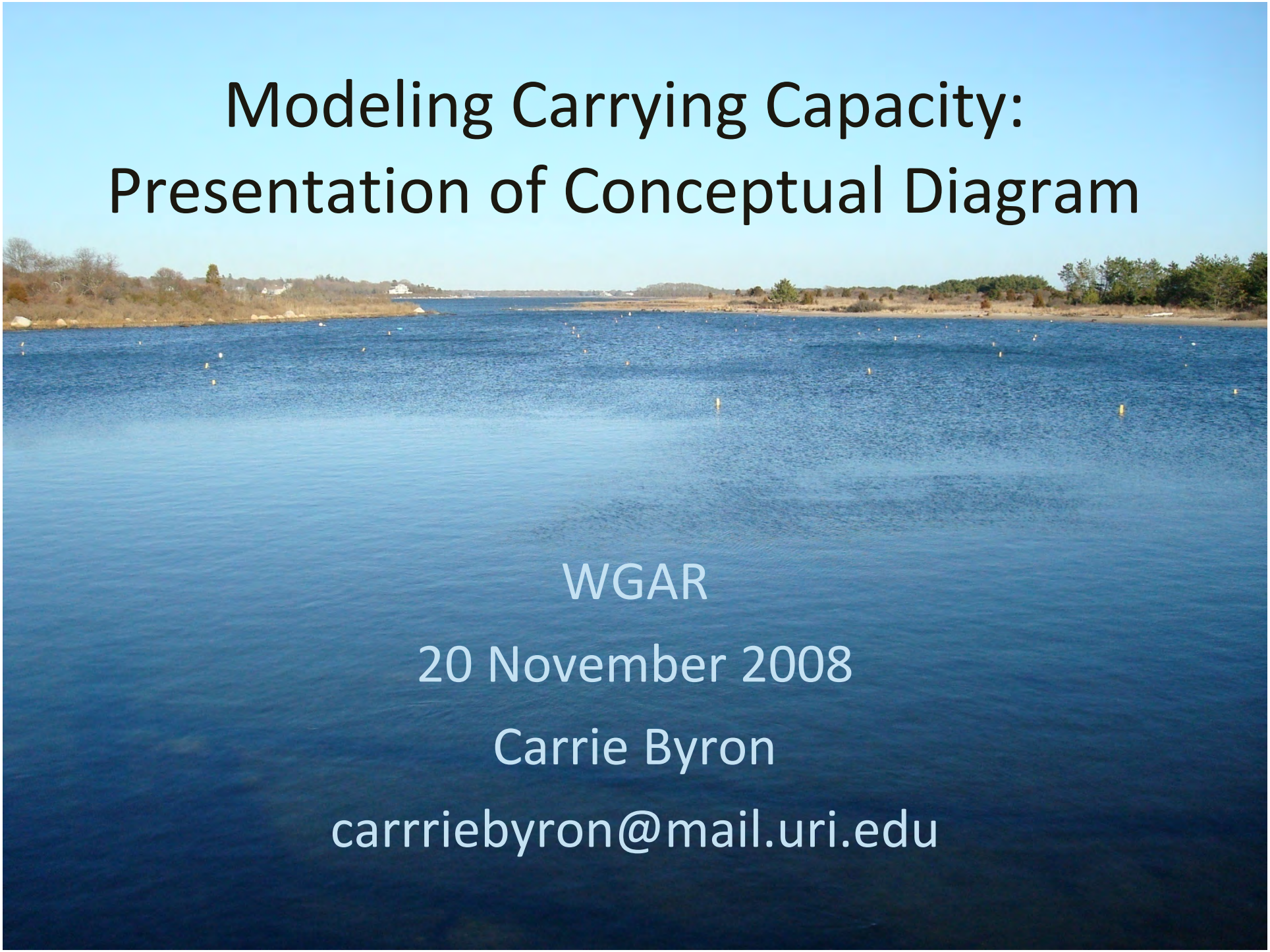
Modeling Carrying Capacity: Presentation of Conceptual Diagram

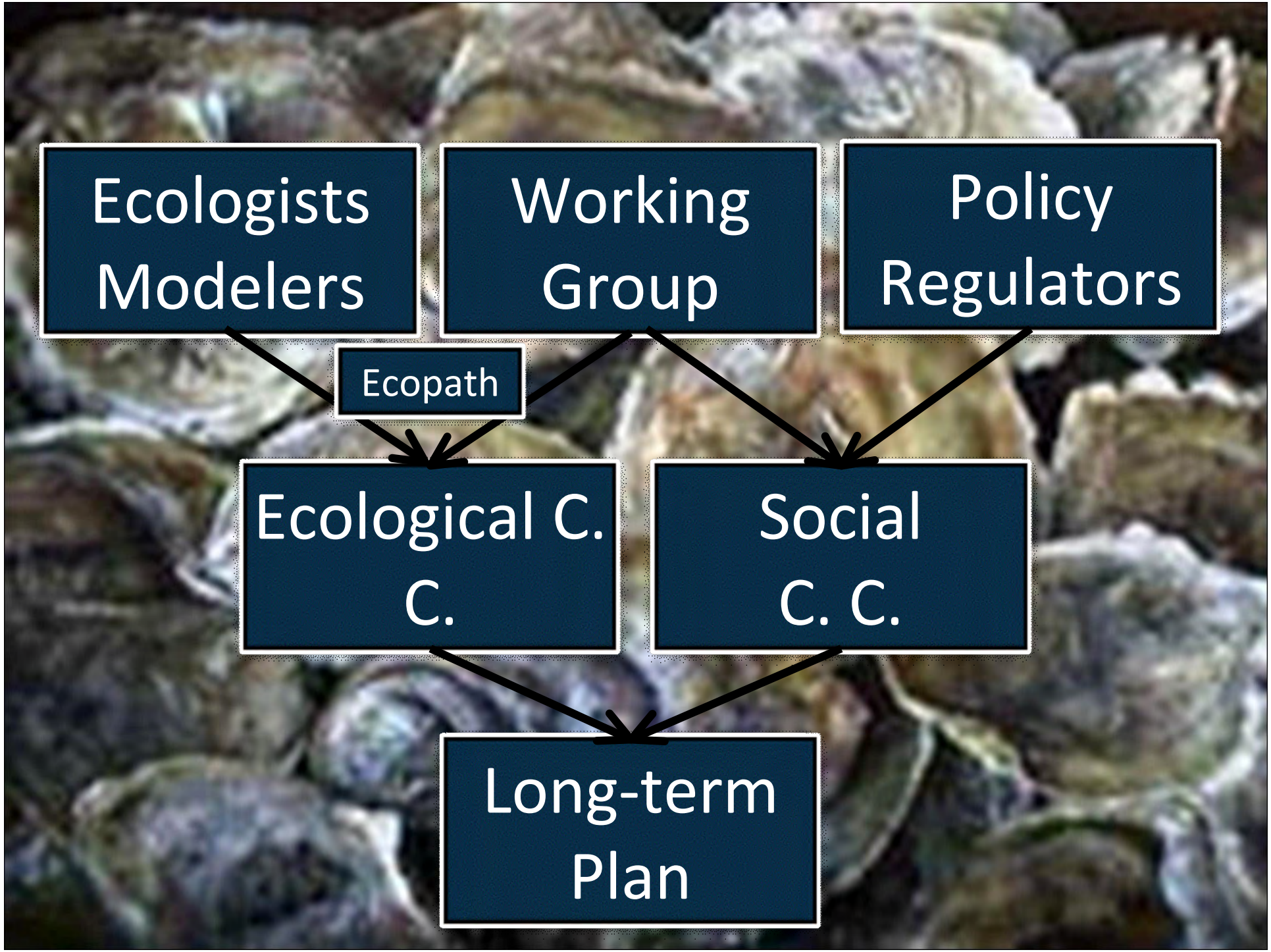


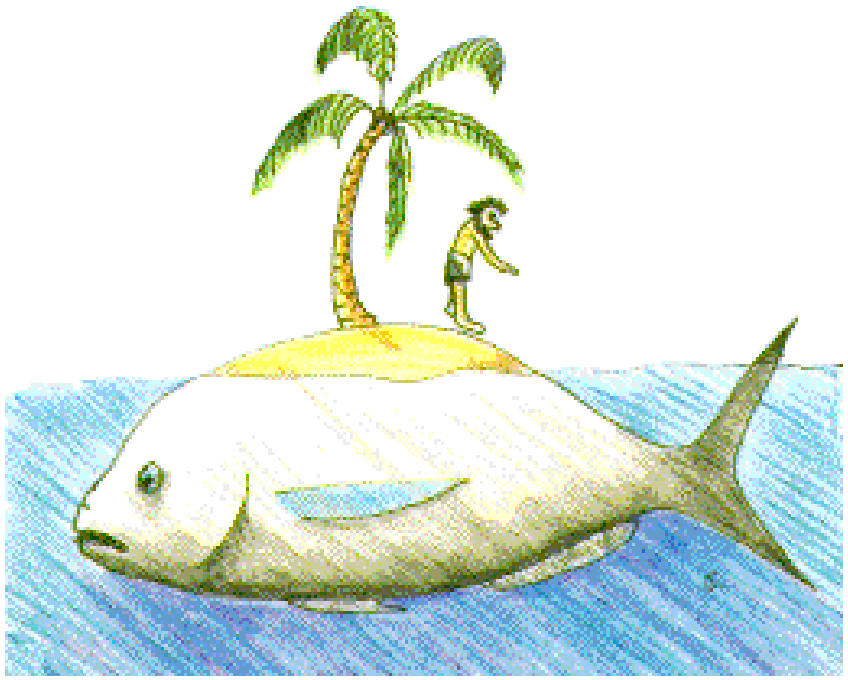
WGAR

20 November 2008

Carrie Byron

carrriebyron@mail.uri.edu


Ecologists Modelers
Working Group
Policy Regulators
Ecopath
Ecological C. C.
Social C. C.
Long-term Plan



