Population and reproductive biology aspects of the vinegar crab *Episesarma mederi* H. Milne Edwards, 1853 (Decapoda, Sesarmidae) from a tropical mangrove area in Capiz, Philippines

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Introduction

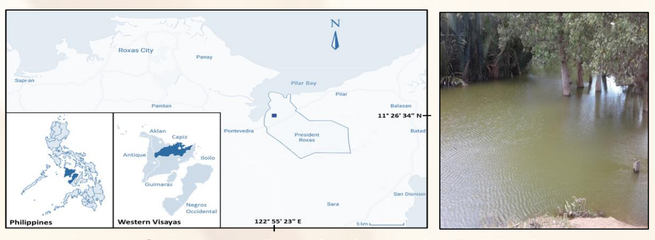
Vinegar crabs of the *Episesarma* genus are among the dominant crab groups in estuarine and mangrove areas in the tropics. These burrow-dwelling crabs play vital roles in the nutrient cycling and substrate biochemistry of their inhabited ecosystems. *Episesarma mederi* is a traditional and a growing fishery resource in the Philippines that may have aquaculture potential. However, a constraint in managing this crab species is the lacking knowledge about its reproductive biology. This holds true for the other members of the genus.

This study was the first to analyze aspects of the population structure and gonadal maturation stages of *E. mederi* in Capiz, Philippines to establish a baseline information on the reproductive biology aspects of this species.

Methodology

Samples were randomly collected from February 2016 to January 2017 (11° 26' 34" N, 122° 55' 23" E). Morphometric analysis and sexual determination were performed. Staging of gonadal development was established by complementing morphological features (i.e. color, volume) with histological analysis (i.e. cell type, size).

Crab Collection
(n = 30 crabs of various sizes and sexes)

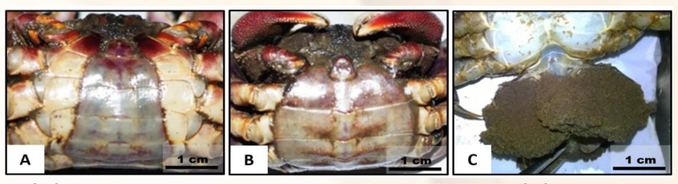


Map of the sampling site in Capiz, Philippines

Morphometrics
(Cold anesthesization, weighing, measuring)

Diagram of carapace width (CW) and carapace length (CL)

Sex Determination



(A) Male with narrow, triangular abdomen; (B) Female with broad, rounded abdomen; (C) Ovigerous female

Dissection
(Carapace cut along the periphery to expose the gonads)

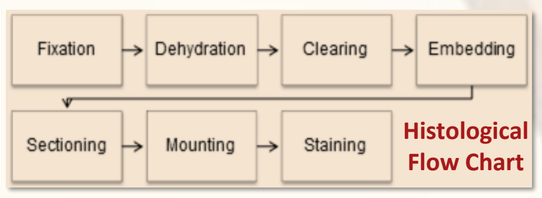
Macroscopic Analysis
(Gonad color and volume)

Testes

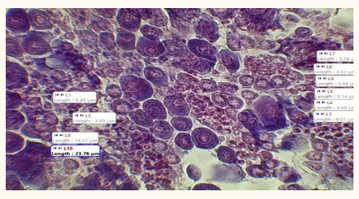
Ovaries

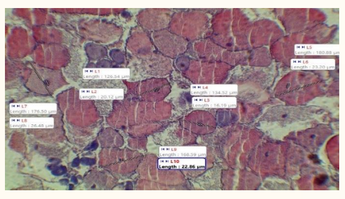
Tissue Preparation
(Histology)

Extracted Gonad



Macroscopic Analysis
(Cell types, stages and diameters)

