Rhode Island's 5% rule for coastal pond aquaculture

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What is the 5% rule?

- Section 300.11, Aquaculture, of the Rhode Island Coastal Management Program:
- One of the Prohibitions is:

"*In the coastal salt ponds the area occupied by aquaculture shall not exceed five percent (5%) of the total open water surface area of the coastal ponds below MLW*"

What is the 5% rule?

- Section 300.11, Aquaculture, of the Rhode Island Coastal Management Program:
- One of the Standards is:

"*The maximum area occupied by aquaculture leases in the coastal salt ponds is five percent (5%) of the total open water surface area of the salt ponds below MLW. This limit is established upon the current knowledge of ecological carrying capacity models. See: Salt Pond SAMP section 100.B.1 and Figure 1-1 for salt pond areas*"

History

- CRMC Working Group on Aquaculture Regulations (WGAR)
- Started in 2000, convened as needed
- Composed of people from government, academia, private sector, and non-profits
- For discussion of aquaculture-related issues
- Suggests consensus solutions to problems

CRMC WGAR background

- First met in 2000
  - CRMC recognized need for communication
- Ceased meeting in 2002
  - All participants decided that goals were met
- Results
  - Narragansett Bay charting project
  - New guidelines in CRMC Regulations
  - Increased communication

The issue in 2007

- Oyster farmers were requesting larger leases
- Shellfish harvesters were opposed
- Marine Fisheries Council (MFC) and DEM became concerned
- MFC and DEM refused to offer opinions on any new aquaculture lease application until CRMC developed an aquaculture development plan for RI

CRMC approach

- Reconvene the WGAR
- Establish subcommittees:
  - Regulations
  - Biological impacts of aquaculture
  - Social impacts of aquaculture
- Monthly meetings of entire WG while subcommittees worked

CRMC WGAR 2007

- Who were the members of the WGAR?
  - NGOs: Save The Bay, Salt Pond Coalition, Sierra Club;
  - Industry representatives: RI Farm Bureau; OSAA, RISA, RISAA, MFC
  - Academia: URI, RWU
  - USDA, State legislators
  - Regulatory agencies: DEM F&W, DOH, CRMC
  - Total of 28 members, 15-20 who regularly attend meetings
  - Monthly meetings, full room, active discussions

Biological Impacts Subcommittee

- David Bengtson, Ph.D. (URI) – Chair
- Barry Costa-Pierce, Ph.D., RI Sea Grant
- Marta Gomez-Chiarri, Ph.D. (URI)
- Dale Leavitt, Ph.D. (RWU)
- Brian Murphy, M.S. (DEM)
- Perry Raso, M.S. (Ocean State Aquaculture Assn)
- Robert Rheault, Ph.D. (Spatco LTD)
- Abby Jane Wood, M.S. (Save the Bay)

Biological Impacts Subcommittee

- Final report accepted by WGAR Jan. 2008 (still available on CRMC Aquaculture web site)
- Chapters on:
  - Water quality issues
  - Disease considerations
  - Invasive nuisance species
  - Physical impacts of aquaculture gear
  - Essential fish habitat
  - Carrying capacity
  - Ecosystem approach to marine aquaculture

Biological Impacts Subcommittee

- Members of the WGAR decided that the notion of Carrying Capacity was what we needed to define limits of oyster culture in RI
- So what is Carrying Capacity?

Aquaculture carrying capacity

- Physical CC
- Production CC
- Ecological CC
- Social CC

(Inglis, 2002; McKindsey et al. 2006)

