

27. The only immediate solution is to place the trout in the rearing ponds after the glochidia season is over. This should be determined annually by a biologist in accord with the procedure described in the Appendix. In 1941 the last glochidia had left the marsupium by July 7. No signs of glochidial infection were observed on 2,000 rainbow trout which were transferred to the tanks on July 9. Even though glochidia may live 11 days or more in the water, they would be washed down the river in 1 or 2 days after the last had been discharged from the mussels, and the number of glochidia in the river is relatively low at the last of the glochidia season.

The practice at present is to stock the rearing ponds on August 15. By keeping a close watch on the mussels it should be possible to place the fish in the ponds at least a month earlier, with the advantages of earlier release into the river and a probable higher survival.

Appendix

Procedure for determining date that trout can be placed in the rearing ponds of the San Francisco Fly Casting Club without danger of infection by mussel glochidia.

1. Examine mussels in the river at the San Francisco Fly Casting Club on or about the following dates: June 1, 14, 21, 28, July 2, 5, 8 and so on until the "incubation season" is over. By incubation season is meant the period that developing eggs or glochidia are to be found in the gill chambers of the mussels.

Both the gonads and the marsupia of the specimens collected should be examined. Samples should be of at least 10 specimens. The dates given are not ironclad; they indicate the most desirable frequencies for the collection dates.

2. It will probably be possible to tell at least two weeks in advance that the "incubation season" is drawing to a close. This will be indicated by the gradual dropping of the percentage of mussels with eggs or glochidia in their marsupia. It is important to tell this in order to make the rearing ponds ready for the fish.

3. Three days after the last mussel has rid itself of its glochidia, it should be safe to plant the rearing ponds. As a check, the river water should be tested with a plankton net (No. 20 or finer).

4. If the recording thermometer can be kept in operation for several years, it should be possible to correlate the end of the "incubation season" with the temperature of the river.

5. Care should be used in determining the end of the glochidia season, and if any doubt exists as to whether the danger is over, stocking of the rearing ponds should be delayed.

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ECONOMIC AND GEOGRAPHICAL RELATIONS OF ABORIGINAL FISHING IN NORTHERN CALIFORNIA

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Aboriginal fishing in northern California is known ethnographically from tribal monographs and from recent Culture Element surveys.² This, plus the reports of fishery specialists, formed the published background for the author's 1940 field investigations. Primitive fisheries may be studied not only as ethno-historical problems, but also in the light of geographical and economic relations. So far, investigations have been limited to analyses of element distributions.

To anthropologists, "fishing" is a term covering any operations engaged in to secure aquatic products useful to man, whether for food, ornaments, fertilizer or glue. Fishing is not only the aquatic counterpart of hunting; it includes gathering as well. Primitive reliance on fisheries ranges from zero to near completeness. Neglect of fisheries may be geographically or culturally determined; the two causes are not necessarily correlated. As a rule, where fisheries meant a worthwhile addition to the food supply, they were developed adequately.³ At least the factor of technological incompetence may be ruled out, as one can not imagine cultures so crude as to be incapable of applying the simpler mass fishing techniques of fish-drives, weirs, scoops, clubs, fishing with the hands, or at least picking up mussels.

In the area of the present study (see map, Fig. 32), boundaries were admittedly arbitrary, including no single cultural or geographical unit. Kroeber recognizes these cultural subdivisions of our area: (1) Lower Klamath, peripheral to the Northwest Coast cultures of British Columbia, (2) California-Northwest Transition, (3) California proper, and (4) its cultural climax, here represented by the Pomo tribal group. Briefly, fisheries are increasingly specialized northward, with the local exception of Clear Lake, in Pomo territory. Socially, effects of fishing specialization there were different from those on the lower Klamath. The importance of diversified hunting and gathering was greater in the south.

Fishing geography is nearly independent of local conditions which influence the primitive economic utility of land plants and animals, especially when migratory fish are concerned. The Indians of California, lacking agriculture of any kind, were directly affected by local variations in the vegetational cover, except where they could supplement their diet with fisheries products. In our area, fisheries developed by the aborigines are divisible as follows: (1) Pelagic, relatively untouched not only because of poor watercraft but because demands were satisfied closer at hand. (2) Offshore rocks with abundant sea lions and mussels. (3) Littoral fisheries for angling, surf fish netting, gathering shellfish and seaweeds. (4) Bays, estuaries and placid

¹ Submitted for publication February, 1942.

