

I read in the newspaper that shellfish are good for the environment. Can anyone comment on that?

## Carrying Capacity

**Eutrophication:** *The process by which a body of water becomes **rich in dissolved nutrients** from **fertilizers** or **sewage**, thereby encouraging the growth and decomposition of **oxygen-depleting plant life** and resulting in **harm to other organisms**.*

Because of this nutrient removal ability, bivalve aquaculture can improve water quality and mitigate **eutrophication** pressure in coastal systems (Newell 2004, Lindahl et al. 2005, Zhou et al. 2006) if the ecological carrying capacity (Section 5.7) is not exceeded.

Effects of Geoduck Aquaculture on the Environment:  
A Synthesis of Current Knowledge, Washington Sea Grant, 2008

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## Carrying Capacity

**Ecological carrying capacity** (ECC) is the **highest level** of culture that can be undertaken **without leading to significant changes in ecological processes, individual species, or communities in the surrounding habitat** (Gibbs 2007).

As **cultured bivalves compete with other filter feeders**, bivalve aquaculture has the **potential to displace other animals in the food web**.

*Effects of Geoduck Aquaculture on the Environment:  
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A letter to the editor said that the geoducks planted on the beach are at the same density as the wild geoducks. Is this true?

## Geoduck Densities Inter-Tidal – On the Beach – Aquaculture

... **information** about **intertidal** population size, **density**, and aggregation is **lacking** ...

*Effects of Geoduck Aquaculture on the Environment:  
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[**Aquaculture**] Inter-tidal harvesting **densities** are **17.4 geoducks/m<sup>2</sup>**.

*Testimony at Pierce County Admin. Appeal AA16-07*

If the density on the beaches is similar to “wild densities”,  
why do they need to be planted; just harvest the wild ones!

# Geoduck Densities

## Sub-Tidal – Under the Water



7.3 geoducks/meter<sup>2</sup>

**Des Moines**  
(Tract # 09900)

Region - South Sound

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Tract No.	Size (Acres)	County	Number of Geoducks	Pounds of Geoducks	Average Tract Density (Geoducks/sq. ft.)	Average Geoduck Weight (lbs.)	Bed Status (See footnotes)
09900	26	King	765,000	1,530,000	0.68	--	6/7

### Comments:

Surveyed in 1976 by WDFW; 7 transects. Polluted due to marina and Des Moines outfall. Surveys done in January, biomass may be over-estimated.

### Footnotes

1. Bed fished in past.	7. Status unclear, noted in comments.
2. Commercial bed presently being fished.	8. Needs pre-fishing survey.
3. Commercial bed surveyed, needs additional survey work.	9. Bed included in recovery study.
4. Commercial bed, ready to fish.	10. Statutory or land use restrictions, noted in comments.
5. Commercial bed fished in past, recovering.	11. X-bed, has not been surveyed.
6. Non-commercial bed for reasons given in comments.	12. Harvest restriction to protect spawning herring.

# Geoduck Densities

## Sub-Tidal – Under the Water



**Buffington**  
(Tract # 15900)

Region - South Sound

[Back to map](#)

4 geoducks/meter<sup>2</sup>

Tract No.	Size (Acres)	County	Number of Geoducks	Pounds of Geoducks	Average Tract Density (Geoducks/sq. ft.)	Average Geoduck Weight (lbs.)	Bed Status (See footnotes)
15900	74	Mason	45,000	94,000	0.03	2.1	5

977 by WDFW; 12 transects. Average pre-fishing density is 0.37 geoducks/sq. ft. Fished 1980-81 as part of old 101 acre tract called



## Geoduck Densities

### Wild Density versus Aquaculture Density

Des Moines (wild)	7.3/meter <sup>2</sup>
Buffington (wild)	4.0/meter <sup>2</sup>
Sound Average* (wild)	1.7/meter <sup>2</sup>
Aquaculture (farmed)	17.4/meter <sup>2</sup>

*\*Goodwin & Pease, 1991.*

Do geoducks eat the same things that the fish eat?

## What do Geoducks Eat?

Geoduck juveniles and adults feed by filtering food particles (e.g., **phytoplankton**) from seawater (Goodwin & Pease 1989).

# Near Shore Open Water Food Web

## Phytoplankton

Flora of freely floating, often minute organisms that drift with water currents. Like land vegetation, phytoplankton uses carbon dioxide, releases oxygen, and converts minerals to a form animals can use.