No fish is an Island

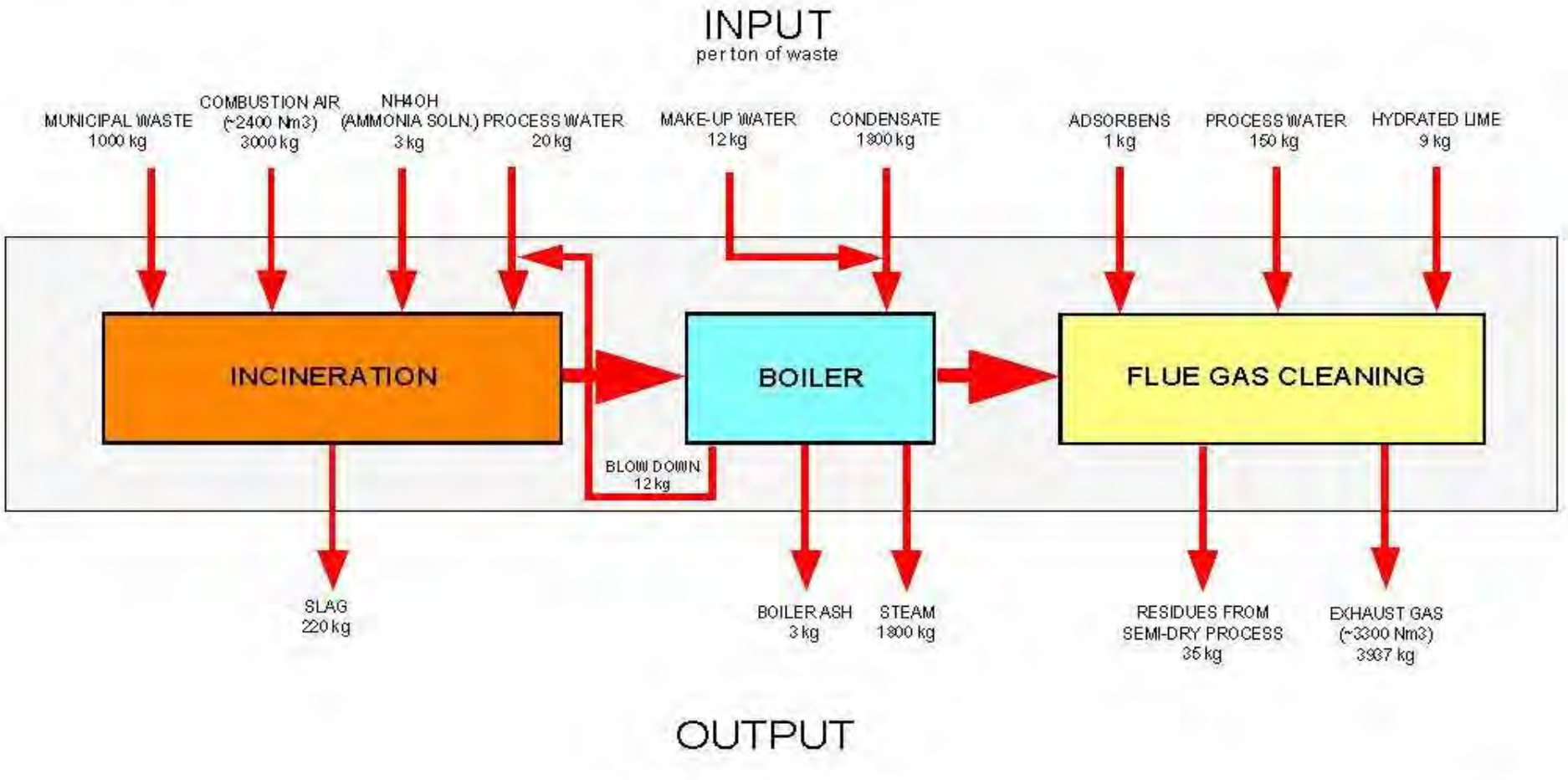
Ecopath

It signifies that all living organisms are linked together.
In the oceans, for example,
despite our great impact,
we are only one of many predators.
We must learn to behave responsibly in a realm
where we are the intruders.