Physical carrying capacity

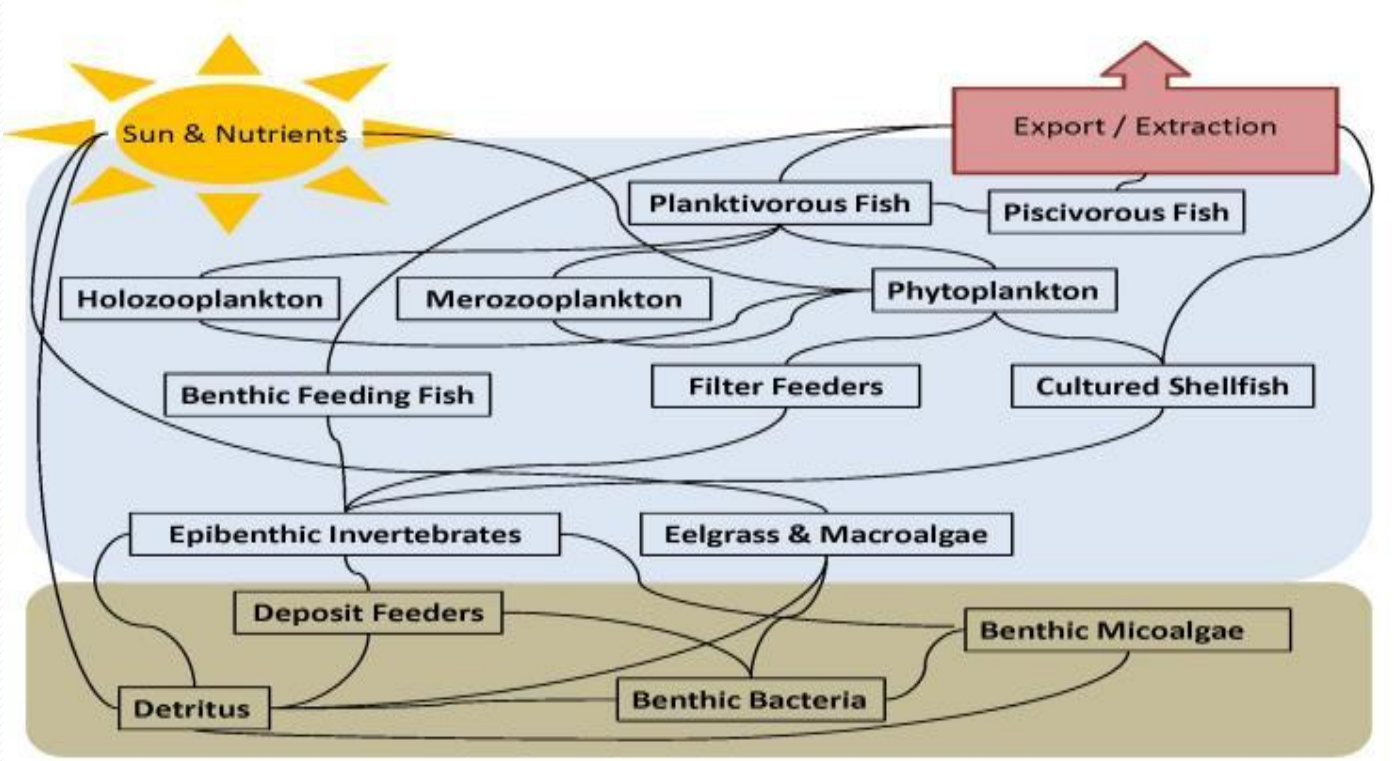
- The amount of aquaculture that can physically fit into a body of water

Production carrying capacity

- Maximum aquaculture production that does not have unacceptable impacts on the farm itself

Ecological carrying capacity

- Maximum aquaculture production that does not cause <u>unacceptable</u> impacts to the ecosystem



Social carrying capacity

- Maximum aquaculture production that does not cause unacceptable impacts to the social system (e.g., fishermen, tourism)

What is the RI oyster aquaculture Carrying Capacity?

