



ECOSYSTEMS

Plasticity of growth rates and sizes at sexual maturity in different populations of the fiddler crab *Minuca vocator* (Herbst, 1804) within the same latitudinal range

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Abstract: The growth rates and size at maturity of decapod crustaceans usually vary throughout latitudes. Here, we evaluated whether these life history traits can be stable within the same latitude range, where some environmental factors are constant, especially temperature. To this end, we estimated and compared the growth rates and size at sexual maturity of three populations of the fiddler crab *Minuca vocator*, located at latitude 23° S, in mangroves of the subtropical Brazilian coast. Variations in the growth rate of the abdominal width of females and of the propodus of the major cheliped of males were assessed by the allometric technique. The abdomen growth rates of females and the cheliped growth rates of males varied among the three populations, resulting in different sizes at maturity. These results do not support our prediction that growth rates and size at sexual maturity would remain stable in populations of the same latitude range. The differences in these life history traits could be a consequence of contrasting local conditions among mangroves. Therefore, we suggest that these crabs show plasticity and responsiveness to local-scale environmental variations, to optimize the energy allocation for maintenance, reproduction, and somatic growth.

Key words: Reproductive traits, allometry, local-scale factors, resource availability, mangroves

INTRODUCTION

Intraspecific variations in the life-history traits of animals result from a combination between genetic background and environmental conditions (Stearns & Koella 1986, Reznick 1990, Husby et al. 2010). Among these traits, metabolic performance and growth rate are influenced by temperature, which is an important environmental factor varying with latitude, a fact that results in a general trend that relates intraspecific body size variation with latitude clines (Tuttle & Gregory 2012, Tseng & Soleimani Pari 2018). The growth rates in turn impact on the size or age at sexual maturity, which is a

relevant trait affecting the reproductive fitness of organisms (Higgins 1992, Bergstad et al. 2001, Chen et al. 2020). Therefore, variations in this reproductive trait among intraspecific populations have usually been considered a phenotypic response to different temperatures and latitudes (Hines 1989, Higgins 1992, Le Bris et al. 2017, Cabezas-Cartes et al. 2018, Amat & Meiri 2018).

In decapod crustaceans, which are ectothermic, temperature has an important effect on their growth (Azra et al. 2020). At colder temperatures, the intermolt period is longer, leading to a larger increase in size at each molt.

Therefore, decapods from colder environments (high latitudes) would reach sexual maturity at larger sizes than conspecifics from warmer environments (low latitudes) (Landers et al. 2002, Kuhn & Darnell 2019, Mullaney & Baker 2020, De Grande et al. 2021). Several species of decapods show this pattern of larger maturity sizes at higher latitudes (Hines 1989, Le Bris et al. 2017, Olson et al. 2018, Johnson et al. 2019, Martínez-Rivera et al. 2020). Nevertheless, other species show an inverse relationship between maturity size and latitudes (Hines 1989, Masunari et al. 2017, Darnell & Darnell 2018), or their size at maturity does not relate with latitudes or temperatures (Hirose et al. 2013, Bakke et al. 2018). The studies which have found a relationship between latitudes and growth rates or size at maturity evaluated these traits throughout several degrees of latitude. However, whether these traits remain stable among populations of the same latitude should still be assessed.

Therefore, the aim of this study was to evaluate whether growth rates and size at sexual maturity can be stable traits within the same latitude range, where some environmental factors, especially temperature, are constant. To

this end, we estimated and compared these traits in three populations of the fiddler crab *Minuca vocator* located at latitude 23° S, in mangroves of the subtropical Brazilian coast. We predicted that growth rates and size at sexual maturity will not vary among the different populations of the same latitude range.

MATERIALS AND METHODS

Study areas and sampling procedure

Three mangrove areas in the same latitude range, inhabited by *Minuca vocator* (Herbst, 1804), were selected for this study. These mangroves are associated with estuaries of the Itapanhaú River (23°49'07"S 46°09'07"W), Indaiá River (23°24'57"S 45°03'10"W), and Itamambuca River (23°24'25"S 45°00'47"W), in the subtropical Brazilian coast, in São Paulo state (Figure 1). It is important to consider that these mangroves have some different local features, mainly in extension, forest structure and sediment characteristics (Table I), which were described by Colpo et al. (2011).

In the three mangroves, the samplings were carried out monthly from August 1999 to July 2000. To evaluate whether temperature

Table I. Environmental features of Itapanhaú, Indaiá, and Itamambuca mangroves, in which the populations of *Minuca vocator* were sampled, according to Colpo et al. (2011).

