

# **Conceptual Model for the Columbia River Estuary**

**Prepared for**

**Lower Columbia Sponsor Ports**

**Navigation Channel Deepening Project**

**by**

**Ron Thom, Walter H. Pearson, and Amy Borde**

**Marine Sciences Laboratory**

**Pacific Northwest National Laboratories**

# Outline of Presentation

- Introduction and Background
  - Definition
  - Purpose and Objectives
- Approach to Model Development
- Model Overview
- Detailed Model Description
- Model Analysis
- Issues and Submodels
- Conclusion

# Background - Definition

## Conceptual Model

- Is a snapshot
- Provides a system-level perspective
- Offers several views of complexity
- Is centered on juvenile salmon
- Is based on habitat

## Conceptual Model

- Is NOT numerical

# Background - Purpose

Purpose of the conceptual model is to provide an integrated picture of the major ecosystem components and processes and what factors affect ecosystem structure and functioning relative to juvenile salmon.

# Background - Objectives

- Identify linkages among physical-chemical and biological components and processes
- Aid identification of salmon vulnerabilities and potential effects of the project
- Inform decision-making about the project through providing a system-level scientific perspective
- Aid baseline analysis and development of adaptive management plan

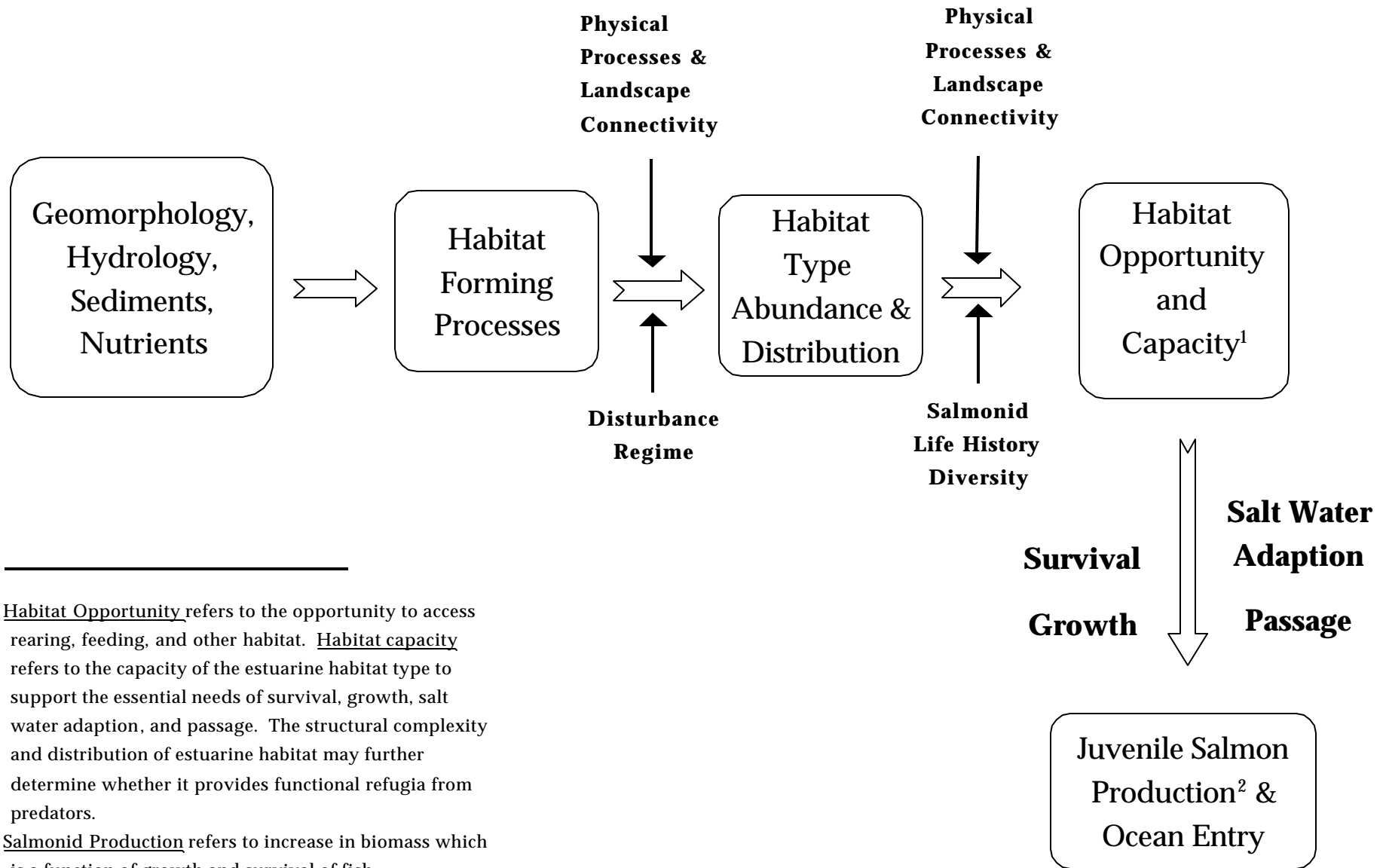
# Approach to Model Development

- Synthesis of available information
- Application of ecological principles

# Model Overview

- Link structures and processes
- Basic components
  - Integrated model
  - Submodels

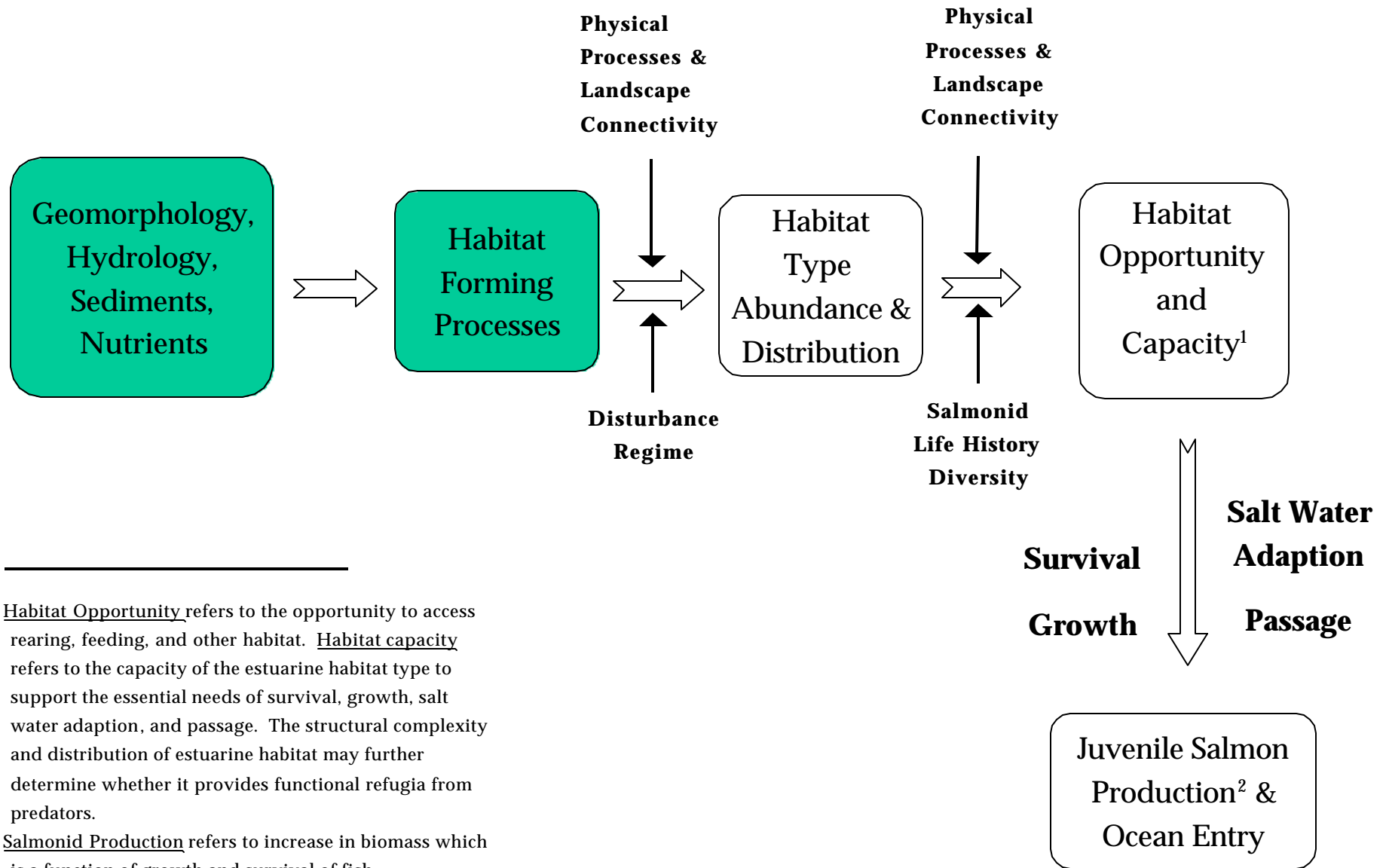
# Integrated Model for Juvenile Salmonids



<sup>1</sup> Habitat Opportunity refers to the opportunity to access rearing, feeding, and other habitat. Habitat capacity refers to the capacity of the estuarine habitat type to support the essential needs of survival, growth, salt water adaption, and passage. The structural complexity and distribution of estuarine habitat may further determine whether it provides functional refugia from predators.

<sup>2</sup> Salmonid Production refers to increase in biomass which is a function of growth and survival of fish.

