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July 1980

An Ecological Characterization of the Pacific Northwest Coastal Region

VOLUME 3

CHARACTERIZATION ATLAS - ZONE AND HABITAT DESCRIPTIONS

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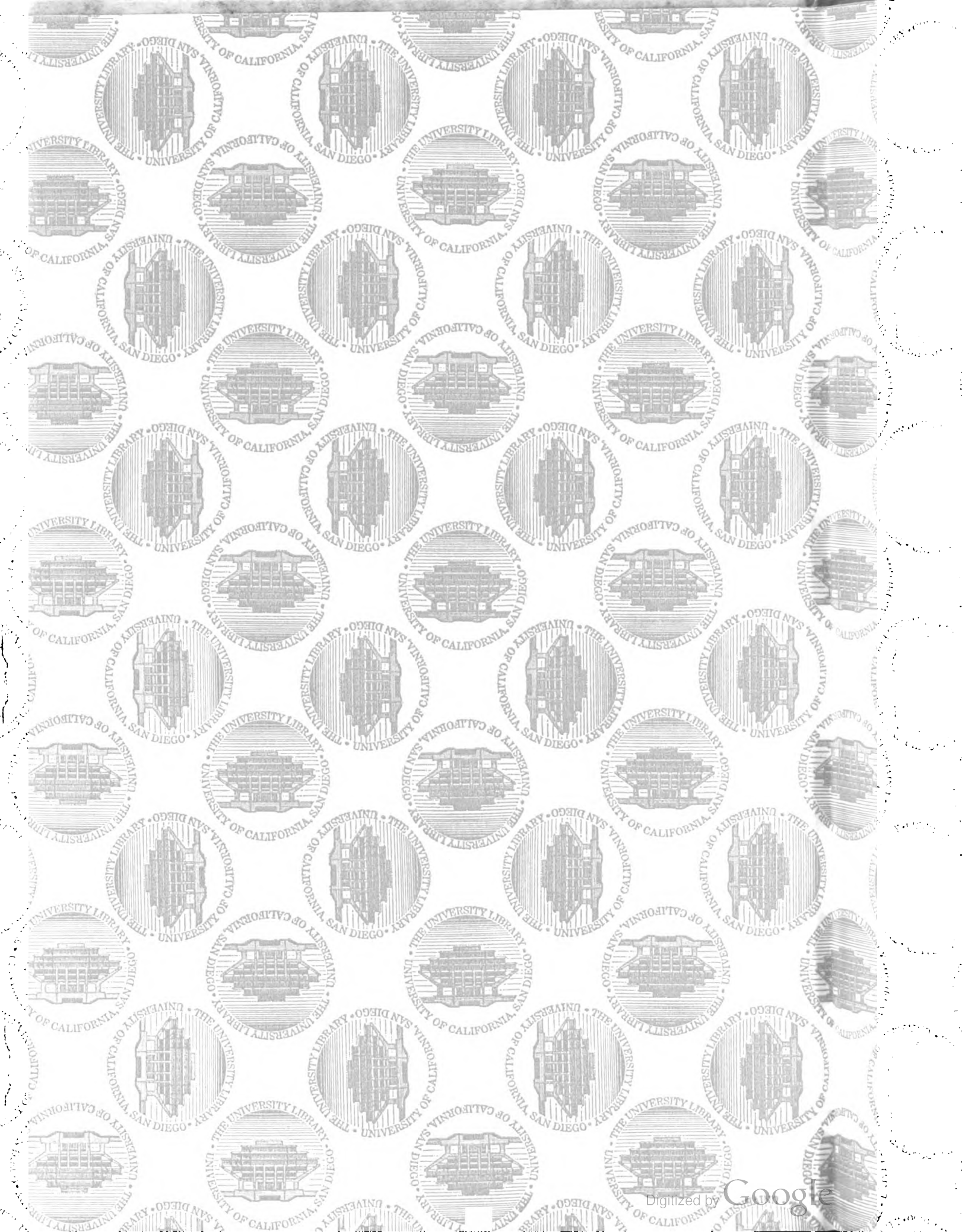
Interagency Energy-Environment Research and Development Program

OFFICE OF RESEARCH AND DEVELOPMENT  
U.S. ENVIRONMENTAL PROTECTION AGENCY



AND  
Fish and Wildlife Service

U.S. Department of the Interior





FWS/OBS-79/13  
JULY 1980

AN ECOLOGICAL CHARACTERIZATION  
OF THE PACIFIC NORTHWEST COASTAL REGION  
VOLUME THREE  
CHARACTERIZATION ATLAS  
ZONE AND HABITAT DESCRIPTIONS

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Prepared by  
Charles M. Proctor, Project Manager  
John C. Garcia, Technical Director  
David V. Galvin, Technical Editor  
Gary B. Lewis  
Lincoln C. Loehr

Ryckman, Edgerley, Tomlinson & Associates, Inc.  
a division of Envirodyne Engineers, Inc.  
100 116th Avenue Southeast  
Bellevue, Washington 98004

U.S. Fish and Wildlife Service  
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Project Officer  
Jay F. Watson  
Office of Biological Services - Region 1  
U.S. Fish and Wildlife Service  
Lloyd 500 Building, Suite 1650  
500 N.E. Multnomah Street  
Portland, Oregon 97232

Performed for  
National Coastal Ecosystems Team  
Office of Biological Services  
Fish and Wildlife Service  
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**DISCLAIMER**

The opinions, findings, conclusions, or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior.

## **PREFACE**

This volume of the Characterization Atlas contains descriptions of biological zones that occur in the study area and of the habitats within those zones. Delineation of zones is based on dominant vegetation (surface cover) and land form for inland areas; on topography and tidal range for coastal areas; on substrate and light penetration in the ocean; and on intensity, quality, and frequency of land use in areas of human activity and habitation. This classification is compared with other systems.

This volume supplements the Conceptual Model by providing extensive modeling at the habitat and zone level. Taken with the Regional Synopsis, it provides a Characterization Atlas of the region; with the Watershed Unit Descriptions, it gives a Characterization Atlas at the watershed unit level.

Model development is described in detail in Volumes 1 and 2. Since the Final Draft Conceptual Model (14 April 1978), all ecosystem models have been reviewed, revised, and redrawn to one generic format. Models were prepared for additional habitats and all models were reviewed again in-house and by outside consultants. At least a few more iterations are needed to further standardize the format and the interrelation between habitats. This should be done at a later date, however, after the models have been used and critiqued by a wider audience.

Ecosystem habitat models are generally very similar from zone to zone. Thirty ecosystem models have been prepared, covering all the major basic habitats. These are applicable to most of the critical habitats within the study area (as indicated in Table 2-1) and can be readily extrapolated to others.

Community Composition lists are provided for eighteen habitats. The Annotated Species List (ASL, see Volume 5) from which they were extracted is an innovation with this project and was not completed in time to prepare a list for each habitat. As a consequence the Food Web Models are representative only and were not checked against the community compositions.

The approach in this volume is to sketch each zone and habitat and briefly outline its characteristic features, then to elaborate with a series of models. Salient features may thus be summarized in a few pages of words, pictures, and diagrams. As far as we know, the final synthesis of this approach to ecological characterization is unique to this project.

Questions or requests for this publication should be addressed to:

Information Transfer Specialist  
National Coastal Ecosystems  
U.S. Fish and Wildlife Service  
NASA-Slidell Computer Complex  
1010 Gause Blvd.  
Slidell, Louisiana 70458

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The following people provided technical/editorial assistance. FWS indicates Fish and Wildlife Service and BLM stands for Bureau of Land Management, both of the U.S. Department of the Interior.

Bunce, Elaine: FWS

Byrne, John: FWS

Hedgepeth, Joel: Consultant

Jamison, Dave: State of Washington, Department of Ecology

Jensen, William: Consultant

Johnston, James: FWS

Keene, Don: BLM

Kline, Gary: FWS

Kroger, Richard: FWS

Watson, Jay: FWS

Willet, Charlotte: Consultant

Yoshinaka, Marvin: FWS

Young, Martha: FWS

Barbara Carney and Daisy Singleton, FWS, provided clerical assistance in preparing the camera-ready document.



# INTRODUCTION AND USERS' GUIDE

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## i. Introduction and Objectives of the Study

The Ecological Characterization of the Pacific Northwest Coastal Region is one of four similar projects of the Fish and Wildlife Service to characterize key coastal areas of the United States in order to provide the means of assessing and minimizing impacts of human activities in important fish and wildlife habitats.

When decisions must be made in land use planning and resource development matters, administrators and planners need an integrated overview of the ecosystems in the locale which may be affected, including the influences of man's activities. This overview must identify the important components of the ecosystem, the interrelationships of these components, how the ecosystem functions and changes, both seasonally and over the long term, and information that is missing. The scientist also needs to know the status of present ecological knowledge in the area.

The ecological characterization is intended to serve the needs of both these groups: to aid decision-makers by supplying an integrated body of information in such form as to implement impact assessment and analyses, and to make research needs apparent to complete the data base.

The ecological characterization compiles and integrates currently available information concerning ecosystems of the study area, but does not claim to include all the data needed for detailed assessments of impacts. The characterization should enable decision-makers to ask the right questions.

The specific objectives of the Study, as stated in the Request for Proposal, are:

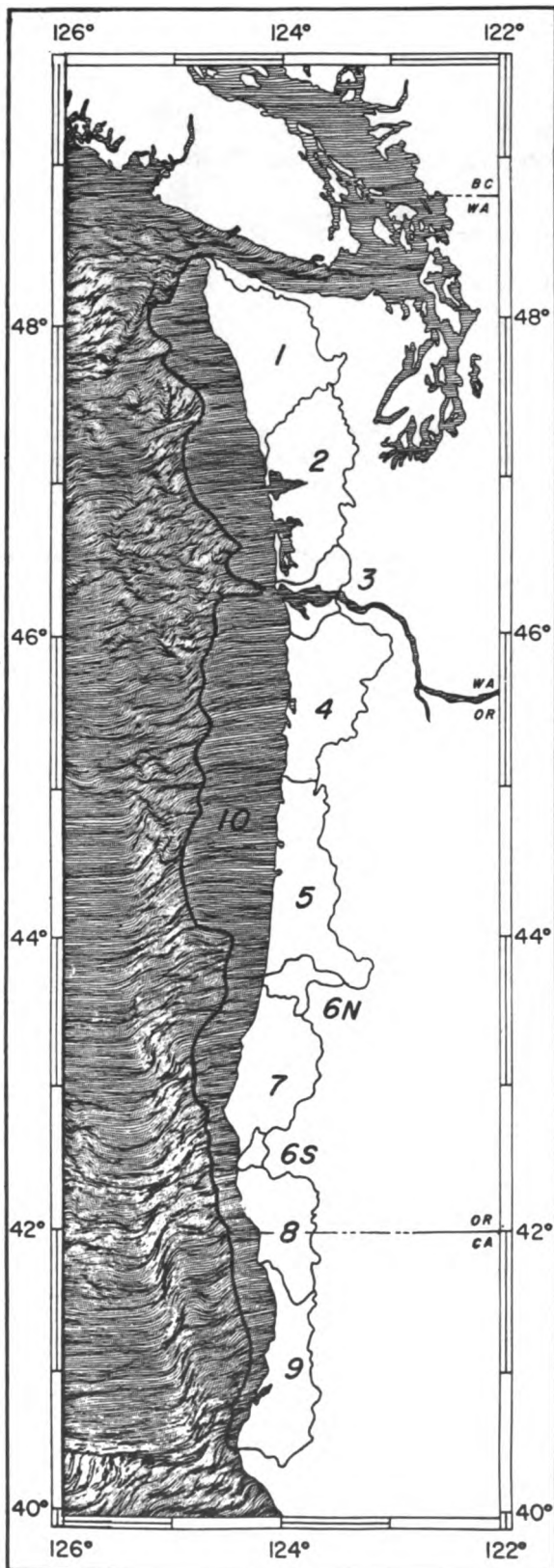
1. To obtain and synthesize available environmental data which identify and describe important resources, ecological processes, and their interrelationships within the study area and to provide an analysis of their functional relationships.
2. To identify additional information that may be required to more completely characterize the study area and recommend special studies to fulfill this need.
3. To present information obtained in the form of detailed reports, graphic illustrations, and descriptive models.

## ii. The Study Area

The Pacific Northwest Coastal Region (Figure 1) extends from Cape Mendocino, California, on the south to Cape Flattery, Washington, on the north - a distance of about 900 kilometers (560 statute miles) - and encompasses the area between the crest of the coastal range and the 200 meter (600 foot) depth contour on the continental shelf - an average width of about 80 kilometers (50 miles). This expanse coincides with the Columbia Province of Cowardin et al. (1977). In Terrell's (1977) hierarchical regional classification: at Level 1, the study area is H. Northwest Pacific, except for H.3. Puget Sound; at Level II, it is H.1. Pacific Northwest plus H.2. Columbia River Estuary to the tip of Puget Island.

This long, narrow coastal strip slopes steeply from east to west. The characteristics of plant and animal communities in the study area change rapidly with elevation change. Although the area extends over 8 degrees of latitude, variations in life forms usually associated with latitudinal effects on climate are minimized by the moderating influence of the Northeast Pacific Ocean. General divisions of the coastal region are shown by topography, land form, and human influence in Figure 2.

Aside from elevation, the most profound effects on the zonation of life forms along the Pacific Northwest Coast are produced by the prevailing winds (as influenced by mountain masses) and the extent and configuration of the watersheds. To provide ecologically coherent subunits for the study, watersheds have been grouped along the general boundaries used in the Pacific Northwest River Basin Water Resources Study (PNRBC, 1970, Vol. 2) into nine watershed units having generally similar physiographic and hydrologic features (as shown in Figure 1).



**PACIFIC NORTHWEST**  
**COASTAL REGION**  
**WATERSHED UNITS**

- 1 Olympic Rainforest*
- 2 Willapa -  
Grays Harbor*
- 3 Columbia Estuary*
- 4 Oregon North Coast*
- 5 Oregon Mid Coast*
- 6 Lower Umpqua  
and Lower Rogue*
- 7 Coos - Coquille*
- 8 Oregon - California  
Border*
- 9 Redwood Coast*
- 10 Continental Shelf*

FIGURE 1. LOCATION OF THE STUDY AREA AND ITS DIVISIONS. Note that "Unit #10" - the continental shelf - is not a Watershed Unit as such, but is a distinct portion of the study area and is numbered to facilitate bibliographic and other reference to oceanic data.

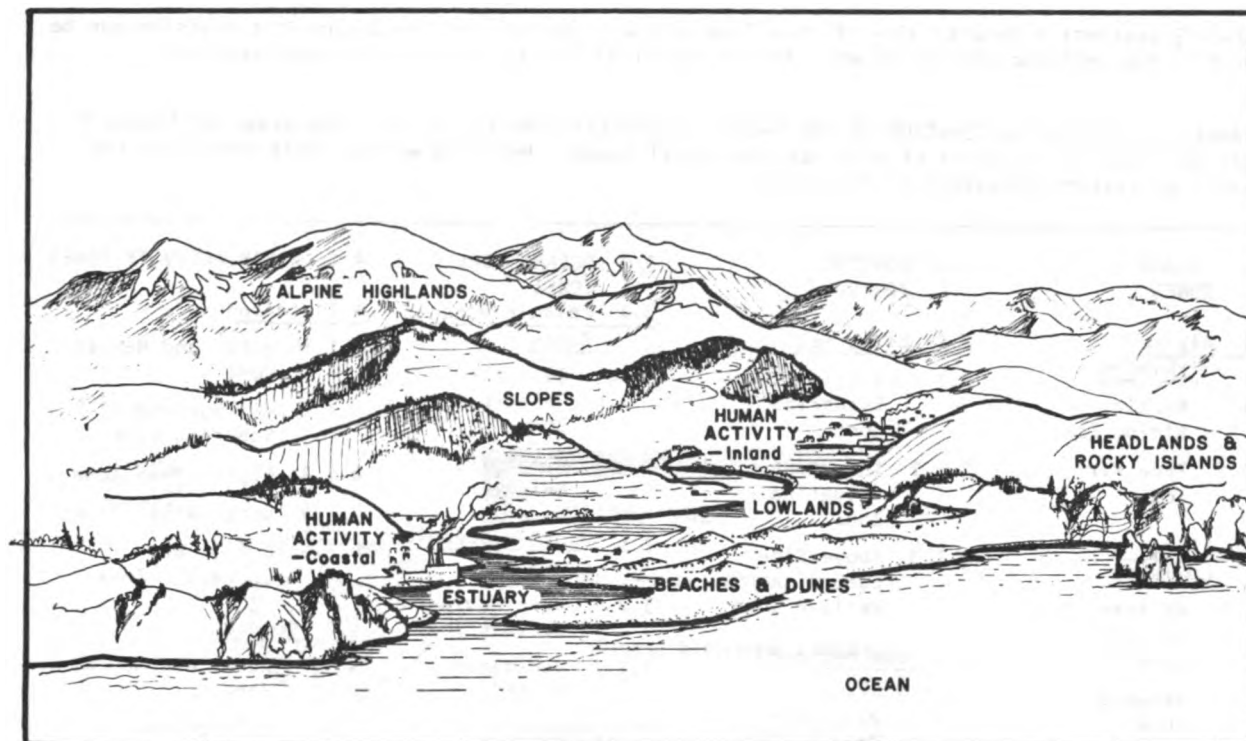


FIGURE 2. GENERAL DIVISIONS OF A COASTAL WATERSHED. Topography, land forms, and human influences are used as criteria for dividing a region into gross areas of similarity, within which biological zones and their component habitats are delineated. (See Table 1.)

### iii. Approach to the Study and Organization of Documents

To organize the collection, synthesis, and presentation of the data to be used for the ecological characterization of the study area, a Conceptual Model of the Pacific Northwest Coastal ecosystems was developed. The Model was tested in the Pilot Study (Test Characterization of Coos-Coquille Watershed Unit 7) and was then extensively revised and reorganized. It now forms a comprehensive framework on which this Characterization Atlas is based.

The organization of documents for this study is illustrated in Figure 3. The Conceptual Model is Volume 1 of the Ecological Characterization of the Pacific Northwest Coastal Region. It is followed by Volume 2, Characterization Atlas - Regional Synopsis, which comprehends the entire study area and, using the same outline and the models of Volume 1, includes information which is characteristic of the region as a whole and is not specific to the Watershed Units. The Regional Synopsis also includes detailed descriptions of species which are important to the Pacific Northwest for economic, ecological, and esthetic reasons. The modeling is continued and expanded here, in Volume 3, Characterization Atlas - Zone and Habitat Descriptions, which includes food web, community composition, succession, and ecosystem models for habitats in the biological zones of the region. This volume is organized around description pages for the biological zones, which are listed in Table 1, and for the habitats within these zones. Models are inserted after the appropriate description pages which appear in Part 2. The classification system and modeling are discussed in Part 1.

In Volume 4, Characterization Atlas - Watershed Unit Descriptions, specific data and/or references are given for each of the Watershed Units. This information is organized and presented primarily in the form of a summary and references, corresponding to sections of Volumes 1 and 2, rather than as an expanded independent document for each unit. Volume 5, Data Source Appendix, contains the Data Gap Report and an explanation of the Annotated Bibliography and Species Lists, computer tapes, programs, and print-outs of which will be on file with Region 1, USFWS.

The same general chapter outline is used for the Model, the Regional Synopsis, and each of the Watershed Unit Descriptions in the Characterization Atlas. Thus Section 2.2.3 is Seismicity and Faults in each of these documents, ranging from a general description of the subject to a Pacific Northwest overview to a presentation of site-specific references.

Figure 3 presents a general view of this five volume organization. An expanded discussion can be found in the Introduction of Volume 1 and in the brief Users' Guide in the next section.

TABLE 1. BIOLOGICAL ZONATION IN THE PACIFIC NORTHWEST COASTAL REGION. The areas of Figure 2 are divided into a number of distinct biological zones. Habitats within these zones are the basic ecosystems discussed in this study.

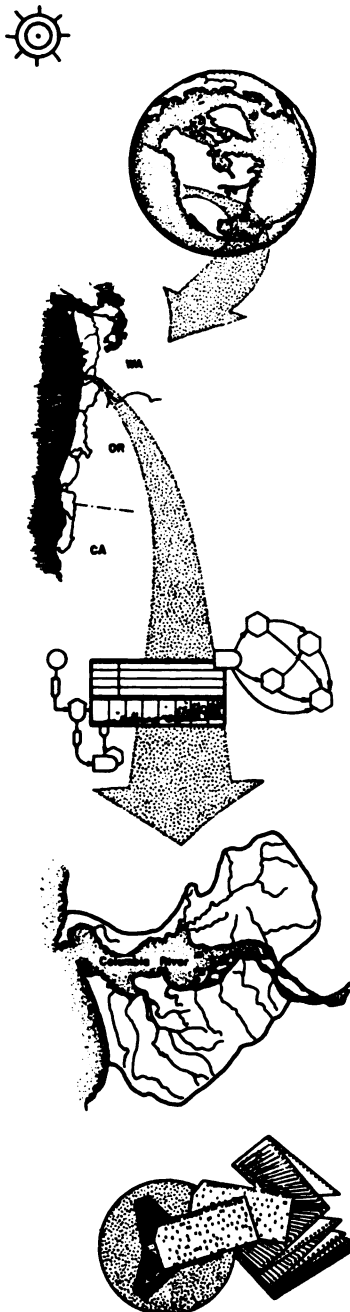
1.0 INLAND ZONES	2.0 COASTAL ZONES	3.0 OCEANIC SHELF ZONES	4.0 HUMAN ACTIVITY ZONES
<u>1.1 Alpine Highlands</u>	<u>2.1 Estuaries</u>	<u>3.1 Pelagic Oceanic Zones</u>	<u>4.1 Inland</u>
1.1.1 Arctic Alpine Zone	2.1.1 Subtidal Estuarine Zone	3.1.1 Euphotic Pelagic Zone	4.1.1 Rural and Hamlet Zone
1.1.2 True Fir Zone	2.1.2 Intertidal Estuarine Zone	3.1.2 Disphotic Pelagic Zone	4.1.2 Village and Suburban Zone
<u>1.2 Slopes and Lowlands</u>	2.1.3 Above Tide Estuarine Wetland Zone	<u>3.2 Benthic Oceanic Zones</u>	4.1.3 Light Urban Zone
1.2.1 Western Hemlock Zone	<u>2.2 Beaches and Dunes</u>	3.2.1 Non-vegetated Benthic Zone	4.1.4 Dense Urban Zone
1.2.2 Redwood Zone	2.2.1 Beach Surf Zone	3.2.2 Vegetated Benthic Zone	4.1.5 Buffer and Connector Zone
1.2.3 Mixed Evergreen Zone	2.2.2 Above Tide Beach and Dune Zone		<u>4.2 Coastal</u>
1.2.4 Sitka Spruce Zone	<u>2.3 Headlands and Rocky Islands</u>		4.2.1 Rural and Hamlet Zone
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	2.3.2 Above Tide Rocky Shore Zone		4.2.3 Light Urban Zone
			4.2.4 Dense Urban Zone
			4.2.5 Buffer and Connector Zone

#### iv. Access to Characterization Information - A Brief Users' Guide

The foregoing discussion, figures, and tables present an introduction to the study area and the general structure of the Ecological Characterization. Organization of the reports is shown in Figure 3. More information on the study organization can be found in the Introduction to the Conceptual Model (Vol. 1). The following paragraphs should help the user to find specific information within five volumes of this study.

Volume 1 - the Conceptual Model - should be read, or at least scanned, in its entirety before the other four volumes are used. For many readers, the information presented in Volume 1 will be familiar, but a basic understanding of the outline, modeling approach and development, biological zonation, etc. used in this study is crucial to the usefulness of the other volumes. A user familiar with the contents and approaches of the Model will find easy access to the Characterization data in the other volumes. It should be noted that the outline of Volume 1 is followed in Volumes 2 and 4 for easy access to subjects, as described below.

Volumes 2, 3, and 4 - the Characterization Atlas - can be approached generally (in sequence) for an overall treatment of the Pacific Northwest Coastal Region, or selectively by subject following the common outline.



**VOLUME ONE**

**CONCEPTUAL MODEL**

(General Ecosystem Modeling)

**VOLUME TWO**

**CHARACTERIZATION ATLAS —  
REGIONAL SYNOPSIS**

(Pacific Northwest Coastal  
Region Overview)

**VOLUME THREE**

**CHARACTERIZATION ATLAS —  
ZONE & HABITAT  
DESCRIPTIONS**

(Models and Descriptions)

**VOLUME FOUR**

**CHARACTERIZATION ATLAS —  
WATERSHED UNIT  
DESCRIPTIONS**

(Site Specific Data  
for 9 Units)

**VOLUME FIVE**

**DATA SOURCE APPENDIX**

(Data Tapes and Printouts)

**FIGURE 3. ORGANIZATION OF THE ECOLOGICAL CHARACTERIZATION OF THE PACIFIC NORTHWEST COASTAL REGION. See the Introduction and User's Guide of Volume 1 for more information.**

A brief overview and summary of significant facts about the study area is found in Chapter 1 of Volume 2, and about the Watershed Units in Chapter 1 of each Unit of Volume 4. Specific topics can be followed from general discussion and models (Volume 1) to regional characteristics (Volume 2) to general habitat descriptions (Volume 3) to watershed-specific references (Volume 4). Soils, for example, can be traced in this way by turning to Section 2.2.5 of Volumes 1 and 2 and each unit of Volume 4. In addition, soils that are characteristic of each biological zone are discussed briefly on the zone description pages in Volume 3.

The Zone and Habitat Descriptions in Volume 3 contain models for the region including food web, community composition, succession, and ecosystem models for various biological zones and habitats.

The computer tape, programs, and print-outs of the Annotated Bibliography and Species Lists, on file at Region 1, USFWS in Portland, Oregon, can be used for machine or manual searching. Separate Lists of References were prepared for each volume; lists for the individual Watershed Units in Volume 4 are annotated. Community composition lists and food webs in Volume 3 were generated from the Annotated Species List.

Once the reader is familiar with the documents, it should be a fairly easy task to find specific data and to use the models to determine significant functional information. Specific approaches to this information include access by habitat, area, man's activity (potential impacts) species, and subject as outlined below:

(1) Access by habitat. First determine the broad category - inland, coastal, oceanic, or human activity - of the type of area of concern, and then its location in the first level of breakdown within this category - slopes and lowlands, estuarine, coastal human activities, etc. - as illustrated in Figure 2 and as listed in Table 1, Biological Zonation. Next, determine the biological zone in which the area is found by reading the zone description pages in Volume 3, and finally determine the habitat type within the appropriate zone by the same process, using the habitat description pages of Volume 3.

Models and data on the selected habitat type are presented in Volume 3 for the region and in Volume 4 for watershed-specific addenda to the regional information. Key example habitats from the various zones are discussed in further detail in Chapter 3 of Volume 2, especially in terms of the major processes and general characterizing data typical for that zone and habitat in the study region. These habitat models are keyed back to pertinent physical-chemical and socio-economic models wherever appropriate.

If the habitat name is known in another classification system, it can be located with the aid of the comparison tables in Section 1.4 of Chapter 1 in this volume. The zone description pages from Part 2 of this volume are reproduced here with, facing each page, a table which lists the habitats that have been identified for the zone(s) and the corresponding habitats in other, major classification systems.

(2) Access by area. Determine the point or area of concern in the Pacific Northwest coastal region, first by the study area key (Figure 1) in order to determine the Watershed Unit, then in the base map (Figure 1-1) of the appropriate Watershed Unit in Volume 4. (Oceanic data which is not limited to any single Watershed Unit is presented in Volume 2 and the Oceanic zones and habitats in Volume 3.)

Once the location of the area of concern is established, data for that location can be found in the appropriate Watershed Unit description in Volume 4 and, by referral from that volume, in the regional descriptions in Volume 2. Zone maps are found in each Watershed Unit description. From these and the process described above under "access by habitat," the zone and habitat of the area can be determined and these models and descriptions followed in Volumes 2, 3, and 4 as described above.

Bibliographic references pertaining to a point (e.g. Coos Bay), a Watershed Unit, or a state can be obtained easily by a computer search of the Annotated Bibliography's descriptor field. A printout of the Annotated Bibliography, with an Index by Key Words, is available at Region 1, USFWS in Portland, Oregon, (as Exhibits to Volume 5), making manual searching possible.

(3) Access by man's activities. Several approaches can be made to gain access to the complex interactions of human activities in the study area. The general socioeconomic models of Chapter 4 describe the structure and functions of economic and social/cultural factors in the industries and other major activities of man in the area. The user wishing to assess the potential impacts of a particular action on the natural environment should begin by studying the appropriate activity model and related discussion in Volumes 1, 2, and 4 for an understanding of the complex factors involved in this activity and its component activities (as well as for an understanding of the potential impacts of an action on purely socioeconomic parameters such as population, income, etc.).

The zone and habitat of concern should next be identified and the appropriate ecosystem model closely reviewed for the significant human activities involved in that particular ecosystem or in influencing the inputs, outputs, or internal processes of that system. Human activities acting as secondary regulating factors in these models should be noted as well as the major activities identified by processes and the human activity symbol (□). The ecosystem model, in addition to identifying the diverse components and interconnecting processes involved in the system, serves to direct the user to the number of component models elaborated in other parts of the study. For example, the internal biological interactions in the community are addressed in the food web and community composition models for each habitat; the gains and losses of habitat are addressed in the succession models; the input and output of sediment is addressed in the appropriate sediment transport model.

Human actions that affect or influence any of the processes in these models should be addressed in a study of potential interactions and impacts on the system in question. The interactions identified by the use of these models also serve as feedback loops to the natural resource or related components of the socioeconomic models. It should be noted that the models in this study are aids to formulating the right questions, and as such do not pretend to be all-inclusive formulations of answers.

(4) Access by species. The Annotated Species List (ASL) is the key to approaching a particular species or group of species in this study. Computer search and sort capabilities allow an almost unlimited number of approaches, permutations, and combinations from the basic data entered in the ASL, as described in Section 3.3 of the Model (Volume 1) and in Part 2 of Volume 5. A printout of the ASL is on file at Region 1, USFWS, Portland, Oregon and can be searched manually. Community composition lists for several habitats were generated from the ASL and are in Part 2.

Approximately 30 plant and animal species of particular importance in the study area are described in detail in the Species of Concern accounts in Part 2 of Volume 2, following the population model format presented in Section 3.4 of the Model (Volume 1). These are cross-referenced in each community composition list in Volume 3. Additional general descriptions of commercial, recreational, and endangered species are located in Section 3.4 of Volume 2.

(5) Access by subject. As described earlier, Volumes 1, 2, and 4 share a common outline in Part 1 (Chapters 1 through 4). Any subject of interest (e.g. estuarine sediment transport) can be followed from general descriptions and model (Volume 1) to Pacific Northwest regional characterization (Volume 2) to site-specific data (Volume 4) by turning to the same section number (for estuarine sediment transport, Section 2.6.3) in each volume. Zone and habitat descriptions and models in Volumes 3 and 4 have identical page numbering for quick cross-referencing between volumes.

The descriptor field in the Annotated Bibliography has hundreds of key words for rapid machine searching and sorting of references. Any combinations ("ands" or "ors") of these key words can be searched by computer and pertinent references obtained. The same can be done manually, using the Index by Key Words of the print-out (available at Region 1, USFWS) to find those references having the desired combinations of descriptors.

#### v. Numbering of the Description and Model Pages

Numbering of pages in the introductory section and in Parts 1 and 3 follow the same plan as used in Volumes 1 and 2. The introductory pages are given small Roman numerals, the pages in the text of Part 1 have two numbers separated by a dash, and the pages of Reference Data, Part 3, are given a combination letter and number. The first number of the text pages is the chapter number, the number following the dash is for the page within that chapter. Page number 1-14 thus means the 14th page of Chapter 1. Reference Data pages are GS-1, GT-14, R-6, and such; these stand for, respectively: Glossary of Symbols, page 1; Glossary of Terms, page 14; and References, page 6. Other page numbers in this part are similarly derived.

A zone or habitat description page is given a number which is the same as the number of the zone or habitat as listed in the preceding tables but with a dash and the number 1 added. For example: the description of the Mixed Evergreen Zone (1.2.3) is on page 1.2.3-1; the Riparian Habitat (D) within that zone is described on page 1.2.3 D-1.

Community Composition and other models, as listed in the Habitat Models Matrix (Table 2-1), will follow the appropriate zone or habitat description page in the same order as the column headings in the Matrix. The model pages will be numbered in sequence, after the description page, e.g., the Food Web Model for the Old Growth Habitat in the Western Hemlock Zone would be on page 1.2.1 K-2 and the Community Composition list would start on page 1.2.1 K-3. Should the Food Web Model be omitted (which is the case for habitat 1.2.3 D at this time) the Community Composition list will start on page 1.2.3 D-2. Should the Food Web be added at a later time, it becomes page 1.2.3 D-2 and the Community Composition list, and any other pages for that habitat, are renumbered in sequence.

ECOLOGICAL CHARACTERIZATION  
OF THE  
PACIFIC NORTHWEST COASTAL REGION

VOLUME THREE  
CHARACTERIZATION ATLAS  
ZONE AND HABITAT DESCRIPTIONS

**Part One**

**CLASSIFICATION AND MODELING**

<u>Chapters</u>	<u>Pages</u>
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## Chapter One – ECOSYSTEM CLASSIFICATION

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1.4 COMPARISON WITH OTHER CLASSIFICATION SYSTEMS.....	1-4

### 1.1 APPROACHES TO CLASSIFICATION

1.1.1 Terrestrial Classification. One of the first efforts to classify the landscape in the United States was by Merriam, who proposed a life zone system essentially based on trans-continental temperature (1894) bands. It was found, however, that major groups of plants and animals did not correlate well in zones at the lower elevation and latitude. The Biome Theory for the distribution of plants and animals was proposed a half century later by Clements and Shelford (1939). A biome was defined as a major biotic community characterized by specific dominant plants and influent animals.

More recently the concept of Biotic Province (Udvardy, 1963) has been used. It is similar to the biome concept but separates the landscape into smaller units. Society for American Foresters (1954) published a list of forest associations which the forestry industry has used extensively. Franklin and Dyrness (1973), in a comprehensive literature review, established a set of major vegetation zones and subcommunities for Oregon and Washington. Garcia (1974) and Maser et al. (1977) have correlated some of these zones and communities with their associated fauna.

The U.S. Army Corps of Engineers (1975F), using Merriam's life zones, identified a set of habitats approximating those published by Wahl and Paulson (1971) for the State of Washington. In California, Munz and Keck (1959) have also established major zones, while more recently Cheatham and Haller (1976) have described habitats for the purpose of designating Natural Land and Water Reserve Areas for California. Hall (1977) has established an "ecoclass" system for classification of ecosystems in the Pacific Northwest for the U.S. Forest Service which includes estuarine, riverine, lake, dune, shrubland, and forestland types.

1.1.2 Aquatic Environments. All of the above classification systems are land-oriented. As our study area includes aquatic (both marine and freshwater) environments as well as terrestrial, it was necessary to include aquatic habitats too. Cowardin et al. (1977) established a national wetland classification system for the U.S. Fish and Wildlife Service which included biological zonation and habitat identification. Ricketts and Calvin (1968) developed and cross-referenced zonation for coastal intertidal areas. Sverdrup et al. (1942) described zonation for marine systems. Likewise, Hedgpeth (1966A) and Thorson (1971) have published marine and estuarine oriented classification systems, as has Beak Consultants (1975). Byrne and Panshin (1968) classified shelf sediments and their community associations.

1.1.3 Zones of Human Activity. Human activity zones have usually been dealt with in terms of economics, legal, and political factors and generally fall within the scope of land use classification, resource exploitation, and land use planning (Clawson and Stewart, 1965; J. R. Anderson et al., 1976). Ian McHarg (1969) advocates "Design with Nature" and treats the interaction of man and nature from the standpoint of achieving a balance with the environment. The classification of human activity zones in the present study is not based on land use per se, but on the habitats for plants and animals that result from man's presence and activities. Some of the effects of man's activities are discussed in Chapter 4 (Volume 1); see especially Section 4.8.4.

1.1.4 The Present System. The classification system that was adopted for this study is introduced in Chapter 1 of the Conceptual Model. Topographic areas (e.g., Alpine Highlands, Slope and Lowlands, shown in Figure 2 of the Introduction of this volume p. xi) are divided into biological zones e.g., Arctic Alpine, Western Hemlock, listed in Table 1 (p. xii) which are further broken down into their component habitats (e.g., Lacustrine, Riparian, Old Growth). The characteristics of freshwater habitats are closely dependent on the zone in which they occur. They are, therefore, included in the Inland Zones and the Dune Zone, rather than being treated as a separate Freshwater zone. The same is true of agricultural areas as habitats.

Beach and dune areas are included with estuaries in the Coastal Zone, where the ocean is a dominant influence. Oceanic zones, here limited to the continental shelf, are another major category. The final grouping in the present system is the Human Activity Zones and the habitats that result.

The zones and habitats that are defined here are fairly distinct assemblages of organisms, environmental conditions, and ecological processes. They are proved useful in ecological characterization and have been modified somewhat as a result of use during the Test Characterization which was submitted to the Fish and Wildlife Service on November 23, 1977. They also provide a logical framework to define the occurrence and range of organisms in the computerized Annotated Species List. This list is introduced and discussed in Section 3.3 of the Conceptual Model (Vol. I) and Regional Synopsis (Vol. II), and is reproduced in Volume 5, the Data Source Appendix. It was used, by computer sorting, to produce the Community Composition print-outs in Part 2 of this volume.

## 1.2 ZONE AND HABITAT SELECTION

The selection of biological zones and the habitat types within zones that are incorporated into this study is applicable to inland, coastal, and marine ecosystems and to zones of human activity. These zones and habitats are easily recognizable with resolution at the habitat level roughly equivalent from zone to zone. The general distribution of Inland Zones in the Pacific Northwest Coastal Region (as listed in Table 1 of the Introduction) is shown in Figure 1-1.

1.2.1 A Hierarchical System. The zones and groups of zones are defined in a hierarchical system as illustrated in Figure 2-1 and outlined in Table 1 of the Introduction. Super zones and zones were chosen to have similar status at each level in the classification, e.g., 1.0 Inland Zones, 2.0 Coastal Zones, and 3.0 Oceanic Zones; and 1.2.2 Redwood Zone, 2.1.1 Subtidal Estuarine Zone, 4.2.5 Buffer and Connector Zone.

Habitats were selected to define particular biological communities, (e.g., Second Growth Forest (Broadleaf), Mud Flat), which can be distinguished ecologically in one or more biological zones. Another major criterion in habitat designation was that they be distinguishable by aerial and satellite reconnaissance. While many more ecological niches can be distinguished by field work than by remote sensing, the latter methods have been shown to provide data for valid delineation of ecological habitats (Cowardin et al., 1977).

1.2.2 Classifying the Influences of Man. A number of habitats that reflect the influence of man's activities have been defined and most are included in the Human Activity Zones (see Table 1, p. xii) (4.0). These habitats are based on land use intensity, not on social or economic considerations as such. They are superimposed on the Inland and Coastal Zone habitats in which they occur and could be included in those zones just as agricultural habitats are. Conversely, agriculture could be added to the human activity zones. Dividing lines often tend to be arbitrary. We have drawn the line at intensive cultivation which nearly always means large, single crop fields. The family garden plot is included in the human activity zones and agriculture in the inland zones for this region. In other regions where agriculture is a more dominant feature of the environment than in the case in the study area, it should probably be reclassified, perhaps to zone status.

1.2.3 Human Activity Zones. In these zones, the emphasis is not on particular activities of humans (such as fishing, logging, or mining), but rather on general categories of uses (e.g., residential, commercial, industrial) which influence the kinds of buildings, open spaces, services, and traffic, and on the density of development (rural, village, light and dune, urban). All of these factors affect the kinds of vegetation that may occur and the cover and food supply for animals. On this basis a series of zones and habitats have been delineated and are presented in 4.0 - Human Activity Zones. They range from Rural and Hamlet to Dense Urban and include especially maintained areas and rights of way which provide cover and migration corridors for wildlife. These latter are grouped under Buffers and Connectors and include parks, greenbelts, and transportation and utility corridors. No other ecological classification system incorporates this range of zones and these diverse human-influenced habitats.

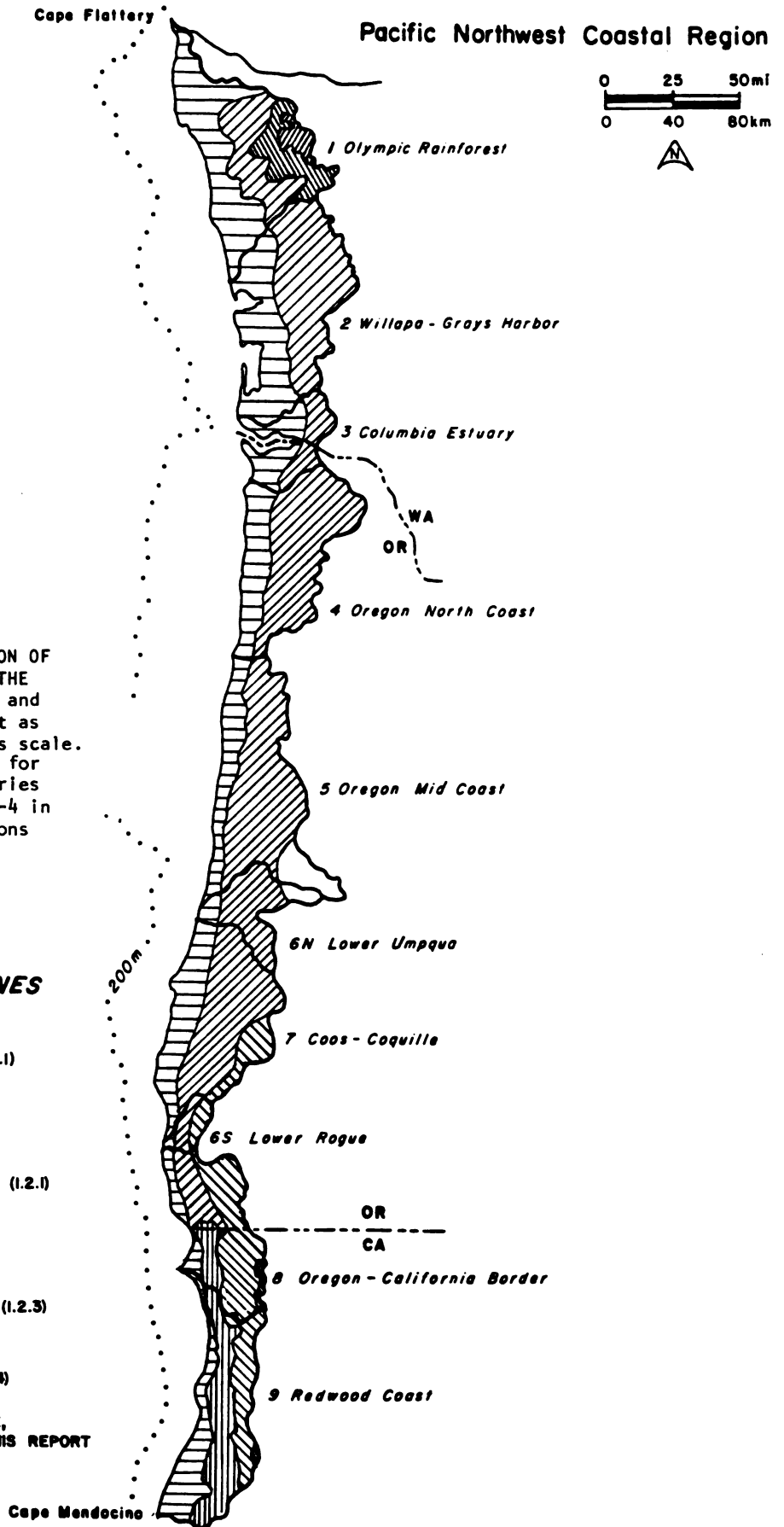


FIGURE 1-1. THE DISTRIBUTION OF INLAND BIOLOGICAL ZONES IN THE REGION. (Coastal, Oceanic, and Human Activity Zones are not as suitable for mapping on this scale. See Figure 2-24 in Volume 2 for location of the major estuaries in the region, and Figure 2-4 in Volume 2 for general locations of beaches and headlands.

**INLAND  
BIOLOGICAL ZONES**

-  ARCTIC ALPINE (1.1.1)
-  TRUE FIR (1.1.2)
-  WESTERN HEMLOCK (1.2.1)
-  REDWOOD (1.2.2)
-  MIXED EVERGREEN (1.2.3)
-  SITKA SPRUCE (1.2.4)
-  INTERIOR ZONE TYPE,  
NOT COVERED IN THIS REPORT

Certain plants and animals seem to follow man. Within the continental United States, grasses and dandelions, house flies and cockroaches, rats, pigeons, and house sparrows usually congregate wherever man does. Many species seem to favor the habitats of man, many others tolerate him well, and there are many that he brings with him by design. Many of these are mentioned in the habitat description pages.

Man establishes and maintains many habitats, e.g. lawns, parks, wood lots, but when his maintenance stops, succession takes over. The succession pattern will tend to follow that of the biological zone in which the area is found, but will, of course, be influenced by the changes that man has made and the effects of his continuing presence and activity, if any, in the area. Man's activities are affected by the sea and salt spray, which, even some distance inland, have an influence on vegetation. These are just two of the reasons that human activity zones are listed in two parallel groups, Inland and Coastal Zones.

1.2.4 Man's Activities in Other Zones. Man's activities often result in long-term alteration of ground cover, soils, hydrology, and topography. Examples are agriculture, commerce, housing, industry, and public works such as dams, harbors, highways, levees, and sea walls. Some of these are recognized in the classification system in Zones 4.1 and 4.2 (Human Activities) and, in other cases (i.e. Agricultural, Channel, Diked Marsh, and Pillings), as specific habitats within Zonal areas 1, 2, and 3. Other harbor and shoreline structures, such as breakwaters, jetties, and sea walls, are special cases of the "natural" rocky shore habitats.

Transient activities of man, such as construction, forestry, and mining, may leave some more or less permanent marks on the landscape (e.g. dams, highways). Except for these long lasting features, the general disruption to the environment is usually comparable to natural events such as land and snow slides, forest fires, or storms. The transient activities of man can often be treated in much the same way as events in natural ecosystems that may trigger succession patterns, and can be modeled and evaluated on much the same basis.

### 1.3 ZONE AND HABITAT DESCRIPTIONS

Each inland biological zone is introduced by a page that gives general comments and a brief description of the topography and soils, climate, and hydrology for the zone. This page also contains a sketch of the zone with habitats designated. Every habitat (within a zone) is briefly characterized on a similar introductory description page. A sketch of that habitat is shown with a brief description of the habitat and its food web, followed by listings of flora and fauna that characterize the habitat.

For the other three areas - coastal, oceanic, and human activity - description pages are presented at a higher level than the zone. In the coastal and human activity areas these are: 2.1 Estuaries (containing three zones), 2.2 Beaches and Dunes (two zones), 2.3 Headlands and Rocky Islands (two zones), 4.1 Inland Human Activity areas (five zones), and 4.2 Coastal Human Activity areas (five zones). For the ocean, a single description page presents the general information and breakdown for the four zones of that area.

These zone and "super" zone description pages are reproduced as section headings in Table 1-1 (which follows) as well as in Part 2 of this volume.

Each zone is identified by a three digit number, the digits separated by periods (see Table 1 in the Introduction); habitats within each zone are identified by letters. Thus, for example, the Emergent Vegetation habitat within the Estuarine Zone is designated 2.1.2 C.

### 1.4 COMPARISON WITH OTHER CLASSIFICATION SYSTEMS

Most habitat classification systems were developed for the land and are mentioned briefly in the first part of this chapter. Aquatic habitats are a major feature of the Pacific Northwest coastal environment and have been increasingly recognized as critical components of the ecosphere. The National Wetlands Inventory (Cowardin et al., 1977) of the U.S. Fish and Wildlife Service is a program to aid in assessment of these critical components.

No single classification system has included all of the habitats with which this study is concerned: i.e., terrestrial, fresh water aquatic, estuarine, coastal, oceanic (continental shelf) and those within man's zones of activity. In the Pacific Northwest Coastal Region 126 habitats have been identified in 27 biological zones.

In Table 1-1, on the following pages, these zones and habitats are depicted and are compared with those of other classification systems, category by category. This table identifies the corresponding names used by different authors for the same habitat types. Some of the previous classification systems have dealt only with terrestrial habitats, others have been concerned only with coastal or marine zones, and still others have been based on the use that man makes of the land. None of the latter have identified habitats as such within the zones of human activity and none encompasses all of the habitats that are identified in this study.

TABLE 1-1. COMPARISON OF THE ZONE AND HABITAT CLASSIFICATION WITH OTHER CLASSIFICATION SYSTEMS. Zone and habitat names are listed with corresponding designations from other classification systems in columns, each headed by the author's name(s) and the date of the reference. This table (on the following pages) thus identifies the corresponding names used by different authors for the same habitat types. Where no correspondence exists, a dash ( - ) is used in that column. Where no correspondence exists for all the habitats on a page, the entire column is omitted.

A zone (or "super" zone) description page with habitats depicted in a strip across the bottom (from Part 2) appears on each even-numbered page, with the section of table which covers the same habitats on the facing odd-numbered page. Sometimes more than one zone appears on a page. The description page and table correspond exactly in each instance.

Table 1-1 starts on page 1-7.

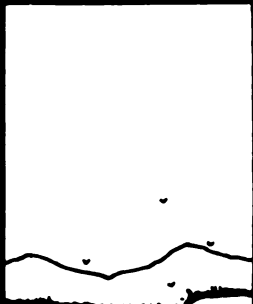
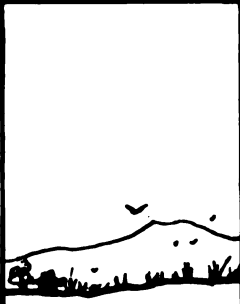
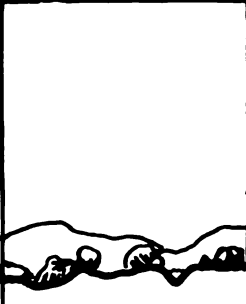
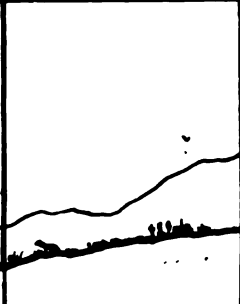


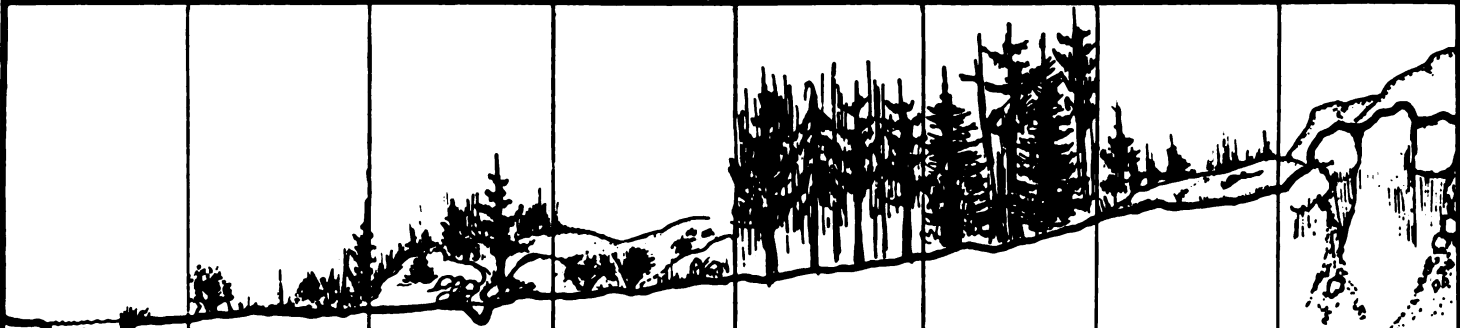
<b>1.1.1 ARCTIC ALPINE ZONE</b>					
<b>GENERAL COMMENT</b>	The Arctic Alpine Zone is restricted to the high peaks of the Olympic Mountains. Because productivity is low, the zone is especially sensitive to disturbances and the rate of re-vegetation is extremely low. Within the study area this zone is under U.S. Department of Interior jurisdiction in Olympic National Park.				
<b>TOPOGRAPHY AND SOILS</b>	Elevation ranges from timberline upward, beginning approximately at 1,460 meters (5000 ft). Youthful substrate (with shallow, rocky soil), active mass wasting (landslides, rockfall, avalanches), and active weathering are characteristic. Slopes and aspects are highly variable.				
<b>CLIMATE</b>	Long, cold winters (8 - 9 months), short growing season and brief summers, strong, sun- and rain-shadow effects, diurnal wind patterns.				
<b>HYDROLOGY</b>	Heavy precipitation peaking during winter months with much of it as snow; rapid discharge peaking at snow melt; retention in form of glaciers and snowfields is characteristic.				
<b>HABITAT TYPES</b>					
					
<b>1.1.1 A Lacustrine</b>	<b>1.1.1 B Palustrine</b>	<b>1.1.1 C Riverine</b>	<b>1.1.1 D Tundra /Alpine</b>	<b>1.1.1 E Rocklands</b>	<b>1.1.1 F Ice Fields/ Glaciers</b>

TABLE 1-1. COMPARISON OF THIS ZONE AND HABITAT CLASSIFICATION WITH OTHER CLASSIFICATION SYSTEMS.

	Merriam 1894	Munz & Keck 1959	Franklin & Dyrness 1973	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
1.0 INLAND ZONES	--	--	--	--	--	--	--
1.1 Alpine Highlands	--	--	--	--	--	--	--
1.1.1 Arctic Alpine Zone	Arctic Alpine	Alpine	Timberline & Alpine Region	Mountains	Alpine	--	TX
A Lacustrine	--	--	--	Freshwater Marsh & Shore	Freshwater Marshes	Lacustrine	WL
B Palustrine	--	--	--	Freshwater Marsh & Shore	Freshwater Marshes	Palustrine	MT
C Riverine	--	--	--	Freshwater Marsh & Shore	Mountain Streams	Riverine	WR
D Tundra/Alpine	--	--	Alpine Meadow	Wet Meadow	Alpine Meadow	--	TX, MS, IS
E Rocklands	--	Alpine Fall Fields	--	--	Alpine Border & Rockfields	--	NA, NR, NRA
F Ice Fields/ Glaciers	--	--	--	--	Alpine Snow & Ice Habitats	--	NI


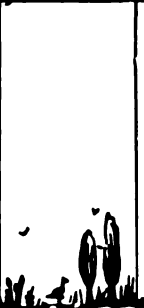
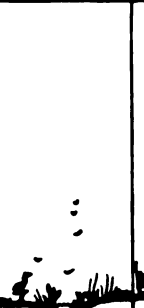

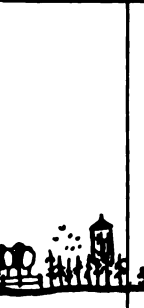
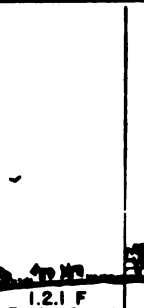





<b>1.1.2 TRUE FIR ZONE</b>							
<b>GENERAL COMMENT</b>	Within the study area the zone is restricted to the slopes of the Olympic Mountains and is largely in the National Park. It is a cool, coniferous, sub-alpine forest and corresponds to the mountain hemlock and silver fir zones as defined by Franklin & Dyrness (1973) and the Canadian and Hudsonian Zones as described by Army Corps of Engineers (1975F).						
<b>TOPOGRAPHY AND SOILS</b>	Elevation ranges from 600 to 1700 meters (1968 to 5576 feet). Topography generally steep and youthful. Soils on steep slopes tend to be shallow, overlying volcanic and sedimentary bedrock. Soils in valleys and more moderate slopes are deep and well formed. Dominant soils are Spodosols, i.e., Cryorthods (Podzols and Grey Podzols), and Haplorthods (Brown Podzolic Soils).						
<b>CLIMATE</b>	The zone is wet and cool with annual precipitation averaging 260 cm (102 inches). Rain shadows, aspect, sun shadows, and diurnal wind patterns produce strong microclimatic effects. Average annual temperature ranges from 3.4 to 5.6°C (38 to 42°F), depending largely on elevation and shadow effects. Average January temperatures range from -3.7°C to -1.7°C (25 to 29°F). Average July temperatures range from 12 to 15°C (54 to 59°F). Summers are short and cool; winters are long and cold.						
<b>HYDROLOGY</b>	The zone is characterized by heavy precipitation and snowfall. Precipitation ranges from 160 to 280 cm (25 to 43 inches) including 400-1400 cm (157 to 551 inches) of snow. A snowpack of 1 to 7.5 meters (3 to 25 feet) (dependent on elevation and shadow effects) is typical. Snow cover can be expected for as long as 6 months in the upper elevations. Retention is moderate and runoff is rapid, peaking during the spring melt.						
<b>HABITAT TYPES</b>							
							
<b>1.1.2 A Lacustrine</b>	<b>1.1.2 B Pelustrine</b>	<b>1.1.2 C Riverine</b>	<b>1.1.2 D Early Seral Shrub</b>	<b>1.1.2 E Second Growth Forest</b>	<b>1.1.2 F Old Growth Forest</b>	<b>1.1.2 G Sub-Alpine Meadow</b>	<b>1.1.2 H Rockland/Talus</b>



## 1.0 INLAND ZONES

1.1 Alpine Highlands  
(continued)

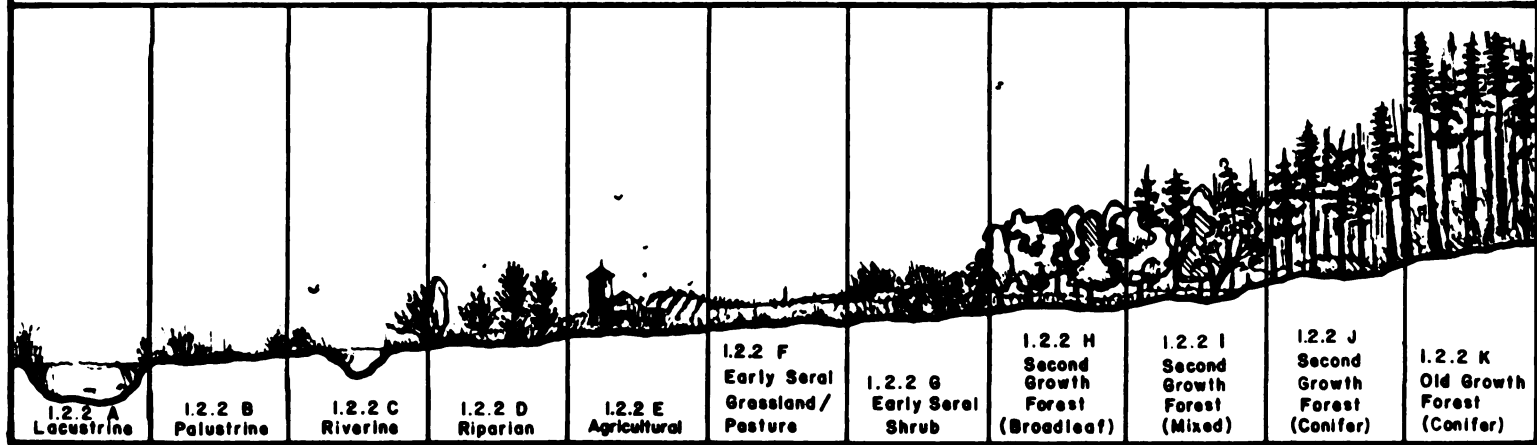
	Merriam 1894	Society of American Foresters 1954	Munz & Keck 1959	Franklin & Dyrness 1973	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
1.1.2 True Fir Zone	Hudsonian, Canadian	--	Sub-Alpine Forest Red Fir Zone	Mountain Hemlock Zone & Silver Fir Zone	Mountains	Upper Montane Coniferous Forest & Sub- Alpine Coni- ferous Forest	--	CA, CM
A Lacustrine	--	--	--	--	Freshwater Marsh & Shore	Lakes & Ponds	Lacustrine	WL
B Palustrine	--	--	--	--	Freshwater Marsh & Shore	Montane Meadows	Palustrine	MT
C Riverine	--	--	--	--	Freshwater Marsh Shore	Mountain Streams, Mt. Rivers	Riverine	WR
D Early Seral Shrub	--	--	--	Blueberry, Bear Grass, Bracken Fern	Wet Meadow	--	--	SS
E Second Growth Forest	--	226 205	--	Douglas Fir, Noble Fir	Wet Coniferous Forest	--	--	CA, CF, CM
F Old Growth Forest	--	205, 226	--	Pacific Silver Fir, Mountain Hemlock	Wet Coniferous Forest	--	--	CA, CF, CM
G Sub-Alpine Meadow	--	--	--	Meadow Communities	Wet Meadows	--	--	FS, MS, MW
H Rockland/Talus	--	--	--	--	--	--	--	NA, NC, NR, NT

<b>1.2.1 WESTERN HEMLOCK ZONE</b>										
<b>GENERAL COMMENT</b>	Highly productive and extensive lowland conifer forest. Currently largely in second growth due to extensive logging and windthrow. Much of the highly productive commercial forestlands of the study area occur in this zone. The zone corresponds to the Western Hemlock Zone of Franklin and Dyrness (1973), and the Humid Transition Zone as described by the Army Corps of Engineers (1975F).									
<b>TOPOGRAPHY AND SOILS</b>	Elevation ranges from 150 to 600 meters (492 to 1968 feet) in the Olympics and from near sea level to 600 meters (1968 feet) in the Coastal Range. Topography is variable but usually not precipitous. Typical are lower mountain slopes, foothills and plains, with many bogs. Soils are moderately deep to deep with medium acidity and high organic content (Franklin and Dyrness, 1973). Dominant soils include Dystrochrepts (Sols Burns Acides), Haplumbrepts (Western Brown Forest Soils), and Haplohumult (Redish Brown Lateritic Soils).									
<b>CLIMATE</b>	The zone has a mild, wet maritime climate. Average annual temperatures range from 8°C to 10°C (46 to 50°F) with summer and winter extremes muted. Average January temperatures are near 1°C (34°F) and average July temperatures are near 17.5°C (64°F). Snow cover is infrequent in the lower elevations. Summer dehydration stress is significant on overly drained soils and south facing slopes.									
<b>HYDROLOGY</b>	The zone is characterized by heavy precipitation varying from 160 to 320 cm (63 to 126 inches). Average annual snowfalls range from 0 at near sea level to nearly 200 cm (79 inches) at higher elevations. However, snow cover is usually of short duration. Most of the precipitation occurs during the winter with summer receiving only 6-9 percent. Late summer and early fall flows are consequently low.									
<b>HABITAT TYPES</b>										
										
1.2.1 A Lacustrine	1.2.1 B Palustrine	1.2.1 C Riverine	1.2.1 D Riparian	1.2.1 E Agricultural	1.2.1 F Early Seral Grassland/ Pasture	1.2.1 G Early Seral Shrub	1.2.1 H Second Growth Forest (Broadleaf)	1.2.1 I Second Growth Forest (Mixed)	1.2.1 J Second Growth Forest (Conifer)	1.2.1 K Old Growth Forest

1.0 INLAND ZONES (continued)	Merriam 1894	Society of American Foresters 1954	Munz & Keck 1959	Franklin & Dyrness 1973	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
					W-Slopes & Lowlands West of Cascade 3,000 Ft.	--	--	--
1.2 Slope and Lowland Zones	--	--	--	--				
1.2.1 Western Hemlock Zone	Humid Tran- sitional	--	North Coastal Coniferous Forest	Western Hemlock Zone	Wet Coniferous Forest	Northern Coast Coniferous Forest	--	CH
A Lacustrine	--	--	--	--	Freshwater Marsh & Shore	Lakes	Lacustrine	WL
B Palustrine	--	--	--	--	Freshwater Marsh & Shore	Coastal & Valley Fresh- water Marsh	Palustrine	MT
C Riverine	--	--	--	--	Freshwater Marsh & Shore	Coastal Streams	Riverine	WR
D Riparian	--	221, 222 235	--	Black Cotton- wood, Oregon Ash, Red Alder Bigleaf Maple	Riparian Woodland	Northern Riparian Woodland	--	HA, HB, HC
E Agricultural Lands	--	--	--	--	Farmland	--	--	AC, AO
F Early Seral Grass- land/Pasture	--	--	--	Weed Stage	Wet Meadow	--	--	AG, MD, MM, GM
G Early Seral Shrub	--	--	--	Shrub- Dominated Period	Shrubby Thickets	--	--	SM
H Second Growth Forest (Broadleaf)	--	221	--	Red Alder Forests	Broadleaf Forest	--	--	HX, HA, HB
I Second Growth Forest (Mixed)	--	221, 227	--	Several Communities	--	--	--	HA, C9
J Second Growth Forest (Conifer)	--	230, 227 229, 231	--	Douglas Fir Communities	Wet Coniferous Forest	Douglas Fir Forest	--	CD, CH, CC
K Old Growth Forest	--	224, 230 227	--	--	Wet Coniferous Forest	Western Hemlock Forest	--	CH, CC,

<b>1.2.2 REDWOOD ZONE</b>	
<b>GENERAL COMMENTS</b>	The zone is restricted to the fog belt (Munz and Keck, 1959) at the southern extremity of the study area and is typically found inland of the Sitka Spruce Zone. It extends intermittently from approximately fifteen kilometers (nine miles) north of the California-Oregon border south to the San Louis Obispo County line. Characteristically, it extends inland no more than 40 to 64 kilometers (25 to 40 miles) where it merges with the mixed-evergreen forest of the interior upper reaches of the coastal watersheds (Griffen and Critchfield, 1972; Munz and Keck, 1959; Cheatham and Haller, 1976).
<b>TOPOGRAPHY &amp; SOILS</b>	Extends from sea level to 900 meters (3,000 feet) (Cheatham and Haller, 1976) with the bulk of its distribution being below 2,000 feet (600 meters) (Griffen and Critchfield, 1972). Found on both alluvial flats with deep well-drained soils and on valley slopes with shallow well-drained soils (Cheatham and Haller, 1976). The alluvial flats are subject to periodic siltation due to flooding (Ornduff, 1974). The zone typically has west-facing slopes with northerly and southerly aspects being common and east-facing slopes uncommon.
<b>CLIMATE</b>	The climate is mild and comparable to that of the Sitka Spruce Zone. Mean annual temperatures vary between 50° and 60°F (10° and 15°C). Seasonal fluctuations between mean annual maximum and mean annual minimum are moderate: 10 to 15°F (5 to 10°C) in lowlands and 30°F (15°C) in higher elevations. Temperatures rarely drop below 15°F (-10°C) or go above 100°F (37°C) (Fowells, 1965). Frost free period ranges from six to eleven months. Of critical importance to the distribution of the zone are frequent summer fogs which decrease water loss from evaporation and transpiration during the relatively dry summer. Condensation of fog on tree crowns and subsequent fog drip adds important moisture to the water budget.
<b>HYDROLOGY</b>	Alluvial stands are subject to periodic winter flooding, and frequent summer fogs (Cheatham and Haller, 1976). Annual precipitation varies from between 25 to 122 inches (62 to 305 cms) falling mostly as winter rain. January is typically the wettest month and August the driest (Fowells, 1965).

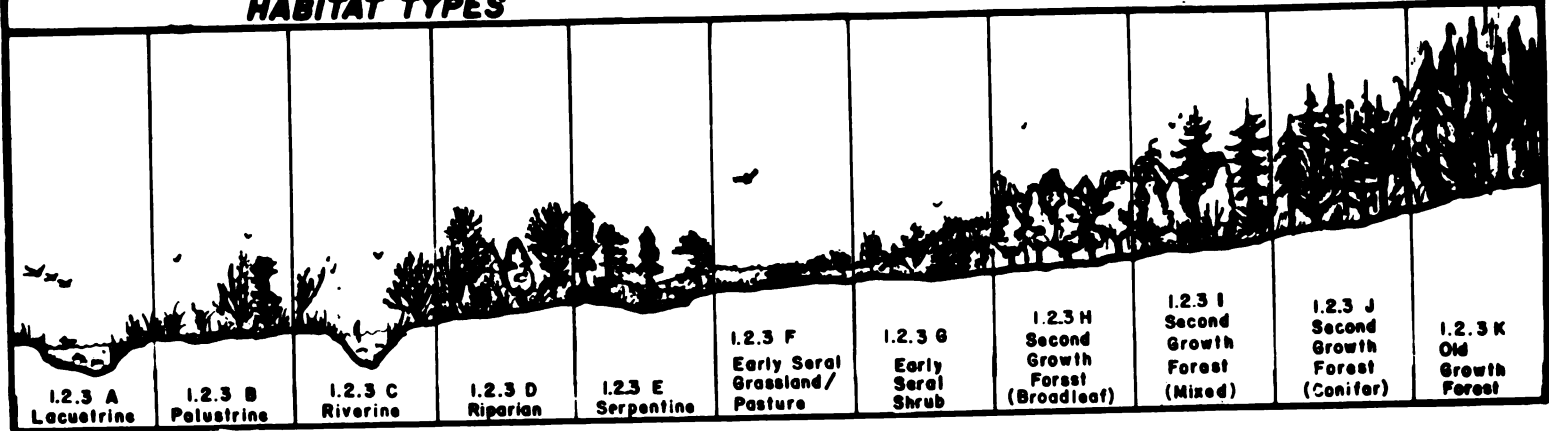
**HABITAT TYPES**



1.0 INLAND ZONES							
1.2 Slope and Lowland Zones (continued)		Merriam 1894	Society of American Foresters 1954	Munz & Keck 1959	Franklin & Dyrness 1973	Ceatham & Haller 1976	Cowardin et al. 1977
		Humid Transi- tional	--	Redwood Forests	--	Redwood Forest	--
1.2.2	Redwood Zone	--	--	--	--	Lakes	Lacustrine
A	Lacustrine	--	--	--	--	Coastal & Valley Fresh- water Marsh	Palustrine
B	Palustrine	--	--	--	--	Coastal Streams & Rivers	Riverine
C	Riverine	--	--	--	--	Northern Riparian Woodland	--
D	Riparian	--	222	--	--	--	--
E	Agricultural Lands	--	--	--	--	--	--
F	Early Seral Grass- land/Pasture	--	--	--	--	--	--
G	Early Seral Shrub	--	--	--	--	--	--
H	Second Growth Forest (Broadleaf)	--	221, 234	--	--	--	--
I	Second Growth Forest (Mixed)	--	221, 232, 234	--	--	--	--
J	Second Growth Forest (Conifer)	--	232	Redwood Forest	--	Redwood Forest	--
K	Old Growth Forest (Conifer)	--	232	Redwood Forest	Redwood Forest	Redwood Forest	--

<b>1.2.3 MIXED EVERGREEN ZONE</b>	
<b>GENERAL COMMENTS</b>	The zone is found in the Klamath Mountain range and the North Coast range of California; it is characteristic of the western Siskiyou Mountains. In northern California it lies immediately east and adjacent to the Redwood Zone. It is an area of vegetational and floristic diversity with large numbers of endemic species. In some areas it is relatively unproductive, but in northern California this zone is very productive. It has scattered areas of serpentine soils and it overlays a very old and complex geology. The zone encompasses floristic elements of both northern coniferous forest and the California sclerophyllous forest/scrub and is considered "central" to the floras of surrounding areas (Whittaker, 1960).
<b>TOPOGRAPHY AND SUBSTRATE</b>	Within the study area the zone is characterized by rugged, deeply dissected terrain with steep slopes, (Franklin and Dyrness, 1973). Average grades are 30° or more and valleys are narrow. Upland soils are predominantly Haplohumults (Reddish Brown Laterites). Scattered throughout the uplands are areas of shallow unproductive soils, Hapludolls (Gray-Brown Podzolic Soils) or Xerochrepts (Regosols), overlying peridotite or serpentine rocks. Whittaker (1960) identifies three major soil types based on parent material of gabbro, peridotite, and serpentine.
<b>CLIMATE</b>	The climate is relatively warm and wet during the winter and hot and dry during summer. Mean monthly temperatures during the hottest month of the year range from 14°-22°C (57 to 72°F). During the coldest month of the year temperatures range from 0°-8°C (32 to 46°F). Mean annual temperature is around 11°C (52°F) (Whittaker, 1960). Hot, dry summers makes this zone prone to frequent fires.
<b>HYDROGRAPHY</b>	Annual precipitation varies from 60 to 170 cm (24 to 67 inches) with generally less than 15% of precipitation falling during summer. Within the study area, precipitation increases with distance from coast and elevation. Snowfall is moderate ranging from 3 to 80 cm (2 to 31 inches) and does not remain for extended periods of time. Flows generally peak during December with minimum flows occurring in September. Stream patterns are well developed, with lakes and wetlands uncommon.

**HABITAT TYPES**

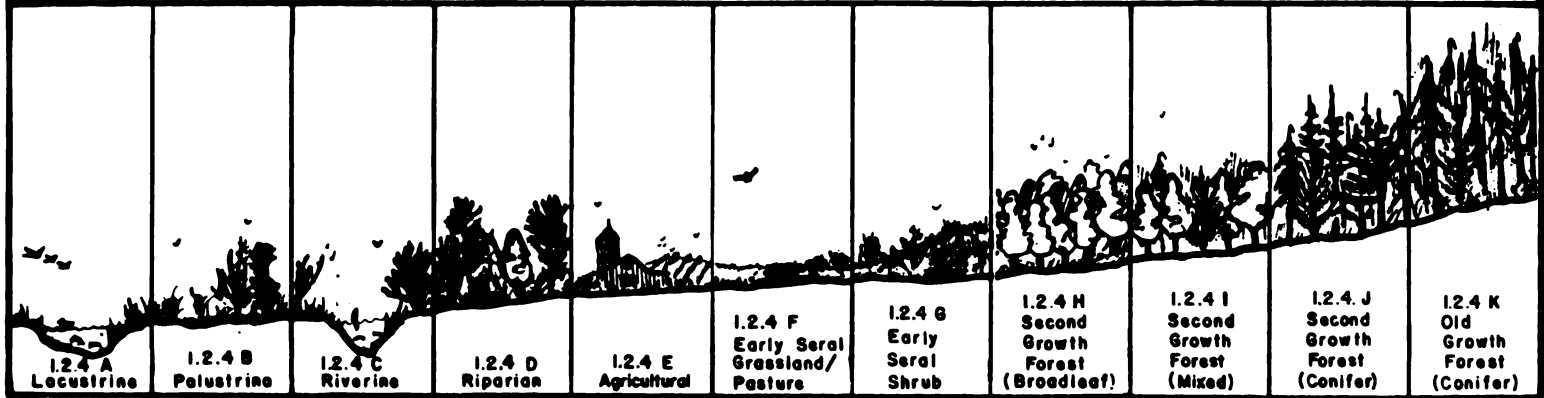


1.0 INLAND ZONES  
 1.2 Slope and Lowland  
 Zones (continued)

	Society of American Foresters 1954	Munz & Keck 1959	Franklin & Dyrness 1973	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
1.2.3 Mixed Evergreen Zone	--	Mixed Evergreen Forest	Mixed Evergreen Zone	--	Mixed Evergreen Forest	--	--
A Lacustrine	--	--	--	--	Lake	Lacustrine	WL
B Palustrine	--	--	--	--	Coastal & Valley Freshwater Marsh	Palustrine	MT
C Riverine	--	--	--	--	Coastal Streams & Rivers	Riverine	WR
D Riparian	222	--	--	--	Northern Riparian Woodland	--	HA, HB, HC
E Serpentine	247	--	Serpentine Areas	--	--	--	CPG6, CLC2
F Early Seral Grass- land/Pasture	--	--	Grasslands	--	--	--	AG, GM, MD
G Early Seral Shrub	--	Chaparral	Evergreen Chaparral	Shrubby Thickets	Mixed Chaparral	--	SC
H Second Growth Forest (Broadleaf)	234	--	--	--	Mixed Evergreen	--	HM, HT, HO
I Second Growth Forest (Mixed)	234, 231	Mixed Evergreen	Douglas Fir, Tanoak	--	Mixed Evergreen	--	CDH1, CDH2, CDH3
J Second Growth Forest (Conifer)	231	Mixed Evergreen	Douglas Fir, Tanoak	--	Mixed Evergreen	--	CD
K Old Growth Forest	234, 231	Mixed Evergreen	Douglas Fir, Tanoak	Dry Coniferous Forest	Mixed Evergreen	--	CD, CDH1, CDH2, CDH3

<b>1.2.4 SITKA SPRUCE ZONE</b>	
<b>GENERAL COMMENTS</b>	Sitka Spruce occurs along a narrow coastal strip that stretches from the Kenai Peninsula, Alaska, to Cape Mendocino, California, at the southern boundary of the study area (Harris et al., 1974; Franklin & Dyrness, 1973; Griffen & Critchfield, 1972). Typically the zone is only a few kilometers wide but extends inland in river valleys and where extensive coastal plains occur. It is comparable to the coastal subzone of the Humid Transitional Life Zone or what some call the Coastal Temperate Rain Forest (Harris et al., 1974). The zone is very productive with substantial commercial timber lands.
<b>TOPOGRAPHY AND SOILS</b>	The zone is restricted to coastal lowlands and is generally found below 150 meters (492 feet), although it may extend to 600 meters (1968 feet) where mountain masses form the coast line. Topography is generally flat to rolling. Soils are typically productive, deep, rich, and fine textured. Characteristic major great soil groups are humults (Brown Lateritics, Reddish Brown Lateritics, and Sols Bruns Acides) and alluvials (Udfluvents). Generally, surface soils are acid, high in organic content and total nitrogen and low in base saturation (Franklin and Dyrness, 1973).
<b>CLIMATE</b>	The climate of the zone is maritime. Temperature and precipitation are moderate throughout the year. Average annual temperature ranges from 10.3 to 11.3°C (50 to 52°F) with average January temperatures between 4-8°C (39 to 46°F) and average July temperatures 13 to 17°C (55 to 63°F). Winds are generally from the northwest during summer and southerly during winter. Winter storms with high winds and precipitation originating in the Pacific often move into the zone. The predicted frequency of winds 55-61 km/h (90 to 100 mph) is one in each hundred years (U.S.D.A., 1975A). Extended freezing periods are rare.
<b>HYDROLOGY</b>	Precipitation ranges from less than 200 cm (78 inches) at the southern boundary of the study area to more than 300 cm (118 inches) at the more northern extremities. Only about 5% of the precipitation falls from June through August (Franklin and Dyrness, 1973). Summer fogs and low clouds are frequent and play an important roll in reducing summer moisture stress (Ruth, 1954). Snow is uncommon. Lakes, peat bogs, and swamps are numerous. River and stream gradients are typical of the Gravel and Pastoral Zones as classified by Bauer (1974A). Some areas in these zones are prone to flooding.

**HABITAT TYPES**

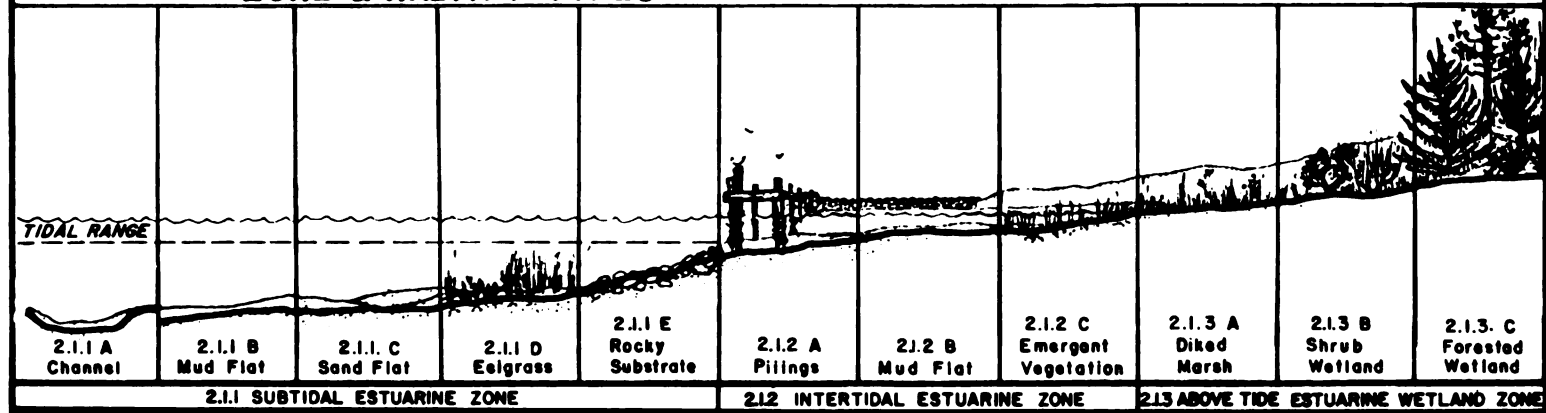




F.0 INLAND ZONES									
1.2 Slope and Lowland Zones (continued)		Merriam 1894	Society of American Foresters 1954	Munz & Keck 1959	Franklin & Dyrness 1973	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
1.2.4	Sitka Spruce Zone	Humid Transi- tional	--	North Coastal Conifer- ous Forests	Sitka Spruce Zone	W-West of Cascades in Lowlands	Sitka Spruce Grand Fir Forest	--	CS
A	Lacustrine	--	--	--	--	Freshwater Marsh & Shore	Lake	Lacustrine	WL
B	Palustrine	--	--	--	--	Freshwater Marsh & Shore	Coastal & Valley Freshwater Marsh	Palustrine	MT
C	Riverine	--	--	--	--	Freshwater Marsh & Shore	Coastal Rivers & Streams	Riverine	WR
D	Riparian	--	221, 222	--	Same as Western Hemlock	Riparian Woodland	Northern Riparian Woodland, Red Alder Groves	--	HA, HB, HC
E	Agricultural	--	--	--	--	Farmland	--	--	AC, AO
F	Early Seral Grass- land/Pasture	--	--	--	Same as Western Hemlock	Wet Meadow	--	--	AG, MD, MM, GM
G	Early Seral Shrub	--	--	--	Same as Western Hemlock	Shrubby Thicket	--	--	SM
H	Second Growth Forest (Broadleaf)	--	221	--	Red Alder Forests	Broadleaf Forest	Red Alder Groves	--	HA
I	Second Growth Forest (Mixed)	--	--	--	--	--	--	--	HAC9
J	Second Growth Forest (Conifer)	--	223, 225, 228	--	Sitka Spruce/ Western Hemlock/ Douglas Fir	Wet Coniferous Forest	Sitka Spruce- Grand Fir Forest	--	CD, CH, CC, CS
K	Old Growth Forest (Conifer)	--	223, 225, 228	--	Western Hemlock/ Sitka Spruce	Wet Coniferous Forest	Sitka Spruce Grand Fir Forest	--	CH, CS

<b>2.1 ESTUARY ZONES</b>	
<b>GENERAL COMMENTS</b>	High productivity and wide variety of habitats. Large spatial and temporal variations in hydrology, hydrography, and geology. The degree of mixing defines three types of estuaries: stratified, well-mixed, and partially mixed. Mixing phenomena may be seasonal and are dependent upon river runoff, tides, winds, shape, and topography. Estuaries provide food and shelter for many kinds of organisms. In addition, they are important to men for transportation, commerce and recreation.
<b>HYDROGRAPHY</b>	Fresh water is supplied either from interior or coastal watersheds. Sea water is brought in by tides and winds. Seasonality is a major feature of the estuarine hydrography of the Pacific Northwest and also affects the structure of food web and biological communities. The range of water temperature is typically from 4-20°C (40-70°F), of salinity from 0 to 34 ‰, and of the tides from 2-3.5 m (7-11 ft). Coastal lagoons are a variety of estuary where the mouth is closed by longshore drift at times of seasonally low flows.
<b>BATHYMETRY AND SEDIMENTS</b>	Depths vary from very shallow (3 m or 10 ft throughout) to 10-16 m (30-50 ft) in those estuaries having channels and energy holes. Sediments vary from coarse-grained clean sands derived from the ocean to fine-grained sediments from the river. Gravel beds in riverine portions are important as spawning areas for anadromous fish. Activities such as logging, farming, and industrialization can substantially modify natural concentrations of nutrients, dissolved oxygen, and sediment conditions.
<b>FOOD WEBS</b>	Production in estuaries is complex, consisting of many interrelated food webs. Characteristically, phytoplankton production is dominant during spring and summer, with detritivores becoming important from late summer through the winter months. Macrophytes (seaweeds and eelgrass) are also important producers. Algal mats often accumulate on intertidal mudflats during summer.


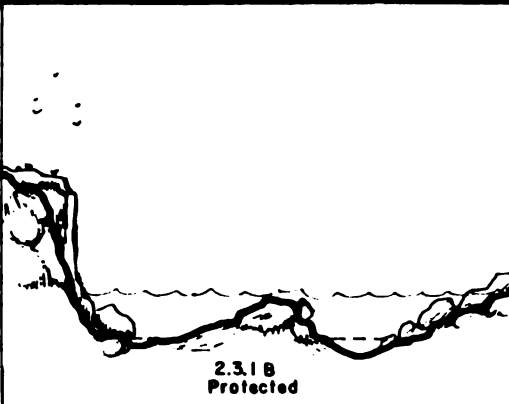
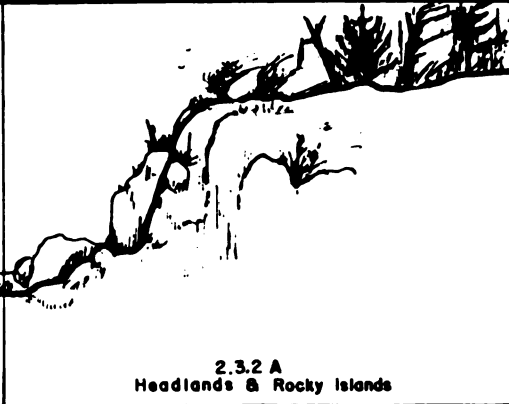
**ZONE & HABITAT TYPES**



		Munz & Keck 1959	Hedgpeth 1966 A	Ricketts & Calvin 1968	Franklin & Dyrness 1973	Beak 1975	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
2.0	COASTAL ZONES	--	--	--	Ocean Front Communities	Open Coast	Coast	Coastal & Shoreline Habitats	--	--
2.1	Estuary Zones	--	--	Bays & Estuaries	--	--	C-Coast	Coastal Esteros	Estuarine System	WE
2.1.1	Subtidal Estuarine Zone	--	Sub- littoral	--	--	Sub- tidal Photo- syn- thetic	--	Coastal Esteros	Subtidal	WE 11-13
A	Channel	--	--	--	--	Silt/ Clay	--	Coastal Esteros	Unconsolidated Bottom	--
B	Mud Flat	--	--	--	--	Silt/ Clay	--	Coastal Esteros	Unconsolidated Bottom - Mud Subclass	WE 1329
C	Sand Flat	--	--	--	--	Sand	--	Coastal Esteros	Unconsolidated Bottom - Sand Subclass	WE 1319
D	Eel Grass	--	--	Eelgrass Flats	--	Eelgrass	--	Coastal Esteros	Aquatic Bed	WE 1359
E	Rocky Substrate	--	--	Rocky Shores of Bays & Estuaries	--	Solid Rock, Boul- der, Cobble	--	Coastal Esteros	Rock Bottom	WE 1339
2.1.2	Intertidal Estuarine Zone	--	Littoral (Intertidal)	--	--	Intertidal	--	--	Intertidal	
A	Pilings	--	--	Wharf Piling	--	--	--	--	--	--
B	Mud Flat	--	--	Mud, Sand Flats	--	Silt/ Clay	--	Tidal Flats	Flat	WE 1329
C	Emergent Vegetation	Salt Marsh	--	--	Tideland Communities	--	--	Northern Coastal Salt Marsh	Emergent Wetland	MT99, GR39 MM, MW
2.1.3	Above Tide Estuarine Wetland Zone	--	--	--	--	--	--	--	Intertidal (See Fig. 2-22)	
A	Diked Marsh	Salt Marsh	--	--	Tideland Communities	--	--	Northern Coastal Salt Marsh	Emergent Wetland	AG, MM
B	Shrub Wetland	--	--	--	--	--	--	--	Scrub/Shrub Wetland	SM
C	Forested Wetland	--	--	--	--	--	--	--	Forested Wetland	CS

<b>2.2 BEACHES AND DUNES</b>	
<b>GENERAL COMMENTS</b>	Extensive beach/dune complexes occur from the Southern Washington coast southward along the Oregon Coast to Cape Blanco. Smaller beaches and strand communities are associated with headland complexes all along the coast. The Beach Surf Zone is a high energy area with shifting substrate and limited species diversity. The Above Tide Beach and Dune Zone are unstable and subject to water and wind erosion as well as flooding.
<b>TOPOGRAPHY AND SOILS</b>	There are only small changes in elevation within the zone but the changes are very important due to tidal cycles in the beaches and water table relationships in the dunes. Predominant dune soils include the Westport and Netart series. Westport soils are typically found in recently stabilized slightly weathered sand. They are a poorly developed soil and are a member of the mixed mesic family of Typic Udipsammerts (U.S.D.A., 1975A). Soils are nutrients poor and become saline near the beach (Ranwell, 1972).
<b>CLIMATE</b>	Marine influences strongly modify climatic conditions, especially on the immediate coastal strip. The climate is mild with small variations in temperature. Mean temperature for January ranges between 5 to 8°C (41 to 47°F) and between 13 to 16°C (55 to 61°F) for July. Snow and heavy freezes are infrequent. Winters are wet and cool with occasional storms generating heavy precipitation and strong winds (90-100 MPH winds can be expected to occur once every 100 years) (U.S.D.A., 1975A). Microclimate changes are dramatic in dunes (Ranwell, 1972).
<b>HYDROLOGY</b>	Precipitation averages between 200 to 300 cm (78 to 118 inches) with the bulk falling between November and April. Frequent summer fogs and subsequent fogdrip compensate for summer hydration stress. The soils are highly permeable. Recharge of ground water and surficial waters is directly from precipitation. The deflation plain and marshes are subject to annual inundation during winter. The water table is usually very close to the surface on the deflation plain but is subject to seasonal variations. If ground water removal is greater than recharge, salt water intrusion frequently occurs.
<b>ZONE &amp; HABITAT TYPES</b>	
<b>2.2.1 BEACH SURF ZONE</b>	<b>2.2.2 ABOVE TIDE BEACH &amp; DUNE ZONE</b>



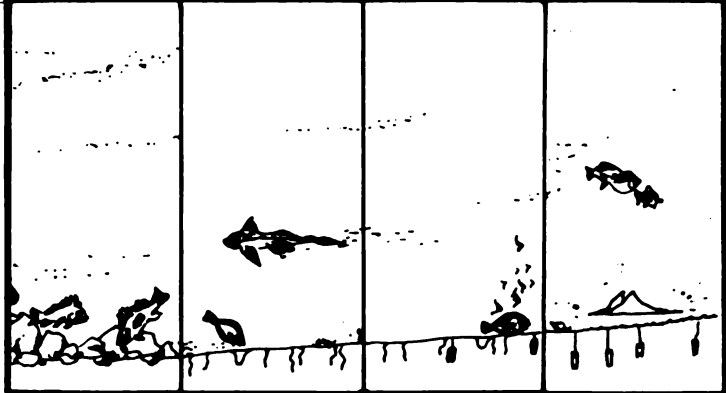

2.0 COASTAL ZONES (continued)		Society of American Foresters 1954	Hedgpeth 1966A	Ricketts & Calvin 1968	Thorson 1971	Franklin & Dyrness 1973	Beak 1975	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
2.2	Beach and Dune Zones	--	--	--	--	--	--	--	Dunes Habitats, Coastal & Shoreline Habitats	Beach/Bar	NS
2.2.1	Beach Surf Zone	--	--	--	--	--	--	--	--	--	--
A	Unprotected Beach	--	--	Open Coast Sandy Beaches	--	--	--	Sandy Shore	Unprotec- ted Sandy Beach	Beach/Bar	W029
B	Protected Beach	--	--	Protected Outer Coast	--	--	--	Sandy Shore	Protected Sandy Beach	Beach/Bar	W029
2.2.2	Above Tide Beach and Dune Zone	--	Supra- littoral Zone	--	Supra- littoral	--	--	--	--	--	--
A	Foredune	--	--	--	--	Foredune	--	--	Northern Coastal Foredunes	Beach/ Bar	NSN1, NSG8, NSG9, GR81
B	Deflation Plain	--	--	--	--	Deflation Plain	--	--	--	--	MM 9811, MW89, MW98
C	Dune Marsh	--	--	--	--	Bogs	--	--	--	Palustrine	MT, MW 8112
D	Active Dune	--	--	--	--	--	--	--	--	--	NSN9
E	Dune Lake	--	--	--	--	--	--	--	--	Lacustrine	--
F	Stabilized Dune	218, 223 225, 230	--	--	--	Shore- pine/ Sitka Spruce	--	--	--	--	CS S411, CL 5821

<b>2.3 HEADLANDS &amp; ROCKY ISLANDS</b>		
<b>GENERAL COMMENTS</b>	Headlands are marine/terrestrial ecotones typical of open rocky coasts. They are stressful, high energy environments. Coastal islands occur all along the coast except in the vicinity of the Columbia River mouth. Many support important sea bird colonies and hauling areas for marine mammals. Intertidal areas are subject to severe physical and chemical conditions. Some Oceanic habitats (e.g. Surfgrass) overlap with the Rocky Surf Zone.	
<b>TOPOGRAPHY AND SOILS</b>	Headlands are typically steep and precipitous. Soils are generally local in origin and derived from basalt north of Cape Blanco and of sedimentary material south of the Cape. Cliffs can drop directly into the marine system to moderate depths. Slumping of cliffs is the sediment source for many local beaches.	
<b>CLIMATE</b>	Climate is maritime with fluctuations of temperature and precipitation muted. Mean temperature ranges between 5° and 8°C (41 to 46°F) for January and between 14° and 16°C (57 to 61°F) for July. Snow and heavy freezes are atypical. Winters are wet and cool with occasional storms generating heavy precipitation, extreme tidal ranges, and strong winds. Strong winds frequently break off trees and carry salt spray inland which strongly influences the makeup of the habitat.	
<b>HYDROLOGY</b>	The three major water inputs to the Above Tide area are winter precipitation, salt spray, and summer fog drip. Fresh water aquatic habitats are uncommon. Discharge is usually directly into the ocean. Waves are concentrated on headlands, and local currents can be severe.	
<b>ZONE &amp; HABITAT TYPES</b>		
 <p>2.3.1 A Unprotected</p>	 <p>2.3.1 B Protected</p>	 <p>2.3.2 A Headlands &amp; Rocky Islands</p>
<b>2.3.1 ROCKY SURF ZONE</b>		<b>2.3.2 ABOVE TIDE ROCKY SHORE ZONE</b>

2.0 COASTAL ZONES (continued)	Society of American Foresters 1954	Hedgpeth 1966A	Ricketts & Calvin 1968	Franklin & Dyrness 1973	Beak 1975	A.C.O.E. 1975F	Cheatham & Haller 1976	Cowardin et al. 1977	Hall 1977
2.3 Headland and Rocky Island Zones	--	--	--	--	--	--	--	Rocky Shore	--
2.3.1 Rocky Surf Zone	--	Littoral (Inter- tidal)	--	--	High Int. Middle Int. Low Int.	--	--	Rocky Shore	--
A Unprotected	--	--	Open Coast, Rocky Shores	--	Solid Rock, Boulder	Rocky Shore	Unprotected Rocky Shore	--	--
B Protected	223, 225	--	Protected Outer Coast Rocky Shore	--	Solid Rock, Boulder	Rocky Shore	Protected Rocky	--	--
2.3.2 Above Tide Rocky Shore Zone	--	Supra- littoral Zone	--	Headlands	--	--	--	Rocky Shore	--
A Headlands & Rocky Islands	--	--	--	Headlands	--	--	Northern Coastal Bluff Scrub, Northern Coastal Scrub, Coastal Prairie	--	SM89, MW99, FX

<b>3.0 OCEANIC ZONES</b>	
<b>GENERAL COMMENTS</b>	In neritic zone (near shore, over continental shelf), Northeastern Pacific surface waters (upper 200 m) mix with runoff and upwelling deeper ocean waters. Runoff recharges nutrient supply during winter. Spring diatom bloom rapidly depletes this supply, but upwelling continually replaces limiting nutrient, chiefly nitrate, sometimes also silicate (Anderson, G. C., 1972). Annual rate of production is over 300 gC/m <sup>2</sup> , more than 6 times the average productivity of the whole ocean, including neritic zone (Curl, 1970).
<b>BATHYMETRY AND SEDIMENTS</b>	Continental shelf relatively flat and featureless. Slopes steeper near shore and outer edge than in wider central area. Slopes steepen and shelf narrows from north to south. Recent sands lie inshore, muddy sediments seaward. Relict sands exposed at places along outer edge. Rocky banks occur irregularly, often associated with headlands. Thickness of sediments is in dynamic equilibrium, accreting in summer, eroding in winter (Bourke et al., 1971; Kulm et al., 1975).
<b>CLIMATE</b>	Small seasonal variation in temperature means range only 4°C (39°F). Large differences in wind and precipitation; prevailing winter winds are southwesterly, bringing storms to the coast; summer winds are mostly from the northwest at speeds usually lower than in winter. About 80% of the annual precipitation occurs from October to March. Shore station precipitation data overestimates rainfall at sea by a factor of 2 to 4 (Elliott et al., 1971). Dense fogs, related to upwelling of colder waters, occur most frequently from midsummer to fall, averaging 3 to 8 days per month (OIW, 1977).
<b>HYDROGRAPHY</b>	Salinity of surface waters varies widely, from 20 to 34‰, altered by runoff and upwelling. Runoff lowers surface salinity to <32.5‰. Upwelling increases surface water salinity to >32.5‰ in summer. Water temperature varies from a mean high of 17.7°C (64°F) to a mean low of 7.6°C (46°F), but annual mean temperature range is only 5°C (41°F), from 14°C (57°F) in summer to 9°C (48°F) in winter. Both highest and lowest temperatures occur in summer during upwelling (Bourke et al., 1971).

**ZONE & HABITAT TYPES**

									
<b>3.1.1 A</b> Euphotic	<b>3.1.2 A</b> Disphotic	<b>3.2.1 A</b> Rocky	<b>3.2.1 B</b> Mud	<b>3.2.1 C</b> Muddy Sand	<b>3.2.1 D</b> Sand	<b>3.2.2 A</b> Kelp	<b>3.2.2 B</b> Surfgrass		
<b>3.1.1 EUPHOTIC PELAGIC ZONE</b>		<b>3.1.2 DISPHOTIC PELAGIC ZONE</b>		<b>3.2.1 NON-VEGETATED BENTHIC ZONE</b>				<b>3.2.2 VEGETATED BENTHIC ZONE</b>	
<b>3.1 PELAGIC OCEANIC ZONES</b>				<b>3.2 BENTHIC OCEANIC ZONES</b>					

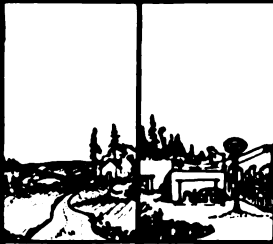
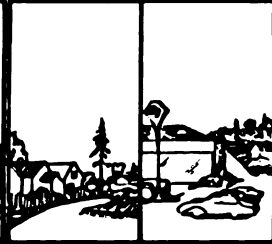

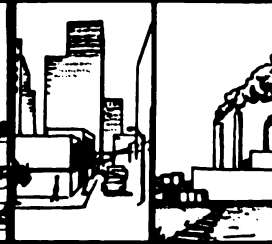

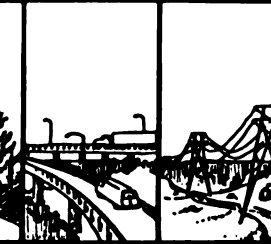



	Sverdrup et al. 1942	Hedgpeth 1966A	Ricketts & Calvin 1968	Thorson 1971	Byrne & Panshin 1968	Beak 1975	A.C.O.E. 1975F	Cowardin et al. 1977	Hall 1977
3.0 OCEANIC ZONES	Neritic Province	Neritic Zone	--	Sub-littoral Zone	--	--	--	Marine System	OC
3.1 Pelagic Zones	Pelagic	Pelagic	--	Pelagic	--	--	--		
3.1.1 Euphotic Pelagic Zone	Euphotic Zone	Photic	--	Photic Zone	--	Surface	Open Salt Water	--	--
A Euphotic	Euphotic Zone	Photic	--	Photic Zone	--	Surface	Open Salt Water	--	--
3.1.2 Disphotic Pelagic Zone	Disphotic Zone	--	--	Meso-pelagial	--	Mid-Water	--	--	--
A Disphotic	Disphotic Zone	--	--	Meso-pelagial	--	Mid-Water	--	--	--
3.2 Benthic Zones	Benthic (Ocean Floor)	Benthic (Bottom)	--	Bottom Benthic	Bottom	Subtidal Non-photo-synthetic	--	--	--
3.2.1 Non-vegetated Benthic Zone	Sublittoral	Outer Sublittoral	--	--	--	--	--	Rock & Unconsolidated Bottoms	--
A Rocky	--	--	--	Rocky	Rock	Rock Boulder	--	Boulder & Cobble/Gravel	--
B Mud	--	--	--	Mud	Mud	Silt & Clay	--	Mud	--
C Muddy Sand	--	--	--	Mud & Sand	Muddy Sand	Mixed - Very Fine	--	--	--
D Sand	--	--	--	Sand	Sand	Sand	--	Sand	--
3.2.2 Vegetated Benthic Zone	Eulittoral	Inner Sublittoral	--	--	--	Subtidal, Photo-synthetic	--	Aquatic Bed	--
A Kelp	--	--	Zone 4 Laminarian Zone	--	--	Kelp	--	Submergent Algal	--
B Surfgrass	--	--	Zone 4 Phyllospadix	--	--	--	--	Submergent Vascular	--

## 4.1 HUMAN ACTIVITY ZONES - INLAND

<p><b>GENERAL COMMENTS</b></p>	<p>These zones are modified and managed for human use and are generally characterized by the continuing presence of man and his activities in varying degrees. They are prepared and maintained in an artificial or highly modified state. The zones are classified by the intensity and type of man's activities and, thus, the degree of departure from the surrounding natural zone. The resulting habitats will contain species planned by man such as lawn grass, shrubs, and pets; adaptable local species such as blackberries and gulls; and exotic species that are attracted to man's activities such as English sparrows and rats. Increasing waste export is a characteristic of urbanization.</p>
<p><b>TOPOGRAPHY AND SOILS</b></p>	<p>Building sites are selected for utilitarian and aesthetic factors including, among others: access to transportation, utilities, population, markets, jobs, view, recreation, climate, topography, drainage, and physical properties of soils. Topography may be extensively modified to provide sites for construction and other activities; streams are often diverted or channelized. This usually means destruction of existing soil structure by grading and filling, covering ground with buildings and pavements, production of fill or spoil banks, and creation of new surface soils for managed vegetation.</p>
<p><b>CLIMATE</b></p>	<p>Except for some air pollution and smog, there is little modification of climate due to human activity in the study region. Microclimatic changes, as in local fog and frost patterns, may occur where air flow patterns are affected by structures, topographic changes, cleared and paved areas, or by waste heat, such as thermal effluents. Rainfall is adequate through most of the year; in summer, lawns and other landscaped areas are usually watered. Coastal fogs extend inland to the mountains and may make a significant contribution of moisture to vegetation and soils. Subject to occasional severe storms.</p>
<p><b>HYDROLOGY</b></p>	<p>Runoff is usually modified and managed for human activity. Changes include dams and dikes, establishing new drainage patterns, rerouting and channelizing streams, extensive modification of ground cover and soil permeability, tapping and disruption of aquifers, and installation of storm and sanitary sewers. Surface runoff is faster. Storm peaks are shorter and higher. Surface pollutants, including fertilizer and spray residues, are washed directly into storm sewers. There is some irrigation and potential for more extensive development.</p>

### HABITAT TYPES


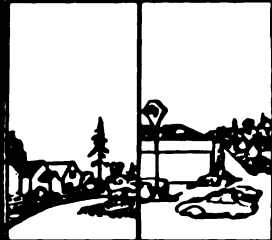
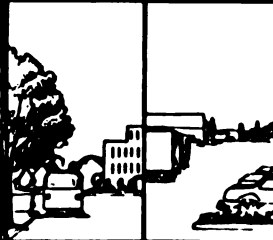
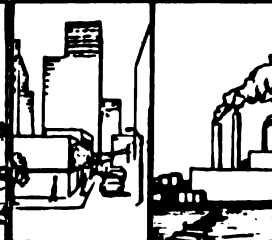
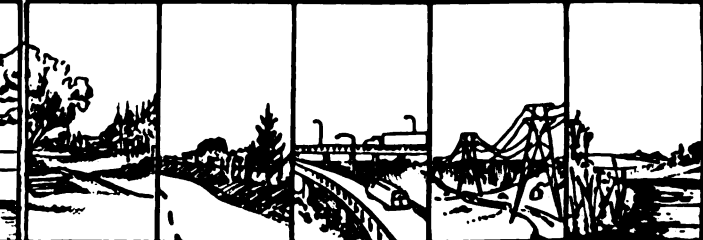
													
4.1.1 A Residential	4.1.1 B Commercial	4.1.2. A Residential	4.1.2 B Commercial	4.1.3 A Res.-Com.	4.1.3 B Industrial	4.1.4 A Res.-Com.	4.1.4 B Heavy Industrial	4.1.4 A Parks & Greenbelts	4.1.5 B Hedgerows	4.1.5 C Transportation Corridors	4.1.5 D Utility Corridors	4.1.5 E Waterways	
<b>RURAL and HAMLET ZONE</b>		<b>VILLAGE and SUBURBAN ZONE</b>		<b>LIGHT URBAN ZONE</b>		<b>DENSE URBAN ZONE</b>		<b>BUFFER and CONNECTOR ZONE</b>					

	URA-BPR, 1965	Gwynn, 1968	Fabos et al., 1973	Anderson et al., 1976
4.0 HUMAN ACTIVITY ZONES	1 Urban or built-up land	1 Urban Uses	--	1 Urban or built-up land
4.1 Inland Zones	--	--	--	--
4.1.1 Rural and Hamlet Zone	--	--	--	--
A Residential	11 Household units	A1 Detached sgl fam	UE Estates	111 single family
B Commercial	5 Trade, 7 Culture, entertmnt, rec	B Comm, Serv, 2 linear, 3 periph, 4 unstr'd	RFB Fr wtr snd bch RSK Alpine ski areas	12 Commercial services
4.1.2 Village and Suburban Zone	--	--	--	--
A Residential	11, 12 Group qtrs (apts)	A1, A2 Attached sgl fam A3 Attached Multi-fam	UCR Clustered residential	111, 112 Multi-fam
B Commercial	5,7,13 Res hotels, 14 Mob home parks & 15 Transient lodg	B1a Shop cntr, b unplnd, B2a Auto oriented, F1b Ath fld, & golf	RFB, RSK, UH Hwy (strip) commercial, US Shopping center	12
4.1.3 Light Urban Zone	--	--	--	--
A Residential and Commercial	11,12,13,14,15,5,7	A1,A2,A3	UA Garden Apts, UCR, RA Ath fld, RFB, RFG Fairgnd, RPG Playgnd UT Townhse	11 Residential, 12
B Industrial	2, 3 Mfg, 4 Transport'n, Comm'l & Util	C1b Open storage, C2a Light fabricating, F1a Stadium & Race tr	UR Urban Res, RC tennis ct, R1 Drive-in thtr, RS Swim pool, U/L Lt ind, UP Inst	15 Industrial & Comm'l complex
4.1.4 Dense Urban Zone	--	--	--	--
A Residential and Commercial	12,13,15,5,7	A3b Medium & high-rise apts	RAP Comm'l amusmt pk UC Urban core	11,12
B Industrial	2,3,4	C2b Heavy fabricating C2c Processing	U1 Hvy ind, UTA airpt, UTR Rail term, etc. UTT Truck term, etc.	15
4.1.5 Buffer and Connector Zone	--	--	--	--
A Parks and Greenbelts	76 Parks	F2a Park areas E5 Cemeteries	RG Golf, RP Urban pk, RT Race tr, UO Urban open land, + cemetery	17 other urban or built-up
B Hedgerows	--	--	--	2.2 Ornamental Horti-cult areas, 2 Ag
C Transportation Corridors	45 Hwy & st rt-of-way	D7 St & Hwy rt-of-way	HW Divided Highway	14 transportation
D Utility Corridors	Part of 48 Utilities	D6 Utility Transmission	--	14 comm'l & util
E Watercourses	93 Water areas	--	--	51 Streams & Canals

## 4.2 HUMAN ACTIVITY ZONES - COASTAL

<p><b>GENERAL COMMENTS</b></p>	<p>These zones are modified and managed for human use and are generally characterized by the continuing presence of man and his activities in varying degrees. They are prepared and maintained in an artificial or highly modified state. The zones are classified by the intensity and type of man's activities and, thus, the degree of departure from the surrounding natural zone. The resulting habitats will contain species planned by man such as lawn grass, shrubs, and pets; adaptable local species such as blackberries and gulls; and exotic species that are attracted to man's activities such as English sparrows and rats. Coastal Zones include activities and developments on or near the shorelines and estuaries.</p>
<p><b>TOPOGRAPHY AND SOILS</b></p>	<p>Building sites are selected for utilitarian and aesthetic factors including, among others: access to transportation, utilities, population, markets, jobs, view, recreation, climate, topography, drainage, and physical properties of soils. Topography may be extensively modified to provide sites for construction and other activities; watercourses are often diverted or channelized. This usually means destruction of existing soil structure by grading and filling, covering ground with buildings and pavements, production of fill or spoil banks, and creation of new surface soils for managed vegetation. Beach and dune stabilization programs occur in some areas, and portions of many estuaries have been filled.</p>
<p><b>CLIMATE</b></p>	<p>Except for some air pollution and smog, there is little modification of climate due to human activity in the study region. Microclimatic changes, as in local fog and frost patterns, may occur where air flow patterns are affected by structures, topographic changes, cleared and paved areas, and by waste heat. The micro-climatic influences of the ocean (temperature, humidity, fog) are more pronounced than in the Inland Zones, with the added factor of salt spray near the water and for some distance inland during storms. Rainfall is generally adequate except in summer.</p>
<p><b>HYDROLOGY</b></p>	<p>Runoff is usually modified and managed for human activity. Changes include dams and dikes, establishing new drainage patterns, rerouting and channelizing streams, extensive modification of ground cover and soil permeability, tapping and disruption of aquifers, installation of storm and sanitary sewers, piers, breakwaters, jetties, and channel dredging. Surface runoff is faster; storm peaks are quicker and higher. Fertilizers and spray residues enter streams directly. Some irrigation occurs, with potential for more. The Coastal Zones are subject to occasional severe storms and "100-year" tides, as well as tsunamis.</p>

### HABITAT TYPES

												
4.2.1 A Residential	4.2.1 B Commercial	4.2.2 A Residential	4.2.2 B Commercial	4.2.3 A Res.-Com.	4.2.3 B Industrial	4.2.4 A Res.-Com.	4.2.4 B Heavy Industrial	4.2.5 A Parks & Greenbelts	4.2.5 B Hedgerows	4.2.5 C Transportation Corridors	4.2.5 D Utility Corridors	4.2.5 E Waterways
<b>RURAL and HAMLET ZONE</b>		<b>VILLAGE and SUBURBAN ZONE</b>		<b>LIGHT URBAN ZONE</b>		<b>DENSE URBAN ZONE</b>		<b>BUFFER and CONNECTOR ZONE</b>				

#### 4.0 HUMAN ACTIVITY ZONES (Continued)

##### 4.2 Coastal Zones

##### 4.2.1 Rural and Hamlet Zone

A Residential

B Commercial

##### 4.2.2 Village and Suburban Zone

A Residential

B Commercial

##### 4.2.3 Light Urban Zone

A Residential and Commercial

B Industrial

##### 4.2.4 Dense Urban Zone

A Residential and Commercial

B Industrial

##### 4.2.5 Buffer and Connector Zone

A Parks and Greenbelts

B Hedgerows

C Transportation Corridors

D Utility Corridors

E Watercourses

#### Notes:

1. Classification comparisons are the same as for 4.1 Inland Zones except, under Fabos et al., 1973, delete RFB Freshwater Sandy Beaches and substitute Saltwater Sandy Beaches (not in Fabos' system).
2. "... the abundance of wildlife in any given place is a function of many parameters such as quantity, quality, and distribution of vegetative cover; climate; topography; and land use." - Fabos et al., 1973, p. 59.
3. Anderson et al., (1976), relate Standard Land Use Code to remote sensor data.
4. Clawson and Stewart (1965) review land use classification.
5. Re 4.1.3B, as habitats, tennis courts and swim pools often look more like industrial areas than residential and commercial.
6. Re 4.1.3B and 4.1.4B, Standard Land Use Code (URA-BPR, 1965) is based in part on Standard Industrial Classification Manual 1957.