- Dr. Bob Rheault in his chapter of the Biology Subcommittee report did a “back of the envelope” calculation of the Ecological Carrying Capacity of Pt. Judith Pond
- Based on
  - Filtration rates of Pt. Judith Pond water by oysters
  - Estimation of production and ecological carrying capacity for mussels in a New Zealand Bay using the Ecopath model (Jiang and Gibbs, 2005)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Neil A Gribble at 18th IMACS/MODSIM World Congress
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Filtration rates

- Oysters filter 50-240 liters (about 13-63 gal.) per day per gram of tissue dry weight (a market-size oyster is about 2 grams DW)
- Using estimates of oyster sizes and abundances on Spatco Ltd's lease in Pt. Judith Pond, along with the numbers above:
  - Spatco oysters filter about 46-230 million liters per day
  - Given the dimensions of PJP, these oysters therefore filter the entire volume of PJP every 55-275 days (removing phytoplankton from the water)

New Zealand carrying capacity

- Using the Ecopath ecosystem food web model, Jiang and Gibbs calculated for Tasman Bay
  - Production CC = 310 tons/km^2/year for mussels
  - Ecological CC = 65 tons/km^2/year
  - That is, 65 t/km^2/yr could be harvested without "significantly changing the major energy fluxes or structure of the food web"
- Caveats for application in RI
  - Tasman Bay is about the size of the entire state of RI
  - Its oceanic waters are likely to be much less productive (phytoplankton-wise) than RI coastal ponds
  - Calculations were for mussels, not oysters

Pt. Judith Pond Carrying Capacity

- Based on Jiang and Gibbs' work, if we assume that 65 t/km^2/yr can be harvested from PJP without significantly impacting the food web
- Area of PJP = 1574 acres = 6.37 km^2
- 65 t/km^2 times 6.37 km^2 = 414 t/yr
- At then-current stocking density of 5 t oysters per acre, 414 t divided by 5 t/acre = 82.8 acres
- 82.8 acres divided by 1574 acres = 5.3%

Recommendation

- The Biological Subcommittee recommended to the WGAR that
  - 5% be used as a rough guess at Ecological CC for oyster aquaculture in RI, but
  - Funding be sought to define the actual Ecological CC for RI waters, given potential large differences between the RI and New Zealand ecosystems
  - (PJP was then at about 2.4% coverage with oyster culture)

NOAA grant

- We obtained a grant from the NOAA Marine Aquaculture Initiative
- Determine Carrying Capacity for oyster culture in RI (Narragansett Bay and coastal ponds)
- Remember the part about "without causing unacceptable impacts to" (farm, ecosystem, social system)? Who decides what is acceptable or not?
- We argued that our stakeholder group, the WGAR, would be the deciders

What to protect?

- From a biological perspective, a critical question is what do we want to protect?
  - Just oyster farms? (Production CC)
  - Perhaps winter flounder populations?
  - How about lobster populations?
  - Etc
- WGAR decided to protect the whole ecosystem, so we could use ecosystem food web model approach (Ecopath)

