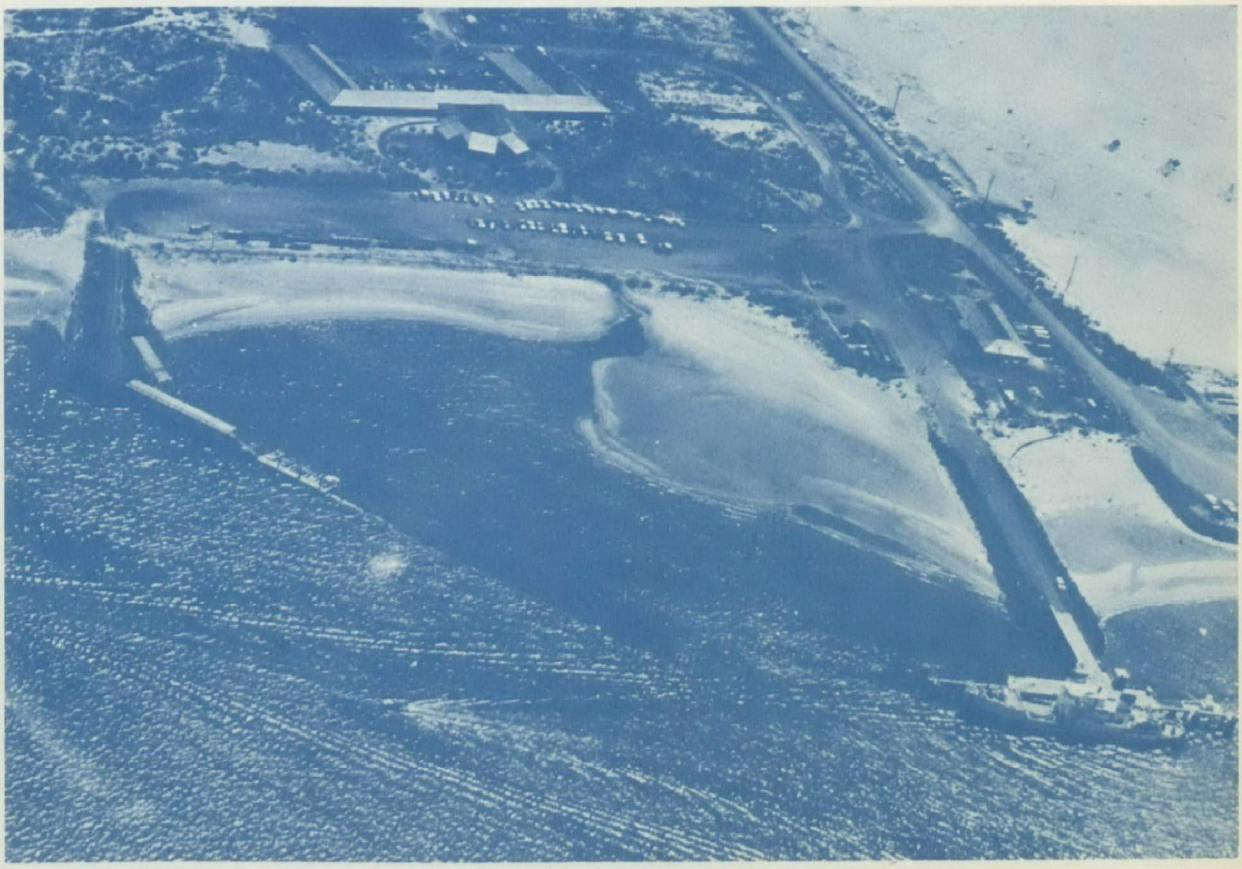
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
NORTHWEST REGION, PACIFIC NORTHWEST WATER LABORATORY

ENVIRONMENTAL FACTORS IN COASTAL AND ESTUARINE WATERS

BIBLIOGRAPHIC SERIES—VOLUME II

COAST OF WASHINGTON



AUGUST 1968

CLEAN WATER

ENVIRONMENTAL FACTORS IN COASTAL AND ESTUARINE WATERS BIBLIOGRAPHIC SERIES - VOLUME II COAST OF WASHINGTON

by

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FEDERAL WATER POLLUTION CONTROL
ADMINISTRATION
U. S. Department of the Interior

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FOREWORD

This volume is the second in a series of bibliographic compilations initiated by Dr. A. F. Bartsch as a planning guide for the development of a national research program on coastal pollution problems, and as a reference for researchers. Volume 1, containing references on the coast of Oregon, was published in October 1966.

While these source documents on past research were being compiled, two inventories of current research were also compiled, one covering the coastal waters throughout the country[1] and the other focusing on waters of the Columbia River basin and other Pacific Coast states[2]. Since then, the Estuarine Studies Office of the Federal Water Pollution Control Administration has sponsored numerous projects, both in the regional office of the FWPCA, and through grants and contracts, to develop inventories of estuarine uses and pollution problems, and to conduct special studies in areas of needed information. Until these reports are completed, no new bibliographies in this series will be initiated. Continuing the FWPCA's concern with coastal pollution problems, these efforts will be supplemented with a comprehensive listing of ocean discharges of waste materials and a discussion of the types and extent of the associated pollution conditions.

D. J. Baumgartner, Ph.D., Chief
National Coastal Pollution
Research Program
Pacific Northwest Water Laboratory

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1 Ditsworth, G. R., Index to Research: Coastal and Estuarine Waters in the United States, September 1967, 33 p.

2 Nielson, L. J., Inventory of Research in Water Pollution and Other Related Fields, November 1966, 135 p.

ABSTRACT

Indexed herein are references to literature pertaining to the marine waters of the State of Washington. References to these papers, most of which have been published since 1955, are indexed under one or more of the following headings: Marine Biology, Fisheries, Geology, Chemical and Physical Oceanography, Water Pollution, and Bibliographies, Literature Surveys and Compilations.

ACKNOWLEDGMENT

Mr. Antony Mecklenburg, a graduate student at the University of Washington, assisted the compiler in the search, review, and annotation of literature for this bibliography. The compiler extends his appreciation for this assistance.

INTRODUCTION

Indexed in this bibliography are more than 300 references to the literature of the marine waters of Washington State.

In 1954 and 1955, respectively, the Department of Oceanography, University of Washington, published comprehensive literature surveys of Puget Sound and Grays Harbor. Most of the literature referenced in this bibliography has been published since that time. Also included, however, are references to literature published prior to the middle 1950's that are not included in the University of Washington bibliographies.

References are listed under one or more of the six subject headings given in the index. In most cases a reference is indexed under a single heading only. However, some papers which contain information pertinent to more than one subject are indexed in each of the appropriate sections.

References included in the bibliography were located by systematically searching the publications listed below. The procedure was to examine the title or table of contents of each for information that suggested work on the marine waters of Washington State. Pertinent articles were reviewed, referenced, and briefly annotated for inclusion in the bibliography.

The publications so searched included:

American Fisheries Society Transactions
Copeia
Deep-Sea Research
Ecological Monographs
Ecology
Geological Society of America Journal
Journal of the Fisheries Research Board of Canada
Journal of the Water Pollution Control Federation
Journal of Marine Research
Limnology and Oceanography
Marine Geology
Northwest Science
Pacific Science
Proceedings of the National Shellfisheries Association
Proceedings of Pacific Coast Oysters Growers Association
Proceedings of Pacific Science Congress
Science
Transactions of the American Geophysical Union

United States Fish and Wildlife Service
  Special Scientific Reports
  Commercial Fisheries Review
United States Army, Corps of Engineers
  Senate and House of Representatives Documents pertaining to River and Harbor projects in Washington State
United States Public Health Service
  Reports
Washington State Department of Fisheries
  Biological Reports
Washington State Pollution Control Commission
Washington, University of, Fisheries School
  Contributions
Washington, University of, Department of Oceanography
  Contributions
  Technical Reports

Practically all of the literature search was conducted at the University of Washington Library, principally in the Fisheries and Oceanography branch. The library facilities of the United States Army, Corps of Engineers, Seattle District, were also utilized.

In a compilation of this kind there is the possibility that some pertinent literature has been overlooked. The compiler will appreciate learning of such omissions from users of the bibliography.

MARINE BIOLOGY

Allen, G.H. 1959. Growth of marked silver salmon (Oncorhynchus kisutch) of the 1950 brood in Puget Sound. Trans. Am. Fish. Soc. 88:310-318.

Silver salmon of two different stocks were marked by excision of fins and released during the spring of 1952 into Minter Creek and Lake Washington drainages of Puget Sound. Growth of the fish over a 3-year life cycle was plotted for demonstration of variations in lengths at maturity.

_____. 1967. Contribution of Puget Sound coho salmon, Oncorhynchus kisutch, to the 1953 Pacific Coast. Trans. Am. Fish. Soc. 96:42-54.

Salmon produced by stream systems entering Puget Sound, finmarked and recovered from the 1953 Puget Sound commercial catch, were used to estimate the contribution these streams made to the commercial troll fishing off Washington and Vancouver Island.

_____, A.C. Delacy, and D.W. Gotshall. 1960. Quantitative sampling of marine fishes - a problem in fish behavior and fishing gear. Waste Disposal in the Marine Environment, Pergamon Press. pp. 448-509.

A comprehensive survey of literature on fishing gear and sampling techniques with special emphasis on fish behavior is given. Results of fishing with a variety of gear under varying conditions at several West Coast locations are discussed. Examples of problems which may be encountered in beach seine and otter trawl fishing are included in a discussion of the use of this gear at Golden Gardens, Puget Sound.

Alverson, D.L. 1953. Notes on the Pacific Ocean perch. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(1):22-34.

A summary of the range, environment, and reproduction of Sebastodes alutus, sold as Pacific Ocean perch, is given.

Anderson, G.C. 1963. Columbia River effluent in the northeast Pacific Ocean, 1961, 1962; selected aspects of phytoplankton distribution and production. University of Washington, Department of Oceanography Technical Report no. 96. 77 p.

Chlorophyll a and phytoplankton productivity distributions off the Oregon and Washington coasts were observed during 1961 and 1962. Water in the Columbia River plume had greater concentrations of phytoplankton and higher photosynthetic rates than did the ambient waters.

_____. 1964. The seasonal and geographic distribution of primary productivity off the Washington and Oregon coasts. Limnology and Oceanography 9:284-302.

Discussion of the distribution of chlorophyll a and phytoplankton, their seasonal variations and the effect the Columbia River has on them.

_____. 1965. Fractionation of phytoplankton communities off the Washington and Oregon coasts. Limnology and Oceanography 10:477-480. (Also as Technical Report no. 146, Department of Oceanography, University of Washington).

Data obtained during 1961-1963 were analyzed to determine the seasonal and annual changes in size distributions of phytoplankton populations.

Aron, W.I. 1960. The distribution of animals in the eastern North Pacific and its relationship to oceanographic conditions. Ph.D. Thesis, University of Washington, Seattle, 82 p. plus appendix.

Animals taken in midwater trawls from the north Pacific Ocean, including the nearshore and inner marine waters of Washington, were identified and their distribution related to oceanographic conditions. Animals captured include adult fishes, larval fishes, euphausiids, pteropods, heteropods, shrimp, copepods, amphipods, and nysids.

_____. 1962. The distribution of animals in the eastern North Pacific and its relationship to physical and chemical conditions. Jour. Fish. Res. Bd. of Canada 19:271-313.

An Isaacs-Kidd midwater trawl was used to collect quantities of indicator organisms which were identified with water masses in the northeastern Pacific Ocean. The studies were conducted during the summer of 1957 and the summer and fall of 1958.

Bakus, G.J. 1962. Marine poecilosceridan sponges of the San Juan Archipelago, Washington. Ph.D. Thesis, University of Washington, Seattle. 302 p.

Anatomy, systematics and zoogeography of 22 species of marine sponges were studied from 1958 to 1961. Certain aspects of larval dispersals and the physical oceanography of the San Juan Archipelago are discussed.

Banse, K. 1963. Polychaetous annelids from Puget Sound and the San Juan Archipelago, Washington. Proceedings of the Biological Society of Washington 76:197-208.

Polychaetes studied at Friday Harbor laboratories during the summers of 1961 and 1962 are described. The environment and sediment related to organisms are discussed.

Barlow, J.P. 1958. Spring changes in phytoplankton abundance in a deep estuary, Hood Canal, Washington. Journal of Marine Research 17:53-67. (Also as Contr. no. 223 and as Technical Report no. 72, Department of Oceanography, University of Washington).

Spring changes in phytoplankton pigment abundance during January-May 1958 are discussed. Phytoplankton abundance was attributed to seasonal solar radiation and transparency.

Batts, B.S. 1960. Lepidology of the adult pleuronectiform fishes occurring in Puget Sound, Washington. M.S. Thesis, University of Washington, Seattle. 71 p.

Constant morphological scale characters were used to identify separate species of flatfish. An attempt was made, using scale morphology, to determine the relationship of the several species of Puget Sound flatfish.

_____. 1964. Lepidology of the adult pleuronectiform fishes of Puget Sound, Washington. Copeia, 1964, No. 4, pp. 666-673. (Also as Contr. no. 180, College of Fisheries, University of Washington).

Morphological characters of scales from flatfish in Puget Sound were analyzed. A key, based on these characters, was developed for distinguishing of flatfish.

Bayliff, W.H. 1954. A review of the Zoarcidae of the northeastern Pacific Ocean. M.S. Thesis, University of Washington, Seattle. 189 p.

Fourteen species of Zoarcidae from the northeastern Pacific are described. A comprehensive bibliography of the literature on each species accompanies each description.

Boden, B.P., M.W. Johnson, and E. Brinton. 1955. The Euphausiacea (Crustacea) of the North Pacific. Scripps Inst. of Ocean. Bull. 6:287-400. University of California Press, Berkeley and Los Angeles.

Classification keys as well as descriptions of euphausiids found in the North Pacific are given. Diagrams of the species described, depth, and geographical distributions are given.

Brinton, E. 1962. The distribution of Pacific euphausiids. Scripps Inst. of Ocean. Bull. 6:287-400. University of California Press, Berkeley and Los Angeles.

Seasonal variations of the distribution and diurnal migration patterns of 59 species of euphausiids are discussed in this comprehensive report. Studies were conducted primarily off western North America from Baja California to British Columbia. Extensive maps and charts of the areas studied are included.

Butler, T.H. 1960. Maturity and breeding of the Pacific edible crab, Cancer magister Dana. Jour. Fish. Res. Bd. of Canada 17:641-646.

Breeding procedures of Cancer magister are noted and identified by premating embracing marks on the exoskeleton. Ecological studies in Queen Charlotte Islands and Washington waters correlate sexual behavior with breeding activities during the period 1953-1955.

Carter, W.R. III. 1965. Racial variations of the arrow goby Clevelandia ios (Jordan and Gilbert) 1882 in Puget Sound and on the coast of Washington State. M.S. Thesis, University of Washington, Seattle. 91 p.

Specimens of the arrow goby collected in three areas, Oyster Bay and Quilcene Bay within Puget Sound, and Grays Harbor on the coast, were compared morphologically and statistically. No differences in characteristics were found in those

specimens taken within Puget Sound. However, there were significant morphological differences between those sampled in Grays Harbor and those sampled in Puget Sound.

Chapman, M.C. and A.H. Banner. 1949. Contribution to the life history of the Japanese oyster drill, Tritonalia japonica, with notes on other enemies of the Olympia oyster, Ostrea lurida. Washington, State of, Department of Fisheries Biological Report no. 49A, pp. 167-200.

Oyster mortalities resulting from drills, drill distribution, spawning and development of drills, rates of drilling, migration, and drill selection of shellfish are discussed. The study was conducted in southern Puget Sound.

Chew, K.K. 1958. A study of the food preference of the Japanese drill Ocinebra (Tritonalia) japonica Dunker. M.S. Thesis, University of Washington, Seattle. 70 p.

Specimens representing four different food organisms (bay mussels, Manila clams, Pacific oysters and Olympia oysters) were placed in salt water aquaria along with individually identified members of Ocinebra japonica. The animals were observed for a total of 140 days (two experiments of 70 days each) to determine if the drill had a preference food organism. It was found that, in general, the drill preferred either Manila clams, Olympia oysters, or bay mussels to Pacific oysters. The drills attacked the same species repeatedly rather than moving to more readily available food organisms. Drilling time on the various organisms varied from 4.5 days on bay mussels to 7-8 days on Manila clams.

_____. 1963. The growth of a population of Pacific oysters (Crassostrea gigas) when transported to three different areas in the State of Washington. Ph.D. Thesis, University of Washington, Seattle. 178 p.

Growth patterns of oysters transplanted to Willapa Bay, Oyster Bay, and Hood Canal were observed from March 1959 to January 1961. Predominant growth periods at all stations were during the summer and fall. Virtually no growth occurred during the winter.

_____ and R. Eisler. 1958. A preliminary study of the feeding habits of the Japanese oyster drill, Ocinebra japonica. Jour. Fish. Res. Bd. of Canada 15:529-535. (Also as Contr. no. 31, College of Fisheries, University of Washington).

Individually marked drills were presented with a choice of four food organisms, mussels, clams, and two species of oysters. During a 65-day experiment the drills attacked mussels most often, clams next, and oysters least often.