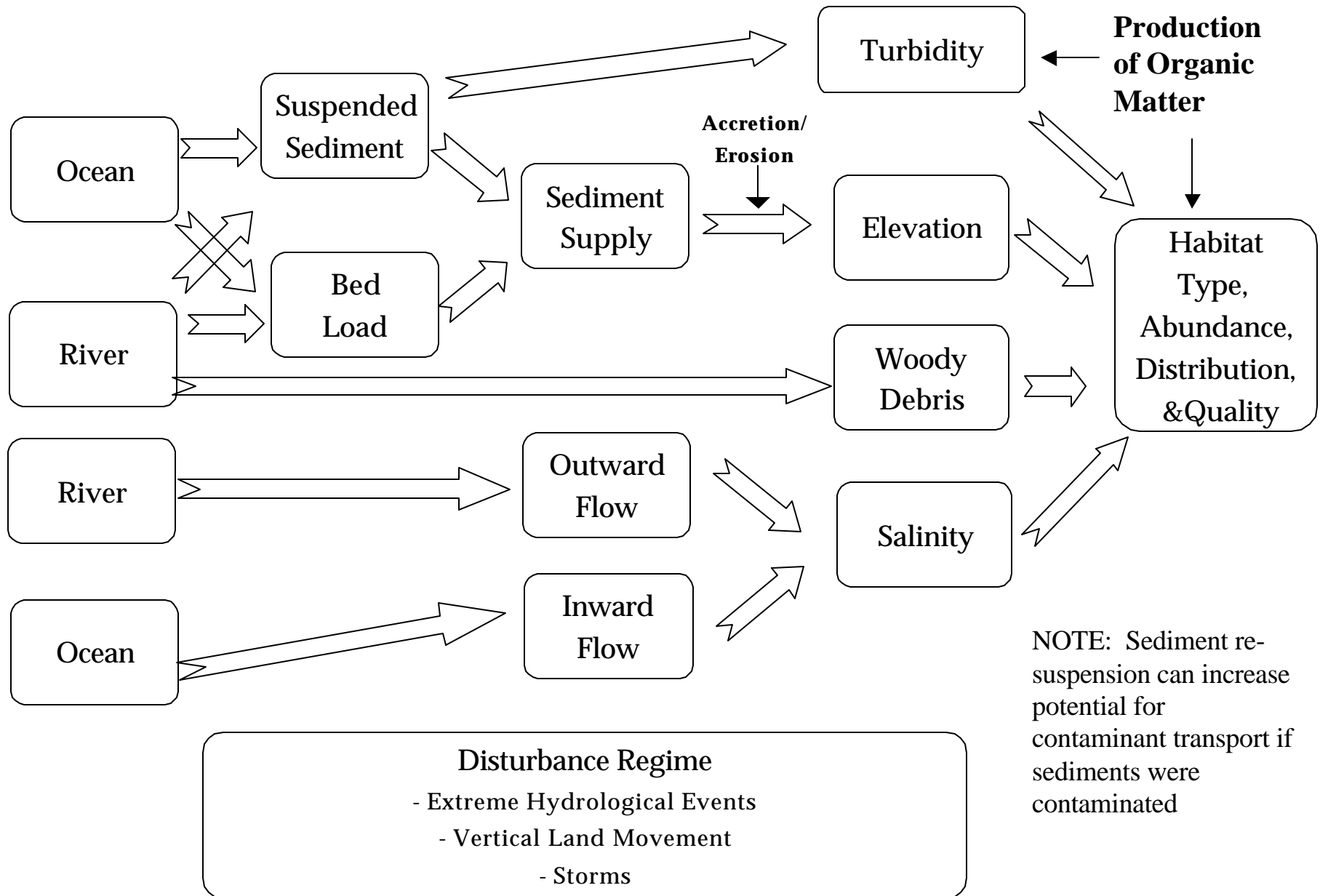
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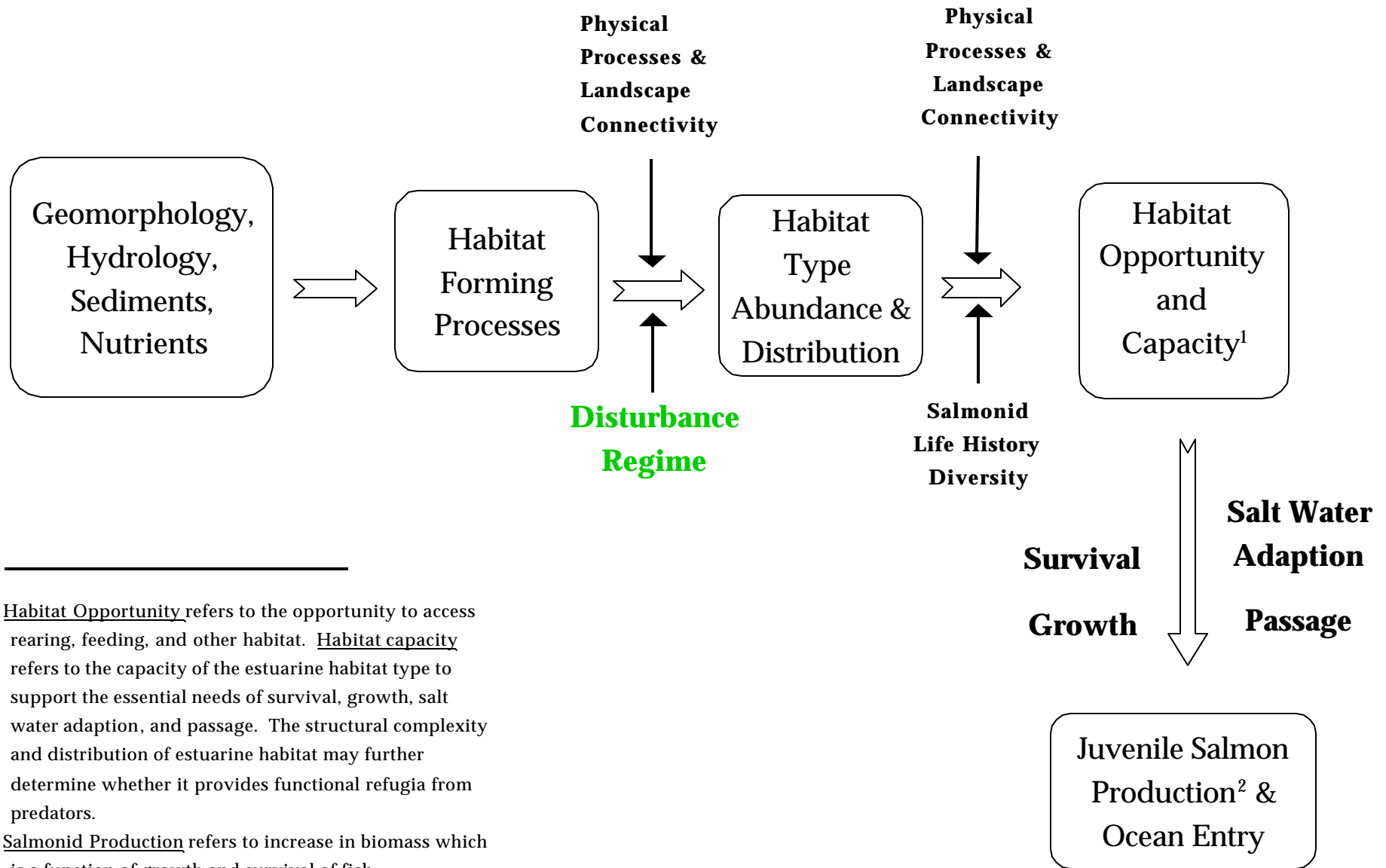
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# Habitat Forming Processes Model