² See the bibliography for references on specific northern California areas.

³ A notable exception is Tasmania, where the aborigines had a strict tabu against eating scaly fish; though they were available in large quantities the Tasmanians lacked the desire to add them to the food supply.

lagoons, safe for canoes, best for spearing and angling. The bar or outlet was strategic for intercepting incoming anadromous species and their hungry predators. Borders of bays and lagoons were useful for

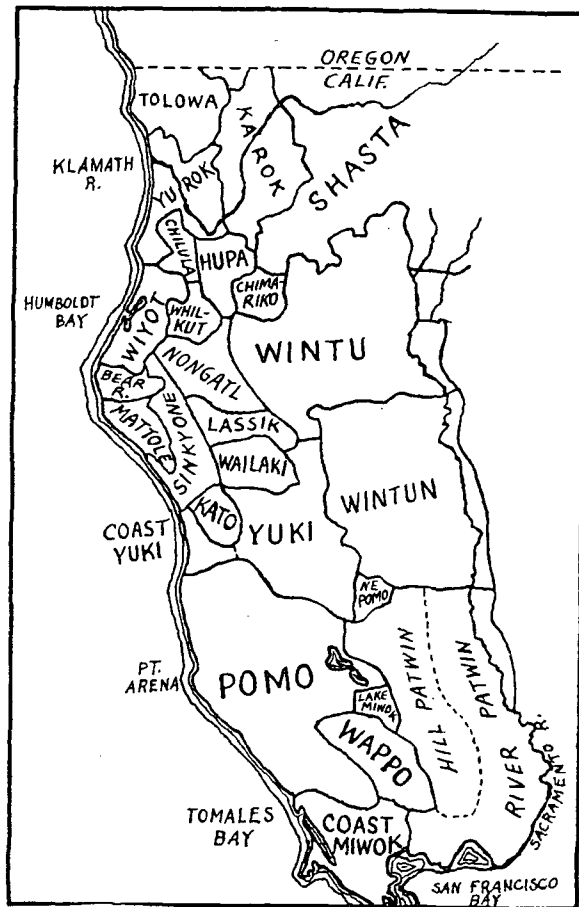


FIG. 32. Map showing location of Indian tribal groups in northern California, from Oregon to San Francisco Bay and inland to the Sacramento River.

Economically significant primitive fishing techniques are all mass methods, concentrating fish in small areas from which they can be taken easily in dip nets, with gaffs, or by hand. The sessile forms can be gathered with a pry or dibble. Except for sea mammals and sturgeon, pursuit of single individuals was not economically justifiable. Spectacular methods such as diving, shooting with fish-arrows and angling, are less efficient, and served more as sports. Mass-fishing is a harvesting operation, though the analogy to agriculture fails in that hus-

⁴ Birket-Smith, 1929, has an extensive treatment of ice-fishing techniques, especially in regard to their rôle in the building of Eskimo culture.

⁵ The chief ritual conservation procedure concerned the "First Salmon," especially on the Klamath River; a glimpse into the elaborate ritual surrounding the erection of a fish-weir is to be found in Waterman and Kroeber, 1938.

tidal pounds and flatfish spearing. (5) Streams for various kinds of fishing. Riffles and shallows for spearing and harpooning, gaffing, and fish-drives. Swifter waters, cascades and falls permitted taking anadromous fish as they leaped upstream, in dip nets, traps, baskets or with harpoons and gaffs. Back-eddies favored use of bag nets, and in deeper waters, seines and drift nets. (6) Lakes and ponds presented different opportunities—basket traps and spearing along the marshy edges; angling or netting on the smooth open water; and in sluggish waters, diving, bare-hand fishing, use of bow and arrow, and fish-poisoning. Serious ice-fishing was lacking, for climatic reasons.⁴

banding of fish resources was unknown aboriginally, if ritual conservation procedures are disregarded.⁵