Chew, K.K., A.K. Sparks, and S.C. Katkansky. 1965. Preliminary results on the seasonal size distribution of Myticula orientalis and the effect of this parasite on the condition of the Pacific oyster, Crassostrea gigas. Jour. Fish. Res. Bd. of Canada 22:1099-1101.

Infection of oysters by this parasite was studied in Humbolt Bay, California, Yaquina Bay, Oregon, and Willapa Bay, Hood Canal, and Oyster Bay, Washington. The condition index of oysters was directly related to the severity of parasite infections.

Chia, F.S. 1964. The developmental and reproductive biology of a brooding starfish, Leptasterias hexactis (Stimpson). Ph.D. Thesis, University of Washington, Seattle. 175 p.

Developmental and reproduction biology of the starfish living in San Juan waters were investigated by histological and ecological methods. Investigations concerned with brooding behavior and breeding patterns were correlated with environmental parameters from 1959 to 1964.

Colwell, R.R. 1961. Commensal bacteria of marine animals, a study of their distribution, physiology, and taxonomy. Ph.D. Thesis, University of Washington, Seattle. 198 p.

Commensal bacteria associated with 25 species of fish and nine species of invertebrates from widely separated geographical areas were studied. Cultures showed that in the Washington coast-Puget Sound area, psychrophilic forms predominated. In the Eniwetok and Rangelap Atoll areas of the South Pacific, mesophilic forms predominated.

_____ and J. Liston. 1960. Microbiology of shellfish. Applied Microbiology 8:104-109.

Bacteria from oysters held experimentally at Willapa Bay, Hood Canal, and Oyster Bay, Washington were analyzed every three weeks. Dominant forms found were gram-negative asporogenous rods of Pseudomonas/Vibro and Flavobacterium.

Colwell, R.R. and J. Liston. 1961. A bacteriological study of the natural flora of Pacific oysters (Crassostrea gigas) when transplanted to various places in Washington. Proceedings, National Shellfisheries Association 50:181-188. (Also as Contr. no. 67, College of Fisheries, University of Washington).

Total viable bacterial populations on oysters in Willapa Bay, Hood Canal, and Oyster Harbor, Washington were investigated. Predominant bacteria were gram-negative, asporogenous, rod-like bacteria of the Pseudomonas, Vibrio, Flavobacterium, and Achromobacter groups.

Cupp, E.E. 1943. Marine plankton diatoms of the west coast of North America. Scripps Inst. of Ocean. Bull. 5:1-237. University of California Press, Berkeley and Los Angeles.

A classification key and descriptions are given. There are diagrams of all diatoms described. Diatom biology and physiology are discussed in general terms and a rather detailed examination of diatom morphology is given.

Damkaer, D.M. 1964. Vertical distributions of copepoda in Dabob Bay, December 1960. M.S. Thesis, University of Washington, Seattle. 84 p.

Zooplankton were sampled on six different days throughout the month beginning on the 3rd and ending on the 29th. Samples were obtained with Clarke-Bumpus samplers at as many as 12 depths ranging from the surface to 150 meters. More than 30 species were identified. Although there was much overlapping of environment, it was found that certain groups of copepods were found in specific vertical ranges.

DeLacy, A.C. and T.S. English. 1954. Variations in beach seine samples caused by net length and repeated hauls. Ecology 35:18-20.

Two beach seines, 60 and 120 feet long, respectively, were used to sample fish under comparable conditions. Using the longer net as a standard, the shorter net collected 48 percent of the specimens, 75 percent of the species, and 12 percent of the poundage.

DeLacy, A.C., C.R. Hitz, and R.L. Dryfoos. 1964. Maturation, gestation and birth of rockfish (Sebastodes) from Washington and adjacent waters. Washington, State of, Department of Fisheries, Fisheries Research Papers 3(2):51-67. (Also as Contr. no. 164, School of Fisheries, University of Washington).

Female rockfish taken near Port Orchard, Washington in the winter of 1959 and spring of 1960 were studied. The gestation period, birth, and fecundity of the species are discussed.

Depalma, J.R. 1966. A study of the marine fouling and boring organisms of Admiralty Inlet, Washington. Oceanographic Surveys Department, U.S. Naval Oceanographic Office, Washington, D.C. 20390.

A comprehensive survey of marine fouling began in June 1963 and continued for two years. The report describes the test site, outlines the techniques of data collection and analysis. The report includes identification of organisms involved in fouling studies.

English, T.S. 1961. An inquiry into distributions of planktonic fish eggs in a restricted area of Puget Sound. Ph.D. Thesis, University of Washington, Seattle. 227 p.

Planktonic fish eggs collected in the Port Orchard area were analyzed to determine their abundance and distribution. Egg samples were taken at the surface and various depths. The most abundant eggs were from the flatfish complex of Parophrys-Platichthys-Psettichthys.

Fahrenbach, W.H. 1961. The biology of a harapacticoid copepod. Ph.D. Thesis, University of Washington, Seattle. 130 p.

Algae containing copepods were collected subtidally and intertidally on Salmon Bank, San Juan County. Anatomical and biological characteristics and the copepods' ecological association with marine red algae are discussed.

Frolander, H.F. 1962. Quantitative estimations of temporal variations of zooplankton off the coast of Washington and British Columbia. Jour. Fish. Res. Bd. of Canada 19:657-675.

Quantitative plankton sampling from December 1956 to May 1957 shows seasonal variations in the volumes of zooplankton collected at the surface and at 200 meters depth. Results were compared with catches from the equatorial Pacific and Alaskan waters.

Fuller, M.S., B. Lewis, and P. Cook. 1966. Occurrence of Pythium sp. on the marine alga Porphyra. Mycologia 58:313-318.

The fungi parasite Pythium sp. living on the algal genus Porphyra is reported from Puget Sound. Observations on the pathology of the algal host tissue with special reference to sporangium production of the host is described. The fungi is further demonstrated to grow in culture form and to readily infect the alga host.

Gardella, C.M. 1962. Some aspects of the biology and development of caprellids. M.S. Thesis, University of Washington, Seattle. 57 p.

General biology, growth, development, and life history of amphipods collected in Friday Harbor and Puget Sound waters are discussed.

Greer, D.L. 1962. Studies on the embryology of Pycnopodia helianthoides (Brandt) Stimpson. Pacific Science 16:280-285.

Studies conducted at Friday Harbor Laboratories on the embryology of starfish larvae are discussed. Larval organisms collected in Friday Harbor waters thrived in tanks of running seawater.

Grinols, R.B. 1965. Check-list of the offshore marine fishes occurring in the northeastern Pacific Ocean, principally off the coasts of British Columbia, Washington, and Oregon. M.S. Thesis, University of Washington, Seattle. 217 p.

About 200 pelagic, bathypelagic and benthic species of fish belonging to 127 genera and 59 families are indexed. Specimens were obtained from an oceanographic region bounded by the west coast of the United States and Canada, 42°00' N. latitude, 55°00' N. latitude, and 166°00' W. longitude. The general locations where specimens were taken and the depths from which they were taken are given. A comprehensive bibliography of literature on each species indexed is given.

Guberlet, M.L. 1956. Seaweeds at ebb tide. University of Washington Press, Seattle. 182 p.

Seaweeds which are found along the Pacific Coast are listed. Nontechnical information concerning their description, habitat, and range are given.

Halstead, B.W. 1959. Dangerous marine animals. Cornell Maritime Press, Cambridge, Md. 146 p.

Included in this book are discussions of sea animals in Pacific Northwest waters which are dangerous in one of the following ways: (1) poisonous to eat (certain mollusca); (2) predaceous (killer whale); (3) venomous (ratfish, sting rays, jellyfish).

Harriss, R.C. and O.H. Pilkey. 1966. Temperature and salinity control of the concentration of skeletal Na, Mn, and Fe in Dendraster excentricus. Pacific Science 20:235-238.

Specimens of the common sand dollar were collected from Baja California to Vancouver Island during 1965. Effects of the environmental parameters, temperature, and salinity on the skeletal concentration of Na, Mn, and Fe were studied.

Hebard, J.F. 1956. The seasonal variation of zooplankton in Puget Sound. M.S. Thesis, University of Washington, Seattle. 64 p.

Seasonal variations were studied at three stations in central Puget Sound from February 1955 through February 1956. Dominant forms during the spring and summer were Pseudocalanus minutus and Microcalanus pusillus. Dominant species during the fall was Corycaeus affinis.

Henry, B.S. and A.M. Partansky. 1935. The rate and extent of anaerobic decomposition of sulfite waste liquor by bacteria of sea bottom mud. II. Bacteriological Proceedings, National Academy of Sciences 21:191-200. (Also as Contr. no. 38, Oceanographic Laboratory, University of Washington).

Marine mud samples, covered with varying concentrations of sulfite waste liquor, were allowed to incubate at three temperatures for 310 days. During this time, anaerobic and facultative bacteria, representing five species previously unknown, were separated into pure culture and tested for their fermentation ability.

Hermans, C.O. 1966. The natural history and larval anatomy of Armandia brevis polychaete: Opheliidae. Ph.D. Thesis, University of Washington, Seattle. 175 p.

Study results concerned with embryology, larval differentiation and reproductive biology are presented. Organisms were collected with plankton nets and petri dishes placed at the bottom of the Friday Harbor pier. Burrowing habits and the substratum which polychaetes selectively prefer are discussed.

Hickman, C.P., Jr. 1959. The larval development of the sand sole (Psettichys melanostictus). Washington, State of, Department of Fisheries, Fisheries Research Papers 2(2):38-47. (Also as Contr. no. 55, College of Fisheries, University of Washington).

Growth and development of sand sole larvae, taken from Puget Sound during the spring and summer of 1955, were observed until they reached a juvenile fish stage.

Hobson, K.D. 1966. Ecological observations on Abarenicola species (Polychaeta) of the North Pacific. M.S. Thesis, University of Washington, Seattle. 75 p.

Studies in Friday Harbor, Washington waters during 1964 correlate habitats of polychaete species to sediment content. Irrigation cycles of lugworms are correlated to respiration and sediment turnover rates.

Hobson, L.A. 1963. Some influences of the Columbia River effluent on marine phytoplankton during January 1961. M.S. Thesis, University of Washington, Seattle. 88 p.

Chlorophyll a, marine diatoms, and micro-flagellate concentrations were studied to evaluate the influence of Columbia River runoff on phytoplankton standing crops. Greatest concentrations were found in the Columbia River plume, which was defined by the 32.5 °/oo isopleth.

_____. 1964. Some influences of the Columbia River effluent on marine phytoplankton during January 1961. University of Washington, Department of Oceanography, Technical Report no. 100. 46 p.

The phytoplankton populations from offshore stations along the Oregon and Washington coasts are correlated with physical, chemical and other biological factors. These are photosynthesis, respiration, water column stability, grazing by zooplankton and sinking of phytoplankton. Tables, graphs, charts, and vertical and horizontal distribution diagrams are presented.

Hobson, L.A. 1966. The seasonal and vertical distribution of suspended particulate matter in an area of the northeast Pacific Ocean. Ph.D. Thesis, University of Washington, Seattle. 107 p.

Particulate matter samples were collected from the surface and from 4000 meters depth on six occasions during 1964 and 1965. Concentrations of the particulate matter, organic carbon, carbohydrate, and the size of the particles were determined to study their variation with depth and season.

_____. 1966. Some influence of the Columbia River effluent on marine phytoplankton during January 1961. Limnology and Oceanography 11:223-234.

The distribution of a phytoplankton standing crop is related to the influences of freshwater runoff. Correlations between critical-to-mixed-depth ratios and the size of phytoplankton standing crop are presented.

Hoffman, E.G. 1962. A morphological and systematic study of the mesozoa of Rossia pacifica (Berry). M.S. Thesis, University of Washington, Seattle. 85 p.

The biology and ecology of mesozoa that inhabit cephalopods are discussed. Collections taken from dredge hauls at Friday Harbor and from shrimp nets in Hood Canal during 1961 were studied.

Holland, G.A. (Ed.) 1953. Toxic effects of sulfite waste liquor on young salmon. Washington, State of, Department of Fisheries, Fisheries Research Bulletin no. 1. 111 p.

Bioassays, utilizing various concentrations of sulfite waste liquor in salt and fresh water, were conducted for varying periods of time on several species of salmon. Data and experimental results are presented.

Hower, J.H. 1938. The seasonal settlement of Bankia, Limnoria, barnacles, bryozoa and other sessile organisms at Shelton, Washington. M.S. Thesis, University of Washington, Seattle. 53 p.

Wooden blocks, serving as organism attaching plates, were submerged at various depths in tidal waters for three-month periods between October 1934 and March 1936. Organisms that

attached themselves to the blocks, their periods of greatest attachment and growth, and the depth of water at which they attached themselves were studied.

Hurst, A. 1966. A description of a new species of Dirona from the northeast Pacific. The Veliger 9:9-15.

The ecological distribution, stomach contents, and general morphology of type specimens are discussed. Specimens were collected by dredge from 30 fathoms of waters west of Blakely Island, Washington.

Johnson, M.E. and J.H. Snook. 1927. Seashore animals of the Pacific Coast. The MacMillan Co., New York. 658 p.

Animals from 12 phyla which are found along the Pacific Coast of North America are described. Ecological and geographical distributions are given. Color plates, pictures, diagrams, and an extensive bibliography.

Katkansky, S.C. 1962. Sexual pattern in the Pacific oyster, Crassostrea gigas (Thunberg), in selected sites in three oyster growing areas of Washington. M.S. Thesis, University of Washington, Seattle. 58 p.

Oysters in Oyster Bay, Willapa Bay, and Hood Canal were studied to determine the proportion of females to males and the number of hermaphroditic specimens as well as those which went through sexual reversal. Older oysters showed a greater percent of females.

Keen, A.M. 1963. Marine molluscan genera of western North America. Stanford University Press. 126 p.

An identification key.

Kendell, A.W., Jr. 1966. Sampling juvenile fishes on some sandy beaches of Puget Sound, Washington. M.S. Thesis, University of Washington, Seattle. 77 p.

The distribution of juvenile fishes on several beaches was studied during the lowest tide of each two-week period from December 1964 to December 1965. Generally, fish distribution was shown to be related to the tide, water depth, and time. However, the distribution of some species could not be related to tidal influences.

Kincaid, T., M.P. Wennekens, and R.O. Sylvestor. 1954. A study of oceanographical and biological characteristics of southeast Georgia Strait. Report to the General Petroleum Corporation, Los Angeles. 142 p.

Intertidal and subtidal environments and biota were described during 1954, prior to the start of operations by a petroleum refinery.

Knudsen, J.W. 1964. Observations of the reproductive cycles and ecology of the common brachyura and crablike anomura of Puget Sound, Washington. Pacific Science 18:3-33.

Growth rates and reproductive cycles of Puget Sound brachyura and anomura as they relate to environmental conditions are discussed. Seasonal changes in gonad development and egg development were studied. Southern Puget Sound crabs were collected in the Tacoma area.

Kollmeyer, R.C. 1962. A demonstration of the diurnal migration of several genera of copepods in near shore waters of the Washington coast. Collected Papers from Oceanography 460, 1962, University of Washington, Seattle. 12 p.

Samples collected in coastal waters less than 100 fathoms deep by water pumps were compared with environmental factors. Fluctuations in copepod counts are correlated with diurnal light intensities.

Larrance, J.D. 1964. A method for determining volume of phytoplankton in a study of detrital chlorophyll a. M.S. Thesis, University of Washington, Seattle. 107 p.

An attempt was made to establish the presence or absence of detrital chlorophyll a in Dabob Bay during the spring of 1961. Changes in nutrient and phytoplankton concentrations are discussed.

Lewis, G.B. and A.H. Seymour. 1965. Distribution of zinc-65 in plankton from offshore waters of Washington and Oregon. 1961-1963. Laboratory of Radiation Biology, University of Washington, Seattle. 73 p.

Zn-65 concentrations in unsorted plankton samples taken within 135 miles of the mouth of the Columbia River conform

to the general pattern of horizontal distribution of the Columbia River effluent. Samples collected indicate seasonal but not annual changes in the relationships between river water and plankton.

Lindsay, C., R.E. Westley, and C.S. Sayce. 1958. Prediction of oyster setting in the State of Washington. Proceedings, National Shellfisheries Association 49:59-70.

Methods for predicting oyster sets in Willapa Bay, southern Puget Sound, and Dabob Bay are discussed. Predictions are made after comparing observations of hydrographic conditions, spawning occurrence, larval distribution and abundance, and larval development of a current year with past years.

Ling, H.Y. 1966. The radiolarian Protocystis thomsoni (Murray) in the northeast Pacific Ocean. Micropaleontology 12:203-214.

The morphology and distribution in the water column of radiolarian species found in 102 plankton samples were studied. Samples were collected from 1956 to 1958 at 75 oceanographic stations located along the British Columbia, Washington, and Oregon coasts.

Love, C.M. 1963. Physical, chemical and biological data from the northeast Pacific Ocean: Columbia River effluent area, January-June 1961. University of Washington, Department of Oceanography, Technical Report no. 86. 405 p.

Five offshore cruises were made into that part of the northeast Pacific Ocean influenced by Columbia River water. At each oceanographic station temperature, salinity, and dissolved oxygen data were taken. Productivity and chlorophyll measurements were made at 75 percent of the stations. In addition, zooplankton, phosphate, silicate, and nitrate determinations were made at selected stations.