	Itapanhaú	Indaiá	Itamambuca
Mangrove features			
Mangrove area (ha)	853	11.5	3.5
Richness of tree species	3	2	1
Mean density of trees (trees.ha ⁻¹)	3,125 ± 1,692	10,657 ± 2,701	2,232 ± 1,728
Mean height of trees (m)	7.8 ± 1.9	10.1 ± 1.6	4.8 ± 0.8
Sediment characteristics			
Central tendency (ø)	2.7 ± 0.9	3.2 ± 0.5	2.1 ± 0.5
Organic matter content (%)	10.5 ± 5	2.1 ± 3	3.1 ± 3.2
Nitrogen content (%)	6.9 ± 0.9	1.5 ± 0.8	2.9 ± 0.5

is a constant environmental factor within this latitude range (23°S), the air temperature was recorded in the mangroves, throughout the sampling year. In each mangrove, shaded areas with dominance of *M. vocator* were selected to carry out the samplings, during low-tide periods. For each population, in each sampling month, one collector randomly explored an area of 20 m², for 15 minutes to extract crabs from their burrows using a diving knife. The fiddler crabs sampled were taken to the laboratory for species confirmation (Crane 1975, Melo 1996). The fiddler crabs were sex separated and the carapace width (CW) of both sexes, the abdominal width (between the fourth and fifth somites) of females (AW), and the length of the propodus of the major cheliped of males (ChL) were measured. Crabs with damaged or regeneration parts were not measured and not considered in the analysis.

Data analysis

The values of temperature were compared between the mangroves throughout the sampling year using a two-way ANOVA, where 'mangrove' was a fixed factor with three levels (Itapanhaú, Indaiá, and Itamambuca) and 'season' of the year was the other fixed factor with four levels (spring, summer, autumn, and winter). The size of fiddler crabs (CW) was compared between the populations using a one-way ANOVA. Tukey's test was used for post-hoc analysis and the Levene's test was used to verify the assumption of homoscedasticity.

The growth rate and size of morphological sexual maturity for each population of *M. vocator* were estimated using the allometric growth analysis. This analysis is based on the power function equation $Y = aX^b$ (Huxley 1924, 1950) transformed to the linear function $\ln Y = b \ln X + \ln a$, where Y is the dependent variable (AW and ChL), X is the independent variable (CW), a is the intercept on the y axis, and b is the regression coefficient (slope), which indicates

