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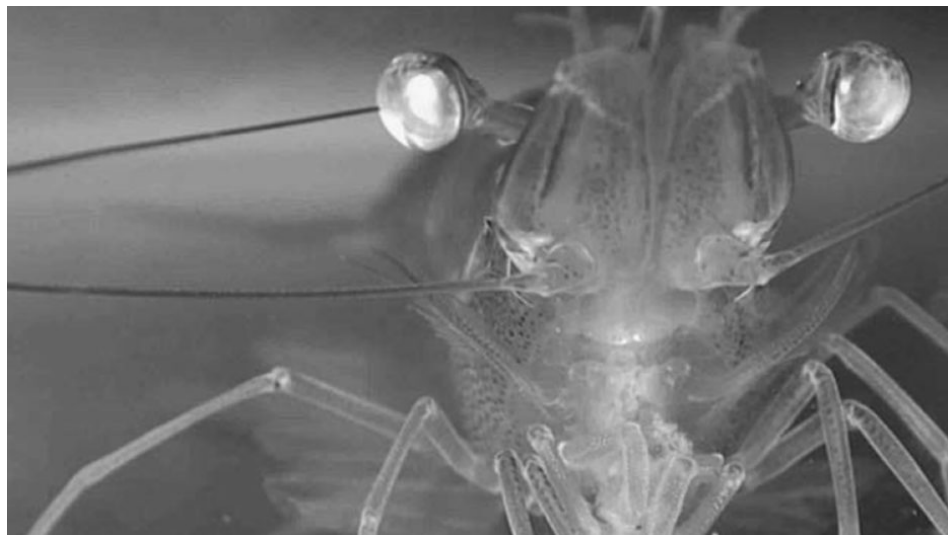
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# Diet size affects shrimp feeding behavior, growth performance

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## Oceanic Institute investigates feed delivery systems, responses to experimental diets



The eating habits of shrimp present challenges for feed managers.

Photo by Luis Pina, Programa Maricultura, UANL.

Understanding the behavioral and physical diet preferences of shrimp is important in determining the nutrient and feeding requirements of the animals. The Oceanic Institute (OI) Nutrition Department, with support from a United States Department of Agriculture-Agricultural Research Service grant, investigated the effectiveness of feed delivery systems and shrimp responses to experimental diets. A small component of the project evaluated the effect of diet size on the feeding behavior and growth of shrimp in an indoor culture system.

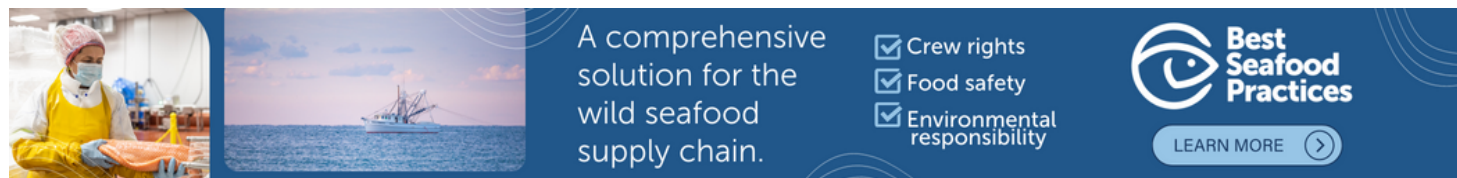
## Experimental methods

### ***Diet preparation and analysis***

Six diets were produced by pelleting a 3.0-mm diet and then crumbling to the following sizes: 0.7, 1.2, 1.7, 2.2 and 2.6 mm. These diets were analyzed for proximate composition and water stability following OI standard laboratory procedures.

### ***Growth experiment***

The six diets, serving as treatments, were fed to 0.9-gram Pacific white shrimp (*Litopenaeus vannamei*) for eight weeks in an indoor controlled laboratory. Eight aquariums per treatment were used, with 12 shrimp stocked in each 52-liter rectangular glass aquarium.