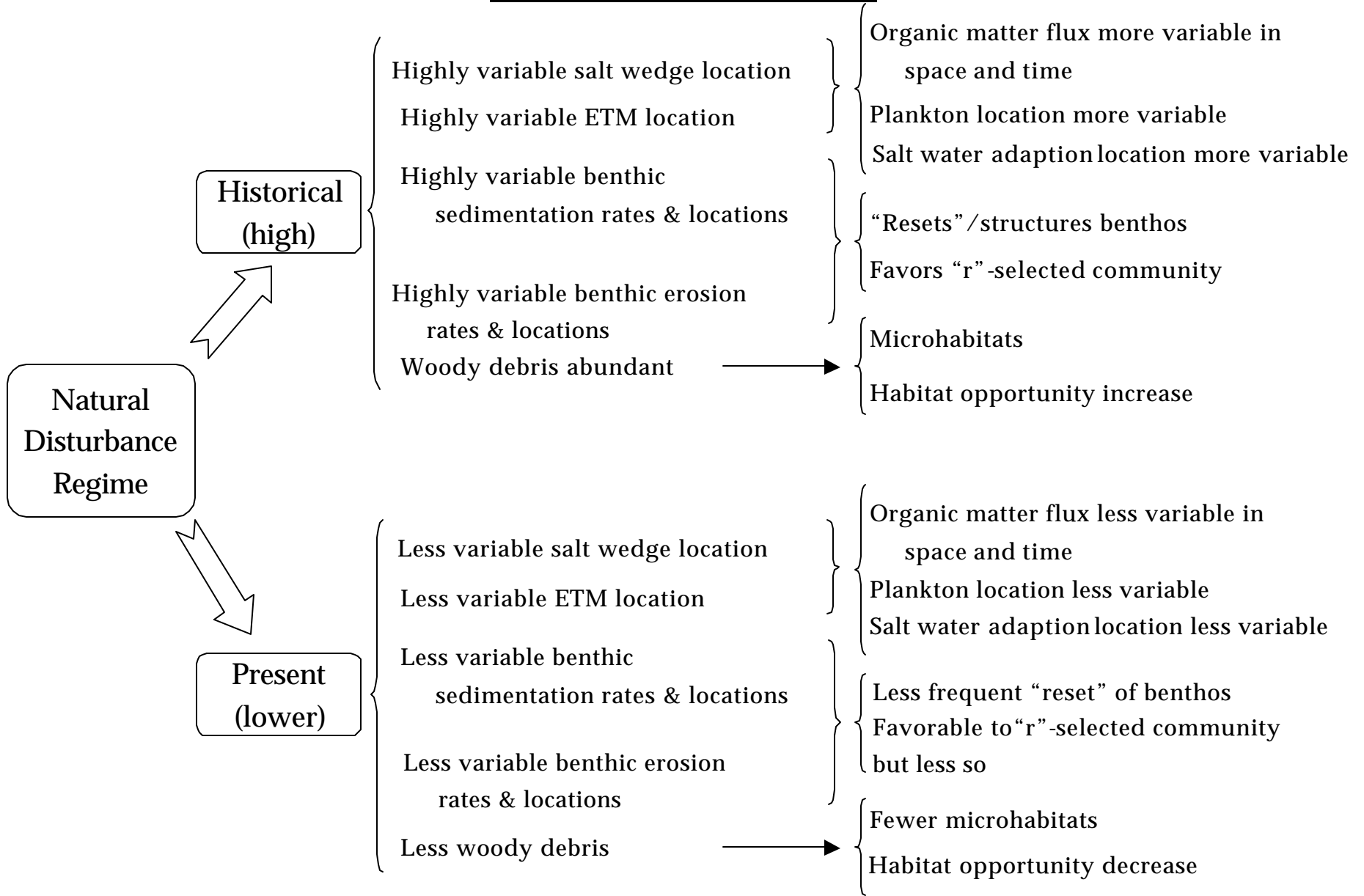
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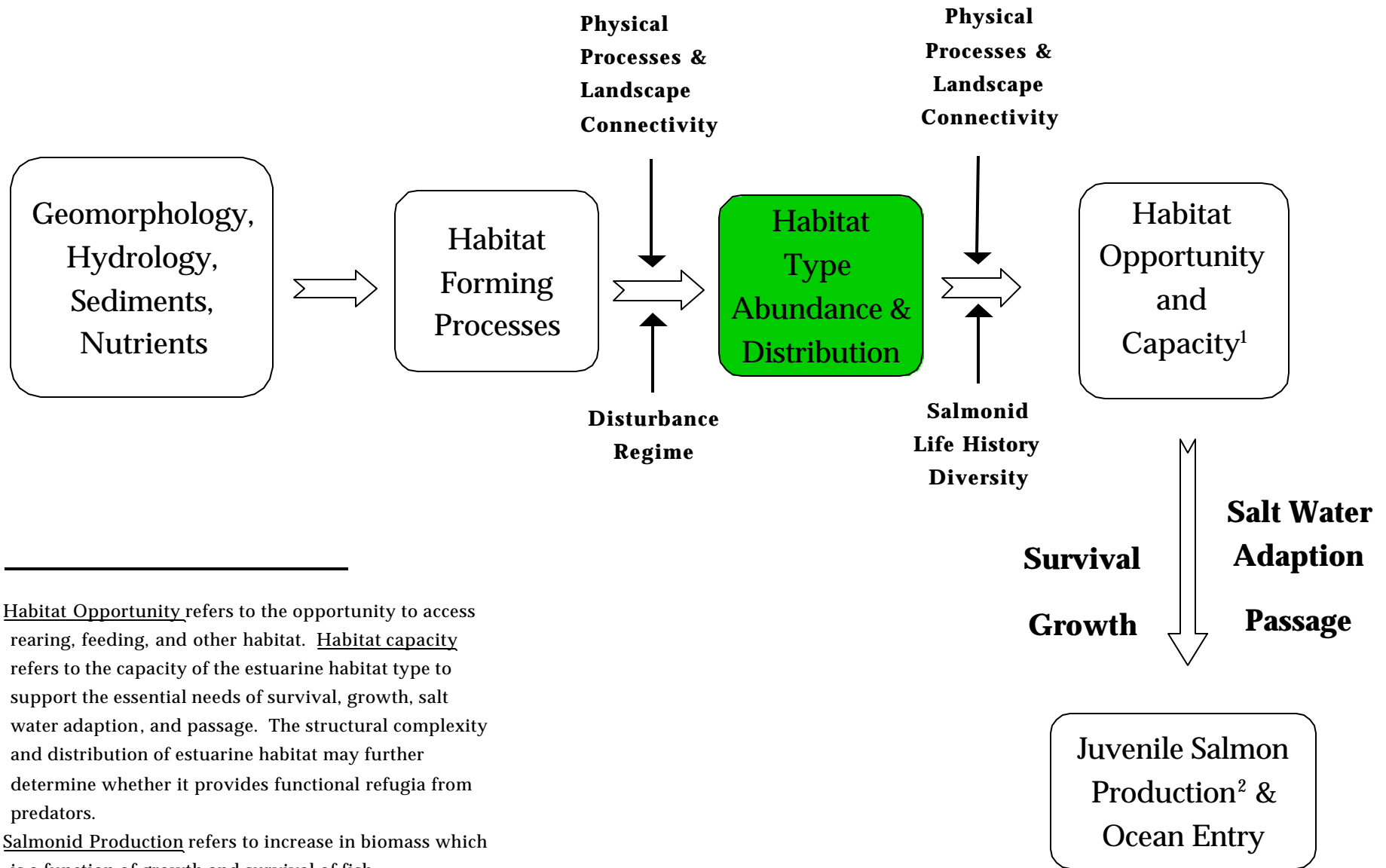
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# Disturbance Submodel



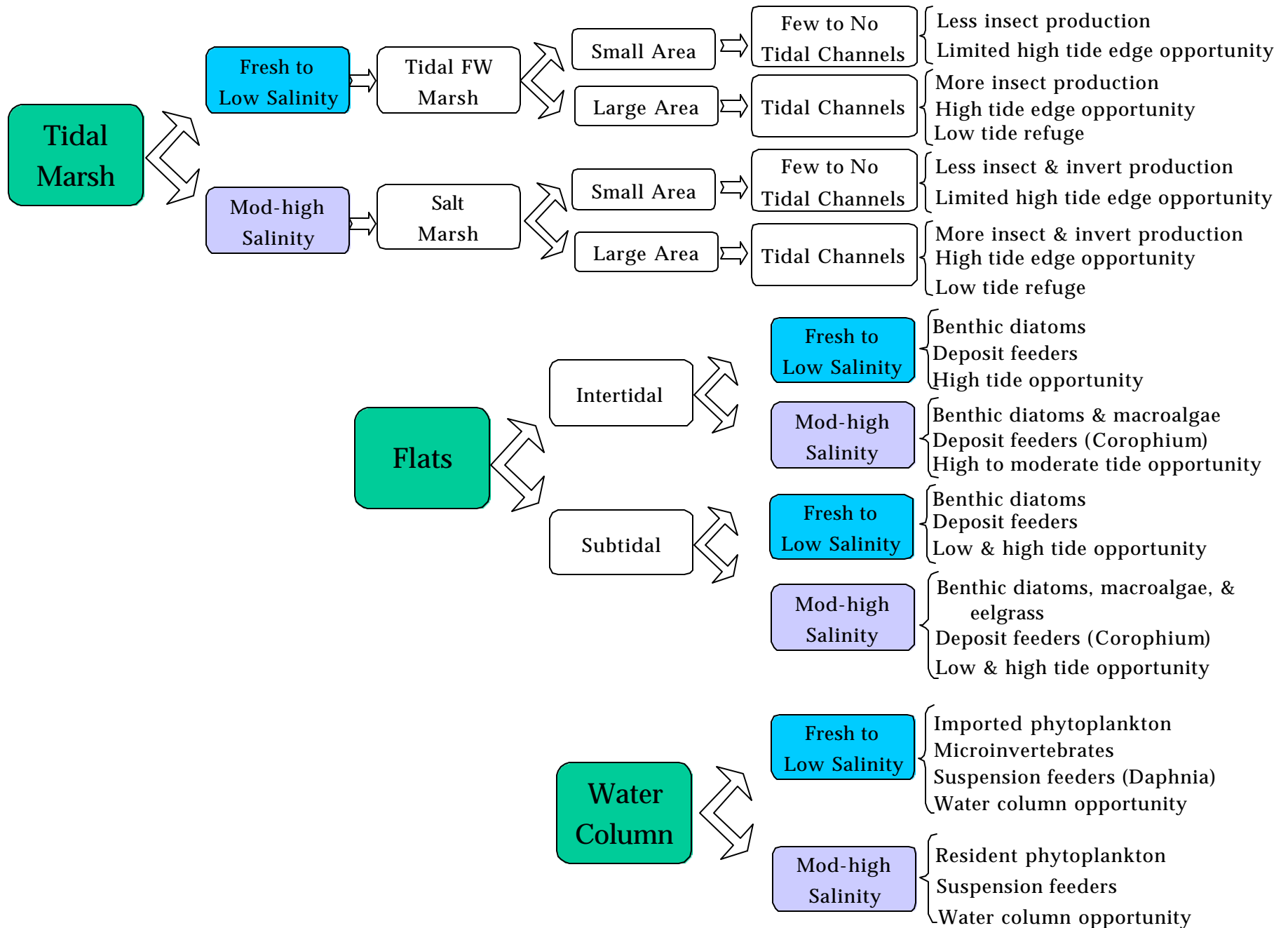
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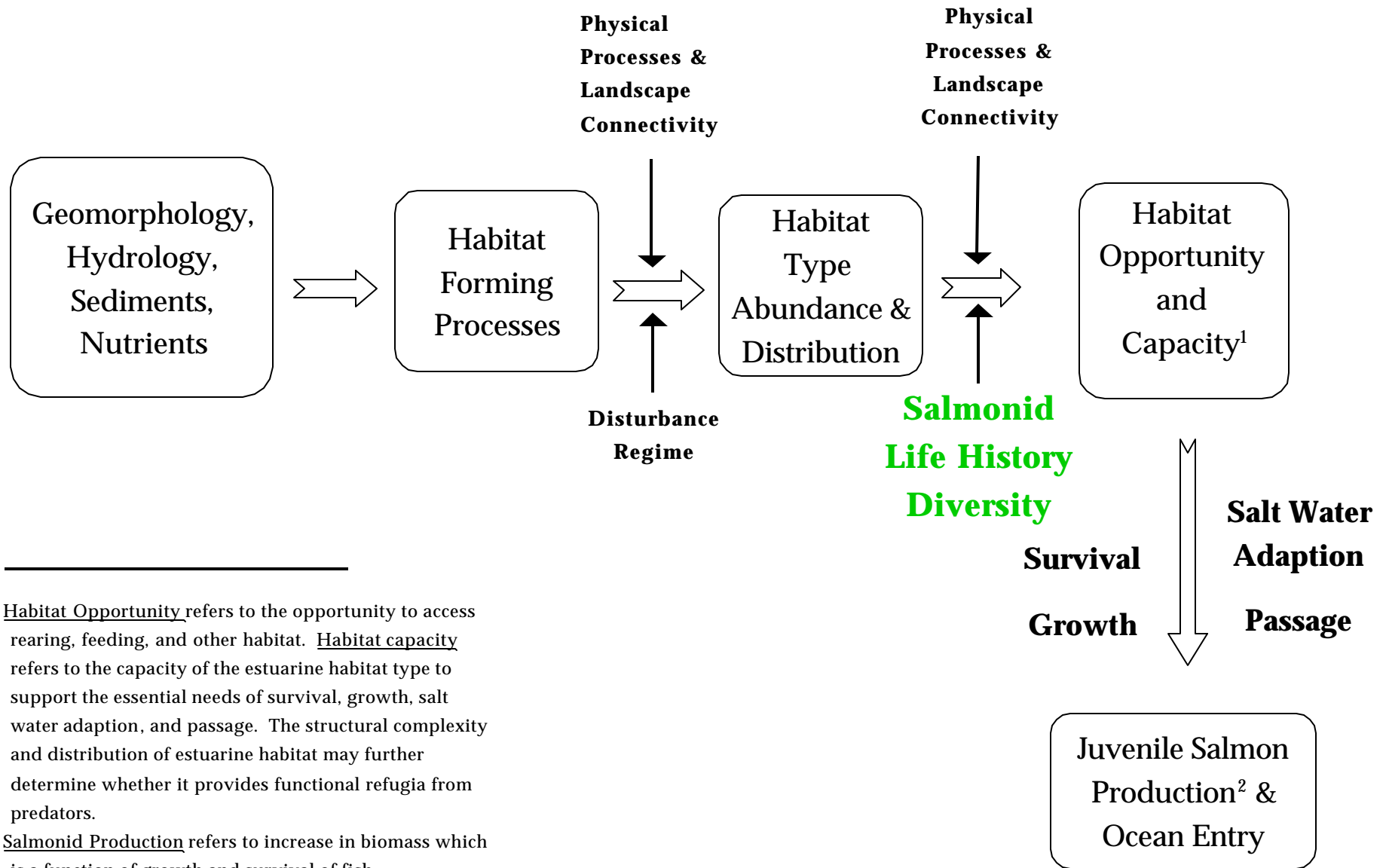
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# Feeding & Rearing Habitat Support Submodel



