CHAPTER FIVE

RESULTS

Macrobrachium birmanicum choprae (Tiwari) (Milne Edward)

1947, Palaemon choprai KK. Tiwari, Rec. Indian

Mus. 45(4): 333 - 347

Morphometry and Bionomics

Taxonomy:

Colouration: It is the biggest sized freshwater prawn among all the collected species. In young condition, the whole body is almost white in colour, but as it attains maturity, very fine minute light red coloured pigments are found in certain parts of the body viz. rostrum, carapace, joints of abdominal segments, periphery of uropods and legs. **Rostrum:** Rostral size is proportionate to its body length. It is strong and compact. The rostrum immediately after origin from the base of carapace, showed greater elevation with the beginning of convexity with lesser concavity there after and finally inclined towards apex. Dorsally highest convexity of rostrum in this species is a diagnostic features. Dorsally almost all spines are present in the convex part which are equidistant from each other. But ventrally all spines in the rostrum are almost equidistant from each other from base to apex. Ventrally the rostrum showed lesser convexity but without concavity after. **Rostral Formula:** 11 – 12 / 4 – 5 **Carapace:** Carapace is smooth in young and rough in adult, almost transparent. Antero-laterally, three pairs of distinct jointed spines are present. One pair at the base of antenna, next pair is located afterwards. The postero –

PLATE - 2

M. birmanicum choprae
(Dorsal view)

M. birmanicum choprae
(Dorso-lateral view)

M. birmanicum choprae (colony)

laterally, the carapace are very thin and delicate Restrum ⩽ carapace. The length of the **eye stalk** is 2.8 – 3.3 mm (3.05 mm ± 0.00163) and diameter ranges from 0.8 – 1.4 mm (1.1mm ± 0.02927) **Anetnnule:** Thin translucent flattened pre coxa. Centrally pre-coxa is highly depressed. The depressed area of the pre – coax is surrounded by fine setale. Pre coax > coax ⩽ basis. **Antenna:** Very elongated highly developed endopodite. The feeler of endopodite is muscular. Coxa < Basis. Base of endopodite is pigmented. Other parts of it are without pigmentation. Anetro – laterally the endopodite bears a distinct pink spine where from uniform distribution of setale are found through out the edges up to the base of its inner side. The arrangement of setae and other structure viz. spine, pigments etc. are very distinct than that of other species. In this species the exopodite showed two distinct parts i.e. centrally located white coloured elongated sword shaped thicker plate surrounded by thin transparent scally parts. This feature of exopodite in the antenna is not prominent in other collected species. In this species, both antenna and antennule are highly developed than that of all the collected species. **First pareopod:** Coxa = basis, ischium < merus, carpus < propodus> dactylus. Coxa and basis - highly muscular with rough surface. Elongated merrus and carpus are rod like and laterally compresed. Chela of dactylus are hairy. **Second pareopod :** It is well developed, highly muscular with a pair of strong pointed chela. It is the largest part of the body even larger than that of total body length. This diagnostic feature is not found in other collected

species. All segments of chelate legs are provided with uniform distribution of many wart like projection making surfaces of all the segments very rough. Coxa> basis, ischium, merus, carpus and propodus are strong, elongated and cylindrical. Ischium, merrus and carpus are laterally compressed. Coxa > basis, Ischium < merus, carpus > propodus > dactylus. **Non-chellate leg :** Coxa > basis, ischium <merus, Carpus is half of propodus. Propodus > dactylus. Many wart like projections are found in all the segments. One carpus and propodus are laterally compressed.

Maximum Size 180 mm

Food and Feeding.

Mostly found in the big rivers like Brahmaputra, Kapilee, Dihing, Disang Dekhow etc. Their abundance is almost nil in standing water and they are mostly carnivorous. Their favourate food through out the year are the zooplankton. Zooplankton includes mostly larva of crustanceans and insects, earthworms besides they prefer rotten flesh of any dead animals floating in the water. During full monsoon, when dead and decaying animals carried by swift current of the river, they jump over the rotten flesh and eat voraciously. During the non availability of food they may become cannibalistic in nature. Mixture of dead, decomposed molluscan shell like Union, Achatina and fine sand grains are also the favourite food.

Maturity and Breeding

All collected spp. of *Macrobrachium* from Assam attain maturity through many larval stages. *M. birmanicum choprae* of Assam takes near about 4 to 6 months to attain full maturity in case of both male and female. The pre monsoons is the breeding period. They lay eggs in March to June and in the later part of rainy season larval development takes place. They become adult during pre monsoon period.

Fecundity

One special feature of all the collected species of *Macrobrachium* is that eggs are visible from outside and the pleopods carry the eggs. In *M.birmanicum choprae* eggs are yellowish in colour. They are very fine and each egg is almost in equal size to that of a sand particle. Nearly 25000-35,000 number of eggs are counted as the maximum numbers of occurrence in both the ovaries of all the collected spp. of *Macrobrachium* naturally.

Sex Ratio

The sex ratio was found as 2 to 3 (♂) : 1 (♀) in the natural condition.

Fisheries

(a) Marketing and Economic Status:

M. birmanicum choprae have very good marketable and public demand within and outside of the state. The species is the food of aristrocates. The local price value are variable. From spring to monsoon period, price of *M.birmancium choprae* ranges from Rs. 240-Rs.280/- per kg. But during winter due to non availability the price goes upto Rs. 350-Rs. 400/- per kg.

(b) Fishing gears: Fishing gears used in beels of Assam –

Information available and gathered from various fisherman of rivers and beels, there is no specific gear used for freshwater Prawns. Prawns are harvested along with the other fishes of beels and rivers. It was observed that some specific fishing gears are used for prawn fishing with some seasonal variation (Table - 9)

The fishing gears can be categorized as –

a) **Impaling Gears** – includes Jongar, Tiara, Pokora, Kol or Kati.

b) **Traps** – Includes, Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Cherka, Torka, Bamidhora, Khoka, Tuna, Dori etc.

c) **Entangling gear** – Langijal, Phansijal,

d) **Encirling gear** – Musarijal, Berjal, Polo, Juluki, Jhupri, Khewalijal, and Angthajal.

e) **Scooping gear** – Dharmajal, Dhenkijal, Thelajal. Jakoi.

f) **Trawling gear** – Moijal, Horhorijal, Shanglajal.

Following are the different fishing gear used in the Beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table - 9

are also used in different beels depending upon the water depth, water current and vegetations through out the years.

Biochemical Composition

The following are the important biochemical parameters of this species because these have some direct impacts on the nutritional aspects of the human beings.

Carotenoid:	**In muscles (ug/g)**	**In carapace (ug/g)**
	3.27-5.01	63.25-66.77
	4.413±0.63245	65.036 ± 1.284523
Total Ash	6.86-11.85	
	9.16+1.70587	
Dry Matters	26.54-32.08	
	29.18±2.08567	
Crude Protein	60.42 – 68.28	
	63.86±2.78927	
Crude Fat	0.97-1.22	
	1.09±0.01211	
Crude Fibre	1.14-2.48	
	1.32±0.50990	
Calcium	3.86-6.08	
	4.98±0.72111	
Phosphorous	1.21 – 1.98	
	1.62±0.26457	

Habited ecosystem

The following parameters were studied where from *M. birmanicum choprae* were collected.

Physico-chemical results

Among the physico–chemical parameters like - Temperature (^{0}C), Transporency (cm), Conductivity (unho), P^H, Dissolved Oxygen (mg/L), Free-carbondioxide (mg/L). Total alkalinity (mg/L), Total hardness (mg/L), Choloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L) values of the different water bodies wherefrom the species are collected are as followes. **Atimospheric Temp (^{0}C):** lowest in the river of retreating monsoon (25.7-29.2) and highest in the river of monsoon (33.5-34.3); Water Tem (^{0}C): lowest in the river of retreating monsoon (23.1-26.2) and highest in the river of monsoon (32.5-33.1); **Transparency:** lowest in the beel of monsoon (35.1-39.5) and highest in the beel of retreating monsoon (42.7-55.2); **Conductivity:** lowest in the river of pre-monsoon (82.3-107.5) and highest in the beels of monsoon (188.2-213.4); **P^H:** lowest in the river of pre-monsoon (5.6-7.5) and highest in the beel of retreating monsoon (7.8-10.2); **Dissolved oxygen:** lowest in the river of monsoon (5.2-6.9) and highest in the beel of retreating monsoon (7.1-11.1); **Free carbondioxide:** lowest in the river of pre-monsoon (3.2-5.9) and highest in the beel of monsoon (6.8-7.1); **Alkalinity :** lowest in the river of monsoon (32.3-72.3) and highest in the beel of retreating monsoon (72.1-86.1); **Hardness**: lowest in the beel of pre-

monsoon (18.2-126-2) and highest in the beel of retreating monsoon (121.8-135.1); **Chloride**: lowest in the river of pre-monsoon (12.5-18.4) and highest in the beel of monsoon (18.3-22.5); **Nitrate**: lowest in the river of pre-monsoon (0.02-0.04) and highest in the beel of monsoon (0.18-0.48) and **Phosphorus**: lowest in the river of pre-monsoon (0.22-0.38) and highest in the beel of monsoon (0.33-0.41).

