What is the 5% rule?

Section 300.11, Aquaculture, of the Rhode Island Coastal Management Program states the following Prohibition:

"*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."*

And the following Standard:

"*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 of the 5% Rule

The Coastal Resources Management Council (CRMC), the governing body for aquaculture in Rhode Island, formed a Working Group on Aquaculture Regulations (Working Group) in 2000. The group convened as needed and was composed of representatives from government, academia, the private sector, and non-profits. The purpose of the group was to discuss aquaculture-related issues and suggest consensus solutions to problems that were identified. CRMC recognized the need for communication around aquaculture as the industry grew. The group ceased to meet in 2002, as all participants decided that the groups' goals were met. Results of the groups' efforts were: 1) A Narragansett Bay charting project, 2) New guidelines in CRMC Regulations, and 3) Enhanced communication between interested and governing groups relating to aquaculture.

What was the main issue in 2007?

As oyster aquaculture grew in scope, farmers were requesting larger leases. Many stakeholders were opposed to further aquaculture expansion without due consideration of other uses and livelihoods. In addition, the Marine Fisheries Council (MFC) and RI DEM became concerned, refusing to offer opinions/decisions on any new aquaculture lease applications until an aquaculture development plan was crafted for the state. In response, CRMC reconvened the Working Group and established three subcommittees which would focus on: 1) Regulations, 2) Biological impacts of aquaculture, and 3) Social impacts of aquaculture. These subcommittees convened frequently and the larger Working Group met periodically.

Who was part of the Working Group in 2007?

Participation in the Working Group widely reflected the key interests and user groups. There were 28 members, 15-20 of whom regularly attended the monthly meetings which were active & lively discussions. NGOs included Save The Bay, the Salt Pond Coalition, and the Sierra Club. Industry representatives included the RI Farm Bureau, the Ocean State Aquaculture Association, RI Shellfishermen's Association, the RI Salt Water Angler's Association, and the Marine Fisheries Council. The academic community included researchers from

URI and Roger Williams University. Others included USDA, state legislators, and regulatory agencies such as RI DEM the RI Department of Health, and the CRMC.

What resulted from the Working Group?

The Working Group generated a Final Report in Jan. 2008 (available on CRMC Aquaculture website). Chapter topics included water quality issues, disease considerations, invasive nuisance species, physical impacts of aquaculture gear, essential fish habitat, carrying capacity, and ecosystem approach to marine aquaculture. Members of the Working Group decided that defining carrying capacity was needed in order to set regulatory limits on oyster culture in the state.

What are the different types of carrying capacity?

Researchers define four types of carrying capacity: 1) Physical carrying capacity which includes the amount of aquaculture that can physically fit into a body of water. 2) Production carrying capacity which is the maximum aquaculture production that does not have *unacceptable* impacts on the farm itself. 3) Ecological carrying capacity, defined as the maximum aquaculture production that does not cause *unacceptable* impacts to the ecosystem. 4) Social carrying capacity is defined as the maximum aquaculture production that does not cause *unacceptable* impacts to the social system (e.g., fishermen, tourism) (Inglis, 2002; McKindsey et al. 2006).

Understanding oyster aquaculture carrying capacity in Rhode Island

The carrying capacity for Rhode Island, upon which the 5% Rule was decided, is based on oyster water filtration rates in Pt. Judith Pond, as well as an estimate of production and ecological carrying capacity for mussels in a New Zealand Bay using the Ecopath model (Jiang and Gibbs, 2005). Ecopath is a free ecological/ecosystem modeling software which uses three main components (mass-balanced system snapshot, time dynamic simulation, and a spatial & temporal module for exploring impacts to protected areas.)

Oysters filter between 50-240 liters (about 13-63 gal.) per day per gram of tissue dry weight (a market-size oyster is about 2 grams dry weight). Using estimates of oyster sizes and abundances on the Spatco Ltd's aquaculture lease in Pt. Judith Pond as an example, along with these numbers, it was determined that Spatco oysters filter about 46-230 million liters per day. Given the dimensions of Point Judith Pond, these oysters potentially filter the entire volume of the pond every 55-275 days.