Oceanic phytoplankton is the primary food source, directly or indirectly, of all sea organisms.

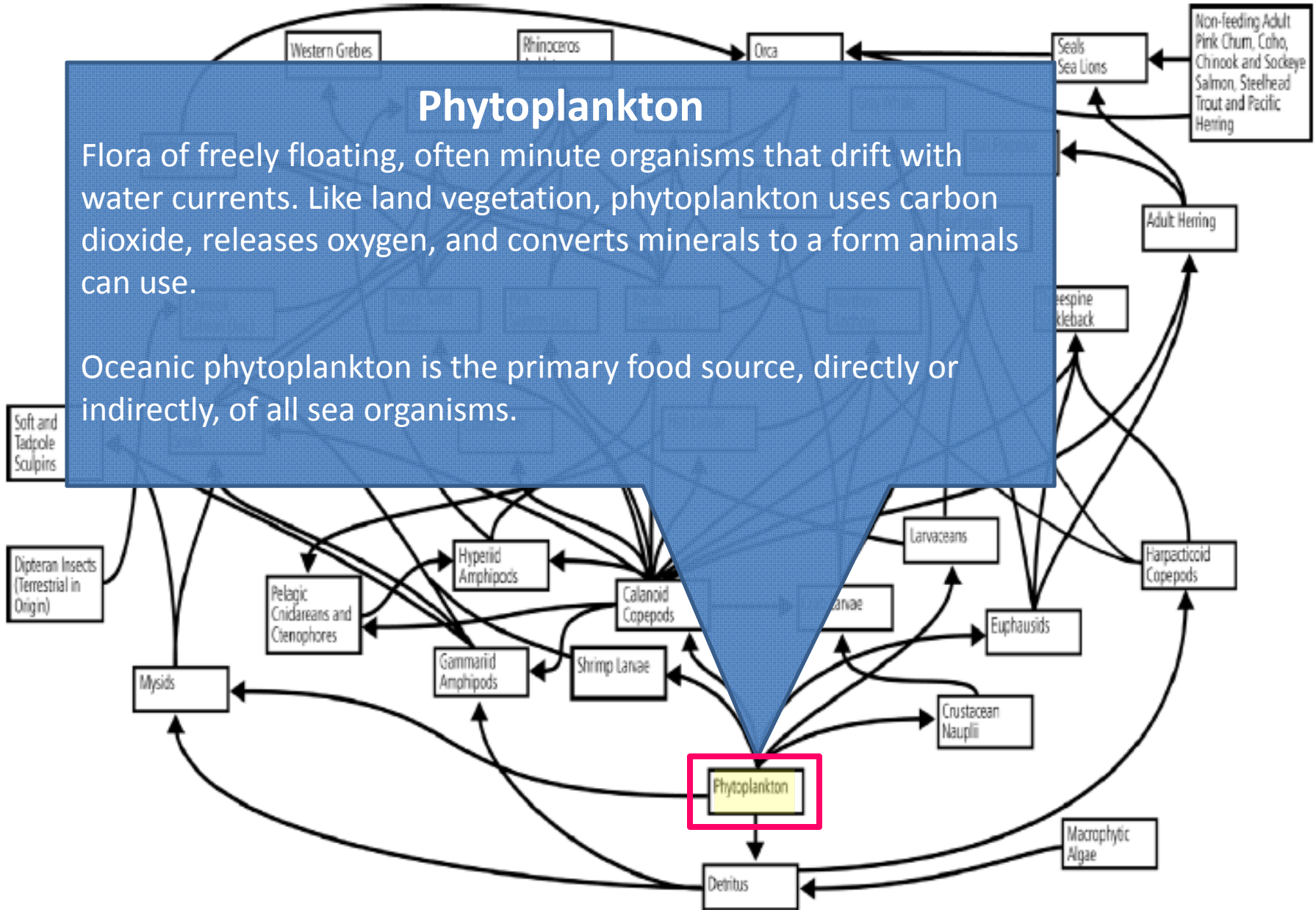


Figure 1. Nearshore open water food web. Note forage fish positions between macro-zooplankton and secondary predators (adapted from Simenstad et al 1979).