# Integrated Model for Juvenile Salmonids



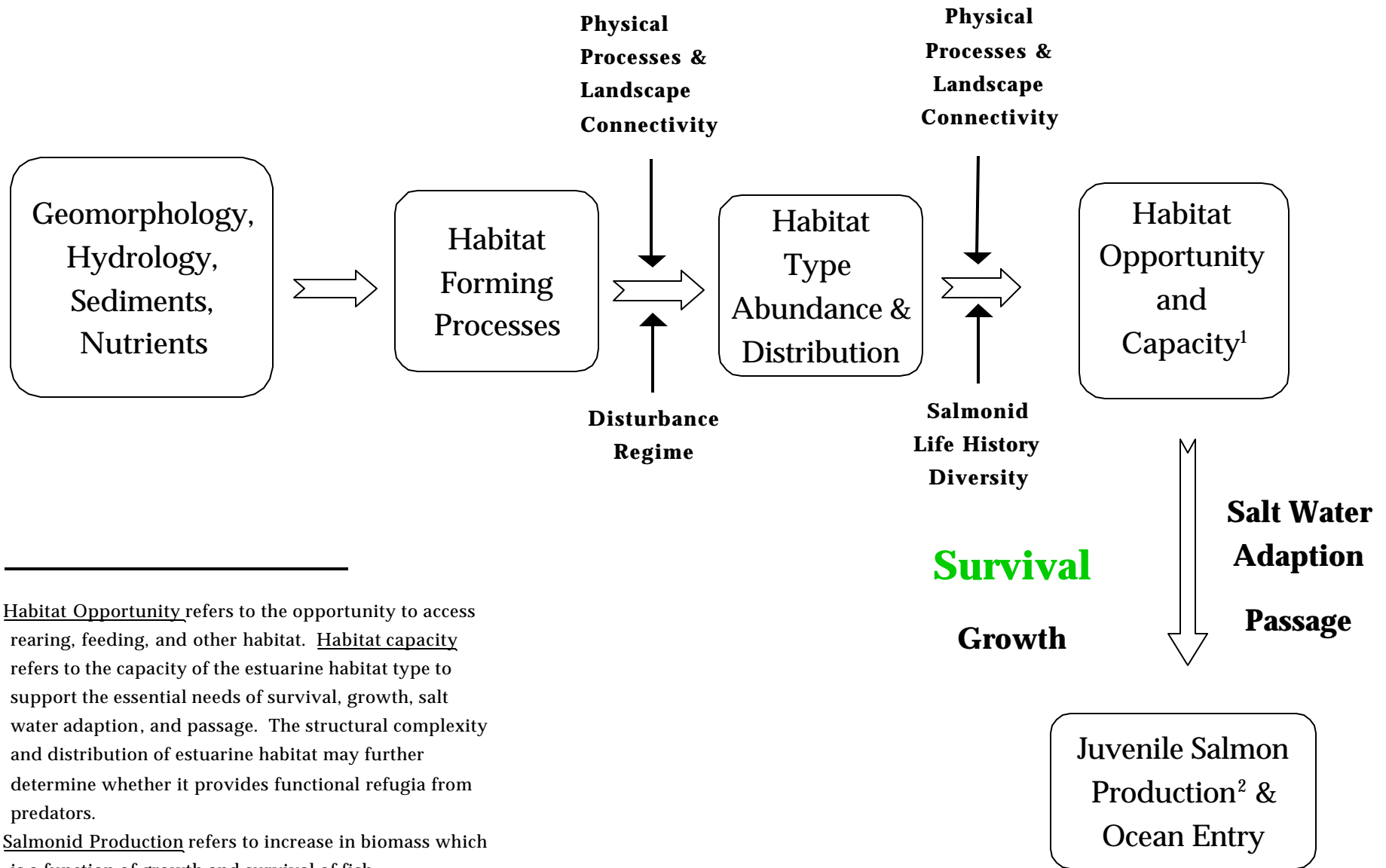
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# Salmon Life History

- Numerous life history strategies
- Juvenile time in estuary varies from days up to 6 months
- Timing is important

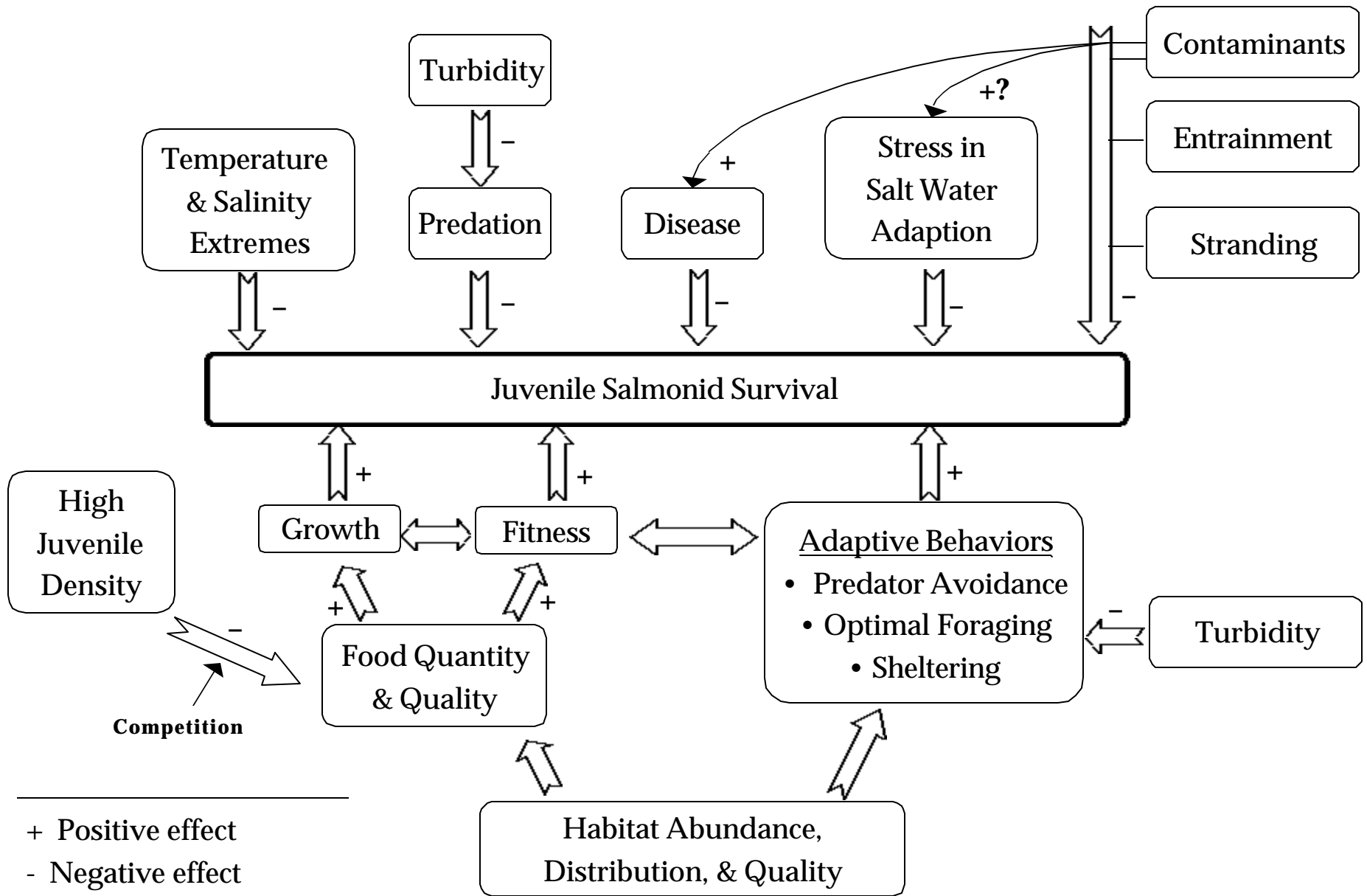
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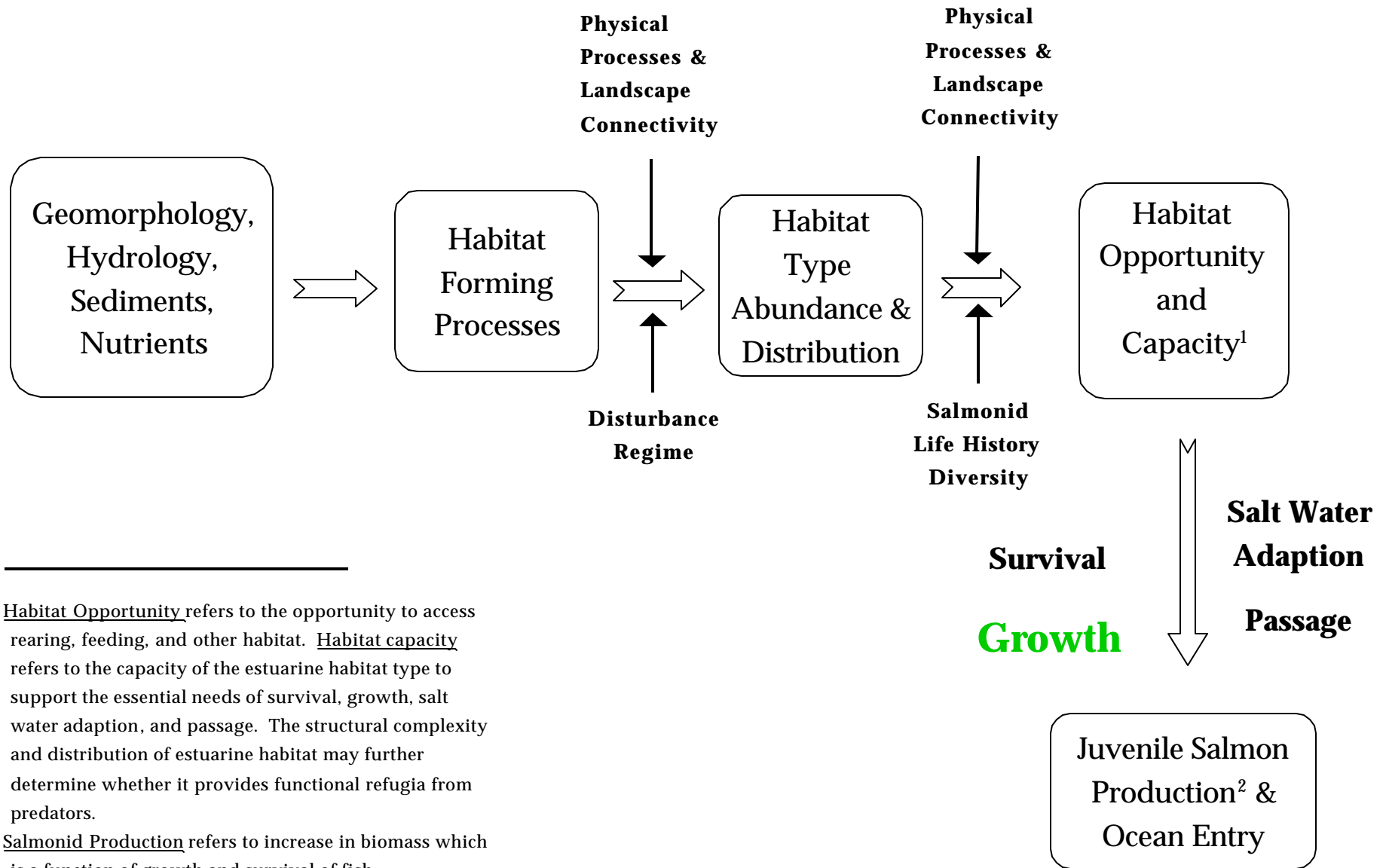
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## Survival Submodel