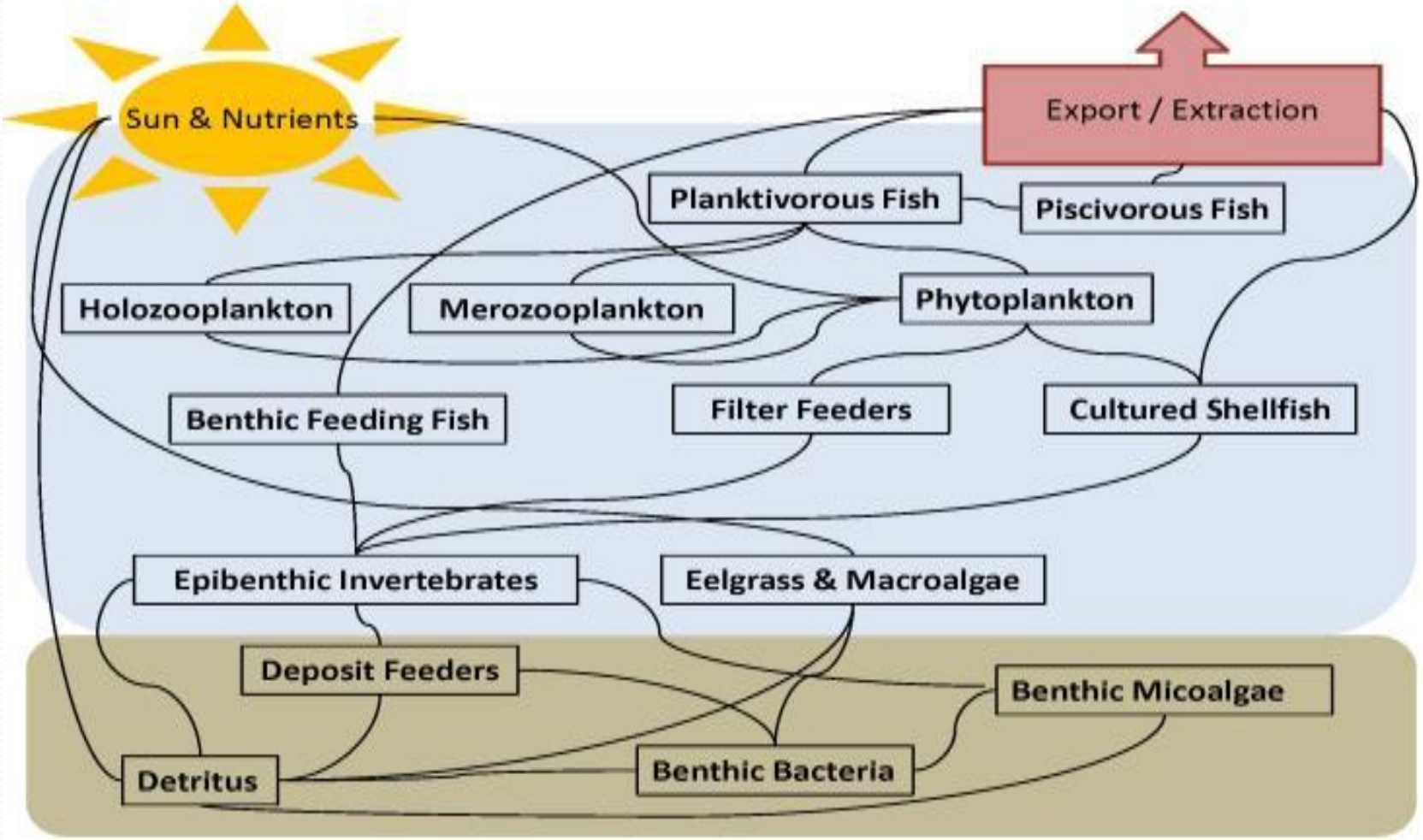
The project

- The real work of this grant project was carried out by Carrie Byron, a graduate student at URI (now Dr. Carrie Byron, Assistant Professor at the University of New England in Maine)