_____. 1964. Physical, chemical, and biological data from the northeast Pacific Ocean: Columbia River effluent area September-December 1961. University of Washington, Department of Oceanography, Technical Report no. 115, Volume I. 258 p.

Oceanographic and meteorological data are tabulated.

Love, C.M. 1964. Physical, chemical, and biological data from the northeast Pacific Ocean: Columbia River effluent area September-December 1961. University of Washington, Department of Oceanography, Technical Report no. 115, Volume II. 174 p.

Oceanographic and meteorological data are tabulated.

_____. 1965. Physical, chemical, and biological data from the northeast Pacific Ocean: Columbia River effluent area January-October 1962. University of Washington, Department of Oceanography, Technical Report no. 119. 194 p.

Oceanographic and meteorological data are tabulated.

MacPhee, C. and W.A. Clemens. 1962. Fishes of the San Juan Archipelago, Washington. Northwest Science 36:27-38.

Studies were done to describe fish fauna composition and distribution and their habitats. The fish were categorized by methods of capture into inshore, offshore, ground, and pelagic populations.

Magill, A.R. and M. Erho. 1963. The development and status of the pink shrimp fishery of Washington and Oregon. Pacific Mar. Fish. Comm. Bull. no. 6, pp. 62-80.

A brief history of the shrimp fishery, regulations, and fishing beds of Oregon and Washington is given. Shrimp biology and landings are discussed. Tables, graphs, and diagrams.

Mauzey, P.K. 1965. Feeding behavior and reproductive cycles in Pisaster ochraceus. M.S. Thesis, University of Washington, Seattle. 54 p.

Results of ecological studies, supplemented by results of laboratory experiments, of the starfish, Pisaster ochraceus, in Friday Harbor waters are presented. Histology of reproductive and digestive organs are correlated to the feeding states of the organism.

McHugh, J.L. and J.E. Fitch. 1951. An annotated list of the clupeoid fishes of the Pacific Coast from Alaska to Cape San Lucas, Baja California. Calif. Fish and Game 37:491-495.

McMillin, H.C. 1924. The life history and growth of the razor clam. Washington, State of, Department of Fisheries. 52 p.

Razor clam life history, including reproduction, growth and migration, anatomy, shell morphology, and food are discussed along with the location and extent of clam beds and the commercial fishery.

Miller, B.S. 1965. Food and feeding studies on adults of two species of pleuronectids (Platichthys stellatus and Psettichthys melanostictus) in East Sound, Orcas Island (Washington). M.S. Thesis, University of Washington, Seattle. 131 p.

The food, periods of feeding, and methods of feeding of adult, female starry flounder, P. stellatus, and sand sole, P. melanostictus, are discussed.

Neushul, M. 1967. Studies of subtidal marine vegetation in western Washington. Ecology 48:83-93.

The ecology of the algal community structure in Puget Sound is discussed. Field studies commenced in the fall of 1960 and continued periodically until 1963 centered around Friday Harbor, Washington. Specialized techniques including SCUBA diving in the field and computerized statistical analyses of data were used in the study.

Nishishimamoto, S. 1958. Age and growth of the rock sole, Lepidopsetta bilineata, in Puget Sound. M.S. Thesis, University of Washington, Seattle. 130 p.

The age and growth rate of 1765 specimens of rock sole from five areas of Puget Sound were determined from the right interopercular bone.

Osterberg, C. 1962. ZN^{65} content of salps and euphausiids. Limnology and Oceanography 7:478-479.

Organisms collected during 1961 from the mouth of the Columbia River were measured for the isotope ZN^{65}. The distribution of salps and euphausiids with respect to the outflow waters of the Columbia River is discussed.

Palmen, A.T. 1956. A comparison of otoliths and interopercular bones as age indicators of English sole. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(4):5-20.

Because wide discrepancies in aging the English sole (Parophrys vetulus) with otoliths had arisen, another structure, the interopercular bone, was tested as an age indicator. Aging data from each method are presented and compared.

Paranjape, M.A. 1967. Observations on molting and respiration of euphausiids. M.S. Thesis, University of Washington, Seattle. 23 p.

Summer (1964 and 1965) studies at Friday Harbor Laboratories were concerned with molts and molting frequencies of several species of euphausiids. Physiological investigations are correlated with the ecological parameters of size, season, and history of population.

Park, T.S. 1965. The biology of a Calanoid copepod Epilabidocera amphitrites McMurrich. Ph.D. Thesis, University of Washington, Seattle. 231 p.

Anatomical structures of growth stages, embryonic through adult, of specimens taken from Friday Harbor during 1964 were extensively studied. Detailed morphologic studies help clarify the organism's relationship to the planktonic environment.

Partansky, A.M. and B.S. Henry. 1935. Anaerobic bacteria capable of fermenting sulfite waste liquor. Jour. Bacteriology 30:559-571. (Also as Contr. no. 49, Oceanographic Laboratory, University of Washington).

Anaerobic bacteria, separated from a fermenting sulfite waste liquor, were tested individually for their contribution to the fermentation. Results of tests and bacteria morphology are discussed.

Pauley, G.B. and A.K. Sparks. 1966. The acute inflammatory reaction of two different tissues of the Pacific oyster, Crassostrea gigas. Jour. Fish. Res. Bd. of Canada 23:1913-1921.

An experimental and comparative description of inflammatory reaction of Pacific oyster is discussed. Possible mechanisms of reactions and protective behavior of oysters are suggested.

Pearce, J.B. 1962. The biology of some pinnotherid crabs from the waters of Puget Sound and San Juan Archipelago. Ph.D. Thesis, University of Washington, Seattle. 279 p.

Investigations during the summers of 1958 and 1959, between two species of parasitic crabs and their host, the horse clam, were undertaken to describe competition for the same ecological niche. Physiological investigations were correlated with ecological studies.

Pereyra, W.T. 1961. Growth of the Pacific oyster (Crassostrea gigas Thunberg) in various exposure situations, with consideration of the experimental and methodological difficulties encountered. M.S. Thesis, University of Washington, Seattle. 87 p.

This study of differential growth and survival of the Pacific oyster at different intertidal elevations and subtidal depths was conducted from January to December 1960 in Oyster Bay, southern Puget Sound, Washington. Results of this experiment show that animal growth increased rapidly during early summer and diminished greatly during late summer and early fall. Those animals which were always submerged showed best growth rates. Condition indices were found to be inversely related to exposure. Survival, however, was independent of both handling and exposure.

_____. 1962. Mortality of Pacific oysters, Crassostrea gigas (Thunberg), in various exposure situations in Washington. Proceedings, National Shellfish Association 53:51-63.

Oysters maintained in baskets at various intertidal and subtidal levels in Oyster Bay, Puget Sound, Washington from January 1960 to December 1960 were examined weekly or biweekly. Specimens held in the subtidal environment suffered the greatest mortality, apparently due to siltation.

Powell, J.H. 1964. The life history of a red algae Constantinia. Ph.D. Thesis, University of Washington, Seattle. 154 p.

A comprehensive investigation of the life history of the marine red algae in the Friday Harbor waters is discussed. The author, using SCUBA, correlated field investigations with extensive laboratory experiments.

Reid, J.L., Jr., G.I. Roden, and J.G. Wyllie. 1958. Studies of the California Current System. Scripps Inst. of Oceanography Contr. no. 998, pp. 298-321.

The physical, chemical, and biological characteristics of the current and conditions which cause variations in these features are discussed.

Ricketts, E.F. and J. Calvin (Revised by J.L. Hedgpeth). 1956. Between Pacific tides. Stanford University Press, Stanford, California. 502 p.

A comprehensive book on the intertidal animals of the Pacific Coast of the United States. Descriptions, including pictures of many of the common forms, are included as well as discussions of environmental and ecological requirements for the animals. An extensive annotated bibliography on the marine biology of the Pacific Coast is included.

Scagel, R.F. 1957. An annotated list of the marine algae of British Columbia and northern Washington. Bulletin of National Museum of Canada no. 150. 289 p.

References to pertinent literature, habitat, and distribution information and records of growth in new locations are summarized for each species listed.

_____. 1959. The role of plants in relation to animals in the marine environment. Marine Biology. Proceedings of the Twentieth Annual Biology Colloquium. Oregon State College, Corvallis, April 1959. pp. 9-24.

This comprehensive review of literature published from 1938 to 1959 stresses the ecological interactions between marine animals and plants. Emphasized is the marine environment from northern California to the Gulf of Alaska.

_____. 1962. Coastal studies of marine algae in British Columbia and the North Pacific. Reported from coastal and shallow water research conference, University of British Columbia, Vancouver. pp. 478-750.

An extensive survey, during 1960, of the flora distribution from the Aleutian Islands to the Columbia River shows a variety of sharp transition points. Physical environment parameters are correlated with the ecological distribution of marine algae.

Scagel, R.F. 1966. The Phaeophyceae in perspective. Oceanography and Marine Biology: an annual review. Hafner Publishing Co., New York, Volume 4, pp. 123-194.

The available literature on brown algae is reviewed in this paper. Several references which discuss the brown algae found in the coastal waters of Washington and British Columbia are listed.

_____. 1966. Marine algae of British Columbia and northern Washington, Part I, Chlorophyceae (Green Algae) Bulletin no. 207. National Museum of Canada Biological Series no. 74.

Identification keys and illustrations of marine green algae found in northern Washington and British Columbia are given. Several annotated references are also included.

Schultz, L.P. 1936. Keys to the fishes of Washington, Oregon, and closely adjoining regions. University of Washington, Publications in Biology 2(4):103-228.

This is a taxonomic key.

Seymour, A.H. and G.B. Lewis. 1964. Radionuclides of Columbia River origin in marine organisms, sediments and water collected from coastal and offshore waters of Washington and Oregon, 1961-1963. United States Atomic Energy Commission Laboratory of Radiation Biology, University of Washington, Seattle, Washington UWFL-86, December 1964.

The distribution of Hanford-produced radionuclides in the marine environment was determined in this comprehensive study by measuring the zinc-65 concentrations in samples of coastal organisms, offshore plankton, demersal fish, and water. The samples obtained from an area bounded by the Oregon-Washington coastline and a line about 150 miles at sea were analyzed by gamma ray spectrometry.

Slipp, J.W. 1952. Status of the crab, Chionoecetes bairdi, in the inshore waters of Washington and British Columbia. The Wasman Jour. of Biology 10:235-239. (Also as Contr. no. 2, College of Fisheries, University of Washington).

Specimens of this crab collected in southern Puget Sound demonstrated that its range extends much further south than was previously believed.

Sparks, A.K. 1963. Some preliminary observations on the incidence of infection and pathological effect of the parasitic copepod, Mytilicola orientalis Mori, in the Pacific oyster, Crassostrea gigas (Thunberg), on the West Coast of the United States. College of Fisheries Reprint, University of Washington, Seattle. 9 p.

Ecological investigations of oyster communities in Puget Sound were conducted from March 1959 to September 1961. Pathological studies on the oyster gut were done to determine the incidence of infection by Mytilicola sp.

_____ and K.K. Chew. 1961. Preliminary report on growth and survival of the Pacific oyster in Washington waters. Proceedings, National Shellfisheries Association 50:125-132. (Also as Contr. no. 65, College of Fisheries, University of Washington).

Oysters held experimentally in baskets at Willapa Bay, Oyster Bay, and Hood Canal were measured weekly or biweekly to determine their growth rate. Growth was greatest during the summer.

_____ and G.B. Pauley. 1964. Studies of the normal post-mortem changes in the oyster, Crassostrea gigas (Thunberg). Jour. Insect. Path. 6(1):78-101. (Also as Contr. no. 165, College of Fisheries, University of Washington).

Sacrificed oysters retained gross normal appearances for about 32 hours. Decomposition odors were detected 48 hours after death and within 136 hours the adductor muscles became detached from the shell.

Sribhibhadh, A. 1959. Racial variations in the populations of the crested blenny, Anoplarchus purpurescens purpurescens Gill, in the Puget Sound area. M.S. Thesis, University of Washington, Seattle. 86 p.

A total of 1,312 specimens collected from 12 localities were examined in a racial analysis to determine the existence and extent of meristic variations and to define populations of the species. Analyses indicate that there are at least four populations of crested blennies in the Puget Sound area. These are (1) the San Juan Archipelago, (2) Puget Sound proper, (3) Oyster Bay, and (4) Hood Canal.

Sribhibhadh, A. 1963. Seasonal variations of paralytic shellfish toxicity in the California mussel, Mytilus californianus Conrad, and the Pacific oyster, Crassostrea gigas (Thunberg), along the Strait of Juan de Fuca and in Willapa Bay. Ph.D. Thesis, University of Washington, Seattle. 171 p.

Seasonal development and geographic distribution of shellfish toxicity were studied from April 1961 to October 1962. Toxicity levels in the Strait were highest in midsummer at the most-seaward station. Inland, toxicity decreased. Toxicity levels in Willapa Bay were relatively low during the study period. A comprehensive bibliography on toxicity is included in this paper.

Stefansson, U. and F. Richards. 1964. Distribution of dissolved oxygen, density, and nutrients off the Washington and Oregon coasts. Deep Sea Research. 11:355-380.

The effects of upwelling, Columbia River water, biological activity, temperature change and anomalous surface exchange on the distribution of nutrients are discussed. Observations were taken during 13 cruises between January 1961 and June 1962. Diagrams, charts, and graphs.

Swan, E.F. 1952. The growth of the clam, Mya arenaria, as affected by the substratum. Ecology 33:530-534. (Also as Contr. no. 157, Department of Oceanography, University of Washington).

Clams, placed in boxes with different substrates, one of sand, the other of shells, gravel, and mud, were allowed to grow for a year. Growth rates of clams in the sand substrate was about double that of clams in the shell mixture.

Ting, R.Y.M. 1965. Ecology of demersal animals: problems in sampling. Ph.D. Thesis, University of Washington, Seattle. 249 p.

Ecological studies in Puget Sound from 1961 to 1964 were conducted using new techniques. New instrumentation useful in quantitative sampling of demersal organisms is described.

Walden, C.C., I.V.F. Allen, and P.C. Trussell. 1967. Estimation of marine-borer attack on wooden surfaces. Jour. Fish. Res. Bd. of Canada 24:261-272.

Several sizes and types of untreated wood samples were immersed in Vancouver Harbor, Elliot Bay, and Tacoma Harbor during the fall and winter months of 1963 to determine the effects of boring organisms on them. Information obtained from the study was used to design procedures for measuring borer attacks and population densities of borers.

Washington, University of. 1963. Physical and chemical and biological data from the northeast Pacific Ocean: Columbia River effluent area: January-June 1961. University of Washington, Department of Oceanography, Technical Report no. 86. 405 p.

Tabulated observed and computed oceanographic data collected on five cruises are presented. Area covered extends from Vancouver Island, B.C. to the Siuslaw River, Oregon and seaward to 131° W. longitude.

Waters, V.L. 1966. Feeding, ecology, and other aspects of the natural history of the nudibranch Eubranchus olivaceus. M.S. Thesis, University of Washington, Seattle. 88 p.

Diet, feeding rates, and prey location of nudibranchs found in Puget Sound are discussed. Ecological and experimental studies undertaken at Friday Harbor Laboratories during the summer of 1965 correlated life cycles with growth rates.

Wennekens, M.P. 1959. Marine environment and macro-benthos of Puget Sound, San Juan Archipelago, Southern Georgia Strait, and Strait of Juan de Fuca. Ph.D. Thesis, University of Washington, Seattle. 298 p.

A broad-scoped investigation of faunistic characters in waters greater than 10 fathoms deep was conducted from 1956 to 1959. Correlations of the interrelationships between the physical environment and bottom-dwelling organisms are presented.

Westley, R.E. 1956. Retention of Pacific oyster larvae in an inlet with stratified waters. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(4):25-31.

Continued disappearances of oyster larvae from Dabob Bay resulted in this biological and hydrographic study. It demonstrated that during periods of northerly winds, surface waters were driven from the bay carrying oyster larvae with it.

Westley, R.E. 1959. Olympia and Pacific oyster condition factor data. State of Washington 1954-1958. Washington Department of Fisheries, State Shellfish Laboratory, Quilcene, Washington.

Condition factor data of oysters taken from commercial beds in south Puget Sound and Willapa Bay are tabulated in this report. Included are the wet and dry weight, and the volume of oysters sampled.

_____. 1967. Phytoplankton photosynthesis and its relationship to oxygen in Grays Harbor, Washington. Washington, State of, Department of Fisheries, Research Division, March, 1967. 30 p.

Hydrography and primary productivity of Grays Harbor were studied during the summers of 1964 and 1965. Nutrients and environmental conditions required for photosynthesis and oxygen produced therefrom were investigated. Hydrographic data are presented in charts and graphs.

_____, C. Lindsay, and C. Woelke. 1964. Shellfish culture potential of Swinomish and Lummi Reservation tidelands. Washington, State of, Department of Fisheries, Research Division, May 1964.

The oyster-growing potential of tidelands in the Swinomish and Lummi Reservation areas was studied from April 1963 to April 1964. Investigations were made of: oyster growth, fatness, and mortality; physical, chemical, and biological characteristics of the water; and bottom sediments. Hydrographic data are given in charts and graphs.

Westrheim, S.J. 1958. On the biology of the Pacific Ocean perch, Sebastodes alutus (Gilbert). M.S. Thesis, University of Washington, Seattle. 106 p.