Techniques used in aboriginal northern California fisheries show endless local variations, for which geographical conditions are chiefly responsible within the limited area of study. Particular gear might be restricted to a geographical point; for instance, a type of net used at Ishipishi Falls on the Klamath, while familiar to Indians up and down the river for fifty miles, is thus restricted. Engineering difficulties

limit sites for native weirs. Poisons are effective only in ponds. Culturally prohibited devices were few, although bow and arrow fishing was tabu in parts of northwestern California, and it was an incidental pastime elsewhere. An important cultural deficiency was in watercraft; dug-out canoes were lacking south of the Sinkyone.⁶ Many techniques have compact distributions in the area (see map, Fig. 33): (1) the A-frame net for surf and river fishing; (2) mutually exclusive, the arc dip net;⁷ (3) fish-poisoning, nearly coterminous with the arc dip net; (4) the truncate cone plunge basket, from which fish are removed through the open apex, not used north of the Pomo. Weirs, traps and pounds are widely distributed, though applied only in locally suitable sites.

⁶ Heizer, 1940, has made a study of native California canoe types.

⁷ The "Arc Dip Net" describes a long-handled gear with a single bowed cross-piece net-stretcher; when the handle is pushed downward into the water the mouth of the net opens, while lifting the handle closes the net by releasing tension on the bow. Such nets were used by the Pomo on Clear Lake, where they attained great dimensions. Smaller forms of the same gear were employed in the surf fishery.

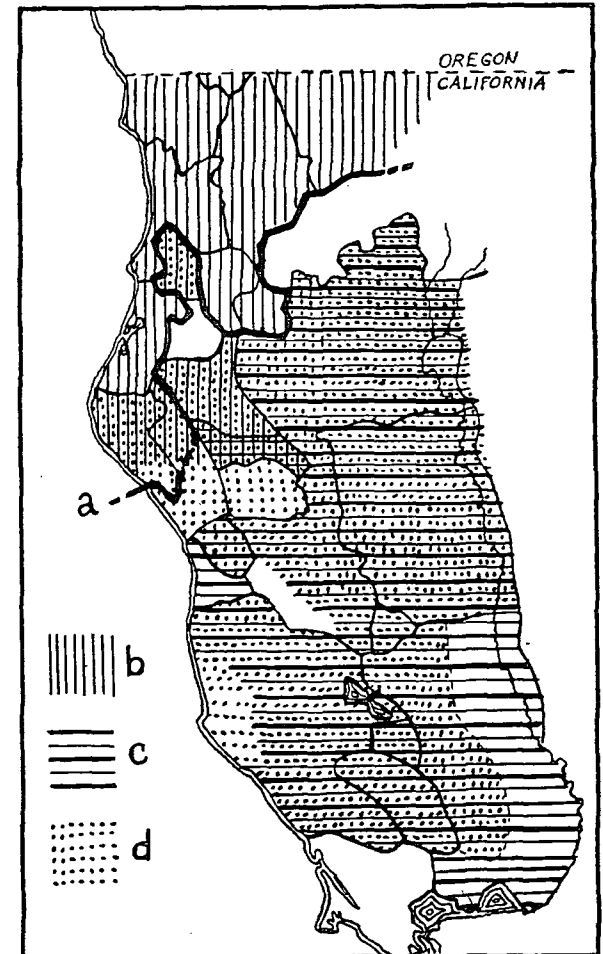


FIG. 33. Map showing limits of Indian fishing traits in northern California.

- A. Southern limit of use of dugout canoes.
- B. A-frame dip nets.
- C. Arc-dip nets.
- D. Use of fish poisons.

