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Effect of water quality parameters on growth and survivability of mud crab (*Scylla tranquebarica)* in grow out culture at Kakinada coast, Andhra Pradesh

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Abstract
An experiment was carried out to study the effect of physico chemical properties of water such as Salinity, Temperature, pH, DO, Ammonia, Nitrate and Nitrite on growth and survivability of mud crab (*Scylla tranquebarica*) in grow out culture in a brackish water fish farm at Fisheries Research Station – Kakinada. The experiment has been started with pond preparation which includes drying, ploughing and culturing with excellent prebiotic and probiotic. Natural seed was purchased and stocked at no.200/0.5 acre pond and fortnight sampling has taken to see the survival and growth associated with the water quality parameters. The study notify that among the water quality parameters salinity plays very important role as it decreases to the 10.5 ppt while the survival rate has been dropped from 87 to 45 percentage. At the same time ADGR/g day-1 has been dropped from 2.68 g to 0.97 g when salinity decreased. In addition to that DO also affect survivability and growth, due to the slight changes in temperature. But the rate of survivability has been constant when salinity has maintained at range of 15 – 25 ppt. So, among the water quality parameters the salinity was limiting factor for determining the survivability and growth of the crablets in the grow out culture.

Keywords: Water Quality Parameters, Survivability, Salinity and Growth.

1. Introduction
Commercial scale mud crab culture is fast developing in the coastal areas of Andhra Pradesh. The resources are very productive and suitable for the crab farming in the Godavari and Krishna estuaries. The greater scope and much importance for the development of crab farming in order to increasethe production as well as securing the livelihood for the fishers and coastal communities. The common mud crabs are *Scylla serrata* and *Scylla tranquebarica* are having comparative advantage that, it grows to a maximum size of 1.5 kg, will not cause any damage to bunds or fencing arrangements in the culture system, disease resistance, less susceptible to the epidemic disease, good market demand, wide tolerance to the temperature and salinity, and greater scope in the export market as well as in the domestic market [1]. A package of technology for culturing of crab in coastal ponds and seed production has been initiated by the R & D.

However, the package of technology for the adoption of new techniques, institutional interventions for the standardization and commercialization of seed and feed technologies for culture system may be no longer effective to produce the economic sustainable yield unless has control over sudden fall and rise of the temperature and salinity in the coastal regions. Because the temperature and salinity and other water quality parameters directly affects feed efficiency, growth rates of crab health and survival. Now a days these parameters have not been constant for a period of time due to the obvious reason that climate change in the environment. These results aquaculture system was facing mass mortality of production when it comes to the farmer's hand. To address these issues Fisheries Research Station, Kakinada has taken keen interest on to study the effectiveness of the water quality parameters in the survivability and growth of the crabs.

2. Materials and Methods
2.1. Study area
0.5 acre of Brackish Water Fish Farm of Fisheries Research Station (FRS), Kakinada, East Godavari District, Andhra Pradesh.

2.2. Pond preparation
HDPE net (5 cm mesh and 1.2 m height) was fixed with casuarinas poleson pond periphery to prevent migration and erected hide outs in pond.The crab bio security is very essential for the controlling the causative agents & disease carriers (snakes, birds & dogs etc.) to enter into the pond. The fenced net made up of HDPE material having durability and strength. This helps to protect from the unwanted animals and from the disease outbreak of epidemic diseases through the carriers.

2.3. Hiding pots
In case of the crab farming the hiding pots are playing very important role especial in the moulting stages. These hiding pots can cover the moulting crab from the other animals. Each pond kept 25 earthen pots/0.5 acres are recommended for the better survival in the moulting stages.

2.4. Stocking
After pond Preparation in Brackish water fish farm, the crablets were purchased (200) in the local markets @ Rs. 20 per crab. The crab hiding pots are kept in the pond as the crabs are highly cannibalistic especially on moulted animals. Crabs are fed with trash fish daily at 10% of body weight.

2.5. Water quality parameters
Fresh tidal water from creek was used for filling of pond.Water quality parameters such as Temperature, pH, Salinity and Dissolved Oxygen (DO) were monitored fortnightly using portable instruments, while critical parameters such as unionised ammonia (NH_3), Nitrate and nitrite (NO_2) were estimated fortnightly, following titration methods as per APHA [2].

2.6. Crab sampling and growth study
Representative numbers of crabs were collected at fortnightly intervals as well as at final harvest and length and weight measurements were recorded. The crabs were harvested at the end of 90 days of culture. The following growth parameters were enumerated as per the methods described by Salama and Al-Harbi [3]: Average daily growth rate (ADGR g day^{-1}) = W_2-W_1/d, Where, W_1 = Initial mean weight (during first/ previous sampling), W_2 = Final mean weight (during subsequent sampling) and 'd' = Number of days between samplings. Survival rate (SR %) = N_2/N_1 X 100, Where, N_1 = Initial number of fish and N_2 = Number of fish harvested. Biomass increase (BI) was calculated as the difference in the biomass (in kg) between sampling.