## Chapter Two — MODELING WITHIN THE ENVIRONMENT

<u>Section</u>	<u>Page</u>
2.1 HIERARCHY OF ZONES, HABITATS, AND MODELS.....	2-1
2.1.1 Geographical Setting .....	2-1
2.1.2 Biological Zones, Habitats, Succession, and Cycles.....	2-1
2.1.3 Zone and Habitat Specific Models.....	2-1
2.1.4 Hierarchical Arrangement.....	2-2
2.2 MODEL FORMATS.....	2-2
2.2.1 Pictures and Symbols.....	2-2
2.2.2 Community Composition.....	2-2
2.3 HABITAT MODELS MATRIX.....	2-2

### 2.1 HIERARCHY OF ZONES, HABITATS, AND MODELS

2.1.1 Geographical Setting. The watershed was chosen as the basic, geographically defined area in the terrestrial portion of the study region. For convenience in organization and study, these were grouped into nine Watershed Units (see Introduction, Section ii and Figure 1) along boundaries that provide units having generally similar physiographic, climatic, and hydrologic features. The oceanic portion of the study area, over the continental shelf, is influenced by the drainage, sediment transport, etc., from the watersheds, but is largely independent of these divisions and has been designated as Unit #10 for reference purposes.

Within a watershed, the general ecological divisions are as shown in Figure 2 (which is repeated from the Introduction on the same page as (p. 2-6) Table 2-1). These divisions form the framework of the zonation outlined in Table 1 in the Introduction (p. xii) and correspond directly to the groups of zones, and "super zones" (Alpine Highlands, Beaches and Dunes, etc.) in that table.

2.1.2 Biological Zones, Habitats, Succession, and Cycles. The basic ecological unit in this classification system is the biological zone, environmentally determined by topography, soils, climate, and hydrology on land, by light penetration, substrate, tidal cycles, and energy levels in aquatic, estuarine, and oceanic environments, and by degree of disturbance in human activity areas. These parameters combine to establish a number of distinct environments either favorable to the growth and dominance of characteristic plant communities (by which the zones and habitats are often named and described) or so harsh as to preclude significant plant growth (named and described by other characteristic factors).

Any major disruption of the plant community in these environments (such as by wildfire, landslide, clearcut, dredging, spoil dump) will ordinarily be followed by a regular succession of habitats until a steady state (e.g. old growth forest, kelp bed) is again established. As this succession of flora progresses, successional changes also occur among the fauna. Within each zone, habitats may be distinguished by the plant community, and a characteristic animal community will usually be found there.

Succession follows an irregular, or unusual event - a non-cyclic happening. The progression of seasons is not considered succession. Similarly, the annual processions of plankton or flowering plants, although sometimes referred to as successions are more strictly sequences or cycles and are labeled as such (e.g., Pelagic Seasonal Cycle Model). For convenience in indexing, these cyclic models are grouped with true succession models (as in column 3 of Table 2-1; 2.1-2).

2.1.3 Zone and Habitat Specific Models. Several kinds of models have been developed to show the dynamic, interactive nature of the regional ecosystems. These models, which are introduced in Section 3.2 of the Conceptual Model (Vol. I) and further developed in the same section of the Regional Synopsis (Vol. II), include food webs, community composition, succession, and ecosystem models.

Community Composition Models have been produced for each specific habitat by print-out from the Annotated Species List (Part 2 of the Data Source Appendix). From these, Food Web Models have been developed for selected habitats.

Ecosystem Models are also habitat-specific. Occasionally, however, it is convenient to include more than one habitat for modeling an ecosystem. An example is the Nonvegetated Benthic Zone where the four bottom-type habitats are included in one zone-level ecosystem model, the primary variable of which is substrate type.

Succession Models, and the accompanying Environmental Indices, are drawn at the zone level although all habitats in the zone may not be included. An example is the Western Hemlock Zone where aquatic and upland successions are separately modeled.

Annual sequences can be modeled at the zone or habitat level but few are included in this study. Seasonal information, where appropriate, is noted in Community Composition and Ecosystem Models.

2.1.4 Hierarchical Arrangement. This hierarchy of watersheds, zones, habitats, and models is illustrated in Figure 2-1. As shown at the top of the figure, the region is divided into watersheds, which have inland and coastal areas, plus the oceanic area over the continental shelf. The watersheds are grouped into watershed units in which inland and coastal biological zones are shown in the central part of the figure. Pelagic and Benthic Zones can be identified in the ocean. The distribution of inland biological zones, cutting across the Watershed Units, was shown in Figure 1-1 in this volume.

Modeling within the habitats is shown at the bottom of Figure 2-1 with an example of the estuary classification. The Habitat Description page is followed by one or more models as indicated by the dots. A complete listing of models is presented in Section 2.3, which follows.

Models at the zonal level, such as Western Hemlock Succession, mentioned in Section 2.1.3, will follow the appropriate zone description page. The zonal hierarchy is as shown in Table 1 in the Introduction.

## 2.2 MODEL FORMATS

2.2.1 Pictures and Symbols. Pictorial models, such as Figure 2-2, are attractive and the meaning is readily grasped. They are limited, however, in the amount of material that can be presented in a given space.

Symbolic diagrams, as in Figure 2-3, are less cluttered. Using a modified version of Odum's "energies" (H. T. Odum, 1971 and 1972), these symbolic diagrams present functional (producer, consumer, storage) information not easily represented in pictorial form. Additional information (regulating factors, process or transfer information) can be readily shown on the symbolic diagram.

An entire pictorial model (or sub-model) can be depicted by a symbol which is then used in a higher level model. A Food Web Model could thus be symbolized and used as a sub-unit in an Ecosystem Model. A series of basic industry models can be symbolized and incorporated into a major economic activity, as was done in Figure 4-12 of the Conceptual Model (Vol. 1).

Symbolic rather than pictorial representation is the primary mode of presentation in this study.

2.2.2 Community Composition. Computer search and print out is used to prepare the Community Composition Models. A more sophisticated presentation, including productivity rates and energy flow, is shown in the Conceptual Model (Fig. 3-7, Vol. 1) but is beyond the scope of the present study.

## 2.3 HABITAT MODELS MATRIX

Table 2-1 lists all the zones and habitats and shows, in matrix form, the models that have been included for each. The model columns are arranged in the table in the same order that the models will appear following the corresponding zone or habitat description page.

Each row of the Matrix shows, under appropriate column headings, the page numbers for the zone or habitat description and for the models that are presented. The Matrix is thus a Table of Contents for Part 2 (Section 4 of the Introduction explains the page numbering). A pictorial sketch and basic description are included for every habitat and for zones or "super zones" as discussed in Section 1.3. In the selection of models for inclusion, emphasis was placed on those habitats in which the U.S. Fish and Wildlife Service has major interest and responsibility.

Models for a particular habitat tend to be similar from zone to zone and are identical in some instances (see Notes to Table 2-1). In some of these instances, page number entries will refer to models for other habitats. Although models have not been prepared for all habitats, the array of models presented here provides a procedural approach for data collection and further analysis. Together with the Conceptual Model, these models provide a comprehensive framework for detailed characterization. Together with the Regional Synopsis, these Zone and Habitat Descriptions and models comprise a regional characterization.

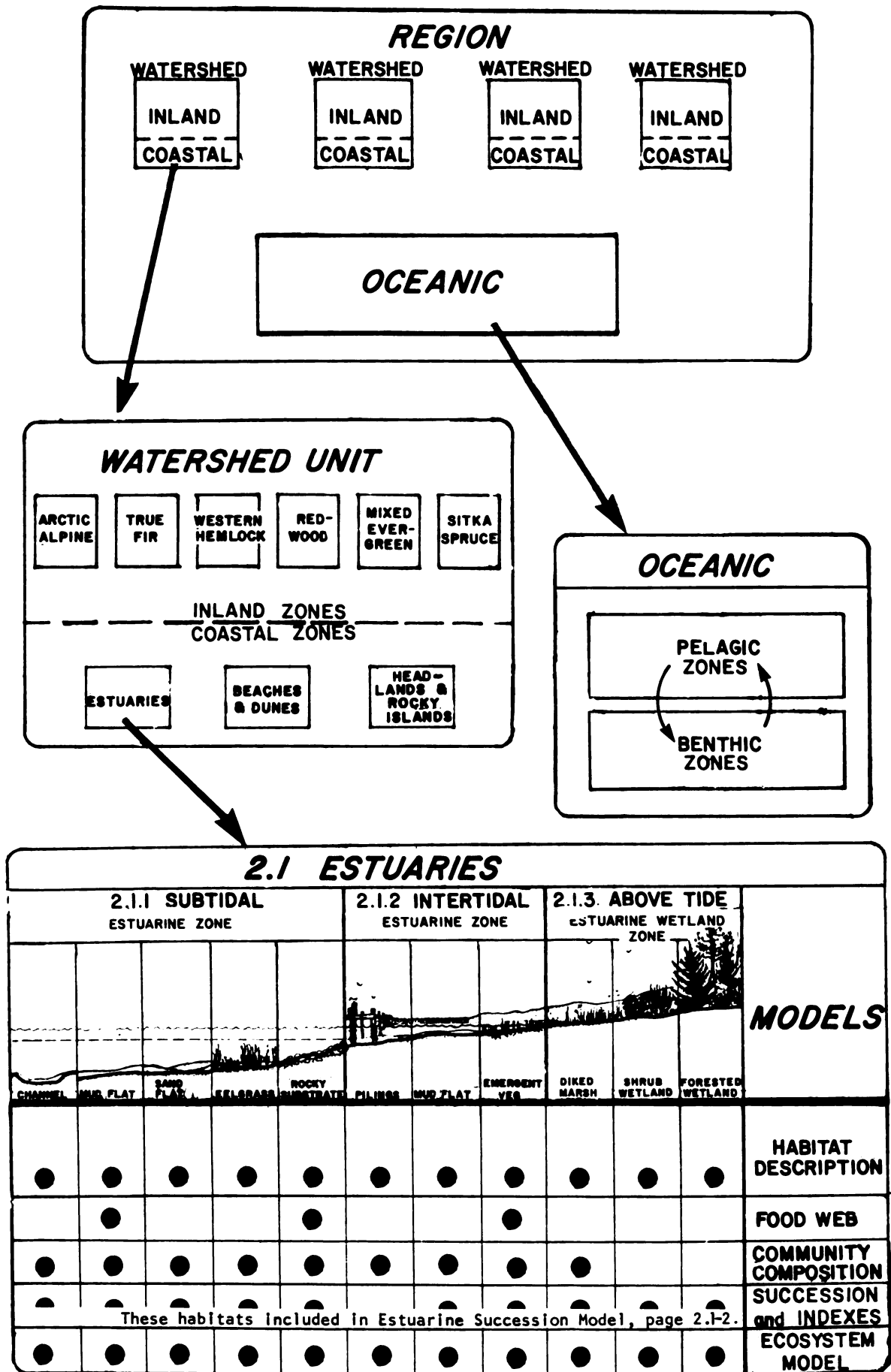
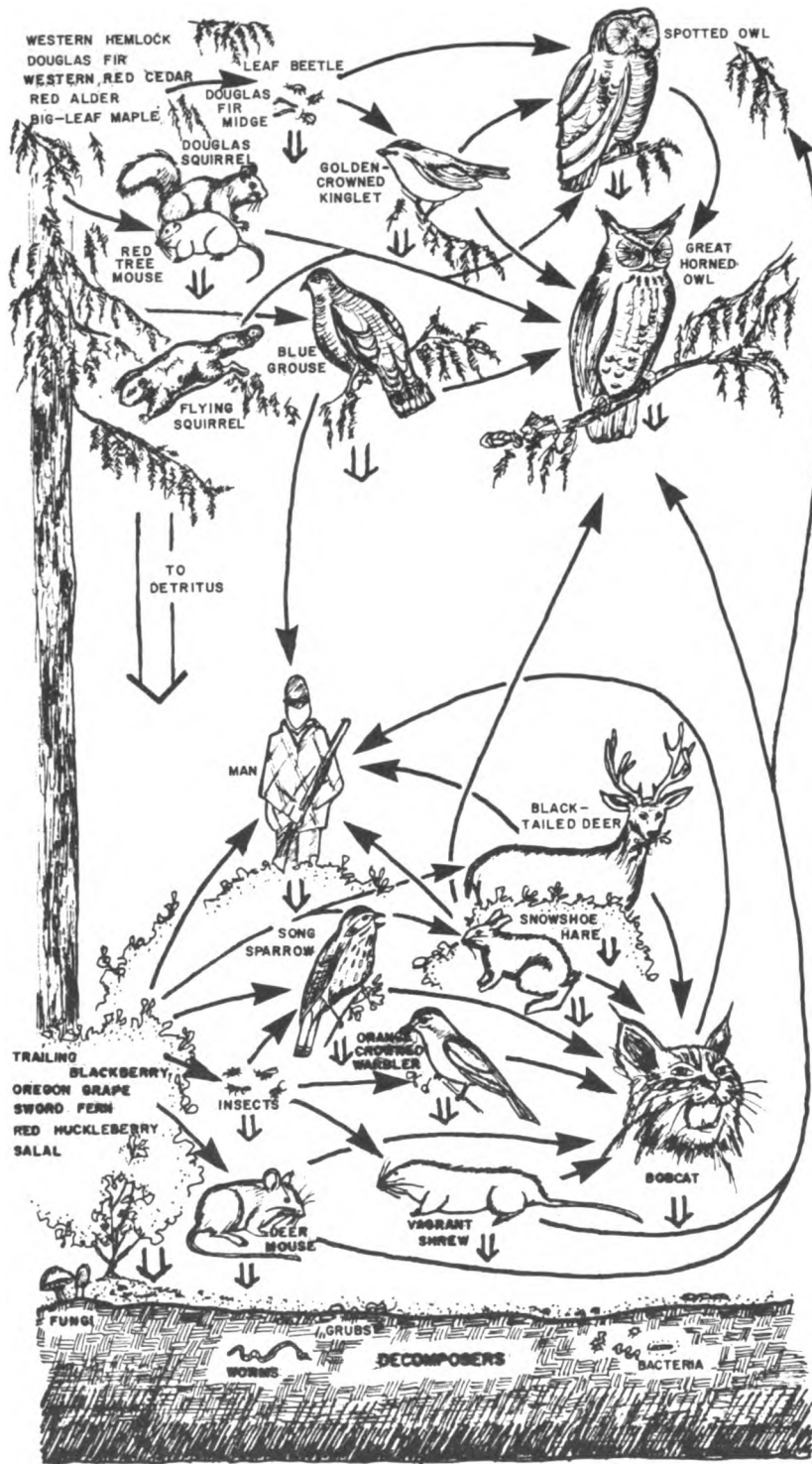


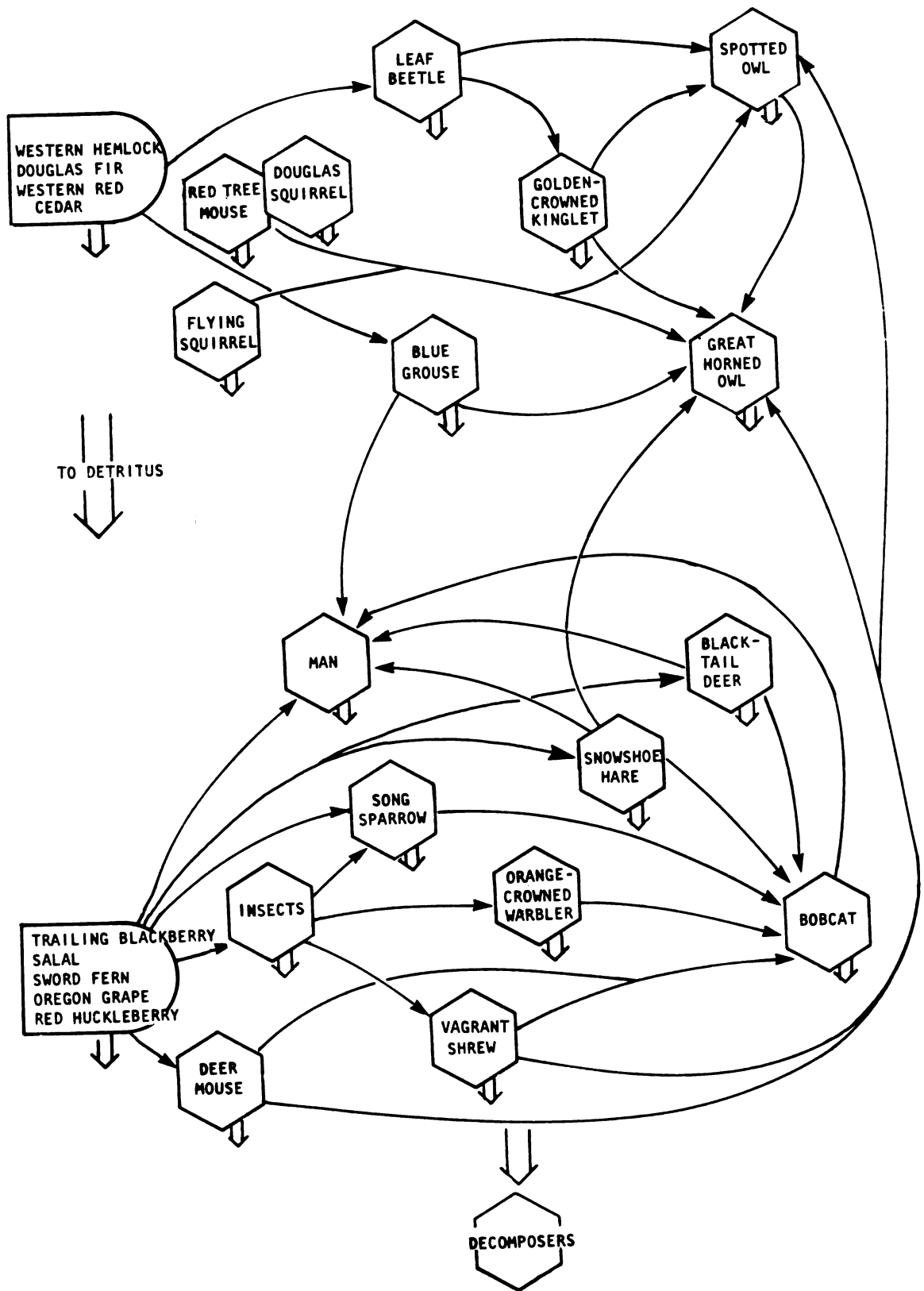
FIGURE 2-1. HIERARCHY OF ZONES, HABITATS, AND MODELS





**PICTORIAL FOOD WEB -  
OLD GROWTH WESTERN HEMLOCK**

FIGURE 2-2. HABITAT MODEL, PICTORIAL DIAGRAM. This is a draft model showing the same food web as the symbolic diagram on the facing page. The arrows indicate direction of energy flow.



**SYMBOLIC FOOD WEB -  
OLD GROWTH WESTERN HEMLOCK**

FIGURE 2-3. HABITAT MODEL, SYMBOLIC DIAGRAM. This is a draft model showing the same food web as the pictorial diagram on the facing page.

Figure 2-4.  
GENERAL DIVISIONS OF A COASTAL WATERSHED

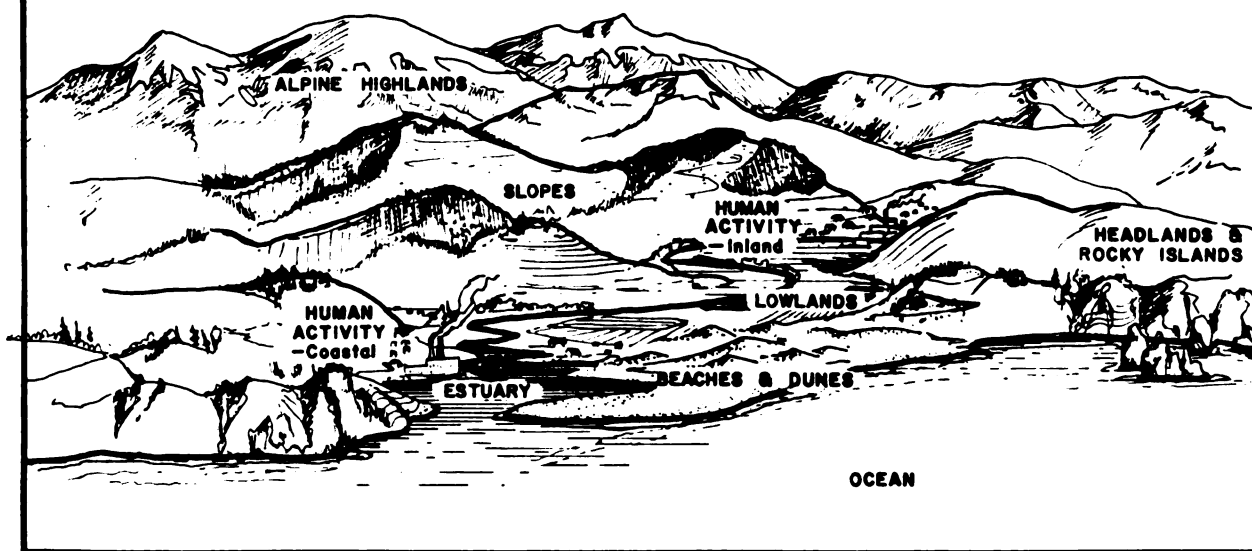


TABLE 2-1. HABITAT MODELS MATRIX<sup>1</sup>

Biological Zonation	Description Page	Food Web Model	Community Composition	Succession Model	Environmental Indices	Ecosystem Model
1.0 INLAND ZONES						
1.1 Alpine Highlands						
1.1.1 Arctic Alpine Zone	1.1.1-1					
A Lacustrine	1.1.1A-1			1.1.1A-2	(1.2.1A-2)	(1.2.1A-3)
B Palustrine	1.1.1B-1			1.1.1B-2	(1.2.1A-2)	(1.2.1A-3)
C Riverine	1.1.1C-1			1.1.1C-2		
D Tundra/Alpine	1.1.1D-1			1.1.1D-2		
E Rocklands	1.1.1E-1			1.1.1E-2		
F Ice Fields/Glaciers	1.1.1F-1					
1.1.2 True Fir Zone <sup>2</sup>	1.1.2-1					
A Lacustrine	1.1.2A-1			1.1.2A-2	(1.2.1A-2)	(1.2.1A-3)
B Palustrine	1.1.2B-1			1.1.2B-2	(1.2.1A-2)	(1.2.1A-3)
C Riverine	1.1.2C-1			1.1.2C-2		(1.2.1C-2)
D Early Seral Shrub	1.1.2D-1				(1.1.1-2)	(1.2.1-3) (1.2.1G-2)
E Second Growth Forest	1.1.2E-1				(1.1.1-2)	(1.2.1-3) (1.2.1H-2)
F Old Growth Forest	1.1.2F-1				(1.1.1-2)	(1.2.1-3) (1.2.1K-9)
G Sub-Alpine Meadow	1.1.2G-1					
H Rockland/Talus	1.1.2H-1					

<sup>1</sup> See Notes on Using the Matrix at the end of this table.

<sup>2</sup> Ecosystems and processes in this zone are similar to those in lowland zones but not identical so model page numbers are in parentheses.

TABLE 2-1. Habitat Models Matrix<sup>1</sup>  
(continued)

Biological Zonation		Description Page	Food Web Model	Community Composition	Succession Model	Environmental Indices	Ecosystem Model
<b>1.2 Slopes and Lowlands</b>							
<b>1.2.1 Western Hemlock Zone</b>							
A	Lacustrine	1.2.1A-1			1.2.1-2	1.2.1-3	
B	Palustrine	1.2.1B-1			1.2.1A-2	1.2.1A-3	1.2.1A-4
					1.2.1A-2	1.2.1A-3	1.2.1B-2
C	Riverine	1.2.1C-1					1.2.1C-2
D	Riparian	1.2.1D-1					1.2.1D-2
E	Agricultural Lands	1.2.1E-1					
F	Early Seral Grasslands/Pasture	1.2.1F-1			1.2.1-2	1.2.1-3	
G	Early Seral Shrub	1.2.1G-1			1.2.1-2	1.2.1-3	1.2.1G-2
H	Second Growth Forest (Broadleaf)	1.2.1H-1			1.2.1-2	1.2.1-3	1.2.1H-2
I	Second Growth Forest (Mixed)	1.2.1I-1			1.2.1-2	1.2.1-3	1.2.1H-2
J	Second Growth Forest (Conifer)	1.2.1J-1			1.2.1-2	1.2.1-3	1.2.1H-2
K	Old Growth Forest	1.2.1K-1	1.2.1K-2	1.2.1K-3	1.2.1-2	1.2.1-3	1.2.1K-9
<b>1.2.2 Redwood Zone</b>							
A	Lacustrine	1.2.2A-1			1.2.2-2		
B	Palustrine	1.2.2B-1			1.2.1A-2	1.2.1A-3	1.2.1A-4
					1.2.1A-2	1.2.1A-3	1.2.1B-2
C	Riverine	1.2.2C-1					1.2.1C-2
D	Riparian	1.2.2D-1					1.2.1D-2
E	Agricultural Lands	1.2.2E-1					
F	Early Seral Grasslands/Pasture	1.2.2F-1					
G	Early Seral Shrub	1.2.2G-1			1.2.2-2		1.2.1G-2
H	Second Growth Forest (Broadleaf)	1.2.2H-1			1.2.2-2		1.2.1H-2
I	Second Growth Forest (Mixed)	1.2.2I-1			1.2.2-2		1.2.1H-2
J	Second Growth Forest (Conifer)	1.2.2J-1			1.2.2-2		1.2.1H-2
K	Old Growth Forest	1.2.2K-1			1.2.2-2		1.2.1K-9
<b>1.2.3 Mixed Evergreen Zone</b>							
A	Lacustrine	1.2.3A-1			1.2.1-2	1.2.1-3	
B	Palustrine	1.2.3B-1			1.2.1A-2	1.2.1A-3	1.2.1A-4
					1.2.1A-2	1.2.1A-3	1.2.1B-2
C	Riverine	1.2.3C-1					1.2.1C-2
D	Riparian	1.2.3D-1					1.2.1D-2
E	Serpentine	1.2.3E-1					
F	Early Seral Grasslands/Pasture	1.2.3F-1					
G	Early Seral Shrub	1.2.3G-1			1.2.1-2	1.2.1-3	1.2.1G-2
H	Second Growth Forest (Broadleaf)	1.2.3H-1			1.2.1-2	1.2.1-3	1.2.1H-2
I	Second Growth Forest (Mixed)	1.2.3I-1			1.2.1-2	1.2.1-3	1.2.1H-2
J	Second Growth Forest (Conifer)	1.2.3J-1			1.2.1-2	1.2.1-3	1.2.1H-2
K	Old Growth Forest	1.2.3K-1			1.2.1-2	1.2.1-3	1.2.1K-2
<b>1.2.4 Sitka Spruce Zone</b>							
A	Lacustrine	1.2.4A-1			1.2.1-2	1.2.1-3	
B	Palustrine	1.2.4B-1			1.2.1A-2	1.2.1A-3	1.2.1A-4
					1.2.1A-2	1.2.1A-3	1.2.1B-2
C	Riverine	1.2.4C-1					1.2.1C-2
D	Riparian	1.2.4D-1					1.2.1D-2
E	Agricultural Lands	1.2.4E-1					
F	Early Seral Grasslands/Pasture	1.2.4F-1			1.2.1-2	1.2.1-3	
G	Early Seral Shrub	1.2.4G-1			1.2.1-2	1.2.1-3	1.2.1G-2
H	Second Growth Forest (Broadleaf)	1.2.4H-1			1.2.1-2	1.2.1-3	1.2.1H-2
I	Second Growth Forest (Mixed)	1.2.4I-1			1.2.1-2	1.2.1-3	1.2.1H-2
J	Second Growth Forest (Conifer)	1.2.4J-1			1.2.1-2	1.2.1-3	1.2.1H-2
K	Old Growth Forest	1.2.4K-1			1.2.1-2	1.2.1-3	1.2.1K-9

TABLE 2-1. Habitat Models Matrix<sup>1</sup>  
(continued)

<u>Biological Zonation</u>	<u>Description Page</u>	<u>Food Web Model</u>	<u>Community Composition</u>	<u>Succession Model</u>	<u>Environmental Indices</u>	<u>Ecosystem Model</u>
<b>2.0 COASTAL ZONES</b>						
<b>2.1 Estuaries</b>	2.1-1			2.1-2		2.1-3
<b>2.1.1 Subtidal Estuarine Zone</b>						
A Channel	2.1.1A-1		2.1.1A-2			2.1.1A-7
B Mud Flat	2.1.1B-1	2.1.1B-2	2.1.1B-3	2.1-2		2.1.1B-5
C Sand Flat	2.1.1C-1		2.1.1C-2	2.1-2		2.1.1C-6
D Eelgrass	2.1.1D-1		2.1.1D-2			2.1.1D-5
E Rocky Substrate	2.1.1E-1	2.1.1E-2	2.1.1E-3			2.1.1E-8
<b>2.1.2 Intertidal Estuarine Zone</b>						
A Pilings	2.1.2A-1		2.1.2A-2			2.1.2A-4
B Mud Flat	2.1.2B-1		2.1.2B-2	2.1-2		2.1.1B-5
C Emergent Vegetation	2.1.2C-1	2.1.2C-2	2.1.2C-3	2.1-2		2.1.2C-6
<b>2.1.3 Above Tide Estuarine Wetland Zone</b>						
A Diked Marsh	2.1.3A-1		2.1.3A-2	2.1-2		2.1.3A-5
B Shrub Wetland	2.1.3B-1		1.2.4G	2.1-2		1.2.1G-2
C Forested Wetland	2.1.3C-1		1.2.4I	2.1-2		1.2.1H-2
<b>2.2 Beaches and Dunes</b>	2.2-1			2.2-2	2.2-3	
<b>2.2.1 Beach Surf Zone</b>						
A Unprotected Beach	2.2.1A-1	2.2.1A-2		2.2-2	2.2-3	2.2.1A-3
B Protected Beach	2.2.1B-1			2.2-2	2.2-3	2.2.1A-3
<b>2.2.2 Above Tide Beach and Dune Zone</b>						
A Foredune	2.2.2A-1			2.2-2	2.2-3	2.2.2A-2
B Deflation Plain	2.2.2B-1			2.2-2	2.2-3	2.2.2B-2
C Dune Marsh	2.2.2C-1			2.2-2	2.2-3	2.2.2C-2
D Active Dune	2.2.2D-1			2.2-2	2.2-3	2.2.2D-2
E Dune Lake	2.2.2E-1	2.2.2E-2		2.2-2	2.2-3	2.2.2E-3
F Stabilized Dune	2.2.2F-1			2.2-2	2.2-3	2.2.2F-2
<b>2.3 Headlands and Rocky Islands</b>	2.3-1					
<b>2.3.1 Rocky Surf Zone</b>						
A Unprotected	2.3.1A-1					2.3.1A-2
B Protected	2.3.1B-1					2.3.1A-2
<b>2.3.2 Above Tide Rocky Shore Zone</b>						
A Headlands and Rocky Islands	2.3.2A-1					2.3.2A-2
<b>3.0 OCEANIC SHELF ZONES</b>	3.0-1					
<b>3.1 Pelagic Oceanic Zones</b>						
<b>3.1.1 Euphotic Pelagic Zone</b>						
A Euphotic	3.1.1A-1					3.1.1A-2
<b>3.1.2 Disphotic Pelagic Zone</b>						
A Disphotic	3.1.2A-1					3.1.2A-2
<b>3.2 Benthic Oceanic Zones</b>						
<b>3.2.1 Non-vegetated Benthic Zone</b>						3.2.1-2
A Rocky	3.2.1A-1					3.2.1-2
B Mud	3.2.1B-1					3.2.1-2
C Muddy Sand	3.2.1C-1					3.2.1-2
D Sand	3.2.1D-1					3.2.1-2
<b>3.2.2 Vegetated Benthic Zone</b>						3.2.2-2
A Kelp	3.2.2A-1					3.2.2-2
B Surfgrass	3.2.2B-1					3.2.2-2

TABLE 2-1. Habitat Models Matrix<sup>1</sup>  
(continued)

Biological Zonation	Description Page	Food Web Model	Community Composition	Succession Model	Environmental Indices	Ecosystem Model
4.0 HUMAN ACTIVITY ZONES						
4.1 Inland	4.1-1			4.1-2	4.1-3	
4.1.1 Rural and Hamlet Zone				4.1-2	4.1-3	
A Residential	4.1.1A-1					
B Commercial	4.1.1B-1					
4.1.2 Village and Suburban Zone				4.1-2	4.1-3	
A Residential	4.1.2A-1					
B Commercial	4.1.2B-1					
4.1.3 Light Urban Zone				4.1-2	4.1-3	
A Residential and Commercial	4.1.3A-1					4.1.3A-2
B Industrial	4.1.3B-1					
4.1.4 Dense Urban Zone				4.1-2	4.1-3	
A Residential and Commercial	4.1.4A-1					
B Industrial	4.1.4B-1					
4.1.5 Buffer and Connector Zone					4.1-3	
A Parks and Greenbelts	4.1.5A-1				4.1-3	
B Hedgerows	4.1.5B-1				4.1-3	
C Transportation Corridors	4.1.5C-1				4.1-3	
D Utility Corridors	4.1.5D-1				4.1-3	
E Waterways	4.1.5E-1				4.1-3	
4.2 Coastal	4.2-1			4.2-2	4.2-3	
4.2.1 Rural and Hamlet Zone				4.2-2	4.2-3	
A Residential	4.2.1A-1					
B Commercial	4.2.1B-1					
4.2.2 Village and Suburban Zone				4.2-2	4.2-3	
A Residential	4.2.2A-1					
B Commercial	4.2.2B-1					
4.2.3 Light Urban Zone				4.2-2	4.2-3	
A Residential and Commercial	4.2.3A-1					4.2.3A-2
B Industrial	4.2.3B-1					
4.2.4 Dense Urban Zone				4.2-2	4.2-3	
A Residential and Commercial	4.2.4A-1					
B Industrial	4.2.4B-1					
4.2.5 Buffer and Connector Zone					4.2-3	
A Parks and Greenbelts	4.2.5A-1				4.2-3	
B Hedgerows	4.2.5B-1				4.2-3	
C Transportation Corridors	4.2.5C-1				4.2-3	
D Utility Corridors	4.2.5D-1				4.2-3	
E Waterways	4.2.5E-1				4.2-3	

Notes on Using the Matrix

1. This Matrix serves as a Table of Contents for Part 2 of this volume.
2. Entries in the Matrix are page numbers where particular models and description pages may be found in Part 2.
3. In general, models will be similar from zone to zone for a particular habitat.
4. Identical models are not repeated so a page number for the first habitat will be used. Thus the Ecosystem Model for 2.1.3 B Shrub Wetland is on page 1.2.1G-2.
5. Succession Models cover several habitats. They will be with the zone or the first seral stage and the page number will be repeated for subsequent stages.
6. Where no page number appears in the Matrix, no model was prepared

ECOLOGICAL CHARACTERIZATION  
OF THE  
PACIFIC NORTHWEST COASTAL REGION

VOLUME THREE  
CHARACTERIZATION ATLAS  
ZONE AND HABITAT DESCRIPTIONS

**Part Two**

**ZONE AND HABITAT DESCRIPTIONS**

<u>Section</u>	<u>Pages</u>
Notes for Part 2 .....	- (over)
Description and Model Pages .....	1.1.1 - 1, et seq.

(See Table 2-1 for complete listing.)

## NOTES FOR PART 2

1. This part of Volume 3 contains description pages for the zones and for each of the habitats within zones. A Community Composition list for each habitat has been printed out from the Annotated Species List, described briefly in Chapter 2 of Part 1 and which appears in full as Part 2 of Volume 5, the Data Source Appendix. Food web models have been prepared from the community composition print-outs for selected habitats.

These and other models follow the habitat (or zone) description pages. The models that have been prepared for each habitat (or zone) are listed in Table 2-1, which is, in effect, a table of contents for this part of the volume.

2. Processes in the inland zones tend to be very similar from one to another so that Ecosystem and Succession models for different forest zones will differ only in relatively minor detail, and sometimes not at all. Community Composition and Food Webs will be quite distinctive but Freshwater Aquatic (Lacustrine) Succession will be almost identical from zone to zone. Where a model has not been included for a particular zone or habitat, therefore, the model from another zone will often serve.
3. Succession models (see Section 3.2.4 of the Conceptual Model, Volume 1) have been prepared for the forests of the Western Hemlock and Redwood Zones and for most of the aquatic zones. Environmental Indices are included for most of these succession models (see Table 2-1).
4. Ecosystem models for the Western Hemlock Zone and the aquatic zones have also been included. The various models follow the zone or habitat description pages in the same order as the column headings in Table 2-1.
5. Classification is first by natural qualities (see Clawson and Stewart, 1965, for discussion of land classification). Division into super zones and zones depends on location and morphology, on the latitude and the relation to the ocean and land masses, and on relief, altitude (or depth), geology, hydrology, light, tides, and vegetative cover. The second or habitat level of classification is functional, in a broad sense, e.g., grassland, old growth forest, active dune, and designates the predominant biological communities.

Second and third order levels of classification (e.g., waste management and sanitary land fill, respectively) would get into local habitats and environmental niches. These are important to detailed local studies but are beyond the scope of a regional characterization.

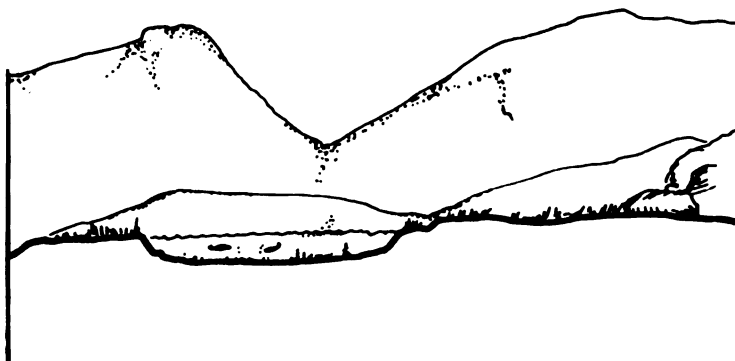
6. Agricultural land will be much more important in other characterization regions because of the larger proportion of land involved, the socioeconomic importance, and the variety of habitats that are provided for weeds and wildlife. In such regions, agricultural land should probably be considered with other Human Activities and given zone status.
7. The distinctions between Inland and Coastal Zones of Human Activity are relatively small in the descriptions which follow (in Section 4.0). They become more striking when the classification system is taken to a second (habitat) order of division.
8. The page numbering system for Part 2 (Section v of the Introduction) consists of two parts, separated by a dash (-). The first part is the numerical (and alphabetical) designation of the zone or habitat; the part after the dash is a serial number for the page within that zone or habitat.

For example, the Mud Flat Food Web in the Subtidal Estuarine Zone will be on page 2.1.1 B-2: 2.1.1 is the zone, B is the Mud Flat habitat, the dash (-) separates the basic parts of the page number, and the 2 indicates that the food web is the second page of material presented for this mud flat habitat.



<b>1.1.1 ARCTIC ALPINE ZONE</b>					
<b>GENERAL COMMENT</b>	The Arctic Alpine Zone is restricted to the high peaks of the Olympic Mountains. Because productivity is low, the zone is especially sensitive to disturbances and the rate of re-vegetation is extremely slow. Within the study area this zone is under U.S. Department of Interior jurisdiction in Olympic National Park.				
<b>TOPOGRAPHY AND SOILS</b>	Elevation ranges from timberline upward, beginning approximately at 1,460 meters (5000 ft). Youthful substrate (with shallow, rocky soil), active mass wasting (landslides, rockfall, avalanches), and active weathering are characteristic. Slopes and aspects are highly variable.				
<b>CLIMATE</b>	Long, cold winters (8 - 9 months), short growing season and brief summers, strong, sun- and rain-shadow effects, diurnal wind patterns.				
<b>HYDROLOGY</b>	Heavy precipitation peaking during winter months with much of it as snow; rapid discharge peaking at snow melt; retention in form of glaciers and snowfields is characteristic.				
<b>HABITAT TYPES</b>					
<b>I.1.1 A Lacustrine</b>	<b>I.1.1 B Palustrine</b>	<b>I.1.1 C Riverine</b>	<b>I.1.1 D Tundra /Alpine</b>	<b>I.1.1 E Rocklands</b>	<b>I.1.1 F Ice Fields/ Glaciers</b>

1.1.1 Arctic Alpine Zone  
A Lacustrine



**LACUSTRINE**

Habitat Description

Clear waters, usually frozen in winter; oligotrophic, i.e. deficient in nutrients and low productivity.

Food Web

Predominantly detrital, depending on surrounding drainage; salmonids and amphibians are at the apex of the food web.

Characteristic Flora

Nannoplankton, ultraplankton.

Characteristic Fauna

Zooplankton: protozoans, rotifers, cladocerans, copepods, mites.

Salmonid fish: rainbow trout, brook trout, cutthroat trout, silver trout (sockeye salmon or kokanee).

Benthos: midges, amphipods, stoneflies, mayflies.

COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 VASCULAR PLANTS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CALAMAGROSTIS CRASSIGLUMIS THURBERG'S REEDGRASS	123456789	U	R
SPIREA DOUGLASII DOUGLAS SPIREA	123456789	U	-

TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
BAETIS MAYFLIES	123456789	A	-
BRILLIA MIDGES	123456789	C	-
CHIRONOMIDAE TRUE MIDGES	123456789	A	-
EPHEMERELLA MAYFLIES	123456789	C	-
GASTROPODA SNAILS	123456789	C	-
HYDROPTILA CADDISFLIES	123456789	A	-
HYDROPTILIDAE CADDISFLIES	123456789	A	-
LIMNephilidae CADDISFLIES	123456789	A	-
PARALEPTOPHLEBIA MAYFLIES	123456789	C	-
PHRYGANEIDAE CADDISFLIES	123456789	A	-
SIPHONURUS MAYFLIES	123456789	C	-

TROPHIC LEVEL: (2) HERBIVORE  
 HERPETOFAUNA

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
BUFO BOREAS BOREAS	123456789	Q	-
NORTHWESTERN TOAD/TADPOLE	123456789	A	-
HYLA REGILA PACIFIC TREE FROG/TADPOLE	12	C	-
RANA CASADA CASCADES FROG, TADPOLE			

TROPHIC LEVEL: (3) CARNIVORE  
 FISHES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
PROSOPIUM WILLIAMSONI MOUNTAIN WHITEFISH	1	C	G
SALMO CLARKI CUTTHROAT TROUT	123456789	A	G

HABITAT: LACUSTRINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (3) CARNIVORE  
 HERPETOFAUNA

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
THAMNOPHIS SIRTALIS PICKERINGI PUGET SOUND RED-SIDED GARTER S	123	C	-

TROPHIC LEVEL: (4) DETRITIVORE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CERATOPOGONIDAE BITING MIDGES	123456789	C	-
ENCHYTRAFDAE OLIGOCHAETES	123456789	A	-
ISOPODA ISOPODS	123456789	C	-
LEPIDOSTOMA CADDISFLIES	123456789	A	-
LEPIDOSTOMATIDAE CADDISFLIES	123456789	A	-
LUMBRICULIDAE OLIGOCHAETE	123456789	A	-
OLIGOCHAETA SEGMENTED ROUNDWORMS	123456789	A	-
TUBIFICIDAE TUBIFICIDS	123456789	A	-

TROPHIC LEVEL: (5) OMNIVORE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
AMPHIPODA AMPHIPODS	123456789	C	-
LIMNephilidae CADDISFLIES	123456789	A	-

TROPHIC LEVEL: (6) PARASITE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
MIRACIDIAE LEECHES	123456789	C	-

KEY TO SYMBOLS  
 (FROM FIGURE 3-10, VOLUME 1).

ABUNDANCE  
 A - ABUNDANT  
 C - COMMON  
 U - UNKNOWN  
 O - PRESENT ABUNDANCE UNKNOWN

STATUS  
 R - RARE  
 E - ENDANGERED  
 T - THREATENED  
 P - PERIPHERAL  
 I - ENDEMIC  
 EG - GAME  
 C - COMMERCIAL  
 c - POTENTIALLY  
 COMMERCIAL  
 X - PEST

COMMUNITY COMPOSITION INLANDS      ZONE: APCTIC ALPINE  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

AMELETUS	123456789	0	-
MAYFLIES			
BOSMINA	123456789	A	-
WATER FLEAS			
CERACLEA	123456789	C	-
CADDISFLIES			
CLADOCERA	123456789	A	-
WATER FLEAS			
COPEPODA	123456789	A	-
COPEPODS			
CULICIDAE	123456789	A	-
MOSQUITOS			
CYCLOPS	123456789	A	-
COPEPODS			
DAPHNIA	123456789	A	-
WATER FLEAS			
DIAPTOMUS	123456789	A	-
COPEPODS			
EPISCHURA	123456789	A	-
COPEPODS			
KELICOTTIA	123456789	A	-
ROTIFERS			
LEPTOCERIDAE	123456789	A	-
CADDISFLIES			
MYSTACIDES	123456789	A	-
CADDISFLIES			
PELECYPODA	123456789	C	-
CLAMS			
PSYCHOMYIA	123456789	C	-
CADDISFLIES			
PSYCHOMYIIDAE	123456789	C	-
CADDISFLIES			
ROTIFERA	123456789	A	-
ROTIFERS			

## HABITAT: LACUSTRINE

SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (8) SCAVENGER  
 INVERTEBRATES

TURBELLARIA	123456789	C	-
FLATWORMS			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

SALMO GAIRDNERI	123456789	A	G
RAINBOW TROUT			
SALVELLINUS FONTINALIS	789	C	G
BROOK TROUT			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 HERPETOFAUNA

AMBYSTOMA GRACILE GRACILE	123456789	C	-
BROWN SALAMANDER			
AMBYSTOMA MACRODOCTYLUM MACROD	1234	C	-
WESTERN LONG-TOED SALAMANDER			
HYLA REGILA	123456789	A	-
PACIFIC TREE FROG			
RANA CASCADAE	12	C	-
CASCADES FROG			
TARICHA GRANULOSA GRANULOSA	123456789	C	-
NORTHERN ROUGH SKINNED NEWT			

## COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPHIC LEVEL: (9) INVERTEBRATE FEEDER  
INVERTEBRATES

AGABUS VANCOUVERENSIS	1	C	-
DIVING BEETLE			
ANSIOPTERA	123456789	A	-
DRAGONFLIES			
ANTHERIX	23456789	C	-
SNIBE FLIES			
COLEOPTERA	123456789	A	-
AQUATIC BEETLES			
DOLICHOPODIDAE	123456789	C	-
LONG-LEGGED FLIES			
DYTISCIDAE	123456789	A	-
PREDACEOUS DIVING BEETLES			
EMPIDIDAE	123456789	C	-
DANCE FLIES			
HYDROPHILIDAE	123456789	C	-
WATER SCAVENGER BEETLES			
NEBRIA KINCAIDI	1	C	-
GROUND BEETLE			
NEBRIA TRIFARIA VANDYKEI	1234	O	I
GROUND BEETLE			
DECETIS	123456789	C	-
CADDISFLIES			
POLYCENTROPODIDAE	123456789	C	-
CADDISFLIES			
RHYACOPHILA	123456789	A	-
CADDISFLIES			
SCAPHINOTUS OLYMPIAE	1	O	-
GROUND BEETLE			
ZYGOPTEA	123456789	A	-
DAMSELFLIES			

## HABITAT: LACUSTRINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPHIC LEVEL: (0) UNKNOWN  
INVERTEBRATES

ACARINA	123456789	A	-
WATER MITES			
CHIRONOMUS	123456789	A	-
TRUE MIDGES			
EPHEMEROPTERA	123456789	A	-
MAYFLIES			
LIMNEPHILUS	123456789	A	-
CADDISFLIES			
MUSCIDAE	123456789	C	-
HOUSE FLIES			
NEMATODA	123456789	C	-
ROUNDWORMS			
OSTRACODA	123456789	A	-
SEED SHRIMP			
PSYCHODIDAE	123456789	A	-
MOTH FLIES			
TIPULIDAE	123456789	A	-
CRANE FLIES			
TRICHOPTERA	123456789	A	-
CADDISFLIES			

1.1.1 Arctic Alpine Zone  
 B Palustrine



**PALUSTRINE**

Habitat Description

Poorly drained, saturated soils with low herbaceous vegetation often associated with lakes.

Food Web

Unknown.

Characteristic Flora

Cottongrass, sedge spp., rush spp., sphagnum, heath.

Characteristic Fauna

Insects: mosquito larvae.

Herpetofauna: rough-skinned newt, northwestern salamander, Cascade frog.

Birds: Brewer's blackbird.

Mammals: mountain vole, Townsend's vole.

COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 NON-VASCULAR PLANTS

SPHAGNUM      123456789      A      -  
 SPHAGNUM MOSS

TROPHIC LEVEL: (1) PRODUCER  
 VASCULAR PLANTS

ALNUS INCANA      1      C      -  
 MOUNTAIN ALDER  
 ANDROMEDA POLIFOLIA      12      U      R  
 BOG-ROSEMARY  
 BOTRYCHIUM LANCEOLATUM      1      U      R  
 LANCE-LEAVED GRAPE-FERN  
 CALAMAGROSTIS CRASSIGLUMIS      123456789      U      R  
 THUKBERT'S REEDGRASS  
 CAREX NIGRICANS      1      U      -  
 BLACK ALPINE SEDGE  
 CAREX SPECTABILIS      1      U      -  
 SNOWY SEDGE  
 EMPETRUM NIGRUM      123456789      U      R  
 CROWBERRY  
 ERIOPHORUM CHAMISSONIS      1      C      -  
 COTTONGRASS  
 KALMIA OCCIDENTALIS      123456789      C      -  
 SWAMP LAUREL  
 LEDUM GLANDULOSUM      123456789      C      -  
 PACIFIC LABRADOR TEA  
 LEDUM GROENLANDICUM      12345      U      R  
 LABRADOR TEA  
 VACCINIUM OXYCOCCUS      123456789      U      -  
 WILD CRANBERRY

TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

BAETIS      123456789      A      -  
 MAYFLIES  
 CHIRONOMIDAE      123456789      A      -  
 TRUE MIDGES  
 CINYGMULA      123456789      O      -  
 MAYFLIES  
 CRICOTOPUS      123456789      C      -  
 TRUE MIDGES  
 ELMIDAE      123456789      U      -  
 RIFFLE BEETLES  
 EPHEMERELLA      123456789      C      -  
 MAYFLIES  
 EUKIEFFERIELLA      123456789      A      -  
 TRUE MIDGES  
 GASTROPODA      123456789      C      -  
 SNAILS  
 HYDROPTILIDAE      123456789      A      -  
 CADDISFLIES

HABITAT: PALUSTRINE

SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

LIMNephilidae      123456789      A      -  
 CADDISFLIES  
 DCHROTRICHIA      123456789      U      -  
 CADDISFLIES  
 PARALEPTOPHLEBIA      123456789      C      -  
 MAYFLIES  
 PHRYGANEIDAE      123456789      A      -  
 CADDISFLIES  
 SIPHLONURUS      123456789      C      -  
 MAYFLIES

TROPHIC LEVEL: (2) HERBIVORE  
 HERPETOFAUNA

BUFO BOREAS BOREAS      123456789      C      -  
 NORTHWESTERN TOAD/TADPOLE  
 Hyla REGILA      123456789      A      -  
 PACIFIC TREE FROG/TADPOLE  
 RANA CASADA      12      C      -  
 CASCADES FROG, TADPOLE

TROPHIC LEVEL: (3) CARNIVORE  
 FISHES

SALMO CLARKI      123456789      A      G  
 CUTTHROAT TROUT

TROPHIC LEVEL: (3) CARNIVORE  
 HERPETOFAUNA

THAMNOPHIS SIRTALIS PICKERINGI 123      A      -  
 PUGT SOUND RED-SIDED GARTER S

KEY TO SYMBOLS - 1.1.1 A-2

## COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

CERATOPOGONIDAE	123456789	C	-
BITING MIDGES			
DIXA	123456789	A	-
DIXA MIDGES			
ENCHYTRAEDAE	123456789	A	-
OLIGOCHAETES			
HYDRUBAENUS	123456789	A	-
TRUE MIDGES			
ISOPODA	123456789	C	-
ISOPODA			
LEPIDOSTOMA	123456789	A	-
CADDISFLIES			
LUMBRICULIDAE	123456789	A	-
OLIGOCHAETE			
MICROTENDIPES	123456789	C	-
TRUE MIDGES			
OLIGOCHAETA	123456789	A	-
SEGMENTED ROUNDWORMS			
ORTHOCLADIUS	123456789	C	-
TRUE MIDGES			
PARAKIEFFERIELLA	123456789	O	-
TRUE MIDGES			
PHAENOPSECTRA	123456789	A	-
TRUE MIDGES			
PROCLADIUS	123456789	C	-
TRUE MIDGES			
TANYTARSUS	123456789	C	-
TRUE MIDGES			
TUBIFICIDAE	123456789	A	-
TUBIFICIDS			

TROPIC LEVEL: (5) OMNIVORE  
INVERTEBRATES

AMPHIPODA	123456789	C	-
AMPHIPODS			
LIMNEPHILIDAE	123456789	A	-
CADDISFLIES			

TROPIC LEVEL: (5) OMNIVORE  
MAMMALS

PEROMYSCUS MANICULATUS	123456789	C	X
DEER MOUSE			

TROPIC LEVEL: (6) PARASITE  
INVERTEBRATES

MIRUDINAE	123456789	C	-
LEECHES			

## HABITAT: PALUSTRINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

AMELETUS	123456789	U	-
MAYFLIES			
CLADOCFRA	123456789	A	-
WATER FLEAS			
COPEPODA	123456789	A	-
COPEPODS			
CORYNONEURA	123456799	C	-
TRUE MIDGES			
CULICIDAE	123456799	A	-
MOSQUITOS			
CYCLOPS	123456789	A	-
COPEPODS			
METROTRIJSOCLADIUS	123456789	A	-
TRUE MIDGES			
LEPTOCFRIDAE	123456789	A	-
CADDISFLIES			
MICROPSECTRA	123456789	C	-
TRUE MIDGES			
MYSTACIDES	123456799	A	-
CADDISFLIES			
PARATANYTARSUS	123456799	O	-
TRUE MIDGES			
PELECYPODA	123456799	C	-
CLAMS			
PSECTROCLADIUS	123456789	C	-
TRUE MIDGES			
ROTIFERA	123456789	A	-
ROTIFERS			
STEMPELLINA	123456789	O	-
TRUE MIDGES			
STEMPELLINELLA	123456789	O	-
TRUE MIDGES			
THIENEMANNIELLA	123456789	C	-
TRUE MIDGES			

TROPIC LEVEL: (8) SCAVENGER  
INVERTEBRATES

TURBELLARIA	123456789	C	-
FLATWORMS			



COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

ANSIOPTERA	123456789	A	-
DRAGONFLIES			
COLEOPTERA	123456789	A	-
AQUATIC BEETLES			
DOLICHOPODIDAE	123456789	C	-
LONG-LEGGED FLIES			
DYTTISCIDAE	123456789	A	-
PREDACEOUS DIVING BEETLES			
EMPIIDAE	123456789	C	-
DANCE FLIES			
HYDROPHILIDAE	123456789	C	-
WATER SCAVENGER BEETLES			
NEBRIA KINCAIDI	1	C	-
GROUND BEETLE			
NEBRIA LABRADORICA CRASSICORNIS	1	C	-
GROUND BEETLE			
NEBRIA SAHLBERGI	1	C	-
GROUND BEETLE			
NEBRIA TRIFARIA VANDYKEI	1234	C	I
GROUND BEETLE			
RHYACOPHILIDAE	123456789	A	-
CADDISFLIES			
ZYGOPTERA	123456789	A	-
DAMSELFLIES			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

SALMO GAIRDNERI	123456789	U	G
RAINBOW TROUT			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 HERPETOFAUNA

AMBYSTOMA GRACILE GRACILE	123456789	C	-
BROWN SALAMANDER			
AMBYSTOMA MACRODACTYLUM MACROD	1234	C	-
WESTERN LONG-TOED SALAMANDER			
HYLA REGILA	123456789	A	-
PACIFIC TREE FROG			
PLETHODON VANDYKEI	12	C	-
WASHINGTON SALAMANDER			
RANA CASCADEAE	12	C	-
CASCADES FROG			
RHYACOTRITON OLYMPICUS OLYMPIC	12345	O	-
NORTHERN OLYMPIC MOUNTAIN SALA			
TARICHA GRANULOSA GRANULOSA	123456789	C	-
NORTHERN ROUGH SKINNED NEWT			

HABITAT: PALUSTRINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (0)  
 INVERTEBRATES

ACARINA	123456789	A	-
WATER MITES			
CHIRONOMUS	123456789	A	-
TRUE MIDGES			
CONCHAPLOPIA	123456789	O	-
TRUE MIDGES			
EPHEMEROPTERA	123456789	A	-
MAYFLIES			
MUSCIDAE	123456789	C	-
HOUSE FLIES			
NEMATODA	123456789	C	-
ROUNDWORMS			
OSTRACODA	123456789	A	-
SEED SHRIMP			
PELTOPERLA	123456789	C	-
STONEFLIES			
PLECOPTERA	123456789	U	-
STONEFLIES			
POLYPEDILUM	123456789	C	-
TRUE MIDGES			
PSYCHODIDAE	123456789	A	-
MOTH FLIES			
THIEMANNIIMYIA	123456789	O	-
TRUE MIDGES			
TIPLIDAE	123456789	A	-
CRANE FLIES			
TRICHOPTERA	123456789	A	-
CADDISFLIES			

1.1.1 Arctic Alpine Zone  
C Riverine



**RIVERINE**

Habitat Description

Streams are fairly small, undeveloped, and frozen during winter. They are predominantly in the boulder zone, as defined by Bauer (1974A), with steep gradients.

Food Web

Primarily detrital.

Characteristic Flora

Periphyton.

Characteristic Fauna

Insects: mayflies, stonefly, caddis fly, and black fly larvae.

Birds: dipper.

## COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPHIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

BAETIS	123456789	A	-
MAYFLIES			
BRACHYCENTRIDAE	123456789	C	-
CADDISFLIES			
BRACHYPTERA	123456789	C	-
STONEFLIES			
BRILLIA	123456789	C	-
MIDGES			
CHIRONOMIDAE	123456789	A	-
TRUE MIDGES			
CINYGHULA	123456789	A	-
MAYFLIES			
CRICOTOPUS	123456789	C	-
TRUE MIDGES			
ELMIDAE	123456789	A	-
RIFFLE BEETLES			
EPEORUS	123456789	A	-
MAYFLIES			
EPHEMERELLA	123456789	A	-
MAYFLIES			
EUCAPNOSIS	1	Q	-
STONEFLIES			
EUKIEFFERIELLA	123456789	C	-
TRUE MIDGES			
GASTROPODA	123456789	C	-
SNAILS			
GLOSSOSOMATIDAE	123456789	C	-
CADDISFLIES			
HEPTAGENIA	123456789	A	-
MAYFLIES			
METERLIMNIUS	123456789	C	-
RIFFLE BEETLES			
HYDROPTILA	123456789	A	-
CADDISFLIES			
HYDROPTILIDAE	123456789	A	-
CADDISFLIES			
LEUCOTRICHIA	456789	A	-
CADDISFLIES			
LEUCTRA	123456789	Q	-
STONEFLIES			
LIMNAPHILIDAE	123456789	A	-
CADDISFLIES			
MICRASEMA	123456789	C	-
CADDISFLIES			
MARPUS	123456789	C	-
RIFFLE BEETLES			
NEMOURA	123456789	C	-
STONEFLIES			
OCHROTRICHIA	123456789	A	-
CADDISFLIES			
OPTIOSERVUS	123456789	C	-
RIFFLE BEETLES			

## HABITAT: RIVERINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPHIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

PARALEPTOPHLEBIA	123456789	C	-
MAYFLIES			
PHRYGANETIDAE	123456789	A	-
CADDISFLIES			
PTERONARCELLA	123456789	C	-
STONEFLIES			
PTERONARCYS	123456789	C	-
STONEFLIES			
RHITHROGENA	123456789	A	-
MAYFLIES			
SIPHONURUS	123456789	C	-
MAYFLIES			
ZAITZEVIA	123456789	C	-
RIFFLE BEETLES			

TROPHIC LEVEL: (2) HERBIVORE  
HERPETOFAUNA

BUFO BOREAS BOREAS	123456789	Q	-
NORTHWESTERN TOAD/TADPOLE			
HYLA REGILA	123456789	A	-
PACIFIC TREE FROG/TADPOLE			
RANA CASADA	12	C	-
CASCADES FROG, TADPOLE			

TROPHIC LEVEL: (3) CARNIVORE  
FISHES

PROSOPIUM WILLIAMSONI	1	C	6
MOUNTAIN WHITEFISH			
SALMO CLARKI	123456789	A	6
CUTTHROAT TROUT			
SALVELLINUS MALMA	123456789	U	6
DOLLY VARDEN			

TROPHIC LEVEL: (3) CARNIVORE  
HERPETOFAUNA

THAMNOPHIS SIRTALIS PICKERINGI	123	C	-
PUGET SOUND RED-SIDED GARTER S			

TROPHIC LEVEL: (3) CARNIVORE  
BIRDS

ACTITIS MACULARIA	123456789	C	-
SPOTTED SANDPIPER			

KEY TO SYMBOLS - 1.1.1 A-2

COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (4) DETRITIVORE  
 INVERTEBRATES

CERATOPOGONIDAE	123456789	C	-
BITING MIDGES			
DIXA	123456789	A	-
DIXA MIDGES			
ENCHYTRAEDAE	123456789	A	-
OLIGOCHAETES			
HYDROBAENUS	123456789	Q	-
TRUE MIDGES			
IRONODES	123456789	C	-
MAYFLIES			
ISOPODA	123456789	C	-
IOSPODS			
KINCAIDIANA	1	Q	-
OLIGOCHAETS			
LEPIDOSTOMA	123456789	A	-
CADDISFLIES			
LEPIDOSTOMATIDAE	123456789	A	-
CADDISFLIES			
LUMBRICULIDAE	123456789	A	-
OLIGOCHAETES			
MICROTENDIPES	123456789	-	-
TRUE MIDGES			
OLIGOCHAETA	123456789	A	-
SEGMENTED ROUNDWORMS			
ORTHOCLADIUS	123456789	C	-
TRUE MIDGES			
PARAKIEFFERIELLA	123456789	Q	-
TRUE MIDGES			
PHAENOPSECTRA	123456789	Q	-
TRUE MIDGES			
PROCLADIUS	123456789	C	-
TRUE MIDGES			
STYLODRILUS	1	Q	-
OLIGOCHAETS			
TANYTARSUS	123456789	C	-
TRUE MIDGES			
TUBIFICIDAE	123456789	A	-
TUBIFICIDS			

TROPHIC LEVEL: (5) OMNIVORE  
 INVERTEBRATES

AMPHIPODA	123456789	C	-
AMPHIPODS			
LIMNAPHILIDAE	123456789	A	-
CADDISFLIES			

TROPHIC LEVEL: (6) PARASITE  
 INVERTEBRATES

HIRUDINAE	123456789	C	-
LEECHES			

## HABITAT: RIVERINE

SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

AMELETUS	123456789	C	-
MAYFLIES			
ARCTOPSYCHE	123456789	C	-
CADDISFLIES			
CERAFLA	123456789	C	-
CADDISFLIES			
CONSTEMPPELLINA	15	Q	-
TRUE MIDGES			
COPLPODA	123456789	C	-
COPEPODS			
CORYNONEURA	123456789	C	-
TRUE MIDGES			
DIAMESA	123456789	C	-
TRUE MIDGES			
METEROTRISOCLADIUS	123456789	Q	-
TRUE MIDGES			
HYDRGPSYCHE	123456789	A	-
CADDISFLIES			
KRENOSMITTIA	123456789	Q	-
TRUE MIDGES			
LEPTOCERIDAE	123456789	A	-
CADDISFLIES			
MICROPSECTRA	123456789	C	-
TRUE MIDGES			
MYSTACIDES	123456789	C	-
CADDISFLIES			
PARAMETRICNEMUS	123456789	Q	-
TRUE MIDGES			
PARAPSYCHE	123456789	C	-
CADDISFLIES			
PARATANYTARSUS	123456789	Q	-
TRUE MIDGES			
PELECYPODA	123456789	C	-
CLAMS			
PHILOPOTAMIDAE	123456789	A	-
CADDISFLIES			
POTTHASTIA	123456789	C	-
TRUE MIDGES			
PSECTROCLADIUS	123456789	C	-
TRUE MIDGES			
PSYCHOMYIA	123456789	C	-
CADDISFLIES			
PSYCHOMYIIDAE	123456789	C	-
CADDISFLIES			
RHEOTANYTARSUS	123456789	C	-
TRUE MIDGES			
ROTIFERA	123456789	C	-
ROTIFERS			
SIMULIIDAE	123456789	A	-
BLACK FLIES			
SIMULIUM	123456789	Q	-
BLACK FLIES			

COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

STEMPELLINA TRUE MIDGES	123456789	O	-
STEMPELLINELLA TRUE MIDGES	123456789	O	-
THIENEMANNIELLA TRUE MIDGES	123456789	C	-
WORMALDIA CADDISFLIES	123456789	A	-

TROPHIC LEVEL: (8) SCAVENGER  
 INVERTEBRATES

TURBELLARIA FLATWORMS	123456789	C	-
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TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

ACRONEURIA STONEFLIES	123456789	C	-
ALLOPERLA STONEFLIES	123456789	A	-
ANSIOPTERA DRAGONFLIES	123456789	C	-
ANTHERIX SNIPER FLIES	23456789	C	-
ARCYNOPTERYX STONEFLIES	123456789	A	-
BEMBIDIUM COMPLANULUM GROUND BEETLE	1234	C	-
BEMBIDIUM CRENULATUM FARRARAE GROUND BEETLE	1	C	I
CARDIOCLADUS MIDGES	123456789	C	-
COLEOPTERA AQUATIC BEETLES	123456789	A	-
CULTUS STONEFLIES	123456789	C	-
DOLICHOPODIDAE LONG-LEGGED FLIES	123456789	C	-
DYTISCIDAE PREDACEOUS DIVING BEETLES	123456789	C	-
EMPIDIDAE DANCE FLIES	123456789	C	-
GEMRINGIA OLYMPICA GROUND BEETLE	1	U	I
HYDROPHILIDAE WATER SCAVENGER BEETLES	123456789	C	-
ISOPERLA STONEFLIES	123456789	C	-
KATHROPERLA STONEFLIES	123456789	O	-

HABITAT: RIVERINE

SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

NEBRIA KINCAIDI GROUND BEETLE	1	C	-
NEBRIA TRIFARIA VANDYKEI GROUND BEETLE	1234	U	I
DECETIS CADDISFLIES	123456789	C	-
PARAPERLA STONEFLIES	123456789	O	-
POLYCENTROPODIDAE CADDISFLIES	123456789	C	-
POLYCENTROPUS CADDISFLIES	123456789	C	-
PSECTROTANYPUS TRUE MIDGES	123456789	O	-
RHYACOPHILA CADDISFLIES	123456789	C	-
RHYACOPHILIDAE CADDISFLIES	123456789	A	-
ZYGOTERA DAMSELFLIES	123456789	C	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

SALMO GARDNERI RAINBOW TROUT	123456789	A	G
SALVELINUS FONTINALIS BROOK TROUT	789	C	G

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 HERPETOFAUNA

AMBYSTOMA GRACILE GRACILE BROWN SALAMANDER	123456789	C	-
HYLA REGILA PACIFIC TREE FROG	123456789	A	-
RANA CASCADAE CASCADES FROG	12	C	-
RHYACOTRITON OLYMPICUS OLYMPIC NORTHERN OLYMPIC MOUNTAIN SALA	12345	C	-
TARICHA GRANULOSA GRANULOSA NORTHERN ROUGH SKINNED NEWT	123456789	U	-

## COMMUNITY COMPOSITION INLANDS

ZONE: ARCTIC ALPINE

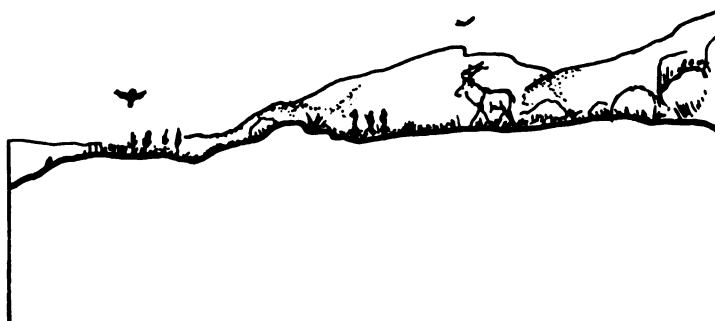
HABITAT: RIVERINE

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
COMMON NAME			

TRUPLIC LEVEL: (O) UNKNOWN  
INVERTEBRATES

ACARINA	123456789	A	-
WATER MITES			
CHIRONOMUS	123456789	A	-
TRUE MIDGES			
CONCHAPELOPIA	123456789	O	-
TRUE MIDGES			
DEUTEROPHEBIIDAE	1	U	-
MOUNTAIN MIDGES			
ECCLISOMYIA	123456789	C	-
CADDISFLIES			
EPHEMEROPTERA	123456789	A	-
MAYFLIES			
HELICOPSYCHE	123456789	C	-
CADDISFLIES			
HYDROPSYCHIDAE	123456789	A	-
CADDISFLIES			
LIMNAPHILUS	123456789	A	-
CADDISFLIES			
MUSCIDAE	123456789	C	-
HOUSE FLIES			
NEMATODA	123456789	C	-
ROUNDWORMS			
NEMATOMORPHA	123456789	O	-
HORSEHAIR WORMS			
NEOPHYLAX	123456789	C	-
CADDISFLIES			
OSTRACODA	123456789	C	-
SEED SHRIMP			
PELTOPERLA	123456789	C	-
STONEFLIES			
PLECOPTERA	123456789	A	-
STONEFLIES			
PSYCHODIDAE	123456789	A	-
MOTH FLIES			
RHEOCRICOTOPUS	123456789	C	-
TRUE MIDGES			
SERICOSTOMATIDAE	123456789	A	-
CADDISFLIES			
THIENEMANNIMYIA	123456789	O	-
TRUE MIDGES			
TIPULIDAE	123456789	A	-
CRANE FLIES			
TRICHOPTERA	123456789	A	-
CADDISFLIES			

1.1.1 Arctic Alpine Zone  
 D Tundra/Alpine



## TUNDRA / ALPINE

### Habitat Description

Open, non-forested, high altitude meadows. Trees entirely lacking except on sheltered slope. Herb layer widespread.

### Food Web

Grazing food web with low productivity. Slow regeneration and succession are typical. Moderate number of herbivores can survive seasonally. Community is exceedingly vulnerable.

### Characteristic Flora

Lupine, Indian paintbrush, black crowberry, mountain heath.

### Characteristic Fauna

Mammals: hoary marmot, mountain goat, Roosevelt elk, black-tailed deer, black bear, meadow vole.

Birds: water pipit, Clark's nutcracker, rufous hummingbird.

## COMMUNITY COMPOSITION INLANDS

ZONE: ARTIC ALPINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

CLADONIA BACILLARIS BRITISH SOLDIER LICHEN	123456789	U	-
CLADONIA BELLIDIFLORA BRITISH SOLDIER LICHEN	123456789	U	-
CLADONIA FURCATA FOLILOSE LICHEN	123456789	U	-
CLADONIA PIXIDATA PIXIE GOBLET LICHEN	123456789	U	-
CLADONIA RANGIFERINA KEINDFER LICHEN	123456789	U	-
STEREOCAULON FRUITICLOSE LICHEN	123456789	U	-
UMBILICARIA ROCK TRIPE	123456789	U	-

TROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

ANTENNARIA LANATA WOOLY EVERLASTING	1	U	-
ANTENNARIA PACEMOSA SLENDER EVERLASTING	1	U	-
ARENARIA JBUSILOBA BLUNT-LEAVED SANDWORT	1	C	-
ARNICA RYDBERGII RYDBERGS ARNICA	1	C	-
ARTEMISIA TRIFURCATA THREE-FORKED WORMWOOD	1	U	-
BOTRYCHIUM LANCEOLATUM LANCE-LEAVED GRAPE-FERN	1	U	R
CALAMAGROSTIS CRASSIGLUMIS THURBERGS REEDGRASS	123456789	U	R
CALTHA LEPTOSEPALA ELKSLIP MARSH-MARIGOLD	1	U	-
CAREX NIGRICANS BLACK ALPINE SEDGE	1	U	-
CASSIOPE MERTENSIANA WHITE MOSS HEATHER	1	U	-
CASTILLEJA PARVIFLORA VAR. TLY 1 OLYMPIC MOUNTAIN FAINTBRUSH	1	U	R
CASTILLEJA PARVIFLORA VAR. JRE 134 MAGENTA PAINT-BRUSH	134	C	-
DOUGLASSII LAEVIOLATA VAR. CILIO 134 SMOOTH DOUGASIA	134	U	R
DRAEA INCERTA YELLOWSTONE DRABA	1	U	R
EMPETRUM NIGRUM CROWBERRY	123456789	C	R
ERIGERON COMPOSITUS VAR. GLA9R 12345 DWARF MOUNTAIN FLEABANE	12345	C	-
GEUM TRIFLORUM VAR. CAPPANLLAT 134 BELL-SHAPED PURPLE AVENS	134	U	R

## HABITAT: TUNDRA/ALPINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

HEDYSARUM OCCIDENTALE SWEETVETCH	1	U	-
LOMATIUM MARTINDALEI VAR. FLAV 1 MARTINDALEYS YELLOW LOMATIUM	1	U	R
LUPINUS LEPIOUS PRAIRIE LUPINE	1	C	-
OXYRIA DIGYNA MOUNTAIN SORREL	1	C	-
OXYTROPIS CAMPESTRIS CRAZYWEED	1	U	-
PEDICULARIS BRACTEOSA VAR. ATR 1 DARK-RED BRACED LOUSEWORT	1	U	R
PHLOX DIFFUSA SPREADING PHLOX	1	C	-
PHYLLODOCE EMPETRIFORMIS RED MOUNTAIN - HEATHER	1	C	-
POLYGONUM BISTORTOIDES AMER. BISTORT	1	C	-
POTENTILLA DIVERSIFOLIA CINGUEFOIL	1	U	-
RANUNCULUS ESCHSCHOLTZII SNOW BUTTERCUP	1	U	-
SAXIFRAGA OCCIDENTALIS VAR. RU 1 WESTERN SAXIFRAGE	1	U	-
SAXIFRAGA OPPOSITIFOLIA PURPLE SAXIFRAGE	1	U	R
SAXIFRAGA TOLMIEI ALPINE SAXIFRAGE	1	U	-
SENECIO NEOWEBSTERI OLYMPIC MOUNTAIN BUTTERWEED	1	U	I
SYNTHYRIS PINNATIFIDA VAR. LAN 1 WOLLY FEATHERLEAF KITTENTAILS	1	U	I
VACCINIUM DELICIOSUM BLUELEAF HUCKLEBERRY	123456789	U	-

TROPIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

HEMPHILLIA DROMEDARUS SLUG	1	C	-
PHROPHYSAON OBSCURUM -NULL-	1	C	-

TROPIC LEVEL: (2) HERBIVORE  
BIRDS

LEUCOSTICTE TEPHROCOTIS GRAY-CROWNED ROSEY FINCH	12	U	-
SELASPHORUS RUFUS RUFIOUS HUMMINGBIRD.	123456789	C	-

KEY TO SYMBOLS - 1.1.1 A-2



COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (2) HERBIVORE  
 MAMMALS

CERVUS CANADENSIS      123456789      C      G  
 ROOSEVELT ELK  
 THOMOMYS MONTICOLA      456      U      -  
 MOUNTAIN POCKET GOPHER  
 PHENACOMYS INTERMEDIUS      123      U      -  
 HEATHER VOLE

TROPHIC LEVEL: (3) CARNIVORE  
 HERPETOFAUNA

THAMNOPHIS SIRTALIS PICKERINGI 123      Q      -  
 PUGLE SOUND RED-SIDED GARTER S

TROPHIC LEVEL: (3) CARNIVORE  
 BIRDS

AQUILA CHRYSAETOS      12      U      -  
 GOLDEN EAGLE  
 BUTEO JAMAICENSIS      123456789      C      -  
 RED-TAILED HAWK  
 CORVUS CORAX      123456789      C      -  
 COMMON RAVEN  
 FALCO PEREGRINUS      123456789      U      E  
 PELEGRINE FALCON  
 FALCO SPARVERIUS      123456789      C      -  
 AMERICAN KESTREL

TROPHIC LEVEL: (3) CARNIVORE  
 MAMMALS

FELIS CONCOLOR      123456789      U      E  
 MOUNTAIN LION  
 MUSTELA ERMINEA      123456789      U      C  
 SHORT-TAILED WEASEL  
 MUSTELA FRENATA      123456789      U      G  
 LONG-TAILED WEASEL

TROPHIC LEVEL: (5) OMNIVORE  
 MAMMALS

PEROMYSCUS MANICULATUS      123456789      C      X  
 DEER MOUSE

HABITAT: TUNDRA/ALPINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

BEMBIDIUM COMPLANULUM      1234      C      -  
 GROUND BEETLE  
 BEMBIDIUM CREMULATUM FARRARAE 1      C      I  
 GROUND BEETLE  
 MEBRIA TRIFARIA VANDYKEI      1234      C      I  
 GROUND BEETLE  
 SCAPHINOTUS JOHNSONI      1      U      I  
 GROUND BEETLE

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 HERPETOFAUNA

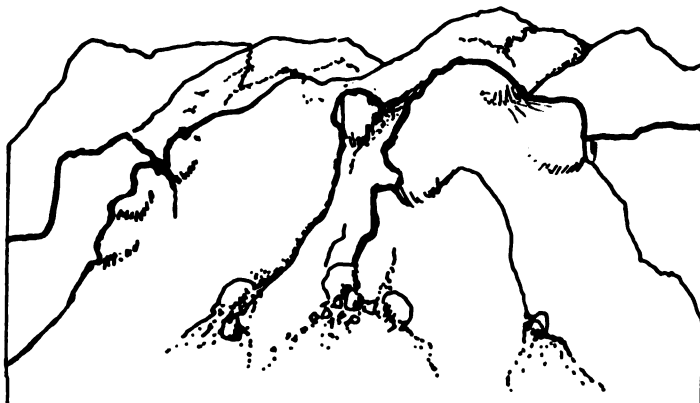
AMBYSTOMA GRACILE GRACILE      123456789      C      -  
 BROWN SALAMANDER  
 AMBYSTOMA MACRODACTYLUM MACROD 1234      C      -  
 WESTERN LONG-TOED SALAMANDER  
 BUFO BOREAS BOREAS      123456789      C      -  
 NORTHWESTERN TOAD  
 ENSATINA ESCHSCHOLTZI OREGONEN 123459      Q      -  
 OREGON RED SALAMANDER  
 HYLIA REGILA      123456789      Q      -  
 PACIFIC TREE FROG

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 BIRDS

ANTHUS SPINOLETTA      123456789      C      -  
 WATER PIPIT  
 EREMOPHILA ALPESTRIS      123456789      U      -  
 HORNED LARK

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 MAMMALS

SOREX CINEREUS      123      U      -  
 MASKED SHREW



1.1.1 Arctic Alpine Zone  
E Rocklands

## ROCKLANDS

### Habitat Description

Dominated by rock outcrops, rock rubble, boulders; soil development severely limited; important escape and nesting habitat.

### Food Web

Grazing food chains; few species, low productivity.

### Characteristic Flora

Predominantly unvegetated; lichens, mosses and some mountain alder occur.

### Characteristic Fauna

Birds: golden eagle, gray-crowned rosy finch, raven.

Mammals: mountain goat, yellow-bellied marmot.

COMMUNITY COMPOSITION INLANDS      ZONE: ARCTIC ALPINE  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 NON-VASCULAR PLANTS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CLADONIA SACILLARIS	123456789	U	-
BRITISH SOLDIER LICHEN			
CLADONIA BELLIDIFLORA	123456789	U	-
BRITISH SOLDIER LICHEN			
CLADONIA FURCATA	123456789	U	-
FOLILOSE LICHEN			
CLADONIA PIXIDATA	123456789	U	-
PIXIE GOBLET LICHEN			
CLADONIA RANGIFERINA	123456789	U	-
REINDEER LICHEN			
STEREOCAULON	123456789	U	-
FRUITICOSE LICHEN			
UMBILICARIA	123456789	U	-
ROCK TRIPE			

TROPHIC LEVEL: (1) PRODUCER  
 VASCULAR PLANTS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ASTRAGALUS COTTONII	1	U	I
COTTONY'S MILK-VETCH			
CALAMAGROSTIS CRASSIGLUMIS	123456789	U	R
THURBERG'S REDGRASS			
DOUGLASSII LAEVIGATA VAR. CILIO	134	U	R
SMOOTH DOUGASIA			
DRABA INCERTA	1	U	R
YELLOWSTONE DRABA			
ELMERA RACEMOSA VAR. PUBERULEN	1	U	R
HAIRY ELMERA			
ELMERA RACEMOSA VAR. RACEMOSA	1	U	R
RACEMED ELMERA			
ERYSIMUM ARENICOLA VAR. ARENIC	1	U	R
SAND-DWELLING WALLFLOWER			
GEUM TRIFLORUM VAR. CAMPANULAT	134	U	R
BELL-SHAPED PURPLE AVENS			
LEWISIA COLUMBIANA VAR. RUPICO	134	U	R
COLUMBIA LEWISIA			
LOMATIUM MARTINDALEI VAR. FLAV	1	U	R
MARTINDALE'S YELLOW LOMATIUM			
POLEMONIUM ELEGANS	1	U	R
ELEGANT SKY-PILOT			
SAXIFRAGA BRONCHIALIS VAR. VES	134	U	R
MATTED SAXIFRAGE			
SAXIFRAGA CAESPITOSA VAR. EMAR	134	U	R
TUFTED SAXIFRAGE			
SAXIFRAGA OPPSITIFOLIA	1	U	R
PURPLE SAXIFRAGE			
SENECIO NEWWEBSTERI	1	U	I
OLYMPIC MOUNTAIN BUTTERWEED			
SYNTHYRIS PINNATIFIDA VAR. LAN	1	U	I
WOOLY FEATHERLEAF KITTENTAILS			

HABITAT: ROCKLANDS

SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
HEMPHILLIA DROMEDAPUS	1	C	-
SLUG			

TROPHIC LEVEL: (3) CARNIVORE  
 BIRDS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
AQUILA CHRYSAETOS	12	U	-
GOLDEN EAGLE			
CORVUS CORAX	123456789	C	-
COMMON RAVEN			
FALCO PEREGRINUS	123456789	U	E
PEREGRINE FALCON			

TROPHIC LEVEL: (3) CARNIVORE  
 MAMMALS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
FELIS CONCOLOR	123456789	U	G
MOUNTAIN LION			
MUSTELA ERMINEA	123456789	U	C
SHORT-TAILED WEASEL			
MUSTELA FRENATA	123456789	C	G
LONG-TAILED WEASEL			

TROPHIC LEVEL: (5) OMNIVORE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
GYLLOBLATTA	1	U	I
ICE CRICKET			

TROPHIC LEVEL: (5) OMNIVORE  
 MAMMALS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
PEROMYSCUS MANICULATUS	123456789	A	X
DEER MOUSE			

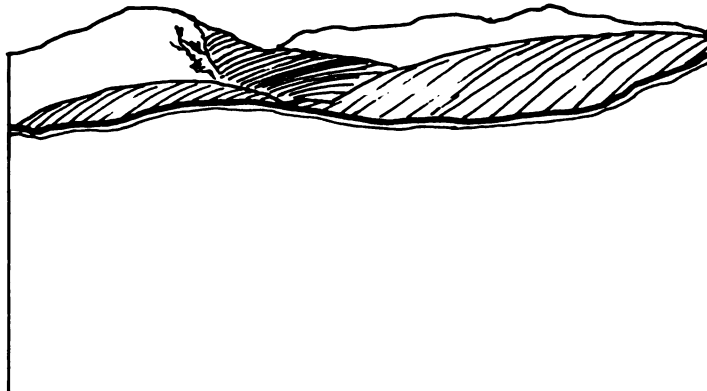
TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
BEMBIIDION COMPLANULUM	1234	C	-
GROUND BEETLE			
NEBRIA TRIFARIA VANDYKEI	1234	U	I
GROUND BEETLE			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 HERPETOFAUNA

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
AMBYSTOMA GRACILE GRACILE	123456789	C	-
BROWN SALAMANDER			
AMBYSTOMA MACRODACTYLUM MACROD	1234	C	-
WESTERN LONG-TOED SALAMANDER			
PLETHODON VANDYKEI	12	C	-
WASHINGTON SALAMANDER			
RHYACOTRITON OLYMPICUS OLYMPIC	12345	Q	-
NORTHERN OLYMPIC MOUNTAIN SALA			

KEY TO SYMBOLS - 1.1.1 A-2



1.1.1 Arctic Alpine Zone  
F Ice Fields/Glaciers

### ***ICE FIELDS / GLACIERS***

Habitat Description

Predominantly ice-covered habitat, unvegetated and unstable.

Food Web

Abbreviated food web with low diversity and few species.

Characteristic Flora

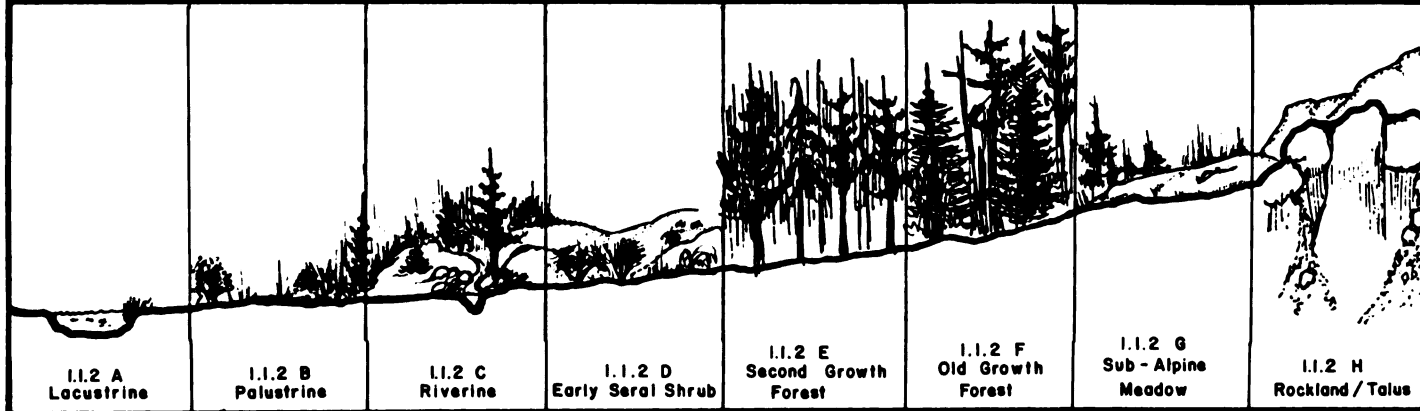
Algae, bacteria.

Characteristic Fauna

Insects, ice worms.

<b>1.1.2 TRUE FIR ZONE</b>	
<b>GENERAL COMMENT</b>	Within the study area the zone is restricted to the slopes of the Olympic Mountains and is largely in the National Park. It is a cool, coniferous, sub-alpine forest and corresponds to the mountain hemlock and silver fir zones as defined by Franklin & Dyrness (1973) and the Canadian and Hudsonian Zones as described by Army Corps of Engineers (1975F).
<b>TOPOGRAPHY AND SOILS</b>	Elevation ranges from 600 to 1700 meters (1968 to 5576 feet). Topography generally steep and youthful. Soils on steep slopes tend to be shallow, overlying volcanic and sedimentary bedrock. Soils in valleys and more moderate slopes are deep and well formed. Dominant soils are Spodosols, i.e., Cryorthods (Podzols and Grey Podzols), and Haplorthods (Brown Podzolic Soils).
<b>CLIMATE</b>	The zone is wet and cool with annual precipitation averaging 260 cm (102 inches). Rain shadows, aspect, sun shadows, and diurnal wind patterns produce strong microclimatic effects. Average annual temperature ranges from 3.4 to 5.6°C (38 to 42°F), depending largely on elevation and shadow effects. Average January temperatures range from -3.7°C to -1.7°C (25 to 29°F). Average July temperatures range from 12 to 15°C (54 to 59°F). Summers are short and cool; winters are long and cold.
<b>HYDROLOGY</b>	The zone is characterized by heavy precipitation and snowfall. Precipitation ranges from 160 to 280 cm (25 to 43 inches) including 400-1400 cm (157 to 551 inches) of snow. A snowpack of 1 to 7.5 meters (3 to 25 feet) (dependent on elevation and shadow effects) is typical. Snow cover can be expected for as long as 6 months in the upper elevations. Retention is moderate and runoff is rapid, peaking during the spring melt.

**HABITAT TYPES**



1.1.2 True Fir Zone  
A Lacustrine



## LACUSTRINE

### Habitat Description

Clear, cold waters characteristically oligotrophic i.e., deficient in nutrients and low in productivity. Lakes are subject to seasonal stratification and mixing.

### Food Web

Predominantly detrital, depending on surrounding drainage; salmonids, and in some lakes amphibians are at the apex. Summer breeding harlequin ducks and common loons are seasonal components.

### Characteristic Flora

Nannoplankton, ultraplankton.

### Characteristic Fauna

Zooplankton: protozoans, rotifers, cladocerans, copepods, and mites.

Salmonid fish: rainbow, brook, cutthroat, and silver trout (sockeye salmon). (Whitefish are found in larger lakes.)

Benthos: midges, amphipods, stonefly and mayfly larvae.

Mammals: mink.

Birds: common loon, harlequin duck.

## COMMUNITY COMPOSITION INLANDS ZONE: TRUE FIP

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (1) PRODUCER  
NONVASCULAR

DIATOM DIATOM	123456789	C	-
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TROPHIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

CALAMAGROSTIS CRASSIGLUMIS THURBERYS REEDGRASS	123456789	U	R
POTAMOGETON ALPINUS MOUNTAIN PONDWEED	123456789	U	-
RORIPPA NASTURTIUM AQUATICUM WATER - CRESS	123456789	C	-
SAGITTARIA LATIFOLIA WAPATO	123456789	C	-
SPIREA DOUGLASII DOUGLAS SPIREA	123456789	U	-

TROPHIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

BAETIS MAYFLIES	123456789	A	-
BRILLIA MIDGES	123456789	C	-
CHIPONCHIDAE TRUE MIDGES	123456789	A	-
EPHEMERELLA MAYFLIES	123456789	C	-
GASTROPODA SNAILS	123456789	C	-
HYDRUPTILA CADDISFLIES	123456789	A	-
HYDROPTILIDAE CADDISFLIES	123456789	A	-
LIMNIPHILIDAE CADDISFLIES	123456789	A	-
PARALEPTOPHLEBIA MAYFLIES	123456789	C	-
PHRYGANEIDAE CADDISFLIES	123456789	A	-
SIPHONURJS MAYFLIES	123456789	C	-

TROPHIC LEVEL: (2) HERBIVORE  
HERPETOFAUNA

BUFO BOREAS BOREAS NORTHWESTERN TOAD/TADPOLE	123456789	0	-
MYLA REGILA PACIFIC TREE FROG/TADPOLE	123456789	A	-
RANA AURORA AURORA NORTHERN RED-LEGGED FROG, TADP	123456789	A	-
RANA CASADAE CASCADES FROG, TADPOLE	12	C	-

## HABITAT: LACUSTRINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (2) HERBIVORE  
MAMMALS

CASTOR CANADENSIS BEAVER	12345678	C	C
ERITHIZON DORSATUM PORCUPINE	12345678	C	G

TROPHIC LEVEL: (3) CARNIVORE  
FISHES

PROSOPUM WILLIAMSONI MOUNTAIN WHITEFISH	1	C	G
PTYCHOCEILUS OREGONENSIS NORTHERN SQUAWFISH	1236	C	-
SALMO CLARKI CUTTHROAT TROUT	123456789	A	G
SALMO TUTRA BROWN TROUT	89	C	G

TROPHIC LEVEL: (3) CARNIVORE  
HERPETOFAUNA

THAMNOPHIS SIRTALIS FITCHI VALLEY GARTER SNAKE	123456789	C	-
THAMNOPHIS SIRTALIS PICKERINGI PUGET SOUND RED-SIDED GARTER S	123	C	-

TROPHIC LEVEL: (3) CARNIVORE  
BIRDS

ACTITIS MACULARIA SPOTTED SANDPIPER	123456789	C	-
FALCO PEREGRINUS PEREGRINE FALCON	123456789	U	E

TROPHIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

CERATOPOGONIDAE BITING MIDGES	123456789	C	-
ENCHYTRAEIDAE OLIGOCHAETES	123456789	A	-
ISOPODA ISOPODS	123456789	C	-
LEPIDOSTOMA CADDISFLIES	123456789	A	-
LEPIDOSTOMATIDAE CADDISFLIES	123456789	A	-
LUMBRICULIDAE OLIGOCHAET	123456789	A	-
OLIGOCHAETA SEGMENTED ROUNDWORMS	123456789	A	-
STRATIOMYIDAE SOLDIER FLIES	123456789	C	-
TUBIFICIDAE TUBIFICIDS	123456789	A	-

KEY TO SYMBOLS - 1.1.1 A-2

## COMMUNITY COMPOSITION INLANDS      ZONE: TRUE FIR

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (5) OMNIVORE  
INVERTEBRATES

AMPHIPODA	123456789	C	-
AMPHIPODS			
HESPEROCORIXA LAEVIGATA	123456789	C	-
WATER BOATMAN			
LIMNEPHILIDAE	123456789	A	-
CADDISFLIES			
SIGARA VANDYKEI	123456789	C	-
WATER BOATMAN			

TROPIC LEVEL: (6) PARASITE  
INVERTEBRATES

CLIMACIA	23456789	U	-
SPONGILIA			
HIRUDINAE	123456789	C	-
LEECHES			

TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

AMELETUS	123456789	O	-
MAYFLIES			
BOSMINA	123456789	A	-
WATER FLEAS			
CERACLEA	123456789	C	-
CADDISFLIES			
CLADOCERA	123456789	A	-
WATER FLEAS			
COPEPODA	123456789	A	-
COPEPODS			
CULEX TARSALIS	123456789	C	X
MOSQUITO			
CULICIDAE	123456789	A	-
MOSQUITOS			
CYCLOPS	123456789	A	-
COPEPODS			
DAPHNIA	123456789	A	-
WATER FLEAS			
DIAPTOMUS	123456789	A	-
COPEPODS			
EPISCHURA	123456789	A	-
COPEPODS			
KELLICOTTIA	123456789	A	-
ROTIFERS			
LEPTOCERIDAE	123456789	A	-
CADDISFLIES			
MYSTACIDES	123456789	A	-
CADDISFLIES			
PELECYPODA	123456789	C	-
CLAMS			
PSYCHOMYIA	123456789	C	-
CADDISFLIES			

## HABITAT: LACUSTRINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

PSYCHOMYIIDAE	123456789	C	-
CADDISFLIES			
ROTIFERA	123456789	A	-
ROTIFERS			

TROPIC LEVEL: (8) SCAVENGER  
INVERTEBRATES

ASTACIDAE	123456789	C	-
CRAYFISH			
TURBELLARIA	123456789	C	-
FLATWORMS			

TROPIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

ANSIOPTERA	123456789	A	-
DRAGONFLIES			
ANTHERIX	23456789	C	-
SNIPE FLIES			
BELOSTOMA FLUMINEUM	123456789	C	-
WATER BUG			
BIDESSUS AFFINIS	123456789	C	-
DIVING BEETLE			
COLEOPTERA	123456789	A	-
AQUATIC BEETLES			
CORIXIDAE	123456789	C	-
WATER BOATMAN			
DOLICHOPODIDAE	123456789	C	-
LONG-LEGGED FLIES			
DYTISCIDAE	123456789	A	-
PREDACEOUS DIVING BEETLES			
EMPIDIDAE	123456789	C	-
DANCE FLIES			
GELASTOCORIS OCULATUS	123456789	C	-
TOAD BUG			
GERRIDAE	123456789	A	-
WATER STRIDERS			
GERRIS NYCTALIS	123456789	C	-
WATER STRIDER			
GYRINIDAE	123456789	A	-
WHIRLIGIG BEETLES			
GYRINUS PICIPES	123456789	C	-
WHIRLIGIG BEETLE			
HYDROPHILIDAE	123456789	C	-
WATER SCAVENGER BEETLES			
HYDOROPORUS UNDULATUS	123456789	C	-
DIVING BEETLE			
NOTONECTA KIRBYI	123456789	C	-
BACKSWIMMER			
NOTONECTA UNDULATA	123456789	C	-
BACKSWIMMER			
NOTONECTIDAE	123456789	C	-
BACK SWIMMERS			



COMMUNITY COMPOSITION INLANDS      ZONE: TRUE FIR  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

DECETIS	123456789	C	-
CADDISFLIES			
OPHIUGOMPHUS	1	0	-
DRAGONFLIES			
POLYCENTRIDIDAE	123456789	C	-
CADDISFLIES			
RHYACOPHILA	123456789	A	-
CADDISFLIES			
SALDULA FLPLANATA	12	0	-
SHOREBUG			
SALDULA PALLIPES	123456789	C	-
SHOREBUG			
SIALIS	23456789	C	-
ALDERFLIES			
ZYGOPTERA	123456789	A	-
DAMSELFLIES			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

CATOSTOMUS CATOSTOMUS	123	C	-
LONGNOSE SUCKER			
SALMO GAIRONERI	123456789	A	G
RAINBOW TROUT			
SALMO TUTRA	89	U	G
BROWN TROUT / JUVENILE			
SALVELINUS FONTINALIS	789	C	G
BRUCK TROUT			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 HERPETOFAUNA

AMBYSTOMA GRACILE GRACILE	123456789	C	-
BROWN SALAMANDER			
AMBYSTOMA MACRODACTYLUM MACROD	1234	C	-
WESTERN LONG-TAILED SALAMANDER			
DICAMPTODON ENSATUS	123456789	U	-
PACIFIC GIANT SALAMANDER			
MYLA REGILA	123456789	A	-
PACIFIC TREE FROG			
RANA AURORA AURORA	123456789	A	-
NORTHERN RED-LEGGED FROG			
RANA CASCADA	12	C	-
CASCADES FROG			
TARICHA GRANULOSA GRANULOSA	123456789	C	-
NORTHERN ROUGH SKINNED NEWT			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 BIRDS

IRIDOPROCNE BICOLOR	123456789	C	-
TREE SWALLOW			

## HABITAT: LACUSTRINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 MAMMALS

SOREX PALUSTRIS	12	C	-
WATER SHREW			

TROPHIC LEVEL: (9) UNKNOWN  
 INVERTEBRATES

ACARINA	123456789	A	-
WATER MITES			
CHIRONOMUS	123456789	A	-
TRUE MIDGES			
EPHEMEROPTERA	123456789	A	-
MAYFLIES			
LIMNEMILUS	123456789	A	-
CADDISFLIES			
MUSCIDA	123456789	C	-
HOUSE FLIES			
NEMATODA	123456789	C	-
ROUNDWORMS			
OSTRACODA	123456789	A	-
SEED SHRIMP			
PSYCHODIDAE	123456789	A	-
MOTH FLIES			
TIPULIDAE	123456789	A	-
CRANE FLIES			
TRICHOPTERA	123456789	A	-
CADDISFLIES			

1.1.2 True Fir Zone  
B Palustrine



## PALUSTRINE

### Habitat Description

Freshwater marsh and shrub swamps. Marshes are dominated by herbaceous plants and shrub swamps by woody plants. Accumulation of organic materials is high and anaerobic soil conditions are typical.

### Food Web

Productivity is high during the fairly short growing season. The food web is dominated by grazers in marshes and undocumented in shrub swamps.

### Characteristic Flora

Periphyton, *Carex* spp. (sedge), heath, pitcher plant, cottongrass, sedges, yellow skunk cabbage, devil's club, Sitka alder.

### Characteristic Fauna

Invertebrates: mosquito larvae, damselfly.

Herpetofauna: cascade frog, rough-skinned newt.

Mammals: Roosevelt elk, northern bog lemming, mountain vole.

Birds: green heron.

