish subsequently recaptured.

On each tag was printed a number, the address of the Marine Science Center in Newport, Oregon, and instructions for mailing the tag and capture information to the center.

During tagging procedures, the salinity and temperature of the water at the surface and bottom were generally recorded using a Kemmerer water bottle, thermometer, and hydrometers.

Starry flounder were tagged with plastic, Petersen-type discs. These tags were placed beneath the base of the dorsal fin midway along the body using a nickel pin. An attempt was made to position the return address side of the tag on the blind side of the flounder with the inscription facing outward.. This portion of the tag would therefore remain free of debris and could be easily read by a sportfisherman. The numbered surface of the other tag was placed against the flesh of the fish, protecting the numerals from possible abrasion by sand and silt.

Eye rotation, location of capture, weight to the nearest tenth of an ounce (converted later to grams) and length to the nearest millimeter were recorded. In addition, a scale sample from the dorsal surface of the caudal peduncle on the blind side was removed, as recommended by Orcutt (1950) for possible age determination. Since no external sexual dimorphism exists in starry flounder, the sex of tagged individuals could not be recorded. The starry flounder is a hardy fish and may remain out of the water for up to one-half hour prior to tagging without apparent injurious effects.

Petersen-discs were not used on surfperch because of the unfavorable infection they caused in a previous investigation on the striped seaperch (Gnose, 1964, personal communication). During 1964 and 1965, surfperch were tagged with a bright yellow spaghetti tag passed underneath the posterior portion of the dorsal fin through the flesh of the fish. A figure-eight knot, tied close to the body of the fish, minimized fouling of the tag loop on barnacles, branches, etc. The trailing ends of the tag were clipped about 3 cm from the knot. After the first year of the study the ratio of recaptured to tagged fish seemed alarmingly low. At this time it was postulated that alternate types of tags might be more suited to these fish. Therefore in 1966, three additional types of tags were applied alternately with the original spaghetti tag. These alternate tags consisted of a clear spaghetti dart (a barb held the single tag into the side of the fish), a yellow spaghetti dart, and an experimental spahetti tag which was looped through the flesh of the fish but not tied. A plastic rod, partially inserted into the hollow center of this tag, was intended to prevent the tag from working free.

At the time of surfperch tagging, location in the bay, tag number, sex, length, and weight of the fish were recorded. Key scales were removed from the fourth scale row behind the pectoral fin on the left side of the body. Relative maturity of the embryos within the females was estimated and recorded.

Tag Advertisement

An extensive advertisement program was conducted in an attempt to increase the number of tags returned by sportfishermen. Publicity was concentrated in the Newport-Toledo areas as most of the tagged fish were taken in either Yaquina Bay or the nearby ocean. Weather resistant posters (Figure 8) were placed on pilings, telephone poles, trees, and buildings near the places most often frequented by sportfishermen. Similar posters were placed in the windows of sporting goods dealers, moorages, and charter boat offices. A slightly different address from that placed on the posters was used on the tags to determine if some sportsmen used the posters for additional information on tagged fish. Several tags were returned in envelopes bearing the address on the posters.

The following announcement was presented over Newport radio station KNPT and Toledo radio station KTDO several times a day during the spring and summer months of 1965, 1966, and 1967.

> The United States Fish and Wildlife Service in cooperation with the Department of Fisheries and Wildlife at Oregon State University is conducting a study on the white, pile, and striped surfperch and starry flounder in Yaquina Bay, Oregon. Many of these fish have been tagged and released in the bay. If one of these fish is caught bearing a bright yellow or colorless tag, please bring or send the tag to the Marine Science Laboratory, P. O. Box 157, Newport,

> Oregon, and give the date and approximate location of capture. Your cooperation in recovering these tags is essential to the study and will be greatly appreciated by those conducting the research.

Progress reports and news releases were occasionally presented by these same two radio stations.

Tagged flounder and surfperch were placed in the large observation chamber of the Undersea Gardens in Newport for viewing by the public. Tour guides called the attention of their patrons to these fish and briefly described the study being conducted in Yaquina Bay. A tagged fish poster was placed near the viewing area.

Several articles appeared in the local Newport and Toledo newspapers as well as major coverage that twice appeared in the Corvallis Gazette-Times and the Portland Oregonian.

Sportfishermen who returned tags were promptly sent information concerning the date, location, and size of the fish when tagged. Commercial fishermen were paid a one dollar reward for tags returned if information on date and location of capture was included. (The Fish Commission of Oregon pays a similar reward for tags returned from bottomfish.)

TAGGED FISH

The Department of Fisheries and Wildlife at Oregon State University in cooperation with the United States Fish and Wildlife Service is conducting a study on the movement and migration of the white, pile, and striped seaperch and the starry flounder in Yaquina Bay, Oregon. Many of these fish have been tagged and released in the bay.

If you catch a fish bearing a BRIGHT YELLOW TAG, please send the tag and the approximate location of capture to:

SEAPERCH AND FLOUNDER STUDY
MARINE SCIENCE LABORATORY
P. O. BOX 157
NEWPORT, OREGON

In return for this information we will return the tag to you along with the age of the fish and the time and location that the fish was tagged. Your cooperation in recovering these tags is essential to the study and will be greatly appreciated.

Figure 8. Poster used to publicize the tagging program to anglers in the Newport-Toledo area.

RESULTS

Starry Flounder

Age and Growth

Length-weight relationships were determined for a random sample of 189 female and 228 male starry flounder. The fish were captured by otter trawl in King Slough on December 12, 1966, and January 11, 1967. The computed regressions of $\log_{10}$ of weight (g) on $\log_{10}$ of length (mm) for males and females are shown in Figure 9. Frequency distributions of age classes and lengths in 50 mm intervals for both sexes are presented in Figure 10. The length-age distribution, including sample size, sex and percent mature are illustrated in Figure 11. Maturity was determined by examination of the gonads.

Tagging

Between July 21, 1964, and September 8, 1967, 6,385 starry flounder were tagged and released in Yaquina Bay. These fish were classified by date and location of tagging (Table 1). Dates were divided into the four summer months (June through September) when the tagging effort was greatest, and the eight months comprising the remainder of the year. During the summer of 1966, the number of flounder tagged was reduced because increased effort was placed

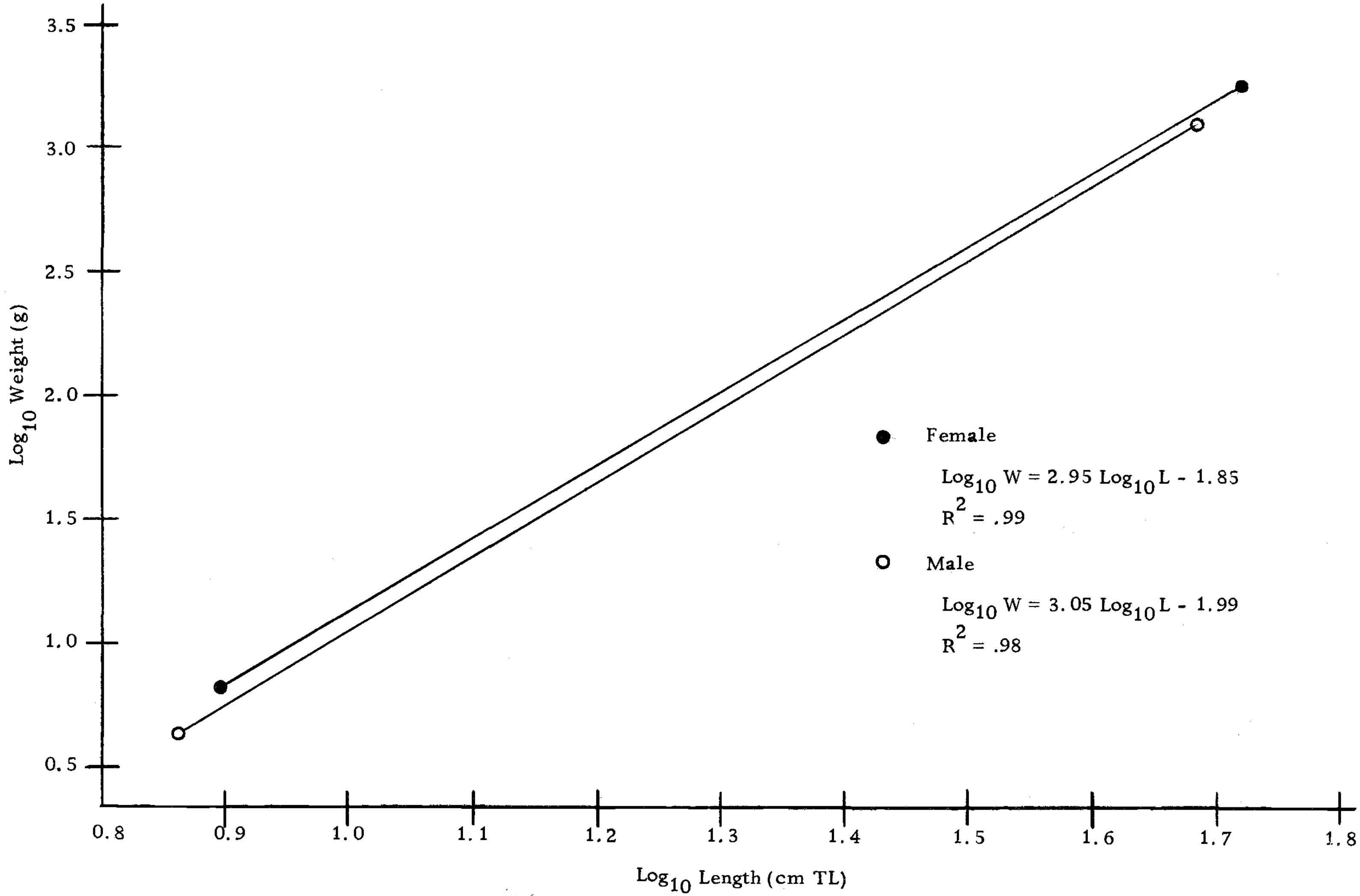
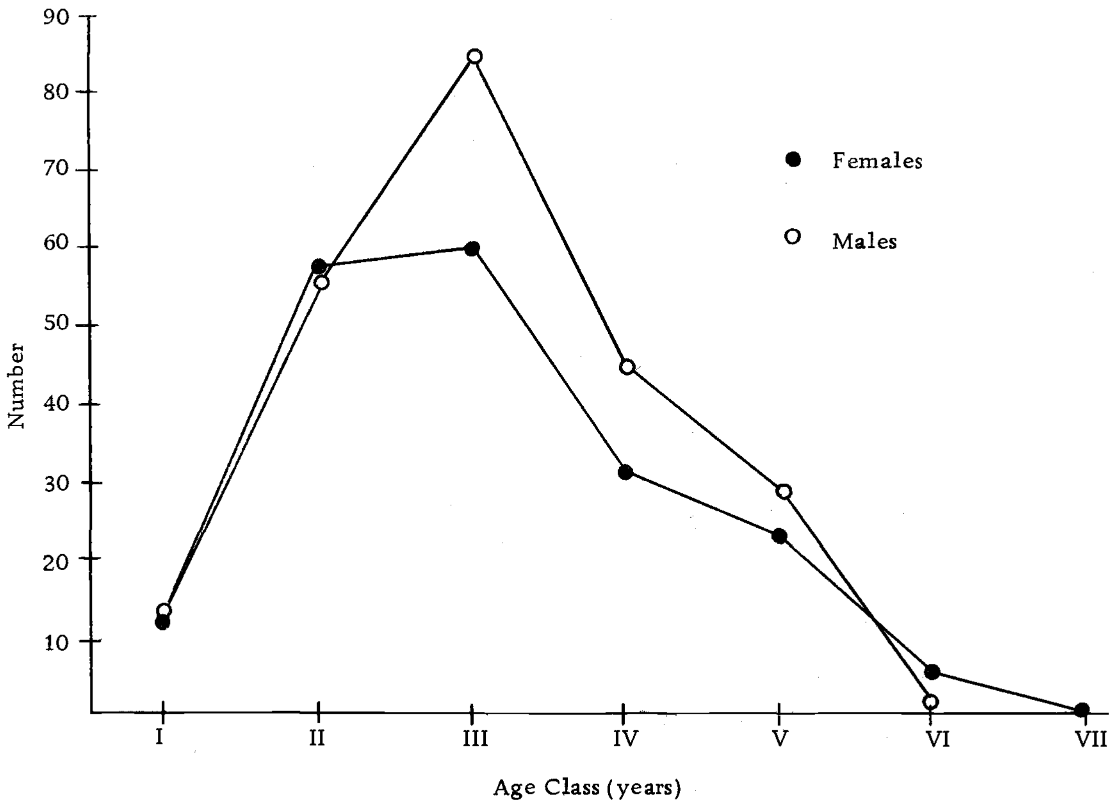


Figure 9. Length-weight relationships for 189 female and 228 male starry flounder collected in Yaquina Bay, Oregon, on December 12, 1966, and January 11, 1967.



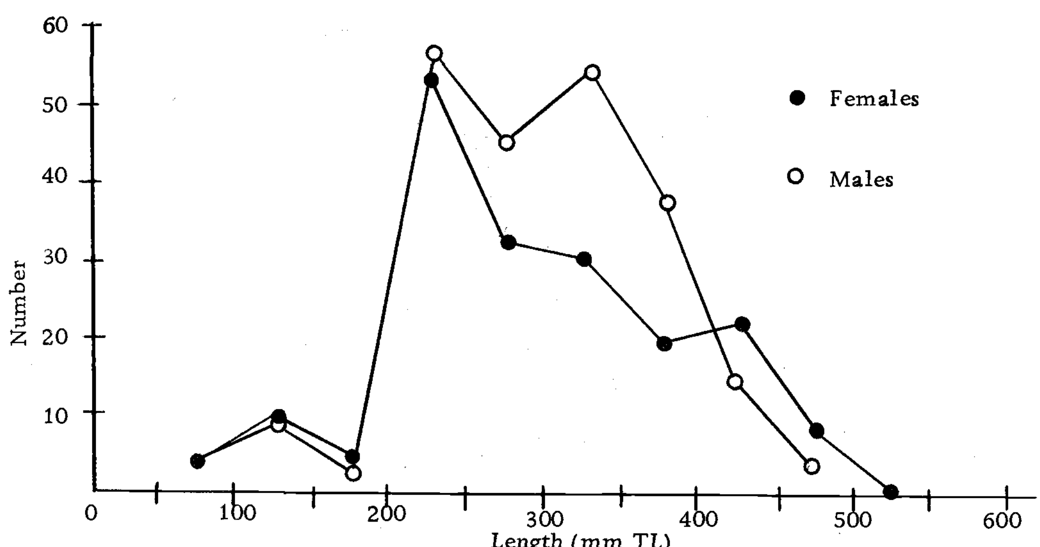


Figure 10. Age class and length frequency distributions for 189 female and 225 male starry flounder collected in Yaquina Bay, Oregon, on December 12, 1966, and January 11, 1967.

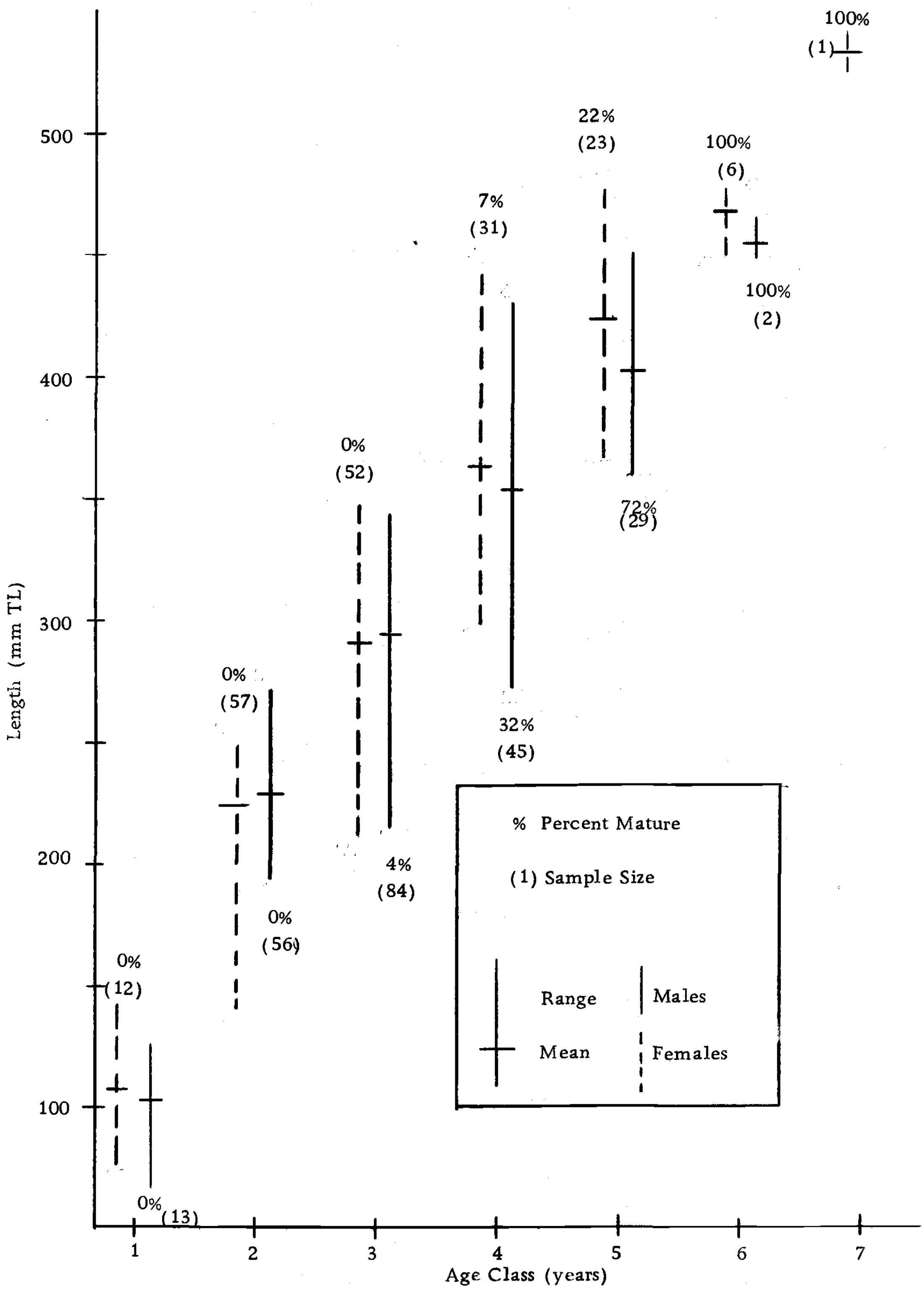


Figure 11. Percent maturity, range and mean of total lengths by age class for 189 female and 225 male starry flounder collected in Yaquina Bay, Oregon on December 12, 1966, and January 11, 1967.

Table 1. Date and location starry flounder were tagged in Yaquina Bay, Oregon.

Date Tagged	Study Zone										
	1	2	3	4	5	6	7	8	9	10	Totals
7/21/64 to 9/30/64	4	4	421	1	31	12	1	1	4	-	479
10/1/64 to 5/31/65	-	5	317	279	31	25	14	5	2	5	683
6/1/65 to 9/30/65	49	14	443	471	18	74	56	3	-	20	1148
10/1/65 to 5/31/66	-	-	378	111	23	5	-	-	3	1	521
6/1/66 to 9/30/66	1	4	195	5	5	5	2	1	1	-	219
10/1/66 to 5/31/67	71	3	223	604	75	53	7	-	-	-	1036
6/1/67 to 9/8/67	2	74	1264	912	41	6	-	-	-	-	2299
Totals	127	104	3241	2383	224	180	80	10	10	26	6385

on the tagging of surfperch.

Tag Recoveries

A total of 469 starry flounder was recaptured by November, 1968. This total represents 7.3% of those tagged. Of those recaptured, 256 were made by scientific investigators working in Yaquina Bay, 125 by sport fishermen in Yaquina Bay, 31 by sport fishermen outside Yaquina Bay, and 57 by commercial fishermen operating chiefly in the Pacific Ocean. Because field work associated with this project was essentially completed in September, 1967, few recaptures were made by investigators after this time. However, returns by sport and commercial fishermen continued until November, 1968, when these data were analysed.

Of the first 1000 starry flounder tagged, 135 (13.5%) were recaptured (seven fish were recaptured twice). A similar rate of recapture could be expected for the remaining tagged flounder if recapture effort remained the same. The maximum time at liberty (826 days) for a tagged flounder seemed to be regulated by an erosion of the tag surface which completely removed the imprinted data (several flounder captured while trawling in Yaquina Bay possessed eroded Petersen-discs with unreadable tag numbers). The manufacturer, Howitt Plastics Company, suggested that a "sand-blasting" effect, due to silt and sand, was causing the damage.

Recaptures by Investigators within Yaquina Bay

A total of 256 tagged flounder was recaptured by trawling in Yaquina Bay. Of this total, 238 flounder were released at the point of original capture; the remainder were transported to other locations in the bay for release. Only 15 of these 238 flounder migrated more than 200 yards from the point of release. When tagged, the mean length of the 15 fish that migrated was 283 mm TL as compared to 324 mm TL at tagging for all flounder recaptured while scientific trawling in Yaquina Bay.

During December, 1966, four starry flounder from King Slough were tagged and released in the Undersea Gardens aquarium in Newport, Oregon. During a winter storm these fish escaped and one was subsequently recaptured in King Slough. The infrequent occurrence of intraestuarine migration of tagged flounder and the apparent homing of a displaced flounder inferred that these fish might maintain a homespot in the estuary until the time of movement from the bay.

To determine whether a "homespot" hypothesis was valid or not, other flounder were captured in two areas of the bay, tagged and released in three different locations in the bay. Transported fish included 74 flounder taken from Sally's to King Slough on March 27, 1967 (group 1); 81 taken from King to Sally's Slough on April 1, 1967 (group 2); and 70 taken from Sally's Slough to the end of the Yaquina Bay south jetty on April 25, 1967 (group 3). Information on the release and recapture of these fish is presented in Table 2.

Of the group 1 fish (Sally's to King Slough) recaptured, 75% (6) were taken in the original capture location. In group 2, 67% (2) were recaptured in the original location of capture. Of the group 3 fish, 82% (9) were eventually recovered in Sally's Slough. The fish bearing tag number 2647 (Table 2) was originally tagged in Sally's Slough on April 2, 1966. It was recaptured in Sally's Slough and transported to the end of the south jetty. Subsequently it was recaptured in Sally's Slough on November 13, 1967.

Recaptures by Sport Fishermen Within Yaquina Bay

Sport fishermen angling in Yaquina Bay returned 125 starry flounder tags. Often information on the date and exact location of recapture was not enclosed with the tag. When the reported area of recapture or date seemed vague, a map with return address was sent to the sport fisherman so he could indicate the position and date of capture.

Of the 125 tags returned by sport fishermen, only 32 revealed intraestuarine migrations of more than 200 yards (the higher rate of intraestuarine migration in flounder caught by sport fishermen as compared to those captured by investigators in Yaquina Bay might

Table 2. Tag and recapture information on intraestuarine transplants of starry flounder in Yaquina Bay, Oregon.

Tag No.	Length (mm TL)	Recapture Date	Recapture Location
Group 1: 74 fish taken from Sally's to King Slough on March 27, 1967. (10.8% eventually recaptured)			
3985	332	4/ 1/67	mouth King Slough
3974	290	4/23/67	Sally's Slough
3754	477	7/11/67	Sally's Slough
3932	282	7/13/67	Sally's Slough
3957	349	8/ 9/67	South Jetty
3956	376	8/10/67	Sally's Slough
3978	271	8/10/67	Sally's Slough
3966	285	9/ 5/67	Sally's Slough
Group 2: 81 fish taken from King to Sally's Slough on April 1, 1967. (3.7% eventually recaptured)			
3891	297	6/20/67	King Slough
4000	479	7/ 2/67	Mouth King Slough
3882	248	8/ 8/67	Sally's Slough
Group 3: 70 fish taken from Sally's Slough to the end of the south jetty on April 25, 1967. (14.3% eventually recaptured)			
4048	355	6/ 9/67	Sally's Slough
4051	345	7/ 6/67	Zone 10
4038	291	7/19/67	Sally's Slough
4063	342	7/21/67	Sally's Slough
4042	399	7/21/67	Sally's Slough
4040	357	7/25/67	Sally's Slough
4032	292	8/ 6/67	Sally's Slough
4096	298	8/ 9/67	OSU Dock
4086	303	8/18/67	Sally's Slough
4053	330	9/ 7/67	Sally's Slough
2647	342	11/13/67	Sally's Slough

be explained by inaccurate reporting of capture location by sport fishermen). The average length at tagging of all flounders recaptured by sportfishermen inside Yaquina Bay was 327 mm TL.

In Figure 12 are plotted the recapture locations of 109 starry flounder caught by sport fishermen in Yaquina Bay. Popular fishing locations seemed to be: under the Oregon Coast Highway bridge; Idaho Point near King Slough; Coquille Point; Yaquina and the Perch Hole across from Riverbend Marina. Although 3, 241 tagged flounder were released in Sally's Slough (Table 1) and many were subsequently recaptured there by investigators, only eight fish were recaptured by sport fishermen in this area.

Hometown locations and the approximate highway mileage from Yaquina Bay are shown in Table 3 for 107 anglers returning flounder tags from the bay. Of this total only 16 people (15%) lived in the Newport-South Beach areas. Willamette Valley towns east of Yaquina Bay are well represented in this table.

Because tagged flounder were available in Yaquina Bay throughout the year, records on frequency of sport fishermen tag returns indicated the relative monthly fishing intensity. These data are shown in Table 4. In Figure 13, the monthly return of starry flounder tags by sport fishermen (data from Table 4) were plotted against the estimated monthly fishing pressure as estimated from an angler survey by Parrish (1966).

