CHAPTER EIGHT

SUMMARY

CHAPTER –VIII

SUMMARY

The studies on the edible crustaceans and particularly the freshwater prawns are of paramount importance in the present day context. Although Assam is having tremendous potentialilities in prawn fishery, yet lack of adequate information and systematic studies on this particular group of crustaceans are posing a serious problem in the process of exploration. Some attempts have been made to study the present status of freshwater prawns of Assam which can be summarized as followes–

Body size : Regarding body size, the smallest size was recorded in case of *M. lamarrie* and the largest size in case of *M. birmanicum choprae* and not *M. malcolmsonii* as reported from other parts of our country. In contrary to other authors sometimes it was found that the sex ratio was reversed in case of freshwater prawns of Assam naturally i.e. number of male is more than that of female. Another significant observation was the performance of female are strongly influenced by the presence of males resulting in growth inhibition.

Colouration : Prawns found in Assam are very significant in their body colouration due to the presence of the different types of colour pigments in different parts of the body. Generally this types of observation were never found among the prawns found in other region of the country.

Rostral Formula : Regarding rostral formula the present finding shows – 11-12/4-5, (*M. birmanicum choprae*), 8-10/4-7 (*M. malcolmsonii*), 15-16/7-8 (*M. menoni*), 7-12/4-8 (*M. lemarrie*), 7-11/5-9 (*M. daynum*), 9-11/3-6 (*M. assemensis*), 10-12/3 (*M. altifrons*) and 5-7/2-5 (*M. tiwari*). Studies on rostrum of various species of *Macrobrachium* is another area of important findings of present work in case of species recognition because simply by studying the structural configuration of rostrum it is easy to identify the species.

Rostrum : The rostrum of *M. birmanicum choprae* immediately after origin from the base of carapace showed greater elevation with the beginning of convexity with lesser concavity thereafter and finally inclined towards apex, In *M. malcolmsonii* dorsally major part of rostrum are serrated and high convexity observed approximately at the middle of the rostrum. In *M. menoni* the upper margin of the rostrum with convexity just behind eye, concavity infront of the eyes, slightly inclined and lowered further. In. *M. dayanum*, both dorsally and ventrally the spines of the rostrum are not equidistant from each other and dorsally rostrum showed slight convexity from the base. In *M. assamensis* dorsally all the spines in the rostrum are equidistant from each other showing slight convexity and finally slightly horizontal at the tip. Rostrum of *M. lamarrie* was long narrow sword shaped, sharper and slightly upturned at the tip. Rostrum of *M. altifrons* is straight shaped structure from base to apex and there is irregular distribution of spines in the rostrum both

dorsally and ventrally from base to apex. The rostrum of *M. tiwari* showed irregular by arranged teeth both dorsally and ventrally from base to apex.

Carapace: The carapace of *M. birmanicum choprae* is smooth in young one, rough in adult and slightly pigmented. Presence of 3 pairs of distinct jointed spines anterolaterally one pair at the base of antenna, next pair located afterwards and very thin delicate carapace postero-laterally are the new observation in the present investigation. In *M.malcomsonii*, chitinous, hard and highly transluscent to transparent carapace with calcium, scantly pigmentation and two pairs of strong pointed spines antero-laterally on either side are the newly observed characters in the present work. The presence of smooth, transparent and delicate carapace was observed in *M. menoni*. The carapace of *M. dayanum* was found to be highly pigmented with frequent changes of colour of carapace and also one pair of small pointed spines antero–laterally. Similarly *M. assamensis* exhibited the smooth carapace in young condition, rough in adult with frequent change of colour and one pair of small pointed spine antero-laterally towards the base of antenna. In case of *M. lamarrie* carapace was found as very smooth and majority of this species beared without coloured structure but only a small number containing very few pigments. The present findings critically described the carapace of *M. altifrons* as smooth, translucent and little bit hard with single pair of indistinct less developed spine antero – laterally. *M. tiwari* revealed very smooth

transparent and delicate carapace bearing only 2 small minute, delicate spines antero – laterally.