Soil texture and constituents :

Soil texture : Mostly sandy to loamy clay

While studying constituents of soil where from the species *M. birmanicum choprae* was collected, the parameters and the minimum and maximum values obtained are as followed- **Organic carbon (%) :** minimum in the river during monsoon (2.8-6.9) and maximum in the beel during retreating monsoon (5.6-7.6); **P^H:** minimum in the river during pre monsoon (5.3-6.2) and maximum in river during retreating monsoon (6.4-7.2); **Nitrate (mg/100gm):** minimum in the river during pre-monsoon (0.15-0.31) and maximum in beel during monsoon (0.42-0.53); **Sulphate (mg/100gm) :** minimum in the beel during pre-monsoon (2.2-3.2) while maximum also in beel during monsoon (3.2-7.8); **Calcium (mg/100gm) :** maximum in the beel during monsoon (3.8-76.2) and maximum in the river during retreating monsoon (45.2-80.0); **Magnesium (mg/100gm):** minimum in the beel during pre-monsoon (21.2-36.4) and maximum also in the beel during monsoon (24.8-54.2) and **Organic Matter (%):** minimum in the beel during monsoon (6.2-11.3) while maximum is also in the beel during pre-monsoon (6.6-14.3)

Abbreviation: Rl – River, **BL**- Beel, **PN** – Ponds, **SW** – Swamp, **PF** – Paddy Filed.

Plankton :

Both the phyto and zooplankton are identified where from the species collected.

Phytoplankton :

The following are the related phytoplankton (Algae, Diatoms ad Desmids).

(i) **Chlorophyceae :** *Spirogyra* spp., *Cosmarium* spp. Oscillatoria spp., *Anabaena* spp. *Aphamocapsa* spp. *Arthrospira*, *Microcystis*, *Nostoc* spp. *Chlorophycea* spp.

(ii) **Diatoms** : *Fragilaria* spp., *Synendra* spp., *Navicula* spp. *Pinnularia* spp.

(iii) **Desmids** : *Closterium* spp., *cosmarium* spp., *staurastrum* spp., *Euastrum* spp.

Zooplankton : The related zooplankton (Protozoa, Rotifera, Cladoceran, Copepoola etc.) are the following ones :-

(i) **Protoza** : *Chilomonas* spp. *Paranema* spp. *Euglena* spp. *Phaecus* spp. *Chlamydomasis* spp. *Gonium* spp, and *didinium* spp., *Litonotus* spp., *Nassula* spp. *Paramoecium* spp.

(ii) **Rotifera** : *Lepadella* spp., *Monostyla* spp., *Euclinis* spp., *Filinia* spp., *Brachionus* spp., *Karatella* spp., *Trichocore* spp., *Asplancha* spp.

(iii) **Cladocera :** *Eurycerus* spp., *Bosmina* spp., *Moina* spp.

(iv) **Copepods :** *Nauplii* spp., *Mesocyclop* spp., *Neo-diaptomus* spp., *Eucyclop* spp., *Artenia*

(v) **Crustaceans :** *Simocephalus* spp., *Daphnia* spp., *Cyclops* pp., *Cypris* spp.

Aquatic Vegetation : Aquatic vegelations were identified from the habitat of the species - *Lemna* Spp., *Pistia*, *Nymphaea*, *Utricularia*, *Hydrilla* spp., *Potamegeton* spp., *Hygrorrhiza* spp., *Ludwigia* spp., and very few *Nelumbo* spp., *Euryale* spp. *Nyriophyllum* spp. etc. are collected from big beels.

Macrobrachium malcolmsonii (Milne Edward)

1844. Palaemon malcolmsonii. Milne Eswards H, 1844-8,

Morphometry and Bionomics

Taxonomy

Coluration : It is a bigger in size next to *M. birmanicum choprae* and almost white in colour in the young condition. On attainment of maturity, pigmentation starts and the body turns mostly dark grey in colour. **Rostrum :** Dorsally major part of the rostrum are serrated and high convexity observed approximately at the middle of the rostrum. After convexity the rostrum show inclination immediately after 5^{th} spine and half part of rostrum towards the proximal region are slightly upturn. Gaps shown by 1^{st} & 2^{nd} and 8^{th} & 9^{th} spines of the rostrum in between. Ventrally from the base of its origin, the rostrum show slight convexity followed by concavity and finally turned the convexed region of the rostrum immediately from the base origin, provided with some hair like out growth. Dorso-ventrally the rostrum shows strong and stout spines but they are not equidistant from each other. Carpace > rostrum, **Rostral Formula :** 8 - 10 / 4 – 7. **Carpace:** The hard carpace shell is a mixture of chitinous and calcium component. Dorsally and antero–laterally the carapace is hard and highly transluscent but ventro-laterally on either side, the carapace shell is thin and transparent. Pigments are scanty. Antero-laterally on either side of the carapace, bears two pairs of strong pointed

PLATE - 3

M. malcolmsonii

(Dorsal view)

(Dorso-lateral view)

(colony)

spines. Both 1st and 2nd pair show about 60^0 angle towards the base of the antennule and antenna. **Eye stalk:** 0.4 – 0.6 mm (0.5 ± 0.063245) in length and diameter is ranged from 0.16 to 0.23 mm (0.20 mm ± 0.025099). scanty pigmentation. **Antennule:** precoxa > coax, coax ⩾ basis, Laterally precoxa, coxa and basis are richly supplied with well developed setae. **Antenna:** Coxa < basis. Exopodite shows uniform distribution of setae towards the antero-lateral side but 2/3 rd part of the exopodite towards left side up to the base of coxa showed lacking of setae. Endopodite showed well developed feeler. Centrally from the base of exopodite a sword like ridge is developed upto the middle of it. Devoid of pigmentation. **First pareopod :** all segments provided with rough surface with sparsely distributed hair. Coxa<basis, ischium = merus < carpus < propodus > dactylus. **Second pareopods :** Coxa, basis, ischium, merus, carpus and propodus are rod like with lateally compressed merus and carpus. Coax = basis, ischium < merus, carpus ½ propodus > dactylus. **Non-Chelate leg:** coax<basis, ischium=merus>carpus, propodus>dactylus. All segments are almost hairy. **Fingers :** in female 3 to 4 small conical teeth with many minute spines. **Male Fingers :** 3 to 4 unequal sized conical teeth with few spines like processes.

Maximum Size :- 162mm

Food and feeding

Mostly found in the big rivers like Brahmaputra, Kapilee, Dihing, Disang etc. their abundance is almost nil in the standing water and they are

mostly carnivorous. Their favourite food through out the year are the zooplankton Zooplankton includes mostly larva of crustaceans and insects, earthworms besides they prefer rotten flesh of any dead animals floating in the water. During full monsoon, when dead and decaying animals carried by swift current of the river, they jump over the rotten flesh and eat voreciously. During the non availability of flood they may become cannibalistic in nature. Mixture of dead, decomposed molluscan shell like Union, Achatina and fine sand grains are also the favourite food.

Maturity and Breeding

M. malcolmsonii of Assam takes about 4 to 6 months to attain full maturity in case of both male and female. The pre monsoon is the breeding period. They lay eggs in water in March to June. The larval development takes place in the leter part of the rainy season. They become adult towards winter.

Feccundity

One special feature of all the colleted species of *Macrobrachium* is that eggs are visible from outside and the pleopods carry the eggs. In *M. malcolmsonii* eggs are yellowish in colour. They are very fine and each egg is almost in equal size to that of a sands particle. Nearly 20,000-30,000 number of eggs are counted as the maximum numbers of occurrence in both the ovaries.

