

# Why Put a Shrimp on a Treadmill?

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## RESEARCH OBJECTIVE:

To determine how changes in marine environments impact the ability of crustaceans to fight bacteria.

### PACIFIC WHITE SHRIMP

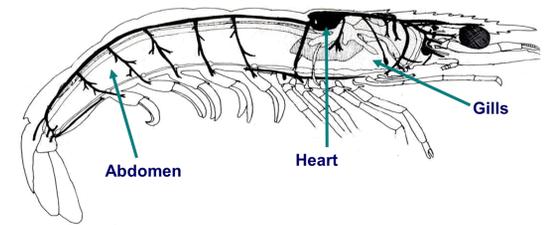


*Litopenaeus vannamei*

### SIGNIFICANCE OF RESEARCH

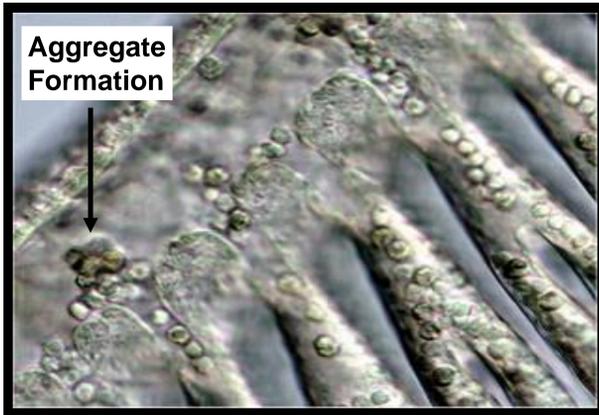
Shrimp remain the largest single seafood commodity in the world, with a global market worth over 15 billion dollars annually. In the United States, shrimp is the most consumed seafood, over 5 billion pounds per year, the second largest consumer of shrimp after China. Emerging diseases are having a serious impact on production, profits, and food safety.

### ANATOMY



Shrimp are active decapod crustaceans with a large muscular abdomen that is edible. They have blue blood (hemolymph) that contains millions immune cells/mL.

### GILL

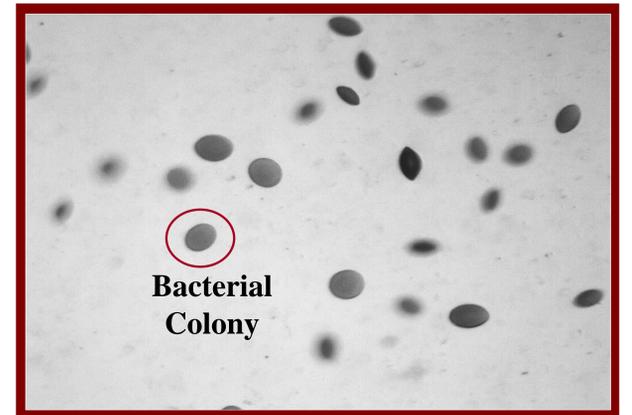


Aggregate Formation

### INFECTED SHRIMP

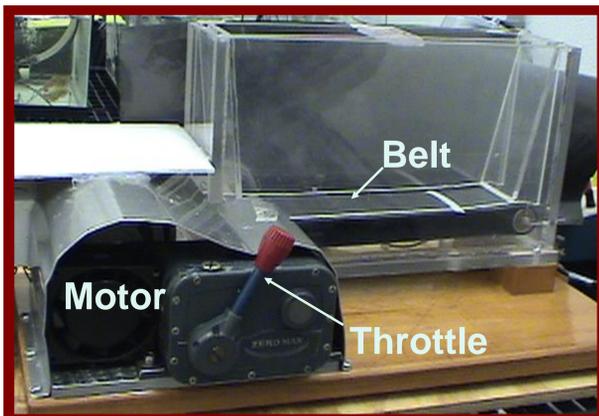
Recent changes in the ocean environment appear to suppress immune response in shrimp. We found high levels of bacteria (*Psychrobacter sp.*) in the blood of otherwise healthy animals when exposed to elevated temperatures and low oxygen; changes thought to be brought about by global climate change. Our studies show that the gill is an important site for removing bacteria, where immune cells (hemocytes) trap and kill bacteria.

### BLOOD

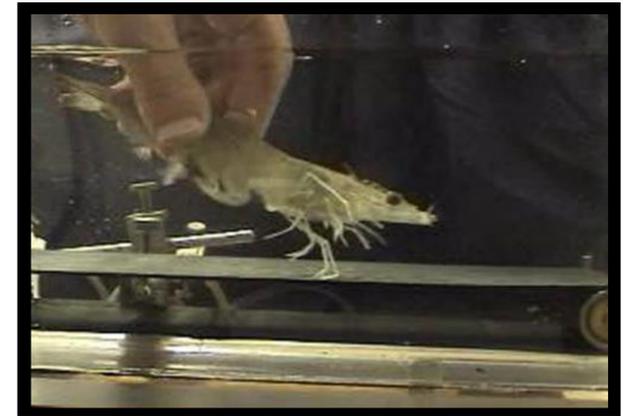


Bacterial Colony

### SHRIMP TREADMILL



A homemade treadmill, built from spare parts, was used to determine if respiratory function is compromised by immune cell aggregate formations at the gill. After 5 minutes of activity on a treadmill, oxygen uptake was significantly reduced in shrimp with bacterial infections. Our data suggest that the consequence of large bacterial infections may be limited circulation to the gills, thereby impacting metabolism, growth, and health of shrimp.



## CONCLUSIONS

- Small changes in the ocean environment can have a large impact on shrimp immune systems.
- We are finding high levels of bacteria in the blood of otherwise healthy shrimp.
- Water temperature and oxygen appear to suppress immune and circulatory function.
- Overall, health of shrimp appears to be tightly linked to opportunistic bacteria that are responding to emerging environmental changes in the oceans.

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### References:

- Holman et al., 2004. *Bio. Bul.* 206:188-196.  
Scholnick and Haynes, 2012. *Biol. Bull.* 222:56-62.  
Scholnick et al., 2006. *J. Crust. Biol.* 26:510-514.  
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