Data on Pacific Ocean perch collected off the coasts of Oregon and Washington during the fall of 1952 were analyzed. Commercial landings, taxonomy, distribution, size-composition, and sex ratios in landings, length-weight relationships, age determinations, growth, mortality, and reproduction are discussed.

Widdowson, T.B. 1965. A survey of the distribution of intertidal algae along a coast transitional in respect to salinity and tidal factors. Jour. Fish. Res. Bd. of Canada 22:1425-1454.

A survey of flora along the northern shores of Juan de Fuca Strait was conducted in 1957 and 1958. In areas of conspicuous algae, the coastline properties and algae distribution were recorded between established stations. Water temperature and salinity were measured at each station.

Wiebe, W.J. 1965. Studies on the bacteriology of marine sediments off the Washington-Oregon coast. Ph.D. Thesis, University of Washington, Seattle. 301 p.

The quantitative distribution and qualitative nature of aerobic, heterotrophic bacteria in the benthos of the coastal waters of Oregon and Washington and in Puget Sound were studied. Included in the thesis is a comprehensive bibliography on bacteriology.

Wieser, W. 1959. Free living nematodes and other small invertebrates of Puget Sound beaches. University of Washington Press, Seattle. vii plus 179 pp., 111 figs.

This comprehensive literature survey discusses the ecology and morphology of several invertebrate species in Puget Sound. Many environmental factors including tidal ranges and temperature differences between summer and winter which affect the ecology and morphology of these animals are also discussed.

Woelke, C.E. 1955. Introduction of the Kumamoto oyster, Ostrea (Crassostrea gigas), to the Pacific Coast. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(3):41-50.

The oyster, first imported from Japan in 1947, is grown in several localities on the Washington coast and in Puget Sound. Data showing growing success during the period 1947-1953 and growth and mortality rates are presented.

_____. 1966. Movement of the Japanese oyster drill Ocinebra japonica. Washington, State of, Department of Fisheries, Fisheries Research Papers 2(4):32-38.

In July 1964, 106 marked oyster drills were released in a tidepool. Individual drill movements were observed for 37 days following their release. Analyses of these movements and the total distance traveled in this time are presented.

Yentsch, C.S. and D.C. Pierce. 1955. "Swimming" anemone from Puget Sound. Science 122:1231-1233. (Also as Technical Report no. 47, Department of Oceanography, University of Washington).

Several specimens of an anemone identified as Stomphia coccinea were observed to free themselves and exhibit a spasmodic swimming motion in response to contact with certain species of starfish. A similar reaction could be stimulated by an electrical current.

_____ and R.F. Scagel. 1958. Diurnal study of phytoplankton pigments; an in situ study in East Sound, Washington. Journal of Marine Research 17:567-583. (Also as Technical Report no. 77, Department of Oceanography, University of Washington).

Water samples taken from East Sound, Washington, bounded by Orcas Island, at depths of 0, 3, 5, 10, 15 and 25 meters were analyzed for phytoplankton pigments. Marked daily fluctuations in these pigments, chlorophyll and carotenoid, were noted. Greatest concentrations occurred near midday and at night and resulted from changes in quantities within the cells. Differential effect of light on chlorophyll a and on carotenoid caused the ratios of these pigments to change throughout the day. The significance of this change is discussed.

Zimmer, R.L. 1964. Reproductive biology and development of Phoronida. Ph.D. Thesis, University of Washington, Seattle. 416 p.

The reproductive biology, ontogeny, and phylogeny of specimens taken from Puget Sound and Friday Harbor were studied. Characteristics of this animal's environment are discussed in detail.

FISHERIES

Allen, G.H. 1967. Contribution of Puget Sound coho salmon, Oncorhynchus kisutch, to the 1953 Pacific Coast commercial troll fishery. Trans. Am. Fish. Soc. 96:42-54.

Salmon produced by stream systems entering Puget Sound, fin-marked and recovered from the 1953 Puget Sound commercial catch, were used to estimate the contribution these streams made to the commercial troll fishing off Washington and Vancouver Island.

Alverson, D.L. 1953. Notes on the Pacific Ocean perch. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(1):22-24.

A summary of the range, environment, and reproduction of Sebastodes alutus, sold as Pacific Ocean perch, is given.

_____. 1953. Deep-water trawling survey off the Oregon and Washington coasts, August 25-October 3, 1952. Comm. Fish. Rev. 15(10):5-15.

Exploratory fishing was conducted to ascertain the availability of bottom fish, to test fishing gear, and to search for new commercial fishing grounds.

_____, R.L. McNeely, and H.C. Johnson. 1960. Results of exploratory shrimp fishing off Washington and Oregon (1958). Comm. Fish. Rev. 22(1):1-11. Separate 574.

During 1958, the R.V. John N. Cobb made four exploratory fishing cruises between Cape Beal, B.C. and Newport, Oregon. Results of the trips are discussed. Diagrams show fishing areas; pictures show fishing gear. Complete log of the field work is shown in Table 2 which accompanies the reprint.

_____, A.T. Pruter, and L.L. Ronholt. 1964. A study of demersal fish and fisheries of the northeastern Pacific Ocean. H.R. MacMillan Lectures in Fisheries, Inst. of Fisheries, University of British Columbia, Vancouver. 190 p.

The development and magnitude of demersal fisheries in the northeastern Pacific Ocean are reviewed in this extensive report. Gear, fishing techniques, and results of exploratory fishing surveys are discussed and provide information on the distribution, relative abundance and sizes of demersal fishes inhabiting the continental shelf and continental slope off North America from Oregon to the Bering Sea.

Chapman, W.M. and G.D. Esveldt. 1943. The spawning and setting of the Pacific oyster (Ostrea gigas Thunberg) in the State of Washington in 1942. Washington, State of, Department of Fisheries, Biological Report no. 43A. 25 p. plus appendices.

Spawning and setting of oysters in Willapa Bay and Dabob Bay were studied during 1942. Spawning and setting in Willapa Bay continued from May to September with several peak periods. Setting in Dabob Bay occurred about one month later than in Willapa Bay.

Chew, K.K. 1963. The growth of a population of Pacific oysters (Crassostrea gigas) when transported to three different areas in the State of Washington. Ph.D. Thesis, University of Washington, Seattle. 178 p.

Growth patterns of oysters transplanted to Willapa Bay, Oyster Bay, and Hood Canal were observed from March 1959 to January 1961. Predominant growth periods at all stations were during the summer and fall. Virtually no growth occurred during the winter.

Cleaver, F.C. 1949. Preliminary results of the coastal crab (Cancer magister) investigation. Washington, State of, Department of Fisheries, Biological Report no. 49A, pp. 47-82.

Life history of the crabs until maturity, 3 years old, landing statistics, and rates of harvest, based on tagging experiments, are discussed.

_____. 1949. The Washington otter trawl fishery with reference to the petrale sole (Eopsetta jordanii). Washington, State of, Department of Fisheries, Biological Report no. 49A, pp. 3-45.

The life history of the fish and history of the fishery are discussed. Size of mature fish, growth rates, diet, and migration patterns were studied. New fishing grounds were developed.

Griffin, E. 1941. Oysters have eyes; or the travels of a Pacific oyster. Wilberlilla Publishers, Seattle. 54 p.

This book gives a nontechnical account of oysters and the oystering industry in Willapa Bay. Numerous pictures in the book, although quite small, give a good graphic account of the oyster beds, oyster farming, and oyster processing.

Holway, T.W. 1934. Some observations on the Pacific oyster, Ostrea gigas Thunberg, and the native oyster, Ostrea lurida Carpenter, in Willapa Bay. M.S. Thesis, University of Washington, Seattle. 62 p.

A resume' of the oyster industry in Willapa Bay is given. Pacific oyster importation, culture, growth, and harvesting are discussed.

Jurkovich, J. 1954. Selectivity of cod-end mesh sizes in otter trawling. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(2):19-24.

Experimental fishing was conducted with nets having a cod-end mesh of 4½ inches, stretch measure, to determine if commercial quantities of adult sole could be taken, while allowing immature fish to escape. Catch data are presented.

Ketchen, K.S. 1955. Climatic trends and fluctuations in yield of marine fisheries of the Northeast Pacific. Jour. Fish. Res. Bd. of Canada 13:357-374.

Literature published from 1900 to 1955 giving air and water temperature data along the British Columbia and Washington coasts is compared with marine fisheries catches. Catch data are correlated with climatic fluctuations.

Kincaid, T. 1951. The oyster industry of Willapa Bay, Washington. Calliostoma Company, Seattle. 45 p.

A good, nontechnical account of the oyster industry is given in this booklet. Included are sections on oyster farming, from seed selection to harvesting, oyster processing and oyster land ownership.

Lindsay, C., R.E. Westley, and C.S. Sayce. 1958. Prediction of oyster setting in the State of Washington. Proceedings, National Shellfisheries Association 49:59-70.

Methods for predicting oyster sets in Willapa Bay, southern Puget Sound, and Dabob Bay are discussed. Predictions are made after comparing observations of hydrographic conditions, spawning occurrence, larval distribution and abundance, and larval development of a current year with past years.

Magill, A.R. and M. Erho. 1963. The development and status of the pink shrimp fishery of Washington and Oregon. Pacific Mar. Fish. Comm. Bull. no. 6, pp. 62-80.

A brief history of the shrimp fishery, regulations, and fishing beds of Oregon and Washington is given. Shrimp biology and landings are discussed. Tables, graphs and diagrams.

McKernan, D.L., V. Tartar, and R. Tollefson. 1949. An investigation of the decline of the native oyster industry in the State of Washington with special reference to the effects of sulfite pulp mill waste on the Olympia oyster (Ostrea lurida). Washington, State of, Department of Fisheries, Biological Report no. 49A, pp. 115-165.

The decline of the oyster industry is discussed and an analysis of possible causes is presented. Lethal effects of dilute concentrations of spent sulfite liquor on oysters are discussed. A technique for accurately determining very low concentrations of spent sulfite liquor in sea water is presented.

McMillin, H.C. 1924. The life history and growth of the razor clam. Washington, State of, Department of Fisheries. 52 p.

Razor clam life history, including reproduction, growth and migration, anatomy, shell morphology, and food are discussed along with the location and extent of clam beds and the commercial fishery.

Menasveta, D. 1958. Migration and fishing mortality of English sole (Parophrys vetulus) in Saratoga Passage and adjacent waters. M.S. Thesis, University of Washington, Seattle. 81 p.

An analysis was done in 1957 on captured fish that had been tagged during 1953 and 1955. Results indicated that the population is dominantly resident and that despite fishing, the stock is maintaining itself.

Pereyra, W.T. 1961. Growth of the Pacific oyster (Crassostrea gigas Thunberg) in various exposure situations, with consideration of the experimental and methodological difficulties encountered. M.S. Thesis, University of Washington, Seattle. 87 p.

This study of differential growth and survival of the Pacific oyster at different intertidal elevations and subtidal depths was conducted from January to December 1960 in Oyster Bay, southern Puget Sound, Washington. Results of this experiment show that animal growth increased rapidly during early summer and diminished greatly during late summer and early fall. Those animals which were always submerged showed best growth rates. Condition indices were found to be inversely related to exposure. Survival, however, was independent of both handling and exposure.

_____. 1962. Mortality of Pacific oysters, Crassostrea gigas (Thunberg), in various exposure situations in Washington. Proceedings, National Shellfish Association 53:51-63.

Oysters maintained in baskets at various intertidal and subtidal levels in Oyster Bay, Puget Sound, Washington from January 1960 to December 1960 were examined weekly or biweekly. Specimens held in the subtidal environment suffered the greatest mortality, apparently due to siltation.

Pruter, A.T. and R. Van Cleve. 1954. English sole in Holmes Harbor, Puget Sound. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(2):3-18.

English sole were tagged during the winter of 1952-1953. Tags recovered during the 1953 fishing season were used to estimate that about 30-40 percent of the population had been caught.

Ronholt, L.L. 1963. Distribution and relative abundance of commercially important pandalid shrimps in the northeastern Pacific Ocean. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report--Fisheries no. 449. 28 p.

Exploratory fishing was conducted between 1950 and 1960. Species caught, average number of shrimp per pound, depth caught, total catch, and average catch per unit effort are discussed.

Royce, W.F., D.E. Bevan, J.A. Crutchfield, G.J. Paulik, and R.L. Fletcher. 1963. Salmon gear limitations in northern Washington waters. University of Washington Publications in Fisheries, New Series, Vol. II, No. I. 123 p. (Also as Contr. no. 145, College of Fisheries, University of Washington).

A biostatistical analysis of the salmon fishery, including studies of migration routes, run sizes, fishing gear, and a mathematical model of the fishery, is given. Legal and economic analyses of the fishery are also presented.

Sayce, C.S. 1963. A method for increasing survival of locally-caught Pacific oyster seed in Willapa Bay, Washington. Proceedings, National Shellfisheries Association 54:41-44.

Oyster spat survival was materially increased by suspending them off the bay bottom and giving them intensive attention during their first winter.

_____ and C.C. Lawson. 1966. Willapa oyster studies--use of the pasture harrow for the cultivation of oysters. Comm. Fish. Rev. 28(10):21-26.

Experiments to evaluate the effect of using pasture harrows on natural oyster beds in southern Willapa Bay were conducted from July 1964 to March 1965. Oysters, arranged in lanes designated as control lanes and survey lanes, were observed to determine their mortality, oysters per cluster, and loose and punctured shells. Temperature, salinity, and water turbidity were recorded.

Schaefer, M.B. 1939. The present status of the razor clam stocks in the State of Washington. Washington, State of, Department of Fisheries, Biological Report no. 37B. 37 p.

History of the razor clam fishery, the current fishery, changes in population, and the age composition of the commercial catch are discussed.

Sparks, A.K. and K.K. Chew. 1961. Preliminary report on growth and survival of the Pacific oyster in Washington waters. Proceedings, National Shellfisheries Association 50:125-132. (Also as Contr. no. 65, College of Fisheries, University of Washington).

Oysters held experimentally in baskets at Willapa Bay, Oyster Bay, and Hood Canal were measured weekly or biweekly to determine their growth rate. Growth was greatest during the summer.

Steele, E.N. 1957. The rise and decline of the Olympia oyster. Olympia Oyster Growers Association, Fulco Publications, Elma, Washington. 126 p.

This is a history of the Olympia oyster industry on Puget Sound.

_____. 1964. The immigrant oyster (Ostrea gigas) now known as the Pacific oyster. Pacific Oyster Growers Association, Warren's Quick Print, Olympia, Washington. 179 p.

This is a history of the development of the Pacific oyster industry on the Pacific coast of Washington.

Stern, J.A. 1957. The new shrimp industry of Washington. Proceedings, Gulf Coast and Caribbean Fisheries Institute, 10th annual session, November, 1957, pp. 37-42. (Also as Contr. no. 25, College of Fisheries, University of Washington).

Shrimp grounds, fishing, and processing methods of the newly developed industry are discussed.

Tegelberg, H.C. and J.M. Smith. 1957. Observations on the distribution of the pink shrimp (Pandalus jordani) off the Washington coast. Washington, State of, Department of Fisheries, Fisheries Research Papers 2(1):25-34.

Exploratory fishing for shrimp was conducted during the fall of 1955 and the spring of 1956 to determine their abundance and distribution.

Townsend, C.H. 1893. Report of observations respecting the oyster resources and oyster fishing of the Pacific Coast of the United States. Appendix to Report of the Commissioner of Fish and Fisheries for 1889 to 1891. Government Printing Office, Washington, D.C. pp. 343-372.

Six pages of this report are devoted to oystering in Willapa Bay and Puget Sound, Washington. A chart of Willapa Bay shows the native and cultivated oyster beds where 80,000 bushels of oysters were harvested annually. In 1890, Puget Sound produced about 700 bushels of oysters weekly from 345 acres of oyster grounds. Limited surface water temperatures from Willapa Bay and Budd Inlet are given. Oyster laws of Washington in effect at this time are given.

VanCleve, R. 1956. The conservation of Northwest fisheries. Pacific Northwest Business 15(11):14-15, 18-24. (Also as Contr. no. 17, College of Fisheries, University of Washington).

The salmon fishing industry in Washington and the problems it will encounter with greater industrialization and development of the state are discussed.

_____. 1956. The conservation and future development of West Coast marine resources. California Academy of Sciences, Fourth Series, 28(12):425-439. (Also as Contr. no. 12, College of Fisheries, University of Washington).

A historical account of West Coast fisheries is given along with a discussion of their future.

_____ and A.T. Pruter. 1956. Problems of sampling a Puget Sound population of English sole, Parophrys vetulus. International Council for the Study of the Sea. Rapports et proces-verbaux 140(1):87-93. (Also as Contr. no. 13, College of Fisheries, University of Washington).

Net selection of fish, results of a fish tagging program, and the relation of fish populations to their environment are discussed. Studies were conducted in the Possession Sound-Saratoga Passage area.

Washington, State of, Department of Fisheries. n.d. Willapa Bay Oyster Bulletin. Washington, State of, Department of Fisheries.

This bulletin published at irregular intervals throughout the year, discusses recent oyster and environmental conditions in Willapa Bay.

Washington, State of, Department of Fisheries. n.d. Puget Sound Oyster Bulletin. Washington, State of, Department of Fisheries.