3. Results and Discussion
Various water quality parameters recorded during the culture period were presented in Table 1. Salinity was observed between 10.4 to 33.2‰ (mean: 25.48‰); temperature ranged from 28.6 to 30.4 °C (mean: 29.5 °C); dissolved oxygen level varied between 5.5 to 6 mg l^{-1} (mean: 5.5 mg l^{-1}). Ammonia level ranged between 0.02 to 0.03 mg l^{-1} (mean: 0.021 mg l^{-1}) and nitrite level varied from 0.01to 0.02 mg l^{-1} (mean: 0.021 mg l^{-1}). The Mean weight, mean length and ADGR of the *Scylla tranquebarica* were noted and every 15 days intervals are shown in Table 2. ADGR was noted throughout the experimental period in average 2 g/day. The feed for the crabs were used mainly trash fish and tilapia meat due to the low cost and availability near the Kakinada harbour and fed with 10% body weight to the crabs during the culture period. But in case of the survival rate (SR) shows significantly low and having only 40% survival at the end of the culture period.

Table 1: Water quality parameters recorded during culture of *Scylla tranquebarica*

Water quality parameters	Temperature (ºC± SD)	pH (± SD)	Salinity (‰ ± SD)	DO (mg^{-1}± SD)	NH_3 (mg^{-1}± SD)	NO_2 (mg^{-1}± SD)	NO_3 (mg^{-1}± SD)
0th Day	29.2 ± 0.2	7.4 ± 0.1	32.6 ± 0.4	5.5 ± 0.12	0.02 ± 0.002	0.025 ± 0.002	0.015 ± 0.008
15th Day	30 ± 0.2	7.2 ± 0.1	23.4 ± 0.2	5.5 ± 0.14	0.02 ± 0.002	0.015 ± 0.002	0.015 ± 0.002
30th Day	30.4 ± 0.3	7.2 ± 0.1	29.6 ± 0.2	5.5 ± 0.86	0.02 ± 0.002	0.015 ± 0.008	0.015 ± 0.002
45th Day	28.6 ± 0.2	7.4 ± 0.2	10.4 ± 0.2	5.5 ± 0.14	0.03 ± 0.002	0.020 ± 0.004	0.020 ± 0.004
60th Day	28.8 ± 0.2	7.2 ± 0.1	33.2 ± 0.5	6.0 ± 1.26	0.02 ± 0.004	0.015 ± 0.002	0.03 ± 0.002
75th Day	30.4 ± 0.3	7.4 ± 0.1	20.6 ± 0.4	5.5 ± 0.58	0.02 ± 0.002	0.015 ± 0.008	0.02 ± 0.002
90th Day	29.2 ± 0.2	7.4 ± 0.2	28.6 ± 0.2	5.5 ± 0.86	0.02 ± 0.004	0.015 ± 0.002	0.015 ± 0.002

Table 2: Mean growth, ADGR and SGR of *Scylla tranquebarica* fortnightly intervals

Days	Mean weight (± SE) (g)	*ADGR g day-1	Mean length (± SE) (cm)
0th Day	53±3.19	1.25	6.97±0.21
15th Day	71.8±7.80	2.68	8.04±0.37
30th Day	112±2.44	0.97	9.02±0.71
45th Day	126.6±3.06	2.30	10.05±0.73
60th Day	161.2±3.70	2.08	12±0.83
75th Day	192.5±3.30	2.00	14.05±0.51
90th Day	222.6±18.19	--	16.2±0.89

*Average daily growth rate

Firstly the survival rate (%) was shown in the Table No 3, it observed that survival of crablets has decline from 100% to 40% (mean: 63.57%), this drastic fall of survival rate of the crablets causes severe loss of the production in the culture system. At the same time salinity having sudden drop from the 29.6 ppt to 10.4 ppt and shows significant effect on survival rate. This infers that salinity fluctuations cause's mass mortality of the crablets in between the 30th to 45th days. In other hand temperature had slight changes shows indirect effect on survivability due to the lowering of dissolved oxygen. So these two limiting factors are directly or indirectly affecting the survival of the crablets in the culture period rather that other water quality parameters. This is clearly shown in the following table. 3 and Fig 1. Secondly factor is

cannibalistic nature of mud crabs may also be another reason for the poor survival of the crab. But the safety measures were taken to reduced cannibalistic nature by using hiding pots which is made by the clay or PVC pipes. So based on the inference, salinity was the main key factor to determine the survivability of the crabs in the present study. The drastic fall of salinity from 29.6‰ to 10.4‰ was effected the survival of the crablets from 87% to 45% in between 30th day to 45th day (Table No 3. & Fig.1), these were similar with previous study of Brick [4]; Hill [5] and Ong [6], who has reported sudden change of salinity below 8 ppt resulted in death of crabs.