Eye – Stalk: Eye – stalk is an another important organ which showed some variation among the *Macrobrachim* spp., *M. birmanicum choprae*, *M. malcolmsonii*, *M. menoni* and *M. lamarrie* beared long narrow spherical eye – stalk with deep large sized eye and *M. dayanum*, *M. assamensis*, *M. altifrons* and *M. tiwari* beared short, stout almost spherical eye stalk with small sized light black coloured eye in comparison to body size.

Antennule : The present investigations show Pre coxa > coxa is the only similar characteristics shown by all the collected 8 species of *Macrobracium* of Assam. Pre coxa > coxa basis – shown by *M. birmanicum choprae, M. menoni, M. dayanum* and *M. altifrons*. Pre coxa > coxa < basis – shown by *M. lamarrie* and *M. assamensis*, but *M. malcolmsonii* and *M. tiwari* showed their own identity in antennule formation as pre coxa > coxa ≥ basis and pre coxa > coxa = basis sequentially.

Antenna: In case of antenna also variations were observed among the collected *Macrobrachium* species of Assam. Presence of very elongated, highly developed pigmented endopodite with muscular feeler plus distinct spines of endopolite, centrally located white coloured elongated sword shaped thicker plate of expodite in antenna (*M. birmancium choprae*), well developed feeler in endopodite, uniform distribution setae with a sword like ridge in

expodite (*M. malcolmsonii*); non muscular feeler of endopodite and thin transparent expodite bearing les developed setae towards periphery (*M. menoni*), leaf – like expodite with uniform distribution of setae and highly muscular feeler of endopodite (*M. dayanum & M. assamensis*); less developed feeler of endopodite and thin slightly transluscent endopodite without uniform distribution of peripherial setae (*M. altifrons*) and non pigmented expodite without uniform distribution of peripherial setae (*M. tiwari*) are the new observation in the present investigation. In *M. lamarrie*, antenna was found very delicate with indistinct expodite and endopodite. Interestingly coxa < basis was possessed by *M. birmanicum choprae, M. malcolmsonii, M. dayanum, M. assamensis* and *M. altifrons* and the characteristics feature of the segment i.e. coxa ≤ basis was found in *M. menoni, M. lamarrie* and *M. tiwari.*

1st and 2nd Pareopod : *M. birmanicum* choprae exhibits the 1st pareopod as highly muscular coxa and basis with rough surface, elongated merrus, rod like and laterally compressed carpus and hairy dactylus. Various segments are found as coxa = basis, ischium < merrus, carpus < propodus > dectylus and 2nd pareopod developed highly muscular walking legs with a pair of strong pointed chela and segments are found as coxa > basis, ischium < merrus, carpus > propodus > dactylus. *M. malcolmsonii* possesses rough surface with sparsely distributed hairs in all segments of 1st Pareopod and the segments are as – coxa < basis, ischium = merus, carpus < propodus > dactylus and

presence of rod like coxa, basis, ischium, merus, carpus and propodus with laterally compressed merus and carpus coxa = basis, ischium < merus, carpus > propodus > dactylus of the 2nd pareopod are the new findings of the present work. In case of M. menoni, the 1st pareopod as all rough segments except coxa and basis are almost cylindrical and laterally compressed and their joints with bunches of hair like structure. Coxa = basis, ischium < merus, carpus < propodus > dactylus. 2nd pareopod found as muscular wart like projection in all segments with rough surface, laterally compressed merus and carpus and the segments found as coxa < basis, ischium < merus, carpus > propodus > dactylus. About *M. lamarrie* the present report carefully observed that both 1st & 2nd less developed non muscular pareopods showed slender, rod like and slightly laterally compressed ischium, delicate chela and slightly findings reveal that curved, pointed dectylus, slightly blunt to inwardly curved immobile finger and 3 – 5 minute teeth instead of 5 on mobile finger. The 1st and 2nd pareopod segments are coxa > basis, ischium > merus, carpus < propodus > dactylus > dactylus and coxa > basis, ischium = merus , carpus > propodus < dactylus respectively. About *M. dayanum*, ischium and fingers are provided with tuft of setae and sparse distribution of hair on the rest of the leg and ischium, merrus and carpus are rod like and laterally compressed. Similarly *M. assamensis* shows the segments as 1st pareopod – coxa < basis, ischium = merus, carpus < propodus > dactylus and 2nd pareopod as coxa < basis, ischium = merus, cylindrical segments with loose joints plus wart like

projection, thinly in carpus, propodus and dactylus. In 2nd pareopod we noticed 2-3 blunt teeth with 4-6 tubercules on immobile and irregularly arranged 3-4 unequal teeth with 4-5 tubercules in mobile fingers. The segment was found as coxa > basis, ischium = merus, carpus < propodus > dactylus. In case of *M. tiwari*, observation was coxa > basis, ichium = merus , carpus > propodus > dactylus.