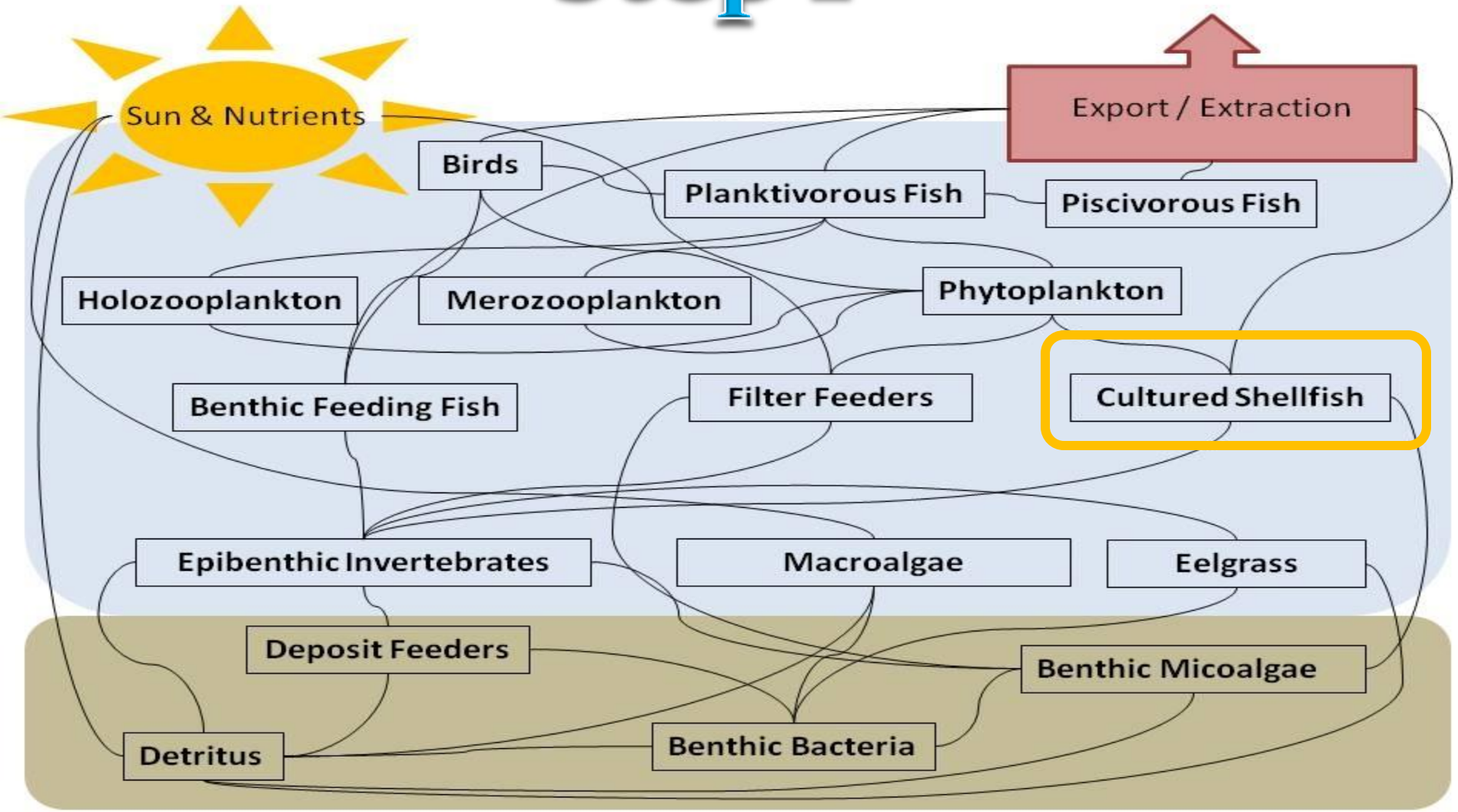
The project

- Four meetings were held with WGAR stakeholders over the course of a year
  - Get feedback on draft conceptual model of coastal pond ecosystem (developed by local estuarine ecologists)
  - Get feedback on data sources to be used to parameterize the Ecopath models (one for Narr Bay, one for a generic coastal pond)
  - Get feedback on the parameterized models
  - Present the results of the model outputs