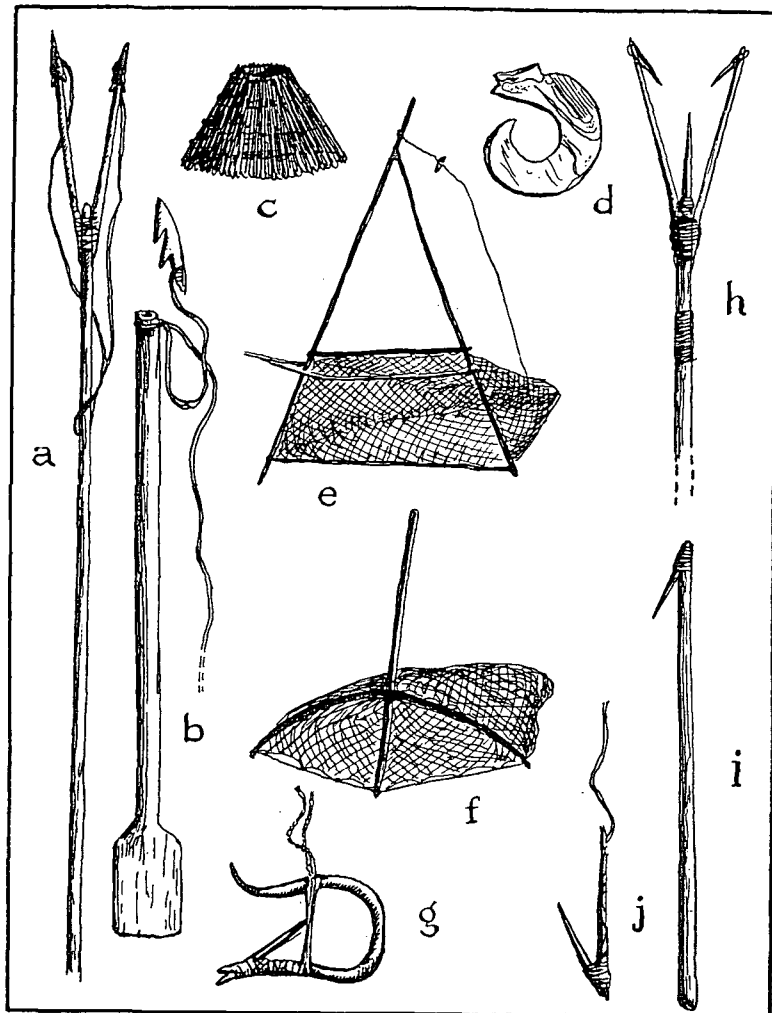


FIG. 34. Some types of Indian gear used on the Pacific Coast (to various scales).

- A. Double-pronged toggle harpoon for salmon, Wailaki tribe, northern California.
- B. Barbed harpoon for sea lion, Yurok of Requa, northern California.
- C. Conical open-end plunge basket, Pomo of Clear Lake, central California.
- D. Shell hook for marine fish, Chumash tribe, southern California.
- E. A-frame net for salmon, Yurok, northern California.
- F. Arc-net for river fish, Yuki, central California.
- G. Halibut hook, Makah and other tribes of Puget Sound and Gulf of Georgia.
- H. Leister, Nez Perce, Idaho.
- I. Lamprey gaff, Nongatl, northern California.
- J. Trout hook, Hupa, northern California.

The possibility of fishery traits having different diffusional dynamics than, say, land hunting traits, is not borne out by the distributions which do not exhibit any particular linearity.

The outstanding economic effect of certain Indian techniques arose from the stability of their localization. Productive sites in a river fishery are ordinarily more permanently valuable than berry patches, hunting grounds, or even cultivated lands, in any society. Sea lion fisheries on offshore rocks are more enduring than comparable land hunting foci to which the closest parallels are water holes. Such localized fisheries are subject to individual or kindred proprietorship; the right to fish in open waters usually belonged to the local sovereign group. On the lower Klamath, native law recognized the ownership not only of well situated rocks, but of riffles and even sea-stacks.⁸ Conflicts were avoided by distributing surplus to those lacking properties; poaching was impractical where the owners worked day and night during the salmon runs. However, violent disputes did arise over stranded whales despite elaborate rules for apportioning shares wherein choicer cuts went to owners of the stretch of shore on which the animal lay. In contrast, the southern end of the area lacked individual fishery ownership; communal drives were characteristic. The specialist native fishermen on Clear Lake were not the proprietors of the waters where they worked. Throughout, division of labor was the same. Women, excluded from actual fishing, took charge of cleaning and preservation. In the south they might participate in drives, but northward the tabu was stricter and females could not use the weirs as bridges. Even during surf fish runs, when everyone was needed to wield the A-frame nets, women could hold them only if the tail of the net were safely in the hands of a small boy.