# Near Shore Open Water Food Web

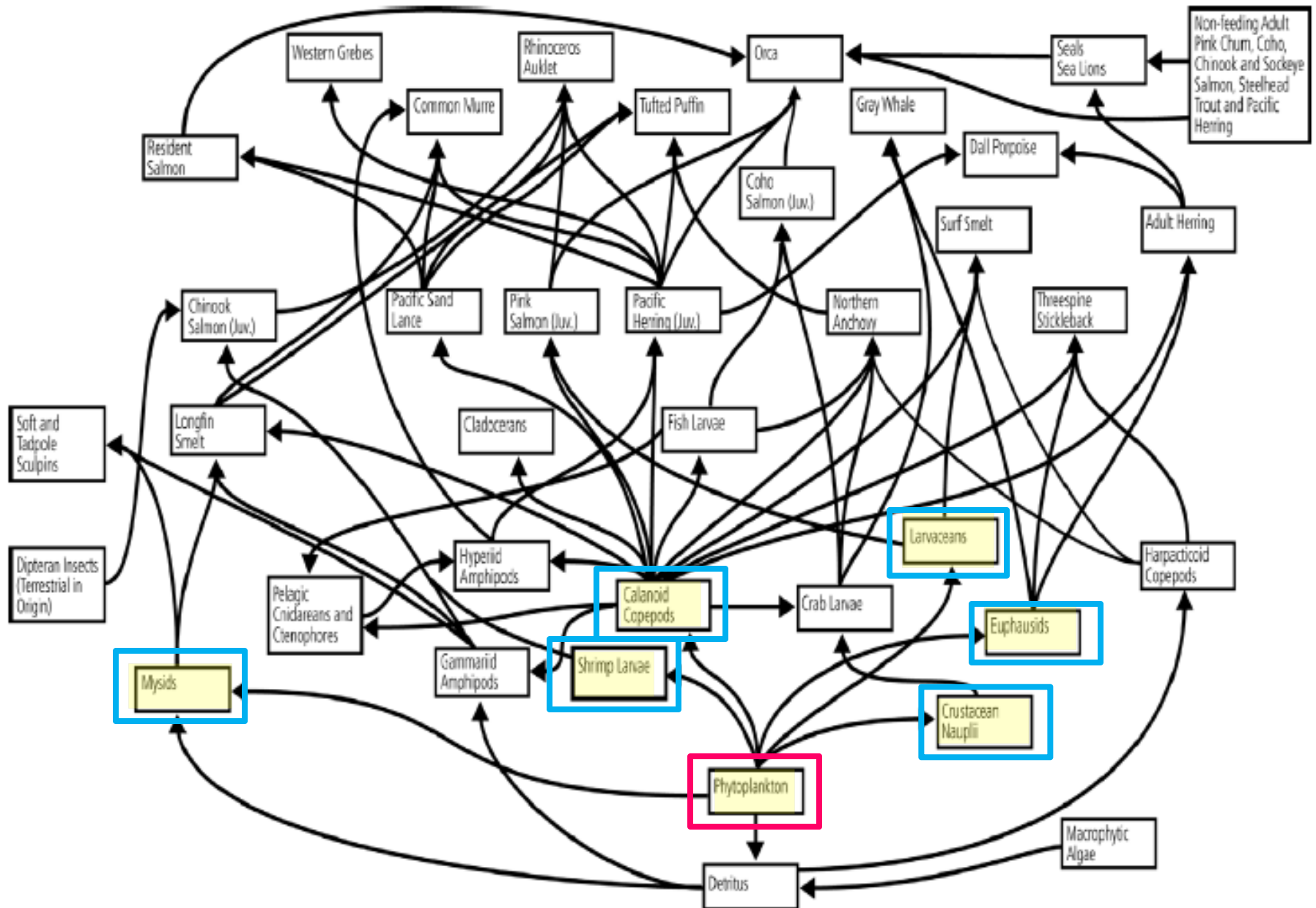