Sex Ratio

During natural condition the sex ratio was found as 3 to 4 (♂) : 1 (♀)

Fisheries

(a) Marketing and Economic status:

M. malcolmsonii have very good marketable and public demand within and outside of the state. The species is the food of aristrocates. The local price value are variable. From spring to monsoon period, price of *M. malcolmsonii* ranges from Rs. 180.00 to Rs. 240.00 per Kg. But during winter due to non availability the price goes upto Rs. 270.00 to Rs. 320.00 per kg.

(b) Fishing gears:

Prawns are harvested along with the other fishes of beels and rivers. It was observed that specific fishing gears used for prawn fishing with some seasonal variation. The fishing gears used are given in (Table -9)

The fishing gears can be categorized as –

a) **Impaling Gears** – includes Jongar, Tiara, Pokora, Kol or Kati.

b) **Traps** – Includes, Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Cherka, Torka, Bamidhora, Khoka, Tuna, Dori etc.

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Following are the different fishing gear used in the Beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table -9 are also used in different beels depending upon the water depth, water current and vegetations through out the years.

Biochemical composition.

The following are the important biochemical parameters of this species because these have some direct impacts on the nutritional aspects of the human beings.

Carotenid :	**In muscles (ug/g)**	**In carapace (ug/g)**
	2.98 – 4.75	56.33 – 60.68
	3.98 ± 0.60497	58.99 ± 1.55885
Total Ash	5.25 – 9.42	
	7.33 ± 1.35647	
Dry Matters	22.32 – 28.05	
	25.25 ± 2.14476	
Crude Protein	58.35 – 63.42	
	61.11 ± 1.93907	
Crude Fat	0.82 – 1.05	
	0.95 ± 0.080311	
Crude Fibre	0.98 – 2.32	
	1.69 ± 0.5120	
Calcium	3.32 – 5.21	
	4.29 ± 0.670820	
Phosphorous	1.02 – 1.73	
	1.40 ± 0.24495	

Habitat ecosystem

The following parameters were studied where from *M. malcolmsonii* were collected.

Physico-chemical results

Among the physico–chemical parameters like - Temperature (^{0}C), Transporency (cm), Conductivity (unho), P^H, Dissolved Oxygen (mg/L), Free-carbondioxide (mg/L). Total alkalinity (mg/L), Total hardness (mg/L), Choloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L) values of the different water bodies wherefrom the species are collected are as followes. **Atimospheric Temp (^{0}C):** lowest in the river of retreating monsoon (25.7-29.2) and highest in the river of monsoon (33.5-34.3); Water Tem (^{0}C): lowest in the river of retreating monsoon (23.1-26.2) and highest in the river of monsoon (32.5-33.1); **Transparency:** lowest in the beel of monsoon (35.1-39.5) and highest in the beel of retreating monsoon (42.7-55.2); **Conductivity:** lowest in the river of pre-monsoon (82.3-107.5) and highest in the beels of monsoon (188.2-213.4); **P^H:** lowest in the river of pre-monsoon (5.6-7.5) and highest in the beel of retreating monsoon (7.8-10.2); **Dissolved oxygen:** lowest in the river of monsoon (5.2-6.9) and highest in the beel of retreating monsoon (7.1-11.1); **Free carbondioxide:** lowest in the river of pre-monsoon (3.2-5.9) and highest in the beel of monsoon (6.8-7.1); **Alkalinity :** lowest in the river of monsoon (32.3-72.3) and highest in the beel of retreating monsoon (72.1-86.1); **Hardness**: lowest in the beel of pre-

monsoon (18.2-126-2) and highest in the beel of retreating monsoon (121.8-135.1); **Chloride**: lowest in the river of pre-monsoon (12.5-18.4) and highest in the beel of monsoon (18.3-22.5); **Nitrate**: lowest in the river of pre-monsoon (0.02-0.04) and highest in the beel of monsoon (0.18-0.48) and **Phosphorus**: lowest in the river of pre-monsoon (0.22-0.38) and highest in the beel of monsoon (0.33-0.41).

Soil texture and constituents :

Soil texture : Mostly sandy

While studying constituents of soil where from the species *M. birmanicum choprae* was collected, the parameters and the minimum and maximum values obtained are as followed- **Organic carbon (%):** minimum in the river during monsoon (2.8-6.9) and maximum in the beel during retreating monsoon (5.6-7.6); **P^H:** minimum in the river during pre monsoon (5.3-6.2) and maximum in river during retreating monsoon (6.4-7.2); **Nitrate (mg/100gm):** minimum in the river during pre-monsoon (0.15-0.31) and maximum in beel during monsoon (0.42-0.53); **Sulphate (mg/100gm) :** minimum in the beel during pre-monsoon (2.2-3.2) while maximum also in beel during monsoon (3.2-7.8); **Calcium (mg/100gm) :** maximum in the beel during monsoon (3.8-76.2) and maximum in the river during retreating monsoon (45.2-80.0); **Magnesium (mg/100gm):** minimum in the beel during pre-monsoon (21.2-36.4) and maximum also in the beel during monsoon

(24.8-54.2) and **Organic Matter (%):** minimum in the beel during monsoon (6.2-11.3) while maximum is also in the beel during pre-monsoon (6.6-14.3)

Plankton: Both the phyto-and Zooplankton are identified where from the species collected.

Phytoplankton: The following are the related phytoplankton (Algae, Diatoms and Desmids).

(i) Chlorophyceae : *Spirogyra* spp., *cosmarium* spp., *Ocscillatoria* spp., *Anabaena* spp. *Aphamocapsa* spp., *Arthrospira* spp., *Microcystis* spp., *Nostoc* Spp., *Chlorophycea* spp.

(ii) Diatoms : *Fragilaria* spp., *Synendra* Spp., *Navicule* Spp., *Pinnularia* spp.

(iii) Desmids : *Closterium* spp., *Casmarium* Spp., *Staurastrum* spp., *Euastrum* spp.

Zooplankton : The related *zooplankton* (*Protozoa, Ratipera, Cladoceran, copepoda* etc.) are the following ones: -

(i) Protozoa : *Chilomonas* spp., *Paranema* spp., *Euglena* spp., *Phaecus* spp., *Chlamydomasis* spp., *Gonium* spp., *Didinium* spp., *Litonotus* spp., *Nassula* spp., *Paramoecium* spp.

(ii)	**Rotifera**	:	*Lepadella* spp., *Monostyla* spp., *Euclinis* spp., *Filina* spp., *Brachionus* spp., *Keratella* spp., *Trichocore* spp., *Asplancha* spp.
(iii)	**Cladocera**	:	*Eurycerus* spp., *Bosmina* spp., *Moina* spp.
(iv)	**Copepods**	:	*Nauplii* spp., *Mesocyclop* spp., *Neo-diaptomus* spp., *Eucyclop* spp.
(v)	**Crustaceans**	:	*Simocephalus* spp., *Daphina* spp., *Cyclops* pp., *Cupris* spp.,
Aquatic vegetation		:	The following *macrophytes* are collected only from the syanding water bodies viz. *Lemna* spp., *Pistia, Nymphaea, Utricularia, Hydrilla* spp., *Potamegeton* spp., *Hygronrhiza* spp., *Ludwigia* spp. And very few. *Nelumbo* spp., *Euryale* spp., *Nyriophyllum* spp. etc.

Macrobrachium menoni

Morphometry and Bionomics

Taxonomy

Colouration: Very very less abundant species. Body without pigmentation but very few fine light yellow pigments found towards the base of restrum. **Rostrum:** Upper margin of the rostrum with convexity just behind the eye, concavity infront of the eyes; slightly inclined and lowered further. Ventrally the half part of the rostrum is almost straight and finally inclined. Dorsally the whole part of the rostrum starting from base beared thickly arranged spine upto tip and they are equidistant from each other and it is a significant character unlike that of other species. Ventrally half part of the rostrum from the base carried spines without having any space in between but the rest part upto apex is without spine. **Rostral Formula:** 15-16/7-8. **Carapace:** Surface is smooth, transparent and delicate. **Eye stalk :** 2.1 – 2.5mm (2.3mm + 0.079057) in length and 0.8 – 1.2mm (1.0mm + 0.079056) in diameter. **Antennule:** Pre coax > Coxa basis. Their joints are almost hairy. **Antenna:** Coxa $\leqslant$ basis, feeler of endopodite is non muscular. Exopodite is thin and transparent bearing less developed setae towards periphery though they are densely arranged. **First Pareopod:** Coxa = basis, ischium < merus, carpus < propodus > dactylus. Except caxa and basis, all segments are almost cylindrical but laterally compressed. All segments are rough and their joints with bunches of hair like structure. **Second Pareopod:** In comparism to body

PLATE - 4

M. menoni *(Dorsal view)*

M. menoni *(Dorso - lateral view)*

size it is muscular. Coax ⩽ basis, ischium < merus, carpus > propodus > dactylus. All segments contained many wart like projections with rough surface. Merus, carpus are laterlly compressed. **Non – Chelate legs:** Coxa = basis, ischium < merus, carpus < propoduk = dactylus. Non muscular, joints are loosely arranged. Surface is smooth. All segments are laterlly compressed. **Finger:** very few indistinct blunt tooth on fingers with few tentacles.