COMMUNITY COMPOSITION INLANDS      ZONE: TRUE FIR  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 NON-VASCULAR PLANTS

SPHAGNUM      123456789      A      -  
 SPHAGNUM MOSS

TROPHIC LEVEL: (1) PRODUCER  
 VASCULAR PLANTS

ALNUS RUBRA      123456789      C      C  
 RED ALDER  
 ANDROMEDA POLIFOLIA      12      U      R  
 BOG-ROSEMARY  
 BENSONIELLA OREGANA      89      U      R  
 BENSONIELLA  
 CALAMAGROSTIS CRASSIGLUMIS      123456789      U      R  
 THURBERG'S REEDGRASS  
 CORNUS CANADENSIS      123456789      U      -  
 BUNCHBERRY DOGWOOD  
 DROSER A ROTUNDFOLIA      123456789      U      R  
 ROUND-LEAVED SUNDEW  
 GAULTHERIA SHALLON      123456789      C      -  
 SALAL  
 KALMIA OCCIDENTALIS      123456789      C      -  
 SWAMP LAUREL  
 LEDUM GLANDULOSUM      123456789      C      -  
 PACIFIC LABRADOR TEA  
 LEDUM GROENLANDICUM      12345      U      R  
 LABRADOR TEA  
 PINUS CONTORTA      123456789      U      -  
 LODGEPOLE PINE  
 PINUS MONTICOLA      157      U      C  
 WESTERN WHITE PINE  
 RORIPPA NASTURTIUM AQUATICUM      123456789      C      -  
 WATER - CRESS  
 RUBUS SPECTABILIS      123456789      U      -  
 SALMONBERRY  
 THUJA PLICATA      123456789      A      C  
 WESTERN REDCEDAR  
 TOFIELDIA GLUTINOSA      123456789      U      -  
 WESTERN TOFIELDIA  
 TSUGA HETEROPHYLLA      123456789      U      C  
 WESTERN HEMLOCK  
 VACCINIUM OXYCOCCUS      123456789      U      -  
 WILD CRANBERRY

TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

BAETIS      123456789      A      -  
 MAYFLIES  
 CHIRONOMIDAE      123456789      A      -  
 TRUE MIDGES  
 CINYGMULA      123456789      Q      -  
 MAYFLIES  
 CRICOTOPUS      123456789      C      -  
 TRUE MIDGES

HABITAT: PALUSTRINE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

ELMIDAE      123456789      U      -  
 RIFFLE BEETLES  
 EPHEMERELLA      123456789      C      -  
 MAYFLIES  
 EUKIEFFERIELLA      123456789      A      -  
 TRUE MIDGES  
 GASTROPODA      123456789      C      -  
 SNAILS  
 HYDROPTILIDAE      123456789      A      -  
 CADDISFLIES  
 LIMNIPHILIDAE      123456789      A      -  
 CADDISFLIES  
 OCHROTPACHIA      123456789      U      -  
 CADDISFLIES  
 PARALEPTOPHEBIA      123456789      C      -  
 MAYFLIES  
 PHRYGANEIDAE      123456789      A      -  
 CADDISFLIES  
 PSEUDOCLOEON      1      Q      -  
 MAYFLIES  
 SIPHLONURUS      123456789      C      -  
 MAYFLIES  
 STENOEMA TRISPINOSUM      123456789      C      -  
 PLANTBUG

TROPHIC LEVEL: (2) HERBIVORE  
 HERPETOFAUNA

BUFO BOREAS BOREAS      123456789      C      -  
 NORTHWESTERN TOAD/TADPOLE  
 MYLA REGILA      123456789      A      -  
 PACIFIC TREE FROG/TADPOLE  
 RANA AURORA AURORA      123456789      A      -  
 NORTHERN RED-LEGGED FROG, TADP  
 RANA CASADA      12      C      -  
 CASCADES FROG, TADPOLE

TROPHIC LEVEL: (2) HERBIVORE  
 BIRDS

MELOSPIZA LINCOLNII      123456789      U      -  
 LINCOLN'S SPARROW

TROPHIC LEVEL: (2) HERBIVORE  
 MAMMALS

CASTOR CANADENSIS      12345678      C      C  
 BEAVER  
 MICROTUS LONGICAUDUS      123456789      U      -  
 LONG-TAILED VOLE  
 MICROTUS OREGONI      123456789      U      -  
 OREGON VOLE  
 REITHRODONTOMYS MEGALOTIS      89      U      P  
 WESTERN HARVEST MOUSE

KEY TO SYMBOLS 1.1.1 A-2

COMMUNITY COMPOSITION INLANDS      ZONE: TRUE FIR  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (3) CARNIVORE  
 FISHES

SALMO CLARKI      123456789      A      G  
 CUTTHROAT TROUT

TROPHIC LEVEL: (3) CARNIVORE  
 HERPETOFAUNA

THAMNOPHIS SIRTALIS FITCHI      123456789      A      -  
 VALLEY GARTER SNAKE  
 THAMNOPHIS SIRTALIS PICKERINGI 123      A      -  
 PUGET SOUND RED-SIDED GARTER S

TROPHIC LEVEL: (3) CARNIVORE  
 MAMMALS

SOPEX OBSCURUS      123456789      U      -  
 DOGSKY SHREW

TROPHIC LEVEL: (4) DETRITIVORE  
 INVERTEBRATES

CERATOPOGONIDAE      123456789      C      -  
 BITING MIDGES  
 DIXA      123456789      A      -  
 DIXA MIDGES  
 ENCHYTRAEIDAE      123456789      A      -  
 OLIGOCHAETES  
 HYDROBAENUS      123456789      A      -  
 TRUE MIDGES  
 ISOPODA      123456789      C      -  
 ISOPODS  
 LEPIDOSTOMA      123456789      A      -  
 CADDISFLIES  
 LUMBRICULIDAE      123456789      A      -  
 OLIGOCHAET      123456789      C      -  
 MICROTENDIPEUS      123456789      A      -  
 TRUE MIDGES  
 OLIGOCHAETA      123456789      A      -  
 SEGMENTED ROUNDWORMS  
 ORTHOCLADIUS      123456789      C      -  
 TRUE MIDGES  
 PARAKIEFFERIELLA      123456789      O      -  
 TRUE MIDGES  
 PHALNOPSPECTRA      123456789      A      -  
 TRUE MIDGES  
 PHOCLADIUS      123456789      C      -  
 TRUE MIDGES  
 STRATIOMYIDAE      23456789      C      -  
 SOLDIER FLIES  
 TANYTARSUS      123456789      C      -  
 TRUE MIDGES  
 TUBIFICIDAE      123456789      A      -  
 TUBIFICIDS

HABITAT: PALUSTRINE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (5) OMNIVORE  
 INVERTEBRATES

AMPHIPODA      123456789      C      -  
 AMPHIPODS  
 LIMNAPHILIDAE      123456789      A      -  
 CADDISFLIES  
 SIGARA VANDYKEI      123456789      C      -  
 WATER SCATMAN

TROPHIC LEVEL: (5) OMNIVORE  
 MAMMALS

PEROMYSCUS MANICULATUS      123456789      C      X  
 DEER MOUSE

TROPHIC LEVEL: (6) PARASITE  
 INVERTEBRATES

HIRUDINAE      123456789      C      -  
 LEECHES

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

AMELETUS      123456789      U      -  
 MAYFLIES  
 CLADOCERA      123456789      A      -  
 WATER FLEAS  
 COPEPODA      123456789      A      -  
 COPEPODS  
 CORYDNEURA      123456789      C      -  
 TRUE MIDGES  
 CULEX TARSALIS      123456789      C      X  
 MOSQUITO  
 CULICIDAE      123456789      A      -  
 MOSQUITOS  
 CYCLOPS      123456789      A      -  
 COPEPODS  
 HETEROTRIBOCLADIUS      123456789      A      -  
 TRUE MIDGES  
 LEPTOCERIDAE      123456789      A      -  
 CADDISFLIES  
 MICROPSICTRA      123456789      C      -  
 TRUE MIDGES  
 MYSTACIDES      123456789      A      -  
 CADDISFLIES  
 PARACLADOPHELMA      123456789      O      -  
 TRUE MIDGES  
 PARATANYTARSUS      123456789      O      -  
 TRUE MIDGES  
 PELECYPODA      123456789      C      -  
 CLAMS  
 PSECTROCLADIUS      123456789      C      -  
 TRUE MIDGES  
 ROTIFERA      123456789      A      -  
 ROTIFERS

## COMMUNITY COMPOSITION INLANDS      ZONE: TRUE FIP

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

STEMPELLINA TRUE MIDGES	123456789	0	-
STEMPELLINELLA TRUE MIDGES	123456789	0	-
THIENEMANNIELLA TRUE MIDGES	123456789	C	-

TROPHIC LEVEL: (8) SCAVENGER  
INVERTEBRATES

ASTACIDAE CRAYFISH	123456789	C	-
TURBELLARIA FLATWORMS	123456789	C	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

ANSILOPTERA DRAGONFLIES	123456789	A	-
BEZZIA BITING MIDGES	23456789	0	-
CICINDELA HIRTICOLLIS TIGER BEETLE	123456789	C	-
COLEOPTERA AQUATIC BEETLES	123456789	A	-
CURIXIDAE WATER BOATHMEN	123456789	C	-
DOLICHOPODIDAE LONG-LEGGED FLIES	123456789	C	-
DYTISCIDAE PREDACIOUS DIVING BEETLES	123456789	A	-
EMPIDIDAE DANCE FLIES	123456789	C	-
GELASTOCORIS OCULATUS TOAD BUG	123456789	C	-
GERRIDAE WATER STRIDERS	123456789	A	-
GERRIS INCURVATUS WATER STRIDER	123456789	C	-
GYRINIDAE WHIRLIGIG BEETLES	123456789	A	-
HYDROPHILIDAE WATER SCAVENGER BEETLES	123456789	C	-
MACROPELOPIA TRUE MIDGES	2345	0	-
NOTONECTA UNDIATA BACKSWIMMER	123456789	C	-
NOTONECTIDAE BACK SWIMMERS	123456789	C	-
RHYACOPHILIDAE CADDISFLIES	123456789	A	-

## HABITAT: PALUSTRINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

SALDULA EXPLANATA SHOREBUG	12	0	-
SALDULA PALLIPES SHOREBUG	123456789	C	-
SIALIS ALDERFLIES	23456789	C	-
ZYGOPTERA DAMSELFLIES	123456789	A	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
FISHES

SALMO GAIKNERI RAINBOW TROUT	123456789	U	G
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TROPHIC LEVEL: (9) INVERTEBRATE EATER  
HERPETOFAUNA

AMBYSTOMA GRACILE GRACILE BROWN SALAMANDER	123456789	C	-
AMBYSTOMA MACRODACTYLUM MACROD WESTERN LONG-TOED SALAMANDER	1234	C	-
DICAMPTODON ENSATUS PACIFIC GIANT SALAMANDER	123456789	U	-
HYLA REGILA PACIFIC TREE FROG	123456789	A	-
PLETHODON VANDYKEI WASHINGTON SALAMANDER	12	C	-
RANA AURORA AURORA NORTHERN RED-LEGGED FROG	123456789	A	-
RANA CASCADEAE CASCADES FROG	12	C	-
RHYACOTRITON OLYMPICUS OLYMPIC NORTHERN OLYMPIC MOUNTAIN SALA	12345	0	-
TARICHA GRANULOSA GRANULOSA NORTHERN ROUGH SKINNED NEWT	123456789	C	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
MAMMALS

MYOTIS LUCIFUGUS LITTLE BROWN MYOTIS	123456789	C	-
SOREX PALUSTRIS WATER SHREW	12	U	-
SOREX VAGRANS VAGRANT SHREW	123456789	C	-

## COMMUNITY COMPOSITION INLANDS

ZONE: TRUE FIP

HABITAT: PALUSTRINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (0) UNKNOWN  
INVERTEBRATES

ACARINA	123456789	A	-
WATER MITES			
CHIRONOMUS	123456789	A	-
TRUE MIDGES			
CONCHAPELPIA	123456789	Q	-
TRUE MIDGES			
EPHEMEROPTERA	123456789	A	-
MAYFLIES			
MUSCIDAE	123456789	C	-
HOUSE FLIES			
NEMATODA	123456789	C	-
ROUNDWORMS			
OSTRACODA	123456789	A	-
SEED SHRIMP			
PELTOPERLA	123456789	C	-
STONEFLIES			
PLECOPTERA	123456789	U	-
STONEFLIES			
POLYPEDILUM	123456789	C	-
TRUE MIDGES			
PSYCHODIDAE	123456789	A	-
MOTH FLIES			
THIENEMANNIHYIA	123456789	Q	-
TRUE MIDGES			
TIPULIDAE	123456789	A	-
CRANE FLIES			
TRICHOPTERA	123456789	A	-
CADDISFLIES			

1.1.2 True Fir Zone  
C Riverine



## **RIVERINE**

Habitat Description

Clear cold oligotrophic water, fairly low flows in summer with heavy flows during spring melt. Streams have considerable white water and are predominantly in the Boulder Zone defined by Bauer (1974A). Gradients are steep and boulders and gravel are the main sediment sizes.

Food Web

Predominantly detrital and dependent on catch basin.

Characteristic Flora

Periphyton

Characteristic Fauna

Insects: stonefly, mayfly, caddisfly, and black fly, nymph stages.

Birds: dipper.

## COMMUNITY COMPOSITION INLANDS      ZONE: TRUE FIR

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

DIATOMA DIATOM	123456789	C	-
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TROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

POTAMOGETON ALPINUS MOUNTAIN PONDWEED	123456789	U	-
RORIPPA NASTURTIUM AQUATICUM WATER - CROSS	123456789	C	-

TROPIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

AMIOCENTRUS CADDISFLIES	123456789	A	-
BAETIS MAYFLIES	123456789	A	-
BOREOGCHLUS TRUE MIDGES	2345	Q	-
BRACHYCENTRIDAE CADDISFLIES	123456789	C	-
BRACHYPTERA STONEFLIES	123456789	C	-
BRILLIA MIDGES	123456789	C	-
CHIRONOMIDAE TRUE MIDGES	123456789	A	-
CINYGULA MAYFLIES	123456789	A	-
CLADOTANYTARSUS TRUE MIDGES	123456789	Q	-
CRICOTOPUS TRUE MIDGES	123456789	C	-
ELMIDAE RIFFLE BEETLES	123456789	A	-
EPEORUS MAYFLIES	123456789	A	-
EPHEMERELLA MAYFLIES	123456789	A	-
EUCAPNISIS STONEFLIES	1	Q	-
EUKIEFFERIELLA TRUE MIDGES	123456789	C	-
GASTROPODA SNAILS	123456789	C	-
GLOSSOSOMATIDAE CADDISFLIES	123456789	C	-
HALIPLUS ROBERTSI HALIPLID	123456789	C	-
HEPTAGFNIA MAYFLIES	123456789	A	-
HETERLIMNIUS RIFFLE BEETLES	123456789	C	-

## HABITAT: RIVERINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

HIMALOPSYCHE CADDISFLIES	23456789	A	-
HYDROPTILA CADDISFLIES	123456789	A	-
HYDROPTILIDAE CADDISFLIES	123456789	A	-
LEUCOTRICHIA CADDISFLIES	456789	A	-
LEUCTRA STONEFLIES	123456789	Q	-
LIMNPHILIDAE CADDISFLIES	123456789	A	-
MICRASEMA CADDISFLIES	123456789	C	-
MARPUS RIFFLE BEETLES	123456789	C	-
NEMOURA STONEFLIES	123456789	C	-
OCHROTRICHA CADDISFLIES	123456789	A	-
OPTIOSERVUS RIFFLE BEETLES	123456789	C	-
PARALEPTOPHLEBIA MAYFLIES	123456789	C	-
PHRYGANIIDAE CADDISFLIES	123456789	A	-
PSEUDOCLOEON MAYFLIES	1	C	-
PTERONARCELLA STONEFLIES	123456789	C	-
PTERONARCYS STONEFLIES	123456789	C	-
RHITHROGENA MAYFLIES	123456789	A	-
SIPHONURUS MAYFLIES	123456789	C	-
ZAITZEVIA RIFFLE BEETLES	123456789	C	-

TROPIC LEVEL: (2) HERBIVORE  
HERPETOFAUNA

ASCAPHUS TRUEI TAILED FROG/TADPOLE	123456789	A	-
BUFO BOREAS BOREAS NORTHWESTERN TOAD/TADPOLE	123456789	Q	-
MYLA REGILA PACIFIC TREE FROG/TADPOLE	123456789	A	-
RANA AURORA AURORA NORTHERN RED-LEGGED FROG, TADP	123456789	A	-
RANA CASADAE CASCADES FROG, TADPOLE	12	C	-

KEY TO SYMBOLS - 1.1.1 A-2



## COMMUNITY COMPOSITION INLANDS      ZONE: TRIF FIR

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (2) HERBIVORE  
MAMMALS

CASTOR CANADENSIS BEAVER	12345678	C	C
ERITHIZON DORSATUM PORCUPINE	12345678	U	G

TROPIC LEVEL: (3) CARNIVORE  
FISHES

PROSOPIUM WILLIAMSONI MOUNTAIN WHITEFISH	1	C	G
PTYCHOCEILUS OREGONENSIS NORTHERN SJAWFISH	1236	C	-
SALMO CLARKI CUTTHROAT TROUT	123456789	A	G
SALMO TUTRA BROWN TROUT	89	C	G
SALVELINUS MALMA DOLLY VARDEN	123456789	U	G

TROPIC LEVEL: (3) CARNIVORE  
HERPETOFAUNA

THAMNOPHIS SIRTALIS FITCHI VALLEY GARTER SNAKE	123456789	C	-
THAMNOPHIS SIRTALIS PICKERINGI PUGLET SOUND RED-SIDED GARTER S	123	C	-

TROPIC LEVEL: (3) CARNIVORE  
BIRDS

ACTITIS MACULARIA SPOTTED SANDPIPER	123456789	C	-
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TROPIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

CERATOPOGONIDAE BITING MIDGES	123456789	C	-
DIXA DIXA MIDGES	123456789	A	-
ENCHYTRAEDIAE OLIGOCHAETES	123456789	A	-
HYDROBAENUS TRUE MIDGES	123456789	Q	-
IRONODES MAYFLIES	123456789	C	-
ISOPODA ISOPODS	123456789	C	-
KINCAIDIANA OLIGOCHAETES	1	Q	-
LEPIDOSTOMA CADDISFLIES	123456789	A	-
LEPIDOSTOMATIDAE CADDISFLIES	123456789	A	-
LUMBRICULIDAE OLIGOCHAETES	123456789	A	-

## HABITAT: RIVERINE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

MICROTENDIPES TRUE MIDGES	123456789	-	-
MONODIAMESA TRUE MIDGES	23456789	Q	-
ODONTOMESA TRUE MIDGES	23456789	Q	-
OLIGOCHAETA SEGMENTED ROUNDWORMS	123456789	A	-
ORTHOCLADIUS TRUE MIDGES	123456789	C	-
PARAKIEFFERIELLA TRUE MIDGES	123456789	Q	-
PHAENOPSECTRA TRUE MIDGES	123456789	Q	-
PROCLADIUS TRUE MIDGES	123456789	C	-
STRATIOMYIDAE SOLDIER FLIES	23456789	C	-
STYLODRILUS OLIGOCHAETES	1	Q	-
TANYTARSUS TRUE MIDGES	123456789	C	-
TUBIFICIDAE TUBIFICIDS	123456789	A	-

TROPIC LEVEL: (5) OMNIVORE  
INVERTEBRATES

AMPHIPODA AMPHIPODS	123456789	C	-
LIMNEMPHILIDAE CADDISFLIES	123456789	A	-

TROPIC LEVEL: (6) PARASITE  
INVERTEBRATES

CLIMACIA SPONGILIA	23456789	U	-
HIRUDINAE LEECHES	123456789	C	-

TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

AMELETUS MAYFLIES	123456789	C	-
ARCTOPSYCHE CADDISFLIES	123456789	C	-
CERACLEA CADDISFLIES	123456789	C	-
CHEMATOPSYCHE CADDISFLIES	123456789	A	-
CONSTEMPPELLINA TRUE MIDGES	15	Q	-

COMMUNITY COMPOSITION INLANDS      ZONE: TRUE FIR  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

COPEPODA	123456789	C	-
COPEPODS			
CRAYFISH	123456789	C	-
TRUE MIDGES			
DIAPYCNIDAE	123456789	C	-
TRUE MIDGES			
DELOPHILODIDAE	123456789	O	-
-NULL-			
HETEROTRISOCLADIUS	123456789	O	-
TRUE MIDGES			
HYDROPSYCHE	123456789	A	-
CADDISFLIES			
KRENSMITHIA	123456789	O	-
TRUE MIDGES			
LEPTOCERIDAE	123456789	A	-
CADDISFLIES			
MICROPSECTRA	123456789	C	-
TRUE MIDGES			
MYSTACIDIDAE	123456789	C	-
CADDISFLIES			
PAPULADIPLOMA	123456789	O	-
TRUE MIDGES			
PARACRITIPUS	123456789	O	-
TRUE MIDGES			
PARAMETRIJONEMUS	123456789	O	-
TRUE MIDGES			
PARAPSYCHE	123456789	C	-
CADDISFLIES			
PARATANYTAPUS	123456789	O	-
TRUE MIDGES			
PELECYPODA	123456789	C	-
CLAMS			
PHILCOTAMIDAE	123456789	A	-
CADDISFLIES			
POTTHASTIA	123456789	C	-
TRUE MIDGES			
PSEUDOCALADIUS	123456789	C	-
TRUE MIDGES			
PSYCHOMYIA	123456789	C	-
CADDISFLIES			
PSYCHOMYIIDAE	123456789	C	-
CADDISFLIES			
RHEOTANYTARUS	123456789	C	-
TRUE MIDGES			
ROTIFERA	123456789	C	-
ROTIFERS			
SIMULIIDAE	123456789	A	-
BLACK FLIES			
SIMULIUM	123456789	O	-
BLACK FLIES			
STEMPELLINA	123456789	O	-
TRUE MIDGES			

HABITAT: RIVERINE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

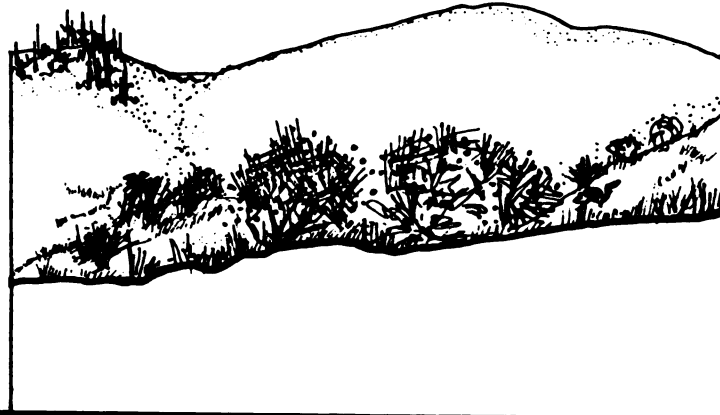
TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

STEMPELLINELLA	123456789	O	-
TRUE MIDGES			
THIENEMANNIELLA	123456789	C	-
TRUE MIDGES			
WORMALDIA	123456789	A	-
CADDISFLIES			
TROPHIC LEVEL: (8) SCAVENGER INVERTEBRATES			
ASTACIDAE	123456789	C	-
CRAYFISH			
TURBELLARIA	123456789	C	-
FLATWORMS			
TROPHIC LEVEL: (9) INVERTEBRATE EATER INVERTEBRATES			
ACRONEURIA	123456789	C	-
STONEFLIES			
ALLOPERLA	123456789	A	-
STONEFLIES			
ANSIPTERA	123456789	C	-
DRAGONFLIES			
ANTHERIX	23456789	C	-
SNIPER FLIES			
APCYNOPTERYX	123456789	A	-
STONEFLIES			
BEMBIDION COMPLANULUM	1234	C	-
GROUND BEETLE			
BEZZIA	23456789	O	-
BITING MIDGES			
BIDESSUS AFFINIS	123456789	C	-
DIVING BEETLE			
CARDIOCLADIUS	123456789	C	-
PIDGES			
CICINDELA HIRTICOLLIS	123456789	C	-
TIGER BEETLE			
COLEOPTERA	123456789	A	-
AQUATIC BEETLES			
CORIXIDAE	123456789	C	-
WATER BOATMEN			
CULTUS	123456789	C	-
STONEFLIES			
DOLICHOPODIDAE	123456789	C	-
LONG-LEGGED FLIES			
DYTISIDAE	123456789	C	-
PREDACEOUS DIVING BEETLES			
EMPIDIDAE	123456789	C	-
DANCE FLIES			
GELASTOCORIS OCULATUS	123456789	C	-
TOAD BUG			
GERRIDAE	123456789	C	-
WATER STRIDERS			

COMMUNITY COMPOSITION INLANDS	ZONE: TRUF FIR		
SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
TROPIC LEVEL: (9) INVERTEBRATE EATER INVERTEBRATES			
GERRIS NYCTALIS WATER STRIDER	123456789	C	-
GYRINIDAE WHIRLIGIG BEETLES	123456789	C	-
GYRINUS PICIPES WHIRLIGIG BEETLE	123456789	C	-
HYDROPHILIDAE WATER SCAVENGER BEETLES	123456789	C	-
ISOPERLA STONEFLIES	123456789	C	-
KATHROPERLA STONEFLIES	123456789	0	-
MACROPTERIDIA TRUE MIDGES	2345	0	-
MICRONELIA BJENJI VELIID	123456789	C	-
NATARSIA TRUE MIDGES	2345	0	-
NOTONECTIDAE BACK SWIMMERS	123456789	C	-
DECEYIS CADDISFLIES	123456789	C	-
OPHIOMPHUS DRAGONFLIES	1	0	-
PARAFERLA STONEFLIES	123456789	0	-
POLYCENTRIDIDAE CADDISFLIES	123456789	C	-
POLYCENTRUPUS CADDISFLIES	123456789	C	-
PSECTROTANYPUS TRUE MIDGES	123456789	0	-
RHYACOPHILA CADDISFLIES	123456789	C	-
RHYACOPHILIDAE CADDISFLIES	123456789	A	-
SALDULA NIGRITA SHOREBUG		C	-
SALDULA PALLIPES SHOREBUG	123456789	C	-
SIALIS ALDERFLIES	23456789	C	-
ZYGOPHTERA DANSELFLEES	123456789	C	-

HABITAT: RIVERINE			
SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
TROPIC LEVEL: (9) INVERTEBRATE EATER FISHES			
CATOSTOMUS CATOSTOMUS LONGNOSE SUCKER	123	C	-
SALMO GARDNERI RAINBOW TROUT	123456789	A	6
SALMO TUTRA BROWN TROUT / JUVENILE	89	C	6
SALVELINUS FONTINALIS BROOK TROUT	789	C	6
TROPIC LEVEL: (9) INVERTEBRATE EATER HERPETOFAUNA			
AMBYSTOMA GRACILE GRACILE BROWN SALAMANDER	123456789	C	-
ASCAPHUS TRUEI TAILED FROG	123456789	A	-
DICAMPTODON ENSATUS PACIFIC GIANT SALAMANDER	123456789	U	-
HYLA REGILA PACIFIC TREE FROG	123456789	A	-
RANA AURORA AURORA NORTHERN RED-LEGGED FROG	123456789	U	-
RANA CASCADAE CASCADES FROG	12	C	-
RHYACOTRITON OLYMPICUS OLYMPIC NORTHERN OLYMPIC MOUNTAIN SALA	12345	C	-
TARICHA GRANULOSA GRANULOSA NORTHERN ROUGH SKINNED NEWT	123456789	U	-
TROPIC LEVEL: (9) INVERTEBRATE EATER BIRDS			
CINCLUS MEXICANUS DIPPER	123456789	C	-
TROPIC LEVEL: (9) INVERTEBRATE EATER MAMMALS			
Sorex palustris WATER SHREW	12	C	-

COMMUNITY COMPOSITION INLANDS	ZONE: TRUE FYR	HABITAT: RIVERINE	
SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
TROPHIC LEVEL: (Q) UNKNOWN INVERTEBRATES			
ACARINA	123456789	A	-
WATER MITES			
CHIRONOMUS	123456789	A	-
TRUE MIDGES			
CONCHAPELOPIA	123456789	Q	-
TRUE MIDGES			
DEUTEROPHEBIIIDAE	1	U	-
MOUNTAIN MIDGES			
ECCLISOMYIA	123456789	C	-
CADDISFLIES			
EPHEMEROPTERA	123456789	A	-
MAYFLIES			
HELICOPSYCHE	123456789	C	-
CADDISFLIES			
HYDATOPHYLAX	123456789	Q	-
CADDISFLIES			
HYDROPSYCHIDAE	123456789	A	-
CADDISFLIES			
LIMNephilus	123456789	A	-
CADDISFLIES			
MUSCIDAE	123456789	C	-
HOUSE FLIES			
NEMATODA	123456789	C	-
ROUNDWORMS			
NEMATOMORPHA	123456789	Q	-
HOORSEHAIR WORMS			
NEOPHYLAX	123456789	C	-
CADDISFLIES			
OSTRACODA	123456789	C	-
SEED SHRIMP			
PELTOPERLA	123456789	C	-
STONEFLIES			
PLECOPTERA	123456789	A	-
STONEFLIES			
PSEPHENIDAE	23456789	U	-
WATER PENNIES			
PSYCHODIDAE	123456789	A	-
MOTH FLIES			
PTILODACTYLIDAE	23456789	Q	-
PTILODACTYL BEETLES			
RHEOCRICHTOPUS	123456789	C	-
TRUE MIDGES			
SERICOSTOMATIDAE	123456789	A	-
CADDISFLIES			
THIENEMANNIYIA	123456789	Q	-
TRUE MIDGES			
TIPULIDAE	123456789	A	-
CRANE FLIES			
TRICHOPTERA	123456789	A	-
CADDISFLIES			



1.1.2 True Fir Zone  
D Early Seral Shrub

## EARLY SERAL SHRUB

### Habitat Description

This habitat occurs following disturbance such as fire or logging. A shrub community quickly becomes established and dominates until overtopped by forest species.

### Food Web

Predominantly grazing or browsing, significant use of shrubs by elk and black-tailed deer.

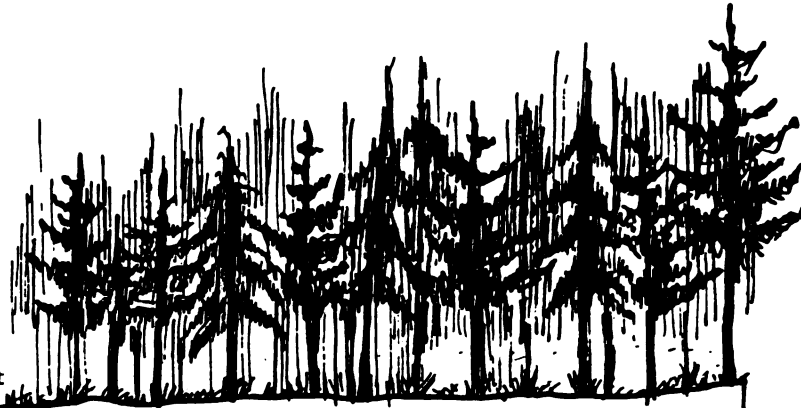
### Characteristic Flora

Bear grass, huckleberry, bracken fern. On wet sites elderberry, gooseberry, and salmonberry dominate.

### Characteristic Fauna

Birds: white-crowned sparrow, dark-eyed junco, Wilson's warbler, mountain chickadee.

Mammals: bats, deer mouse, bushy-tailed woodrat, Townsend's chipmunk, coyote.



1.1.2 True Fir Zone  
E Second Growth Forest

## **SECOND GROWTH FOREST**

### Habitat Description

Young vigorous even-aged forest (100 years old or less) with fairly closed canopy.

### Food Web

The food web is compartmentalized into two segments - a canopy which is dominated by grazers (including seed eaters) and a forest floor web which is largely detrital.

### Characteristic Flora

In the lower reaches of the zone Douglas fir, noble fir, and western hemlock are the dominant tree species. In the higher elevations silver fir, mountain hemlock, lodgepole pine, and sub-alpine fir are more common.

### Characteristic Fauna

**Mammals:** Townsend's chipmunk, deer mouse, heather vole, coyote, Trowbridge shrew, snowshoe hare.

**Birds:** western tanager, evening grosbeak, Clark's nutcracker, raven, red-breasted nuthatch, hermit thrush, brown creeper, Stellar's jay, Swainson's thrush, and black-throated gray warbler.



1.1.2 True Fir Zone  
F Old Growth Forest

## OLD GROWTH FOREST

### Habitat Description

Aging conifer forest with partially opened canopy contains snags and some diseased trees.

### Food Web

The food web is compartmentalized into two segments: a canopy which is dominated by grazers and a forest floor community which is largely detrital. However, due to the partially open canopy, browse and other forest floor growth occurs.

### Characteristic Flora

Silver fir is the dominant species. Western hemlock and Douglas fir are common at lower, and mountain hemlock at higher elevations. Climax species are silver fir and mountain hemlock.

### Characteristic Fauna

**Birds:** spotted owl, saw-whet owl, goshawk, gray jay, varled thrush, hairy woodpecker, pileated woodpecker, chestnut-backed chickadee, hermit warbler.

**Mammals:** red tree mouse, dusky shrew, marten, flying squirrel.

**Herpetofauna:** Pacific giant salamander, tailed frog.

1.1.2 True Fir Zone  
G Sub-Alpine Meadow



## ***SUB-ALPINE MEADOW***

### Habitat Description

Nonforested glades more common in the higher reaches of the zone. Moisture conditions vary considerably. This is a fragile habitat, which can be damaged by excessive use and subsequent erosion.

### Food Web

Grazing food web with low productivity, slow regeneration and succession. Concentrations of herbivores are common during summer months.

### Characteristic Flora

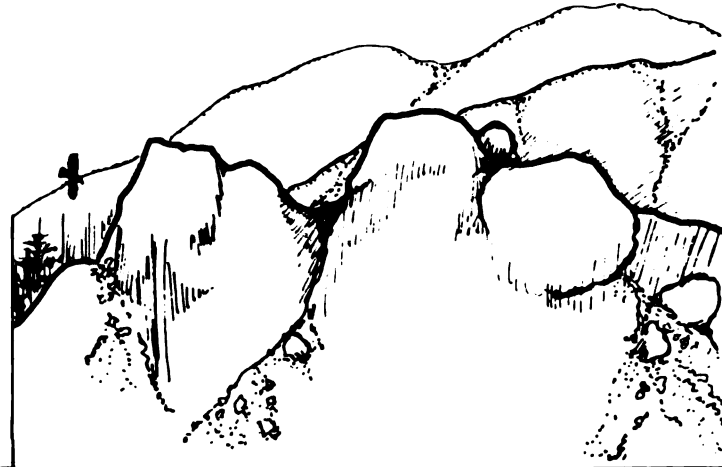
Xeric to mesic vegetation is similar to that identified for the Arctic alpine meadow habitat. In poorly drained areas cotton-grass, sphagnum, and rushes are more frequent.

### Characteristic Fauna

Mammals: mountain vole, Richardson's vole, Townsend's mole, Roosevelt elk, black-tailed deer, black bear.

Birds: water pipit, white-crowned sparrow, killdeer, American kestrel, golden eagle, Clark's nutcracker, Lincoln's sparrow, rufous hummingbird.





1.1.2 True Fir Zone  
H Rockland/Talus

## **ROCKLAND / TALUS**

### Habitat Description

Dominated by rock outcrops, boulders, cliffs.  
Lack of soil severely limiting to plant growth.

### Food Web

Off-site grazing food web; few species, low productivity.

### Characteristic Flora

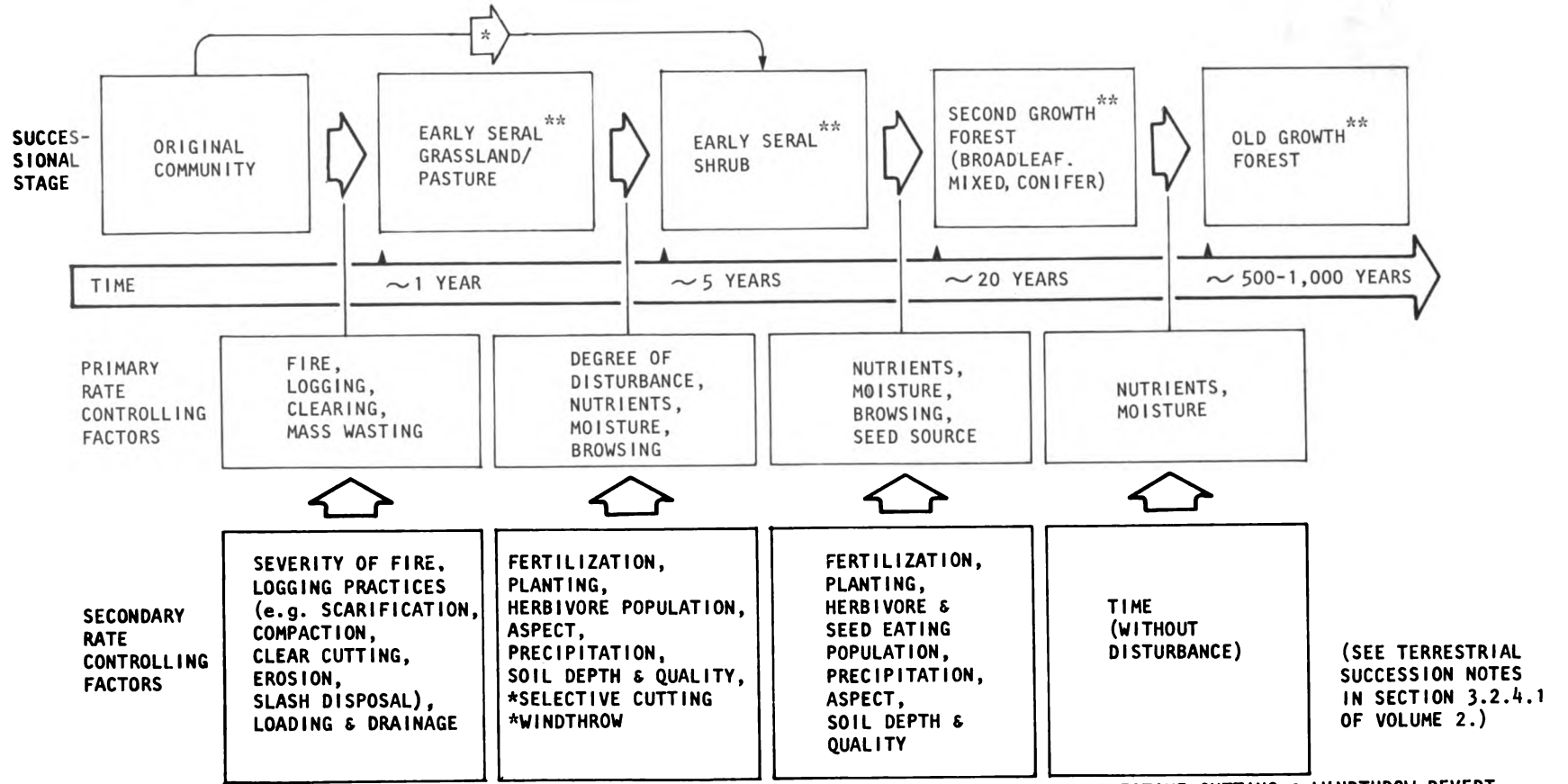
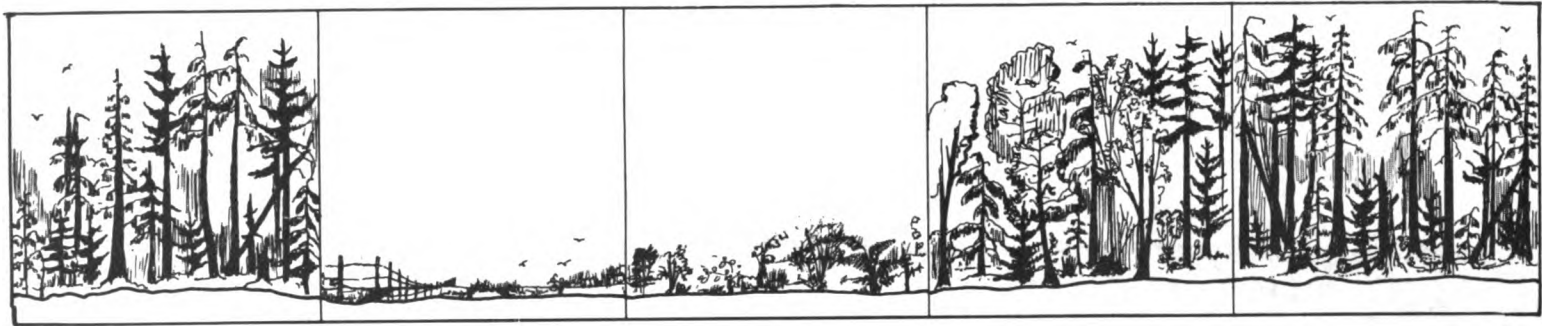
Predominantly unvegetated; lichens and mosses most common.

### Characteristic Fauna

Birds: golden eagle, raven.

Mammals: mountain goat, yellow-bellied marmot, long-tailed weasel.

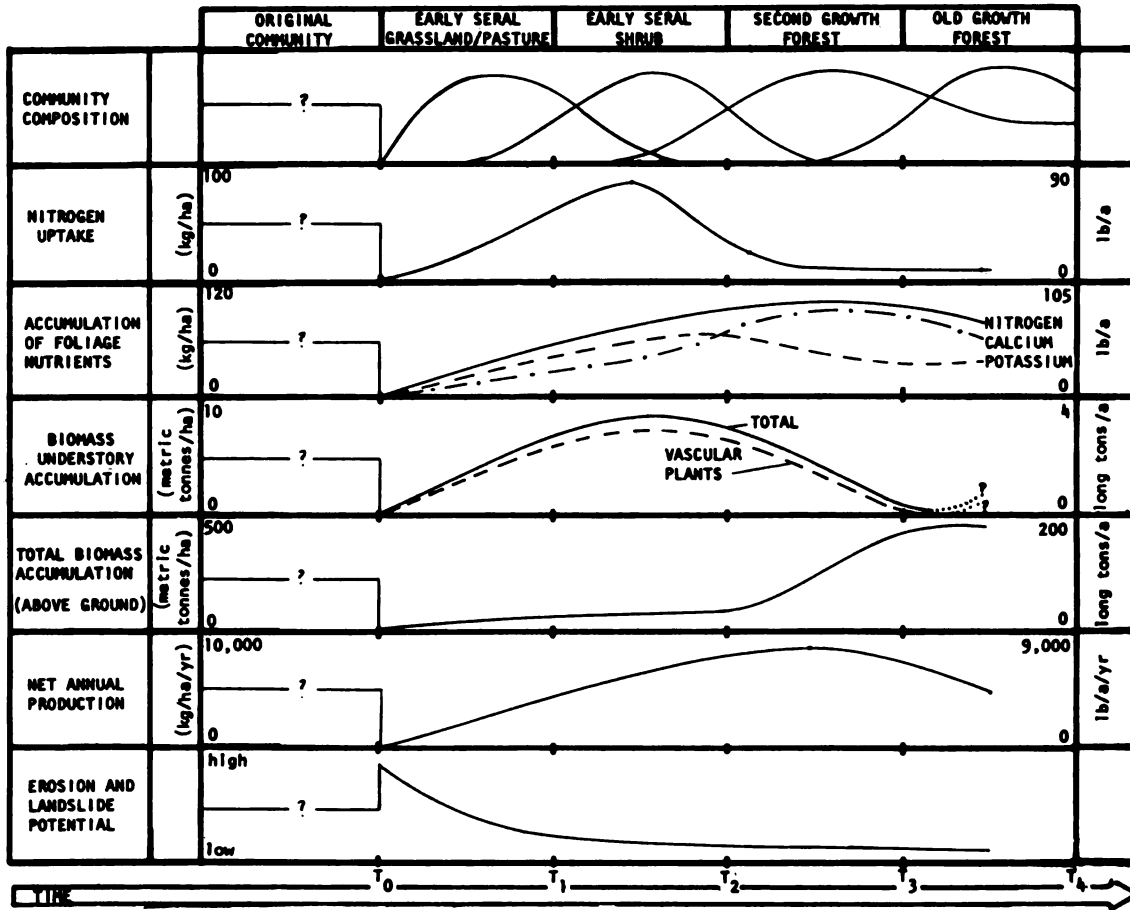
<b>1.2.1 WESTERN HEMLOCK ZONE</b>										
<b>GENERAL COMMENT</b>	Highly productive and extensive lowland conifer forest. Currently largely in second growth due to extensive logging and windthrow. Much of the highly productive commercial forestlands of the study area occur in this zone. The zone corresponds to the Western Hemlock Zone of Franklin and Dyrness (1973), and the Humid Transition Zone as described by the Army Corps of Engineers (1975F).									
<b>TOPOGRAPHY AND SOILS</b>	Elevation ranges from 150 to 600 meters (492 to 1968 feet) in the Olympics and from near sea level to 600 meters (1968 feet) in the Coastal Range. Topography is variable but usually not precipitous. Typical are lower mountain slopes, foothills and plains, with many bogs. Soils are moderately deep to deep with medium acidity and high organic content (Franklin and Dyrness, 1973). Dominant soils include Dystrochrepts (Soils Burns Acides), Haplumbrepts (Western Brown Forest Soils), and Haplohumult (Redish Brown Lateritic Soils).									
<b>CLIMATE</b>	The zone has a mild, wet maritime climate. Average annual temperatures range from 8°C to 10°C (46 to 50°F) with summer and winter extremes muted. Average January temperatures are near 1°C (34°F) and average July temperatures are near 17.5°C (64°F). Snow cover is infrequent in the lower elevations. Summer dehydration stress is significant on overly drained soils and south facing slopes.									
<b>HYDROLOGY</b>	The zone is characterized by heavy precipitation varying from 160 to 320 cm (63 to 126 inches). Average annual snowfalls range from 0 at near sea level to nearly 200 cm (79 inches) at higher elevations. However, snow cover is usually of short duration. Most of the precipitation occurs during the winter with summer receiving only 6-9 percent. Late summer and early fall flows are consequently low.									
<b>HABITAT TYPES</b>										
1.2.1 A Lacustrine	1.2.1 B Palustrine	1.2.1 C Riverine	1.2.1 D Riparian	1.2.1 E Agricultural	1.2.1 F Early Seral Grassland/ Pasture	1.2.1 G Early Seral Shrub	1.2.1 H Second Growth Forest (Broadleaf)	1.2.1 I Second Growth Forest (Mixed)	1.2.1 J Second Growth Forest (Conifer)	1.2.1 K Old Growth Forest



**SUCCESSION MODEL - WESTERN HEMLOCK ZONE**

\* SELECTIVE CUTTING & WINDTHROW REVERT ONLY AS FAR AS SHRUB STAGE.

\*\* REFER TO APPROPRIATE HABITAT DESCRIPTION.



(SOURCES)

(EDMONDS, 1974)

(COLE et al., 1975)

(COLE et al., 1975)

(EDMONDS, 1974)

(GRIER et al., 1974)

(MONTGOMERY, 1976)

**ENVIRONMENTAL INDICES ASSOCIATED WITH WESTERN HEMLOCK SUCCESSION**

1.2.1 Western Hemlock Zone  
A Lacustrine



## LACUSTRINE

### Habitat Description

Lakes are oligotrophic to mesotrophic. Characterized by emergent vegetation, shallow water, and thick shoreline vegetation. They are generally more productive than the lakes of the higher zones.

### Food Web

Productivity is dominated by phytoplankton in large deep lakes and by periphyton and emergent vegetation in smaller shallow lakes. Both grazing and detrital components of the food web are well-developed.

### Characteristic Flora

Nannoplankton and ultraplankton dominate the oligotrophic lakes. Yellow pond lily, cattails, and pond weed are common macrophytes.

### Characteristic Fauna

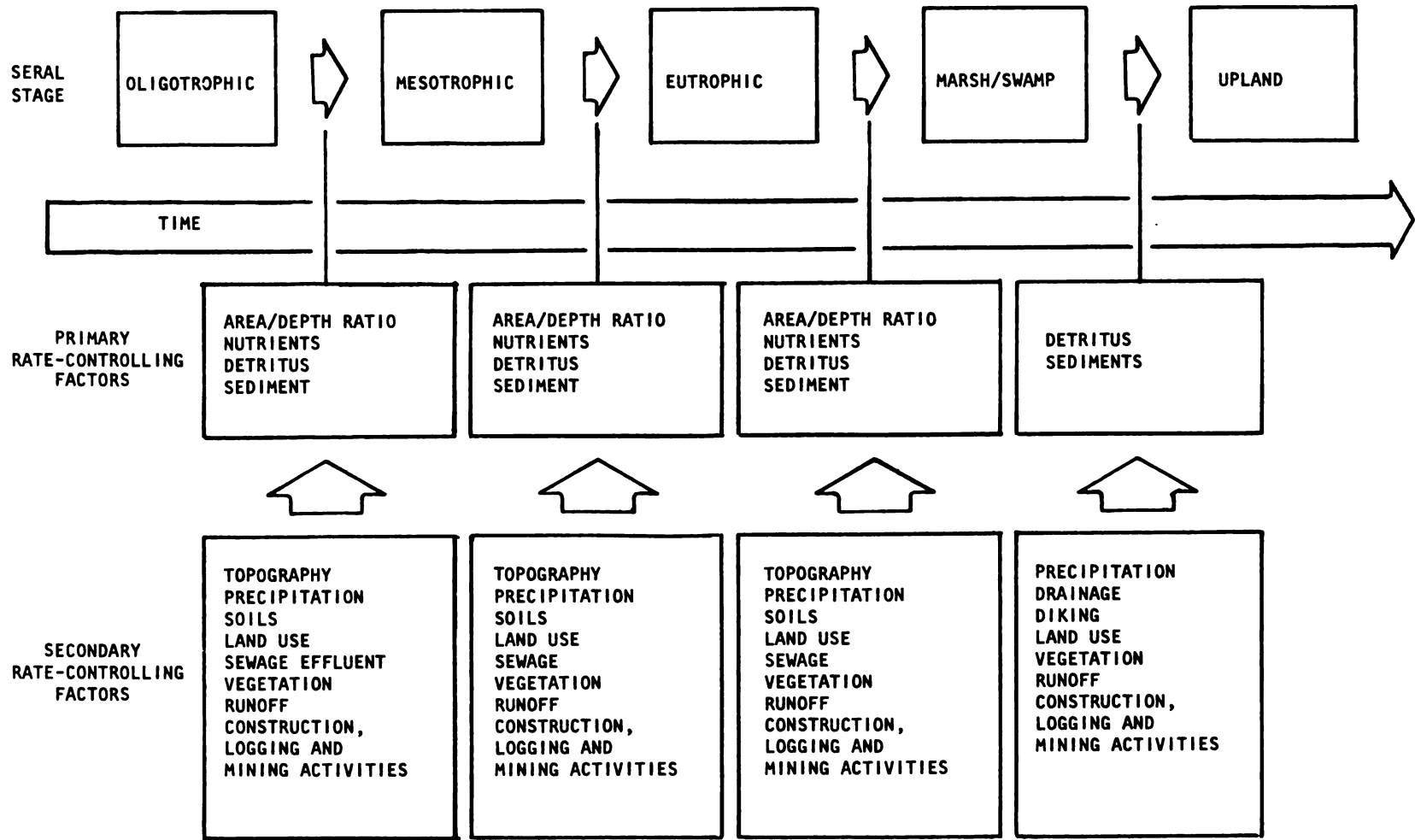
Zooplankton: protozoans, rotifers, copepods, mites, with copepods the most numerous.

Fish: In oligotrophic waters, rainbow trout, Dolly Varden, brook trout, cutthroat trout, sockeye salmon (silver trout), whitefish. In warmer, more enriched waters, perch, bullhead, crappie, and largemouth bass.

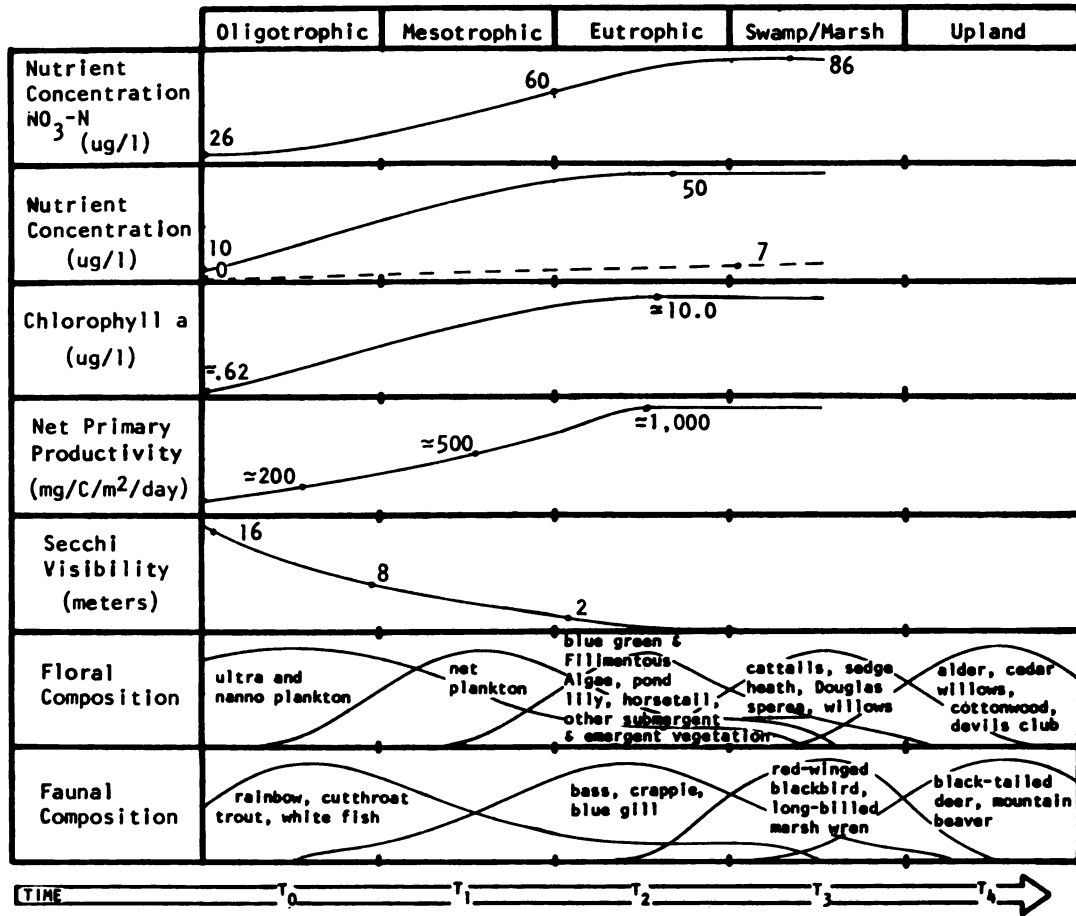
Mammals: mink, river otter, muskrat, beaver, and raccoon.

Birds: mallard, widgeon, bufflehead, great blue heron, Canada goose, gadwall, American coot, belted kingfisher, osprey.

Herpetofauna: painted turtle, garter snakes, rough-skinned newt, western toad, bull frog.



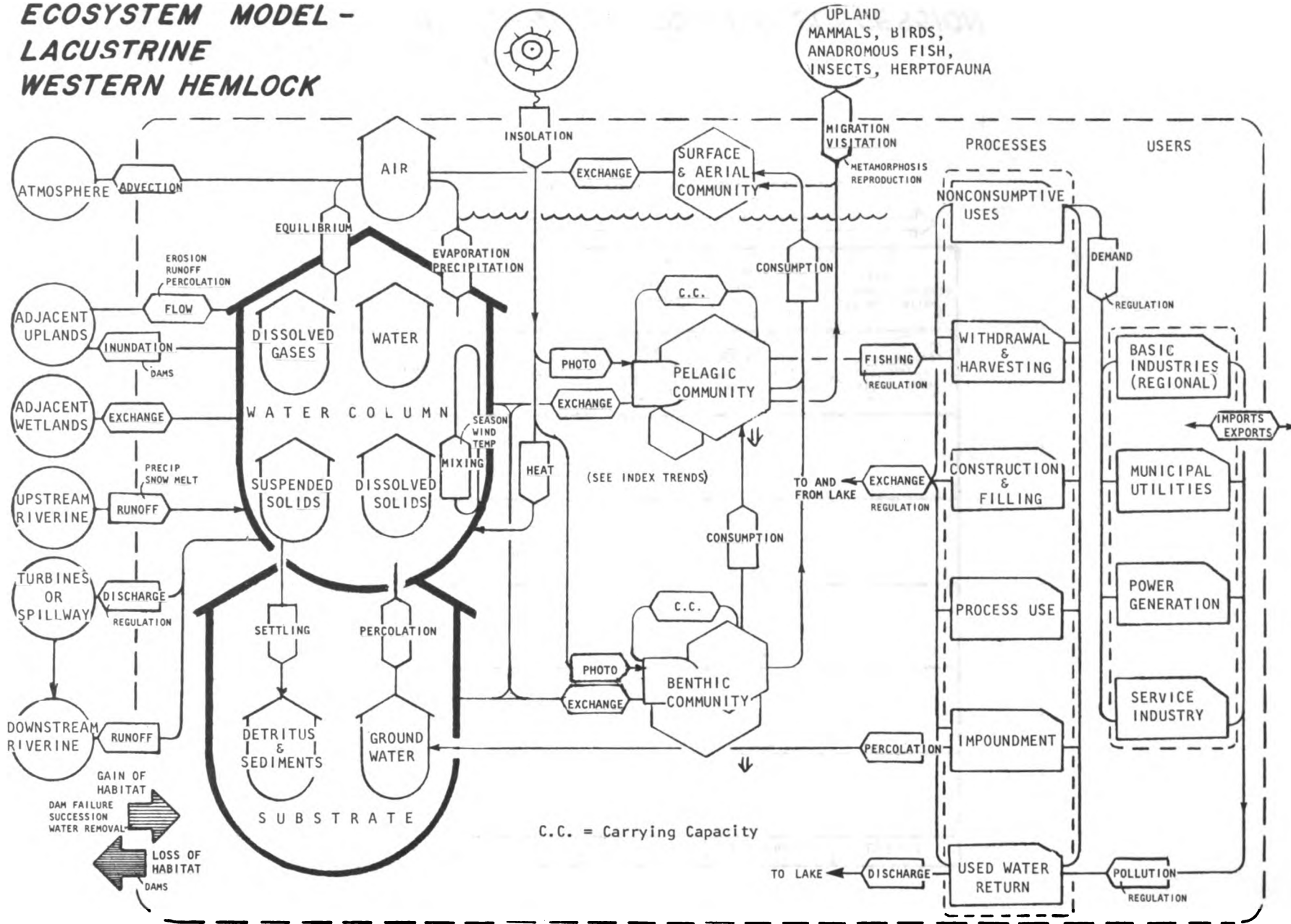
**AQUATIC SUCCESSION MODEL -  
LACUSTRINE/PALUSTRINE WESTERN HEMLOCK**



Data from selected lakes, actual conditions vary seasonally and with site-specific conditions.

## ENVIRONMENTAL INDICES ASSOCIATED WITH FRESHWATER AQUATIC SUCCESSION

# ECOSYSTEM MODEL - LACUSTRINE WESTERN HEMLOCK





1.2.1 Western Hemlock Zone  
B Palustrine



## ***PALUSTRINE***

### Habitat Description

Freshwater marsh and swamps typified by standing water and poor drainage and hydric vegetation. Marshes are dominated by herbaceous plants and swamps by woody plants. Organic accumulation and anaerobic soil conditions are common.

### Food Web

Productivity is fairly high and the grazing component of food web predominates.

### Characteristic Flora

Marsh: cattails, rushes, sedges, duckweed, sphagnum, heath, skunk cabbage, pitcher plant, Douglas spirea.

Swamp: red alder, western red cedar, black cottonwood, sweet gale, and willows.

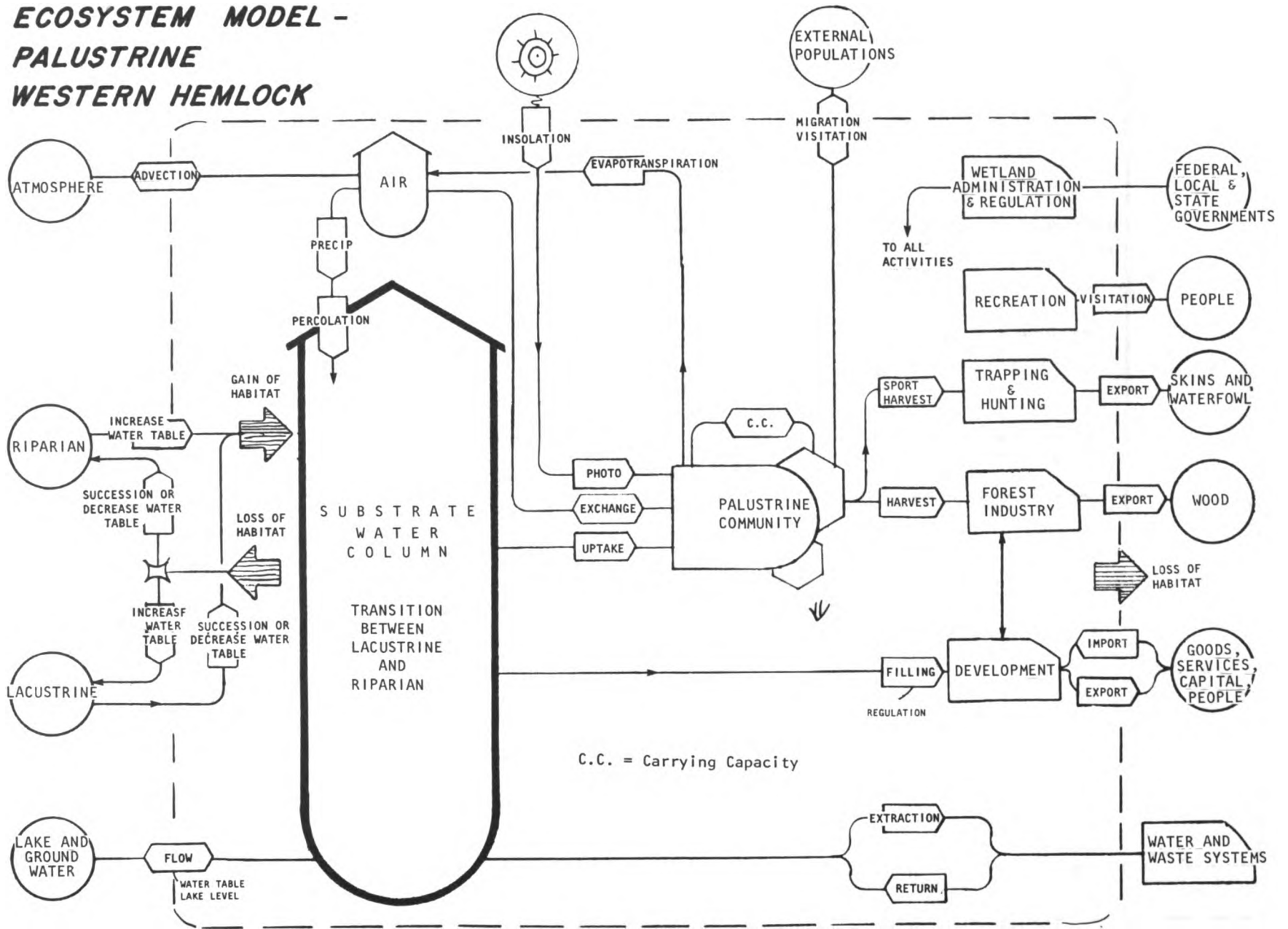
### Characteristic Fauna

Invertebrates: dragonflies, damselflies, mosquitoes, mites, other arachnids.

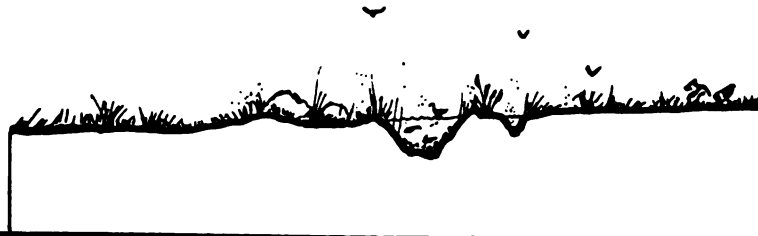
Mammals: muskrat, beaver, raccoon, northern water shrew, eastern cottontail, Oregon vole.

Birds: great blue heron, American bittern, red-winged blackbird, common yellowthroat, waterfowl, and long-billed marsh wren.

# ECOSYSTEM MODEL - PALUSTRINE WESTERN HEMLOCK



1.2.1 Western Hemlock Zone  
C Riverine



## RIVERINE

### Habitat Description

Cold, clear waters generally are low in nutrients. The turbid Columbia River is an exception, as it drains an extensive inland area.

The rivers are predominantly in the floodway zone with smaller sections falling in the pastoral and boulder zones (Bauer, 1974A). Channel gradient is usually from one to three meters per kilometer, steeper in the boulder zone and less in the pastoral zone. Bed materials are primarily gravel and sand. Boulders and cobbles occur on steeper gradients, while sand and silt occur on flatter gradients. Channels are generally braided but may become sinuous at lower elevations and flatter gradients.

### Food Web

In smaller streams the components of the food web are primarily detrital and dependent on the drainage basin. In larger streams and rivers, periphyton and phytoplankton contribute significantly to the food web.

### Characteristic Flora

Typical phytoplankton include: Spirogyra, Aphanizomenon, Oscillatoria, Melosira, Navicula, Pinnelaria, Gomphonema, Diatoma, Nitzschia, Cymbella. Emergents such as cattails, sedges, and rushes can also occur.

### Characteristic Fauna

**Invertebrates:** stoneflies, caddisflies, and mayflies are common invertebrates and are typical of riffle areas, while tubificids and oligochaetes are more common in pools.

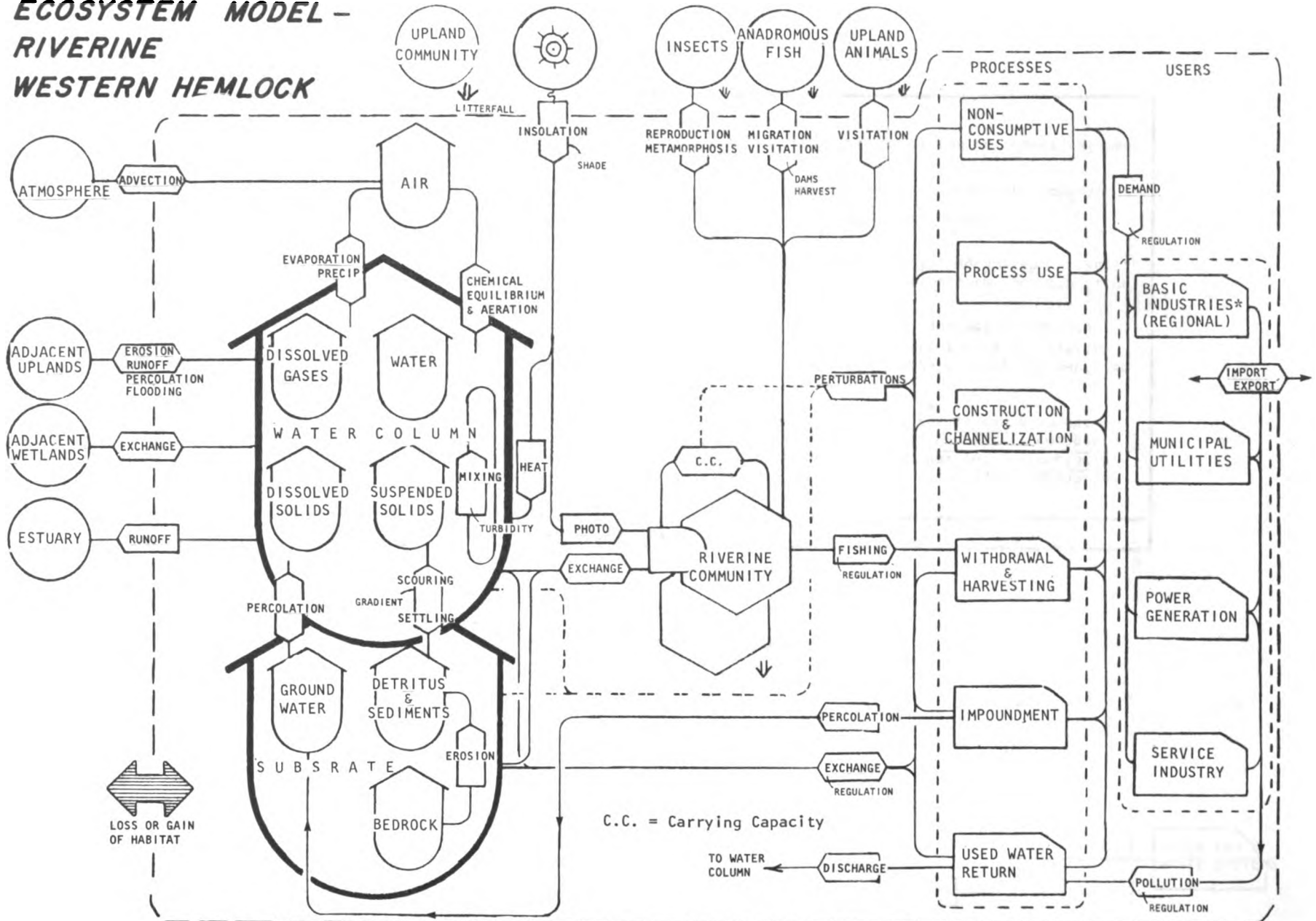
**Fish:** coho salmon, chinook salmon, rainbow trout, cutthroat trout, whitefish, sculpin, squawfish, suckers, and stickleback.

**Mammals:** mink, river otter, raccoon.

**Birds:** dipper, harlequin duck, hooded and common mergansers.

**Herpetofauna:** tiger salamander and northwest salamander (small streams).

# ECOSYSTEM MODEL - RIVERINE WESTERN HEMLOCK



\*SEE VOLUME 1, FIGURE 4-12, MAJOR ACTIVITY SUMMARY MODEL

1.2.1 Western Hemlock Zone  
D Riparian



**RIPARIAN**

Habitat Description

Water edge habitat generally differentiated from surrounding areas by altered vegetation, often subject to periodic flooding.

Food Web

Productivity is water dependent. Considerable interaction occurs at the water/land edge.

Characteristic Flora

Black cottonwood, red alder, Oregon ash, cascara, willows, western waxmyrtle.

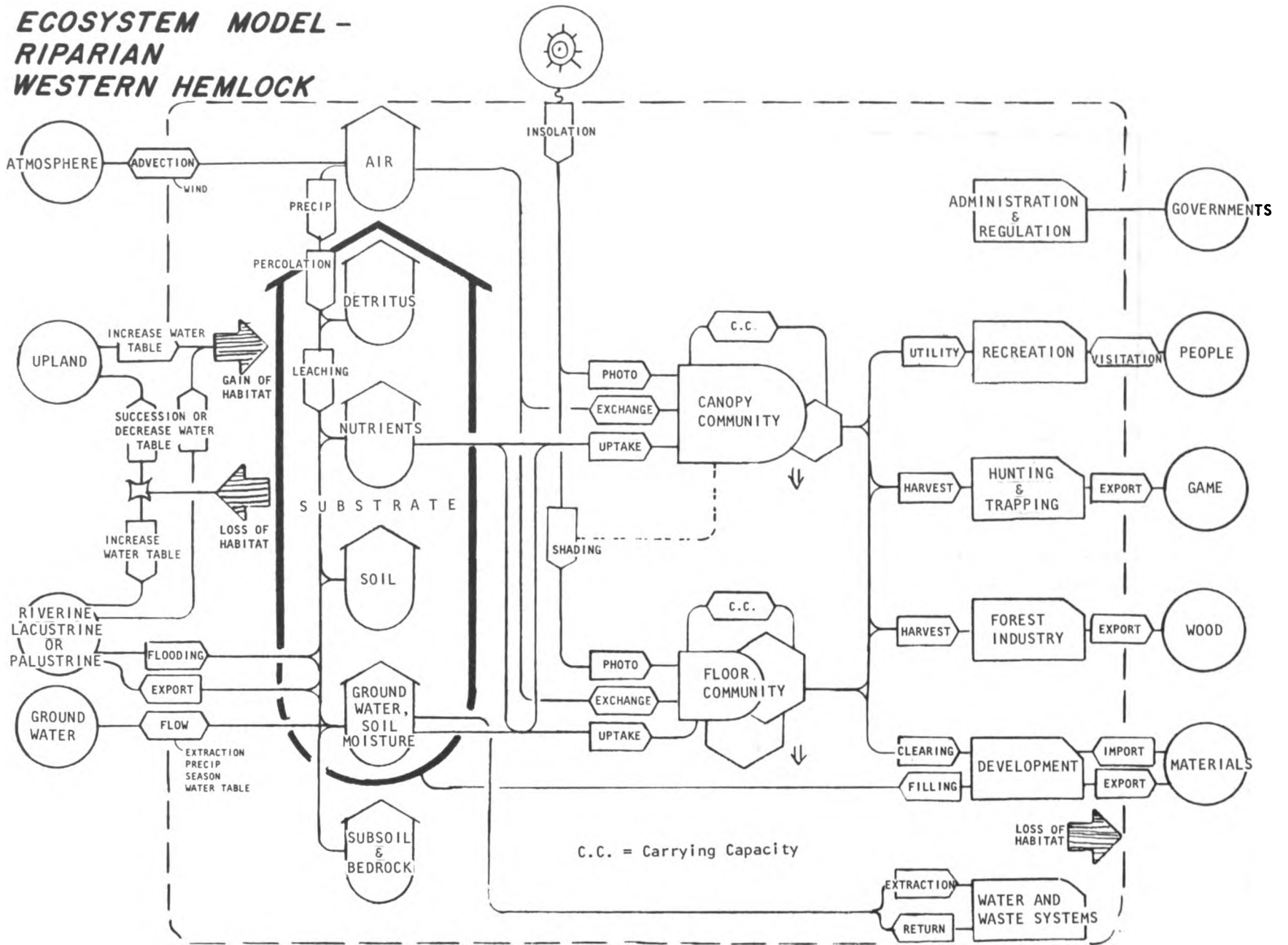
Characteristic Fauna

Mammals: mink, long-tailed weasel, river otter, raccoon, bobcat, Roosevelt elk, coyote, vagrant shrew.

Birds: eastern kingbird, screech owl, great horned owl, red-tailed hawk, grouse, swallows, crow, belted kingfisher, great blue heron.

Herpetofauna: northern alligator lizard, garter snakes, Pacific tree frog, western toad, red-legged frog, long-toed salamander.

# ECOSYSTEM MODEL - RIPARIAN WESTERN HEMLOCK



1.2.1 Western Hemlock Zone  
E Agricultural



## AGRICULTURAL

### Habitat Description

Areas under cultivation, truck crops, orchards, berry farms.

### Food Web

Managed for human use.

### Characteristic Flora

Cultivated vegetation and weed plants.

### Characteristic Fauna

Mammals: vagrant shrew, Townsend's mole, coyote, eastern cottontail, Townsend's vole, Oregon vole, raccoon, striped skunk, red fox.

Birds: swallows, Savannah sparrow, red-tailed hawk, ring-necked pheasant, gulls, killdeer, crow, mourning dove, short-eared owl.

Herpetofauna: gopher snake, garter snakes, western toad.

1.2.1 Western Hemlock Zone  
 F Early Seral  
 Grassland/Pasture



## ***EARLY SERAL GRASSLAND/PASTURE***

### Habitat Description

Herbaceous, low vegetation with no overstory. Includes open slopes and summits of the mountains within the Western Hemlock Zone as well as the lowland open fields.

### Food Web

Grazing and often directed to man's utility.

### Characteristic Flora

Grasses, herbs.

### Characteristic Fauna

**Mammals:** cows, horses, black-tailed deer, Roosevelt elk, dusky shrew, coast mole, Townsend's mole, eastern cottontail, Oregon vole, Pacific jumping mouse, coyote, red fox.

**Birds:** red-tailed hawk, marsh hawk, American kestrel, killdeer, swallows, robin, western meadowlark, Brewer's blackbird, Savannah sparrow, vesper sparrow, Oregon junco.

**Herpetofauna:** garter snakes, tiger salamander, northwestern salamander, Pacific tree frog.



1.2.1 Western Hemlock Zone  
G Early Seral Shrub



### **EARLY SERAL SHRUB**

Habitat Description

Early successional thicket. Shrub stage in forest lands.

Food Web

Browsing - grazing.

Characteristic Flora

Trailing blackberry, Oregon grape, vine maple, salal, Pacific rhododendron, snowbush, willows, sword fern, huckleberries.

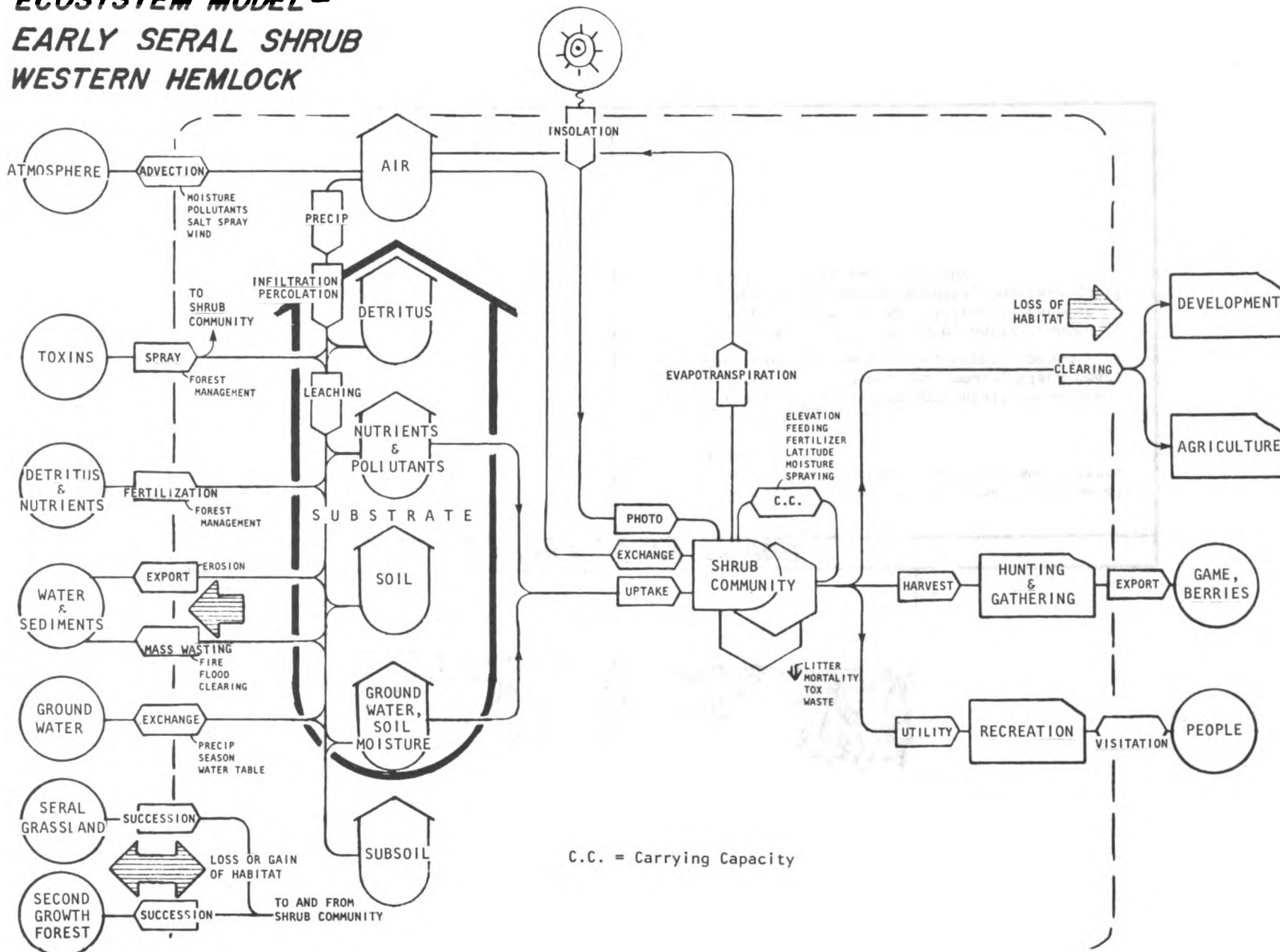
Characteristic Fauna

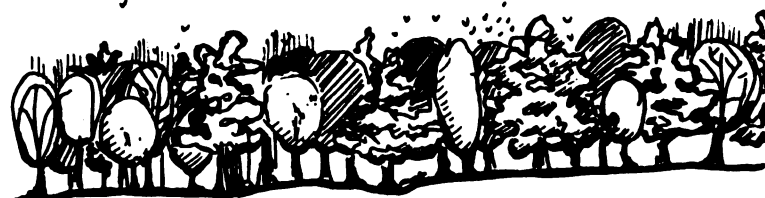
Mammals: coast mole, eastern cottontail, mountain beaver, Townsend chipmunk, deer mouse, black bear, black-tailed deer, Roosevelt elk, coyote, bobcat.

Birds: song sparrow, Oregon junco, white-crowned sparrow, common nighthawk, MacGillivray's warbler, ruffed grouse, robin, common bushtit, mountain quail, sharp-shinned hawk, willow flycatcher.

# ECOSYSTEM MODEL - EARLY SERAL SHRUB WESTERN HEMLOCK

1.2.1 G - 2





1.2.1 Western Hemlock Zone  
 H Second Growth Forest  
 (Broadleaf)

**SECOND GROWTH FOREST (Broadleaf)**

Habitat Description

Young, vigorous broadleaf forest.

Food Web

Both canopy and forest floor components of the food web are well developed. The canopy web is dominated by grazers, while that of the forest floor is primarily detrital.

Characteristic Flora

Red alder, big-leaf maple, cherry, dogwood, black cottonwood, Oregon ash.

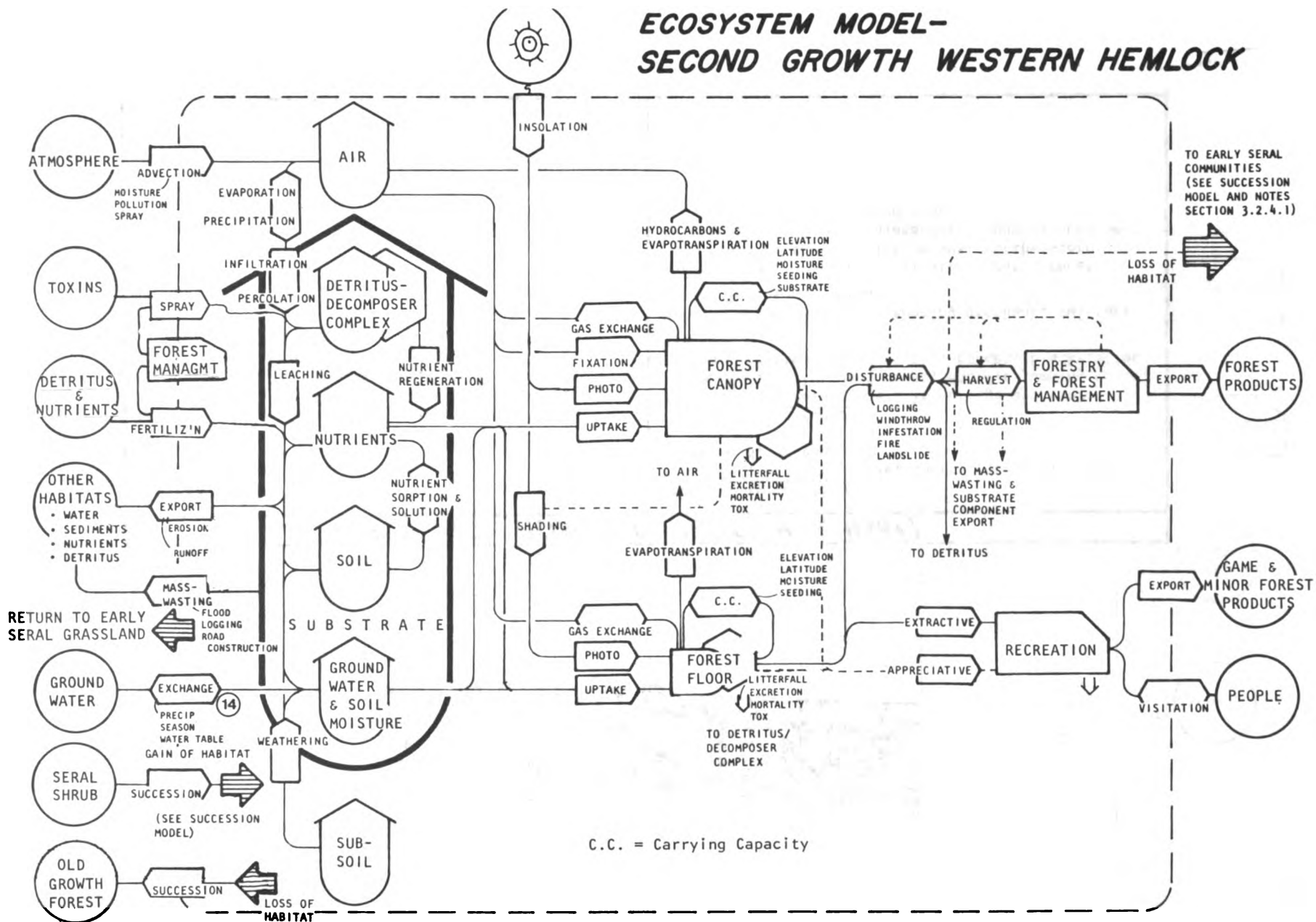
Characteristic Fauna

Mammals: mountain beaver, Trowbridge and vagrant shrew, coast mole, deer mouse, Pacific jumping mouse, raccoon, spotted skunk, coyote, bobcat, black-tailed deer.

Birds: western tanager, evening grosbeak, solitary vireo, Swainson's thrush.

Herpetofauna: northern alligator lizard, racer, common and northern garter snakes, northwestern salamander, long-toed salamander, rough-skinned newt, red salamander, red-legged frog.

# ECOSYSTEM MODEL- SECOND GROWTH WESTERN HEMLOCK





1.2.1 Western Hemlock Zone  
 I Second Growth Forest  
 (Mixed)

**SECOND GROWTH FOREST (Mixed)**

Habitat Description

Young, vigorous forest with mixture of conifer and broadleaf tree species.

Food Web

Both canopy and forest floor are components that sustain the food web. The canopy food web is dominated by grazers while that of the forest floor is detrital.

Characteristic Flora

Douglas fir, red alder, western red cedar, big-leaf maple, western hemlock, and black cottonwood.

Characteristic Fauna

**Mammals:** Trowbridge shrew, vagrant shrew, coast mole, mountain beaver, deer mouse, Pacific jumping mouse, coyote, red fox, bobcat, black-tailed deer, Roosevelt elk.

**Birds:** ruffed grouse, band-tailed pigeon, Vaux's swift, western woodpecker, eastern kingbird, black-capped chickadee, red-breasted nuthatch, robin, Bewick's wren, Swainson's thrush.

**Herpetofauna:** garter snakes, rough-skinned newt, red salamander, Pacific treefrog.



1.2.1 Western Hemlock Zone  
 J Second Growth Forest  
 (Conifer)

**SECOND GROWTH FOREST (Conifer)**

<p><u>Habitat Description</u>                  Young, vigorous, second-growth conifer forest less than 120 years old, generally with a closed canopy.</p> <p><u>Food Web</u>                  Both the canopy grazing and the forest floor detrital components of the food web are well-developed.</p>	<p><u>Characteristic Flora</u>                  Douglas fir, western red cedar, Port Orford cedar, grand fir.</p> <p><u>Characteristic Fauna</u>                  Mammals: mountain beaver, chickaree, northern flying squirrel, deer mouse, long-tailed weasel, Oregon vole, Pacific jumping mouse, marten, bobcat.                  Birds: blue grouse, ruffed grouse, band-tailed pigeon, western flycatcher, rufous hummingbird, Steller's jay, crow, chestnut-backed chickadee, winter wren, robin, varied thrush.</p>
--	---



1.2.1 Western Hemlock Zone  
K Old Growth Forest

## OLD GROWTH FOREST

### Habitat Description

Old growth, predominately conifer forest (120 years old). Dead snags, and diseased trees are typical. The canopy is not closed.

### Food Web

Both the canopy grazing and the forest floor detrital components of the food web are well developed.

### Characteristic Flora

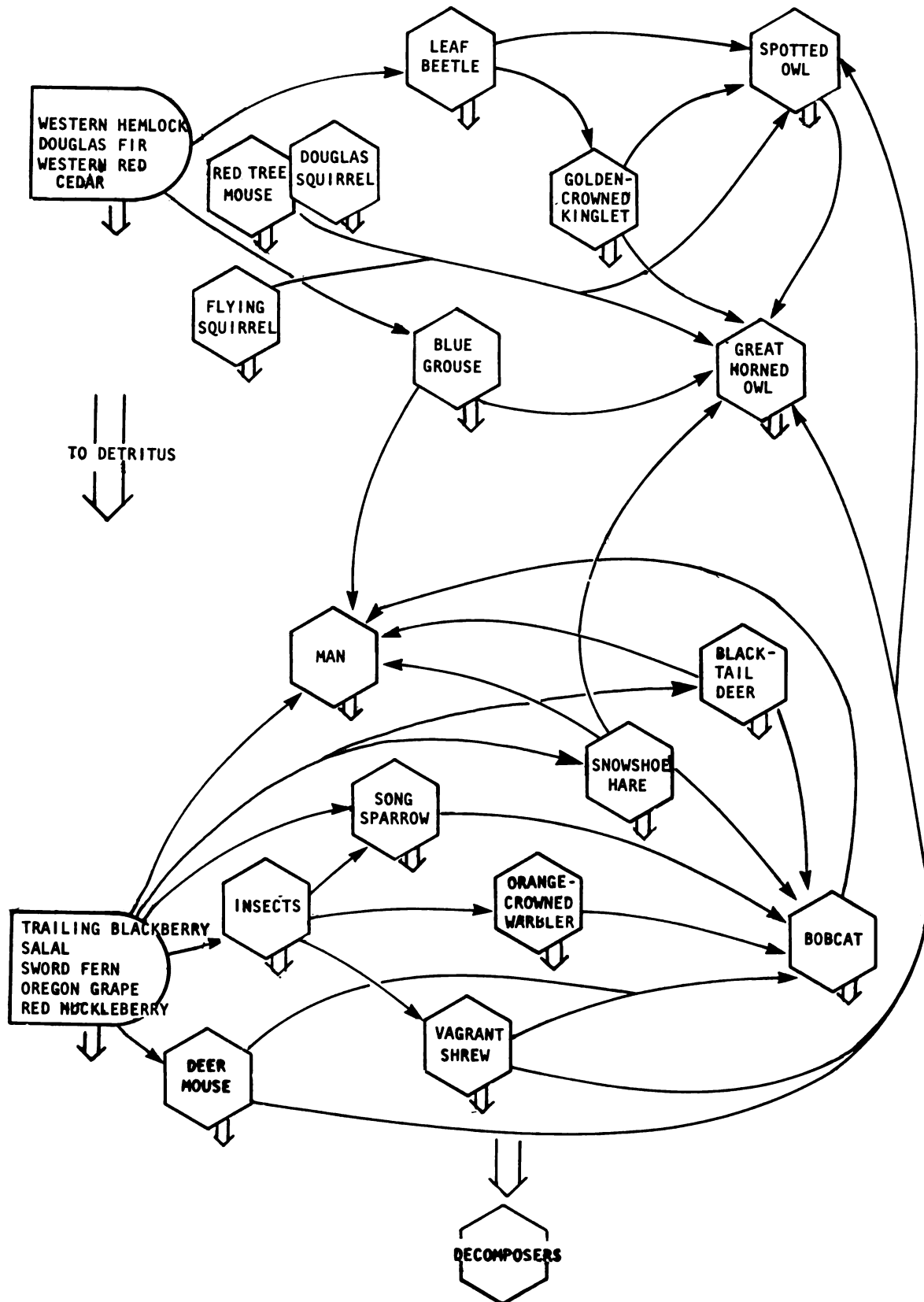
Climax species is western hemlock with Douglas fir dominant on dry sites and western red cedar and Port Orford cedar prevalent on moist sites. Long-lived, seral species can remain a component of the community for several hundred years.

### Characteristic Fauna

**Mammals:** marten, Pacific water shrew, dusky shrew, Townsend chipmunk, bobcat, long-tailed weasel, mink, Roosevelt elk.

**Birds:** bald eagle, osprey, band-tailed pigeon, screech owl, hairy woodpecker, olive-sided flycatcher, brown creeper, Hermit warbler, western tanager, purple finch, spotted owl, Vaux's swift.

**Herpetofauna:** Pacific giant salamander, tailed frog, Olympic salamander, Oregon newt, western red-backed salamander.



**SYMBOLIC FOOD WEB-  
OLD GROWTH WESTERN HEMLOCK**



## COMMUNITY COMPOSITION INLANDS      ZONE: WESTERN HEMLOCK

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

ALECTORIA	123456789	C	-
BLACK BEARD LICHEN			
CLADONIA PACIFICA	123456789	U	-
FRUITICOSE LICHEN			
CLADONIA PANGIFERINA	123456789	U	-
REINDEER LICHEN			
DICRANUM FUSCESCENS	123456789	C	-
MOSS			
DICKANUM SCOPARIUM	123456789	U	-
MOSS			
HYPNUM CIRCINALE	123456789	C	-
FEATHER MOSS			
HYPOGYMNIA ENTEROMORPHA	123456789	C	-
FOLIOSE LICHEN			
HYPOGYMNIA PHYSOIDES	123456789	C	-
FOLIOSE LICHEN			
HYPOGYMNIA VITTATA	123456789	C	-
FOLIOSE LICHEN			
ISOTHECIUM STOLONIFERUM	12	C	-
FEATHER MOSS			
LECIDEA CINNABARINA	123456789	U	-
CRUSTOSE LICHEN			
LOBARIA OREGANA	123456789	A	-
LUNGWORT			
LOBARIA PULMONARIA	123456789	C	-
LUNGWORT			
MNIUM PUNCTULATUM	123456789	O	-
MOSS			
MYCOBLASTUS SANGUINARIUS	123456789	U	-
CRUSTOSE LICHEN			
OCMROLECHIA OREGONENSIS	123456789	U	-
CRUSTOSE LICHEN			
PARMELIA SULCATA	123456789	U	-
FOLIOSE LICHEN			
PELTIGERA CANINA	123456789	U	-
FOLIOSE LICHEN			
PERTUSARIA AMARA	123456789	U	-
CRUSTOSE LICHEN			
PLAGIOTHECIUM UNULATUM	123456789	U	-
MOSS			
PLATISMATIA GLAUCA	123456789	C	-
FOLIOSE LICHEN			
POLYTRICHUM JUNIPERINUM	123456789	U	-
HAIRCAP MOSS			
POLYTRICHUM PILIFERUM	123456789	U	-
HAIRCAP MOSS			
PORELLA NAVICULARIS	123456789	C	-
LEAFY LIVERWORT			
SPHAEROPHYRUS GLUBOSUS	123456789	C	-
FRUITICOSE LICHEN			
USNEA	123456789	A	-
OLD MAN'S BEARD			

## HABITAT: OLD GROWTH FOREST

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

ABIES AMABILIS	1	A	C
PACIFIC SILVER FIR			
ABIES GRANDIS	123456789	U	C
GRAND FIR			
ACER CIRCINATUM	123456789	C	-
VINE MAPLE			
ACER MACROPHYLLUM	123456789	U	C
BIGLEAF MAPLE			
ACHLYS TRIPHYLLA	1	C	-
VANILLA LEAF			
ADENOCALUM BICOLOR	123456789	U	-
TRAIL PLANT			
ARBUTUS MENZIESII	123456789	U	-
PACIFIC MADRONE			
ARCTOSTAPHYLOS UVA-URSI	123456789	U	-
KINNIKINNICK			
ATHYRIUM FELIX-FEMINA	123456789	C	-
LADY FERN			
BERBERIS NERVOSEA	123456789	C	-
OREGONGRAPE			
BLECHNUM SPICANT	123456789	C	-
DEER FERN			
CALOCEDRUS DECURRENS	6789	U	C
INCENSE-CEDAR			
CALYPSO BULBOSA	123456789	U	R
FAIRY-SLIPPER			
CAREX DEWEYANA	123456789	U	-
DEWEY SEDGE			
CASTANOPSIS CHRYSOPHYLLA	3456789	U	C
GOLDEN CHINKAPIN			
CHAMAECYPARIS NOOTKATENSIS	123	C	C
ALASKA-CEDAR			
CLADOTHAMNUS PYROLAEFLORUS	134	U	R
COPPER BUSH			
CLINTONIA UNIFLORA	123456789	A	-
QUEENCUP BEADLILY			
CORNUS CANADENSIS	123456789	A	-
BUNCHBERRY DOGWOOD			
CORNUS NUTTALLII	123456789	U	-
PACIFIC DOGWOOD			
CORYLUS CORNUTA	123456789	U	-
WESTERN HAZELNUT			
DISPORUM SMITHII	123456789	U	-
SMITH'S FAIRYBELL			
DRYOPTERIS AUSTRIACA	23456789	U	-
MOUNTAIN WOODFERN			
EBURPHYTON AUSTINIAE	12	U	R
PHANTOM-ORCHID			
EMPETRUM NIGRUM	123456789	U	R
CROWBERRY			
ERYTHRONIUM REVOLUTUM	123478	U	R
GLACIER-LILY			

KEY TO SYMBOLS - 1.1.1 A-2

## COMMUNITY COMPOSITION INLANDS      ZONE: WESTERN HEMLOCK

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

ERYTHRONIUM STOKESII	123456789	U	-
FAWN-LILLY			
GALIUM TRIFLORUM	123456789	C	-
SWEETSCENTED BEDSTRAW			
GAULTHERIA SHALLON	123456789	A	-
SALAL			
HABENARIA SACCATA	123456789	U	-
BOG - ORCHID			
HEMITOMES CONGESTUM	123456789	U	R
GNOME-PLANT			
LILIUM COLUMBIANUM	123456789	U	-
TIGER LILY			
LINNAEA BOREALIS	123456789	A	-
TWINFLOWER			
LITHOCARPUS JENSIFLORUS	789	U	C
TANOAK			
LONICEKA INVOLUCRATA	123456789	U	-
BEARBERRY HONEYSUCKLE			
LYCOPodium CLAVATUM	123456789	U	R
GROUNDPIE CLUBMOSS			
MAIANthemum DILATATUM	123456789	C	-
FALSE - LILY - OF - THE - VALL			
MELICA GYFERI	456789	U	-
GEYER'S ONIONGRASS			
OPLOPLANAX HORRIDUM	123456789	C	-
DEVILSCLUB			
OXALIS OREGANA	123456789	A	-
OREGON OXALIS			
PACHISTIMA MYRSINITES	123456789	U	-
OREGON BOXWOOD			
PICEA SITCHENSIS	123456789	A	C
SITKA SPRUCE			
POLYSTICHUM MUNITUM	123456789	A	-
SWORDFERN			
PRUNUS EMARGINATA	123456789	U	-
BITTER CHERRY			
PSEUDOTSUGA MENZIESII	123456789	A	C
DOUGLAS FIR			
PTERIDIUM AQUILINUM	123456789	U	-
BRACKEN FERN			
RADULA BOLANDERI	678	U	-
-NULL-			
RANUNCULUS UNCINATUS VAR. PARV	123456789	U	-
BONGARD'S BUTTERCUP			
RHAMNUS PURSHIANA	123456789	U	-
CASCARA			
RHODODENDRON MACROPHYLLUM	123456789	C	-
PACIFIC RHODODENDRON			
RHUS DIVERSILOBATA	123456789	U	X
POISON OAK			
ROSA NUTKANA	123456789	U	-
WILD ROSE			

## HABITAT: OLD GROWTH FOREST

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

RUBUS DISCOLOR	123456789	U	-
HIMALAYAN BLACKBERRY			
RUBUS LACINIATUS	123456789	C	-
EVERGREEN BLACKBERRY			
RUBUS PARVIFLORIS	123456789	U	-
THIMBLEBERRY			
RUBUS PEDATUS	123456789	U	-
STRAWBERRY-LEAF BLACKBERRY			
RUBUS URSINUS	123456789	A	-
TRAILING BLACKBERRY			
SAMBUCUS RACEMOSA VAR. ARDREES	123456789	C	-
RED ELDERBERRY			
SMILACINA RACEMOSA	123456789	C	-
LARGE FALSE SOLOMON'S SEAL			
STACHYS MEXICANA	123456789	U	-
MEDGE NETTLE			
SYMPHORICARPOS MOLLIS	123456789	A	-
CREeping SNOWBERRY			
TAXUS BREVIFOLIA	123456789	U	C
WESTERN YEW			
THUJA PLICATA	123456789	A	C
WESTERN REDCEDAR			
TSUGA HETEROPHYLLA	123456789	A	C
WESTERN HEMLOCK			
UMBELLULARIA CALIFORNICA	6789	U	C
CALIFORNIA LAUREL			
VACCINIUM ALASKAENSE	123456789	A	-
ALASKA HUCKLEBERRY			
VACCINIUM OVALIFOLIUM	123456789	A	-
OVALLEAF HUCKLEBERRY			
VACCINIUM OVATUM		A	-
EVERGREEN HUCKLEBERRY			
VACCINIUM PARVIFOLIUM	123456789	A	-
RED HUCKLEBERRY			
VANCOUVERIA HEXANDRA	23456789	U	-
WHITE INSIDE-JUT FLOWER			
XEROPHYLLUM TENAX	123456789	A	-
COMMON BEARGRASS			
HYPOPITYS MONOTRUPA **	123456789	U	R
PINESAP			
MONOTRUPA UNIFLORA **	123456789	U	R
INDIAN-PIPE			
PLEURICOSPORA FIMBRIOLATA **	123456789	U	R
FIRNGED PINESAP			

\*\* DATA ENTRY ERROR

## COMMUNITY COMPOSITION INLANDS      ZONE: WESTERN HEMLOCK

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

ADELGES PICEAE	123456789	C	X
BALSAM WOOLY APHID			
ALLOGNA TOWNSENDIANA SNAIL	1230	C	-
ARIOLIMAX COLUMBIANUS	123456789	C	X
BANANA SLUG			
ARION ATER	1230	U	X
BLACK SLUG			
ATIMIA CONFUSA	123456789	C	-
LONGHORN BEETLE			
BANASA	123456789	C	-
STINK BUG			
CHORISTONEURA OCCIDENTALIS	123456789	C	X
WESTERN SPRUCE BUDWORM			
COPTODISCA ARBUTIELLA	123456789	U	-
LEAF MINER			
DENDROCTONUS PSEUDOTSUGAE	123456789	C	X
DOUGLAS FIR BARK BEETLE			
DIORYCTRIA ABIEIVORELLA	123456789	O	X
CONEWORM			
HALISODOTA ARGENTATA	123456789	C	X
SILVERSPOTTED TIGERMOTH			
HEMPHILLIA	1230	C	X
SLUG			
KLEIDOCERYX RESEDAE	123456789	C	-
SEED BUG			
LAMBDA FISCCELLARIA LUGUBROSA	123456789	C	X
WESTERN HEMLOCK LOOPER			
LYGUS	123456789	C	-
PLANTBUG			
MEGASTIGMYS SPERMOTROPHUS	123456789	C	X
DOUGLAS FIR SEED CHALCID			
MEGASTIGMYS TSUGAE	123456789	C	X
SEED MIDGE			
MELANOPHILA DRUMMONDI	123456789	C	X
FLAT HEADED BORER			
MONADENIA FIDELIS	1230	O	-
SNAIL			
NEMOCESTES INCOMPTUS	123456789	O	X
WEEVIL			
NEODIPRION TSUGAE	123456789	C	X
HEMLOCK SAWFLY			
NEPYTIA PHANTASMARIA	123456789	C	X
PHANTOM HEMLOCK LOOPER			
ORGYIA PSEUDOTSUGATA	123456789	C	X
DOUGLAS FIR TUSSOCK MOTH			
PROPHYSADON ANDERSONI	1230	C	X
SLUG			
PSEUDOHYLESINUS NEBULOSUS	123456789	C	X
BARK BEETLE			
PSEUDOHYLESINUS TSUGAE	123456789	C	X
BARK BEETLE			

## HABITAT: OLD GROWTH FOREST

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

SCOLYTUS ABIEIETUS	123456789	O	X
BARK BEETLE			
SEMANOTUS AMETHYSTINUS	789	C	-
LONGHORN BEETLE			
TRACHYKELE BLONDELI	123456789	C	X
WESTERN CEDAR BORER			
URO CERUS CALIFORNICUS	123456789	U	-
HORNTAIL			

TROPHIC LEVEL: (2) HERBIVORE  
BIRDS

CARDUELIS PINUS	123456789	C	-
PINE SISKIN			
CARPODACUS PURPUREUS	123456789	C	-
PURPLE FINCH			
CATHARUS JUSTULATUS	123456789	C	-
SWAINSON'S THRUSH			
COLUMBA FASCIATA	123456789	C	-
BAND-TAILED PIGEON			
DENDRAGAPUS OBSCURUS	123456789	C	-
BLUE GROUSE			
HESPERIPHONA VESPERTINA	123456789	C	-
EVENING GROSBEAK			
IXOREUS NAEVIUS	123456789	C	-
VARIED THRUSH			
JUNCO HYEMALIS	123456789	C	-
DARK-EYED JUNCO			
LOXIA CURVIROSTRA	123456789	C	-
RED CROSSBILL			

TROPHIC LEVEL: (2) HERBIVORE  
MAMMALS

APLODONTIA RUFA	123456789	C	-
MOUNTAIN BEAVER			
ARBORIMUS ALBIPES	3456789	U	R
WHITE-FOOTED VOLE			
ARBORIMUS LONGICAUDUS	3456789	U	I
RED TREE VOLE			
ARBORIMUS SILVICOLA	4	U	R
DUSKY TREE VOLE			
CERVUS CANADENSIS	123456789	C	6
ROOSEVELT ELK			
CLETHRIONOMYS OCCIDENTALIS	123456789	U	-
WESTERN RED-BACKED VOLE			
EPITHIZON DORSATUM	12345678	C	6
PORCUPINE			
LEPUS AMERICANUS	1234567	C	6
SNOWSHOE HARE			
MICROTUS LONGICAUDUS	123456789	U	-
LONG-TAILED VOLE			

## COMMUNITY COMPOSITION INLANDS      ZONE: WESTERN HEMLOCK

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPHIC LEVEL: (2) HERBIVORE  
MAMMALS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
MICROTUS OREGONI OREGON VOLE	123456789	C	-
NEOTOMA CINEREA BUSHY-TAILED WOOD RAT	123456789	U	-
NEOTOMA FUSCIPES DUSKY-FOOTED WOOD RAT	89	C	P
ODOCOILEUS MEMORIANUS COLUMBIANUS BLACK-TAILED DEER	123456789	C	G
REITHRODONTOMYS MEGALOTIS WESTERN HARVEST MOUSE	89	C	P
TAMIASCIURUS DOUGLASSII DOUGLAS SQUIRREL	123456789	C	G

TROPHIC LEVEL: (3) CARNIVORE  
HERPETOFAUNA

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CHARINA BOETTAE PLUMBEA PACIFIC RUBBER BOA	123456789	C	-
DIADOPHIS PUNCTATUS OCCIDENTALIS NORTHWESTERN RINGSNECK SNAKE	456789	C	-
PITUOPHIS MELANOLEUCUS CATANTHUS PACIFIC GOPHER SNAKE	56789	U	-

TROPHIC LEVEL: (3) CARNIVORE  
BIRDS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ACCIPITER GENTILIS GOSHAWK	123456789	U	-
ACCIPITER STRIATUS SHARP-SHINNED HAWK	123456789	U	-
AEGLIUS ACADICUS SAW-WHET OWL	123456789	C	-
BUBO VIRGINIANUS GREAT HORNED OWL	123456789	C	-
CORVUS CORAX COMMON RAVEN	123456789	C	-
FALCO COLUMBARIUS MERLIN	123456789	U	-
GLAUCIDIUM GNOA PYGMY OWL	123456769	C	-
STRIX OCCIDENTALIS ** SPOTTED OWL	123456789	U	T

\*\* DATA ENTRY ERROR

## HABITAT: OLD GROWTH FOREST

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPHIC LEVEL: (3) CARNIVORE  
MAMMALS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CANIS LATRANS COYOTE	123456789	U	G
FELIS CONCOLOR MOUNTAIN LION	123456789	U	G
MARTES AMERICANA MARTEN	123456789	U	C
MUSTELA ERMINEA SHORT-TAILED WEASEL	123456789	U	C
MUSTELA FRENATA LONG-TAILED WEASEL	123456789	C	G
SOREX OBSCURUS ** DUSKY SHREW	123456789	C	-
SPILOGALE PUTORIUS SPOTTED SKUNK	123456789	U	G
UROCYON CINEREARGENTUS GRAY FOX	3456789	U	G
LYNX RUFUS ** BOBCAT	123456789	C	-
MARTES PENNANTI ** FISHER	123456789	U	-

TROPHIC LEVEL: (5) OMNIVORE  
INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
APHODIUS ROGERSI SCARAB	123456789	U	-

TROPHIC LEVEL: (5) OMNIVORE  
BIRDS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CYANOCITTA STELLERI STELLER'S JAY	123456789	C	-
PERISOREUS CANADENSIS GRAY JAY	123456789	C	-

TROPHIC LEVEL: (5) OMNIVORE  
MAMMALS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
DIDELPHIS MARSUPIALIS COMMON OPPOSSUM	123456789	U	G
EUARCTOS AMERICANUS BLACK BEAR	123456789	C	G
EUTAMIAS TOWNSENDII TOWNSEND'S CHIPMUNK	123456789	C	-
GLAUCOMYS SABRINUS NORTHERN FLYING SQUIRREL	123456789	C	-
MEPHITIS MEPHITIS STRIPED SKUNK	123456789	U	-