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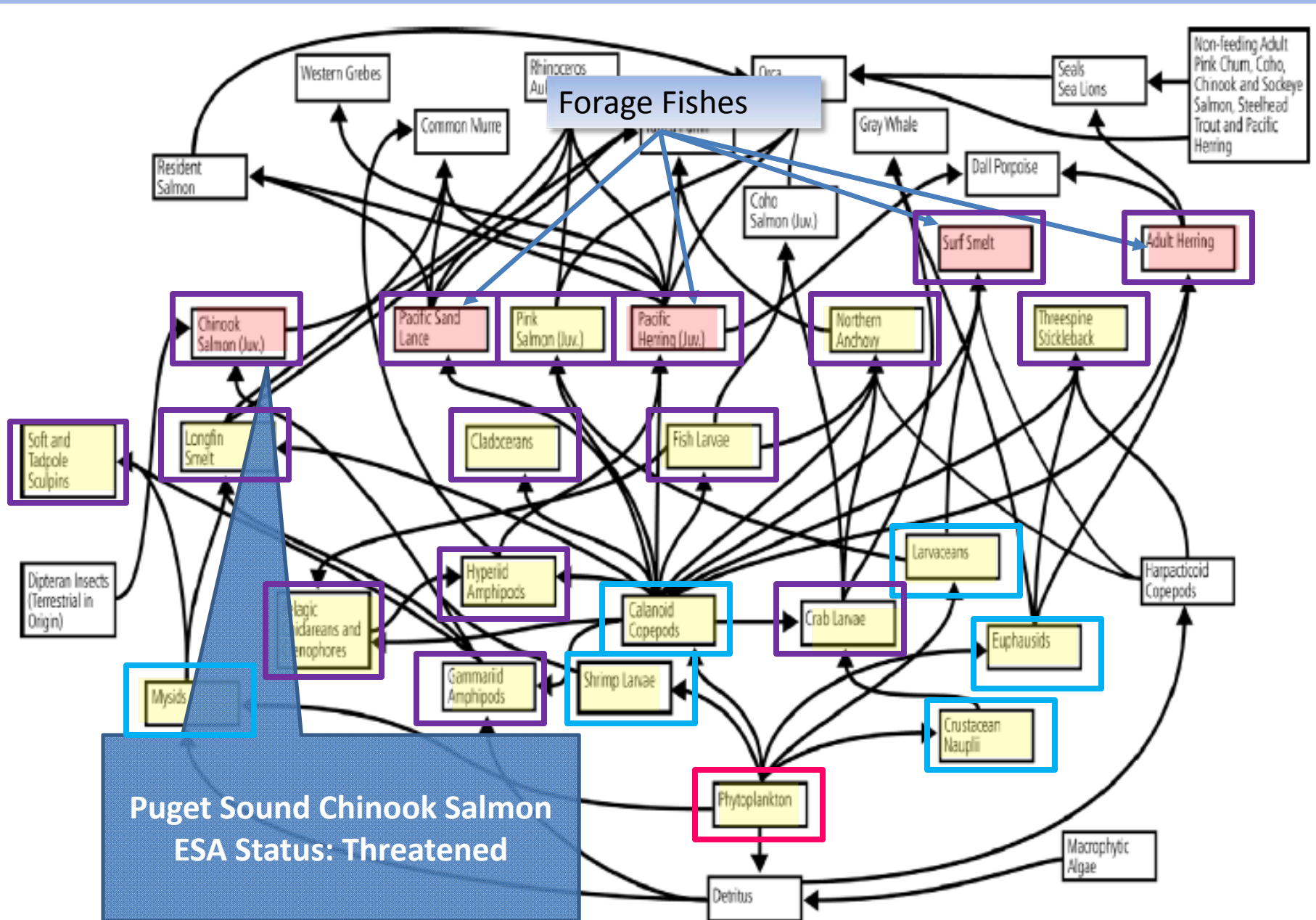