Non – chelate leg: About this structure of *M. birmanicum* choprae, the present work clearly described as wart like projection in all segments, laterally compressed carpus and propodus and coxa > basis, ischium < merus, carpus in half of propodus > dactylus. The non chelate leg of *M. malcolmsonii* was found all hairy segments, 3 to 4 small conical teeth with minute spine in the mobile finger, 3-4 unequal sized conical teeth with few spine like processes in the immobile finger and coxa < basis, ischium < merus, carpus ½ of propodus > dactylus are the new findings in the present investigation. About *M. menoni*, the findings are non muscular loosely arranged joints with smooth surface, laterally compressed segments and very few indistinct blunt tooth with few tentacles on the finger and coxa = basis, ischium < merus, carpus < propodus = dactylus are the new information of non – chelate walking legs of species. Studies on *M. dayanum* indicates that except merus and carpus, all parts are hairy and coxa = basis, ischium < merus, carpus < propodus > dactylus. About *M. assemensis* present findings reveal that curved, pointed dectylus, slightly rough surface leg and coxa =

basis, ischium < merus, carpus < propodus > dactylus. Attempt was made to study about *M. lamarrie* and found smooth surface of all the segments from coxa to dactylus and the leg formula viz. coxa < basis, ischium < merus, carpus < propodus > dactylus. The present observation tried to give a comprehensive thought on the taxonomy of non – chelate legs of both *M. altifrons* and *M. tiwari*. Hairy dactylus, muscular coxa and basis, loosely arranged joints, almost straight and cylindrical segments with sparse distribution of few spines along with coxa < basis, ischium < merus, carpus < propodus > dactylus in *M. altifrons* and coxa = basis, ischium < merus, carpus < propodus > dactylus in *M. tiwari* are new taxonomic findings in the present work.

Habitat Ecology of Freshwater Prawn : The various physico – chemical parameters of water and soil have some influence on freshwater prawns.

Dissolved Oxygen : Prawns become stressed below 2 ppm dissolved oxygen and usually die below 1ppm. Prawn can tolerate temporary low dissolved oxygen condition, however exposure should be avoided if possible. In fact, large number of prawns like *M. dayanum, M. assamensis, M. lamarrie* are actually seen resting on the platform especially during the early morning hour when usually oxygen level go down at the bottom. The present work reported that the prawn collection specially *M. dayanum, M. assamensis* and *M. lamarrie* from standing water bodies containing heavy aquatic vegetation plus

algal bloom was found of low percentage of return due to the increase carbon dioxide concentration upto 7.8 mg/L.

Alkalinity : Higher alkalinity value helped to utilize calcium carbonate from water by prawns for development of exo – skeleton. It was observed that gradual increase of alkalinity concentration is due to the large number of fallen leaves which form a sort of mat in the water bottom and sometime even discolouring the water where mostly *M. dayanum* and *M. assamensis* were found. It was also found that the total hardness influence the occurrence of enhancing phytoplankton for better production after liming. Extreme hardness limits the occurrance of the species.

P^H: Sometimes very few number of *M. dayanum* and *M. assamensis* were collected from the standing water bodies may be due to high p^H range and heavy aquatic vegetation. Prawn mortality can occur if p^H level reaches above 10.0 and greater fluctuation in p^H can cause and poor growth to prawns. During observation a number of healthy prawn viz. *M. birmanicum choprae, M. malcolmsonii, M. menoni, M. dayanum, M. assamensis* and *M. lamarrie* were collected from different water bodies where the p^H value ranged from 5.8-8.0. It was also observed that heavy turbidity in the pond and beels due to the large number of fallen leaves where from a few, number of *M. dayanum, M. assamensis* and *M. lamarrie* were collected.

Temperature & Conductivity : Temperature also plays an important role, and above 31^0C leads to high mortality to most of the collected prawn.