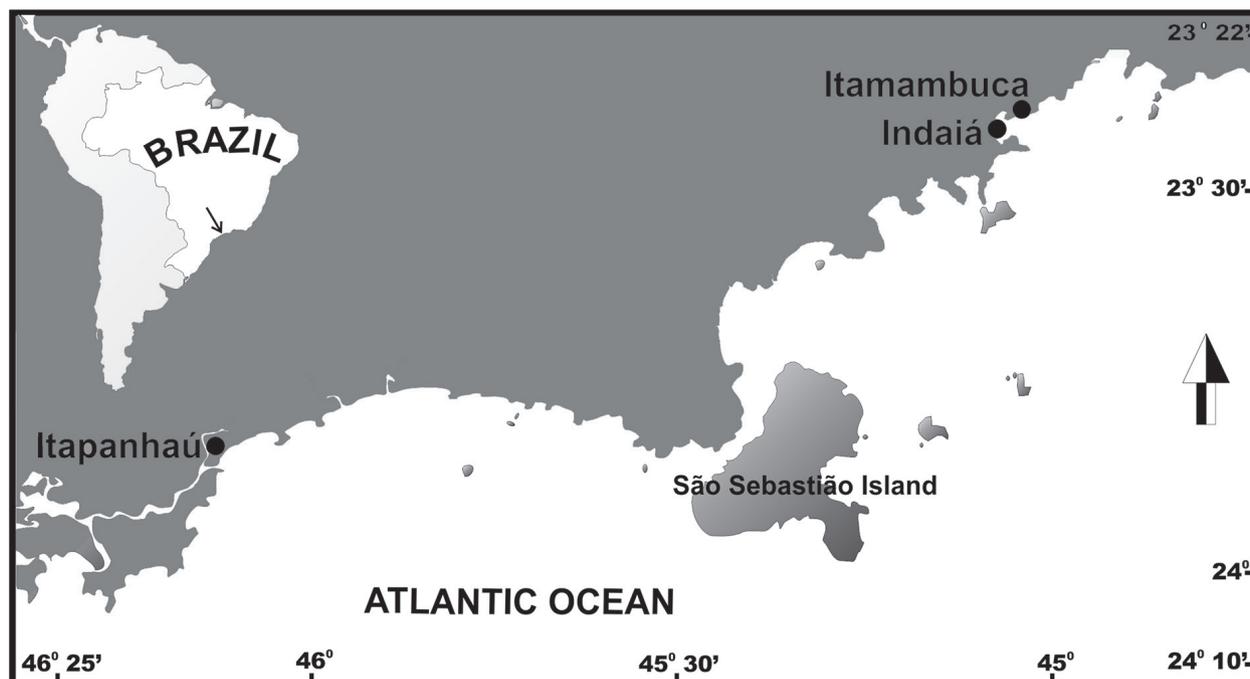


Figure 1. Locations of the three mangroves studied at latitude 23° S, of the subtropical Brazilian coast (São Paulo).

the growth rate of the body part analyzed (AW or ChL) (Hartnoll 1978). AW and ChL were chosen as dependent variables because they are important reproductive traits in fiddler crabs (Negreiros-Franozo et al. 2003, Hirose et al. 2013, Fogo et al. 2019).

To recognize the life stages of fiddler crabs (juvenile and adult) of both sexes of each population, we used the K-means clustering test, to separate the data set in two clusters. Additionally, discriminant analysis was carried out to re-allocate misclassified points, if any (Sampedro et al. 1999, Hirose et al. 2013, Chaves et al. 2019). This procedure resulted in a total of twelve regressions, considering the two life stages (juvenile and adult), the two sexes (lnCW versus lnAW regressions for females, and lnCW versus lnChL regressions for males), and the three populations (Itapanhaú, Indaiá, and Itamambuca). The growth rates of each regression were identified using Student's *t*-test to assess whether the regression coefficient *b* (slope) deviated from the expected slope *b*=1. When *b*>1, it means that the dependent variable (AW or ChL) grows at a greater rate than the independent variable (CW) (positive allometry); when *b*<1, it means that the dependent variable grows at a lower rate than CW (negative allometry); and when *b*=1, it means that both variables grow at a similar rate (isometry) (Hartnoll 1978). To assess the variation in the growth rates in the ontogeny of fiddler crabs, we used GLM - Homogeneity of slopes to compare the regression coefficients (*b*) and when slopes did not differ, we used GLM - Analysis of covariance to compare the intercepts (*a*). These analyses were also used to compare the growth rates of *M. vocator* of the same life stage and sex, among the three populations. Tukey's test was used for post-hoc analysis (Hirose et al. 2013, Chaves et al. 2019).

The size at sexual maturity of *M. vocator* was considered as the CW at which 50% of crabs

showed the reproductive traits analyzed (AW and ChL) with adult morphology. This size (CW_{50}) was obtained for both sexes, in each population of *M. vocator*, adjusting the relative frequencies of adults, in each size class (1 mm of CW) at the logistic function $y=1/(1+e^{r(CW-CW_{50})})$ by the least squares technique, setting the value of maturity (CW_{50}) by interpolation (50%) (Rufino et al. 2016, Vazzoler 1996). To compare the sexual maturity (CW_{50}) among the three populations (Itapanhaú, Indaiá, and Itamambuca), the relative size at onset of maturity (RSOM) was determined for females and males from each population (Charnov 1990, Conde & Díaz 1992, Hirose et al. 2013). The RSOM was calculated as CW_{50}/W_{∞} , where W_{∞} is the asymptotic maximum size reached by crabs (Charnov 1990). However, since we only assessed the maximum sizes of fiddler crabs in each population, the asymptotic size was estimated by the empirical equation: $W_{\infty} = CW \text{ maximum}/0.95$ (Hirose et al. 2013). This allowed determining that the W_{∞} of *M. vocator* was 22.2 mm of CW in Itapanhaú, 24.2 mm of CW in Indaiá, and 26.5 mm of CW in Itamambuca.

RESULTS

The recorded temperatures ranged from 18 °C to 31 °C. The mean temperature was lowest in winter, intermediate in spring, and highest in summer and autumn (two-way ANOVA_{season}: $F = 35.5$; $p < 0.001$). However, the temperature did not vary between the mangroves (two-way ANOVA_{mangrove}: $F = 1.93$; $p = 0.150$), (two-way ANOVA_{mangrove*season}: $F = 0.61$; $p = 0.724$) (Figure 2).