Aquatic products are easily preserved by drying, which may be aided by smoke-curing, intentional or unintentional (smudge to keep away flies). Dried salmon, even in the dampness of northwestern California, would keep a year. Aboriginally, salt was not used for preservation, though it was gathered from ocean rocks and inland mineral sources as a condiment.⁹

The position of fisheries in the primitive subsistence pattern varied from moderate to overwhelming importance, from south to north. Likewise, coast-dwellers had more diversified resources than river-dwellers, though it is mistaken to assume that river-mouth dwellers caught the most salmon. Aside from the bar or outlet, fishing places for native gear are rare in river estuaries, which are often too deep, or too much affected by the tide to permit efficient mass tactics. Fewer salmon were caught aboriginally at Requa than at Kepel, 20 miles upstream, by the Yurok, and the Pomo at the mouth of the Russian River were at a similar disadvantage.

Acculturational changes in Indian fishery are apparent, though white settlement has perhaps affected fishing least of aboriginal economic activities. New devices from the whites are few; actually techniques have declined in number since first contact times. However the Yurok at Requa accepted the gill net readily. New materials for hooks, harpoon points and nets have been accepted, but informants assert that wild iris fibre cordage is superior to any modern cordage in strength

⁸ Kroeber, 1925, especially the chapter on the Yurok.
⁹ Kroeber, 1941.

and durability. The elaborate trout angling complex with artificial flies, rods and reels, has not spread to the natives, whose earlier interests in trout were limited to snagging with a bunch of hair at the end of a hand-line. Whites in fencing their lands prevented food-gathering by Indians. Game has been driven from accessible areas, and to maintain it for sport, strict limits have been imposed even on Indians. Indians have been permitted to retain much of their aboriginal fishing, although weirs can no longer be erected except on Hoopa Reservation. White communications facilitating intertribal contacts have spread a lamprey trap in post-contact times from Humboldt Bay to the Klamath River. The sea mammal fisheries have been virtually eliminated since the 1860's, as sea otters, whales and seals have been brought close to extinction. Native river-fishing techniques have been little affected by the introduction of exotic species or by the establishment of trout hatcheries. Catches of transplanted Atlantic shad were first greeted with disgust by lower Klamath River Indians. Reciprocal acculturational effects are noticeable; surf nets and lamprey gaffs now used by whites are copies of Indian gear.¹⁰ Our modern taste for abalones, however, was stimulated by the Chinese rather than by the Indian abalone fishery. Failure of our culture to impose a new "fishing pattern" on that of the Indians is due to the lack of a consistent pattern on our part. Despite the antiquity of fishing, it is still not always possible to determine the most efficient use of gear; 100 per cent effectiveness in the salmon fishery obviously destroys the supply, yet even with primitive methods one can come very close to 100 per cent stoppage of the run.¹¹

Fisheries biologists usually assume that fishery resources remained virtually in a state of nature until the period of white settlement. This is true of the pelagic fisheries but certainly does not hold for fresh-water fisheries, particularly salmon. Lack of ethnographic information is not entirely the fault of ecologists; it has not occurred to many anthropologists that their results are useful to any but social scientists. The decline in catch totals from earlier peaks in commercial salmon fishing in this area may represent not a decline from the abundance of fish in "nature," but a falling off from the abnormal peak caused by the disruption of Indian fishing in the middle decades of the 19th Century. The sudden arrival of white immigrants on the Sacramento, Klamath, Columbia and Fraser between 1845 and 1865 must certainly have diminished the Indian salmon catch. Thus relieved of the pressure of providing food for tens of thousands of Indians, the fish population probably increased greatly for a few decades. In our area, Kroeber conservatively estimated the Indian population on the lower Klamath in pre-white times as 5,000, with salmon as the most important source of food.¹² To regard the fish population of that river prior to 1850 as a part of the "natural landscape" is obviously erroneous.

So far the historical position of the area in respect to fishing has not been mentioned. Recent influences from either the Great Basin tribes or those of the Southwest can be ruled out. The only important California Indian fishing elements which do not appear to be integral

¹⁰ Bonnot, 1930, discusses Indian gear adopted by the whites.

¹¹ Snyder, 1924, describes the salmon weir annually erected in Hoopa Valley. For details of the construction of an even larger weir, see Waterman and Kroeber, 1938.