## COMMUNITY COMPOSITION INLANDS      ZONE: WESTERN HEMLOCK

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (5) OMNIVORE  
MAMMALS

PEROMYSCUS MANICULATUS DEER MOUSE	123456789	A	X
PROCYON LOTOR RACCOON	123456789	U	G
ZAPUS TRINOTATUS PACIFIC JUMPING MOUSE	123456789	U	-

TROPIC LEVEL: (6) PARASITE  
INVERTEBRATES

GLYPTA FUMIFERANAE -NULL-	123456789	C	-
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TROPIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

DERAEOCOPIUS TSUGAE PLANT BUG	123456789	Q	-
PARADACERLA FORMICINA PLANT BUG	123456789	U	-
PODISUS MACULIVENTRIS STINKBUG	123456789	C	-

TROPIC LEVEL: (9) INVERTEBRATE EATER  
HERPETOFAUNA

AMBYSTOMA GRACILE GRACILE BROWN SALAMANDER	123456789	C	-
ANEIDES FERRUGINEUS CLOUDED SALAMANDER	456789	U	-
BUFONIDAE BUREAS NORTHWESTERN TOAD	123456789	C	-
DICAMPTODON ENSATUS PACIFIC GIANT SALAMANDER	123456789	U	-
ENSATINA ESCHSCHOLTZI GREGGII OREGON RED SALAMANDER	123459	U	-
GERRHONOTIS COERULEUS PRINCIPIS NORTHERN ALLIGATOR LIZARD	123456789	C	-
PLETHODON DUNNI DUNN'S SALAMANDER	34567	U	-
PLETHODON VANDYKEI WASHINGTON SALAMANDER	12	C	-
PLETHODON VEHICULUM WESTERN RED-BACKED SALAMANDER	1234567	C	-
TARICHA GRANULOSA GRANULOSA NORTHERN ROUGH SKINNED NEWT	123456789	U	-

## HABITAT: OLD GROWTH FOREST

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (9) INVERTEBRATE EATER  
BIRDS

CERTHIA FAMILIARIS BROWN CREEPER	123456789	C	-
CHAETURA VAUXII VAUX'S SWIFT	123456789	C	-
COLAPTES AURATUS COMMON FLICKER	123456789	U	-
DENDROCOPIUS VILLOSUS HAIRY WOODPECKER	1234567	C	-
DENDROICA CRONATA YELLOW-RUMPED WARBLER	123456789	C	-
DENDROICA OCCIDENTALIS HERMIT WARBLER	3456789	U	-
DENDROICA TOWNSENDI TOWNSEND'S WARBLER	123456789	C	-
DRYOCOPUS PILEATUS PILEATED WOODPECKER	123456789	U	-
EPIDORNAX HAMMONDII HAMMOND'S FLYCATCHER	123456789	C	-
MYAESTES TOWNSENDI TOWNSEND'S SOLITAIRE	123456789	U	-
NUTTALLORNIS BOREALIS OLIVE-SIDED FLYCATCHER	123456789	C	-
OTUS ASIATICUS SCREECH OWL	123456789	C	-
PARUS RUFESCENS CHESTNUT-BACKED CHICKADEE	123456789	C	-
PIRANGA LUDOVICIANA WESTERN Tanager	123456789	C	-
REGULUS SATRAPA GOLDEN-CROWNED KINGLET	123456789	C	-
SITTA CANADENSIS RED-BREASTED NUTHATCH	123456789	C	-
TROGLODYTES TROGLODYTES WINTER WREN	123456789	C	-
VERMIVORA CELATA ORANGE-CROWNED WARBLER	123456789	C	-
WILSONIA PUSILLA WILSON'S WARBLER	123456789	C	-

## COMMUNITY COMPOSITION INLANDS

ZONE: WESTERN HEMLOCK

HABITAT: OLD GROWTH FOREST

SCIENTIFIC NAME  
COMMON NAME

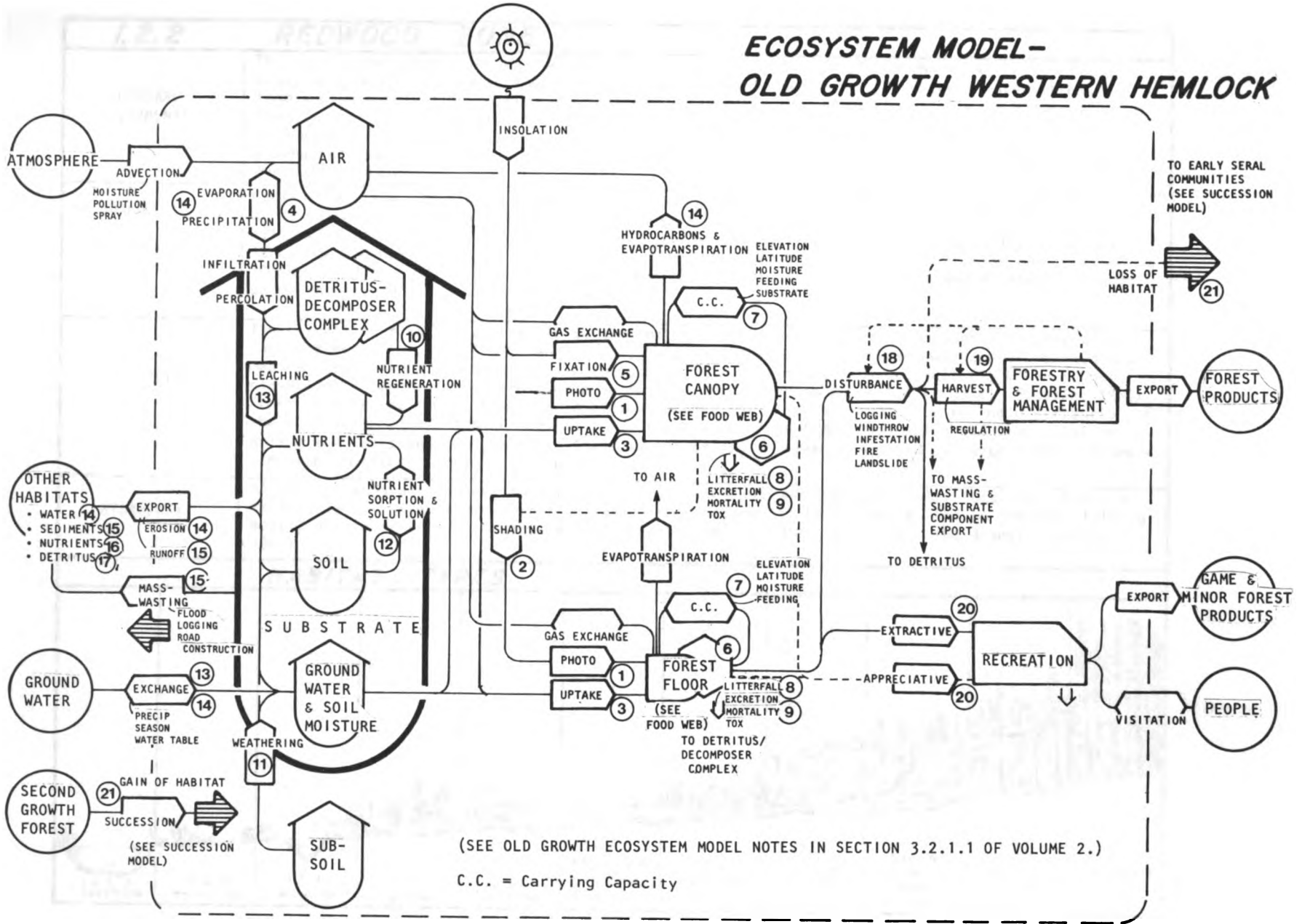
RANGE ABUNDANCE STATUS

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
MAMMALS

EPTESICUS FUSCUS BIG BROWN BAT	123456789	C	-
LASIONYCTERIS NOCTIVAGANS SILVER-HAIRED BAT	123456789	U	-
LASIURUS CINEREUS HOARY BAT	123456789	U	-
MYOTIS CALIFORNICUS CALIFORNIA MYOTIS	123456789	C	-
MYOTIS EVOTIS LONG-EARED MYOTIS	123456789	U	-
MYOTIS KEENII KEEN MYOTIS	12	U	P
MYOTIS LUCIFUGUS LITTLE BROWN MYOTIS	123456789	C	-
MYOTIS THYSANODES FRINGED MYOTIS	456789	C	-
MYOTIS VOLANS LONG-LEGGED MYOTIS	123456789	U	-
MYOTIS YUMANENSIS YUMA MYOTIS	123456789	C	-
NEUROTRICHUS GIBBSII SHREW-MOLE	123456789	A	-
PLECOTUS TOWNSENDII WESTERN BIG-EARED BAT	123456789	U	-
SCAPANUS ORARIUS COAST MOLE	123456789	C	-
SOREX BENDIRII MARSH SHREW	123456789	U	-
SOREX TROWBRIDGII TROWBRIDGE SHREW	123456789	C	-
SOREX VAGRANS VAGRANT SHREW	123456789	C	-

1.2.2 REDWOOD

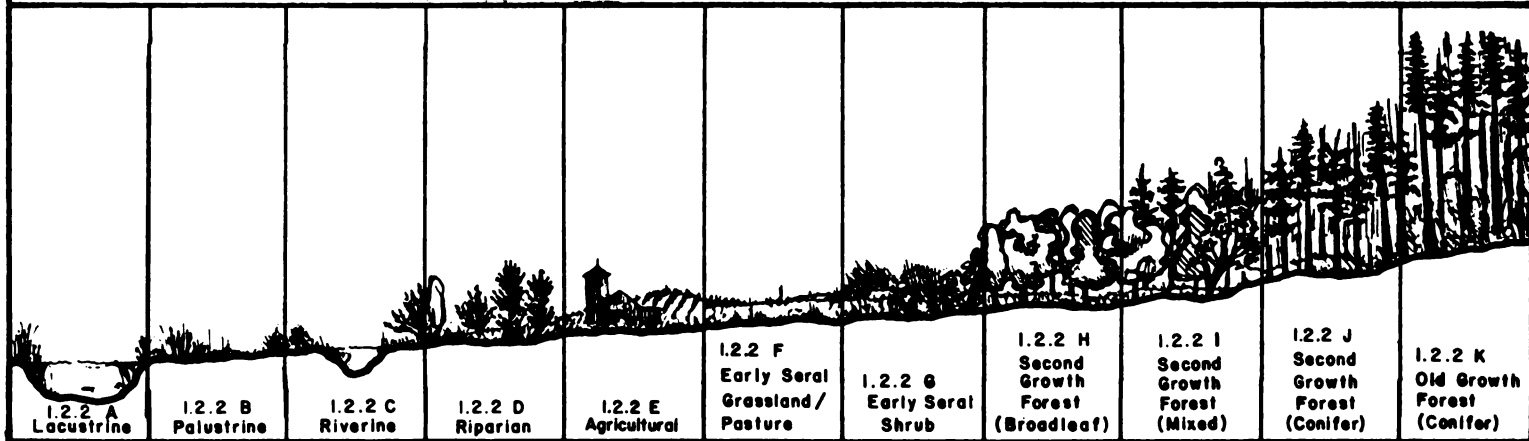
# ECOSYSTEM MODEL - OLD GROWTH WESTERN HEMLOCK



**1.2.2 REDWOOD ZONE**

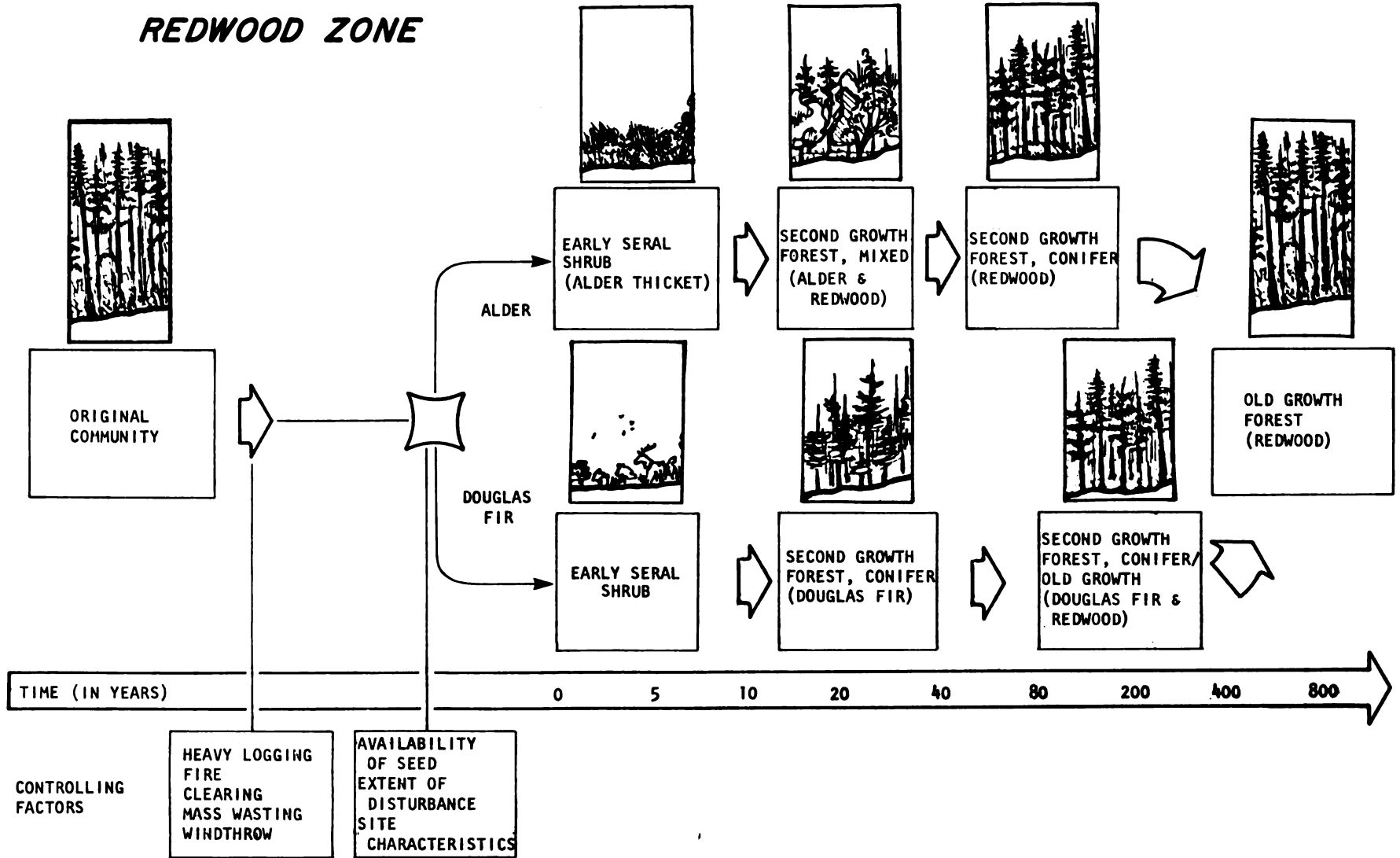
<p><b>GENERAL COMMENTS</b></p>	<p>The zone is restricted to the fog belt (Munz and Keck, 1959) at the southern extremity of the study area and is typically found inland of the Sitka Spruce Zone. It extends intermittently from approximately fifteen kilometers (nine miles) north of the California-Oregon border south to the San Luis Obispo County line. Characteristically, it extends inland no more than 40 to 64 kilometers (25 to 40 miles) where it merges with the mixed-evergreen forest of the interior upper reaches of the coastal watersheds (Griffen and Critchfield, 1972; Munz and Keck, 1959; Cheatham and Haller, 1976).</p>
<p><b>TOPOGRAPHY &amp; SOILS</b></p>	<p>Extends from sea level to 900 meters (3,000 feet) (Cheatham and Haller, 1976) with the bulk of its distribution being below 2,000 feet (600 meters) (Griffen and Critchfield, 1972). Found on both alluvial flats with deep well-drained soils and on valley slopes with shallow well-drained soils (Cheatham and Haller, 1976). The alluvial flats are subject to periodic siltation due to flooding (Ornduff, 1974). The zone typically has west-facing slopes with northerly and southerly aspects being common and east-facing slopes uncommon.</p>
<p><b>CLIMATE</b></p>	<p>The climate is mild and comparable to that of the Sitka Spruce Zone. Mean annual temperatures vary between 50° and 60° F (10° and 15° C). Seasonal fluctuations between mean annual maximum and mean annual minimum are moderate: 10 to 15° F (5 to 10° C) in lowlands and 30° F (15° C) in higher elevations. Temperatures rarely drop below 15° F (-10° C) or go above 100° F (37° C) (Fowells, 1965). Frost free period ranges from six to eleven months. Of critical importance to the distribution of the zone are frequent summer fogs which decrease water loss from evaporation and transpiration during the relatively dry summer. Condensation of fog on tree crowns and subsequent fog drip adds important moisture to the water budget.</p>
<p><b>HYDROLOGY</b></p>	<p>Alluvial stands are subject to periodic winter flooding, and frequent summer fogs (Cheatham and Haller, 1976). Annual precipitation varies from between 25 to 122 inches (62 to 305 cms) falling mostly as winter rain. January is typically the wettest month and August the driest (Fowells, 1965).</p>

**HABITAT TYPES**

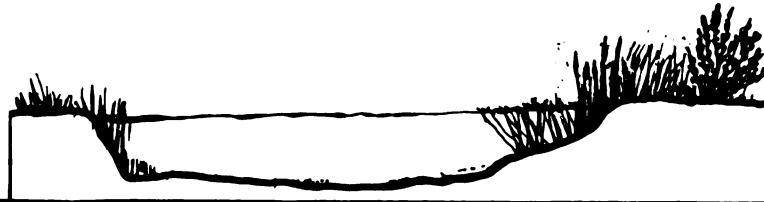




# SUCCESSION MODEL - REDWOOD ZONE



1.2.2 Redwood Zone  
A Lacustrine



### LACUSTRINE

#### Habitat Description

Freshwater lakes and ponds. Lacustrine habitats are uncommon in the zone due to the well developed drainage pattern. No large lakes occur in this zone within the study area. Ponds are formed by beaver dams along smaller streams.

#### Food Web

Productivity is varied. The food web is predominantly based on detrital input from the surrounding drainage basin except where eutrophic.

#### Characteristic Flora

**Emergents:** cattails, yellow pond lily, rushes, sedges, willows.

**Submergents:** Plantago (plantain) spp. Phytoplankton go through the typical annual cycle of spring: diatom; early summer: diatom - green algae; late summer: blue-green algae. Actual conditions in a given lake or pond vary and reflect local environmental conditions.

#### Characteristic Fauna

**Zooplankton:** protozoans, copepods, rotifers, mites.

**Benthos:** chironomids.

**Fish:** rainbow trout, cutthroat trout, bullhead, large mouth bass, crappie, yellow perch.

**Herpetofauna:** yellow-legged frog, bullfrog, western aquatic garter snake.

**Birds:** bufflehead, American coot, kingfisher, common loon, shoveler, American widgeon.

**Mammals:** mink, river otter, raccoon, beaver.

1.2.2 Redwood Zone  
B Palustrine,



## ***PALUSTRINE***

### Habitat Description

Freshwater marsh and swamps characterized by standing water, poor drainage, and hydric vegetation. Marshes are dominated by herbaceous plants and swamps by woody plants. Organic accumulation and anaerobic soil conditions are common. These habitats are often found in flood plains or associated with Lacustrine habitats.

### Food Web

Productivity is high with grazing portion of food web being dominant. The detrital compartment is truncated due to anaerobic conditions. Accumulation of organic materials in the form of peat is typical.

### Characteristic Flora

Marsh: cattails, rushes, sedges, duckweed, sphagnum, heath, pitcher plant.

Swamp: willows, crabapple, sweet gale, Labrador tea, Oregon ash, red alder.

### Characteristic Fauna

Invertebrates: dragonflies, damselflies, mosquitoes, mites, and other arachnids.

Herpetofauna: yellow-legged frog, western pond turtle, black salamander, western aquatic garter snake.

Mammals: beaver, Oregon vole, raccoon, mink, marsh shrew, dusky shrew, Pacific jumping mouse.

Birds: great blue heron, green heron, red-winged blackbird, long-billed marsh wren, common yellowthroat, egret, Virginia rail, killdeer.

1.2.2 Redwood Zone  
C Riverine



### **RIVERINE**

#### Habitat Description

Freshwater streams and rivers with moderate to steep gradient. Waters are typically clear, cold, and oligotrophic. Bed material includes boulders, gravel, and sand, with finer materials occurring in some quiet pools.

#### Food Web

Food web is typically heterotrophic and dependent on detritus from the surrounding drainage basins. Where adequate sunlight reaches the habitat periphyton and emergent productivity can be important.

#### Characteristic Flora

Diatoms, periphyton, Aphanizomen spp., Anaebana spp., Spirogyra, watercress, Navicula and Nitzschia algal spp.

#### Characteristic Fauna

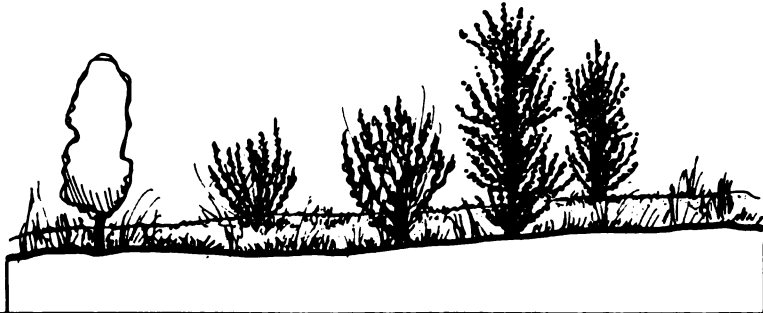
Fish: chinook and coho salmon, rainbow trout, cut-throat trout, whitefish, sculpin, suckers, stickleback, lamprey.

Herpetofauna: black salamander, western aquatic garter snake, red-legged frog.

Birds: American merganser, kingfisher, dipper.

Mammals: mink, river otter, raccoon.

1.2.2 Redwood Zone  
D Riparian



## ***RIPARIAN***

### Habitat Description

The riparian community in the Redwood Zone is similar to that found in the other lowland forest zones of the study area. It is a water edge habitat that differs from the surrounding area by having altered vegetation.

### Food Web

Productivity is dominated by water edge plants. Second and third trophic levels are typically water-dependent insect larvae and fish. Top carnivores are typically terrestrial or semi-aquatic.

### Characteristic Flora

Red alder, black cottonwood, Oregon ash, willows, California myrtle, Juncus spp., Dewey sedge, mitrewort, devil's club.

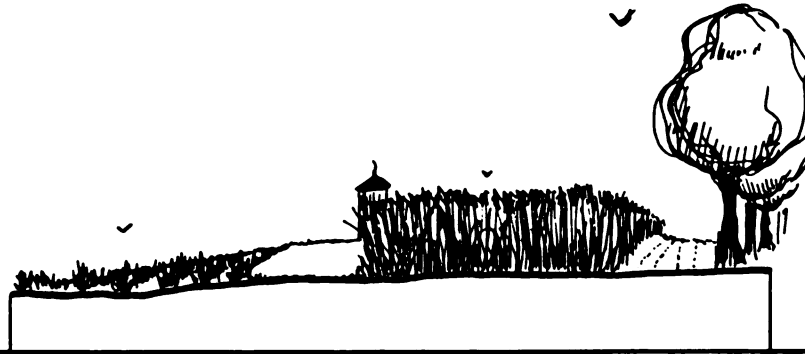
### Characteristic Fauna

**Herpetofauna:** bullfrog, red-legged frog, rough-skinned newt, Pacific tree frog.

**Birds:** kingfisher, long-billed marsh wren, red-winged blackbird, dipper, great blue heron, green heron, osprey, swallows, California quail.

**Mammals:** river otter, mink, raccoon, marsh shrew, vagrant shrew, ringtail.

1.2.2 Redwood Zone  
E Agricultural



## **AGRICULTURAL**

**Habitat Description**

Areas under cultivation; truck crops, berry farms, alfalfa fields, etc.

**Food Web**

Typically monocrop early seral species, managed for the production of fiber and food for man.

**Characteristic Flora**

Cultivated vegetation and weed species.

**Characteristic Fauna**

**Herpetofauna:** gopher snake, garter snake, western toad.

**Birds:** swallows, Savannah sparrow, red-tailed hawk, ring-necked pheasant, gulls, killdeer, crow, barn owl.

**Mammals:** vagrant shrew, Townsend's mole, coyote, eastern cottontail, Townsend's vole, Oregon vole, raccoon, striped skunk, red fox, gray fox.

1.2.2 Redwood Zone  
 F Early Seral  
 Grassland/Pasture



### **EARLY SERAL GRASSLAND/PASTURE**

**Habitat Description**

Early seral grass/forb community established after disturbance.

**Food Web**

A greater proportion of net primary productivity is incorporated into the non-detrital food web than occurs in the forested habitats.

**Characteristic Flora**

Brome grass, fireweed, willow-weed, brakenfern, fescue species, bent grass, pampas grass, Pacific reed grass, tufted hairgrass.

**Birds:** turkey vulture, white-tailed kite, American kestrel, willet, killdeer, mourning dove, common nighthawk, Allen's hummingbird, common goldfinch, Savannah sparrow.

**Mammals:** coast mole, little brown myotis, brush rabbit, Botta pocket gopher, dusky-footed wood rat, California meadow vole, gray fox, opossum.

1.2.2 redwood Zone  
G Early Seral Shrub



### **EARLY SERAL SHRUB**

#### Habitat Description

Shrub stage in succession which merges into chaparral on less favorable sites with poor moisture or shallow soils. On windy, exposed, shallow-soiled sites, it becomes permanent vegetation and is called northern coastal scrub (Cheatham and Haller, 1975).

#### Food Web

Grazing food web is better developed than on forested sites and litter is sparse.

#### Characteristic Flora

Vegetation on mesic to hydric sites includes saplings of tree species such as redwood, tanoak, Douglas fir, and understory shrub species such as evergreen huckleberry and Pacific rhododendron. On drier sites salal, Suksdorf sage, fleabane, coyote brush, madrone, poison oak, and ceanothus are common.

#### Characteristic Fauna

**Herpetofauna:** western rattlesnake, gopher snake, western fence lizard, racer, Eschscholtz's salamander.

**Birds:** red-tailed hawk, turkey vulture, American kestrel, California quail, poorwill, hummingbirds, white-crowned sparrow, scrub jay, song sparrow, bushtit, warblers, rufous-sided towhee.

**Mammals:** black-tailed deer, bobcat, coyote, brush rabbit, wood rat, white-footed mouse, gray fox, Trowbridge shrew, Beechey ground squirrel, coyote.





1.2.2 Redwood Zone  
H Second Growth Forest  
(Broadleaf)

**SECOND GROWTH FOREST (Broadleaf)**

Habitat Description

Second growth hardwood forest usually found on hydric or xeric sites within the zone.

Food Web

Both the forest canopy grazing food web and the forest floor detrital food web are well-developed. The detrital web, however, transfers the great majority of the biomass and energy.

Characteristic Flora

Red alder, wax myrtle, big-leaf maple, and vine maple form stands on hydric to mesic sites, while Pacific madrone, tanoak, and Oregon white oak are established on drier sites.

Characteristic Fauna

**Birds:** blue grouse, Stellar's jay, purple finch, solitary vireo, robin, dark-eyed junco, song sparrow, screech owl.

**Mammals:** opossum, black bear, ermine, raccoon, deer mouse, western harvest mouse, hoary bat.



1.2.2 Redwood Zone  
 | Second Growth Forest  
 (Mixed)

## SECOND GROWTH FOREST (Mixed)

### Habitat Description

The habitat frequently occurs as a secondary phase of succession as alder is topped by redwood or Douglas fir. Also on xeric sites, particularly hillsides, mixed stands of Douglas fir, tanoak, and madrone are typical on a semipermanent basis and are similar to communities of the Mixed Evergreen Zone. Older cavity infested hardwood are critical niches for several species.

### Food Web

Food web is well-developed and includes both canopy and forest floor components. Mast crops play an important role in this food web. The vast majority of productivity, however, flows through the detritus food web.

### Characteristic Flora

Douglas fir, redwood, tanoak, madrone, red alder, big-leaf maple.

### Characteristic Fauna

Rhododendron, evergreen huckleberry, salal.

Birds: red-tailed hawk, Cooper's hawk, blue grouse, great horned owl, pygmy owl, rufous hummingbird, mountain chickadee, olive-sided flycatcher, golden-crowned kinglet.

Mammals: Townsend chipmunk, red tree mouse, coyote, northern flying squirrel, chickaree.



1.2.2 Redwood Zone  
J Second Growth  
Forest (Conifer)

## **SECOND GROWTH FOREST (Conifer)**

### Habitat Description

Young vigorous second growth forest, typically with a closed canopy.

### Food Web

Both canopy grazing and forest floor detrital webs are developed, although much of the energy flows through the detrital path.

### Characteristic Flora

On alluvial flats the forest is frequently dominated by redwood with a sparse understory of swordfern and Oregon oxalis. On uplands, Douglas fir, grand fir, and western hemlock become an important component of the canopy and bushy species such as evergreen huckleberry and Pacific rhododendron become more important understory species.

### Characteristic Fauna

**Birds:** Cooper's hawk, red-tailed hawk, gray jay, hairy woodpecker, blue grouse, winter wren.

**Mammals:** vagrant shrew, little brown myotis, California myotis, yuma myotis, Townsend chipmunk, chickaree, northern flying squirrel, white-footed vole, black bear.



1.2.2 Redwood Zone  
K Old Growth Forest

## OLD GROWTH FOREST (Conifer)

### Habitat Description

Dense, tall, dark, closed canopy forest with large trees over 200 feet tall and usually older than 400 years.

### Food Web

Both canopy grazing and forest floor detrital webs are developed, although the great majority of the energy flow occurs through the detrital web.

### Characteristic Flora

Redwood, Douglas fir, grand fir, western hemlock, tanoak, Pacific madrone. Understory species include salal, Oregon oxalis, sword fern, Pacific rhododendron, evergreen huckleberry. Alluvial areas are nearly completely dominated by redwood.

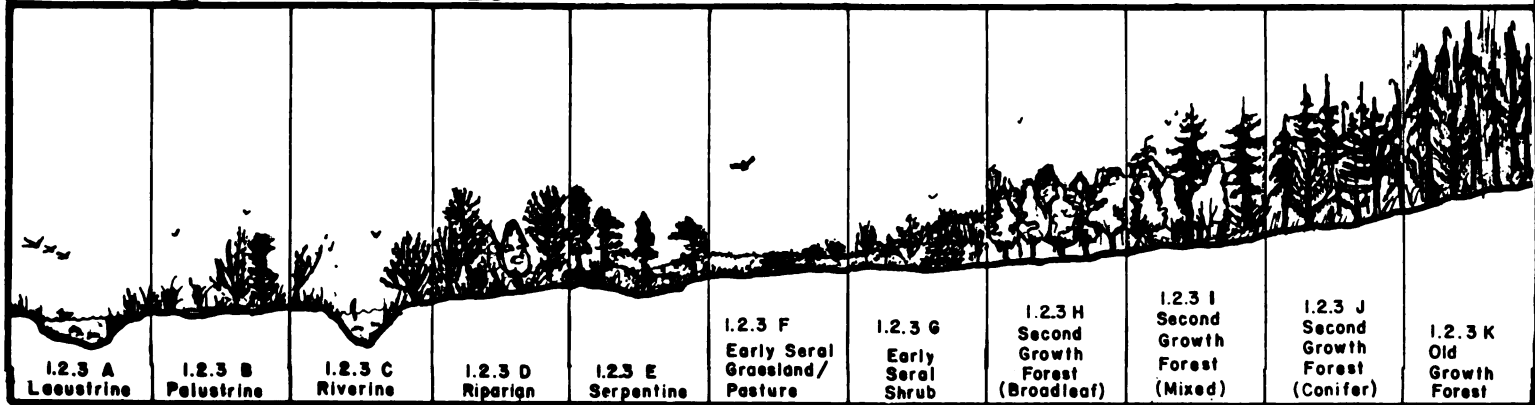
### Characteristic Fauna

**Birds:** great horned owl, spotted owl, pileated woodpecker, common raven, western tanager, Swainson's thrush.

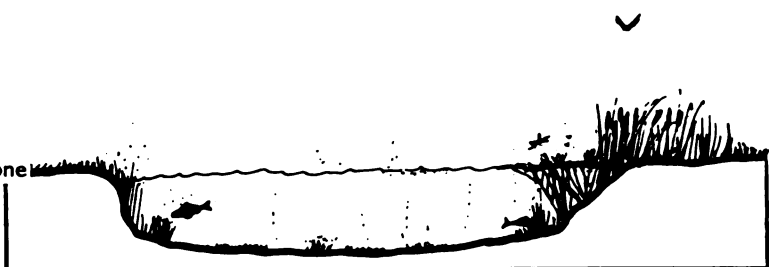
**Mammals:** white-footed vole, red tree mouse, deer mouse, Trowbridge's shrew, northern flying squirrel, coast mole, marten, fisher.

<b>1.2.3 MIXED EVERGREEN ZONE</b>	
<b>GENERAL COMMENTS</b>	The zone is found in the Klamath Mountain range and the North Coast range of California; it is characteristic of the western Siskiyou Mountains. In northern California it lies immediately east and adjacent to the Redwood Zone. It is an area of vegetational and floristic diversity with large numbers of endemic species. In some areas it is relatively unproductive, but in northern California this zone is very productive. It has scattered areas of serpentine soils and it overlays a very old and complex geology. The zone encompasses floristic elements of both northern coniferous forest and the California sclerophyllous forest/scrub and is considered "central" to the floras of surrounding areas (Whittaker, 1960).
<b>TOPOGRAPHY AND SUBSTRATE</b>	Within the study area the zone is characterized by rugged, deeply dissected terrain with steep slopes, (Franklin and Dyrness, 1973). Average grades are 30° or more and valleys are narrow. Upland soils are predominantly Haplohumults (Reddish Brown Laterites). Scattered throughout the uplands are areas of shallow unproductive soils, Hapludolls (Gray-Brown Podzolic Soils) or Xerochrepts (Regosols), overlying peridotite or serpentine rocks. Whittaker (1960) identifies three major soil types based on parent material of gabbro, peridotite, and serpentine.
<b>CLIMATE</b>	The climate is relatively warm and wet during the winter and hot and dry during summer. Mean monthly temperatures during the hottest month of the year range from 14°-22°C (57 to 72°F). During the coldest month of the year temperatures range from 0°-8°C (32 to 46°F). Mean annual temperature is around 11°C (52°F) (Whittaker, 1960). Hot, dry summers makes this zone prone to frequent fires.
<b>HYDROGRAPHY</b>	Annual precipitation varies from 60 to 170 cm (24 to 67 inches) with generally less than 15% of precipitation falling during summer. Within the study area, precipitation increases with distance from coast and elevation. Snowfall is moderate ranging from 3 to 80 cm (2 to 31 inches) and does not remain for extended periods of time. Flows generally peak during December with minimum flows occurring in September. Stream patterns are well developed, with lakes and wetlands uncommon.

**HABITAT TYPES**



1.2.3 Mixed Evergreen Zone  
A. Lacustrine



**LACUSTRINE**

Habitat Description

Freshwater lakes and ponds. Lacustrine habitats are uncommon in the zone due to the area's well-developed drainage pattern. No large lakes occur in this zone.

Food Web

Productivity is varied. The food web is based on detrital input from the surrounding drainage basin.

Characteristic Flora

Emergents: cattails, pond lily, rushes, sedges, willows.

Submergents: Plantago (plantain) spp., phytoplankton. Spring - diatoms; early summer - diatom and green algae; late summer blooms are typically blue-green algae.

Characteristic Fauna

Zooplankton: protozoans, copepods, rotifers, mites.

Benthos: chironomids.

Fish: rainbow trout, cutthroat trout.

Mammals: mink, river otter, raccoon, muskrat, beaver.

Birds: bufflehead, American coot, kingfisher, green heron, red-winged blackbird, long-billed marsh wren.

Herpetofauna: yellow-legged frog, western pond turtle, western aquatic garter snake.

1.2.3 Mixed Evergreen Zone  
B Palustrine



## PALUSTRINE

### Habitat Description

Freshwater marsh and swamps typified by standing water and poor drainage and hydric vegetation. Marshes are dominated by herbaceous plants and swamps by woody plants. Organic accumulation and anaerobic soil conditions are common. Palustrine habitats are uncommon due to the area's geologic age and subsequent well-developed drainage pattern.

### Food Web

Productivity is high with the grazing food web being dominant. The detrital compartment is truncated due to anaerobic conditions. Accumulation of organic materials in the form of peat is typical.

### Characteristic Flora

Marsh: cattails, rushes, sedges, duckweed, sphagnum, heath, pitcher plant.

Swamp: willows, crabapple, sweet gale, Labrador tea, Oregon ash, red alder.

### Characteristic Fauna

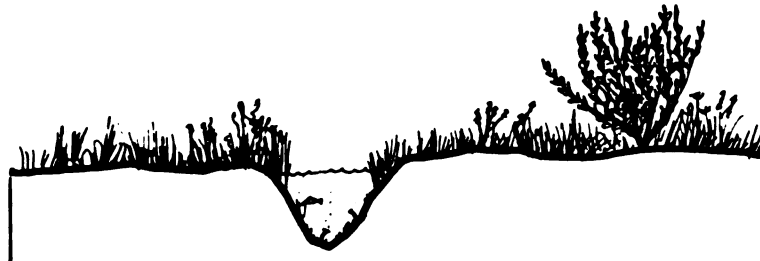
Invertebrates: dragonflies, damselflies, mosquitoes, mites, and other arachnids.

Mammals: muskrat, beaver, Oregon vole, raccoon, mink, marsh shrew, dusky shrew.

Birds: great blue heron, red-winged blackbird, long-billed marsh wren, common yellowthroat, green heron.

Herpetofauna: yellow-legged frog, western pond turtle, black salamander, western aquatic garter snake.

1.2.3 Mixed Evergreen Zone  
C Riverine



### **RIVERINE**

**Habitat Description**

Freshwater stream typically with steep gradient (5 meters/kilometer) and classified in the Boulder Zone (Bauer, 1974A). Bed material is typically boulder to gravel with sand and sand mixtures occurring in pools. Channels are generally straight.

**Food Web**

The food web is typically heterotrophic and dependent on detritus from the drainage basin.

**Characteristic Flora**

Some periphyton, sedges, and rushes.

**Characteristic Fauna**

Invertebrates: stoneflies, caddisflies, and mayflies are common in riffle areas, while tubificera and oligochaetes are more common in pools.  
Fish: chinook, coho, rainbow trout, cutthroat trout, whitefish, sculpin, suckers.

**Characteristic Fauna Con't.**

Mammals: mink, river otter, raccoon.

Birds: dipper, Harlequin duck.

Reptiles and Amphibians: black salamander, western aquatic garter snake.



1.2.3 Mixed Evergreen Zone  
D Riparian



<b>RIPARIAN</b>	
<p><u>Habitat Description</u> Water edge habitat generally differentiated from surrounding area by altered vegetation.</p> <p><u>Food Web</u> First trophic level is dominated by terrestrial/water edge plants. Second and third trophic levels are water dependent. Top carnivores are typically terrestrial or semi-aquatic animals.</p>	<p><u>Characteristic Flora</u> Willows, black cottonwood, red alder, Oregon ash, <u>Juncus</u> spp., yew.</p> <p><u>Characteristic Fauna</u> Mammals: beaver, mink, river otter, raccoon, ring-tail. Birds: kingfisher, red-winged blackbird, dipper, great blue heron.</p>

1.2.3 Mixed Evergreen Zone  
E Serpentine



**SERPENTINE**

Habitat Description

Areas of serpentine soils that differ floristically from the surrounding vegetation. Typically they are more open and savannah-like.

Food Web

Productivity is low with browsing/grazing components of the food web better developed than those of adjacent more-forested sites. Soils are nutrient-deficient, low in calcium, xeric, and shallow.

Characteristic Flora

Canopy: Jeffrey pine, knobcone pine, lodgepole pine, Port Orford cedar, western white pine, and incense cedar.

Ground vegetation: huckleberry oak, pine mat manzanita, hoary manzanita, coffeeberry, ceanothus, snowberry, dwarf juniper, and beargrass.

Characteristic Fauna

Mammals: black-tailed deer, Roosevelt elk, ringtail, California vole, Townsend's vole, long-tailed vole, pinyon mouse, western harvest mouse, mazana pocket gopher, Douglas squirrel, and western gray squirrel.

Birds: red-tailed hawk, great horned owl, golden-crowned kinglet, vesper sparrow, pine siskin, lesser goldfinch.

1.2.3 Mixed Evergreen Zone  
 F Early Seral  
 Grassland/Pasture



**EARLY SERAL GRASSLAND/PASTURE**

Habitat Description

Early seral grass/forb community established after disturbance. "Balds" are maintained indefinitely due to fire and browsing on shallow droughty, rocky soils.

Food Web  
 Browsing.

Characteristic Flora

Grasses: lemon needle grass, western needle grass, bottlebrush squirreltail.

Forbs: Sierra snake-root, barestem lomatium, mountain false caraway.

Characteristic Fauna

Mammals: long-tailed vole, Oregon vole, Botta pocket gopher, western pocket gopher, California vole, black-tailed deer.

Birds: California quail, American goldfinch, vesper sparrow, brown-headed cowbird, rufous-sided towhee.

Herpetofauna: western rattlesnake, western skink, western terrestrial garter snake.

1.2.3 Mixed Evergreen Zone  
G Early Seral Shrub



### **EARLY SERAL SHRUB**

#### Habitat Description

Early seral shrub, typically sclerophyllous, it is a semipermanent fire-induced seral type and may remain indefinitely on shallow south-facing soils. This chaparral community becoming the dominant climax community inland and south of the study area.

#### Food Web

Browsing food webs are well-developed with the detrital web not as significant as in forested stages.

#### Characteristic Flora

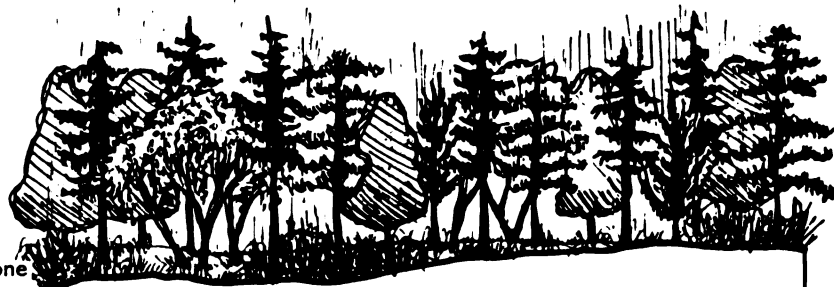
Hoary manzanita, green manzanita, small golden chinkapin, mountain tanoak, huckleberry oak, huckleberry oak, saddler oak, pygmy Oregon grape, bear bush, California coffee berry, snowbrush ceanothus, whitehorn ceanothus.

#### Characteristic Fauna

Mammals: black-tailed deer, Roosevelt elk, Botta pocket gopher, golden-mantled ground squirrel, California ground squirrel, long-tailed vole, deer mouse, yellow-pine chipmunk.

Birds: white-crowned sparrow, song sparrow, lesser goldfinch, scrub jay, calliope hummingbird, California quail.

Herpetofauna: western rattlesnake, western skink, southern alligator lizard, western fence lizard, gopher snake.



- 1.2.3 Mixed Evergreen Zone  
 | Second Growth Forest  
 (Mixed)

### ***SECOND GROWTH FOREST (Mixed)***

#### Habitat Description

Young vigorously growing mixed conifer/hardwood forest typically with two strata.

#### Food Web

Canopy grazing and forest floor detrital components of the food web are well-established.

#### Characteristic Flora

Knobcone pine are dominant here on areas that have undergone forest fires. On other sites tanoak, Douglas fir, madrone, canyon live oak, Port Orford cedar, incense cedar.

#### Characteristic Fauna

**Mammals:** black-tailed deer, Roosevelt elk, brush rabbit, snowshoe hare, Townsend chipmunk, red-backed voles, long-tailed vole.

**Birds:** Nashville warbler, solitary vireo, orange-crowned warbler, mourning dove, tree swallow, pygmy owl.



- 1.2.3 Mixed Evergreen Zone
  - u Second Growth Forest (Conifer)

**SECOND GROWTH FOREST (Conifer)**

Habitat Description

Young vigorously growing conifer forest typically found on mesic sites in low elevations (0-1000 meters) with a greater distribution at higher elevations. Most second growth forests are of a mixed broadleaf/conifer character.

Food Web

Both grazing canopy and detrital forest floor components of food web are well-developed. The principal avenue of energy flow is through the detrital web.

Characteristic Flora

Douglas fir, Port Orford cedar (hydric areas, low elevations and draws), incense cedar, sugar pine, vine maple, Oregon grape.

Characteristic Fauna

**Birds:** pine siskin, red crossbill, evening grosbeak, western tanager, black-throated gray warbler, Townsend's solitaire, winter wren, gray jay, western flycatcher, saw-whet owl.

**Mammals:** bobcat, long-tailed weasel, black bear, Oregon vole, California red-backed vole, chickaree, Trowbridge's shrew.



1.2.3 Mixed Evergreen Zone  
K Old Growth Forest

## OLD GROWTH FOREST

### Habitat Description

A two-strata forest with upper stratum being conifers and lower stratum being sclerophyllous evergreen trees. Canopy closure of both strata varies from closed to open.

### Food Web

Grazing canopy, grazing forest floor, and detrital forest floor components of the food web are well-developed. Can support greater densities of forest floor browsers than other old growth forests.

### Characteristic Flora

Upper stratum: Douglas fir, Port Orford cedar, western white pine.

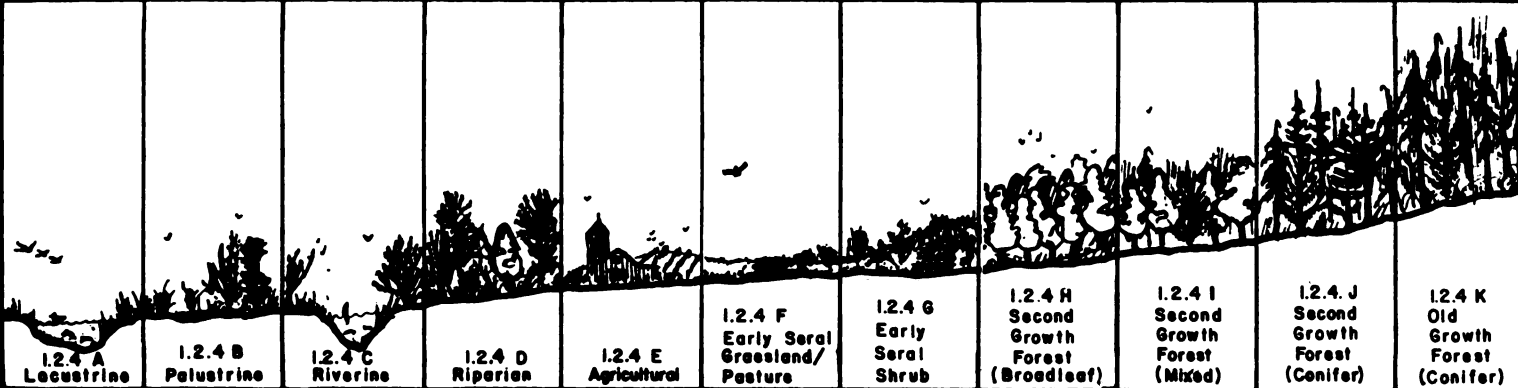
Mid stratum: tanoak, madrone, golden chinkapin, canyon live oak.

Shrub species include codler oak, huckleberry oak, Oregon grape, trailing blackberry, baldhip rose, Pacific poison oak.

### Characteristic Fauna

Birds: gray jay, raven, pygmy owl, spotted owl, sharp-shinned hawk, blue grouse, pileated woodpecker, brown creeper, Townsend's solitaire.

Mammals: chickaree, flying squirrel, dusky-footed wood rat, white-footed vole, red tree mouse, long- and short-tailed weasels.

<b>1.2.4 SITKA SPRUCE ZONE</b>										
<b>GENERAL COMMENTS</b>	Sitka Spruce occurs along a narrow coastal strip that stretches from the Kenai Peninsula, Alaska, to Cape Mendocino, California, at the southern boundary of the study area (Harris et al., 1974; Franklin & Dyrness, 1973; Griffen & Critchfield, 1972). Typically the zone is only a few kilometers wide but extends inland in river valleys and where extensive coastal plains occur. It is comparable to the coastal subzone of the Humid Transitional Life Zone or what some call the Coastal Temperate Rain Forest (Harris et al., 1974). The zone is very productive with substantial commercial timber lands.									
<b>TOPOGRAPHY AND SOILS</b>	The zone is restricted to coastal lowlands and is generally found below 150 meters (492 feet), although it may extend to 600 meters (1968 feet) where mountain masses form the coast line. Topography is generally flat to rolling. Soils are typically productive, deep, rich, and fine textured. Characteristic major great soil groups are humults (Brown Lateritics, Reddish Brown Lateritics, and Soils Bruns Acides) and alluvials (Udifuvents). Generally, surface soils are acid, high in organic content and total nitrogen and low in base saturation (Franklin and Dyrness, 1973).									
<b>CLIMATE</b>	The climate of the zone is maritime. Temperature and precipitation are moderate throughout the year. Average annual temperature ranges from 10.3 to 11.3°C (50 to 52°F) with average January temperatures between 4-8°C (39 to 46°F) and average July temperatures 13 to 17°C (55 to 63°F). Winds are generally from the northwest during summer and southerly during winter. Winter storms with high winds and precipitation originating in the Pacific often move into the zone. The predicted frequency of winds 55-61 km/h (90 to 100 mph) is one in each hundred years (U.S.D.A., 1975A). Extended freezing periods are rare.									
<b>HYDROLOGY</b>	Precipitation ranges from less than 200 cm (78 inches) at the southern boundary of the study area to more than 300 cm (118 inches) at the more northern extremities. Only about 5% of the precipitation falls from June through August (Franklin and Dyrness, 1973). Summer fogs and low clouds are frequent and play an important roll in reducing summer moisture stress (Ruth, 1954). Snow is uncommon. Lakes, peat bogs, and swamps are numerous. River and stream gradients are typical of the Gravel and Pastoral Zones as classified by Bauer (1974A). Some areas in these zones are prone to flooding.									
<b>HABITAT TYPES</b>										
										
1.2.4 A Lacustrine	1.2.4 B Palustrine	1.2.4 C Riverine	1.2.4 D Riparian	1.2.4 E Agricultural	1.2.4 F Early Seral Grassland/ Pasture	1.2.4 G Early Serai Shrub	1.2.4 H Second Growth Forest (Broadleaf)	1.2.4 I Second Growth Forest (Mixed)	1.2.4 J Second Growth Forest (Conifer)	1.2.4 K Old Growth Forest (Conifer)



1.2.4 Sitka Spruce Zone  
A. Lacustrine



## LACUSTRINE

### Habitat Description

Lakes are generally shallow and mesotrophic to eutrophic with both emergent and submergent vegetation. Water clarity is usually low with Secchi disk readings typically two meters or less.

### Food Web

Emergent and submergent plant production dominates. Algae blooms are common and appreciably add to the total productivity. Food web has well-developed compartments dominated by grazers in the water column and detritus in the benthos. Lakes are generally more productive with larger standing crops than lakes at higher elevations.

### Characteristic Flora

Emergents are yellow pond lily, cattail, and Scirpus spp. Submergents are Potamogeton spp. Spring and early summer phytoplankton genera are the diatom Fragilaria and the green algae Oedogonium and Spirogyra. Late summer blooms are typically the blue-green algae

### Characteristic Flora, continued

Aphanizomenon, Coelosphaesium, and Anabaena.

### Characteristic Fauna

Zooplankton: protozoans, rotifers, copepods, mites, with copepods typically dominant.

Fish: in oligotrophic-mesotrophic lakes, rainbow trout, cutthroat trout. In mesotrophic to eutrophic lakes, introduced warmwater fish such as large-mouth bass, yellow perch, catfish, blue-gill.

Mammals: mink, river otter, raccoon, muskrat, beaver.

Birds: mallard, widgeon, bufflehead, great blue heron, Canada goose, gadwall, American coot, belted kingfisher.

Herpetofauna: painted turtle, rough-skinned newt, bullfrog.

1.2.4 Sitka Spruce Zone  
B Palustrine



***PALUSTRINE***

Habitat Description

Freshwater marsh and/or swamp typified by standing water, poor drainage and hydric vegetation. Marshes are dominated by herbaceous plants and swamps by woody plants. Organic accumulation in the form of peat and anaerobic soil conditions are common.

Food Web

Productivity is high with grazing component of the food web dominant. Detrital compartment is truncated due to anaerobic conditions.

Characteristic Flora

Marsh: cattails, rushes, sedges, duckweed, sphagnum, heath, pitcher plant.

Swamp: willows, crabapple, sweet gale, Labrador tea, western red cedar, red alder, skunk cabbage.

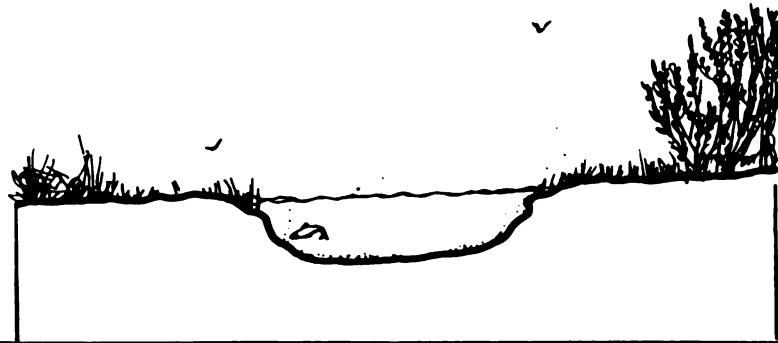
Characteristic Fauna

Invertebrates: dragonflies, damselflies, mosquitoes, mites, other arachnids.

Mammals: muskrat, beaver, Oregon vole, raccoon, mink, marsh shrew.

Birds: red-winged blackbird, long-billed marsh wren, common yellowthroat, great blue heron.

1.2.4 Sitka Spruce Zone  
C Riverine



## RIVERINE

### Habitat Description

The waters are generally cold and clear and low in nutrients, although nutrient concentrations are typically greater than in the upstream reaches. Rivers are predominantly in the pastoral zone with smaller sections in the gravel zone (Bauer, 1974A). Gradient is typically from 0 to 3 meters per kilometer. Bed materials typically range from silt to sand with gravels and cobbles occurring in steeper gradients. Channels are usually sinuous but may be braided.

### Food Web

In smaller streams the components of the food web are primarily detrital and dependent on the drainage basin. In larger streams periphyton, phytoplankton, and emergent vegetation contribute significantly to the food web.

### Characteristic Flora

Diatoms, Green and Blue-green algae.

### Characteristic Fauna

Invertebrates: stoneflies, mayflies, caddisflies.

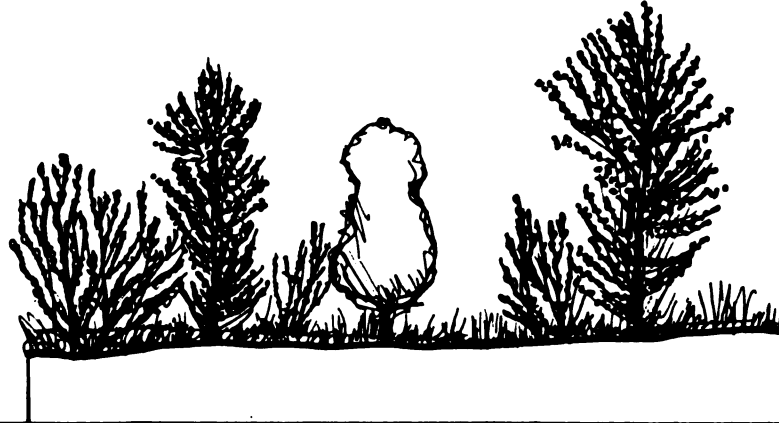
Fish: chinook and coho salmon, steelhead trout, cutthroat trout.

Herpetofauna: tailed frog.

Birds: belted kingfisher.

Mammals: mink, river otter, beaver.

1.2.4 Sitka Spruce Zone  
D Riparian



**RIPARIAN**

Habitat Description

Water edge habitat generally differentiated from surrounding areas by altered vegetation. Subject to periodic flooding.

Food Web

First trophic level is dominated by terrestrial/water edge plants. Second and third trophic levels are water-dependent. Top carnivores are either terrestrial or semi-aquatic animals.

Characteristic Flora

Willows, black cottonwood, red alder, western wax myrtle.

Characteristic Fauna

Mammals: raccoon, mink, river otter, beaver.

Birds: kingfisher, red-winged blackbird, warblers.

Herpetofauna: tailed frog, red-legged frog.

1.2.4 Sitka Spruce Zone  
E Agricultural



**AGRICULTURAL**

Habitat Description

Areas under cultivation, truck crops, orchards, berry farms.

Food Web

Managed for human use.

Characteristic Flora

Cultivated vegetation and weed plants.

Characteristic Fauna

Mammals: vagrant shrew, Townsend's mole, coyote, eastern cottontail, Townsend's vole, Oregon vole, raccoon, striped skunk, red fox.

Birds: swallows, Savannah sparrow, red-tailed hawk, ring-necked pheasant, gulls, killdeer, crow, mourning dove, short-eared owl.

Herpetofauna: gopher snake, garter snakes, western toad.

1.2.4 Sitka Spruce Zone  
 F Early Seral  
 Grassland/Pasture



### **EARLY SERAL GRASSLAND/PASTURE**

#### Habitat Description

Herbaceous low vegetation with no overstory. Often maintained as pasture for grazing. Also includes early seral "weed" stage after clearcutting or fire.

#### Food Web

Grazing food web is well-developed.

#### Characteristic Flora

Early seral communities include woodland groundsel, fireweed, autumn willowweed. Pastures harbor a host of native and introduced grasses.

#### Characteristic Fauna

**Mammals:** cows, horses, black-tailed deer, elk, dusky shrew, coast mole, Townsend's mole, eastern cottontail, Oregon vole, Pacific jumping mouse, coyote, red fox.

**Birds:** red-tailed hawk, marsh hawk, American kestrel, killdeer, swallows, robin, western meadowlark, Brewer's blackbird, Savannah sparrow, vesper sparrow, Oregon junco.

**Herpetofauna:** garter snakes, tiger salamander, northwestern salamander, Pacific tree frog.

1.2.4 Sitka Spruce Zone  
 G Early Seral Shrub



**EARLY SERAL SHRUB**

Habitat Description

Early successional thicket usually occurring from five to fifteen years after disturbance.

Food Web

Browsing-grazing.

Characteristic Flora

Salmonberry, swordfern, elderberry, vine maple, salal, grasses.

Characteristic Fauna

Mammals: coast mole, mountain beaver, black bear, black-tailed deer, bobcat.

Birds: song sparrow, Oregon junco, white-crowned sparrow, ruffed grouse, robin, common bushtit, mountain quail, sharp-shinned hawk.

1.2.4 Sitka Spruce Zone  
 h Second Growth Forest  
 (Broadleaf)



**SECOND GROWTH FOREST (Broadleaf)**

Habitat Description

Young, generally less than fifty years, vigorous deciduous broadleaf forest.

Food Web

Both canopy and forest floor components of the food web are developed. The canopy food web is a grazing one, while the forest floor web is based on detritus.

Characteristic Flora

Overstory is typically dominated by red alder, with an understory of salmonberry, swordfern, Oregon oxalis and trailing blackberry. Epiphytic cryptogams are common.

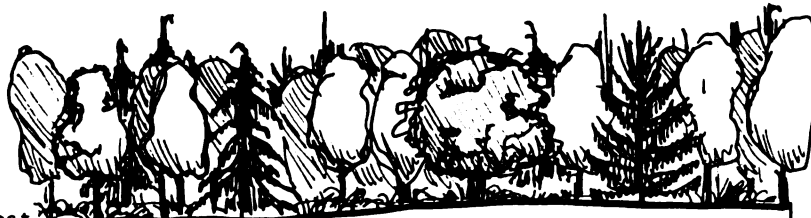
Characteristic Fauna

Mammals: mountain beaver, Trowbridge and vagrant shrew, shrew-mole, coast mole, deer mouse, Pacific jumping mouse, raccoon, spotted skunk, coyote, bobcat, black-tailed deer.

Birds: western tanager, evening grosbeak, solitary vireo, Swainson's thrush.

Herpetofauna: northern alligator lizard, racer, common and northern garter snake, northwestern salamander, long-toed salamander, rough-skinned newt, red salamander, red-legged frog.





1.2.4 Sitka Spruce Zone  
 I Second Growth Forest  
 (Mixed)

**SECOND GROWTH FOREST (Mixed)**

Habitat Description

Young vigorous forest with mixture of conifer and broadleaf tree species.

Food Web

Both canopy grazing and forest floor detrital components of the food web occur.

Characteristic Flora

Canopy: red alder, big-leaf maple, Sitka spruce Douglas fir.

Forest floor: swordfern, salmonberry, trailing blackberry, Oregon oxalis. Epiphytic cryptogams (lichens, mosses, clubmosses, and ferns) are common on hardwoods.

Characteristic Fauna

Mammals: mountain beaver, chickaree, northern flying squirrel, deer mouse, long-tailed weasel, black-tailed deer, bobcat.

Birds: western tanager, Stellar's jay, crow, evening grosbeak, robin, varied thrush.



1.2.4 Sitka Spruce Zone  
 J Second Growth Forest  
 (Conifer)

**SECOND GROWTH FOREST (Conifer)**

Habitat Description

Young vigorous second growth conifer forest less than 120 years old. Generally with a closed canopy.

Food Web

Both canopy grazing and forest floor detrital components of the food web are well-developed.

Characteristic Flora

Overstory: Sitka spruce, western hemlock, Douglas fir, shorepine, Port Orford cedar, grand fir, western red cedar.

Understory: swordfern, Oregon oxalis, false lily-of-the-valley, western spring beauty, with well-drained sites being dominated by salal, Pacific rhododendron, and red huckleberry.

Characteristic Fauna

Mammals: mountain beaver, chickaree, northern flying squirrel, deer mouse, long-tailed weasel, Oregon vole, Pacific jumping mouse, marten, bobcat.

Birds: blue grouse, ruffed grouse, band-tailed pigeon, Hammond's flycatcher, rufous hummingbird, Stellar's jay, crow, chestnut-backed chickadee, winter wren, robin, varied thrush.



1.2.4 Sitka Spruce Zone  
K Old Growth Forest  
(Conifer)

### ***OLD GROWTH FOREST (Conifer)***

#### Habitat Description

Aging conifer forest with partially opened canopy, typically with snags and diseased trees.

#### Food Web

Both grazing canopy and forest floor detrital components of the food web are well-developed. In addition, considerable forest floor browsing occurs due to the open canopy. Also diseased trunks and snags are important food sources to species such as woodpeckers and creepers.

#### Characteristic Flora

Forest canopy is dominated by Sitka spruce and western hemlock with Douglas fir, Port Orford cedar, western red cedar and big-leaf maple are locally abundant. Cryptogams are common. Characteristic forest floor species are Oregon oxalis, western spring beauty, three-leaved cool wart, evergreen wood violet, salal, rhododendron, and evergreen huckleberry. In wet areas, devil's club, red elderberry, and deerfern are common.

#### Characteristic Fauna

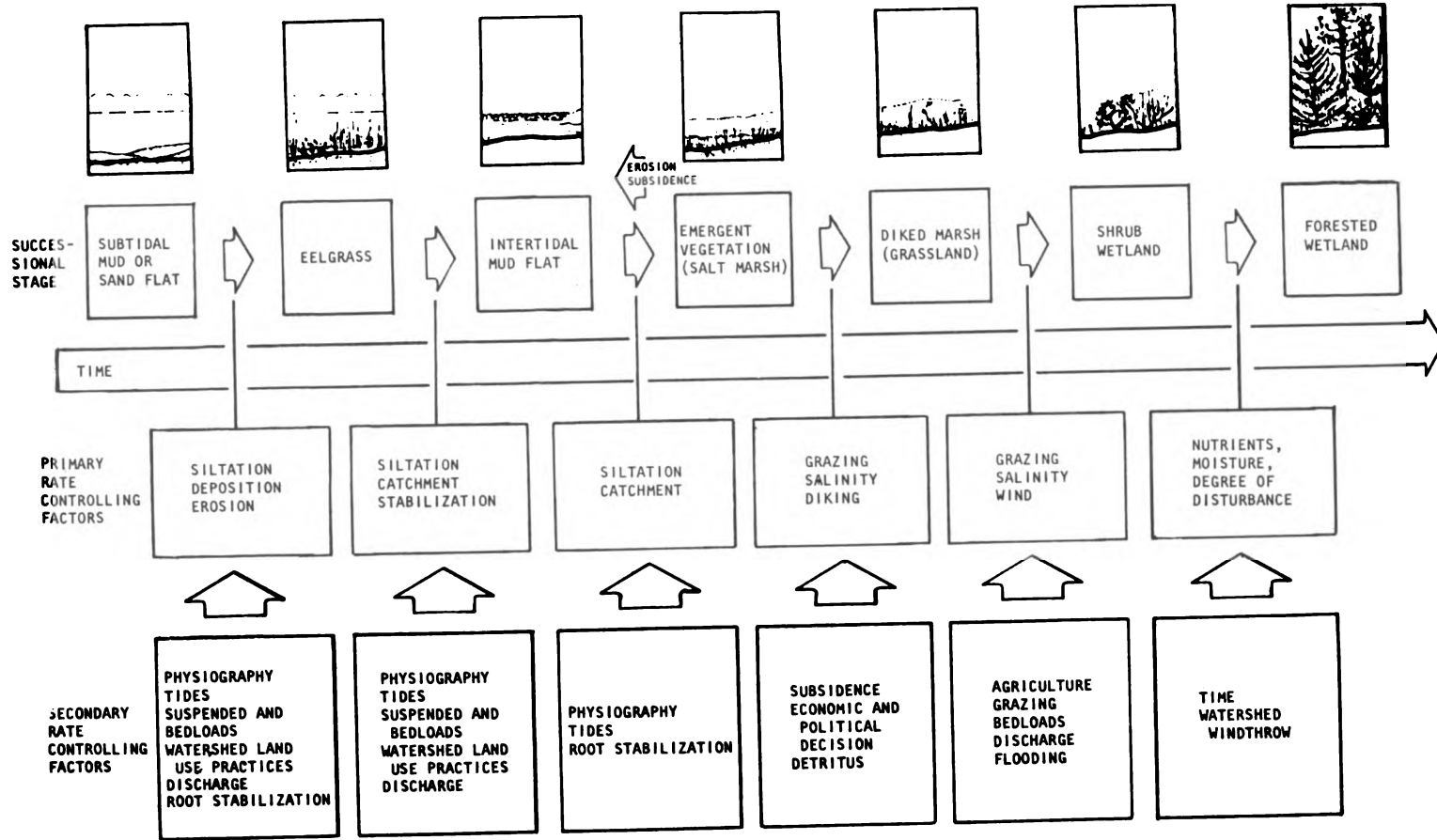
**Mammals:** red tree mouse, dusky shrew, marten, flying squirrel, chickaree.

**Birds:** spotted owl, saw-whet owl, goshawk, gray jay, varied thrush, hairy woodpecker, pileated woodpecker.

**Herpetofauna:** Pacific giant salamander, tailed frog.

<b>2.1 ESTUARY ZONES</b>																							
<b>GENERAL COMMENTS</b>	High productivity and wide variety of habitats. Large spatial and temporal variations in hydrology, hydrography, and geology. The degree of mixing defines three types of estuaries: stratified, well-mixed, and partially mixed. Mixing phenomena may be seasonal and are dependent upon river runoff, tides, winds, shape, and topography. Estuaries provide food and shelter for many kinds of organisms. In addition, they are important to men for transportation, commerce and recreation.																						
<b>HYDROGRAPHY</b>	Fresh water is supplied either from interior or coastal watersheds. Sea water is brought in by tides and winds. Seasonality is a major feature of the estuarine hydrography of the Pacific Northwest and also affects the structure of food web and biological communities. The range of water temperature is typically from 4-20°C (40-70°F), of salinity from 0 to 34 ‰, and of the tides from 2-3.5 m (7-11 ft). Coastal lagoons are a variety of estuary where the mouth is closed by longshore drift at times of seasonally low flows.																						
<b>BATHYMETRY AND SEDIMENTS</b>	Depths vary from very shallow (3 m or 10 ft throughout) to 10-16 m (30-50 ft) in those estuaries having channels and energy holes. Sediments vary from coarse-grained clean sands derived from the ocean to fine-grained sediments from the river. Gravel beds in riverine portions are important as spawning areas for anadromous fish. Activities such as logging, farming, and industrialization can substantially modify natural concentrations of nutrients, dissolved oxygen, and sediment conditions.																						
<b>FOOD WEBS</b>	Production in estuaries is complex, consisting of many interrelated food webs. Characteristically, phytoplankton production is dominant during spring and summer, with detritivores becoming important from late summer through the winter months. Macrophytes (seaweeds and eelgrass) are also important producers. Algal mats often accumulate on intertidal mudflats during summer.																						
<b>ZONE &amp; HABITAT TYPES</b>																							
<p>The diagram illustrates the transition of habitats from subtidal to intertidal and then to above-tide wetlands. The tidal range is shown as a dashed line. The subtidal zone (2.1.1) includes a channel, mud flats, sand flats, eelgrass beds, and rocky substrates. The intertidal zone (2.1.2) features pillings, mud flats, and emergent vegetation. The above-tide zone (2.1.3) consists of diked marshes, shrub wetlands, and forested wetlands.</p>																							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%; text-align: center;">2.1.1 A Channel</td> <td style="width: 16.6%; text-align: center;">2.1.1 B Mud Flat</td> <td style="width: 16.6%; text-align: center;">2.1.1 C Sand Flat</td> <td style="width: 16.6%; text-align: center;">2.1.1 D Eelgrass</td> <td style="width: 16.6%; text-align: center;">2.1.1 E Rocky Substrate</td> <td style="width: 16.6%; text-align: center;">2.1.2 A Pillings</td> <td style="width: 16.6%; text-align: center;">2.1.2 B Mud Flat</td> <td style="width: 16.6%; text-align: center;">2.1.2 C Emergent Vegetation</td> <td style="width: 16.6%; text-align: center;">2.1.3 A Diked Marsh</td> <td style="width: 16.6%; text-align: center;">2.1.3 B Shrub Wetland</td> <td style="width: 16.6%; text-align: center;">2.1.3 C Forested Wetland</td> </tr> <tr> <td colspan="5" style="text-align: center;">2.1.1 SUBTIDAL ESTUARINE ZONE</td> <td colspan="3" style="text-align: center;">2.1.2 INTERTIDAL ESTUARINE ZONE</td> <td colspan="3" style="text-align: center;">2.1.3 ABOVE TIDE ESTUARINE WETLAND ZONE</td> </tr> </table>		2.1.1 A Channel	2.1.1 B Mud Flat	2.1.1 C Sand Flat	2.1.1 D Eelgrass	2.1.1 E Rocky Substrate	2.1.2 A Pillings	2.1.2 B Mud Flat	2.1.2 C Emergent Vegetation	2.1.3 A Diked Marsh	2.1.3 B Shrub Wetland	2.1.3 C Forested Wetland	2.1.1 SUBTIDAL ESTUARINE ZONE					2.1.2 INTERTIDAL ESTUARINE ZONE			2.1.3 ABOVE TIDE ESTUARINE WETLAND ZONE		
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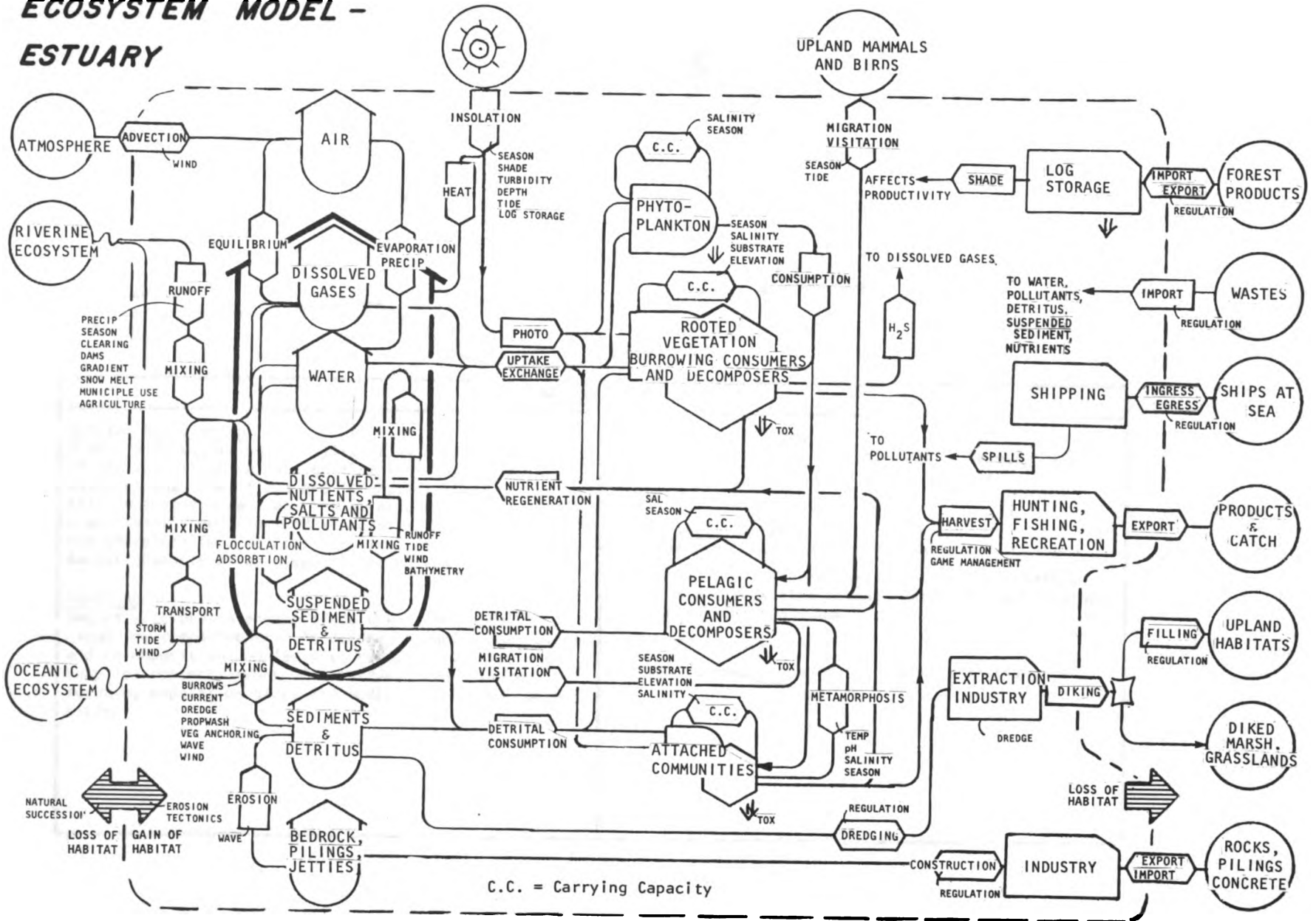
# ESTUARY SUCCESSION MODEL



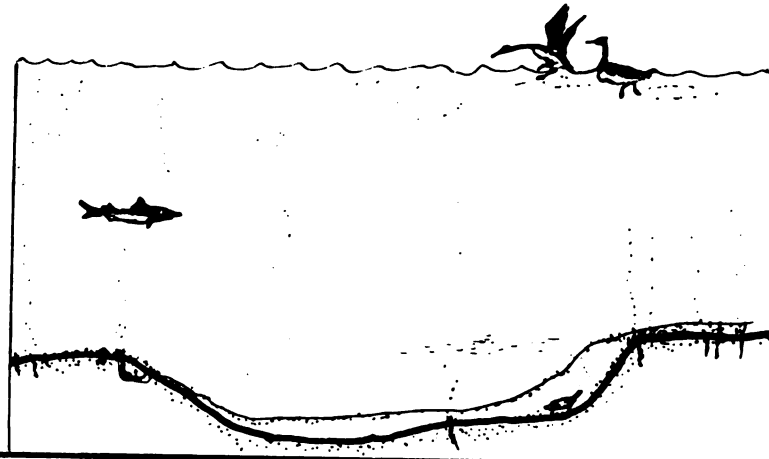
(SEE ESTUARINE SUCCESSION NOTES IN SECTION 3.2.4.2 OF VOLUME 2.)

# ECOSYSTEM MODEL - ESTUARY

Habitat



2.1.1 Subtidal  
Estuarine Zone  
A Channel



**CHANNEL**

Habitat Description

A naturally occurring or artificially dredged portion of the estuary which is significantly deeper than the adjacent shallower flats and is characterized by different sedimentary and faunal assemblages. Dredging significantly modifies and affects benthic population and therefore food sources for fish. Subtidally, the deeper channels often disphotic at bottom.

Food Web

Begins with phytoplankton or detritus from other estuarine compartments. In deeper channels respiration and decomposition coupled with reduced flows may produce low concentrations of dissolved oxygen thereby reducing population sizes and modifying species composition.

Characteristic Flora

Diatoms dominate the phytoplankton. Because of depth and turbidity there are no producers in the benthos.

Characteristic Fauna

Zooplankton: copepods are dominant.

Fish: starry flounder, staghorn sculpin, sharks, lingcod and rock fish (around jetties), and feeding salmon (spring and summer).

Mammals: harbor seal.

Birds: grebes, cormorants, scoters, pelican, etc.

## COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
--------------------------------	-------	-----------	--------

TROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

ACNATHES	70	C	-
DIATOMS			
ASTERIONELLA JAPONICA	70	U	-
DIATOMS			
BACTERIASTRUM DELICATULUM	70	Q	-
DIATOMS			
BIDDULPHIA	70	U	-
DIATOMS			
CERATIUM	70	Q	-
DIATOMS			
CHAETOCEROS	70	A	-
DIATOMS			
CHAETOCEROS DEBILIS		Q	-
DIATOMS			
CHAETOCEROS DECIPIENS	123456789	Q	-
DIATOMS			
CHAETOCEROS SOCIALIS	789	Q	-
DIATOMS			
CORETHRON	70	Q	-
DIATOMS			
COSCINODISCUS	70	Q	-
DIATOMS			
COSCINODISCUS RADATUS	123456789	Q	-
DIATOMS			
DITYLUM	70	Q	-
DIATOMS			
EUCAMPIA ZODIACUS	123456789	Q	-
DIATOMS			
FRAGILLARIA STRIATULA	70	Q	-
DIATOMS			
ISTHIA NERVOZA	70	Q	-
DIATOMS			
LAUDERIA	70	C	-
DIATOMS			
LICOPHORA ABBREVIATA	70	Q	-
DIATOMS			
MELOSIRA	70	A	-
DIATOM			
MELOSIRA MONILIFORMIS	1234567	Q	-
DIATOMS			
MELOSIRA SULCATA	789	Q	-
DIATOMS			
NAVICULA	70	Q	-
DIATOMS			
NITZSCHIA	70	U	-
DIATOMS			
NITZSCHIA PARADOXA	70	Q	-
DIATOMS			
NOCTILUCA	70	Q	-
DIATOMS			
PERIDINIUM	70	Q	-
DIATOMS			

## HABITAT: CHANNEL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
--------------------------------	-------	-----------	--------

TROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

PLEUROSIGMA	70	Q	-
DIATOMS			
RHIZOLENIA	70	Q	-
DIATOMS			
SCHROEDERELLA	70	Q	-
DIATOMS			
SKELETONEMA COSTATUM	123456789	A	-
DIATOMS			
SYNEDRA TABULATA	70	Q	-
DIATOMS			
THALASSIONEMA NITZSCHIOIDES	123456789	Q	-
DIATOMS			
THALASSIOSIRA	70	U	-
DIATOMS			
THALASSIOTHRIX	70	Q	-
DIATOMS			

TROPIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

HARPACTICOID	123456789	A	-
COPEPOD			
OITHONA	70	C	-
COPEPOD			

TROPIC LEVEL: (2) HERBIVORE  
FISHES

CATOSTOMUS MACROCHEILUS	1234567	C	-
LARGESCALE SUCKER			

TROPIC LEVEL: (2) HERBIVORE  
BIRDS

AYTHYA VALISINERIA	123456789	C	G
CANVASBACK			
FULICA AMERICANA	123456789	C	G
AMERICAN COOT			
OXYURA JAMAICENSIS	123456789	C	G
RUDDY DUCK			

TROPIC LEVEL: (3) CARNIVORE  
FISHES

ACIPENSER MEDIOSTRIS	123456789	C	G
GREEN STURGEON			
ACIPENSER TRANSMONTANUS	123456789	C	G
WHITE STURGEON			
ALPESIAURUS FEROX	123456789	U	-
LONGNOSE LANCETFISH			
AMPHISTICHUS RHODOTERUS	123456789	C	G
REDTAIL SURFPERCH			
ANARRHICHTHYS OCELLATUS	123456789	Q	-
WOLF-EEL			

KEY TO SYMBOLS - 1.1.1 A-2



## COMMUNITY COMPOSITION ESTUARY      ZONE: SURTIDAL

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPIC LEVEL: (3) CARNIVORE  
FISHES

ARTEIDIUS FENESTRALIS	123456789	0	-
PADED SCULPIN			
BRAMA JAPONICA	123456789	U	-
POMFRET			
CITHARICHTHYS STIGMAEUS	123456789	0	G
SPECKLED SANDDAB			
COTTUS ASPER	123456789	A	-
PRICKLY SCULPIN			
ENOPHRYS BISON	123456789	0	-
RUFFALO SCULPIN			
HEXAGRAMMUS DEFAGRAMMUS	123456789	0	G
KELP GREENLING			
MICROPTERUS SALMOIDES	3	C	G
LARGEMOUTH BASS			
MORONE SAXATILIS	123456789	C	G
STRIPED BASS			
ONCORHYNCHUS GORRUSCHIA	123456789	U	C
PINK SALMON			
ONCORHYNCHUS KETA	123456789	U	C
CHUM SALMON			
ONCORHYNCHUS KISUTCH	123456789	C	C
COHO SALMON			
ONCORHYNCHUS TSHAWYTSCHA	123456789	0	-
CHINOOK SALMON / JUVENILE			
ONCORHYNCHUS TSHAWYTSCHA	123456789	C	C
CHINOOK SALMON			
OPHIODON ELONGATUS	123456789	U	C
LINGCOD			
PALLASINA BARBATA	123456789	0	-
TURENOSE PLACHER			
PAROPHYRYS VETULUS	123456789	0	G
ENGLISH SOLE			
PEPRILUS SIMILLIMUS	123456789	0	G
PACIFIC POMFANO			
PLATICTHYS STELLATUS	123456789	A	G
STARRY FLOUNDER			
PSETTICHTHYS MELANOSTICTUS	123456789	0	G
SAND SOLE			
PTYCHOCHEILUS OREGONENSIS	30	U	-
NORTHERN SQUAWFISH			
SALMO CLARKI	123456789	C	G
CUTTHROAT TROUT			
SALMO GAIRDNERI	123456789	U	F
RAINBOW TROUT			
SALVELINUS MALMA	123456789	U	G
DOLLY VARDEN			
SCORPAENICHTHYS MARMORATUS	123456789	C	G
CAREZON			
SEBASTES CAURINUS	123456789	C	G
COPPER ROCKFISH			
SEBASTES MELANOPS	123456789	C	G
BLACK ROCKFISH			

## HABITAT: CHANNEL

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
COMMON NAMETROPIC LEVEL: (3) CARNIVORE  
FISHES

SEBASTES PAUCISPINIS	123456789	U	0
BOCACCIO			
SQUALUS ACANTHIAS	123456789	A	-
SPINY DOGFISH			
TRIAKIS SEMIFASCIATA	70	0	-
LEOPARD SHARK			

TROPIC LEVEL: (3) CARNIVORE  
BIRDS

AECYMOPHOROUS OCCIDENTALIS	123456789	C	-
WESTERN GREBE			
BRACHYRAMPHUS MARMORATUS	123456789	U	-
MARbled MURRELET			
BUCEPHALA ALBEOEA	123456789	C	G
BUFFLEHEAD			
BUCEPHALA CLANGULA	123456789	C	G
COMMON GOLDENEYE			
CEPHALUS COLUMBA	123456789	C	-
PIGEON GUILLEMOT			
CLANGULA HYEMALIS	123456789	U	G
OLDSQUAW			
GAVIA ARCTICA	123456789	U	-
ARCTIC LOON			
GAVIA IMMER	123456789	C	-
COMMON LOON			
GAVIA STELLATA	123456789	C	-
RED-THROATED LOON			
HISTRIONICUS HISTRIONICUS	123456789	U	G
HARLEQUIN DUCK			
LARUS ARGENTATUS	123456789	U	-
HERRING GULL			
LARUS CALIFORNICUS	123456789	A	-
CALIFORNIA GULL			
LARUS CANUS	123456789	A	-
MEW GULL			
LARUS DELAWARENSIS	123456789	C	-
RING-BILLED GULL			
LARUS GLAUDESCENS	123456789	A	-
GLAUCOUS-WINGED GULL			
LARUS HEERMANNI	123456789	C	-
HEERMANN'S GULL			
LARUS OCCIDENTALIS	123456789	A	-
WESTERN GULL			
LARUS PHILADELPHIA	123456789	A	-
BONAPARTE'S GULL			
LARUS THAYERI	123456789	U	-
THAYER'S GULL			
MEGACERYLE ALCYON	123456789	U	-
RELTED KINGFISHER			
MELANITTA DEGLANDI	123456789	C	E
WHITE-WINGED SCOTER			

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (3) CARNIVORE  
 BIRDS

MELANITTA NIGRA BLACK SCOTER	123456799	U	G
MELANITTA PERSPICILLATA SURF SCOTER	123456709	C	G
MERGUS MERGANSER COMMON MERGANSER	123456789	U	G
MERGUS SERRATOR RED-BREASTED MERGANSER	123456789	C	G
PANDION HALIAETUS OSPREY	123456789	U	R
PELECANUS OCCIDENTALIS BROWN PELICAN	23456789	U	E
PHALACROCORAX AURITUS DOUBLE-CRESTED CORMORANT	123456789	C	-
PHALACROCORAX PELAGICUS PELAGIC CORMORANT	123456789	C	-
PHALACROCORAX PENICILLATUS BRANDT'S CORMORANT	123456789	C	-
PODICEPS AURITUS HORNED GREBE	123456789	C	-
PODICEPS CASPICUS EARED GREBE	123456789	C	-
PODICEPS GRISEGENA RED-NECKED GREBE	123456789	C	-
PODILYMBUS PODICEPS PIED-BILLED GREBE	123456789	U	-
RISSA TRIDACTYLA BLACK-LEGGED KITTIWAKE	123456789	U	-
STERNA CASPIA CASPIAN TERN	123456789	U	-
STERNA HIRUNDO COMMON TERN	123456799	U	-
URIA AALGE COMMON MURRE	123456789	C	-

TROPHIC LEVEL: (3) CARNIVORE  
 MAMMALS

EUMETOPIAS JURATA STELLAR SEA LION	3	C	-
PHOCA VITOLINA HARBOR SEAL	123456789	A	-
ZALOPHUS CALIFORNICUS CALIFORNIA SEA LION	39	U	-

TROPHIC LEVEL: (5) OMNIVORE  
 FISHES

ANODIARCHUS PJPURPESCENS HIGH COCKSCOMB	123456789	0	-
HYPERPROSOPON ARGENTEUM WALLEYE SURFPERCH	123456789	0	-
HYPERPROSOPON ELLIPTICUM SILVER SURFPERCH	3456789	0	-

HABITAT: CHANNEL  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (5) OMNIVORE  
 FISHES

ICTALURUS BULLHEAD	3	C	-
LEPIDOGOBIOUS LEPIDUS RAY GOBY	123456789	0	-
PHANERODON FURCATUS WHITE SEAPERCH	123456789	C	-

TROPHIC LEVEL: (5) OMNIVORE  
 BIRDS

AYTHYA AFFINIS LESSER SCAUP	123456789	U	G
AYTHYA MARILA GREATER SCAUP	123456789	C	G

TROPHIC LEVEL: (6) PARASITE  
 INVERTEBRATES

CLAUSTIDIUM VANCOUVERENSE COPEPOD	270	0	-
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TROPHIC LEVEL: (6) PARASITE  
 FISHES

LAMPETRA AYRESI RIVER LAMPREY	123456789	C	-
LAMPETRA PACIFICA PACIFIC BROOK LAMPREY	89	C	-
LAMPETRA RICHARDSONI WESTERN BROOK LAMPREY	12345678	0	-

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

ANISOGAMMARUS PUGETTENSIS AMPHIPOD	123456789	0	-
CAULIBUGULA CILIATA BRYOZOANS	70	0	-
CAULORAMPHUS SPINIFERUM BRYOZOANS	70	0	-
MODIOLUS -NULL-	270	C	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

AEQUOREA AEQUOREA HYDRIDS	70	C	-
BEROE CUCUMIS COMB JELLIES	70	C	-
CANCER MAGISTER DUNGENESS CRAB	123456789	A	C
CRANGON ALBA WHITE SHRIMP	20	C	-

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CRANGON FRANCISCORUM -NULL-	123456789	0	-
CRANGON NIGRICAUDA BLACK-TAILED SHRIMP	123456789	0	-
NEOMYSIS MERCEDESIS MYSID SHRIMP	320	0	-
NEPHTYS CAECA NEREID WORM	270	C	-
JAELIA HYDROIDS	70	C	-
PLEUROBRACHIA RACHEI COMB JELLIES	70	C	-
POLYORCHIS PENCILLATUS HYDROIDS	70	C	-
VELELLA VELELLA HYDROIDS	70	U	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ALLUSMERUS ELONGATUS WHITERAIT SMELT	123456789	0	-
ALOSA SAPIDISSIMA AMERICAN SHAD	35789	A	C
AMMODYTES HEXAPTERUS PACIFIC SAND LANCE	123456789	A	C
APODICTHYS FLAVIUS PENPOINT GUNNEL	123456789	0	-
ATHERINOPS AFFINIS TOPSMELT	123456789	0	-
ATHERINOPSIS CALIFORNENSIS JACKSMELT	70	0	-
AULORHYNCHUS FLAVIUS TUBESNOOT	123456789	0	-
CLINOCOTTUS GLORICEPS MOSSHEAD SCULPIN	123456789	0	-
CLUPPA HARENGUS PALLASI PACIFIC HERRING	123456789	C	C
CYMATOASTER AGGREGATA SHINER PERCH	123456789	A	-
EMBROTICA LATERALIS STRIPED SEAPERCH	123456789	0	G
ENGRAULIS MORDAX NORTHERN ANCHOVY	123456789	C	C
GASTEROSTEUS ACULEATUS THREESPINE STICKLEBACK	123456789	C	-
HYPOMESUS PRETIOSUS SURFSMELT	123456789	0	C
LEPTOCOTTUS ARMATUS PACIFIC STAGHORN SCULPIN	123456789	A	-
LUMPENUS SAGITTA SNAKE PRICKLEBACK	123456789	A	-

HABITAT: CHANNEL

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
MICROGADUS PROXIMUS PACIFIC TONGOD	123456789	A	-
OLIGOCOTTUS SNYDERI FLUFFY SCULPIN	123456789	0	-
ONCORHYNCHUS GORRUSCHA PINK SALMON / JUVENILE	123456789	0	-
ONCORHYNCHUS KETA CHUM SALMON / JUVENILE	123456789	0	-
ONCORHYNCHUS KISUTCH COHO SALMON / JUVENILE	123456789	0	-
ONCORHYNCHUS MERKA SOCKEYE SALMON / JUVENILE	123456789	0	-
ONCORHYNCHUS MERKA SOCKEYE SALMON	123456789	U	C
PERCA FLAVESCENS YELLOW PERCH	30	0	G
RHACOGCHILUS VACCA PILE PERCH	123456789	C	G
RHINICHTHYS OSCULUS SPECKLED DACE	123456789	0	-
RICHARDSONIUS BALTEATUS REDSIDE SHINER	12347	C	-
SPRINCHUS THALEICHTHYS LONGFIN SMELT	123456789	A	-
SYNGNATHUS GRISEOLINFATUS RAY PIPEFISH	123456789	A	-
THALEICHTHYS PACIFICUS EULACHON	123456789	A	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 BIRDS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
LOBIPES LOBATUS NORTHERN PHALAROPE	123456789	U	-
PHALAROPUS FULICARIUS RED PHALAROPE	123456789	R	-

TROPHIC LEVEL: (0) UNKNOWN  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ACARTIA CLAUDII COPEPOD	123456789	A	-
ACARTIA LONGIREMIS COPEPOD	123456789	A	-
ACARTIA TONSA COPEPOD	70	A	-
AMPITHOE AMPHIPOD	70	0	-
ANTHESSIUS NORTONI COPEPOD	70	0	-
AUTOLYTUS POLYCHAETE WORM	70	0	-

## COMMUNITY COMPOSITION ESTUARY

ZONE: SUBTIDAL

HABITAT: CHANNEL

SCIENTIFIC NAME  
COMMON NAME

RANGE ABUNDANCE STATUS

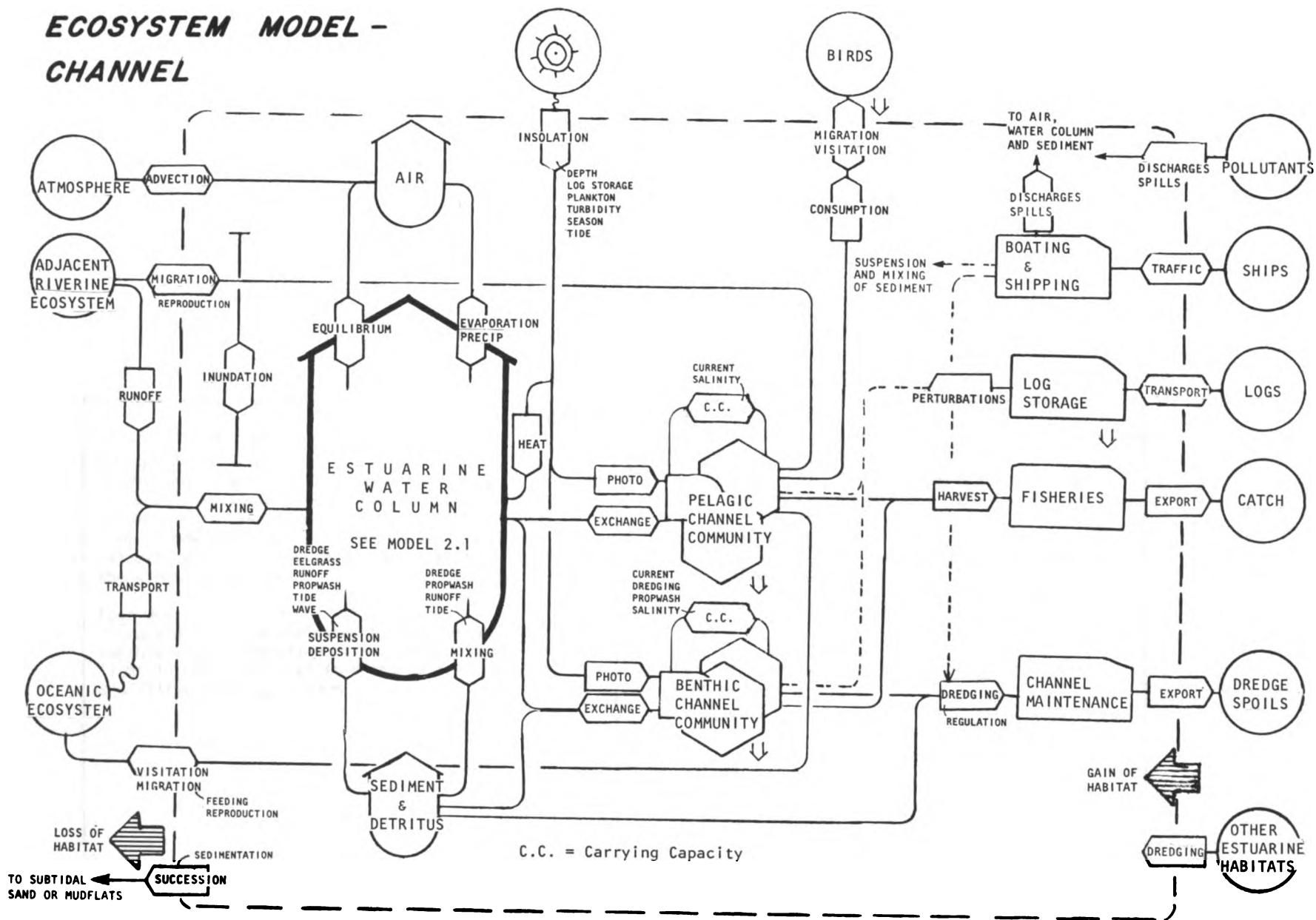
TROPIC LEVEL: (0) UNKNOWN  
INVERTEBRATES

CALANUS MARSHALLAE	570	A	-
COPEPOD			
CAPITELLA OVINCOLA	70	U	-
LUGWORMS			
CENTROPAGES	70	U	-
COPEPOD			
CTENOCALANUS VANUS	123456789	C	-
COPEPOD			
DIASTYLIS	20	C	-
CUMACEAN			
ETEONE LIGHTI	70	U	-
POLYCHAETE WORM			
ETEONE LONGA	20	C	-
POLYCHAETE WORM			
EURYTHEUS	70	C	-
COPEPOD			
GLYCINDE ARMIGERA	270	U	-
POLYCHAETE WORM			
GRANDIDIRELLA JAPONICA	799	O	-
AMPHIPODS			
HYPERIA	70	U	-
HYPERIID AMPHIPOD			
NOTOMASTUS TENUIIS	270	U	-
LUGWORMS			
PAPACALANUS PARVUS	123456789	C	-
COPEPODS			
PARAPHOXUS EPITOMIUS	799	O	-
AMPHIPODS			
PARAPHOXUS SPINOSUS	799	O	-
AMPHIPODS			
PARAPHOXYS MILLERI	2789	O	-
AMPHIPODS			
PARAPLEUSTHES PUGETTENSIS	123456789	O	-
AMPHIPODS			
POLYDORA LIGHTI	270	U	-
SPIONID WORM			
PONTOGENIA INERMIS	123456789	O	-
AMPHIPODS			
PSEUDOCALANUS	123456789	A	-
COPEPOD			
PSEUDOPOLYDORA KEMPI	270	A	-
SPIONID WORM			
STREBLOSPIID BENEDICTI	270	A	-
SPIONID WORM			
TYPSYLLIS PULCHRA	70	A	-
POLYCHAETE WORM			

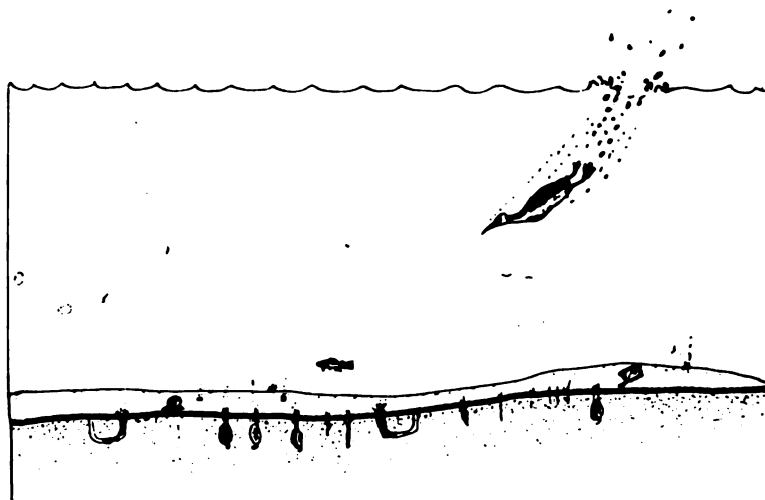
TROPIC LEVEL: (0) UNKNOWN  
FISHES

PHOLIS ORNATA	123456789	A	-
SADDLEBACK GUNNEL			

# ECOSYSTEM MODEL - CHANNEL



2.1.1 Subtidal  
Estuarine Zone  
B Mud Flat



### MUD FLAT

#### Habitat Description

No emergent vegetation. Primary production restricted to epibenthic algae on the flats and to phytoplankton in the water. Variable depth. Acts as nutrient trap, encouraging high clam production. Current velocities, light penetration or other factors prevent the growth of eelgrass.

#### Food Web

Primary production dominated by phytoplankton. Epibenthic algal production often restricted by low light levels. Detrital food chains are characteristic and filter feeding is common.

#### Characteristic Flora

Diatoms dominate the phytoplankton and are present with green and blue-green algae on the flats.

#### Characteristic Fauna

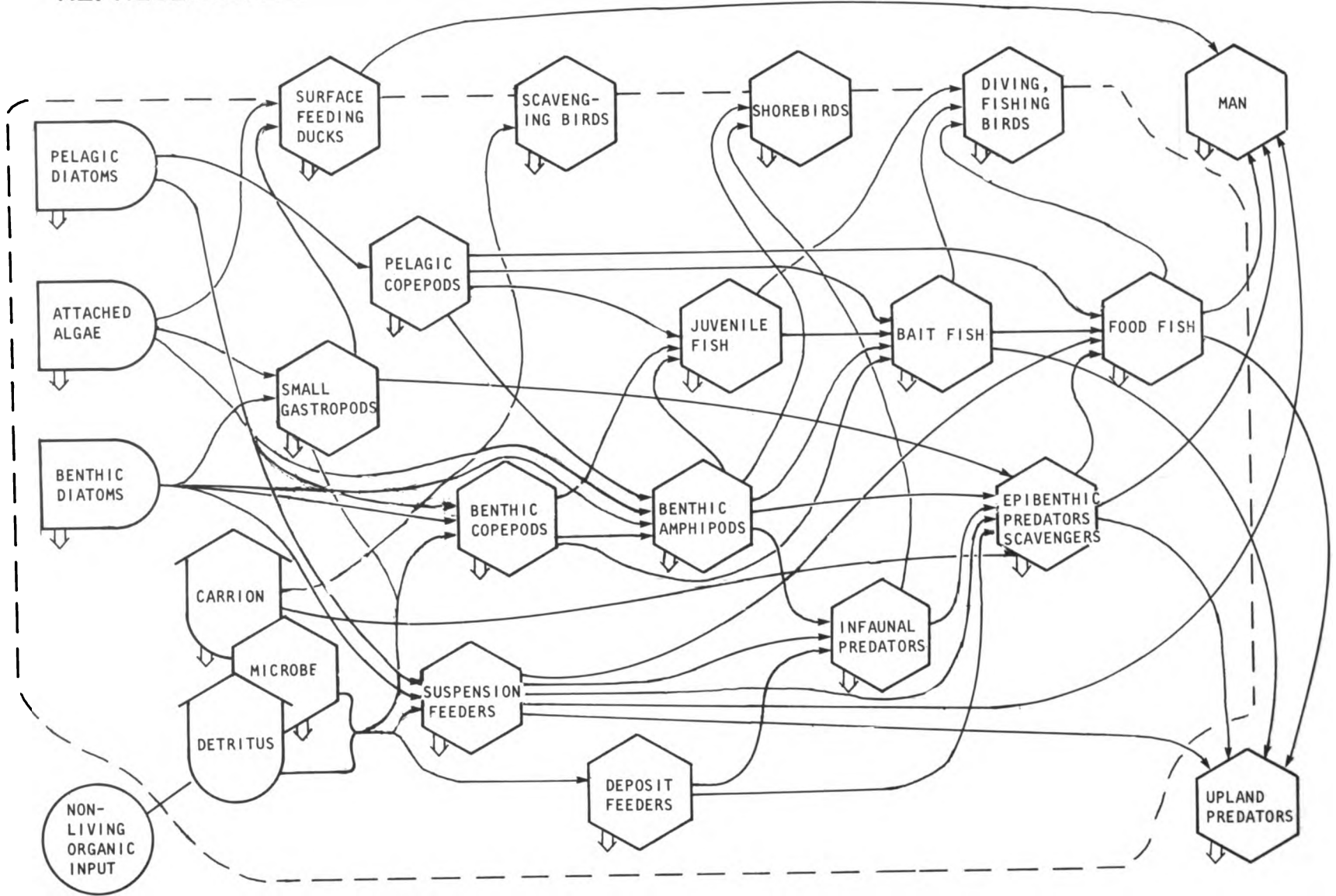
Zooplankton: copepods dominate the zooplankton with mysids sometimes abundant.

Fish: starry flounder, staghorn sculpin, Pacific herring, and shiner perch (*Cymatogaster* spp.) are most common.

Benthos: soft-shell clam (*Mya arenaria*) and polychaete worms dominate.

Birds: western grebe, scoter, cormorants, great blue heron.