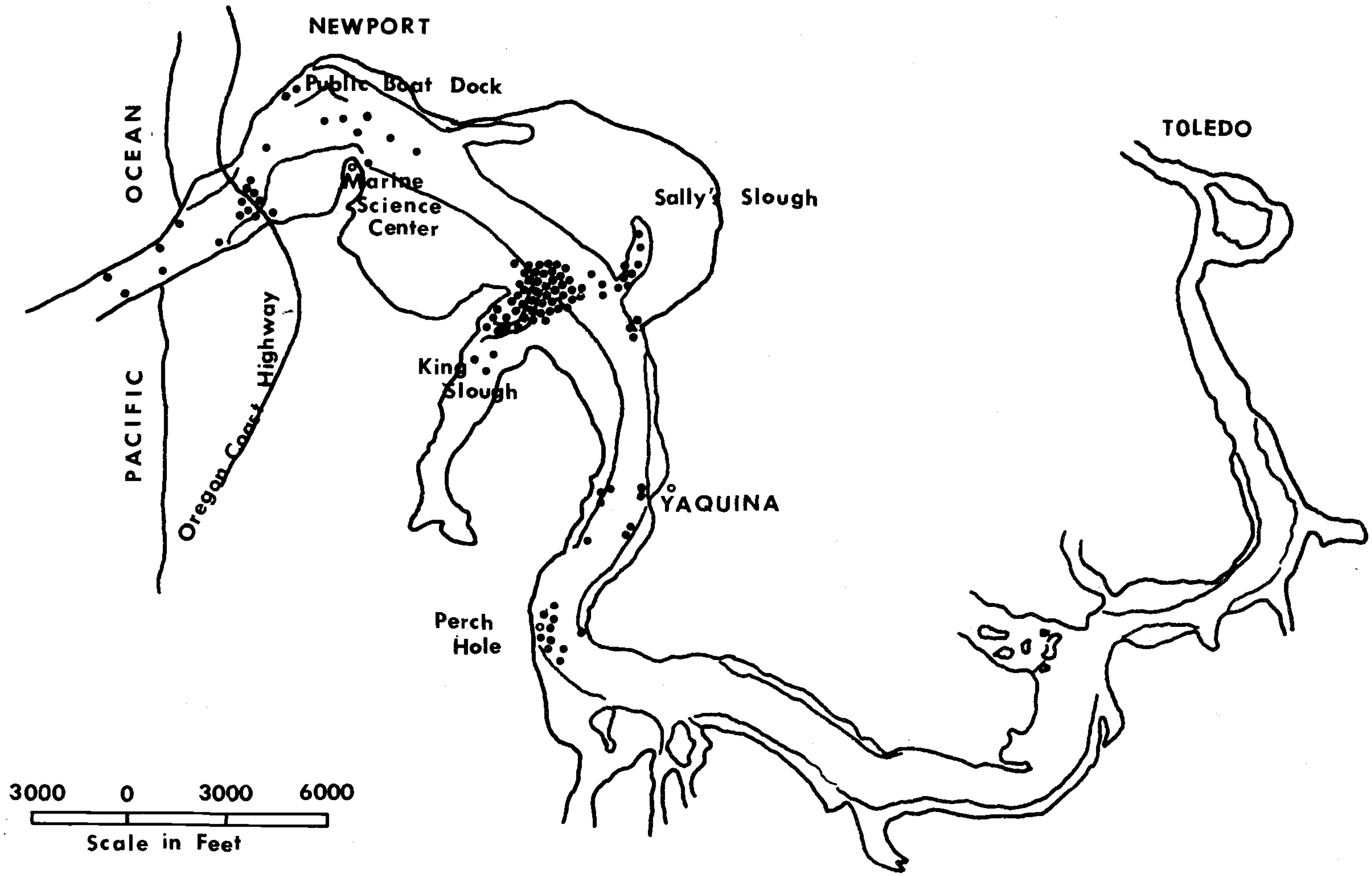


Figure 12. Location of recapture for 109 starry flounder caught by sport fishermen in Yaquina Bay, Oregon.

Table 3. Residence of sport fishermen returning tags from starry flounder caught in Yaquina Bay, Oregon, from February 23, 1965 to October 8, 1968.

Residence	Number of Returns	Highway Distance (miles) from Yaquina Bay
Oregon		
Corvallis	18	55
Newport	15	0
Albany	10	68
Salem	7	89
Portland	7	119
Lebanon	5	71
McMinnville	5	74
Dallas	3	72
Neotsu	3	27
Philomath	3	49
Depoe Bay	2	15
Independence	2	78
Silverton	2	99
Toledo	2	0
Aumsville	1	91
Burns	1	324
Gladstone	1	116
Jefferson	1	73
Leaburg	1	119
Lyons	1	96
Lake Oswego	1	114
Madras	1	213
Marcola	1	107
Milwaukie	1	114
Mollala	1	122
Oregon City	1	116
Otis	1	32
Sheridan	1	63
South Beach	1	0
Tualatin	1	114
Yachats	1	24
Waldport	1	16
California		
Martinez	1	606
Napa	1	595
Seiad Valley	1	347
Washington		
Longview	2	163

Table 4. Frequency of return of starry flounder tags from sport fishermen in Yaquina Bay by month and year.

Month	1965	1966	1967	1968	Totals
January	-	-	-	3	3
February	-	2	1	4	7
March	6	4	4	6	20
April	6	12	6	1	25
May	1	13	2	5	21
June	3	5	2	1	11
July	6	2	7	2	17
August	4	-	12	1	17
September	1	-	1	1	3
October	-	-	-	1	1
November	-	-	-	-	-
December	-	-	-	-	-
Totals	27	38	35	25	125

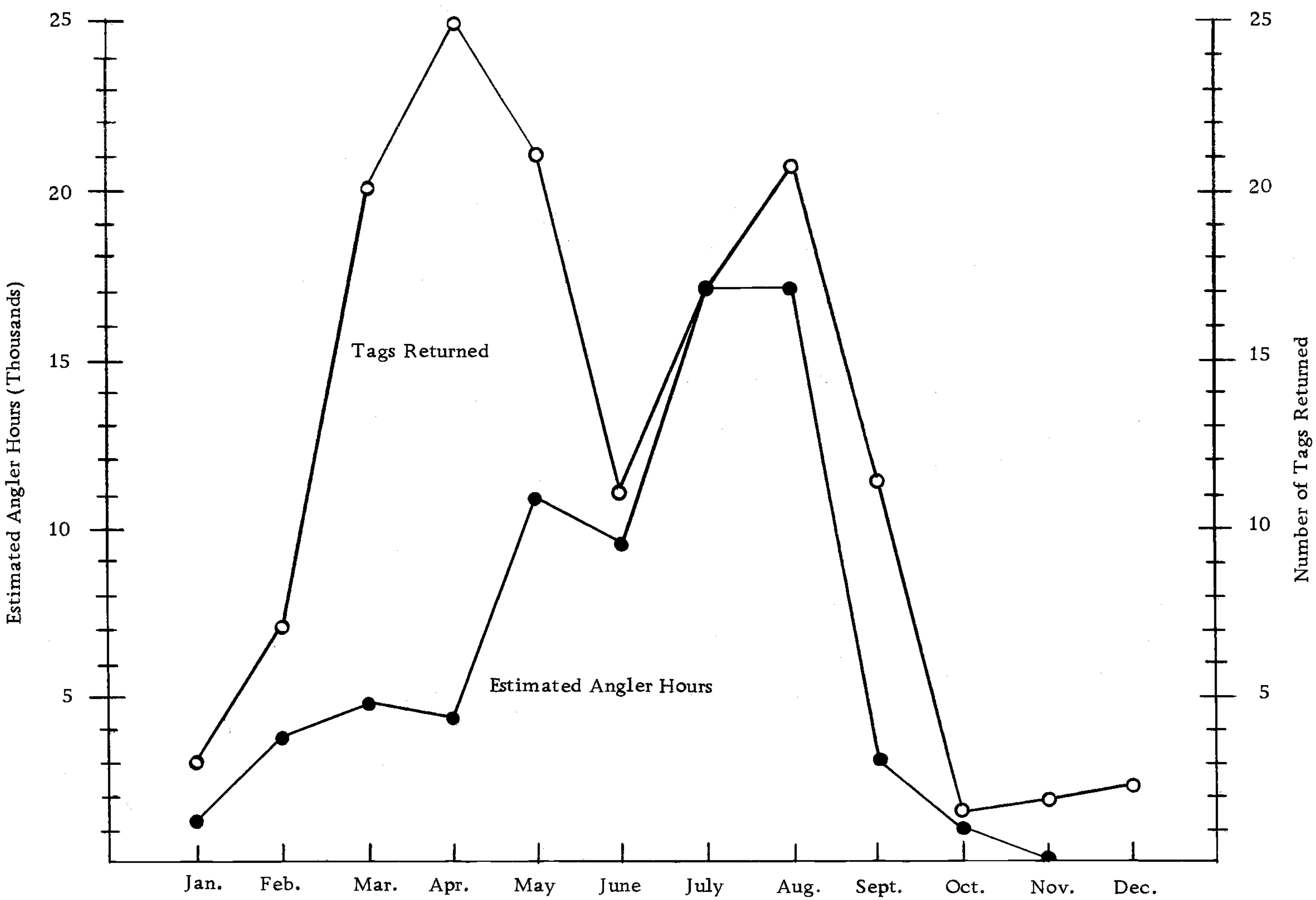


Figure 13. Comparison of the estimated angler hours per month spent sport fishing in Yaquina Bay (Parrish, 1966) and monthly return of starry flounder tags accumulated over a three year period.

Recaptures by Sport Fishermen Outside Yaquina Bay

Of the 31 tagged flounder recaptured by sport fishermen outside Yaquina Bay, the most northerly was made by an individual trolling for salmon near Willapa Bay, Washington, and the most southerly was outside Winchester Bay, Oregon (Figure 14). Other recaptures were made near the mouth of the Necanicum River, in Sand Lake, in Siletz Bay and near Florence and Tiernan on the Siuslaw River. The majority of ocean recaptures (21) occurred near the mouth of Yaquina Bay.

Recaptures by Commercial Fishermen Outside Yaquina Bay

Commercial fishermen, operating largely in the Pacific Ocean trawl fishery, returned 57 flounder tags. Gill nets in the Columbia River were responsible for one recapture near Megler, Washington, and two near the Point Adams Lifeboat Station (west of Warrenton, Oregon). The geographic distribution of tags returned by commercial fishermen is shown in Figure 15. Figure 16 represents a depth-frequency distribution of 25 tagged flounder captured by commercial fishermen in the Pacific Ocean.

Total length measurements reported for flounder recaptured by commercial fishermen indicated all fish were shorter than when tagged. The possibility of error in measurement was discounted

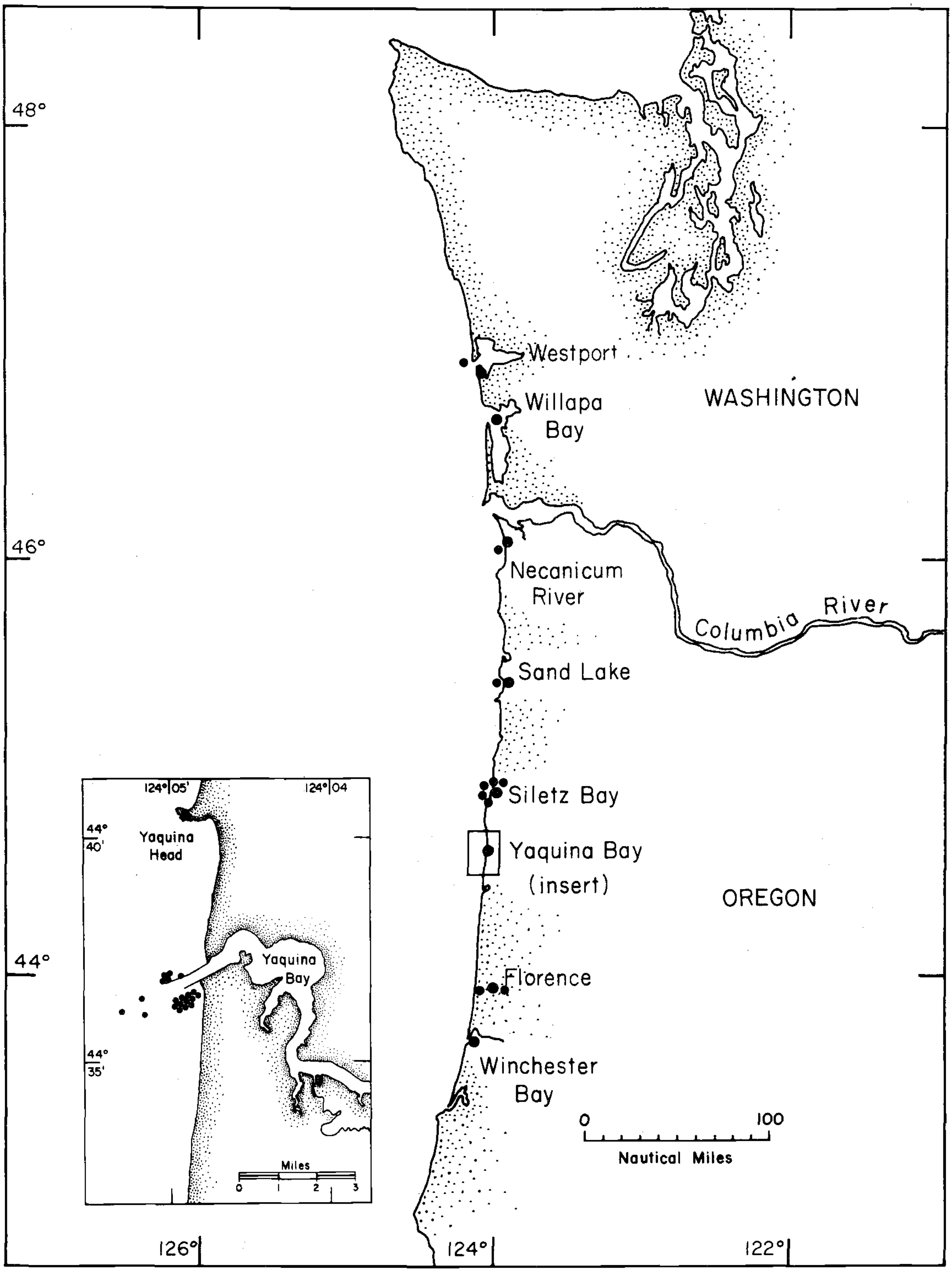


Figure 14. Locations where tagged flounder were caught outside Yaquina Bay by sport fishermen.

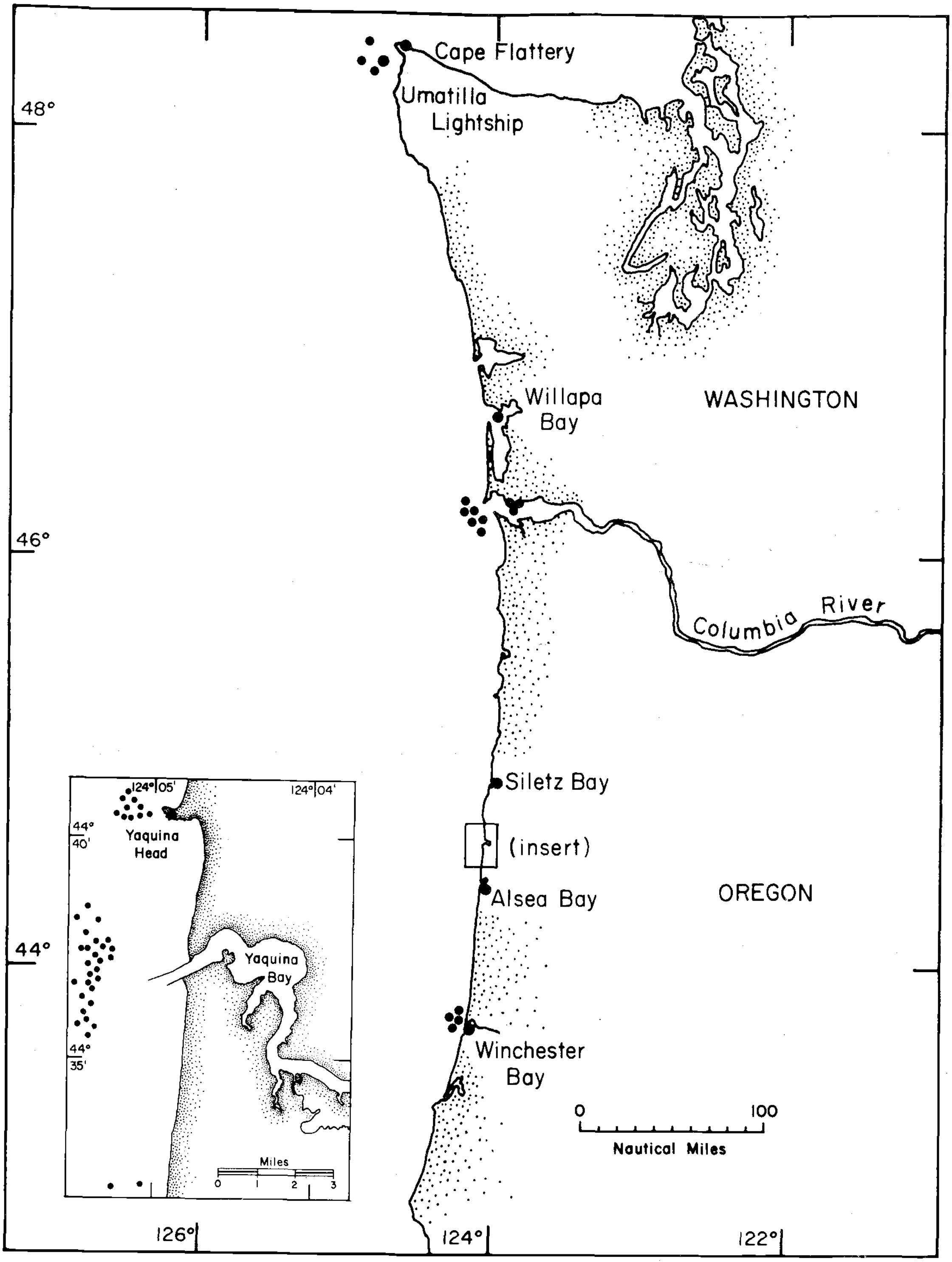


Figure 15. Locations where starry flounder were captured by commercial fishermen.

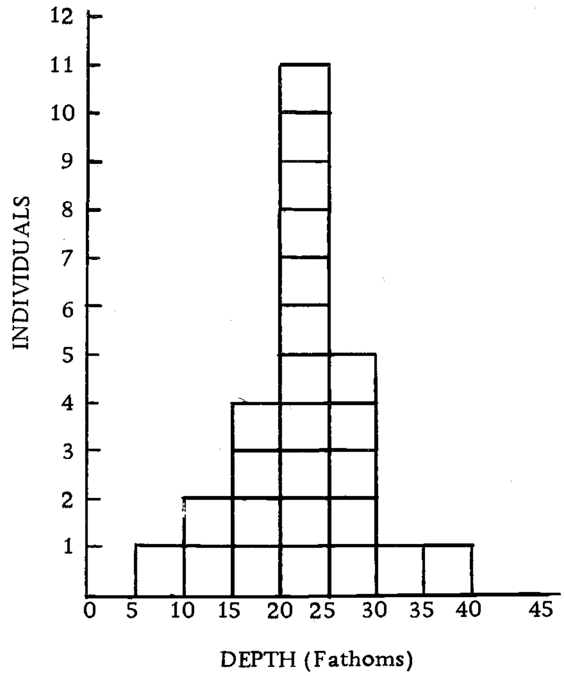


Figure 16. Depth-frequency distribution for 25 tagged starry flounder recaptured by commercial fishermen in the Pacific Ocean.

since all recaptured fish were shorter than when tagged (one would expect increases or decreases in total length on a random basis if measurement errors occurred).

An experiment was devised to estimate the post mortem shrinkage in starry flounder. In July, 1965, 20 flounder of varying length were collected in the Sally's Slough area of Yaquina Bay. Subsequently all were weighed, measured and tagged. Each flounder was paired with an individual of similar length and randomly one of each pair was removed from the sample. This resulted in two subsamples of ten fish which represented the size range of the sample. One subsample was placed in crushed ice in a constant temperature (1 C) cold room. The other was placed alive aboard the F/V Miss Connie, a commercial trawler, just prior to her departure from Newport on a fishing trip. The crew distributed the flounder in the hold with the fish from their first tow (approximately four hours later). After 80 hours, the flounders were removed from the hold of the vessel and the cold room. Final total lengths were taken without reference to previous measurements. Initial and final lengths are given in Table 5. Because of this shrinkage, a "contraction coefficient" of 1.5% was added to the measured total length of all starry flounder returned by the commercial trawl fishermen.

Table 5. Total lengths of starry flounder before and after 80 hours in a constant temperature (1 C) cold room and 80 hours in the iced fish hold of a commercial trawler.

Cold Room		Commercial Trawler	
Initial Length (mm)	Final Length (mm)	Initial Length (mm)	Final Length (mm)
224	222	300	296
285	281	310	305
315	312	354	350
325	324	367	358
335	335*	375	373
348	345	379	374
420	411	392	385
436	431	427	419
447	437	461	457
475	464	474	465
Mean reduction per fish - 4.8 mm (1.35%)		Mean reduction per fish - 5.7 mm (1.50%)	

*This flounder was alive at conclusion of the experiment.

Length Distribution by Recapture Category

Information on tag and recovery lengths (mm TL) and days at liberty for 469 recaptured starry flounder are presented in Table 6. Data on the mean length and range of lengths (mm TL) for 500 consecutively tagged flounder also are shown in this table.

Mean lengths at tagging for flounder recaptured in Yaquina Bay, including those recovered by scientists (324 mm TL) and sport

Table 6. Data on length (mm TL) when tagged and recovered and days at liberty for 469 recaptured starry flounder (data from Appendix 1), and on lengths (mm TL) for 500 consecutively tagged flounder.

		Number	Tagging Length		Recovery Length		Days at Liberty	
			Mean	Range	Mean	Range	Mean	Range
Recaptured inside Yaquina Bay								
A.	Scientists	256	324[a]	207-540	344	209-540	163	1-688
	Sport Fishermen	125	327[a]	230-511	374	243-551	250	7-670
Recaptured outside Yaquina Bay								
B.	Commercial Fishermen	57	407[b]	245-586	450	305-646	270	18-826
	Sport Fishermen	31	342[b]	269-472	387	275-528	258	21-535
C.	Pacific Ocean	76	389[c]	245-586	430			
	Bays or Rivers	12	320[c]	237-470	362			
Flounder consecutively tagged during Summer 1965		500	335[d]	201-563				

Statistical significance (t-test at 95%)

a/ No significant difference (.7234 with 379 d.f.)
b/ Significant difference (3.885 with 86 d.f.)
c/ Significant difference (6.470 with 86 d.f.)
d/ Significant difference with A (2.061 with 879 d.f.) Significant difference from B and C (5.051 with 586 d.f.)

fishermen (327 mm TL) were significantly shorter (Table 6) than the mean length for the 500 consecutively tagged flounder (335 mm TL). Mean lengths at tagging for flounder recaptured outside Yaquina Bay, including catches by commercial fishermen (407 mm TL) and sport fishermen (342 mm TL), were significantly longer (Table 6) than the averages for specimens recaptured inside the bay and the 500 consecutively tagged fish. Of the flounder recaptured outside Yaquina Bay, those in the Pacific Ocean were significantly longer (Table 6) at tagging (389 mm TL) than those recaptured in bays or rivers (320 mm TL). Specimens recaptured by scientific personnel within Yaquina Bay were generally at liberty for a shorter period of time (average 163 days) than those caught by sport fishermen within the bay (250 days) or commercial fishermen (270 days) or sport fishermen outside Yaquina Bay (258 days).

Growth of Tagged and Non-tagged Starry Flounder

The growth rate of a population may be estimated from tagged fish provided the length at tagging and recapture and the intervening time period are known. If growth rates of tagged fish are to approximate those of fish in nature, there must be no change in growth rate due to tagging. Comparison of growth in tagged and non-tagged flounder was made in Figure 17. Fish from the non-tagged population were represented by the diagonal regression line of Log_{10} length

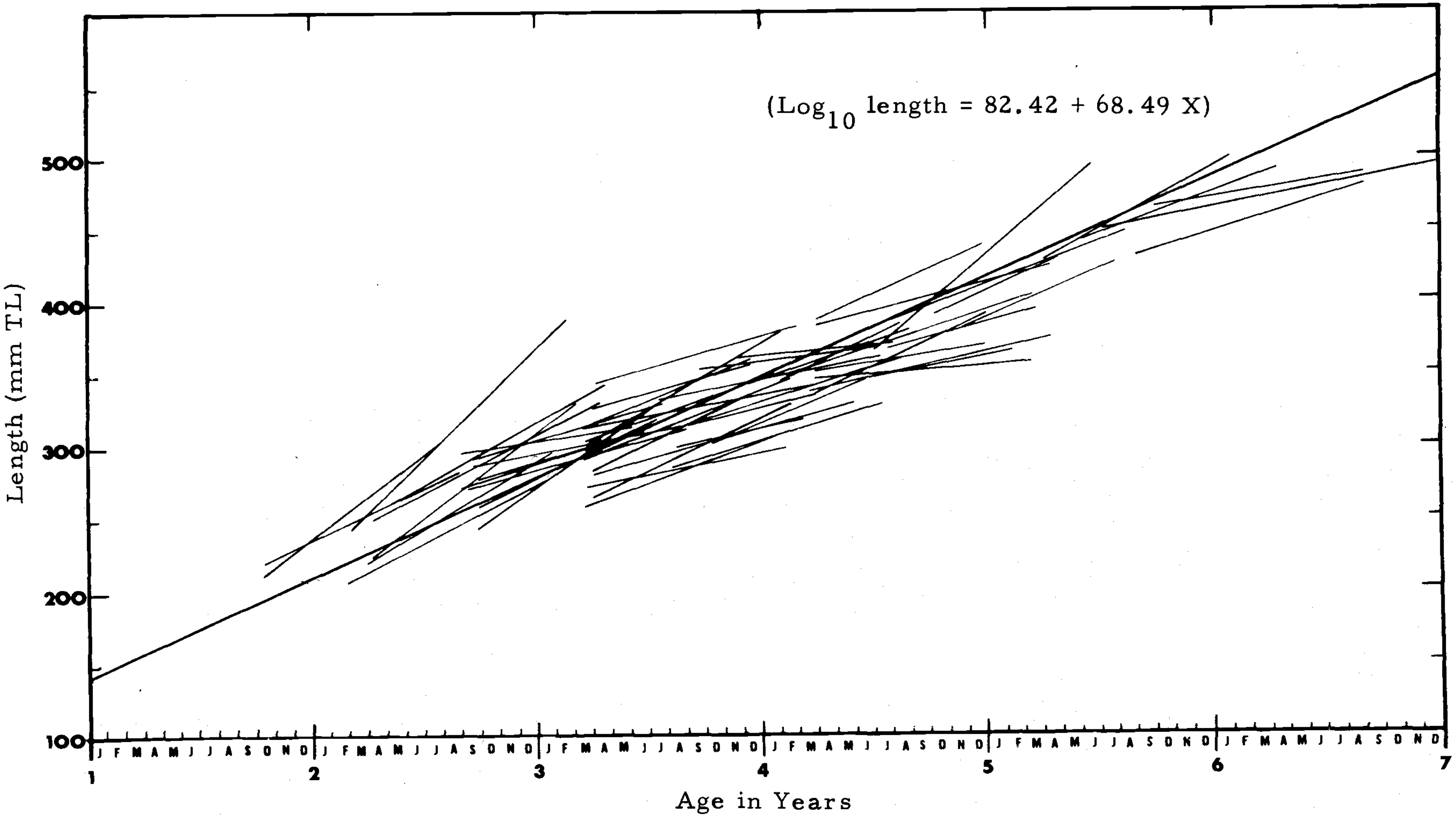


Figure 17. Comparison of length-age relationship (long diagonal line) of 420 starry flounder to growth of tagged flounder (short diagonal lines) at liberty for at least eight months (240 days). Growth comparisons for tagged and untagged flounder are represented by the angle between the regression line and growth lines for individual fish (parallel lines represent similar growth).

on age. The equation for this line (Log_{10} length = 82.42 + 68.49X where X is the age in years) was computed from length-age data on 420 starry flounder collected in Sally's Slough in January, 1968.

Individual lines in Figure 17 represents the growth of 55 tagged fish recaptured in Yaquina Bay by investigators. Only fish at liberty for at least eight months (240 days) are shown. In plotting the growth line for these fish, the month at tagging was correlated with the length and month in the year giving this point the least distance to the regression line, irrespective of the age class. The recapture length was then plotted the proper time interval from tagging and the two points connected by a straight line. In both the regression line representing growth in natural populations and the individual lines representing growth of tagged fish, the assumption of uniform growth throughout the year is made. Although this assumption is undoubtedly invalid, for the general purposes of this comparison, I found the growth rates of tagged and untagged flounder were not strikingly different. Use of fish at liberty for at least six months minimized the short term effect on growth that the tagging procedure may cause.