This bulletin, published at irregular intervals during each year, discusses the oyster industry, oyster biology, and environmental conditions in Puget Sound.

Westley, R.E. 1959. Olympia and Pacific oyster condition factor data. State of Washington 1954-1958. Washington Department of Fisheries, State Shellfish Laboratory, Quilcene, Washington.

Condition factor data of oysters taken from commercial beds in south Puget Sound and Willapa Bay are tabulated in this report. Included are the wet and dry weight, and the volume of oysters sampled.

_____, C. Lindsay, and C. Woelke. 1964. Shellfish culture potential of Swinomish and Lummi Reservation tidelands. Washington, State of, Department of Fisheries, Research Division. May 1964.

The oyster-growing potential of tidelands in the Swinomish and Lummi Reservation areas was studied from April 1963 to April 1964. Investigations were made of: oyster growth, fatness, and mortality; physical, chemical, and biological characteristics of the water; and bottom sediments. Hydrographic data are given in charts and graphs.

Westrheim, S.J. 1958. On the biology of the Pacific Ocean perch, Sebastodes alutus (Gilbert). M.S. Thesis, University of Washington, Seattle. 106 p.

Data on Pacific Ocean perch collected off the coasts of Oregon and Washington during the fall of 1952 were analyzed. Commercial landings, taxonomy distribution, size-composition and sex ratios in landings, length-weight relationships, age determinations, growth, mortality, and reproduction are discussed.

Williams, R.W. 1959. The fishery for herring (Clupea pallasii) on Puget Sound. Washington, State of, Department of Fisheries, Fisheries Research Papers 2(2):5-29.

The life history of herring, history of the fishery, fishing gear, management of the fishery, catch trends, and condition of the stock are discussed.

Woelke, C.E. 1955. Introduction of the Kumamoto oyster, Ostrea (Crassostrea) gigas, to the Pacific Coast. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(3):41-50.

The oyster, first imported from Japan in 1947, is grown in several localities on the Washington coast and in Puget Sound. Data showing growing success during the period 1947-1953 and growth and mortality rates are presented.

GEOLOGY

Andrews, R.S. 1965. Modern sediments of Willapa Bay, Washington: a coastal plain estuary. M.S. Thesis, University of Washington, Seattle. 60 p.

The physical and chemical characteristics of recent sediments in the bay were studied. Sediment distribution in relation to the environment, such as river silting and tidal currents is discussed.

_____. 1965. Modern sediments of Willapa Bay, Washington, a coastal plain estuary. University of Washington, Department of Oceanography, Technical Report no. 118. 43 p.

Sediment distribution and carbon/nitrogen ratios in the bay were studied. It was found that finer sediments predominate near stream mouths and have a smaller ratio of carbon to nitrogen.

Bader, R.G. 1954. Carbon and nitrogen in near shore marine sediments. University of Washington, Department of Oceanography, Technical Report no. 36. 15 p.

Carbon/nitrogen ratios of several sediment samples from Puget Sound are given. Well defined relationships between carbon and nitrogen depend on the environment of deposition, the organic decay rate, and the type of organics in the sediment.

_____. 1954. Use of factors for converting carbon or nitrogen to total sedimentary organics. Science 120:709-710. (Also as Contr. no. 176, Department of Oceanography, University of Washington).

Various factors that have been used to calculate total organics in sediments are discussed.

_____. 1955. Carbon and nitrogen relations in surface and subsurface marine sediments. Geochimica et Cosmochimica Acta 7:205-211. (Also as Contr. no. 189, Department of Oceanography, University of Washington).

Carbon/nitrogen ratios of marine sediments associated with various sedimentation rates, environments of deposition and diagenesis were investigated. Sediment samples from Puget Sound were included in the study.

Bader, R.G. 1956. The lignin fraction of marine sediments. Deep Sea Research 4:15-22. (Also as Technical Report no. 54 and as Contr. no. 200, Department of Oceanography, University of Washington).

Lignin in 31 surface samples from the Gulf of Maine and two cores from Puget Sound were analyzed. Results indicated that lignin is stable in marine environments and may be useful in sedimentation rate studies.

Ballard, R.L. 1964. Distribution of beach sediment near the Columbia River. M.S. Thesis, University of Washington, Seattle. 82 p.

The coastline between Tillamook Head, Oregon and Grays Harbor, Washington is characterized by prograding beaches which contrast with most of the Oregon and Washington coastline where sea cliff erosion is in progress. The Columbia River appears to be the major contributor of sediment. Although littoral sediment transport varies seasonally, it is thought that net movement is northward. Mechanical and mineral analyses were made of the sediments and longshore wave energy fluxes were computed.

Brundage, W.L., Jr. 1960. Recent sediments of the Nisqually River Delta, Puget Sound, Washington. M.S. Thesis, University of Washington, Seattle. 178 p.

Dominate surface sediments of the delta are medium- and fine-grained sands originally from the bedload of the Nisqually River but subsequently reworked by wave and tidal action. The delta fills a former inlet and has grown seaward until now the delta front is in equilibrium with tidal currents in Nisqually Reach of Puget Sound.

Burns, R.E. 1962. A model of sedimentation in small, sill-less, embayed estuaries of the Pacific Northwest. Ph.D. Thesis, University of Washington, Seattle. 117 p.

Sediment distribution in relation to environmental factors was evaluated by model studies of Port San Juan, Dabob Bay,

and Port Discovery. Parameters specified for the model study included estuary type, importance and general effects of sediment sources, processes of transport, deposition, and erosion.

Cooper, W.S. 1958. Coastal sand dunes of Oregon and Washington. Geological Society of America Memoir no. 72. 169 p.

This comprehensive study of the coastal sand dunes of Oregon and Washington is divided into three parts. Part one discusses the environments in which the dunes are formed. Part two describes the processes active in forming the dunes. Part three is a description of the dune localities. Dune localities are shown in maps and pictures show dune formations and stabilization.

Enbysk, B.J. 1960. Distribution of foraminifera in the northeast Pacific. Ph.D. Thesis, University of Washington, Seattle. 150 p.

This extensive plankton survey of northeastern Pacific waters at the surface and deeper depths demonstrates foraminifera distribution. Environmental factors correlating with organism distribution are presented.

_____ and F.I. Unger. 1966. Mysid statoliths in shelf sediments off northwest North America. Journal of Sedimentary Petrology 36:839-840.

Statoliths from several species of mysidacea recovered from core samples taken in Puget Sound and straits off British Columbia and Washington were studied. The numbers of statoliths found in core samples from shoal areas correlate with the organism's patterns of swarming, settling, and ecdysis.

Gross, M.G., D.A. McManus, and J.S. Creager. 1963. Preliminary report on the sediment and radioactivity in the vicinity of the Columbia River effluent. University of Washington, Department of Oceanography, Technical Report no. 84. 32 p.

Sediment samples collected in that part of the Pacific Ocean influenced by Columbia River effluent were analyzed for radionuclides. The radionuclides chromium-51, zinc-65, cobalt-57, and cobalt-60 were found in sandy sediments as far north as Grays Harbor. Finer-grained sediments nearer the river mouth had higher concentrations of the radionuclides.

Gross, M.G. and J.L. Nelson. 1966. Sediment movement on the continental shelf near Washington and Oregon. Science 154:879-885.

Observations off the Columbia River during 1964 demonstrate changes in relative concentrations and activities of the nuclides zinc-65 and cobalt-60 in the sediment. Nuclide changes are related to the northward and westward movements of the sediment along the shelf.

Jennings, D., N. Cutshall, and C. Osterberg. 1965. Radioactivity detection of gamma-ray emission in sediments in situ. Science 148:948-950.

A portable gamma-ray probe, capable of measuring radioactivity in situ was used in the Columbia River estuary. Data obtained was considered to be more accurate than data obtained from samples that had been transported to a laboratory for analysis.

Kaarsberg, E.A. 1967. Magnetic survey of the Puget Sound earthquake zone. Geophysics 32:119-123.

Epicenter locations of earthquakes originating in Puget Sound are described. The epicenters are discussed with relation to several geological factors. Magnetic surveys conducted during the summer of 1965 verified the existence of this fault zone.

McLaughlin, W.T. and R.L. Brown. 1942. Controlling coastal sand dunes in the Pacific Northwest. U.S. Department of Agriculture Circular no. 660. 46 p.

Sand dunes along the Oregon and Washington coasts are discussed. Factors which cause the dunes and methods of controlling the dunes are given. Dune growth, destruction, and control are shown in photographs.

Milliman, J.D. 1963. Recent marine sediments in Grays Harbor, Washington. M.S. Thesis, University of Washington, Seattle. 172 p.

Most of the sediment in Grays Harbor is derived from the Chehalis River. Three characteristic type sediments are found in the bay: (1) poorly sorted lag gravels near the channel entrance, (2) well-sorted sands in the Outer Harbor,

southern North Bay, and the western part of the Inner Harbor, and in the Aberdeen-Hoquiam area.

Nayudu, Y.R. 1959. Recent sediments of the Northeast Pacific. Ph.D. Thesis, University of Washington, Seattle. 217 p.

Lithological and textural characters of sediments and their relation to the environment were used during this 1957-1959 study to evaluate large scale aspects of sedimentation and sediment distribution.

_____. 1962. A new hypothesis for origin of guyots and seamount terraces. Crust of the Pacific Basin, Geophysics Monograph no. 6:171-180.

Several volcanic rock types were dredged from the summit terraces of Cobb Seamount off the coast of Washington and Bowie Bank off the coast of British Columbia. Palagonite tuff, crystal fragments, and basaltic glass were correlated to complexes of pillow lavas and bedded palagonite breccia formed in areas where Columbia River basalts entered lakes.

_____. 1964. Carbonate deposits and paleoclimatic implications in the northeast Pacific Ocean. Science 146:515-517.

A narrow carbonate band consisting of Globigerina-rich sediments extending along, and almost parallel to the coasts of Washington and Oregon was studied during 1962-1964. These sediments accumulated from 12,000 to 27,000 years ago; an age determined by radiocarbon dating of five core samples. This period corresponds to Vashon glacial times of the Puget Sound.

_____ and B.J. Enbysk. 1964. Bio-lithology of northeast Pacific surface sediments. Marine Geology 2:310-342.

Seven bio-lithologic areas based on the relative abundance of diatoms, radiolorians, planktonic foraminifera and lithic elements are defined for northeast Pacific surface sediments from the study of 200 gravity cores taken from 1954-1962.

Royse, C.F., Jr. 1964. Sediments of Willapa Submarine Canyon. M.S. Thesis, University of Washington, Seattle. 87 p.

Sediment distribution and the rates of sedimentation in the canyon were studied. Organic and carbonate carbon, heavy mineral and clay mineral analyses indicate that the Columbia River is the major source of sediments.

Seymour, A.H. and G.B. Lewis. 1964. Radionuclides of Columbia River origin in marine organisms, sediments and water collected from coastal and offshore waters of Washington and Oregon, 1961-1963. United States Atomic Energy Commission Laboratory of Radiation Biology, University of Washington, Seattle UWFL-86, December 1964.

The distribution of Hanford-produced radionuclides in the marine environment was determined in this comprehensive study by measuring the zinc-65 concentrations in samples of coastal organisms, offshore plankton, demersal fish, and water. The samples obtained from an area bounded by the Oregon-Washington coastline and a line about 150 miles at sea were analyzed by gamma ray spectrometry.

Sternberg, R.W. 1965. Observations of boundary layer flow in a tidal current. Ph.D. Thesis, University of Washington, Seattle. 71 p.

A device was constructed and used to monitor current movement within two meters of the sea floor. On command the device would monitor the sea floor by television, measure the current velocity profile, take stereophotographs of the bottom or obtain suspended sediment.

Utterback, C.L. and L.A. Sanderman. 1937-1938. Radium content of some inshore bottom samples in the Pacific Northwest. Journal of Marine Research 1:187-191. (Also as Contr. no. 75, Oceanographic Laboratory, University of Washington).

Samples were taken from Puget Sound. Sampling locations, sediment descriptions, and radium concentrations are given.

Wang, F.H. 1955. Recent sediments in Puget Sound and portions of Washington Sound and Lake Washington. Ph.D. Thesis, University of Washington, Seattle. 160 p.

Bottom sediments in these areas were classified into several types based upon environmental occurrence, grain size distribution, carbonate content, and water content. Diagrams, graphs, and tables are used to show sampling localities, sediment descriptions, analyses, and other information.

CHEMICAL AND PHYSICAL OCEANOGRAPHY

Barkley, R.A. 1958. A comparison of the amperometric and catalytic methods for the determination of iodine in sea water. M.S. Thesis, University of Washington, Seattle. 42 p.

Sea water from Puget Sound was analyzed by both methods; results compared favorably. The iodine profile from the sample locality was found to be fairly uniform from the surface to the bottom.

_____ and T.G. Thompson. 1960. The total iodine and iodate-iodine content of sea-water. Deep Sea Research 7:24-34.

Water samples ranging from oceanic waters of the North Pacific to inland waters of Washington State were analyzed for iodine and iodate-iodine content. The greatest variations in the iodine-chlorinity ratios were shown in the upper 200 meters in open ocean waters and inshore samples were shown to be 15 percent lower than offshore samples. The water samples were collected from 1956 to 1957.

Barnes, C.A. and E.E. Collias. 1956. Physical and chemical data for Puget Sound and approaches January-December 1953. University of Washington, Department of Oceanography, Technical Report no. 45. 212 p.

Tabulated temperature, salinity and dissolved oxygen data are presented for a range of depths at several hundred oceanographic stations throughout Puget Sound and Strait of Juan de Fuca, Washington.

_____ and _____. 1958. Some considerations of oxygen utilization rates in Puget Sound. Journal of Marine Research 17:68-80. (Also as Technical Report no. 73 and as Contr. no. 227, Department of Oceanography, University of Washington).

Concentrations of dissolved oxygen were measured at selected stations throughout Puget Sound during periods of minimum diffusion and advection effects to determine local rates of exchange. The average rate of exchange was 5.8 mg/yr. Exchange rates within the Sound were higher in shallow basins than in deep basins and were considerably higher than rates reported for oceanic waters.

Barnes, C.A. and E.E. Collias. 1956. Physical and chemical data for Puget Sound and approaches January-December 1954. University of Washington, Department of Oceanography, Technical Report no. 46. 259 p.

Tabulated temperature, salinity and dissolved oxygen data are presented for a range of depths at several hundred oceanographic stations throughout Puget Sound and Strait of Juan de Fuca, Washington.

_____ and R.G. Paquette. 1957. Circulation near the Washington coast. Proceedings of the Eighth Pacific Science Congress 3:585-608. (Also as Contr. no. 194, Department of Oceanography, University of Washington).

Water circulation along the coasts of Oregon, Washington, and Vancouver Island was studied during the springs and summers of 1952 and 1953 utilizing dynamic topographies and the Geomagnetic-Electro-Kinetograph (G.E.K.). Currents measured by the G.E.K. were believed to be short-termed and caused by wind action.

Bennett, E.B. 1959. Some oceanographic features of the northeast Pacific Ocean during August 1955. Jour. Fish. Res. Bd. of Canada 16:565-633.

An extensive oceanographic survey to investigate temperature, salinity, and density distributions of northeast Pacific waters was conducted. Paths of calculated geostrophic currents, their circulation and direction are shown. Several charts and graphs are included.

Budinger, T.F., L.K. Coachman, and C.A. Barnes. 1963. Description of Columbia River plume and certain aspects of the mixing of river water in the sea. (Abstract) Trans. Am. Geophysical Union 44:208-209.

The movement and dispersion of the Columbia River effluent were observed. Oceanographic measurements attempt to correlate losses of fresh water by diffusion and advection with the addition of river flow. Plume movements are described by geostrophic circulation and wind stress.

_____, _____, and _____. 1964. Columbia River effluent in the northeast Pacific Ocean 1961, 1962: Selected aspects of physical oceanography. University of Washington, Department of Oceanography, Technical Report no. 99. 78 p.

Observations from 12 oceanographic cruises are used to describe the dispersion of Columbia River water off Oregon and Washington. Graphs, charts, and diagrams.

Caldwell, J.M. 1955. Tidal currents of inlets in the United States. 1955. American Society of Civil Engineers, Proceedings, Vol. 81, Separate no. 716. 12 p.

Tidal currents along the coasts of the United States are discussed. Three types of tidal currents are evaluated utilizing the strength of flood currents which precede high tide by less than one hour and by the tidal range.

Chow, T.J. and T.G. Thompson. 1954. Seasonal variations in the concentration of copper in the surface waters of San Juan Channel, Washington. Journal of Marine Research 13:233-244. (Also as Contr. no. 179, Department of Oceanography, University of Washington).

Copper concentrations were measured over a period of 17 months from 1951 through 1953. The average concentration was 0.023 μg-at/L. Concentrations varied seasonally, reaching an autumn minimum of 0.016 μg-at/L and a summer maximum of 0.028 μg-at/L.

Collias, E.E. and C.A. Barnes. 1965. Physical and chemical data for Puget Sound and approaches January 1958-December 1959. University of Washington, Department of Oceanography, Technical Report no. 113. 225 p.

Oceanographic and meteorological data are tabulated.

_____ and _____. 1966. Physical and chemical data for Puget Sound and approaches January 1960-December 1961. University of Washington, Department of Oceanography, Technical Report no. 114. 286 p.