Studies reveal that conductivity between 100-150 umho/cm is suitable for prawn.

Nitrate, Phosphorus & Chloride : Similarly important elements like Nitrate, Phosphorous, Chloride etc. in water are found important for the growth of many prawns and certain elements directly affect the body of the prawn. Nitrate is highly toxic to prawn and affect the tissue and blood colour development. Phosphours regulate the productivity of prawns in the water. Chloride is also one of the most important elements for the normal growth of prawn although the information about the role of chloride is almost nil.

Plankton : The survival of prawns depend on the production on thick swarms of phytozooplankton at the time of stocking in the water bodies. The present work also noticed the death of plankton blooms in some of the standing water bodies like beel, ponds with aquatic vegetations suppress the growth of some *Macrobrachium* species like *M. dayanum, M. assamensis* and *M. lamarrie*. It was found that high range of p^H in the standing water bodies with and without phytoplankton like *Spirogyra Chlorophlora, Anabaena, Arthrospira* etc. where from *M. dayanum* and *M. assamensis* were collected. High rate of mortality due to poor oxygen level in the pond caused by affecting growth and algal coating appearing on the body of prawns like *M. lamarrie* are some of the main problems. Rotifers are the good food of many prawns. The present findings reported that certain *Chladocerans* spp. Like *Moina* spp. etc. is one of the nutritive and favourite food of many *Macrobrachium* spp. like

M. birmancium choprae, M. menoni, M. lamarrie and sometime *M. altifrons* and *M. tiwari*. Many of the collected species of *Macrobrachium* like *M. dayanum, M. assamensis*, *M. lamarrie* and scarcely *M. atilfrons* and *M. tiwari* prefer to stay in the standing water bodies like beel, pond, ditches, deep paddy field with full of aquatic vegetation. Except few water hyacinth, eichornia and some amphibious vegetation, rivers are free from any other aquatic vegetation due to the swift water current. Some *M. malcolmsonii* and few *M. menoni* were collected from the big beel like Garjan beel, Dora beel, Kukurmara beel, Ghorajan beel, Silsakoo beel. These beels have direct connection with the great river Brahmaputra. *Salvania* and *Eichornia* are the favourite food for *M. malcolmsonii*. It was observed that heavy siltation in the bed of both standing and running water year after year in most of the water bodies and gradual increase in the mass of aquatic vegetation resulting in the production of harmful gases with high mortality of *M. dayanum, M. lamarrie even M. malcolmsonii* and few *M. menoni*. During collection it was noticed that many aquatic vegetation provides shelter to small and moulted soft prawn and even the adult.

Biochemical Analysis : Biochemical constituents is yet another area which reveals some interesting information about fresh water prawns. Lowest quantity of fat 0.61(µg/g) was observed in the muscles of prawns like *M. tiwari* and highest in *M. birmanicum choprae* 1.22(µg/g). Highest quantity of Carotenoid 6.27(µg/g), was estimated in the body of *M. assamensis.*

However, in all species it was observed that carapace contains highest amount of carotenoid pigment. The present findings about the amount of biochemical parameters can be sumerised as – Total Ash (lowest 1.02(µg/g) in *M. lamarrie* & highest 11.85 (µg/g) in *M. birmanicum choprae;* Dry matter (lowest 13.25(µg/g) in +98+*M. lamarrie* & highest 32.08 (µg/g) in *M. birmanicum choprae*); crude protein (lowest 35.21(µg/g) in *M. lamarrie* & highest 68.28 (µg/g) in *M. birmanicum choprae*) and crude fibre (lowest 0.75 (µg/g) in *M. lamarrie* & highest 2.48 (µg/g) in *M. birmanicum choprae*).

