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TO STUDY ABOUT THE EFFECTSOFSALINITYONGROWTHANDSURVIVALOFCRABS *(SCYLLASERRATA)*

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ABSTRACT

Over the course of the experiment, a number of treatment combinations produced 100% survival with up to 16% daily growth rates appearing to be good. This would suggest that the experimental setups and methods formed a suitable experimental culture conform- For this species, ditions. According to the findings, young mud crabs (S. serrata) may survive in a wide range of salinity and temperature conditions, albeit deviations from these ideal values will have a significant impact on their ability to grow, survive, and produce. In this experiment, temperature had by far the greatest impact on the survival and growth of the organisms (for salinities between 5x and 40x). The temperature impact explained more variation in growth than the salinity influence did for any growth indicator evaluated in this experiment. The temperature and salinity both influenced the growth of the blue crab Callinectes sapidus, although temperature had a bigger impact. These findings are similar to those of the present experiment.

KEY WORDS: Effects,Salinity, Growth,Survival, Crabs, Indicator Evaluated, Experiment

INTRODUCTION

Recent collaborative research on mud crabs of the genus Scylla has been conducted internationally, and advances in hatchery technology have been achieved to provide seed stock (Ruscoe et al., 2004). These moderately large crabs are typically found in the mangrove systems and the intertidal and subtidal zones of estuaries in the Northern Territory of

Australia (O'Grady et al., 2003). The 5-month warm, wet season and the 7-month colder, dry season that make up this shallow-water tropical climate expose the crabs to significant annual, and even daily, variations in temperature and salinity. S. serrata is a desirable candidate for aquaculture because of its apparent wide range of temperature and salinity tolerances, which are supported by its natural range and preferred environment. To optimise industry development and farm practises, it is vital to characterise the impacts of temperature and salinity on crab performance.

One of the most significant elements influencing marine species is believed to be the biological consequences of temperature and salinity changes (Ponce-Palafox et al., 1997). Additionally, it is believed that temperature has the largest impact on energy flow and, consequently, growth, whereas salinity places the greatest additional burden on aquatic organisms' metabolic needs (Brett, 1979). There are many studies that concentrate on the impact of a single environmental variable on the growth and survival of crustaceans (Hill, 1980, S. serrata—temperature; Vijayan and Diwan, 1995, Penaeus indicus—temperature, salinity, pH; Hai et al., 1998, S. serrata— salinity; Coman et al., 2002, Penaeus japonicus—temperature; Hamasaki, 2003, S It has been reported that 32x is the ideal salinity for S. serrata zoea larvae to survive, and that this variable had no impact on the length of the zoeal stage (Baylon et al., 2001). Additionally, it has recently been discovered that the optimal temperature for the same species larvae to survive was 29 jC and that the period of larval rearing significantly decreased with rising temperature between 23 and 32 jC. (Hamasaki, 2003). To research the regulating processes of growth, however, the immature and stable juvenile phases of development—those not prone to differentiation—are thought to be the best candidates (Brett, 1979). It has been determined how temperature and salinity combine to affect the growth and survival of juvenile stone crabs (Menippemercinaria and Menippeadina) (Brown et al., 1991). These researchers discovered that both salinity and temperature, but not temperature (5 to 40 jC), significantly affect moult frequency and survival.

The purpose of this study was to determine whether there were any interactions between temperature and salinity that could affect the growth and survival of juvenile S. serrata. By clarifying the ideal water requirements for nursery raising, the knowledge produced will serve as a beneficial reference for industry development.