www.ecopath.org

- Snapshot in time
- Food-web based
- Mass balance model

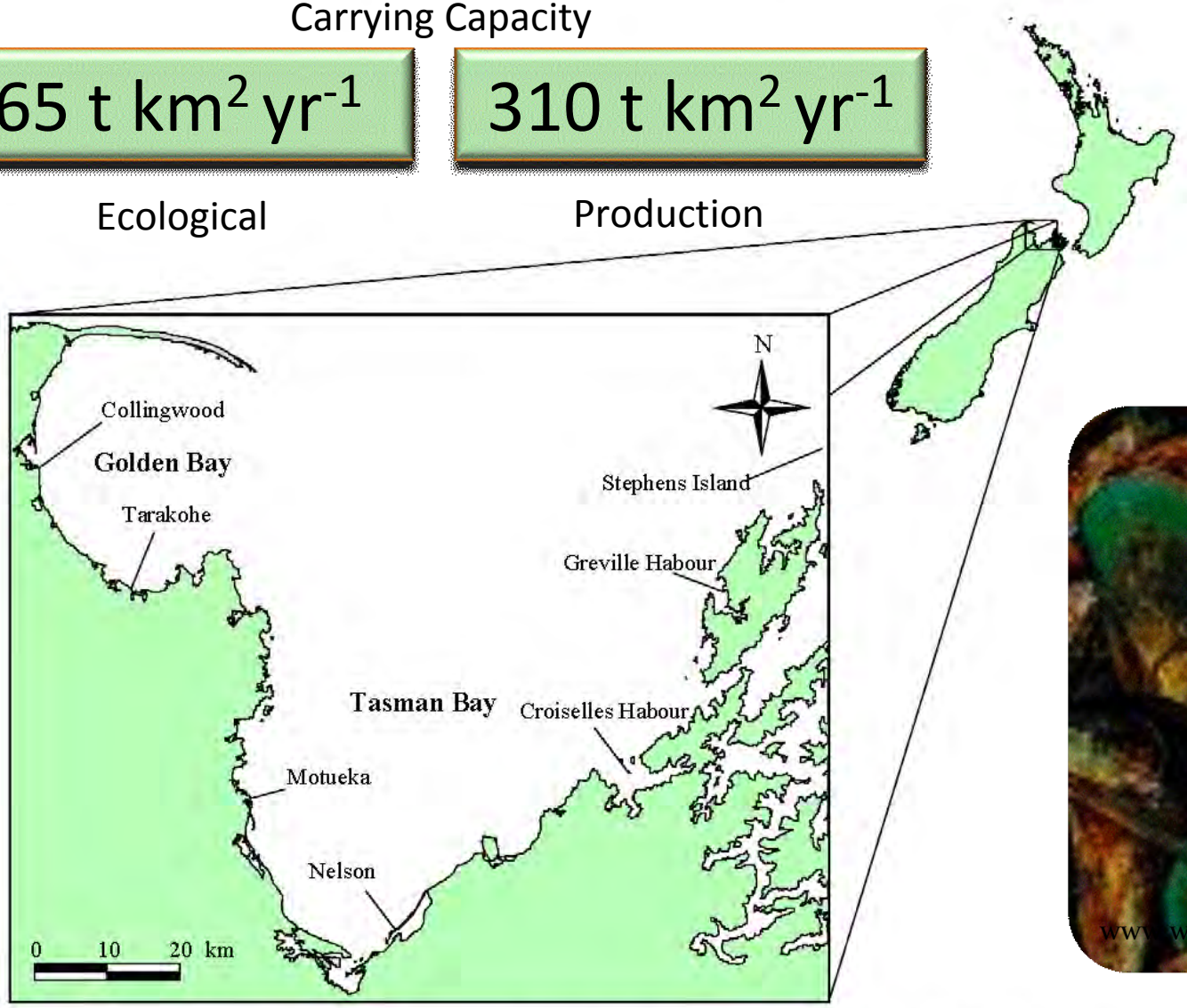
MASS BALANCE



ECOLING

Carrying Capacity

65 t km^2 yr^{-1}	310 t km^2 yr^{-1}
Ecological	Production



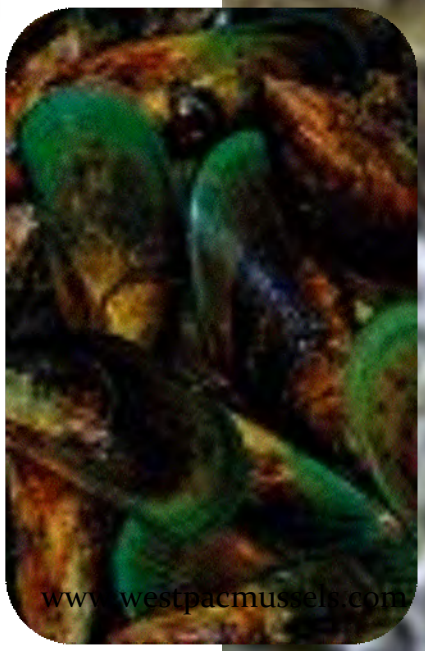
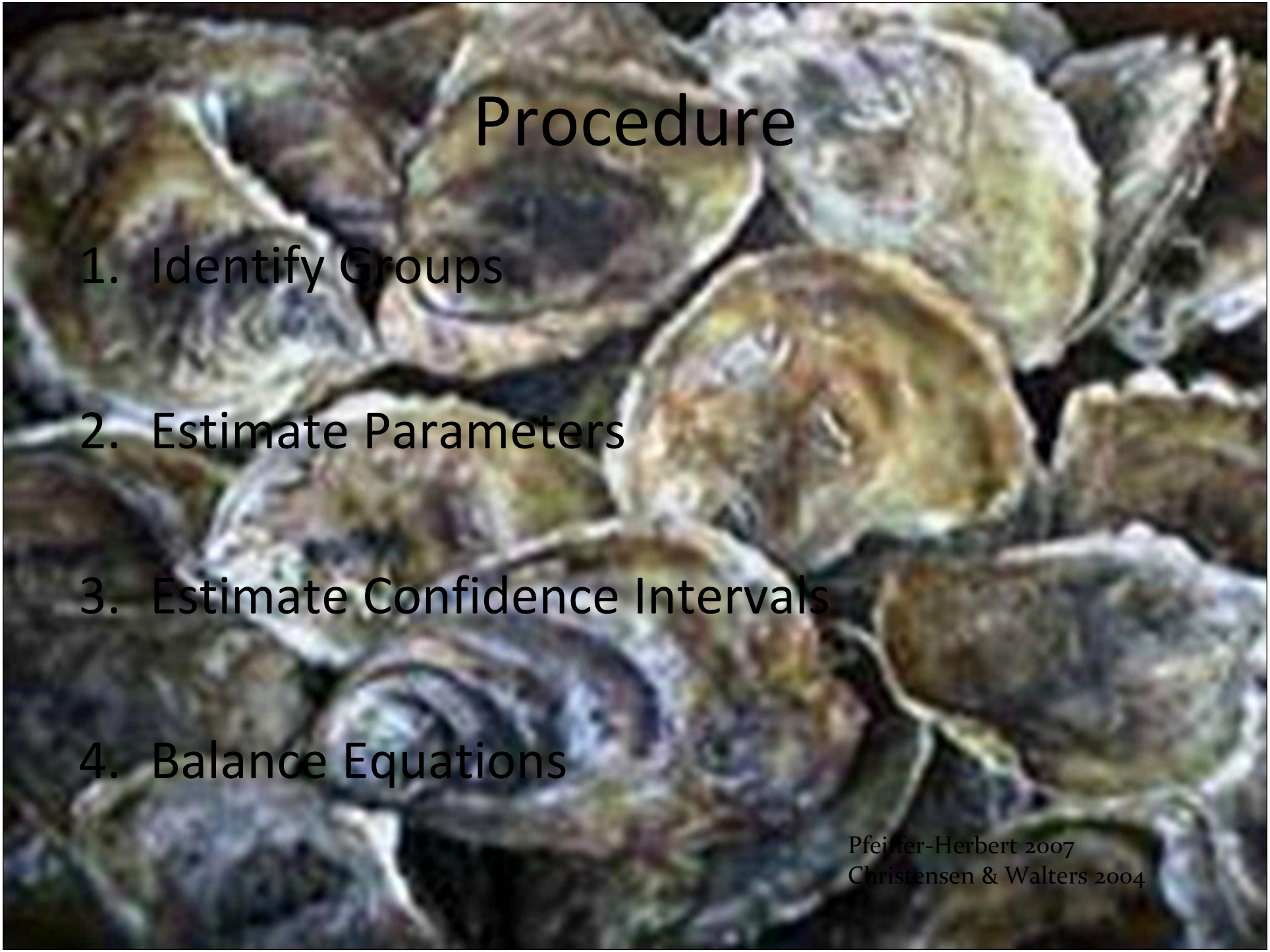


Fig. 1. Map showing Golden and Tasman Bays, northern end of the South Island of New Zealand.