Oceanographic and meteorological data are tabulated.

_____, J. Dermody, and C.A. Barnes. 1962. Physical and chemical data for southern Puget Sound: August 1957-October 1958. University of Washington, Department of Oceanography, Technical Report no. 67. 151 p.

Data tabulated in this report are principally from that portion of Puget Sound south of Tacoma Narrows. Observed data which are tabulated include temperature, salinity, dissolved oxygen, phosphate, and spent sulfite liquor. Current velocities were measured at selected stations.

Collias, E.E., C.M. Love, and R.G. Paquette. 1956. Eastern North Pacific and Gulf of Alaska offshore physical and chemical data April 1954-January 1955. University of Washington, Department of Oceanography, Technical Report no. 49. 33 p.

Tabulated temperature, salinity, and dissolved oxygen data from several oceanographic stations along the Washington coast are included in this report.

Driggers, V.W., Jr. 1964. Tracer dye studies in Lake Union and Bellingham Bay. M.S. Thesis, University of Washington, Seattle. 73 p.

Rhodamine B dye solution was introduced at the surface of Bellingham Bay once in February and twice in March 1961. Dye patches were traced visually and with the aid of a fluorometer. The dye patch elongated downwind and moved apparently in response to tidal currents. A vertical coefficient of diffusion was found to be about 4 cm^2/sec.

Duxbury, A.C. 1956. The velocity profiles and stresses above the sea floor in Agate Passage and San Juan Channel. M.S. Thesis, University of Washington, Seattle. 82 p.

Instantaneous current measurement data were recorded by a triple stage pressure plate current meter. These velocity profile data were used to calculate stresses near the sea floor.

_____. 1965. The union of the Columbia River and the Pacific Ocean--general features. Ocean Sciences and Ocean Engineering, Washington, D.C., pp. 914-922. (Also as Technical Report no. 149, Department of Oceanography, University of Washington).

Runoff from the Columbia River and its effect on waters of the Pacific Ocean are summarized.

Farmer, H.G. and M. Rattray, Jr. 1962. A model study of the steady-state salinity distribution in Puget Sound. University of Washington, Department of Oceanography, Technical Report no. 85. 33 p.

Steady-state salinity distribution in Puget Sound was determined using an oceanographic model. Salinity determinations were made at seven stations, each of which was located in a major arm of the Sound. Salinity profiles were obtained at each station for three conditions of fresh water runoff and five values of tidal range.

Favorite, F. 1961. Surface temperature and salinity off the Washington and British Columbia coasts, August 1958 and 1959. Jour. Fish. Res. Bd. of Canada 18:311-319.

Oceanographic data were collected in conjunction with studies on spawning patterns of the sockeye salmon (Oncorhynchus nerka). The data were compared with yearly August spawning information results in order to trace the effects of local run-off.

Fofonoff, N.P. and S. Tabata. 1966. Variability of oceanographic conditions between Ocean Station P and Swiftsure Bank off the Pacific Coast of Canada. Jour. Fish. Res. Bd. of Canada 23:825-868.

Oceanographic observations taken from January 1959 through January 1962 included serial temperature and salinity observations. Salinity variations were related to freshwater runoff from land and the component of Ekman transport normal to the coast. Variations of depths of isopycnal surfaces appeared to be related to the curl of wind stress.

Glancy, T.J., Jr. 1960. Microstructure in Dabob Bay, September, 1959. M.S. Thesis, University of Washington, Seattle. 95 p. plus appendices.

Thermal microstructures, sharply defined variations in temperature of 0.1-0.2°C over depth ranges of fractions of a meter to several meters, were studied. These variations superimposed over the macrostructure are believed to cause mixing and interleaving of water masses. They may persist for several hours in quiescent areas.

Gross, M.G., C.A. Barnes, and G.K. Riel. 1965. Radioactivity of the Columbia River effluent. Science 149:1088-1090. (Also as *Technical Bulletin no. 145, Department of Oceanography*, University of Washington).

Radioactivity of surface water was measured in August, 1963. Chromium-51 and zinc-65, principally from the river, were found up to 115 Km offshore. Zirconium-65 and niobium-65, principally from atmospheric fallout, were more abundant in offshore waters.

Hansen, D.V. 1964. Similarity solutions for salt balance and circulation in partially mixed estuaries. Ph.D. Thesis, University of Washington, Seattle. 76 p.

A set of partial differential equations was derived for the salt balance and circulation dynamics in partially mixed estuaries. The equations were applied to data from the Strait of Juan de Fuca to estimate eddy coefficients.

_____. 1965. Current mixing in the Columbia River Estuary. *Ocean Science and Ocean Engineering Conference*, Transactions of the Joint Conference and Exhibit, June 1965. pp. 943-951.

Tidal and turbulent diffusion studies in the Columbia River Estuary were evaluated from data taken from 1956 to 1960. These studies describe influences of tidal forces on types and mechanisms of salinity intrusions into the Columbia River.

_____ and M. Rattray, Jr. 1965. Gravitational circulation in straits and estuaries. Journal of Marine Research 23:104-122.

Mathematical models which describe circulation and salt water fluxes of estuaries where mixing results primarily from tidal currents are discussed. Data for the Strait of Juan de Fuca and the Columbia River Estuary are included.

_____ and _____. 1966. New dimensions in estuary classification. Limnology and Oceanography 11:319-326.

Theoretical results for a two-parameter system of estuarine classification based on eddy coefficients of viscosity and diffusivity were derived from experimental studies of the Columbia River and Strait of Juan de Fuca. Parameters included in the investigation were current, river flow, and geomorphology.

Harris, R.G. 1954. The surface winds over Puget Sound and the Strait of Juan de Fuca and their oceanographic effects. M.S. Thesis, University of Washington, Seattle. 101 p.

Available wind data were analyzed. It was found that winds in the Sound are dominantly southerly in the winter and northerly in the summer. In the Strait, winds are dominantly easterly in summer and westerly in winter. Estimated wind wave heights, wind stresses, surface currents, and slopes were computed using average wind velocities.

_____ and M. Rattray, Jr. 1954. The surface winds over Puget Sound and the Strait of Juan de Fuca and their oceanographic effects. University of Washington, Department of Oceanography, Technical Report no. 37. 101 p.

Available wind data from several reporting stations were reviewed, compiled and collated into wind rose diagrams to delineate dominant wind directions and velocities at these stations. Selected meteorological conditions in the Puget Sound area are discussed.

Herlineaux, R.H. 1957. On tidal current and properties of the sea water along British Columbia coast. Progress reports of Pacific Coast stations of the Fish. Res. Bd. of Canada no. 108, pp. 7-9.

Daily observations of sea water temperature and salinity were made from Langara Island to Juan de Fuca Strait from 1952 to 1954. Observations correlate temperature fluctuations to current changes.

_____ and I.P. Tully. 1961. Some oceanographic features of Juan de Fuca Strait. Jour. Fish. Res. Bd. of Canada 18:1027-1071.

An extensive description of the properties of the water, oceanographic structure and currents in the Juan de Fuca Strait is given. Literature published from the 1920's to

1960 is summarized in this paper. Several correlations with meteorological conditions over the same period are presented. Included are graphs, charts, and tables.

Hobson, L.A. 1963. Some influences of the Columbia River effluent on marine phytoplankton during January 1961. M.S. Thesis, University of Washington, Seattle. 88 p.

Chlorophyll a, marine diatoms, and micro-flagellate concentrations were studied to evaluate the influence of Columbia River runoff on phytoplankton standing crops. Greatest concentrations were found in the Columbia River plume, which was defined by the 32.5 °/oo isopleth.

_____. 1964. Some influences of the Columbia River effluent on marine phytoplankton during January 1961. University of Washington, Department of Oceanography, Technical Report no. 100. 46 p.

The phytoplankton populations from offshore stations along the Oregon and Washington coasts are correlated with physical, chemical, and other biological factors. These are photosynthesis, respiration, water column stability, grazing by zooplankton, and sinking of phytoplankton. Tables, graphs, charts, and vertical and horizontal distribution diagrams are given.

_____. 1966. The seasonal and vertical distribution of suspended particulate matter in an area of the northeast Pacific Ocean. Ph.D. Thesis, University of Washington, Seattle. 107 p.

Particulate matter samples were collected from the surface and from 4000 meters depth on six occasions during 1964 and 1965. Concentrations of the particulate matter, organic carbon, carbohydrate, and the size of the particles were determined to study their variation with depth and season.

_____. 1966. Some influence of the Columbia River effluent on marine phytoplankton during January 1961. Limnology and Oceanography 11:223-234.

The distribution of a phytoplankton standing crop is related to the influences of freshwater runoff. Correlations between critical-to-mixed-depth ratios and the size of phytoplankton standing crop are presented.

Hollister, H.J. 1960. Bathythermograms and meteorological data record, Swiftsure Bank and Umatilla Reef Lightships, 1959. Fish. Res. Bd. of Canada, Manuscript Report Series no. 62. 97 p.

Bathythermograms and meteorological data, recorded twice daily during this period, are presented.

_____. 1961. Bathythermograms and meteorological data record, Swiftsure Bank and Umatilla Reef Lightships, January 1, 1960 to June 30, 1961. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological no. 99. 89 p.

Bathythermograph records and meteorological data taken daily at 8:00 A.M. and 4:00 P.M. are given.

_____. 1964. Classification of monthly mean sea surface temperatures and salinities at shore stations along the British Columbia and adjacent American coasts, 1915-1962. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological no. 177. 123 p.

Data from the Strait of Juan de Fuca are included.

_____. 1965. Graphs of seawater temperature and salinity observations at British Columbia coastal stations, 1963. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological no. 204. 39 p.

Temperature and salinity data taken in the Strait of Juan de Fuca and the Strait of Georgia are included.

_____. 1966. A report on bathythermograph observations at the Swiftsure Bank and Umatilla Reef Lightship stations 1954-1961. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological no. 206. 83 p.

Data obtained from semi-diurnal bathythermograph observations and surface salinity and temperature observations are presented.

Isaac, G.W., G.D. Farris, and C.V. Gibbs. 1964. Special Duwamish River studies. Seattle, Municipality of Metropolitan, Water Quality Series no. 1. 35 p.

Water chemistry and its relation to tidal influences, river flow, and vertical mixing were investigated. Dissolved oxygen and salinity concentrations are given.

Ketchen, K.S. 1955. Climatic trends and fluctuations in yield of marine fisheries of the Northeast Pacific. Jour. Fish. Res. Bd. of Canada 13:357-374.

Literature published from 1900 to 1955 giving air and water temperature data along the British Columbia and Washington coasts is compared with marine fisheries catches. Catch data are correlated with climatic fluctuations.

Kollmeyer, R.C. 1965. Water properties and circulation in Dabob Bay, autumn 1962. M.S. Thesis, University of Washington, Seattle. 111 p.

Water movement is interpreted and circulation patterns are postulated. Water was found to enter the bay near the bottom and leave at the surface except during strong winds when it flows in at both the surface and bottom and leaves at middepths.

Laevastu, T. 1954. The determination and occurrence of nickel in sea water, marine animals, and plants. M.S. Thesis, University of Washington, Seattle. 27 p.

A convenient and reliable method for measuring minute quantities of nickel was developed. Nickel concentrations in Puget Sound waters and in the fishes and plankton therefrom, were measured.

_____ and T.G. Thompson. 1956. The determination of nickel in sea water, marine organisms and sediments. Extrait Du Journal Du Conseil International Pour L'Exploration De La Mer 21(2):125-143. (Also as Technical Report no. 50, Department of Oceanography, University of Washington).

Pertinent literature on the occurrence of nickel in sea water is reviewed and values of nickel in several of the world's seas are tabulated. Nickel content of sea water, organisms, and sediments in Puget Sound and the method for determining it are discussed.

Laevastu, T. and T.G. Thompson. 1958. Soluble iron in coastal waters. Journal of Marine Research 16:192-198. (Also as Contr. no. 222, Department of Oceanography, University of Washington).

Soluble iron from inshore waters of Washington ranged in concentration from 5.5 to 32 ug/L.

Love, C.M. 1956. Northeast Pacific Ocean physical and chemical data: Summers of 1955 and 1956. University of Washington, Department of Oceanography, Technical Report no. 55. 107 p.

Temperature, salinity, dissolved oxygen, and phosphate data, tabulated for several oceanographic stations along the Washington coast, are included in this report.

_____. 1960. Physical and chemical data for a portion of the northeast Pacific Ocean extending from the coasts of Washington and British Columbia westward to 131°W, April 1956-April 1958. University of Washington, Department of Oceanography, Technical Report no. 66. 201 p.

Observed temperature, salinity, dissolved oxygen, and phosphate data for oceanographic stations in Puget Sound and the Washington coast are included in this report.

_____. 1963. Physical, chemical, and biological data from the northeast Pacific Ocean: Columbia River effluent area, January-June 1961. University of Washington, Department of Oceanography, Technical Report no. 86. 405 p.

Five offshore cruises were made into that part of the northeast Pacific Ocean influenced by Columbia River water. At each oceanographic station temperature, salinity, and dissolved oxygen data were taken. Productivity and chlorophyll measurements were made at 75 percent of the stations. In addition, zooplankton, phosphate, silicate, and nitrate determinations were made at selected stations.

_____. 1964. Physical, chemical, and biological data from the northeast Pacific Ocean: Columbia River effluent area September-December 1961. University of Washington, Department of Oceanography, Technical Report no. 115, Volume I. 258 p.

Oceanographic and meteorological data are tabulated.

Love, C.M. 1964. Physical, chemical, and biological data from the northeast Pacific Ocean: Columbia River effluent area September-December 1961. University of Washington, Department of Oceanography, Technical Report no. 115, Volume II. 174 p.

Oceanographic and meteorological data are tabulated.

_____. 1965. Physical, chemical, and biological data from the northeast Pacific Ocean: Columbia River effluent area January-October 1962. University of Washington, Department of Oceanography, Technical Report no. 119. 194 p.

Oceanographic and meteorological data are tabulated.

Morse, B.A. and N. McGary. 1965. Graphic representation of the salinity distribution near the Columbia River mouth. Ocean Science and Ocean Engineering, Washington, D.C., pp. 923-942. (Also as Technical Report no. 148, Department of Oceanography, University of Washington).

The 32.5 °/oo isohaline was used to define the boundary of the Columbia River discharge plume. Salinity distributions for maximum discharge, in June, and minimum discharge, in September, are given.

_____, M. Rattray, Jr., R.G. Paquette, and C.A. Barnes. 1958. The measurement of transports and currents in small tidal streams by an electromagnetic method. University of Washington, Department of Oceanography, Technical Report no. 57. 70 p.

Potentials associated with saline water moving through the earth's magnetic field were measured across tidal streams at Mosquito Pass, Westcott Channel, and Deception Pass, Washington. Observed potentials were calibrated with known transport values and tidal velocities. Subsequently observed potentials agreed satisfactorily with known transports and velocities.

Olcay, N. 1959. Oceanographic conditions near the head of southern Puget Sound, August 1957 through September 1958. M.S. Thesis, University of Washington, Seattle. 59 p. plus data sheets.

Oceanographic and meteorological data are tabulated. The data are discussed and their meaning interpreted.

Pacific Oceanographic Group of the Fisheries Research Board of Canada. Annual. Observations of seawater temperature and salinity on the Pacific coast of Canada. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological.

Tabulated seawater temperature and salinities are given annually in one number of each volume of this series. Data from stations in the Strait of Juan de Fuca and the Strait of Georgia are included. This record has been kept since 1934.

_____. 1957. Bathythermograms and meteorological data record Swiftsure Bank and Umatilla Reef Lightships. 1957. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological no. 22. 143 p.

Bathythermograms and meteorological data, recorded twice daily during the period, are presented.

_____. 1958. Bathythermograms and meteorological data record, Swiftsure Bank and Umatilla Reef Lightships, June 1954 to December 1956. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological no. 8. 214 p.

Bathythermograms and meteorological data, recorded twice daily during the period, are given.

_____. 1959. Bathythermograms and meteorological data record, Swiftsure Bank and Umatilla Reef Lightships, 1958. Fish. Res. Bd. of Canada, Manuscript Report Series, Oceanographic and Limnological no. 37. 121 p.

Bathythermograms and meteorological data, recorded twice daily during this period, are presented.

Procter, C.M., E. Papadopulus, and R.H. Firminhac. 1962. Gamma scintillation probe for field use and measurements of radiation background in Puget Sound. Limnology and Oceanography 7:280-286.

Gamma scintillation probe tests were conducted periodically during 1962 at various depths in Puget Sound to determine radiation background. Discussed in the paper are possible sources of instrumental error and the effects of cosmic ray background.

Rattray, M., Jr. and D.V. Hansen. 1962. A similarity solution for circulation in an estuary. Journal of Marine Research 20:121-133. (Also as Contr. no. 260 and Technical Report no. 78, Department of Oceanography, University of Washington).

Partial differential equations and boundary conditions are given to describe flow and mixing in estuaries.

_____ and J.H. Lincoln. 1954. Operating characteristics of an oceanographic model of Puget Sound. Trans. Am. Geophysical Union 36:251-261. (Also as Technical Report no. 43, Department of Oceanography, University of Washington).