Estimation of elements : Some elements were estimated in the muscle of the prawns and the results can be summarized as Calcium (µg/g): lowest in the *M. lamarrie* (2.05-4.12) and highest in the *M. assamensis* (3.04-7.12); Phosphorus : lowest in the *M. tiwari* (0.79-1.89) and highest *M. assamensis* (0.98-2.04). However some elements were also studied in four selected prawns are results could be summarized as Copper: lowest in the *M. malcolmsonii* (0.148-0.218) and highest is *M. dayanum* (0.218-0.332) in case of carapace and lowest in *M.malcolmsonii* (0.016-0.020) and highest in *M. dayanum* 0.036-0.048) in case of muscle; Zinc : lowest in *M.dayanum* (0.067-0.192) and highest in *M. birmanicum choprae* (0.685-0.736) in case of carapace and lowest in *M. malcolmsonii* (0.067-0.099) and Iron: lowest in *M. malcolmsonii* (0.205-0.218) and highest in *M. assamensis* (0.255-0.270) in case of carapace and lowest in *M. malcolmsonii* (0.156-0.224) and highest in *M. assamensis* (0.298-0.306)

Fishing Gears : Various fishing gears viz. traps, lines, hand, nets, sieves, cast nets, not nets and bamboo basket packed with moist moss or aquatic plants were used to catch the various freshwater prawns. It was observed that during extreme winter, the paddy field becomes dry and prawns like *M. dayanum, M. assamensis* and *M. lamarrie* migrate to the trenches and channels in and around the paddy field where they were caught by sieves and cast nets.

Biological Parameters : Fecundity; regarding the study on fecundity it was noticed that the mother prawn vibrate rapidly her pleopods, the hatchings are disposed so that all the eggs are hatched out at a time. A great variation in the total number of egg during collection was observed with low larval survavility. The highest number of eggs was recorded in *M. birmanicum chaporae, M. malcolmsonii, M. menoni* and *M. lammrie* and lowest number of eggs were counted in *M. dayanum* and *M. assamensis*. The findings can be summerised as *M. birmanicum chaprae* (25000-35000) > *M. malcolmsonii* (20000-30000) > *M. menoni* (10000-15000) > *M. altriforns & M. tiwari* (5000-10000) > *M. lamarrie* (2000-5000) > *M. dayanum* (1200-2000) > *M. assemensis* (1000-1850) where the number of eggs found in each species is indicated within the bracket.

Length-weight Relationship :

Length-weight relationship was studied in four Macrobrachium species which can be summarized as – the maximum and minimum body length and corresponding body-weight, seasons and habitat are in *M. birmanicum*

choprae 142.7 mm/46.3g in river of monsoon and 102.4 mm/34.0g in the in the beel of premonsoon; in *M. malcolmsonii* – 120.2mm/94.3mm in river of monsoon and beel of pre-monsoon respectively and maximum weight as 36.35g in river of mansoon and minimum weight as 29.75 g in river of pre monsoon; in *M. dayanum* – value obtained as 70.0mm/3.84g in the beel of monsoon and minimum value obtained as 45.35mm/3.19g in the paddy field of pre-monsoon and in *M. assamensis* – value obtained as maximum 53.6mm/4.08g in the beel during monsoon and minimum as 39.65mm/3.14g in the paddy field during pre-monsoon.

Gonado-Somatic Index :

Similarly gonado-somatic index (GSI) was also studied in four *Macrobrachium species* and the result can be summarised as – in *M. birmanicum choprae.* Male the maximum gonadal weight was found in middle part of pre-monsoon (2.15gm) with an average body weight 38.0 gm and in female maximum gonadal weight was found in early pre monsoon (3.96gm); in *M. malcolmsoni* – Male the maximum gonadal weight was found in late pre-monsoon and early part of mansoon (2.24gm) with corresponding body weight 29.8 gm and in female maximum gonadal weight in middle part of pre-mansoon (4.96gm) with the body weight 42.6gm; in *M.daynum*- male the maximum gonadal weight during monsoon (0.28gm) with a body weight 4.1 gm and in female the maximum gonadal weight recorded during monsoon (0.45gm) with a body weight 4.8gm, and in case of *M. assamensis* – male –

indicates that the average maximum gonadal weight found in monsoon (0.26gm) with a body weight 3.8gm and in female the maximum gonadal weight was also in monsoon (0.26gm) with a body-weight 3.8gm. The minimum gonadal weight was observed during pre-monsoon (0.21gm) with a body weight 4.3 gm.

Relative Gut Length

Reletive gut length study was made in four selected species viz. *M. dayanum, M. assamensis, M.birmanicum choprae and M. malcolmsonii.* The results obtained were tested with analysis of variance (ANOVA) and the conclusion was between the species, the length and gut length were significantly different. But in the other tests for seasons and habitat the outcome was not significantly different.