A total of 1025 fiddler crabs *Minuca vocator* were sampled in the three mangroves. The fiddler crabs were smallest in Itapanhaú (12.0 ± 4.0 mm of CW), of intermediate size in Indaiá (13.1 ± 4.7 mm of CW), and largest in Itamambuca (17.6 ± 4.6 mm of CW) (ANOVA, $F = 110.7$, $p < 0.001$).

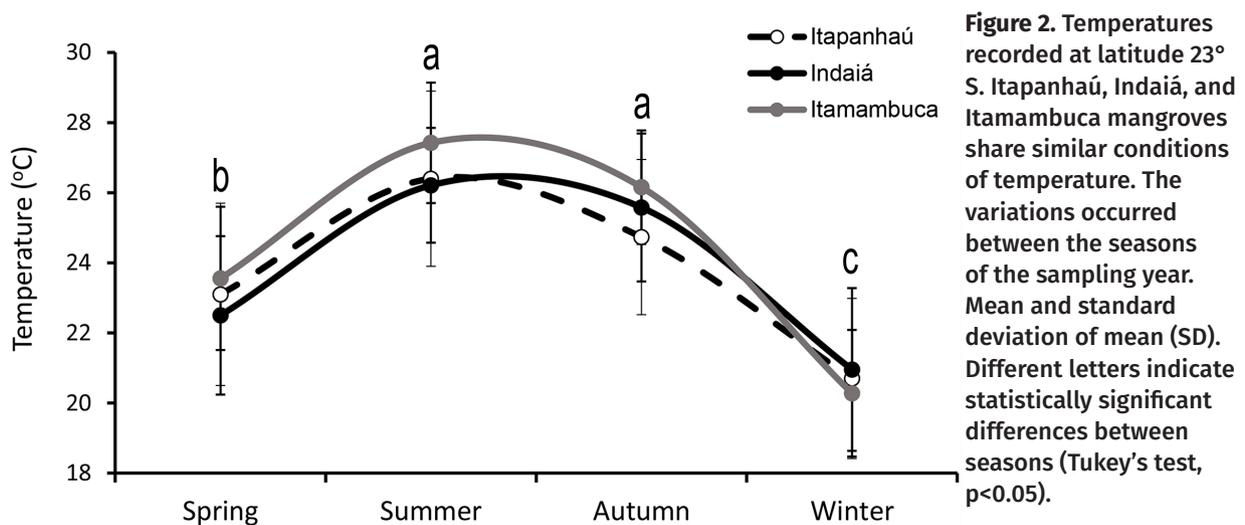


Figure 2. Temperatures recorded at latitude 23° S. Itapanhaú, Indaiá, and Itamambuca mangroves share similar conditions of temperature. The variations occurred between the seasons of the sampling year. Mean and standard deviation of mean (SD). Different letters indicate statistically significant differences between seasons (Tukey's test, $p < 0.05$).

More descriptive details about each population are shown in Table II.

The CW versus AW relationship for females and the CW versus ChL relationship for males were appropriate to detect the size at sexual maturity in *M. vocator*, since both functions showed changes in the growth pattern of dependent variables (AW and ChL) (Figure 3). The growth pattern of females showed a maturation range with females of the same size (CW) with different AW, some of which had juvenile and others adult morphology. The maturation range was established as the sizes between the smallest adult female and the largest juvenile female for each population. In Itapanhaú, such range was from 9 to 12.3 mm of CW; in Indaiá from 9.8 to 13.4 mm of CW; and in Itamambuca from 12.5 to 15.9 mm of CW (Figure 3). The growth pattern of males showed a breaking point, which separated juvenile from adult regressions. The size of males in the breaking point was 10.9 mm of CW in Itapanhaú, 11.8 mm of CW in Indaiá, and 15.1 mm of CW in Itamambuca (Figure 3). The abdomen growth rate of females showed positive allometry in both life stages (juvenile and adult) ($p < 0.05$ for all t tests). Moreover, the abdomen growth rates of juveniles were greater than those of adult females in the three

populations ($p < 0.001$ for all comparisons of slopes) (Table III). For males, the growth rate of the propodus of the major cheliped also showed positive allometry in both life stages ($p < 0.05$ for all t tests). However, the cheliped growth rates of juveniles were smaller than those of adult males in the three populations ($p < 0.05$ for all comparisons of slopes) (Table III).