Population Estimates

An absolute estimate of population size using mark and recapture techniques requires, among other things, that marked individuals become randomly mixed with the unmarked or that the distribution of fishing effort is proportional to the number of fish present in different sections of the body of water (Ricker, 1958). Because starry flounder inhabit such a large area in Yaquina Bay and only limited manpower and equipment were available to sample these fish, it was not possible to meet the above requirement for a population estimate in the entire bay. To efficiently use existing manpower and gear, flounder were sampled and tagged during one week periods at low tide when fish were concentrated. Absolute population estimates for starry flounder were restricted to King Slough. Once the population of flounder in King Slough was determined, the population in the entire bay might be estimated knowing the area of the bay inhabited by flounder and the relative abundance in various sections of the bay as compared to the estimated population in King Slough.

King Slough is characterized by its relatively narrow opening to the main channel of Yaquina Bay, by its exposed mudflat and meandering channel during low tides (below two feet) and by the gradual decrease in depth (15 to 3 feet) of the channel as one proceeds from the mouth of the slough to the end of the study area. King Slough was divided into six study areas of nearly equal length which were used as reference locations for tagged and recaptured flounder (Figure 18).

Figure 18. King Slough showing the six study areas used in the estimation of the starry flounder population.

During the [0.0-to minus0.3-foot] daylight low tides between March 1 and 5, 1967, 500 starry flounder over 200 mm TL were captured and tagged in King Slough. During this period trawling effort was centered in study area 3 (Figure 18), but all areas were sampled at least once each day. All tagged fish were released in study area 3. Flounder were recaptured chiefly in study area 3 on days three and four (3-3-67 and 3-4-67), but on day five recoveries occurred only in areas 5 and 6. The water temperature and salinity varied from 9.4 C to 10.1 C and from 27.7 $^{o}/oo$ to 29.8 $^{o}/oo$ respectively during the five day study.

Table 8 contains computed population estimates based on the data in Table 7. The formulae of Petersen and modified Petersen (Ricker, 1958), Petersen with Jolly modification (Jolly, 1963) and Schnabel (Ricker, 1958) were used in these computations.

Petersen: $$N = \frac{MC}{R}$$

Modified Petersen: $$N = \frac{M(C + 1)}{R + 1}$$

where:

N = estimated population size

M = number marked

C = number subsequently sampled

R = number recaptured in C

Table 7. Information used for computing Petersen and Schnabel population estimates of starry flounder in King Slough from March 1 to 5, 1967.

Date	Number Captured C_t	Number Marked R_t	Marked Flounder At Large M_t	Number Recaptured	Day Recapture Tagged	Zone Where Recaptured	Jolly Mod. of M_t	C_tM_t
(1) 3-1-67	120	120	0	0	-	-		0
(2) 3-2-67	169	164	120	0	-	-		20,280
(3) 3-3-67	329	216	284	9	3-Day 1 6-Day 2	2-Zone 2 6-Zone 3 1-Zone 4	40	93,436
(4) 3-4-67	344	0	500	12	1-Day 2 11-Day 3	2-Zone 2 10-Zone 3		172,000
(5) 3-5-67	313	0	500	4	1-Day 2 3-Day 3	3-Zone 5 1-Zone 6		156,500
Totals	1,275	500	500	25				442,216

Table 8. Population estimates of starry flounder in King Slough during March 1 to 5, 1967.

Statistical Method	Population Estimate	95% Confidence Interval
Petersen		
Day 3	10, 381	8, 264 - 13, 960
Day 4	14, 333	12, 111 - 17, 552
Day 5	39, 125	21, 722 - 190, 909
Jolly Modficiation for Day 3	1, 462	1, 164 - 1, 966
Modified Petersen		
Day 3	9, 372	7, 643 - 12, 111
Day 4	13, 267	11, 364 - 15, 941
Day 5	31, 500	20, 190 - 70, 573
Jolly Modification for Day 3	1, 316	1, 073 - 1, 701
Schnabel	17, 688	16, 340 - 18, 474
Modified Schnabel	17, 008	15, 759 - 18, 472

Petersen with Jolly Modification (the Jolly Modification estimates the number originally tagged that were still available for recapture at time t):

$$M_t = S_t \cdot \frac{Z_t}{R_t} + m_t$$

where:

M_t = total number of marked animals in the population at time t

S_t = number marked at t

Z_t = number marked before t which are not caught at t but caught subsequently

R_t = number released at t caught subsequently

m_t = recaptures at t

Schnabel:
$$N = \frac{\Sigma(C_t \; M_t)}{R}$$

Modified Schnabel:
$$N = \frac{\Sigma(C_t M_t)}{R + 1}$$

A second attempt at starry flounder enumeration in King Slough was made during June, 1967. Flounder were released in the zone of capture (Table 9) rather than transporting them to study area 3 (Figure 18) as before. Trawling was adjusted so that approximately 25 flounder were caught in each study area each day. The low number of flounder recaptured (3) prevented use of these data for population estimation. Sampling was not conducted for a longer period of time due to the absence of minus tides.

Table 9. Number of starry flounder tagged and released in King Slough from June 19 to 23, 1967. In parentheses are given the day of tagging, zone of release and zone of recapture of the three recaptured flounder.

Date and Day of Tagging	Flounders Tagged by Zone					
	1	2	3	4	5	6
1 6-19-67				30	29	4
2 6-20-67	29	30 (1-1-4)	24	27	19	20
3 6-21-67	29	30	28	27	34	23
4 6-22-67	22	25	21	36	29	24
5 6-23-67	30	21	27	21 (1-4-6) (1-3-4)	23	30

Eye Rotation

Differences in morphology between geographical variations or races of fish have been used to recognize representatives of local populations found anywhere along the range of distribution of the species. One geographically variable characteristic of the starry flounder is the location of eyes and pigment on one side of the body or the other.

Gudger (1935), in summarizing the published records of reversed flatfishes, reported that the starry flounder in California is about 50% reversed (sinistral), in Alaska 75% reversed and in Japan practically 100% reversed. Papers by Hubbs and Kuronuma (1941), Townsend (1936), Lockington (1880) and Orcutt (1950) substantiate his data. In addition, Townsend (1937) looked at 530 Puget Sound starry flounder and reported that 52.1% were sinistral. Using a chi square test, Townsend (1937) found that the possibilities were fewer than one in a million that the differences between Puget Sound and Alaskan samples were due to chance variation alone. The complete sinistrality of Japanese starry flounder (Hubbs and Kuronuma, 1941) indicates this population is a distinct race.

Examination of 5,503 starry flounder from Yaquina Bay revealed 3,167 (57.6%) were sinistral. A similar degree of sinistrality has been reported in Puget Sound, San Francisco Bay and Monterey Bay (Table 10). However, a chi square test indicated a significant difference in the degree of sinistrality in these four collections (χ^2 with 3df = 9.8). In addition, all collections in Table 10 were compared using standard deviations between sample means. Results of this analysis (Table 11) indicate the samples from Puget Sound (Townsend, 1937), San Francisco (Lockington, 1880) and Monterey Bay (Orcutt, 1950) do not differ from the Yaquina collection with a > 96% confidence level. The suggestion by Orcutt (1950) that there is a trend toward increased sinistrality between Puget Sound and Monterey Bay does not seem logical after this analysis.

Table 10. Variation in eye rotation of starry flounder from various locations in the Pacific Ocean.

Source	Location	Sample Size	No. and % Sinistral
Hubbs and Kuronuma (1942)	Japan	476	476 (100%)
Townsend (1937)	Alaska	3,196	2,145 (67.1%)
Townsend (1937)	Puget Sound	530	276 (52.1%)
Beardsley (this study)	Yaquina Bay	5,503	3,167 (57.6%)
Lockington (1880)	San Francisco	282	154 (54.6%)
Orcutt (1950)	Monterey Bay	1,439	856 (59.5%)

Ambicolored Starry Flounder

An ambicolored starry flounder (224 mm SL) was captured in Yaquina Bay on September 24, 1964 (Beardsley and Horton, 1965). This is the second known occurrence of an ambicolored starry flounder (Gudger, 1941), and the first for which photographs are

Table 11. Standard deviations between sample means (degree of sinistrality) for starry flounder collected throughout their geographic range (data from Table 10).

Sample	Japan (Hubbs and Kuronoma)	Alaska (Townsend)	Puget Sound (Townsend)	Yaquina Bay (Beardsley)	San Francisco (Lockington)	Monterey Bay (Orcutt)
Japan (Hubbs and Kuronoma)	-	39.5	22.1	63.8	15.2	31.3
Alaska (Townsend)	15.2	-	7.4	15.1	4.4	6.1
Puget Sound (Townsend)	20.9	17.0	-	8.1	2.0*	5.6
Yaquina Bay (Beardsley)	18.7	10.9	2.5*	-	.95*	1.4*
San Francisco (Lockington)	19.8	14.2	1.1*	4.4	-	3.7*
Monterey Bay (Orcutt)	18.0	8.8	3.5*	2.9*	1.9*	-

*Not significantly different with > 96% confidence.

available (Figure 19). The fish is now catalogued as OS 1343 in the ichthyological collection of the Department of Fisheries and Wildlife at Oregon State University.

Fin-ray counts were within the normal range listed for the species by Clemens and Wilby (1961). On the blind and normally white side of the fish, brownish-black pigmentation occurred on all but the anterior one-third of the head and leading edge of the pectoral fin (Figure 19). The lips were dark and the mouth was symmetrical, also anamalous conditions. Of significance was the incompletely rotated left eye and the dorsal fin which was hooked slightly at the anterior end. These anomalies are apparently common for ambicolored flounders of all species (Gudger, 1941). The ocular side of the specimen possessed normal coloration. An X-ray photograph of the specimen showed no apparent vertebral damage. Spinous stellate plates, usually not as prevalent on the blind as on the ocular side, appeared extensively on the blind side and extended well onto the head region, seemingly related to the absence or presence of pigmentation (Figure 19).

Surfperch

Age and Growth

The age and growth relationships of the striped seaperch and

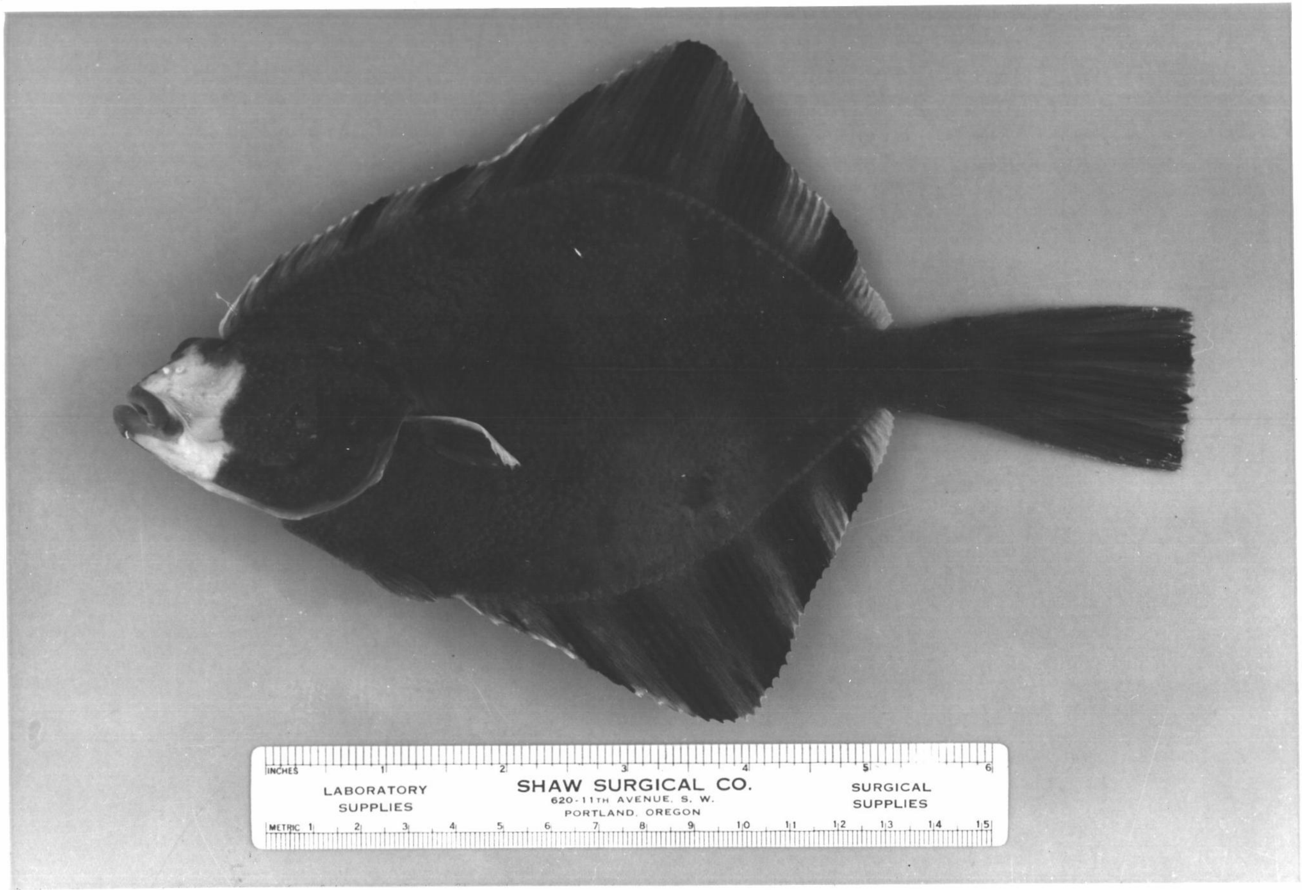


Figure 19. Ambicolored starry flounder collected in Yaquina Bay, Oregon.

pile perch in Yaquina Bay have been described by Gnose (1968) and Wares (1968) respectively. Because similar data were not available for the white seaperch in Yaquina Bay, length-weight (Figure 20), length-frequency (Figure 21), and length-age (Figure 22) relationships were computed from fish collected during this study.

Tagging

A total of 1, 655 surfperch of all three species were tagged and released into Yaquina Bay. The distribution of tagged fish by species, sex, zone of the bay and time of release is shown in Table 12 and Figure 23. Reduced tagging of surfperch during winter months was caused by a scarcity of fish and a decrease in collecting efforts.

Tag Recoveries

Of the 1, 655 surfperch tagged, 55 (3. 3%) were subsequently recaptured (Appendix 2). Those recaptured included 9 white seaperch (1. 6% of those tagged), 28 striped seaperch (7. 4% of those tagged), and 18 pile perch (3. 0% of those tagged). Of those recaptured, 22 were caught by scientists within Yaquina Bay, 30 by sports fishermen within Yaquina Bay and 3 by sport fishermen in the Pacific Ocean. Recaptures in the ocean (three striped seaperch) were made near Yaquina Head, the mouth of Yaquina Bay and near Florence, Oregon (about 50 miles south of Yaquina Bay). Locations within

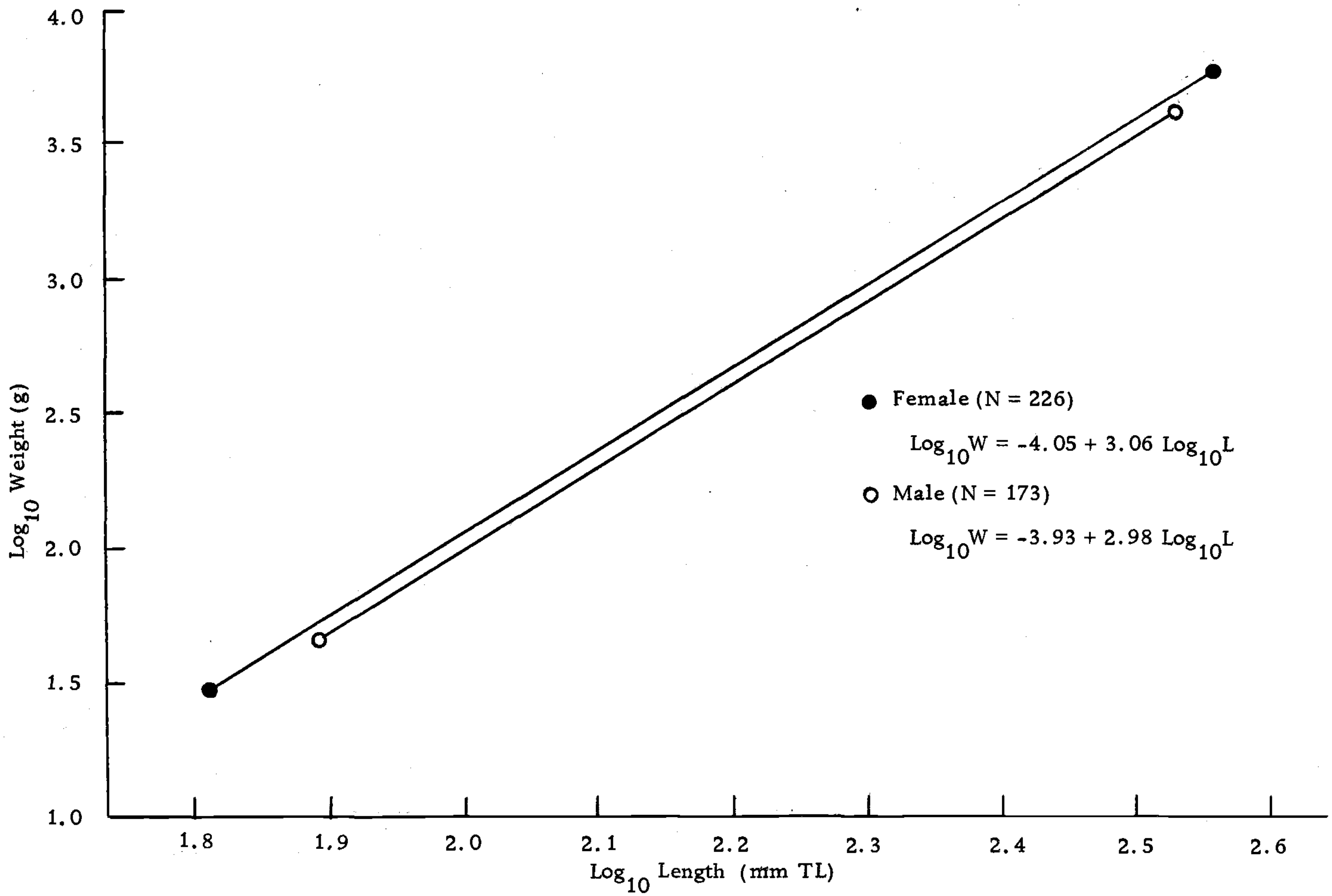


Figure 20. Length-weight relationship for 400 white seaperch collected in Yaquina Bay, Oregon, from August, 1964, to September, 1966.

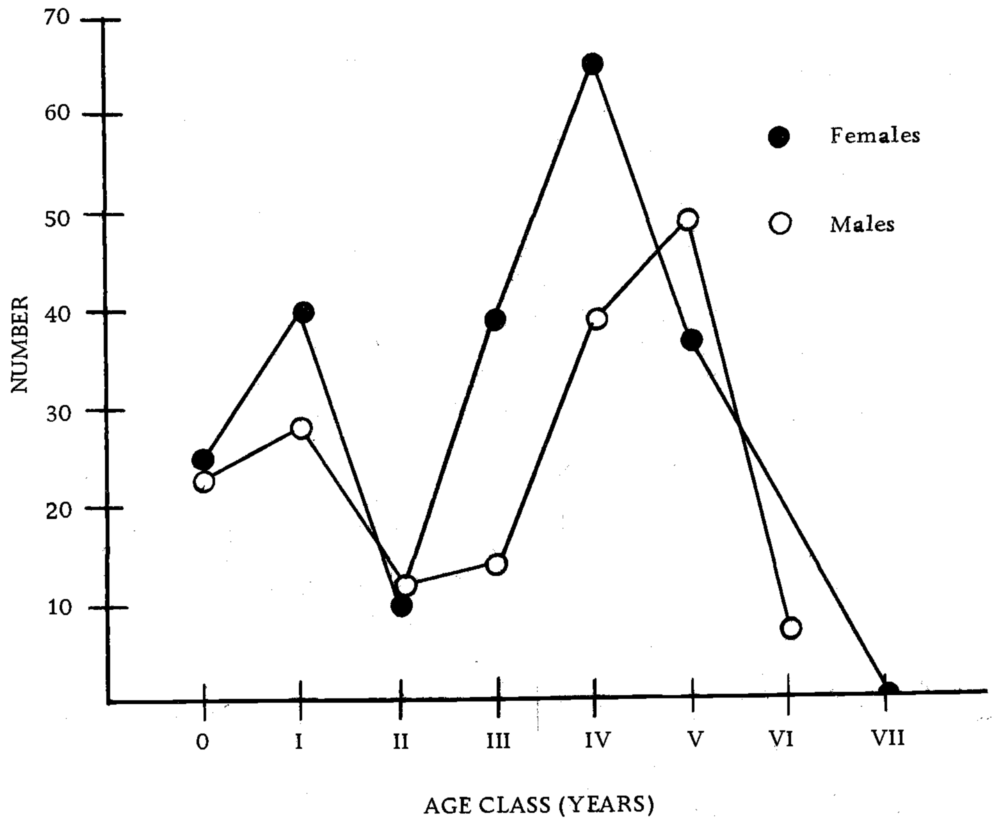


Figure 21. Age class-frequency distribution for 219 female and 172 male white seaperch collected in Yaquina Bay, Oregon, during the summer of 1967.

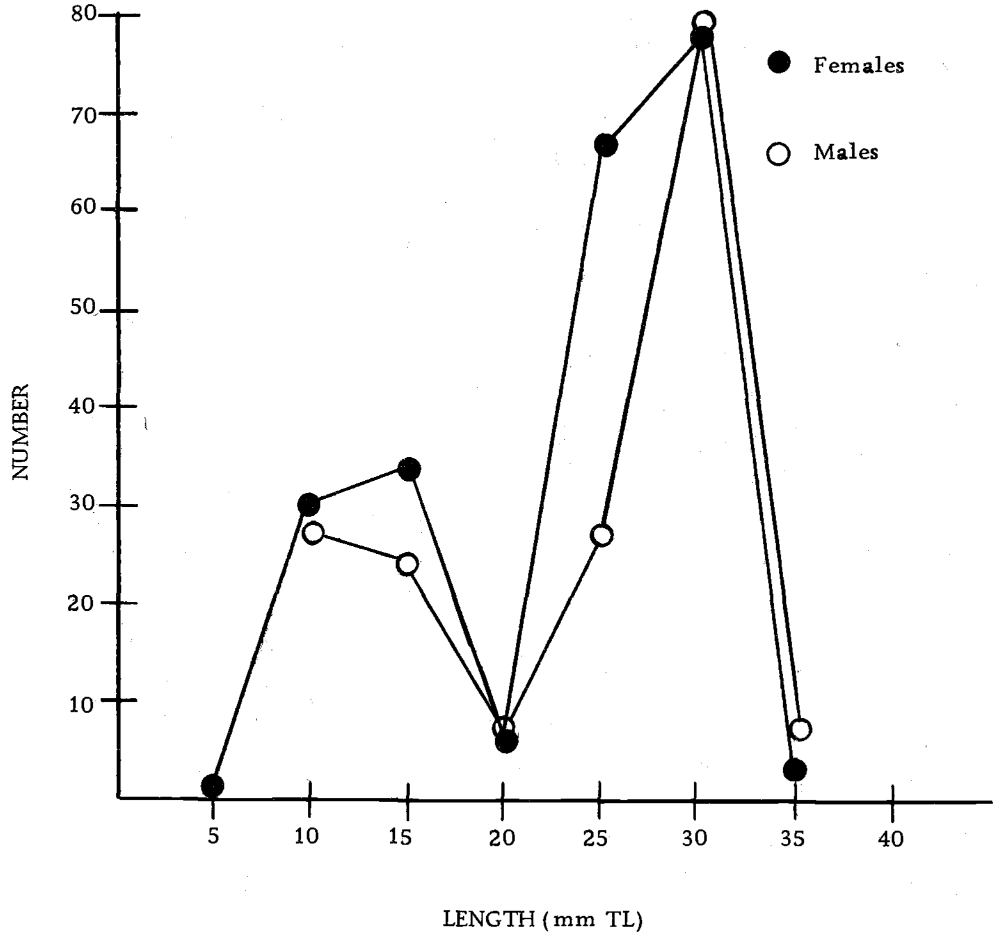


Figure 22. Length frequency distributions for 219 female and 172 male white seaperch collected in Yaquina Bay, Oregon, during the summer of 1967.

Table 12. Distribution by species, sex, date and location of capture of 1,655 surfperch tagged in Yaquina Bay, Oregon.

Location and Date	White Seaperch		Striped Seaperch		Pile Perch	
	Female	Male	Female	Male	Female	Male
Zones 1-4 October to April	26	22	14	7	2	2
Zones 5-7 October to April	8	7	1	7	1	2
Zones 1-4 April to October	132	180	40	27	68	43
Zones 5-7 April to October	144	51	261	23	476	111
Totals	310	260	316	64	547	158

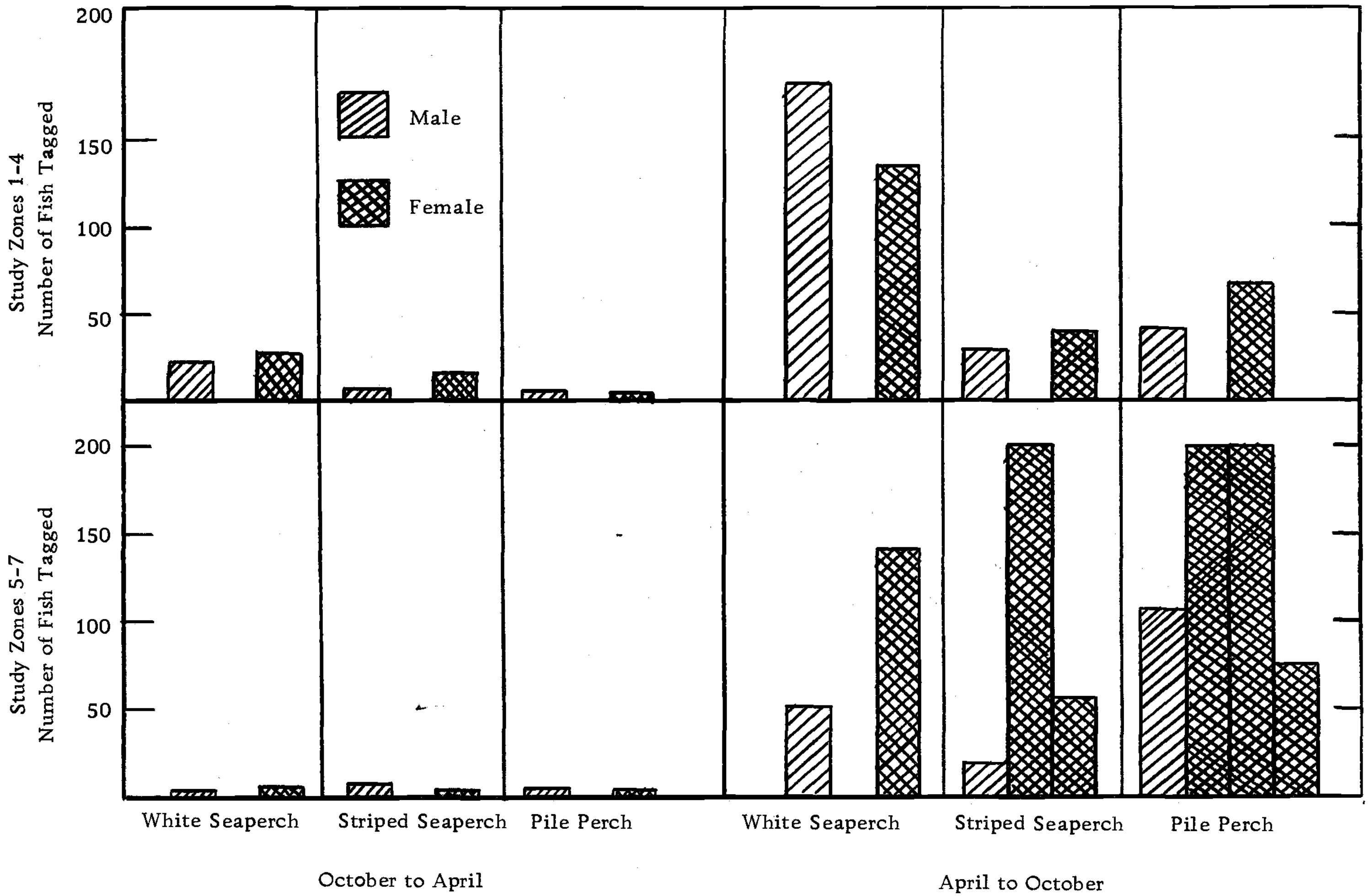


Figure 23. Distribution by location, date, sex and species of all surfperch tagged in Yaquina Bay, Oregon, on this study (data from Table 12) as indicated by the cumulative cross-sectional area of the histograms.