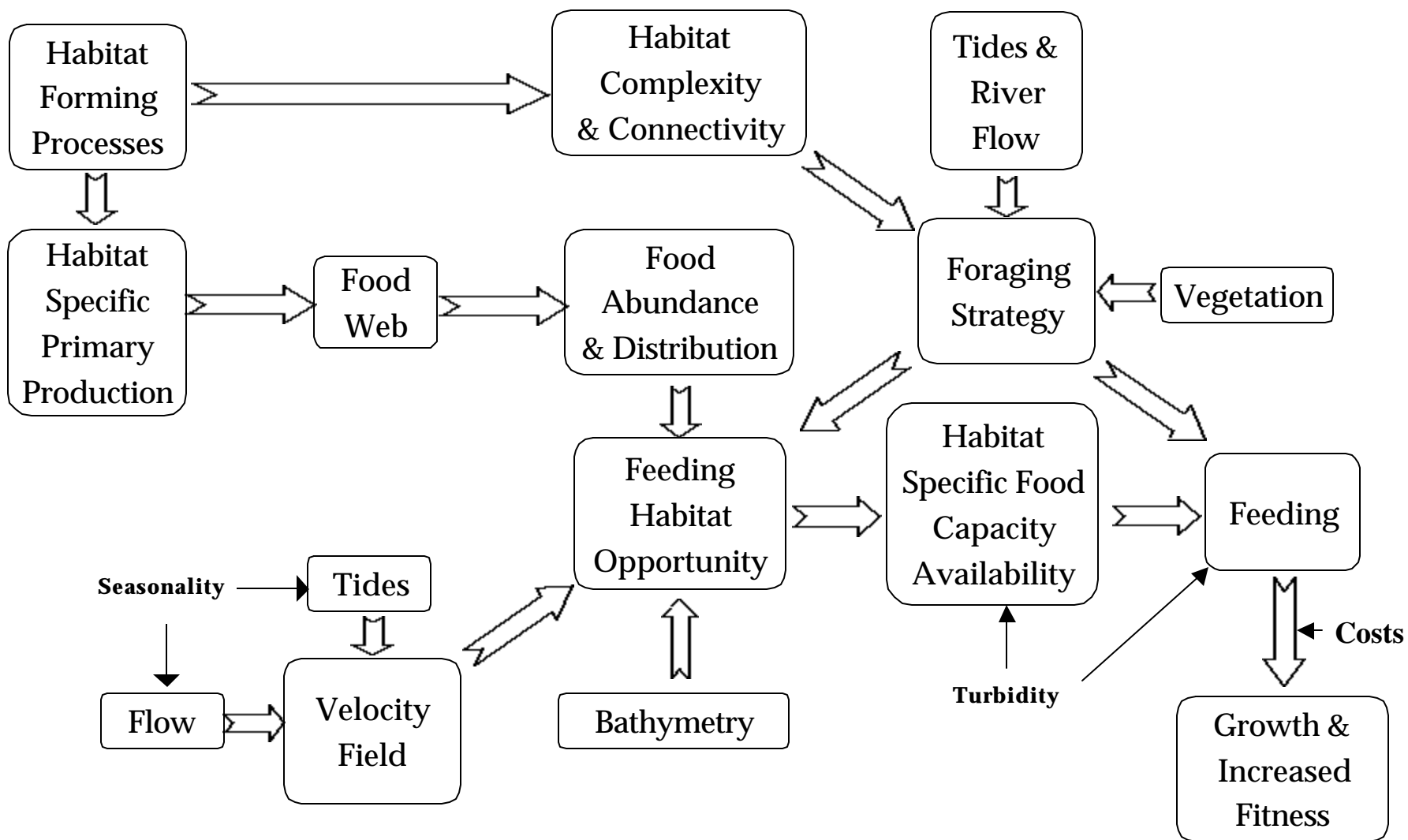
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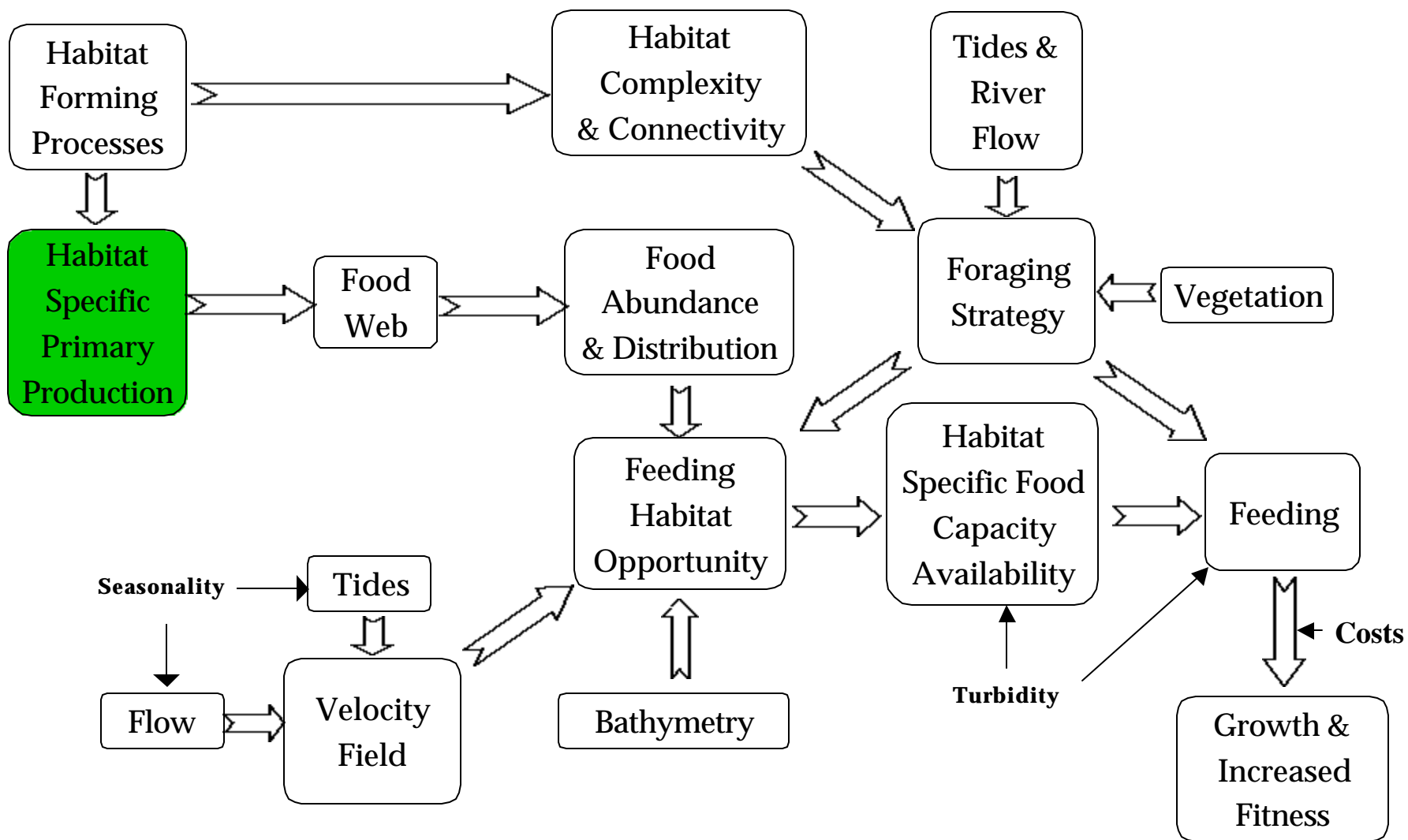
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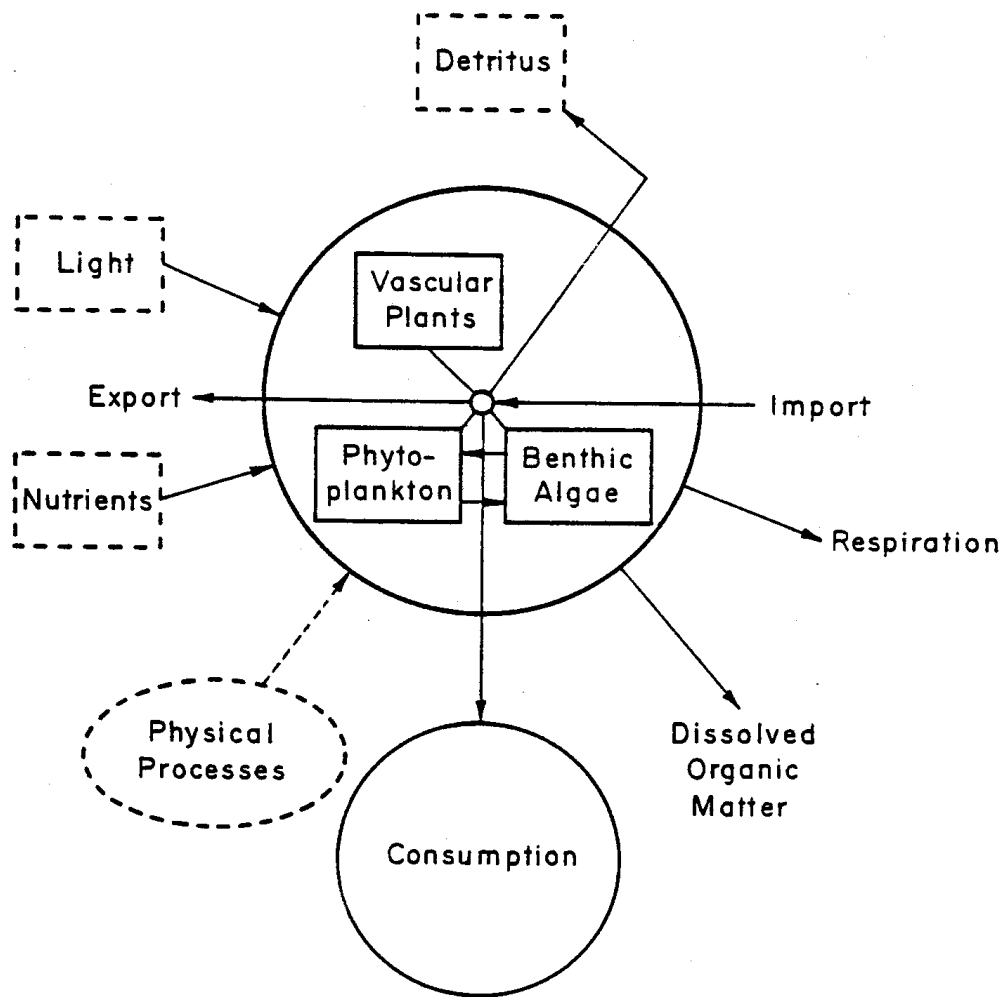
## Growth Submodel



