P. argus © Josh More

The biology, ecology, and diseases of the Caribbean spiny lobster, *Panulirus argus*

 # symbiosis # parasitism # pathogenic interactions

DATES
2017-2021

COUNTRY
Saint-Kitts-and-Nevis

STUDENT
Nicole A M Atherley

EDUCATION LEVEL
Doctorate

CONTACT
NicoleAtherley@students.rossu.edu

Context

The Caribbean spiny lobster, *Panulirus argus*, is a long-lived crustacean found in the tropical and sub-tropical waters of the western Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea. This species supports important fisheries in countries throughout its geographical range. There are few pathogens reported in *P. argus*, some of which cause mortality or affect marketability of affected individuals. One such pathogen, Panulirus argus virus 1 (PaV-1) causes mortality in juveniles and sub-clinical infection in adult lobsters. Some parasites and pathogens may also reduce reproductive potential, which may in turn have implications in the number of lobsters eventually recruited to fishing stock. Disease surveillance is therefore of utmost importance since pathogens may affect reproduction, population size, and by extension fishery and ecosystem health.

Panulirus argus is either fully- or over-fished, thus highlighting the need for sustainable fishing practices. Sustainable fisheries are dependent upon the management practices adopted, which include a closed season and no fishing of lobsters carrying eggs. In addition, many countries prohibit removal of lobsters below a stipulated size based on the length of the carapace. These measures are necessary to regulate fishing pressure and thus reduce overfishing. In some territories, size restrictions are based upon research conducted decades ago. Some countries have also adopted regulations based on research in other territories. This practice may have negative implications on the status of lobster populations.

Objectives

Pathogens and fishing pressure are two drivers of marine species health. To this end, the main objectives of this study were to:

- Provide a dissection manual and highlight the lesions and epibionts observed in *P. argus*, in comparison to the normal histology observed.
- Establish the size-at-sexual maturity in order to determine whether the existing minimum legal size for lobster fishery in Saint-Kitts-and-Nevis needs to be updated.
- Identify the periods of peak reproductive activity of *P. argus* using the gonadosomatic index (GSI), a method novel for the test species. A closed season for the Saint-Kitts-and-Nevis population will be proposed based on the results.

- Assess the health of the lobster population in Saint-Kitts and determine the presence of pathogens, parasites and diseases that may affect population size, and by extension, sustainable fisheries and aquaculture. If any such pathogens exist, the formulation of a conservation plan may be necessary.

Methods

Post-mortem examination

Three hundred and thirteen lobsters ranging from 66 mm to 157 mm carapace length were sourced from fishermen in Saint Kitts. Lobsters were anaesthetized and euthanized within two hours of collection and prior to dissection. Samples were collected and fixed for subsequent histological and molecular analyses. Photographs of the dissection process and of lesions and epibionts were taken, and the presence and prevalence recorded.

Sexual maturity and seasonal reproductive activity

The gonads of 166 females and 147 males were weighed and the gonadosomatic index calculated. The ovaries were also assessed grossly and histologically for physiological maturity, while the presence of eggs and/or a spermatophore was used to determine functional maturity. The length of setal hairs in females was measured as a cue of morphological maturity. Using these parameters, the size at physiological, functional, and morphological maturity were calculated using RStudio. The peak months of reproduction was determined by noting the months during which there was highest proportion of grossly and histologically mature male and female lobsters.

Screening for egg-predators

The gills of 320 lobsters and the brood mass of 31 ovigerous females were screened for the presence of nemertean worms. Mitochondrial DNA of worm samples was amplified using COI primers. A phylogenetic tree was constructed.

Microsporidian characterization

Samples collected from microsporidian-infected lobsters were prepared for histological analysis. In addition, histological sections were stained with Uvitex 2B and Gram stain for better visualization of spores within lobster tissue. Molecular analyses were done to identify the microsporidian, and a phylogenetic tree constructed. Collaborators prepared electron micrographs for analysis of microsporidian ultrastructure and species characterization.