Maximum size 95mm

Food and Feeding

Mostly found in the big rivers like Brahmaputra Kapilee, Disang etc. Their abudance is very rear in standing water and they are mostly curnivarous. Their favourite food through out the year are the Zooplankton. Zooplankton includes mostly larva of crustanceas and insects, earthworms besides they prefer rotten flesh of any dead animals. floating in the water. During full monsoon, when dead and decaying animals carried by swift current of the river, they jump over the rotten flesh and eat voreciously. During the non-availability of flood they may become connibalastic in nature. Mixture of dead, decomposed molluscan shall like Unio, Achatina and fine sand grain mothuscen.

Maturity and Breeding

All collected spp. of *Macrobrachium* from Assam attain maturity through many larva stages. *M. menoni* of Assam takes near about 4 to 6 months to attain full maturity in case of both male and female. In the pre-

monsoon is the breeding period. They lay eggs in March to June. The larval development starts from the later part of the rainy season. They become adult during winter.

Feccundity

One special feature of all the colleted species of *Macrobrachium* is that the eggs are visible from outside and the pleopods carry the eggs. In *M.menoni* the eggs are yellowish in colour. They are very fine and each egg in almost in equal size to that of a sand particle. Nearly 10,000-15,000 number of eggs are counted as the maximum numbers of occurrence in both the ovaries.

Sex Ratio

In *M. menoni,* through number of male is more then that of females during mating, in this giant sized species, sex ratio is also found as 2 to 3 (♂):1(♀) naturally.

Fisheries

(a) **Marketing and Economic status :** In *M. menoni,* the price and economic status could not be ascertained due to non availability of the species.

(b) **Fishing gears: Fishing gears used in beels of Assam –**

Information available and gathered from various fisherman of rivers and beels, there is no specific gear used for freshwater Prawns. Prawns are harvested along with the other fishes of beels and rivers. But from the

information it was observed that some beels use specific fishing gears and there are some seasonal variation in the use of fishing gears (Table -9)

The fishing gears can be categorized as –

a) **Impaling Gears** – includes Jongar, Tiara, Pokora, Kol or Kati.

b) **Traps** – Includes, Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Cherka, Torka, Bamidhora, Khoka, Tuna, Dori etc.

c) **Entangling gear** – Langijal, Phansijal,

d) **Encirling gear** – Musarijal, Berjal, Polo, Juluki, Jhupri, Khewalijal, and Angthajal.

e) **Scooping gear** – Dharmajal, Dhenkijal, Thelajal. Jakoi.

f) **Trawling gear** – Moijal, Horhorijal, Shanglajal.

Following are the different fishing gear used in the beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table -9 are also used in different beels depending upon the water depth, water current and vegetations through out the years.

Biochemical Composition.

The following are the important biochemical parameters of this species because these have some direct impacts on the nutritional aspects of the human beings.

Carotenoid :	**In muscle (ug/g)**	**In carapace (ug/g)**
	2.21-3.32	39.17 – 44.04
	2.98 ± 0.37417	42.5 ± 1.676305
Total Ash	3.17 – 6.85	
	5.10 ± 1.32288	
Dry Matters	19.21 – 25.46	
	22.61 ± 2.15638	
Crude Protein	52.31 – 57.41	
	55.61 ± 1.8735	
Crude Fat	0.75 – 0.83	
	0.79 ± 0.028284	
Crude Fibre	0.94 – 2.28	
	1.65 ± 0.5124	
Calcium	2.92 – 4.85	
	3.90 ± 0.68556	
Phosphorus	0.99 -1.52	
	1.29 ± 0.173205	

Habitat ecosystem

The following parameters are studied where from *M. menoni* collected.

Physico-chemical results

Among the physico–chemical parameters like - Temperature (^{0}C), Transporency (cm), Conductivity (unho), P^H, Dissolved Oxygen (mg/L),

Free-carbondioxide (mg/L). Total alkalinity (mg/L), Total hardness (mg/L), Choloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L) values of the different water bodies wherefrom the species are collected are as followes. **Atimospheric Temp (^{0}C):** lowest in the river of retreating monsoon (25.7-29.2) and highest in the river of monsoon (33.5-34.3); **Water Tem (^{0}C):** lowest in the river of retreating monsoon (23.1-26.2) and highest in the river of monsoon (32.5-33.1); **Transparency:** lowest in the beel of monsoon (35.1-39.5) and highest in the beel of retreating monsoon (42.7-55.2); **Conductivity:** lowest in the river of pre-monsoon (82.3-107.5) and highest in the beels of monsoon (188.2-213.4); **P^H:** lowest in the river of pre-monsoon (5.6-7.5) and highest in the beel of retreating monsoon (7.8-10.2); **Dissolved oxygen:** lowest in the river of monsoon (5.2-6.9) and highest in the beel of retreating monsoon (7.1-11.1); **Free carbondioxide:** lowest in the river of pre-monsoon (3.2-5.9) and highest in the beel of monsoon (6.8-7.1); **Alkalinity :** lowest in the river of monsoon (32.3-72.3) and highest in the beel of retreating monsoon (72.1-86.1); **Hardness**: lowest in the beel of pre-monsoon (18.2-126-2) and highest in the beel of retreating monsoon (121.8-135.1); **Chloride**: lowest in the river of pre-monsoon (12.5-18.4) and highest in the beel of monsoon (18.3-22.5); **Nitrate**: lowest in the river of pre-monsoon (0.02-0.04) and highest in the beel of monsoon (0.18-0.48) and **Phosphorus**: lowest in the river of pre-monsoon (0.22-0.38) and highest in the beel of monsoon (0.33-0.41).

Soil texture and constituents :

Soil texture : Mostly sandy

While studying constituents of soil where from the species *M. birmanicum choprae* was collected, the parameters and the minimum and maximum values obtained are as followed- **Organic carbon (%) :** minimum in the river during monsoon (2.8-6.9) and maximum in the beel during retreating monsoon (5.6-7.6); **P^H:** minimum in the river during pre monsoon (5.3-6.2) and maximum in river during retreating monsoon (6.4-7.2); **Nitrate (mg/100gm):** minimum in the river during pre-monsoon (0.15-0.31) and maximum in beel during monsoon (0.42-0.53); **Sulphate (mg/100gm) :** minimum in the beel during pre-monsoon (2.2-3.2) while maximum also in beel during monsoon (3.2-7.8); **Calcium (mg/100gm) :** maximum in the beel during monsoon (3.8-76.2) and maximum in the river during retreating monsoon (45.2-80.0); **Magnesium (mg/100gm):** minimum in the beel during pre-monsoon (21.2-36.4) and maximum also in the beel during monsoon (24.8-54.2) and **Organic Matter (%):** minimum in the beel during monsoon (6.2-11.3) while maximum is also in the beel during pre-monsoon (6.6-14.3)

Plankton:

Both the phyto-and zooplankton were identified where from the species were collected.

Phytoplanktocon : The following are the related phytoplnliton (Angae, Diatoms and Desmids).

(I) Chlorophyceae : *Spirogya* spp., *cosmarium* spp *Oscillatoria* spp, *Anabaena*, spp. *Aphamocapsa Arthrospira*, *Microcystis*, *Nostoc* spp., *Chlorophycea* spp.

(II)Diatoms : *Fragilaria* spp., *synendra* spp, *Navicula* spp, *Pinnularia* spp.

(III)Dismids : *Closterium* spp., *cosmarium* spp. *Staurastrum* spp., *Euastrum* spp.

Zooplakton : The related *zooplankton* (*Protozoa*, *Rotifera*, *Cladoceran*, *copepoda* etc.) are the following ones-

(I) Protozoa : *Chilomonas* spp. *Paranema*, spp. *Englena* spp., *Phaecus* spp., *Chlamydomasis* spp. *Gonium* spp., *Didinium* spp., *Litonotus* spp., *Nassula* spp., *Paramoecium* spp.