Limit aquaculture to 5 percent of R.I. waters, experts say

Providence Journal Sunday, March 2, 2008

Journal file photo / Bill Murphy



Procedure

1. Identify Groups
2. Estimate Parameters
3. Estimate Confidence Intervals
4. Balance Equations

Pfeiffer-Herbert 2007
Christensen & Walters 2004

Monaco & Ulanowicz 1997

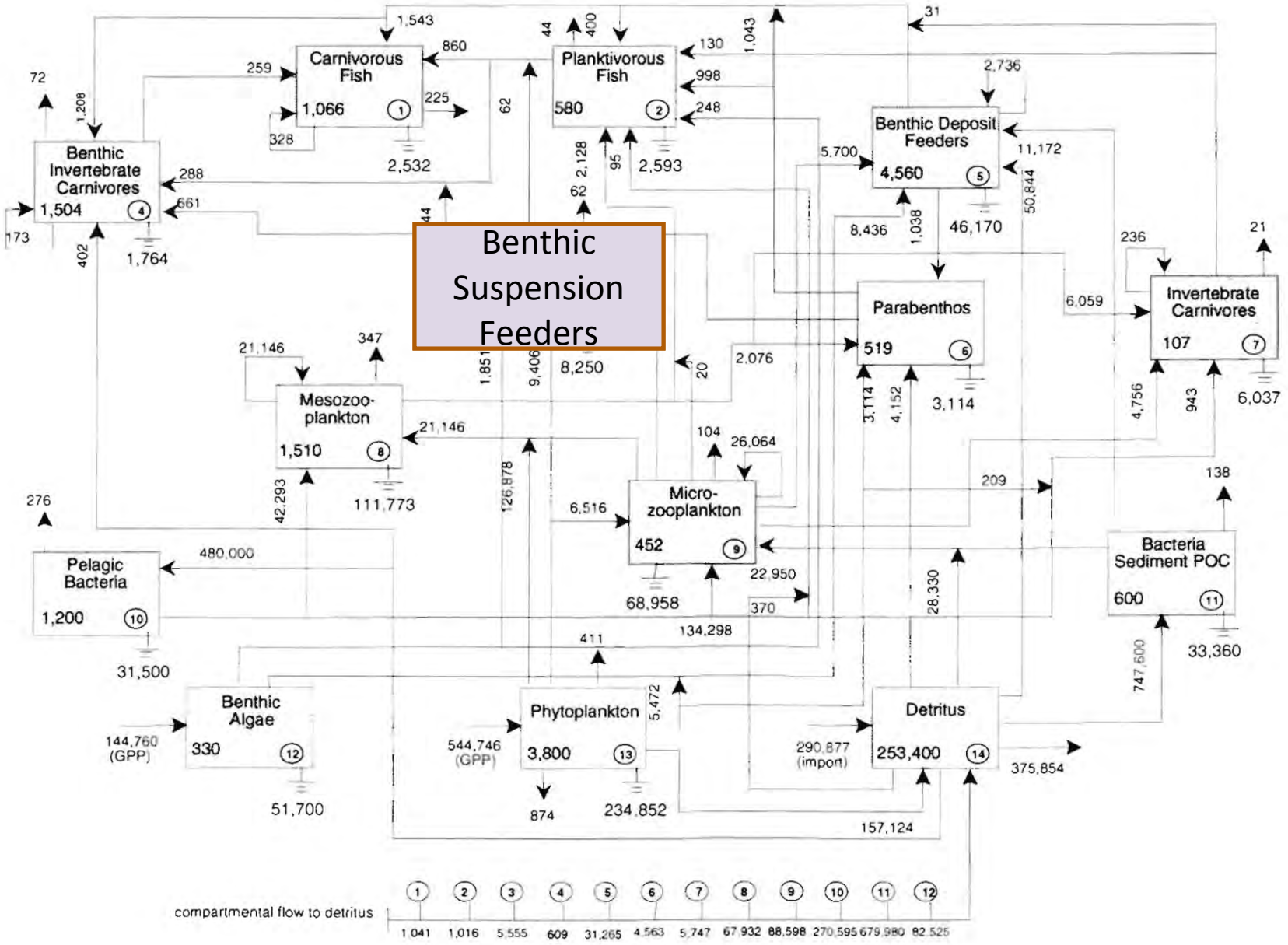
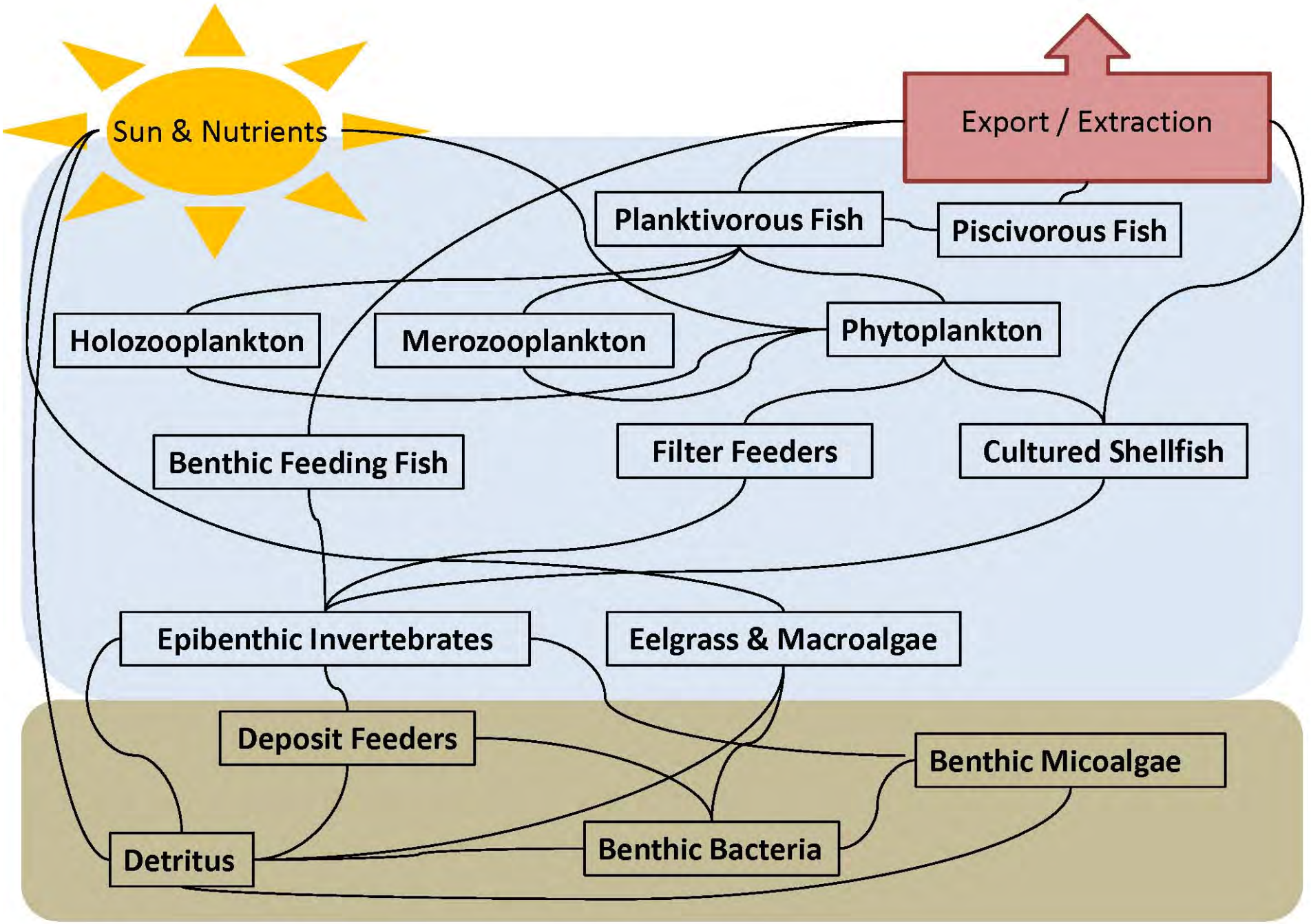
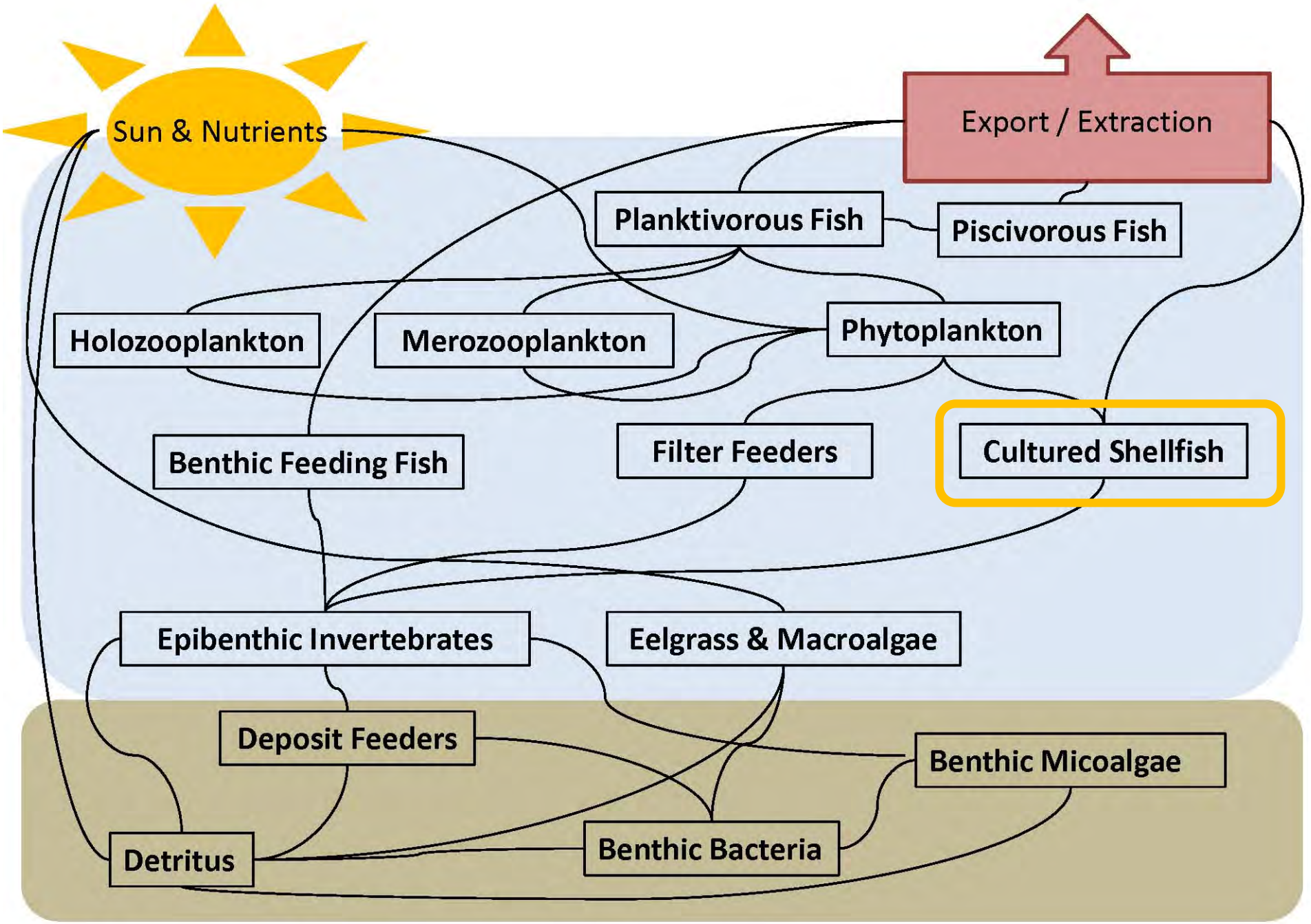


Fig. 2. Average annual energy flow (mg C m^{-2} yr^{-1}) and compartmental biomass (mg C m^{-2}) in Narragansett Bay


Sun & Nutrients
Export / Extraction
Planktivorous Fish
Piscivorous Fish
Holozooplankton
Merozooplankton
Phytoplankton
Benthic Feeding Fish
Filter Feeders
Cultured Shellfish
Epibenthic Invertebrates
Eelgrass & Macroalgae
Deposit Feeders
Benthic Micoalgae
Detritus
Benthic Bacteria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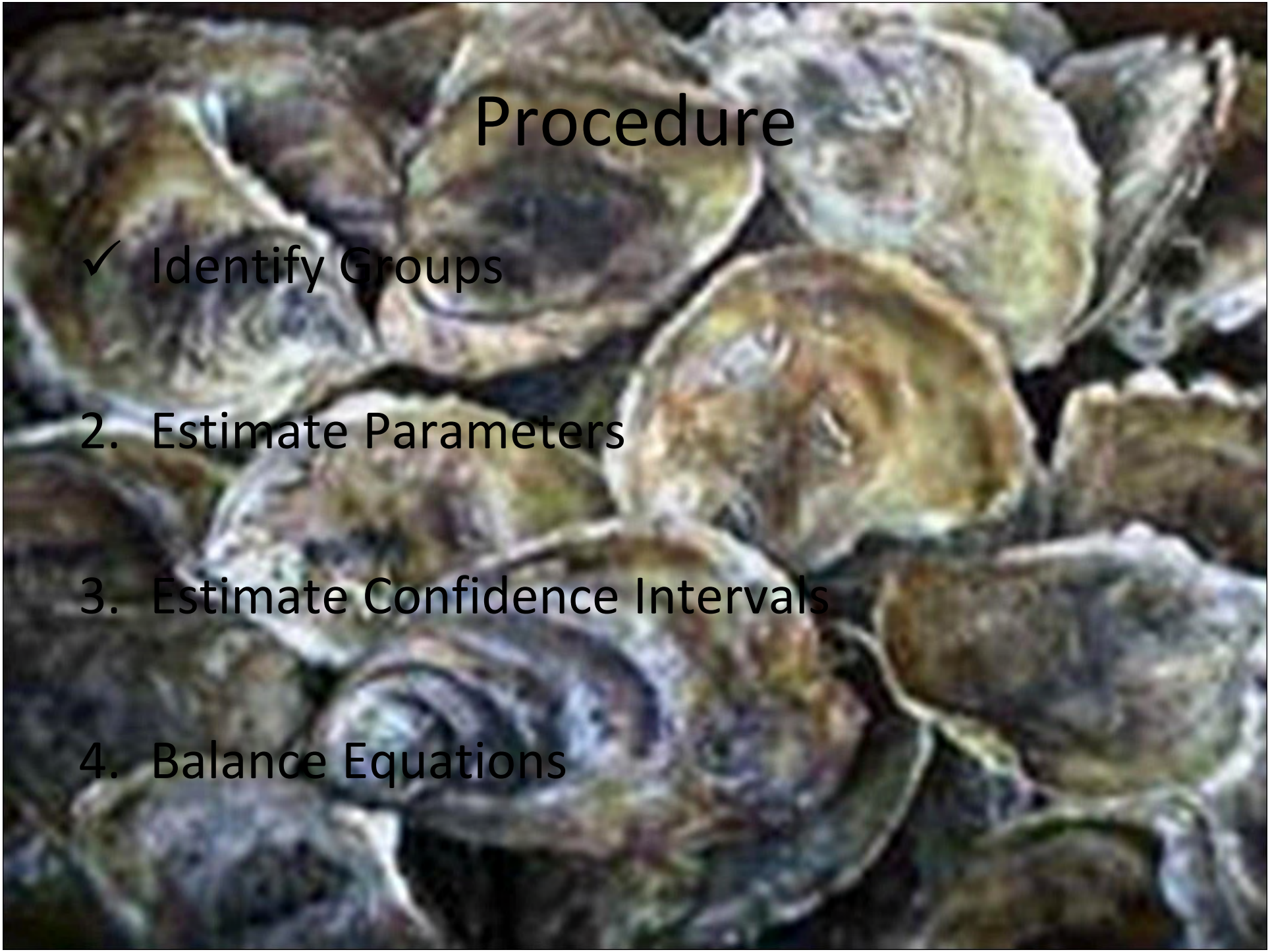
Deposit Feeders
Benthic Micoalgae
Detritus
Benthic Bacteria