## Growth Submodel

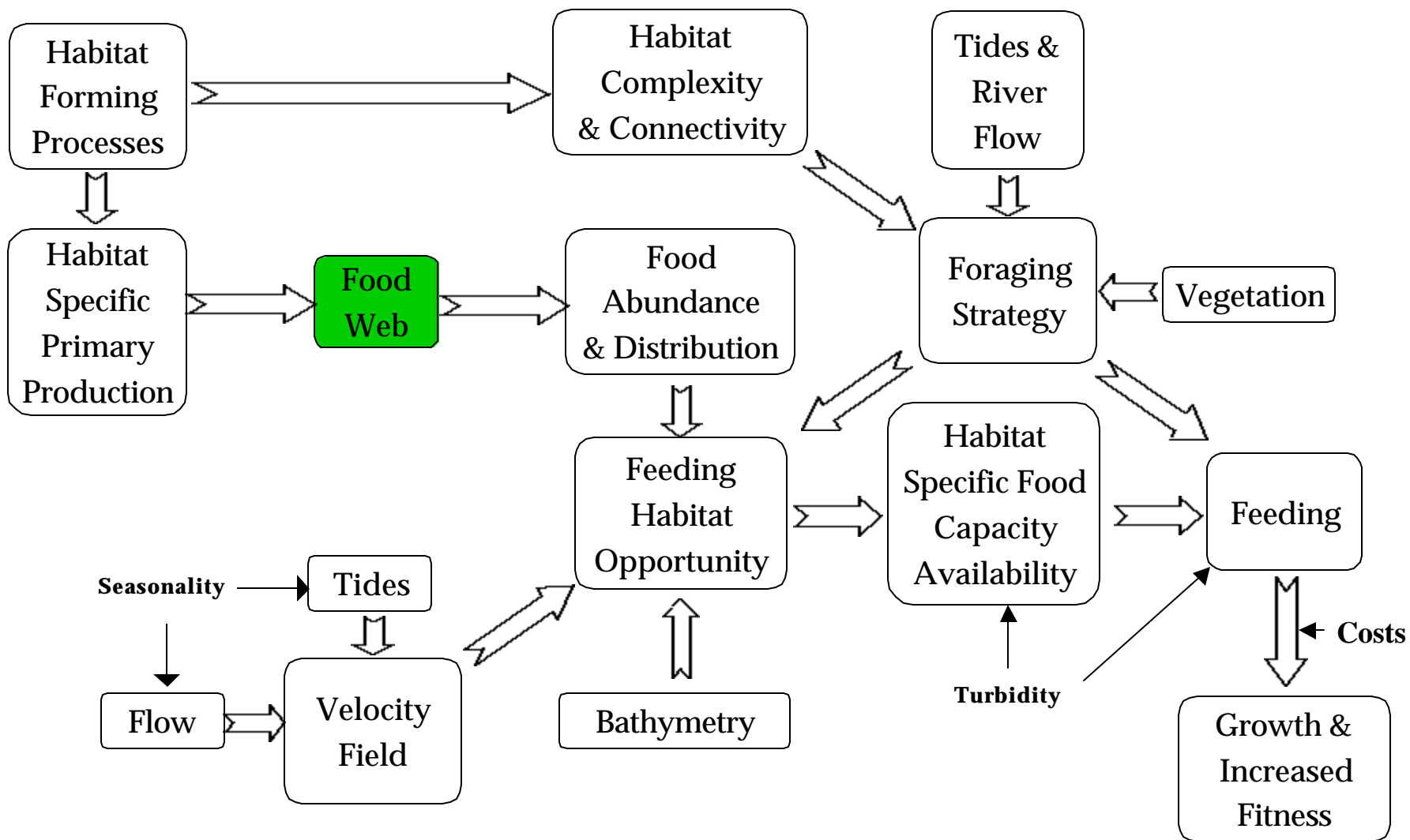


# Primary Productivity Submodel

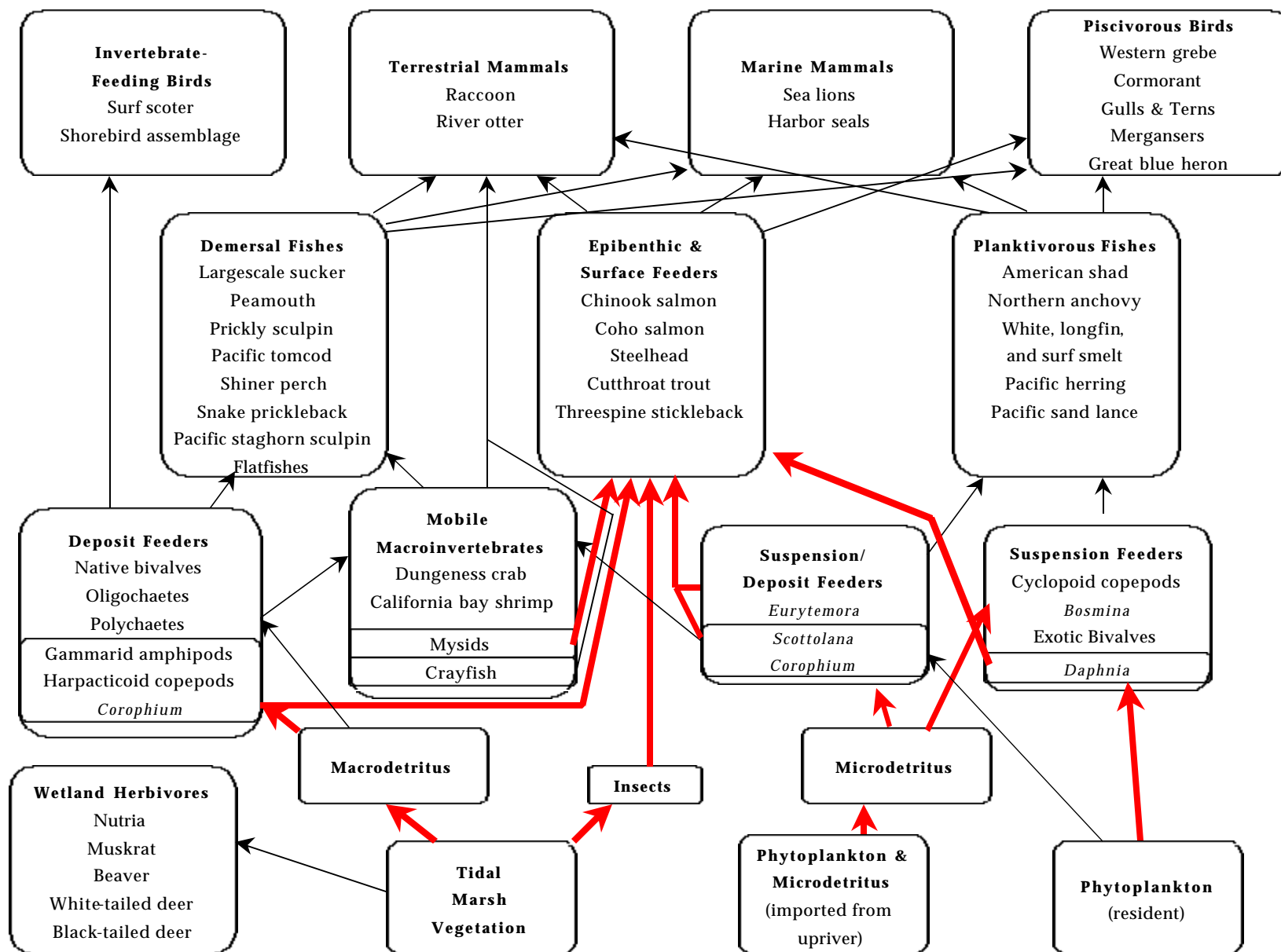


From: McIntire 1984

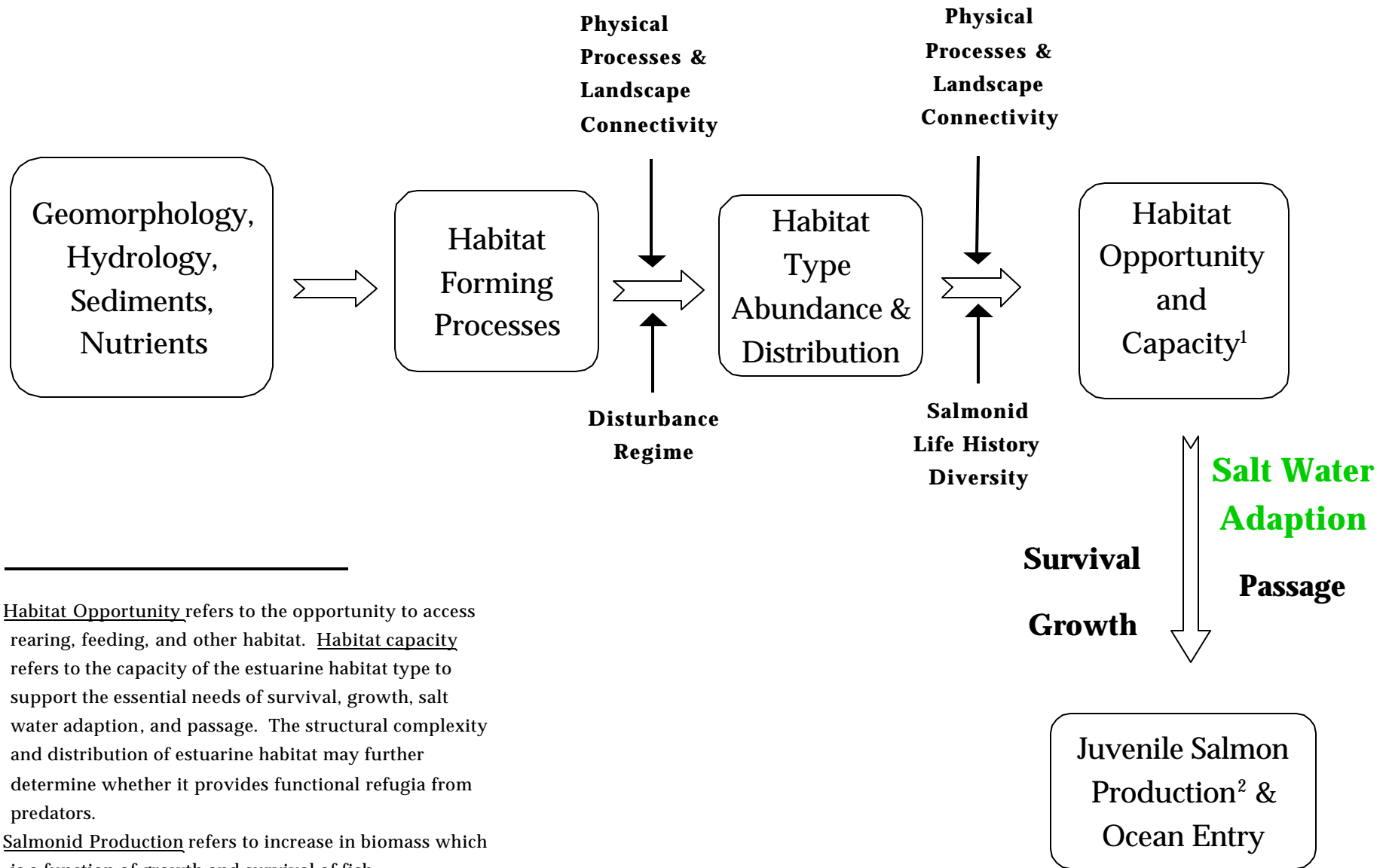