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A flow-through culture system with a water exchange rate of 100 percent per hour was used to grow the shrimp and maintain desired water quality. Shrimp were weighed at the start and end of the trial, and every two weeks during the trial. All treatments were fed by hand to satiation three times daily and evaluated for final weight, growth, feed-conversion ratio and survival.

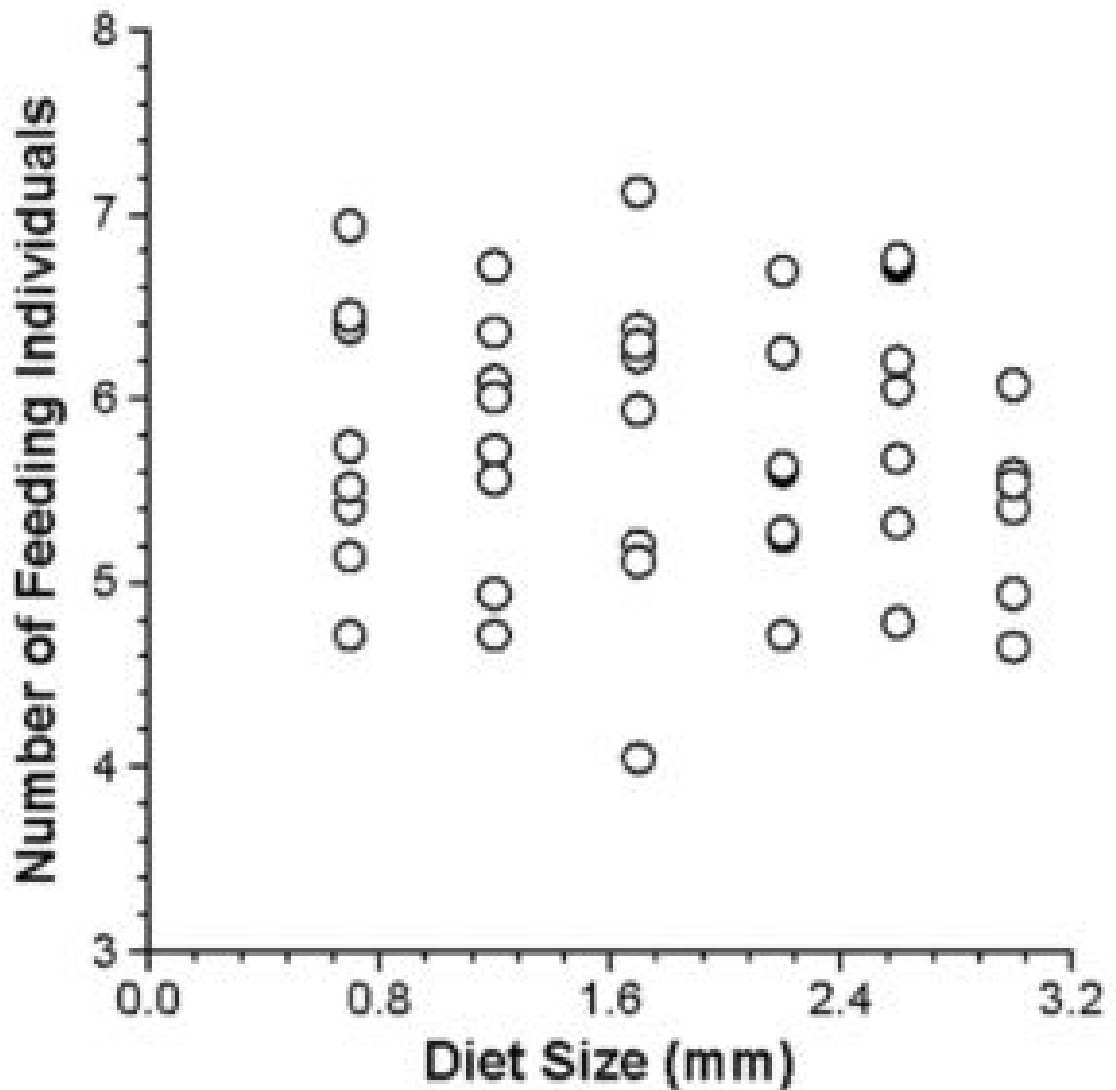


Fig. 1: Effect of diet size on the average number of feeding individuals in each aquarium.