Functional Group	Species Common Name
Detritus	
Benthic Microalgae	Diatoms, dianoflagellates, cyanobacteria
Benthic Bacteria	
Deposit Feeders	Polychaete Worms
	Benthic copepods
Eelgrass & Macroalgae	Eelgrass
	Red algae
	Green algae
Epibenthic Invertebrates	Crabs
	Grass shrimp
	Amphipods
	Juvenile lobster
	Mud snail
Benthic Feeding Fish	Tautog
	Cunner
	Black Sea Bass
	Scup
	Winter Flounder

Filter Feeders	Oysters
	Clam
	Slipper limpet
	Ascidians, Tunicates, Sea Squirts
	Clam
	Annelid worms
Cultured Oysters	Oysters
Phytoplankton	
Holozooplankton	Pelagic Copepods
Merozooplankton	Crustacean larvae (Nauplii)
	Bivalve larvae
	Fish larvae
Planktivorous Fish	Silversides
	Menhaden
	Mummichog
	Striped Kilifish
	Sheepshead Minnows
	Ctenophores
	Lions Mane Jelly
Piscivorous Fish	Bluefish
	Striped bass



Procedure

- ✓ Identify Groups

2. Estimate Parameters

3. Estimate Confidence Intervals

4. Balance Equations

2. Parameters

1. Biomass
2. .
3. .
4. .
5. .
6. .
7. .
8. .
9. .

2. Parameters

1. Biomass
2. Production/biomass ratio
3. .
4. .
5. .
6. .
7. .
8. .
9. .

2. Parameters

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2. Production/biomass ratio
3. Consumption/biomass ratio
4. .
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2. Parameters

1. Biomass
2. Production/biomass ratio
3. Consumption/biomass ratio
4. Ecotrophic efficiency
5. .
6. .
7. .
8. .
9. .

2. Parameters

1. Biomass
2. Production/biomass ratio
3. Consumption/biomass ratio
4. Ecotrophic efficiency
5. Catch rate
6. .
7. .
8. .
9. .

2. Parameters

1. Biomass
2. Production/biomass ratio
3. Consumption/biomass ratio
4. Ecotrophic efficiency
5. Catch rate
6. Net migration rate into pond
7. .
8. .
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2. Parameters

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2. Production/biomass ratio
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2. Production/biomass ratio
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4. Ecotrophic efficiency
5. Catch rate
6. Net migration rate into pond
7. Biomass accumulation rate
8. Food assimilation rate
9. .

2. Parameters

1. Biomass
2. Production/biomass ratio
3. Consumption/biomass ratio
4. Ecotrophic efficiency
5. Catch rate
6. Net migration rate into pond
7. Biomass accumulation rate
8. Food assimilation rate
9. Diet composition

2. Parameters

1. **Biomass**
2. **Production/biomass ratio**
3. **Consumption/biomass ratio**
4. Ecotrophic efficiency
5. Catch rate
6. Net migration rate into pond
7. Biomass accumulation rate
8. Food assimilation rate
9. **Diet composition**

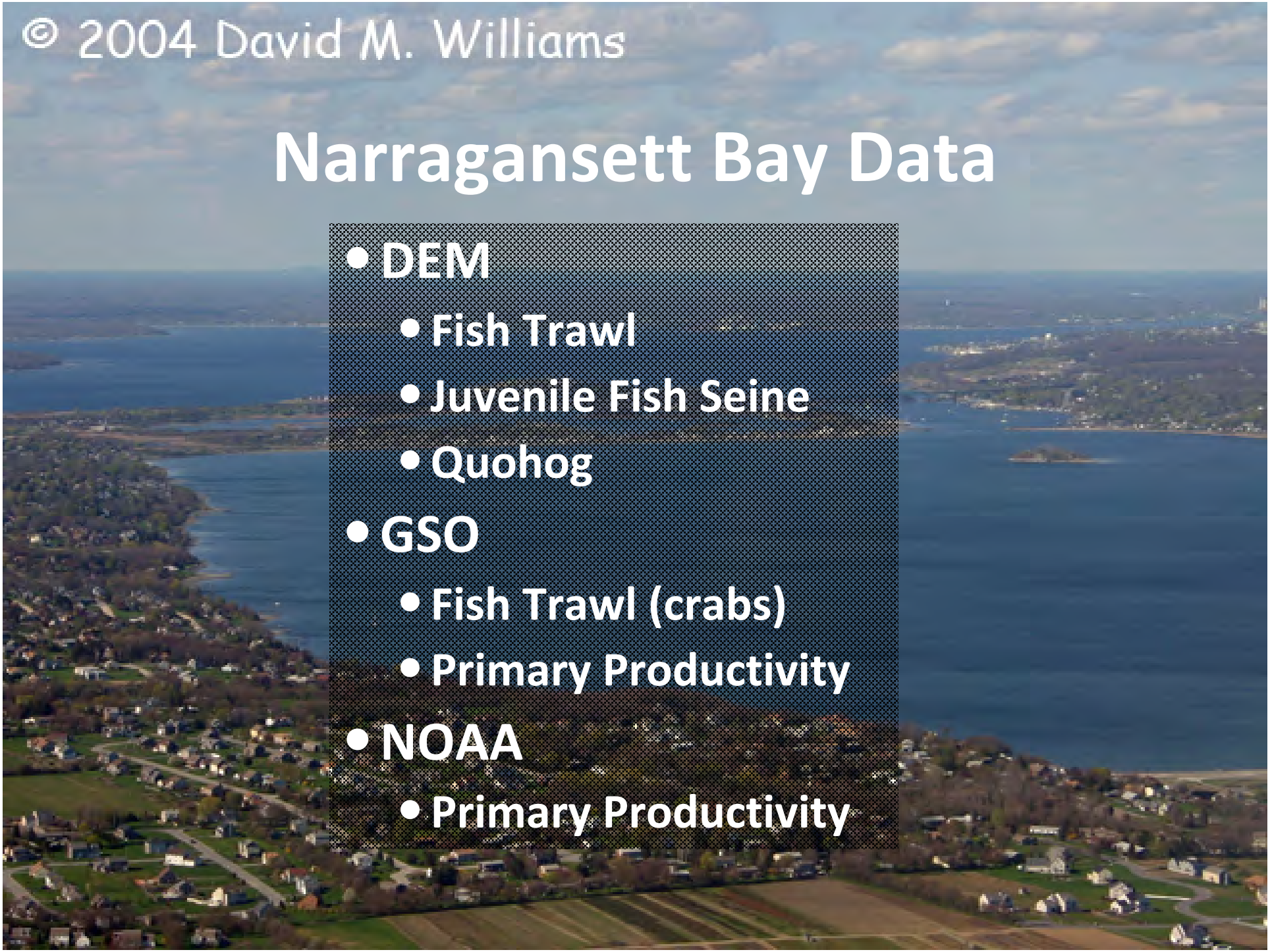
Pond Data

- Peer Review Literature
  - Macro-algae
  - Eelgrass
  - Productivity
  - Physical
  - Flushing rates

www.pubs.usgs.gov
www.horta.uac.pt
www.cybercolloids.net
www.solpugid.com/cabiota/ulva_lobata.jpg