The abdomen growth rates (slope = b) differed among females of the three populations at both life stages (GLM - Homogeneity of slopes, juvenile: $F = 6.52$, $p = 0.002$ and adult: $F = 4.47$, $p = 0.012$). Tukey's test showed that in Itapanhaú, the abdomen growth rates of juvenile ($b = 1.74$) and adult ($b = 1.30$) females were greater than in the other mangroves, whereas in Itamambuca, these rates were the smallest ($b = 1.47$ and $b = 1.19$ for juvenile and adult females, respectively) ($p < 0.001$). The cheliped growth rates of males also differed among the three populations at both life stages (GLM - Homogeneity of slopes, juvenile: $F = 8.04$, $p < 0.001$ and adult: $F = 6.05$, $p = 0.003$). Tukey's test showed that the cheliped growth rate of juvenile males from Itamambuca ($b = 1.38$) was smaller than that from Itapanhaú ($b = 1.49$) and Indaiá ($b = 1.64$) ($p < 0.001$). However, the cheliped growth of juvenile males from Itapanhaú and Indaiá did not differ statistically

Table II. Descriptive features of *Minuca vocator* populations from Itapanhaú, Indaiá, and Itamambuca mangroves. CW = carapace width.

		CW (mm) minimum	CW (mm) maximum	CW (mm) mean ± sd
Itapanhaú	Females	4.9	21.1	12.4 ± 4.0
	Males	4.8	20.6	11.2 ± 3.7
Indaiá	Females	6.4	23.0	13.8 ± 4.6
	Males	4.7	22.8	12.3 ± 4.7
Itamambuca	Females	6.1	25.2	18.1 ± 4.2
	Males	6	24.8	16.7 ± 5.2

($p = 0.82$). In this case, the GLM - Analysis of covariance followed by Tukey's test was carried out to compare the intercepts of regressions and the results showed the same trend: the chelipeds of juvenile males from Itamambuca grew more slowly than those from Itapanhaú and Indaiá (the values of the intercepts are shown in Table III). The Tukey's test that compared the regression coefficients of adult males showed that the cheliped growth rate was greater in Itamambuca ($b = 2.02$), intermediate in Indaiá ($b = 1.92$), and smaller in Itapanhaú ($b = 1.66$) ($p < 0.001$).

The sizes at which 50% (CW_{50}) of females and males of *M. vocator* of each population showed mature morphology of the abdomen and cheliped, respectively, are shown in Table IV. The RSOM did not differ between females and males within the populations (Table IV). However, we detected differences among populations. Itamambuca showed the greatest RSOM. In this mangrove, *M. vocator* matured 10% larger than in Itapanhaú and Indaiá, which differed only 2% from each other (Table IV).

DISCUSSION

The results of this study did not support our prediction that the growth rates and size at sexual maturity would remain stable in populations

of the same latitude range. In contrast, these life history traits differed between the three populations of the fiddler crab *Minuca vocator* assessed, which inhabit mangroves within the latitude 23° S. The studied mangroves share similar conditions of temperature, and although this environmental factor is an important regulator of the intermolt period, growth rate, and maturation size of decapods (Azra et al. 2020, De Grande et al. 2021), other factors such as food availability and quality (Terwilliger & Dumler 2001, Stumpf et al. 2020), and environmental stressors and contaminants (Conde & Díaz 1992, Harris & Santos 2000, Hosamani et al. 2017) can also affect their growth processes and body sizes. Since the studied mangroves show different local features, mainly in forest structure and sediment characteristics (Table I, Colpo et al. 2011), we suggest that these local-scale factors can be affecting the growth rates and size at sexual maturity of *M. vocator*.

Like other brachyurans, fiddler crabs show a positive correlation between reproductive output and female body size, because larger females have more space available in their body cavity for greater gonadal development, and thus can carry more eggs in their pleopods (Hines 1982, Ramirez Llodra 2002). The female abdomen in these crabs plays a key role, since it protects the brood, and its size and shape can also be a