Panulirus argus virus 1 (PaV1)

Juvenile lobsters were hand collected and screened for PaV1 using histological and molecular techniques. Postlarvae collected using GuSi postlarval collectors and adult lobsters in this study were also screened.

Octolasmis spp. *in* P. argus

Stalked barnacles were collected from the gills of male and female *P. argus*. Barnacles were identified using morphology of capitular plates. DNA was extracted and the COI and 18s regions amplified for molecular analysis.

Results

A detailed dissection manual was produced from this project. The manual included illustrations which will aid in post-mortem examination of *P. argus* and other spiny lobsters. Presence and prevalence of lesions and epibionts were outlined. A novel microsporidian, *Ameson herrnkindi*, (present in 0.6% of lobsters screened) was described. *Carcinonemertes conanobrieni*, an egg predator found in Florida and Colombia, was found in the brood masses of 27 out of 31 ovigerous females. In addition, an undescribed *Carcinonemertes sp.* was found. This species was not previously described in *P. argus*. The presence of both

has implications on the fecundity of *P. argus* and future recruitment of postlarvae to coastal habitats and lobster fisheries. Overall, lobster aquaculture in Saint-Kitts-and-Nevis may be a feasible venture. However, there should be regular screening of *P. argus* stock for pathogens which may cause mortality or affect fecundity in the species.

Based on the gonadosomatic index (GSI) and other cues of functional and physiological maturity, the period of elevated reproductive activity spans from March to May. The size at sexual maturity of *P. argus* in Saint-Kitts-and-Nevis is below the minimum legal size of 95 mm carapace length, indicating that lobsters reproduce at least once before being removed from the fishing stock. Each country adopts differing fishing regulations, and have different fishing pressure, and this may affect population dynamics. Climate change, such as increasing sea temperatures and changes in other biotic and abiotic factors, affect the physiology of marine organisms. It is therefore recommended that each territory conducts its own research and enforces size limits based on the characteristics of their existing lobster stock. Maximizing spawning potential will have both local and regional benefits.

About the research team

Nicole obtained her Bachelor's degree at the University of the West Indies in Barbados and worked there as a microbiology technician. She started her Master's project at Ross University School of Veterinary Medicine (Saint-Kitts-and-Nevis) in 2017 and converted her project to PhD the following year. The project was jointly funded by Ross University School of Veterinary Medicine and Caribaea Initiative. The project was also supported by the Department of Marine Resources, Saint-Kitts. Her project was supervised by Dr. Mark Freeman (RUSVM), Dr. Michelle Dennis (RUSVM) and Dr. Donald Behringer (University of Florida). She successfully defended her thesis in 2021.

Publications

Atherley, N.A.M., Dennis, M.M., Behringer, D.C., Freeman, M.A. 2021. Size at sexual maturity and seasonal reproductive activity of the Caribbean spiny lobster, *Panulirus argus*. Marine Ecology Progress Series, 671: 129-145.

Atherley, N.A.M., Dennis, M.M, Freeman, M.A. 2020. Two species of Carcinonemertes Coe, 1902 (Nemertea: Carcinonemertidae) infesting the Caribbean spiny lobster, *Panulirus argus* (Latreille, 1804) (Decapoda: Achelata: Palinuridae), in Saint Kitts, West Indies. Journal of Crustacean Biology, 40 (6): 933–942.

Atherley, N.A.M., Freeman, M.A., Dennis, M.M. 2020. Post-mortem examination of the Caribbean spiny lobster (*Panulirus argus*, Latreille 1804) and common pathology in a fishery of the Lesser Antilles. Journal of Invertebrate Biology, 175: 107453.

Small, H.J., Stentiford, G.D., Behringer, D.C., Freeman, M.A., Atherley, N.A.M., Reece, K.S., Bateman, K.S., Shields, J.D. 2019. Characterisation of microsporidian *Ameson herrnkindi* sp. nov. infecting Caribbean spiny lobsters *Panulirus argus*. Diseases of Aquatic Organisms, 136: 209–218.