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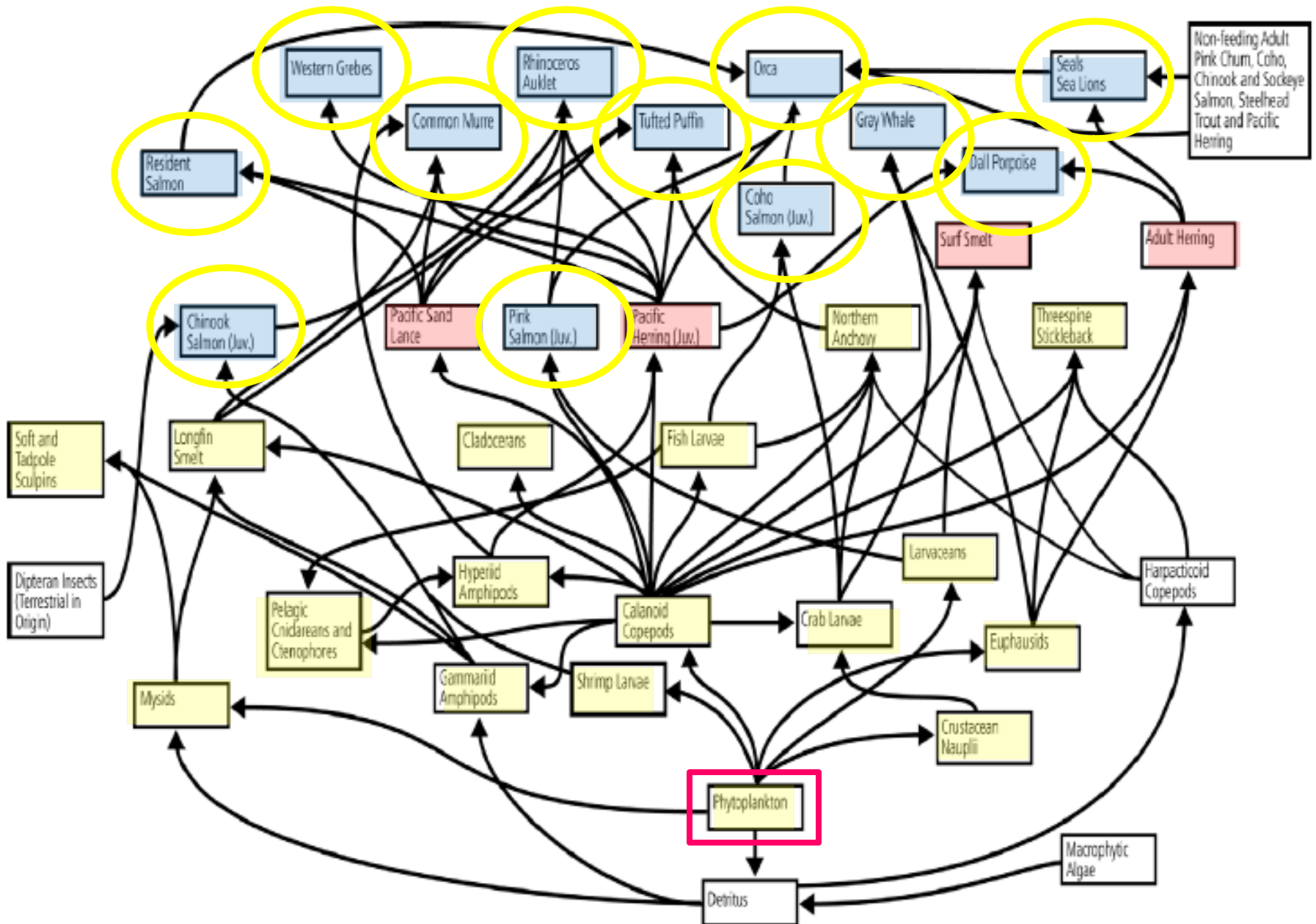