(II)Rotifera : *Lepadella* spp., *Monostyla* spp., *Euclinis* spp., *Filinia* spp., *Brachionus* spp., *Keratella* spp., *Trichocore* spp., *Asplancha* spp.

(III) Cladocera : *Eurycerus* spp., *Bosmina* spp., *Moina* spp.,

(IV) Copepods : *Nauplii* spp., *Mesocyclop* spp., *Neo-diaptomus* spp., *Eucyclop* spp., *Artemiapp.*

(V) Crustaceans : *Simocephalus* spp., *Daphnia* spp., *Cyclops* pp., *Cypris* spp.,

Aquatic Vegetation : Very few aquatic vegetations were found where from the speies was collected as *Lemna* spp., *Pistia, Nymphaea, Utricularia, Hydrilla* spp., *Potamageton* spp., *Hygrorrhiza* spp., *Ludwigia* spp., and very few. *Nelumbo* spp., *Euryale* spp., *Nyriophyllum* spp., etc.

Macrobrachium lamarrei (Edwards)

1837, Palaemon lamarrie, Mline Edward H, Histoire Naturelle des crustaces, comorenant 1, Anatomie, Pa Physiologie *et al.* Classification de ces anixaur, II. Paris.

Morphometry and Bionomics.

Taxonomy

Coloration : Elongated body more or less spindle shaped and bilaterally symmetrical. Body colouration is white and translusceu. Absence of body pigments totally in the young but very few towards antero-tateral border of carapace in the adult. **Rostral Formula:** $^{7\text{-}12}/_{4\text{-}8}$. **Rostrum :** RL $\geqslant$ As. Teeth on the dorsal edge present throughout the rostrum. Rostrum shows convexity towards base, concavity at the middle and generally inclined. Cervical sulcus well developed. Gastro – orbital cornea (GOC) highly developed. Adrostral sulcus is not very distinct. 3rd maxilipod long. All segments of it are hairy. **Carapace:** Carapace is very smooth and only a small number contains very few pigments. One pair of well developed stalked compound eye present. The length of the **eye stalk:** varies from 0.6 – 0.9mm (0.75mm ±0.1010544) and diameter is 0.18 – 0.21mm (0.195mm ±0.076551). **Antennules:** pre coxa > coxa < basis. On either side of the coxa bears fine hair like structure. **Antenna:** coxa $\leqslant$ basis. **First pareopod:** coxa $\geqslant$ basis, ischium > merus, carpus < propodus $\geqslant$ dactylus. **Second pareopod:** coxa > basis, ischium = merus, carpus > propodus < dactylus. Ischium is rod like and is slightly laterally comoressed. Less developed non muscular chelate legs with delicate

PLATE - 5

M. lamarrie *(Dorsal view)*

M. lamarrie *(Dorso-lateral view)*

M. lamarrie *(colony)*

chela. Immobile finger is slightly blunt to inwardly curved. Teeth are equidistant from each other. **Mobile finger** – 3 to 5 minute teeth. Carpus of 2nd chiliped is twice as long as chela. **Non – chelate leg:** coxa < basis, ischium < merus, carpus < propodus > dactylus.

Maximum size = 55mm

Food and Feeding:

Presently found in big water bodies like beels, swampy area, moderate sized river towards bank side. They like to stay in the turbid water with sparsed distribution of aquatic vegetation. They are omnivorous in nature. They prefer to ingest very soft food, may be of plants or animals body. It is the smallest sized prawn with highest population densities among all the collected species.

Maturity and Breeding:

As the smallest sized *Macrobrachium*, it shows the highest population density among the all collected species from Assam. Like that of other species of *Macrobrachium* from Assam, sexual maturity attain during late part of rainy season and larval stages completed during winter.

Fecundity:

In *M. lamarrie,* eggs are a mixture of light yellow plus light greenish colour and size is equal to that of a sand particle. The total number of eggs in both the ovaries are counted as 2000-5000.

Sex Ratio:

They always like to stay with a big colony. So actual sex ratio though was not able to ascertain, during investigation, it has been carefully observed that, many males come to mate with single female viz approximately 8-10 (♂) : 1(♀)

Fisheries:

(a) **Marketting and Economic status:**

In *M. lamarrei*, the price ranges from Rs. 40/- to Rs. 60/- per Kg. from spring to monsoon and during winter because of non availability, the price may go up to Rs 80/- per Kg. Because of the smallest sized and highest population density and cheapest value among all the collected *Macrobrachium* spp., of Assam, it is a very favourite food of lower to middle class people of Assam.

(b) Fishing gears:

Fishing gears used in beels of Assam –

Information available and gathered from various fisherman of rivers and beels, there is no specific gear used for freshwater Prawns. Prawns are harvested along with the other fishes of beels and rivers. But from the information it was observed that some beels use specific fishing gears and there are some seasonal variation in the use of fishing gears (Table -9)

The fishing gears can be categorized as –

a) **Impaling Gears** – includes Jongar, Tiara, Pokora, Kol or Kati.

b) **Traps** – Includes, Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Cherka, Torka, Bamidhora, Khoka, Tuna, Dori etc.

c) **Entangling gear** – Langijal, Phansijal,

d) **Encircling gear** – Musarijal, Berjal, Polo, Juluki, Jhupri, Khewalijal, and Angthajal.

e) **Scooping gear** – Dharmajal, Dhenkijal, Thelajal. Jakoi.

f) **Trawling gear** – Moijal, Horhorijal, Shanglajal.

Following are the different fishing gear used in the beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table -9 are also used in different beels depending upon the water depth, water current and vegetations through out the years.

Biochemical composition:

The following are the important biochemical parameters of this species because these have some direct impacts on the nutritional aspects of the human beings.

Carotenoid :	**In muscles (ug/g)**	3.85 – 5.23
		4.67 ± 0.47932
	In carapace (ug/g)	12.98 – 15.84
		14.15 ± 0.50683
Total Ash :		1.02 – 3.48
		2.46 ± 0.773175
Dry Matters		13.25 – 18.31
		16.11 ± 1.81383
Crude Protein		35.21 – 38.56
		37.08 ± 1.24096

Crude Fat	0.62 – 0.74
	0.68 ± 0.044721
Crude Fibre	0.75 – 1.98
	0.68 ± 0.437835
Calcium	2.05 – 4.12
	3.22 ± 0.755943
Phosphorus	0.75 – 1.88
	0.66 ± 0.416523

Habitat ecosystem:

The following parameters are studied where from *M. lamarrei* collected.

Physico – chemical result:

The following are the results obtained as water parameters where from *M. lamarrie* was collected viz. Temperature(^{0}C), Transparency (cm), Conductivity (Чnho), P^H, Dissolved oxygen (mg/L), Free carbon dioxide (mg/L), Total alkalinity (mg/L), Total hardness (mg/L), Chloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L). **Atmospheric Temp (^{0}C):** the minimum temperature found in the swamp of retreating monsoon (25.5-29.3) and the maximum temperature recorded in the river of monsoon (33.4-34.3); **Water Temp(^{0}C):** the minimum water temperature recorded in the swamp of retreating monsoon (22.8-25.1) while maximum temperature recorded in the river during monsoon (33.5-33.1); **Transparency:** the minimum transparency

recorded in the swamp of monsoon (18.9-27.8) and the maximum recorded in the river of pre-monsoon (41.3-75.4); **Conductivity :** the minimum conductivity recorded in the swamp of pre-monsoon (61.5-102.2) and maximum recorded in the beel during monsoon (188.3-213.8); **P^H:** the minimum P^H value found in the river of pre-monsoon (5.8-7.5) and maximum recorded in the beel of monsoon (7.4-8.3); **Dissolved Oxygen :** the minimum amount recorded in the river of monsoon (5.2-7.0) and the maximum amount recorded in the beel during retreating monsoon (7.1-11.1); **Free carbondioxide :** the minimum amount recorded in the river of pre-monsoon (3.1-5.9) and the maximum amount recorded in the swamp of monsoon (6.8-7.5); **Alkalinity:** the minimum amount obtained in the river of monsoon (34.1-72.3) and the maximum amount found in the beel of pre-monsoon (68.3-96.6); **Hardness :** the minimum amount recorded in the river of pre-monsoon (18.4-126.4) and the maximum amount recorded in the swamp of pre-monsoon (35.4-136.4); **Chloride :** the minimum amount recorded in the river of pre-monsoon (12.3-18.5) and the maximum amount recorded in the river of monsoon (16.1-24.6); **Nitrate:** the minimum amount recorded in the river of pre-monsoon (0.02-0.42) and the maximum amount recorded in the swamp of retreating monsoon (0.75-0.91) and **Phosphate :** the minimum amount recorded in the river of pre-monsoon (0.22-0.26) and the maximum amount found in the swamp of monsoon (0.38-0.57)