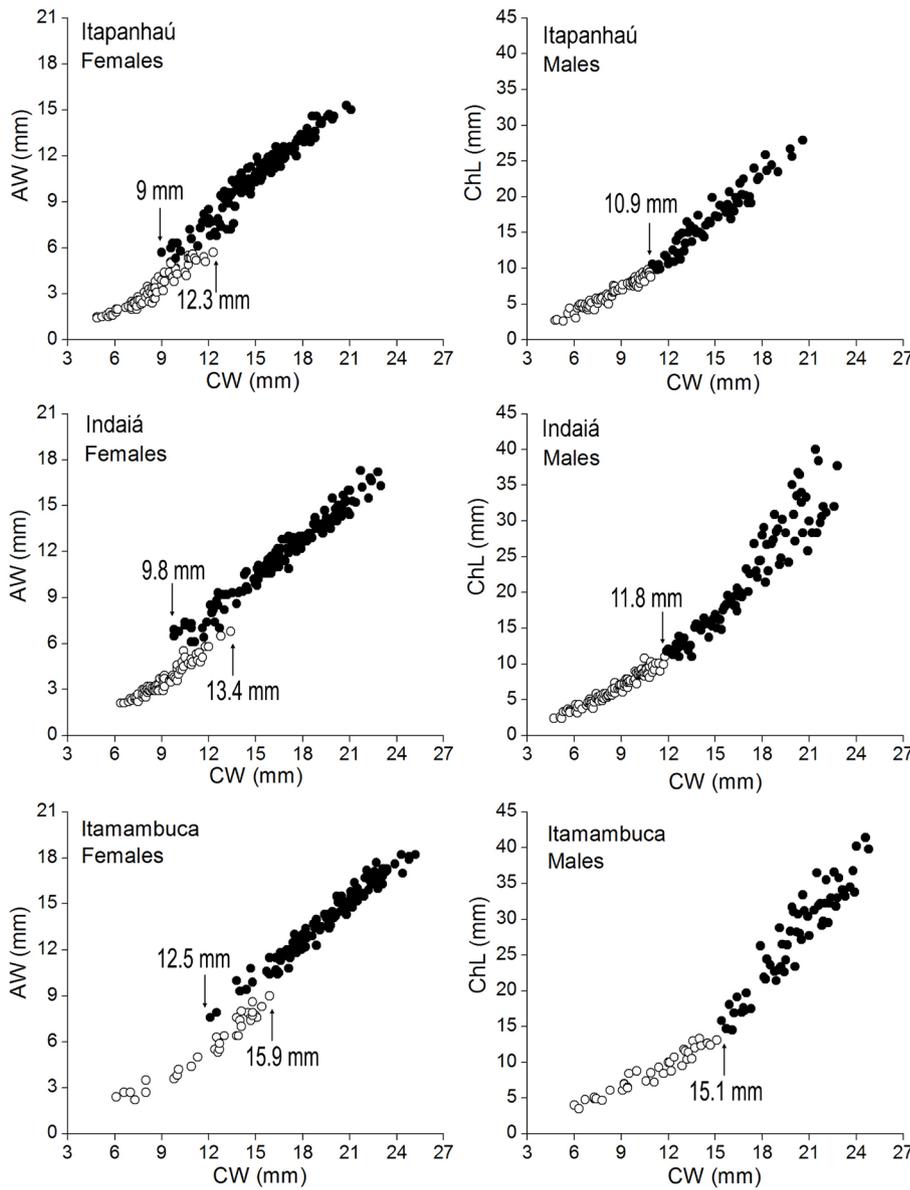


Figure 3. Scatterplots showing the allometric growth pattern of females and males of *Minuca vocator* populations from Itapanhaú, Indaiá, and Itamambuca mangroves. The relationship between carapace width (CW) and abdomen width (AW) was used to evaluate the growth of females, whereas the relationship between carapace width (CW) and length of the propodus of the major cheliped (ChL) was used to evaluate the growth of males. The juvenile (open circles) and adult (black circles) life stages were recognized by the K-means clustering test. The arrows indicate the maturation range of females and the maturation breaking point of males.

constraint factor of crab fecundity. In the three *M. vocator* populations here studied, during the preparation of the females for reproductive life, their abdomen grew at a higher rate during the juvenile phase than during the adult phase. This strong positive allometry of the abdomen before sexual maturity, followed by a reduced positive allometry during the adult stage, is a frequent pattern in crabs (Hartnoll 1974). This growth model of females has been recorded in 80% of Brazilian fiddler crab species (Castiglioni &

Negreiros-Franzozo 2004, Cardoso & Negreiros-Franzozo 2004, Hirose & Negreiros-Franzozo 2007, Pralon & Negreiros-Franzozo 2008, Araújo et al. 2012, Hirose et al. 2013, Vieira dos Santos et al. 2020, and this study). *Minuca burgersi*, however, shows an opposite trend (Benetti & Negreiros-Franzozo 2004) and the relative growth of *Minuca victoriana* has not yet been studied. In the present study, the abdomen growth rate of juvenile and adult females of the population from Itapanhaú was higher than that of the other