# REPRESENTATIVE FOOD WEB — MUD FLAT



## COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

CHAETOMORPHA CANNABINNA GREEN ALGAE	123456789	C	-
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TROPHIC LEVEL: (2) HERRIVORE  
BIRDS

AYTHYA VALISINERIA CANVASBACK	123456789	C	G
FULICA AMERICANA AMERICAN COT	123456789	C	G
OLOR COLUMBIANUS WHISTLING SWAN	123456789	U	-
OXYURA JAMAICENSIS RUDDY DUCK	123456789	C	G

TROPHIC LEVEL: (3) CARNIVORE  
FISHES

CITHARICHTHYS STIGMAEUS SPECKLED SANDDAB	123456789	O	G
RAJA RHINA LONGNOSE SKATE	123456789	C	-
SQUALUS ACANTHIAS SPINY DOGFISH	123456789	A	-

TROPHIC LEVEL: (3) CARNIVORE  
BIRDS

BUCEPHALA ALBEOLA BUFFLEHEAD	123456789	C	G
BUCEPHALA CLANGULA COMMON GOLDENFYE	123456789	C	G
MELANITTA DEGLANDI WHITE-WINGED SCOTER	123456789	C	G
MELANITTA PERSPICILLATA SURF SCOTER	123456789	C	G
MERGUS MERGANSER COMMON MERGANSER	123456789	U	G
MERGUS SERRATOR RED-BREADED MERGANSER	123456789	C	G
PHALACROCORAX AURITUS DOUBLE-CRESTED CORMORANT	123456789	C	-
PHALACROCORAX PELAGICUS PELAGIC CORMORANT	123456789	U	-
PHALACROCORAX PENICILLATUS BRANDT'S CORMORANT	123456789	U	-

TROPHIC LEVEL: (3) CARNIVORE  
MAMMALS

PHOCA VITOLINA HARBOR SEAL	123456789	C	-
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## HABITAT: MUD FLAT

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

ARARENICOLA CLAPARESDII VAGABUN 7 LUGWORMS		A	-
ARARENICOLA PACIFICA LUGWORMS	70	A	-
AMAGS AURICULA BRISTLE WORMS	7	U	-
COROPHIUM BREVIS AMPHIPOD	123456789	O	-
COROPHIUM SALMONIS AMPHIPOD	1234567	O	-
COROPHIUM SPINICORNE AMPHIPOD	123456789	A	-
MACOMA BALTHICA CLAM	123456789	A	-
MACOMA NASUTA RENT-NOSED CLAM	123456789	A	-
OWENIA FUSIFORMIS POLYCHAETEWORM	70	A	-

TROPHIC LEVEL: (5) OMNIVORE  
BIRDS

AYTHYA AFFINIS LESSER SCAUP	123456789	U	G
AYTHYA MARILA GREATER SCAUP	123456789	C	G

TROPHIC LEVEL: (6) PARASITE  
INVERTEBRATES

CAPRINONEMERTES EPIALTI RIBBON WORMS	70	C	-
PINNIXA FABA PEA CRAB	70	A	-
PINNIXA LITTORALIS PEA CRAB	70	A	-
PINNIXA OCCIDENTALIS PEA CRAB	70	U	-
PINNIXA SCHMITTI PEA CRAB	70	A	-
PINNIXA TUBICOLA PEA CRAB	70	C	-

KEY TO SYMBOLS - 1.1.1 A-2



## COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

ANISOGAMMARUS PUGETTENSIS	123456789	C	-
AMPHIPOD			
BOWERBANKIA GRACILIS	70	O	-
BRYOZOANS			
CLINOCARCIUM NUTTALLII	123456789	A	G
BASKET COCKLE OR HEART COCKLE			
MYA ARENARIA	123456789	A	G
SOFT-SHELL CLAM			
TADES JAPONICA	20	O	-
-NULL-			
TELLINA MODESTA	123456789	A	-
TELLEN			
TELLINA NUCULOIDES	123456789	A	-
TELLEN			
TRESUS CAPAX	123456789	A	G
GAPER CLAM OR EMPIRE CLAM			
TRESUS NUTTALLII	123456789	A	G
SOUTHERN GAPER			

TROPIC LEVEL: (9) INVERTEBRATE FATER  
INVERTEBRATES

CRANGON ALBA	20	C	-
WHITE SHRIMP			
CRANGON FRANCISCORUM	123456789	C	-
-NULL-			
CRANGON NIGRICAUDA	123456789	C	-
BLACK-TAILED SHRIMP			
GLYCERA AMERICANA	123456789	A	-
POLYCHAETE WORM			
HARMOTHOE IMBRICATA	270	U	-
POLYNOID WORMS			
HESPERONOE COMPLANATA	270	C	-
POLYNOID WORMS			
NEOMYSIS MERCEDIS	320	A	-
MYSID SHRIMP			
NEPHTYS CAECA	270	U	-
NEREID WORM			
NEPHTYS CAECOIDES	70	A	-
NEREID WORM			
NEREIS BRANDTI	270	A	-
NEREID WORM			
NEREIS EAKINI	70	O	-
NEREID WORM			

TROPIC LEVEL: (9) INVERTEBRATE FATER  
FISHES

PERCA FLAVESCENS	30	C	G
YELLOW PERCH			

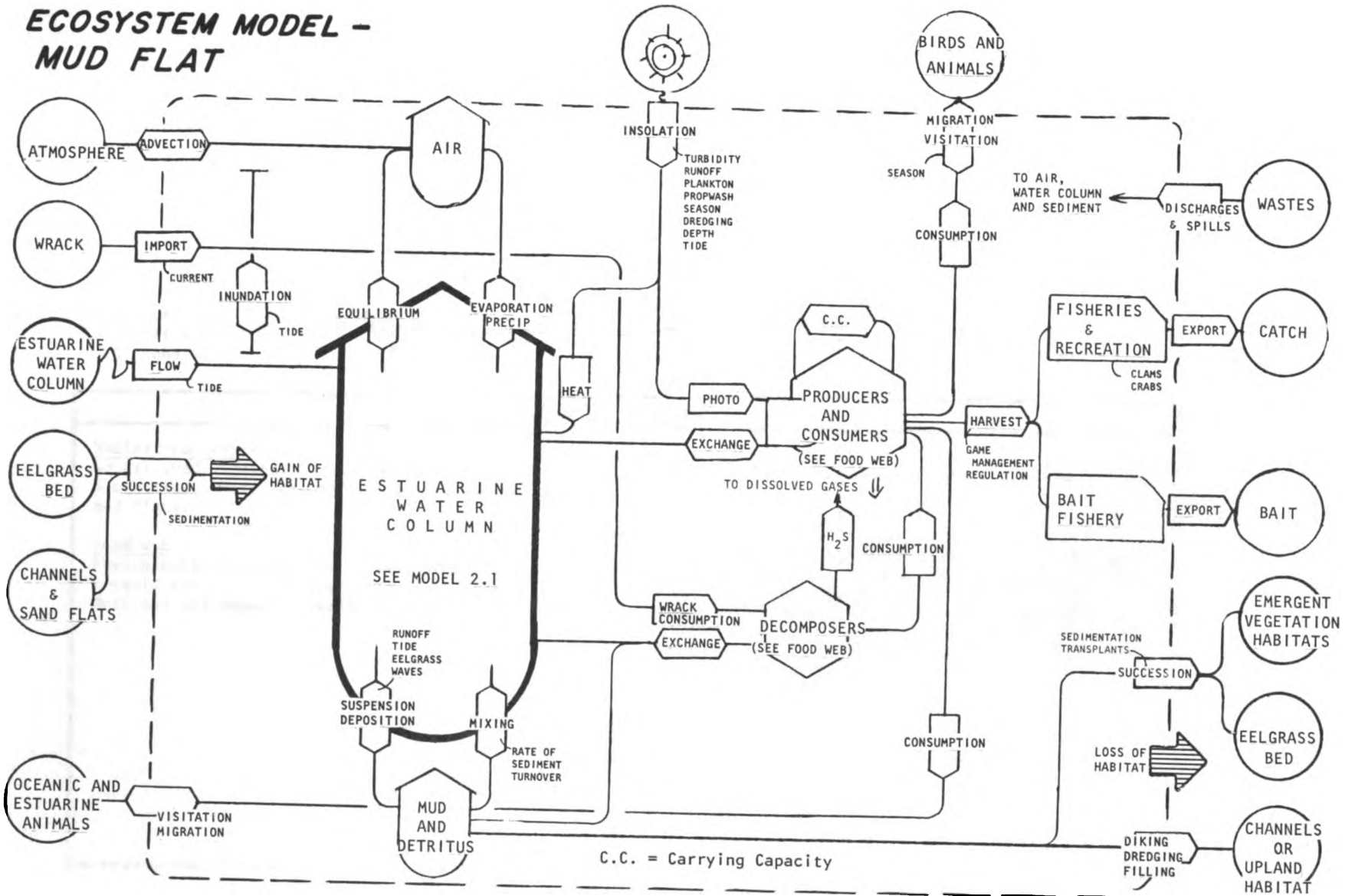
## HABITAT: MUD FLAT

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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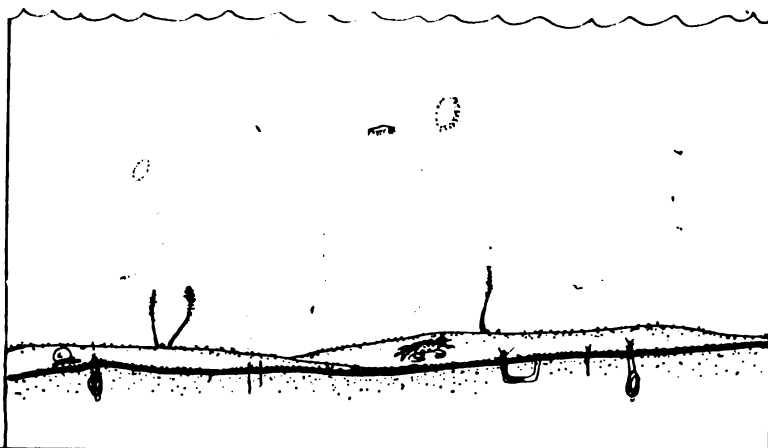
TROPIC LEVEL: (9) UNKNOWN  
INVERTEBRATES

CAPITELLA CAPITATA	270	A	-
LUGWORMS			
DIASTYLIS	20	U	-
CUMACEAN			
FTEONE LIGHTI	70	A	-
POLYCHAETE WORM			
ETEONE LONGA	20	C	-
POLYCHAETE WORM			
GLYCERA CAPITATA	70	U	-
POLYCHAETE WORM			
GLYCERA ROBUSTA	70	A	-
POLYCHAETE WORM			
GLYCINDE ARMIGERA	270	C	-
POLYCHAETE WORM			
HAPLOSCOLOPUS ELONGATA	270	C	-
POLYCHAETE WORM			
HEMIPODUS BOREALIS	70	O	-
POLYCHAETE WORM			
HETEROMASTUS FILIFORMIS	270	A	-
LUGWORMS			
LEPTOCHELIA SAVIGNYI	20	A	-
CRUSTACEAN			
LEPTOCHEIA	20	C	-
CUMACEAN			
MANAYUNKIA ESTUARINA	20	C	-
SABELLID WORM			
MEDIOMASTUS CALIFORNIENSIS	2739	C	-
LUGWORMS			
NERINE CIRRATULUS	70	C	-
POLYCHAETE WORM			
PANCOLUS CALIFORNIENSIS	20	A	-
CRUSTACEAN			
POLYDORA BRACHYCEPHALA	70	C	-
SPIONID WORM			
POLYDORA SOCIALIS	70	U	-
SPIONID WORM			
PSEUDOPOLYDORA KEMPI	270	C	-
SPIONID WORM			
RHITHROPANOPEUS HARRISSI	70	C	-
ZUIDER ZEE CRAB			
STREBLOSPTO BENEDICTI	270	A	-
SPIONID WORM			
SYLLIS ELONGATA	270	U	-
POLYCHAETE WORM			
NOTOMASTUS TENUIIS	270	C	-
LUGWORMS			
SCOLOPDIOS ARMIGER	20	O	-
POLYCHAETE WORM			

# ECOSYSTEM MODEL - MUD FLAT



2.1.1 Subtidal  
Estuarine Zone  
C Sand Flat



## SAND FLAT

### Habitat Description

No attached vegetation. Low epibenthic algal production. Water column same as that above mud flats.

### Food Web

Phytoplankton dominant in primary production. Organic detritus less available than on mud flat. Detrital and deposit feeders less abundant.

### Characteristic Flora

Diatoms dominant in phytoplankton and on substrate.

### Characteristic Fauna

Similar to the mud flat but with shifts in the proportions of the dominant organisms. Clinocardium nuttalli (cockle) and Macoma secta (white-sand clam) where sand is preponderant in substrate; Macoma nasuta (bent-nosed clam) where mud is preponderant. As sand gets coarser and its residence time is diminished close to the channel, benthic populations and organic matter are reduced.

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 NON-VASCULAR PLANTS

RYZOPSIS HYPNOIDES GREEN ALGAE	123456789	U	-
CERAMIMUM CALIFORNICUM POTTERY SEAWEED	123456789	C	-
ENTEROMORPHA TUBULOSA GREEN ALGAE	123456789	U	-
GRACILARIA SJOESTEDII RED ALGAE	123456789	C	-
GRACILARIOPHILA ORYZOIDES RED ALGAE	123456789	Q	-
ULVA FENESTRATA GREEN ALGAE	123456789	U	-
ULVA LACTUCA SEA LETTUCE	123456789	A	-
ULVA LORATA ULVA	123456789	U	-
ULVA TAENIATA GREEN ALGAE	123456789	U	-

TROPHIC LEVEL: (1) PRODUCER  
 VASCULAR PLANTS

SIDALCEA HENDERSONII * HENDERSON'S CHECKER-MALLOW	123456	U	-
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TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

LUMBRINERIS ZONATA POLYCHAETE WORM	70	A	-
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TROPHIC LEVEL: (2) HERBIVORE  
 FISHES

CATOSTOMUS MACROCHETUS LARGESCALE SUCKER	1234567	Q	-
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TROPHIC LEVEL: (2) HERBIVORE  
 BIRDS

ANSER ALPHELONS WHITE-FRONTED GOOSE	123456789	U	G
AYTHYA VALISINERIA CANVASBACK	123456789	C	G
CHEN CAFRULESCENS SNOW GOOSE	123456789	U	G

\* INTERTIDAL

HABITAT: SAND FLAT  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (3) CARNIVORE  
 INVERTEBRATES

HAMINOEA BUBBLE SHELL	70	U	-
PISASTER BREVISPINUS STAR FISH OR SEA STARS	123456789	Q	-
POLINICES LEWISII MOON SNAIL	123456789	U	-

TROPHIC LEVEL: (3) CARNIVORE  
 FISHES

ACIPENSER MEDIOSTRIS GREEN STURGEON	123456789	C	G
ACIPENSER TRANSMONTANUS WHITE STURGEON	123456789	C	G
ARTEDIUS FENESTRALIS PADDED SCULPIN	123456789	Q	-
CITHARICHTHYS STIGMAEUS SPECKLED SANDDAB	123456789	A	G
ENOPHRYS BISON BUFFALO SCULPIN	123456789	C	-
ONCHOPHYNCHEUS TSHAWYTSCHA CHINOOK SALMON / JUVENILE	123456789	A	-
PAROPHRYS VETULUS ENGLISH SOLE	123456789	A	G
PLATICTHYS STELLATUS STARRY FLounder	123456789	Q	G
PSETTICHTHYS MELANOSTICTUS SAND SOLE	123456789	C	G
RAJA RHINA LONGNOSE SKATE	123456789	U	-
SALMO CLARKI CUTTHROAT TROUT	123456789	C	G
SALVELINUS MALMA JOLLY VARDEN	123456789	U	G
SQUALUS ACANTHIAS SPINY DOGFISH	123456789	A	-

TROPHIC LEVEL: (3) CARNIVORE  
 BIRDS

AECHMOPHORUS OCCIDENTALIS WESTERN GREBE	123456789	C	-
BUCEPHALA ALBEOLA RUFFLEHEAD	123456789	C	G
BUCEPHALA CLANGULA COMMON GOLDENEYE	123456789	C	G
MELANITTA DEGLANDI WHITE-WINGED SCOTER	123456789	C	G
MELANITTA NIGRA BLACK SCOTER	123456789	U	G
MELANITTA PERSPICILLATA SURF SCOTER	123456789	C	G

KEY TO SYMBOLS 1.1.1 A-2

## COMMUNITY COMPOSITION ESTUARY ZONE: SUBTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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## TROPHIC LEVEL: (3) CARNIVORE

## BIRDS

MERGUS MERGANSER COMMON MERGANSER	123456789	U	G
MERGUS serrator	123456789	C	G
RED-BREASTED MERGANSER			
PHALACROCORAX AURITUS	123456789	C	-
DOUBLE-CRESTED Cormorant			
PHALACROCORAX PELAGICUS	123456789	U	-
PELAGIC Cormorant			
PHALACROCORAX PENICILLATUS	123456789	U	-
BRANDT'S Cormorant			
PODICEPS AURITUS	123456789	C	-
HORNED GREBE			
PODICEPS GRISEGENA	123456789	C	-
RED-NECKED GREBE			
STERNA CASPIA CASPIAN TERN	123456789	X	-

## MAMMALS

PHOCA VITOLINA HARBOR SEAL	123456789	C	-
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TROPHIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

ANSIOGRAMMARUS CONFERVICOLIUS	20	C	-
PILL BUGS			
ARMADIA BICUCULATA	70	A	-
POLYCHAETE WORM			
AXIOTHELLA RUPROCINCTA	70	C	-
BAMBOO WORMS			
CALLIANASSA CALIFORNIENSIS	123456789	A	-
GHOST SHRIMP			
CALLIANASSA GIGAS	20	U	-
GHOST SHRIMP			
CALLIANASSA LONGIMANIA	70	U	-
GHOST SHRIMP			
COROPHIUM ACHERUSICUM	123456789	O	-
AMPHIPOD			
COROPHIUM BREVIS	123456789	O	-
AMPHIPOD			
COROPHIUM OAKLANDENSE	20	O	-
AMPHIPOD			
COROPHIUM SALMONIS	1234567	O	-
AMPHIPOD			
COROPHIUM SPINICORNE	123456789	C	-
AMPHIPOD			
COROPHIUM SIMPSONI	20	A	-
AMPHIPOD			
EUPLYMNIA CRESCENTIS	70	C	-
POLYCHAETE WORM			
EUZONUS MUCRONATA	123456789	C	-
POLYCHAETE WORM			

## HABITAT: SAND FLAT

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

MACOMA BALTHICA CLAM	123456789	A	-
MACOMA NASUTA	123456789	A	-
BENT-NOSED CLAM			
ORCHESTOIDEA CALIFORNIANA	123456789	A	-
BEACH HOPPER			
ORCHESTOIDEA CORNICULATA	789	A	-
BEACH HOPPER			
PISTA PACIFICA	70	C	-
POLYCHAETE WORM			
PYGOSPIO ELEGANS	20	A	-
SPIONID WORM			
SCHISTOCORHUS HILTONI	789	U	-
BRISTLE WORMS			

TROPHIC LEVEL: (5) OMNIVORE  
FISHES

CLEVELANDIA IOS ARROW GOPY	123456789	C	-
HYPERPROSOPON ARGENTEUM	123456789	O	-
WALLEYE SURPERCH			
HYPERPROSOPON ELLIPTICUM	3456789	O	-
SILVER SURPERCH			

TROPHIC LEVEL: (5) OMNIVORE  
BIROS

AYTHYA AFFINIS	123456789	U	G
LESSER SCAUP			
AYTHYA MARILA	123456789	C	G
GREATER SCAUP			

TROPHIC LEVEL: (6) PARASITE  
INVERTEBRATES

MALACOBOLLA GROSSA RIBBON WORMS	123456789	U	-
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TROPHIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

CRASSOSTREA GIGAS PACIFIC OR JAPANESE OYSTER	123456789	A	C
CRYPTOMYA CALIFORNICA	123456789	A	-
SOFT-SHELL CLAM			
EMERYTA ANALOGA	123456789	U	-
MOLE CRAB			
LYONSIA CALIFORNICA	123456789	U	-
CALIFORNIA PAPERSHELL			
MYA ARENARIA	123456789	A	G
SOFT-SHELL CLAM			

COMMUNITY COMPOSITION ESTUARY      ZONE: SURTIDAL  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
PHORONOPSIS VIRIDIS BRYOZOANS	70	C	-
PROTHACA STAMINEA COMMON LITLLENECK OR ROCK COCK	123456789	A	G
SAXIDOMUS GIGANTEUS WASHINGTON CLAM	123456789	A	G
SILIQUA PATULA RAZOR CLAM	123456789	A	G
TADES JAPONICA -NULL-	20	0	-

TROPHIC LEVEL: (8) SCAVENGER  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
OLIVELLA BPLICATA PURPLE OLIVE SNAIL	123456789	C	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CANCER MAGISTER DUNGENESS CRAB	123456789	A	C
CANCER PRODUCTUS TRUE CRABS	270	A	G
CAPINOMA MUTABILIS RIBBON WORMS	70	U	-
CEREBRATULUS CALIFORNIENSIS RIBBON WORMS	270	U	-
MICRURA ALASKENSIS RIBBON WORMS	70	0	-
NEPHTYS CAECA NEREID WORM	270	C	-
NEPHTYS CALIFORNIENSIS NEREID WORM	70	C	-
NEPHTYS FERRUGINEA NEREID WORM	20	C	-
PARANEMERTES PEREGRINA RIBBON WORMS	70	C	-

HABITAT: SAND FLAT

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ALLOSMERUS ELONGATUS WHITEBAIT SMELT	123456789	0	-
AMMOBTES HEXAPTERUS PACIFIC SAND LANCE	123456789	A	C
CLUPEA HARENGUS PALLASI PACIFIC HERRING	123456789	A	C
CYMATOGASTER AGGREGATA SHINER PERCH	123456789	A	-
ENGRAULIS MORDAX NORTHERN ANCHOVY	123456789	A	C
GASTROSTEUS ACULFATUS THREESPINE STICKLERACK	123456789	0	-
HYDYMESUS PRETIOSUS SURFSMELT	123456789	A	C
LEPTOCOTTUS ARMATUS PACIFIC STAGHORN SCULPIN	123456789	A	-
OLIGOCOTTUS SNYDERT PLUFFY SCULPIN	123456789	0	-
ONCORHYNCHUS GORBUSCHA PINK SALMON /JUVENILE	123456789	0	-
ONCORHYNCHUS KETA CHUM SALMON /JUVENILE	123456789	U	-
ONCORHYNCHUS NERKA SIOCKEYE SALMON /JUVENILE	123456789	U	-
PERCA FLAVESCENS YELLOW PERCH	30	C	G

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 BIRDS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ACTITIS MACULARIA *	123456789	U	-
SPOTTED SANDPIPER			
ACTITIS MACULARIA *	123456789	U	-
SPOTTED SANDPIPER			

\* INTERTIDAL

## COMMUNITY COMPOSITION ESTUARY

ZONE: SUBTIDAL

HABITAT: SAND FLAT

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
COMMON NAME			

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
COMMON NAME			

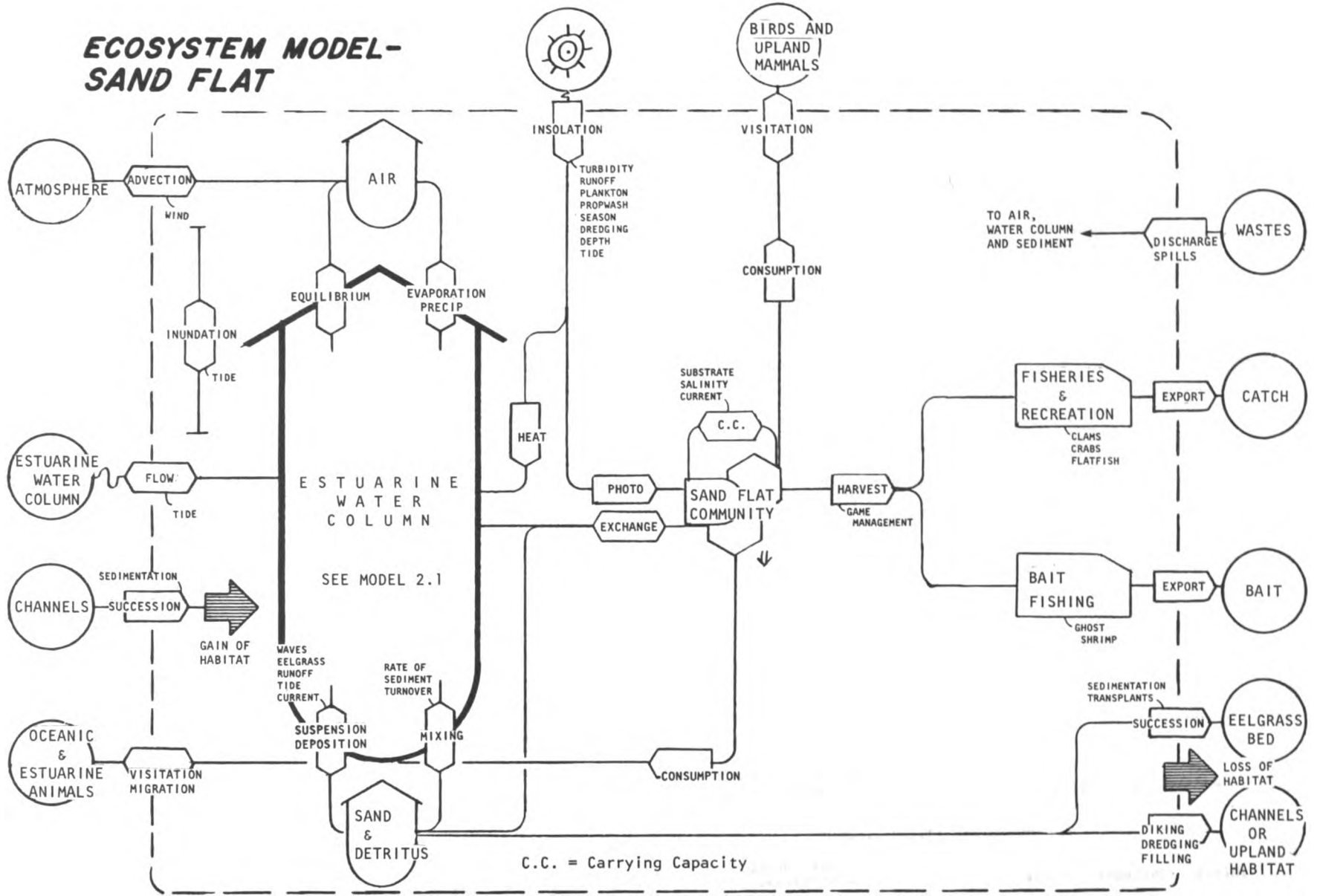
TROPHIC LEVEL: (0) UNKNOWN  
INVERTEBRATES

TROPHIC LEVEL: (0) UNKNOWN  
FISHES

AGLAJA DIOMEDEA SLUG	123456789	A	-
CANCER GRACILIS TRUE CRABS	70	C	-
CANCER OREGONENSIS TRUE CRABS	270	C	-
DIASTYLIS CUMACEAN	20	U	-
DORVILLEA GRACILIS POLYCHAETE WORM	70	U	-
EOHAUSTORIUS ESTUARIIS AMPHIPOD	20	A	-
ETEONE LONGA POLYCHAETE WORM	20	C	-
GLYCERA TENUIS POLYCHAETE WORM	70	U	-
HAUSTORIUS AMPHIPODS	70	C	-
HETEROMASTUS FILIFORMIS LUGWORMS	270	C	-
LEPTOCUMA CUMACEAN	20	C	-
LOPHOPANORPEUS BELLUS TRUE CRABS	70	C	-
NASSARIUS PROPINGUS SNAIL	20	0	-
NOTHRIA IRIDESCENS POLYCHAETE WORM	70	U	-
OPHELIA LIMACINA POLYCHAETE WORM	70	C	-
POLINICES DRACONIS SNAIL	20	0	-
PONTOGENIA INERMIS AMPHIPODS	123456789	0	-
PSEUDOPOLYDORA KEMPI SPIONID WORM	270	C	-
SACCOCTIRRUS SP. POLYCHAETE WORM	70	U	-
TELMESSUS CHEIRAGONUS CRAB	70	U	-
TYPOSYLLIS PULCHRA POLYCHAETE WORM	70	A	-
SCOLOPOTIS ARMIGER POLYCHAETE WORM	20	0	-

PHOLIS ORNATA SADDLEBACK GUNNEL	123456789	C	-
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# ECOSYSTEM MODEL - SAND FLAT





2.1.1 Subtidal  
Estuarine Zone  
D Eelgrass



## EELGRASS

### Habitat Description

Bays and estuaries with moderate currents and where surge is not extreme. Mean lower low water to 20-30 feet (6 to 9 m) deep. Substrate sandy to fine mud. Eelgrass provides primary production, shelter, temperature regulation, and sediment consolidation in subtidal estuarine systems.

### Food Web

Productivity dominated by the eelgrass (*Zostera* spp.) However, macrophytic algae occurring on scattered rocks or shells, epiphytic algae on the leaves and phytoplankton also contribute. Principal food web is detrital with minor grazing components.

### Characteristic Flora

Eelgrass (*Zostera* spp.) is dominant. *Ulva* (a green alga) is common in the eelgrass meadows. A variety of epiphytic algae (including *Smithora*, a red, and *Petalonia*, a brown) and diatoms are found on the leaves of *Zostera*.

### Characteristic Fauna

**Infauna:** nereid worms, clams (*Macoma*, *Clinocardium*, *Tresus*), nematodes, and burrowing anemones.

**On the leaves:** isopods, amphipods, hydroids, bryozoa, harpacticoids, herring eggs, snails, sessile jellyfish, limpet, protozoa, ciliates, nudibranchs.

**Among the leaves:** amphipods, jellyfish, harpacticoid copepods, fish (herring, young salmonids, striped sea perch, pipefish, blennies).

**On the substrate:** flatfish (soles and flounders), (in substrate: deposit feeders), crabs (Dungeness, red rock, hermit), moon snail.

**Waterfowl:** Canada geese, black brant, scaups, widgeon, canvasback, redhead.

## COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

BLIGHTINGIA MINIMA GREEN ALGAE	123456789	C	-
ENTEROMORPHA INTESTINALIS LINK CONFETTI	123456789	A	-
ENTEROMORPHA TUBULOSA GREEN ALGAE	123456789	U	-
SMITHORA NAIADUM RED FRINGE	123456789	A	-
ULVA FENESTRATA GREEN ALGAE	123456789	U	-
ULVA LACTUCA SEA LETTUCE	123456789	A	-
ULVA LJBATA ULVA	123456789	U	-
ULVA TAENIATA GREEN ALGAE	123456739	U	-

TROPHIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

ZOSTERA MARINA EELGRASS	123456789	A	-
ZOSTERA NODITII EELGRASS	20	C	-

TROPHIC LEVEL: (2) HERBIVORE  
BIRDS

ANAS ACUTA PINTAIL	123456789	C	G
ANAS AMERICANA AMERICAN WIDGEON	123456789	A	G
ANAS CLYPEATA NORTHERN SHOVELER	123456789	U	G
ANAS PENELOPE EUROPEAN WIDGEON	123456789	U	G
ANSER ALPIONIS WHITE-FRONTED GOOSE	123456739	U	G
AYTHYA VALISINERIA CANVASBACK	123456789	C	G
BRANTA BERGII GOOSE	123456739	A	G
BRANTA CANADENSIS CANADA GOOSE	123456789	C	G
CHEN CAERULESCENS SNOW GOOSE	123456789	U	G
FULICA AMERICANA AMERICAN COOT	123456789	C	G

## HABITAT: EELGRASS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (3) CARNIVORE  
FISHES

ARTEIUS FENESTRALIS PADDED SCULPIN	123456789	Q	-
CITHARICHTHYS STIGMAEUS SPECKLED SANDBAR	123456789	Q	G
ONCORHYNCHUS TSHAWYTSCHA CHINOOK SALMON / JUVENILE	123456789	C	-
PAROPHRYX VETULUS ENGLISH SOLE	123456789	A	G
PSETTICHTHYS MELANOSTICTUS SAND SOLE	123456789	Q	G
SALMO CLARKI CUTTLEBUT TROUT	123456789	C	G
SALVELINUS MALMA DOLLY VARDEN	123456789	U	G

TROPHIC LEVEL: (3) CARNIVORE  
BIRDS

NOTORIDES STRIATUS GREEN HERON	123456789	U	-
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TROPHIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

ANODOTHRUS GRACILIS BRISTLE WORMS	270	U	-
COROPHIUM BREVIS AMPHIPOD	123456789	Q	-
COROPHIUM SALMONIS AMPHIPOD	1234567	Q	-
COROPHIUM STIMPSONI AMPHIPOD	20	A	-
IDOTEA FEWKESI PILL BUGS	270	C	-
IDOTEA RUFESCENS ISOPOD	20	C	-
IDOTEA WOSNESENSKII PILL BUGS	270	A	-
MACOMA BALTHICA CLAM	123456789	A	-
MACOMA INCONSPICUA CLAM	123456789	C	-
MACOMA NASUTA BENT-NOSED CLAM	123456789	A	-
ORCHESTIA TRASKIANA BEACH HOPPER OR SAND FLEA	123456789	A	-
PISTA PACIFICA POLYCHAETE WORM	70	A	-
TRICHOPTIXA VERTICALIS CALIF WATER RATMAN	123456789	U	I

KEY TO SYMBOLS 1.1.1 A-2

## COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (5) OMNIVORE  
FISHES

CLEVELANDIA TOS ARROW GORY	123456789	C	-
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TROPIC LEVEL: (5) OMNIVORE  
FISHES

AYTHYA AFFINIS LESSER SCAUP	123456789	U	G
AYTHYA MARILA GREATER SCAUP	123456789	C	G

TROPIC LEVEL: (6) PARASITE  
INVERTEBRATES

CLAUSIDIUM VANCOUVERENSE COPEPOD	270	C	-
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TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

Aedes DORSALIS MOSQUITO	123456789	C	-
ALCYONIDIUM BRIDGESIAN	70	O	-
ANISOGAMMARUS CONFERVICOLUS AMPHIPOD	123456789	A	-
CLINOCARPUM NUTTALLII BASKET COCKLE OR HEART COCKLE	123456789	A	G
CARYOTOMYA CALIFORNICA SOFT-SHELL CLAM	123456789	A	-
EPHYRIDAE NITIPHILA SHOREFLY	123456789	C	-
IDONEA TRYPAZOANS	70	O	-
TELLINA MODESTA TELLEN	123456789	A	-
TELLINA NUCULOIDES TELLEN	123456789	A	-
TRESUS CAPAX GAPEL CLAM OR EMPIRE CLAM	123456789	A	G
TRESUS NUTTALLII SOUTHERN GAPEL	123456789	A	G

## HABITAT: EELGRASS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

BEMBIDION INDISTINCTUM GROUND BEETLE	123456789	C	I
CEREBRATULUS CALIFORNIENSIS RIBBON WORMS	270	U	-
CRANGON ALBA WHITE SHRIMP	20	C	-
CRANGON FRANCISCORUM -NULL-	123456789	C	-
CRANGON NIGRICAUDA BLACK-TAILED SHRIMP	123456789	C	-
HERMISSENDA CRASSICORNIS NUDIBRANCH	123456789	C	-
NEOMYSIS MERCEDIS MYSID SHRIMP	320	A	-
NEREIS BRANDTI NEREID WORM	270	C	-
SALDA BUENDI SALOTIDAE	45	U	I
SALDULA PALUSTRIS SHOREBUG	123456789	C	I

TROPIC LEVEL: (9) INVERTEBRATE EATER  
FISHES

AMMODYTES HEXAPTERUS PACIFIC SAND LANCE	123456789	C	C
ATHERINOPS AFFINIS TOPSMILT	123456789	O	-
CLUPEA HARENGUS PALLASI PACIFIC HERRING	123456789	U	C
CYMATOGASTER AGGREGATA SHINER PERCH	123456789	A	-
ENGRAULIS MORDAX NORTHERN ANCHOVY	123456789	A	C
GASTEROSTEUS ACULEATUS THREESPINE STICKLEBACK	123456789	A	-
HYPOMESUS PRETIOSUS SURFSMILT	123456789	A	C
LEPTOCOTTUS ARMATUS PACIFIC STAGHORN SCULPIN	123456789	A	-
ONCORHYNCHUS GORBUSCHA PINK SALMON / JUVENILE	123456789	O	-
ONCORHYNCHUS KETA CHUM SALMON / JUVENILE	123456789	U	-
ONCORHYNCHUS NEKA SOCKEYE SALMON / JUVENILE	123456789	U	-
SYNGNATHUS BRITSENLINATUS RAY PIPEFISH	123456789	A	-

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 BIRDS

CHARADRIUS SEMIPALMATUS \*      123456789      C      -  
 SEMIPALMATED PLOVER

TROPHIC LEVEL: (0)  
 INVERTEBRATES

AMPITHOE VALIDA      789      A      -  
 AMPHIPOD  
 CAPITELLA      20      A      -  
 LUGWORMS  
 CAPITELLA CAPITATA      270      C      -  
 LUGWORMS  
 CAPITELLA OVINCOLA      70      U      -  
 LUGWORMS  
 CAPRELLA      20      A      -  
 AMPHIPOD  
 ECHAUSTORIUS      20      A      -  
 AMPHIPOD  
 GLYCTIDE ARMIGERA      270      C      -  
 POLYCHAETE WORM  
 HAPLOSCOLOPUS ELONGATA      270      U      -  
 POLYCHAETE WORM  
 LACUNA      123456789      U      -  
 CHINK SHELL  
 LEPTOCHELIA SAVIGNYI      20      A      -  
 CRUSTACEAN  
 LOXORHYNCHUS CRISPATUS      70      U      -  
 TRUE CRABS  
 NAINERIS DENDRITICA      70      C      -  
 POLYCHAETE WORM  
 NERINE CIRRATULUS      70      C      -  
 POLYCHAETE WORM  
 PANCOLUS CALIFORNIENSIS      20      A      -  
 CRUSTACEAN  
 PHOTIS BREUIPES      20      A      -  
 AMPHIPOD  
 PHOTIS CALIFORNICA      789      C      -  
 AMPHIPODS  
 PONTHAPPINIA OBTUSIDENS      789      C      -  
 AMPHIPODS  
 SCHLEROPLAX GRANULATA      70      C      -  
 CRAB  
 SYNDOTEA RITTERI      70      U      -  
 PILL BUGS

HABITAT: EELGRASS

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (0)  
 INVERTEBRATES

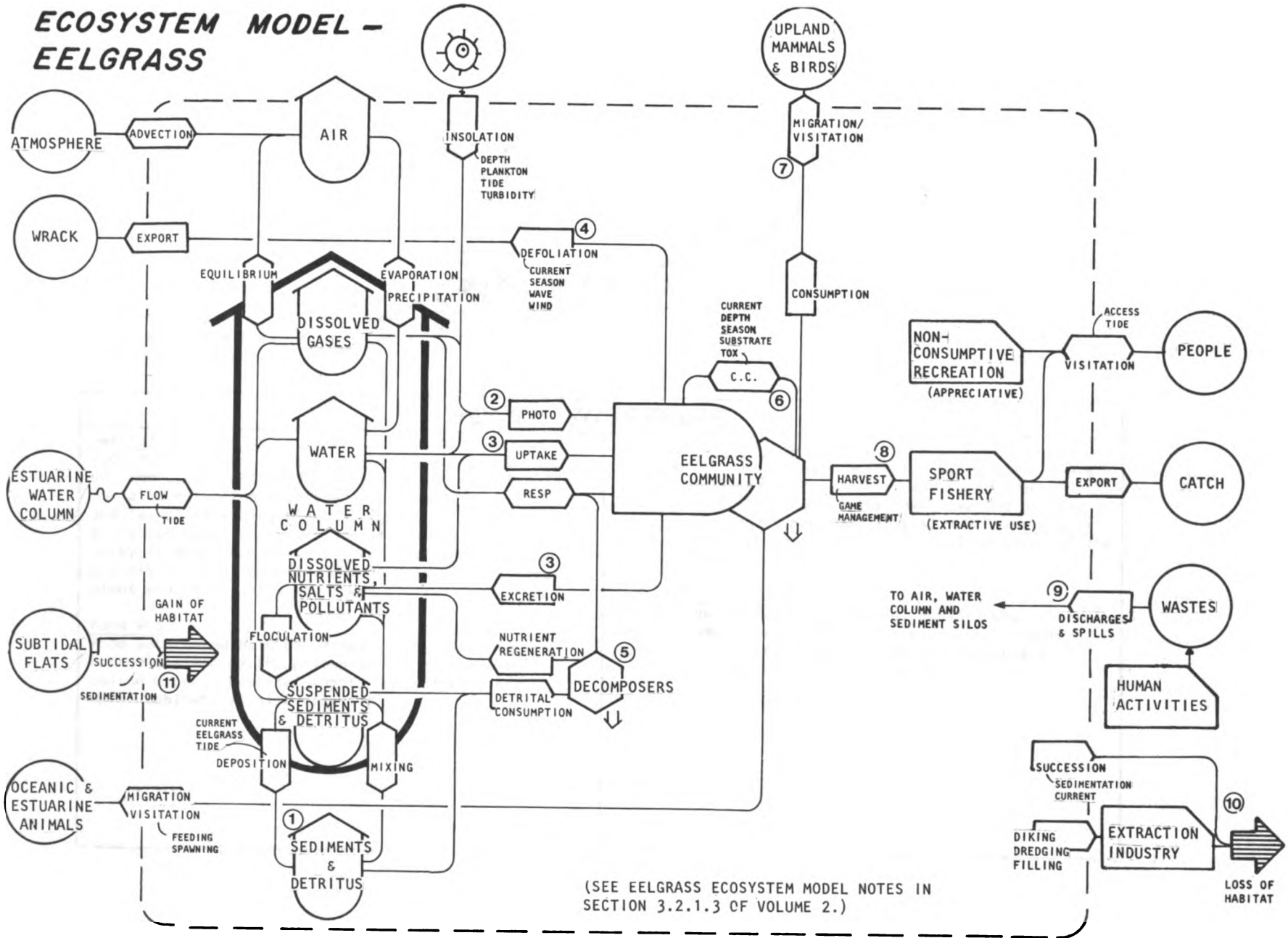
CIRRATULUS CIRRATUS      270      C      -  
 LUGWORMS  
 CIRRIFORMIA SPIRABRANCHIA      70      0      -  
 LUGWORMS  
 SCOLOPOIUS ARMIGER      20      U      -  
 POLYCHAETE WORM

TROPHIC LEVEL: (0) UNKNOWN  
 FISHES

PHOLIS ORNATA      123456789      C      -  
 SADDLEBACK GUNNEL

\* INTERTIDAL

# ECOSYSTEM MODEL - EELGRASS



2.1.1 Subtidal  
Estuarine Zone  
E Rocky Substrate



### **ROCKY SUBSTRATE**

#### Habitat Description

Rock outcroppings and gravel/shingle substrates occur in some estuaries, predominantly in the subtidal zone but also extending into the intertidal zone. Floral and faunal assemblages resembling those of the protected outer coast (kelp beds and headlands and rocky islands) are present. Vertical zonation of organisms is noticeable and tidepools with diverse plant and animal life are found.

#### Food Web

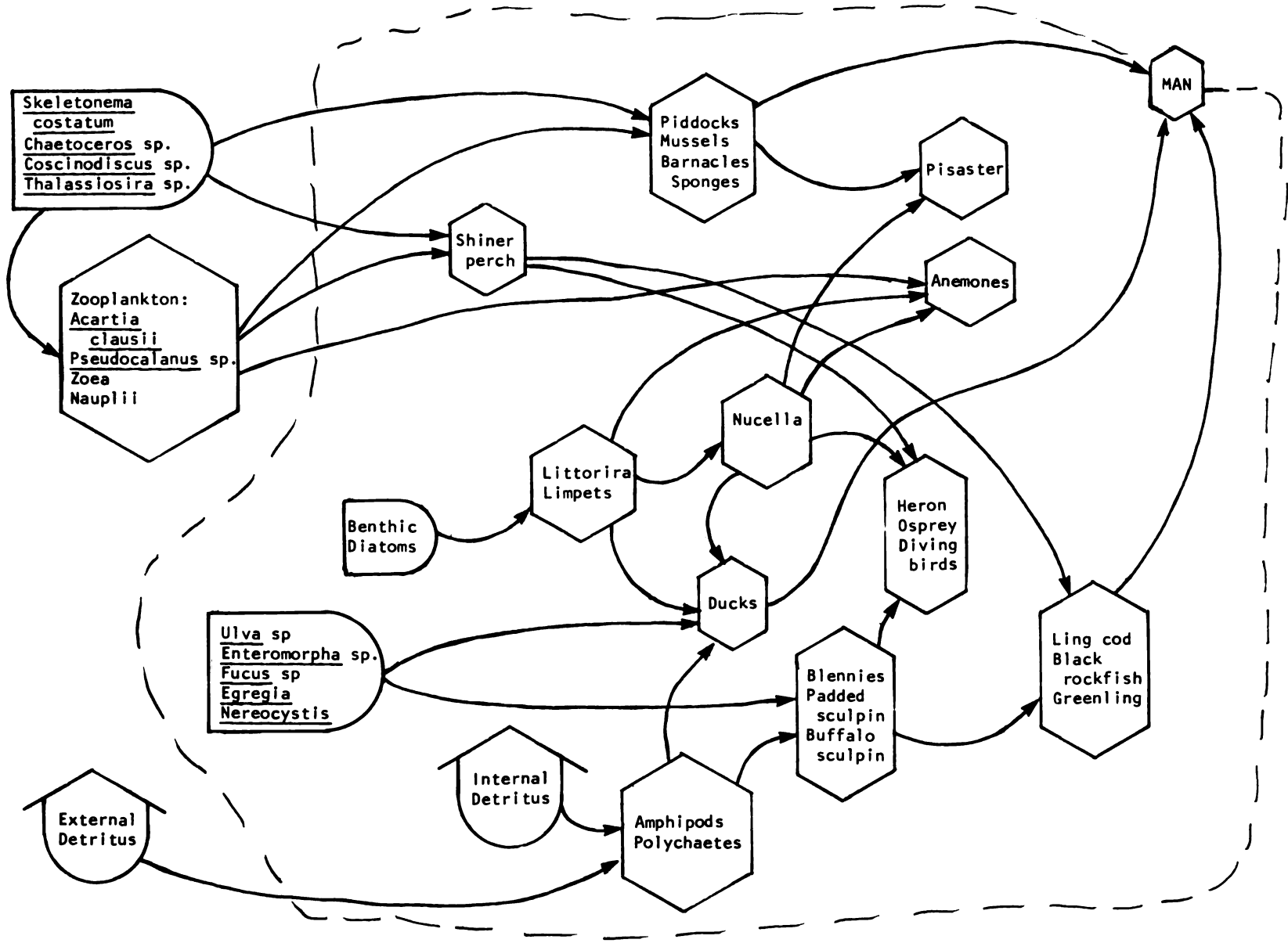
Food webs based both on production by attached macroalgae and by the phytoplankton of the water column occur. Detrital input from eelgrass and marsh habitats is also significant.

#### Characteristic Flora

Attached macroalgae are dominant. Lower level algae include bull kelp (*Nereocystis*) and sugar wrack (*Laminaria*). Sandstone flats have covering of *Ulva* and *Enteromorpha*. Rockweed (*Fucus*) and *Pelvetiopsis* spp. occur on the exposed (intertidal) portions of the rock surfaces.

#### Characteristic Fauna

Sponges, hydroïds, sea anemones, nudibranchs, shore crabs, hermit crabs, tubeworms, piddocks, limpets, mussels, blennies, sculpins, and rockfishes are among the inhabitants of the habitat.



**FOOD WEB-ROCKY SUBSTRATE**

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 NON-VASCULAR PLANTS

ALARIA	7	C	-
MONEY WARE			
BRYOPSIS CORTICULANS	123456789	U	-
SEA FERN			
CALLOPHYLLIS FLABELLULATA	123456789	O	-
RED ALGAE			
CODIUM FRAGILE	123456789	U	-
SEA STAGHORN			
COILODESME CALIFORNICA	123456789	O	-
STICK BAG			
CRYPTOPLEURA RUPRECHTIANA	123456789	C	-
RUCHE			
CRYPTOSIPHONIA WOODII	123456789	O	-
RED ALGAE			
CUMAGLOIA ANDERSONII	123456789	C	-
RED ALGAE			
CYSTOSEIRA OSMUNDACEA	123456789	C	-
WOODY CHAIN BLADDER			
DELESSENA DECIPIENS	123456789	C	-
BARON DELESSERT			
DESMARESTIA HERRACEA	123456789	C	-
BROWN ALGAE			
DESMARESTIA VIRIDIS	123456789	C	-
BROWN ALGAE			
ECTOCARPUS CONFEROIDES	123456789	O	-
BROWN ALGAE			
ECTOCARPUS GRANULOSUS	123456789	O	-
BROWN ALGAE			
ECTOCARPUS DIVIGER	123456789	O	-
BROWN ALGAE			
EGREGIA MENZIESII	123456789	C	-
FEATHER ROA			
ENTEROMORPHA INTESTINALIS	123456789	A	-
LINK CONFETTI			
ENTEROMORPHA LINZA	123456789	C	-
GREEN STRING LETTUCE			
FUCUS EVANESCENS	123456789	C	-
BROWN ALGAE			
FUCUS EVANESCENS	123456789	C	-
BROWN ALGAE			
FUCUS FURCATUS	123456789	A	-
ROCK WEED POPPING WRACK			
GELIDIUM PULCHRUM	123456789	O	-
RED ALGAE			
GIGARTINA AGARDHII	123456789	O	-
GRAPESTONE			
GIGARTINA BINGHAMIAE	123456789	O	-
GRAPESTONE			
GIGARTINA CALIFORNICA	123456789	O	-
GRAPESTONE			
GIGARTINA CORYMBIFERA	123456789	C	-
GRAPESTONE			

HABITAT: ROCKY SUBSTRATE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 NON-VASCULAR PLANTS

GYMNODONGRUS LINEARIS	123456789	C	-
RED ALGAE			
HALOSACCION GLANDIFORME	123456789	C	-
SEA SAC			
HAPLOGLOIA ANDERSONII	123456789	C	-
BROWN ALGAE			
HYMENENA FLABELLIGERA	123456789	C	-
RED ALGAE			
IRIDAEA CORDATA	123456789	O	-
TRIDESCENT SEAWEED			
LAMINARIA SACCHARINA	123456789	C	-
SUGAR WRACK			
LEATHESTA DIFFORMIS	123456789	C	-
BROWN ALGAE			
MELANOPHYCUS INTESTINALIS	123456789	U	-
RED ALGAE			
MEMBRANOPTERA DIMORPHA	123456789	O	-
RED ALGAE			
MICROCLADIA BOREALIS	123456789	C	-
COURSE SEA LACE			
NEPECEPTIS LEUTKEANA	123456789	C	-
BULL WHIP KELP			
DONTHALIA FLOCOSSA	123456789	O	-
SHARP TOOTH BRUSH			
PELVETIOPSIS LIMITATA	123456789	C	-
BROWN ALGAE			
PETALONIA FASCIA	123456789	O	-
BROWN ALGAE			
POLYNEURA LATISSIMA	123456789	C	-
CRISSCROSS NETWORK			
POLYSIPHONIA CALIFORNICA	123456789	O	-
RED ALGAE			
POLYSIPHONIA HENDRYI	123456789	O	-
RED ALGAE			
PORPHYRA NEREOCYSTIS	123456789	U	-
RED ALGAE			
PORPHYRA OCCIDENTALIS	123456789	U	-
RED ALGAE			
PORPHYRA PERFORATA	123456789	C	-
RED LAVER			
PRIONITIS LYALLII	123456789	C	-
LYALL'S SEAWEED			
PTILOTA FILICINA	123456789	C	-
RED WING			
RHODOCHORTON ROTHII	123456789	U	-
RED ALGAE			
SCYTOSIPHON LOMENTARIA	123456789	C	-
WHIP TUBE			
SORANTHERA ULVOTDEA	123456789	C	-
BROWN ALGAE			
SPONGOMORPHA ARCTA	123456789	O	-
GREEN ROPE			

KEY TO SYMBOLS 1.1.1 A-2



COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 NON-VASCULAR PLANTS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
SPONGOMORPHA COALITA GREEN ALGAE	123456789	C	-
SPONGOMORPHA MERTENSII GREEN ROPE	123456789	0	-
SPONGOMORPHA SPINIFSCENS GREEN ROPE	123456789	0	-
TREMPEROLIA ODORATA GREEN ALGAE	123456789	C	-
ULOTHRIX FLOCCA GREEN ALGAE	123456789	0	-
ULVA FENESTRATA GREEN ALGAE	123456789	C	-
ULVA LOBATA ULVA	123456789	U	-
ULVA TAENIATA GREEN ALGAE	123456789	U	-
UROSPORA WORMSKIOLDII GREEN ALGAE	123456789	0	-

TROPHIC LEVEL: (2) HERBIVORE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
AMPHISSA SNAIL	70	U	-
COLLISELLA LIMPET	0	0	-
COLLISELLA DIGITALIS LIMPET	123456789	C	-
COLLISELLA DELTA LIMPET	123456789	A	-
DIODORA ASPERA KEYHOLE LIMPET	123456789	U	-
KATHARINA TUNICATA BLACK CHITON	123456789	0	-
LITTORINA PERIWINKLE	123456789	A	-
LITTORINA SCUTULATA PERIWINKLE	123456789	A	-
LUMBRINERIS SPECIES POLYCHAETE WORM	123456789	U	-
MORPHELA CILIATA CHITONS	123456789	0	-
NOTOACMEA LIMPETS	123456789	0	-
NOTOACMEA FENESTRATA LIMPET	123456789	U	-
NOTOACMEA PERSONA LIMPET	123456789	C	-
NOTOACMEA SCUTUM LIMPET	123456789	U	-

HABITAT: ROCKY SUBSTRATE

SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (3) CARNIVORE  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ACANTHODORIS COLUMBINA NUDIBRANCH	789	U	-
AEOLIOIDIA PAPILLOSA NUDIBRANCH	123456789	U	-
ANISODORIS VORTILIS SEA LEMON	123456789	C	-
ARCHIDORIS MONTEREYENSIS NUDIBRANCH	123456789	C	-
DIRONA ALBOLINEATA NUDIBRANCH	123456789	U	-
EVASTERIAS TROSCHELI STAR FISH OR SEA STARS	123456789	C	-
NUCELLA LAEVLLOSA WRINKLED PURPLE SNAIL	123456789	C	-
PISASTER PREVISPINUS STAR FISH OR SEA STARS	123456789	0	-
PISASTER GIGANTEUS STAR FISH OR SEA STARS	789	0	-
PISASTER OCHROCEOUS OCHRE STAR	123456789	0	-
PYCNOPODIA HELIANTHOIDES SUNFLOWER STAR	123456789	0	-

TROPHIC LEVEL: (3) CARNIVORE  
 FISHES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ANARRHICHTHYS OCELLATUS WOLF-EEL	123456789	0	-
ARTEDIUS FENESTRALIS PADDED SCULPIN	123456789	0	-
HEXAGRAMMUS DECAGRAMMUS KELP GREENLING	123456789	C	G
ONCORHYNCHUS KETA CHUM SALMON	123456789	U	C
PHOTICCHUS ELONGATUS LINGCOD	123456789	U	C
PAROPHRYS VETULUS ENGLISH SOLE	123456789	C	G
PLATICTHYS STELLATUS STARRY FLOUNDER	123456789	C	G
SCORPAENICHTHYS MARMORATUS CABEZON	123456789	C	G
SERASTES CAURINUS COPPER ROCKFISH	123456789	C	G
SERASTES MELANOPS BLACK ROCKFISH	123456789	C	G
SERASTES PAUCISPINIS BOCACCI	123456789	U	G
SQUALUS ACANTHIAS SPINY DOGFISH	123456789	U	-

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPIC LEVEL: (3) CARNIVORE BIRDS			
CALIDRIS PHTLONEMIS *	123456789	U	-
ROCK SANDPIPER			
HAFMATOPUS BACHMANI *	123456789	U	-
BLACK OYSTERCATCHER			
MYSTRIONICUS HISTRIONICUS	123456789	U	G
HARLEQUIN DUCK			
LARUS GLAUDESCENS	123456789	C	-
GLAUCOUS-WINGED GULL			
LARUS OCCIDENTALIS	123456789	C	-
WESTERN GULL			
MELANITTA DEGLANDI	123456789	C	G
WHITE-WINGED SCOTER			
MELANITTA NIGRA	123456789	U	G
BLACK SCOTER			
MELANITTA PERSPICILLATA	123456789	C	G
SURF SCOTER			
MERGUS MERGANSER	123456789	U	G
COMMON MERGANSER			
MERGUS SERRATOR	123456789	C	G
RED-BREASTED MERGANSER			
PHALACROCORAX AURITUS	123456789	C	-
DOUBLE-CRESTED CORMORANT			
PHALACROCORAX PELAGICUS	123456789	C	-
PELAGIC CORMORANT			
PHALACROCORAX PENTICILLATUS	123456789	C	-
BRANDT'S CORMORANT			
TROPIC LEVEL: (3) CARNIVORE MAMMALS			
PHOCA VITOLINA	123456789	C	-
HARBOR SEAL			
TROPIC LEVEL: (4) DETRITIVORE INVERTEBRATES			
AMPHITRITE ROBUSTA	70	C	-
POLYCHAETE WORM			
ANSIGRAMMARUS CONFERVICOLIUS	20	0	-
PILL BUGS			
CIRRIANA HAREJROI	7	U	-
PILL BUGS			
EUDIPTYLIA VANCOUVERT	70	0	-
POLYCHAETE WORM			
IDOTEA FEWKESI	270	C	-
PILL BUGS			
IDOTEA SCHMITTI	70	U	-
PILL BUGS			
IDOTEA WOSNESENSKII	270	A	-
PILL BUGS			
POLYCURRUS SP.	70	U	-
POLYCHAETE WORM			
SABELLARIA CEMENTARIUM	70	C	-
SABELLID WORM			

HABITAT: ROCKY SUBSTRATE  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPIC LEVEL: (4) DETRITIVORE INVERTEBRATES			
SABELLARIA GRACILIS	70	0	-
SABELLID WORM			
THELEPUS CRISPUS	70	C	-
POLYCHAETE WORM			
TIGRIOPUS CALIFORNICUS	70	0	-
COPEPOD			
TROPIC LEVEL: (5) OMNIVORE INVERTEBRATES			
MOPALIA MUSCOSA	123456789	0	-
CHITON			
TROPIC LEVEL: (5) OMNIVORE FISHES			
ANOPLARCHUS PURPURESCENS	123456789	0	-
HIGH COCKSCOMB			
TROPIC LEVEL: (5) OMNIVORE BIRDS			
CORVUS BRACHYRHYNCHOS *	123456789	C	-
COMMON CROW			
CORVUS CORAX *	123456789	U	-
COMMON RAVEN			
TROPIC LEVEL: (6) PARASITE FISHES			
LAMPETRA AYRESI	123456789	0	-
RIVER LAMPREY			
TROPIC LEVEL: (7) FILTER FEEDER INVERTEBRATES			
ADULA CALIFORNIENSIS	123456789	U	-
CLAM			
ADULA FALCATA	789	U	-
CLAM			
AXOCIELITA ORIGINALIS	70	0	-
SPONGES			
BALANUS GLANDULA	20	C	-
BARNACLE			
BIOCCARDIA PROBOSCIDEA	70	A	-
POLYCHAETE WORM			
CLITONA	70	0	-
SPONGES			
COMPEUM	70	0	-
BRYZOANS			
HALICLONA	70	0	-
SPONGES			
DIATELLA	70	U	-
NESTLING CLAM			
LEPAS	20	C	-
BARNACLE			

\* INTERTIDAL

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (7) FILTER FEEDER  
 INVERTEBRATES

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
MEMBRANIPORA TUBERCULATA	70	Q	-
BRYOZOANS			
MYTILUS CALIFORNIANUS	123456789	A	-
CALIFORNIA MUSSEL			
MYTILUS EDULIS	123456789	A	-
BAY MUSSEL			
OPHLITASPONGIA PENNATA	70	Q	-
SPONGES			
PENITELLA PENITA	123456789	C	-
BORING CLAM			
PETRICOLA CARDITOIDES	123456789	U	-
BIVALVE			
PSEUDOPOTAMILLA OCCELATA	70	C	-
POLYCHAETE WORM			
SCHIZOBRANCHIA INSIGNIS	70	C	-
POLYCHAETE WORM			
SERPULA VERMICULARIS	70	C	-
POLYCHAETE WORM			

TROPHIC LEVEL: (8) SCAVENGER  
 INVERTEBRATES

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
HEMIGRAPSUS NUDUS	270	A	-
PURPLE SHORE CRAB			
PACHYCHELES RUDIS	70	C	-
PORCELAIN CRAB			
PACHYGRAPSUS CRASSIPES	70	C	-
LINED SHORE CRAB			
PAGURISTES TURGIDUS	70	U	-
HERMIT CRAB			
PAGURUS HEMPHILLII	70	C	-
HERMIT CRAB			
PETROLISTHES CINCTIPES	70	C	-
PORCELAIN CRAB			
PETROLISTHES ERIOMERUS	70	U	-
PORCELAIN CRAB			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
AMPHIPORUS	123456789	Q	-
RIBBON WORMS			
ANTHOPELURA ARTEMISIA	70	A	-
SEA ANEMONES			
ANTHOPELURA ELEGANTISSIMA	70	A	-
SEA ANEMONES			
ANTHOPELURA XANTHOGRAMMICA	70	C	-
SEA ANEMONES			
CALLIOPIELLA PRATTI	789	Q	-
AMPHIPOD			
CANCER ANTENNARIUS	123456789	C	-
ROCK CRAB			

HABITAT: ROCKY SUBSTRATE

SCIENTIFIC NAME      RANGE    ABUNDANCE    STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
CORYLOPHORA LACUSTRIS	70	C	-
HYDROIDS			
GARVEIA ANNUALTA	70	C	-
HYDROIDS			
HALIPLANELLA LUCIAE	70	Q	-
SEA ANEMONES			
HALOSYDRA BREVISETOSA	70	C	-
POLYNOID WORMS			
HYALE FREQUENS	56789	A	-
AMPHIPODS			
HYALE PLUMULOSA	789	C	-
AMPHIPOD			
METRIDIUM	70	Q	-
SEA ANEMONES			
MICRURA PARADALIS	70	Q	-
RIBBON WORMS			
NOTOPLANA	70	C	-
-NULL-			
STYLOCHUS	70	Q	-
-NULL-			
TETRASTEMMA NIGRIFRONS	70	U	-
RIBBON WORMS			
TUBULARIA	123456789	Q	-
HYDROIDS			
TUBULANUS POLYMORPHUS	70	C	-
RIBBON WORMS			
TUBULANUS SEXLINEATUS	70	Q	-
RIBBON WORMS			

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 FISHES

SCIENTIFIC NAME	RANGE	ABUNDANCE	STATUS
APPODICTHYS FLAVIDUS	123456789	Q	-
PENPOINT GUNNEL			
AULORHYNCHUS FLAVIDUS	123456789	C	-
TUBENOUT			
CLINOCTYTUS GLOUCEPS	123456789	C	-
MOSSHEAD SCULPIN			
CLUPEA HARENGIUS PALLASI	123456789	A	C
PACIFIC HERRING			
CYMATOGASTER AGGREGATA	123456789	A	-
SHINER PERCH			
ENGRAULIS MORDAX	123456789	A	C
NORTHERN ANCHOVY			
GASTEROSTEUS ACULEATUS	123456789	C	-
THREESPINE STICKLEBACK			
HYPOMESUS PRETINSUS	123456789	A	C
SURFSMELT			
OLIGOCYTUS MACULOSUS	123456789	A	-
TIDEPOOL SCULPIN			
OLIGOCYTUS SNYDERI	123456789	Q	-
FLUFFY SCULPIN			

COMMUNITY COMPOSITION ESTUARY      ZONE: SUBTIDAL  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 BIRDS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ACTITIS MACULARIA * SPOTTED SANDPIPER	123456789	U	-
ACTITIS MACULARIA * SPOTTED SANDPIPER	123456789	U	-
APHRIZA VIRGATA * SURFBIRD	123456789	U	-
ARENARIA INTERPRES * RUDDY TURNSTONE	123456789	U	-
ARENARIA MELANOCEPHALA * BLACK TURNSTONE	123456789	U	-
CALIDRIS ALPINA * DUNLIN	123456789	U	-

TROPHIC LEVEL: (0) UNKNOWN  
 INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
AMPITHOE SIMULANS AMPHIPOD	123456789	C	-
CANCER GIGROSULUS ROCK CRABS	70	C	-
EULALIA QUADRIOCULATA POLYCHAETE WORM	70	C	-
EUMIDA SANGUINEA POLYCHAETE WORM	70	U	-
GENETYLLIS CASTANEA POLYCHAETE WORM	70	U	-
HYPJEULALIA BILINEATA POLYCHAETE WORM	70	U	-
IDOEATEA SCHITTE PILL BUGS	70	U	-
MIMULUS FOLIATUS TRUE CRABS	70	U	-
VASSARIUS PROPINGUS SNAIL	20	0	-
NEOSPHAEROMA OREGONENSIS PILL BUGS	70	A	-
NEREIS MEDIATOR NEREID WORM	70	C	-
NEREIS PELAGICA NEREID WORM	70	C	-
NEREIS VEXILLOSA NEREID WORM	270	A	-
NOTOPHYLLUM IMBRICATUM -NULL-	70	U	-
PACHYCHELES PUBESCENS PORCELAIN CRAB	70	U	-
PLATYNEREIS AGASSIZI NEREID WORM	70	A	-
POLINICES DRACONIS SNAIL	20	0	-
POLYDORA ARMATA SPIONID WORM	70	U	-

HABITAT: ROCKY SUBSTRATE

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (0) UNKNOWN  
 INVERTEBRATES

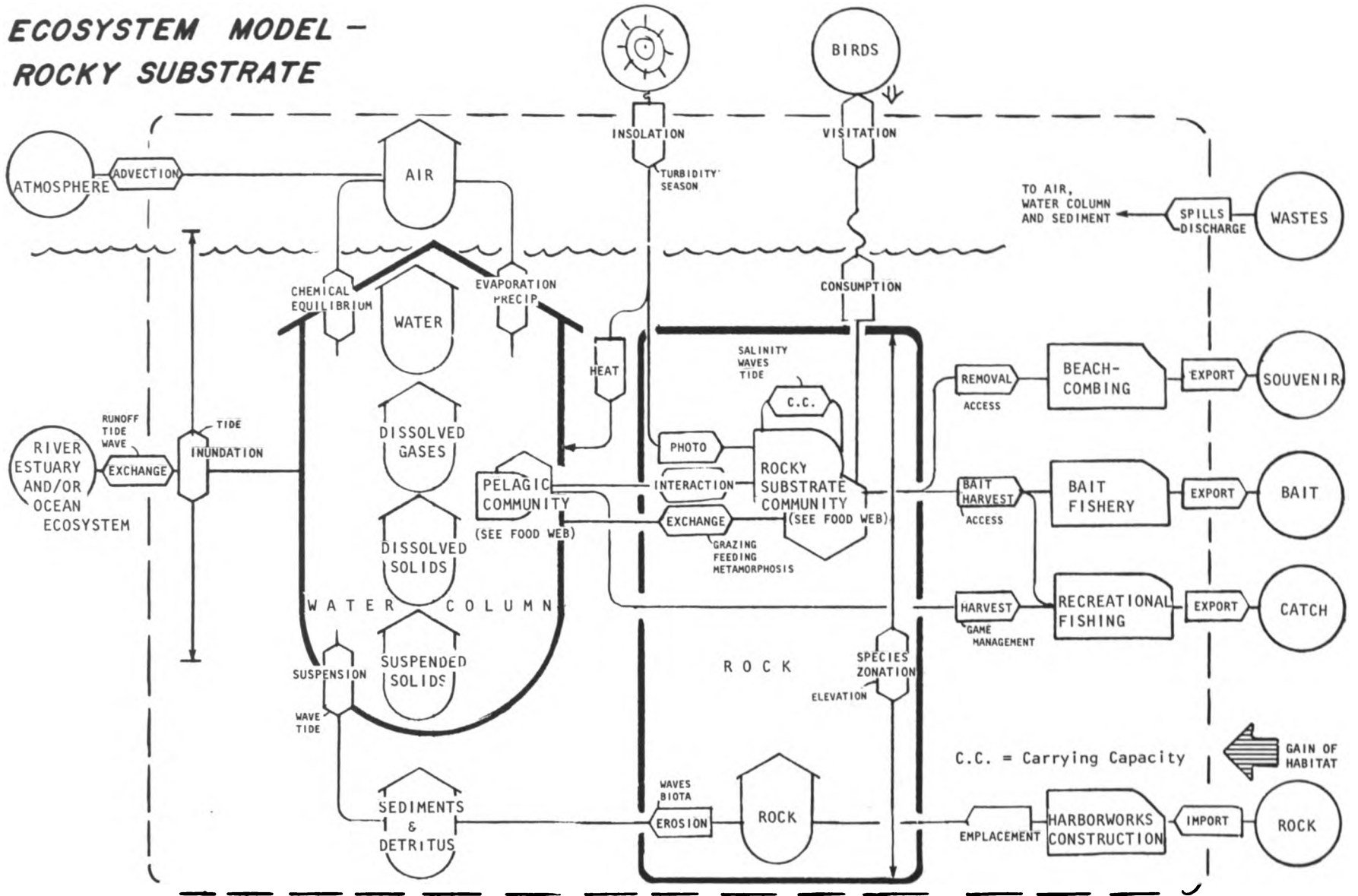
SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
PUGETTIA GRACILIS KELP CRAB	19	C	-
PUGETTIA PRODUCTA KELP CRAB	19	C	-
SCYRA ACUTIFRONS CRAB	70	U	-
SYLLIS ELONGATA POLYCHAETE WORM	270	U	-
TRYPANOSYLLIS ADAMANTIFUS POLYCHAETE WORM	70	C	-

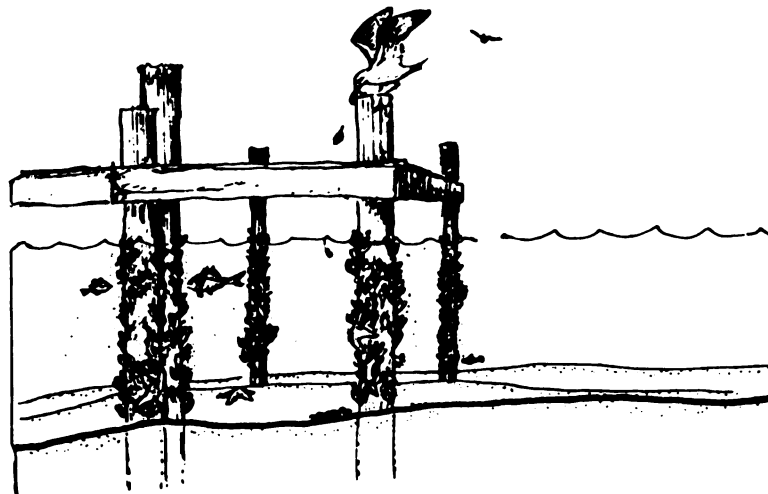
TROPHIC LEVEL: (0) UNKNOWN  
 FISHES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
HEXAGRAMMUS LAGOCEPHALUS ROCK GREENLING	123456789	C	0

\* INTERTIDAL

# ECOSYSTEM MODEL - ROCKY SUBSTRATE





2.1.2 Intertidal  
Estuarine Zone  
A Pilings

## **PILINGS**

### Habitat Description

Wharves, pilings and docks may be intertidal or subtidal artificial structures which modify both the pelagic and benthic habitats in estuaries or offshore. Pilings and docks provide substrate for attachment, shade and protection for a myriad of flora and fauna. These structures modify benthic habitats through changes in current patterns and subsequent man-induced litter and pollutants.

### Food Web

Typically the components of the food web are a mix between phytoplankton based communities and those benthic communities associated with macrophytes and epiphytes. The benthic communities surrounding the bottoms of the pilings are slightly different in that there is a significant detrital input from the pilings above.

### Characteristic Flora

The macroalgae Enteromorpha, Ulva, Fucus, and Dasyopsis plumosa are most common.

### Characteristic Fauna

Mytilus edulis (mussel), barnacles (Balanus sp.) tunicates, hydroids, anemones, ectoprocts, nudibranchs, polychaetes, amphipods and other small crustaceans, starfish (Pisaster ochraceus), pile perch (Cymatogaster), and crabs (Pachycheles rudis and Cancer magister).

## COMMUNITY COMPOSITION ESTUARY ZONE: INTERTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

ANTITHAMNION GLANDULIFERUM RED ALGAE	123456789	C	-
ANTITHAMNION TENUISSIMUM RED ALGAE	123456799	Q	-
BRYOPSIS HYPNOIDES GREEN ALGAE	123456789	U	-
CERAMTUM GARDERI POITERY SEAWEED	123456789	Q	-
ECTOCARPUS CONFEROIDES BROWN ALGAE	123456799	Q	-
ENTEROMORPHA CRINITA GREEN ALGAE	123456739	Q	-
ENTEROMORPHA LINZA GREEN STRING LETTUCE	123456789	C	-
FUCUS EVANESCENS BROWN ALGAE	123456799	C	-
FUCUS FURCATUS ROCK WEED POPPING WRACK	123456799	C	-
LICHOPHORA ABBREVIATA DIATOMS	70	C	-
PLATYTHAMNION PECTINATUM RED ALGAE	123456789	C	-
PLATYTHAMNION REVERSUM RED ALGAE	123456799	C	-
PLOCAMTUM PACIFICUM RED ALGAE	123456799	C	-
POLYSIPHONIA CALIFORNICA RED ALGAE	123456789	C	-
POLYSIPHONIA PACIFICA POLLY PACIFIC	123456789	C	-
RHIZOCLONIUM RIPARIUM GREEN ALGAE	123456789	Q	-
UROSPORA PENICILLIFORMIS GREEN ALGAE	123456789	Q	-

TROPIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

COLISELLA DIGITALIS LIMPET	123456789	C	-
COLISELLA DELTA LIMPET	123456789	A	-
LIMNORIA GRIBBLE	70	U	-
LITTORINA PERIWINKLE	123456789	A	-
LITTORINA SCUTULATA PERIWINKLE	123456799	A	-
NOTJAMEA PERSONA LIMPET	123456789	C	-

## HABITAT: PILINGS

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (3) CARNIVORE  
FISHES

OPHIODON ELONGATUS LINGCOD	123456789	U	C
PALLASINA BARBATA TURFNOSE PJACHER	123456789	Q	-
SCORPAENICHTHYS MARMORATUS CARZON	123456789	C	G
SEBASTES CAURINUS COPPER ROCKFISH	123456799	C	G
SEBASTES MELANOPS BLACK ROCKFISH	123456789	C	G
SEBASTES PAUCISPINIS BOCACCIO	123456789	U	G

TROPIC LEVEL: (3) CARNIVORE  
BIRDS

BUCEPHALA CLANGULA COMMON GOLDENEYE	123456799	U	G
MELANITTA DEGLANDI WHITE-WINGED SCOTER	123456799	C	G
MELANITTA NIGRA BLACK SCOTER	123456799	U	G
MELANITTA PERSPICILLATA SURF SCOTER	123456789	C	G

TROPIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

EUDYSTYLIA VANCOUVERI POLYCHAETE WORM	70	A	-
LIGIA PALLASII ROCK LOUSE	123456789	C	-

TROPIC LEVEL: (5) OMNIVORE  
BIRDS

STURNUS VULGARIS STARLING	123456789	U	-
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TROPIC LEVEL: (6) PARASITE  
FISHES

LAMPETRA AYRESI RIVER LAMPREY	123456799	Q	-
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KEY TO SYMBOLS 1.1.1 A-2

## COMMUNITY COMPOSITION ESTUARY ZONE: INTERTIDAL

SCIENTIFIC NAME RANGE ABUNDANCE STATUS  
COMMON NAMETROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
BALANUS GLANDULA BARNACLE	20	C	-
BANKIA SETACEA SHIPWORM	123456789	C	-
LEPAS BARNACLE	20	C	-
MYTILUS EDULIS RAY MUSSEL	123456799	A	-
SCHIZORRANCHIA INSIGNIS	70	C	-
POLYCHAETE WORM			
SERPULA VERMICULARIS POLYCHAETE WORM	70	C	-

TROPIC LEVEL: (9) SCAVENGER  
INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
ANISCLABRIS MARITIMA EARWIG	25789	U	I

TROPIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
AGLADPHENTA HYDROID	123456799	C	-
EMPLECTONEMA GRACILE RIBBON WORMS	70	O	-
METRIDIUM SEA ANEMONES	70	A	-
TRELLIA LONGISSIMA HYDROID	70	C	-
SYNDRYNE EXTIMA HYDROID	70	C	-
TURULARIA MARINA HYDROID	70	C	-

## HABITAT: PILINGS

SCIENTIFIC NAME RANGE ABUNDANCE STATUS  
COMMON NAMETROPIC LEVEL: (9) INVERTEBRATE EATER  
FISHES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
CLINOCOTTUS GLORICEPS MOSSHEAD SCULPIN	123456789	O	-
CLUPEA HARENGUS PALLASI PACIFIC HERRING	123456789	C	C
CYMATOGASTER AGGREGATA SHINER PERCH	123456789	A	-
EMBIOTOCA LATERALIS STRIPED SEAPERCH	123456789	O	G
ENGRAULIS MORDAX NORTHERN ANCHOVY	123456789	A	C
GASTEROSTEUS ACULEATUS THREESPINE STICKLEBACK	123456799	A	-
LEPTOCOTTUS ARMATUS PACIFIC STAGHORN SCULPIN	123456789	A	-
LUMPENUS SAGITTA SNAKE PRICKLEBACK	123456789	C	-
RHACOCHEILUS VACCA PILE PERCH	123456799	A	G

TROPIC LEVEL: (9) INVERTEBRATE EATER  
BIRDS

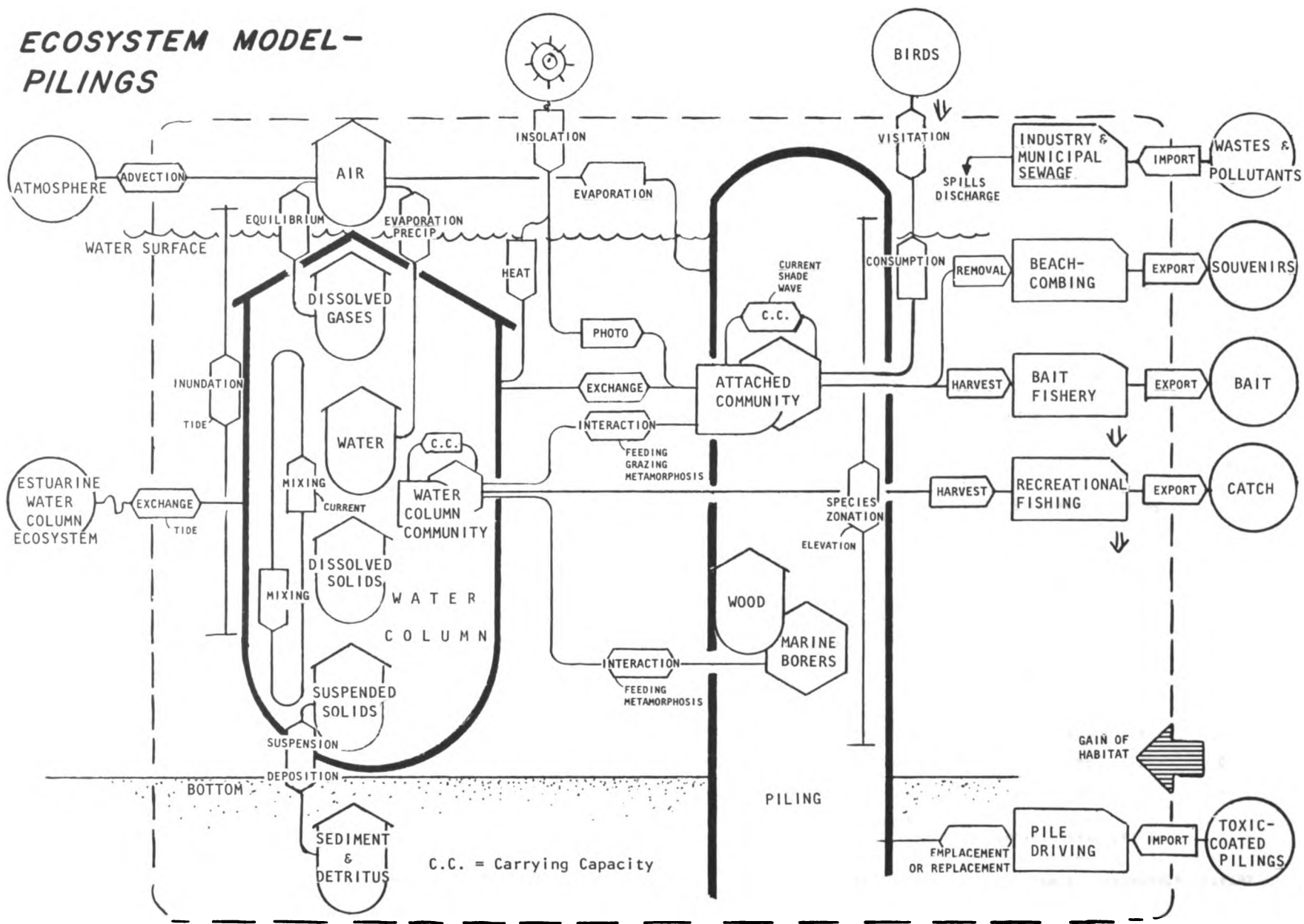
SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
PROGNE SUBIS PURPLE MARTIN	23456789	U	R

TROPIC LEVEL: (9) UNKNOWN  
INVERTEBRATES

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
AMPITHOE LACERTOSA AMPHIPOD	123456789	O	-
POLINICES DRACONIS SNAIL	20	O	-
PORCELLIO SCABER PILL BUGS	70	C	-
TEREDU NAVALIS SHIPWORM	123456789	C	C



# ECOSYSTEM MODEL - PILINGS



2.1.2 Intertidal  
Estuarine Zone  
B Mud Flat



**MUD FLAT**

Habitat Description

Nearly identical to subtidal mud flat except for exposure during low tide, when predators such as shorebirds feed on the infauna (which are the same as subtidal flat).

Food Web

Primary production dominated by phytoplankton. Detrital food webs and filter feeding are characteristic, with predation by birds common at low tides.

Characteristic Flora

Diatoms dominate the phytoplankton and are present with green and blue green algae on the flats.

Characteristic Fauna

Zooplankton: copepods dominate, with mysids sometimes abundant.

Fish (high tide): starry flounder, staghorn sculpin, and shiner perch (*Cymatogaster* spp.) are most common.

Invertebrates: soft-shell clam (*Mya arenaria*), bent-nosed clam (*Macoma nasuta*), and polychaete worms dominate the benthos.

Birds: western grebe, scoter, cormorants, and great blue heron when tide is in; shorebirds such as western sandpiper, sanderling, yellowlegs, dunlin, dowitchers, curlews, etc., when tide is out and flat is exposed.

## COMMUNITY COMPOSITION ESTUARY      ZONE: INTERTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

BLINDINGIA MINIMA	123456789	C	-
GREEN ALGAE			
CHAETOMORPHA CANNABINNA	123456789	C	-
GREEN ALGAE			
CLADOPHORA	123456789	C	-
GREEN ALGAE			
DESMARESTIA MUNDA	123456789	C	-
WIDE BRANCH COLOR CHANGER			
ENTEROMORPHA CLATHRATA	123456789	C	-
GREEN ALGAE			
ENTEROMORPHA INTESTINALIS	123456789	A	-
LINK CONFETTI			
ENTEROMORPHA LINZA	123456789	C	-
GREEN STRING LETTUCE			
ENTEROMORPHA SALINA	123456789	A	-
GREEN ALGAE			
ENTEROMORPHA TUBULOSA	123456789	U	-
GREEN ALGAE			
FUCUS	123456789	C	-
BROWN ALGAE			
MICROCOLEUS	123456789	O	-
BLUE GREEN ALGAE			
OSCILLATORIA	123456789	A	-
BLUE GREEN ALGAE			
RHIZOCLONIUM LUBRICUM	123456789	A	-
GREEN ALGAE			
SPIRULINA	123456789	O	-
BLUE GREEN ALGAE			
ULVA EXPANSA	123456789	U	-
GREEN ALGAE			
ULVA FENESTRATA	123456789	U	-
GREEN ALGAE			
ULVA LACTUCA	123456789	A	-
SEA LETTUCE			
ULVA LOBATA	123456789	U	-
ULVA			
ULVA TAENIATA	123456789	U	-
GREEN ALGAE			
VAUCHERIA	70	A	-
DIATOMS			

TROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

SCIRPUS MARITIMUS	1234567	C	-
SEACOAST BULRUSH			
TRIGLOCHIN MARITIMUM	123456789	A	-
SEASIDE ARROWGRASS			

## HABITAT: MUD FLAT

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (2) HERBIVORE  
BIRDS

ANAS ACUTA	123456789	C	G
PINTAIL			
ANAS AMERICANA	123456789	A	G
AMERICAN WIDGEON			
ANAS CLYPEATA	123456789	U	G
NORTHERN SHOVELER			
ANAS CRECCA	123456789	C	G
GREEN-WINGED TEAL			
ANAS PENELOPE	123456789	U	G
EUROPEAN WIDGEON			
ANSER ALBIFRONS	123456789	U	G
WHITE-POINTED GOOSE			
CHEN CAERULESCENS	123456789	U	G
SNOW GOOSE			
COLUMBA FASCIATA	123456789	A	G
BAND-TAILED PIGEON			
FULICA AMERICANA	123456789	C	G
AMERICAN COOT			
COLUR COLUMBIANUS	123456789	U	-
WHISTLING SWAN			

TROPIC LEVEL: (3) CARNIVORE  
INVERTEBRATES

POLINICES LEWISII	123456789	U	-
MOJN SNAIL			

TROPIC LEVEL: (3) CARNIVORE  
FISHES

CITHARICHTHYS STIGMAEUS	123456789	O	G
SPECKLED SANDDAR			

TROPIC LEVEL: (3) CARNIVORE  
BIRDS

ARDEA HERODIAS	123456789	C	-
GREAT BLUE HERON			
BUTORIDES STRIATUS	123456789	U	-
GREEN HERON			
LARUS ARGENTATUS	123456789	U	-
HERRING GULL			
LARUS CALIFORNICUS	123456789	A	-
CALIFORNIA GULL			
LARUS CANUS	123456789	A	-
MEW GULL			
LARUS DELAWARENSIS	123456789	C	-
PING-BILLED GULL			

KEY TO SYMBOLS 1.1.1 A-2

## COMMUNITY COMPOSITION ESTUARY ZONE: INTERTIDAL

SCIENTIFIC NAME RANGE ABUNDANCE STATUS  
COMMON NAMETROPIC LEVEL: (3) CARNIVORE  
BIRDS

LARUS GLAUCESCENS GLAUCOUS-WINGED GULL	123456789	A	-
LARUS OCCIDENTALIS WESTERN GULL	123456789	A	-
LARUS PHILADELPHIA BONAPARTE'S GULL	123456789	A	-
LARUS THAYERI THAYER'S GULL	123456789	U	-
TRINGA FLAVIPES LESSER YELLOWLEGS	123456789	C	-

TROPIC LEVEL: (3) CARNIVORE  
MAMMALS

PHOCA VITOLINA HARBOR SEAL	123456789	C	-
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TROPIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

ABARENICOLA CLAPAREDI VAGABUNDUM LUGWORMS	7	A	-
ABARENICOLA PACIFICA LUGWORMS	70	A	-
AMAGE AURICULA BRISTLE WORMS	7	U	-
ANSIOGRAMMARUS CONFERVICOLUS PILL BUGS	20	C	-
CALLIANASSA CALIFORNIENSIS GHOST SHRIMP	123456789	A	-
CALLIANASSA GIGAS GHOST SHRIMP	20	U	-
COROPHIUM BREVIS AMPHIPOD	123456789	O	-
COROPHIUM SALMONIS AMPHIPOD	1234567	Q	-
COROPHIUM SPINICORNIS AMPHIPOD	123456789	A	-
COROPHIUM STIMPSONI AMPHIPOD	20	A	-
MACOMA BALTHICA CLAM	123456789	A	-
MACOMA INCONSPICUA CLAM	123456789	A	-
MACOMA INQUINATA CLAM	123456789	C	-
MACOMA NASUTA BENT-NOSED CLAM	123456789	A	-
QWENTIA FISIFORMIS POLYCHAETE WORM	70	A	-
PELOSCOLEX GABRIELLE TUBIFICIDS	20	C	-
TARPHIOTA GENICULATA ROVE BEETLE	123456789	Q	I

## HABITAT: MUD FLAT

SCIENTIFIC NAME RANGE ABUNDANCE STATUS  
COMMON NAMETROPIC LEVEL: (5) OMNIVORE  
INVERTEBRATES

NASSARIUS DORSOLETUS BASKET SHELL	123456789	U	-
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TROPIC LEVEL: (5) OMNIVORE  
BIRDS

AYTHYA AFFINIS LESSER SCAUP	123456789	U	G
AYTHYA MARILA GREATER SCAUP	123456789	C	G
CORVUS BRACHYRHYNCHOS COMMON CROW	123456789	U	-
CORVUS CORAX COMMON RAVEN	123456789	U	-

TROPIC LEVEL: (5) OMNIVORE  
MAMMALS

PROCYON LOTOR RACCOON	123456789	C	C
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TROPIC LEVEL: (6) PARASITE  
INVERTEBRATES

ALEOCHARA SULCYCOLLIS ROVE BEETLE	123456789	Q	-
CARCINONEMERTES EPIALTI RIBBON WORMS	70	C	-
CLAUSTIDIUM VANCOUVERENSE COPEPOD	270	C	-
MALACORDELLA GROSSA RIBBON WORMS	123456789	U	-
PINNIXA FABA PEA CRAB	70	A	-
PINNIXA LITTORALIS PEA CRAB	70	A	-
PINNIXA OCCIDENTALIS PEA CRAB	70	U	-
PINNIXA SCHMITTI PEA CRAB	70	A	-
PINNIXA TUBICOLA PEA CRAB	70	C	-

TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

ANISOGAMMARUS CONFERVICOLUS AMPHIPOD	123456789	A	-
ANISOGAMMARUS PUGETTENSIS AMPHIPOD	123456789	C	-
BOWERBANKIA GRACILIS BRIDGES	70	O	-
CLINOCARDIUM MITTALLII BASKET COCKLE OR HEART COCKLE	123456789	A	G

## COMMUNITY COMPOSITION ESTUARY

ZONE: INTERTIDAL

HABITAT: MUD FLAT

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

CRASSOSTREA GIGAS PACIFIC OR JAPANESE OYSTER	123456789	A	C
LYONSIA CALIFORNICA CALIFORNIA PAPERSHELL	123456789	U	-
MYA ARENARIA SOFT-SHELL CLAM	123456789	A	G
PHORONOPSIS VIRIDIS BRYNZONS	70	C	-
PROTOTHACA TENERRIMA BIVALVE	123456789	C	-
TADES JAPONICA -NULL-	20	0	-
TELLINA MODESTA TELLEN	123456789	A	-
TELLINA NUCULOIDES TELLEN	123456789	A	-
TRESUS CAPAX GAPEY CLAM OR EMPIRE CLAM	123456789	A	G
TRESUS NITTALIT STUTHERY GAPEY	123456789	A	G
UPOGEBIA PUGETTENSIS BLUE MUD SHRIMP	123456789	A	-

TROPIC LEVEL: (8) SCAVENGER  
INVERTEBRATES

PAGURUS HERPIDIUSCULUS HERMIT CRAB	70	C	-
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TROPIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

ALLOPHECETES ANGUSTUS AMPHIPOD	27890	U	-
BLENNIUS MNSTRATUS ROVE BEETLE	123456789	Q	-
CAPINOMA MUTABILIS RIBBON WORMS	70	U	-
CEREBRATULUS CALIFORNIENSIS RIBBON WORMS	270	U	-
CRANGON ALBA WHITE SHRIMP	70	C	-
CRANGON FRANCISCORUM -NULL-	123456789	C	-
CRANGON NIGRICAUDA BLACK-TAILED SHRIMP	123456789	C	-
GLYCERA AMERICANA POLYCHAETE WORM	123456789	A	-
HALIPLANELLA LEUCOLENA SEA ANEMONES	70	0	-
HARMOTHOE IMBRICATA POLYNOID WORMS	270	U	-
HESPERONDE COMPLANATA POLYNOID WORMS	270	C	-

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

LINEUS RUBER RIBBON WORMS	70	U	-
MICRURA ALASKENSIS RIBBON WORMS	70	Q	-
NEMATOSTELLA VECTENSIS SEA ANEMONES	70	C	-
NEOMYSTS MERCEDIS MYSID SHRIMP	320	A	-
NEPHTYS CAECA NEREID WORM	270	U	-
NEPHTYS CAECIDIENS NEREID WORM	70	A	-
NEREIS BRANDTI NEREID WORM	270	A	-
PARAMERTES PEREGRINA RIBBON WORMS	70	C	-
SALDULA PALUSTRIS SHORE BUG	123456789	Q	I
THINOBIOUS FRIZZELLI ROVE BEETLE	12	Q	I
TUBULANUS POLYMORPHUS RIBBON WORMS	70	C	-

TROPIC LEVEL: (9) INVERTEBRATE EATER  
BIRDS

ARENARIA INTERPRES RUDDY TURNSTONE	123456789	U	-
ARENARIA MELANOCEPHALA BLACK TURNSTONE	123456789	U	-
ACTITIS MACULARIA SPOTTED SANDPIPER	123456789	U	-
CALIDRIS ALBA SANDPELING	123456789	U	-
CALIDRIS ALPINA DUNLIN	123456789	A	-
CALIDRIS BAIRODII BAYDIPS SANDPIPER	123456789	R	-
CALIDRIS CANUTUS REDKNOT	123456789	U	-
CALIDRIS MAURI WESTERN SANDPIPER	123456789	A	-
CALIDRIS MINUTILLA LEAST SANDPIPER	123456789	C	-
CATOPTROPHORUS SEMIPALMATUS WILLET	456789	U	-
CHARADRIUS VOCTEFERUS KILLDEER	123456789	C	-
LIMNODROMUS GRISEUS SHORT-BILLED DOWITCHER	123456789	C	-
LIMNODROMUS SCOLOPACEUS LONG-BILLED DOWITCHER	123456789	C	-

## COMMUNITY COMPOSITION ESTUARY

ZONE: INTERTIDAL

HABITAT: MUD FLAT

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (9) INVERTEBRATE FATER  
BIRDS

LIMOSA FEDDA MARBLED GODWIT	123456789	U	-
LARIPES LOBATUS NORTHERN PHALAROPE	123456789	U	-
NUMENTIUS AMERICANUS LONG-BILLED CURLEW	123456789	U	-
NUMENTIUS PHAEOPUS WHIMBREL	123456789	U	-
PLUVIALIS DOMINICA AMERICAN GOLDEN PLOVER	123456789	U	-
PLUVIALIS SCUATAROLA BLACK-BELLIED PLOVER	123456789	C	-
TRINGA MELANOLEUCA GREATER YELLOWLEGS	123456789	C	-

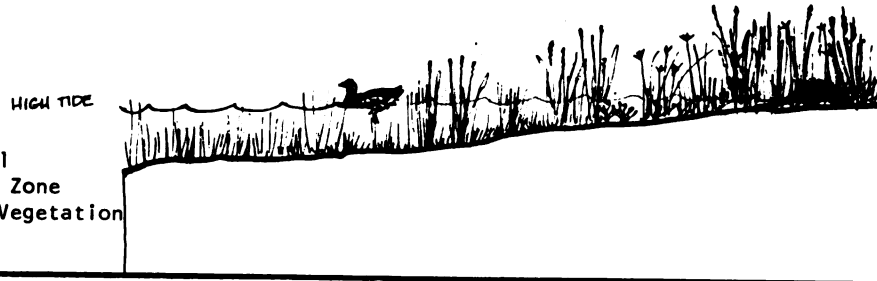
TROPHIC LEVEL: (0) UNKNOWN  
INVERTEBRATES

AGLAJA DIOMEDEA SLUG	123456789	A	-
AMPHICTETS MUCRONATA BRISTLE WORMS	70	U	-
AMPHITOE VALIDA AMPHIROD	789	A	-
CAPITELLA CAPITATA LUGWORMS	270	A	-
ETEONE LIGHTI POLYCHAETE WORM	70	A	-
ETEONE LONGA POLYCHAETE WORM	70	C	-
GLYCERA CAPITATA POLYCHAETE WORM	70	U	-
GLYCERA ROBUSTA POLYCHAETE WORM	70	A	-
GLYCINDE ARMIGERA POLYCHAETE WORM	270	C	-
HAPLOSCHOLOPUS ELONGATA POLYCHAETE WORM	270	C	-
HEMIGRAPSUS OREGONENSIS HAIRY SHORE CRAB	270	A	-
HEMIPODUS ADREALIS POLYCHAETE WORM	70	O	-
METEROMASTUS FILIFORMIS LUGWORMS	270	A	-
LEPTOCHELIA SAVIGNYI CRUSTACEAN	20	A	-
LEPTOCUMA CUMACEAN	20	C	-
MANAYUNKIA ESTUARINA SABELLID WORM	20	C	-
MEDIOMASTUS CALIFORNIENSIS LUGWORMS	2780	C	-

TROPHIC LEVEL: (0) UNKNOWN  
INVERTEBRATES

MESIDOTEA ENTOMON PILL BUGS	70	U	-
NASSARIUS PROPINGUS SNAIL	20	O	-
NEREIS PROCERA NEREID WORM	70	U	-
NERINE CIRRATULUS POLYCHAETE WORM	70	C	-
NOTOMASTUS TENNIS LUGWORMS	270	C	-
PANCOLIUS CALIFORNIENSIS CRUSTACEAN	20	A	-
POLINICES DRACONIS SNAIL	20	O	-
POLYDORA BRACHYCEPHALA SPIONID WORM	70	C	-
POLYDORA SOCIALIS SPIONID WORM	70	U	-
PSUEDOPOLYDORA KEMPI SPIONID WORM 1	270	C	-
RHITHROPANOEPEUS HARRISSI TUJIDER ZEE CRAB	70	C	-
SCHLEROPLAX GRANULATA CRAB	70	C	-
SCOLOPDIOS ARMIGER POLYCHAETE WORM	20	O	-
STREBLOSPIO BENEDICTI SPIONID WORM	270	A	-
SYLLIS ELONGATA POLYCHAETE WORM	270	U	-

2.1.2 Intertidal  
 Estuarine Zone  
 C Emergent Vegetation



## **EMERGENT VEGETATION**

**Habitat Description**

Low, emergent, herbaceous, halophytic vegetation. Includes both "low" and "high" salt marsh. Tidal influence and low-energy wave conditions. It is transitional between lowlands and mud flats. Typically in mud to sandy mud substrate.

**Food Web**

Predominantly detrital with much of the productivity exported as detritus to other estuarine habitats during spring tides. However, the marsh supports a small grazing food web dominated by insects and provides food and shelter for waterfowl.

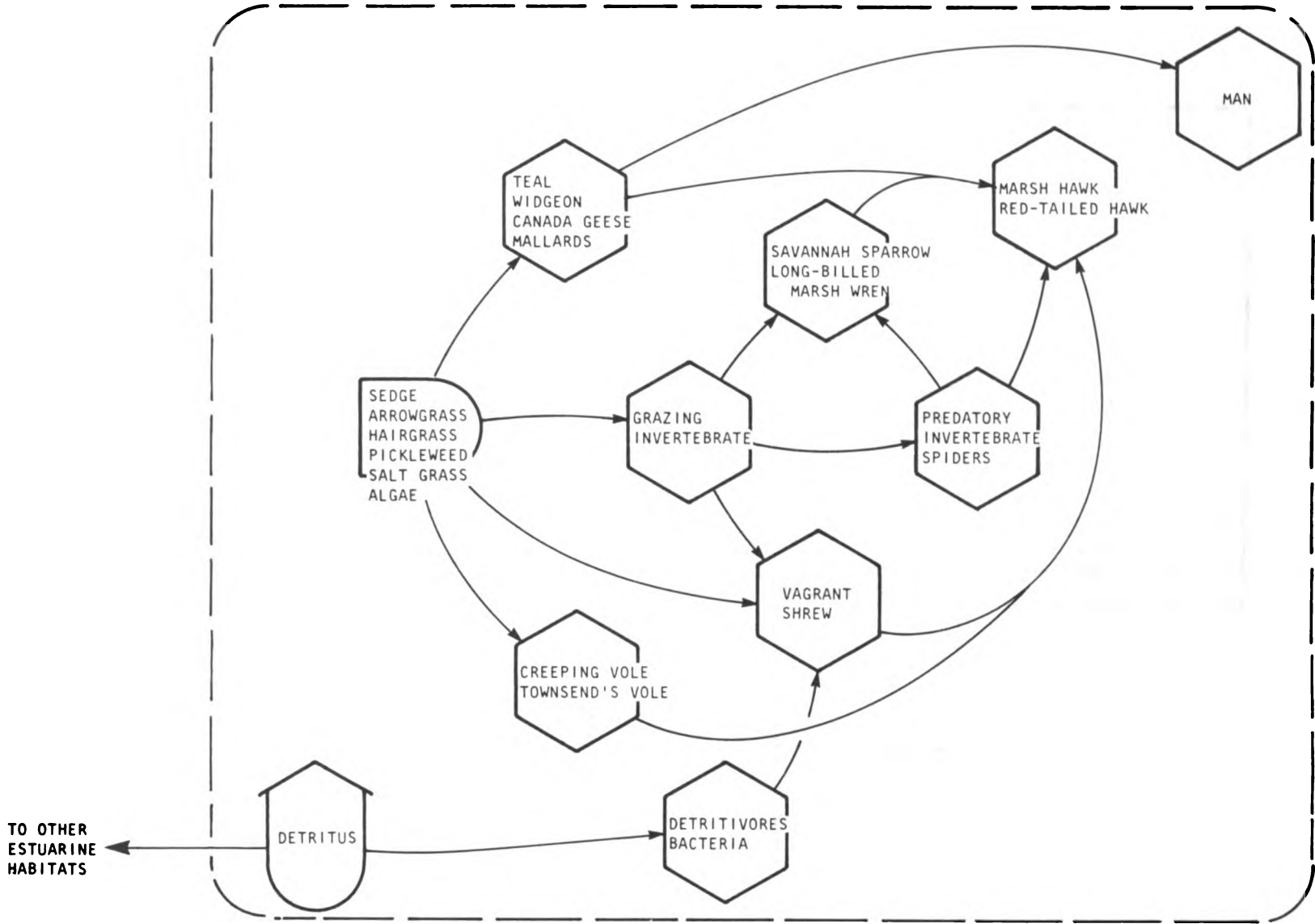
**Characteristic Flora**

Three-square rush, arrowgrass, spike rush, sand spurry, tufted hair grass, salt grass, bulrush, saltwort, Lyngbye's sedge.

**Characteristic Fauna**

**Birds:** black brant, Canada geese, scaup, mallard, widgeon, canvasback, trumpeter and whistling swans, coot, bald eagle, kestrel, Savannah sparrow.