Yaquina Bay where sport fishermen recaptured tagged surfperch are shown in Figure 24.

Due to the low number of tagged surfperch that were recaptured, three alternate tag-types (in addition to the original yellow spaghetti tag) were used. A greater return on one of these alternate tags would indicate a tag more suited for use on surfperch. The alternate tags, however, produced an even smaller return than did the yellow spaghetti tag (Table 13).

Table 13. Number and percent return of four types of tags applied to surfperch in Yaquina Bay, Oregon.

Tag Type	Number Tagged	Number Recaptured
Yellow Spaghetti	1271	54 (4.2%)
Yellow Dart	98	0
Clear Dart	258	2 (0.7%)
Experimental	30	0

Three laboratory experiments were conducted to determine whether the low recovery rate was due to fish mortality and/or tag loss rather than to an extremely large population size. In one experiment, white seaperch and pile perch were collected in King Slough using the otter trawl. All fish were weighed, measured and placed in circulating sea water containers aboard the boat and transferred later into large concrete pools in the laboratory. Fish

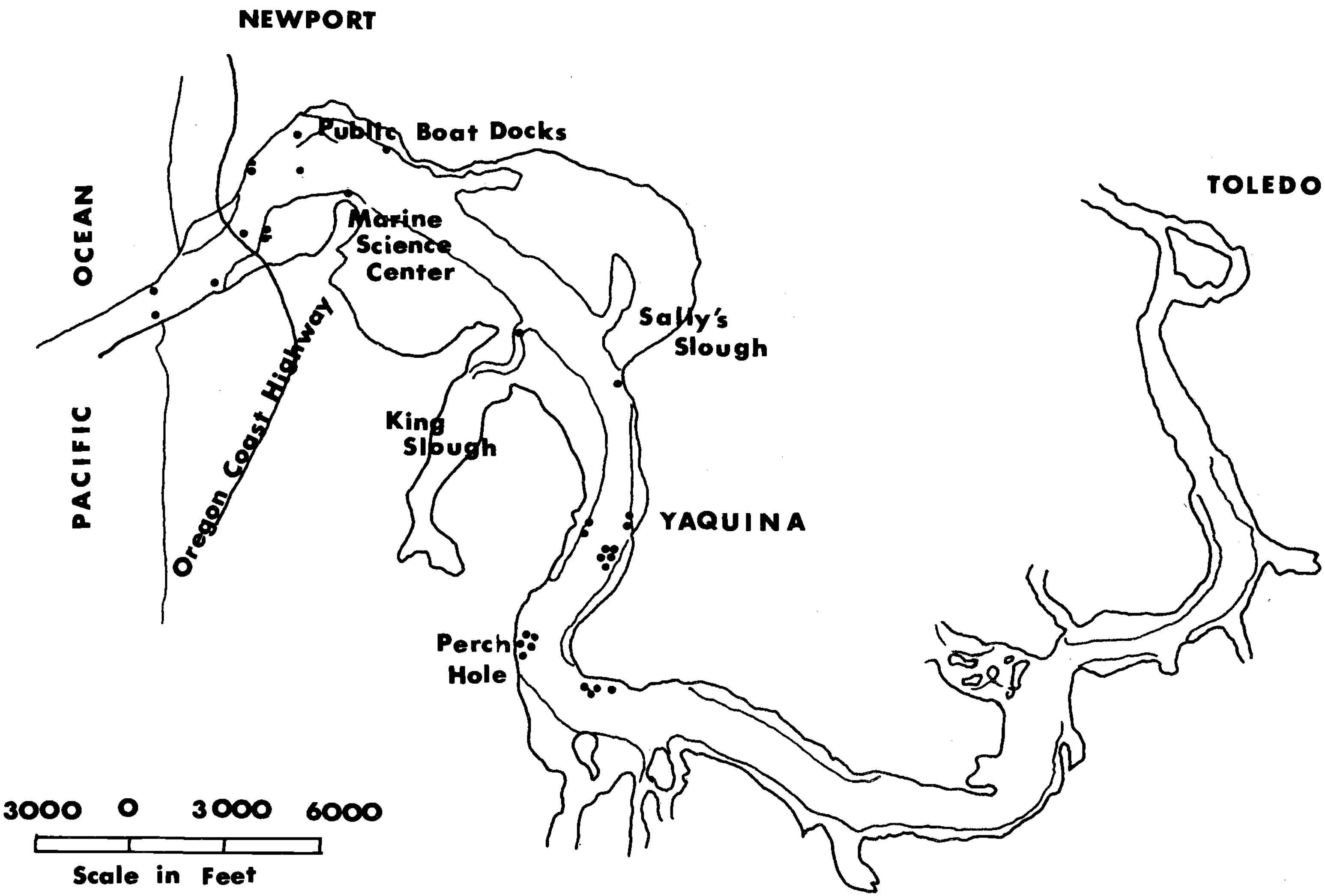


Figure 24. Locations in Yaquina Bay where sport fishermen recaptured tagged surfperch.

were fed portions of cockle clams (Clinocardium nuttalli) daily. Within five days all but 3 of the 21 surfperch were dead. Pregnant females were among the first to die. A clouding of the cornea and a fungus-like growth on fins and scales preceded death. The pools were subsequently drained and disinfected.

Several days later 15 striped seaperch and 15 white seaperch were collected in Sally's Slough using the 200 foot beach seine. Following transportation to the laboratory, representatives from both species were randomly placed into three experimental categories. Ten fish, five of each species, were weighed, measured and had a scale sample removed prior to tagging with a yellow spaghetti tag. Ten additional fish were weighed, measured and had a scale sample removed prior to passing the tagging needle (without attached tag) through the fish (sham-tagged). The remaining ten fish were placed directly into the concrete tanks (controls). Again sections of cockle clam were fed to the fish. After a two-week period all ten controls, eight sham-tagged and eight tagged fish appeared to be healthy. The other four fish had been removed earlier due to death or apparent diseased condition.

In a third experiment, pile and striped surfperch were placed in the same concrete pools following collection with the beach seine. Five fish were tagged with spaghetti tags tied in a figure-eight knot, five were tagged with clear spaghetti darts. At the end of three months all fish exhibited a swelling near the base of the tag and the perforation in the flesh of the fish was considerably enlarged (Figure 25). One dart tag had fallen out of a fish and another was loose. All tags had hydrozoan and algal growth on them.

As a result of these experiments, use of the otter trawl was discontinued in the collection of surfperch for tagging, greater care was taken in the handling of surfperch, pregnant females were tagged only when collected with hook and line and all fish were tagged exclusively with the yellow spaghetti tag tied in a figure-eight knot.

Movement and Migration

Although the seasonal abundance of surfperch in Yaquina Bay is not accurately represented in Table 12 and Figure 23 due to unequal tagging effort, differences in capturing effort were probably not great enough to account for the indicated high abundance of surfperch during summer months. In addition, recapture of several surfperch in the lower estuary during spring and fall that had been tagged in the upper estuary during summer (Appendix 2) supported this assumption. The fact that white seaperch exhibited less marked reduction in winter abundance (Table 12) than did the striped seaperch and pile perch, and, therefore, are available to the sport fishermen throughout the year, could be the reason they are ranked number one (by weight) in the Yaquina Bay sport catch (Parrish, 1966).

Figure 25. Open wound in the side of a pile perch tagged (dart) for three months.

Because there was no evidence to suggest collecting or tagging was selective toward either male or female surfperch, the sex ratios are assumed to be accurately presented in Table 12 and Figure 23.

Angler Use

Similar angling techniques are used in Yaquina Bay to capture either surfperch or starry flounder. Therefore, angling data previously presented for starry flounder apply to surfperch as well.

From a creel census of sport fishermen and angling with hook and line by individuals working on this project, length frequencies for both male and female surfperch of all three species were plotted in Figures 26, 27 and 28. Fecundity-length relationships for striped seaperch (from Gnose, 1968) and pile perch (from Wares, 1968) were included in these figures.

Species Composition

Prior to this study, only limited data was available regarding the seasonal abundance of many species of fish found in Yaquina Bay. Because this information is valuable to anyone studying estuarine and marine fishes, records were kept on the availability of most fishes collected. Information on the catch composition by species were recorded for 89 gill net sets, 13 seine hauls, 76 fyke net sets

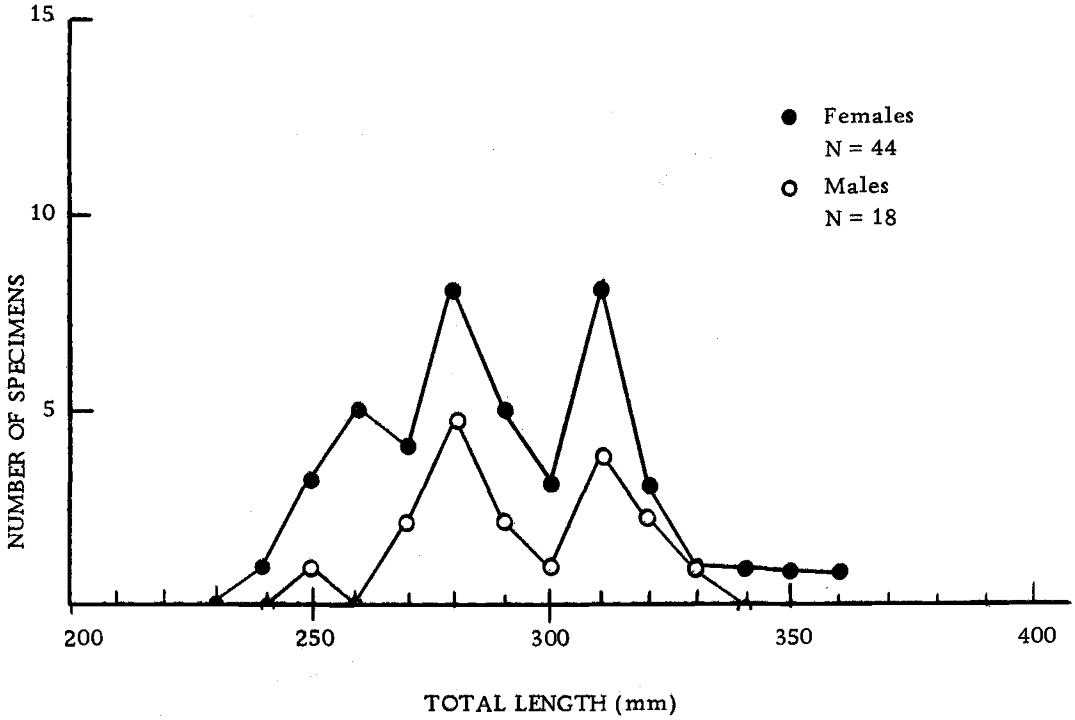


Figure 26. Length-frequency for white seaperch collected by angling with hook and line during 1966 and 1967 in Yaquina Bay, Oregon.

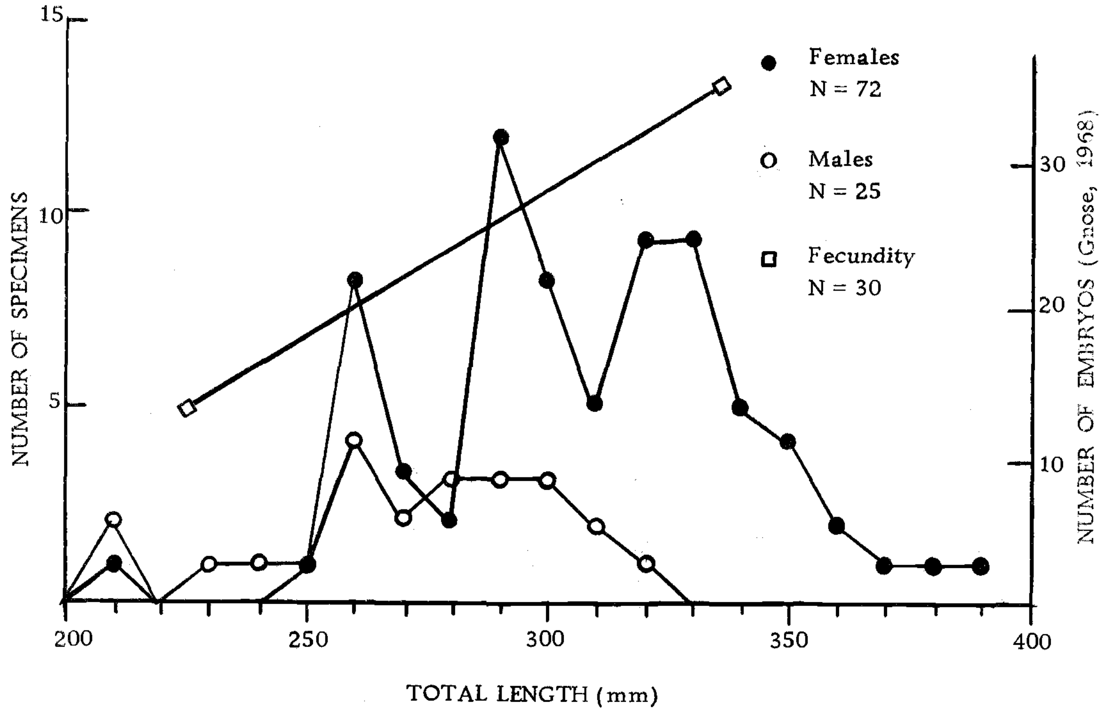


Figure 27. Estimated fecundity (Gnose, 1968) and length-frequency for striped seaperch collected by angling with hook and line during 1966 and 1967 in Yaquina Bay, Oregon.

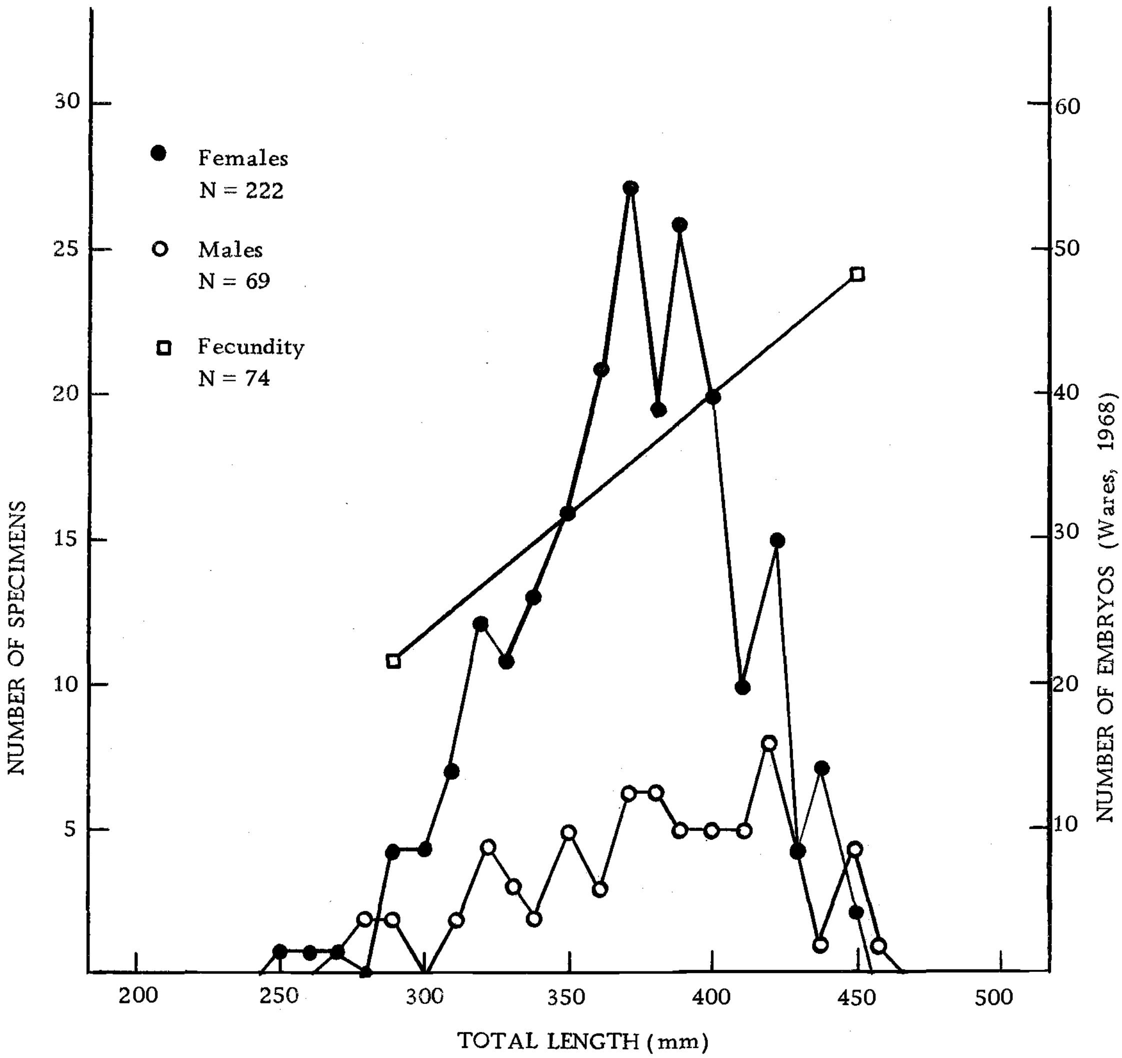


Figure 28. Estimated fecundity (Wares, 1968) and length-frequency for pile perch collected by angling with hook and line during 1966 and 1967 in Yaquina Bay, Oregon.

and 396 otter trawl tows. The zonal and seasonal distributions for these collections are presented in Table 14, while the catch composition by species (recorded as percent by number) is presented in Appendix 3.

Table 15 includes summarized information on 39 prominent fish species collected during the entire study. This table contains data from Appendix 3 as well as additional collections made with the otter trawl, scuba gear and angling with hook-and-line. Species not included in Table 15, but reported in Yaquina Bay (Bond, personal communication; Dimick, personal communication; Shultz and DeLacy, 1935) are presented in Table 16.

Table 14. Distribution by study zone and date of 396 otter trawl tows (OT), 89 gill net sets (GN), 13 seine hauls (S) and 76 fyke net sets (FN) in Yaquina Bay, Oregon.

Date	Study Zone 1	2	3	4	5	6	7	8	9	10
January	4 OT	4 OT	8 OT	6 OT	7 OT	6 OT	3 OT	1 OT	--	--
	--	--	--	--	--	--	--	--	--	--
February	5 GN	10 GN	2 GN	1 GN	6 GN	2 GN	2 GN	--	--	--
	--	--	--	--	--	--	--	--	--	--
March	3 OT	5 OT	18 OT	4 OT	4 OT	--	1 OT	2 OT	2 OT	--
	--	--	--	4 S	--	--	--	--	--	--
April	6 GN	9 GN	1 GN	6 GN	6 GN	5 GN	6 GN	--	--	--
	--	--	--	--	--	12 GN	--	--	--	--
May	2 OT	4 OT	17 OT	7 OT	2 OT	21 OT	34 OT	8 OT	4 OT	10 OT
	--	--	--	--	--	--	--	--	--	--
June	9 GN	4 GN	1 GN	--	--	5 GN	5 GN	--	--	--
	--	--	--	--	--	13 FN	--	--	--	--
July	14 OT	17 OT	17 OT	22 OT	19 OT	21 OT	11 OT	7 OT	8 OT	9 OT
	--	--	6 S	--	--	--	--	--	--	--
August	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	24 FN	--	--	--	--
September	4 OT	3 OT	3 OT	4 OT	3 OT	4 OT	3 OT	3 OT	3 OT	2 OT
	--	--	3 S	--	--	--	--	--	--	--
October	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	15 FN	--	--	--	--
November	--	2 OT	2 OT	4 OT	4 Ot	3 OT	--	--	--	--
	--	--	--	--	--	--	--	--	--	--
December	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	12 FN	--	--	--	--

Table 15. Relative abundance, length range and seasonal distribution of some prominent Yaquina Bay fishes.

Species[1]	Number[2] (mm TL)	Month	Location[3]	Comments[4]
Raja binoculata	8(250-1160)	IV, VI, VII, XII	2-6	1 adult in GN in XII, juveniles caught in OT, FN
Acipenser medirostris	15^{+}(250-630)	I - XII	1-10	OT, GN
Acipenser transmontanus	1 (640)	V	10	OT, second one reported in Yaquina Bay
Alosa sapidissima	40(70-380)	I-VI, IX	3, 4, 6, 7, 9	Adults GN, FN, juveniles OT
Clupea harengus	Com (60-250)	II-XII	1-8	Spawning II, III in 2-7, adults GN, juveniles S
Engraulis mordax	Com (40-100)	V-VIII	3-9	Juveniles 5-9 summer, adults in commercial seine fishing V-IX, 2-6
Oncorhynchus keta	20 (60)	IV	3	Juveniles in S
Oncorhynchus kisutch	10^{+} (80-200)	IV	1-10	Juveniles in S, adults abundant IX-XI
Oncorhynchus tshawytscha	10^{+} (80-150)	IV, V, VI	1-10	Juveniles in S, feeder adults common in 1-3 during V-IX
Salmo gairdneri	2 (430-615)	I, VIII	3, 7	S, GN, occassionally caught by sportfishermen in estuary
Hypomesus pretiosus	Abt. (500-650)	III, IV	3, 4	S
Microgadus proximus	Com (130-200)	I-VIII	2-6	OT
Gasterosteus aculeatus	10^{+} (50-60)	VII, VIII	8	OT, abundant in brackish sloughs and ponds along upper estuary
Aulorhynchus flavidus	10^{+} (90-115)	II, XI, XII	1, 3	OT, S, in eel grass beds
Syngnathus griseolineatus	Com (90-200)	I-VII, XI, XII	1-5	OT, S, in eel grass beds
Amphistichus rodoterus	30^{+} (150-275)	I-V, VII, XII	1-3, 6-7	OT, S, FN, scarce during summer months
Cymatogaster aggregata	Abt (50-175)	I-XII	1-10	OT, S, GN, infrequent during winter months
Embiotoca lateralis	Abt (60-380)	I-XII	1-9	OT, S, GN, FN, limited to lower estuary in winter, adults 1-8
Hyperprosopon argenteum	Com (60-290)	I-XII	1-10	OT, S, GN, GN
Hyperprosopon ellipticum	20^{+} (90-250)	III-VI	3, 6	OT, FN, often confused with Phanerodon furcatus
Phanerodon furcatus	Abt. (60-375)	I-XII	1-10	OT, S, GN, FN, abundant throughout the year in 1-5
Rhacochilus vacca	Abt. (60-448)	I-XII	1-10	OT, S, GN, FN, rare during winter months, adults 1-8
Sebastodes sp.	Abt. (40-420)	I-XII	1-8	S, GN, adults usually zone 1, juveniles abundant 1-8
Hexagrammos decagrammus	Com (60-440)	I-XII	1-7	OT, S, GN, adults most often 1, 2, juveniles 1-7
Hexagrammos stelleri	25^{+} (125-250)	V-X	1-6	OT, GN, adults limited to zones 1-3
Hexagrammos superciliosus	15^{+} (110-310)	VII, VIII	1, 2	OT, GN, adults generally zones 1 and 2

(continued)

Table 15. Continued.

Species[1]	Number[2] (mm TL)	Month	Location[3]	Comments[4]
Ophiodon elongatus	Com (150-450)	I-XII	1-7	OT, S, GN, larger adults caught by sportfishermen in zone 1 and 2
Cottus asper	Com (75-125)	I-XII	3-10	OT, spawning adults found in zones 3-10 in winter, zones 7-10 in summer
Enophrys bison	Com (110-290)	I-XII	1-10	OT, GN, adults 1-5, dense under U.S. 101 bridge
Leptocottus armatus	Abt. (50-280)	I-XII	1-10	OT, S, GN
Scorpaenichthys marmoratus	20^{+} (150-450)	IV-VIII	1-5	OT, GN, one adult in GN zone 1, juveniles in OT zones 1-5
Apodichthys flavidus	6 (150-290)	IV-VIII	1-3	OT
Pholis ornata	Com (125-250)	I-XII	1-10	OT, abundant in eel grass beds and under rocks
Lumpenus sagitta	Abt. (180-455)	IV-X	2-8	OT, rare in winter
Atherinopsis californiensis	Com (110-400)	IV-VIII	1-7	S, adults generally zones 1-5
Citharichthys stigmaeus	Com (50-130)	IV-VIII	1-5	OT
Parophrys vetulus	Abt. (40-150)	I-XII	1-10	OT, S, only 2 specimen over 200 mm TL found
Platichthys stellatus	Abt. (40-600)	I-XII	1-10	OT, S, GN, adults rarely above zone 8, spawn II, III
Psettichthys melanostictus	40^{+} (100-450)	I-VIII	1-7	OT, S

[1] Taxonomic order and nomenclature according to American Fisheries Society (1960).

[2] Number: Com. = common (> 50 individuals); Abt. = abundant (>1000 individuals).

[3] Refer to study zones (Figure 4).

[4] Gear: OT (otter trawl), S (seine), GN (gill net), FN (fyke net).

Table 16. Fish species infrequently seen or not observed during this study but reported in Yaquina Bay, Oregon.