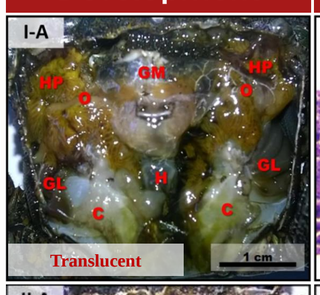
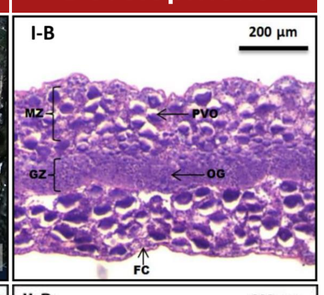
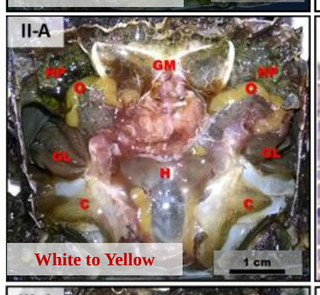
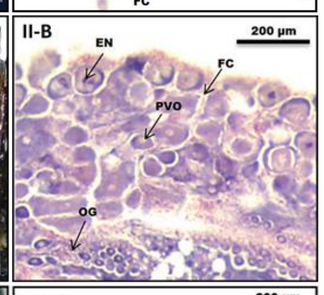
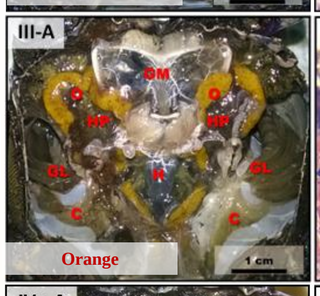
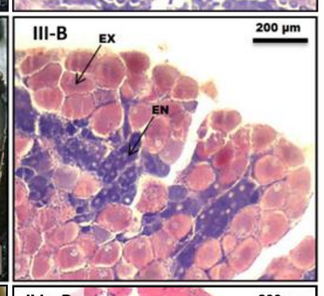
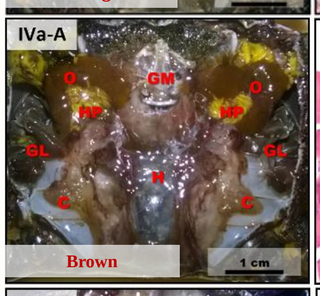
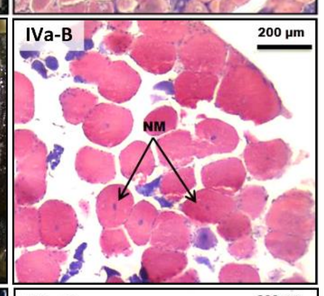
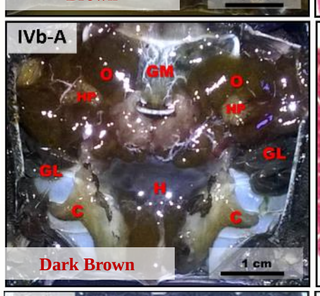
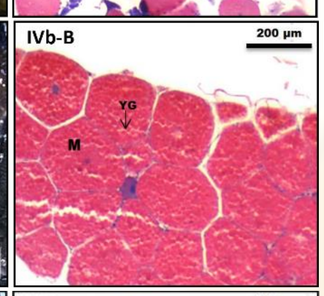
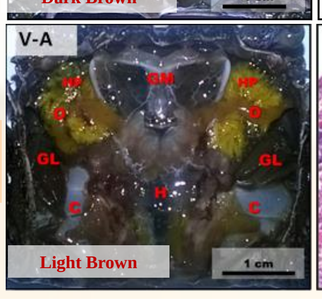
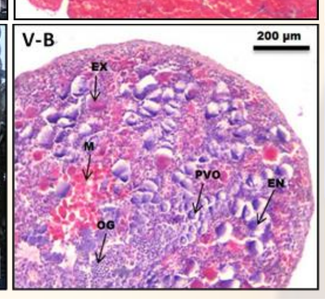