**Mammals:** nutria, muskrat, vagrant shrew, Townsend's vole.



**FOOD WEB-EMERGENT VEGETATION**



## COMMUNITY COMPOSITION ESTUARY      ZONE: INTERTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
NON-VASCULAR PLANTS

ANABAENA	123456789	0	-
BLUE GREEN ALGAE			
FUCUS	123456789	C	-
BROWN ALGAE			
MICROCOLEUS	123456789	0	-
BLUE GREEN ALGAE			
OSCILLATORIA	123456789	A	-
BLUE GREEN ALGAE			
RIVULARIA	70	A	-
BLUE GREEN ALGAE			
SPIRULINA	123456789	0	-
BLUE GREEN ALGAE			

TROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

AGROSTIS ALBA	123456789	A	-
CREEPING BENTGRASS			
ATRIplex PATULA	123456789	C	-
SALT BUSH			
CHARIS PILULARIS	670	0	-
CHAPARRAL BROOM			
POISDUVALIA DENSIFLORA	123456789	0	-
SPIKE PRIMROSE			
CAREX LYNGBYEI	123456789	A	-
LYNGBY'S SEDGE			
CAREX OBNUPTA	123456789	U	-
SLOUGH SEDGE			
CORDYLANTHUS MARITIMUS SSP. PA	6789	U	R
MARSH BIRD'S BEAK			
CORDYLANTHUS MARITIMUS VAR. MA	6789	U	R
SEASIDE BIRD'S BEAK			
COTULA CORONOPIFOLIA	123456789	C	-
BRASS BUTTONS			
DESCHAMPSIA CAESPITOSA	123456789	A	-
TUFTED HAIRGRASS			
DISTICHLIS SPICATA	123456789	A	-
SEASHORE SALTGRASS			
ELEOCHARIS MACROSTACHYA	67	U	-
SPIKE-RUSH			
ELEOCHARIS PALUSTRIS	123456789	C	-
COMMON SPIKE-RUSH			
ELEOCHARIS PARISHII	67	U	-
SPIKE-RUSH			
ELEOCHARIS PARVULA	123456789	C	-
SMALL SPIKE-RUSH			
ELYMUS TRITICOIDES	123456789	0	-
CREEPING RYEGRASS			
GLAUX MARITIMA	123456789	A	-
SEA MILKWORT			
GRINDELIA INTEGRIFOLIA	1234567	C	-
GUM PLANT			

## HABITAT: EMERGENT VEGETATION

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

HOLCUS LANATUS	123456789	U	-
COMMON VELVET GRASS			
HORDEUM BRACHYANTHRUM	123456789	C	-
MEADOW BARLEY			
HORDEUM JUBATUM	123456789	U	-
FOXTAIL OR SQUIRREL-TAIL BARLEY			
JAUMEA CARNOSEA	123456789	A	-
JAUMEA			
JUNCUS BALTICUS	123456789	C	-
BALTIC RUSH			
JUNCUS GERARDII	123456789	U	R
MUD RUSH			
JUNCUS LESUEURII	123456789	C	-
SALT RUSH			
JUNCUS TENUIS	123456789	U	-
RUSH			
LIMONIUM COMMUNE	9	C	-
-NULL-			
MYOSURUS MINIMUS	20	Q	-
LEAST MOUSE-TAIL			
ORTHOCARPUS CASTILLEJOIDES	123456789	U	-
PAINTBRUSH ORTHOCARPUS			
ORTHOCARPUS CASTILLEJOIDES VAR 9	9	U	R
HUMBOLDT ORTHOCARPUS			
PLANTAGO MARITIMA	123456789	A	-
SEASIDE PLANTAIN			
PLECTRITIS CONGESTA	123456789	U	-
ROSY PLECTRITIS			
POTENTILLA PACIFICA	123456789	C	-
PACIFIC SILVERWEED			
RUMEX OCCIDENTALIS	123456789	A	-
WESTERN DOCK			
RUPPIA MARITIMA	123456789	A	-
DITCH GRASS			
SALICORNTA VIRGINICA	123456789	A	-
GLASSWORT OR PICKLEWEED			
SCIRPUS ACUTUS	3456789	C	-
COMMON TULE, HARDSTEM BULRUSH			
SCIRPUS AMERICANUS	123456789	A	-
THREE-SQUARE BULRUSH			
SCIRPUS CERNUUS	123456	C	-
LOW BULRUSH			
SCIRPUS MARITIMUS	1234567	C	-
SEACOAST BULRUSH			
SCIRPUS VALIDUS	123456789	A	-
AMERICAN GREAT BULRUSH; TULE			
SPARTINA ALTERNIFLORA	7	C	-
CORDGRASS			
SPARTINA FOLIOSA	9	A	-
CORDGRASS			
SPERGULARIA CANADENSIS	123456789	C	-
CANADIAN SAND SPURRY			

KEY TO SYMBOLS 1.1.1 A-2

## COMMUNITY COMPOSITION ESTUARY

ZONE: INTERTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (1) PRODUCER  
VASCULAR PLANTS

SPERGULARIA MACROTHECA BEACH SAND SPURRY	123456789	C	-
SPERGULARIA MARINA SALT MARSH SAND SPURRY	123456789	C	-
STELLARIA CALYCANtha NORTHERN STARWORTS	1234567	C	-
STELLARIA HUMIFUSA SPREADING STARWORT	12345	U	R
TRIFOLIUM RATENSE RED CLOVER	70	C	-
TRIFOLIUM WORMSKJOLDT MARSH CLOVER	123456789	C	-
TRIGLOCHIN MARITIMUM SEASIDE ARROWGRASS	123456789	A	-
TYPIA LATIFOLIA CATTAIL OR SOFT FLAG	123456789	C	-
ZANNICHELLIA PALUSTRIS HORNED PONDWEED	450	O	-

TROPIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

ASSIMINEA CALIFORNICA SNAIL	123456789	C	-
LITTORINA ALGAMPDA NECKEMBS LITTORINE	789	C	R
LITTORINA SCUTULATA PERIWINKLE	123456789	C	-

TROPIC LEVEL: (3) HERBIVORE  
BIRDS

ANAS ACUTA PINTAIL	123456789	C	G
ANAS AMERICANA AMERICAN WIDGEON	123456789	A	G
ANAS CLYPEATA NORTHERN SHOVELER	123456789	C	G
ANAS CRECCA GREEN-WINGED TEAL	123456789	C	G
ANAS PENFLOPE EUROPEAN WIDGEON	123456789	U	G
ANAS PLATYRHYNCHOS MALLARD	123456789	C	G
ANAS STREPERA GADWALL	123456789	U	G
ANSER ALAIFRONS WHITE-FRONTED GOOSE	123456789	U	G
BRANTA CANADENSIS CANADA GOOSE	123456789	U	G
CHEN CAERULESCENS SNOW GOOSE	123456789	U	G
FULICA AMERICANA AMERICAN COOT	123456789	C	G

## HABITAT: EMERGENT VEGETATION

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (2) HERBIVORE  
BIRDS

MELOSPIZA MELODIA SONG SPARROW	123456789	C	-
COLUR COLUMBIANUS WHISTLING SWAN	123456789	U	-

TROPIC LEVEL: (2) HERBIVORE  
MAMMALS

CASTOR CANADENSIS BEAVER	123456789	U	C
ONDATRA ZIBETHICA MUSKRAT	1234567	U	-

TROPIC LEVEL: (3) CARNIVORE  
BIRDS

ARDEA HERODIAS GREAT BLUE HERON	123456789	C	-
BUTORIDES STRIATUS GREEN HERON	123456789	U	-
TRINGA FLAVIPES LESSER YELLOWLEGS	123456789	C	-

TROPIC LEVEL: (3) CARNIVORE  
MAMMALS

PHOCA VITOLINA HARBOR SEAL	123456789	U	-
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TROPIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

ANSIOGRAMMARUS CONFERVICOLUS PILL BUGS	23	O	-
GNDRIMOSPHAEROMA OREGONENSIS PILL BUGS	270	C	-
MACOMA INCONSPICUA CLAM	123456789	A	-
MACOMA NASUTA BENT-NOSED CLAM	123456739	C	-
TIGRIOPUS CALIFORNICUS COPEPOD	70	O	-

TROPIC LEVEL: (5) OMNIVORE  
BIRDS

CORVUS BRACHYRHYNCHOS COMMON CROW	123456789	C	-
STURNUS VULGARIS STARLING	123456789	U	-

## COMMUNITY COMPOSITION ESTUARY

ZONE: INTERTIDAL

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPIC LEVEL: (5) OMNIVORE  
MAMMALS

PEROMYSCUS MANICULATUS DEER MOUSE	123456789	C	-
PROCYON LOTOR RACCOON	123456789	C	C
Sorex TROWBRIDGEI TROWBRIDGE SHREW	123456789	U	-
Sorex VAGRANS VAGRANT SHREW	123456789	A	-

TROPIC LEVEL: (6) PARASITE  
VASCULAR PLANTS

CUSCUTA SALINA SALT MARSH OODDER	123456789	C	-
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TROPIC LEVEL: (7) FILTER FEEDER  
INVERTEBRATES

CRYPTOMYA CALIFORNICA SOFT-SHELL CLAM	123456789	A	-
MYA ARENARIA SOFT-SHELL CLAM	123456789	C	G

TROPIC LEVEL: (8) SCAVENGER  
BIRDS

HALIAEETUS LEUCOCEPHALUS HALD EAGLE	123456789	U	T
HALIAEETUS LEUCOCEPHALUS HALD EAGLE	89	U	E

TROPIC LEVEL: (9) INVERTEBRATE EATER  
INVERTEBRATES

CRANGON ALBA WHITE SHRIMP	20	C	-
CRANGON FRANCISCONUM -NULL-	123456789	C	-
CRANGON NIGRICAUDA BLACK-TAILED SHRIMP	123456789	C	-
NEMATOSTELLA VECTENSIS SEA ANEMONES	70	A	-
NEOMYSIS MERCEDES MYSID SHRIMP	320	A	-

TROPIC LEVEL: (9) INVERTEBRATE EATER  
BIRDS

CALIDRIS ALPINA DUNLIN	123456789	C	-
CALIDRIS MAURI WESTERN SANDPIPER	123456789	U	-
CALIDRIS MINUTILLA LEAST SANDPIPER	123456789	C	-
CATOPTROPHORUS SEMIPALMATUS WILLET	456789	U	-

## HABITAT: EMERGENT VEGETATION

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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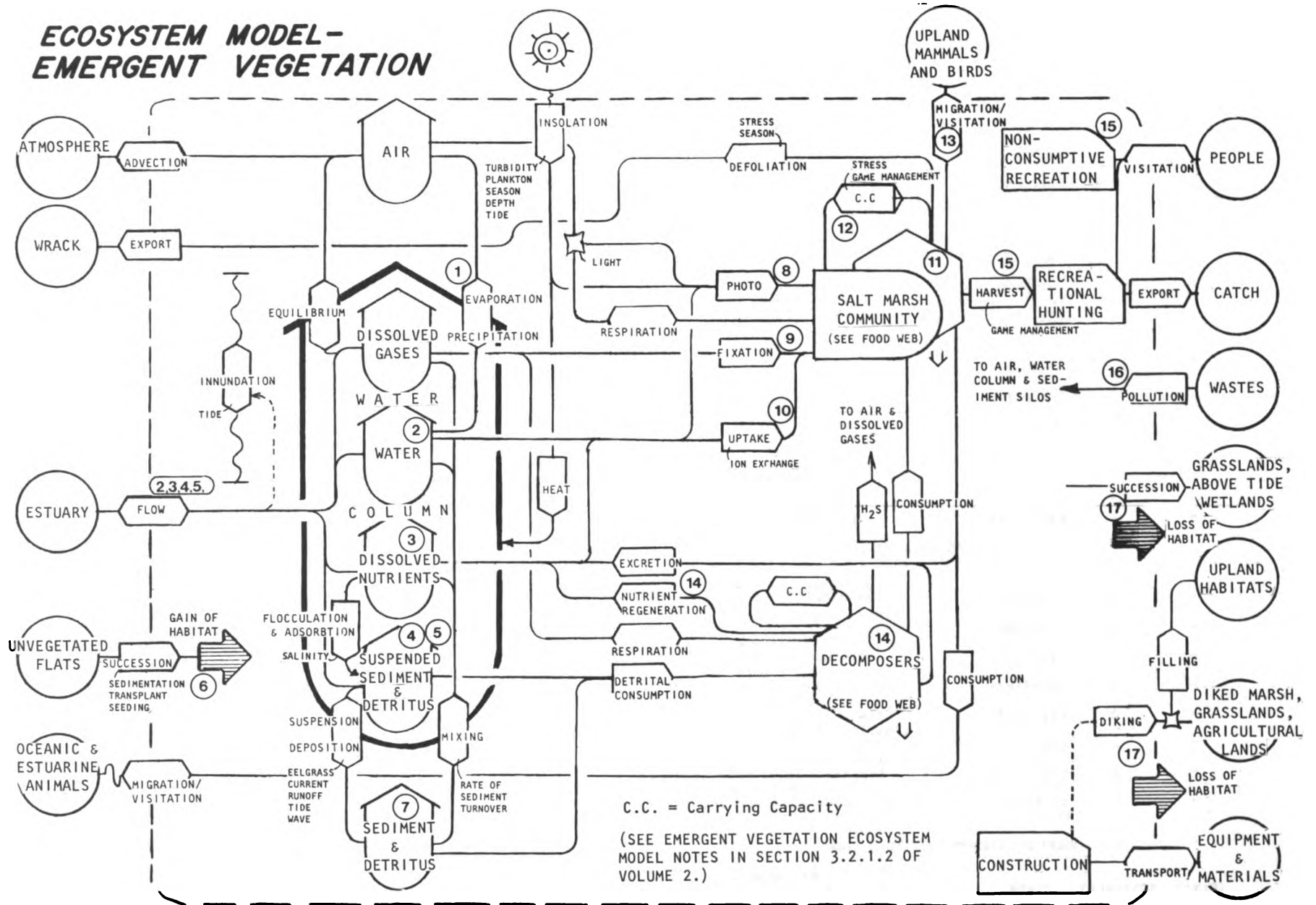
TROPIC LEVEL: (9) INVERTEBRATE EATER  
BIRDS

CHARADRIUS VOCIFERUS KILLDEER	123456789	C	-
LIMNODROMUS GRISEUS SHORT-BILLED DOWITCHER	123456789	C	-
LIMNODROMUS SCOLOPACEUS LONG-BILLED DOWITCHER	123456789	C	-
NUMENIUS AMERICANUS LONG-BILLED CURLEW	123456789	U	-
NUMENIUS PHAEOPUS WHIMBREL	123456789	U	-
PLUVIALIS DOMINICA AMERICAN GOLDEN PLOVER	123456789	U	-
PLUVIALIS SQUATAROLA BLACK-BELLIED PLOVER	123456789	C	-
TRINGA MELANOLEUCA GREATER YELLOWLEGS	123456789	C	-

TROPIC LEVEL: (9) UNKNOWN  
INVERTEBRATES

OVATELLA MYOSOTIS BUTTON SHELL	123456789	C	-
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# ECOSYSTEM MODEL - EMERGENT VEGETATION





2.1.3 Above Tide  
 Estuarine Wetland  
 Zone  
 A Diked Marsh

**DIKED MARSH**

Habitat Description

Grassland areas only covered by extreme high tide or diked salt marshes used as pasture. Usually adjacent to salt marshes and covered by a mixture of halophytic and inland herbs and grasses.

Food Web

Predominantly grazing with small mammals and raptors as significant components.

Characteristic Flora

Tufted hair grass, salt rush, creeping bent grass, Pacific silverweed, gumweed, alkali grass, bird's-foot trefoil, dock, Kentucky bluegrass, dandelion.

Characteristic Fauna

Mammals: Townsend's vole, creeping vole, harvest mouse, California vole, vagrant shrew, black-tailed deer, coyote.

Birds: Savannah sparrow, American goldfinch, common nighthawk, barn, cliff, and tree swallows, common crow, marsh hawk, red-tailed hawk, short-eared owl.

COMMUNITY COMPOSITION ESTUARY      ZONE: ABOVE TIDE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 VASCULAR PLANTS

ACHILLEA MILLEFOLIUM	123456789	U	-
YARROW			
AGROPYRON	450	0	-
WHEATGRASS			
AGROSTIS ALBA	123456789	A	-
CREeping BENTGRASS			
AGROSTIS TENUIS	90	A	-
BENTGRASS			
ASTER SUBSPICATUS	450	C	-
DOUGLAS ASTER			
SACCHARIS PILULARIS	670	0	-
CHAPARRAL BROOM			
BROMUS VULGARIS	123456789	C	-
COMMON BROME			
CAREX OXYURTA	123456789	U	-
SLOUGH SEDGE			
CORNUM MACULATUM	70	U	-
POISON HEMLOCK			
COTULA CORONOPHOLIA	123456789	C	-
BRASS BUTTONS			
CYTISUS MONSPESSULANUS	123456789	0	-
FRENCH BROOM			
DACTYLIS GLOMERATA	90	C	-
ORCHARD GRASS			
DESCHAMPSIA CAESPITOSA	123456789	A	-
TUFTED HAIRGRASS			
DISTICHLIS SPICATA	123456789	A	-
SEASHORE SALTGRASS			
ELEOCHARIS PALUSTRIS	123456789	C	-
COMMON SPIKE-RUSH			
ELYMUS TRITICOIDES	123456789	0	-
CREeping RYEGRASS			
EPILOBIUM WATSONII	450	U	-
WILLOW-HERB			
FESTUCA RUBRA	450	C	-
RED FESCUE			
SALICORNIA VIRGINICA	450	U	-
BEOSTRAW			
HERACLEUM LANATUM	345678	C	-
COW-PARSNIP			
HOLCUS LANATUS	123456789	U	-
COMMON VELVET GRASS			
HORDEUM BRACHYANTHERUM	123456789	C	-
MEADOW BARLEY			
JUNCUS EFFUSUS	123456789	U	-
RUSH			
JUNCUS GERARDII	123456789	U	R
MUD RUSH			
JUNCUS LESUEURII	123456789	C	-
SALT RUSH			
JUNCUS TENUIS	123456789	U	-
RUSH			

HABITAT: DIKED MARSH  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (1) PRODUCER  
 VASCULAR PLANTS

LATHYRUS PALUSTRIS	123456789	U	-
PEAVINE			
LILAFOPSIS OCCIDENTALIS	123456789	C	-
LILEOPSIS			
LIMONIUM COMMUNE	9	C	-
-NULL-			
LOLIUM MULTIFLORUM	90	A	-
ITALIAN RYE-GRASS			
LONICERA INVOLUCRATA	450	U	-
BLACK TWINGBERRY			
LOTUS CORNICULATUS	450	U	-
DEER - VETCH			
MYOSURUS MINIMUS	70	0	-
LEAST MOUSE-TAIL			
OENANTHE SARMENTOSA	123456789	U	-
WATER PARSLEY			
ORTHOCAARPUS CASTILLEJOIDES	123456789	U	-
PAINTBRUSH ORTHOCAARPUS			
PHALARIS ARUNDINACEA	450	U	-
CANARY GRASS			
PICEA SITCHENSIS	123456789	C	-
SITKA SPRUCE			
PLANTAGO LANCEOLATA	90	A	-
BUCKHORN PLANTAIN			
PLECTRITIS CONGESTA	123456789	U	-
ROSY PLECTRITIS			
POTENTILLA PACIFICA	123456789	C	-
PACIFIC SILVERWEED			
PUCCINFLLIA DISTANS	123456789	C	-
ALASKA ALKALI GRASS			
RANUNCULUS SEPENS	90	C	-
RUTTERCUP			
RUMEX MARITIMUS	123456	C	-
SEASIDE DOCK			
RUMEX OCCIDENTALIS	123456789	A	-
WESTERN DOCK			
SALICORNIA VIRGINICA	123456789	A	-
GLASSWORT OR PICKLEWEED			
SALIX HOOKERIANA	123456789	U	R
COAST WILLOW			
SCIRPUS CERNUUS	123456	C	-
LOW BULRUSH			
SCIRPUS MARITIMUS	1234567	C	-
SEACOAST BULRUSH			
SCIRPUS VALIDUS	123456789	A	-
AMERICAN GREAT BULRUSH; TULE			
SPARTINA ALTERNIFLORA	2	C	-
CORDGRASS			
TRIFOLIUM RATENSE	70	C	-
RED CLOVER			
TRIFOLIUM WORMSKJOLDII	123456789	C	-
MARSH CLOVER			

KEY TO SYMBOLS 1.1.1 A-2

## COMMUNITY COMPOSITION ESTUARY ZONE: ABOVE TIDE

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (2) HERBIVORE  
INVERTEBRATES

LITTORINA SCUTULATA PERIWINKLE	123456789	C	-
LYGUS VARIUS LYGUS BUG	2345679	C	-

TROPHIC LEVEL: (2) HERBIVORE  
BIRDS

ANAS ACUTA PINTAIL	123456789	C	G
ANAS AMERICANA AMERICAN WIDGEON	123456789	A	G
ANAS CRECCA GREEN-WINGED TEAL	123456789	C	G
ANAS PENELOPE EUROPEAN WIDGEON	123456789	U	G
ANAS PLATYRHYNCHOS MALLARD	123456789	C	G
ANAS STREPERA GADWALL	123456789	U	G
ANSER ALBIFRONS WHITE-FRONTED GOOSE	123456789	U	G
BRANTA CANADENSIS CANADA GOOSE	123456789	U	G
CARDUELIS TRISTIS AMERICAN GOLDFINCH	123456789	U	-
CHEN CAERULESCENS SNOW GOOSE	123456789	U	G
FULICA AMERICANA AMERICAN Coot	123456789	C	G
MELOSPIZA MELODIA SONG SPARRROW	123456789	C	-
TRINGA COLUMBIANA WHYSTLING SWAN	123456789	U	-

TROPHIC LEVEL: (2) HERBIVORE  
MAMMALS

CASTOR CANADENSIS BEAVER	123456789	U	C
CLETHRIONOMYS OCCIDENTALIS WESTERN RED-BACKED VOLE	123456789	U	-
MICROTUS CALIFORNICUS CALIFORNIA VOLE	89	C	-
MICROTUS OREGONI OREGON VOLE	123456789	U	-
MICROTUS TOWNSENDII TOWNSEND VOLE	123456789	U	-
ONDRATRA ZIBETHICA MUSKRAT	1234567	U	-
REITHRODONTOMYS MEGALOTTIS WESTERN HARVEST MOUSE	89	C	-

## HABITAT: OPEN MARSH

SCIENTIFIC NAME COMMON NAME	RANGE	ABUNDANCE	STATUS
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TROPHIC LEVEL: (2) HERBIVORE  
MAMMALS

THOMOMYS BOTTAE POTTA POCKET GOPHER	89	C	X
ZAPUS TRINOTATUS PACIFIC JUMPING MOUSE	123456789	C	-

TROPHIC LEVEL: (3) CARNIVORE  
BIRDS

ARDEA HERODIAS GREAT BLUE HERON	123456789	C	-
BOTAURUS LENTIGINOSUS AMERICAN BITTERN	123456789	U	-
BUTEO JAMAICENSIS RED-TAILED HAWK	123456789	U	-
BUTORIDES STRIATUS GREEN HERON	123456789	U	-
CIRCUS CYANEUS MARSH HAWK	123456789	U	-
FALCO SPARVERTUS AMERICAN KESTREL	123456789	U	-
NYCTICORAX NYCTICORAX BLACK-CROWNED NIGHT HERON	123456789	U	-

TROPHIC LEVEL: (3) CARNIVORE  
MAMMALS

LUTRA CANADENSIS RIVER OTTER	123456789	U	C
LYNX RUFUS BOBCAT	123456789	U	C
MUSTELA FRENATA LONG-TAILED WEASEL	123456789	C	-
MUSTELA VISON MINK	123456789	U	C
UROCYON CINEREOARGENTEUS GREY FOX	3456789	U	C

TROPHIC LEVEL: (4) DETRITIVORE  
INVERTEBRATES

ANSIOGRAMMARUS CONFERTICOLUS PILL BUGS	20	0	-
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TROPHIC LEVEL: (5) OMNIVORE  
BIRDS

CORVUS BRACHYRHYNCHOS COMMON CROW	123456789	C	-
STURNUS VULGARIS STARLING	123456789	U	-

COMMUNITY COMPOSITION ESTUARY      ZONE: ABOVE TIDE  
 SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (5) OMNIVORE  
 MAMMALS

CANIS LATRANS COYOTE	123456789	U	C
DIDELPHIS MARSUPIALIS COMMON OPOSSUM	234589	C	-
MEPHITIS MEPHITIS STRIPED SKUNK	123456789	U	C
PEROMYSCUS MANICULATUS DEER MOUSE	123456789	C	-
PROCYON LOTOR RACCOON	123456789	C	C
RATTUS RATTUS BLACK RAT	123456789	U	-
Sorex TROWBRIDGII TROWBRIDGE SHREW	123456789	U	-
Sorex VAGRANS VAGRANT SHREW	123456789	A	-
SPILOGALE PUTORIUS SPOTTED SKUNK	123456789	C	C

TROPHIC LEVEL: (6) PARASITE  
 VASCULAR PLANTS

CUSCUTA SALINA SALT MARSH DODDER	123456789	C	-
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TROPHIC LEVEL: (8) SCAVENGER  
 BIRDS

HALIAEETUS LEUCOCEPHALUS BALD EAGLE	89	U	F
HALIAEETUS LEUCOCEPHALUS BALD EAGLE	12345679	U	T

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 INVERTEBRATES

DOLOPHYNABIS PROPINQUUS NARIDAE	5	U	-
SALPA RUENDI SALPIDAE	45	U	-
SALDULA PALUSTRIS SHOREBUG	123456789	C	-
SALDULA VILLOSA SALPIDAE	7	U	T
STALIA MAJOR JANSEL BUG	45679	U	-

## HABITAT: DIKED MARSH

SCIENTIFIC NAME      RANGE      ABUNDANCE      STATUS  
 COMMON NAME

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 BIRDS

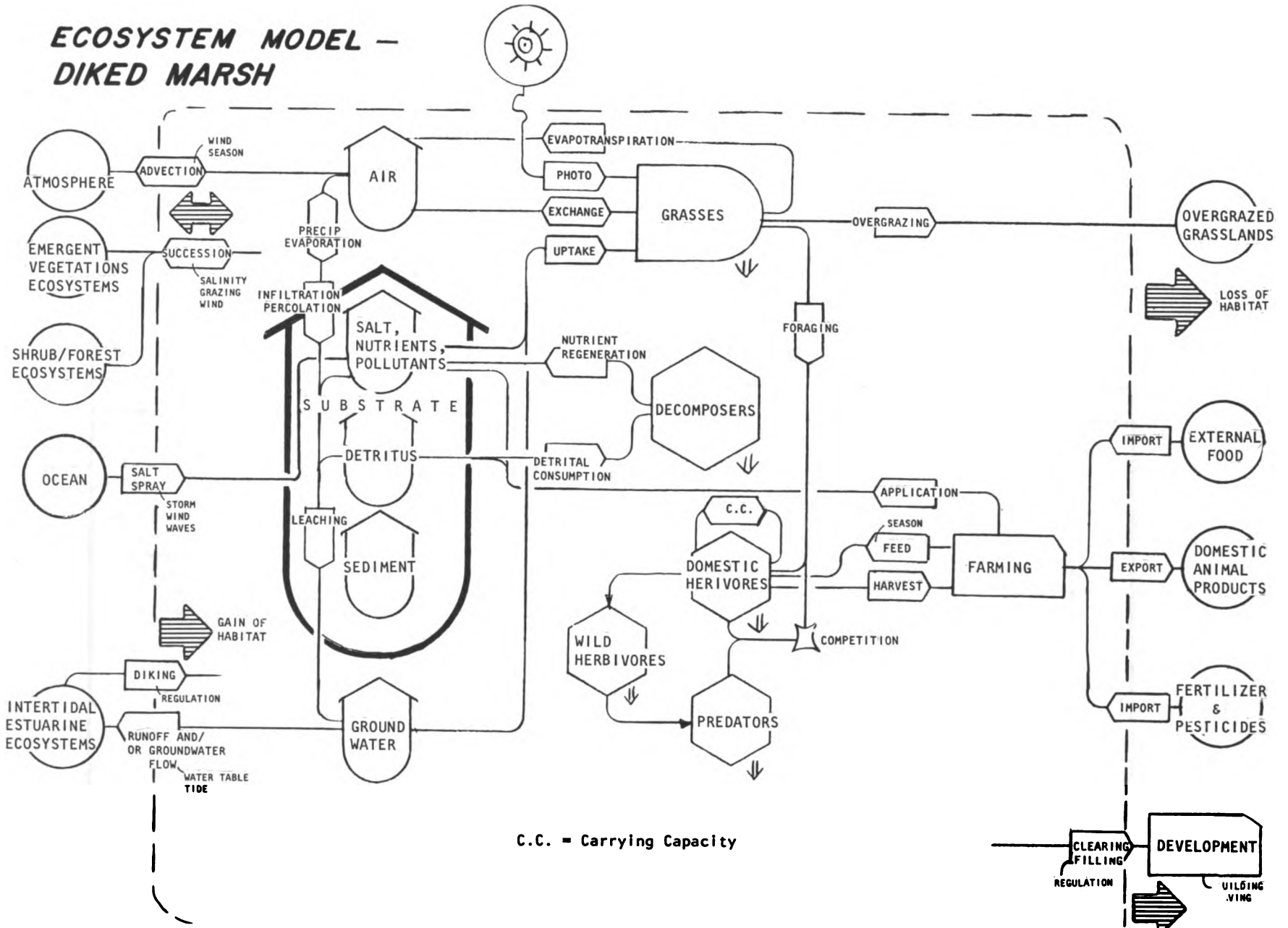
CALIDRIS MELANOTOS PECTORAL SANDPIPER	123456789	C	-
CALIDRIS MINUTILLA LEAST SANDPIPER	123456789	C	-
CAPELLA GALLINAGO COMMON SNIFE	123456789	C	G
CHARADRIUS VOCIFERUS KILLDEER	123456799	C	-
CISTOTHORUS PALUSTRIS LONG-BILLED MARSH WREN	123456789	C	-
HIRUNDO RUSTICA BARN SWALLOW	123456789	C	-
IRIDOPROCTE BICOLOR TREE SWALLOW	123456789	C	-
NUMENIUS AMERICANUS LONG-BILLED CURLEW	123456789	U	-
NUMENIUS PHAEOPIUS WHIMBREL	123456799	U	-
PETROCHELIDON PYRRHONOTA CLIFF SWALLOW	123456799	C	-
PLUVIALIS DOMINICA AMERICAN GOLDEN PLOVER	123456789	U	-
POZZANA CAROLINA SORA	123456739	U	-
PROGNE SUBIS PURPLE MARTIN	23456789	U	R
CALLUS LIMICOLA VIRGINIA RAIL	123456799	U	-
STELGIDOPTERYX RUFICOLLIS ROUGH-WINGED SWALLOW	123456789	C	-
TACHYGINETA THALASSINA VIOLET-GREEN SWALLOW	123456789	C	-

TROPHIC LEVEL: (9) INVERTEBRATE EATER  
 MAMMALS

EPTESTICUS FUSCUS BIG BROWN BAT	123456789	C	-
LASIONYCTERIS NOCTIVAGANS SILVER - HATRED BAT	123456799	C	-
LASTIURUS CINEREUS HOARY BAT	123456789	C	-
MYOTIS CALIFORNICUS CALIFORNIA MYOTIS	123456789	C	-
MYOTIS LUCIFUGUS LITTLE BROWN MYOTIS	123456799	C	-
MYOTIS THYSANODES FRINGED MYOTIS	456789	C	-
MYOTIS YUMANENSIS YUMA MYOTIS	123456789	C	-
SCAPANUS ORARIUS COAST MOLE	123456799	C	-



# ECOSYSTEM MODEL - DIKED MARSH



C.C. = Carrying Capacity



2.1.3 Above Tide  
 Estuarine Wetland  
 Zone  
 B Shrub Wetland

**SHRUB WETLAND**

Habitat Description

The habitat is typically found as a boundary condition between forest and estuarine grassland habitats and along channels and dikes. It provides cover and forage for several wildlife species of recreational value and adds habitat diversity to the estuarine zone.

Food Web

Browsing/grazing components of the food web predominate. Many species utilize the habitat for cover while feeding on adjacent estuarine grasslands.

Characteristic Flora

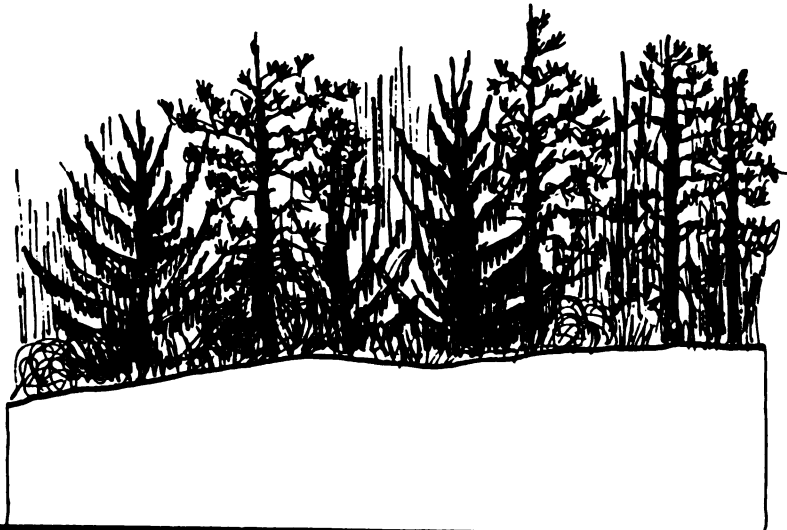
Blackberry, coast willow, western crabapple, coyote brush, California wax myrtle.

Characteristic Fauna

Mammals: brush rabbit, deer mouse, black-tailed deer, vagrant shrew, gray fox, skunk, rat.

Birds: ruffed grouse, ring-necked pheasant, fox sparrow, song sparrow, quail, warblers, red-winged blackbird, kingbird.

2.1.3 Above Tide  
 Estuarine Wetland  
 Zone  
 C Forested Wetland



### FORESTED WETLAND

Habitat Description

This habitat defines the landward boundary of the estuarine zone and is essentially a forested inland community. Environmental factors of storm winds and salt spray are not as significant as on headlands and dunes. However, succession may be restricted by saline conditions.

Food Web

The components of the food web are complex and have well-developed canopy and ground/floor compartments as well as a detritus compartment. Energy flow is predominantly through the detrital compartment.

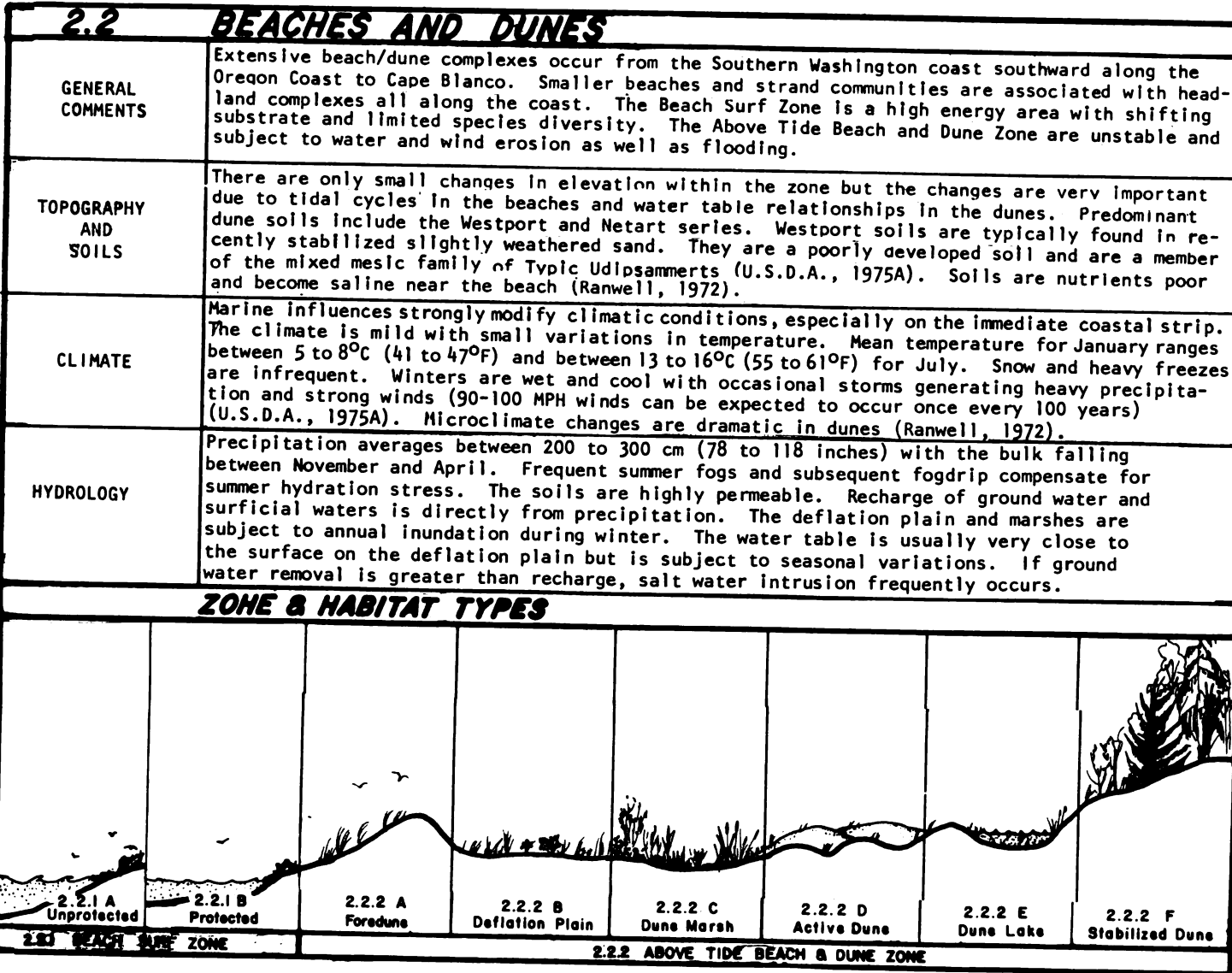
Characteristic Flora

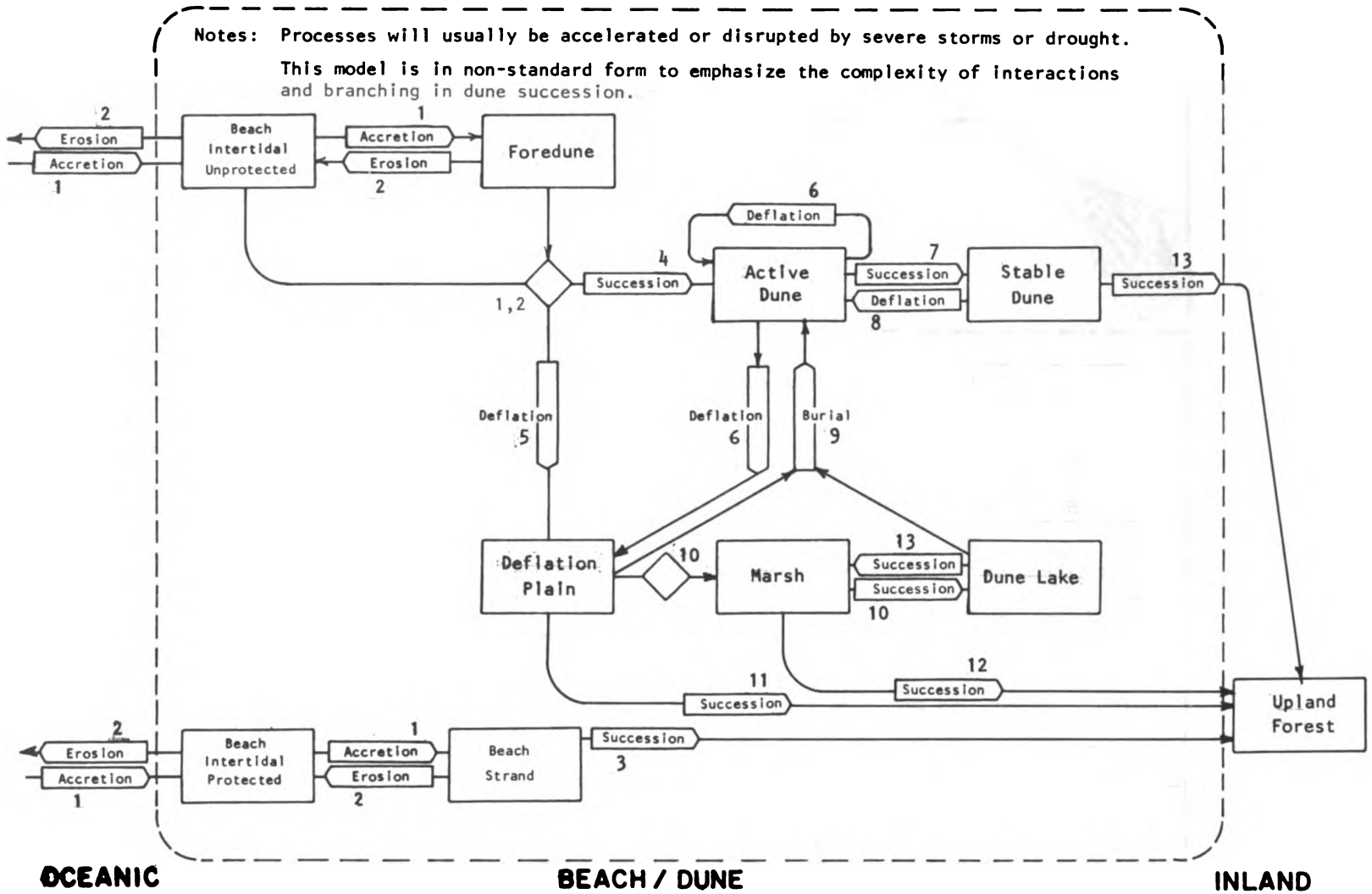
Sitka spruce, western hemlock, red alder, California wax myrtle, salal, red huckleberry, trailing blackberry, red elderberry.

Characteristic Fauna

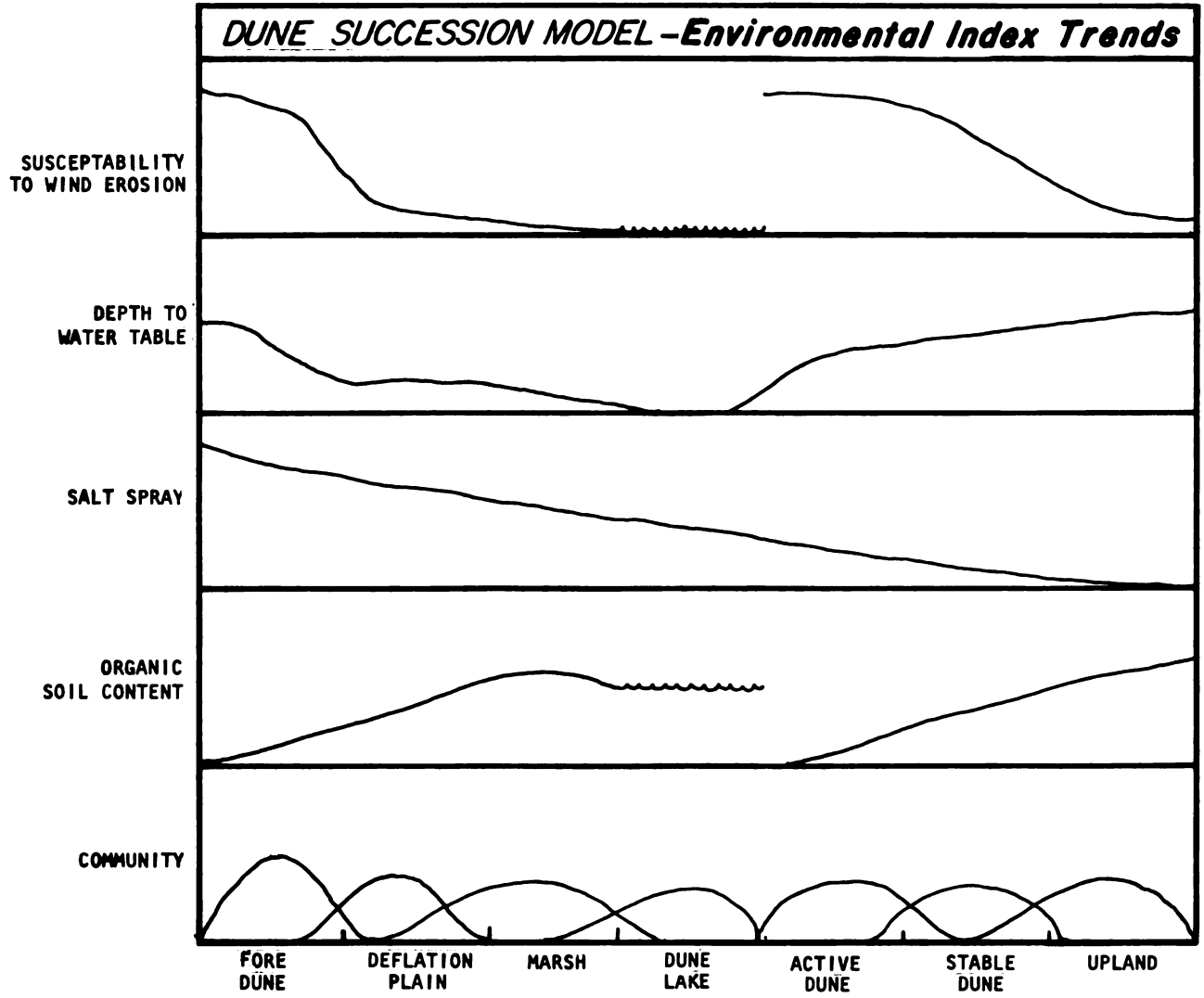
**Mammals:** chickaree, red and dusky tree mice, red-backed vole, deer mouse, vagrant shrew, Trowbridge shrew, mountain beaver, black-tailed deer.

**Birds:** Steller's jay, fox sparrow, chickadee, robin, crow, Oregon junco, winter wren, rufous-sided towhee, brown creeper, woodpeckers.





**SUCCESSION MODEL - BEACH & DUNE**



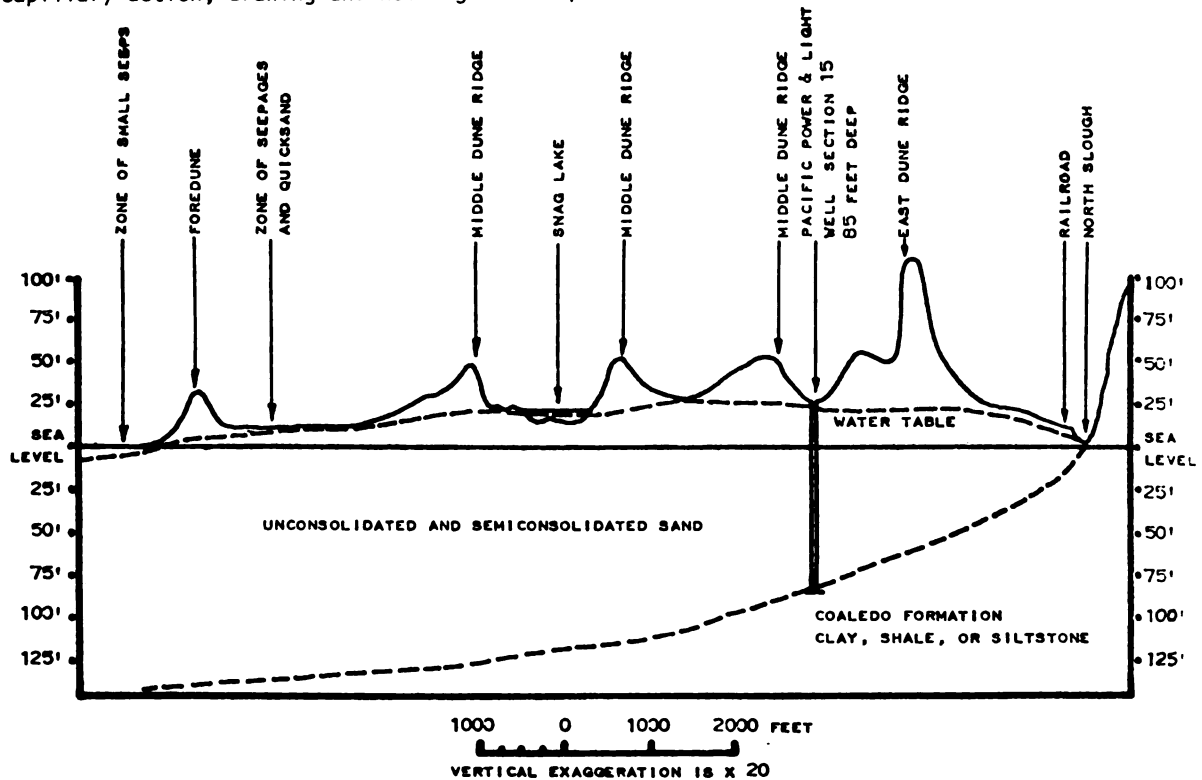
## CONTROLLING FACTORS FOR DUNE SUCCESSION MODEL

1. **Accretion:** The accretion process is dependent on the sediment availability, wave energy, and wind direction. A seasonal cycle occurs which erodes the beaches and fore dunes during winter due to high energy waves, and accretes during the summer when waves are better suited to carry bed loads towards shore. For more detail see Section 2.7.4 in Volume 1.
2. **Erosion:** As indicated in (1) above, erosion occurs seasonally, primarily during winter storms. Erosion can also occur if sediment transport mechanisms or sediment sources are altered. Sediment sources in the study area are primarily from enormous relict land deposits from earlier geological periods which occur on the shelf. These are augmented by bed and suspended loads from contemporary rivers which provide sediment adjacent to the shoreline. Longshore drift is the transport mechanism. On semi-protected beaches headlands are the sediment source. For more detail refer to Volume 1, Sections 2.2.4, 2.5.4, and 2.7.4 on sediments.
3. **Succession:** Under accreting conditions on a protected or semi-protected beach with a moderate sediment supply, the strand community can succeed directly to an upland forest type - typically Sitka spruce.
4. **Succession:** Under conditions of excessive sand supply, sand is blown from the beach, and forms active, unstable dunes. This was the prevalent condition prior to the introduction of European beach grass. The introduction of European beach grass and subsequent foredune formation is thought to have blocked the sand source to the active more inland dunes (Pinto et al., 1972; Czemeris, personal communication, 1977). Also sand supplies have been reduced for the last 3,000 years due to changes in sea level, runoff, and estuary entrapment.
5. **Deflation:** Under conditions of moderate sand supply and/or strong winds, sand can be removed by wind landward of the fore dune to near the level of the water table. The resulting landscape is called a deflation plain. The introduction of European beach grass has stopped sand transport to these areas. The results are expanding deflation plains as the sand starved active dunes move landward and leave deflation plains behind. Consequently acreage of the highly aesthetic active dune areas are being reduced. Rates, however, are not documented (Pinto et al., 1972; Czemeris, pers. comm., 1977).
6. **Deflation:** Deflation is frequent in active dunes, and occurs throughout the year. The process can move the dunes further inland, leaving a deflation plain behind in interdune areas.
7. **Succession:** Active dunes are eventually stabilized by increasing vegetative cover which results in changes in soil make up, litter, productivity, and community.
8. **Deflation:** After a dune has been stabilized it can be reactivated due to perturbations i.e., fire, removal of vegetation.
9. **Burial:** Moving active dunes frequently bury deflation plains and associated habitats. Vegetation of some dunes has been necessary due to lake encroachment (Pinto et al., 1972; Czemeris, 1977).
10. **Succession:** Deflation plains/marsh conditions are significantly affected by past and present water table levels, see Dune Hydrology on the next page.
11. **Succession:** Under conditions of low sand supply, deflation plains can succeed to upland forest types: typically lodgepole pine/Sitka spruce.
12. **Succession:** Dune lakes succeed to dune marshes, bogs, and finally uplands due to sedimentation in a sequence very similar to that shown in the Estuarine Succession Model, page 2.1-2.
13. **Succession:** Under continued accreting coastal conditions, stable dunes are effectively moved from the marine influences and succeed to inland forest conditions.

## DUNE HYDROLOGY

Precipitation on the dunes is generally the major source of ground water, although in some areas ground water flows from inland sources through the dunes to seeps in the beach area or further out from shore. Part of the precipitation returns to the atmosphere by evaporation and transpiration. The remaining precipitation falls into lakes or infiltrates into sand and recharges the water table. In areas underlain by rocks of low permeability, small streams may form and run off into the sea.

The water table profile in a dune area is shown below. The general features of this example, from the Coos-Coquille Watershed Unit, are representative for the region. Note the lensing (upward bulge) of the water table under the central part of the dunes. While some of this may be due to hydrostatic pressure from inland ground water sources, it is primarily the result of capillary action, drawing and holding water up in the dunes.



GROUND WATER PROFILE FOR A "TYPICAL" DUNE ZONE. This example is for Snag Lake in Watershed Unit 7. (Drawing from Pinto et al., 1972. Source: Brown and Newcomb, 1963.)

Some dune lakes are surface expressions of the water table and are continuous with aquifers underlying the lake. Water in the saturated zone is constantly moving through the permeable formations and most water eventually seeps into the ocean. Due to layers of clay in old dune formations below sea level, horizontal movement of water, measured in the dunes between Tenmile Creek and North Bend, is much more rapid than vertical movement by a ratio of 150:1 (Pinto et al., 1972).

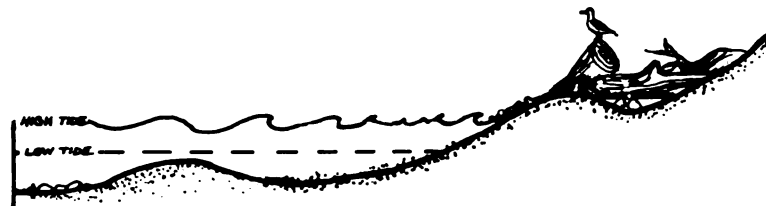
The dynamic action of infiltration movement and discharge maintains fresh water throughout the aquifer beneath the dunes north of Coos Bay. Although data are limited for the rest of the region (Pinto et al., 1972), this condition may be assumed to be typical of dune systems throughout the Pacific Northwest. Exceptions may be expected, however, when rainfall is low and connection with fresh water aquifers is absent.

Salt water may underlie fresh in the water table (Robinson, 1973), and may intrude into aquifers when the rate of replenishment is low or when this rate is exceeded by the rate of fresh water removal through wells. Lake levels may drop when wells in a connecting aquifer are heavily pumped and pollutants that seep, or are discharged, into the ground may be drawn toward and into the well (Pinto et al., 1972).

The dunes and the water table underlying them are in a state of dynamic equilibrium. Activities of man can have serious impacts on this relatively fragile system.



2.2.1 Beach Surf Zone  
A Unprotected Beach



### UNPROTECTED BEACH

#### Habitat Description

Open ocean beaches are exposed to surf action all year. As a result of waves and associated currents, the sands are continually in motion parallel to the coast and offshore or onshore depending on the season. Summer movement is toward the south and onshore; winter movement is toward the north and offshore. Because of pounding waves and shifting sands this is a rigorous environment as reflected by the reduced standing crops and low diversity. Diatom community in surf zone water column is distinct from that beyond the breakers. Habitat extends from driftwood on berm seaward to breaker depth and includes the foreshore and nearshore. Logs and other debris are stranded behind the berm.

#### Food Web

Lower beach macrofauna (burrowing in sand) depend primarily on surf zone phytoplankton. Meiofauna (living on and between sand grains) depend mainly on dissolved organic matter and microdetritus filtered from sea water by sand. Beach wrack at and above high tide line is food source for scavengers such as beach hoppers.

#### Characteristic Flora

Surf zone water column often dominated by one species of diatom, *Chaetoceros armatum*, associated with *Asterionella socialis* (Lewin and Mackas, 1972).

#### Characteristic Fauna

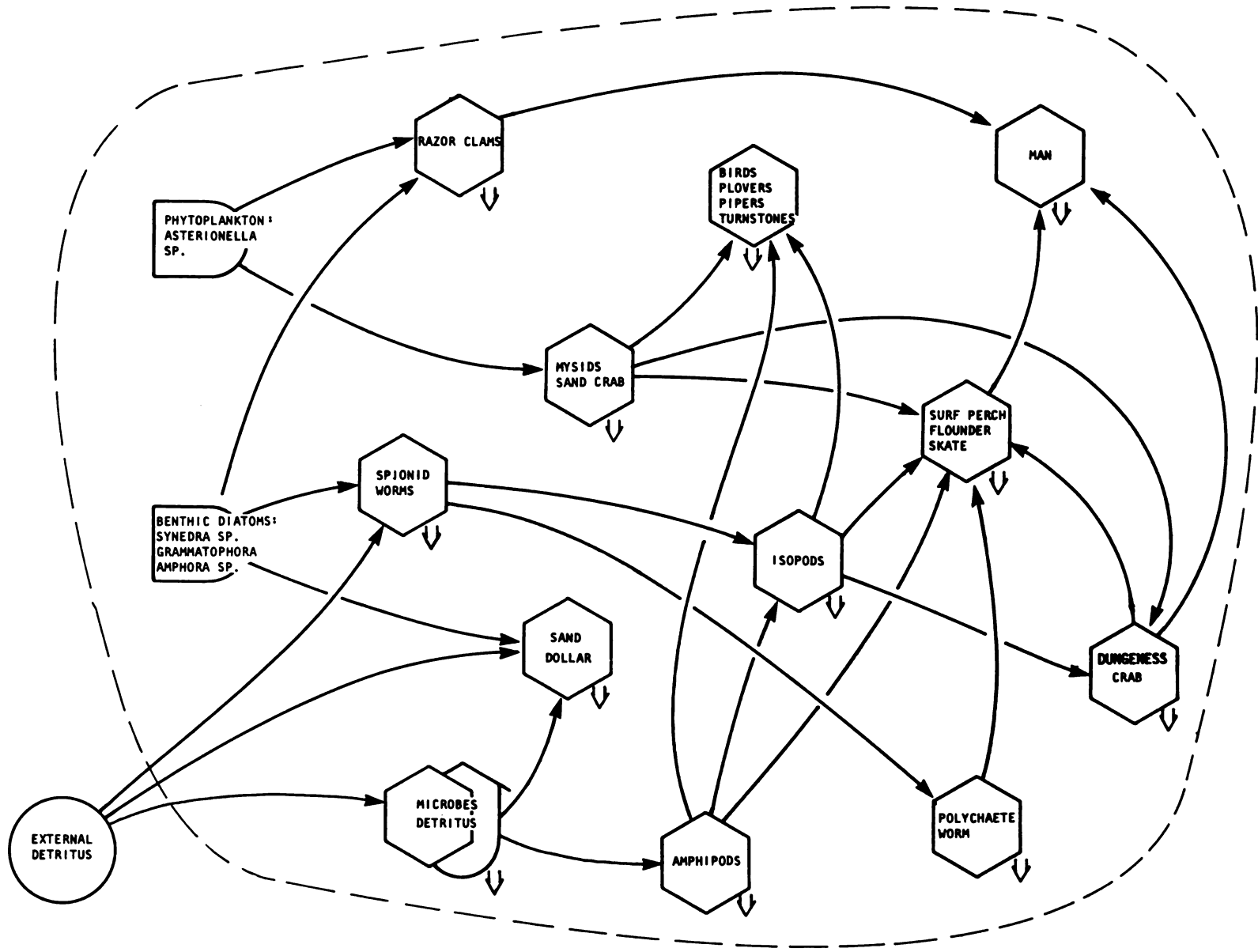
Invertebrates: razor clam, mole crab, purple olive snail, nereid worms, blood worm, shrimp, mysids, amphipods, isopods.

Fish: surf perch, starry flounder.

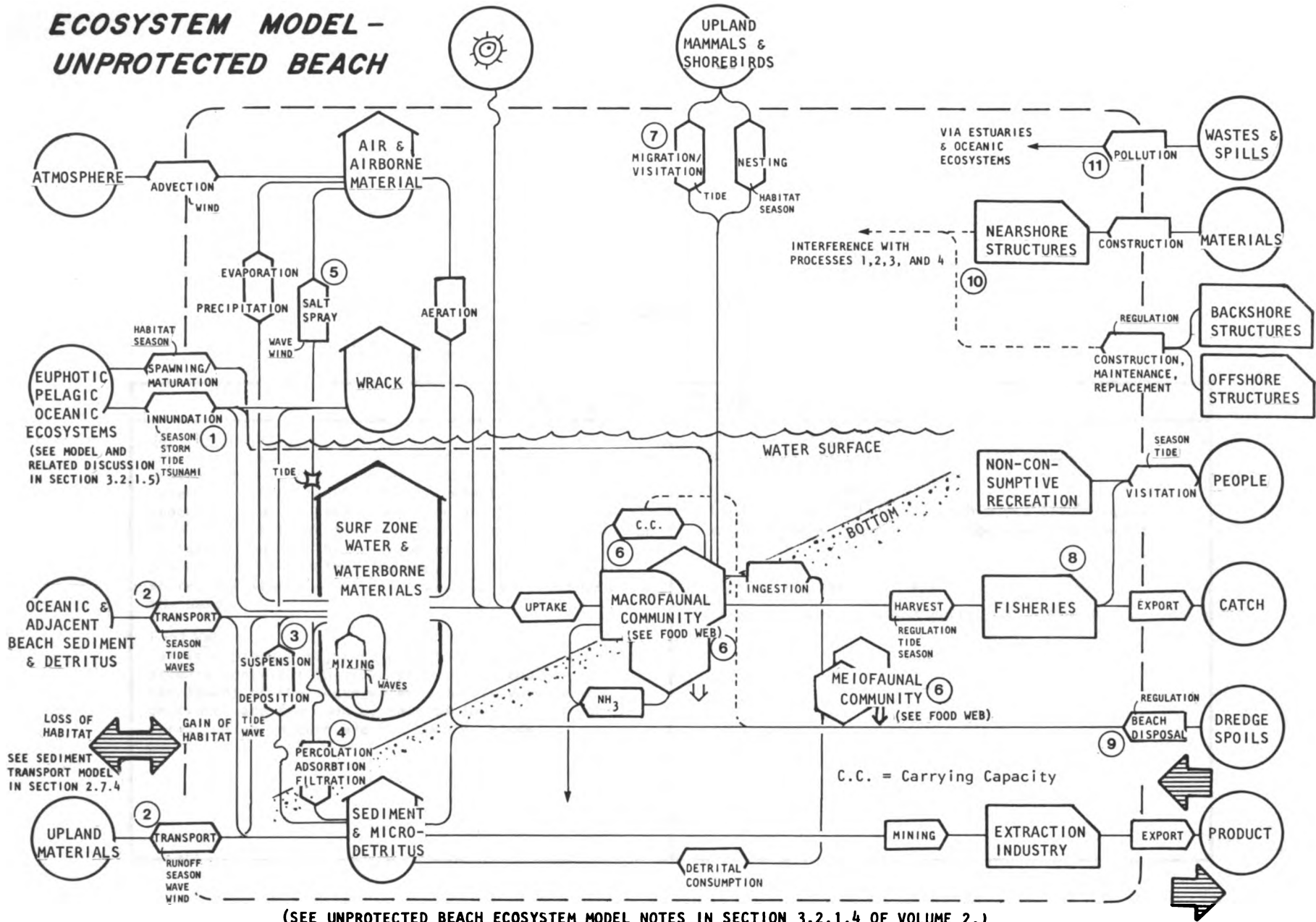
Birds: gulls, sanderling.

# FOOD WEB - UNPROTECTED BEACH

2.2.1 A - 2



# ECOSYSTEM MODEL - UNPROTECTED BEACH



(SEE UNPROTECTED BEACH ECOSYSTEM MODEL NOTES IN SECTION 3.2.1.4 OF VOLUME 2.)

2.2.1 Beach Surf Zone  
B Protected Beach



### PROTECTED BEACH

#### Habitat Description

Low energy beaches associated with headlands and behind protective barriers (e.g. offshore reefs). More organic material in sand than on the unprotected beaches. Beaches not as subject to erosion and hence provide a more stable habitat for the more diverse fauna found on protected beaches than on beaches subject to the pounding surf. Habitat includes foreshore and near-shore. Driftwood and beach wrack are stranded behind the berm.

#### Food Web

Detritus plays a major role in the food web. Additional primary contributions come from the phytoplankton complement of the ocean water. Detritivores and omnivores are fed upon by several invertebrate carnivores, which in turn are fed upon by birds.

#### Characteristic Flora

No significant primary production occurs.

#### Characteristic Fauna

**Invertebrates:** isopods, amphipods, beach hopper, spionid worms, phoronids, Dungeness crab, hermit crab.

**Fish:** surf perch, flatfish.

**Birds:** shorebirds and gulls.

2.2.2 Above Tide Beach  
and Dune Zone  
A Foredune



### FOREDUNE

#### Habitat Description

The foredune is a vegetated ridge of sand paralleling the beach just inland of the logs and debris. Where extensive beaches and dunes occur along with European beach grass, the ridge is well elevated and pronounced. Smaller beaches interspersed with headlands have an unpronounced vegetated ridge generally called "beach strand." The habitat is subject to severe physical stresses (deflation, flooding, salt spray, and desiccation), and is characterized by hylophytic vegetation.

#### Food Web

There is principally a grazing food web on foredunes. It becomes detritus-based on strand communities where detrital inputs from the marine system are an important food source for beach hoppers and dependent organisms. Due to severe environmental conditions, primary productivity is low.

#### Characteristic Flora

European beach grass, American sea rocket, American dune grass, beach pea, and giant vetch are typical of foredunes. In strand communities big head sedge, dune wild eye, and seaside plantain are more common.

#### Characteristic Fauna

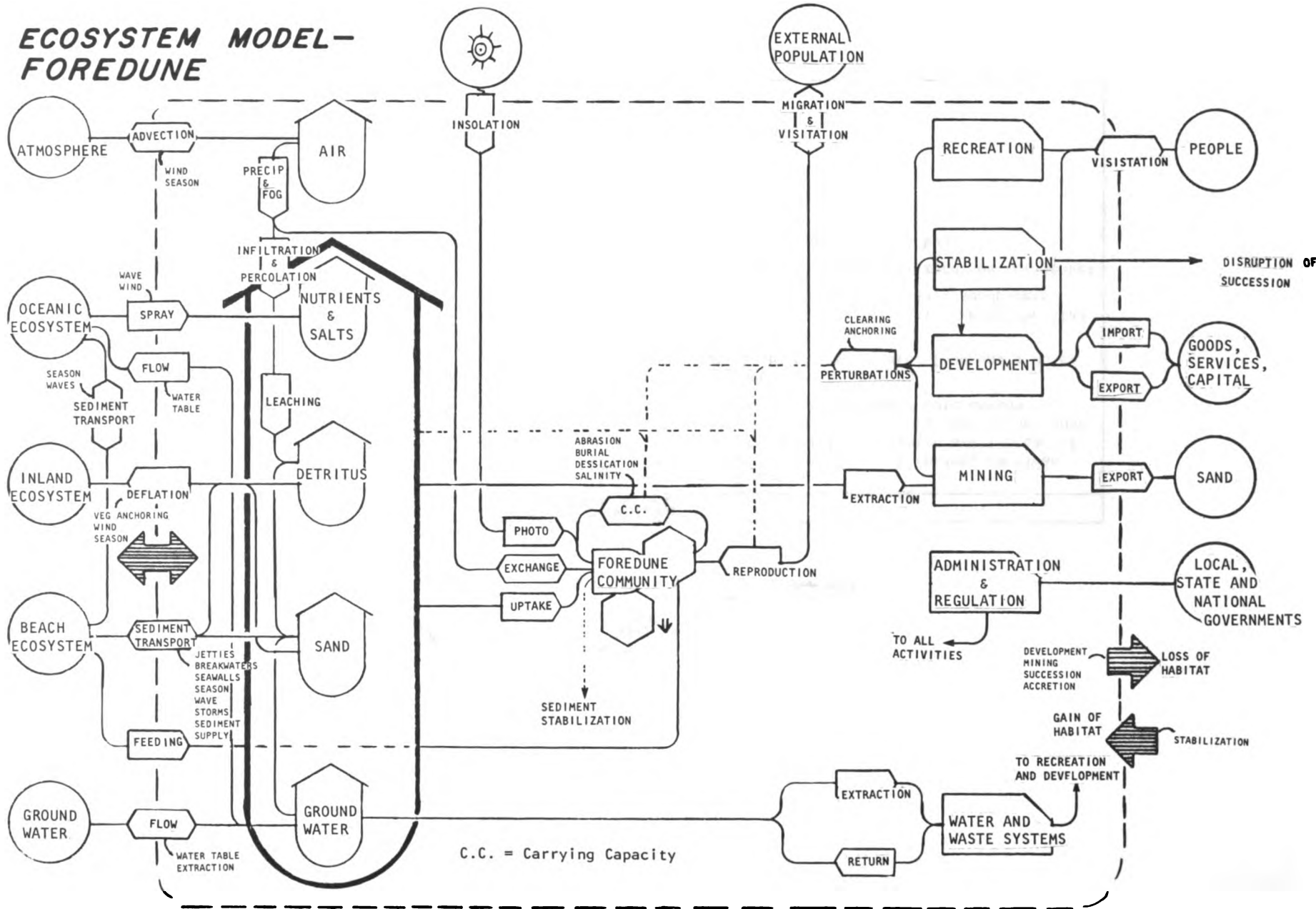
**Mammals:** vagrant shrew, deer mouse, Townsend's vole, California ground squirrel.

**Birds:** Savannah sparrow, gulls, dunlin, black-bellied plover, snowy plover, western and least sandpipers.

**Herpetofauna:** northern alligator lizard, garter snakes.

**Invertebrates:** beach hoppers, pill bug.

# ECOSYSTEM MODEL - FOREDUNE



2.2.2 Above Tide Beach  
and Dune Zone  
B Deflation Plain



### DEFLATION PLAIN

Habitat Description

The plain usually occurs landward of the fore dune and between dune ridges. It is a low, flat plain with the water table near the surface and frequently ponds during the winter. The water table varies considerably with season. This habitat is dryer than the dune marsh.

Food Web

A grazing food web predominates in the deflation plain.

Characteristic Flora

Douglas aster, slough sledge, smooth cats-ear rushes, common silverweed, spring bank clover, coast willow, western crabapple, red alder.

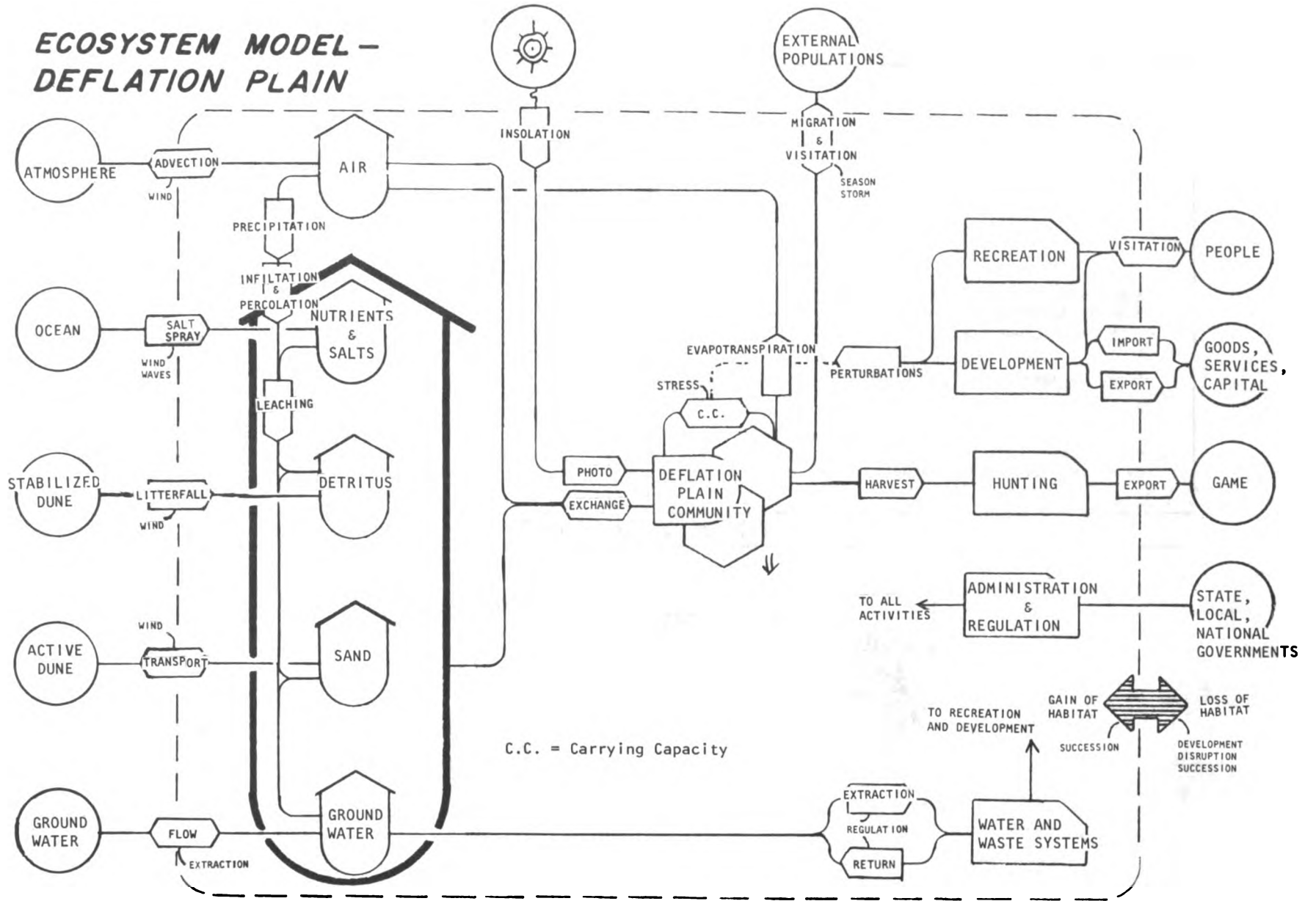
Characteristic Fauna

Mammals: coyote, black-tailed deer, creeping vole, Townsend's vole, vagrant shrew.

Birds: long-billed marsh wren, Savannah sparrow, cedar waxwing, western meadowlark, brown-headed cowbird, red-tailed hawk, American kestrel, marsh hawk, short-eared owl, snowy owl.

Herpetofauna: garter snakes.

# ECOSYSTEM MODEL - DEFLATION PLAIN





2.2.2 Above Tide Beach  
and Dune Zone  
C Dune Marsh



## DUNE MARSH

### Habitat Description

The dune marsh usually occurs landward of the foredune and between dune ridges. It is a low, flat plain with the water table near the surface and frequently ponds during the winter. The water table varies considerably with the season, being highest in winter and lowest in late summer. This habitat is typically covered with water six to nine months of the year (Wiedemann, A.M., pers. comm. 17 August 1978, The Evergreen State College, Olympia, Washington 98505).

### Food Web

A grazing food web predominates.

### Characteristic Flora

Douglas aster, slough sledge, smooth cats-ear, rushes, common silverweed, spring bank clover, coast willow, western crabapple, red alder.

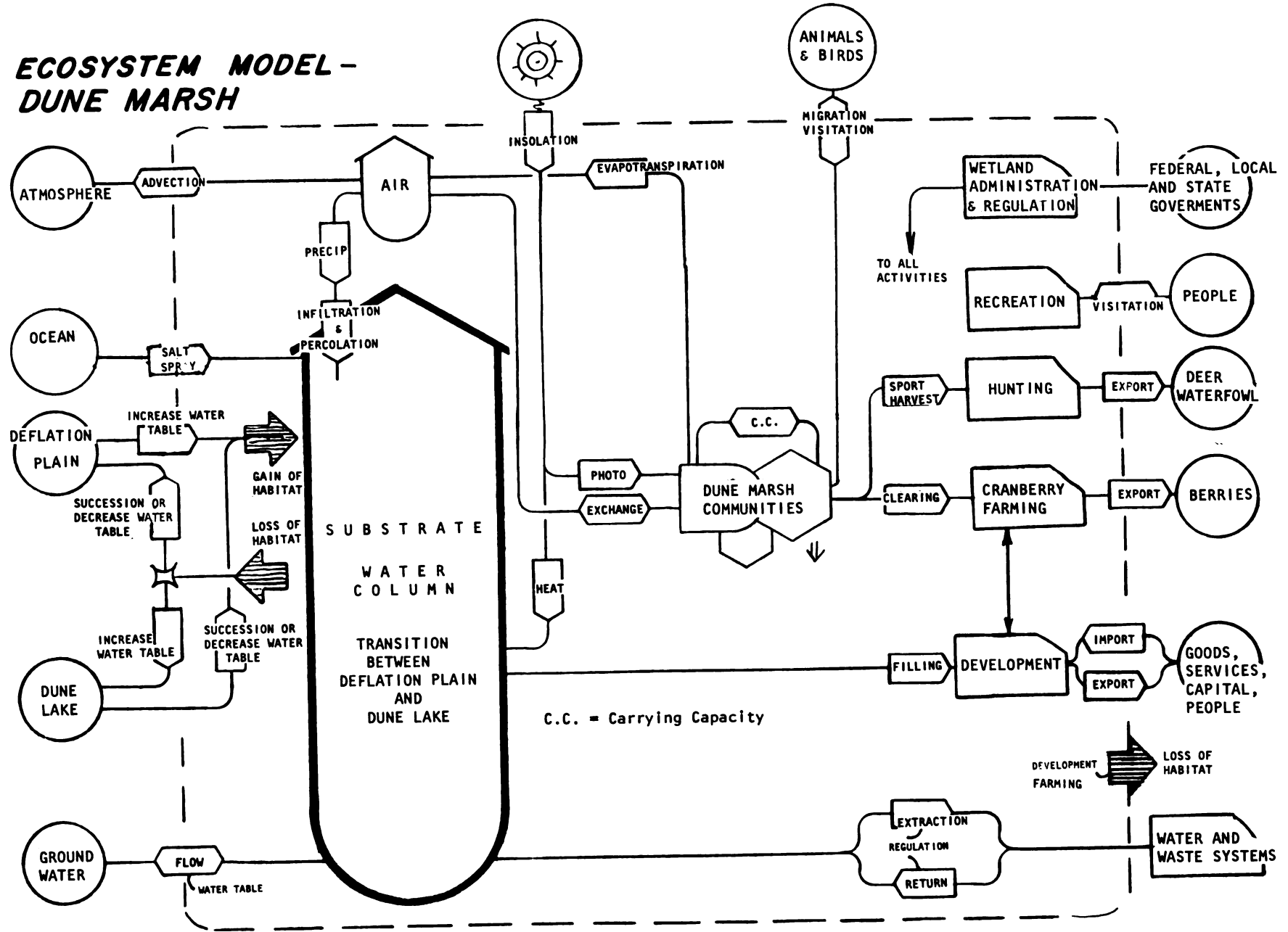
### Characteristic Fauna

**Mammals:** coyote, black-tailed deer, creeping vole, Townsend's vole, vagrant shrew.

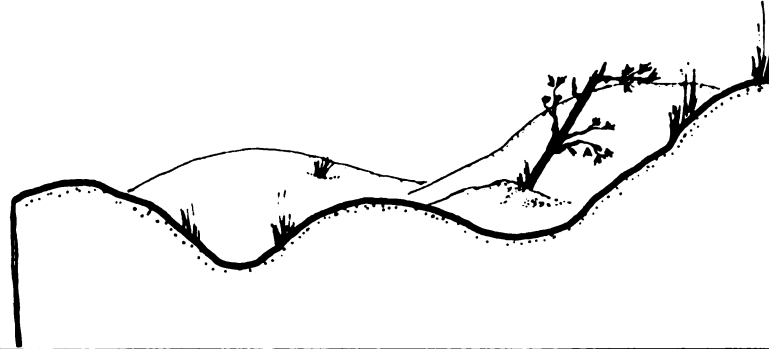
**Birds:** long-billed marsh wren, Savannah sparrow, cedar waxwing, western meadowlark, brown-headed cowbird, red-tailed hawk, American kestrel, marsh hawk, short-eared owl, snowy owl, waterfowl (particularly swans).

**Herpetofauna:** garter snakes.

# ECOSYSTEM MODEL - DUNE MARSH



2.2.2 Above Tide Beach  
and Dune Zone  
D Active Dune



**ACTIVE DUNE**

Habitat Description

Wind drifted sand in the form of dunes and ridges inland of the foredune. These are nonvegetated or sparsely vegetated and are unstable moving land forms subject to wind erosion.

Food Web

Productivity is limited and components of the food web are abbreviated.

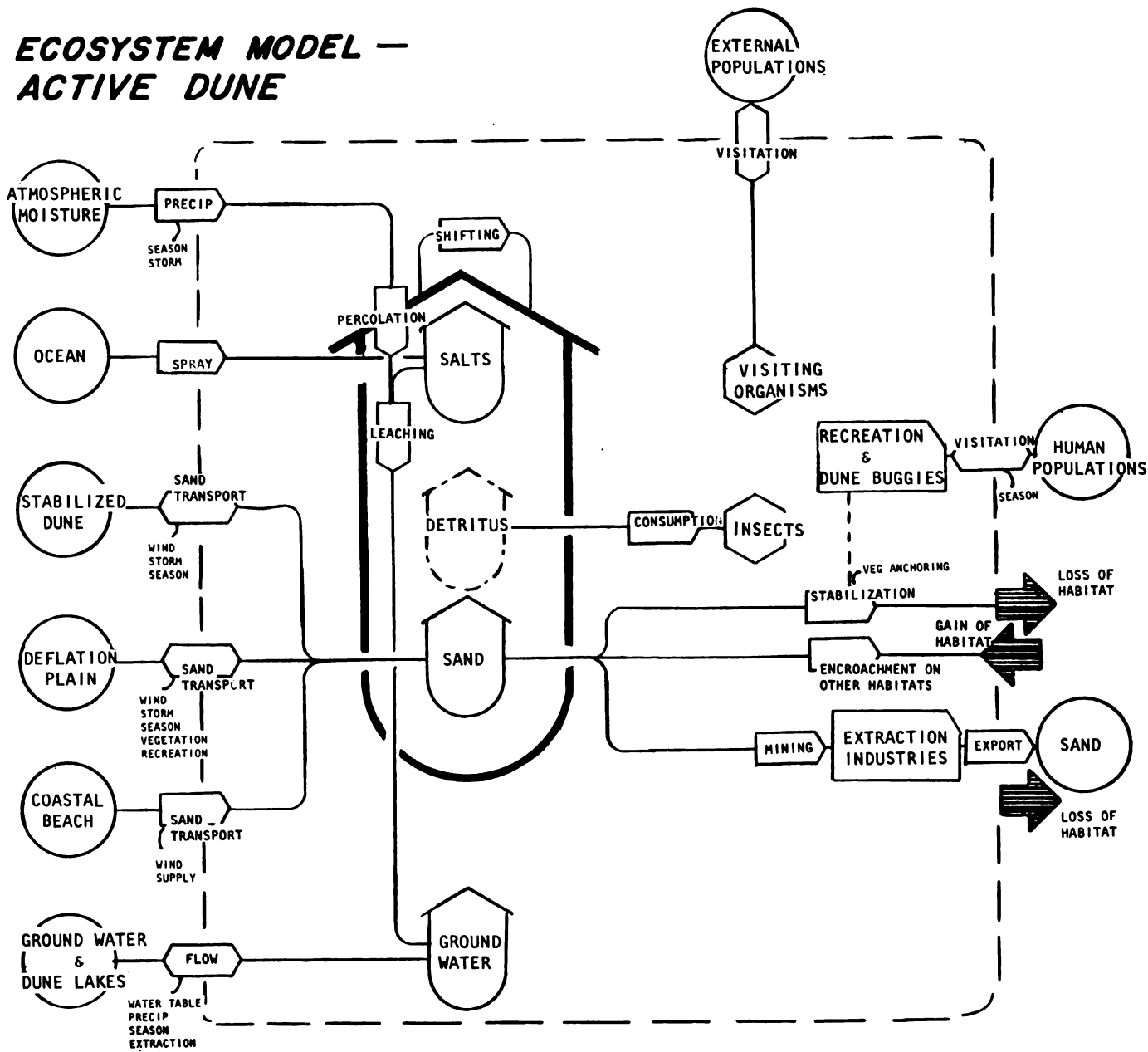
Characteristic Flora

Seashore bluegrass, large-headed sedge, European beach grass, pussy-toes, seashore lupine, seaside plantain, beach sea, shore pine.

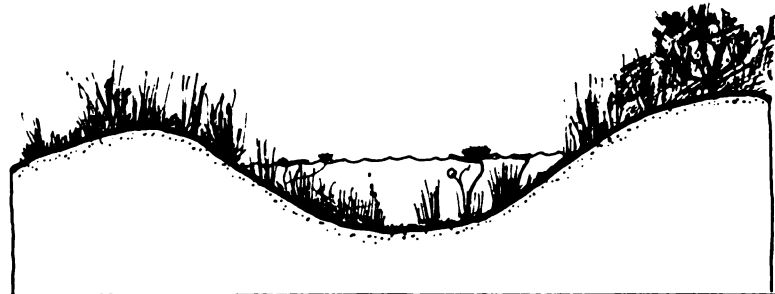
Characteristic Fauna

Grazing insects, spiders, ants; very limited faunal community.

# ECOSYSTEM MODEL — ACTIVE DUNE



2.2.2 Above Tide Beach  
and Dune Zone  
E Dune Lake



### **DUNE LAKE**

**Habitat Description**

Dune lakes are shallow, mesotrophic/eutrophic, and occasionally dystrophic. Most are seep lakes and are recharged through ground water. They are primarily formed by deflation followed by a rising in the water table.

**Food Web**

Components of the food web are both grazing and detritus based; the benthos are detritivores and the water column species are grazers. Top carnivores feed on both components.

**Characteristic Flora**

**Water Column:** (plankton) diatoms, green and blue-green algae, filamentous algae.

**Rooted Macrophytes:** cattails, Elodea, slough sedge, epiphytic algae.

**Characteristic Fauna**

**Mammals:** raccoon, mink, beaver, muskrat, river otter.

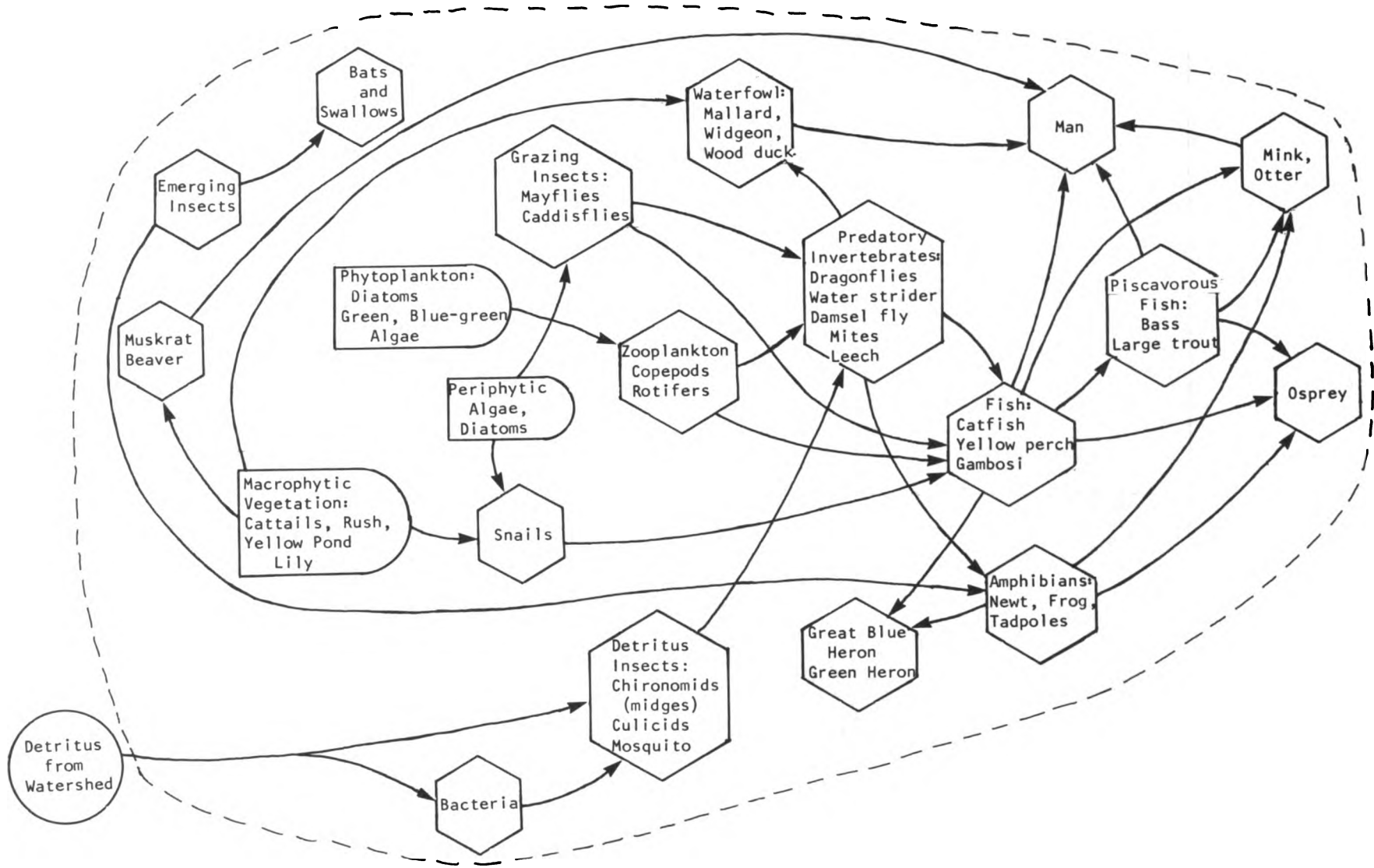
**Birds:** Canada goose, mallard, teals, great blue heron.

**Herpetofauna:** bullfrog, rough-skinned newt.

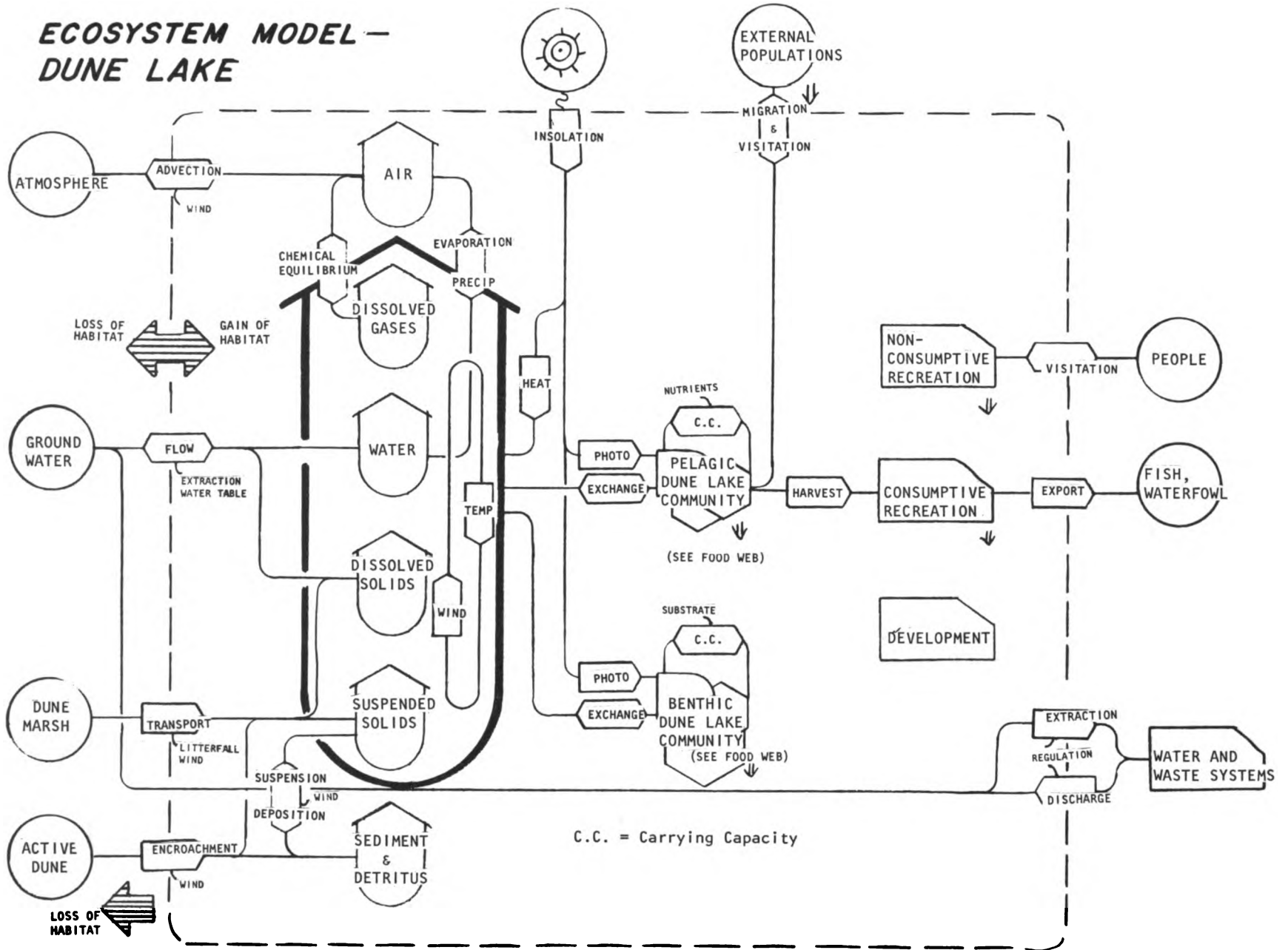
**Fish:** cutthroat trout, rainbow trout, yellow perch, largemouth bass, stickleback.

**Invertebrates:** chironomids, sphaeriids, gastropods, rotifers, cladocerans, copepods.

# FOOD WEB- DUNE LAKE



# ECOSYSTEM MODEL - DUNE LAKE





2.2.2 Above Tide Beach  
and Dune Zone  
F Stabilized Dune

**STABILIZED DUNE**

Habitat Description

Well vegetated and stabilized dune. Characterized by an uneven-aged forest stand with open canopy and well-developed shrub layer. Snags are common. Soils are moderately well-developed with Netarts soils predominating.

Food Web

The components of the food web are multi-layered and have well-developed grazing and detrital compartments.

Characteristic Flora

Shore pine, Sitka spruce, Douglas fir, salal, evergreen huckleberry, trailing blackberry, salmon-berry.

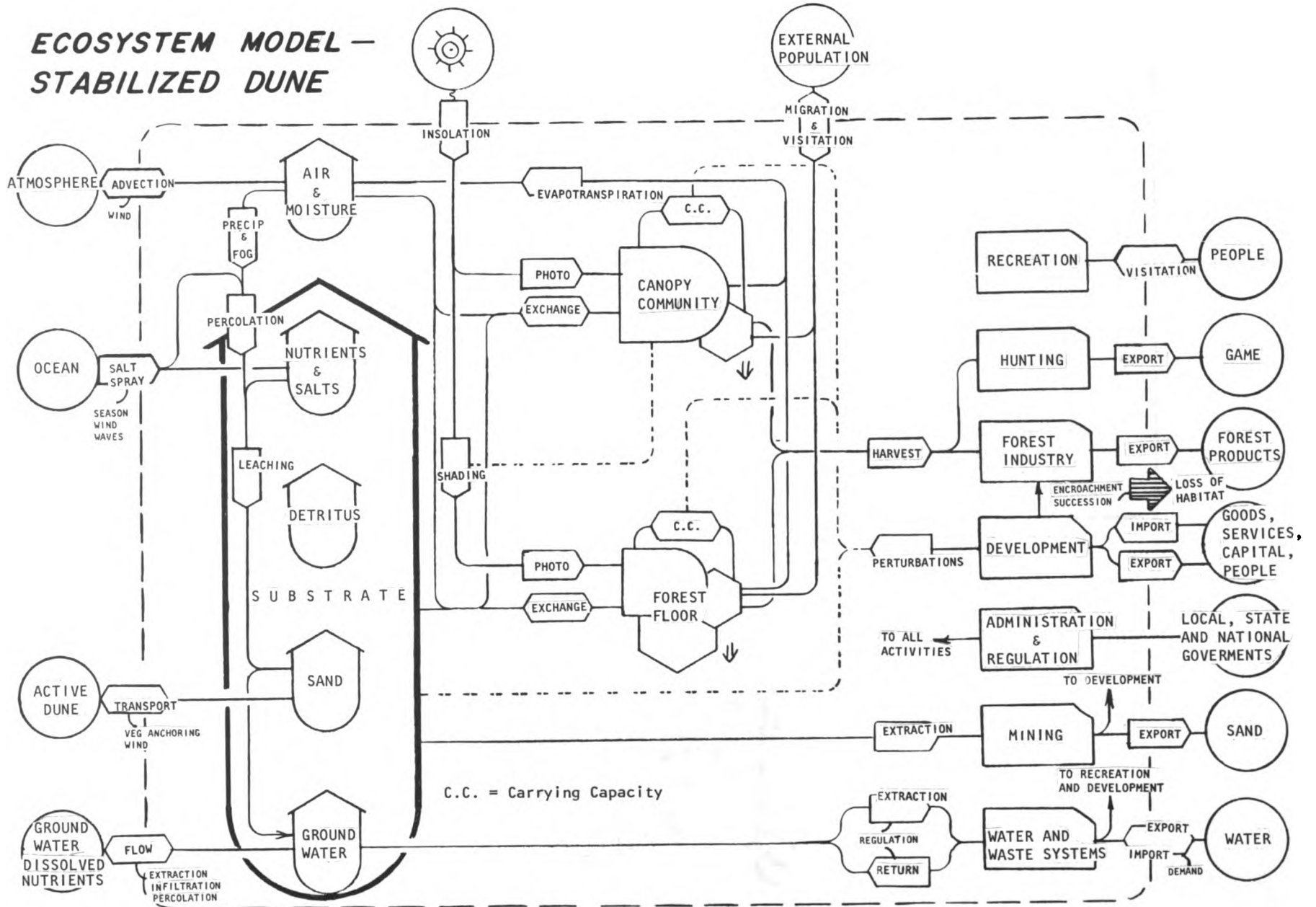
Characteristic Fauna

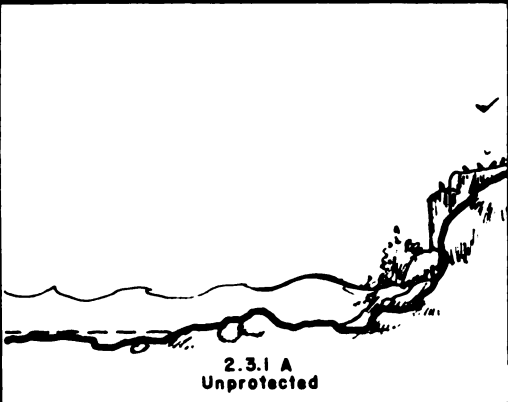
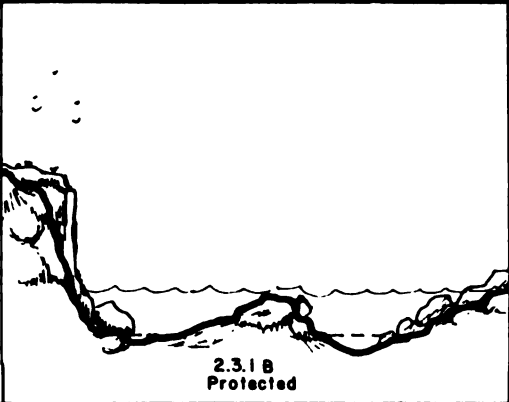

Mammals: black-tailed deer, northern flying squirrel, Douglas squirrel, Beechey ground squirrel, snowshoe hare, brush rabbit, hoary bat, masked shrew, dusky shrew, striped skunk.

Birds: barn owl, Steller's jay, crow, varied thrush, pine siskin, song sparrow, accipiter hawks, robin, nuthatch, yellow-bellied sapsucker, screech owl.

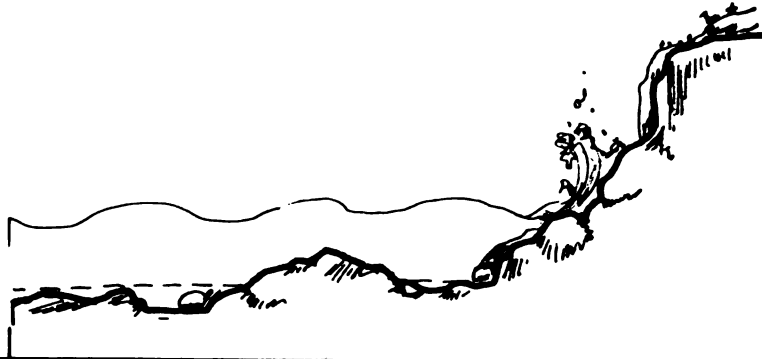


# ECOSYSTEM MODEL — STABILIZED DUNE



<b>2.3 HEADLANDS &amp; ROCKY ISLANDS</b>		
<b>GENERAL COMMENTS</b>	Headlands are marine/terrestrial ecotones typical of open rocky coasts. They are stressful, high energy environments. Coastal islands occur all along the coast except in the vicinity of the Columbia River mouth. Many support important sea bird colonies and hauling areas for marine mammals. Intertidal areas are subject to severe physical and chemical conditions. Some Oceanic habitats (e.g. Surfgrass) overlap with the Rocky Surf Zone.	
<b>TOPOGRAPHY AND SOILS</b>	Headlands are typically steep and precipitous. Soils are generally local in origin and derived from basalt north of Cape Blanco and of sedimentary material south of the Cape. Cliffs can drop directly into the marine system to moderate depths. Slumping of cliffs is the sediment source for many local beaches.	
<b>CLIMATE</b>	Climate is maritime with fluctuations of temperature and precipitation muted. Mean temperature ranges between 5° and 8°C (41 to 46°F) for January and between 14° and 16°C (57 to 61°F) for July. Snow and heavy freezes are atypical. Winters are wet and cool with occasional storms generating heavy precipitation, extreme tidal ranges, and strong winds. Strong winds frequently break off trees and carry salt spray inland which strongly influences the makeup of the habitat.	
<b>HYDROLOGY</b>	The three major water inputs to the Above Tide area are winter precipitation, salt spray, and summer fog drip. Fresh water aquatic habitats are uncommon. Discharge is usually directly into the ocean. Waves are concentrated on headlands, and local currents can be severe.	
<b>ZONE &amp; HABITAT TYPES</b>		
 <p>2.3.1 A Unprotected</p>	 <p>2.3.1 B Protected</p>	 <p>2.3.2 A Headlands &amp; Rocky Islands</p>
<b>2.3.1 ROCKY SURF ZONE</b>		<b>2.3.2 ABOVE TIDE ROCKY SHORE ZONE</b>

2.3.1 Rocky Surf Zone  
A Unprotected  
Headlands &  
Rocky Islands



### ROCKY SURF - UNPROTECTED

#### Habitat Description

This zone is characterized as a high energy environment. Both plant and animals living in this zone must be able to withstand the force of the pounding surf. Many of the organisms must also be adapted to extreme temperatures and salinity variability, as well as exposure to fresh water rain conditions. This habitat is coincident with part of the near-shore Kelp habitat (3.1.2B) and of the Surfgrass habitat (3.1.2 A) of the oceanic Vegetated Benthic Zone.

#### Food Web

The food chains are quite short (often with only three trophic levels) and include at least the following modes of feeding: planktonic foods extracted by filter feeders; macroalgae harvested by the grazing animals; bacteria and periphyton eaten by other grazers. Predators are from both the terrestrial and marine realms.

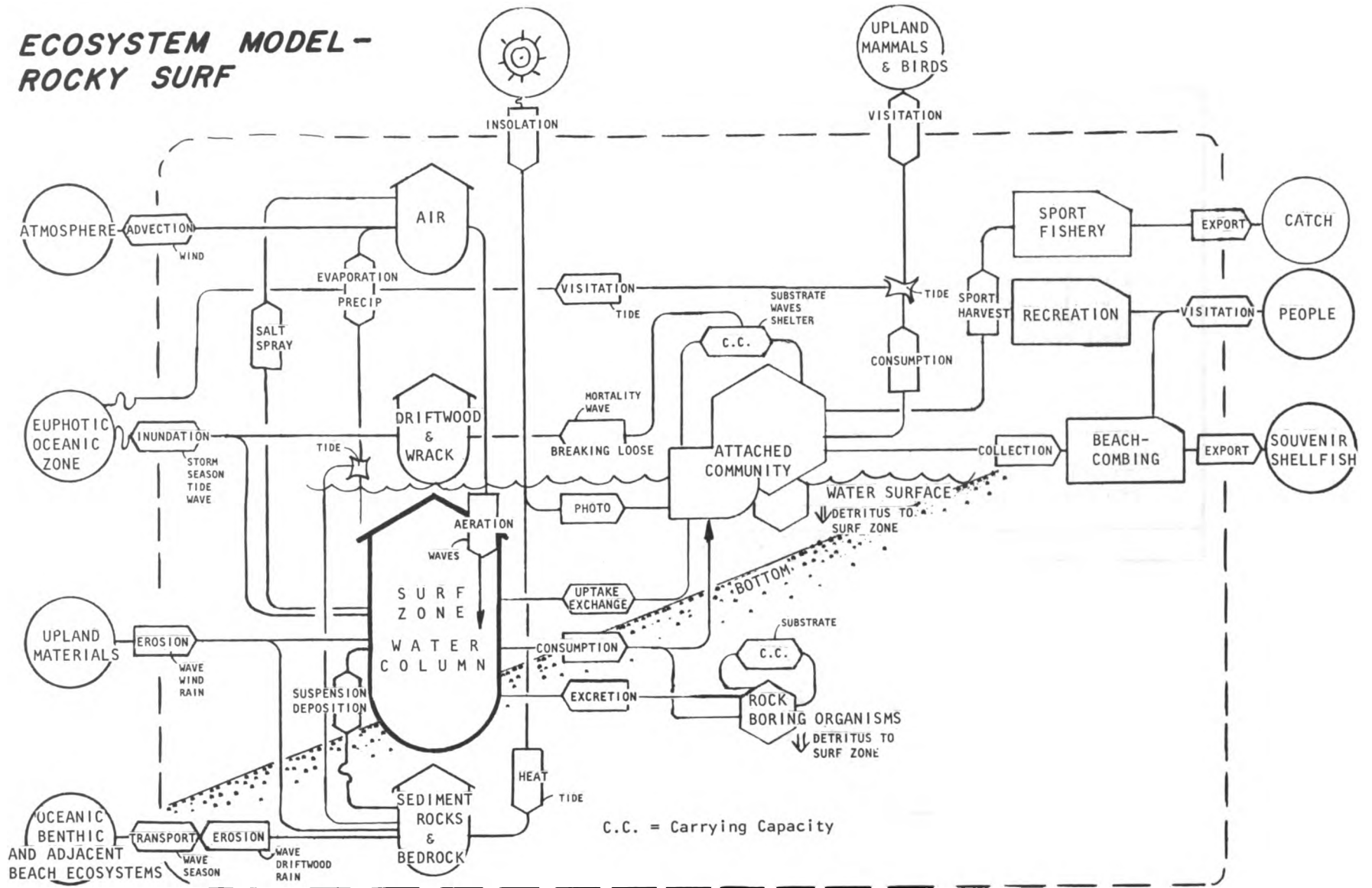
#### Characteristic Flora

Macroalgae are the most visible flora. Important genera include Ulva, Fucus, Postelia, Iridophycus, Corallina, Lamanacia, and Lithothamnium. A surfgrass (Phyllospadix scouleri) is the principal vascular plant. Benthic diatoms are probably important. Distinct intertidal benthic zonations are found.

#### Characteristic Fauna

The mussel, Mytilis californianus, and the goose barnacle, Mitella polymeris, are characteristic and important species. These species form a biotic substrate which provides the necessary habitat for many other species. The predacious starfish, Pisaster ochraceus, is also characteristic.

# ECOSYSTEM MODEL - ROCKY SURF



2.3.1 Rocky Surf Zone  
 B Protected  
 Headlands and  
 Rocky Islands



### ROCKY SURF - PROTECTED

#### Habitat Description

The wave energy in this region is lower than for unprotected headlands, but is high enough so that almost no fine sediments and very little sand occurs. The organisms must be adapted to the extremes in temperature and salinity characteristic of this environment. Vertical zonation is very pronounced. Parts of two oceanic Vegetated Benthic Zone habitats coincide with this habitat; they are Surfgrass (3.1.2 A) and nearshore Kelp (3.1.2 B).

#### Food Web

The food web consists of three rather short and distinct food chains, as were characteristic of the unprotected coast. Surfgrass becomes much more prevalent in this area and the associated community is important.

#### Characteristic Flora

Surfgrass (*Phyllospadix torreyi* and *P. scouleri*) is important. Attached macroalgae are abundant in this region.

#### Characteristic Fauna

Most of the species found in the unprotected outer coast are also found in this region, but some added forms are also apparent. The various sea anemones (*Auttroplewra* spp.) are especially notable. Various sea stars and brittle stars also occur.

2.3.2 Above Tide Rocky  
Shore Zone  
A Headlands and  
Rocky Islands



### ABOVE TIDE - HEADLANDS & ROCKY ISLANDS

Habitat

This habitat occurs on steep topography, shallow soils, and non-erosive substrate above the previously described salt spray zone and seaward of the coastal forests. Islands are small and are usually within ten miles of shore.

Food Web

On terrestrial habitats, browsing components of the food web are typical. The food web on islands is limited. However, islands provide a base from which sea birds and marine mammals exploit marine food sources.

Characteristic Flora

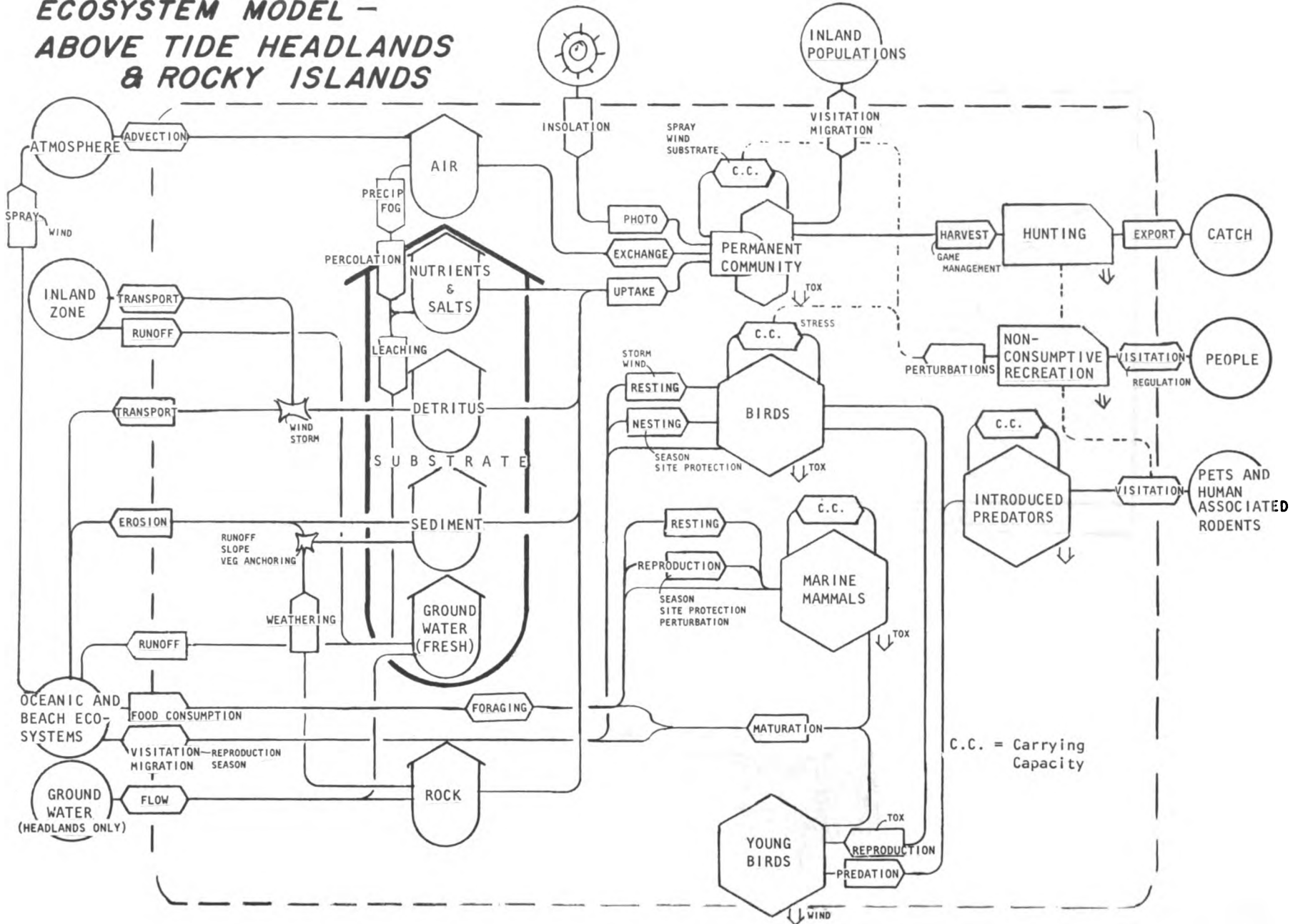
Vegetation is low lying, gradating from herbacious plants nearest the coast (seaside plantain, red fescue, thrift, seawatch, vetch) to shrubs (thimbleberry, salal, Suksdorf sage, Nootka rose) and finally to inland forest typically dominated by Sitka spruce and western hemlock.

Characteristic Fauna

**Mammals:** black-tailed deer, Townsend's mole, vagrant shrew, California sea lion, northern sea lion, sea otter, gray fox.

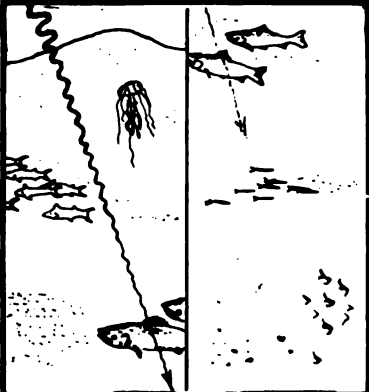
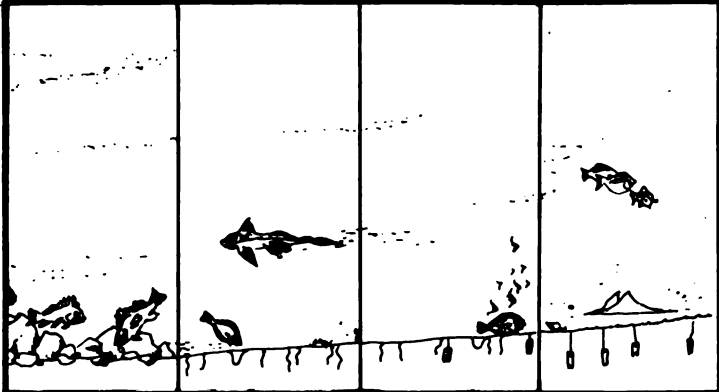

**Birds:** storm-petrels, western gull, California gull, common murre, pigeon guillemot, auklets, other alcids, black oystercatcher, cormorants. Many of the islands are intensively used by colonial sea bird nesters.