Table III. Morphometric analysis for each sex and life stage (J, juvenile and A, adult) of *Minuca vocator* of the populations from Itapanhaú, Indaiá, and Itamambuca mangroves. N, number of fiddler crabs. Regression parameters and coefficient of determination of transformed data (ln) using the carapace width as independent variable, and the abdomen width and the length of the propodus of the major cheliped as dependent variables to females and males, respectively. t test values that confirm the allometry of each growth phase, and results of the GLM - Homogeneity of slopes, comparing the regression coefficient (slope = b) between juvenile and adult *M. vocator* within each sex and population.

Mangroves	Sex	Life stage	N	Regression parameters		r ²	Allometry	t test (b=1)	GLM - Homogeneity of slopes	
				Intercept (ln)	slope				F	p
Itapanhaú	Females	J	77	-2.54	1.74	0.92	+	12.48	50.5	<0.001
		A	128	-1.16	1.30	0.92	+	8.62		
Indaiá	Females	J	80	-2.54	1.72	0.93	+	13.89	107.3	<0.001
		A	127	-0.89	1.19	0.95	+	8.21		
Itamambuca	Females	J	33	-1.95	1.47	0.95	+	7.95	33.3	<0.001
		A	116	-0.92	1.19	0.96	+	8.49		
Itapanhaú	Males	J	90	-1.31	1.49	0.93	+	11.45	5.6	0.019
		A	66	-1.67	1.66	0.93	+	11.37		
Indaiá	Males	J	118	-1.67	1.64	0.94	+	15.09	22.2	<0.001
		A	92	-2.38	1.92	0.93	+	15.92		
Itamambuca	Males	J	37	-1.16	1.38	0.95	+	6.83	35.9	<0.001
		A	61	-2.77	2.02	0.89	+	11.25		

two populations. Despite this higher abdomen growth, the population from Itapanhaú matured at the smallest size and reached the smallest body size. Thus, the abdomen growth pattern could be compensating their small dimensions. In this mangrove, the females reached sexual maturity at 10.7 mm of CW, and juvenile females of the size class preceding puberty (9 -10 mm of CW) showed an abdomen 13% and 15% larger than females of the same size class from Indaiá and Itamambuca, respectively. Since a larger abdomen increases the crab's capacity to carry eggs (Ramirez Llodra 2002, Sharma et al. 2017), the highest growth rate of female abdomen can minimize the limiting effects of the size on the reproductive output of *M. vocator* in Itapanhaú. Despite this, the *M. vocator* fecundity in Itapanhaú and Indaiá was lower than in Itamambuca (Colpo & Negreiros-Franzo 2003).

In male fiddler crabs, the major cheliped is an important morphological sexual trait, because this appendage is displayed to attract females and used in fights with other males to protect the mating burrow (Crane 1975, Fogo et al. 2019). In the three populations of *M. vocator* here studied, the growth rate of chelipeds was higher in adult than in juvenile males. This growth pattern has been recorded for all Brazilian species of the genus *Minuca* (Benetti & Negreiros-Franzo 2004, Castiglioni & Negreiros-Franzo 2004, Araújo et al. 2012, Vieira dos Santos et al. 2020). The strong positive allometry after maturity can be due to the fact that larger/older males with larger cheliped size are preferred by female fiddler crabs (Reaney 2009, Callander et al. 2012, Hayes et al. 2013). Therefore, keeping an increase in the cheliped size even after puberty is beneficial for males, because it allows them

Table IV. Sizes at which 50% (CW_{50}) of females and males of *Minuca vocator* of each population (Itapanhaú, Indaiá, and Itamambuca) reached sexual maturity and their respective relative size at onset of maturity (RSOM).