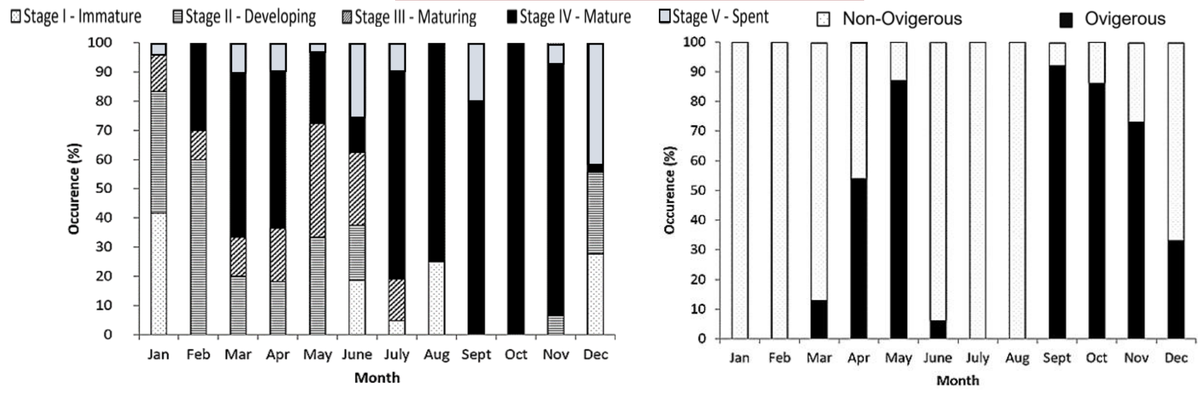
Results and Discussion

A total of 448 crabs (184 males, 264 females, 105 ovigerous females) were collected. Males were fewer but larger and heavier than females. Five stages of ovarian development were identified.

Ovarian Development

	Macroscopic Development	Microscopic Development	Cell Parameters & Descriptions	
			Oocyte Stage	Average Oocyte Diameter (µm)
Stage I Immature			Oogonia (OG) Previtellogenic (PV)	43.3 ± 7.1
			Oogonia and previtellogenic oocytes found in germinative (GZ) and maturation zones (MZ), respectively; follicle cells irregularly distributed throughout the ovary	
Stage II Developing			Oogonia (OG) Previtellogenic (PV)	48.3 ± 7.5
			Fewer oogonia and previtellogenic oocytes, some of which have differentiated into endogenous vitellogenic oocytes; follicle cells begin to surround the oocytes	
Stage III Maturing			Endogenous (EN) Exogenous (EX)	89.0 ± 22.5
			Endogenous oocytes compose the inner region surrounded by the exogenous oocytes; follicle cells form one layer around the oocytes	
Stage IV-A Early Mature			Nearly mature (NO)	~162.0
			Nearly mature oocytes develop with large yolk globules in the cytoplasm; nucleus decreased in size with less visible nucleolus and follicle cells	
Stage IV-A Late Mature			Mature (MO)	~230.0
			Oocytes fully mature (~230 µm) with larger yolk globules; nucleus and follicle cells are hardly recognizable	
Stage V Spent			Oogonia (OG) Previtellogenic (PV) Endogenous (EN) Exogenou (EX) Nearly mature (NO) Mature (MO)	85.5 ± 60.8
			All cell types are present, arranged in disarray as new oocytes develop	

Monthly Variation



Among the ovigerous females, the smallest size has 29 mm carapace width (CW) and the size class range of 30-34 mm CW had the highest prevalence of spawning samples. Monthly ovarian development indicates a continuous breeding cycle. However, two periods of higher reproductive activity were identified in females, which coincided with the onset and culmination of the rainy season in the Philippines. This suggests that *E. mederi* exhibits a seasonal-continuous reproduction strategy. Accordingly, these reproductive features must be accounted in management strategies to prevent the overexploitation of the wild stocks of this species.