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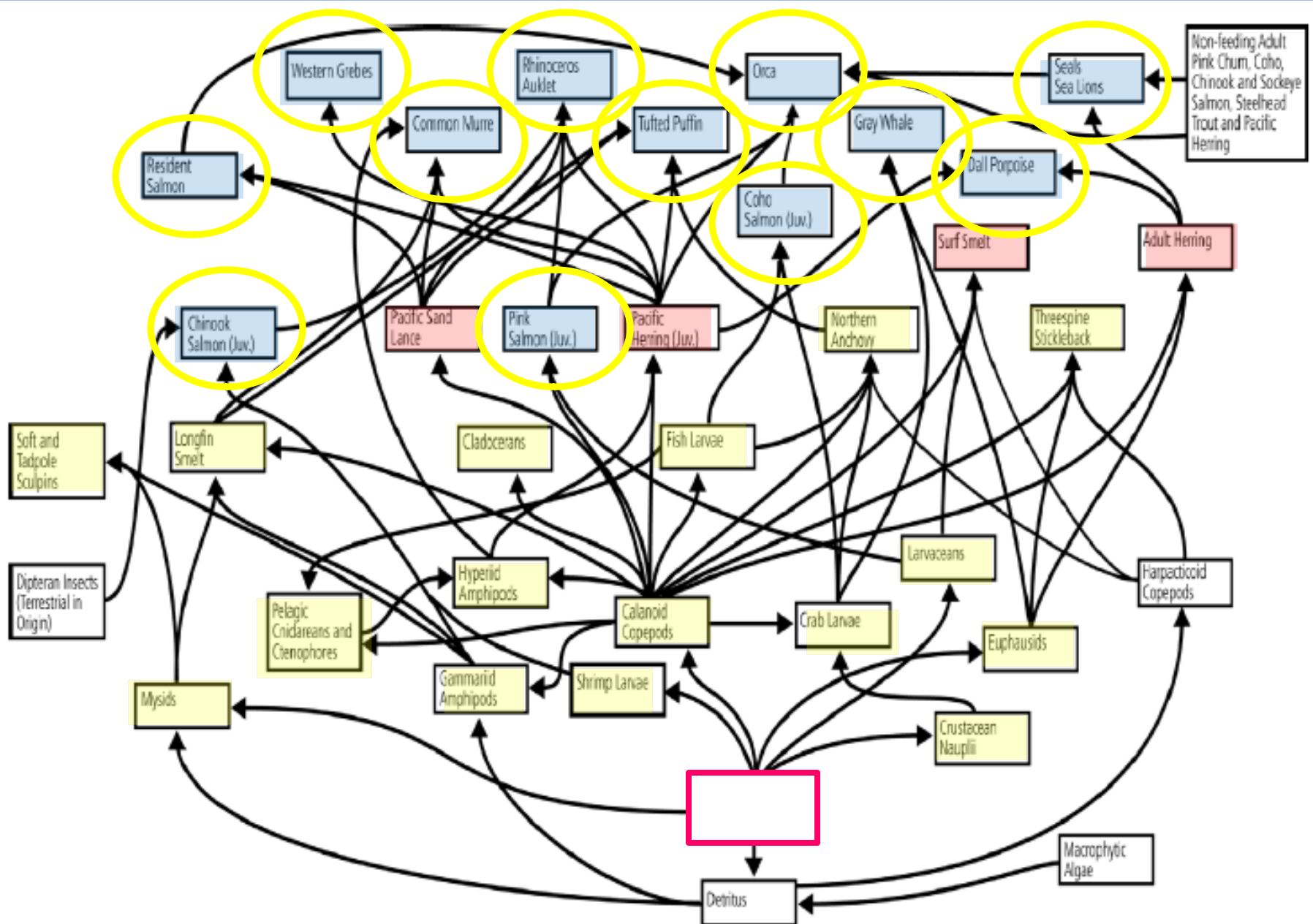


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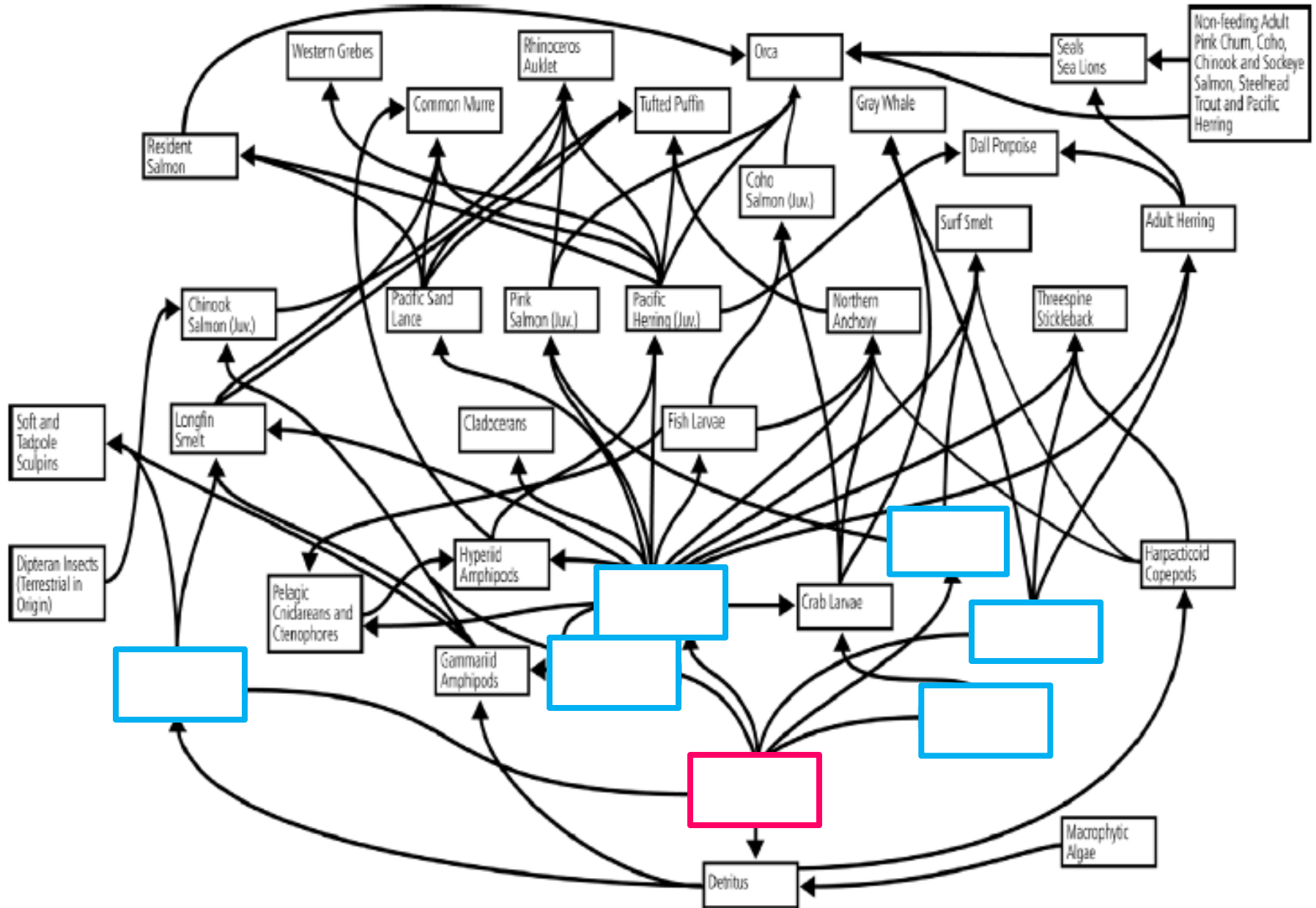