Polistrotrema deani	*Sebastodes rastrelliger*
Polistrotrema stouti	*Anoplopoma fimbria*
Lampetra ayresi	*Oxylebius pictus*
Lampetra tridentata	*Artedius fenestralis*
Triakis semifasciata	*Artedius lateralis*
Squalus acanthias	*Ascelichthys rhodorus*
Raja rhina	*Blepsias cirrhosus*
Myliobatis californicus	*Clinocottus acuticeps*
Hydrolagus collei	*Clinocottus globiceps*
Sardinops sagax	*Cottus aleuticus*
Oncorhynchus gorbuscha	*Hemilepidotus hemilepidotus*
Salmo clarki	*Hemilepidotus spinosus*
Allosmerus elongatus	*Oligocottus maculosus*
Spirinchus starksi	*Oligocottus snyderi*
Macropinna microstoma	*Pallasina barbata*
Alepisaurus richardsoni	*Liparis florae*
Lucania parva	*Liparis rutteri*
Gadus macrocephalus	*Trichodon trichodon*
Merluccius productus	*Ammodytes hexapterus*
Cynoscion nobilis	*Anarrhichthys ocellatus*
Seriphus politus	*Anoplarchus purpurescens*
Phanerodon atripes	*Cebidichthys violaceus*
Scomber japonicus	*Delolepis gigantea*
Clevlandia ios	*Phytichthys chirus*
Lepidogobius lepidus	*Citharichthys sordidus*
Sebastodes caurinus	*Eopsetta jordani*
Sebastodes flavidus	*Lyopsetta exilis*
Sebastodes melanops	*Pleuronichthys coenosus*
Sebastodes nigrocinctus	*Hippoglossus stemolepsis*
Sebastodes paucispinus	*Gobioesox maeandricus*
Sebastodes pinniger	

DISCUSSION

Starry Flounder

Age and growth relationships for starry flounder from Yaquina Bay appear similar to those computed for fish collected in Monterey Bay by Orcutt (1950). In both studies the regressions of Log_{10} weight on Log_{10} length revealed that for a given length, female flounder weigh slightly more than males (Figure 9), and only the first age class (I) is distinguishable in a length-frequency polygon (Figure 10). Sampling error probably accounted for the low number of age class I fish observed in my Yaquina Bay study (Figure 10), because fish of this size may escape under the footrope or pass through the meshes of the trawl. Male flounder appeared to mature one year earlier than females (Figure 11).

Data on the recapture of flounder in Yaquina Bay by sport fishermen and project personnel indicated the majority of flounder remained in the location of release. In addition, flounder transported to other areas prior to release, tended to return to the original capture location. Because the total length of 15 trawl-caught flounder exhibiting intraestuarine migration was significantly shorter than those recaptured in the original capture location (i. e. 283 mm TL as compared to 324 mm TL), and because flounder of above average length tended to leave the estuary in greater numbers than smaller fish (Table 6), I assume that the tendency of fish to maintain a resident "homespot" in Yaquina Bay was highest among flounder of intermediate length. Westrheim (1955) also found that the mean total length at tagging of fish captured outside the Columbia River estuary (388 mm TL) was greater than the average length at tagging of all recaptured fish (340 mm TL), which in turn was greater than the average length at tagging of flounder recaptured within the Columbia River (320 mm TL). Of tagged flounder recovered outside Yaquina Bay during my study, those recaptured in the Pacific Ocean were significantly larger at tagging (mean 388 mm TL) than specimens recaptured within bays or rivers other than Yaquina Bay (320 mm TL). This difference in length may be explained by the selectivity of commercial trawls for larger fish and the tendency of smaller fish to re-enter estuaries.

Results of the study by Westrheim (1955), where starry flounder were tagged and released in the Columbia River, and my Yaquina Bay study are compared in Table 17. The principal differences between the two investigations lie in the number of fish tagged and recaptured (although the recapture rates are nearly equal) and the main method of recapture (commercial gill nets are legal in Oregon only in the Columbia River). The slight difference in return ratio might be explained by the reliance on commercial fishermen for returns in the Columbia River, whereas in Yaquina Bay active sampling was conducted throughout the year by project personnel.

Table 17. Comparison of results from starry flounder tagging studies conducted in the Columbia River (Westrheim, 1955) and Yaquina Bay.

	Columbia River	Yaquina Bay
Number tagged	1,846	6,385
Recaptures	111 (6%)	469 (7.3%)
Geographic range of recaptures	Umatilla Lightship to Yaquina Bay	Cape Flattery to Winchester Bay
Ocean recaptures	26 (23%)	88 (19%)
Maximum days at liberty	735	826
Principal means of recovery	salmon gill nets (74)	shrimp try-net (256)
Size range at tagging (mean in parenthesis)	152-686 mm TL (315 mm TL)	200-630 mm TL (324 mm TL)

Analysis of tags returned by sport fishermen from Yaquina Bay revealed that anglers traveled many miles to angle for marine food fishes (Table 3) and tended to congregate in particular areas of the bay (Figure 12). The infrequent return by sport fishermen of flounder tagged in Sally's Slough may be explained by the inaccessability of the slough from land because soft mudflats surround the area during low tides. Generally, anglers in boats combined sport crabbing with fishing. The area around Sally's Slough is rather shallow and did not seem to be nearly as productive to crabbers as the deep channel around the mouth of King Slough (Figure 2). As a consequence, boaters appeared to angle near the mouth of King Slough (Figure 12) more frequently than Sally's Slough.

The comparison (Figure 13) of estimated monthly angling hours in Yaquina Bay (from Parrish, 1966) and the monthly return of tagged starry flounder indicated that although the angling pressure for all non-salmonid species reached a peak in August, returns of starry flounder tags peaked in April, decreased in June and increased to another peak in August. Because the total estimated angling hours in Yaquina Bay were at a low level in April, but flounder tag returns were at their highest level, I concluded that bay fishing was highly selective for flounder during this time of year. This hypothesis was supported by knowledge that the abundance of starry flounder was greatest in March and April due to spawning (Appendix 3), but during the same period the abundance of most surfperch species was low (Table 19). The large number of tags returned in July may be explained by increased angling pressure during the Fourth of July weekend. Foggy days in August frequently prevented salmon anglers from crossing the Yaquina Bay bar. Conversion of their fishing efforts to non-salmonid fishes within Yaquina Bay would explain the relatively high number of tags returned during August.

Monthly fluctuations in commercial landings of ocean-caught starry flounder to Oregon ports are indicated in Table 18 (Reed, personal communication). For example, in May, 1967, nearly one-third of the total poundage for the year was landed. Since weather and economic considerations (availability of a suitable market for the fish) directly affect landings, it is difficult to correlate monthly landings with seasonal abundance of starry flounder in the Pacific Ocean.

The annual commercial and sport fishermen harvest of starry flounder was compared using data provided by Reed, (personal communication) (Table 18), and Parrish (1966) (1963-64 Yaquina Bay angler survey). If it is assumed that Yaquina Bay angling accounts for 20% of the annual sport catch of marine foodfish in Oregon (the other 80% being divided between other Oregon estuaries and the Pacific Ocean), the 16, 200 pounds of starry flounder landed in Yaquina Bay (Parrish, 1966) would be extrapolated to 81, 000 pounds for the entire coast. The ratio, by weight, of commercially landed flounder (average of 376, 683 pounds landed during 1967 in Table 18) to the estimated angler yield (81, 000) would be 4. 6:1. Because the average weight of commercially landed starry flounder approaches three pounds and angler caught fish average one pound six ounces (from Table 6 and Figure 9), the ratio of commercial to sport landings, by number of fish, is 2. 1:1.

Because starry flounder annually landed by the commercial

Table 18. Oregon commercial otter trawl landings (pounds in the round) of starry flounder and surfperch during 1967 (data from Reed, personal communication).

Month	Pounds in the Round	
	Starry Flounder	Surfperch
January	3, 211	
February	26, 876	
March	13, 137	
April	34, 229	
May	118, 561	1, 719
June	28, 039	
July	16, 968	
August	48, 241	
September	6, 383	
October	4, 527	
November	71, 645	
December	4, 865	
Total for year	376, 683	1, 719

fishery are larger in size and greater in number than those taken by the sport fishery, it is probable that commercial fishing has the greater impact on the population dynamics of this species. Considering the apparent high abundance, wide geographic dispersion and relatively low fishing intensity (376,683 pounds in Table 18) by sport and commercial fishermen (starry flounder bring only a moderate financial return at market) for starry flounder in Oregon's marine waters, it is doubtful whether regulations for the management of this species are warranted at this time.

Post mortem shrinkage in starry flounder was demonstrated (Table 5). Since the difference in length between flounder held in the coldroom and those held in the hold of the commercial trawler was not significant, one might assume that shrinkage is not a direct result of rough handling and pressure encountered in the fishhold, but more likely due to contraction and stiffening of body muscles in rigor mortis. Fish in this stiffened condition, in addition, may not lie flat on the measuring device, thereby reducing the length recorded.

The amount of shrinkage of flatfish following death agreed with the finding of Harry (1956). He used a controlled experiment to show that petrale sole (*Eopsetta jordani*) shrank an average of 3 mm TL when stored on ice and an average of 6 mm TL when iced at sea and frozen at the fish plant. Best (1963) reported that 13 petrale sole at liberty for 30 days or less revealed a linear relationship of increased shrinkage with larger sizes of fish.

Precise population estimates for starry flounder within King Slough were seriously hindered by the low recapture rate of tagged fish. This low rate of recapture was partially due to a large population of flounder present in the slough as indicated by the numbers (120-344) sampled each day in relatively few trawl tows (6-10). Starry flounder following placement in aquaria were observed to flutter fins so as to create a depression in the substrate and cover the "eyed side" with a thin layer of mud and sand. Probably the "tagging experience" also caused fish to burrow in the mud, thereby making them unavailable to subsequent samples. A differential emigration of tagged fish, as compared to untagged fish, could also reduce the number recaptured and increase the population estimate.

Evidence for a higher incidence of tagged than untagged fish leaving the slough was indicated since both Petersen and modified Petersen population estimates (Table 8) increased as the experiment continued. Movement of tagged fish from the principal area of trawling effort (i. e. study areas 2, 3, 4, in Figure 18) was evident on the fifth day of sampling (Table 7) when flounder were recaptured only in study areas 5 and 6 (Figure 18) but unmarked flounder were abundant in other areas of King Slough (313 sampled that day).

Emigration of tagged flounder from King Slough was evident during the second population estimate (Table 9) when several specimens were recaptured as far away as Toledo (Figure 1) several days after the experiment was concluded. Part of the problem of apparent overestimation of population size lies in the experimental design. Since all fish were released in study area 3 (Figure 18), one would not expect marked fish to be randomly located throughout the slough. However, when tagged flounder were released throughout the area of capture (Table 9), so few fish were recaptured (3) that no reasonable estimates of population size could be made.

The Jolly modification (Table 8) should compensate for differential emigration or burrowing of tagged fish. However, Petersen and modified Petersen population estimates using the Jolly modification (i. e. 1, 462 and 1, 316 respectively) appeared small when as many as 344 different flounder (Table 7) could be captured in six to ten trawl tows over a two hour period. Because tagged fish were released only in study area 3 (Figure 18) during the first experiment, perhaps the population estimates are more applicable to that portion of the slough surrounding study area 3.

The reason for variation in degree of sinistrality along the geographic range of the starry flounder is not understood. If eye rotation is heritable, the fish in Japan appear to be isolated from other stocks showing dextral rotation. Populations of flounder interbreeding along the Eastern Pacific could explain the nearly uniform degree of sinistrality south of Alaska (Tables 10 and 11). The northerly and southerly migration of starry flounder tagged in Yaquina Bay and the Columbia River (Table 17) support this hypothesis. Interbreeding of Eastern Pacific and Japanese stocks could explain the higher degree of sinistrality in Alaskan flounder as compared to those in the Eastern Pacific.

In the period from 1815 to 1963, some 30 references are on record of abnormal coloration in flatfishes from American waters (Dawson, 1962; Fitch, 1963). Dawson reported on more than 39 specimens, possessing eight anamalous conditions, and Fitch mentioned that either partially- or fully-ambicolored individuals had been noted among all species of *Pleuronichthys* except *ocellatus*. Only two of these reports pertained to anamalous starry flounders. Orcutt (1950) did not mention ambicoloration in his comprehensive treatment of the life history of the species.

Anamalous conditions are probably due either to mutations or to external influences prior to metamorphosis. Perhaps a correlation exists between eye migration and the melanistic side. This could explain pigmentation occurring on both sides of the flounder resulting from the incomplete migration of the eye.

Surfperch

A low abundance of white seaperch of age class II (ca. 20 mm TL) was indicated by age frequency and length frequency distributions

(Figure 21). Wares (1968) found pile perch in age classes II and III were less abundant in samples than older and younger fish. Sampling error may explain the lack of surfperch in these age classes because smaller fish were caught primarily in the otter trawl while larger fish were captured in the gill and fyke nets. Fish of intermediate length might avoid the trawl and be too small to be caught in the gill or fyke nets. In addition, surfperch in age classes II and III could be independent of the estuary as a nursery area, but not mature enough to return to the estuary for reproductive purposes.

Recovery rates for tagged surfperch were low when compared to the Siletz Bay study by Morgan (1961) where 229 (16. 2%) of 1, 409 tagged pile perch and 262 (65. 9%) of 397 tagged striped perch were recaptured (Petersen disc tags were used in this study). However, Gnose (1968), in his Yaquina Bay study, recovered only 10 (7. 0%) of 142 striped seaperch tagged with Petersen discs. This return ratio is comparable to the 7. 4% recovered during my study when spaghetti and dart tags were used on striped seaperch. Higher return rates in Siletz Bay (Morgan, 1961) might be attributed to more efficient sampling (three fyke nets in a smaller estuary).

The apparent winter migration of pile perch from the estuary is supported by the research of Morgan (1961) and Wares (1968). Observations made by Wydoski (personal communication) while diving on Johnson's Rock (approximately one mile southwest of the

Yaquina Bay south jetty in ten fathoms of water) indicated large schools of mature pile perch were present during the fall when numbers of these fish were declining in the estuary (Appendix 3).

Evidence for the seasonal movement of striped seaperch was less conclusive. Morgan (1961) found that striped seaperch migrate less than the pile perch and only one specimen was recaptured outside Siletz Bay (three miles north). Hindered by low recapture rates, Gnose (1968) did not catch striped seaperch with the otter trawl nor hear of any sport catches of this species above my study zone 2 (Figure 4) from November, 1962, to March, 1963. Catches of 1.55 striped seaperch per gill net set in study zones 1 and 2 during January and February (Table 19) in my study indicated fish were present in the lower estuary but in reduced numbers. The probability that some of these fish enter the ocean was also indicated by recaptures of tagged fish in the ocean near Florence, Newport and Yaquina Head, Oregon (Appendix 2).

White seaperch appeared to migrate least of the surfperch investigated during my study. Data on catch-per-unit-of-effort (Table 19) indicated white seaperch were numerous throughout the lower estuary (study zones 1-7) in winter months. Some reduction in summer abundance was indicated by gill net catches (Table 19).

The underlying mechanisms behind seasonal movements of surfperch in Yaquina Bay are not well understood. Of the host of

Table 19. Average seasonal catch-per-unit-of-effort (by number of individuals) for three surfperch species in Yaquina Bay, Oregon (computed from data in Appendix 3).

Average catch per gillnet set (6 hour) - Study Zones 1 and 2

	January-February	March-April	May-June	December
Embiotoca lateralis	1.55	0.384	2.82	0.00
Phanerodon furcatus	8.10	9.12	2.11	16.62
Rhacochilus vacca	0.966	0.390	5.29	1.33

Average catch per gillnet set (6 hour) - Study Zones 6 and 7

	January-February	March-April	May-June	December
Embiotoca lateralis	0.00	1.80	13.98	0.00
Phanerodon furcatus	10.80	14.4	1.00	4.86
Rhacochilus vacca	0.00	7.20	21.48	0.666

Average catch per fyke net set (6 hour) - Study Zone 6

	April	May	June	July	August	September	October	November	December
Embiotoca lateralis	4.40	2.80	1.00	0.94	0.25	0.80	0.70	0.40	0.00
Phanerdon furcatus	0.08	0.00	2.10	0.69	0.50	0.00	0.00	0.50	0.00
Rhacochilus vacca	2.00	3.80	11.0	8.90	9.40	1.20	0.40	0.20	0.00

possible circumstances influencing surfperch migration, temperature and salinity of the water, food abundance and reproductive behavior appear to be the most obvious. The relationships between monthly mean water temperature and catch-per-unit-of-effort for surfperch are compared in Figures 29 and 31. In study zones 1 and 2 (Figure 29) white seaperch were most abundant during periods of low temperature, whereas abundance of pile and striped seaperch increased with increasing temperatures. In study zones 6 and 7, (Figure 31) white seaperch abundance again showed an inverse relationship with increasing water temperature, whereas pile and striped seaperch catches increased directly. A similar pattern existed when surfperch abundance was compared with changes in salinity (Figures 30 and 32). White seaperch in both the lower (study zones 1 and 2) and upper middle (study zones 6 and 7) estuary increased in abundance with decreasing salinity. Pile and striped seaperch showed a reversed trend.

If food were the underlying mechanism behind surfperch migration, a relationship between seasonal availability of food items and abundance of surfperch would be expected. However, Wares (1968) found adult pile perch, the species having the most marked seasonal migration, were entirely benthic feeders, preying mainly on organisms such as <u>Mytilus</u>, <u>Balanus</u>, <u>Upogebia</u>, <u>Clinocardium</u>, <u>Mya</u>, <u>Protothaca</u> and <u>Cancer</u>. These food organisms show little

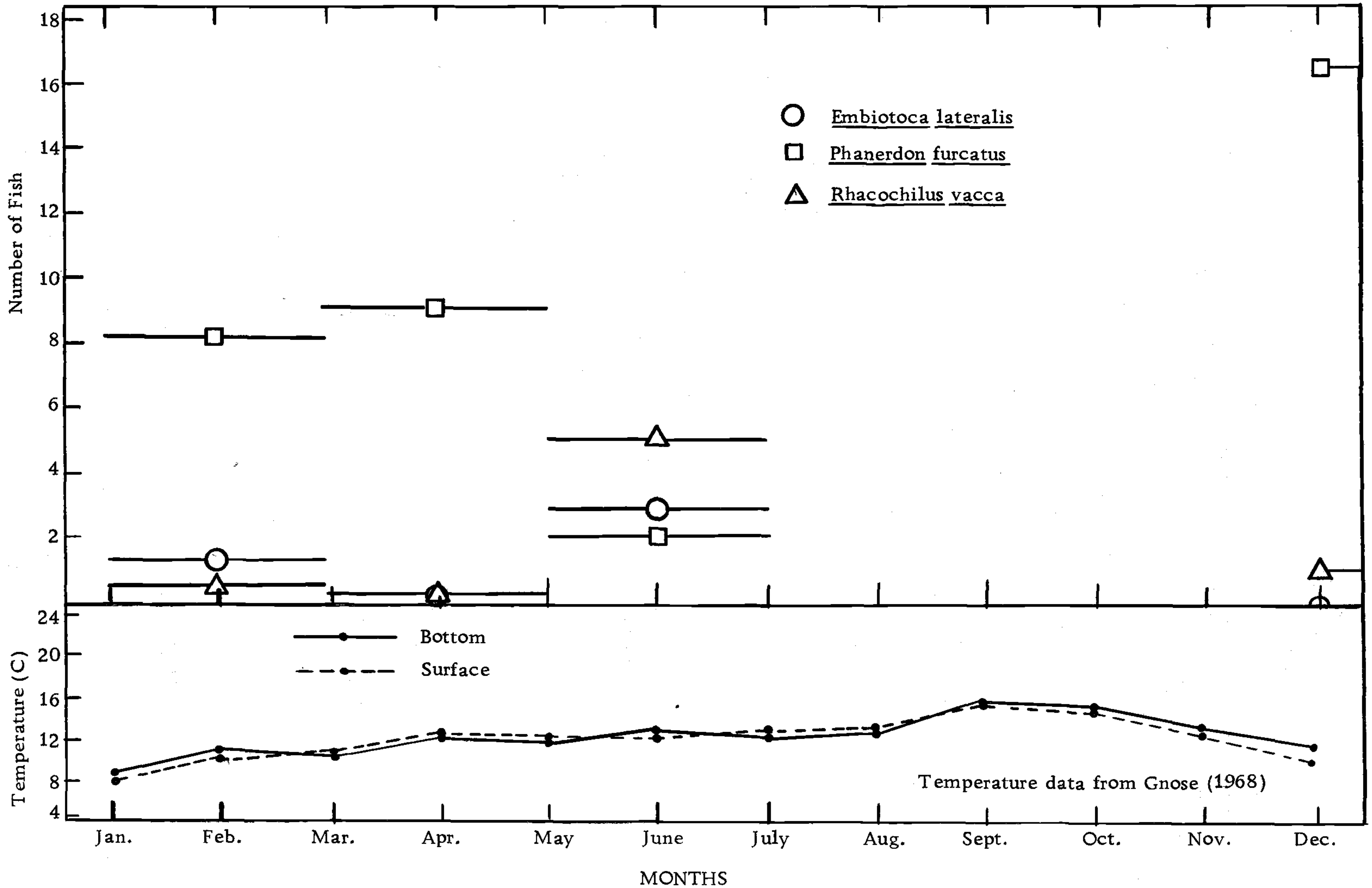


Figure 29. Relationship between average seasonal catch-per-gill net set (6 hour) and water temperature in study zones 1 and 2 (data from Table 19).

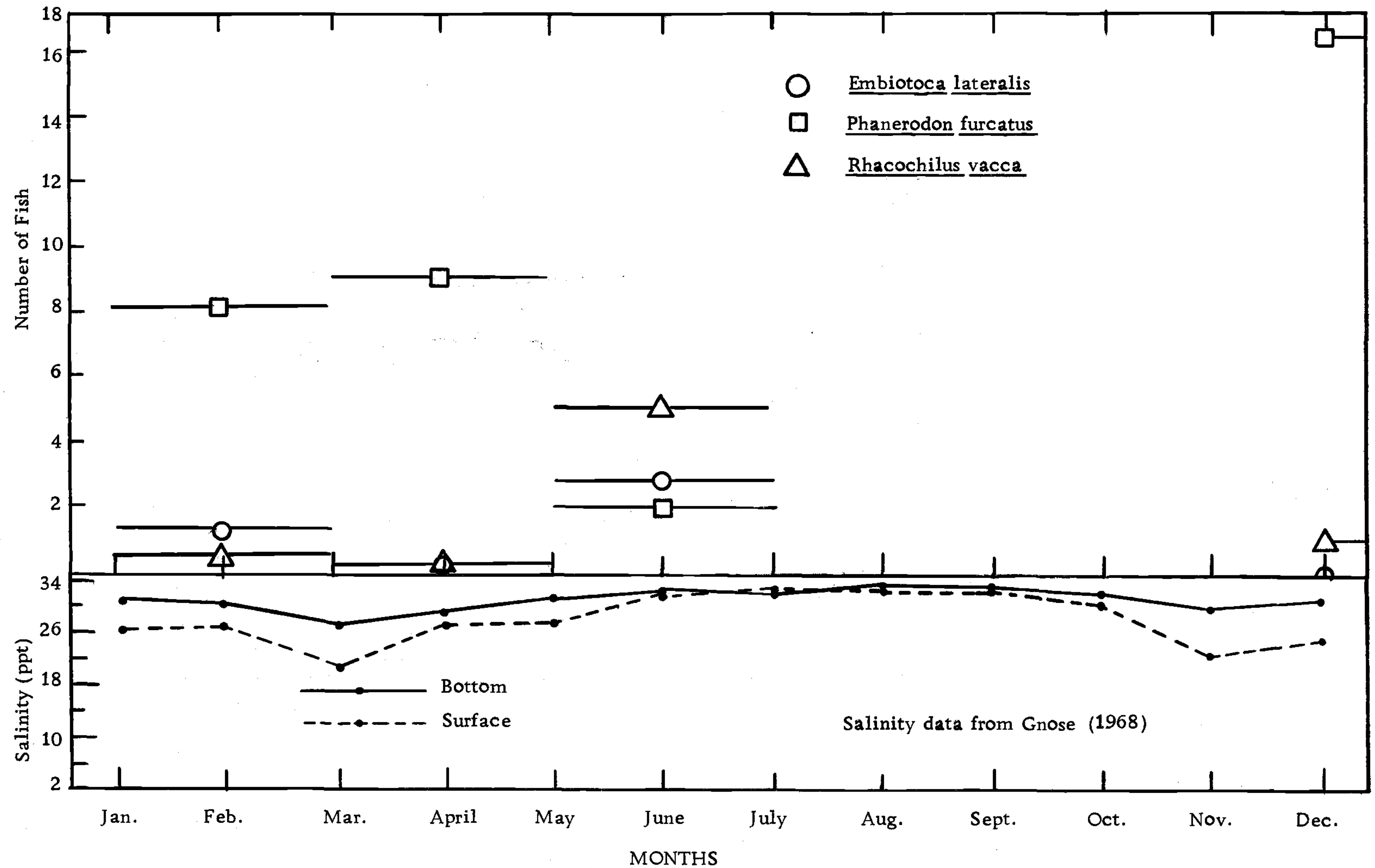


Figure 30. Relationship between average seasonal catch-per-gill net set (6 hour) and water salinity in study zones 1 and 2 (data from Table 19).

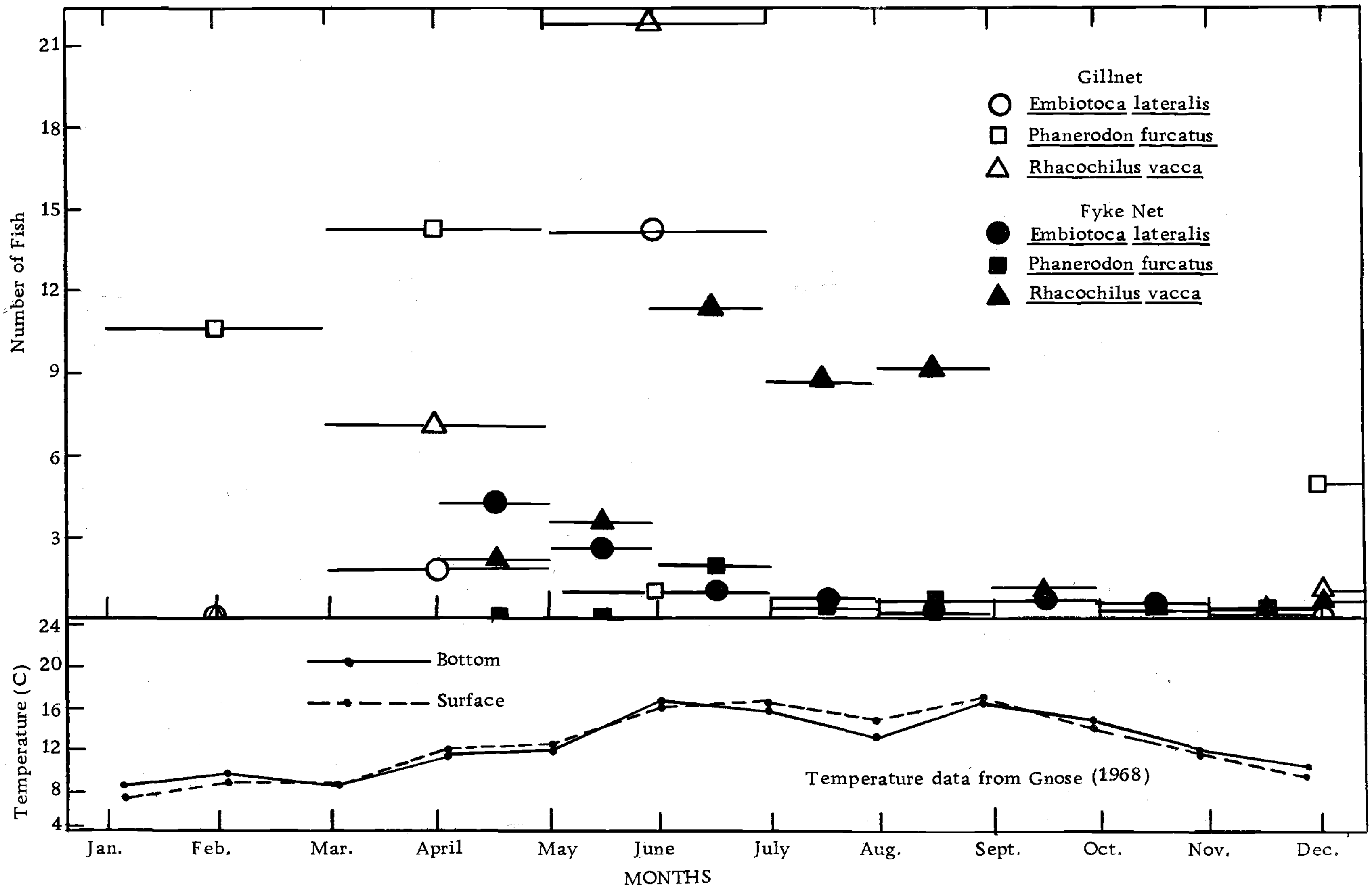


Figure 31. Relationship between average seasonal catch-per-gill net and fyke net set (6 hour) and water temperature for study zones 6 and 7 (data from Table 19).