## ***Feeding behavior***

Feeding behavior was observed three times weekly starting on the fourth week. Carried out immediately after feeding in the morning, noon, and afternoon, the observations focused on two aspects: the number of feeding individuals in each tank and the number of “attacking” incidents. The latter was defined as the behavior of one shrimp to obstruct the feeding behavior of other shrimp.

A total of 45 observations was compiled for each aquarium throughout the trial. The number of feeding individuals and attacks were compared among different diet sizes by analysis of variance followed by Tukey’s test of significance.

## **Results**

As expected, all the diets had similar proximate mean compositions of 4.6 percent moisture, 44.7 percent crude protein, 8.2 percent crude lipid, 14.7 percent ash, and 4371.2 cal per grams energy. Water stability values appeared to show a direct relationship with diet size. The water stability decreased from 80.9 percent to 75.5 percent as the 3.0-mm pellets were reduced to 0.7-mm crumbles.

## ***Effect on feeding behavior***

The average number of feeding individuals in each aquarium was not significantly different among the various diet sizes (Fig. 1). However, the total incidents of attacking behavior in each aquarium were significantly different among the diet sizes (Fig. 2).

The attacking behavior of shrimp was observed more frequently in aquariums fed with the larger diet sizes. This suggested that when shrimp were fed larger pellets, some of the individuals may have obstructed other individuals and monopolized the diet. In the long run, such “selfish” behavior of aquacultured animals can result in increased size variation within the final product.