# Growth Submodel



# Food Web Submodel



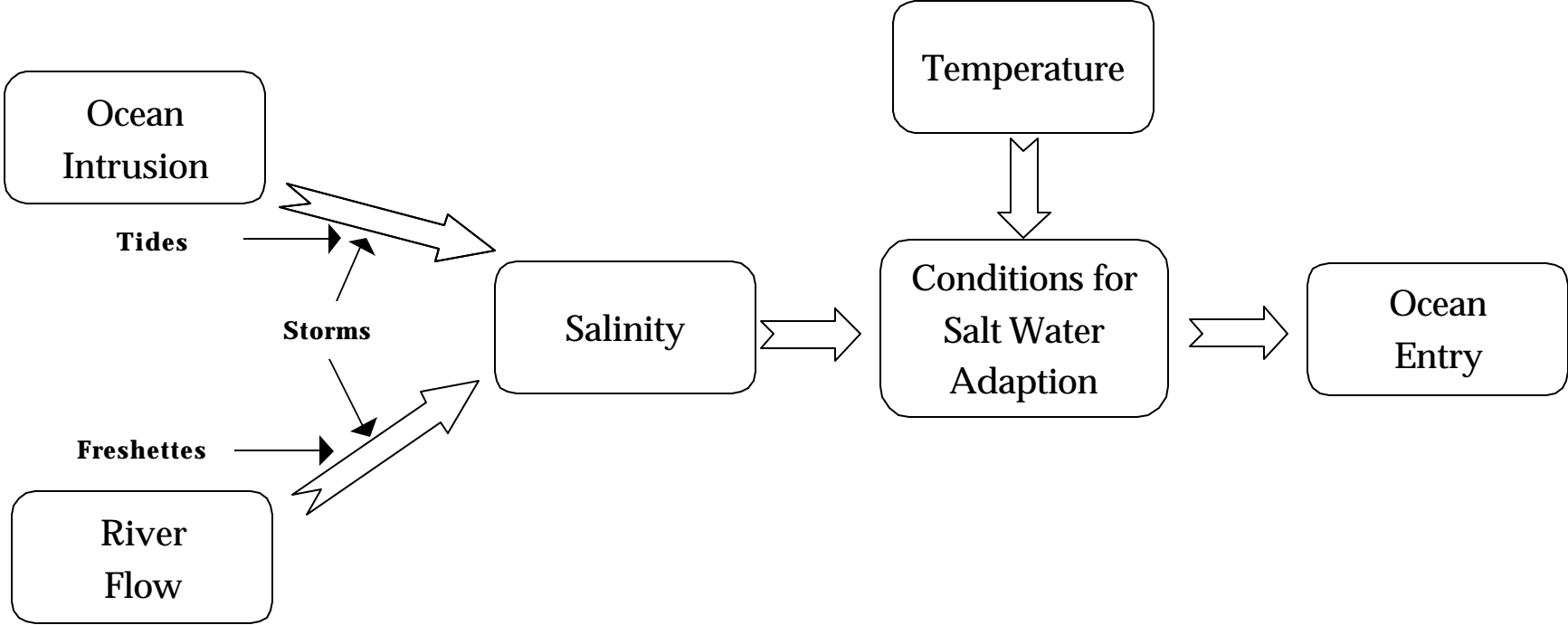
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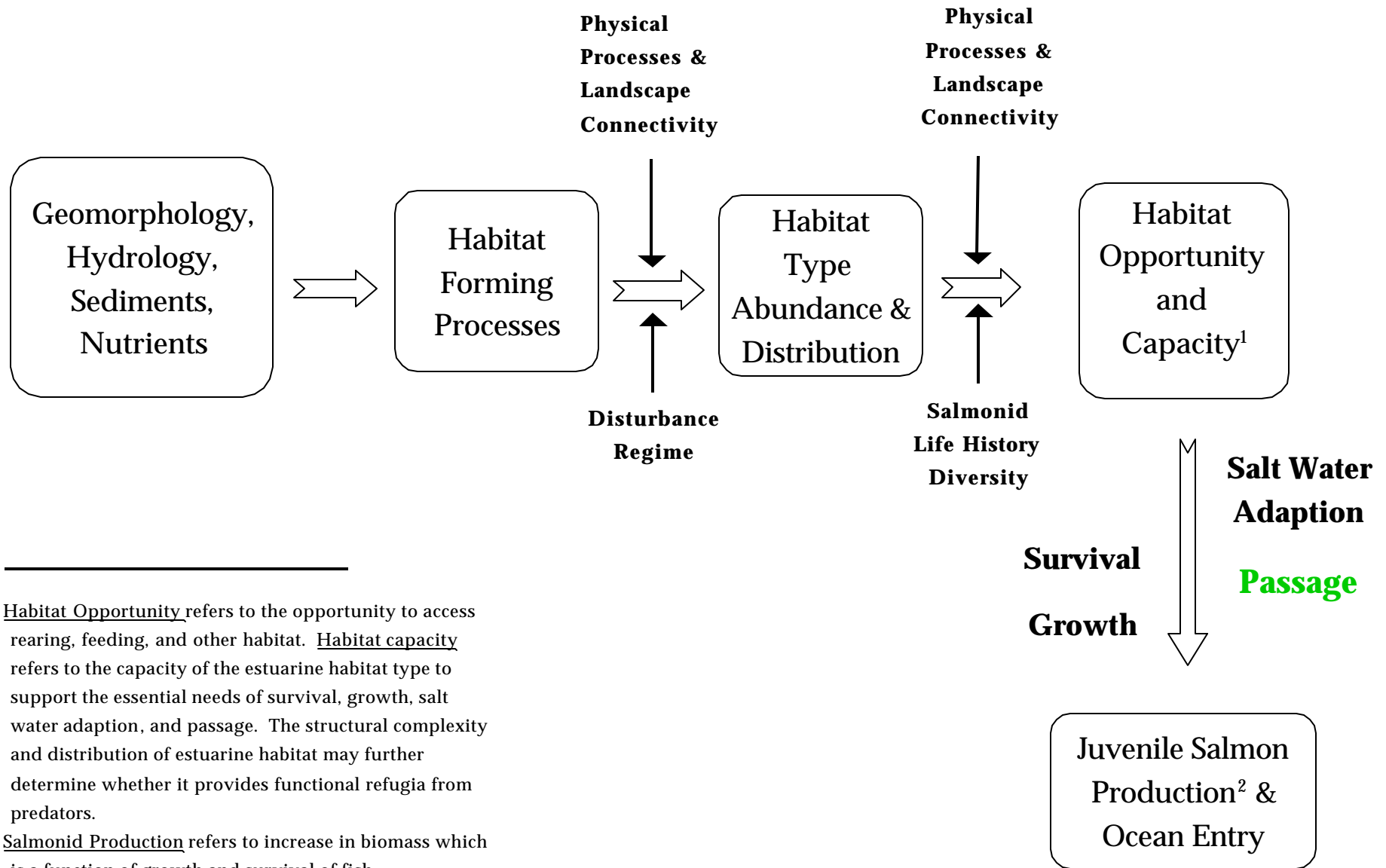
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# Salt Water Adaption Submodel