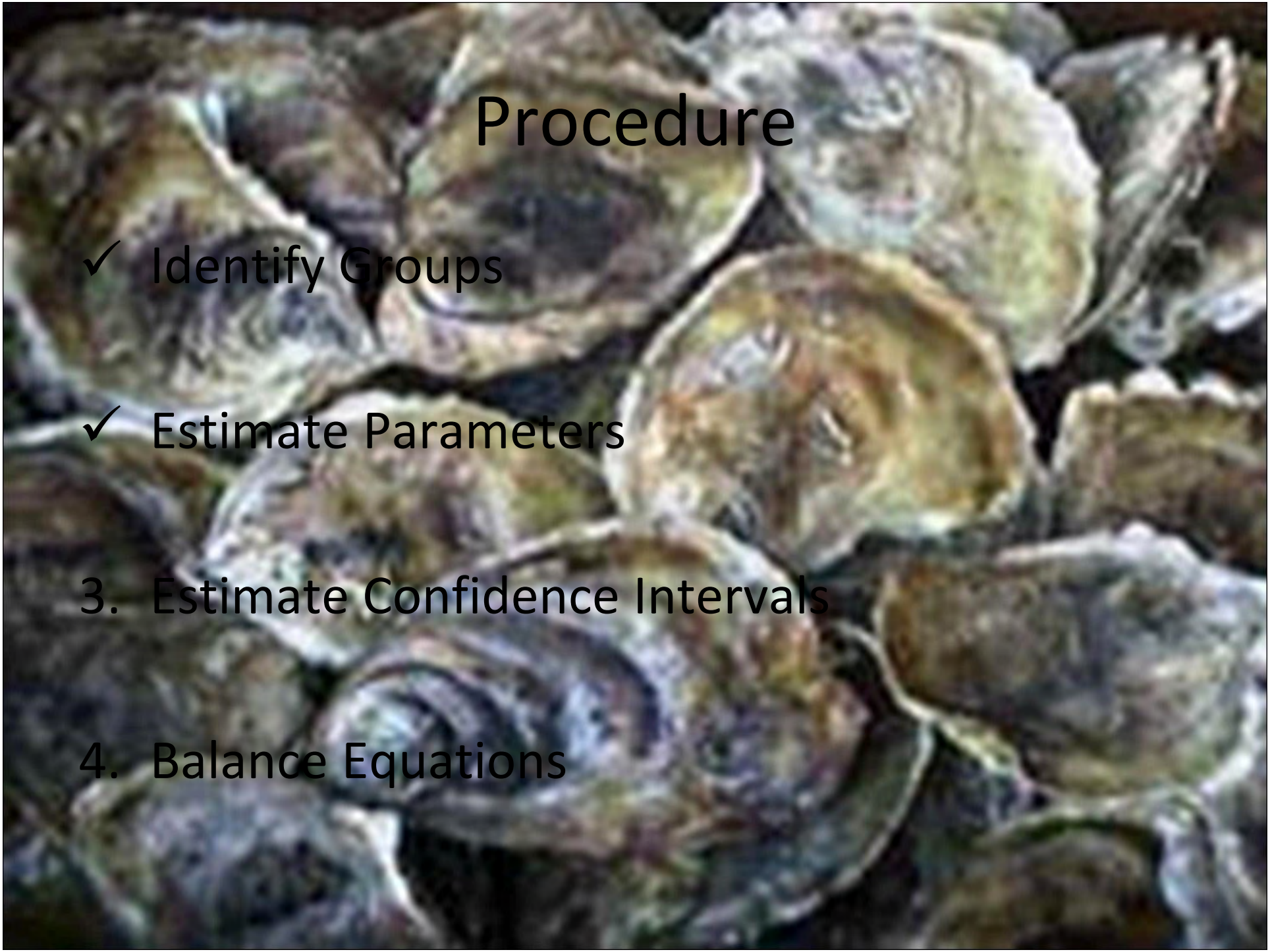
Pond Data

- DEM
  - Larval fish : Quonnie, Pt. Judith, Ninigret, Winnapaug
  - Finfish : Quonnie, Pt. Judith & Potters
  - Shellfish : RI aquaculture, Narr Bay Quohogs
- Pond Watchers
  - Primary Productivity
- RI South Shore Sea Grant Project
  - Physical
- MapCoast
  - Habitat



Narragansett Bay Data

- DEM
  - Fish Trawl
  - Juvenile Fish Seine
  - Quohog
- GSO
  - Fish Trawl (crabs)
  - Primary Productivity
- NOAA
  - Primary Productivity

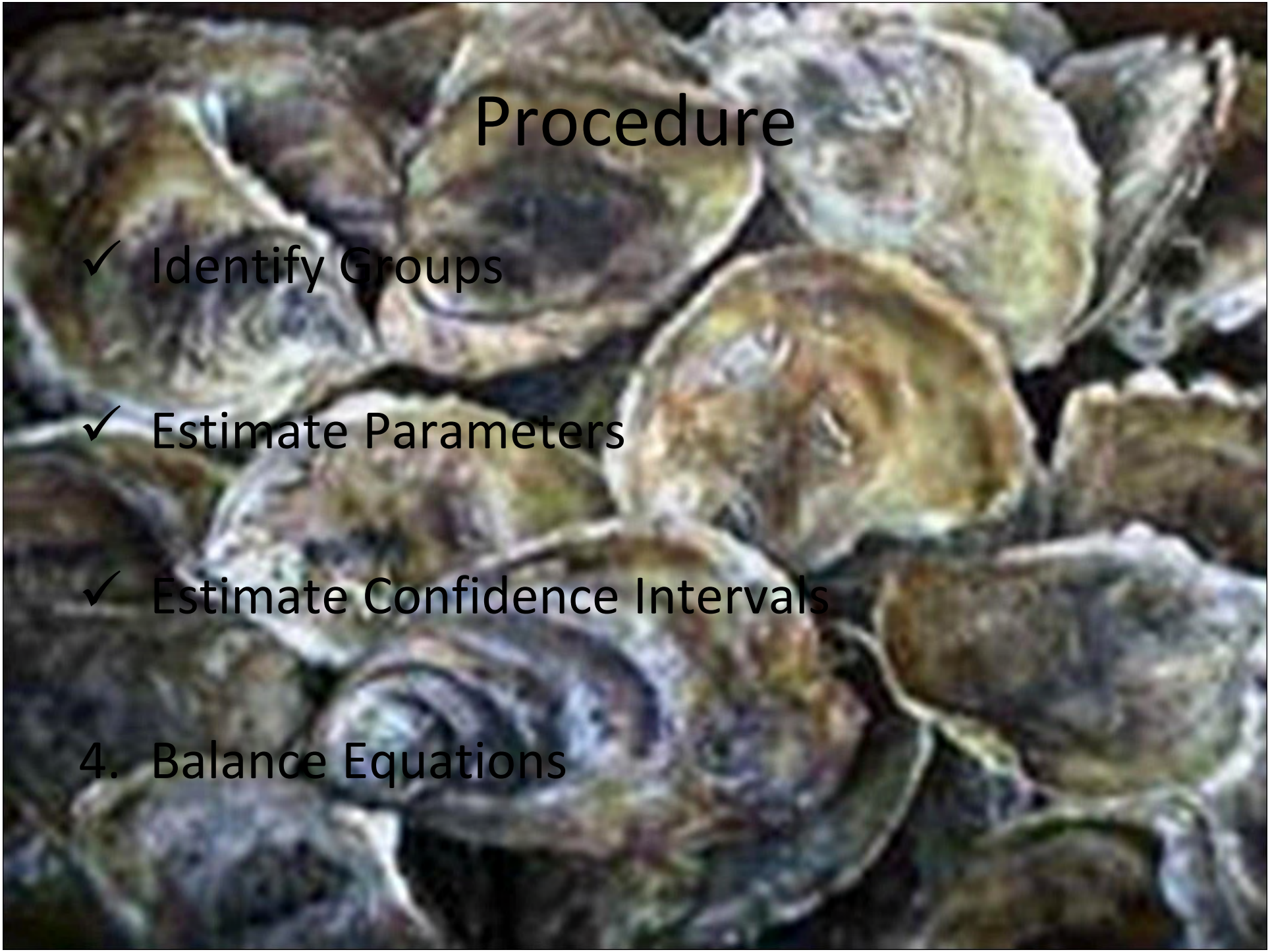


Procedure

- ✓ Identify Groups
- ✓ Estimate Parameters

3. Estimate Confidence Intervals

4. Balance Equations



Procedure

- ✓ Identify Groups
- ✓ Estimate Parameters
- ✓ Estimate Confidence Intervals

4. Balance Equations

4. Balance Equations

Production =

predation

+fishery

+ other mortality

+ biomass accum.

+ net migration

4. Balance Equations

Production =

predation

+fishery

+ other mortality

+ biomass accum.