Researchers (Jiang and Gibbs) used the Ecopath ecosystem food web model to calculate the carrying capacity for Tasman Bay, New Zealand. The production carrying capacity for Tasman Bay was 310 tons/km^2/year for mussels. The ecological carrying capacity was calculated to be 65 tons/km^2/year. In other words, 65 t/km^2/yr could be harvested without "significantly changing the major energy fluxes or structure of the food web."

The Working Group and researchers set caveats for application of the work in Tasman Bay to Rhode Island. Tasman Bay is about the size of the entire state of RI and its oceanic waters are likely to be much less

productive (phytoplankton-wise) than RI coastal ponds. In addition, the calculations were for mussels, not oysters.

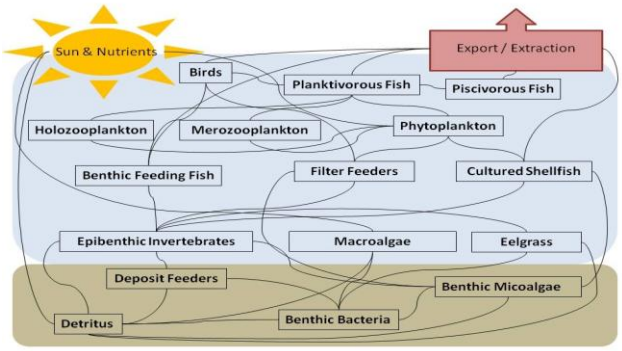
Based on Jiang and Gibbs' work, it was assumed that 65 t/km^2/yr could be harvested from Point Judith Pond without significantly impacting the food web. The total area of the pond is 1574 acres (6.37 km^2). Therefore, taking 65 t/km^2 multiplied by 6.37 km^2 equals 414 t/yr. At then-current stocking density of 5 t oysters per acre, 414 t divided by 5 t/acre = 82.8 acres. Taking these 82.8 acres and dividing by 1574 acres gives 5.3%.

What happened after the calculation was made?

The Biological Subcommittee recommended to the Working Group to use 5% as a rough guess at the ecological carrying capacity for oyster aquaculture in RI. However, it was further recommended that funding be sought to define the actual ecological carrying capacity for RI waters, given potential large differences between the RI and New Zealand ecosystems. At the time of the calculation, Point Judith Pond had about 2.4% oyster aquaculture. From a biological perspective, a critical question the Working Group posed was what exactly to protect in the ponds, deciding that protection of the whole ecosystem was important in order to facilitate use of the ecosystem food web model approach (Ecopath).

What research ensued and what were the results?

Four meetings were held with Working Group stakeholders over the course of a year, soliciting feedback on a draft conceptual model of the coastal pond ecosystem (developed by local estuarine ecologists). Feedback was also collected on data sources to be used to parameterize the Ecopath models (one for Narr Bay, one for a generic coastal pond), as well as getting general feedback on the parameterized models. Results from the model outputs were presented to these stakeholders. The data used included abundances of organisms in all the compartments in the models, how much (and who) they eat, published literature on RI waters, theses and dissertations at local universities, RI DEM data, and other data on similar systems nearby as necessary. Results are shown in the figures below. Note: The ecological carrying capacity for the salt ponds in Rhode Island was determined to be far greater than 5% (46%).



	New Zealand Tasman Bay	RI coastal ponds	Narragansett Bay
Area (km²)	4500	22	355
Current production	20.68	11.65	0.47
Ecological CC	65	722	297
As % area of water	---	46%	9%

So we have a grasp on ecological carrying capacity, what about social carrying capacity?

While the ecological carrying capacity was determined to be far greater than the 5% that was selected by the Working Group, it was determined that at such high numbers there would be social carrying capacity issues. Researchers such as Dr. Carrie Byron (University of New England) and Dr. Tracey Dalton (URI), are currently looking at ways to model social carrying capacity. Not having an estimate for social carrying capacity, the 5% estimate is considered the "de facto" social carrying capacity, which is very different from the model-driven ecological carrying capacity estimated for RI waters. The state does not have plans to change the 5% rule at this time, siting that 5% for aquaculture indicates 95% area available for other uses/industries. The current percentage of the ponds being utilized for aquaculture is listed in the Figure below (2015 estimates).

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