# ECOSYSTEM MODEL - ABOVE TIDE HEADLANDS & ROCKY ISLANDS



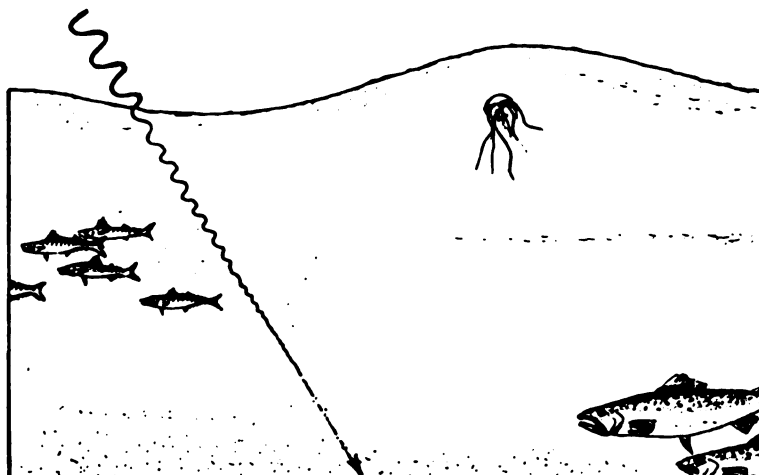
<b>3.0 OCEANIC ZONES</b>	
<b>GENERAL COMMENTS</b>	In neritic zone (near shore, over continental shelf), Northeastern Pacific surface waters (upper 200 m) mix with runoff and upwelling deeper ocean waters. Runoff recharges nutrient supply during winter. Spring diatom bloom rapidly depletes this supply, but upwelling continually replaces limiting nutrient, chiefly nitrate, sometimes also silicate (Anderson, G. C., 1972). Annual rate of production is over 300 gC/m <sup>2</sup> , more than 6 times the average productivity of the whole ocean, including neritic zone (Curl, 1970).
<b>BATHYMETRY AND SEDIMENTS</b>	Continental shelf relatively flat and featureless. Slopes steeper near shore and outer edge than in wider central area. Slopes steepen and shelf narrows from north to south. Recent sands lie inshore, muddy sediments seaward. Relict sands exposed at places along outer edge. Rocky banks occur irregularly, often associated with headlands. Thickness of sediments is in dynamic equilibrium, accreting in summer, eroding in winter (Bourke et al., 1971; Kulm et al., 1975).
<b>CLIMATE</b>	Small seasonal variation in temperature means range only 4°C (39°F). Large differences in wind and precipitation; prevailing winter winds are southwesterly, bringing storms to the coast; summer winds are mostly from the northwest at speeds usually lower than in winter. About 80% of the annual precipitation occurs from October to March. Shore station precipitation data overestimates rainfall at sea by a factor of 2 to 4 (Elliott et al., 1971). Dense fogs, related to upwelling of colder waters, occur most frequently from midsummer to fall, averaging 3 to 8 days per month (OIW, 1977).
<b>HYDROGRAPHY</b>	Salinity of surface waters varies widely, from 20 to 34‰, altered by runoff and upwelling. Runoff lowers surface salinity to <32.5‰. Upwelling increases surface water salinity to >32.5‰ in summer. Water temperature varies from a mean high of 17.7°C (64°F) to a mean low of 7.6°C (46°F), but annual mean temperature range is only 5°C (41°F), from 14°C (57°F) in summer to 9°C (48°F) in winter. Both highest and lowest temperatures occur in summer during upwelling (Bourke et al., 1971).

**ZONE & HABITAT TYPES**

							
3.1.1A Euphotic	3.1.2A Disphotic	3.2.1A Rocky	3.2.1B Mud	3.2.1C Muddy Sand	3.2.1D Sand	3.2.2A Kelp	3.2.2B Surfgrass
3.1.1 EUPHOTIC PELAGIC ZONE		3.2.1 NON-VEGETATED BENTHIC ZONE				3.2.2 VEGETATED BENTHIC ZONE	
3.1 PELAGIC OCEANIC ZONES		3.2 BENTHIC OCEANIC ZONES					



3.1 Pelagic Oceanic Zones  
 3.1.1 Euphotic Pelagic Zone  
 A Euphotic



## EUPHOTIC

### Habitat Description

This habitat is the upper layer of neritic ocean water which is supplied with sunlight sufficient for the photosynthesis of plants, i.e. down to compensation depth. All net production of organic matter in the oceanic pelagic environment occurs in this habitat. Depth of this layer varies seasonally and locally, generally ranging between 20 to 80 meters (60 to 260 ft) deep (Sverdrup et al., 1942; Small et al., 1972). In winter, low primary production is balanced by grazing, maintaining dependent populations. In spring, diatom blooms indicate high primary production temporarily exceeding consumption. At night, many carnivores from deeper waters (disphotic zone) invade this habitat to feed.

### Food Web

Primary productivity is provided by phytoplankton. Grazing food chains are predominant. Herbivorous crustaceans, principally copepods and euphausiids, dominate the second trophic level; jellyfish, fishes, and shrimp are important consumers at the third trophic

### Food Web, continued

Level (Pearcy, 1972). Suspended detrital material may enter food web through microplankton.

### Characteristic Flora

Phytoplankton: diatoms are generally predominant in shelf waters, with dinoflagellates showing increased abundance in late summer and fall.

### Characteristic Fauna

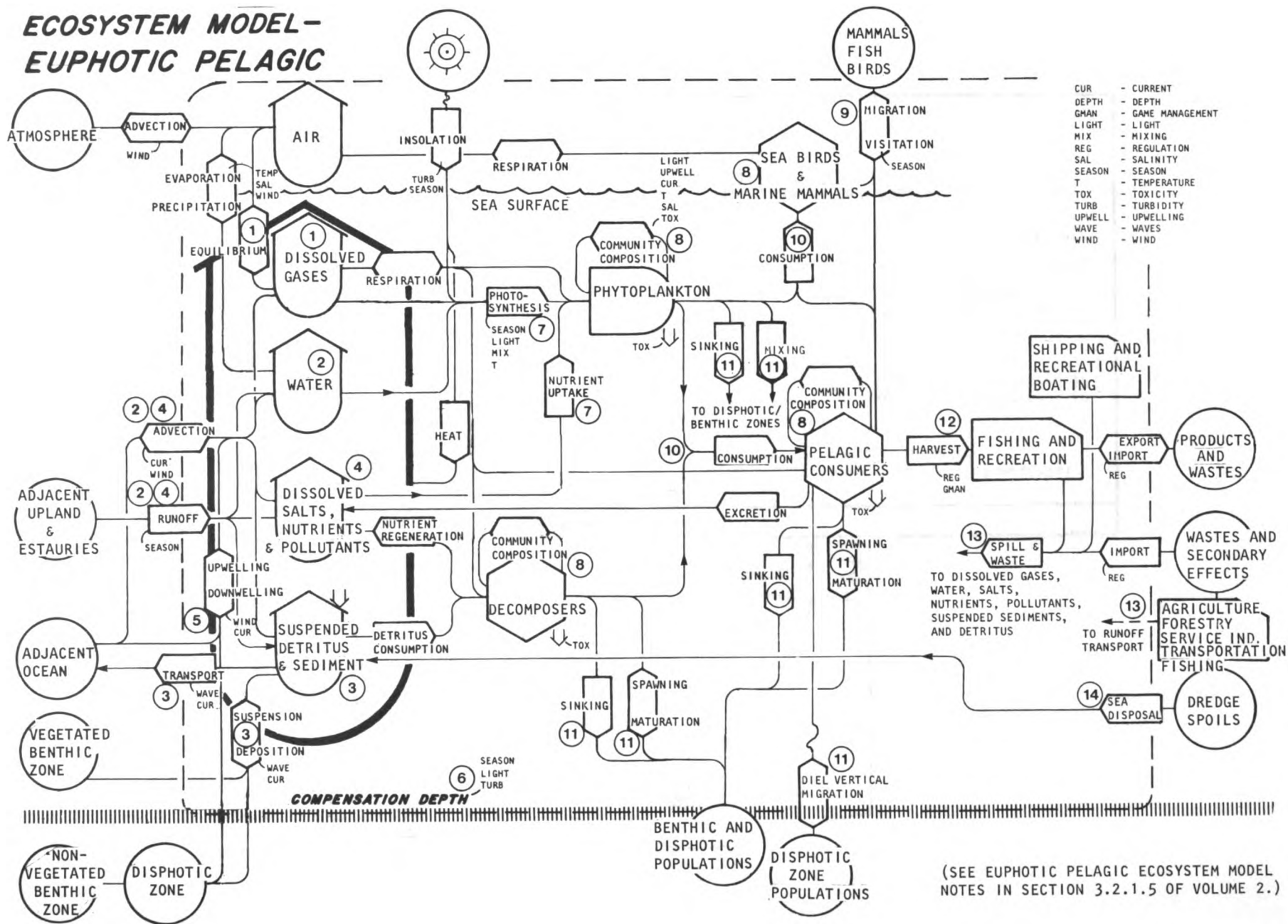
Zooplankton: copepods, euphausiids, medusae, salps, shrimps, chaetognaths, ctenophores, amphipods.

Nekton: lantern fish, anchovy, saury, squid, salmon.

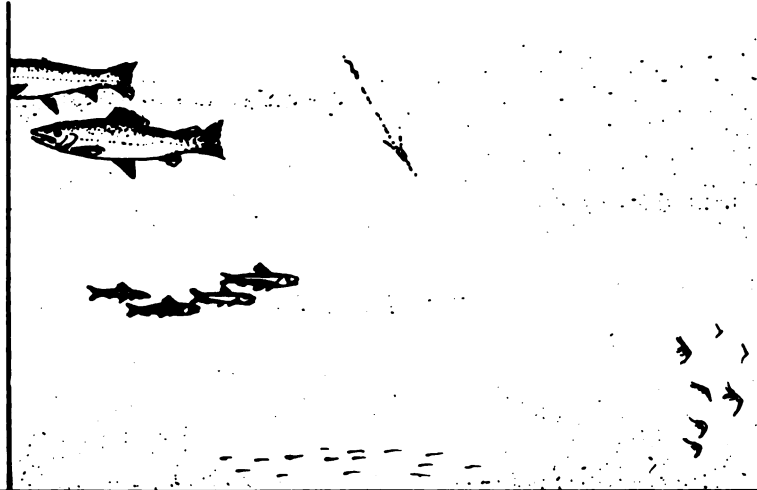
Sea birds: common murre, western gull, sooty shearwater, Cassin's auklet, cormorants.

Mammals: baleen whales (gray whale), killer whale, porpoises, California sea lion, northern sea lion, northern fur seal.

# ECOSYSTEM MODEL - EUPHOTIC PELAGIC



- 3.1 Pelagic Oceanic Zones
- 3.1.2 Disphotic Pelagic Zone
- A Disphotic



## **DISPHOTIC**

### Habitat Description

Deeper, dark, daytime location of pelagic carnivores that migrate vertically each day in response to light. These animals form vertically compressed layers (called scattering layers because of their effect on sonar transmissions) during daylight but rise toward the surface, spreading out vertically to feed throughout the upper layer (euphotic zone) during the night.

### Food Web

Grazing and detrital food chains based on primary production in euphotic zone above. Local transfers are primarily between third and fourth trophic level.

### Characteristic Flora

None. Phytoplankton, sinking through this zone, are very sparse and unproductive.

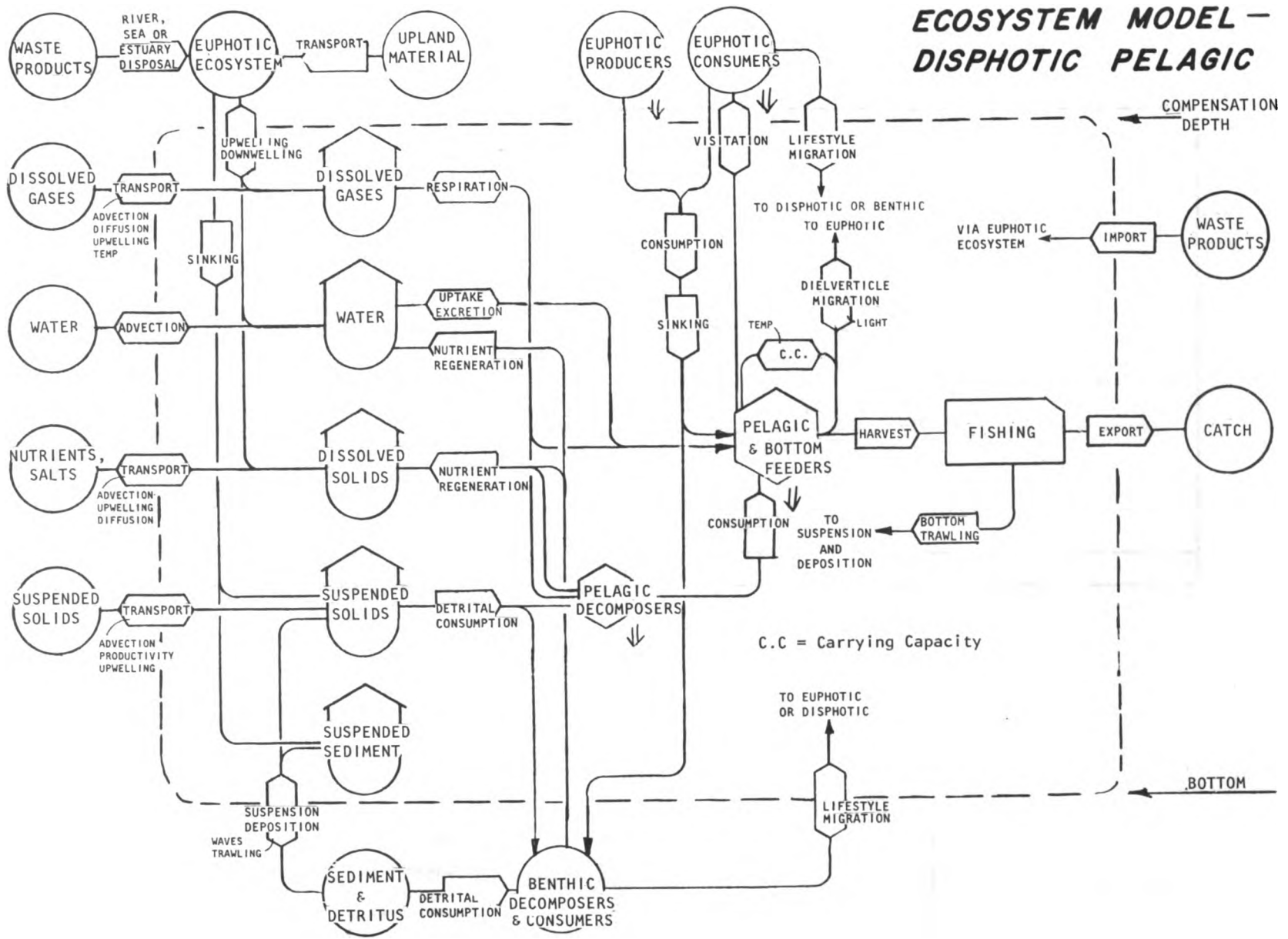
### Characteristic Fauna

Zooplankton: euphausiid (*Euphausia pacifica*), shrimp (*Sergestes similis*).

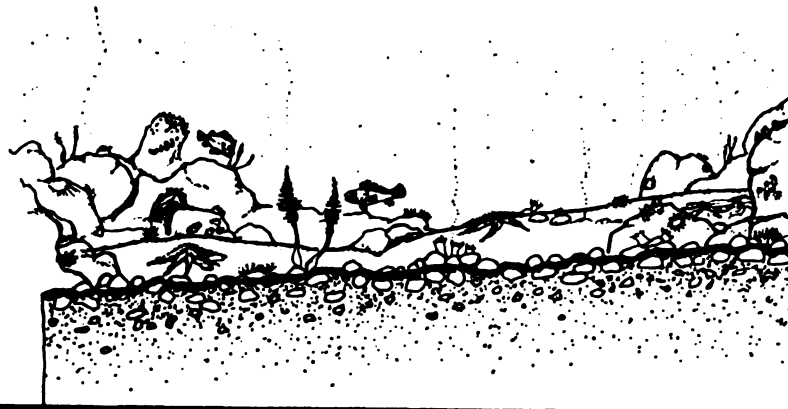
Nekton: lantern fishes (*Diaphus theta*, *Stenobranchius leucopsarus*, and *Tarletonbeania crenularis*).

Mammals: baleen whales.

# ECOSYSTEM MODEL - DISPHOTIC PELAGIC



- 3.2 Benthic Oceanic Zones
- 3.2.1 Non-vegetated Benthic Zone
- A Rocky



## ROCKY

### Habitat Description

Rocky bottom, below compensation depth but often higher than the surrounding shelf, occurs in scattered banks at various distances offshore all along the coast. The rough, irregular terrain has more wave and current activity, little finer sediment. These areas are generally avoided by trawl fisheries.

### Food Web

Primarily detrital food chains based on production in overlying waters. Some demersal fish also feed periodically in euphotic zone grazing food chains.

### Characteristic Flora

Only phytoplankton which sinks to the bottom from the photic zone. No primary production.

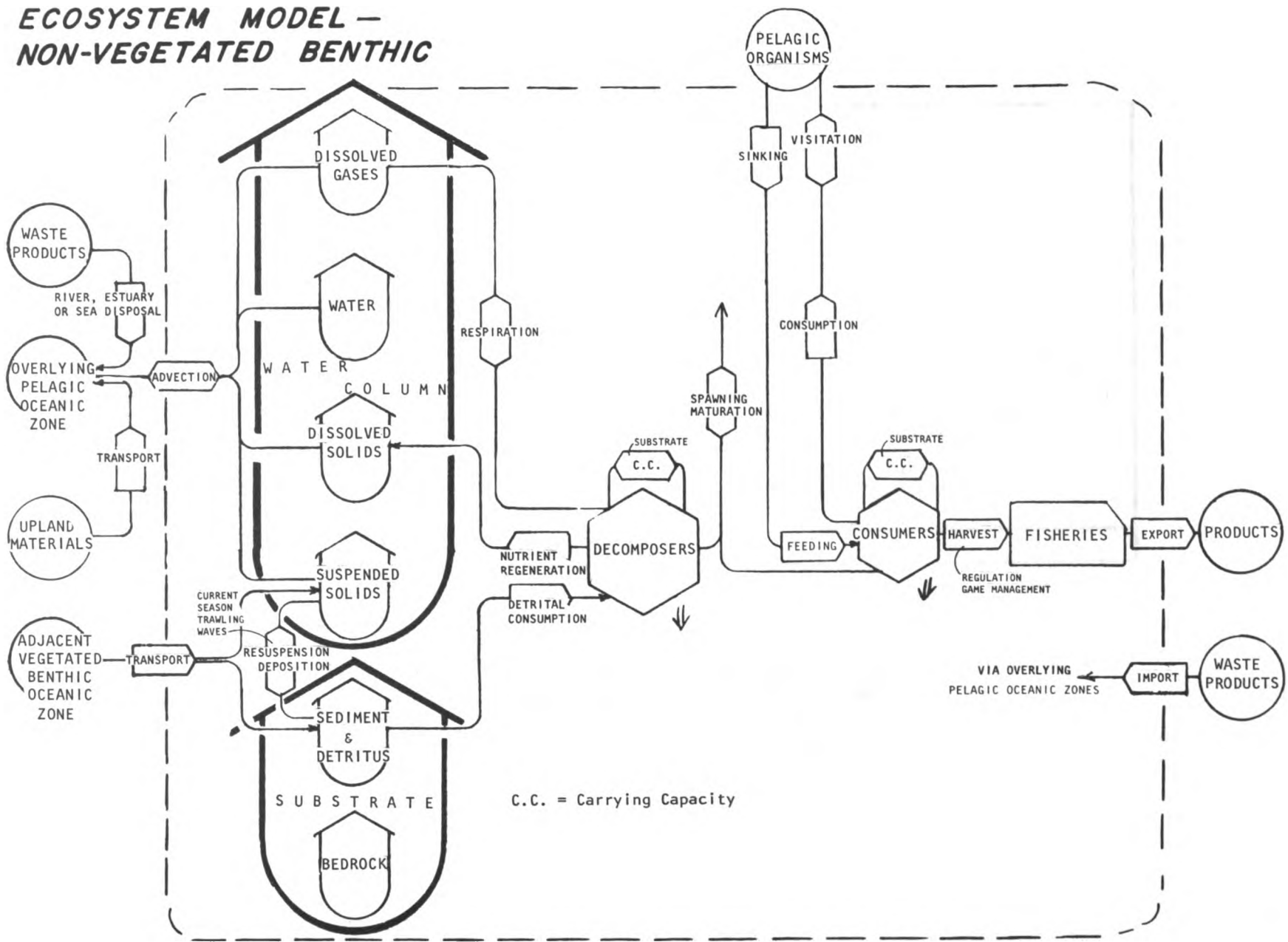
### Characteristic Fauna

Attached invertebrates: barnacles, sea anemones, bryozoans, tube worms, hydroids, corals, and tunicates.

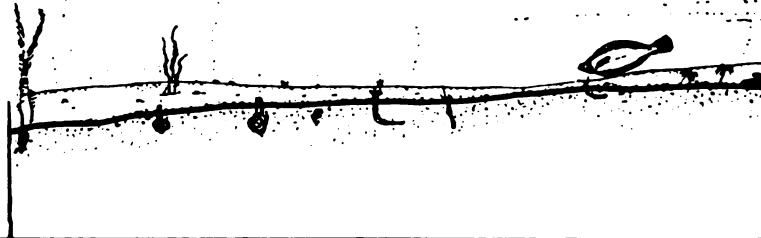
Unattached invertebrates: starfish, crabs, shrimp, hermit crabs, nereid worms, nudibranchs, and snails.

Fish: halibut, rockfish.

# ECOSYSTEM MODEL — NON-VEGETATED BENTHIC



3.2 Benthic Oceanic  
Zones  
3.2.1 Non-vegetated  
Benthic Zone  
B Mud



**MUD**

Habitat Description

Marine soft bottom communities where most of the sediment grains are less than 0.062 mm in diameter form a major portion of the offshore region at depths between 100 and 200 m. These level bottom communities contain a much more abundant and diverse community than the level bottom sandy substrates and can be composed of fine grained silts and clays but most often are mixed with either relict or terrigenous sands. They are thought to be very stable environments with diverse benthic populations which serve as major feeding areas for demersal fish and shrimp.

Food Web

The food web of this system is dependent on detritus both from the production in overlying waters and to a lesser extent from terrigenous sources. Detritivores, scavengers, and carnivores are important links in this system.

Characteristic Flora

Due to a paucity of light, few plants are found in this region.

Characteristic Fauna

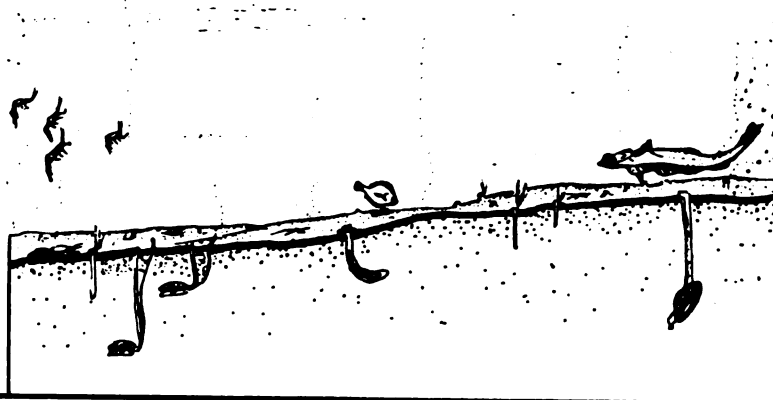
Primarily infaunal and epifaunal invertebrates and demersal fish.

Infauna: sea urchin (Brisaster), bristleworms (Sternaspis), snails.

Epifauna: shrimp (Pandalus), brittle stars (Ophiura), sea urchin (Allocentrotus).

Fish: Dover sole, arrowtooth flounder, sablefish.

- 3.2 Benthic Oceanic Zones  
 3.2.1 Non-vegetated Benthic Zone  
 C Muddy Sand



### MUDDY SAND

#### Habitat Description

This habitat is intermediate between sand and mud bottoms (50-75% of grains greater than 0.0625 mm in diameter). Muddy (finer) sediments accumulated during summer are mixed into the sandier substrate by the burrowing-feeding activity of benthos before winter storms resuspend them. There is more organic matter in the sediment here than in the sandy bottom, less than in a mud bottom.

#### Food Web

The food web of this habitat is dependent on detritus both from the production in overlying waters and to some extent from terrigenous sources. Detritivores, scavengers, and carnivores are important.

#### Characteristic Flora

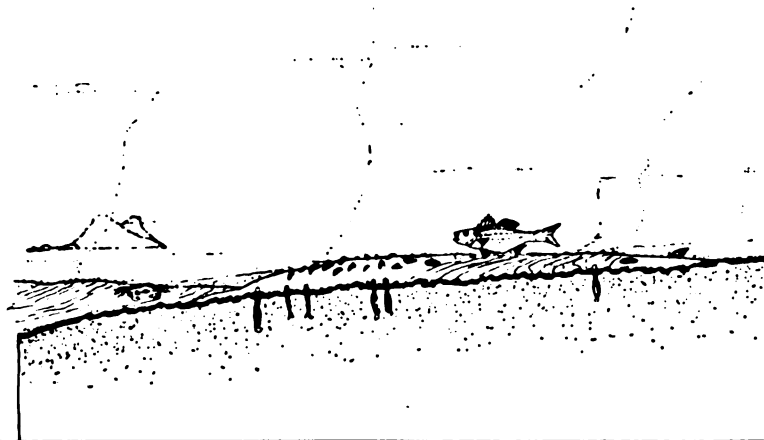
Due to a paucity of light, there is no plant production in this habitat. Some heterotrophic diatoms may persist.

#### Characteristic Fauna

Infauna: clams (*Macoma elimata*), polychaetes (*Nephtys* sp., *Sternaspis fossor*), and amphipods (*Paraphoxus variatus*).

Epifauna: sea cucumber (*Stichopus*), urchins (*Allocentrotus*), shrimp (*Pandalus*), starfish (*Lurida*), snails (*Polinices*).





- 3.2 Benthic Oceanic Zones  
 3.2.1 Non-vegetated Benthic Zone  
 D Sand

## **SAND**

### Habitat Description

This is the smooth, relatively hard bottom area seaward of the surf zone and beyond the immediate influence of breaking waves and longshore currents. Current activity is regular and fairly strong, though not as strong as in rocky areas. The bottom sediment is sand (75% or more of grains are larger than 0.0625 mm in diameter) similar to that on the beaches but significantly more stable. As a result of the greater stability, lack of wave breaking action, and more organic material than on beaches, populations are larger and there are more species than in the beach habitat. This habitat gradually grades into the muddy sand bottom habitat as the water deepens to the west. Relict sand patches occur along outer shelf.

### Food Web

The energy for the habitat comes from phytoplankton in the overlying waters and from the detrital material which continually rains down from above or is introduced from nearby estuaries. Many of the important organisms are detrital feeders and components of the food web are relatively simple.

### Characteristic Flora

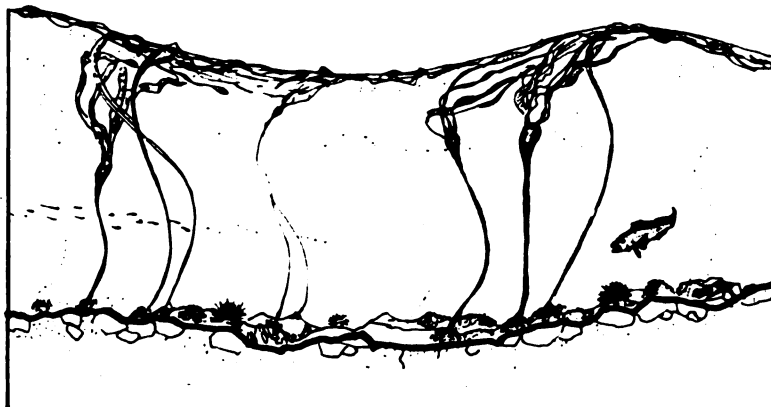
There are no primary producers on the substrate because of the reduced light level over most of this environment. Diatoms in the phytoplankton enter from the euphotic zone, and may concentrate near the bottom.

### Characteristic Fauna

Invertebrates: polychaete worms, gammaridian amphipods, Slota's razor clam, Dungeness crab, gastropods, and sand dollars.

Fish: English sole, Pacific sanddab, butter sole, skates, and dogfish.

3.2 Benthic Oceanic  
Zones  
3.2.2 Vegetated Benthic  
Zone  
A Kelp



## KELP

### Habitat Description

Kelps occur in what is called the Protected Outer Coast. They persist on rocky reefs subject to occasionally severe wave action and tidal currents. Kelps range from extreme low water (ELW) to a depth of about 40 feet (13 m).

### Food Web

Productivity is dominated by the kelps and their associated algal flora. The food web is dominated by grazing organisms. Detrital components of the food web are present, but of secondary importance.

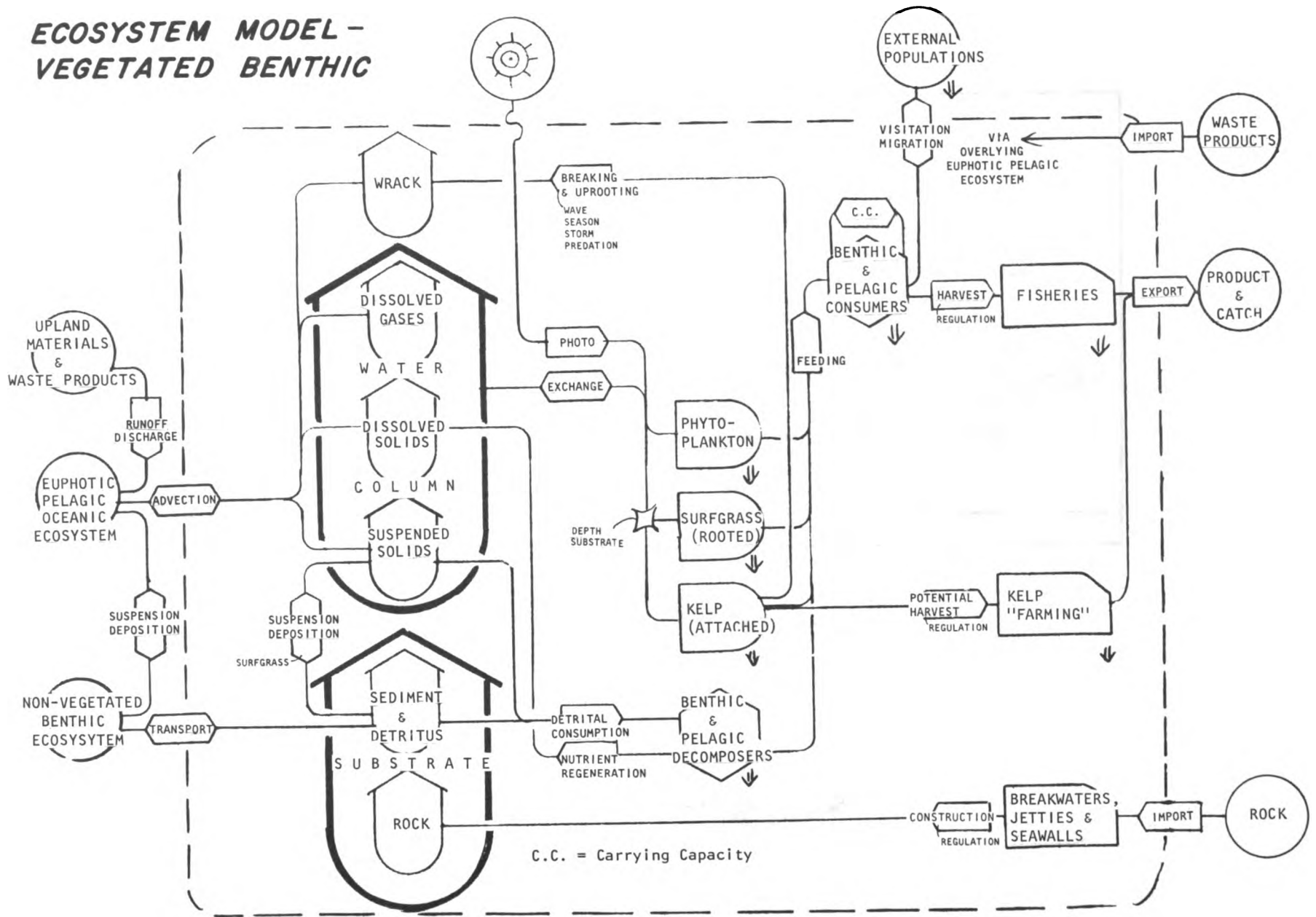
### Characteristic Flora

The typical kelp habitat is multilayered, being composed of canopy, understory, turf, and crustose layers. The canopy is made up of Nereocystis luetkeana (bull kelp). The understory is made up of several kelps, notably Pterygophora californica, Alaria marginata, Laminaria saccharina, Laminaria setchellii, and Egregia menziesii. The turf layer is made up of filamentous and thallose red algae. The crustose layer is largely made up of Kildenbrandtia and Lithophyllum.

### Characteristic Fauna

**Invertebrates:** a variety of sea urchins, limpets, chitons, starfish, crabs, snails, amphipods, isopods.  
**Fish:** copper, brown, quillback, and black rockfishes, lingcod, kelp greenling.

# ECOSYSTEM MODEL - VEGETATED BENTHIC



- 3.2 Benthic Oceanic Zones  
 3.2.2 Vegetated Benthic Zone  
 B Surfgrass



## SURFGRASS

### Habitat Description

Surfgrass occurs on rocks on protected outer coast from Alaska to Baja California. It is most common from Monterey to southern Vancouver Island. It is found from the intertidal to 7 meters deep and is associated with Fucus.

### Food Web

Surfgrass along with several species of kelps are responsible for most of the primary productivity. Some coastlines have beaches dominated by surfgrass; others have a mixture of surfgrass and benthic algae. Principal components of the food web are detrital.

### Characteristic Flora

Surfgrass (Phyllospadix spp.) predominates. Ulva (sea lettuce), Iridaea cordata, Rhodomela laux, Calliarthron tuberculosa, and Odonthalia floccosa are common as understory plants. Diatoms, Simthora (a red alga), and Petalonia (a brown alga) are found on the leaves. Commonly associated kelps are: Alaria, Laminaria, and Egregia.

### Characteristic Fauna








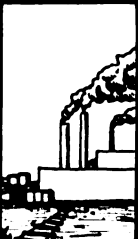






Invertebrates: nereid worms, isopods, amphipods, snails, limpets, copepods, crabs, starfishes, and sea urchins.

Birds: black brant.

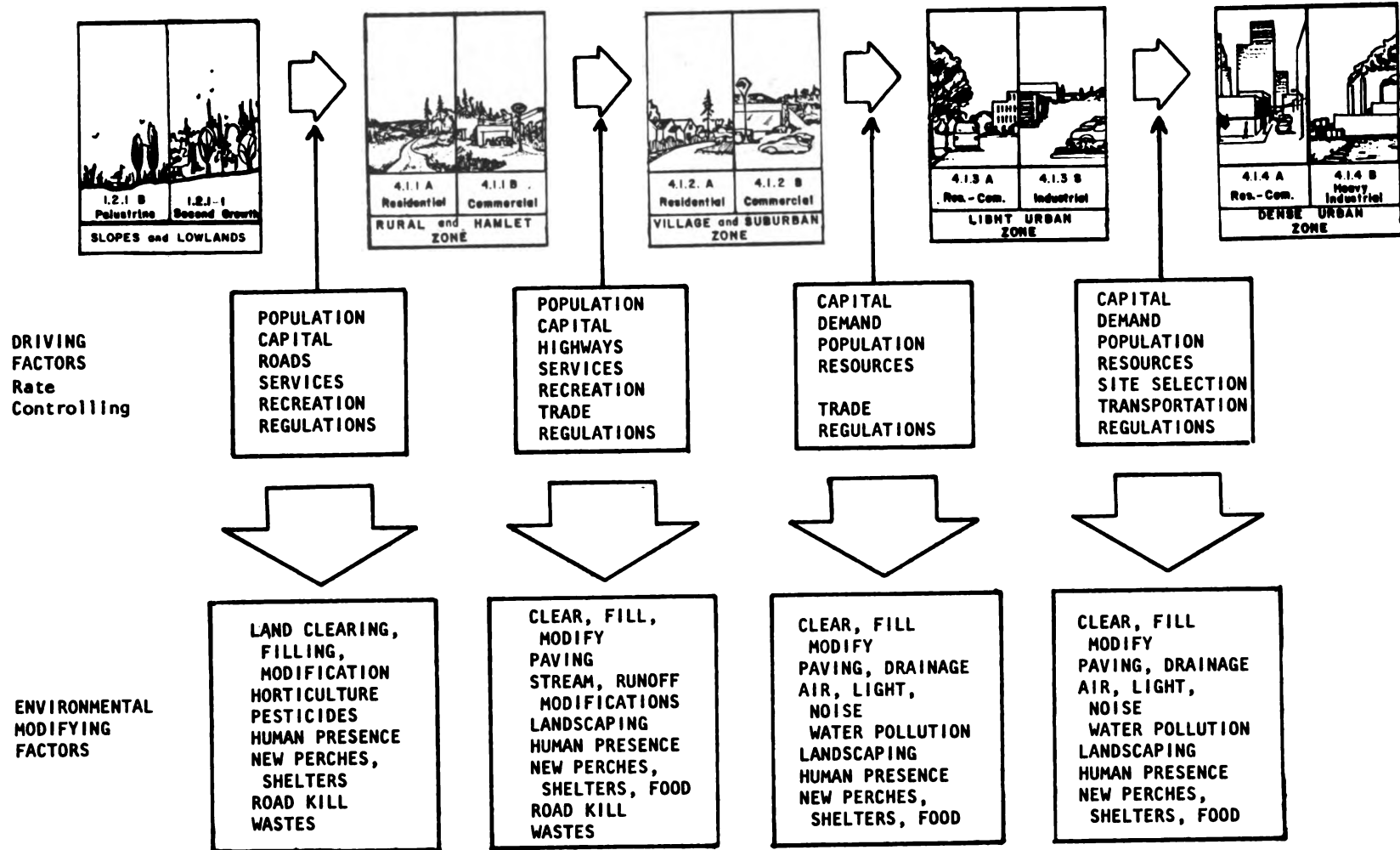
Fish: coho juveniles.

<b>4.1 HUMAN ACTIVITY ZONES - INLAND</b>	
<b>GENERAL COMMENTS</b>	These zones are modified and managed for human use and are generally characterized by the continuing presence of man and his activities in varying degrees. They are prepared and maintained in an artificial or highly modified state. The zones are classified by the intensity and type of man's activities and, thus, the degree of departure from the surrounding natural zone. The resulting habitats will contain species planned by man such as lawn grass, shrubs, and pets; adaptable local species such as blackberries and gulls; and exotic species that are attracted to man's activities such as English sparrows and rats. Increasing waste export is a characteristic of urbanization.
<b>TOPOGRAPHY AND SOILS</b>	Building sites are selected for utilitarian and aesthetic factors including, among others: access to transportation, utilities, population, markets, jobs, view, recreation, climate, topography, drainage, and physical properties of soils. Topography may be extensively modified to provide sites for construction and other activities; streams are often diverted or channelized. This usually means destruction of existing soil structure by grading and filling, covering ground with buildings and pavements, production of fill or spoil banks, and creation of new surface soils for managed vegetation.
<b>CLIMATE</b>	Except for some air pollution and smog, there is little modification of climate due to human activity in the study region. Microclimatic changes, as in local fog and frost patterns, may occur where air flow patterns are affected by structures, topographic changes, cleared and paved areas, or by waste heat, such as thermal effluents. Rainfall is adequate through most of the year; in summer, lawns and other landscaped areas are usually watered. Coastal fogs extend inland to the mountains and may make a significant contribution of moisture to vegetation and soils. Subject to occasional severe storms.
<b>HYDROLOGY</b>	Runoff is usually modified and managed for human activity. Changes include dams and dikes, establishing new drainage patterns, rerouting and channelizing streams, extensive modification of ground cover and soil permeability, tapping and disruption of aquifers, and installation of storm and sanitary sewers. Surface runoff is faster. Storm peaks are shorter and higher. Surface pollutants, including fertilizer and spray residues, are washed directly into storm sewers. There is some irrigation and potential for more extensive development.

**HABITAT TYPES**

													
4.1.1 A Residential	4.1.1 B Commercial	4.1.2. A Residential	4.1.2 B Commercial	4.1.3 A Res.-Com.	4.1.3 B Industrial	4.1.4 A Res.-Com.	4.1.4 B Heavy Industrial	4.1.4 A Parks & Greenbelts	4.1.5 B Hedgerows	4.1.5 C Transportation Corridors	4.1.5 D Utility Corridors	4.1.5 E Waterways	
<b>RURAL and HAMLET ZONE</b>		<b>VILLAGE and SUBURBAN ZONE</b>		<b>LIGHT URBAN ZONE</b>		<b>DENSE URBAN ZONE</b>		<b>BUFFER and CONNECTOR ZONE</b>					

# INLAND HUMAN ACTIVITY ZONES - AREA DEVELOPMENT MODEL

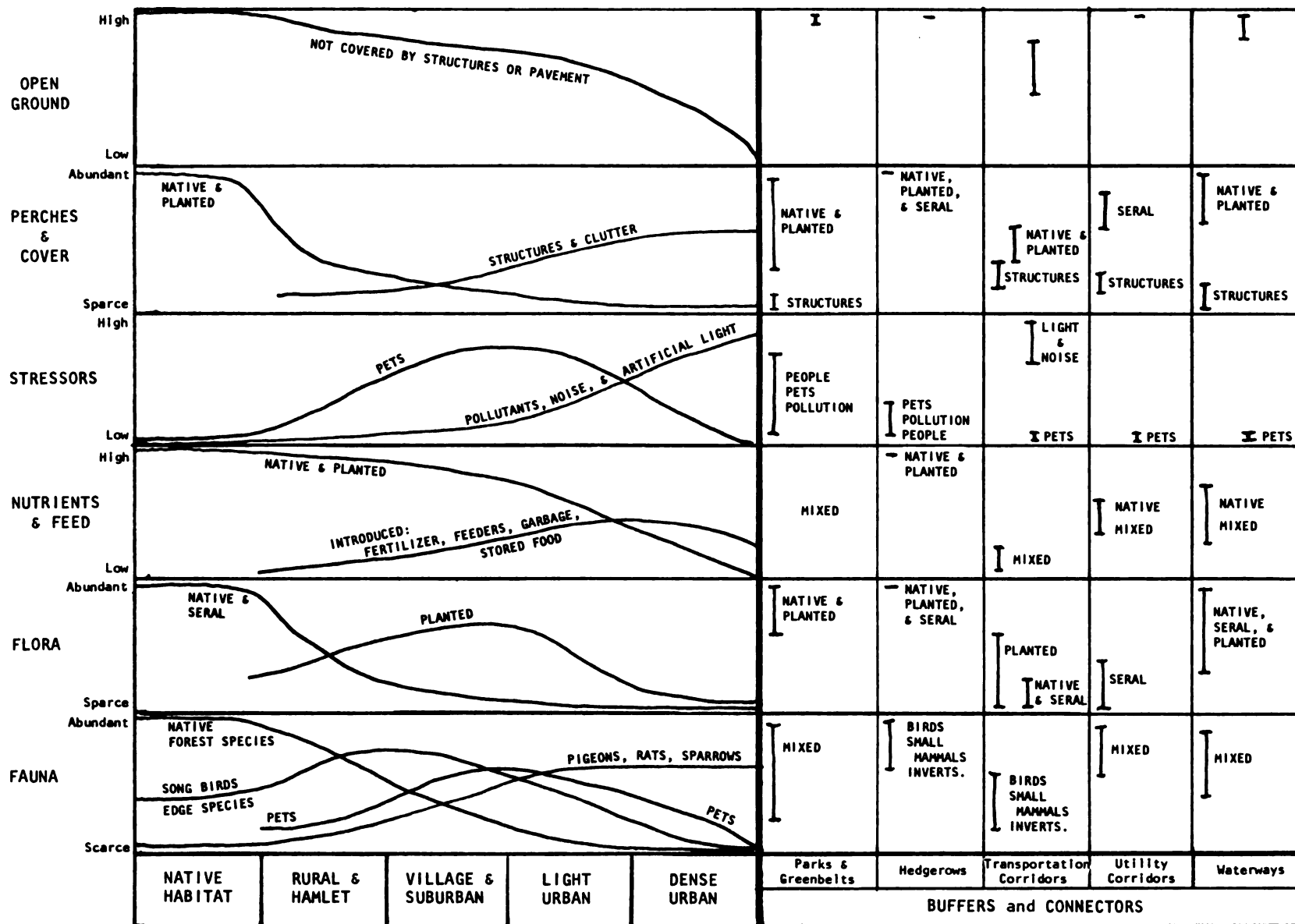


NOTE:



RATE CONTROLLING GATE. DEVELOPMENT STAGES ARE USUALLY SEQUENTIAL FOR AN AREA BUT DEVELOPMENT MAY START AT ANY STAGE FOR A PARTICULAR PARCEL OF GROUND.

# INLAND AREA DEVELOPMENT MODEL - Environmental Index Trends



- 4.1 Inland Human  
Activity Zones  
4.1.1 Rural and  
Hamlet Zone  
A Residential



### ***RURAL and HAMLET — Residential***

#### Habitat Description

These human residence areas differ from farmland (e.g. Agricultural habitat in Western Hemlock, Redwood, and Sitka Spruce Zones) in that they are not directly related to and dependant on large cultivated areas. Directly influenced by surrounding slope and lowland biological zones. May include separated, small real estate developments or multi-acre lot developments in "natural" settings. Essentially clearings with scattered houses and yards in other inland biological zones.

#### Food Web

Some selection of plants to attract or repel certain animals, some bird and animal feeding stations, some garbage.  
Influenced by pesticide and herbicide use, and by periodic cutting or other maintenance activities.

#### Characteristic Flora

Cultivated lawn, shrubs, shade and fruit trees, flower and vegetable gardens, exotics and natives, volunteers, and weeds.

Selected trees are often left during land development; native ground cover sometimes retained.

#### Characteristic Fauna

**Mammals:** dogs, cats, eastern cottontail rabbit, opossum, raccoon, white-footed mouse (deer mouse).

**Birds:** robin, swallows, starling, house sparrow, crow, finches, Stellar's jay, common bushtit.

**Herpetofauna:** garter snakes.

**Invertebrates:** slugs, house fly, mosquitoes; many invertebrates from neighboring "natural" habitats.



- 4.1 Inland Human Activity Zones
- 4.1.1 Rural and Hamlet Zone
- B Commercial



***RURAL and HAMLET—Commercial***

Habitat Description

Single or small cluster of business or small industry. Activity usually related to surrounding agricultural, forest, or recreational zones. Sometimes special waste problems - used oil, sawdust, etc.

Food Web

Some actions to attract or repel animals. Some garbage, trash, litter. Some use of pesticides, herbicides. Sometimes food or agricultural products available as waste.

Characteristic Flora

Landscaped or ruderal; exotic and native plantings, volunteers, weeds. Some native trees and ground cover may be retained.

Characteristic Fauna

Mammals: dogs, cats, white-footed mouse.

Birds: robin, swallows, house sparrow, starling, crow, finches.

Herpetofauna: garter snakes.

Invertebrates: slugs, house fly, mosquitoes; many invertebrates from neighboring habitats.

- 4.1 Inland Human Activity Zones
- 4.1.2 Village and Suburban Zone
- A Residential



**VILLAGE and SUBURBAN — Residential**

Habitat Description

Typically single family residences on 1/4 acre or larger lots, often with shrubs and other ground cover. Streets with low traffic density, except occasional arterials.

Food Web

Mostly adventitious.  
Some plant selection, numerous bird feeders.  
Some pesticide and herbicide use.

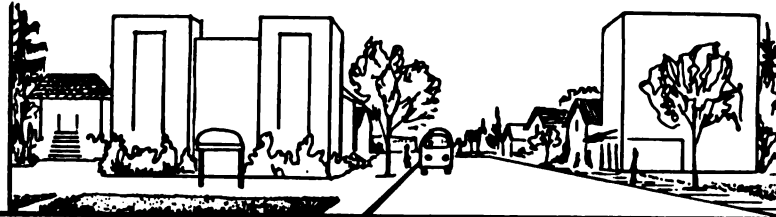
Characteristic Flora

Cultivated; lawn, shrubs, shade and fruit trees, ground cover, exotics and natives; some volunteers and weeds; some flower and vegetable gardens. Some native trees retained.

Characteristic Fauna

Mammals: dogs, cats, white-footed mouse, opossum, raccoon, eastern gray squirrel, striped skunk.  
Birds: robin, house sparrow, starling, Stellar's jay, crow, finches, common bushtit.  
Herpetofauna: garter snakes.  
Invertebrates: slugs, housefly; many invertebrates from neighboring "natural" habitats.

- 4.1 Inland Human Activity Zones
- 4.1.3 Light Urban Zone
  - A Residential and Commercial



***LIGHT URBAN — Residential and Commercial***

Habitat Description

Houses on small lots, small apartments and apartment complexes, row houses and shops, small or open shopping centers, motels, and resorts. Planned plantings may be designed to attract desired fauna.

(Large developments with little green space provide Dense Urban habitat.)

Food Web

Generally adventitious.

Characteristic Flora

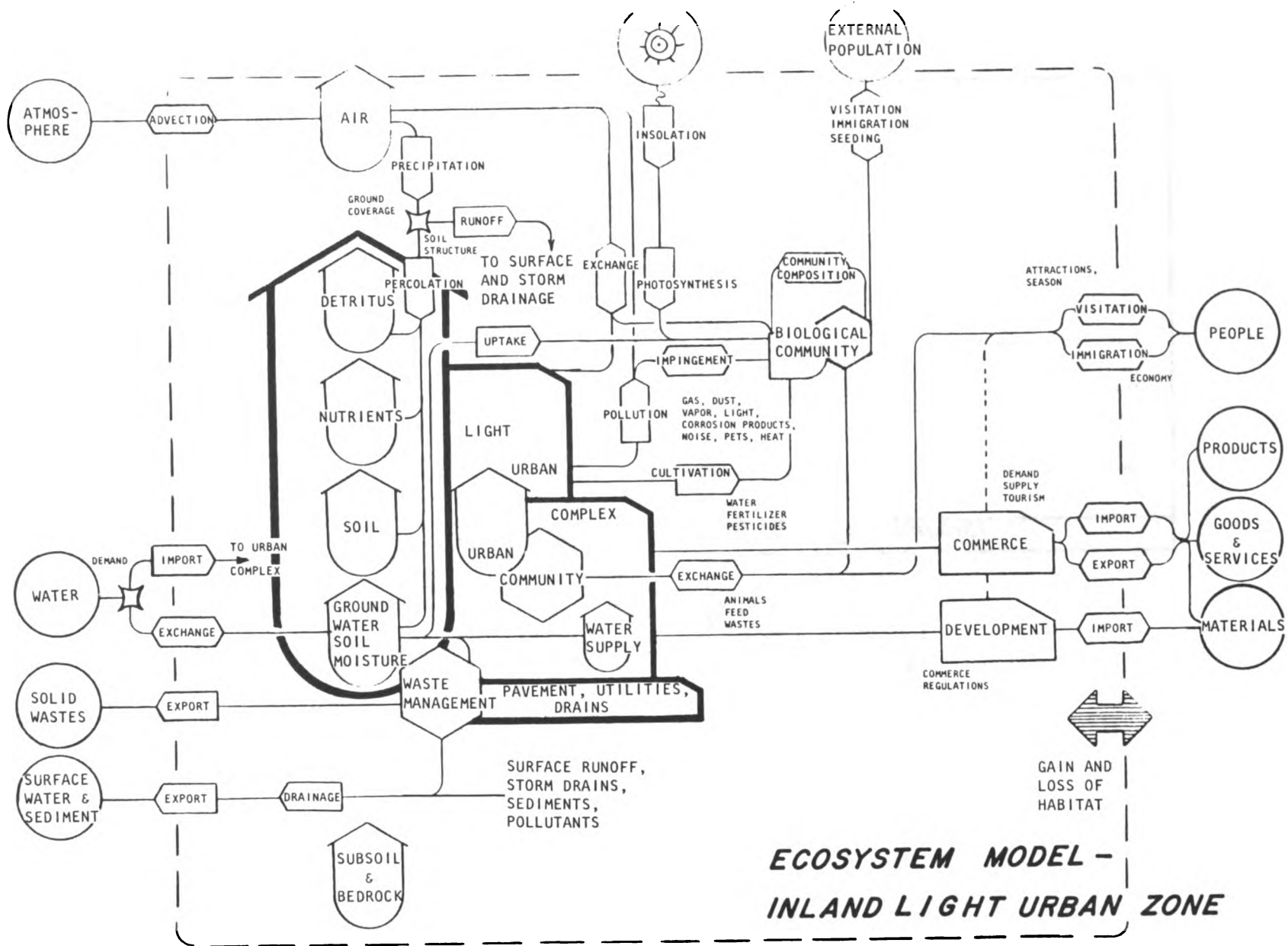
Landscaped, may utilize natural areas, native plants or exotics.

Characteristic Fauna

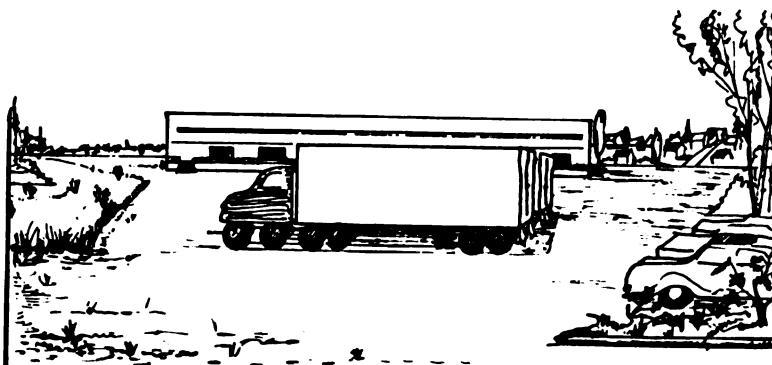
Mammals: rats, eastern gray squirrel, house mouse, striped skunk.

Birds: pigeon (rock dove), gulls, house sparrow, starling.

Invertebrates: flies.



- 4.1 Inland Human Activity Zones
- 4.1.3 Light Urban Zone
- B Industrial



***LIGHT URBAN — Industrial***

Habitat Description

Light industry with some open space. Typical are engineering and light manufacturing or processing firms. Transport, utility, and waste handling requirements resemble commercial establishments of similar size, but may include processing wastes, gaseous, liquid, solids, typical of light industry. Docks, wharves, and light shipping traffic common.

(Dense installations with little open space provide habitat more like Dense Urban - Commercial, and are classified there.)

Food Web

Adventitious.

Characteristic Flora

Often landscaped, may include natural areas, native and exotic plantings, lawns.

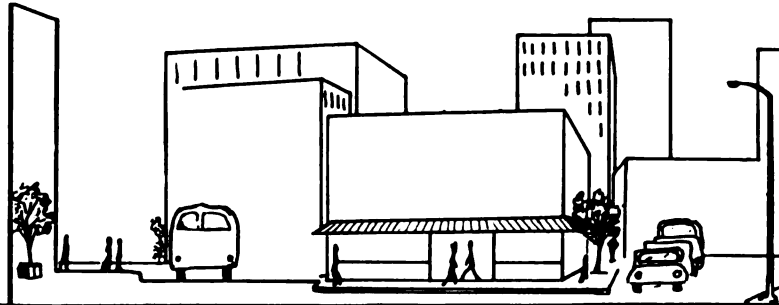
Characteristic Fauna

Mammals: rats, house mouse.

Birds: pigeon (rock dove), house sparrow, starling, crow, gulls.

Invertebrates: flies, mosquitoes.

- 4.1 Inland Human  
Activity Zones  
4.1.4 Dense Urban Zone  
A Residential and  
Commercial



### ***DENSE URBAN—Residential and Commercial***

#### Habitat Description

The city center, no vacant ground. Usually multistory residential and commercial buildings, often highrise. Large, dense apartment, shopping, or recreational complexes. Patterns of traffic, utility and service requirements, trash, garbage, sewage are similar in dense residential and commercial areas.

#### Food Web

Litter, garbage, trash provide food for scavengers. People feed pigeons, gulls, and sparrows.

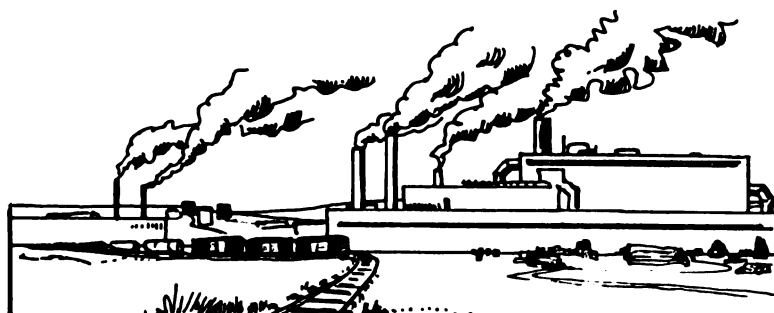
#### Characteristic Flora

Predominantly unvegetated; cultivated trees, shrubs, ground cover, flowering plants in planter strips and boxes.

#### Characteristic Fauna

Mammals: rats, house mouse, eastern gray squirrel.  
Birds: pigeon (rock dove), house sparrow, gulls, starling.  
Invertebrates: flies, roaches, silverfish.

- 4.1 Inland Human  
Activity Zones  
4.1.4 Dense Urban Zone  
B Industrial



### ***DENSE URBAN — Heavy Industrial***

#### Habitat Description

Large buildings, high stacks, often water towers, open space used for parking and storage yards. Heavy transportation, usually both truck and rail, sometimes water also. Heavy utility demand. High production of waste water, heat, gases, solid wastes, some salvagable. Herbicides or waste oil sometimes used for weed control. Point-sources of pollution, particularly from older plants, include: sewer outfalls, stacks, piles of sawdust and tailings, cannery wastes.

#### Food Web

Adventitious. Garbage from cafeteria; workers may feed birds.

#### Characteristic Flora

Predominantly unvegetated; some plantings around administrative and engineering offices; usually ruderal elsewhere in older areas.

#### Characteristic Fauna

Mammals: rats, house mouse.

Birds: pigeon (rock dove), house sparrow, gulls, starling, crow.

Invertebrates: flies.

- 4.1 Inland Human Activity Zones
- 4.1.5 Buffer and Connector Zone
- A Parks and Greenbelts



***BUFFERS and CONNECTORS — Parks & Greenbelts***

Habitat Description

Dedicated open space for esthetic, recreational, and educational values. Character varies from virtually untouched wilderness to formally landscaped areas and golf courses. Usually have picnic areas and may have camping spaces.

Green belts usually separate developed areas or are incorporated into them.

Food Web

Adventitious to typical for the habitat. Often planted to provide feed or browse for desired fauna.

Characteristic Flora

Formally or informally cultivated, or relatively undisturbed natural areas. Plantings range from exotics to entirely natives and may include year around display of blossoms.

Characteristic Fauna

Mammals: eastern gray squirrel, shrews, white-footed mouse, voles, raccoons.

Birds: robin, Stellar's jay, finches, song sparrow, house wren, black-capped chickadee, downy woodpecker, swallows, American Kestrel.

Herpetofauna: garter snakes.

Invertebrates from neighboring "natural" habitats.



- 4.1 Inland Human  
Activity Zones  
4.1.5 Buffer and  
Connector Zone  
B Hedgerows



### ***BUFFERS and CONNECTORS — Hedgerows***

#### Habitat Description

A row of shrubs, bushes, or trees forming a hedge. Native, planted, or volunteer vegetation forming boundaries, or along fences or roadsides. May be planned as windbreaks, or as cover for desired animals. Provides feed, cover, and nesting places; also cover for movement through agricultural and developed areas.

#### Food Web

Adventitious or similar to local habitats; may be planted to encourage certain fauna.

#### Characteristic Flora

Natural, planted, or volunteer. Natives, exotics, or mixed. Blackberries, raspberries, gorse, Scotch broom, and other shrubs typical.

#### Characteristic Fauna

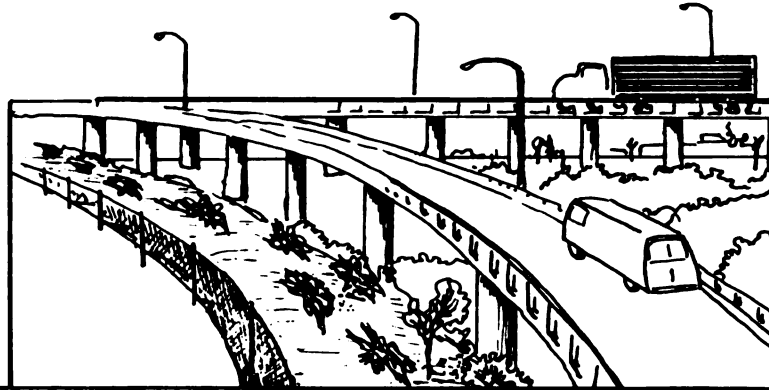
Mammals: eastern cottontail rabbit, white-footed mouse (deer mouse).

Birds: song sparrow, rufous-sided towhee, California quail, common bushtit, ring-necked pheasant, Oregon junco, American goldfinch, white-crowned sparrow.

Herpetofauna: garter snakes.

Invertebrates from neighboring "natural" habitats.

- 4.1 Inland Human Activities Zones
- 4.1.5 Buffer and Connector Zone
- C Transportation Corridors



***BUFFERS and CONNECTORS—Transportation Corridors***

Habitat Description

Right of way along freeways or railways, including median strips.

Access for people and animals may be limited by fencing.

Vegetation formerly controlled by clearcutting, burning, or herbicides, especially along railways.

Landscaping now used on freeways for esthetics, sound and visual control, ground cover, stabilization, and low maintenance.

Forms barriers to vegetation spread and animal movements across the route but provide corridors for migration and for some species to extend their ranges. Provides some routes across streams and difficult terrain.

Food Web

Usually adventitious.

Characteristic Flora

Natural, planted, or volunteer.

Natives, exotics, weeds, or mixed.

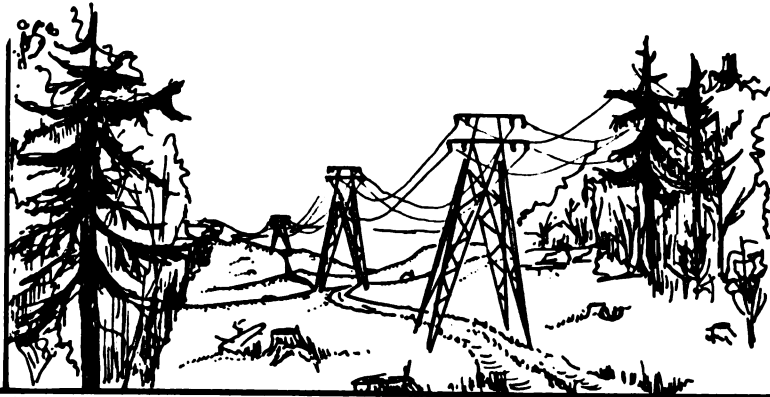
Characteristic Fauna

Mammals: voles.

Birds: crow, American kestrel, pigeon (rock dove), California quail.

Invertebrates from neighboring "natural" habitats.

- 4.1 Inland Human  
Activities Zones  
4.1.5 Buffer and  
Connector Zone  
D Utility Corridors



### ***BUFFERS and CONNECTORS — Utility Corridors***

#### Habitat Description

Right of way for communication and electrical transmission lines, oil, gas, water, and sewer pipelines. May include maintenance road, may be fenced. Vegetation controlled for safety and function of above-ground lines and equipment, stumps often left in place. May contain unauthorized trash dumps.

#### Food Web

Usually typical of cleared and early succession areas in the biological zones.

#### Characteristic Flora

Ruderal; scrub, shrub, meadow.

#### Characteristic Fauna

Mammals: black-tailed deer.

Birds: red-tailed hawk, American kestrel, swallows, flycatchers, Stellar's jay, starling, song sparrow.

Herpetofauna: garter snakes.

Invertebrates from neighboring "natural" habitats.

- 4.1 Inland Human Activity Zones
- 4.1.5 Buffer and Connector Zone
- E Watercourses



***BUFFERS and CONNECTORS — Waterways***

Habitat Description

Stream and canal banks; riparian; similar to emergent, scrub/shrub, and forested wetlands of Cowardin et al. (1977).

May provide long stretches of undisturbed habitat, with access to water, through developed areas.

May contain old sewer outfalls and unauthorized trash dumps.

Water quality often medium to low.

Food Web

Generally riparian in character if in natural state.

Characteristic Flora

Riparian in character. Usually ruderal or natural, sometimes planted. Emergent, scrub/shrub, and forest, usually hydrophytic.

Characteristic Fauna

Riparian in character but modified by what goes on in adjacent human activity lands.

Mammals: muskrat.

Birds: coot, mallard, pied-billed grebe, great blue heron, swallows, red-winged blackbird.


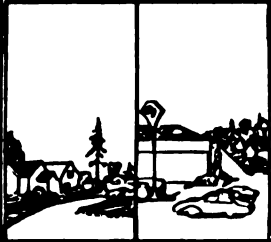

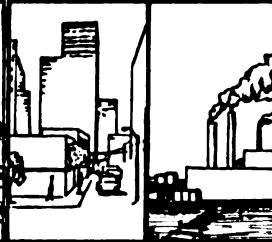
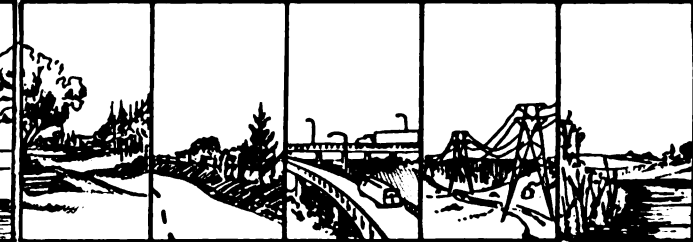
Herpetofauna: frogs.

Invertebrates: mosquitoes, flies; many invertebrates typical of riparian and aquatic habitats with medium to low water quality.

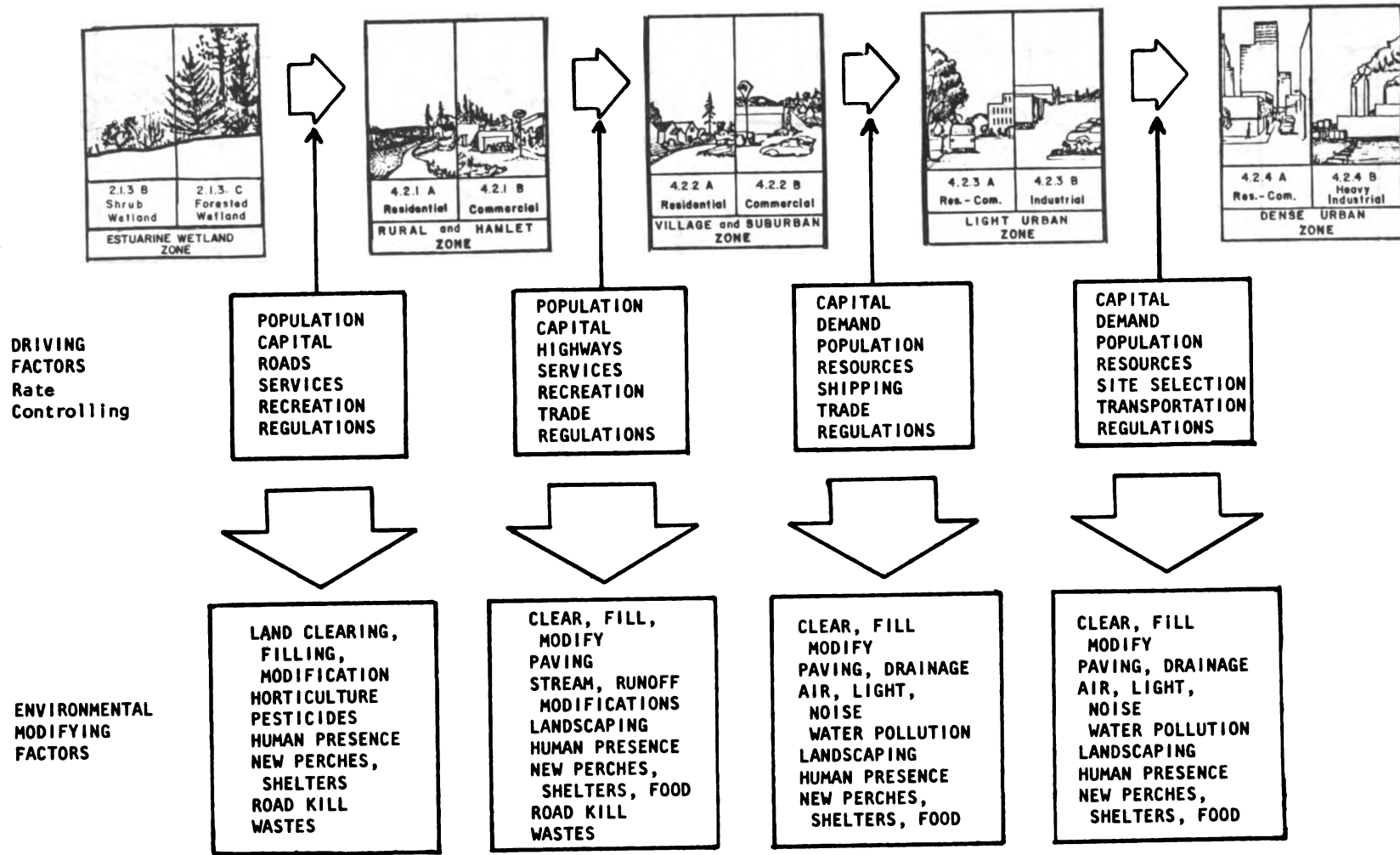
## 4.2 HUMAN ACTIVITY ZONES - COASTAL

<p><b>GENERAL COMMENTS</b></p>	<p>These zones are modified and managed for human use and are generally characterized by the continuing presence of man and his activities in varying degrees. They are prepared and maintained in an artificial or highly modified state. The zones are classified by the intensity and type of man's activities and, thus, the degree of departure from the surrounding natural zone. The resulting habitats will contain species planned by man such as lawn grass, shrubs, and pets; adaptable local species such as blackberries and gulls; and exotic species that are attracted to man's activities such as English sparrows and rats. Coastal Zones include activities and developments on or near the shorelines and estuaries.</p>
<p><b>TOPOGRAPHY AND SOILS</b></p>	<p>Building sites are selected for utilitarian and aesthetic factors including, among others: access to transportation, utilities, population, markets, jobs, view, recreation, climate, topography, drainage, and physical properties of soils. Topography may be extensively modified to provide sites for construction and other activities; watercourses are often diverted or channelized. This usually means destruction of existing soil structure by grading and filling, covering ground with buildings and pavements, production of fill or spoil banks, and creation of new surface soils for managed vegetation. Beach and dune stabilization programs occur in some areas, and portions of many estuaries have been filled.</p>
<p><b>CLIMATE</b></p>	<p>Except for some air pollution and smog, there is little modification of climate due to human activity in the study region. Microclimatic changes, as in local fog and frost patterns, may occur where air flow patterns are affected by structures, topographic changes, cleared and paved areas, and by waste heat. The micro-climatic influences of the ocean (temperature, humidity, fog) are more pronounced than in the Inland Zones, with the added factor of salt spray near the water and for some distance inland during storms. Rainfall is generally adequate except in summer.</p>
<p><b>HYDROLOGY</b></p>	<p>Runoff is usually modified and managed for human activity. Changes include dams and dikes, establishing new drainage patterns, rerouting and channelizing streams, extensive modification of ground cover and soil permeability, tapping and disruption of aquifers, installation of storm and sanitary sewers, piers, breakwaters, jetties, and channel dredging. Surface runoff is faster; storm peaks are quicker and higher. Fertilizers and spray residues enter streams directly. Some irrigation occurs, with potential for more. The Coastal Zones are subject to occasional severe storms and "100-year" tides, as well as tsunamis.</p>

### HABITAT TYPES

												
4.2.1 A Residential	4.2.1 B Commercial	4.2.2 A Residential	4.2.2 B Commercial	4.2.3 A Res. - Com.	4.2.3 B Industrial	4.2.4 A Res. - Com.	4.2.4 B Heavy Industrial	4.2.5 A Parks & Greenbelts	4.2.5 B Hedgerows	4.2.5 C Transportation Corridors	4.2.5 D Utility Corridors	4.2.5 E Waterways
<b>RURAL and HAMLET ZONE</b>		<b>VILLAGE and SUBURBAN ZONE</b>		<b>LIGHT URBAN ZONE</b>		<b>DENSE URBAN ZONE</b>		<b>BUFFER and CONNECTOR ZONE</b>				

# COASTAL HUMAN ACTIVITY ZONES - AREA DEVELOPMENT MODEL

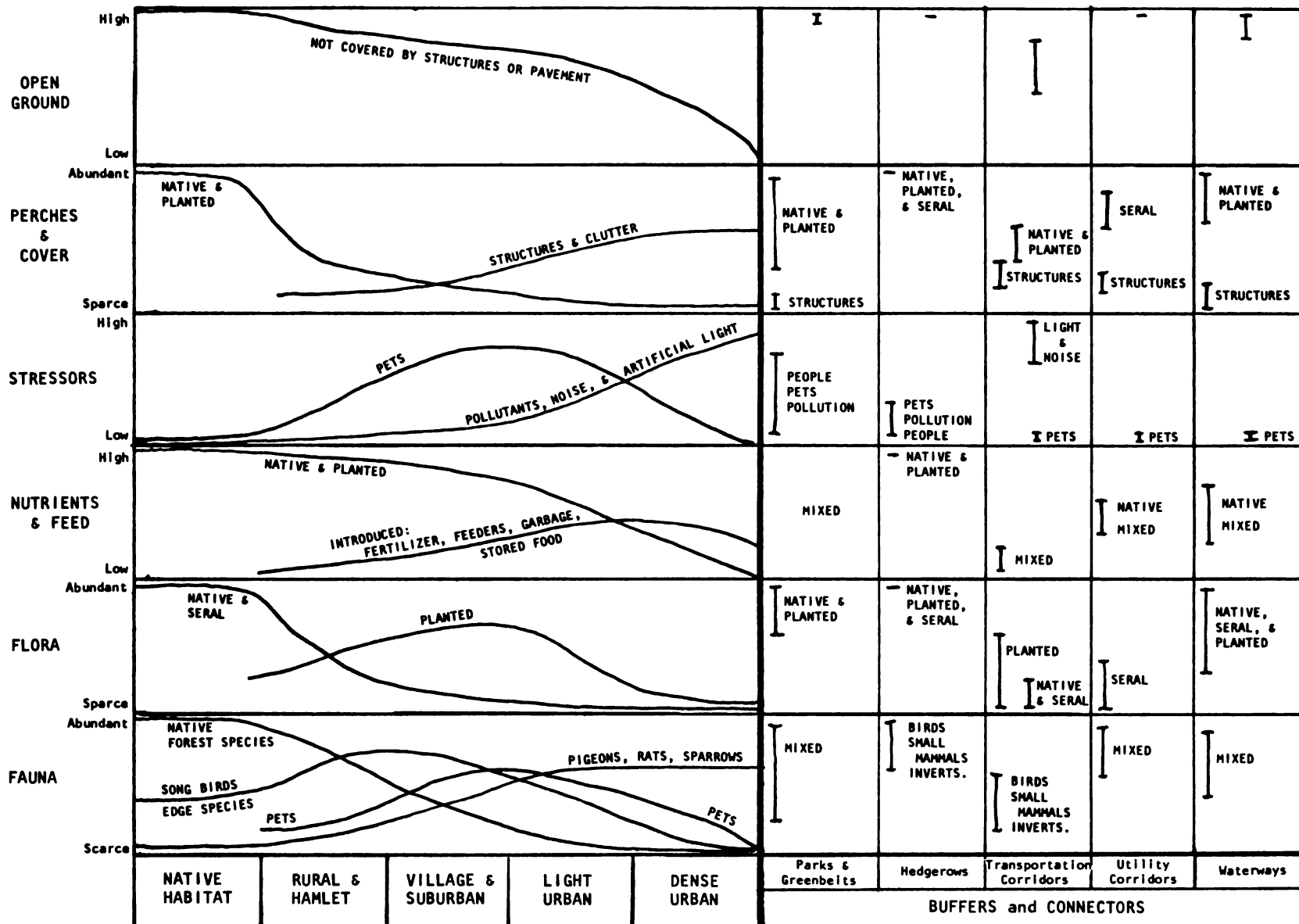


NOTE:



RATE CONTROLLING GATE. DEVELOPMENT STAGES ARE USUALLY SEQUENTIAL FOR AN AREA BUT DEVELOPMENT MAY START AT ANY STAGE ON A PARTICULAR PARCEL OF GROUND.

# COASTAL AREA DEVELOPMENT MODEL - Environmental Index Trends



Habitat

- 4.2 Coastal Human Activity Zones  
 4.2.1 Rural and Hamlet Zone  
 A Residential



### ***RURAL and HAMLET — Residential***

#### Habitat Description

Usually water-oriented in some way - view, recreation, tourist industry support, commercial fishing, and such. Directly influenced by surrounding coastal and lowland zones.

May include multi-acre-lot residential developments, or small isolated developments, featuring a high proportion of "natural" space.

#### Food Web

Some selection of plants to attract or repel certain animals, some animal and bird feeders, some garbage.

Affected by pesticides and herbicides where used, and by periodic cutting or other maintenance activities.

#### Characteristic Flora

Cultivated vegetation, salt tolerant if in spray or brackish water zone, may include garden plot. Native vegetation often retained.

#### Characteristic Fauna

Mammals: dogs, cats, raccoon, white-footed mouse (deer mouse), eastern cottontail rabbit.

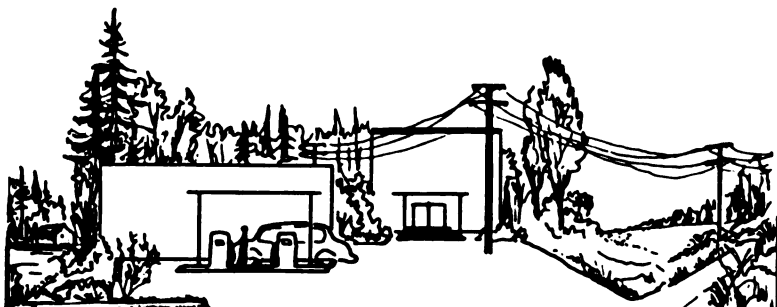
Birds: robin, swallows, starling, gulls, house sparrow, crow, killdeer, finches, common bushtit.

Herpetofauna: garter snakes.

Invertebrates: slugs, flies, mosquitoes; many invertebrates from neighboring "natural" habitats.



- 4.2 Coastal Human Activity Zones
- 4.2.1 Rural and Hamlet Zone
- B Commercial



***RURAL and HAMLET—Commercial***

Habitat Description

Single or small cluster of businesses or small industry. Activity likely to be tourist, timber, or water related.

Some special waste products, such as used oil or sawdust.

Food Web

Some action to attract or repel certain animals. Some use of pesticides, herbicides.

Some garbage, trash, litter: sometimes food, agricultural, or fishing products.

Characteristic Flora

Newer units usually landscaped, older ones often natives or weeds.

Ruderal to cultivated species, often salt tolerant. Native vegetation common.

Characteristic Fauna

Mammals: Dogs, cats, white-footed mouse, rats.

Birds: robin, swallows, house sparrow, starling, crow, finches, gulls.

Herpetofauna: Garter snakes.

Invertebrates: slugs, flies, mosquitoes; many invertebrates from neighboring "natural" habitats.

4.2 Coastal Human  
Activity Zones  
4.2.2 Village and  
Suburban Zone  
A Residential



***VILLAGE and SUBURBAN — Residential***

Habitat Description

Typically single-family residences on 1/4-acre or larger lots. Low traffic density except occasional arterials. Some older developments are very small lots on or near the beach, adjacent to undeveloped land.

Food Web

Mostly adventitious. Some plant selection, occasional feeders. Some pesticide and herbicide use.

Characteristic Flora

Cultivated: lawn, shrubs, shade and fruit trees, ground cover, exotic and native, some volunteers and weeds, some flower and vegetable gardens. Some native trees and ground cover retained, especially in beach and dune areas.

Characteristic Fauna

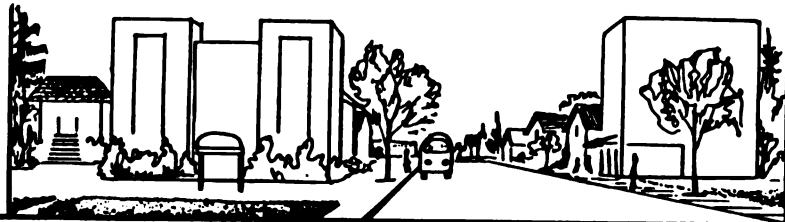
Mammals: cats, dogs, opossum, raccoon, eastern gray squirrel, striped skunk.

Birds: gulls, robin, house sparrow, starling, crow, finches, common bushtit.

Herpetofauna: garter snakes.

Invertebrates: slugs, flies; many invertebrates from neighboring "natural" habitats.

- 4.2 Coastal Human Activity Zones
- 4.2.3 Light Urban Zone
- A Residential and Commercial



***LIGHT URBAN — Residential and Commercial***

Habitat Description

Houses on small lots, small apartments and apartment complexes, row houses and shops, small or open shopping centers, motels, marinas, and resorts. Planned plantings, may be designed to attract desired fauna.

Food Web

Generally adventitious.

Characteristic Flora

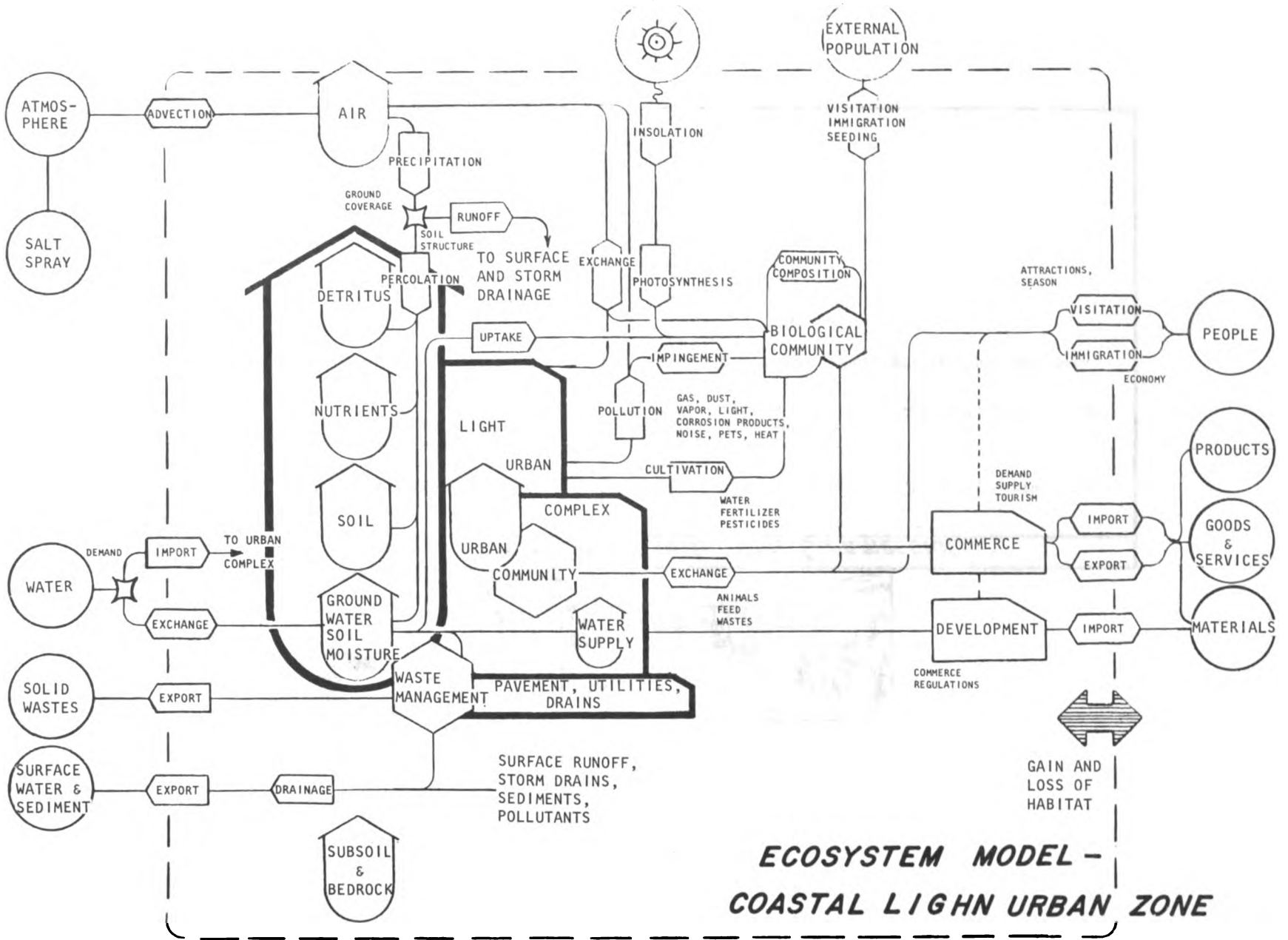
Landscaped, may utilize natural areas, native plants or exotics.

Characteristic Fauna

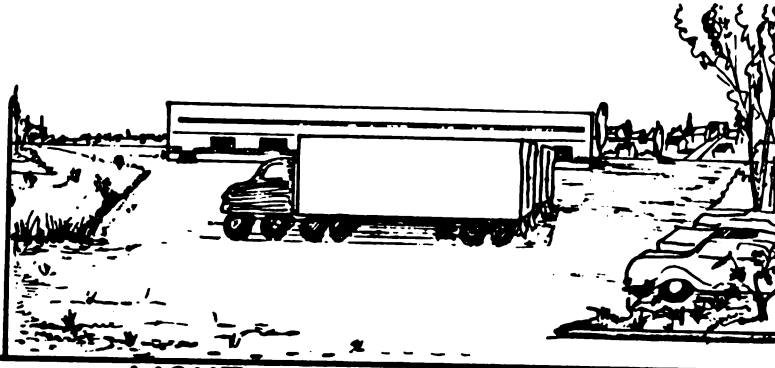
Mammals: rats, eastern gray squirrel, house mouse, striped skunk.

Birds: pigeon (rock dove), gulls, house sparrow, starling.

Invertebrates: flies.



4.2 Coastal Human  
Activity Zones  
4.2.3 Light Urban Zone  
B Industrial



### ***LIGHT URBAN — Industrial***

**Habitat Description**

Light industry with some open space. Typical are engineering and light manufacturing or processing firms. Transport, utility, and waste handling requirements resemble commercial establishments of similar size, but may include processing wastes, gaseous, liquid, solids, typical of light industry. Docks, wharves, and light shipping traffic common.

(Dense installations with little open space provide habitat more like Dense Urban - Commercial, and are classified there.)

**Food Web**

Adventitious.

**Characteristic Flora**

Predominantly unvegetated, with ruderal margins. Often small areas landscaped, may include small natural areas, native and exotic plantings, lawns.

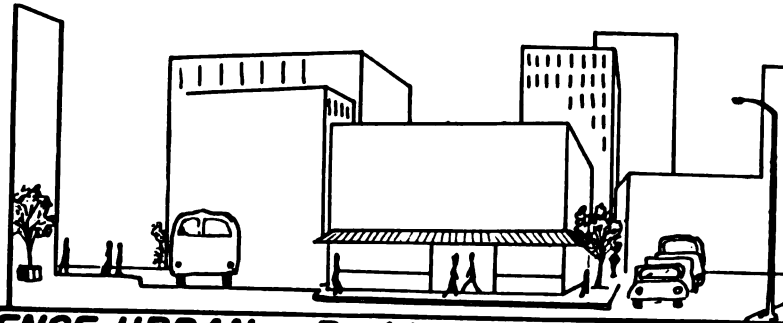
**Characteristic Fauna**

Mammals: rats, house mouse.

Birds: pigeon (rock dove), gulls, house sparrow, starling, crow.

Invertebrates: flies, mosquitoes.

- 4.2 Coastal Human Activity Zones
- 4.2.4 Dense Urban Zone
  - A Residential and Commercial



***DENSE URBAN—Residential and Commercial***

Habitat Description

The city center, no vacant ground. Usually multistory residential and commercial buildings, often highrise. Large, dense apartment, shopping or recreational complexes, and marinas. Patterns of traffic, utility and service requirements, trash, garbage, sewage are similar in dense residential and commercial areas.

(Light Industrial, if dense, is included here.)

Food Web

Litter, garbage, trash provide food for scavengers. People feed pigeons, gulls, and sparrows.

Characteristic Flora

Predominantly unvegetated. Cultivated trees, shrubs, ground cover, flowering plants in planter strips and boxes.

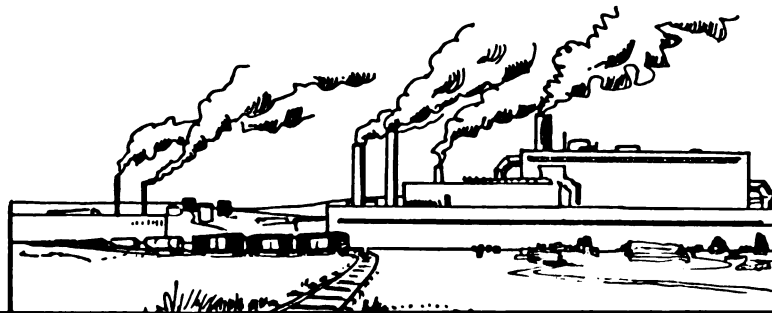
Characteristic Fauna

Mammals: rats, house mouse.

Birds: pigeon (rock dove), sparrow, gulls, starling.

Invertebrates: flies, roaches, silverfish.

4.2 Coastal Human  
Activity Zones  
4.2.4 Dense Urban Zone  
B Industrial



***DENSE URBAN — Heavy Industrial***

Habitat Description

Large buildings, high stacks, often water towers, open space used for parking and storage yards. Heavy transportation includes both truck and rail, often predominantly water based, with dock and wharf facilities and heavy shipping traffic. Heavy utility demand. High production of waste water, heat, gases, solid wastes, some salvagable. Herbicides or waste oil sometimes used for weed control. Point-sources of pollution, particularly with older plants, may include: sewer outfalls, stacks, piles of sawdust and tailings, cannery wastes.

Commonly located on filled land in estuaries.

Food Web

Adventitious.

Characteristic Flora

Predominantly unvegetated. Some plantings around administrative and engineering offices; usually ruderal elsewhere in older marginal areas.

Characteristic Fauna:

Mammals: rats, house mouse.

Birds: pigeon (rock dove), house sparrow, gulls, starling, crow.

Invertebrates: flies.

- 4.2 Coastal Human Activity Zones
- 4.2.5 Buffer and Connector Zone
- A Parks and Greenbelts



***BUFFERS and CONNECTORS — Parks & Greenbelts***

Habitat Description

Dedicated open space for esthetic, recreational, and educational values. Character varies from virtually untouched natural areas to formally landscaped areas and golf courses.

Often are typical of relatively undisturbed habitats of the biological zone. Usually have picnic areas and may have camping spaces.

Waterfront parks usually allow shell fish and sport fishing. Greenbelts separate, or are included in, developed areas.

Food Web

Adventitious to typical for the local habitat. May be planted to encourage desired fauna.

Characteristic Flora

Formally or informally cultivated or relatively undisturbed natural vegetation.

Characteristic Fauna

Mammals: eastern gray squirrel, white-footed moose, voles, shrews, raccoon.

Birds: robin, Stellar's jay, gulls, finches, song sparrow, house wren, black-capped chickadee, downy woodpecker, swallows, American kestrel.

Herpetofauna: garter snakes.

Invertebrates from neighboring "natural" habitats.



- 4.2 Coastal Human Activity Zones
- 4.2.5 Buffer and Connector Zone
- B Hedgerows



### ***BUFFERS and CONNECTORS — Hedgerows***

**Habitat Description**

A row of vegetation forming a hedge or windbreak, usually along property lines or boundaries. May be natural, planted, or volunteer and may be planned to provide ground cover, feed, and nesting sites for game or other animals. Also provides cover for animal movement through developed areas.

**Food Web**

Adventitious or similar to the local habitat. May be planted to encourage desired animals.

**Characteristic Flora**

Natural, planted, or volunteer; natives, exotics, or mixed. Blackberries, raspberries, gorse, and Scotch broom are common shrubs in hedgerows.

**Characteristic Fauna**

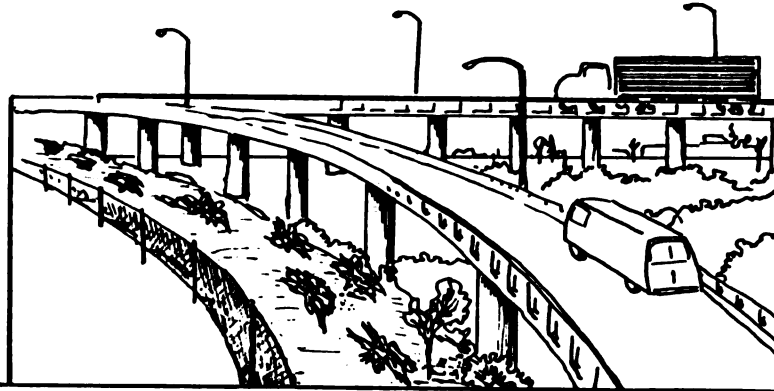
**Mammals:** eastern cottontail rabbit, white-footed mouse, voles.

**Birds:** song sparrow, rufous-sided towhee, ring-necked pheasant, Oregon junco, American goldfinch.

**Herpetofauna:** garter snakes.

**Invertebrates** from neighboring "natural" habitats.

- 4.2 Coastal Human Activities Zones
- 4.2.5 Buffer and Connector Zone
- C Transportation Corridors



***BUFFERS and CONNECTORS—Transportation Corridors***

Habitat Description

Right of way along freeways or railways, including median strips. Access for people and animals is often limited. Vegetation formerly controlled by clearcutting, burning, and herbicides, especially along railways. Landscaping used on freeways for esthetics, sound and visual control, ground cover, stabilization, and low maintenance. Provides routes across streams, estuaries, difficult terrain. Movement inhibited across freeways.

Food Web

Usually adventitious.

Characteristic Flora

Natural, planted, or volunteer; natives, exotics, weeds, or mixed.

Characteristic Fauna

Mammals: Voles.

Birds: American kestrel, crow, pigeon (rock dove), gulls.

Invertebrates from neighboring "natural" habitats.

- 4.2 Coastal Human  
Activities Zones  
4.2.5 Buffer and  
Connector Zone  
D Utility Corridors



### ***BUFFERS and CONNECTORS — Utility Corridors***

#### Habitat Description

Right of way for communication and electrical transmission lines; oil, gas, coal slurry, water, and sewer pipelines.

May include maintenance-road, may be fenced. Vegetation controlled for safety and function of above-ground lines and equipment. Stumps often left. May contain unauthorized trash dumps.

#### Food Web

Usually typical of cleared and early succession areas in the biological zone.

#### Characteristic Flora

Ruderal; scrub, shrub, meadow, (almost always volunteer, natives and herbaceous weeds).

#### Characteristic Fauna

Mammals: black-tailed deer.

Birds: red-tailed hawk, American kestrel, swallows, fly catchers, starling, song sparrow.

Herpetofauna: garter snakes.

Invertebrates from neighboring "natural" habitats.

4.2 Coastal Human  
Activity Zones  
4.2.5 Buffer and  
Connector Zone  
E Watercourses



***BUFFERS and CONNECTORS — Waterways***

Habitat Description

Banks of a stream, canal, estuary, or inlet; riparian or shore zone; like emergent, scrub/shrub, and forested wetlands of Cowardin et al. (1977).

May provide long stretches of undisturbed habitat through developed areas with access to water. May be on tidal or estuarine water.

May contain unauthorized trash dumps and old sewer outfalls.

Food Web

Adventitious. Generally riparian or dense in character depending on the biological zone.

Characteristic Flora

Riparian in character, or dune. Natural emergent, scrub/shrub, and forest; or planted or volunteer; usually hydrophytic, halophytes if near sea level or subject to spray.

Characteristic Fauna

Riparian or dune in character, depending on location and land form. Modified by what goes on in adjacent human activity habitats.

Mammals: muskrat.

Birds: coot, mallard, grebes, loons, great blue heron, green heron, swallows, red-winged blackbird, gulls, terns.

Herpetofauna: frogs.

Invertebrates: mosquitoes, flies; many invertebrates typical of riparian and aquatic habitats with medium to low water quality.

ECOLOGICAL CHARACTERIZATION  
OF THE  
PACIFIC NORTHWEST COASTAL REGION

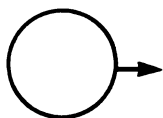
VOLUME THREE  
CHARACTERIZATION ATLAS  
ZONE AND HABITAT DESCRIPTIONS

**Part Three**

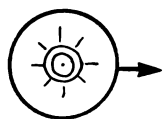
**REFERENCE DATA**


<u>Sections</u>	<u>Pages</u>
Glossary of Symbols.....	GS-1 to GS-3
Glossary of Terms.....	GT-1 to GT-19
List of Measurements, Abbreviations, and Symbols.....	MA-1
English-Metric Measurement Unit Conversions.....	MC-1 to MC-4
References.....	R-1 to R-5

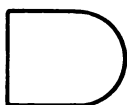
GLOSSARY OF SYMBOLS



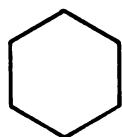
SOURCE OF ENERGY OR MATTER external to the system or portion of a system being modeled. This symbol, and many of the others here, are based on H. T. Odum (1971 and 1972).



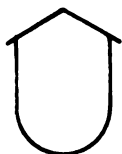
SOLAR RADIATION. The central figure , which is used for the sun in pictorial diagrams, is taken directly from a pteroglyph left by Pacific Northwest Coastal Indians (Meade, 1971).



PRODUCER: plant, or plant community. For thermodynamic balance, H.T. Odum (1971 and 1972) often shows heat sinks in connection with this and other symbols. Heat sinks are not used for the qualitative ecosystem diagrams in this report.



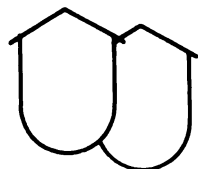
CONVERTER: animal, microbe, or community of animals or microbes; can be consumers or decomposers or both.



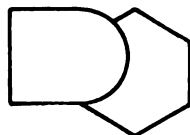
STORAGE COMPARTMENT OR SUBSTRATE.



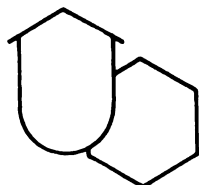
SOCIOECONOMIC ACTIVITY. Used, with labels, to cover the whole range of human activities except for the strictly biological, such as eating.



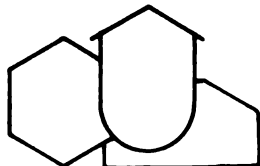
MULTI-COMPARTMENT STORAGE.



BIOLOGICAL COMMUNITY: producers and converters. The boundary between the compartments may be omitted, and their relative positions may vary. Converters may sometimes be presented separately as consumers and decomposers, and sizes of all three components may vary to show relative significance within the particular biological community.



SUBSTRATE-CONVERTER COMBINATION, such as the detritus-decomposer union, where the distinction between the two is not essential for the system being modeled.



COMPOSITE HUMAN COMMUNITY AND ACTIVITY; a combination of conversion, storage, and socioeconomic functions.

GLOSSARY OF SYMBOLS (continued)



TO DETRITUS. Indicates a flow of material and energy to the non-living compartment. Combines mortality and flow to detritus, thus simplifying models.



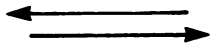
BOUNDARY for the specific ecological unit being modeled.



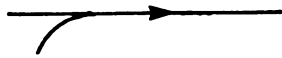
FLOW PATH FOR ENERGY OR MATTER OR DOLLARS.



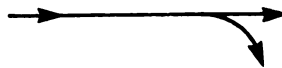
FLOW PATH FOR REGULATING INFLUENCE OR EFFECT (i.e. not flow of energy, matter, or dollars).



DIRECTIONAL FLOWS.



CONVERGING OR COMBINING FLOWS.



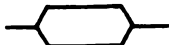
DIVERGING OR BRANCHING FLOWS.



SWITCH. Incoming flow is divided into two or more different paths by a primary regulating process, or goes one way or another depending on the regulating process and its secondary regulating factors.



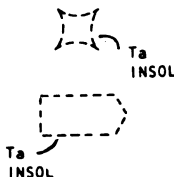
ONE-WAY VALVE. Flow in one direction along a single path occurs through and is controlled by a primary regulating process, and depends on its secondary regulating factors.



TWO-WAY VALVE. Flow in two directions along a single path occurs through and is controlled by a primary regulating process and its secondary regulating factors. Flow can go either or both directions, e.g., materials in and out. This symbol often represents a complex group of interacting processes.



SEQUENTIAL VALVE. Flow occurs through and is regulated by a series of primary regulating processes acting in sequence with little or no interaction. (Previous two valves are used for non-sequential or complex interacting processes.)



SECONDARY REGULATING FACTOR. The controlling factors that regulate a primary regulating process (represented by either a switch or a valve, as above). Examples illustrated here represent the regulating factors air temperature ( $T_a$ ) and insolation (INSOL).

GLOSSARY OF SYMBOLS (continued)



CYCLICAL OR PERIODIC FLOW FROM SOURCE, such as tides, daily and seasonal cycles of the sun, etc.



GAIN AND/OR LOSS OF HABITAT. When not otherwise labeled, the arrow applies to the regulating (or process) value by which it is placed. The arrow points out of the habitat boundary (dotted line enclosing the habitat) for loss, into the boundary for gain.



BOUNDARY BETWEEN ECOSYSTEM MODEL COMPARTMENTS (PHYSICAL-CHEMICAL, BIOLOGICAL, SOCIOECONOMIC).



## GLOSSARY OF TERMS

An attempt has been made to use common language, usage, and word forms throughout the volumes of this study, with the American Heritage Dictionary of the English Language (Morris, 1976) as referee. Many terms used in ecology and its component disciplines, however, do not enjoy "hard and fast," universally-accepted definitions, and/or have a variety of meanings depending on usage. For such words, the following definitions are given for the terms as used in this Ecological Characterization of the Pacific Northwest Coastal Region. Where these are taken directly from another reference, citation is given.

- ADVECTION.** A LOCAL CHANGE IN A PROPERTY OF A SYSTEM THAT TAKES PLACE IN THE PRESENCE OF A CURRENT, AS OF AIR OR WATER; INCLUDES TRANSPORT OF WATER VAPOR, HEAT, SEDIMENT LOAD, SALT CONTENT (SALINITY).
- AEROBIC.** REQUIRING OXYGEN; REFERRING TO LIFE OR PROCESSES THAT CAN OCCUR ONLY IN THE PRESENCE OF OXYGEN. (COMPARE.....ANAEROBIC.)
- ALLOCHTHONOUS.** IMPORTED FROM ANOTHER HABITAT, AS OF SOLID MATTER.
- ALLUVIAL SOIL.** SOIL COMPOSED OF ALLUVIUM AND ORGANIC MATERIAL. (SEE.....ALLUVIUM; COMPARE.....COLLUVIAL SOIL, RESIDUAL SOIL, LOESS SOIL.)
- ALLUVIUM.** A SURFICIAL DEPOSIT OF WEATHERED EARTH MATERIAL THAT WAS TRANSPORTED AND DEPOSITED BY WATER, SUCH AS FROM FORMER RIVER BEDS, DELTAS, AND FLOODPLAIN DEPOSITS. (SEE.....ALLUVIAL SOIL; COMPARE.....COLLUVIUM, LOESS, RESIDUUM.)
- ANADROMOUS.** MIGRATING FROM THE OCEAN TO FRESH OR LOWER SALINITY WATERS TO SPAWN. (COMPARE.....CATADROMOUS.)
- ANAEROBIC.** REFERRING TO LIFE OR PROCESSES THAT OCCUR IN THE ABSENCE OF OXYGEN; ANOXIC; INCLUDES FACULTATIVE ANAEROBES (ORGANISMS THAT DO NOT NEED OXYGEN BUT CAN LIVE IN THE PRESENCE OF OXYGEN) AND OBLIGATORY ANAEROBES (ORGANISMS THAT REQUIRE THE ABSENCE OF OXYGEN); USUALLY ASSOCIATED WITH REDUCING CONDITIONS. (COMPARE.....AEROBIC.)
- APPRECIATIVE ACTIVITY.** HUMAN RECREATIONAL ACTIVITY WHICH REQUIRES FEW SPECIAL FACILITIES OR EQUIPMENT AND WHICH IS NOT RESOURCE-DEPLETING; INCLUDES SUCH PASSIVE ACTIVITIES AS CAMPING, PICNICKING, OR DRIVING FOR PLEASURE TO VIEW SCENERY, AND SUCH ACTIVE PASTIMES AS BACKPACKING, HORSEBACK RIDING OR BIKING. (COMPARE.....EXTRACTIVE ACTIVITY, EXPRESSIVE ACTIVITY.)
- AQUATIC.** LIVING, GROWING, OR OCCURRING IN WATER; INCLUDES BOTH FRESH WATER AND MARINE ENVIRONMENTS.
- AQUIFER.** AN UNDERGROUND AREA (BED OR STRATUM) OF EARTH, GRAVEL, OR POROUS ROCK THAT CONTAINS WATER.
- ATLAS.** A VOLUME OF TABLES, CHARTS, MAPS, OR SYSTEMATICALLY-ARRANGED DATA ILLUSTRATING A SPECIFIC SUBJECT.
- ATMOSPHERE.** THAT PORTION OF THE ECOSPHERE COMPOSED OF THE GASEOUS MASS OR ENVELOPE SURROUNDING THE EARTH.
- AUTOTROPHIC.** SELF-NOURISHING; REFERRING TO ORGANISMS THAT ARE CAPABLE OF CONSTRUCTING ORGANIC MATTER WITH HIGH-ENERGY BONDS FROM INORGANIC SUBSTANCES FOR THEIR FOOD SUPPLY, BY PHOTOSYNTHESIS OR CHEMOSYNTHESIS. (SEE.....PRODUCER; COMPARE.....HETEROTROPHIC.)