100% survival was recorded in the crab without acclimation at average 32.6 ppt, which was indicating the euryhaline nature of the crabs, present study corroborated with previous study of Nair [7] and Marichamy [8]. Mud crabs are highly tolerant to varying salinity conditions ranging between Salinity 10 ppt to 34 ppt, PH - 8.0 to 8.5, Temperature – 23 ºC to 30 ºC and Dissolved oxygen content should be more than 3 ppm [9], so brackish water would be ideal for crab culture and fattening operation of crabs. The mud crab species *S. serrate* is known to occur in water bodies having a range of salinity from to 8ppt to 45 ppt reported by Jones and Sujansinghani [10]. Several attempts at commercial culture of mud crab have been made but low survival has been the major constraint to commercial operation [11]. Salinity is important to control growth and survival of crabs. Each and every aquatic organism requires particular salinity for normal growth and survival. The sudden drop in survival rates has been noticed from 87% to 45% in between (30th day to 45th day) when salinity has been decreased from 29.6 ppt to 10.4 ppt. at the same time the growth of the crabs were crippled at 0.97 g/day when the salinity has been dead fall.

Table 3: *Survival* rate (%) of *Scylla tranquebarica* at fortnightly intervals during culture period.

Days	Salinity (‰)	Survival rate (%)
0th Day	32.6	100
15th Day	23.4	90
30th Day	29.6	87
45th Day	10.4	45
60th Day	33.2	43
75th Day	20.6	40
90th Day	28.6	40

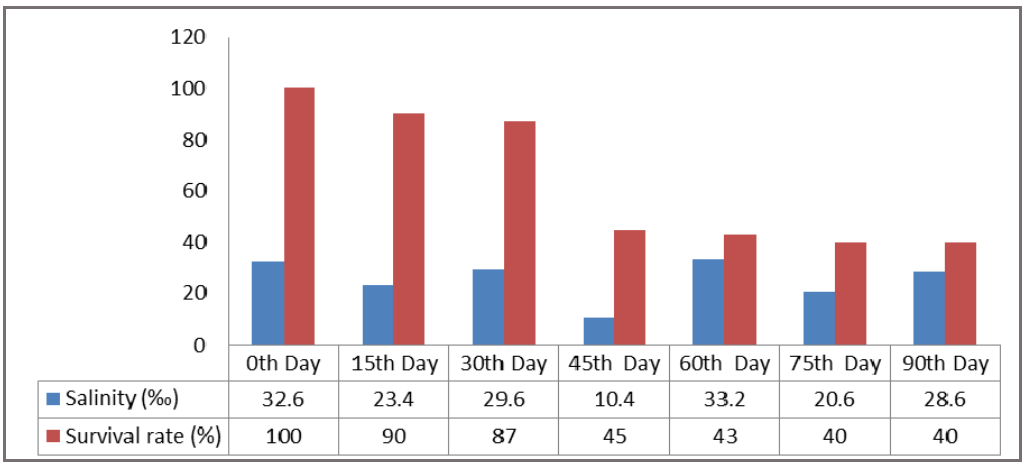

Fig 1: Effect of salinity on Survival of mud crabs (%)

Hence, maintain of salinity is far most important in the crab culture and gives better survival and growth. But maintain of these parameters (salinity and temperature) in the field level is very difficult due to the unseasonal rains, very high temperature and lofty humid conditions even in the coastal regions. These water quality fluctuations are very high and causes heave mortality in the culture system when production comes to the farmer's hand. Further fisher folks are not concerned about crab culture due to lack of awareness and proper technology utilization. So, fishers were depending on the wild catch of crabs in the mangroves areas as a livelihood option. This causes severe stress on wild stock for the remuneration of the over exploitation and sustainability.

4. Conclusion

The study has inferred that, to mitigate the problems of the unseasonal rains, drastic fluctuation in the temperature, salinity and high humid conditions in the coastal regions causing severe problems in the mass mortality in the culture system. These changes ultimate affect sustainability of the growth and production and also affecting the livelihood opportunity to the fisher communities. This can be mitigated by the conservation of the mangroves and forest areas by the effective public-private partnership, validating and integrating local needs through community participation will ensure the sustainability of growth and production.

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