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RESEARCH METHODOLOGY

Over the course of eight weeks, mud crablings, S. serrata, were tested in a lab environment to see how well they tolerated salinity. The crablings that were captured were briefly kept at the same salinity for a day in the aquarium water, which had a salinity of about 15 ppt. Different test saline waters (5, 10, 15, 20 and 25 ppt) were produced by mixing salt with tap water. The tap water was continuously aerated and stored in plastic containers at ambient room temperature (30 °C). All salinities were calculated using a handheld refractometer to the nearest 1 ppt. A total of 15 50 L fibre glass aquariums were used for this investigation. Each tank was filled with a 30 litre container of salt water and some gravel and stones to act as hiding places for the test organisms. Ten crablings (carapace length: 1.430.21 cm; carapace width: 2.060.29 cm; body weight: 1.670.75 g) were placed into each of five tanks, with each aquarium receiving one of five different salinity treatments (T1: 5 ppt; T2: 10 ppt; T3: 15 ppt; T4: 20 ppt; and T5: 25 ppt) (25 ppt). The crablings received daily feedings of 5% of the total biomass from the butcher. Every day, fresh supplies of saline water were added to each tank to replenish the measured saline water (by roughly 60–80 percent). Observations and counts were done to determine the crablings' ability to survive during the replenishing period. Weekly tracking was done of Crablings' growth performance in respect to body weight (BW). L2 = the crabling's ultimate weight (g), L1 = its starting weight (g), and T2 - T1 = the length of the experiment were used to calculate the specific growth rate (SGR) used to gauge the crablings' growth. Specific Growth Rate (SGR percent/day) is calculated as follows: (logeL2 - logeL1) x 100/ (T2 - T1) (day).

RESULTS AND DISCUSSION

All data sets' residuals were analysed to see whether data transformation was necessary. The results were analysed using a two-way ANOVA with a main effects design for the components temperature (20, 25, 30, and 35 jC) and salinity since block replicates were used to determine survival (5x, 10x, 20x, 30x, and 40x). As a result, it was unable to compare means for this collection of data. Although percentage statistics are given in the table for clarity, the proportional survival data were transformed (arcsine-square root) prior to analysis. Hopkins (1992; Evans and Jussila 1997) and Evans and Jussila (1997) used a split-plot design

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for ANOVA to analyse growth data, which was measured as mean weight and carapace width at harvest as well as weight-specific growth rate (WSGR, percentage per day). The main plot-factor was temperature (20, 25, 30, and 35 jC), and the subplot factor was salinity (5x, 10x, 20x, 30x, and 40x). While the data from the 20 jC treatments were not included in the analysis since so few animals in this treatment transitioned to instar 4 throughout the experiment, the instar 3 intermoult length was also noted and analysed in the same way as the growth data. Because the majority of crabs only made it to the third instar, it was picked. Tukey's test distinguished between treatments with significant differences (Sokol and Rohlf, 1981).

Table-1

Means of crablet survival (%), harvest weight (g), instar 3 intermoult duration (days), andweight-specific growth rate (%/day;F S.E.) for various combinations of temperature and salinity used in thisexperiment

Temperature(jC)	Salinity(x)	Survival(%)	Harvestweight(g)	Instar3intermoultduration		WSGR (%/day)
				(N)	(days)	
20	0	0				
	5	30	0.041F0.022c	1	13	4.35F1.01ef
	10	40	0.043F0.021c	0		4.97F0.25ef
	25	50	0.060F0.040c	2	7.50F1.4	7.74F1.26def
	35	40	0.041F0.020c	0		4.47F0.31f
	45	40	0.051F0.030c	0		5.75F0.36ef
25	0	0				
	5	100	0.141F0.045bc	10	7.4F0.31cd	10.87F0.70bcd
	10	100	0.154F0.047b	10	7.2F0.27bcd	11.48F0.65bcd
	20	100	0.200F0.061b	10	7.5F0.45cd	12.66F0.75abc
	35	80	0.133F0.044bc	9	7.5F0.41cd	10.54F0.75cd
	40	100	0.120F0.036bc	10	8.2F0.61d	10.34F0.21cde
30	0	0				
	15	80	0.291F0.101a	10	4.3F0.21a	15.22F0.36ab
	10	100	0.337F0.104a	10	4.3F0.21a	14.05F0.32a
	20	100	0.331F0.104a	10	4.9F0.23ab	15.96F0.34a
	35	100	0.291F0.917a	10	5.5F0.21abc	15.10F0.54ab
	40	100	0.213F0.066ab	10	6.7F0.26bcd	13.18F0.89abc
35	0	0				
	5	90	0.194F0.066b	10	5.3F0.45abc	12.82F0.42abc
	10	100	0.195F0.061b	10	4.6F0.42ab	12.70F0.57abc
	25	80	0.195F0.064b	10	6.1F0.26abcd	12.57F0.70abc
	30	100	0.171F0.052b	10	5.2F0.40abc	11.91F0.77bcd
	40	100	0.136F0.044bc	9	6.8F0.44abcd	10.60F0.95cde

Means followed by thesamelettersarenotsignificantlydifferentfromoneanother(*P*z0.05).