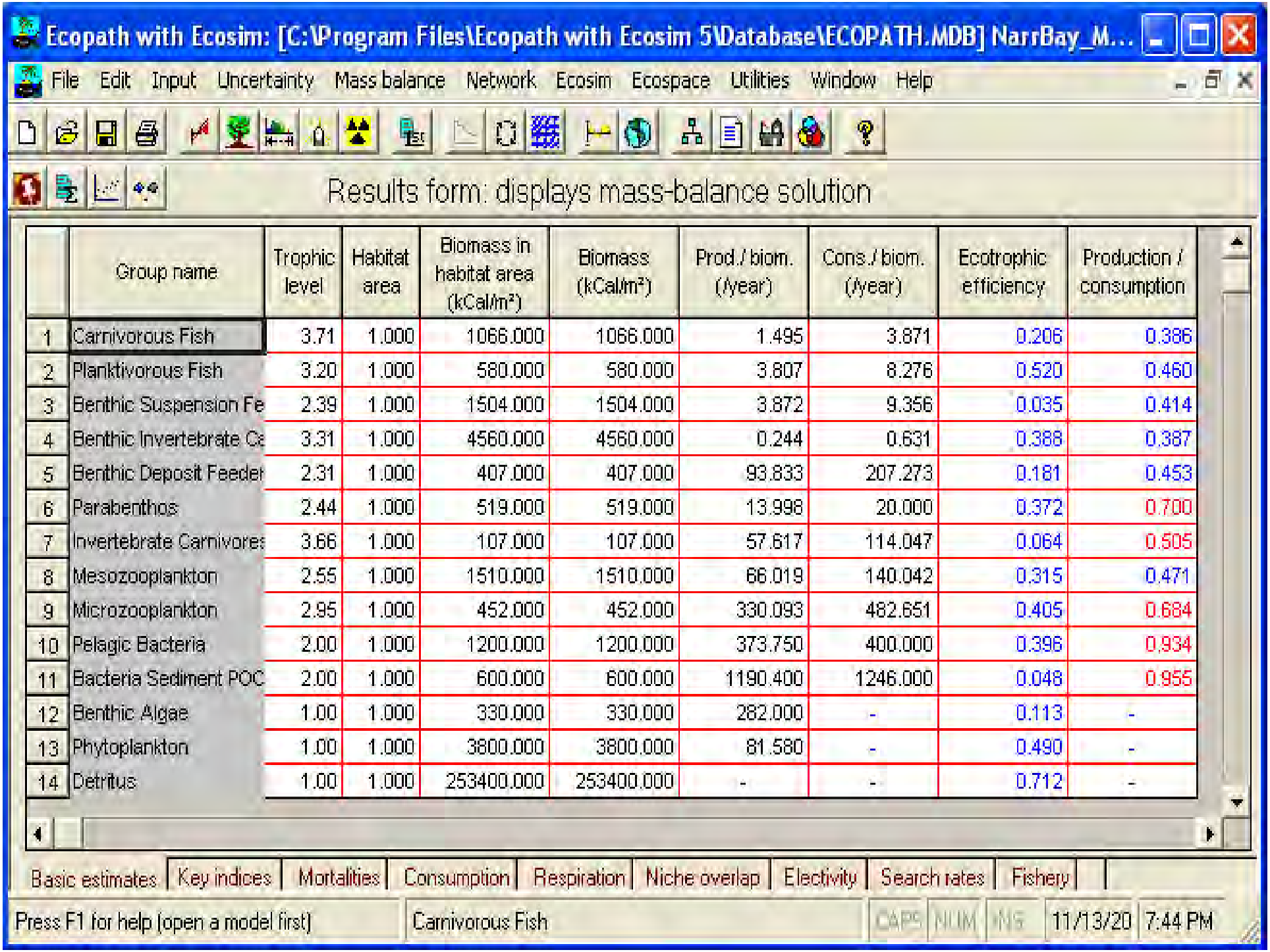
+ net migration

Consumption =

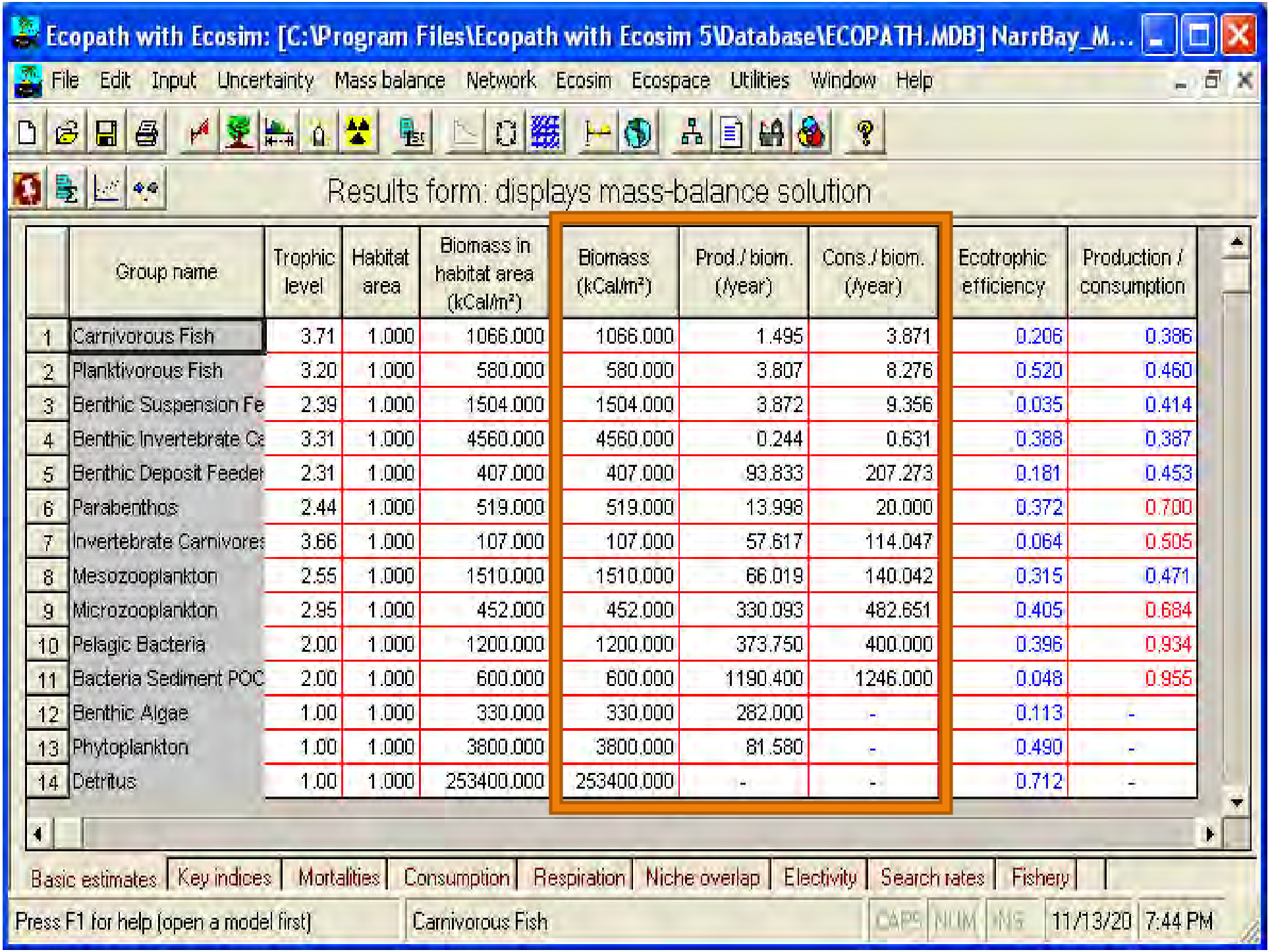
production

+ unassimilated food

+ respiration



	Group name	Trophic level	Habitat area	Biomass in habitat area (kCal/m²)	Biomass (kCal/m²)	Prod./ biom. (/year)	Cons./ biom. (/year)	Ecotrophic efficiency	Production / consumption
1	Carnivorous Fish	3.71	1.000	1066.000	1066.000	1.495	3.871	0.206	0.386
2	Planktivorous Fish	3.20	1.000	580.000	580.000	3.807	8.276	0.520	0.460
3	Benthic Suspension Fe	2.39	1.000	1504.000	1504.000	3.872	9.356	0.035	0.414
4	Benthic Invertebrate Ca	3.31	1.000	4560.000	4560.000	0.244	0.631	0.388	0.387
5	Benthic Deposit Feeder	2.31	1.000	407.000	407.000	93.833	207.273	0.181	0.453
6	Parabenthos	2.44	1.000	519.000	519.000	13.998	20.000	0.372	0.700
7	Invertebrate Carnivores	3.66	1.000	107.000	107.000	57.617	114.047	0.064	0.505
8	Mesozooplankton	2.55	1.000	1510.000	1510.000	66.019	140.042	0.315	0.471
9	Microzooplankton	2.95	1.000	452.000	452.000	330.093	482.651	0.405	0.684
10	Pelagic Bacteria	2.00	1.000	1200.000	1200.000	373.750	400.000	0.396	0.934
11	Bacteria Sediment POC	2.00	1.000	600.000	600.000	1190.400	1246.000	0.048	0.955
12	Benthic Algae	1.00	1.000	330.000	330.000	282.000	-	0.113	-
13	Phytoplankton	1.00	1.000	3800.000	3800.000	81.580	-	0.490	-
14	Detritus	1.00	1.000	253400.000	253400.000	-	-	0.712	-