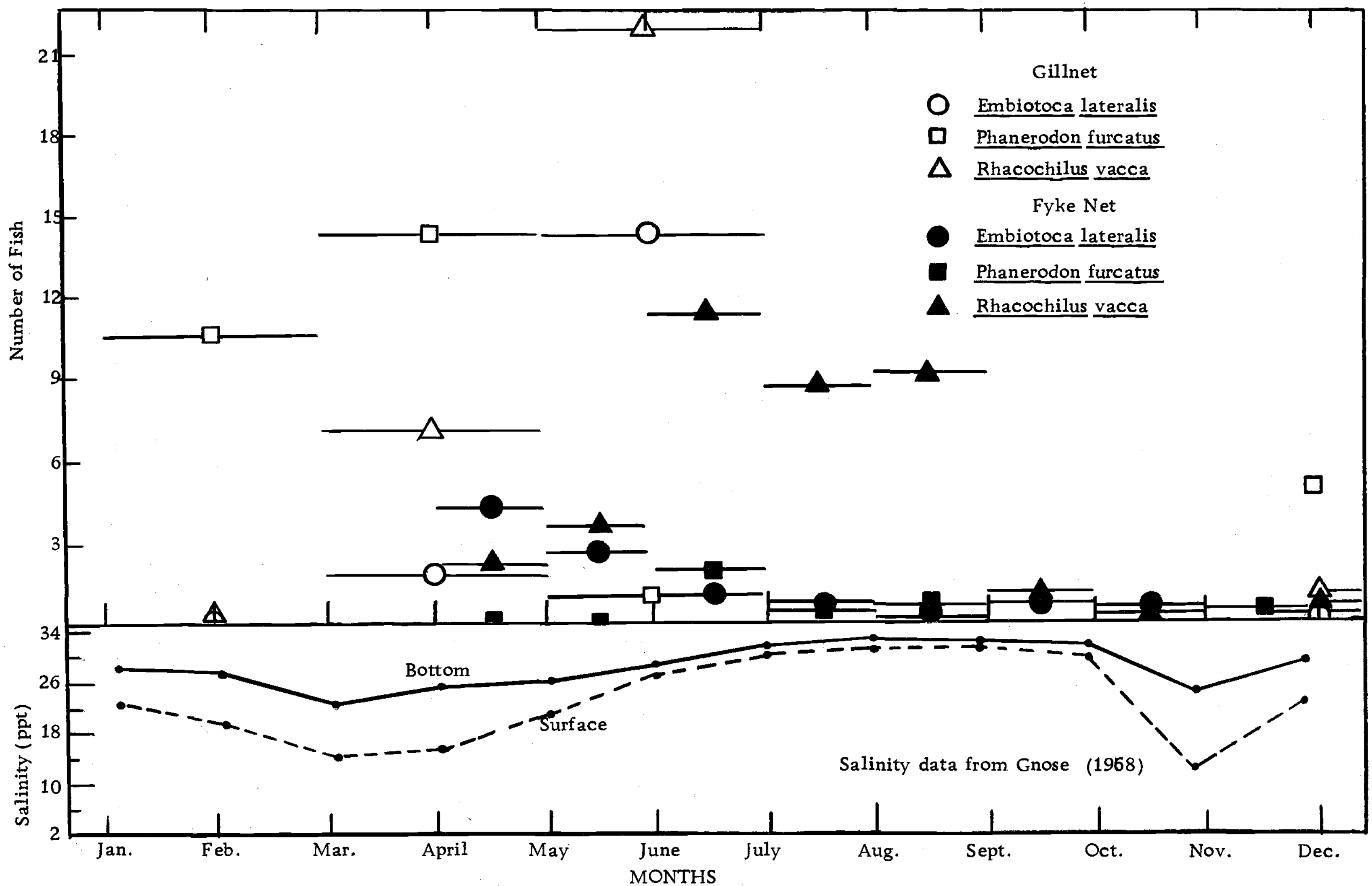


Figure 32. Relationship between average seasonal catch-per-gill net and fyke net set (6 hour) and water salinity for study zones 6 and 7 (data from Table 19).

seasonal change in availability being either attached on living in burrows (Cancer an exception). In addition, if food abundance alone explains seasonal migration of adult surfperch, why weren't males and females equally numerous in the upper estuary prior to birth of young? It has been shown by Wares (1968) that juvenile prey organisms, probably progeny of the same season as the young-of-the-year surfperch, are an important source of food for these young surfperch. High abundance of small food organisms in summer, as well as protection from predators, would explain why pregnant surfperch seemingly choose the upper estuary for the birth of young. Winter extremes in temperature and salinity probably cause winter emigration from this area (Figures 31 and 32).

Longshore movement of tagged surfperch was not encountered by Gnose (1968). Morgan (1961) reported two pile perch and one striped seaperch released in Siletz Bay were recovered two to three miles north of the entrance to the bay. Ocean recaptures during this study included three striped seaperch taken near Yaquina Head, the mouth of Yaquina Bay and near Florence, Oregon (Appendix 2). The latter recovery, if properly reported, presents some evidence for longshore movement of striped seaperch.

Angler surveys (Figures 26, 27 and 28) indicated mature females predominate in surfperch catches. From a management standpoint, the months when pregnant surfperch nearly isolate themselves from the males (Figure 23) may be the most critical period in their life history. This isolation of females occurs when angling pressure is at one of the highest levels of the year (Figure 13). Fishermen commonly catch a flour-sack of female surfperch during this time and it is not unusual to find the bottom of their boat speckled with the aborted premature surfperch. Observations (Swedberg, 1965) have shown that even if these premature fish are returned quickly to the water, the mortality is extremely high.

Angler surveys (this study) revealed that the principal species, in addition to surfperch, caught by sport fishermen in the upper estuary during the time of surfperch birth was the starry flounder. Because flounder appeared in even greater numbers in the lower estuary at this time, as well as male surfperch and many other species, the upper estuary could be closed to sport fishing during May and June without seriously affecting the availability of food fishes (excepting pregnant female surfperch).

Administrative Order FO 162 of the Fish Commission of Oregon (establishing a commercial hook and line season for ocean food fish) has not resulted in measurable landings of surfperch (Reed, personal communication). Commercial trawl landings only amounted to 1,719 pounds in 1967 (Table 18). Therefore, the current Oregon commercial harvest of surfperch appears to be relatively inconsequential.

SUMMARY

1. The relationship of weight to length of starry flounder was $Log_{10}W = 2.95\ Log_{10}L - 1.85$ for females, $Log_{10}W = 3.05\ Log_{10}L - 1.99$ for males.

2. Age class and length frequency distributions for starry flounder indicated males are more abundant than females and fish in age class III (200-250 mm TL) are most numerous.

3. Mature male flounder appeared (4%) in the third year class, whereas the first mature females were in the fourth year class (7%). Female flounder older than three years were larger than males of equal age.

4. Tagging of 6,385 flounder in Yaquina Bay resulted in 469 recaptures (7.3%). The majority were recaptured in Yaquina Bay by sport fishermen (125) and scientific investigators (256). Flounder recaptured outside Yaquina Bay were caught by sport fishermen (31) and commercial fishermen (57).

5. Mean lengths at tagging of flounder recaptured outside Yaquina Bay (380 mm TL) were significantly larger than 500 consecutively tagged flounder (335 mm TL), which in turn were significantly larger than recaptures within Yaquina Bay (325 mm TL).

6. Eventual deterioration of Petersen disc tags prevented tag returns from flounder at liberty for more than 826 days.

7. Only 15 of the 238 flounder recaptured by investigators within Yaquina Bay showed migration of more than 200 yards. Tagged flounder transported within the bay tended to return to the point of original capture.

8. Sport fishermen traveled considerable distances to angle in Yaquina Bay for food fishes. They selected particular areas of the bay and caught more flounder during April than any other month.

9. Post mortem shrinkage in commercially landed flounder was about 1.5% of the total length.

10. The most northerly and southerly recapture of tagged starry flounder occurred near Tatoosh Island, Washington, and Winchester Bay, Oregon.

12. Growth of tagged flounder subsequently recaptured was similar to that of non-tagged fish.

13. The population size of flounder in King Slough was estimated using mark and recapture techniques. Relatively low recapture rates increased the confidence intervals around population estimates. Depending on the statistical method and day of estimation, population estimates varied between 1, 164 and 39, 125. Possible causes of error are discussed.

14. Examination of 5, 503 starry flounder for reversed eye rotation (sinistrality) revealed 3, 167 (57. 6%) were reversed. The Yaquina Bay fish appear to differ significantly in degree of sinistrality from collections from Japan and Alaska, but not with fish from Puget Sound, San Francisco Bay and Monterey Bay.

15. A photograph and description of an ambicolored starry flounder from Yaquina Bay is presented. This is the second known occurrence of ambicoloration in this species.

16. Comparison of the commercial and sport harvest of starry flounder indicated commercial fishermen harvest more fish (by number and weight). It was concluded that neither fishery warranted regulation at the present time.

17. The relationship of weight to length for white seaperch was $\mathrm{Log}_{10} W = -4.05 + 3.06 \mathrm{Log}_{10} L$ for females and $\mathrm{Log}_{10} W = -3.93 + 2.98 \mathrm{Log}_{10} L$ for males.

18. A low abundance of age class II white seaperch was indicated in population samples.

19. Tagging of 1, 655 surfperch resulted in 55 recaptures (3. 3%). Three striped seaperch taken near Florence, Newport and Yaquina Head, Oregon, accounted for the only ocean recaptures.

20. Laboratory experiments indicated rough treatment of surfperch and tag loss were probably causes of low recapture rates. The spaghetti tag provided the greatest rate of return of four

tag-types tested.

21. Intraestuarine movements of surfperch were indicated by changes in catch-per-unit-of-effort and tag recoveries. During winter months pile perch appeared to leave the estuary, striped seaperch retreated to the lower estuary and ocean, and white seaperch were numerous in the lower and middle portions of the estuary.

22. During spring months mature females of all three species were numerous in the middle and upper estuary. In summer and fall mature males became more abundant in these areas. The possible roles of temperature, salinity, food organisms and reproductive behavior of surfperch were discussed as causative agents for migration.

23. The surfperch sport fishery focused on mature females as indicated by angler interviews and creel census data. Closure of the upper estuary during the period when young are born was discussed as a conservation measure. Commercial harvest of surfperch by trawling and hook and line fishing appeared to be inconsequential at the present time.

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APPENDICES

Appendix 1. Resume of information on the application and recovery of tags placed on starry flounder in Yaquina Bay, Oregon.

	Application			Recovery			
Tag number	Date tag applied	Length at tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
000	8/1/64	---	5	7/1/65	43.7	C	Pacific Ocean off Beaver Cr., Oregon
001	7/21/64	---	5	5/15/65	33.3	S	5
002	7/23/64	---	5	9/8/64	335	S	3
003	8/4/64	330	6	4/20/65	349	SB	6
045	8/5/64	365	8	4/13/66	435	C	Pacific Ocean off Yaquina Hd.
068	8/11/64	235	3	2/20/66	325	SB	5
069	8/11/64	---	3	3/23/65	271	S	3
071	8/11/64	---	3	7/19/65	327	S	4
086	8/19/64	540	6	8/21/64	540	S	6
087	8/19/64	380	6	5/15/65	433	S	6
104	8/28/64	390	3	8/24/65	425	C	Pacific Ocean off Yaquina Bay
106	8/28/64	432	3	9/3/64	433	S	3
114	8/28/64	343	3	9/24/64	352	S	3
127	8/28/64	284	3	9/24/64	285	S	3

[1] S = scientific personnel; SB = sport fishermen in Yaquina Bay; SO = sportfishermen outside Yaquina Bay; C = commerical fishermen.

[2] Numbers refer to study zones within Yaquina Bay.

(continued)

Appendix 1. Continued

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
134	8/28/64	380	3	5/7/65	44	S	3
137	9/11/64	359	3	9/14/64	362	S	3
157	9/2/64	326	3	9/25/64	324	S	3
178	9/2/64	320	3	9/12/64	320	S	3
183	9/2/64	406	3	9/25/64	408	S	3
189	9/2/64	347	3	6/17/65	395	S	3
203	9/3/64	345	3	4/12/65	385	S	3
207	9/3/64	315	3	8/16/65	358	S	3
				9/11/65	356	S	3 (Fish recaptured twice)
209	9/3/64	333	3	1/14/65	350	S	3
219	9/3/64	272	3	5/31/65	306	S	3
247	9/4/65	363	3	7/3/65	420	SO	Yaquina Bay Mouth
254	9/14/64	324	3	9/14/64	324	S	3
265	9/4/64	296	3	7/2/65	314	S	3
284	9/8/64	333	3	4/5/66	450	S	3
298	9/3/64	340	3	7/16/65	295	SO	Yaquina Bay Mouth

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
304	9/10/64	313	3	3/7/65	---	SB	4
314	9/10/64	362	3	9/25/64	353	S	3
316	9/10/64	358	3	6/19/65	390	S	3
329	9/10/64	271	3	8/29/65	311	S	3
333	9/10/64	334	3	9/25/64	335	S	3
335	9/10/64	427	3	6/17/65	475	C	Pacific Ocean off Columbia R.
343	9/10/64	305	3	12/1/64	313	S	3
			6	2/33/65	327	SB	6
344	9/14/64	305	3	9/14/64	305	S	3
353	9/14/64	474	3	6/17/65	520	S	3
357	9/14/64	443	3	8/22/65	483	C	Pacific Ocean off Yaquina Bay
371	9/14/64	299	3	5/31/65	328	S	3
375	9/14/64	267	3	5/7/65	295	S	3
383	9/22/64	292	3	7/21/65	328	S	3
388	9/22/64	255	3	8/16/65	305	SB	3
389	9/22/64	438	3	5/15/65	482	S	3
				8/28/65	500	S	3

(continued)

Appendix 1. Continued.

Application				Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
391	9/23/64	392	3	8/22/65	435	C	Pacific Ocean off Yaquina Bay
402	9/23/64	586	3	7/17/66	640	C	Pacific Ocean off Yaquina Bay
424	9/23/64	287	3	7/2/65	313	S	3
				3/27/66	335	S	3
438	9/23/64	325	3	4/2/66	339	S	3
440	9/25/64	214	3	6/22/65	265	S	3
443	9/25/64	353	3	7/2/65	367	S	3
450	9/25/64	320	3	8/25/65	380	S	3
465	9/25/64	325	3	6/16/65	365	S	3
490	10/1/64	386	4	10/15/64	390	S	4
491	10/1/64	317	4	7/23/65	367	SB	4
494	10/1/64	317	4	4/6/65	346	S	4
501	10/1/64	283	4	7/29/65	312	S	4
505	10/1/64	295	4	2/18/65	325	SB	4
510	10/1/64	258	4	7/17/65	318	S	4
513	10/1/64	302	4	5/15/66	407	SB	4
516	10/1/64	329	4	5/15/66	427	SB	4

(continued)

Appendix 1. Continued.

		Application			Recovery		
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
526	10/15/64	312	4	8/10/65	380	SB	1
527	10/15/64	466	4	3/23/65	497	C	Pacific Ocean off Yaquina Bay
534	10/15/64	396	4	4/3/65	430	SB	4
546	10/15/64	302	4	7/9/65	348	S	4
560	10/15/64	409	4	2/16/66	493	C	Pacific Ocean off Yaquina Hd.
571	10/15/64	276	4	3/3/65	305	SB	4
573	10/15/64	212	4	7/30/65	304	S	4
576	10/15/64	333	4	4/3/65	360	SB	4
579	10/15/64	220	4	8/26/65	281	S	4
583	10/15/64	477	4	8/6/65	532	C	Pacific Ocean off Yaquina Bay
589	10/15/64	270	4	4/9/65	305	SB	4
595	10/29/64	378	7	6/26/66	494	C	Pacific Ocean off Yaquina Bay
605	11/19/64	378	4	7/26/65	425	S	4
				8/26/65	435	C	Pacific Ocean off Yaquina Bay
613	11/19/64	360	4	7/29/65	370	S	4

(continued)

Appendix 1. Continued

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
619	11/19/64	296	4	3/20/65	315	SB	4
622	11/19/64	447	4	6/5/66	486	SB	4
631	1/7/65	332	3	4/23/66	413	SB	4
655	1/12/65	466	3	6/25/65	472	SB	3
				4/4/66	520	SB	6
664	1/12/65	477	3	8/16/65	507	S	3
696	1/14/65	293	5	4/11/65	307	SB	5
700	1/21/65	272	4	4/9/66	350	SB	4
711	1/21/65	371	4	4/4/65	388	SB	4
717	1/21/65	361	4	7/19/65	389	S	4
719	1/21/65	251	4	3/24/65	278	S	4
721	1/21/65	301	4	7/27/65	335	C	Pacific Ocean 10 mls. south of Columbia Riv. mouth
723	1/21/65	230	4	4/9/66	320	SB	4
739	2/11/65	322	7	4/13/66	370	C	Pacific Ocean off Yaquina Hd.
746	2/11/65	322	3	3/26/66	330	SB	4

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
751	2/11/65	356	3	6/17/66	330	SB	4
754	2/11/65	294	3	6/15/65	310	SB	---
755	2/11/65	368	3	8/22/65	414	C	Pacific Ocean off Yaquina Bay Mouth
776	2/18/65	298	6	3/7/65	302	SB	6
787	2/18/65	283	4	8/25/65	406	S	4
788	2/18/65	384	4	7/1/65	306	SB	4
793	2/18/65	257	4	8/25/65	299	S	4
795	2/18/65	268	4	7/30/65	305	S	4
801	3/23/65	258	3	5/15/66	335	SB	4
802	3/23/65	435	3	8/24/65	470	SO	Mouth Siletz Bay, Oregon
813	3/23/65	289	3	7/1/65	305	S	3
818	3/23/65	302	3	6/25/65	305	C	Pacific Ocean off Yaquina Bay
820	3/23/65	292	3	2/19/66	345	S	3
826	3/23/65	451	3	7/2/65	455	C	Pacific Ocean off Yaquina Bay
828	3/23/65	313	3	4/2/66	343	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
830	3/23/65	408	3	6/4/66	500	SO	Pacific Ocean off West Port, Wash.
838	3/23/65	384	3	8/22/65	396	C	Pacific Ocean off Yaquina Bay
839	3/23/65	298	3	6/22/65	315	S	3
842	3/23/65	377	3	7/1/65	401	C	Pacific Ocean off Beaver Ck., Oregon
*842A	4/10/65	245	3	8/10/66	305	C	Pacific Ocean off Yaquina Hd.
844	3/23/65	308	3	7/12/65	332	SO	Yaquina Bay Mouth
849	3/23/65	338	3	8/29/65	359	S	3
852	3/23/65	439	3	6/16/65	495	S	3
862	3/23/65	337	3	4/2/66	373	S	3
864	3/23/65	412	3	8/16/65	428	C	Pacific Ocean off Yaquina Hd.
871	3/23/65	314	3	4/12/65	317	S	3
				2/11/67	353	S	3

*Tag reused

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
873	3/23/65	264	3	6/22/65	282	S	3
881	3/23/65	348	3	8/28/65	370	S	3
903	3/24/65	388	4	4/26/66	463	C	Pacific Ocean off Yaquina Bay
907	3/24/65	420	4	7/30/65	420	C	Pacific Ocean off Yaquina Bay
909	3/24/65	314	4	3/11/67	447	SB	4
917	3/24/65	319	4	8/19/65	348	SB	4
919	3/24/65	276	4	9/ 66	373	C	Pacific Ocean off Winchester Bay, Oregon
921	3/24/65	282	4	7/30/65	305	SO	In Siletz Bay, Oregon
923	3/24/65	258	4	3/26/66	314	S	4
928	3/24/65	305	4	6/6/65	320	SB	---
940	3/24/65	295	4	8/15/65	315	SO	Pacific Ocean off Yaquina Bay
941	3/24/65	319	4	4/9/66	390	SB	4
943	3/24/65	349	4	3/26/66	414	SB	4

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
948	3/24/65	358	4	8/14/66	385	C	Pacific Ocean off Columbia R.
960	2/24/65	368	4	4/14/65	380	SB	4
965	3/24/65	309	4	9/12/65	345	SO	Pacific Ocean off Yaquina Bay
966	3/24/65	311	4	4/9/66	327	S	4
987	3/24/65	279	4	7/1/65	300	SO	In Siuslaw River, Oregon
992	3/24/65	350	4	5/10/65	359	SB	5
994	3/25/65	273	4	2/12/66	297	S	4
995	3/24/65	335	4	7/17/65	364	S	4
1005	4/17/65	372	3	8/15/65	393	SB	3
1033	4/9/65	372	2	7/17/65	388	SB	2
1037	5/14/65	438	3	4/2/66	488	S	3
1040	5/14/65	459	3	4/15/66	468	C	Pacific Ocean off Yaquina Bay
1045	5/14/65	328	3	8/29/65	331	S	3
1053	5/14/65	374	3	4/3/66	433	SB	5
1057	5/14/65	363	3	7/28/65	365	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
1069	5/14/65	312	3	8/2/66	342	S	3
1073	5/14/65	322	3	3/27/66	332	S	3
1080	5/14/65	310	6	7/19/65	322	SB	5
1096	5/31/65	388	3	---	---	S	3
1110	5/31/65	490	3	---	---	C	Pacific Ocean off Yaquina Bay
1117	5/31/65	310	3	9/9/65	311	S	3
1123	5/31/65	382	3	8/16/65	393	C	Pacific Ocean off Yaquina Hd.
1130	5/31/65	297	3	8/29/65	306	S	3
1133	5/31/65	325	3	8/30/65	322	S	3
				9/1/65	362	S	3
1136	5/31/65	465	3	8/7/65	471	C	Pacific Ocean off Yaquina Bay
1139	5/31/65	354	3	7/3/65	360	SB	---
1158	5/31/65	380	3	6/29/65	370	SB	---
1163	5/31/65	386	3	6/10/66	436	C	Pacific Ocean off Yaquina Bay
1180	6/8/65	417	1	5/1/66	480	SB	2

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
1218	6/22/65	268	3	7/13/65	275	SO	Pacific Ocean off Yaquina Bay
1268	6/21/65	382	6	4/30/66	427	SB	6
1271	6/22/65	463	4	4/15/66	473	C	Pacific Ocean off Yaquina Bay
1294	6/25/65	363	7	6/29/65	368	S	7
1308	6/29/65	452	6	4/26/66	495	C	Pacific Ocean off Yaquina Bay
1313	7/1/65	493	3	11/1/67	525	C	Pacific Ocean off Yaquina Bay
1319	7/1/65	374	3	8/30/65	374	S	3
1321	7/1/65	268	3	7/22/56	337	S	3
1324	7/1/65	390	3	9/12/65	406	C	Pacific Ocean off Yaquina Bay
1329	7/1/65	405	3	4/13/66	429	C	Pacific Ocean off Yaquina Bay
1333	7/1/65	297	3	8/28/65	301	S	3
1334	7/1/65	344	3	8/7/65	341	C	Pacific Ocean off Yaquina Bay
1339	7/1/65	447	3	12/28/66	494	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
1341	7/1/65	392	3	8/16/65	392	S	3
1357	7/1/65	376	3	8/29/65	378	S	3
1390	7/7/65	466	6	6/18/66	493	S	3
1404	7/9/65	309	4	8/25/65	309	S	4
1409	7/9/65	318	4	3/27/66	360	SB	4
1410	7/9/65	404	4	4/23/66	460	SB	4
1414	7/9/65	261	4	7/22/65	257	S	4
1431	7/9/65	336	1	9/4/65	345	SO	In Sandlake, Oregon
1450	7/15/65	579	6	9/8/65	566	C	---
1468	7/17/65	231	1	9/13/65	243	SB	1
1472	7/16/65	298	1	4/10/66	348	SB	1
1481	7/16/65	472	4	8/8/65	478	SO	Pacific Ocean off Yaquina Bay
1483	7/16/65	317	4	8/25/65	321	S	4
1490	7/16/65	383	4	5/15/66	438	SB	4
1506	7/17/65	423	4	8/2/65	419	C	Pacific Ocean off Yaquina Bay
1517	7/19/65	395	4	4/9/66	424	S	4

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
1519	7/19/65	358	4	6/15/66	417	SB	4
1530	7/19/65	514	4	9/30/65	530	C	Pacific Ocean off Columbia R.
1562	7/31/65	511	2	8/16/65	499	C	Pacific Ocean off Yaquina Hd.
1564	8/10/65	346	3	9/2/66	398	S	3
1571	8/7/65	290	6	4/17/66	335	SO	Pacific Ocean off Yaquina Bay
1596	8/10/65	299	3	9/9/65	298	S	3
1615	7/29/65	357	4	5/7/66	408	SB	4
1624	7/29/65	318	4	8/25/65	313	S	4
1664	7/29/65	402	4	8/25/65	385	S	4
1689	7/29/65	437	4	4/22/66	490	SB	5
1802	7/31/65	322	4	8/25/65	322	S	4
1831	8/25/65	346	4	7/4/66	403	SB	---
1858	8/25/65	425	4	6/13/66	433	SO	Pacific Ocean off Yaquina Bay
1859	8/25/65	315	4	5/15/66	360	SB	4
1860	8/25/65	342	4	6/28/66	373	SB	4

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
1873	8/25/65	324	4	4/6/66	365	SB	4
1904	8/26/65	403	4	2/29/66	437	C	Pacific Ocean off Yaquina Bay
1941	8/27/65	511	4	5/15/66	555	SB	4
1945	8/27/65	312	4	6/15/67	437	SB	4
1952	8/27/65	368	4	6/10/66	409	SB	4
1965	8/28/65	342	3	3/26/66	355	S	3
1970	8/28/65	323	3	8/29/65	320	S	3
1973	8/28/65	332	3	8/29/65	331	S	3
1985	8/28/65	430	3	7/18/66	495	C	Pacific Ocean off Yaquina Hd.
2000	8/28/65	342	3	9/9/65	332	S	3
2002	8/28/65	362	3	11/3/67	520	C	Pacific Ocean off Cape Flattery, Wash.
2003	8/28/65	311	3	2/19/66	307	S	3
2067	8/28/65	397	3	9/8/67	467	S	3
2091	8/28/65	328	3	4/2/66	346	S	3
2133	8/29/65	430	3	8/31/66	477	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
2142	8/29/65	459	3	9/ 66	530	C	Pacific Ocean off Winchester Bay, Oregon
2233	8/29/65	370	3	7/22/66	375	S	3
2311	9/1/65	237	7	4/25/67	350	SB	5
2341	2/12/66	353	3	7/22/66	368	S	3
2347	2/12/66	276	3	7/20/66	295	S	3
2366	2/12/66	367	4	3/26/66	378	SB	4
2369	2/12/66	284	4	9/ 66	325	C	Pacific Ocean off Winchester Bay, Oregon
2379	2/12/66	247	3	7/4/67	343	SB	3
2382	2/12/66	339	3	4/5/66	344	S	3
2385	2/12/66	270	3	2/25/66	275	SB	5
2392	2/12/66	277	3	4/2/66	287	S	3
2398	2/12/66	348	3	3/19/67	403	S	3
2424	3/5/66	244	3	2/24/67	386	S	3
2440	3/25/66	385	3	3/27/66	385	S	3
2427	3/5/66	417	3	5/22/66	430	SB	1