The physical description, specifications, and operating characteristics of a small model of Puget Sound are presented. Horizontal scale of the model is 1/40,000 and the vertical scale 1/1152. The model agrees well with the prototype.

Reid, J.L., Jr., G.E. Roden, and J.G. Wyllie. 1958. Studies of the California Current System. Scripps Inst. of Oceanography Contr. no. 998, pp. 298-321.

Physical, chemical and biological characteristics of the current and conditions which cause variations in these features are discussed.

Robinson, M.K. 1957. Sea temperature in the Gulf of Alaska and in the Northeast Pacific Ocean, 1941-1952. Scripps Inst. of Ocean. Bull., University of California Press, Berkeley and Los Angeles 7:1-98.

Charts of monthly average temperatures taken by bathythermographs and reversing thermometers at 100 foot depth intervals, from the surface to 400 feet, are given. The oceanic region covered extends from Alaska to California.

Roden, G.I. 1966. Low-frequency sea level oscillations along the Pacific Coast of North America. Jour. Geophysical Research 71:4755-4776. (Also as Contr. no. 385, Department of Oceanography, University of Washington).

Monthly sea level records and the combined causes of sea level variations were used to make statistical analyses of low-frequency sea level oscillations. Data collected from 1850 to 1966 at Pacific Coast tide measuring stations,

including those at Neah Bay and Seattle, Washington, were used in the analysis.

Seymour, A.H. and G.B. Lewis. 1964. Radionuclides of Columbia River origin in marine organisms, sediments and water collected from coastal and offshore waters of Washington and Oregon, 1961-1963. United States Atomic Energy Commission Laboratory of Radiation Biology, University of Washington, Seattle, Washington UWFL-86, December 1964.

The distribution of Hanford-produced radionuclides in the marine environment was determined in this comprehensive study by measuring the zinc-65 concentrations in samples of coastal organisms, offshore plankton, demersal fish, and water. The samples obtained from an area bounded by the Oregon-Washington coastline and a line about 150 miles at sea were analyzed by gamma ray spectrometry.

Stefansson, U. and F. Richards. 1964. Distribution of dissolved oxygen, density, and nutrients off the Washington and Oregon coasts. Deep Sea Research 11:355-380.

The effects of upwelling, Columbia River water, biological activity, temperature change, and anomalous surface exchange on the distribution of nutrients are discussed. Observations were taken during 13 cruises between January 1961 and June 1962. Diagrams, charts, and graphs.

_____ and _____. 1963. Processes contributing to the nutrient distributions off the Columbia River and Strait of Juan de Fuca. Limnology and Oceanography 8:394-410.

Observations on nutrients, dissolved oxygen, and salinity are given for 12 cruises between January 1961 and April 1962. The paper discusses the horizontal distribution of nutrients in the upper 10 meters, processes affecting nutrient distribution, seasonal changes, and nutrient relationships. Charts, graphs, and diagrams.

Sternberg, R.W. 1965. Observations of boundary layer flow in a tidal current. Ph.D. Thesis, University of Washington, Seattle. 71 p.

A device was constructed and used to monitor current movement within two meters of the sea floor. On command the

device would monitor the sea floor by television, measure the current velocity profile, take stereophotographs of the bottom, or obtain suspended sediment.

Tsao, W.S. 1954. A study of sewage movement in Puget Sound. A model study. M.S. Thesis, University of Washington, Seattle. 74 p.

Studies of sewage movement in four areas of Puget Sound, Olympia, Tacoma, Seattle, and Everett, were conducted in a model of Puget Sound which had a horizontal scale of 1:40,000 and a vertical scale of 1:1,152. Other parameters were scaled down appropriately. Scale model tidal action and river runoff were produced by a tide machine and head tanks, respectively. Detailed studies in each area were made utilizing dye. Results, shown in plots of the dye measurement, are used to interpret fates of wastes discharged into Puget Sound at various points.

Tully, J.P. and A.J. Dodimead. 1957. Properties of the water in the Strait of Georgia, British Columbia, and influencing factors. Jour. Fish. Res. Bd. of Canada 14:241-319.

Serial oceanographic observations were made monthly from November 1930 to January 1932 from the northern portions of the Strait of Georgia to the Friday Harbor Islands. Observations were made of temperature, salinity, pH, concentration of dissolved oxygen, dissolved nitrates, nitrites, inorganic phosphates, and silicates. Occurrence of the properties, their seasonal and diurnal cycles are shown to be related to the mechanism of tidal exchange, discharge of the Fraser River, weather, and growth of plankton.

United States Army, Corps of Engineers. 1925. Port Orchard Bay, Washington. House of Representatives Document no. 109, 68th Congress, 1st Session.

This project provides for removing the shoal near Point Glover in Rich Passage to a depth of 40 feet. Depth refers to the plane of M.L.L.W.

_____. 1933. Skagit River, Skagit Bay. House of Representatives Document no. 187, 73rd Congress, 2nd Session.

The project was adopted 25 June 1910 and modified 2 March 1919. This document provides for construction of a reliable

channel entrance through the delta by means of a dike at the mouth of the South Fork. The document also recommends increasing the available depth at the Skagit City Bar by dredging and by constructing training dikes.

United States Army, Corps of Engineers. 1935. Olympia Harbor, Washington. House of Representatives Document no. 21, 73rd Congress, 2nd Session.

This project provides for a channel 500 feet wide and 30 feet deep from deep water in Budd Inlet to the Port Terminal and a turning basin adjacent to the Port Terminal 3,350 feet long, 500 feet to 960 feet wide, and 30 feet deep.

_____. 1938. Neah Bay. House of Representatives Committee Document no. 51, 75th Congress, 2nd Session.

This project provides for a breakwater approximately 3000 feet long between Waada Island and the westerly shore of the bay, and reinforcement of the existing rock revetment extending approximately 2,200 feet west from Baada Point.

_____. 1954. Anacortes Harbor, Washington. Senate Document no. 102, 83rd Congress, 2nd Session.

Construction of a new mooring basin, 960 feet long, 570 feet wide, and 12 feet deep at M.L.L.W. and the treatment of a pile breakwater 380 feet long and 50 feet east of the basin are recommended.

_____. 1955. Plans for the improvement of Grays Harbor and Point Chehalis, Washington. Technical Memorandum no. 2-417. 79 p.

This report is of a hydraulic model investigation conducted of Grays Harbor and Point Chehalis to determine the most effective plan for protection of Point Chehalis, Westhaven Harbor from wave and tidal current action. Studies were also made to determine the desirability of certain areas as disposal areas to be utilized for the wasting of dredged spoil removed from the navigation channel.

_____. 1957. Report of the Chief of Engineers, Dept. of the Army, Document no. 46, 85th Congress, 1st Session. U.S. Government Printing Office, Washington, D.C.

Synopsis of harbor conditions existing in Bellingham presented at a congressional hearing. Evaluation included tides and currents, climate, resources, and industries.

United States Army, Corps of Engineers. 1958. Bellingham Harbor, Washington. Senate Document no. 46, 85th Congress, 1st Session.

This document recommends that Whatcom Creek Waterway be maintained and deepened. It is noted that dredging has been done within 50 feet of the existing pierhead lines.

_____. 1960. Everett Harbor and Snohomish River, Washington. House of Representatives Document no. 348, 86th Congress, 2nd Session.

This report recommends the widening of the channel. Rectification works were recommended at the heads of Steamboat and Ebey Sloughs to reduce sedimentation in the downstream section of Snohomish River.

_____. 1962. Kingston Harbor, Washington. Authorized by 1962 River and Harbor Act. House of Representatives Document no. 417, 87th Congress, 2nd Session.

The report recommends the construction of a rubble-mound breakwater and armor rock suitable to withstand forces of 5-foot waves. Included in this report is a recommendation to dredge an entrance channel 12 feet deep and 80 to 120 feet wide and 70 feet long.

_____. 1962. Swinomish Channel, Washington. House of Representatives Document no. 499, 87th Congress, 2nd Session.

This report recommends dredging and dike construction of a channel 100 feet wide and 12 feet deep for 11 miles and removal of projecting rock points of McGlinn and Fidalgo Islands obstructing navigation. Report shows the tidal variations in the area.

_____. 1967. Water Resources Development, U. S. Army, North Pacific Division, Portland, Oregon.

This pamphlet contains descriptions of the civil projects assigned to the Corps of Engineers for investigation, survey and planning, construction, maintenance or operation in the State of Washington. Flood control and navigation studies on the Washington coast are emphasized.

United States Navy, Hydrographic Office. n.d. Unclassified sections of H.O. Misc. no. 15359-8S. Inshore survey results. Approaches to Puget Sound, Spring 1957. 229 p.

This report includes the data from a seasonal inshore survey during the period between 18 April and 3 June 1957. The investigations were concentrated in Admiralty Inlet. Four stations were occupied during the studies. In the survey, measurements were made of current, bottom samples, salinity, temperature, plankton, and associated meteorological data.

Waldichuk, M. 1955. Physical oceanography of the Strait of Georgia, British Columbia. Ph.D. Thesis, University of Washington, Seattle. 273 p.

A comprehensive study of the physical oceanography in the Strait of Georgia was made. Thoroughly analyzed were water mass characteristics, circulation, mixing, fresh water budget, and heat budget.

_____. 1957. Physical oceanography of the Strait of Georgia, British Columbia. Jour. Fish. Res. Bd. of Canada 14:321-486. (Also as Contr. no. 205, Department of Oceanography, University of Washington).

Water mass characteristics, circulation, mixing, fresh water budget, and heat budget are discussed in this comprehensive paper.

Washington, State of, Department of Fisheries. n.d. Hydrographic data. Washington, State of, Department of Fisheries.

Biological, chemical, and physical hydrographic data are presented, in a series of reports, for the oyster growing areas of Washington. These areas are Willapa Bay, Grays Harbor, and Puget Sound.

Washington, University of. 1956. Physical and chemical data for Puget Sound and approaches January 1955-March 1956. University of Washington, Department of Oceanography, Technical Report no. 51. 141 p.

Tabulated temperature, salinity, and dissolved oxygen data for oceanographic stations in the Puget Sound area are presented in this report.

_____. 1963. Physical and chemical and biological data from the northeast Pacific Ocean: Columbia River effluent area: January-June 1961. University of Washington, Department of Oceanography, Technical Report no. 86. 405 p.

Tabulated observed and computed oceanographic data collected on five cruises are presented. Area covered extends from Vancouver Island, B.C. to the Siuslaw River, Oregon and seaward to 131°W longitude.

Westley, R.E. 1956. Retention of Pacific oyster larvae in an inlet with stratified waters. Washington, State of, Department of Fisheries, Fisheries Research Papers 1(4):25-31.

Continued disappearances of oyster larvae from Dabob Bay resulted in this biological and hydrographic study. It demonstrated that during periods of northerly winds, surface waters were driven from the bay carrying oyster larvae with it.

_____. 1957. An automatic water sampler for marine shore stations. Proceedings, National Shellfisheries Association 48:79-82.

A machine was designed to take water samples hourly for periods of one week. It was used successfully in oyster growing areas in south Puget Sound.

_____. 1967. Phytoplankton photosynthesis and its relationship to oxygen in Grays Harbor, Washington. Washington, State of, Department of Fisheries, Research Division, March 1967. 30 p.

Hydrography and primary productivity of Grays Harbor were studied during the summers of 1964 and 1965. Nutrients and environmental conditions required for photosynthesis and oxygen produced therefrom were investigated. Hydrographic data are presented in charts and graphs.

Brown, K.W., D.H. Caldwell, and H.E. Miller. 1958. Metropolitan Seattle sewerage and drainage survey. Brown and Caldwell Engineers, San Francisco, California. 558 p.

This comprehensive report outlines sewage disposal problems that exist in the Metropolitan Seattle area and plans for solving them. Results of oceanographic and biological studies in Puget Sound adjacent to sewer outfalls are included in this report.

Cheyne, H. and R. Foster. 1942. Supplementary report on pollution of Everett Harbor. Washington, State of, Pollution Commission, Pollution Series, Bulletin no. 23. 15 p.

History of the pollution problem in the bay is discussed along with current conditions.

Eldridge, E.F. and G.T. Orlob. 1951. Investigation of pollution of Port Gardner Bay and Snohomish River Estuary. Sewage and Industrial Wastes 23:782-795. (Also as WPCC Tech. Bull. no. 3).

Surveys during October and November 1949 showed that a pollutional barrier to migrant fish existed. Dissolved oxygen and spent sulfite liquor concentrations were used to define the barrier.

Eriksen, A. and L.D. Townsend. 1940. The occurrence and cause of pollution in Grays Harbor. Washington, State of, Pollution Commission, Pollution Series, Bulletin no. 2. 100 p.

Pollution conditions were studied during 1938 and 1939. Sources of pollution, observations of distressed fish, flushing, dissolved oxygen, B.O.D., pH, temperature, and pollutional effects are discussed.

Gunter, G. and J. McKee. 1960. On oysters and sulfite waste liquor. Report to Washington Pollution Control Commission. 93 p.

Available pertinent information concerning the effects of sulfite waste liquor on oysters in Puget Sound is discussed in this comprehensive report. Recommendations for water quality standards in oyster producing areas are given.

Henry, B.S. and A.M. Partansky. 1935. The rate and extent of anaerobic decomposition of sulfite waste liquor by bacteria of sea bottom mud. II. Bacteriological Proceedings, National Academy of Sciences 21:191-200. (Also as Contr. no. 38, Oceanographic Laboratory, University of Washington).

Marine mud samples, covered with varying concentrations of sulfite waste liquor, were allowed to incubate at three temperatures for 310 days. During this time, anaerobic and facultative bacteria, representing five species previously unknown, were separated into pure culture and tested for their fermentation ability.

Holland, G.A. (Ed.) 1953. Toxic effects of sulfite waste liquor on young salmon. Washington, State of, Department of Fisheries, Fisheries Research Bulletin no. 1. 111 p.

Bioassays, utilizing various concentrations of sulfite waste liquor in salt and fresh water, were conducted for varying periods of time on several species of salmon. Data and experimental results are presented.

Isaac, G.W., G.D. Farris, and C.V. Gibbs. 1964. Special Duwamish River studies. Seattle, Municipality of Metropolitan, Water Quality Series, no. 1. 35 p.

Water chemistry and its relation to tidal influences, river flow, and vertical mixing were investigated. Dissolved oxygen and salinity concentrations are given.

Kincaid, T., M.P. Wennekens, and R.O. Sylvestor. 1954. A study of oceanographical and biological characteristics of southeast Georgia Strait. Report to the General Petroleum Corporation, Los Angeles. 142 p.

Intertidal and subtidal environments and biota were described during 1954, prior to the start of operations by a petroleum refinery.

McKernan, D.L., V. Tartar, and R. Tollefson. 1949. An investigation of the decline of the native oyster industry in the State of Washington with special reference to the effects of sulfite pulp mill waste on the Olympia oyster (Ostrea lurida). Washington, State of, Department of Fisheries, Biological Report no. 49A, pp. 115-165.

The decline of the oyster industry is discussed and an analysis of possible causes is presented. Lethal effects of dilute concentrations of spent sulfite liquor on oysters are discussed. A technique for accurately determining very low concentrations of spent sulfite liquor in sea water is presented.

Montgomery, W.L. 1960. The feasibility of digested sludge disposal in Puget Sound near Alki Point. M.S. Thesis, University of Washington, Seattle. 55 p.

A complex of parameters which would influence a decision to discharge digested sludge into Puget Sound near Alki Point is evaluated. Systems of sludge disposal in other seaboard cities are analyzed and compared to the situation in Seattle. The writer feels that disposal of digested sludge into the Sound is the optimum solution to the problem.

Neale, A.T. 1955. Pulp and paper mill waste disposal problems. Washington, State of, Pollution Control Commission, Technical Bulletin no. 19. 16 p.

Brief resumes of pulp and paper mills in Washington are given. History, type of operation, wastes, waste disposition, and W.P.C.C. requirements regarding wastes are given for each mill listed.

Okey, R.W. 1957. A study of present and future pollutional effects in the Green-Duwamish River. M.S. Thesis, University of Washington, Seattle. 96 p. plus appendices.

Data collected during this study were collated with existing data to evaluate existing and predicted pollutional effects in the waterway. Parameters evaluated were pH, salt water intrusion, dissolved oxygen, temperature, biochemical oxygen demand and phosphates.

Orlob, G.T., D.R. Peterson, and K.R. Jones. 1950. An investigation of pollution in Commencement Bay and the Puyallup River Basin. Washington, State of, Pollution Control Commission, Technical Bulletin no. 8. 26 p. plus tables.

These waters were surveyed during the summer of 1950 to determine their current conditions and to assess pollution in the river and its effect on the bay.

_____, K.R. Jones, and D.R. Peterson. 1951. An investigation of domestic and industrial waste pollution in the lower Chehalis River and Grays Harbor. Washington, State of, Pollution Control Commission, Technical Bulletin no. 6. 36 p. plus appendix.

Information on water quality conditions was gathered during the summer and fall of 1950. Dissolved oxygen and spent sulfite liquor concentrations were analyzed. Field data are tabulated.

_____, D.R. Peterson, and K.R. Jones. 1951. A reinvestigation of pollution in Port Gardner Bay and the lower Snohomish River. Washington, State of, Pollution Control Commission, Technical Bulletin no. 11. 11 p.