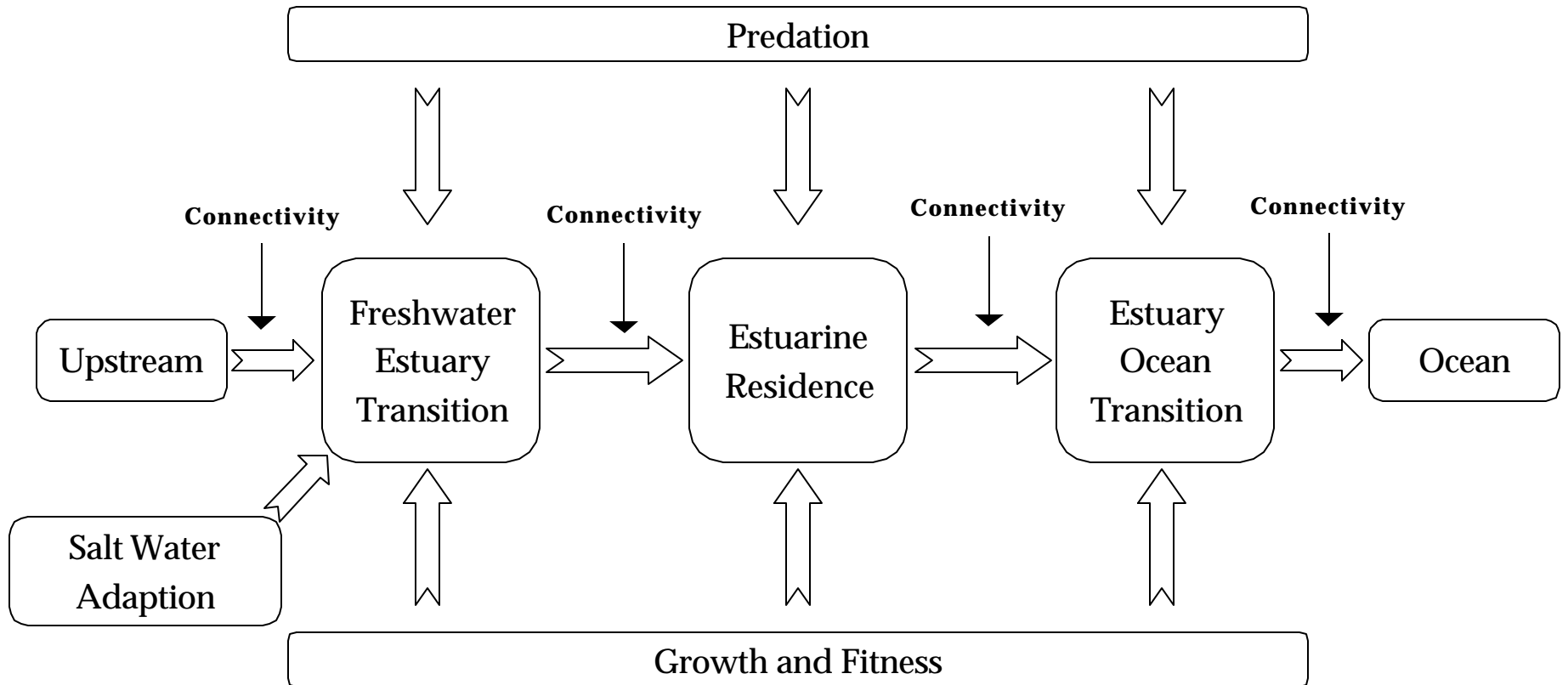
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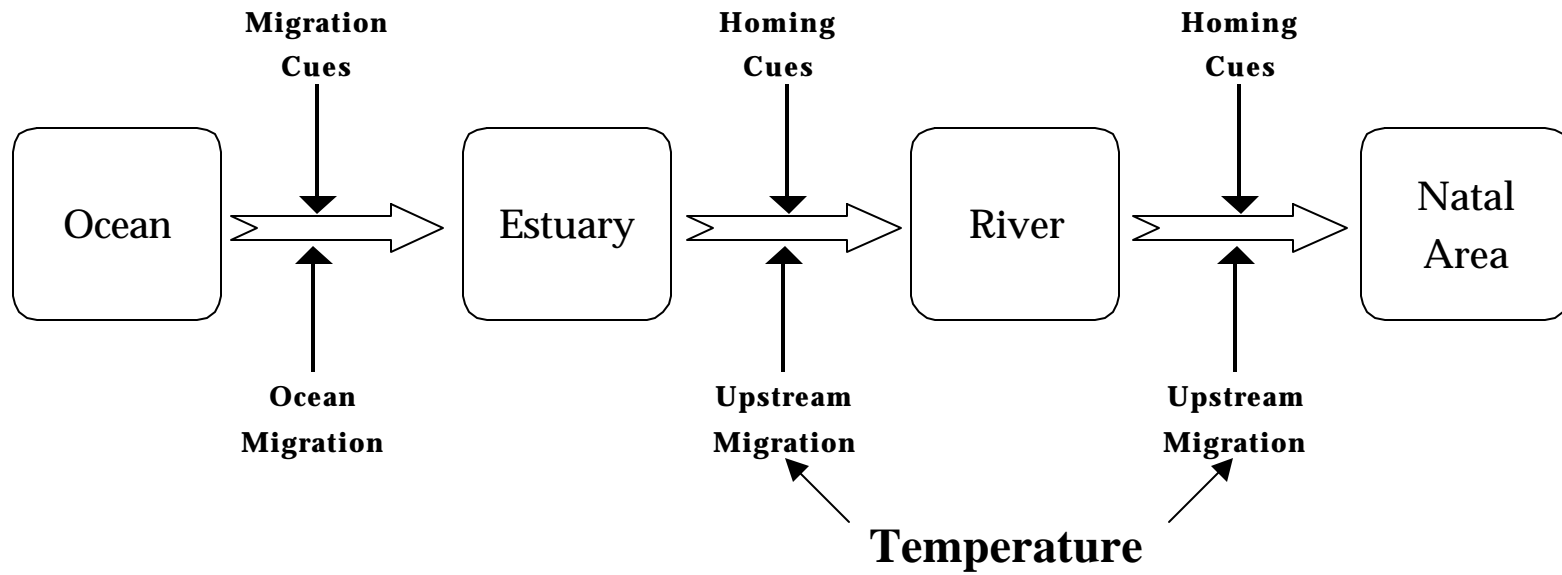
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# Juvenile Passage Submodel



# Adult Migration



# Model Analysis

- Linkages
- Vulnerabilities

# Issues and Submodels

Issue	Relevant Submodel	
	Primary	Secondary
Alteration of Flow, Salinity, ETM	Habitat Forming Processes	Growth, Salt Water Adaption
Alteration of salmon habitat	Habitat Forming Processes	All submodels
Increased suspended sediment	Habitat Forming Processes	Disturbance
Bathymetry change	Habitat Forming Processes	Disturbance
Sand transport to ocean	Habitat Forming Processes	
Dredging Window	Salmon Life History	
Redistribution of contaminants	Survival	
Effects of turbidity	Survival	Growth
Entrainment	Survival	Habitat Forming Processes
Stranding	Survival	Habitat Forming Processes
Alteration of food web	Growth	Food Web, Primary Production
Ability to function as a conduit	Passage	Salt Water Adaption, Life History
Monitoring	All submodels	
Adult salmon migration	Adult migration	Salmon Life History
Dredging forecast too low	Not in Conceptual Model	
Deposition in spawning beds	Not in Conceptual Model	

# Conclusions

Conceptual model enables views of the most relevant linkages

Flow, depth, salinity, temperature, sediment



Habitat and processes relative to essential needs

Survival

Growth

Salt Water Adaption

Increased Fitness

Passage