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# Genetics key to maximum growth rate for shrimp

23 January 2017

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## Faster growth for Pacific white shrimp contributes in many ways to the profit equation

Shrimp genetics primarily determines the amount of additional growth that can be achieved by the animals during a culture cycle. Photo by Darryl Jory.

Shrimp growth rate is considered the primary factor in affecting pond profitability in typical shrimp farming under normal production conditions. Despite its importance, few shrimp producers actually know the maximum growth rate potential of their shrimp.

Growth rate is a very important characteristic in farmed species, and faster growth rate contributes in many ways to the profit equation. When shrimp grow faster, they are cultured in ponds for a shorter period of time, which significantly reduces the risk factor, and there are opportunities to grow the shrimp to a larger size or to increase the number of pond rotations (crops) per year. A reduced time spent in the pond can result in higher survival and lower feed conversion ratios, and total operating costs are reduced, contributing to better results and higher profits that can be quite significant.

## Shrimp growth rate

To manage shrimp growth rate effectively, it is first important to understand how shrimp grow, and a hypothetical example is presented in Fig. 1. There are three phases that can be identified in the growth curve of shrimp.

First, from approximately postlarvae 1, or $PL_1$ to 3 to 4 grams, the animals grow exponentially, where the incremental increase in weight increases at an increasing rate. During the second phase, from approximately 3 to 4 grams to approximately 25 grams, the growth rate of shrimp is lineal, where the incremental increase in weight is constant per unit of time.

And during the third phase, at about 25 grams or when the animals start reaching sexual maturity, the females continue to grow at the same lineal rate, but the growth rate of the males declines. We selected the latter to focus on because most of the increase in animal weight takes place during the lineal phase and quality data is more easily collected.

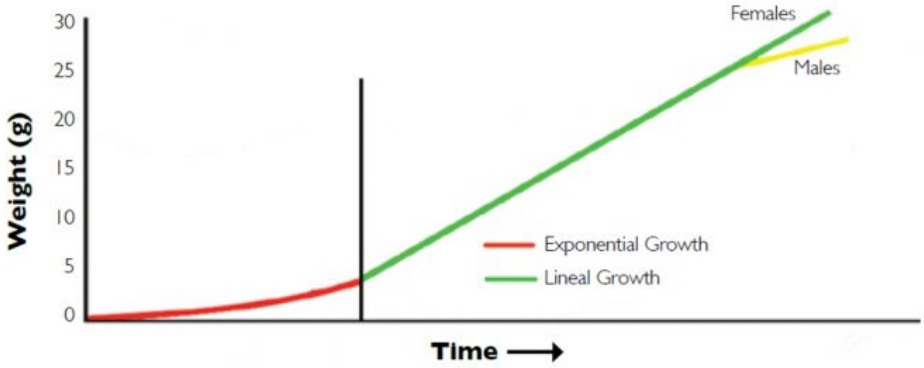


Fig. 1: A hypothetical growth curve for farmed shrimp – note that the growth rate of males slows down at about 25 g.

All living organisms are the result of their genetics (genes) and their environment. In order to determine the maximum growth rate of shrimp as determined by their genetics, we must provide them the opportunity to grow under optimum conditions, that is, an environment where conditions are not limiting in any way.

Fig. 2 presents the data where a particular line of fast-growing shrimp was stocked at very low densities, and were fed a very high-quality feed in a very favorable, green water environment. Sample counts were taken approximately every seven days. The data were analyzed by regression analysis and the average growth rate was calculated to be 2.59 grams per week, which is a very good estimate of the maximum growth rate of these particular animals, as determined by their genetics.

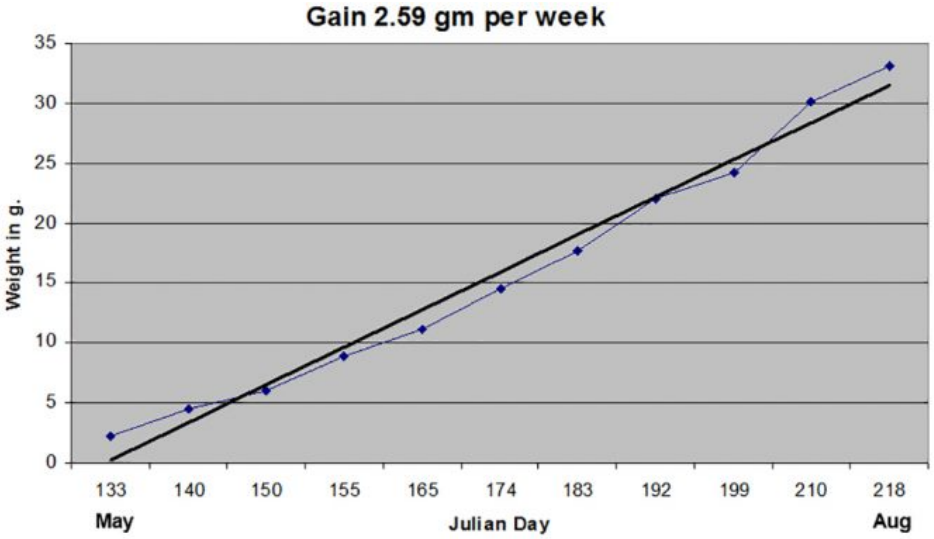


Fig. 2: Growth rate of a fast-growing line of shrimp under optimum conditions.