¹² Kroeber, 1939, has mapped the aboriginal population density in California, and tabulated it by tribes.

traits of the native Pacific salmon fishing complex are the use of fish poisons and shell hooks. Poisons are used very widely in Indian fisheries of South America, and sporadically by the Indians of the southeastern United States. In the southwest and Great Basin, poisons were rarely used for fishing; the Californian fish poisons seem to be local discoveries. Shell hooks were used in pelagic fisheries by the southern California Chumash and maritime Shoshoneans. Ecologically and technologically the southern California marine fishery of aboriginal times was altogether unrelated to that of the "Salmon Area." Superficially, the shell hooks of the Channel Islanders resemble those used in the marine fisheries of Oceania.¹³ Possible historical connections of these cultures need not be discussed here. Within the "Salmon Area" some good cases for ancient cultural continuities may be made. Double foreshaft toggle harpoons occupy a compact area from California through to the Columbia-Fraser Plateau and the middle coast of British Columbia; these harpoons reappear in identical form in Asia, solely among the Ainu of Hokkaido, northern Japan.¹⁴ The trident fish spear or leister is typically Eskimo, but it reaches as far south as the Columbia River on the west, and well down the Atlantic Coast among the Algonkian tribes. On the other hand, simple barbed harpoons, fish hooks, weirs, nets, scoops and traps are nearly universal wherever fishing is practiced.

Fishing techniques of all peoples, including those of the first migrants to the New World, have had a long and complex history; some traits are demonstrably very ancient; others, like the Eskimo type leister, may be of fairly recent spread. Still others, like the double pronged harpoon may represent diffusions from North America to northeast Asia. From archaeological evidence it appears that Early Man in America was contemporary with the great post-glacial lakes of the Great Basin. As these vast lakes were no doubt well stocked with fish, the early connections of fishing in North America promise to become even more intricate as they become better known.

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¹³ Compare Olson, 1930, p. 9, and Krause, 1904, pl. 9.

¹⁴ Hewes, 1942 (in press).

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PROGRESS REPORT ON ADULT SALMON TAGGING IN 1939-1941¹

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A part of the California salmon program and a phase of the Central Valley investigation initiated during 1939 but not mentioned in the previous report,² is the tagging of ocean-caught salmon off the California coast. Tagging was undertaken as the only direct means of solving several important problems in connection with salmon fisheries management, foremost of which are the stream sources of salmon frequenting the ocean waters off the California coast and the relative contribution of each stream to the ocean commercial catch. The time for such a program is favorable because of the large number of counting weirs maintained at present on West Coast streams.

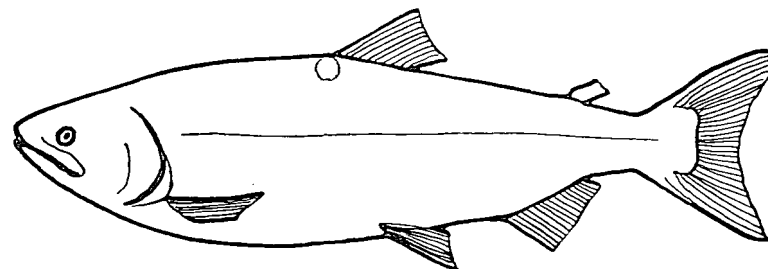


FIG. 35. Diagrammatic view of a salmon, showing where tag is placed.

Salmon are caught for tagging by a chartered commercial fishing boat using trolling gear, with an employee of the California Division of Fish and Game aboard, who does the actual tagging and recording. The usual type of button tag is used, consisting of red and white celluloid disks, the white one serially numbered. The tags are placed immediately in front of the dorsal fin and secured by a metal pin which pierces the back of the fish. (See Fig. 35.) Salmon tagged south of Point Arena bear disk arrangements different from those tagged north of that Point. This has been done in order to detect from which general locality the fish have come when they pass through a counting weir and the tag numbers can not be seen.

Tagging and recoveries for each of the three years, 1939 to 1941, inclusive, are summarized in tables 1-3. These show the number tagged and the recoveries from the same year in which the fish were tagged. No recoveries have been made from fish tagged in a previous year.

This material is presented only as a matter of record, and an analysis of the recoveries will be withheld until additional data are available.

¹ Submitted for publication, January, 1942.

² Hatton, S. Ross. Progress report on the Central Valley fisheries investigations, 1939. California Fish and Game, vol. 26, no. 4, pp. 334-373, 1940.