Examining the performance of three strains of disease resistant oysters

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Introduction

In recent years, populations of the American oyster, *Crassostrea virginica*, have been impacted by disease outbreaks. These diseases include dermo disease, Multinucleated Sphere X (MSX) disease, and Juvenile Oyster Disease (JOD). Dermo and MSX are caused by the protozoan parasites *Perkinsus marinus* and *Haplosporidium nelsoni* respectively. JOD is caused by a bacterium, *Roseovarius crassostreae* (Ewart, 1993). Diseases are detrimental both economically and ecologically. Resistance to MSX and dermo diseases is heritable in oysters, making it possible to selectively bred oyster stocks for disease resistance (Ragone Calvo, 2003). However, no disease resistant strains have been tested in Rhode Island waters, in which JOD is an important disease. Identifying a strain of oyster that is resistant to disease and performs well in local waters would help secure adequate oyster stocks for Rhode Island farmers and restoration projects. To identify this strain, an evaluation of the performance of three strains of oysters in local shellfish farms was conducted. Growth and mortality as well as the prevalence and intensity of disease in these oysters were monitored.

Methods

Evaluation of the performance of the three strains of oysters in Rhode Island waters involved measurements of length, volume, mass, and mortality. Oysters were spawned at Roger William University in March 2008. They were distributed to four local Rhode Island shellfish farms in June 2008. The three strains used are **Green Hill Pond (GHP)**, a local wild strain, **Rutgers (NEH)**, a strain selected for dermo and MSX resistance, and a **Hybrid HYB** cross of GHP x NEH. The oysters were placed in upwellers at the 4 farms (2 in Narragansett Bay and 2 in salt ponds,) until they were greater than 10mm in shell height at week 7 (mid-July, Figure 1). Performance was monitored for 20 weeks during the peak months of oyster growth, from June till mid-October. Measurements of mortality, total volume, length, and average abundance were collected providing a view of the performance of each strain. The length of one hundred random oysters from each strain was measured using calipers (Figure 2). Graduate cylinders and beakers were used to measure the total volume of each strain (Figure 3). The number of live and dead oysters in two piles of 250mL were counted to determine mortality. The data obtained was analyzed using two-way ANOVAs to examine if there were significant differences in the three strains of oysters.

Figure 1: Oyster Upweller. Nursery for juvenile oysters.

Figure 2: Measuring an oyster using calipers.

Figure 3: Taking the volume of oysters using a graduated plastic beaker.

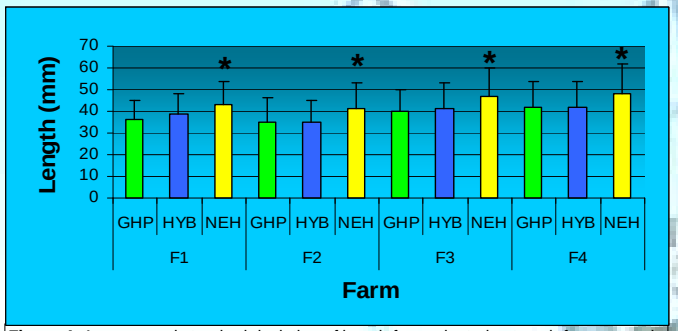

Figure 4: Average and standard deviation of length for each strain at each farm at week 20 after deployment (mid-October 2008). NEH oysters were significantly larger ($p<0.05$, two-way ANOVA) than GHP or HYB oysters at each farm.

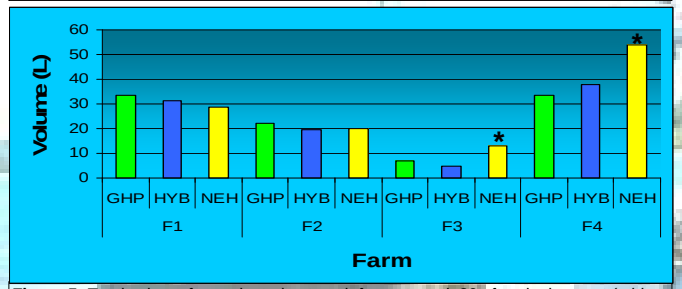

Figure 5: Total volume for each strain at each farm at week 20 after deployment (mid-October). There was a significantly higher volume of NEH oysters ($p<0.05$, two-way ANOVA) than GHP or HYB oysters at Farm 3 and Farm 4.