Soil texture and constituents:

Soil texture : Mostly clay and sandy loamy

The following are the various soil parameters investigated from the different water bodies where from the species was collected –viz. Organic carbon (%), P^H, Nitrate(mg/100gm), Sulphate (mg/100gm), Calcium (mg/100gm), Magnesium (mg/100gm) and Organic matter(%). **Organic Carbon (%) :** the minimum amount recorded in the river of monsoon (2.8-6.9) and the maximum amount recorded in the swamp of monsoon(4.2-8.6); **P^H:** the minimum value recorded in the river of pre-monsoon (5.3-6.2) and the maximum value recorded in the swamp of monsoon and river of retreating monsoon (6.4-7.2); **Nitrate (mg/100gm):** the minimum amount observed on the river of pre-monsoon (0.15-0.31) and the maximum amount observed in the swamp of monsoon (0.42-0.72); **Sulphate (mg/100gm):** the minimum amount found in the beel of pre-monsoon (2.2-3.2) and the maximum amount found in the beel of monsoon (3.2-7.8); **Calcium (mg/100gm):** the minimum amount found in the beel of monsoon (38.4-76.2) and the maximum amount found in the swamp of monsoon (53.1-86.2); **Magnesium (mg/100gm):** the minimum amount recorded in the beel of pre-monsoon (21.2-36.6) and the maximum amount recorded in the beel of monsoon (24.8-54.2) and **Organic matter(%):** the minimum amount recorded in the beel of monsoon (6.2-11.3) while the maximum amount observed in the swamp of monsoon (6.6 – 15.2).

Plankton:

Both the phyto and zooplankton are identified where from the species collected.

Phytoplankton : The following are the related phytoplankton (Algae, Diatoms and Desmids).

(I) Chlorophyceae: *Spirogyra* spp., *cosmarium* spp., *Oscillatoria* spp., *Edurina*, *Anabeena* spp., *Aphanocapsa*, *Arthrospira*, *Microcystis*, *Nostoc*.

(II) Diatom : *Fragilaria* spp., *Synendra* spp., *Navicula* spp., *Pinnularia* spp..

(III) Desmids : *Cosmarium* spp., *closterium* spp., *Euastrum* spp., *Staurastrum* spp.

Zooplankton : The related *zooplankton* (*Protozoa, Rotifera, Cladoceran, copepoda* etc.) are the following ones-

(I) Protozua : *Paramoecium* spp., *Volvox* spp., *Euglena* spp., *Chilomonas* spp., *Paranema* spp., *Phaceus* spp., *Chlamydo-monas* spp., *Gonium* spp., *Litonotus* spp., *Brachionus* spp., *Nassula* spp.

(II) Rotifera : *Euclinis* spp., *Filinia* spp., *Kerotella* spp., *Trichocera* spp., *Asplancha* spp., *Lepadella* spp., *Monostyla* spp.,

(III) Cladocera : *Eury cerrus* spp., *Bosmina* spp., *Moina* spp.,

(IV) Copepods : *Naupli* spp., *Neo-diaptamus* spp., *Eucyclop* spp., *Artemia* spp.,

(V) Crustaceans : *Daphnia* spp. *Cylop* spp. *Cypris* spp., *Zoea* and *Protozoea* larva.

Aquatic Vegetation: The following related macrophytes are observed-

(a) Floating : *Azolla* spp., *Salvinia* spp. *Pistia* spp., *Eichornia* spp., *Wolffia* spp., *Spirodella* spp., *Nepturua* spp., *Trapa* spp., *Ipomea* spp.

(b) Semi submerged : *Nelumbo naucifera*, *Nymphea* spp., *Neptunea* spp., *Nymphodus* spp., *Nepturia* spp., *Sagittaria* spp.

(c) Submerged : *Ceratophyllum* spp., *Hydrilla* spp., *Vallisneria* spp., *Ottleria* spp., *Najas* spp., *Potamugeton* spp., *Myriophyllum* spp.,

Macrobrachium dayanum (Henderson)

1892. Palaeomon dayanum Henderson, Trans. Linn. Soc. Landon 5(2) 443-444, Pl (XI) figs. 7-13

Morphometry and Bionomics

(i) Taxonomy

Colouration: In young condition light greenish colour is more towards dorsal part of the body. Adult shows light to dark ash colour. In adult, the body shows heavy deposition of green, pink to light black coloured pigments. **Rostrum:** Dorsally in the rostrum, all spines are not equidistant from each other but ventrally, specially the second, third, fourth and fifth are equidistant. Moreover, dorsally the rostrum shows slight convexity from the base. The concavity starts just immediately after 3rd spine and finally upturn towards apex. Ventrally the spines develop from the concavity apart. **Rostral Formula (RF):** 7 – 11 / 5 – 9. **Carapace:** It is smooth and highly pigmented with frequent change of colour. Antro-laterally on either side of the rostrum, towards the base of the eye stalk, one pair of small pointed spine is present. One pair of well developed stalked compounded eye. The length of the **eye stalk:** ranges from 2.5 – 3.3 mm (2.75 ± 0.5123 mm) and diameter is 0.5 – 1.2 mm (0.85 ± 0.3548 mm). **Antennules:** Pre Coxa > Coxa ≤ basis. Laterally towards the left side the coax bears fine hair like structure but the basis shows hair like out growth laterally towards both side. **Antenna:** Coxa half of basis. Basis with single pointed spine. It showed uniform distribution of large

PLATE - 6

M. dayanum *(Dorsal view)*

M. dayanum *(Dorso-lateral view)*

M. dayanum *(colony)*

number of very fine, spherical, red coloured pigments. Leaf – like expodite with uniform distribution of setae towards periphery. Antero-laterally 2/3 rd of the expodite towards inner side from the base shows hair like structure without setae. Coxa < Basis. **First pareopod:** Coxa = basis, ischium ⩽ merus, Carpus < Propodus > dactylus. The ischium and fingers are provided with left setae, while on the rest of the legs, hairs are sparsely distributed. **Second pareopod:** coax < basis, ischium = merus, carpus ⩽ propodus, propodus > dactylus. The ischium, merus and carpus are rod like and laterally compressed. **Non-chelate legs:** Coxa = basis, ischium < merus, carpus < propodus > Dactylus. Except merus and carpus, all parts are hairy. **Finger:** In female 2 – 3 conical teeth with 7 – 9 minute spines. **In male fingers:** three equal sized conical teeth having three minute spines like processes.

Maximum size = 93 mm.

(ii) Food and Feeding:

They are generally omnivorous in nature. It is abundantly found in the standing water like beel, big swampy water bodies, ponds, tank with full of plankton and aquatic vegetation. Decayed fallen leaves, soft vegetation and plankton are the favourite food. They also never hesitate to eat the earthworm and the larva of many crustaceans and insects. Some species are also collected species from many small rivers of sandy loamy soil bed plus remnants of soft aquatic vegetation and plankton. Rice band, oil cake are also the favourite food because of surface column dwelling habit.

(iii) Maturity and Breeding:

M̃. dayanum take 5 to 6 months to attain full maturity. In this species it was observed change in colouration of body during maturity. In young condition the body colour is slight grayish with scanty deposition of greenish coloured β carotene pigments. As the growth approaches towards maturity, the body colour changes to dark grey with full deposition of greenish coloured carotenoid pigments in the body surface. Towards old stages, the species is black in colour and it is a very diagnostic character for this species. These types of frequent changes of body colouration are not observed in other collected species of *Macrobrachium* of Assam except *M. assamensis.* This species attains maturity towards late monsoon and lays eggs towards early part of winter. Larval stages completed during late part of the winter and becomes adult before the spring.

(iv) Fecundity:

In this species, the eyes are larger in size and very less in number in compare to other running water prawn. During the development of eggs, the gradual change in colour from light green to green and finally to light black are noticed. In *M. dayanum*, the total number of eggs counted in both the ovaries are ranged from 1200 – 2000.