Conceptual pond ecosystem model



Step 1


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

Morgan and Ulanowicz (1997) Ecopath model of Narragansett Bay

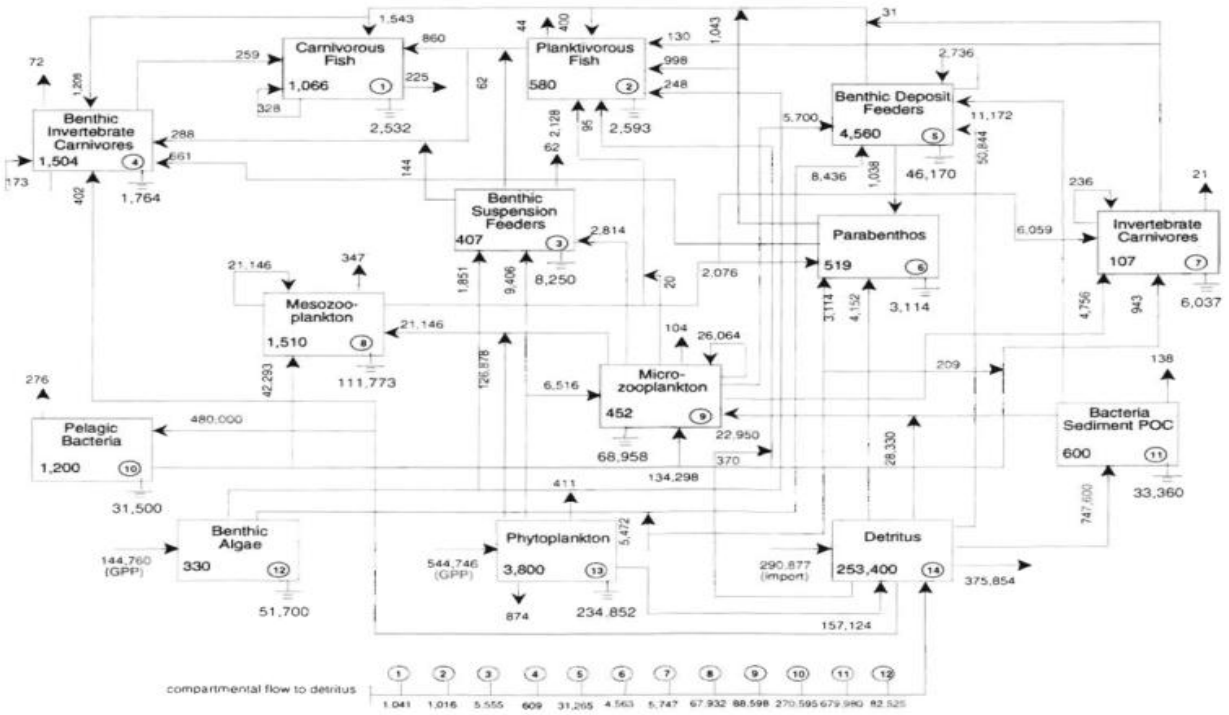


Fig. 2. Average annual energy flow (mg C m^{-2} yr^{-1}) and compartmental biomass (mg C m^{-2}) in Narragansett Bay