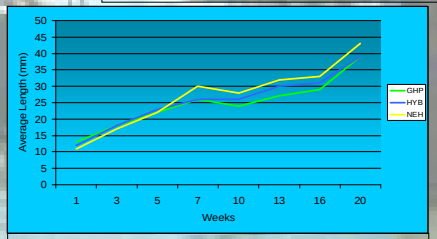

Figure 6: Temporal patterns of performance for each strain at Farm 1 (Coastal Pond)

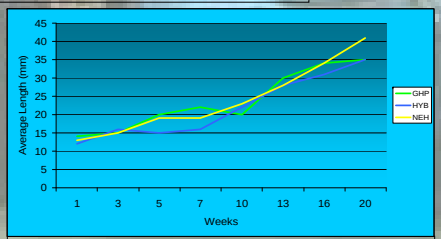

Figure 7: Temporal patterns of performance for each strain at Farm 2 (Coastal Pond)

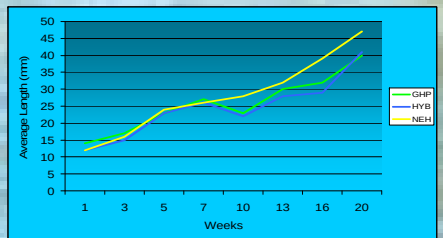

Figure 8: Temporal patterns of performance for each strain at Farm 3 (Narragansett Bay).

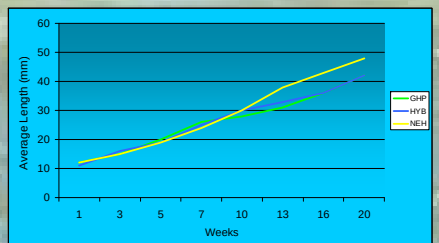

Figure 9: Temporal patterns of performance for each strain at Farm 4 (Narragansett Bay).

Results

The results from Fig 4 – 9 illustrated that NEH was significantly larger than GHP and HYB at all farms ($p<0.05$). We also observed a significant difference ($p<0.05$) in volume (more oysters and/or larger) for the NEH strain at two of the farms. Mortality was highest at the farms in Narragansett Bay (farms 3 and 4) (Table 1)

Table 1: Percent mortality for each strain at each sampling period

Farm	Strain	week 7-10	week 10-13	week 13-16	week 16-20	average
F3	GHP	19%	39%	54%	59%	43%
	HYB	33%	36%	69%	66%	51%
	NEH	15%	33%	40%	46%	34%
F4	GHP	0%	2%	5%	35%	11%
	HYB	0%	0%	5%	32%	9%
	NEH	1%	1%	3%	18%	6%
F1	GHP	3%	5%	1%	4%	4%
	HYB	2%	5%	5%	6%	5%
	NEH	1%	1%	3%	4%	2%
F2	GHP	3%	3%	6%	9%	5%
	HYB	4%	4%	5%	9%	6%
	NEH	5%	2%	3%	4%	4%

Discussion

There is a significant difference ($p<0.05$) in the average size of NEH versus GHP and HYB at all four farms. However, a difference in overall performance (total volume) of NEH in comparison to GHP and HYB was only evident at the two farms that experienced the highest mortality (F3 and F4, Narragansett Bay farms). We have confirmed that the mortality was mostly due to Juvenile Oyster Disease.

The differences in mortality and performance suggest that the NEH strain, through generations of selective breeding, is more resistant to JOD than GHP and HYB. The NEH strain has been bred to be resistant to disease such as MSX and dermo, therefore it may have attributes that make it more resistant to JOD than other strains (Allen, 1993). Future studies could incorporate testing the performance of oysters from hatcheries that supply local farms against NEH.

Literature Cited

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