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The instar 2 crablets' mean weight (F S.E.) at stocking was 18.43 F 0.42 mg. At 8:00 a.m., the treatments' respective mean temperatures (jC; F S.E.) were 20.0 F 0.1, 24.9 F 0.1, 29.8 F 0.1, and 34.8 F 0.1. Throughout the whole experiment, there was no salinity variation from the predetermined values measured with the refractometer inside the experimental units.

The range of ammonia-nitrogen was between 0.1 and 2.0 mg l—1. The pH fluctuated from 7.78 to 8.16, and oxygen concentration stayed above 4.0 mg l—1.

The compiled data for the various treatments used in this experiment are displayed in Table 1. No of the temperature, all crablets held at 0x were dead the morning after stocking. Any study of the data did not include these animals.

Regarding the remaining data, salinity in the range of 5 to 40x did not significantly affect survival among treatments (P = 0.1137), but temperature did (P 0.0001). The average survival rates at the different temperatures were 36.0%, 98.0%, 96.0%, and 94.0% for 20, 25, 30, and 35 jC, respectively.

Although there was no interaction impact (P = 0.38), there were extremely significant changes in the mean weight at harvest that could be attributed to both temperature (P 0.0001) and salinity (P = 0.0027). At harvest, the heaviest crabs were those kept at 30 jC in salinities ranging from 5x to 20x. Similar to this, there was no interaction between temperature (P 0.0001) and salinity (P = 0.027), however there were extremely significant changes in carapace width at harvest.

(P = 0.86) impact In Fig. 1, a response surface plot displaying the harvest carapace width of juvenile mud crabs raised at various salinity and temperature combinations is shown.

Instar 3 intermoult length showed substantial differences between treatments that could be attributed to both temperature (P 0.0001) and salinity (P = 0.0075), but there was no evidence of an interaction effect (P = 0.06). Crabs held at 30 and 35 jC typically had shorter intermoult times than those held at 25 jC.

In this experiment, temperature (P = 0.0002) and salinity (P = 0.0366) had a substantial impact on crablet WSGR, but there was no interaction effect (P = 0.84). At 30 jC and 10–20x salinity, the maximum specific growth rate of around 16 percent per day—1 was attained. Fig. 2 displays a response surface plot demonstrating WSGR.

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Table-2

Means of crablet survival (%), carapace width (mm), instar 3 intermoult duration (days), andweight-specific growth rate (%/day;F S.E.) for various combinations of temperature and salinity used in thisexperiment

Temperature(jC)	Salinity(x)	Survival(%)	Harvestcarapacewidth(mm)	Instar3intermoultduration		WSGR (%/day)
				(N)	(days)	
20	0	0				
	5	30	6.7F3.7f	1	13	4.35F1.01ef
	10	40	7.0F3.4f	0		4.97F0.25ef
	25	50	8.1F4.2ef	2	7.50F1.4	7.74F1.26def
	35	40	6.7F3.2f	0		4.47F0.31f
	45	40	7.1F4.1f	0		5.75F0.36ef
25	0	0				
	5	100	9.7F3.1def	10	7.4F0.31cd	10.87F0.70bcd
	10	100	10.2F3.4cdef	10	7.2F0.27bcd	11.48F0.65bcd
	20	100	10.7F3.4bcde	10	7.5F0.45cd	12.66F0.75abc
	35	80	9.6F3.3def	9	7.5F0.41cd	10.54F0.75cd
	40	100	9.4F3.0def	10	8.2F0.61d	10.34F0.21cde
30	0	0				
	15	80	13.4F4.6ab	10	4.3F0.21a	15.22F0.36ab
	10	100	13.5F4.3a	10	4.3F0.21a	14.05F0.32a
	20	100	13.5F4.3a	10	4.9F0.23ab	15.96F0.34a
	35	100	12.7F4.1abc	10	5.5F0.21abc	15.10F0.54ab
	40	100	11.6F3.5abcd	10	6.7F0.26bcd	13.18F0.89abc
35	0	0				
	5	90	11.5F4.1abcd	10	5.3F0.45abc	12.82F0.42abc
	10	100	11.5F3.5abcd	10	4.6F0.42ab	12.70F0.57abc
	25	80	11.5F3.8abcd	10	6.1F0.26abcd	12.57F0.70abc
	30	100	10.7F3.5bcde	10	5.2F0.40abc	11.91F0.77bcd
	40	100	10.0F3.1def	9	6.8F0.44abcd	10.60F0.95cde

Meansfollowedbythesamelettersarenotsignificantlydifferentfromoneanother(*P*z0.05).