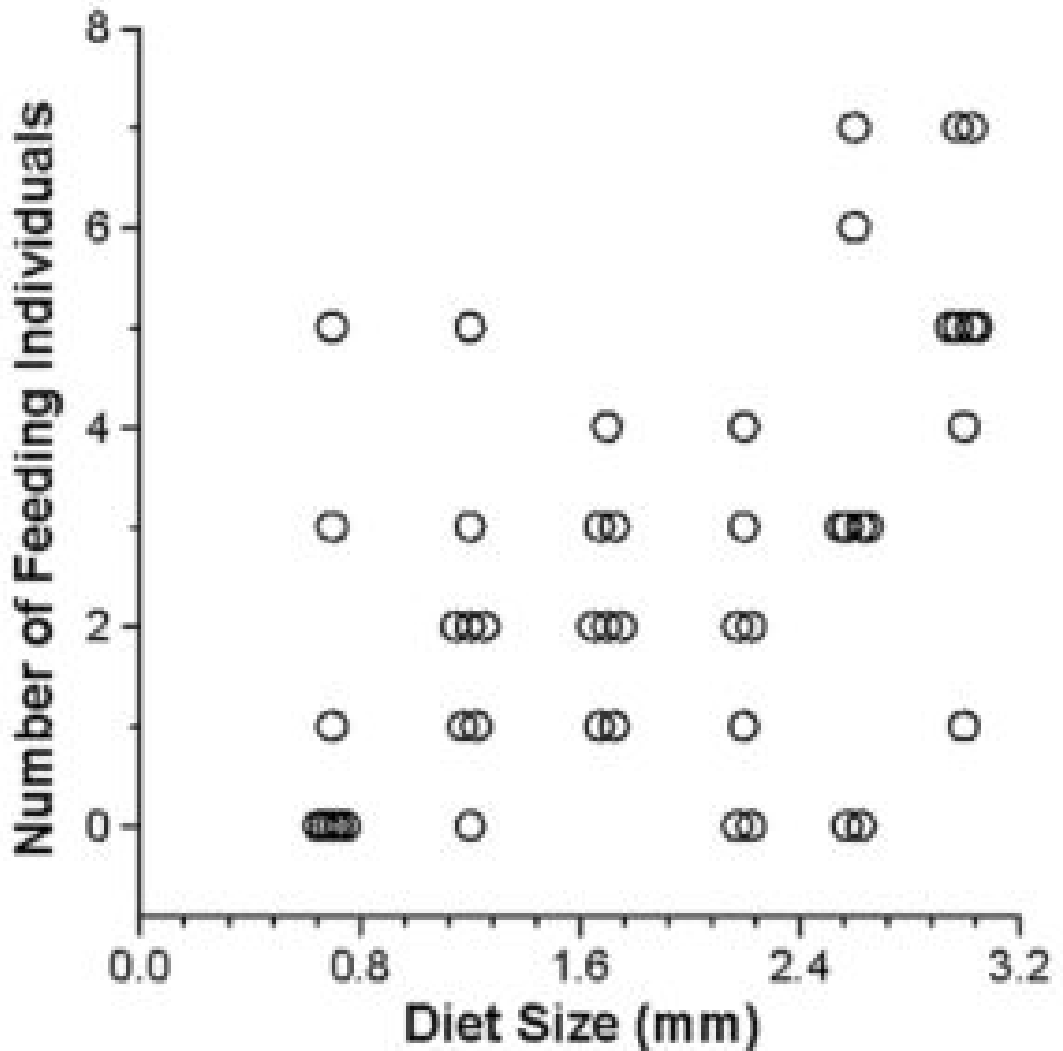


Fig. 2: Effect of diet size on incidents of shrimp attacking behavior in each aquarium.

## ***Effect on growth***

Table 1 summarizes the shrimp growth performance. Variations in shrimp biological performance were not significantly different among the diet sizes. For sizes ranging 0.7 to 3.0 mm, the final weights ranged 5.34 to 5.92 grams, weekly growth rate ranged 0.55 to 0.63 grams, feed-conversion ratios ranged 1.70 to 2.11, and survival ranged 80.2 to 90.6 percent. This suggested that any of the diet sizes could be used for 1-gram shrimp, although preference could be given to 2.2-mm or 2.6-mm crumbles, due to their higher growth performance.

## Obaldo, Biological performance of Pacific white shrimp reared in an indoor culture system, Table 1

Diet	Weight (g)	Weekly Growth (g)	Feed-Conversion Ratio	Survival (%)
0.7-mm crumble	5.34 ± 0.41	0.55 ± 0.05	1.84 ± 0.20	86.5 ± 7.6
1.2-mm crumble	5.50 ± 0.66	0.57 ± 0.08	1.90 ± 0.28	86.5 ± 10.8
1.7-mm crumble	5.57 ± 0.64	0.58 ± 0.08	1.81 ± 0.29	88.5 ± 8.8
2.2-mm crumble	5.85 ± 0.54	0.62 ± 0.07	1.70 ± 0.17	89.6 ± 10.7
2.6-mm crumble	5.92 ± 0.55	0.63 ± 0.07	1.71 ± 0.08	90.6 ± 9.4
3.0-mm x 3.0-mm pellet	5.69 ± 0.67	0.59 ± 0.08	2.11 ± 0.45	80.2 ± 10.9

Table 1. Biological performance of Pacific white shrimp reared in an indoor culture system with test diets of various particle sizes. Values are means ± SD of eight aquaria at 12 shrimp/aquarium.

## Conclusion

Diet size tends to influence the attacking and feeding behavior of shrimp. In this trial, attacking behavior was associated with larger pellets, where some of the individuals monopolized the diet. If shrimp were not fed to satiation, the attacking behavior could have resulted in more serious problems, such as significant size variation and the mortality of smaller individuals. Future studies should consider an experimental period to produce market-size shrimp, to better address diet size and feeding behavior throughout grow-out.

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