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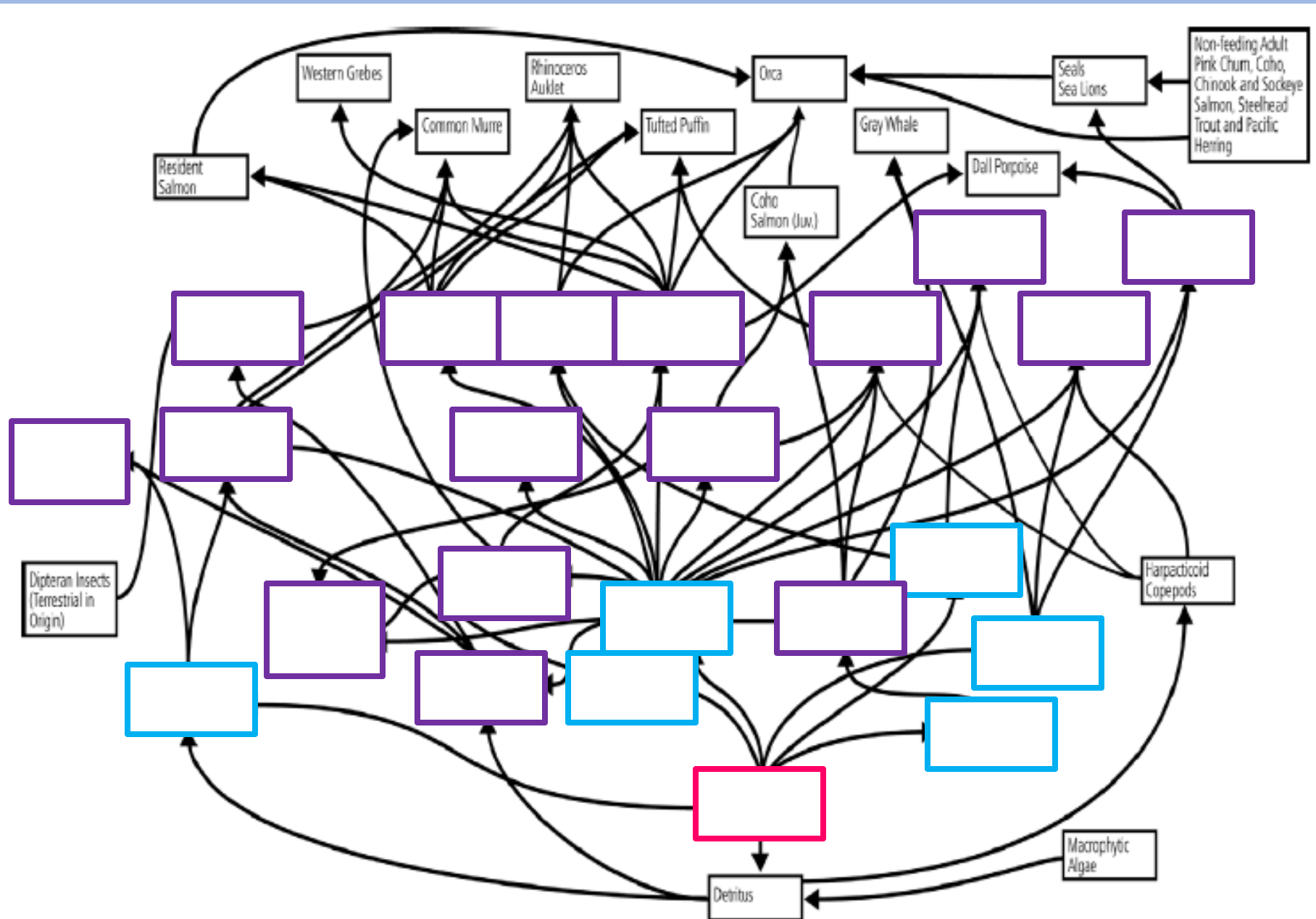