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
2457	3/25/66	376	3	9/29/66	391	S	3
2480	3/25/66	370	3	9/1/66	387	S	3
2482	3/25/66	301	3	2/11/67	379	S	3
2487	3/25/66	242	3	4/2/66	241	S	3
2498	3/25/66	411	4	5/15/66	420	SB	6
2499	3/25/66	347	4	3/5/67	358	S	4
2509	3/26/66	364	3	4/2/66	364	S	3
2520	3/26/66	403	3	8/6/67	490	SB	2
2536	3/26/66	343	3	9/1/66	362	S	3
2542	3/26/66	335	3	2/11/67	365	S	3
2547	3/26/66	303	3	8/29/67	380	S	3
2568	3/26/66	378	3	7/8/67	444	SO	In Siuslaw River, Oregon
2573	3/26/66	342	3	7/22/66	348	S	3
2579	3/26/66	352	3	7/22/66	361	S	3
2590	3/26/66	270	3	8/2/66	302	S	3
2597	3/26/66	355	3	4/2/66	357	S	3
2612	4/2/66	283	5	8/1/67	380	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
2629	4/2/66	470	3	5/23/66	490	C	In Columbia R.
2636	4/2/66	476	3	12/22/66	515	C	Pacific Ocean off Yaquina Bay
2640	4/2/66	269	3	1/20/68	385	SB	5
2644	4/2/66	245	3	10/24/66	278	S	3
2647	4/2/66	252	3	4/25/67	342	S	3
				11/13/67	363	S	3
2649	4/2/66	443	3	7/2/67	385	SB	3
2652	4/2/66	368	3	4/8/66	533	S	2
2657	4/2/66	341	3	12/28/66	370	S	3
2659	4/2/66	340	3	8/31/66	350	S	3
2664	4/2/66	220	3	1/26/67	295	S	3
2667	4/2/66	384	3	2/11/67	415	S	3
2668	4/2/66	437	3	9/13/66	470	SO	Pacific Ocean off Yaquina Bay
2673	4/2/66	333	3	8/10/66	342	S	3
2674	4/2/66	352	3	12/28/66	369	S	3
2683	4/2/66	234	3	4/8/66	240	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
2689	4/2/66	375	3	9/1/66	---	S	3
2691	4/2/66	236	3	Fall/66	290	S	3
2707	4/2/66	280	3	5/6/66	264	S	3
				3/1/67	317	S	4
2713	4/2/66	251	3	8/2/66	264	S	3
2720	4/2/66	326	3	12/16/66	332	S	3
2721	4/2/66	303	3	1 or 2/68	410	SB	3
2725	4/2/66	386	3	12/28/66	438	S	3
2733	4/2/66	403	3	7/15/67	493	C	Pacific Ocean off Yaquina Bay
2736	4/2/66	430	3	11/1/66	467	C	Pacific Ocean off Winchester Bay, Oregon
2740	4/2/66	427	3	1/26/67	497	S	3
2743	4/2/66	353	3	9/1/66	355	S	3
2745	4/2/66	295	3	7/21/67	375	S	3
2746	4/2/66	335	3	9/2/66	360	S	3
2749	4/2/66	503	3	8/2/66	505	S	3
2752	4/2/66	362	3	8/16/67	448	S	3

(continued)

Appendix 1. Continued.

Application				Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
2758	4/2/66	265	3	2/24/67	327	S	3
2769	4/2/66	207	3	1/26/67	278	S	3
2784	4/2/66	316	3	12/16/66	359	S	3
2789	4/2/66	339	3	4/22/66	342	SB	5
2793	4/2/66	216	3	5/6/66	220	S	3
2795	4/3/66	413	6	5/29/66	423	SB	6
2798	4/3/66	303	6	5/15/66	310	SB	6
2813	4/9/66	373	4	9/9/67	473	SB	5
2815	4/9/66	224	4	3/6/67	328	S	4
2816	4/9/66	264	4	5/7/67	337	SB	---
2822	4/9/66	250	4	4/10/67	328	S	4
2834	4/9/66	345	4	2/25/67	403	SB	4
2835	4/9/66	274	4	7/7/66	292	SB	1
2840	9/4/66	365	4	7/27/68	497	SO	Pacific Ocean off Yaquina Bay
2842	4/9/66	270	4	3/26/67	334	SB	4
2856	4/9/66	325	4	5/20/66	334	SB	4
2863	4/9/66	344	4	3/1/67	386	S	4

(continued)

Appendix I. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
2881	4/9/66	410	4	7/30/67	495	SB	4
2892	6/8/66	292	1	2/26/67	342	SO	In Necanicum River, Oregon
2895	7/6/66	333	3	5/29/68	460	SB	1
2903	10/6/66	400	6	2/1/67	414	C	Pacific Ocean off Yaquina Bay
2921	11/30/66	297	5	7/16/67	340	SB	5
2934	11/30/66	323	4	8/11/67	374	SO	Pacific Ocean off Yaquina Bay
2953	11/30/66	402	4	3/5/67	398	S	4
2956	11/30/66	217	4	8/3/67	368	SB	2
2960	11/30/66	220	4	---	---	SB	4
2972	2/27/67	267	4	4/10/67	275	S	4
2973	2/27/67	303	4	6/15/68	390	SO	Pacific Ocean off Yaquina Bay
2986	2/27/67	266	4	8/22/67	300	SB	1
2991	10/24/66	438	3	3/1/68	528	SB	3
2992	2/27/67	342	4	3/11/67	345	SB	4
2994	2/27/67	344	4	8/20/67	350	SO	Pacific Ocean off Yaquina Bay

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
3004	7/22/66	366	3	3/27/67	393	S	3
				10/8/68	410	SB	3
3007	7/22/67	374	3	3/19/67	411	S	3
3019	7/22/66	250	3	7/24/67	326	S	3
3036	7/22/66	266	3	9/29/66	265	S	3
3038	7/22/66	400	3	9/22/66	415	S	3
3041	7/22/66	409	3	9/29/66	382	S	3
3044	7/22/66	381	3	10/15/66	274	S	3
3072	7/22/66	331	3	7/11/67	361	S	3
3082	7/22/66	416	3	7/25/66	420	C	Pacific Ocean off Yaquina Hd.
3084	7/22/66	283	3	2/24/67	328	S	3
3099	7/22/66	516	3	11/1/67	513	C	Pacific Ocean off Yaquina Bay
3100	7/22/66	407	3	1/ 68	505	SB	3
3109	7/22/66	412	3	10/24/66	310	S	3
3131	8/21/66	405	3	3/19/67	428	S	3
3154	9/29/66	386	3	3/27/67	427	S	3
3156	9/29/66	295	3	4/30/67	335	SB	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
3157	9/29/66	237	3	3/20/68	298	SO	In Siletz Bay
3160	9/29/66	474	3	8/16/67	485	S	3
3166	9/29/66	410	3	3/19/67	441	S	3
3169	3/19/67	300	3	8/4/67	302	S	3
3174	9/29/66	243	3	7/21/67	329	S	3
3178	9/29/66	357	3	2/7/67	372	S	3
3196	9/30/66	338	4	3/24/67	379	S	3
				3/27/67	368	S	3
3227	3/1/67	287	4	7/14/67	307	S	5
3241	3/1/67	321	4	4/7/68	395	SB	4
3264	3/1/67	278	4	8/9/67	310	S	2
3286	3/1/67	251	4	1/ 68	305	SB	3
3298	3/1/67	306	4	6/20/67	328	S	4
3339	2/27/67	426	4	4/21/67	440	SB	5
3373	2/27/67	413	4	3/20/67	413	S	4
3377	2/27/67	263	4	4/15/67	271	SB	4
3426	3/1/67	265	4	4/10/67	269	S	4
3446	3/1/67	353	4	8/27/67	388	SB	2

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
3467	3/4/67	286	4	9/25/67	325	C	In Columbia R.
3478	3/4/67	287	4	4/1/67	290	S	4
3482	3/4/65	255	4	3/20/67	253	S	4
3488	3/4/67	289	4	4/9/67	300	SB	4
3490	3/4/67	275	4	5/14/67	287	SB	4
3507	3/4/67	310	4	4/1/67	311	S	4
3517	3/4/67	265	4	8/16/67	295	S	1
3551	3/4/67	312	4	8/3/67	336	SB	1
3564	3/4/67	332	4	5/30/67	348	SB	---
3569	3/4/67	378	4	5/12/68	458	SB	4
3572	3/4/67	285	4	7/24/67	355	S	5
3584	3/4/67	275	4	6/20/67	297	SB	4
3594	3/4/67	246	4	8/9/67	246	S	2
3603	3/4/67	338	4	8/4/67	360	SB	2
3613	3/4/67	265	4	8/23/67	285	SB	2
3615	3/4/67	312	4	8/18/67	360	SO	Pacific Ocean off Yaquina Bay
3616	3/4/67	437	4	7/6/68	528	SO	Pacific Ocean off Yaquina Bay

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
3619	3/4/67	302	4	8/4/67	317	C	Pacific Ocean off Columbia R.
3623	3/4/67	331	4	1/ 68	387	SB	3
3624	3/4/67	306	4	4/10/67	313	S	4
				5/23/68	388	SB	1
3640	3/4/67	277	4	3/14/67	280	SB	4
3650	3/4/67	317	4	7/26/68	410	SO	Pacific Ocean off Yaquina Bay
3657	3/4/67	297	4	3/18/68	365	SB	4
3714	3/19/67	315	3	6/8/67	400	S	3
3750	3/21/67	335	5	10/26/67	367	S	5
3752	3/21/67	370	5	7/24/67	355	S	5
				9/2/68	---	SO	Mouth Siletz Bay, Oregon
3761	3/27/67	442	3	9/5/67	450	S	3
3762	3/27/67	415	3	9/8/67	427	S	3
3775	3/27/67	267	3	9/7/67	290	S	3
3776	3/27/67	355	3	9/25/67	357	S	3
3779	3/27/67	324	3	4/19/68	398	SO	Pacific Ocean off Yaquina Bay

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
3785	3/27/67	345	3	8/28/67	373	SO	Pacific Ocean off Yaquina Bay
3802	3/29/67	384	6	6/20/68	466	SB	6
3805	3/29/67	269	6	7/11/67	298	SO	Pacific Ocean off Yaquina Bay
3882	4/1/67	248	4	8/8/67	296	S	3
3891	4/1/67	297	4	6/20/67	302	S	4
3917	3/27/67	347	3	4/25/67	350	S	3
3932	3/27/67	282	3	7/13/67	301	S	3
3954	3/27/67	477	3	7/11/67	470	S	3
3956	3/27/67	376	3	8/10/67	387	S	3
3957	3/27/67	349	3	8/9/67	373	SO	Pacific Ocean off Yaquina Bay
3966	3/27/67	285	3	9/5/67	303	S	3
3974	3/27/67	290	3	4/24/67	301	S	3
3978	3/27/67	271	3	8/10/67	286	S	3
3985	3/27/67	332	4	4/1/67	336	S	4
4000	4/1/67	479	4	7/2/67	495	SB	4
4032	4/25/67	292	3	8/7/67	300	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
4038	4/25/67	291	3	7/19/67	300	S	3
4040	4/25/67	357	3	7/25/67	355	S	3
4047	4/25/67	399	3	7/21/67	406	S	3
4048	4/25/67	355	3	6/9/67	351	S	3
4051	4/25/67	345	3	7/6/67	357	S	10
4053	4/25/67	330	3	7/7/67	360	S	3
4063	4/25/67	342	3	7/21/67	353	S	3
4086	4/25/67	303	3	8/18/67	322	S	3
4096	4/25/67	298	3	8/9/67	308	S	2
4111	6/19/67	245	4	2/15/68	290	SB	4
4174	6/20/67	207	4	4/3/68	255	S	3
4190	6/20/67	263	4	3/15/68	307	SB	4
4294	6/20/67	437	4	5/20/68	500	SB	4
4296	6/20/67	160	4	8/8/67	161	S	3
4303	6/20/67	230	4	8/7/67	226	S	4
4337	6/21/67	260	4	5/15/68	322	SB	4
4354	6/21/67	166	4	7/6/67	174	SB	4
4420	6/21/67	336	4	3/15/68	385	SB	4

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
4521	6/22/67	258	4	5/31/68	320	SB	2
4639	6/22/67	237	4	5/10/68	302	SB	4
4771	6/23/67	279	4	5/10/68	328	SB	4
4827	6/24/67	280	4	8/7/67	281	S	4
4919	6/25/67	238	4	7/11/67	240	S	4
4928	6/25/67	265	4	3/4/68	312	SB	4
4973	6/25/67	252	4	7/6/67	255	S	10
5004	7/14/67	207	5	3/18/68	248	S	5
5005	7/14/67	356	5	3/24/68	400	SB	3
5065	7/21/67	269	3	9/8/67	271	S	3
5089	7/21/67	375	3	8/21/67	375	S	3
5090	7/21/67	449	3	9/5/67	453	S	3
5103	7/21/67	315	3	9/7/67	320	S	3
5107	7/21/67	312	3	9/4/67	320	S	3
5138	7/24/67	544	3	9/7/68	550	SB	3
5147	7/24/67	229	3	8/10/67	235	S	3
5193	7/25/67	413	3	8/21/67	412	S	3
5198	7/25/67	396	3	8/14/67	400	SB	1

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
5260	7/26/67	210	3	8/3/67	209	S	3
5278	7/26/67	314	3	9/4/67	125	S	3
5314	7/28/67	254	4	8/4/67	255	SB	4
5340	8/2/67	320	3	1/20/68	348	SB	5
5387	8/4/67	285	3	8/10/67	287	S	3
5391	8/4/67	215	3	8/10/67	215	S	3
5409	8/8/67	318	3	9/5/67	320	S	3
5467	8/8/67	219	3	8/23/67	225	S	3
5472	8/8/67	343	3	9/4/67	340	S	3
5493	8/8/67	433	3	9/5/67	434	S	3
5500	8/8/67	320	3	8/23/67	323	S	3
5510	8/8/65	257	3	8/23/67	253	S	3
5521	8/8/67	298	3	1/ 68	325	SB	3
5628	8/10/67	398	3	8/21/67	400	S	3
5635	8/10/67	298	3	8/23/67	300	S	3
5642	8/10/67	294	3	9/8/67	293	S	3
5706	8/10/67	394	3	8/21/67	390	S	3
5748	8/10/67	234	3	8/23/67	233	S	3

(continued)

Appendix 1. Continued.

	Application			Recovery			
Tag number	Date tag applied	Length of tagging (mm TL)	Release location (Study zone)	Date tag recovered	Length at recovery (mm TL)	Method of recovery[1]	Recovery location[2]
5780	8/11/67	250	3	9/13/68	330	C	In Columbia R.
5848	8/15/67	330	2	7/30/68	390	SB	1
6043	8/30/67	320	2	7/25/68	383	SB	2
6075	9/4/67	310	3	7/15/68	337	S	3
6107	9/5/67	249	3	9/7/67	250	S	3
6111	9/5/67	332	3	7/30/68	395	C	Pacific Ocean off Columbia
6200	9/5/67	435	---	11/5/68	482	C	Pacific Ocean off Umatilla Lightship
6266	9/5/67	292	3	1/ 68	312	SB	3
6273	9/5/67	254	3	7/28/68	310	SB	3
6315	9/7/67	250	3	7/15/68	246	S	3
6318	9/7/67	245	3	9/8/67	245	S	3
6364	9/8/67	316	3	11/13/67	322	S	3
6375	9/8/67	390	3	5/10/68	437	SO	In Siletz Bay
*---	---	---	---	10/16/67	465	C	Pacific Ocean off Umatilla Lightship

*Tag eroded

Appendix 2. Resume of information on the application and recovery of tags placed on surfperch in Yaquina Bay, Oregon.

Application					Recovery		
Tag number	Date tag applied	Length at tagging (mm TL)	Sex	Release[1] location (Study zone)	Date tag recovered	Method of[2] recovery	Recovery[1] location
				STRIPED SEAPERCH			
1363	5/14/65	317	F	6	7/4/65	SF	5
1390	6/9/65	230	F	7	9/1/65	S	2
1393	6/9/65	279	F	7	7/21/65	SF	Pac. Ocean (Newport)
1416	7/15/67	320	F	7	6/24/67	SF	2
1596	7/19/65	284	M	4	2/20/66	SF	1
3274	8/24/66	316	M	6	6/26/67	S	2
3115	10/24/66	243	F	6	10/27/66	S	6
1883	4/1/67	307	F	4	7/23/67	SF	Florence, Oregon
1886	4/1/67	314	F	4	3/2/68	SF	1
1901	4/16/67	326	F	6	5/25/67	S	6
1905	4/17/67	266	F	6	7/4/67	SF	2
1927	4/23/67	275	F	6	7/19/67	SF	5
1934	4/24/67	314	F	6	6/26/67	S	6
1938	4/27/67	279	F	6	5/9/67	SF	6
1953	4/26/67	342	F	6	5/27/67	SF	3
1970	4/28/67	272	F	6	5/17/67	S	6
1971	4/28/67	288	F	6	6/26/67	S	6
1985	6/7/67	302	F	6	6/15/67	S	6
2036	6/13/67	315	F	6	7/23/67	SF	Yaquina Head
2071	6/15/67	314	F	6	7/4/67	SF	2
2062	6/15/67	323	F	6	7/1/67	SF	1
2076	6/15/67	302	F	6	8/14/67	SF	2
2084	6/15/67	307	F	6	7/10/67	SF	1
2163	6/20/67	265	F	6	8/15/67	SF	2

(continued)

Appendix 2. Continued.

Application					Recovery		
Tag number	Date tag applied	Length at tagging (mm TL)	Sex	Release[1] location (Study zone)	Date tag recovered	Method of[2] recovery	Recovery[1] location
				STRIPED SEAPERCH (continued)			
2179	6/26/67	345	F	6	6/27/67	S	6
2181	6/26/67	376	F	6	6/27/67	S	6
2186	6/27/67	291	F	6	9/17/67	SF	5
2302	7/9/67	307	F	6	7/10/67	S	6
				PILE PERCH			
1036	8/11/64	360	F	6	8/29/64	SF	6
1262	8/25/64	421	M	6	9/17/64	SF	3
1303	8/20/65	328	F	6	8/26/65	SF	6
1705	6/17/66	413	F	6	6/23/66	S	6
1742	6/30/66	397	F	6	9/1/67	SF	2
1764	7/11/66	357	M	6	7/4/67	SF	6
1767	7/11/66	341	F	6	6/3/67	SF	6
1812	7/27/66	290	F	6	2/2/67	S	2
1835	8/9/66	378	F	6	8/17/67	SF	5
1923	4/22/67	368	F	6	6/17/67	S	6
1931	4/23/67	392	F	6	7/10/67	S	6
2014	6/12/67	365	F	6	7/26/67	SF	5
2016	6/12/67	240	F	6	7/4/67	S	6
2086	6/15/67	325	F	6	7/20/67	SF	5
2101	6/16/67	375	F	6	7/9/67	SF	5
2198	6/29/67	382	F	6	7/21/68	SF	5
2216	7/6/67	362	F	6	8/27/67	SF	5
2323	7/18/67	350	F	6	8/19/67	SF	6

(continued)

Appendix 2. Continued.

	Application				Recovery		
Tag number	Date tag applied	Length at tagging (mm TL)	Sex	Release[1] location (Study zone)	Date tag recovered	Method of[2] recovery	Recovery[1] location
				WHITE SEAPERCH			
1698	2/12/66	261	F	4	4/9/66	SF	4
1719	6/20/66	313	F	6	10/11/66	S	6
2264	7/7/67	288	F	3	8/10/67	S	3
2265	7/7/67	280	M	3	8/3/67	S	3
2285	7/7/67	312	M	3	8/10/67	S	3
2237	7/7/67	342	M	3	7/10/67	SF	5
2251	7/7/63	293	M	3	8/2/67	S	3
2259	7/7/67	322	M	3	7/21/67	S	3
2330	7/21/67	294	F	3	8/2/67	S	3

[1]Numbers refer to study zones within Yaquina Bay (Figure 4).

[2]S = scientific personnel; SB = sport fishermen in Yaquina Bay; SO = sport fishermen outside Yaquina Bay; C = commerical fishermen.

Appendix 3. Resume of species composition collections using try-net (otter trawl), beach seine, gill nets and fyke net. Each species is recorded as as a percentage (by number) of all fish collected.

Date: January - February					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	4	4	8	6	7	6	3	1	----	----
Number individuals	27	21	193	82	104	94	41	15	----	----
Individuals/tow	6.8	5.3	24.1	13.7	14.9	15.7	13.7	15	----	----
Temperature range (C)	9.6-9.8	9.7-9.9	7.2-8.8	9.3-9.5	7.5-9.6	8.7-9.1	8.6	8.6	----	----
Salinity range (0/00)	29.8-31.3	29.2-31.0	27.3-29.4	26.9-30.0	25.4-28.7	23.1-25.7	23.6	18.7	----	----
Raja binoculata										
Acipenser medirostris							11.1			
Alosa sapidissima										
Clupea harengus										
Engraulis mordax										
Oncorhynchus keta										
Oncorhynchus kisutch										
Oncorhynchus tshawytscha										
Salmo gairdneri										
Hypomesus pretiosus										
Microgadus proximus						2.7				
Gasterosteur aculeatus										
Aulorhynchus flavidus										
Syngnathus griseolineatus	11.1		1.5							
Amphistichus rodoterus		25.0								
Cymatogaster aggregata										
Embiotoca lateralis	11.1		2.9							
Hyperprosopon argenteum	11.1					2.7				
Hyperprosopon ellipticum										
Phanerodon furcatus						2.7				
Rhacochilus vacca										

(continued)

Appendix 3. Continued.

Date: January - February (continued)					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	4	4	8	6	7	6	3	1	----	----
Number individuals	27	21	193	82	104	94	41	15	----	----
Individuals/tow	6.8	5.3	24.1	13.7	14.9	15.7	13.7	15	----	----
Temperature range (C)	9.6-9.8	9.7-9.9	7.2-8.8	9.3-9.5	7.5-9.6	8.7-9.1	8.6	8.6	----	----
Salinity range (0/00)	29.8-31.3	29.2-31.0	27.3-29.4	26.9-30.0	25.4-28.7	23.1-25.7	23.6	18.7	----	----
Sebastodes sp.										
Hexagrammos decagrammus	33.3				12.5					
Hexagrammos stelleri										
Hexagrammos superciliosus										
Ophiodon elongatus			1.5		3.1					
Cottus asper						13.8				
Enophrys bison			1.5	1.9						
Leptocottus armatus	22.2		2.9		6.5	8.3	11.1			
Scorpaenichthys marmoratus										
Apodichthys flavidus										
Pholis ornata										
Lumpenus sagitta										
Atherinopsis californiensis										
Citharichthys stigmaeus										
Parophrys vetulus			1.5		3.1	11.1				
Platichthys stellatus		25.0	87.0	98.1	75.0	58.0	77.8	100.0		
Psettichthys melanostictus	11.1	50.0	1.5							

Appendix 3. Continued.

Date: March - April					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	3	5	18	4	5	---	1	2	2	---
Number individuals	3	18	286	150	32	---	22	17	75	---
Individuals/tow	1	3.6	15.9	37.5	6.4	---	22	8.5	37.5	---
Temperature range (C)	11.1-11.4	10.5-10.9	10.1-12.1	9.5-11.6	10.1-12.0	---	10.3	14.3	15.1	---
Salinity range (0/00)	30.1-31.6	29.0-30.3	28.0-29.7	28.1-29.9	27.6-29.5	---	23.7	20.6	17.3	---
Raja binoculata										
Acipenser medirostris										
Alosa sapidissima										
Clupea harengus										
Engraulis mordax										
Oncorhynchus keta										
Oncorhynchus kisutch										
Oncorhynchus tshawytscha										
Salmo gairdneri										
Hypomesus pretiosus										
Microgadus proximus										
Gasterosteus aculeatus										
Aulorhynchus flavidus										
Syngnathus griseolineatus	33.3								1.3	
Amphistichus rodoterus										
Cymatogaster aggregata			.4		28.1		45.5	52.9	32.0	
Embiotoca lateralis										
Hyperprosopon argenteum										
Hyperprosopon ellipticum										
Phanerodon furcatus				4.7	6.3					
Rhacochilus vacca										
Sebastodes sp.										
Hexagrammos decagrammus		5.6	1.8		6.3					

(continued)

Appendix 3. Continued.

Date: March - April (continued)					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	3	5	18	4	5	---	1	2	2	---
Number individuals	3	18	286	150	32	---	22	17	75	---
Individuals/tow	1	3.6	15.9	37.5	6.4	---	22	8.5	37.5	---
Temperature range (C)	11.1- 11.4	10.5- 10.9	10.1- 12.1	9.5- 11.6	10.1 12.0	---	10.3	14.3	15.1	---
Salinity range (0/00)	30.1- 31.6	29.0- 30.3	28.0- 29.7	28.1- 29.9	27.6- 29.5	---	23.7	20.6	17.3	---
Hexagrammos stelleri										
Hexagrammos superciliosus										
Ophiodon elongatus					3.1					
Cottus asper									1.3	
Enophrys bison		33.3	3.5	0.7			4.6			
Leptocottus armatus	66.7	33.3			3.1			11.8	14.7	
Scorpaenichthys marmoratus										
Apodichthys flavidus										
Pholis ornata										
Lumpenus sagitta										
Atherinopsis californiensis										
Citharichthys stigmaeus										
Parophrys vetulus			2.8		18.8		36.4	17.7	32.0	
Platichthys stellatus		16.7	90.6	94.7	34.4		13.6	17.7	18.7	
Psettichthys melanostictus		11.1	1.1							

Appendix 3. Continued.