Narragansett Bay

Monaco & Ulanowicz 1997

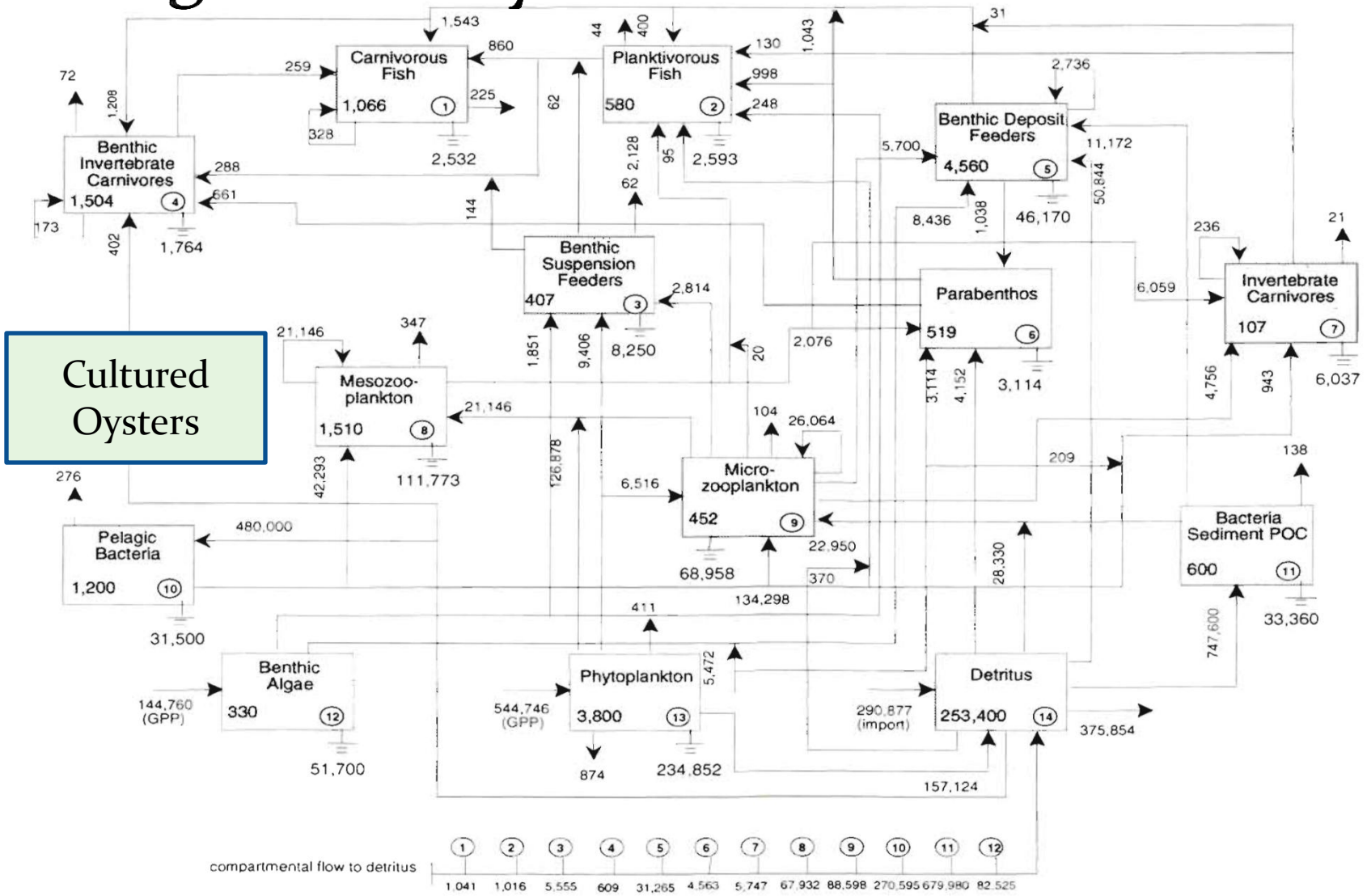
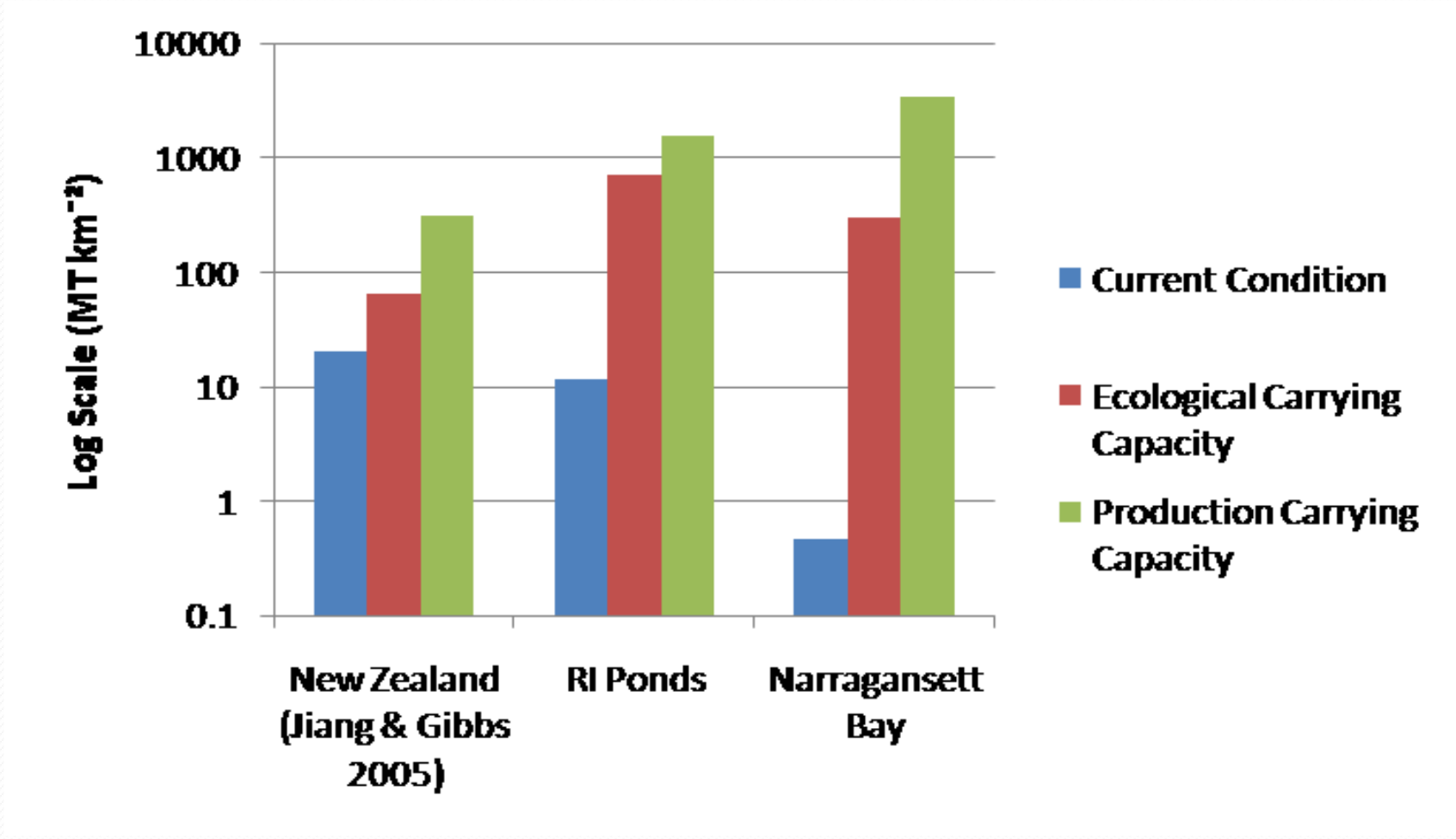