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I understand that the site at McMicken Island is some kind of test site. Is the DNR waiting until the tests are complete before doing the other leases?

# Adaptive Management

**Adaptive management** (AM), also known as adaptive resource management (ARM), is a structured, **iterative process** of optimal decision making in the face of **uncertainty**, with an aim to **reducing uncertainty over time via system monitoring**. In this way, decision making simultaneously maximizes one or more resource objectives and, either passively or actively, accrues information needed to improve future management. AM is often characterized as "**learning by doing**."

# Precautionary Principle

The **precautionary principle** is a moral and political principle which states that **if an action or policy might cause severe or irreversible harm to the public**, in the **absence** of a **scientific consensus that harm would not ensue**, the **burden of proof falls on those who would advocate taking the action**. It aims to provide guidance for **protecting** public health and the **environment** in the face of **uncertain risks**, stating that the absence of full scientific certainty shall not be used as a reason to postpone measures where there is a risk of serious or irreversible harm to public health or the environment.

## Adaptive versus Precautionary Risk

Is the risk of damaging the ESA “threatened” Chinook Salmon acceptable?

Is the risk of possible PVC pollution acceptable?

Is the loss of habitat for migratory birds worth the risk?

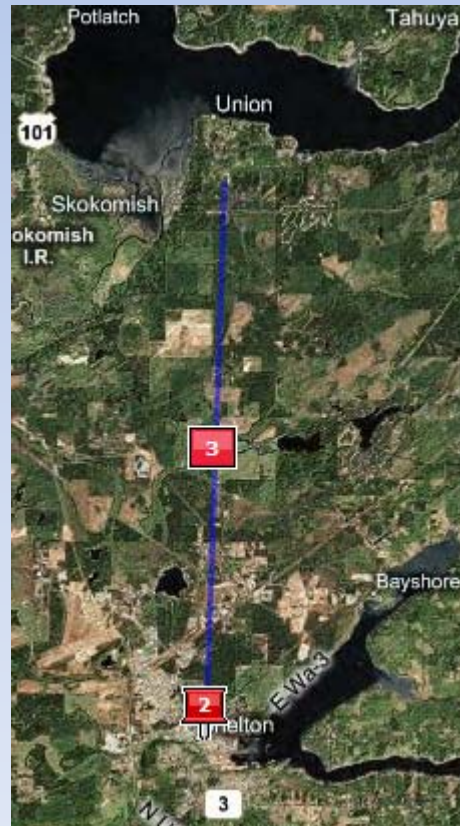
Etcetera

**What are the risks? We will not know until the science is done.**

Geoduck Aquaculture  
Plain Talk Analogies

# Interesting Analogies

- 1 acre of farm is equivalent to a beach 100' deep and 435 feet long (1.45 football fields)
- 43,500 PVC tubes placed end-to-end would be 8.5 miles long



## Interesting Analogies

- 43,500 4-inch PVC tubes have a total area (inside and outside) of 2.1 acres (same area as 60, 1,500 square foot homes)
- 37,000 6-inch PVC tubes have a total area (inside and outside) of 2.7 acres (same area as 77, 1,500 square foot homes)





## Interesting Analogies

- 1 acre of geoducks (ready for harvest) has the same biomass as 7,000, 20-pound salmon