Date: May - June					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	2	4	17	7	2	21	34	8	4	10
Number individuals	10	42	1013	352	30	3911	6280	1130	300	180
Individuals/tow	5	10.8	59.6	50.3	15.0	162.4	147.1	141.3	75.0	18.0
Temperature range (C)	11.5-14.5	13.0-15.6	12.9-16.7	16.0-16.8	15.8-16.8	10.2-19.2	13.8-18.8	15.8-19.5	15.5-17.6	15.7-18.2
Salinity range (0/00)	30.1-32.4	30.6-31.9	29.8-30.6	29.4-30.2	28.9-29.7	27.3-29.4	25.4-29.3	24.3-28.6	24.1-27.3	22.1-23.3
Raja bioculata										
Acipenser medirostris							0.1			0.6
Alosa sapidissima										
Clupea harengus			2.5			0.4				
Engraulis mordax								0.1	0.3	
Oncorhynchus keta										
Oncorhynchus kisutch										
Oncorhynchus tshawytscha										
Salmo gairdneri										
Hypomesus pretiosus										
Microgadus proximus										
Gasterosteus aculeatus										
Aulorhynchus flavidus										
Syngnathus griseolineatus				0.3						
Amphistichus rodoterus			0.1							
Cymatogaster aggregata		11.6	29.6	7.4	26.7	40.6	18.3	25.2	34.3	47.8
Embiotoca lateralis			2.6	1.7	10.0	12.3	4.3	2.3		0.6
Hyperprosopon argenteum				1.4	3.3	0.6	1.0	0.4	0.3	
Hyperprosopon ellipticum										
Phanerodon furcatus			0.8		3.3	1.4	1.5	1.5		
Rhacochilus vacca						0.2	0.3			
Sebastodes sp.										
Hexagrammos decagrammus		9.3	0.5		3.3	0.3	0.2			

(continued)

Appendix 3. Continued.

Date: May - June (continued)					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5min. each at low tide)	2	4	17	7	2	21	34	8	4	10
Number individuals	10	42	1013	352	30	2911	6280	1130	300	180
Individuals/tow	5	10.8	59.6	50.3	15.0	162.4	147.1	141.3	75.0	18.0
Temperature range (C)	11.5-14.5	13.0-15.6	12.9-16.7	16.0-16.8	15.8-16.8	10.2-19.2	13.8-18.8	15.8-19.5	15.5-17.6	15.7-18.2
Salinity range (0/00)	30.1-32.4	30.6-31.0	29.8-30.6	29.4-30.2	28.9-29.4	27.3-29.4	25.4-29.3	24.3-28.6	24.1-27.3	22.1-23.7
Hexagrammos stelleri										
Hexagrammos superciliosus										
Ophiodon elongatus			0.1			0.5	0.1			
Cottus asper			0.1				0.1	1.1	6.3	15.0
Enophrys bison		11.6	1.1			0.2	0.4	0.3		5.6
Leptocottus armatus	10.0	2.3	11.9	3.4	16.7	7.6	8.6	7.7	4.3	8.3
Scorpaenichthys marmoratus			0.1							
Apodichthys flavidus										
Pholis ornata			0.4	1.7		0.5		0.4		0.6
Lumpenus sagitta			5.6		3.3	3.8	0.9	0.1		
Atherinopsis californiensis										
Citharichthys stigmaeus										
Parophrys vetulus	50.0	20.9	24.8	8.2	23.3	27.5	58.9	57.3	21.0	0.6
Platichthys stellatus	20.0	37.2	19.8	75.9	10.0	3.2	5.8	3.7	33.3	21.1
Psettichthys melanostictus	20.0	7.0				0.8				

Appendix 3. Continued.

Date: July - August	Collection method: Try-net (trawl)									
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	14	17	17	22	19	21	11	7	8	9
Number individuals	282	940	1234	1555	1384	1600	704	439	274	197
Individuals/tow	20.1	55.3	72.6	70.7	72.8	76.2	64.0	62.7	34.5	21.9
Temperature range (C)	10.0-14.0	11.0-14.8	10.8-16.5	11.0-17.8	13.3-19.9	12.5-19.3	15.7-21.8	13.9-21.8	19.9-20.5	20.3-22.3
Salinity range (0/00)	31.2-33.4	30.9-32.9	29.6-31.2	29.3-30.4	28.5-30.1	28.1-29.8	27.6-29.1	24.3-28.3	26.4	24.3
Raja binoculata										
Acipenser medirostris						0.1				
Alosa sapidissima										
Clupea harengus	0.4	1.5		0.1	0.2	0.3				
Engraulis mordax						0.4				
Oncorhynchus keta										
Oncorhynchus kisutch										
Oncorhynchus tshawytscha										
Salmo gairdneri										
Hypomesus pretiosus										
Microgadus proximus		0.5	0.2		0.1					
Gasterosteus aculeatus								2.7		
Aulorhynchus flavidus										
Syngnathus griseolineatus										
Amphistichus rodoterus										
Cymatogaster aggregata	6.0	4.6	7.3	26.8	32.3	18.6		25.2	28.5	38.6
Embiotoca lateralis	14.2	1.6	0.8	9.9	2.7	15.4	3.3		0.4	
Hyperprosopon argenteum			0.1	0.8	0.2	1.9	3.6	7.3	29.2	35.0
Hyperprosopon ellipticum										
Phanerodon furcatus	0.4	0.5	0.3	4.1	3.0	10.4	5.5	4.1		
Rhacochilus vacca	0.7	0.7		0.4	0.4	3.4	0.4	5.5	9.5	
Sebastodes sp.		0.4	0.5	0.1		0.2				
Hexagrammos decagrammus	13.1	0.9	0.2	0.1	0.9	0.7				

(continued)

Appendix 3. Continued.

Date: July - August (continued)					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	14	17	17	22	19	21	11	7	8	9
Number individuals	282	940	1234	1555	1384	1600	704	439	274	197
Individuals/tow	20.1	55.3	72.6	70.7	72.8	76.2	64.0	62.7	34.5	21.9
Temperature range (C)	10.0-14.0	11.0-14.8	10.8-16.5	11.0-17.8	13.3-19.9	12.5-19.3	15.7-21.8	13.9-21.8	19.9-20.5	20.3-22.3
Salinity range (0/00)	31.2-33.4	30.9-32.9	29.6-31.2	29.3-30.4	28.5-30.1	28.1-29.8	27.6-29.1	24.3-28.3	26.4	24.3
Hexagrammos stelleri										
Hexagrammos superciliosus	1.1	0.7								
Ophiodon elongatus		0.2	0.2		0.7	0.5	0.4			
Cottus asper							0.6	1.6		1.0
Enophrys bison	9.9	1.3	0.5		0.4	0.3		0.2		
Leptocottus armatus	7.8	2.8	3.0	5.9	9.5	7.5	9.5	10.0	6.2	9.6
Scorpaenichthys marmoratus		0.1		0.1	0.1					
Apodichthys flavidus		0.1								
Pholis ornata			0.3	0.1	1.6	0.1				
Lumpenus sagitta		0.3	2.8	1.9	1.7	0.2				
Atherinopsis californiensis										
Citharichthys stigmaeus	0.7	0.4								
Parophrys vetulus	23.8	80.2	70.6	34.5	42.1	37.4	66.3	33.5	12.0	1.5
Platichthys stellatus	18.8	2.9	13.1	15.2	4.0	2.4	10.2	9.8	14.2	14.2
Psettichthys melanostictus	3.2	0.2			0.1	0.2	0.1			

Appendix 3. Continued.

Date: September - October					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	4	3	3	4	3	4	3	3	3	2
Number individuals	22	53	131	71	42	255	302	42	93	76
Individuals/tow	5.5	17.7	43.7	17.8	14.0	63.8	100.7	14.0	31.0	38.0
Temperature range (C)	11.1-12.6	11.0-12.1	11.7-13.4	12.2-15.7	12.9-16.4	15.3-17.4	16.5-17.5	18.8	19.2	19.9
Salinity range (0/00)	31.3-33.0	31.0-32.1	31.1-31.9	30.9-31.6	31.0-31.8	31.1-31.9	29.9-31.2	28.1	25.5	23.8
Raja binoculata										
Acipenser medirostris										
Alosa sapidissima										2.6
Clupea harengus						2.0				
Engraulis mordax										
Oncorhynchus keta										
Oncorhynchus kisutch										
Oncorhynchus tshawytscha										
Salmo gairdneri										
Hypomesus pretiosus						1.2				
Microgadus proximus										
Gasterosteus aculeatus										
Aulorhynchus flavidus										
Syngnathus griseolineatus										
Amphistichus rodoterus										
Cymatogaster aggregata	12.6	32.1	30.5	25.4	40.5	14.9	10.3	42.9	19.4	46.1
Embiotoca lateralis	13.6					2.4				
Hyperprosopon argenteum		1.9	0.8		2.4			7.1	6.5	27.6
Hyperprosopon ellipticum										
Phanerodon furcatus		1.9	1.5	2.8	2.4	24.3	37.4	9.5	9.7	3.9
Rhacochilus vacca		5.7			4.8	11.0	8.9	21.4	7.4	1.3
Sebastodes sp.										
Hexagrammos decagrammus	27.3				2.4					

(continued)

Appendix 3. Continued.

Date: September - October (continued)					Collection method: Try-net (trawl)					
Location (Study zone)	1	2	3	4	5	6	7	8	9	10
Tows (5 min. each at low tide)	4	3	3	4	3	4	3	3	3	2
Number individuals	22	53	131	71	42	255	302	42	93	76
Individuals/tow	5.5	17.7	43.7	17.8	14.0	63.8	100.7	14.0	31.0	38.0
Temperature range (C)	11.1-12.6	11.0-12.1	11.7-13.4	12.2-15.7	12.9-16.4	15.3-17.4	16.5-17.5	18.8	19.2	19.9
Salinity range (0/00)	31.3-33.0	31.0-32.1	31.1-31.9	30.9-31.6	31.0-31.8	31.1-31.9	29.9-31.2	28.1	25.5	23.8
Hexagrammos stelleri										
Hexagrammos superciliosus						3.9				
Ophiodon elongatus	13.6		0.8			0.8				
Cottus asper								2.4	3.2	7.9
Enophrys bison						1.6				
Leptocottus armatus			5.3	8.5		2.0	1.0	7.1	4.3	1.3
Scorpaenichthys marmoratus										
Apodichthys flavidus										
Pholis ornata										
Lumpenus sagitta										
Atherinopsis californiensis										
Citharichthys stigmaeus										
Parophrys vetulus		43.4	46.6	31.0	33.3	35.3	41.1	2.4	5.4	
Platichthys stellatus	22.7	15.1	14.5	32.4	14.3	0.8	1.3	7.1	44.1	9.2
Psettichthys melanostictus	9.1									

Appendix 3. Continued.

Date: November - December — Collection method: Try-net (trawl)

Location (Study zone)	1	2	3	4	5
Tows (5 min. each at low tide)	2	2	4	4	3
Number individuals	1	3	3	28	10
Individuals/tow	0.5	1.5	0.8	7.0	3.3
Temperature range (C)	10.5	10.0-11.5	11.2	12.0	11.5
Salinity range (0/00)	31.5	27.1-31.0	19.4-28.5	22.9	26.3-30.0
Raja binoculata					
Acipenser medirostris					
Alosa sapidissima					
Clupea harengus					
Engraulis mordax					
Oncorhynchus keta					
Oncorhynchus kisutch					
Oncorhynchus tshawytscha					
Salmo gairdneri					
Hypomesus pretiosus					
Microgadus proximus					
Gasterosteus aculeatus					
Aulorhynchus flavidus	100.0				
Syngnathus griseolineatus			33.3		10.0
Amphistichus rodoterus					
Cymatogaster aggregata					
Embiotoca lateralis					
Hyperprosopon argenteum		33.3			
Hyperprosopon ellipticum					
Phanerodon furcatus					
Rhacochilus vacca					
Sebastodes sp.					
Hexagrammos decagrammus		33.3			

(continued)

Appendix 3. Continued.

Date: November - December (continued)					Collection method: Try-net (trawl)
Location (Study zone)	1	2	3	4	5
Tows (5 min. each at low tide)	2	2	4	4	3
Number individuals	1	3	3	28	10
Individuals/tow	0.5	1.5	0.8	7.0	3.3
Temperature range (C)	10.5	10.0-11.5	11.2	12.0	11.5
Salinity range (0/00)	31.5	27.1-31.0	19.4-28.5	22.9	26.3-30.0
Hexagrammos stelleri					
Hexagrammos superciliosus					
Ophiodon elongatus					
Cottus asper					
Enophrys bison					
Leptocottus armatus			33.3		
Scorpaenichthys marmoratus					
Apodichthys flavidus					
Pholis ornata					
Lumpenus sagitta					
Atherinopsis californiensis					
Citharichthys stigmaeus					
Parophrys vetulus			33.3		
Platichthys stellatus		33.3		100.0	90.0
Psettichthys melanostictus					

Appendix 3. Continued.

	Collection method: Seine								
Date:	8/17/66	8/17/66	8/18/66	8/19/66	8/19/66	8/31/66	9/15/66	2/7/67	2/7/67
Location (Study zone)	3	3	3	3	3	3	3	3	3
Seine hauls	1	1	1	1	1	1	1	1	1
Number individuals	255	570	112	325	51	35	23	66	90
Individuals/haul	255	570	112	325	51	35	23	66	90
Temperature (C)	17.8	17.8	11.8	---	12.8	16.0	---	---	---
Salinity (0/00)	31.8	31.4	33.4	---	33.1	32.4	---	---	---
Raja binoculata									
Acipenser medirostris									
Alosa sapidissima								1.7	6.7
Clupea harengus									
Engraulis mordax									
Oncorhynchus keta									
Oncorhynchus kisutch									
Oncorhynchus tshawytscha									
Salmo gairdneri						2.9			
Hypomesus pretiosus								22.7	44.4
Microgadus proximus									
Gasterosteus aculeatus									
Aulorhynchus flavidus								6.1	3.3
Syngnathus griseolineatus								21.2	
Amphistichus rodoterus									
Cymatogaster aggregata	58.8	70.2		60.0					
Embiotoca lateralis	11.8	1.8		4.9			4.3		
Hyperprosopon argenteum	3.9	8.7		0.9		43.1			
Hyperprosopon ellipticum									
Phanerodon furcatus	11.8	8.8	31.3	19.7	96.1	54.0	95.6		
Rhacochilus vacca	9.8	10.5	68.7	4.0					
Sebastodes sp.									
Hexagrammos decagrammus					3.9				

(continued)

Appendix 3. Continued.

	Collection method: Seine								
Date: (continued)	8/17/66	8/17/66	8/18/66	8/19/66	8/19/66	8/31/66	9/15/66	2/7/67	2/7/67
Location (Study zone)	3	3	3	3	3	3	3	3	3
Seine hauls	1	1	1	1	1	1	1	1	1
Number individuals	255	570	112	325	51	35	23	66	90
Individuals/haul	255	570	112	325	51	35	23	66	90
Temperature (C)	17.8	17.8	11.8	---	12.8	16.0	---	---	---
Salinity (0/00)	31.8	31.4	33.4	---	33.1	32.4	---	---	---
Hexagrammos stelleri									
Hexagrammos superciliosus									
Ophiodon elongatus									
Cottus asper									
Enophrys bison									
Leptocottus armatus								10.6	15.6
Scorpaenichthys marmoratus									
Apodichthys flavidus									
Pholis ornata	2.8								
Lumpenus sagitta	1.2								
Atherinopsis californiensis									
Citharichthys stigmaeus									
Parophrys vetulus									
Platichthys stellatus								7.6	7.8
Psettichthys melanostictus								30.3	12.2

Appendix 3. Continued.

	Collection method: Seine			
Date:	4/3/67	4/25/67	4/25/67	4/25/67
Location (Study zone)	4	4	4	4
Seine hauls	1	1	1	1
Number individuals	6038	226	179	283
Individuals/haul	6038	226	179	283
Temperature (C)	--	--	12.3	--
Salinity (0/00)	--	--	28.7	--
Raja binoculata				
Acipenser medirostris				
Alosa sapidissima	0.3			
Clupea harengus				
Engraulis mordax				
Oncorhynchus keta		32.3	34.1	1.8
Oncorhynchus kisutch		0.9	0.6	
Oncorhynchus tshawytscha		4.0	0.6	0.7
Salmo gairdneri				
Hypomesus pretiosus	99.4	48.2	48.6	47.3
Microgadus proximus				
Gasterosteus aculeatus				
Aulorhynchus flavidus				
Syngnathus griseolineatus	0.1			
Amphistichus rodoterus				
Cymatogaster aggregata				
Embiotoca lateralis				
Hyperprosopon argenteum				
Hyperprosopon ellipticum				
Phanerodon furcatus		0.4	1.7	0.7
Rhacochilus vacca	0.1			
Sebastodes sp.				
Hexagrammos decagrammus				

(continued)

Appendix 3. Continued.

	Collection method: Seine			
Date:	4/3/67	4/25/67	4/25/67	4/25/67
Location (Study zone)	4	4	4	4
Seine hauls	1	1	1	1
Number individuals	6038	226	179	283
Individuals/haul	6038	226	179	283
Temperature (C)	--	--	12.3	--
Salinity (0/00)	--	--	28.7	--
Hexagrammos stelleri				
Hexagrammos superciliosus				
Ophiodon elongatus				
Cottus asper				
Enophrys bison				
Leptocottus armatus		13.3	10.1	16.6
Scorpaenichthys marmoratus				
Apodichthys flavidus				
Pholis ornata				
Lumpenus sagitta		0.4		
Atherinopsis californiensis	0.3	0.4	0.6	
Citharichthys stigmaeus				
Parophrys vetulus				
Platichthys stellatus				32.9
Psettichthys melanostictus				

Appendix 3. Continued.

Date: January - February				Collection method: Gill net			
Location (Study zone)	1	2	3	4	5	6	7
Gill net sets (low tide to high tide-6 hrs)	10	21	4	3	15	3	2
Number individuals	28	57	19	5	79	4	2
Individuals/set	2.8	2.7	4.7	1.7	18.9	1.3	1.0
Raja binoculata							
Acipenser medirostris	7.1	1.8					
Alosa sapidissima			5.3		8.9		
Clupea harengus							
Engraulis mordax							
Oncorhynchus keta							
Oncorhynchus kisutch							
Oncorhynchus tshawytscha							
Salmo gairdneri							50.0
Hypomesus pretiosus							
Microgadus proximus							
Gasterosteus aculeatus							
Aulorhynchus flavidus							
Syngnathus griseolineatus							
Amphistichus rodoterus		21.2	5.3		1.2		
Cymatogaster aggregata							
Embiotoca lateralis	28.6			40.0	2.5		
Hyperprosopon argenteum							
Hyperprosopon ellipticum							
Phanerodon furcatus	42.8	52.6	89.5		65.8	100.0	50.0
Rhacochilus vacca		8.7			1.3		
Sebastodes sp.	3.6						
Hexagrammos decagrammus					1.2		
Hexagrammos superciliosus							
Ophiodon elongatus							
Cottus asper							

(continued)

Appendix 3. Continued.

Date: January - February (continued)				Collection method: Gill net			
Location (Study zone)	1	2	3	4	5	6	7
Gill net sets (low tide to high tide-6 hrs)	10	21	4	3	15	3	2
Number individuals	28	57	19	5	79	4	2
Individuals/set	2.8	2.7	4.7	1.7	18.9	1.3	1.0
Enophrys bison	17.9	7.0			10.1		
Leptocottus armatus		1.8			2.5		
Scorpaenichthys marmoratus							
Apodichthys flavidus							
Pholis ornata							
Lumpenus sagitta							
Atherinopsis californiensis							
Citharichthys stigmaeus							
Parophrys vetulus							
Platichthys stellatus		7.0		60.0	6.3		
Psettichthys melanostictus							

Appendix 3. Continued.

Date: March - April				Collection method: Gill net			
Location (Study zone)	1	2	3	4	5	6	7
Gill net sets (low tide to high tide-6 hrs)	10	21	4	3	15	3	2
Number individuals	36	83	19	--	39	67	43
Individuals/set	3.6	3.9	4.8	--	2.5	22.3	21.5
Raja binoculata							
Acipenser medirostris	2.8					1.5	
Alosa sapidissima							2.3
Clupea harengus		36.1				1.5	4.7
Engraulis mordax							
Oncorhynchus keta							
Oncorhynchus kisutch							
Oncorhynchus tshawytscha							
Salmo gairdneri							
Hypomesus pretiosus							
Microgadus proximus							
Gasterosteus aculeatus							
Aulorhynchus flavidus							
Syngnathus griseolineatus							
Amphistichus rodoterus	5.6	4.8	5.3			4.5	14.0
Cymatogaster aggregata						13.4	
Embiotoca lateralis	5.6		52.6			1.5	
Hyperprosopon argenteum		1.2			23.7	13.4	20.9
Hyperprosopon ellipticum							
Phanerodon furcatus	33.3	42.2	15.8		71.1	53.8	30.3
Rhacochilus vacca		2.4	26.4				27.9
Sebastodes sp.						9.0	
Hexagrammos decagrammus	2.8					1.5	
Hexagrammos stelleri							
Hexagrammos superciliosus							
Ophiodon elongatus		1.2					
Cottus asper							

(continued)

Appendix 3. Continued.

Date: March - April (continued)				Collection method: Gill net			
Location (Study zone)	1	2	3	4	5	6	7
Gill net sets (low tide to high tide-6 hrs)	10	21	4	3	15	3	2
Number individuals	36	83	19	--	39	67	43
Individuals/set	3.6	3.9	4.8	--	2.5	22.3	21.5
Enophrys bison	47.2	10.8			5.3		
Leptocottus armatus							
Scorpaenichthys marmoratus							
Apodichthys flavidus							
Pholis ornata							
Lumpenus sagitta							
Atherinopsis californiensis							
Citharichthys stigmaeus							
Parophrys vetulus							
Platichthys stellatus	2.8	1.2					
Psettichthys melanostictus							

Appendix 3. Continued.

Date: May - June				Collection method: Gill net			
Location (Study zone)	1	2	3	4	5	6	7
Gill net sets (low tide to high tide-6 hrs)	14	3	1	--	--	7	5
Number individuals	28	17	19	--	--	200	31
Individuals/set	2.0	5.7	19	--	--	28.6	6.2
Raja binoculata							
Acipenser medirostris	3.6	5.9					
Alosa sapidissima						0.5	
Clupea harengus						1.0	
Engraulis mordax							
Oncorhynchus keta							
Oncorhynchus kisutch							
Oncorhynchus tshawytscha							
Salmo gairdneri							
Hypomesus pretiosus							
Microgadus proximus						1.5	
Gasterosteus aculeatus							
Aulorhynchus flavidus							
Syngnathus griseolineatus							
Amphistichus rodoterus		17.6				2.0	6.5
Cymatogaster aggregata	3.6					50.6	
Embiotoca lateralis	28.6		26.3			12.5	9.7
Hyperprosopon argenteum			26.3			8.5	6.7
Hyperprosopon ellipticum							
Phanerodon furcatus	10.7	17.6	21.0			2.1	12.9
Rhacochilus vacca	17.9	58.8	21.2			13.0	54.9
Sebastodes sp.	14.3						
Hexagrammos decagrammus	7.1						
Hexagrammos stelleri							
Hexagrammos superciliosus							
Ophiodon elongatus	7.1						
Cottus asper							

(continued)

Appendix 3. Continued.

Date: May - June (continued)				Collection method:	Gill net		
Location (Study zone)	1	2	3	4	5	6	7
Gill net sets (low tide to high tide-6 hrs)	14	3	1	--	--	7	5
Number individuals	28	17	19	--	--	200	31
Individuals/sets	2.0	5.7	19	--	--	28.6	6.2
Enophrys bison	7.1						
Leptocottus armatus						0.5	3.2
Scorpaenichthys marmoratus							
Apodichthys flavidus							
Pholis ornata							
Lumpenus sagitta							
Atherinopsis californiensis							
Citharichthys stigmaeus							
Parophrys vetulus							
Platichthys stellatus						1.5	
Psettichthys melanostictus			5.3			0.5	6.5

Appendix 3. Continued.

Date: December — Collection method: Gill net

Location (Study zone)	1	2	3	4	5	6
Gill net - Hours	--	9	--	--	10	4
Number individuals	--	48	--	--	41	18
Individuals/set	--	5.3	--	--	4.1	4.5
Raja binoculata		2.1				
Acipenser medirostris		4.2				
Alosa sapidissima						
Clupea harengus					7.3	
Engraulis mordax						
Oncorhynchus keta						
Oncorhynchus kisutch						
Oncorhynchus tshawytscha						
Salmo gairdneri						
Hypomesus pretiosus						
Microgadus proximus					2.4	
Gasterosteus aculeatus						
Aulorhynchus flavidus						
Syngnathus griseolineatus						
Amphistichus rodoterus		4.2			2.4	16.7
Cymatogaster aggregata						
Embiotoca lateralis					17.1	
Hyperprosopon argenteum		27.1				
Hyperprosopon ellipticum						
Phanerodon furcatus		52.1			24.4	55.5
Rhacochilus vacca		4.2			12.2	11.1
Sebastodes sp.					7.3	
Hexagrammos decagrammus					2.4	
Hexagrammos stelleri						
Hexagrammos superciliosus						
Ophiodon elongatus					2.4	
Cottus asper						

(continued)

Appendix 3. Continued.

Date: December (continued)				Collection method: Gill net		
Location (Study zone)	1	2	3	4	5	6
Gill net - Hours	--	9	--	--	10	4
Number individuals	--	48	--	--	41	18
Individuals/set	--	5.3	--	--	4.1	4.5
Enophrys bison					2.4	
Leptocottus armatus		6.3			7.3	11.1
Scorpaenichthys marmoratus						
Apodichthys flavidus						
Pholis ornata						
Lumpenus sagitta						
Atherinopsis californiensis						
Citharichthys stigmaeus						
Parophrys vetulus						
Platichthys stellatus					12.2	5.6
Psettichthys melanostictus						

Appendix 3. Continued.

				Collection method: Fyke net					
Date:	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Location (Study zone)				6					
Fyke net sets (24 Hours)	12	4	9	16	8	5	10	10	2
Number individuals	105	31	127	221	82	14	13	13	5
Individuals/set	8.8	7.8	14.1	13.8	10.3	2.8	1.3	1.3	2.5
Raja binoculata	1.0								
Acipenser medirostris	1.9								
Alosa sapidissima	1.0								
Clupea harengus									
Engraulis mordax									
Oncorhynchus keta									
Oncorhynchus kisutch									
Oncorhynchus tshawytscha									
Salmo gairdneri									
Hypomesus pretiosus									
Microgadus proximus									
Gasterosteus aculeatus									
Aulorhynchus flavidus									
Syngnathus griseolineatus									
Amphistichus rodoterus									20.0
Cymatogaster aggregata	1.0								
Embiotoca lateralis	50.5	35.5	7.1	6.8	2.4	28.6	53.8	30.8	
Hyperprosopon argenteum	6.7	6.5		2.3	1.2	28.6	15.4		
Hyperprosopon ellipticum	1.9								
Phanerodon furcatus	1.0		15.0	5.0	4.9			38.5	
Rhacochilus vacca	22.8	48.3	78.0	86.0	91.5	42.9	30.8	15.4	20.0
Sebastodes sp.									
Hexagrammos decagrammus									
Hexagrammos stelleri									
Hexagrammos superciliosus									

(continued)

Appendix 3. Continued.

	Collection method: Fyke net								
Date: (continued)	April	May	June	July	August	Dept.	Oct.	Nov.	Dec.
Location (Study zone)				6					
Fyke net sets (24 Hours)	12	4	9	16	8	5	10	10	2
Number individuals	105	31	127	221	82	14	13	13	5
Individuals/set	8.8	7.8	14.1	13.8	10.3	2.8	1.3	1.3	2.5
Ophiodon elongatus									
Cottus asper									
Enophrys bison									
Leptocottus armatus									
Scorpaenichthys marmoratus									
Apodichthys flavidus									
Pholis ornata									
Lumpenus sagitta									
Atherinopsis californiensis									
Citharichthys stigmaeus									
Parophrys vetulus									20.0
Platichthys stellatus	11.4	9.7						15.4	40.0
Psettichthys melanostictus	1.0								