Migration barriers, caused by pollution, were studied to determine to what extent they were reduced by a deep water spent sulfite liquor discharge line. Spent sulfite liquor and dissolved oxygen concentrations in the bay are tabulated and shown in charts.

Partansky, A.M. and B.S. Henry. 1935. Anaerobic bacteria capable of fermenting sulfite waste liquor. Jour. Bacteriology 30:559-571. (Also as Contr. no. 49, Oceanographic Laboratory, University of Washington).

Anaerobic bacteria, separated from a fermenting sulfite waste liquor, were tested individually for their contribution to the fermentation. Results of tests and bacteria morphology are discussed.

Pearson, E.A. and G. Holt. 1960. Water quality and upwelling at Grays Harbor entrance. Limnology and Oceanography 5:48-53.

An extended research program initiated in 1950 was designed to study the relationship between pulp mill effluent and water quality in Grays Harbor. This paper, which discusses that research, presents a survey of physical processes occurring in the harbor as well as analysis of dissolved oxygen and sulfite concentrations in harbor waters.

Peterson, D.R. 1953. Sewage pollution in the estuarial river areas of Grays Harbor. Washington, State of, Pollution Control Commission, Technical Bulletin no. 16. 17 p.

A bacteriological study was conducted in Grays Harbor during the summer of 1953. Coliform counts of 1000 m.p.n. or more were found at nearly all stations sampled.

_____. 1957. An investigation of pollution in the vicinity of Port Angeles. Washington, State of, Pollution Control Commission, Technical Bulletin no. 23. 35 p.

Water current, bacteriological, salinity, temperature and spent sulfite liquor measurements were made during the summer of 1957 to evaluate the extent of domestic and industrial pollution in Port Angeles harbor. Dissolved oxygen, salinity, spent sulfite liquor, and temperature values are tabulated.

_____, A. Livingston, and J.H. Belke. 1955. An investigation of pollution in the Green-Duwamish River. Washington, State of, Pollution Control Commission, Technical Bulletin no. 20. 22 p.

The river estuary and lower basin were surveyed during the summer and fall of 1955. Sources of pollution are listed. Dissolved oxygen and m.p.n. data are given.

_____, G.T. Orlob, and K.R. Jones. 1951. An investigation of pollution in the vicinity of the Fort Lewis sewer outfall. Washington, State of, Pollution Control Commission, Technical Bulletin no. 10. 10 p.

Bacteriological and circulation studies were conducted in the vicinity of Cormorant Passage and Ketron Island during the summer of 1951 to assess pollution conditions arising from the Fort Lewis sewer outfall.

Peterson, D.R., R.A. Wagner, and A. Livingston III. 1957. A re-investigation of pollution in the lower Chehalis River and Grays Harbor (1956-1957). Washington, State of, Pollution Control Commission, Technical Bulletin no. 21. 52 p.

Water quality was studied intensively from June 1956 to February 1957, prior to the construction of a new paper mill. Various sources of pollution are noted. Spent sulfite liquor, dissolved oxygen, and m.p.n. concentrations in the water are given.

Rogers, E.H. 1955. A pollution study of Puget Sound using a hydraulic model. M.S. Thesis, University of Washington, Seattle. 105 p.

Circulation of the inland marine waters of Washington were studied in a distorted hydraulic model (horizontal scale 1:40,000, vertical 1:1,152). Congo Red dye was injected into the model at depths and locations corresponding to sewer outfalls. Photographs of the dye dispersion were then taken. Dye studies were done in the vicinity of Everett, Seattle, and Tacoma. Results, shown in photographs, are briefly discussed and used to evaluate possible pollution loads in each area.

Saxton, W.W. and A. Young. n.d. Investigation of sulfite waste liquor pollution in Fidalgo and Padilla Bays. Washington, State of, Pollution Control Commission, Technical Bulletin no. 1. 25 p.

Tidal flushing in the area is discussed. Water current and spent sulfite liquor data are presented.

Seattle, The Municipality of Metropolitan. 1965. Disposal of digested sludge to Puget Sound; the engineering and water quality aspects July 1965. Seattle, The Municipality of Metropolitan. 74 p. plus appendices.

History of the METRO plan, effects of existing sewage effluent, beneficial uses of Sound waters, costs of disposal, engineering features, and the hydraulics of the diffuser are discussed.

Stein, J.E., J.G. Dennison, and G.W. Isaac. 1963. An oceanographic survey of Port Angeles Harbor. Proceedings, Eleventh Pacific Northwest Industrial Waste Conference 1963, pp. 172-202.

Chemical, physical, and biological measurements were made in Port Angeles Harbor to determine the influence of pulp mill wastes on the biota. Conclusions in the report indicate that environmental conditions are satisfactory for a normal marine ecological community.

Sylvestor, R.O. 1956. Report on the reinspection of the intertidal zone in the vicinity of the Ferndale refinery for the General Petroleum Corporation. Report to the General Petroleum Corporation, Los Angeles. 10 p.

The intertidal zone between Sandy Point and Point Whitehorn, southeast Strait of Georgia, Washington, was inspected to determine if effluent from the refinery was affecting the biota or the environment.

_____. 1957. A report for the General Petroleum Corporation on the intertidal beach zone in the vicinity of the Ferndale, Washington refinery. Report to the General Petroleum Corporation, Los Angeles. 16 p.

The intertidal zone between Sandy Point and Point Whitehorn, southeast Georgia Strait, Washington, was inspected to determine if effluent from the refinery was affecting the biota or the environment.

_____ and F.L. Clogston. 1958. A study of the pre-operational environment in the vicinity of the Texas Company refinery, Puget Sound Works, Anacortes, Washington. Report to the Texas Company, Anacortes. 157 p. plus appendices.

Intertidal and subtidal environments and biota of Padilla and Fidalgo Bays were described during the spring and summer of 1958, prior to the start of operations by a petroleum refinery.

_____ and _____. 1958. A report on the reinspection of the intertidal zone in the vicinity of the Ferndale, Washington refinery. Report to the General Petroleum Company, Los Angeles. 14 p. plus plates.

This is the fourth report of a series on the monitoring of sub- and inter-tidal environments and their biota in the vicinity of the refinery. Conditions appeared normal during this inspection.

Sylvestor, R.O. and F.L. Clogston. 1959. A report on a reinspection of the intertidal beach zone in the vicinity of the Ferndale, Washington refinery. Report to the General Petroleum Corporation, Los Angeles. 19 p. plus appendix and plates.

The intertidal zone between Sandy Point and Point Whitehorn, southeast Strait of Georgia, Washington, was inspected to determine if operations at the refinery were affecting the biota and environment.

_____, J.S. Creager, and T.S. English. 1961. A study of the Alki Point marine environment and its relationship to the discharge of digested sludge. A report to the City of Seattle, Department of Engineering. 153 p.

Water quality, hydrography, bathymetry, bottom sediments, zooplankton, and bottom fauna of the area are discussed along with information on treatment plant characteristics and its effluent.

_____ and R.T. Oglesby. 1963. A report on a survey of the intertidal zone and related environment in the vicinity of the Ferndale, Washington refinery. Report to the Mobile Oil Company, Los Angeles. 17 p. plus plates.

This, the eighth report of a survey series started in 1954 to monitor the sub- and inter-tidal environment and its biota near the refinery, was conducted during June 1963. No adverse environmental conditions were detected.

_____, G.T. Orlob, K.R. Jones, D.R. Peterson, and A.T. Neale. 1950. A report on the Willapa River Estuary. Washington, State of, Pollution Control Commission. 9 p. plus tables.

"Normal" environmental conditions were studied and predictions of the effects of wastes from a proposed pulp mill as well as domestic sewage were made. Biological, chemical, and physical hydrographic data are plotted on graphs.

_____, _____, A. Young, W. Montgomery, and L.C. Orlob. 1949. A survey of Puget Sound Pollution, Seattle Metropolitan area. Washington, State of, Pollution Control Commission, Technical Bulletin no. 2. 32 p. plus tables and plates.

Beach observations, current measurements, and bacteriological concentrations were made during the summer of 1949 to evaluate pollution in Puget Sound adjacent to the Seattle Metropolitan area.

Townsend, L.D., A. Eriksen, and D. Earnest. 1938. Progress report on field investigations and research. Washington, State of, State Pollution Commission, Pollution Series Bulletin no. 1. 47 p.

This is a report of a survey conducted in Grays Harbor between August 24, 1938 and November 8, 1938. Temperature, salinity, and dissolved oxygen determinations were made at about weekly intervals at several stations within the bay. Distressed fish and dead fish were observed in the bay. The report indicates that pollution was responsible for the fish kills. Reconnaissance surveys of benthic organisms and qualitative plankton samples were also taken.

_____, _____, and H. Cheyne. 1941. Pollution of Everett Harbor. Washington, State of, Pollution Control Commission Pollution Series Bulletin no. 3. 58 p.

Field studies were conducted from August 1939 to October 1940 to determine the cause and extent of pollution. Dissolved oxygen, B.O.D., pH, and S.S.L. measurements indicated that pollution conditions, severe in the harbor, were less evident seaward.

Tsao, W.S. 1954. A study of sewage movement in Puget Sound. A model study. M.S. Thesis, University of Washington, Seattle. 74 p.

Studies of sewage movement in four areas of Puget Sound, Olympia, Tacoma, Seattle, and Everett, were conducted in a model of Puget Sound which had a horizontal scale of 1:40,000 and a vertical scale of 1:1,152. Other parameters were scaled down appropriately. Scale model tidal action and river runoff were produced by a tide machine and head tanks, respectively. Detailed studies in each area were made utilizing dye. Results, shown in plots of the dye measurement, are used to interpret fates of wastes discharged into Puget Sound at various points.

United States Public Health Service. 1951. Report on water pollution control, Puget Sound Basin. U.S. Public Health Service and Washington Pollution Control Commission. 73 p.

Causes of pollution and its effect on the natural and economic environment in the Puget Sound area are summarized. Water supply sources and waste disposal localities for communities and industries are tabulated. Recommendations for pollution abatement are given.

Wagner, R.A., A. Livingston, and C.D. Ziebell. 1958. An investigation of water quality conditions in the Chambers Creek Estuary. Washington, State of, Pollution Control Commission, Technical Bulletin no. 24. 67 p. plus appendices.

A series of water quality studies and field and laboratory fish bioassays were used in the spring of 1958 to evaluate pollution in Chambers Creek, near Tacoma.

_____, C.D. Ziebell, and A. Livingston III. 1957. An investigation of pollution in northern Puget Sound. Washington, State of, Pollution Control Commission, Technical Bulletin no. 22. 26 p.

Data collected in Bellingham, Fidalgo, and Padilla Bays during 1957 were used to evaluate water quality conditions. Dissolved oxygen, spent sulfite liquor and coliform m.p.n. were tabulated.

Washington, State of, Department of Fisheries. 1960. Reports on sulfite waste liquor in a marine environment and its effect on oyster larvae. Washington, State of, Department of Fisheries Research Bulletin no. 6. 161 p.

This bulletin contains a series of papers which discuss sulfite waste liquor in the marine waters of Washington and a series of papers pertaining to the bioassay of oysters in saltwater containing various concentrations of sulfite waste liquor.

Wennekens, M.P., K. Trevor, and R.O. Sylvestor. 1955. A supplementary study of the oceanographical and biological characteristics of southeast Georgia Strait. Report to the General Petroleum Corporation, Los Angeles. 78 p.

Investigations were made in the spring of 1955 to determine if operations of a petroleum refinery in the area were affecting the biota and the environment. Intertidal beaches and commercial oyster beds were inspected, water currents were measured, and plankton samples were taken.

Williams, R.W., W.E. Eldridge, E.M. Mains, and A. Reid. n.d. A preliminary report of toxic effects of sulfite pulp mill waste liquor on downstream salmon migrants in brackish water. Washington, State of, Pollution Control Commission, Technical Bulletin no. 7. 46 p.

Young salmon of several species were subjected to varying concentrations of spent sulfite liquor in brackish water. Symptoms of lethality and other results of these bioassays are discussed.

BIBLIOGRAPHIES, LITERATURE SURVEYS, AND COMPILATIONS

Anderson, G.C., C.A. Barnes, T.F. Budinger, C.M. Love, and D.A. McManus. 1961. The Columbia River discharge area of the northeast Pacific Ocean; a literature survey. University of Washington, Department of Oceanography, Seattle. 99 p.

Abstracts of the current state of knowledge (1961) and annotated bibliographies of the subjects studied are given. Three major subjects are physical and chemical oceanography, biological oceanography, and geological oceanography. Each of these is further subdivided into specific subjects.

Love, C.M. 1956. Sources of oceanographic data for a portion of the North Pacific Ocean: Area from 20°N to 55°N latitude and the west coast of North America to 150°W longitude for years 1916-1954. University of Washington Special Report no. 25.

This report has annotated bibliographies of publications which list sources of data, publications or charts showing average conditions, publications and manuscripts listing coastal data, temperature studies based on bathythermograph data, data available from the U.S. Weather Bureau, McEwen's temperature charts and data from oceanographic observations made prior to 1916. It also lists the names of ships, expeditions and organizations that have gathered data, the year of data collection, the locations where data were gathered, the observations taken, and the locations where the data are now available.

Moore, H.L. (Compiler). 1959. Doctoral dissertations on the management and ecology of fisheries additional listings 1952-1955. U.S. Department of the Interior, Fish and Wildlife Service. Special Scientific Report--Fisheries no. 272. 31 p.

Non-annotated list of Ph.D. theses written in the United States and Canada during 1952-1955.

Ricketts, E.F. and J. Calvin (Revised by J.L. Hedgpeth). 1956. Between Pacific tides. Stanford University Press, Stanford, California. 502 p.

A comprehensive book on the intertidal animals of the Pacific Coast of the United States. Descriptions, including pictures of many of the common forms, are included as well as discussions of environmental and ecological requirements for the animals. An extensive annotated bibliography on the marine biology of the Pacific Coast is included.

United States Fish and Wildlife Service. 1950. Doctoral dissertations on the management and ecology of fisheries. Special Scientific Report: Fisheries no. 31. 35 p.

A non-annotated bibliography of theses written between 1934 and 1939, in the United States and Canada.

_____. 1952. Doctoral dissertations on the management and ecology of fisheries. Special Scientific Report: Fisheries no. 87. 44 p.

A non-annotated bibliography of theses on subjects related to the ecology and management of fisheries written between 1934 and 1951, in the United States and Canada.

United States Geological Survey. n.d. Publications of the Geological Survey 1879-1961. 457 p.

Indexed in this publication are all published papers and maps, exclusive of topographic maps, that have been published by the Geological Survey of the United States Department of the Interior. Annual supplements will be published.

_____. 1963. Publications of the Geological Survey 1962. 43 p.

This is the first supplement to Publications of the Geological Survey 1879-1961.

_____. 1964. Geological Survey Research Chapter A. Geological Survey Professional Paper 501-A. 367 p.

Included in this publication are summaries of significant scientific and economic results, a list of publications released in fiscal 1964, a list of geologic and hydrologic investigations in progress, and a report on the status of topographic mapping.

Washington, University of. 1953. Puget Sound and approaches; a literature survey: Volume I geography, climatology, hydrology. University of Washington, Department of Oceanography. 130 p.

This is volume I of a three-volume literature survey in which available published and unpublished information concerning the Puget Sound region is reviewed. Of the 11 subject headings used, Geography, Climatology, and Hydrology are in this volume. A comprehensive bibliography accompanies each section.

_____. 1953. Puget Sound and approaches; a literature survey: Volume II geology, volcanology, seismology, geomagnetism, geodesy, hydrography. University of Washington, Department of Oceanography. 118 p.

This is volume II of a three-volume literature survey.

_____. 1954. Puget Sound and approaches; a literature survey: Volume III physical oceanography, marine biology, general summary. University of Washington, Department of Oceanography. 175 p.

This is volume III of a three-volume literature survey.

_____. 1955. Grays Harbor, Washington. A literature survey. University of Washington, Department of Oceanography. 142 p.

This literature survey gives a brief resume of the state of knowledge on the following subjects in the Grays Harbor area: geography, climatology, hydrology, regional geology, geophysics, recent sedimentation, hydrography, physical oceanography, marine biology. An annotated bibliography of references accompanies each section.

Whitebrook, R.B. 1959. Coastal exploration of Washington. Pacific Books, Palo Alto, California. 146 p.

History of the early exploration along the Washington coast is the subject of this book. It contains a fairly comprehensive bibliography of early works related to the exploration.

Wilimovsky, N.J. and W.G. Freihofer. 1957. Guide to literature on systematic biology of Pacific salmon. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report--Fisheries no. 209. 266 p.

A comprehensive subject index and annotated bibliography on Pacific salmon. Included are references from over 100 journals and serials that were searched systematically. In addition several individual articles are indexed.

BIBLIOGRAPHIC: Ditsworth, George R. Environmental factors in coastal and estuarine waters. Bibliography series volume II. Coast of Washington. FWPCA Publication 1968. 79 p.

ABSTRACT: Indexed herein are references to literature pertaining to the marine waters of Washington. References to these papers, most of which have been published since 1955, are indexed under one or more of the following headings: Marine Biology, Fisheries, Geology, Chemical and Physical Oceanography, Water Pollution, and Bibliographies, Literature Surveys and Compilations.

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