(v) Sex Ratio:

In *M. dayanum* sex ratio found in nature is 4 to 6 (♂) : 1 (♀). Though they are found mostly in the standing water having full of plankton and macrophytes, they almost prefer clear free water for mating.

(vi) Fisheries:

(a) Marketing and Economic status:

In *M. dayanum* from spring to monsoon, the price ranges from Rs. 120.00 to 150.00 per kg and during winter due to availability of the species, the price goes down to Rs. 80.00 to Rs. 100.00 per kg.

(b) Fishing gears: Fishing gears used in beels of Assam –

Information available and gathered from various fisherman of rivers and beels, there is no specific gear used for freshwater Prawns. Prawns are harvested along with the other fishes of beels and rivers. But from the information it was observed that some beels use specific fishing gears and there are some seasonal variation in the use of fishing gears (Table -9)

The fishing gears can be categorized as –

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c) **Entangling gear** – Langijal, Phansijal,

d) **Encircling gear** – Musarijal, Berjal, Polo, Juluki, Jhupri, Khewalijal, and Angthajal.

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Following are the different fishing gear used in the beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table -9 are also used in different beels depending upon the water depth, water current and vegetations through out the years.

(vii) Biochemical composition:

The following are the important biochemical parameters of this species because of these have some direct impacts on the nutritional aspects of the human beings.

	In muscles (µg/g)	**In carapace (µg/g)**
Carotenoid	3.93 – 5.87	17.03 – 21.51
	4.49 ± 0.8393	19.91 ± 1.58745
Total Ash	2.73 – 5.45	
	3.16 ± 0.94339	
Dry Matter	17.21 – 22.04	
	19.03 ± 1.66733	
Crude Protein	49.28 – 53.15	
	51.51 ± 1.3784	
Crude Fat	0.66 – 0.72	
	0.69 ± 0.02242	
Crude Fibre	0.98 – 2.23	
	1.132 ± 0.435889	
Calcium	2.95 – 5.31	
	4.29 ± 0.842614	
Phosphorous	0.96 – 1.97	
	1.45 ± 0.475784	

Habitat ecosystem.

The following parameters are studied where from *M. dayanum* collected.

Physico – chemical result:

The following are the various water parameters observed where from *M. dyanum* was collected viz. Temperature (^{0}C), Transparancy (cm), Conductivity (unho), P^H, Dissolved Oxygen (mg/L), Free Carbondioxide(mg/L), total Alkalinity (mg/L), Total Hardness (mg/L), Chloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L). **Atmospheric temp (^{0}C):** In the investigation, river of retreating monsoon showed minimum value (22.2-24.2) while maximum value was obtained in the beel during monsoon (32.8-33.9); **Water temperature:** the minimum value was observed in the river of retreating monsoon (22.5-25.8) while maximum value observed in the river of monsoon (32.3-33.1); **Transparency (cm): t**he minimum value was obtained in the paddy field during pre-monsoon (24.7-38.6) while maximum value was obtained in the pond during retreating monsoon (58.2-62.7); **Conductivity (μnho):** the minimum value was obtained in the pond during pre-monsoon (53.8-96.7) while maximum value was observed in the beel during monsoon (188.3-213.8); **P^H:** Similarly P^H value was obtained minimum in the river during pre-monsoon (5.8-7.3) while maximum value was obtained in the beel during retreating monsoon (7.7.-10.2); **Dissolved oxygen (mg/L):** the minimum value was obtained in the river during pre-monsoon (4.4.-4.8) while maximum value was obtained in the pond during retreating monsoon (9.4-11.5); **Free Carbondioxide (mg/L):** the minimum

value was obtained in the river of pre-monsoon (3.3-5.9) while maximum value obtained in the pond of monsoon (7.1-7.8); **Alkalinity(mg/L):** the minimum value was obtained in the pond of monsoon (40.3-58.8) while maximum value obtained in the beel during pre-monsoon (68.6-110.9); **Total Hardness(mg/L) :** the maximum value obtained in the beel of pre-monsoon (17.9-126.8) while maximum value was obtained also in the beel during pre-monsoon (30.4-139.2); **Chloride (mg/L):** the minimum value obtained in the river of pre-monsoon (12.2-18.5) while maximum value obtained in the river of monsoon (16.1-23.8); **Nitrate (mg/L):** the minimum value obtained in the river of pre-monsoon (0.02-0.42) while maximum value obtained in the paddy filed during retreating monsoon (0.54-1.63) and **Phosphate:** the minimum value obtained in the river of pre-monsoon (0.22-0.26) while maximum value obtained in the paddy filed during retreating monsoon (0.66-1.64).

Soil texture and Constituents:

Soil texture : Mostly clay and sandy loamy

The following are the various values viz. .....Organic carbon, P^H: Nitrate (mg/100), Sulphate (mg/L), Calcium (mg/100gm), Magnesium (mg/100gm) and Organic matters (%) where from prawn species were collected. **Organic matter (%):** the minimum value was obtained in the river of monsoon period (2.8-6.9) and maximum value was obtained in the paddy filed during retreating monsoon (6.8-8.1); **P^H:** the minimum P^H found in the river of pre monsoon (5.3-6.2) and maximum is the swamp of monsoon and river of retreating monsoon (6.4-7.2); **Nitrate(mg/100gm):** the minimum amount obtained in the river of pre-monsoon (0.15-0.31) and maximum amount

obtained in the paddy filed during monsoon (0.56-0.78); **Sulphate :** the minimum amount obtained in the beel of pre-monsoon (2.2-3.2); **Calcium (mg/100gm):** the minimum amount obtained in the pond of monsoon (36.5-72.2) and maximum amount in the paddy filed of monsoon (49.2-96.1); **Magnesium (mg/100gm):** the minimum amount obtained in the pond of pre-monsoon (20.8-32.2) and the maximum amount obtained in the paddy filed during monsoon (35.1-63.4) and **Organic matter (%):** the minimum amount obtained in the pond of pre-monsoon (5.5-12.4) while maximum obtained in the swamp of monsoon (6.6-15.2).

(IX) Plankton: Both the phyto and zooplankton are identified where from the species collected.

Phytoplankton : The following are the related phytoplankton (Algae, Diatoms and Desmids).

(I) Chlorophycea : *Spirogya* spp., *Cosmarium* spp., *Oscillatoria* spp., *Edurina* spp.

(II) Diatom : *Fragilaria* spp. *Synendra* spp., *Navicula* spp., *Pinnularia*, spp.,

(III) Desmids : *Cosmarium* spp., *closterium* spp., *Evastrum* spp., *Staurastrum* spp.

Zooplankton : The related zooplankton (*Protozoa, Rotifera, Cladoceran, copepoda* etc.) are the following ones-

(I) Protozoa : *Paramoecium* Spp., *Volvox* Spp, *Englena* spp.

(II) Rotifera	:	*Euclinis* spp., *Filinia* spp., *Brachionus* spp., *Keratella* spp., *Trichocera* spp., *Asplancha* spp.
(III) Cladecera	:	*Eurycerus* spp., *Bosmina* spp., *Moina* spp.
(IV) Copepods	:	*Mesocyclop, Neo-diaptomus* spp.
(V) Crustaceans	:	*Daphnia* spp., *Cyclop* spp., *Cypris* cpp., *Zoea* and *Protozoea* larva
Aquatic Vegetation	:	The following related macrophytes are observed.
(a) Floating	:	*Azolla* spp., *Salvinia* spp., *Pistia* spp., *Eichornia* spp., *Wolffia* spp., *Spirodella* spp., *Nepturua* spp., *Trapa* spp, *Lemna* spp.
(b) Semi submerged	:	*Nelumbo naucifera, Nymphaea* spp., *Neptunea* spp., *Nymphoidus* spp., *Nepturia* spp., *Sagittaria* spp.
(C) Submerged	:	*Ceratophyllum* spp., *Hydrilla* spp., *Vallisneria* spp., *Ottleria* spp., *Najas* spp., *Potageton* spp., *Myriophyllum* spp.
(D) Rooted emergent hydrophytes	:	*Alsma plantago* spp., *Colocasia* spp., *Alocasia* spp., *Aeschynomese* spp., *Orize* spp., *Ammania* spp.

Macrobrachium assamensis (Tiwari)

1858 *Macrobracium assamnsis* Tiwari Soc. Indian Mus 53 (162), 197-300.