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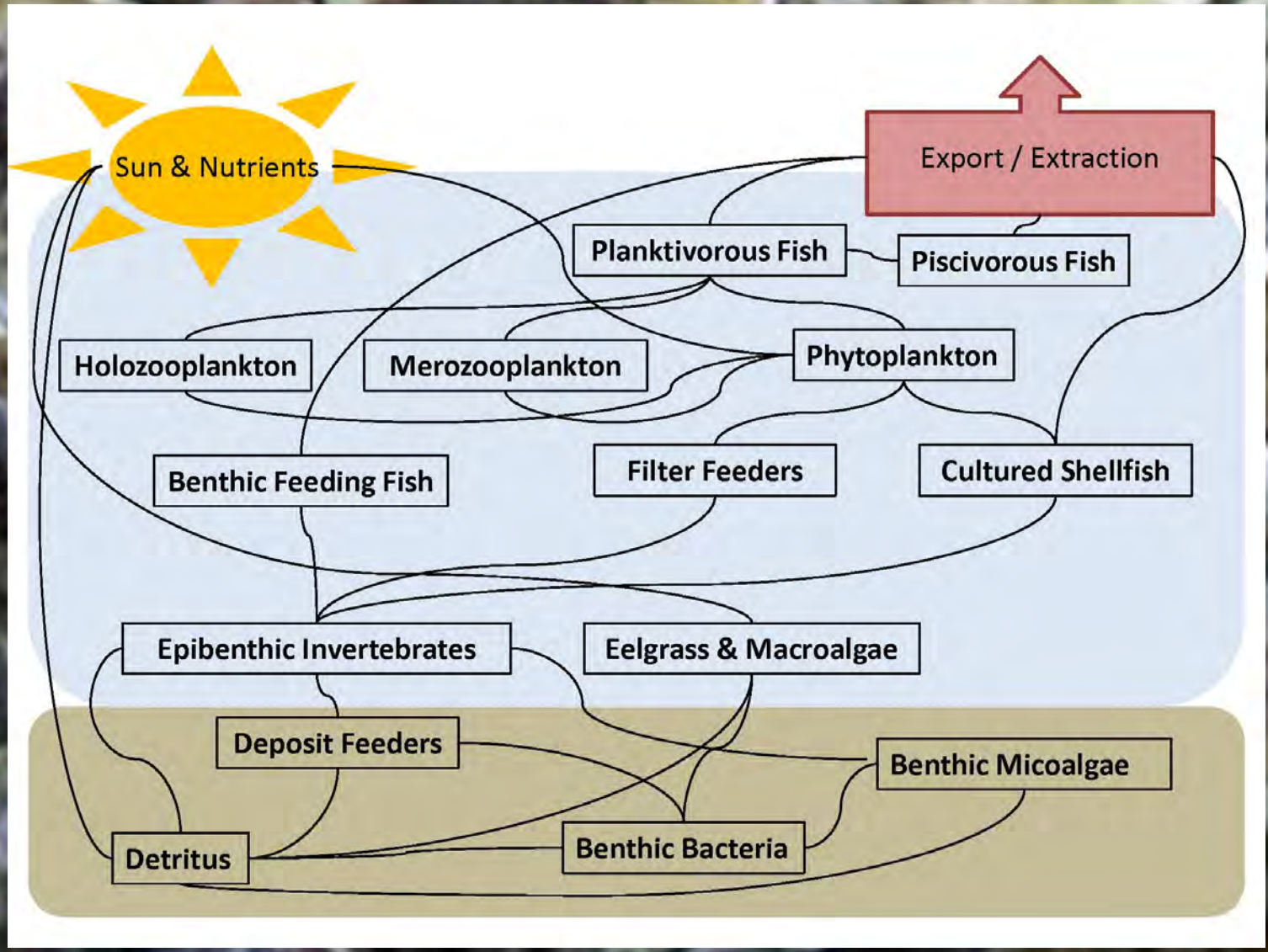
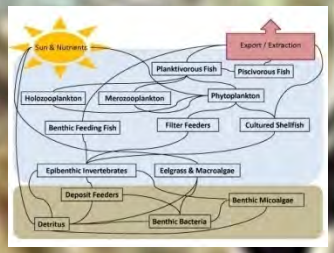
Calculate Carrying Capacity



Modelers will present the..

1. conceptual food-web diagram



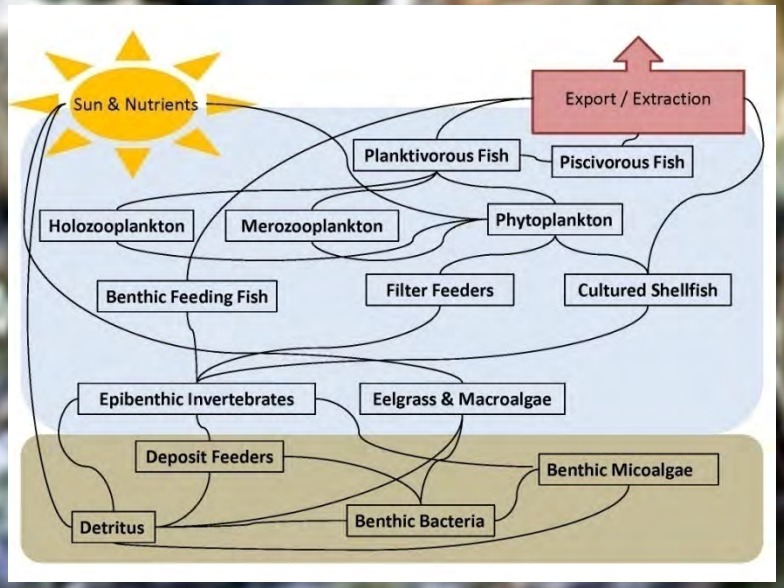
2. sources of data used for parameter inputs to the model

3. balanced and validated model

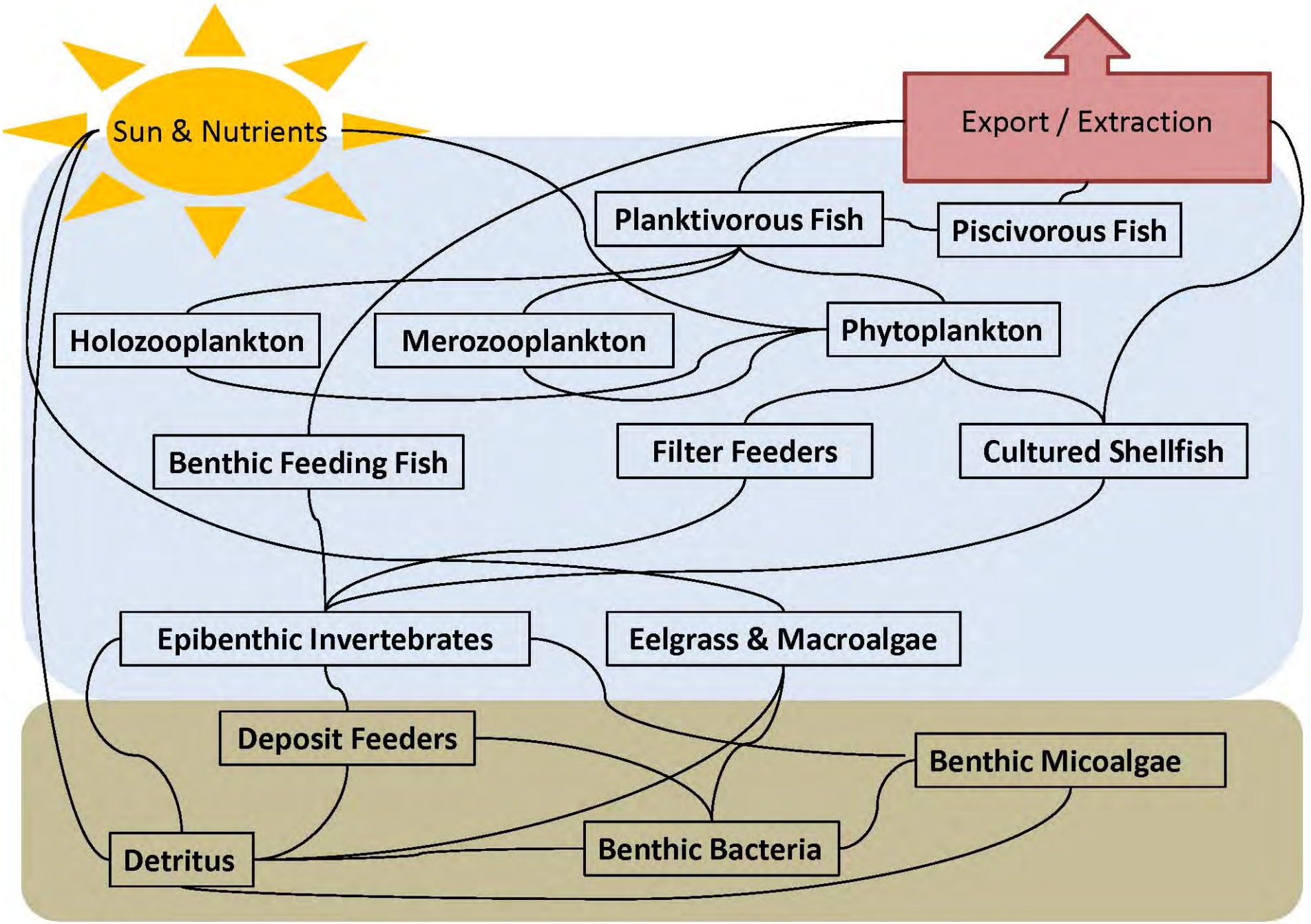
4. ecological carrying capacity

Questions

- Point of clarification
- Discussion on conceptual diagram



- Other comments/concerns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