Fig. 2. Average annual energy flow (mg C m^{-2} yr^{-1}) and compartmental biomass (mg C m^{-2}) in Narragansett Bay

Data sources

- Needed information on abundances of organisms in all the compartments in the models, how much (and who) they eat, etc.
- Published literature on RI waters
- Theses and dissertations at local universities
- DEM data
- Other data on similar systems nearby if necessary

Ecological and Production CC in RI



The actual numbers for Ecological CC, based on Ecopath models (t/km^2)

	New Zealand Tasman Bay	RI coastal ponds	Narragansett Bay
Area (km^2)	4500	22	355
Current production	20.68	11.65	0.47
Ecological CC	65	722	297
As % area of water	---	46%	9%

Response of stakeholders

- Thanked Carrie for her work
- They understood the process and accepted the numbers
- 46% of the area of coastal ponds devoted to oyster aquaculture, while biologically acceptable, is not socially acceptable
- Accept 5% of pond area as the socially acceptable number (Social CC)

Current status

- People, including Carrie Byron and Dr. Tracey Dalton at URI, are now trying to figure out how to model Social CC
- The 5% rule now exists as a socially based number. It is no longer the best available biologically based number.
- There is no plan to change the 5% rule.
- 5% means 95% is available for everything else.

Current pond usage

Water body	Area (acres)	Acres in aquaculture	% area in aquaculture
Pt. Judith Pond	1574	56.71	3.6
Potter's Pond	329	6.9	2.1
Green Hill Pond	431	0	0
Ninigret Pond	1711	42.14	2.5
Quonnie	723	4.3	0.6
Winnipaug	446	8	1.8

Source: CRMC 2015 Aquaculture Report

Bottom line

- There is room for aquaculture expansion before we get to 5% anywhere
- The 5% figure is now based on *de facto* Social CC, not biologically determined Ecological CC

- Thank you
- Any questions?