## The opportunity for faster growing animals

A visual illustration of the opportunity from faster growing animals is presented in Fig. 3. If the normal expected growth under farm conditions is 1gram per week, as represented by the bottom line, and the maximum growth rate from the animal's genetics is 2.5 grams per week as represented by the top line representing the potential growth, then the opportunity is represented by the yellow area.

It is within this area that we may safely conclude that one or more environmental factors are limiting. It could be one or more factors, including nutrition, feeding technique, any of the many water quality parameters (temperature, dissolved oxygen, others), diseases and other factors. Learning and understanding what these limiting factors are and how to properly manage them more effectively is key to improving production, yield and profits.

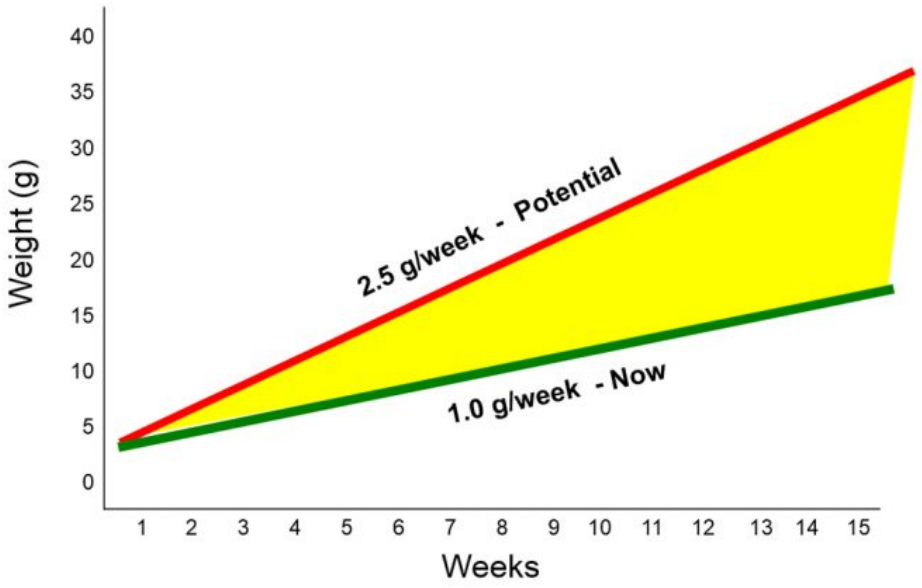


Fig. 3: Illustration of the potential growth opportunity for faster growing shrimp.

## There is more to the story

Fundamental to understanding the amount of additional growth that is achievable is the understanding of the maximum growth rate of the animal as determined by its genetics. Without this knowledge, our opportunity is limited.

Several selective breeding programs have been developed in the last decade or so and are being used by the more progressive shrimp hatcheries. One of their most important selection criteria is faster growth, which for penaeid shrimp we know can be increased by up to 10 percent per generation. Goals for maximum growth can therefore increase constantly, and managers will be accordingly required to continually make improvements in their production and management techniques.

Commercial breeders and suppliers of the various species that we grow on land for food – like poultry, swine and row crops – all provide performance statistics based on genetically selected strains. For example, for broiler chickens and for turkeys, statistics are available for growth rate, feed conversion ratio and survival at **www.hyline.com (http://www.hyline.com/)** and **www.hendrix-genetics.com (http://www.hendrix-genetics.com/)**. These examples should be used as models within the shrimp industry and shrimp hatcheries should develop these relative types of performance profiles and provide them to the industry for each of their improved genetic lines.

Globally, the shrimp farming industry today relies almost exclusively on hatchery-reared postlarvae, often from selectively bred lines. Photo by Darryl Jory.

# Perspectives

In the last 15 years or so, the global shrimp farming industry has moved almost exclusively to depending on hatchery reared postlarvae, after many years of relying on and using wild-caught postlarvae. Several hatchery producers have developed selective breeding programs, or rely on selectively-bred broodstock from other companies. As a result, significant increases have been made in the growth rate of farmed shrimp, and there have been reports of animals that have grown 7 to 10 grams a week during the lineal growth phase. When it comes to genetics and your farmed shrimp, the bottom line is to know the genetic potential of your animals for maximum growth rate.

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