GLOSSARY OF TERMS (CONTINUED)

- BACKSHORE.** THE UPPER PART OF A BEACH OR BANK EXTENDING FROM ABOVE MEAN HIGHER HIGH WATER (OR TIDE) TO UPPER BOUNDARY OF GEHYDRAULIC INFLUENCE (100 YEAR FLOOD/TIDE) (BAUER, 1975). SEE FIG. 2-27 IN MODEL (VOL. 1). (COMPARE.....FORESHORE, NEARSHORE, OFFSHORE.)
- BASIC HUMAN ACTIVITY.** SOCIOECONOMIC ACTIVITY WHICH PRODUCES, HARVESTS, PROCESSES, OR DISTRIBUTES NATURAL RESOURCES. (COMPARE.....NON-BASIC HUMAN ACTIVITY.)
- BATHYMETRY.** THE TOPOGRAPHY OF THE SEA FLOOR; THE DETAILED PHYSICAL FEATURES (SUCH AS DEPTH CONTOURS) OF THE SURFACE OF THE SEA FLOOR.
- BEACH.** AN ACCUMULATION OF UNCONSOLIDATED ROCK FRAGMENTS (SAND, PEBBLES, COBBLES) OR SHELL FRAGMENTS ALONG THE SHORELINE, BOUNDED BY THE MAXIMUM LIMITS OF SHORELINE MOVEMENTS, I.E., FROM LOWEST MEASURED TIDE TO LANDWARD LIMIT OF 100 YEAR STORM TIDE. THIS INCLUDES FORESHORE AND BACKSHORE. (SEE.....SHORELINE, COAST, FORESHORE, BACKSHORE, DUNE.)
- BED-LOAD.** SAND, GRAVEL, OR HEAVY ROCK FRAGMENTS THAT ROLL, SLIDE, OR BOUNCE ALONG THE BED OF A STREAM, OR ALONG THE BOTTOM OF AN ESTUARY OR THE OCEAN. (COMPARE .....SUSPENDED LOAD, DISSOLVED LOAD.)
- BENTHIC.** RELATING TO THE BOTTOM OF A BODY OF WATER (LAKE, RIVER, ESTUARY, OCEAN); INCLUDES SUBSTRATE AND OVERLYING PORTION OF WATER WITHIN ONE METER OF SUBSTRATE. (COMPARE.....PELAGIC, NERITIC.)
- BENTHOS.** BOTTOM-DWELLING ORGANISMS (PLANTS AND ANIMALS), SESSILE, CREEPING, OR BURROWING. (SEE.....BENTHIC; COMPARE.....DEMERSAL.)
- BERM.** NEARLY HORIZONTAL TERRACE OF SAND ABOVE HIGH TIDE, DEPOSITED AND SHAPED BY WAVE ACTION. IN SUMMER, THE BERM IS LOW AND WIDE, BUT IN WINTER IT IS NARROWER AND HIGHER, INDICATIVE OF THE HEIGHT OF THE WAVES THAT CREATED IT (BASCOM, 1964). THE CREST OF THE BERM IS THE BOUNDARY BETWEEN THE FORESHORE AND THE BACKSHORE. SEE FIGS. 2-27 AND 2-35 IN MODEL (VOL. 1).
- BIOCHEMICAL OXYGEN DEMAND (BOD).** A MEASURE OF THE AMOUNT OF OXYGEN CONSUMED IN THE BIOLOGICAL PROCESSES THAT BREAK DOWN ORGANIC MATTER IN WATER.
- BIOGENOUS.** LIVING OR DERIVED FROM LIVING MATTER; ORGANIC. BIOGENOUS DEPOSITS ARE DEPOSITS HAVING MORE THAN 30 PERCENT MATERIAL DERIVED FROM ORGANISMS (HUNT AND GROVES, 1965).
- BIOLOGICAL ZONE.** AN AREA TYPIFIED BY CLEARLY IDENTIFIABLE GROUPS OF ORGANISMS ASSOCIATED WITH SPECIFIC REGIONAL FEATURES OF CLIMATE AND SUBSTRATE. ELEVATION, SLOPE, AND SOIL TYPE ARE THE MOST SIGNIFICANT SUBSTRATE FEATURES CONTROLLING THE ZONATION OF LIFE FORMS ON LAND. IN THE AQUATIC REGIONS, THE KEY FEATURES ARE TIDES, DEPTH, TEMPERATURE, FERTILITY OF THE WATER, AND TYPE OF BOTTOM.
- BIOMASS.** THE TOTAL MASS OF ALL ORGANISMS OR LIVING MATTER IN A SPECIFIED AREA OR VOLUME.
- BIOME.** A LARGE-SCALE ENVIRONMENTAL SUBDIVISION BASED ON DOMINANT VEGETATION AND CONCOMITANT FAUNA OVER LARGE CONTINENTAL REGIONS; THE LARGEST ECOLOGICAL CATEGORY OF ECOSYSTEMS BELOW THE ECOSPHERE LEVEL. (COMPARE.....BIOLOGICAL ZONE.)
- BIOSPHERE.** ALL LIVING ORGANISMS; THAT COMPONENT OF THE ECOSPHERE MADE UP OF ALL LIFE.
- BLOOM.** AN ENORMOUS CONCENTRATION OF PLANKTON (USUALLY PHYTOPLANKTON) IN AN AREA, CAUSED EITHER BY AN EXPLOSIVE OR GRADUAL MULTIPLICATION OF ORGANISMS IN RESPONSE TO INCREASED NUTRIENT SUPPLY, AND USUALLY PRODUCING A DISCOLORATION OF THE WATER SURFACE (GROSS, 1972).

GLOSSARY OF TERMS (CONTINUED)

- BOD.** SEE.....BIOCHEMICAL OXYGEN DEMAND.
- BREAKER DEPTH.** THE STILL WATER DEPTH OVER A SHOALING BOTTOM AT THE POINT WHERE WAVES BREAK (HUNT AND GROVES, 1965).
- BROWSE.** LEAVES, TWIGS, AND OTHER VEGETATION USED AS FOOD BY BROWSING ANIMALS. (SEE DEFINITION (2) OF.....GRAZER.)
- CANOPY.** THE TREETOP ZONE IN A FOREST WHERE LIGHT IS NOT A LIMITING FACTOR AND WHERE LIVE BRANCHES AND FOLIAGE OFTEN ARE CONCENTRATED.
- CARNIVORE.** AN ORGANISM THAT GETS ITS NOURISHMENT BY EATING ANIMAL TISSUE; PREDATOR; A SECONDARY OR HIGHER TROPHIC LEVEL CONSUMER. (COMPARE.....HERBIVORE, OMNIVORE, DETRITIVORE.)
- CARRION.** (1) DEAD OR DECAYING FLESH (MORRIS, 1976). (2) DEAD ANIMAL MATTER, EITHER A WHOLE OR A PORTION OF AN ANIMAL BODY IN EARLY STAGES OF DECOMPOSITION. (COMPARE.....LITTER.)
- CARRYING CAPACITY.** THE NUMBER OR BIOMASS OF ORGANISMS WHICH CAN THEORETICALLY BE SUSTAINED IN A GIVEN AREA OR ENVIRONMENT, WITHOUT ADVERSELY AFFECTING THAT AREA.
- CAST.** SOLID ORGANIC MATTER DISCARDED BY AN ORGANISM, E.G., (1) THE WASTE EXCRETED BY AN EARTHWORM, (2) THE SKIN SHED BY A MOLTING INSECT OR REPTILE, OR THE SHELL SHED BY A CRAB, (3) THE MASS OF FEATHERS, FUR, BONES, AND OTHER MATTER EJECTED FROM THE CROPP OF AN OWL, OR (4) THE LEAVES OF ATTACHED SEaweEDS ADRIFT. (COMPARE.....LITTER, WRACK.)
- CATADROMOUS.** MIGRATING FROM FRESH WATERS TO WATERS OF HIGHER SALINITY TO SPAWN. (COMPARE.....ANADROMOUS.)
- CELERITY.** WAVE SPEED RELATIVE TO THE WATER (NOT RELATIVE TO THE BOTTOM).
- CHANNELIZED FLOW.** RUNOFF OF WATER IN DEFINABLE CHANNELS, AS IN STREAMS AND RIVERS. (COMPARE.....NON-CHANNELIZED FLOW, SURFACE RUNOFF, RUNOFF.)
- CLIMATE.** THE METEOROLOGICAL CONDITIONS, INCLUDING TEMPERATURE, PRECIPITATION, AND WIND, THAT CHARACTERISTICALLY PREVAIL IN A PARTICULAR REGION (MORRIS, 1976).
- CLIMAX COMMUNITY.** THE COMMUNITY CAPABLE OF PERPETUATION UNDER THE PREVAILING CLIMATIC AND SOIL CONDITIONS OF A GIVEN AREA. (SEE.....SUCCESSION, SERE; COMPARE.....SERAL STAGE.)
- COAST.** (1) A LARGE PHYSIOGRAPHIC FEATURE OFTEN EXTENDING SEVERAL MILES INLAND FROM THE SHORELINE (BASCOM, 1964). (2) A STRIP OF LAND OF INDEFINITE WIDTH (MAY BE SEVERAL MILES) THAT EXTENDS FROM THE SEASHORE INLAND TO THE FIRST MAJOR CHANGE IN TERRAIN FEATURES (HUNT AND GROVES, 1965). (3) THE LAND NEXT TO OR NEAR THE SEA; SEASHORE (MORRIS, 1976).
- COLLUVIAL SOIL.** SOIL COMPOSED OF COLLUVIUM AND ORGANIC MATERIAL. (SEE.....COLLUVIUM; COMPARE.....ALLUVIAL SOIL, RESIDUAL SOIL, LOESS SOIL.)
- COLLUVIUM.** A SURFICIAL DEPOSIT OF WEATHERED EARTH MATERIAL THAT WAS TRANSPORTED BY GRAVITY FREE-FALL AND NOT BY WATER OR WIND; CHARACTERISTIC PARTICLE SHAPE IS ANGULAR AND SHARP. (SEE.....COLLUVIAL SOIL; COMPARE.....ALLUVIUM, LOESS, RESIDUUM.)
- COMMUNITY.** A GROUP OF PLANTS AND ANIMALS OCCUPYING A HABITAT AND HAVING CLOSE INTERACTIONS, ESPECIALLY THROUGH FOOD CHAINS AND WEBS.

GLOSSARY OF TERMS (CONTINUED)

- COMPENSATION DEPTH.** THE DEPTH SEPARATING THE EUPHOTIC AND DISPHOTIC ZONES OF A BODY OF WATER, AT WHICH THE ENERGY OF THE PENETRATING SUNLIGHT ALLOWS PHOTOSYNTHESIS TO OCCUR TO A DEGREE JUST SUFFICIENT TO PROVIDE FOR THE MAINTENANCE OF PLANT LIFE.
- COMPOUND ESTUARY.** A TYPE OF ESTUARY (UNDER THE CLASSIFICATION SCHEME OF BAUER, 1975) THAT CONTAINS OPEN-WATER, STREAMWAY, AND MARINEWAY SECTORS. SEE FIG. 2-23 IN MODEL (VOL. 1).
- CONSUMER.** AN ORGANISM THAT EATS OTHER ORGANISMS AS A SOURCE OF ENERGY AND NUTRIENTS; INCLUDES HERBIVORES, CARNIVORES, OMNIVORES. (COMPARE.....PRODUCER, CONVERTER, DECOMPOSER.)
- CONTINENTAL SHELF.** THE ZONE BORDERING A CONTINENT EXTENDING FROM THE LINE OF PERMANENT IMMERSION (LOWEST MEASURED TIDE) TO THE DEPTH (USUALLY ABOUT 200 METERS, 100 FATHOMS, OR 200 YARDS) WHERE THERE IS A MARKED OR RATHER STEEP DESCENT TOWARD THE GREAT DEPTHS (HUNT AND GROVES, 1965).
- CONVERTER.** (1) AN ORGANISM THAT CANNOT MAKE ITS OWN FOOD, BUT RATHER RELIES ON OTHER ORGANISMS (PRODUCERS OR OTHER CONVERTERS) OR THEIR REMAINS FOR ITS ENERGY AND NUTRIENTS; HETEROTROPH; INCLUDES CONSUMERS AND DECOMPOSERS. (2) FUNCTIONAL COMPONENT (ANIMAL, BACTERIUM, FUNGUS) OF AN ECOSYSTEM WHICH RELIES DIRECTLY OR INDIRECTLY ON STORED CHEMICAL ENERGY SYNTHESIZED BY PRODUCERS (GREEN PLANTS). (COMPARE.....PRODUCER.)
- CRYPTOGAM.** ANY FLOWERLESS AND SEEDLESS PLANT THAT REPRODUCES BY SPORES, SUCH AS FUNGI, ALGAE, LICHENS, MOSSES, AND FERNS.
- CURRENT.** A HORIZONTAL MOVEMENT OF WATER, EITHER TIDAL OR NON-TIDAL; CAUSED BY GRAVITY (AS IN STREAMS AND RIVERS), AND DENSITY GRADIENTS AND GLOBAL CIRCULATION (AS IN PERMANENT OCEAN CURRENTS.)
- DECOMPOSER.** AN ORGANISM THAT BREAKS DOWN DEAD PLANTS (LITTER), DEAD ANIMALS (CARRION), OR THEIR FECES OR REMAINS INTO SIMPLER PARTS FOR ITS NUTRITION. (COMPARE.....PRODUCER, CONVERTER, CONSUMER.)
- DEFLATION.** THE REMOVAL OF SAND BY THE WIND.
- DEFLATION PLAIN.** A DEPRESSION WITHIN A DUNE SYSTEM OWING ITS ORIGIN TO EXCAVATION BY WIND.
- DEMERSAL.** PERTAINING TO SWIMMING FAUNA (NEKTON) LIVING ON OR NEAR THE LAKE OR SEA BOTTOM. (COMPARE.....BENTHOS.)
- DETRITIVORE.** AN ORGANISM WHICH GAINS ITS NOURISHMENT FROM CONSUMING DETRITUS. (COMPARE.....HERBIVORE, CARNIVORE, OMNIVORE.)
- DETRITUS.** ALL TYPES OF BIOGENIC MATERIAL IN VARIOUS STAGES OF MICROBIAL DECOMPOSITION AND WHICH REPRESENTS A POTENTIAL ENERGY SOURCE TO CONSUMER ORGANISMS (DARNELL, 1976); INCLUDES CARRION, LITTER, CAST, AND WRACK AS WELL AS PARTICULATE ORGANIC DEBRIS DERIVED FROM DECOMPOSITION.
- DIAGENESIS.** REACTIONS THAT TAKE PLACE WITHIN A SEDIMENT BETWEEN ONE MINERAL AND ANOTHER OR BETWEEN ONE OR SEVERAL MINERALS AND THE INTERSTITIAL OR SUPERNATANT FLUIDS. DIAGENESIS IS A PROCESS THAT MAKES ROCK OUT OF SEDIMENT BY CHEMICAL REORGANIZATION SUCH AS SOLUTION, PRECIPITATION, CRYSTALLIZATION, RECRYSTALLIZATION, OXIDATION, REDUCTION, ETC. THESE REACTIONS TAKE PLACE AT LOWER TEMPERATURES AND PRESSURES THAN METAMORPHIC REACTIONS (PETTIJOHN, 1957).

GLOSSARY OF TERMS (CONTINUED)

- DIFFRACTION.** THE PHENOMENON BY WHICH ENERGY IS TRANSMITTED Laterally ALONG A WAVE CREST. WHEN A PORTION OF A WAVE TRAIN IS INTERRUPTED BY A BARRIER SUCH AS A BREAKWATER, THE EFFECT OF DIFFRACTION IS MANIFESTED BY PROPAGATION OF WAVES INTO THE SHELTERED REGION WITHIN THE GEOMETRIC SHADOW OF THE BARRIER (HUNT AND GROVES, 1965).
- DISCHARGE, STREAM OR RIVER.** THE VOLUME OF WATER AND SEDIMENTS RELEASED INTO THE RECEIVING BODY OF WATER (LAKE, RIVER, ESTUARY, OR OCEAN).
- DISPHOTIC ZONE.** THE LOWER ZONE IN A BODY OF WATER BELOW THE COMPENSATION POINT IN WHICH LIGHT ENERGY IS INSUFFICIENT TO MEET THE METABOLIC NEEDS OF PLANT LIFE. (COMPARE.....EUPHOTIC ZONE; SEE.....COMPENSATION DEPTH.)
- DISSOLVED LOAD.** THAT PORTION OF THE SEDIMENT BURDEN CARRIED BY A STREAM OR RIVER IN CHEMICAL SOLUTION. (COMPARE.....SUSPENDED LOAD, BED-LOAD.)
- DISTRIBUTARY.** A BRANCH OF A RIVER THAT FLOWS AWAY FROM THE MAIN CHANNEL AND DOES NOT RETURN TO IT, AS IN A DELTA REGION (MORRIS, 1976). (COMPARE.....TRIBUTARY.)
- DIVERSITY.** SPECIES RICHNESS; THE NUMBER OF SEPARATE SPECIES LIVING IN A SPECIFIED AREA OR VOLUME, AS DETERMINED BY A GIVEN SAMPLING TECHNIQUE.
- DOMINANT.** HAVING A MAJOR ROLE IN A COMMUNITY BECAUSE OF NUMBER, SIZE, OR ACTIVITY, AS OF PLANTS OR ANIMALS.
- DRIFT SECTOR.** A UNIT OF COASTLINE OR RIVER BANK WHICH INCLUDES SUPPLY, TRANSPORT, AND FINAL ACCRETION PHASES OF THE LOCAL SEDIMENTATION PROCESS.
- DUNE.** A WIND-FORMED RIDGE OR HILL OF SAND (MORRIS, 1976). (SEE.....PRIMARY DUNE, STABILIZED DUNE; COMPARE.....BEACH.)
- DYSTROPHIC.** CHARACTERIZED BY HIGH OXYGEN CONSUMPTION AND POOR BOTTOM-DWELLING FAUNA POPULATIONS, AS OF LAKES.
- ECOLOGICAL MODEL.** A CONCEPTUAL REPRESENTATION OF ACTUAL ECOSYSTEMS OR THEIR COMPONENT PHENOMENA IN SYMBOLIC TERMS. (SEE.....MODEL.)
- ECOLOGY.** THE INTERRELATIONSHIPS OF LIVING ORGANISMS TO ONE ANOTHER AND TO THEIR ENVIRONMENT, OR THE STUDY OF THESE INTERRELATIONSHIPS.
- ECOSPHERE.** THE TOTAL ASSEMBLAGE OF LIVING ORGANISMS AND THE SPACE, ENERGY, AND MATTER NEEDED TO SUSTAIN IT; CONTAINS ATMOSPHERE, LITHOSPHERE, HYDROSPHERE, AND BIOSPHERE.
- ECOSYSTEM.** A SYSTEM, WITH SPECIFIED BOUNDARIES, OF INTERRELATED ORGANISMS AND THE NON-LIVING ENVIRONMENT SUSTAINING IT; MAGNITUDE CAN RANGE FROM THE MICROSCOPIC TO THE PLANETARY.
- ECOTONE.** THE TRANSITION AREA OR BOUNDARY BETWEEN TWO BIOMES, ZONES, OR HABITATS.
- EFFLUENT.** A DISCHARGE OF POLLUTANTS INTO THE ENVIRONMENT (AIR OR WATER), EITHER TREATED OR UNTREATED (STUDDARD, 1974).
- EKMAN TRANSPORT.** NET MOTION OF AN ENTIRE MASS OF MOVING WATER, WHICH, IN THE ABSENCE OF INTERFERING LAND MASSES, IS DIRECTED NINETY DEGREES TO THE RIGHT (IN THE NORTHERN HEMISPHERE) OF THE DIRECTION OF THE WIND THAT SET IT MOTION (GROSS, 1972). NOTE THAT THE SURFACE WIND DRIFT CURRENT WILL BE ONLY 45 DEGREES TO THE RIGHT OF THE WIND DIRECTION IN THE NORTHERN HEMISPHERE, THE CURRENT DEFLECTING FURTHER TO THE RIGHT WITH DEPTH.

GLOSSARY OF TERMS (CONTINUED)

- EMERGENT VEGETATION.** AQUATIC PLANTS WHICH ARE NOT TOTALLY SUBMERGED; TYPICALLY BEING ROOTED IN AN AQUATIC ENVIRONMENT BUT HAVING MOST OF THE PHOTOSYNTHESIS OCCURRING ABOVE WATER, E.G., CATTAIL, BULRUSH, SEDGE.
- ENDANGERED.** IN DANGER OF EXTINCTION THROUGH ALL OR A SIGNIFICANT PORTION OF A SPECIES RANGE; A CLASSIFICATION CATEGORY OF THE ENDANGERED SPECIES ACT OF 1973. (COMPARE.....THREATENED.)
- ENDANGERED SPECIES.** SPECIES CLASSIFIED AS ENDANGERED UNDER THE ENDANGERED SPECIES ACT OF 1973; ANY NATIVE SPECIES OR SUBSPECIES WHICH THE SECRETARY OF INTERIOR, AFTER CONSULTATION WITH APPROPRIATE AFFECTED STATES OR KNOWLEDGEABLE PERSONS, DETERMINES TO BE IN DANGER OF EXTINCTION.
- ENDEMIC.** NATIVE AND FOUND ONLY IN A SMALL AREA (LOCAL ENDEMIC) OR REGION (REGIONAL ENDEMIC); HAVING A RANGE RESTRICTED TO A PARTICULAR LOCATION OR REGION.
- ENVIRONMENT.** THE SUM OF ALL EXTERNAL CONDITIONS AND INFLUENCES (MATTER AND ENERGY) AFFECTING OR IMPINGING ON THE LIFE, DEVELOPMENT, AND SURVIVAL OF AN ORGANISM OR GROUP OF ORGANISMS.
- ENVIRONMENTAL RESISTANCE.** (1) THE DIFFERENCE BETWEEN ACTUAL POPULATION AND CARRYING CAPACITY OF AN AREA; A MEASURE OF DEFICIT OR SURPLUS RESOURCES. (2) SUPPRESSION OR INHIBITION OF GROWTH BY PHYSICAL OR BIOLOGICAL FACTORS AS A POPULATION INCREASES IN NUMBERS.
- EPIBENTHIC.** PERTAINING TO NON-SWIMMING FAUNA (BENTHOS) ON THE LAKE OR SEA BOTTOM.
- EPIFAUNA.** AQUATIC ANIMALS LIVING ON THE SURFACE OF BOTTOM SEDIMENTS. (COMPARE.....INFAUNA, BENTHOS.)
- EPIPHYTE.** A PLANT THAT GROWS ON ANOTHER PLANT UPON WHICH IT DEPENDS FOR MECHANICAL SUPPORT BUT NOT AS A DIRECT SOURCE OF NUTRIENTS.
- EPIPSAMMIC.** PERTAINING TO ORGANISMS LIVING ATTACHED TO THE SURFACE OF SAND GRAINS.
- ERODABILITY.** QUALITY OF ROCK DERIVED FROM ITS CHEMICAL AND PHYSICAL COMPOSITION AND AFFECTING THE RATE AT WHICH IT MAY BE ERODED.
- EROSION.** THE GROUP OF NATURAL PROCESSES INCLUDING WEATHERING, DISSOLUTION, ABRASION, CORROSION, AND TRANSPORTATION BY WHICH EARTHY OR ROCK MATERIAL IS REMOVED FROM ANY PART OF THE SURFACE OF THE EARTH (MORRIS, 1976).
- ESTUARY.** A SEMI-ENCLOSED COASTAL BODY OF WATER WHICH HAS A FREE CONNECTION WITH THE OPEN SEA AND WITHIN WHICH SEA WATER IS MEASURABLY DILUTED WITH FRESH WATER DERIVED FROM LAND DRAINAGE (CAMERON AND PRITCHARD, 1963). SEE OTHER DEFINITIONS IN SECTION 2.6 OF MODEL (VOL. 1).
- EUPHOTIC ZONE.** THE UPPER ZONE IN A BODY OF WATER IN WHICH RADIANT ENERGY PENETRATES IN SUFFICIENT LEVELS TO MEET OR EXCEED THE METABOLIC NEEDS OF PLANT LIFE. (COMPARE.....DISPHOTIC ZONE, COMPENSATION DEPTH.)
- EUTROPHIC.** NUTRIENT-RICH; CHARACTERISTIC OF OLD OR POLLUTED LAKES, SUPPORTING HIGH BIOLOGICAL PRODUCTION. (COMPARE.....MESOTROPHIC AND OLIGOTROPHIC.)
- EVAPOTRANSPIRATION.** WATER LOSS BY A PLANT INCLUDING NORMAL EVAPORATION OF WATER THAT DIFFUSES THROUGH THE PLANT SURFACES AND THAT WHICH IS RELEASED BY TRANSPIRATION THROUGH STOMATA OF THE LEAVES.

GLOSSARY OF TERMS (CONTINUED)

- EXPRESSIVE ACTIVITY.** HUMAN RECREATIONAL ACTIVITY WHICH IS DEPENDENT ON MAN-MADE RECREATIONAL FACILITIES SUCH AS BOATING, SWIMMING, AND WATER SKIING, AND FACILITY EXPRESSIVE ACTIVITIES SUCH AS COURT GAMES, FIELD GAMES, AND GOLF. (COMPARE.....APPRECIATIVE ACTIVITY, EXTRACTIVE ACTIVITY.)
- EXTERNALITY.** A SOCIOECONOMIC COST, SUCH AS REDUCED PRODUCTIVITY OR A NECESSARY MITIGATING MEASURE, WHICH IS NOT BORNE BY THE OWNERS OR MANAGERS OF THE ACTIVITY THAT PRODUCES IT.
- EXTRACTIVE ACTIVITY.** HUMAN RECREATIONAL ACTIVITY WHICH REMOVES RESOURCES; INCLUDES SUCH ACTIVITIES AS ROCKHOUDING, SPORT FISHING, CLAM DIGGING, AND HUNTING. (COMPARE.....APPRECIATIVE ACTIVITY, EXPRESSIVE ACTIVITY.)
- FACIES, SEDIMENT, SAND, OR MUD.** A STRATIGRAPHIC BODY DISTINGUISHED FROM OTHERS BY APPEARANCE OR COMPOSITION.
- FETCH.** IN WAVE FORECASTING, THE CONTINUOUS AREA OF WATER OVER WHICH THE WIND BLOWS IN ESSENTIALLY A CONSTANT DIRECTION. SOMETIMES USED SYNONYMOUSLY WITH FETCH LENGTH (HUNT AND GROVES, 1965).
- FIXATION.** THE PROCESS IN WHICH GASEOUS SUBSTANCES, ESPECIALLY NITROGEN, ARE REMOVED FROM THE ATMOSPHERE AND INCORPORATED INTO ORGANISMS. (COMPARE.....UPTAKE.)
- FLOCCULATION.** A LUMPING TOGETHER OF SUSPENDED COLLOIDAL CLAY-SIZED MATERIAL INTO A FLUFFY, SLOW-SETTLING PRECIPITATE. FLOCCULATION OCCURS IN ESTUARIES WHERE FRESH AND SALT WATER ARE MIXED.
- FLOOD PLAIN.** ALL LANDS THAT MAY BE INUNDATED BY THE MAXIMUM POSSIBLE CALCULATED FLOOD. TERM MAY BE APPLIED TO MARINE AND ESTUARINE BORDERLAND AS WELL AS TO RIVERINE BORDERLAND, AND MAY REFLECT MAXIMUM TIDAL CONDITIONS, AS WELL AS RIVER FLOW CONDITIONS. SEE FIG. 2-27 IN MODEL (VOL. 1).
- FOOD CHAIN.** A LINEAR SEQUENCE OF PREDATORS AND PREY SHOWING A DIRECT RELATIONSHIP SERIES OF EATERS AND EATEN IN A FOOD WEB AND EXHIBITING THE ENERGY FLOW FROM PRODUCERS THROUGH SEVERAL TROPHIC LEVELS OF CONSUMERS. (COMPARE.....FOOD WEB.)
- FOOD WEB.** (1) A MODEL SHOWING NUTRITIONAL INTERRELATIONSHIPS OF THE ORGANISMS IN A COMMUNITY, DEPICTING THE WEB-LIKE INTERCONNECTIONS OF THE NUMEROUS FOOD CHAINS OF EATERS AND EATEN; A ROAD MAP OF WHO EATS WHOM. (2) A COMPLEX NETWORK OF PATHWAYS BY WHICH ENERGY MOVES WITHIN A BIOTIC COMMUNITY, FROM PRODUCERS THROUGH ALL THE INTERCONNECTING TROPHIC LEVELS OF CONSUMERS. (COMPARE.....FOOD CHAIN.)
- FORB.** ANY NON-WOODY (HERBACEOUS) PLANT OTHER THAN A GRASS.
- FORESHORE.** (1) THE LOWER PART OF A BEACH OR FLOOD PLAIN EXTENDING FROM LOWEST MEASURED TIDE OR RIVER STAGE TO MEAN HIGHER HIGH WATER OR BANK FULL CONDITION (BAUER, 1975). (2) THE PART OF THE SHORE, LYING BETWEEN THE CREST OF THE SEAWARD BERM (OR THE UPPER LIMIT OF WAVE WASH AT HIGH TIDE) AND THE ORDINARY LOW WATER MARK, THAT IS ORDINARILY TRAVERSED BY THE UPRUSH AND BACKRUSH OF THE WAVES AS THE TIDES RISE AND FALL ALSO CALLED THE BEACH FACE (HUNT AND GROVES, 1965). SEE FIG. 2-27 IN MODEL (VOL. 1). (COMPARE.....BACKSHORE, NEARSHORE, OFFSHORE.)
- FRACTURED ECOSYSTEM.** AN ECOSYSTEM SIGNIFICANTLY ALTERED BY MAN IN WHICH NATURAL PROCESSES ARE SEVERELY DISRUPTED BY IMPROPER MANAGEMENT AND ITS MAJOR IMPACTS, INCLUDING POLLUTION. (COMPARE.....NATURAL ECOSYSTEM, MANAGED ECOSYSTEM.)
- FRASS.** INSECT FECES.

GLOSSARY OF TERMS (CONTINUED)

- GRAZER.** (1) IN GENERAL ECOLOGY, ANY PRIMARY CONSUMER. (2) IN WILDLIFE ECOLOGY, A HERBIVORE WHICH FEEDS ON HERBACEOUS PLANTS, E.G., GRASSES AND FORBS, AS OPPOSED TO BROWSE.
- HABITAT.** (1) THE AREA OR TYPE OF ENVIRONMENT WITHIN A BIOLOGICAL ZONE IN WHICH AN ORGANISM, POPULATION, OR COMMUNITY NORMALLY LIVES OR OCCURS. (2) THE SUM TOTAL OF ENVIRONMENTAL CONDITIONS OF A SPECIFIC PLACE THAT IS OCCUPIED BY AN ORGANISM, POPULATION, OR COMMUNITY (STUDDARD, 1974). (3) THE PARTICULAR PREFERRED ENVIRONMENT OF AN ORGANISM. (COMPARE.....BIOLOGICAL ZONE, NICHE.)
- HALOCLINE.** A VERTICAL SALINITY GRADIENT IN SOME LAYER OF A BODY OF WATER, WHICH IS APPRECIABLY GREATER THAN THE GRADIENTS ABOVE AND BELOW IT; ALSO A LAYER IN WHICH SUCH A GRADIENT OCCURS. SEE FIG. 2-30 IN MODEL (VOL. 1).
- HEADLAND.** A PROMONTORY OF ROCK ALONG THE COAST THAT IS RELATIVELY RESISTANT TO EROSION.
- HERBIVORE.** AN ORGANISM THAT GETS ITS NUTRITION BY EATING GREEN PLANT MATERIAL; GRAZER; PRIMARY CONSUMER. (COMPARE.....CARNIVORE, DETRITIVORE, OMNIVORE.)
- HERPETOFAUNA.** REPTILES AND AMPHIBIANS.
- HETEROTROPHIC.** OBTAINING NUTRIENTS AND ENERGY FROM ORGANIC SUBSTANCES PRODUCED BY AUTOTROPHIC ORGANISMS SUCH AS GREEN PLANTS; INCAPABLE OF SYNTHESIZING OWN FOOD FROM ENERGY OF SUN. (SEE.....CONVERTER.)
- HINDCAST.** TO CALCULATE OR ESTIMATE AN EFFECT OR EVENT FROM OBSERVED DATA AS OPPOSED TO PREDICTING (FORECASTING) FUTURE EFFECTS OR EVENTS. HINDCASTING IS USED TO TEST HYPOTHESES IN THE DEVELOPMENT OF PREDICTIVE THEORIES, ESPECIALLY IN THE GEOPHYSICAL SCIENCES.
- HOLOPLANKTON.** PERMANENT PLANKTON COMPRISING ORGANISMS THAT REMAIN AS PLANKTON THROUGHOUT THEIR COMPLETE LIFE CYCLE (SVERDRUP ET AL., 1942). (COMPARE.....MEROPLANKTON.)
- HUMIFICATION.** THE PROCESS OF HUMUS FORMATION BY DECOMPOSITION OF VEGETABLE MATTER.
- HUMUS.** A BROWN OR BLACK ORGANIC SUBSTANCE CONSISTING OF PARTIALLY OR WHOLLY DECAYED VEGETABLE MATTER THAT PROVIDES NUTRIENTS FOR PLANTS AND INCREASES THE ABILITY OF SOIL TO RETAIN WATER (MORRIS, 1976).
- HYDRIC.** WET; PERTAINING TO A WET CONDITION, AS IN A HYDRIC HABITAT SUCH AS A SWAMP OR MARSH. (COMPARE.....MESIC, XERIC.)
- HYDROLOGIC CYCLE.** THE MODEL OF WATER MOVEMENT OR CIRCULATION BETWEEN THE ATMOSPHERE, LITHOSPHERE, AND HYDROSPHERE, INVOLVING PRECIPITATION, PERCOLATION, RUN-OFF, AND EVAPORATION. SEE FIGS. 1-2, 2-15, 2-16, 2-17, AND SECTION 2.4 IN MODEL (VOL. 1).
- HYDROSPHERE.** THE PORTION OF THE ECOSPHERE THAT IS OR INVOLVES WATER (AS DISTINGUISHED FROM ATMOSPHERE AND LITHOSPHERE AND BIOSPHERE). (SEE.....ECOSPHERE.)
- INFAUNA.** AQUATIC ANIMALS LIVING BENEATH THE SURFACE OF THE BOTTOM SEDIMENTS. (COMPARE.....EPIFAUNA, BENTHOS.)
- INFILTRATION.** THE PENETRATION OR PASSING OF WATER INTO SOIL. (COMPARE.....PERCOLATION.)
- INSOLATION.** INCOMING SOLAR RADIATION OR ITS INTENSITY INCIDENT ON A GIVEN SITE OVER A GIVEN PERIOD OF TIME.



GLOSSARY OF TERMS (CONTINUED)

**JACKSON TURBIDITY UNIT (JTU).** A MEASURE OF THE SUSPENDED PARTICULATE MATTER IN WATER, E.G., CLAY, SILT, FINELY DIVIDED ORGANIC AND INORGANIC MATTER, COLLOIDS, PLANKTON AND OTHER MICROSCOPIC ORGANISMS. AN EXPRESSION OF THE OPTICAL PROPERTY OF A SAMPLE CAUSING LIGHT TO BE SCATTERED AND ABSORBED RATHER THAN BEING TRANSMITTED THROUGH THE SAMPLE. THE TURBIDITY UNIT WAS ORIGINALLY BASED ON A MEASUREMENT MADE WITH THE JACKSON CANDLE TURBIDIMETER EMPLOYING A STANDARD KAOLIN SUSPENSION, NOW LARGELY SUPERSEDED BY A NEPHELOMETRIC METHOD EMPLOYING STANDARD FORMAZIN SUSPENSIONS. THE NEPHELOMETRIC METHOD YIELDS TURBIDITY UNITS APPROXIMATELY EQUIVALENT TO JACKSON TURBIDITY UNITS AND EXTENDS THE RANGE OF SAMPLE MEASUREMENT. PURE WATER HAS ZERO TURBIDITY UNITS, TEST WATER MAY RANGE FROM 0 - >1000 UNITS. (BASED ON TARAS ET AL., 1971, PP. 349-353.)

**LACUSTRINE.** PERTAINING TO OR LIVING IN, ON, OR UNDER A LAKE OR POND. (COMPARE.....RIVERINE, RIPARIAN, PALUSTRINE.)

**LIMITING FACTOR.** AN ENVIRONMENTAL PARAMETER WHICH IS OF PRIME IMPORTANCE IN THE REGULATION OF BIOLOGICAL PROCESSES, SUCH AS INDIVIDUAL GROWTH (BIOMASS), POPULATION GROWTH, ETC.

**LITHOSPHERE.** THE PORTION OF THE ECOSPHERE THAT IS THE SOLID CRUST OF THE EARTH (AS DISTINGUISHED FROM ATMOSPHERE, HYDROSPHERE, AND BIOSPHERE). COMPARE.....ECOSPHERE.)

**LITTER.** (1) THE UPPERMOST LAYER OF THE FOREST FLOOR OR OTHER TERRESTRIAL ENVIRONMENT GROUND SURFACE CONSISTING CHIEFLY OF DECAYING ORGANIC MATTER (MORRIS, 1976). (2) THE DEAD VEGETABLE (OF PLANT ORIGIN) MATTER, SUCH AS LEAVES, TWIGS, OR WOOD THAT FALLS TO THE GROUND AND ACCUMULATES AS IN (1). (COMPARE.....CAST, WRACK, HUMUS, CARRION.)

**LITTORAL.** THE BENTHIC ENVIRONMENT IN THE OCEAN FROM THE SHORE TO ABOUT 200 METERS (100 FATHOMS), ARBITRARILY CHOSEN TO REPRESENT THE EDGE OF THE CONTINENTAL SHELF AND ROUGHLY THE LOWER EXTENT OF THE PHOTIC ZONE (SVERDRUP ET AL., 1942). (SEE.....BENTHIC.)

**LITTORAL DRIFT.** MOVEMENT OF SEDIMENT PARALLEL TO A BEACH, BOTH ALONG THE BEACH FACE AND IN THE SURF ZONE WITHIN THE LONGSHORE CURRENT. NET LITTORAL DRIFT.....REFERS TO THE DIFFERENCE BETWEEN THE VOLUME OF SEDIMENT MOVING IN ONE DIRECTION ALONG A BEACH AND THAT MOVING IN THE OPPOSITE DIRECTION (CAUSED BY SHIFTS IN THE DIRECTION OF WAVE APPROACH) (BASCOM, 1964). (SEE.....LONGSHORE CURRENT.)

**LOESS.** A SURFICIAL DEPOSIT OF WEATHERED EARTH MATERIAL THAT IS TRANSPORTED AND DEPOSITED BY WIND; CHARACTERISTIC PARTICLE SHAPE SMOOTH AND ROUNDED; SIZE IS FINE. DUNES ARE EXAMPLES OF LOESS. (SEE.....LOESS SOIL; COMPARE.....ALLUVIUM, COLLUVIUM, RESIDUUM.)

**LOESS SOIL.** SOIL COMPOSED OF LOESS AND ORGANIC MATERIAL. (SEE.....LOESS; COMPARE.....ALLUVIAL SOIL, COLLUVIAL SOIL, RESIDUAL SOIL.)

**LONGSHORE CURRENT.** THE RESULTANT CURRENT PRODUCED BY WAVES BEING DEFLECTED AT AN ANGLE BY THE SHORE. IN THIS CASE THE CURRENT RUNS ROUGHLY PARALLEL TO THE SHORELINE. THE LONGSHORE CURRENT IS CAPABLE OF CARRYING A CERTAIN AMOUNT OF MATERIAL (HUNT AND GROVES, 1965); ALSO CALLED LITTORAL CURRENT. (SEE.....LITTORAL DRIFT.)

**LOWLAND.** LOW ELEVATION TERRAIN WHERE ALTITUDE AND SLOPE ARE NOT IMPORTANT ECOLOGICAL FACTORS.

**MACROPHYTE, MACROFLORA.** PLANT FORMS, INDIVIDUALS OF WHICH CAN BE OBSERVED WITH THE UNAIDED EYE, I.E., WITHOUT USE OF A MICROSCOPE.

GLOSSARY OF TERMS (CONTINUED)

- MACROPLANKTON.** PLANKTON ORGANISMS, MOSTLY ANIMALS 1 MM OR MORE IN LENGTH, TAKEN IN A COARSE PLANKTON NET (SVERDRUP ET AL., 1942). (COMPARE.....MICROPLANKTON, NANNOPLANKTON.)
- MAJOR NUTRIENT.** CHEMICAL ELEMENT NECESSARY FOR THE GROWTH AND MAINTENANCE OF AN ORGANISM THAT IS REQUIRED IN PROPORTIONS MEASURABLE IN AT LEAST PARTS PER THOUSAND OF DRY TISSUE; INCLUDES, IN ADDITION TO C, H, AND O, THE ELEMENTS N, P, K, MG, CA, NA, CL, AND S FOR MOST ORGANISMS, ALSO SI FOR DIATOMS.
- MANAGED ECOSYSTEM.** AN ECOSYSTEM SIGNIFICANTLY ALTERED BY MAN IN WHICH ADVERSE IMPACTS (INCLUDING POLLUTION) ARE MINIMIZED BY PROPER MANAGEMENT PRACTICES. (COMPARE.....NATURAL ECOSYSTEM, FRACTURED ECOSYSTEM.)
- MARINE.** OF, OR PERTAINING TO, THE SALTY WATERS OF THE OCEANS AND ASSOCIATED SEAS OF THE EARTH.
- MARINEWAY SECTOR.** THAT PORTION OF AN ESTUARY WHICH IS BOUNDED BY LAND, WITH A RESTRICTED OPENING TO THE OCEAN, AND IS NOT A PART OF THE STREAMWAY. THE FLOW IS ESSENTIALLY TIDAL CONTROLLED, AND NOT RIVER CONTROLLED. LAGOONS AND BAYS ARE EXAMPLES OF THE MARINEWAY SECTOR (BAUER, 1975). SEE FIG. 2-23 AND SECTION 2.6.1 IN MODEL (VOL. 1). (COMPARE.....STREAMWAY SECTOR, OPEN-WATER SECTOR.)
- MARSH.** A LOW-LYING WETLAND CHARACTERIZED BY EMERGENT VEGETATION SUCH AS TYPHA WHICH IS PREDOMINANTLY HERBACEOUS. (COMPARE.....SWAMP.)
- MASS WASTING.** THE DOWNSLOPE MOVEMENT OF ROCK AND/OR SOIL MATERIAL IN RESPONSE TO GRAVITY. A NUMBER OF DIFFERENT TYPES OF MASS MOVEMENT ARE RECOGNIZED ON THE BASIS OF NATURE OF MOVEMENT, RATE OF MOVEMENT, TYPE OF MATERIAL, AND WATER CONTENT OF MATERIAL. SEE SECTION 2.2.5.7 IN MODEL (VOL. 1).
- MEIOFAUNA.** DIMINUTIVE ANIMALS SO SMALL THAT ANATOMICAL DETAIL IS NOT VISIBLE TO THE UNAIDED EYE, BUT LARGER THAN UNICELLULAR MICROBES.
- MEROPLANKTON.** TEMPORARY PLANKTON COMPRISING THE EGGS AND LARVAE OF THE BENTHOS AND NEKTON, SEASONALLY VERY ABUNDANT IN NERITIC WATERS; COMPOSED MAINLY OF DEVELOPMENTAL STAGES OF THE INVERTEBRATES, BUT INCLUDING ALSO THE YOUNG OF FISHES (SVERDRUP ET AL., 1942). (COMPARE.....HOLOPLANKTON.)
- MESIC.** PERTAINING TO A MODERATE MOISTURE OR PRECIPITATION CONDITION, AS IN A MESIC HABITAT. (COMPARE.....HYDRIC, XERIC.)
- MESOTROPHIC.** MEDIUM IN NUTRIENT LEVELS; CHARACTERISTIC OF AGING OR PARTIALLY-POLLUTED LAKES, SUPPORTING MEDIUM BIOLOGICAL PRODUCTION. (COMPARE.....OLIGOTROPHIC AND EUTROPHIC.)
- MICROCLIMATE.** THE CLIMATE OF A SPECIFIC PLACE WITHIN AN AREA, CONTRASTED WITH THE CLIMATE OF THIS AREA AS A WHOLE (MORRIS, 1976).
- MICRODETRITUS.** EXTREMELY FINE PARTICULATE ORGANIC MATTER DERIVED FROM DISSOLVED ORGANIC MATTER BY AIR BUBBLING, AS IN SURF.
- MICROPLANKTON.** PLANKTON ORGANISMS, BELOW ABOUT 1 MM IN SIZE, WHICH CAN BE CAPTURED IN A FINE-MESHED PLANKTON NET (MESH APERTURE ABOUT 0.076 MM) (SVERDRUP ET AL., 1942). ALSO CALLED NET PLANKTON. (COMPARE.....MACROPLANKTON, NANNOPLANKTON, ULTRAPLANKTON.)
- MIGRATION.** THE MOVEMENT OF INDIVIDUALS OR GROUPS BETWEEN AREAS IN RESPONSE TO SEASONAL CHANGES OR STAGES IN LIFE CYCLE.
- MINOR NUTRIENT.** CHEMICAL ELEMENT NECESSARY FOR GROWTH AND MAINTENANCE BY AN ORGANISM THAT IS REQUIRED IN PROPORTIONS LESS THAN PARTS PER THOUSAND OF DRY TISSUE; INCLUDES FE, MN, CU, CO, ZN, AND MO FOR MOST ORGANISMS; ALSO CALLED TRACE NUTRIENT OR TRACE ELEMENT.

GLOSSARY OF TERMS (CONTINUED)

- MODEL.** (1) A SYMBOLIC REPRESENTATION OF A REAL-LIFE PHENOMENON, EXPRESSED EITHER VERBALLY, GRAPHICALLY, OR MATHEMATICALLY. (2) THE FIRST VOLUME OF THE ECOLOGICAL CHARACTERIZATION OF THE PACIFIC NORTHWEST COASTAL REGION, CONTAINING GENERAL ECOLOGICAL THEORY, BACKGROUND DATA, AND DEVELOPMENT OF MAJOR CHARACTERIZATION MODELS.
- MULTIPLIER.** SOCIOECONOMIC INDEX OF THE RELATIONSHIP BETWEEN BASIC AND NON-BASIC EMPLOYMENT: THE NUMBER OF BASIC INDUSTRY JOBS, TIMES MULTIPLIER, EQUALS TOTAL NUMBER OF JOBS.
- MYCORRHIZA.** THE SYMBIOTIC ASSOCIATION OF THE MYCELIUM OF A FUNGUS WITH THE ROOTS OF CERTAIN PLANTS SUCH AS CONIFERS OR ORCHIDS (MORRIS, 1976).
- NANNOPLANKTON.** VERY SMALL (5 TO 60 MICRONS) PLANKTON WHICH PASS THROUGH A FINE COLLECTING NET AND MUST BE COLLECTED BY CENTRIFUGATION; INCLUDES BACTERIA, SMALL PROTOZOANS, DIATOMS, DINOFLAGELLATES, AND OTHERS (SVERDRUP ET AL., 1942). (COMPARE.....MACROPLANKTON, MICROPLANKTON, ULTRAPLANKTON.) ALSO SPELLED NANOPLANKTON.
- NATURAL ECOSYSTEM.** AN ECOSYSTEM WHICH HAS NOT BEEN SIGNIFICANTLY ALTERED OR AFFECTED BY MAN. (COMPARE.....MANAGED ECOSYSTEM AND FRACTURED ECOSYSTEM.)
- NEAP TIDE.** THE DAILY TIDAL CYCLE OF LEAST VERTICAL RANGE. (COMPARE.....SPRING TIDE.)
- NEARSHORE.** THE MARINE REGION CLOSEST TO SHORE, EXTENDING FROM THE LINE OF LOWEST MEASURED TIDE SEAWARD TO THE DEPTH AT OUTER LINE OF BREAKERS. SEE FIG. 2-27 IN MODEL (VOL. 1). (COMPARE.....FORESHORE, OFFSHORE, BACKSHORE.)
- NEARSHORE CIRCULATION CELL.** A WAVE-DRIVEN CURRENT SYSTEM IN, AND JUST SEAWARD OF, THE SURF ZONE CONSISTING OF (1) A LANDWARD DRIFT OF WATER THROUGH THE SURF ZONE, (2) LONGSHORE CURRENTS WHICH RUN PARALLEL TO THE SHORE BETWEEN THE SHORE AND SUBMERGED SAND BARS PARALLEL TO SHORE, AND (3) BORDERING RIP CURRENTS WHICH CARRY THE SURPLUS WATER SEAWARD TO JUST BEYOND THE SURF ZONE THROUGH LOW POINTS IN THE SUBMERGED SAND BARS (KOMAR, 1971).
- NEGATIVE MATERIAL BUDGET.** MATERIAL DEPOSITED IS LESS THAN THE AMOUNT OF MATERIAL REMOVED, AS IN EROSION.
- NEKTON.** MARINE ANIMALS THAT ARE ABLE TO SWIM AGAINST NORMAL WAVE AND CURRENT ACTION. (COMPARE .....PLANKTON, BENTHOS.)
- NERITIC.** PERTAINING TO THE MARINE WATERS OF THE PELAGIC ENVIRONMENT OVERLYING THE CONTINENTAL SHELF (SVERDRUP ET AL., 1942). (COMPARE.....PELAGIC, BENTHIC.)
- NICHE.** (1) THE FUNCTIONAL ROLE OF AN ORGANISM IN A HABITAT; THE PROFESSION OF THE ORGANISM (ODUM, E.P., 1971). (2) THE AREA OR SET OF ENVIRONMENTAL CONDITIONS WITHIN A HABITAT OCCUPIED BY AN ORGANISM (MORRIS, 1976). COMPARE.....HABITAT, BIOLOGICAL ZONE.)
- NON-BASIC HUMAN ACTIVITY.** SOCIOECONOMIC ACTIVITY WHICH EXCLUSIVELY SERVES THE DEMAND FOR LOCAL GOODS AND SERVICES, RATHER THAN THE HANDLING OF NATURAL RESOURCES. (COMPARE.....BASIC HUMAN ACTIVITY.)
- NON-CHANNELIZED FLOW.** FLOW OF WATER NOT IN A DEFINABLE CHANNEL. ON THE SURFACE IT IS SURFACE RUNOFF. MOVEMENT OF GROUNDWATER BY INFILTRATION AND PERCOLATION IS ALSO A NON-CHANNELIZED FLOW. (SEE.....SURFACE RUNOFF; COMPARE.....CHANNELIZED FLOW, RUNOFF.)
- NON-POINT-SOURCE.** A GENERAL AREA OR NON-ISOLATABLE SOURCE OF AIR OR WATER POLLUTION SUCH AS TRANSPORTATION, FUEL COMBUSTION, OR URBAN RUNOFF. (COMPARE.....POINT-SOURCE.)

GLOSSARY OF TERMS (CONTINUED)

- NOT-SOIL.** WETLAND SUBSTRATE WHICH IS TOO DEEP TO SUPPORT EMERGENT VEGETATION (U.S.D.A. SOIL CONSERVATION SERVICE, 1975, AS QUOTED IN CWARDIN ET AL., 1977).
- NUTRIENT.** AN ELEMENT OR CHEMICAL COMPOUND THAT IS USED TO SUPPORT GROWTH OR MAINTENANCE OF AN ORGANISM. (COMPARE.....MAJOR NUTRIENT AND MINOR NUTRIENT).
- OFFSHORE.** (1) IN BEACH TERMINOLOGY, THE ZONE EXTENDING SEAWARD FROM THE OUTER LINE OF BREAKERS TO THE SEAWARD EDGE OF THE CONTINENTAL SHELF (HUNT AND GROVES, 1965; INMAN AND BAGNOLD, 1963). SEE FIG. 2-27 IN MODEL (VOL. 1). (COMPARE.....NEARSHORE, FORESHORE, BACKSHORE; SEE...SURF ZONE, BREAKER DEPTH.) (2) IN PLANKTON STUDIES, PERTAINING TO THOSE SPECIES OR COMMUNITIES CHARACTERISTIC OF MARINE WATERS WITH A SALINITY EQUAL TO OR GREATER THAN 32.5 PARTS PER THOUSAND.
- OLIGOTROPHIC.** NUTRIENT-POOR; CHARACTERISTIC OF YOUNG, CLEAR LAKES, SUPPORTING LOW BIOLOGICAL PRODUCTION. (COMPARE.....MESOTROPHIC, EUTROPHIC.)
- OMNIVORE.** AN ORGANISM THAT EATS BOTH PLANTS AND ANIMALS. (COMPARE.....HERBIVORE, CARNIVORE, DETRITIVORE.)
- OPEN-WATER SECTOR.** THE OUTWASH FRINGE OR PLUME OF COASTAL RIVERS AND ESTUARIES. THIS SECTOR OF AN ESTUARY IS BEYOND THE CONFINED BORDERS OF THE MARINEWAY OR STREAMWAY SECTORS. THE EXTENT OF THE OPEN-WATER SECTOR IS EVER-CHANGING AND POORLY DEFINED IN THE FORESHORE, NEARSHORE, AND OFFSHORE COASTAL ZONES (BAUER, 1975). SEE FIG. 2-23 AND SECTION 2.6.1 IN MODEL (VOL. 1). (COMPARE.....STREAMWAY SECTOR, MARINEWAY SECTOR.)
- ORGANIC.** REFERRING TO OR DERIVED FROM LIVING ORGANISMS; IN CHEMISTRY, ANY COMPOUND CONTAINING CARBON. (COMPARE.....BIODGENOUS.)
- OROGRAPHIC LIFTING.** LIFTING OF AN AIR MASS PRODUCED BY FLOW OVER MOUNTAINS AND MOUNTAIN RANGES (AS OPPOSED TO LIFTING DUE TO THERMAL EXPANSION OR INTERACTION WITH OTHER AIR MASSES).
- PALUSTRINE.** PERTAINING TO OR LIVING IN OR BY A SWAMP, MARSH, OR OTHER WETLAND. (COMPARE.....LACUSTRINE, RIPARIAN, RIVERINE.)
- PEDOGENIC.** DERIVED DIRECTLY FROM ROCK MATERIAL; USED IN SOIL TERMINOLOGY.
- PELAGIC.** PERTAINING TO THE OPEN SEA, INDEPENDENT OF THE COAST OR BOTTOM; OCEANIC. (COMPARE.....NERITIC, BENTHIC.)
- PERCOLATION.** THE PENETRATION OR PASSING OF WATER THROUGH THE SOIL. (COMPARE.....INFILTRATION.)
- PERIPHYTE, PERIPHYTON.** AQUATIC PLANT (PRIMARILY MICROSCOPIC) LIVING ON THE SURFACE OF SUBMERGED OBJECTS.
- PERMEABILITY.** THE ABILITY OF ROCK TO TRANSMIT WATER UNDER PRESSURE. A ROCK MUST BE POROUS (SEE.....POROSITY) TO BE PERMEABLE, BUT THE REVERSE IS NOT TRUE (GILLULY ET AL., 1959).
- PHOTIC ZONE.** THE ZONE OF A BODY OF WATER IN WHICH RADIANT ENERGY (SUNLIGHT) PENETRATES; INCLUDES EUPHOTIC AND DISPHOTIC ZONES.
- PHYTOPLANKTON.** SUSPENDED AQUATIC ORGANISMS WHICH DO NOT REQUIRE A SOLID SUBSTRATE OR ATTACHMENT AND WHICH ARE ABLE TO PHOTOSYNTHESIZE; USUALLY SMALL TO MICROSCOPIC, MAY BE MOTILE.
- PIONEER.** A PLANT, ANIMAL, OR COMMUNITY THAT FIRST INVADES A BARE AREA IN A SUCCESSIONAL SEQUENCE OR SERE (E.G., GRASSES ON FOREDUNE, LICHENS ON ROCK).

GLOSSARY OF TERMS (CONTINUED)

- PISCAVORE.** ANIMAL THAT USES FISH AS A FOOD SOURCE.
- PLANKTON.** AQUATIC ORGANISMS WHICH ARE NOT ATTACHED TO ANY SUBSTRATE AND CANNOT SWIM EFFECTIVELY AGAINST WATER CURRENTS AND WAVES; MAY BE PLANT, ANIMAL, OR PROTIST AND VARY IN SIZE FROM SUB-MICROSCOPIC TO A METER OR MORE (FOR LARGE JELLYFISH AND FLOATING SARGASSUM); DRIFTERS. (SEE.....PHYTOPLANKTON, NANNOPLANKTON, ZOOPLANKTON, MICROPLANKTON, MACROPLANKTON.)
- POINT-SOURCE.** A STATIONARY, IDENTIFIABLE SOURCE OF AIR OR WATER POLLUTION EMISSIONS OR DISCHARGES, SUCH AS A SMOKESTACK OR EFFLUENT PIPE. (COMPARE.....NON-POINT-SOURCE.)
- POLLUTION.** THE PRESENCE OF MATTER OR ENERGY WHOSE NATURE, LOCATION, OR QUANTITY PRODUCES UNDESIREN ENVIRONMENTAL EFFECTS (STUDDARD, 1974).
- POPULATION.** A GROUP OF ORGANISMS OF THE SAME SPECIES, CONFINED TO A DEFINED GEOGRAPHICAL AREA; THE NUMBER OF INDIVIDUALS WHICH SHARE A COMMON GENE POOL.
- POROSITY.** THE PERCENTAGE OF A ROCK OR SOIL THAT IS REPRESENTED BY OPEN SPACES. THE POROSITY OF SEDIMENTS AND SEDIMENTARY ROCKS DEPENDS UPON THE SHAPE, RELATIVE SIZES, AND ARRANGEMENT OF THE GRAINS, AND THE DEGREE OF COMPACTION AND CEMENTATION (GILLULY ET AL., 1959).
- POSITIVE MATERIAL BUDGET.** MATERIAL DEPOSITED IS MORE THAN THE AMOUNT OF MATERIAL REMOVED, AS IN SEDIMENTATION. (COMPARE.....NEGATIVE MATERIAL BUDGET.)
- PRIMARY CONSUMER.** GRAZER; FEEDING ON PLANT (PRODUCER) MATERIAL; HERBIVORE. (COMPARE.....SECONDARY CONSUMER; SEE.....GRAZER.)
- PRIMARY DUNE.** A DUNE IN FIRST STAGE OF SUCCESSION, INHABITED BY PIONEER SAND-STABILIZING PLANTS (ESPECIALLY THE INTRODUCED EUROPEAN BEACH GRASS); A STRESS STAGE EASILY ERODED, SENSITIVE TO WINTER STORMS AND OVERUSE BY MAN. (COMPARE.....STABILIZED DUNE.)
- PRIMARY MINERAL.** A MINERAL FORMED DEEP WITHIN THE EARTH AT TEMPERATURES AND PRESSURES VERY MUCH HIGHER THAN THOSE ON THE SURFACE; INCLUDES OXIDES, SILICATES, ALUMINOSILICATES, SULFIDES, AND PHOSPHATES. (COMPARE.....SECONDARY MINERAL.)
- PRIMARY PRODUCTIVITY.** THE MEASURE OF GRAMS OF CARBON FIXED PER UNIT AREA PER UNIT TIME BY PHOTOSYNTHETIC ORGANISMS (PRODUCERS). (COMPARE.....SECONDARY PRODUCTIVITY.)
- PRIMARY REGULATING PROCESS.** A PROCESS OR CONDITION THAT IS THE MAJOR CONTROLLER OR REGULATOR OF THE FLOW OF ENERGY AND/OR MATTER THROUGH AN ECOSYSTEM FLOW PATH; USUALLY REPRESENTED IN AN ECOLOGICAL MODEL AS A VALVE OR A SWITCH, AND USUALLY CONTROLLED IN TURN BY ONE OR MORE SECONDARY REGULATING FACTOR(S). SEE GLOSSARY OF SYMBOLS. (COMPARE.....SECONDARY REGULATING FACTOR.)
- PRODUCER.** AN ORGANISM THAT MAKES ITS OWN FOOD BY CAPTURING THE RADIANT ENERGY OF THE SUN AND STORING IT IN HIGH-ENERGY CARBOHYDRATE BONDS; AUTOTROPH. (COMPARE.....CONVERTER.) SOMETIMES CALLED PRIMARY PRODUCER, WITH SAME MEANING.
- PRODUCTION PROCESSES.** SOCIOECONOMIC ACTIVITY. INVOLVING ANY NECESSARY CONVERSION OF NATURAL RESOURCES TO SUPPLY REQUIREMENTS FOR GOODS AND SERVICES; BASIC HUMAN ACTIVITY.
- PSAMMIC.** PERTAINING TO ORGANISMS LIVING AMONG THE SAND GRAINS.
- PYCNOCLINE.** A STEEP, VERTICAL GRADIENT OF DENSITY IN THE OCEAN, SEPARATING THE UPPER, MIXED LAYER(S) FROM THE DEEPER, COOLER, MORE SALINE WATER MASSES.

GLOSSARY OF TERMS (CONTINUED)

- RARE.** HAVING A VERY LIMITED RANGE, OR HAVING A WIDESPREAD RANGE BUT A VERY LOW DENSITY.
- REFRACTION.** THE PROCESS BY WHICH THE DIRECTION OF A WAVE MOVING IN SHALLOW WATER AT AN ANGLE TO THE CONTOURS IS CHANGED. THE PART OF THE WAVE ADVANCING IN SHALLOWER WATER MOVES MORE SLOWLY THAN THAT PART STILL ADVANCING IN DEEPER WATER, CAUSING THE WAVE CREST TO BEND TOWARD ALIGNMENT WITH THE UNDERWATER CONTOURS (HUNT AND GROVES, 1965).
- RELATIVE HUMIDITY.** THE RATIO (IN PERCENT) OF THE AMOUNT OF WATER VAPOR IN THE AIR TO THE MAXIMUM AMOUNT OF WATER VAPOR THAT THE AIR CAN HOLD AT A PARTICULAR TEMPERATURE. SINCE WARMER AIR CAN CONTAIN MORE WATER VAPOR THAN COOLER AIR, RELATIVE HUMIDITY DEPENDS UPON THE TEMPERATURE OF THE AIR.
- RESIDUAL SOIL.** SOIL COMPOSED OF RESIDUUM AND ORGANIC MATERIAL. (SEE.....RESIDUUM; COMPARE.....ALLUVIAL SOIL, COLLUVIAL SOIL, LOESS SOIL.)
- RESIDUUM.** A SURFICIAL DEPOSIT FORMED FROM WEATHERING-IN-PLACE OF PARENT ROCK MATERIAL (I.E., NOT TRANSPORTED). (SEE.....RESIDUAL SOIL; COMPARE.....ALLUVIUM, COLLUVIUM, LOESS.)
- RESOURCE.** A PRODUCT OF PHYSICAL OR BIOLOGICAL SYSTEMS WHICH CAN BE UTILIZED BY MAN.
- RESPIRATION.** PROCESS BY WHICH STORED, CHEMICALLY-BOUND ENERGY IS RELEASED TO BE UTILIZED IN METABOLIC LIFE PROCESSES BY A PLANT OR ANIMAL.
- RHIZOSPHERE.** THE VOLUME DIRECTLY SURROUNDING THE ROOTS OF A PLANT, IN WHICH ARE FOUND THE SEDIMENT, MOISTURE, GASSES, NUTRIENTS, AND ORGANISMS THAT MAKE UP SOIL.
- RIPARIAN.** REFERRING TO OR LIVING IN OR BY LAND BORDERING A STREAM, LAKE, OR TIDEWATER. (COMPARE.....RIVERINE, LACUSTRINE, PALUSTRINE.)
- RIVERINE.** PERTAINING TO OR LIVING IN OR UNDER A RIVER OR STREAM. (COMPARE.....RIPARIAN, LACUSTRINE, PALUSTRINE.)
- ROCK FLOUR.** FINE SILT FOUND IN SUSPENSION IN GLACIER-FED STREAMS, CONSISTING OF UNWEATHERED FELDSPAR AND OTHER UNDECOMPOSED MINERALS WHICH ARE PRODUCED FROM ROCK FRAGMENTS THAT HAVE BEEN CRUSHED AGAINST EACH OTHER AND AGAINST THE BEDROCK BY THE GLACIER. SOIL MINERALS THAT RESULT FROM CHEMICAL WEATHERING AND HUMUS ARE CONSPICUOUSLY ABSENT IN ROCK FLOUR (GILLULY ET AL., 1959).
- RUDERAL.** WEEDY; GROWING ON SPOIL OR REFUSE BANKS, OR ON POOR OR WASTE LAND, WHERE NATURAL COVER HAS BEEN DISTURBED, AS BY MAN.
- RUNOFF.** MEASUREABLE DOWNHILL FLOW OF FRESH WATER FROM A WATERSHED; INCLUDES CHANNELIZED AND NON-CHANNELIZED FLOWS (WHICH SEE) INCLUDING SEEPAGES AND ADDITIONS FROM GROUND WATER.
- SALINITY.** THE TOTAL AMOUNT OF DISSOLVED SOLID MATERIAL (IN GRAMS) CONTAINED IN ONE KILOGRAM OF WATER. FOR THIS MEASUREMENT ALL ORGANIC MATTER IS OXIDIZED, ALL CARBONATE CONVERTED TO OXIDE, AND ALL BROMIDE AND IODIDE REPLACED BY CHLORIDE (SVERDRUP ET AL., 1942); THE SALTINESS OF A BODY OF WATER.
- SALMONID.** A FISH OF THE FAMILY SALMONIDAE; INCLUDES THE SALMONS, TROUTS, CHAR, AND WHITEFISHES.
- SALT MARSH.** A MARSH IN WHICH THE WATER IS SALTY OR BRACKISH, WITH SALINITY GREATER THAN FRESH WATER BUT LESS THAN SEA WATER, AND CONTAINING HALOPHYTIC VEGETATION.

GLOSSARY OF TERMS (CONTINUED)

- SAPROPEL.** THE FOUL-SMELLING, MUDDY REMAINS OF ANAEROBIC DECOMPOSITION, CONTAINING METHANE, AMMONIA, HYDROGEN SULFIDE, AND FATTY SUBSTANCES.
- SAPROVORE.** AN ORGANISM THAT GAINS ITS NOURISHMENT FROM CONSUMING DEAD OR DECAYING ORGANIC MATTER. (COMPARE.....DETRITIVORE, CARNIVORE, ETC.)
- SCAVENGER.** AN ORGANISM WHICH OBTAINS FOOD FROM ALREADY DEAD ORGANISMS AND DOES NOT KILL FOR FOOD. (COMPARE.....CARNIVORE, DETRITIVORE, ETC.)
- SCLEROPHYLLOUS.** CHARACTERIZED BY TOUGH, THICK LEAVES AND TWIGS, AS OF EVERGREEN SHRUBS AND SOMETIMES TREES TYPICALLY FOUND IN DRY (XERIC) CONDITIONS, SUCH AS CHAPARRAL (HUCKLEBERRY OAK, CEDNOTHUS SPP.).
- SEA.** SHORT-PERIOD, STEEP WAVES GENERATED BY LOCAL WINDS AND STORMS. (COMPARE.....SWELL.)
- SECONDARY CONSUMER.** ORGANISM THAT FEEDS ON PRIMARY CONSUMERS (GRAZERS); CARNIVORE.
- SECONDARY MINERAL.** A MINERAL FORMED AT OR NEAR THE SURFACE OF THE EARTH DURING THE PROCESS OF WEATHERING. (COMPARE.....PRIMARY MINERAL.)
- SECONDARY PRODUCTIVITY.** (1) THE MEASURE OF RATE OF BIOMASS ACCRETION PER UNIT AREA PER UNIT TIME BY CONSUMERS OF PLANT MATERIALS (I.E., PRIMARY CONSUMERS). (2) THE MEASURE OF RATE OF BIOMASS ACCRETION BY ALL CONSUMERS.
- SECONDARY REGULATING FACTOR.** A CONDITION, STATE, OR PROCESS THAT CONTROLS OR REGULATES A PRIMARY REGULATING PROCESS; A PHYSICAL, CHEMICAL, BIOLOGICAL, OR HUMAN FACTOR THAT AFFECTS A REGULATING PROCESS IN AN ECOLOGICAL MODEL. SEE GLOSSARY OF SYMBOLS. (COMPARE.....PRIMARY REGULATING PROCESS.)
- SEDIMENT.** (1) ANY MATERIAL CARRIED IN SUSPENSION BY WATER, WHICH WILL ULTIMATELY SETTLE TO THE BOTTOM. (2) SOME WATER-BORNE MATTER DEPOSITED OR ACCUMULATED IN BEDS (NOTE: INCLUDES MATERIAL THAT MAY HAVE BEEN IN A DISSOLVED LOAD BUT PRECIPITATED) (HUNT AND GROVES, 1965). SEDIMENT ORIGINS INCLUDE WEATHERED CONSOLIDATED MATERIAL, AS WELL AS BIOLOGICAL DETRITUS AND MAN-MADE WASTES.
- SERIAL STAGE.** ONE TRANSITORY COMMUNITY IN A SERE. (SEE.....SERE; COMPARE.....CLIMAX COMMUNITY.)
- SERE.** THE ENTIRE SERIES OR SEQUENCE OF COMMUNITIES SUCCESSIVELY OCCUPYING AN AREA. (SEE.....SUCCESSION.)
- SERVICES.** THE NON-BASIC COMPONENT OF A HUMAN COMMUNITY SOCIOECONOMIC BASE THAT INCLUDES ALL THOSE ACTIVITIES WHICH SERVE THE LOCAL POPULATION OR SUPPORT LOCAL BASIC INDUSTRIES, AND WHICH RECIRCULATE INCOME DERIVED FROM THE BASIC INDUSTRY WITHIN THE COMMUNITY; NON-BASIC HUMAN ACTIVITY.
- SESTON.** THE COMPLEX OF DECOMPOSING PLANT MATERIAL AND DECOMPOSERS (BACTERIA, FUNGI, AND PROTOZOANS) IN AQUATIC ENVIRONMENTS, BEING A MAJOR PART OF THE DIET OF FILTER-FEEDING ORGANISMS.
- SHORE PROCESS CORRIDOR.** THE DYNAMIC SHORE ZONE STRADDLING THE EXTREME SURGE-LIMITS OF THE OCEAN, ESTUARY, OR RIVER, AND INCLUDING THOSE AQUATIC AND TERRESTRIAL OUTER FRINGES ON EACH SIDE THAT CAN AFFECT, OR ARE AFFECTED BY, THE PREVAILING GEO-HYDRAULIC SYSTEM OF THE SHORE (BAUER, 1974A). SEE FIG. 2-27 IN MODEL (VOL. 1).

GLOSSARY OF TERMS (CONTINUED)

- SHORELINE.** THE LINE OF CONTACT BETWEEN WATER AND LAND (BRASCOM, 1964). THIS TERM IS IMPRECISE AND IS USED IN A VARIETY OF WAYS. THE LINE OF CONTACT VARIES WITH TIDES OR WATER LEVELS. THE ARBITRARY LINES CHOSEN ON MAPS AND CHARTS VARY, DEPENDING ON USAGE AND RATIONALE BEHIND WATER LEVEL CONSIDERATION. (COMPARE.....COAST, SHORE PROCESS CORRIDOR.)
- SIGNIFICANT WAVE HEIGHT.** THE AVERAGE HEIGHT OF THE 1/3 HIGHEST WAVES OF A GIVEN WAVE GROUP (HUNT AND GROVES, 1965).
- SIGNIFICANT WAVE PERIOD.** AN ARBITRARY PERIOD GENERALLY TAKEN AS THE PERIOD OF THE 1/3 HIGHEST WAVES WITHIN A GROUP (HUNT AND GROVES, 1965).
- SINK, KITCHEN.** THE ULTIMATE ITEM IN AN INCLUSIVE LIST. TERM USED TO INDICATE THAT A THOROUGH AND USUALLY UNSELECTIVE JOB HAS BEEN DONE.
- SOCIOECONOMIC.** PERTAINING TO HUMAN ACTIVITIES, BOTH SOCIAL/CULTURAL AND ECONOMIC.
- SOIL.** (1) A NATURAL, THREE-DIMENSIONAL BODY ON THE SURFACE OF THE EARTH THAT SUPPORTS PLANTS AND THAT HAS PROPERTIES RESULTING FROM THE INTEGRATED EFFECT OF CLIMATE AND LIVING MATTER ACTING ON EARTH PARENT MATERIAL, AS CONDITIONED BY RELIEF OVER PERIODS OF TIME (U.S.D.A., 1975A). (2) MATERIAL THAT HAS WEATHERED IN THE PLACE WHERE IT IS NOW FOUND AND IS MIXED WITH ORGANIC MATTER NEAR THE SURFACE (GILLULY ET AL., 1959).
- SOIL HORIZON.** A LAYER OF SOIL, APPROXIMATELY PARALLEL TO THE SURFACE, THAT HAS DISTINCT CHARACTERISTICS PRODUCED BY SOIL-FORMING PROCESSES (U.S.D.A., 1975A). MAJOR SOIL HORIZONS ARE IDENTIFIED AND DESCRIBED IN SECTION 2.2.5 OF MODEL (VOL. 1).
- SPRING TIDE.** THE DAILY TIDAL CYCLE OF GREATEST VERTICAL RANGE. (COMPARE.....NEAP TIDE.)
- STABILIZED DUNE.** A DUNE PROTECTED BY VEGETATION FROM FURTHER MOVEMENT OR MODIFICATION BY WIND OR STORMS. (COMPARE.....DUNE, PRIMARY DUNE.)
- STANDING CROP.** AMOUNT OF LIVING TISSUE EXISTING AT ANY GIVEN TIME.
- STEELHEAD.** A RAINBOW TROUT, SALMO GAIRDNERI, THAT MIGRATES TO THE SEA, AT WHICH TIME IT TAKES ON A SILVERY ASPECT.
- STREAM SECTOR.** A LENGTH OR REACH OF RIVERINE SHORE THAT EXHIBITS AN INTEGRATED GEO-HYDRAULIC PROCESS SYSTEM CONTAINING A MATERIAL SOURCE, A TRANSPORT WAY, AND AN ACCRETION TERMINUS (BAUER, 1975).
- STREAMWAY SECTOR.** THAT LOWER PORTION OF A LOW GRADIENT STREAM WHERE THERE IS A TIDAL REVERSAL OF FLOW AND SALT WATER INTRUSION (BAUER, 1975). SEE FIG. 2-23 AND SECTION 2.6.1 IN MODEL (VOL. 1). (COMPARE.....MARINEWAY SECTOR, OPEN-WATER SECTOR.)
- SUBMERSIBLE.** BETWEEN MEAN LOW WATER AND MEAN HIGH WATER; INTERTIDAL.
- SUBSTRATE.** (1) THE SURFACE ON WHICH A PLANT OR ANIMAL GROWS OR IS ATTACHED. (2) THE VOLUME, SURFACES, AND MATERIALS THAT PROVIDE LIVING SPACE, PHYSICAL SUPPORT, AND NOURISHMENT FOR ORGANISMS.
- SUCCESSION.** THE REPLACEMENT OF ONE KIND OF COMMUNITY BY ANOTHER KIND; THE PROGRESSIVE CHANGES IN VEGETATION AND ANIMAL LIFE WHICH OCCUR IN ONE PLACE OVER TIME, CULMINATING IN THE CLIMAX COMMUNITY FOR THAT LOCATION. (SEE.....SERE.)



GLOSSARY OF TERMS (CONTINUED)

- SURF ZONE.** A REGION ALONG AN UNPROTECTED OCEAN BEACH EXTENDING FROM THE SHORELINE TO THE OUTER LINE OF BREAKERS, OR EXTENDING ALONG THE BOTTOM TO BREAKER DEPTH; THE EXTENT VARIES WITH THE STAGE OF THE TIDE, THE CHARACTER OF THE INCOMING WAVES, AND THE SLOPE OF THE BOTTOM.
- SURFACE RUNOFF.** RUNOFF OF WATER OVER THE LAND SURFACE TO STREAMS AND RIVERS WITHOUT FORMING, OR FLOWING IN, DEFINABLE CHANNELS; A TYPE OF NON-CHANNELIZED FLOW, ALSO CALLED SURFACE FLOW.  
(COMPARE.....NON-CHANNELIZED FLOW, CHANNELIZED FLOW, RUNOFF.)
- SURGE PLAIN.** THAT LAND WHICH IS OVERRUN (FLOODED) BY TIDAL REVERSAL UNDER BANK FULL RIVER AND HIGHER HIGH TIDE CONDITIONS; THE UPPERMOST AREA OF LAND/WATER INTERACTION BORDERING THE STREAMWAY SECTOR OF AN ESTUARY, CONTAINING MOSTLY FRESHWATER ORGANISMS (BAUER, 1975).
- SUSPENDED LOAD.** THE AMOUNT OF SEDIMENT PER UNIT VOLUME OF WATER BEING TRANSPORTED IN SUSPENSION IN A RIVER, STREAM, LAKE, ESTUARY, OR OCEAN. (COMPARE.....DISSOLVED LOAD, BED LOAD.)
- SWAMP.** A WETLAND CHARACTERIZED BY PREDOMINANTLY WOODY VEGETATION.  
(COMPARE.....MARSH.)
- SWELL.** LONG-PERIOD WAVES GENERATED BY OCEANIC STORMS UP TO THOUSANDS OF MILES AWAY. (COMPARE.....SEA.)
- THALWEG.** THE MAIN CHANNEL OF A RIVER OR STREAM.
- THREATENED.** LIKELY TO BECOME ENDANGERED WITHIN THE FORESEEABLE FUTURE THROUGH ALL OR A SIGNIFICANT PORTION OF A SPECIES RANGE; A CLASSIFICATION CATEGORY OF THE ENDANGERED SPECIES ACT OF 1973.  
(COMPARE.....ENDANGERED.)
- TIDAL PRISM.** THE TOTAL AMOUNT OF WATER THAT FLOWS INTO OR OUT OF AN ESTUARY, BAY, OR HARBOR WITH THE MOVEMENT OF THE TIDE. THIS VOLUME IS A FUNCTION OF THE TIDAL RANGE AND THE SURFACE AREA OF THE ESTUARY, BAY, OR HARBOR INTEGRATED OVER THE RANGE OF THE TIDE.
- TIDAL SIGNATURE.** TIME-HEIGHT HISTORY OF THE SEA LEVEL PORTRAYED GRAPHICALLY, WITH EFFECTS OF WAVES AND SWELL FILTERED OUT.
- TIDE.** THE PERIODIC RISE AND FALL OF SEA LEVEL PRODUCED BY GRAVITATIONAL FORCES OF THE MOON AND SUN ACTING UPON THE ROTATING EARTH. SEE FIG. 2-25 IN MODEL (VOL. 1) FOR TIDE LEVEL TERMINOLOGY.  
(COMPARE.....SPRING TIDE, NEAP TIDE, TIDAL PRISM, TIDAL SIGNATURE.)
- TOMBOLO.** AN AREA OF UNCONSOLIDATED MATERIAL, DEPOSITED BY WAVE ACTION OR CURRENTS, THAT CONNECTS A ROCK OR ISLAND, ETC., TO THE MAINLAND OR TO ANOTHER ISLAND (HUNT AND GROVES, 1965).
- TOPOGRAPHY.** THE PHYSICAL FEATURES OF THE SURFACE OF A REGION.  
(COMPARE.....BATHYMETRY.)
- TRANSPIRATION.** THE PLANT PROCESS OF GIVING OFF WATER VAPOR (AND WASTE PRODUCTS) THROUGH THE STOMATA OF LEAF TISSUE.  
(COMPARE.....EVAPOTRANSPIRATION.)
- TRIBUTARY.** A STREAM OR RIVER FLOWING INTO A LARGER STREAM OR RIVER (MORRIS, 1976). (COMPARE.....DIS-TRIBUTARY.)
- TROPHIC LEVEL.** A STRATUM IN THE HIERARCHY OF PRODUCERS (FIRST TROPHIC LEVEL) AND CONVERTERS, AS MODELED IN A PYRAMID OF RELATIVE BIOMASS OR ENERGY; HERBIVOROUS CONSUMERS (GRAZERS) ARE AT THE SECOND-TROPHIC LEVEL; CARNIVOROUS CONSUMERS MAY BE AT THE THIRD OR A HIGHER TROPHIC LEVEL.

GLOSSARY OF TERMS (CONTINUED)

- TSUNAMI.** A SEISMIC SEA WAVE OF HIGH VELOCITY AND LONG PERIOD, GENERATED AT SEA BY LARGE SHOCK OR IMPULSE, SUCH AS AN UNDERSEA EARTHQUAKE; ALSO CALLED TIDAL WAVE, ALTHOUGH IT HAS NOTHING TO DO WITH TIDES.
- TURBIDITY.** THE STATE OR CONDITION OF HAVING THE TRANSPARENCY OR TRANSLUCENCE DISTURBED, AS WHEN SEDIMENT IN WATER IS STIRRED UP, OR WHEN DUST, HAZE, CLOUDS, ETC., APPEAR IN THE ATMOSPHERE BECAUSE OF WIND OR VERTICAL CURRENTS (HUNT AND GROVES, 1965).
- ULTRAPLANKTON.** PLANKTON ORGANISMS BELOW ABOUT 5 MICRONS (0.005 MM) WHICH ARE NOT RETAINED BY FINE-MESHED PLANKTON NETS OR OBTAINED BY NORMAL CENTRIFUGATION OF WATER SAMPLES (SVERDRUP ET AL., 1942). THEY CAN BE COLLECTED BY SPECIAL ULTRA-CENTRIFUGATION PROCEDURES. (COMPARE.....NANNOPLANKTON, MICROPLANKTON, MACROPLANKTON.)
- UPPER SUBTIDAL ZONE.** THE SUBTIDAL AREA OF THE NEARSHORE BOTTOM WHICH IS BETWEEN THE LOWEST MEASURED TIDE AND THE BREAKER DEPTH.
- UPTAKE.** THE COMBINATION OF PROCESSES IN WHICH VARIOUS SUBSTANCES SUCH AS WATER, NUTRIENT IONS, AND DISSOLVED GASES ARE REMOVED FROM LIQUID SUBSTANCES SUCH AS SEA WATER AND SOIL MOISTURE, AND ARE INCORPORATED INTO ORGANISMS. (COMPARE.....FIXATION.)
- UPWELLING.** THE RISING OF WATER TOWARD THE SURFACE FROM SUBSURFACE LAYERS OF A BODY OF WATER; MOST PROMINENT WHERE PERSISTENT WIND BLOWS PARALLEL TO A COASTLINE SO THAT THE RESULTANT WIND-DRIVEN CURRENT SETS AWAY FROM THE COAST. IT CONSTITUTES A DISTINCT CLIMATOGENETIC INFLUENCE BY BRINGING COLDER WATER TO THE SURFACE WHICH IS RICHER IN PLANT NUTRIENTS, SO THAT REGIONS OF UPWELLING ARE GENERALLY ALSO AREAS OF RICH FISHERIES (HUNT AND GROVES, 1965).
- WATER COLUMN.** THE SPACE BETWEEN THE SURFACE AND BOTTOM OF A BODY OF WATER, ESPECIALLY A VOLUME HAVING A LIMITED HORIZONTAL EXTENT AROUND AND INCLUDING A SAMPLING STATION OR STUDY AREA.
- WATER TABLE.** THE UPPER SURFACE OR EXPRESSION OF THE LEVEL OF GROUND WATER IN PERMEABLE ROCK OR SOIL.
- WATERSHED UNIT.** GROUP OF WATERSHEDS HAVING ROUGH SIMILARITIES WITH RESPECT TO LATITUDE, CLIMATE, GEOLOGIC STRUCTURE, HYDROLOGY, AND EXTENT OF PENETRATION INLAND FROM THE COAST.
- WAVE FRONT.** AN EXPRESSION WHICH IS APPLIED TO A PROGRESSIVE WAVE IN SPACE AT ANY GIVEN INSTANT, AND IS THE LINE OR SURFACE OVER WHICH THE PHASE IS EVERYWHERE THE SAME AT THE GIVEN INSTANT. ALL POINTS LYING ON THE CREST OF A SURFACE WATER WAVE ARE IN THE SAME PHASE AND MAY DEFINE A WAVE FRONT (HUNT AND GROVES, 1965).
- WAVE HEIGHT.** THE VERTICAL DISTANCE BETWEEN A WAVE CREST AND THE FOLLOWING WAVE TROUGH. (DIFFERENT THAN THE WAVE AMPLITUDE, WHICH IS THE VERTICAL MEASURE BETWEEN THE WAVE CREST AND STILL WATER LEVEL).
- WAVE LENGTH.** THE HORIZONTAL DISTANCE BETWEEN SUCCESSIVE OCEAN WAVE CRESTS OR THE DISTANCE TRAVELED BY A WAVE DURING THE TIME INTERVAL OF ONE COMPLETE CYCLE. IT IS EQUAL TO THE VELOCITY DIVIDED BY THE FREQUENCY (HUNT AND GROVES, 1965).
- WAVE PERIOD.** THE TIME ELAPSED BETWEEN THE PASSAGE OF A GIVEN PHASE ON ONE WAVE AND THE ARRIVAL OF THE SAME PHASE ON THE NEXT SUCCEEDING WAVE, AS OBSERVED FROM A FIXED LOCATION (HUNT AND GROVES, 1965).
- WAVE STEEPNESS.** THE RATIO OF WAVE HEIGHT TO WAVE LENGTH (HUNT AND GROVES, 1965).
- WEATHER.** THE STATE OF THE ATMOSPHERE AT A GIVEN TIME AND PLACE, DESCRIBED BY SPECIFICATION OF VARIABLES SUCH AS TEMPERATURE, MOISTURE, WIND, VELOCITY, AND PRESSURE (MORRIS, 1976).

GLOSSARY OF TERMS (CONTINUED)

- WEATHERING.** ANY OF THE CHEMICAL OR MECHANICAL PROCESSES BY WHICH ROCKS EXPOSED TO THE WEATHER ARE BROKEN DOWN INTO SMALLER PARTICLES OR COMPONENT MATERIALS (MORRIS, 1976). (COMPARE.....EROSION.)
- WETLAND.** (1) LAND WHERE AN EXCESS OF WATER IS THE DOMINANT FACTOR DETERMINING THE NATURE OF SOIL DEVELOPMENT AND THE TYPES OF PLANT AND ANIMAL COMMUNITIES LIVING AT THE SOIL SURFACE (COWARDIN ET AL., 1977). (2) LAND WHERE THE WATER TABLE IS AT, NEAR, OR ABOVE THE LAND SURFACE LONG ENOUGH TO PROMOTE THE FORMATION OF HYDRIC SOILS OR TO SUPPORT THE GROWTH OF HYDROPHYTES (COWARDIN ET AL., 1977).
- WRACK.** A TANGLED MASS OF SEAWEED OR OTHER MARINE VEGETATION CAST ASHORE OR FLOATING.
- XERIC.** DRY; PERTAINING TO AN ARID CONDITION, AS IN A XERIC HABITAT SUCH AS A DESERT. (COMPARE.....HYDRIC, MESIC.)
- ZONE.** (1) AN AREA CHARACTERIZED BY DISTINCT PHYSICAL CONDITIONS AND POPULATED BY COMMUNITIES OF CERTAIN KINDS OF ORGANISMS (MORRIS, 1976). (2) A DISTINCT ASSEMBLAGE OF ORGANISMS, ENVIRONMENTAL CONDITIONS, AND ECOLOGICAL PROCESSES COMPOSED OF RELATED HABITATS (OFTEN BY SUCCESSION).
- ZONE OF COMPATIBILITY.** THE MIDDLE SECTOR BETWEEN ENVIRONMENTAL EXTREMES FOR A GIVEN FACTOR AND A GIVEN ORGANISM.
- ZOOPLANKTON.** AQUATIC ANIMALS OR PROTISTS WHICH CANNOT ACTIVELY SWIM AGAINST THE CURRENT AND WHICH CANNOT MAKE THEIR OWN FOOD BY PHOTOSYNTHESIS; INCLUDES MANY LARVAL FORMS OF OTHERWISE NON-PLANKTONIC ORGANISMS. (COMPARE.....PHYTOPLANKTON; SEE.....PLANKTON.)

## LIST OF MEASUREMENT ABBREVIATIONS AND SYMBOLS

The following symbols and abbreviations appear in the Ecological Characterization documents for measurements, units, or regulating factors. Short forms for many of these items (e.g. ft for feet, m for meter) are symbols, not abbreviations, and are not followed by a period. Exponents (2 and 3) are frequently used with linear measurement units to indicate areas and volumes, e.g. in<sup>2</sup> = square inch or sq in, m<sup>3</sup> = cubic meter.

### A. MEASUREMENT UNITS AND SYMBOLS:

a	=	acre (area)
a ft	=	acre foot (volume)
atm	=	atmosphere (pressure)
b	=	bar (pressure)
BOD	=	biological oxygen demand
C	=	Celsius (temperature)
cc	=	cubic centimeter (volume)
cm	=	centimeter (length)
dbh	=	diameter at breast height (length)
DO	=	dissolved oxygen
F	=	Fahrenheit (temperature)
f	=	fathom (length)
ft	=	foot (length)
g	=	gram (weight)
gal	=	gallon (volume)
ha	=	hectare (area)
hr	=	hour (time)
hz	=	hertz (periodicity)
in	=	inch (length)
JTU	=	Jackson turbidity unit
k	=	Kelvin (temperature)
kg	=	kilogram (length)
km	=	kilometer (length)
kt	=	knot (velocity)
kph	=	kilometer per hour (velocity)
l	=	liter (volume)
lb	=	pound (weight)
ly	=	langley (energy)
M	=	mole (concentration)
m	=	meter (length)
mb	=	millibar (pressure)
mbf	=	million board feet (timber volume)
mgd	=	million gallons per day (flow)
mi	=	statute mile (length)
min	=	minute (time)
ml	=	milliliter (volume)
mm	=	millimeter (length)
mph	=	mile per hour (velocity)
nm	=	nautical mile (length)
oz	=	ounce (volume or weight)
ppm	=	parts per million (concentration)
pt	=	pint (volume)
qt	=	quart (volume)
sec	=	second (time)
t	=	ton, long, short, or metric (weight)
T	=	temperature
Ta	=	air temperature
Tw	=	water temperature
yd	=	yard (length)
%	=	percent (parts per hundred)
‰	=	permille (parts per thousand)
μ-	=	micro- (fraction = 10 <sup>-6</sup> )
m-	=	milli- (fraction = 10 <sup>-3</sup> )
c-	=	centi- (fraction = 10 <sup>-2</sup> )
d-	=	deci- (fraction = 10 <sup>-1</sup> )

### B. SECONDARY REGULATING FACTORS IN MODELS:

ACC	=	access
A/D	=	area to depth ratio
BATH	=	bathymetry
CAPIL	=	capillary action
CHCAP	=	channel capacity
CLIM	=	climate
COND	=	condensation
CUR	=	current velocity
DIKE	=	diking
DIS	=	discharge
DREDG	=	dredging
DRIFT	=	littoral drift
EFTR	=	effluent treatment
EROD	=	erodability (chemical and structural make-up of rock)
FWIN	=	fresh water in
GEO	=	geology
GMAN	=	game management
GRAD	=	gradient
HEAD	=	hydraulic head
INSOL	=	insolation
MIX	=	mixing
NUTS	=	nutrients
PERM	=	permeability
PERT	=	perturbations (fire, vegetation removal, etc.)
PHOT	=	photosynthesis
POROS	=	porosity of soil or rock
PRECIP	=	precipitation
PROD	=	net productivity
REG	=	regulation
RO	=	runoff
SAL	=	salinity
SEN	=	annual senescence
SIZE	=	particle size and density
SOC	=	socioeconomic decision
STR	=	man made structures
SUCC	=	natural succession
T	=	temperature
Ta	=	air temperature
TIDE	=	tides (energy, cycle, etc.)
TOPO	=	topography
TOX	=	toxins (man made pollutants)
TURB	=	turbulence
Tw	=	water temperature
VEG	=	vegetation
VEGAN	=	vegetative anchoring
WIND	=	wind (speed, direction)
WAVE	=	wave (energy, direction)
?	=	not well known

ENGLISH-METRIC MEASUREMENT UNIT CONVERSIONS

Many, perhaps most, of the measurements used in this series of volumes of the Ecological Characterization are approximations or typical values. For example the depth at the edge of the Continental Shelf in the Pacific Northwest is variously given as 100 fathoms, 200 meters, or 600 feet. Obviously 600 feet is exactly 182.88 meters but, since 100 fathoms (600 feet) is an approximation of the shelf depth, the nearest round metric number will be an equally good approximation. Therefore 200 meters is equivalent to 600 feet or 100 fathoms in this instance. Similarly, a 300 foot Douglas fir tree is 90 meters tall, not 91.44 meters tall!

We have tried to make all conversions consistent with the observed or implied accuracy of the original data. Some conversions are carried to several significant figures. Mt. Olympus, for example, is 7,965 feet high; the metric equivalent is 2,427.7 meters, but the heights of peaks in the Olympic and Cascade mountain ranges are only given to the nearest foot on the U.S.G.S. maps. This degree of precision is indicated by the first metric conversion using only one decimal place. Greater precision in the measurement of elevations in this region is not warranted for most purposes nor is greater precision in the conversion justified due to the degree of accuracy of the U.S.G.S. measurement.

The units (metric or English) used by the author in the source of the data are reported first in the text, figures, and tables throughout the Ecological Characterization volumes, followed by the equivalent in parentheses. Both units are given. The result is often a mixture of primary (non-parenthetical) units in a discussion or table, but the reader is thus aware of which units are the original data and which are the conversions.

The following are some basic conversions used in this report.

**LENGTH**

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<u>1 cm</u> (centimeter)	=	0.3937 in (inch)				
0.3048 m (meter)	=	12 in	=	<u>1 ft</u> (foot)		
<u>1 m</u>	=	39.37 in	=	3.28 ft	=	0.547 f (fathom)
1.83 m	=	72 in	=	6 ft	=	<u>1 f</u>
<u>1 km</u> (kilometer)			=	3,280 ft	=	0.621 mi (mile)
1.609 km			=	5,280 ft	=	<u>1 mi</u>
1.852 km			=	6,076 ft	=	<u>1 nm</u> (nautical mile)

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**AREA**

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<u>1 cm<sup>2</sup></u>		=	0.155 in <sup>2</sup>			
6.45 cm <sup>2</sup>		=	<u>1 in<sup>2</sup></u>			
930 cm <sup>2</sup>	=	0.093 m <sup>2</sup>	=	<u>1 ft<sup>2</sup></u>		
10 <sup>4</sup> cm <sup>2</sup>	=	<u>1 m<sup>2</sup></u>	=	10.76 ft <sup>2</sup>	=	1.196 yd <sup>2</sup>
4047 m <sup>2</sup>	=	0.405 ha (hectare)	=	<u>1 a</u> (acre)	=	4,840 yd <sup>2</sup>
10 <sup>4</sup> m <sup>2</sup>	=	<u>1 ha</u>	=	2.47 a	=	11,960 yd <sup>2</sup>
<u>1 km<sup>2</sup></u>	=	100 ha	=	247 a	=	0.386 mi <sup>2</sup>
2.59 km <sup>2</sup>	=	259 ha	=	540 a	=	<u>1 mi<sup>2</sup></u>

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**MASS**

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<u>1 g</u> (gram)	=	0.035 oz (ounce)		
28.3 g	=	<u>1 oz</u>		
0.454 kg (kilogram)	=	<u>1 lb</u> (pound)		
<u>1 kg</u>	=	2.2 lb		
0.907 t (metric tonne)	=	<u>1 t</u> (short ton)	=	0.905 t (long ton)
<u>1 t</u>	=	1.102 t	=	0.984 t
1.016 t	=	1.12 t	=	<u>1 t</u>

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ENGLISH-METRIC CONVERSIONS (CONTINUED)

TEMPERATURE

$0^{\circ}\text{K}$ (Kelvin)	=	$-273.2^{\circ}\text{C}$ (Celsius)	=	$-459.7^{\circ}\text{F}$ (Fahrenheit)
$255.4^{\circ}\text{K}$	=	$-17.78^{\circ}\text{C}$	=	$0^{\circ}\text{F}$
$273.2^{\circ}\text{K}$	=	$0^{\circ}\text{C}$	=	$32^{\circ}\text{F}$
$293.2^{\circ}\text{K}$	=	$20^{\circ}\text{C}$	=	$68^{\circ}\text{F}$
$310.2^{\circ}\text{K}$	=	$37^{\circ}\text{C}$	=	$98.6^{\circ}\text{F}$
$323.2^{\circ}\text{K}$	=	$50^{\circ}\text{C}$	=	$122^{\circ}\text{F}$
$373.2^{\circ}\text{K}$	=	$100^{\circ}\text{C}$	=	$212^{\circ}\text{F}$
		$^{\circ}\text{C} = 0.55 (^{\circ}\text{F} - 32)$		$^{\circ}\text{F} = 1.8(^{\circ}\text{C}) + 32$

VOLUME

$1 \text{ cm}^3$ (or cc)	=	$1 \text{ ml}$ (milliliter)	=	$0.0338 \text{ oz}$ (ounce)		
		$29.6 \text{ ml}$	=	$1 \text{ oz}$		
		$0.946 \text{ l}$ (liter)	=	$1 \text{ qt}$ (quart)		
$0.001 \text{ m}^3$	=	$1 \text{ l}$	=	$1.057 \text{ qt}$	=	$0.264 \text{ gal}$ (gallon)
		$3.79 \text{ l}$	=	$4 \text{ qt}$	=	$1 \text{ gal}$
$0.0283 \text{ m}^3$			=	$1 \text{ ft}^3$	=	$7.48 \text{ gal}$
$0.765 \text{ m}^3$	=	$765 \text{ l}$	=	$1 \text{ yd}^3$	=	$202 \text{ gal}$
$1 \text{ m}^3$	=	$999.973 \text{ l}$	=	$1.308 \text{ yd}^3$	=	$264 \text{ gal}$
$1234 \text{ m}^3$			=	$1 \text{ a ft}$ (acre foot)	=	$324,851 \text{ gal}$
$1 \text{ km}^3$	=	$10^9 \text{ m}^3$	=	$8.1 \times 10^4 \text{ a ft}$	=	$0.0237 \text{ mi}^3$
$42.2 \text{ km}^3$			=	$3.42 \times 10^6 \text{ a ft}$	=	$1 \text{ mi}^3$

ATMOSPHERIC PRESSURE

$27 \text{ in}$	=	$686 \text{ mm}$	=	$914 \text{ mb}$ (millibar)		
$28 \text{ in}$	=	$711 \text{ mm}$	=	$948 \text{ mb}$		
$29 \text{ in}$	=	$737 \text{ mm}$	=	$982 \text{ mb}$		
$29.54 \text{ in}$	=	$750 \text{ mm}$	=	$1000 \text{ mb}$	=	$1 \text{ bar}$
$29.92 \text{ in}$	=	$760 \text{ mm}$	=	$1013.2 \text{ mb}$	=	$1 \text{ atm}$ (standard atmosphere)
$31 \text{ in}$	=	$787 \text{ mm}$	=	$1050 \text{ mb}$		
$32 \text{ in}$	=	$813 \text{ mm}$	=	$1084 \text{ mb}$		
$32.8 \text{ ft}$	=	$10.0 \text{ m}$ (sea water)	=	$1 \text{ atm}$		
$33.9 \text{ ft}$	=	$10.3 \text{ m}$ (fresh water)	=	$1 \text{ atm}$	=	$14.7 \text{ lb/in}^2$

(in and mm both refer to the height of a mercury barometer and are, therefore, in-Hg and mm-Hg respectively. Ft and m refer to the height of a water column.)

ENGLISH-METRIC CONVERSIONS (CONTINUED)

VELOCITY

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<u>1 cm/min</u>	=	0.033 ft/min	=	1 furlong/fortnight
0.51 cm/sec	=	<u>1 ft/min</u>	=	0.011 mph (mile/hour)
<u>1 cm/sec</u>	=	1.97 ft/min	=	0.022 mph
0.28 m/sec	=	<u>1 kph</u> (kilometer/hour)	=	55 ft/min = 0.62 mph = 0.54 kt (knot, nm/hr)
0.48 m/sec	=	1.6 kph	=	88 ft/min = <u>1 mph</u> = 0.87 kt
0.51 m/sec	=	1.85 kph	=	101 ft/min = 1.15 mph = <u>1 kt</u>
<u>1 m/sec</u>	=	3.6 kph	=	2.24 mph = 1.94 kt

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FLOW

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0.063 l/sec	=	0.000063 m <sup>3</sup> /sec	=	0.0022 ft <sup>3</sup> /sec	=	<u>1 gpm</u> (gallons per minute)
<u>1.0 l/sec</u>	=	0.001 m <sup>3</sup> /sec	=	0.0353 ft <sup>3</sup> /sec	=	15.85 gpm
28.32 l/sec	=	0.0283 m <sup>3</sup> /sec	=	<u>1.0 ft<sup>3</sup>/sec</u>	=	450 gpm
43.8 l/sec	=	0.0438 m <sup>3</sup> /sec	=	1.55 ft <sup>3</sup> /sec	=	<u>1 mgd</u> (million gal per day)
1000 l/sec	=	<u>1.0 m<sup>3</sup>/sec</u>	=	35.314 ft <sup>3</sup> /sec	=	15,850 gpm
		20.6 m <sup>3</sup> /sec	=	<u>1 acre ft/min</u>	=	325,851 gpm

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DENSITY OF SPECIFIC SUBSTANCES

(From Lange, 1956, except as noted)

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Carbohydrates, (cellulose, starch, sugar)	=	1.47-1.61 g/cc	=	92-100 lb/ft <sup>3</sup>
Fats and oils	=	0.90-0.97	=	56-60
Protein (silk)	=	1.56	=	97.2
Tar	=	1.02	=	63.6
Basalt	=	2.7-3.2	=	168-200
Clay	=	1.8-2.6	=	112-162
Concrete	=	1.8-2.45	=	112-145
Gravel	=	1.8-2.0	=	112-125
Granite	=	2.51-3.05	=	156-190
Ice, pure	=	0.917	=	57.1 (Sverdrup et al., 1942)
Ice, sea	=	0.86-0.92	=	54-57 (Sverdrup et al., 1942)
Limestone	=	2.46-2.84	=	153-177
Sand, coarse, dry	=	1.4-1.5	=	87-94
Sand, fine, dry	=	1.40-1.56	=	87-103
Sand, fine, moist	=	1.90-2.05	=	118-128
Sandstone	=	2.2-2.5	=	137-156
Soil, loamy, dry	=	1.6-1.9	=	100-118
Soil, loamy, pressed	=	2.0	=	125
Snow, loose	=	0.125	=	7.8
Water, fresh	=	1.00	=	62.3 = 1.042 lb/pt
Water, normal sea	=	1.0026	=	62.5 = 1.039

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ENGLISH-METRIC CONVERSIONS (CONTINUED)

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MISCELLANEOUS UNITS DEFINED

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LIGHT:

Langley (LY) = 1 g cal/cm<sup>2</sup> = unit of irradiance energy

Foot candle = 1 lumen/ft<sup>2</sup> = unit of illumination (visible spectrum only)

Lux = 1 lumen/m<sup>2</sup>

(Note: although not readily convertible because of brightness variations, 1 langley per minute of sunlight x 6700 gives approximate illumination in foot candles (E.P. Odum, 1971).)

TURBIDITY:

Jackson Turbidity Unit (JTU) = measure of turbidity referenced to amount of light scattered by 1 milligram of silicon dioxide dissolved in 1 liter of water, which is defined as 1 JTU.

CHEMICAL CONCENTRATIONS:

Mole (M) = 1 gram atoms/liter (g-at/l) = concentration of 1 gram atomic weight of element or compound per liter; often used in micro ( $\mu$ -) or milli (m-) fractions.

Equivalent (eq) = the quantity of a chemical substance that could hypothetically react with, or take the place of, one gram-atomic weight of hydrogen ion. Thus, the equivalent weight of hydrogen is 1.008 grams, of oxygen is 8 grams, and of sodium chloride (NaCl) is 58.45 grams.

Part(s) per million (ppm) = part or parts (individuals, units of mass or volume) of solute substance in million parts (individuals, units of mass or volume) of total solute-solvent solution, as of chemicals in air (gas) or water (liquid) or soil (solid).

$\mu\text{g}/\text{m}^3$  (microgram(s) per cubic meter) = mass of solute (in micrograms) per unit (cubic meter) volume of solution, as of chemicals in air, etc.

(Note: for sulfur dioxide in air, at N.T.P. (0°C and 1 bar), 1 ppm = 2860  $\mu\text{g}/\text{m}^3$ ; at 20°C, 1 ppm(SO<sub>2</sub>) = 2660  $\mu\text{g}/\text{m}^3$  (Ferry et al., 1973).)

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## LIST OF REFERENCES

The following list of cited references has been prepared using the Annotated Bibliography system developed for this study based on the FAMULUS program of the U. S. Forest Service. This open-ended program allows for multiple searching and sorting by authors, dates, key words, etc., and enables printing of reference lists by volume or Watershed Unit as cited.

Multiple authors are listed uniformly, i.e. initials (for given names) following the surname in all cases. This is a departure from the Council of Biological Editors and the FWS style manuals, but facilitates computer searching and printing of author lists, provides uniformity of name listing, and makes for easier editing.

This list of references cited in Volume 3 contains only the author, date, title, and publication fields for each reference. The descriptor (key word), annotation, location, and other fields of the full entry have been suppressed for this printout.

See Part 1 of Volume 5, the Data Source Appendix, for more information on the Annotated Bibliography.

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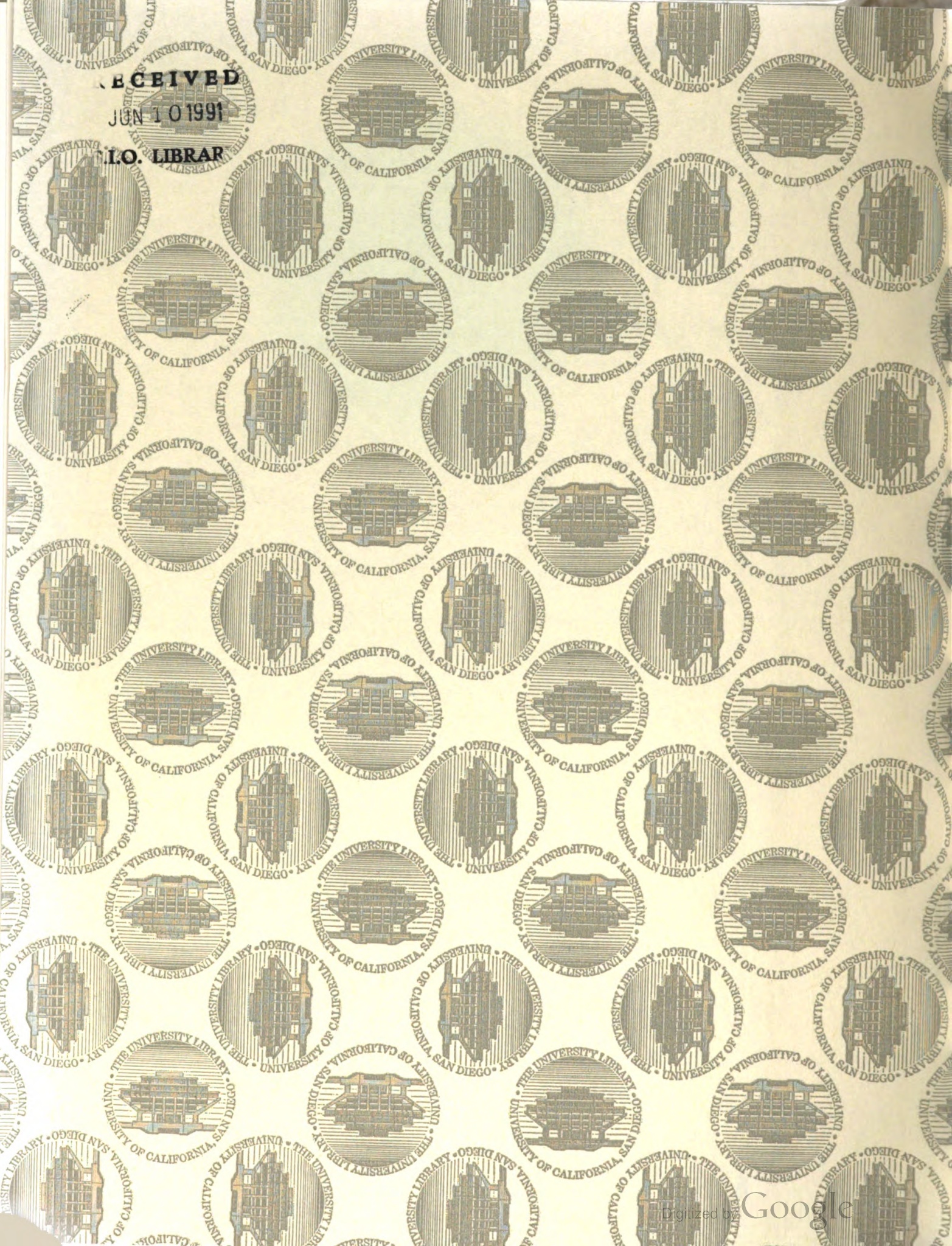
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