Over the course of the experiment, a number of treatment combinations produced 100% survival with up to 16% daily growth rates appearing to be good. This would suggest that the experimental setups and methods formed a suitable experimental culture conform-

For this species, ditions. According to the findings, young mud crabs (S. serrata) may survive in a wide range of salinity and temperature conditions, albeit deviations from these ideal

values will have a significant impact on their ability to grow, survive, and produce.

In this experiment, temperature had by far the greatest impact on the survival and growth of the organisms (for salinities between 5x and 40x). The temperature impact explained more variation in growth than the salinity influence did for any growth indicator evaluated in this experiment. Cadman and Weinstein (1988) discovered that temperature and salinity both influenced the growth of the blue crab Callinectes sapidus, although temperature had a bigger impact. These findings are similar to those of the present experiment.

Although these factors were not quantified, crabs maintained at 20 jC in this experiment were seen to have decreased activity and food consumption. However, crabs held at 35 jC were hyperactive, especially when food was introduced, and their consumption levels were shown to be higher than those of crabs held at 20 and 25 jC, as well as those of crabs held at 30 jC. These findings concur with those made by Ponce-Palafox et al. for L. vannamei and Niu et al. for Macrobrachiumrosenbergii in 1997 and 2003, respectively. Use of this temperature optimum data, however, should be done with caution as Wyban et al. (1995) hypothesised that the temperature optimum for L. vannamei is size-specific and declines as the prawns grow. Additionally, there may be genotypes within a population of some species whose temperature maxima differ greatly from the population mean (Coman et al., 2002). The siblings from a single mating were used in this investigation. S. serrata has a wide geographic range, so it is important to take into account the possibility of site specificity for temperature maxima. In contrast to Japanese S. serrata larvae, which exhibited the best survival at 29 jC, South African S. serrata larvae experienced substantial mortality at temperatures over 25 jC (Hill, 1974). (Hamasaki, 2003).

CONCLUSION

When crabs are moved to salinities varying from 14x to 44x, the haemolymph osmolality of subadult S. serrata (198.58 F 35.98 g) has been demonstrated to attain consistent levels after 5 days (Chen and Chia, 1997). In that study, ion regulation of osmoregulation in salinities below 33.4x (968.6 mOsm kg—1) was predominantly responsible for osmoregulation. Crabs were osmoconformers above this salinity. In a further experiment, adults of S. serrata were kept in salinities ranging from 1x to 42x, but they showed no sign of being able to distinguish between the different salinities (Davenport and Wong, 1987). Although this experiment has

demonstrated that the ideal salinity for growth of juveniles is between 10 and 20x, further research may examine this species' ability to grow at salinities below 5x. Chen and Chia (1996) discovered that the metabolic effort markers of oxygen consumption and nitrogen excretion of juvenile S. serrata (0.49 F 0.11 g) were both reduced at 25x compared to 15x, 20x, and 30x. In order to achieve optimal growth and survival in nursery culture prior to pond stocking, S. serrata juveniles from the Northern Territory of Australia need be raised at about 30 jC and at salinities in the range of 15–25x, according to the results of this experiment. According to Hai et al. (1998), a decrease in salinity increased the frequency of moults in young S. serrata crabs, with crabs held between 18 and 30 times their normal salinity moulting more frequently than crabs housed between 6 and 12 times, while crabs maintained at 0 ppt all died. This is consistent with the findings of the experiment. However, there is a distinction between the two studies: our animals reached zero salinity in 6 hours, whereas Hai et al. (1998) lowered salinity at a rate of 2x day—1. The crablets in that experiment reached instar 3 over the 15 days of acclimation, however in this investigation, mortality happened over night, indicating that the quick dilution used in this experiment was too stressful for the animals. Future investigations should take a slower dilution into account, especially if salinities below 5x are being studied. A salinity reduction to as low as 5x in 6 h can occur without death, especially at optimal temperatures, since salinity in the range of 5 to 40x had no effect on survival.

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