	Size at sexual maturity (CW_{50}) (carapace width in mm)		Relative size at onset of maturity (RSOM)	
	Females	Males	Females	Males
Itapanhaú	10.7	10.5	0.48	0.48
Indaiá	11.1	11.2	0.46	0.46
Itamambuca	14.6	14.9	0.55	0.56

to improve their reproductive success. In the present study, the growth rate of the major cheliped was higher in juveniles of Itapanhaú and Indaiá than in juveniles of Itamambuca. This increased allometry during the juvenile phase can enhance the courtship behavior and the reproductive performance of these small males at the onset of sexual maturity. However, the enlarged appendage of male fiddler crabs has an important physiological cost, since it demands high energy expenditure for its growth, maintenance and display during reproductive activities (Matsumasa & Murai 2005, Allen & Levinton 2007, Colpo & López-Greco 2018). The resources destined to the growth of the cheliped depend on the energetic demands and conflicts with other life history traits (Allen & Levinton 2007). The different cheliped growth rates of the adult males between the three populations studied could be a response to the local features of each mangrove, which probably represent distinct values of resources and energetic demands.

Crab maturation involves costly physiological and morphological processes (Paul & Fuji 1989, Colpo & López-Greco 2018, Marciano et al. 2021), suggesting that the size or age in which an individual reaches sexual maturity depends on a trade-off between energy assignment to maturation, maintenance, and growth. Considering that the three populations of *M. vocator* here studied inhabit

the same latitude range and experience similar conditions of temperature, we suggest that the different maturity sizes recorded could be a consequence of the contrasting local conditions among mangroves, which can imply differences in the availability of resources or in the requirement of physiological costs. The amount of food resources available in each mangrove could have affected the energetic budget of *M. vocator*, and thus, promoted the different sizes at maturity. Since fiddler crabs feed on the sediment, the contents of organic matter and nitrogen of substrates are usually considered food resources that affect the growth of these crabs (Miller 1961, von Hagen 1987, Sayão-Aguiar et al. 2012). In a previous study (Colpo et al. 2011), we recorded that the mangrove of Indaiá showed sediments with lower organic matter and nitrogen contents than that of Itapanhaú and Itamambuca. These data suggest that the *M. vocator* population of Indaiá would have less food available, a fact that may have affected its growth performance, resulting in small size at sexual maturity. It is important to point out that, in 1983, 35 million liters of oil spilled into the Itapanhaú mangrove zone (Lamparelli et al. 1997, Santos et al. 2012, Dourado et al. 2012). Considering that oil and oil residues can remain in marsh sediments for decades (Turner et al. 2019), the high values of organic matter and nitrogen recorded in the sediment of Itapanhaú can represent poor quality food for *M. vocator*.

Moreover, petroleum residues have negative long-term effects on fiddler crabs, affecting their behavior and feeding rate (Culbertson et al. 2007). Therefore, the *M. vocator* population of Itapanhaú would be under the stress promoted by the contaminants and few and poor-quality food resources. Probably, such fact negatively influenced its energetic budget, resulting in a smaller size at sexual maturity. In contrast, the greater organic matter and nitrogen content in the sediment of Itamambuca would indicate abundant food resources for fiddler crabs. In this mangrove, the growth of *M. vocator* was greater, and females and males reached sexual maturity at larger sizes than the other two populations studied. The mangrove of Itamambuca seems to show good conditions for the establishment and development of fiddler crabs, since *M. burgersi* and *Minuca rapax* also show larger sizes at sexual maturity in this mangrove, compared to other areas (Benetti & Negreiros-Franozo 2004, Castiglioni & Negreiros-Franozo 2004). Additionally, the size at sexual maturity and the RSOM that we recorded to *M. vocator* populations of Itapanhaú and Indaiá were similar to recorded to this species at the latitude 1° S (Koch et al. 2005), suggesting that these traits of *M. vocator* can be more influenced by local-scale features than latitudinal scales.

The differences recorded in the growth patterns and size at sexual maturity between the three *M. vocator* populations studied in the present work suggest plasticity and responsiveness to local-scale environmental variations, since pelagic larvae ensure the genetic connectivity of populations (Laurenzano et al. 2012, Marochi et al. 2017), especially considering short distances, within the same latitude. To increase the probability of survival under differing environments, plasticity affects species fitness, since that is the result of selecting a pattern for optimal energy allocation between

maintenance, reproduction, and somatic growth (Caswell 1983, Reznick et al. 2000, Reedy et al. 2016). The results of the present study showed that, despite inhabiting mangroves within the same latitude, the three populations of the fiddler crab *M. vocator* showed contrasting body size, size at sexual maturity and fecundity (Colpo & Negreiros-Franozo 2003) among these mangroves. In Itapanhaú, this fiddler crab showed the lowest growth performance and reproductive output, suggesting that the local environmental conditions prevent *M. vocator* to attain its maximum fitness, whereas, in Itamambuca, *M. vocator* showed maximum growth performance and reproductive output.

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