Morphometry and Bionomics

(I) Taxonomy

Colouration: Young one shows sparsed distribution of very fine light greenish pigments all over the body. The adult stage shows almost similar body colouration like that of *M. dayanum* rostrum. **Rostrum:** dorsally all the spines in the rostrum are equidistant from each other. Immediately after origin, from the base of carapace, the rostrum shows slight convexity followed by slight concavity and finally slightly upturn at the tip. Towards the ventral side convexity starts approximately from the base of eye stalk followed by concavity and finally slightly horirzontal Ventrally the rostral teeth, though few in number are not equidistant from each other. **Rostral Formula:** 8 – 11 / 2 – 4. **Carapace:** is smooth in the young condition and rough in the adult condition. With full deposition of red to black coloured pigments towards later stages in the legs with frequent changes of colour. Antero-laterally towards the base of antenna, on either side of the rostrum, the carapace bears one pair of small pointed spine. Presence of single pair of stout structural compound eyes. The length of the **eye stalk:** varies from 1.4 – 2.2 mm and the diameter varies from 0.7 – 1.2 mm (0.95 ± 0.3856 mm) **Antennule:** Pre coxa > coxa < basis. Pre coxa and coxa bear few hair like

PLATE - 7

M. assamensis

(Dorsal view)

(Dorso-lateral view)

(Colony)

structure sparsely. **Antenna:** Feeler of endopodite are highly muscular having 3 unequal sized segments (2 equal & 1 small) and major parts of endopodite towards apex are thickly segmented. Coxa<basis. Laterally towards left side, at about 2/3 rd; the expodite bears single spine having uniform distribution of setae from the base of the spine towards right side up to the base of the endopodite. **First pareopod:** all segments are non muscular. Coxa ⩽ basis, ischium = merus, carus, propodus > dactylus. Except coxa and basis, all surfaces are rough. Dactylus is provided with minute wart like projection. **Second Pareopod**: In compare to body size, it is highly muscular. Coxa < basis, ischium = merus, carpus, propodus = dactylus. Ischium, merus and carpus are cylindrical and laterally compressed. All segments showed uniform distribution of red pigments. **Non chelate legs:** coxa = basis, ischium < merus, carpus, propodus > dactylus. Dactylus is curved and pointed. Surface of the leg is slightly rough.

Maximum size = 78.6 mm.

(II) Food and Feeding:

They are generally omnivorous in nature. It is abundantly found in the standing water like beel, big swampy water bodies, ponds, tanks with full of plankton and aquatic vegetation. Decayed fallen leaves, soft vegetation and phytoplankton are the favourite food. They also never hesitate to eat the earthworm and the larva of many crustaceans and insects. The collection was also made from many small rivers of sandy loam soil bed plus remnant of soft

aquatic vegetation and plankton. Rice band, oil cake are also the favourite food because of surface column dwelling habit.

(III) Maturity and Breeding:

M. assamensis take 5 to 6 months to attain full maturity. In this species changes in colouration of body during maturity was detected. In young condition the body colour is slight greyish with scanty deposition of greenish coloured β carotene pigments. As the growth approaches towards maturity, the body colour changes to dark grey with full deposition of greenish coloured carotenoid pigments in the body surface. Towards old stages, the species is black in colour and it is a very diagnostic character for this species. These types of frequent changes of body colouration are not observed in other collected species of *Macrobrachium* of Assam except *M. assamensis*. This species attains maturity towards late monsoons and lays eggs towards early part of winter. Larval stages completed during late part of the winter and becomes adult before the spring.

(IV) Fecundity:

In this species, the eggs are larger in size and very less in number in compare to other running water prawn. During the development of eggs, the gradual change incolour from light green to green and finally to light black are noticed. In *M. assamensis* the total number of eggs counted in both the ovaries are ranged from 1000 – 1850.

(V) Sex Ratio

In *M. assamensis* sex ratio is 4 to 6 (♂) : 1 (♀) in natural condition. Though they are found mostly in the standing water having full of plankton and macrophytes, they almost prefer clear free water for mating.

(VI) Fisheries:

(a) Marketing and Economic status:

In *M. assamensis* from spring to monsoon, the price ranges from Rs. 120.00 to Rs. 150.0 per kg and during winter due to availability of the species, the price goes down to Rs. 80.00 to Rs. 100.00 per kg.

(b) Fishing gears: Fishing gears used in beels of Assam –

Information available and gathered from various fisherman of rivers and beels, there is no specific gear used for freshwater Prawns. Prawns are harvested along with the other fishes of beels and rivers. But from the information it was observed that some beels use specific fishing gears and there are some seasonal variation in the use of fishing gears (Table -9)

The fishing gears can be categorized as –

a) **Impaling Gears** – includes Jongar, Tiara, Pokora, Kol or Kati.

b) **Traps** – Includes, Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Cherka, Torka, Bamidhora, Khoka, Tuna, Dori etc.

c) **Entangling gear** – Langijal, Phansijal,

d) **Encircling gear** – Musarijal, Berjal, Polo, Juluki, Jhupri, Khewalijal, and Angthajal.

e) **Scooping gear** – Dharmajal, Dhenkijal, Thelajal. Jakoi.

f) **Trawling gear** – Moijal, Horhorijal, Shanglajal.

Following are the different fishing gear used in the beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table -9 are also used in different beels depending upon the water depth, water current and vegetations through out the years.

(VII) Biochemical composition:

The following are the important biochemical parameters of this species because these have some direct impacts on the nutritional aspects of the human beings.

Carotenoid:	**In muscles (µg/g)**	**In carapace (µg/g)**
	4.25 – 6.27	18.92 – 23.21
	5.12 ± 0.74911	22.45 ± 1.54747
Total Ash	2.91 – 6.14	
	4.36 ± 1.21655	
Dry Matter	18.05 – 24.26	
	20.32 ± 2.15174	
Crude Protein	51.63 – 56.45	
	53.86 ± 2.26121	
Crude Fat	0.76 - 0.84	
	0.79 ± 0.0018	

Crude Fibre	0.96 – 2.46
	1.562 ± 0.55678
Calcium	3.04 – 7.12
	5.08 ± 1.50997
Phosphorus	0.98 – 2.04
	1.26 ± 0.43589

(VIII) Habitat ecosystem:

The following parameters are studied where from *M. assamensis* (Tiwari) collected.

Physico – chemical result

The following are the various water parameters observed where from *M. assamensis* was collected viz. Temperature (^{0}C), Transparancy (cm), Conductivity (unho), P^H, Dissolved Oxygen (mg/L), Free Carbondioxide(mg/L), total Alkalinity (mg/L), Total Hardness (mg/L), Chloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L). **Atmospheric temp (^{0}C):** In the investigation, river of retreating monsoon showed minimum value (22.2-24.2) while maximum value was obtained in the beel during monsoon (32.8-33.9); **Water temperature:** the minimum value was observed in the river of retreating monsoon (22.5-25.8) while maximum value observed in the river of monsoon (32.3-33.1); **Transparency (cm):** the minimum value was obtained in the paddy field during pre-monsoon (24.7-38.6) while maximum value was obtained in the pond during retreating monsoon (58.2-

62.7); **Conductivity (μmho):** the minimum value was obtained in the pond during pre-monsoon (53.8-96.7) while maximum value was observed in the beel during monsoon (188.3-213.8); **P^H:** similarly P^H value was obtained minimum in the river during pre-monsoon (5.8-7.3) while maximum value was obtained in the beel during retreating monsoon (7.7.-10.2); **Dissolved oxygen (mg/L):** the minimum value was obtained in the river during pre-monsoon (4.4.-4.8) while maximum value was obtained in the pond during retreating monsoon (9.4-11.5); **Free Carbondioxide (mg/L):** the minimum value was obtained in the river of pre-monsoon (3.3-5.9) while maximum value obtained in the pond of monsoon (7.1-7.8); **Alkalinity(mg/L):** the minimum value was obtained in the pond of monsoon (40.3-58.8) while maximum value obtained in the beel during pre-monsoon (68.6-110.9); **Total Hardness(mg/L) :** the maximum value obtained in the beel of pre-monsoon (17.9-126.8) while maximum value was obtained also in the beel during pre-monsoon (30.4-139.2); **Chloride (mg/L):** the minimum value obtained in the river of pre-monsoon (12.2-18.5) while maximum value obtained in the river of monsoon (16.1-23.8); **Nitrate (mg/L):** the minimum value obtained in the river of pre-monsoon (0.02-0.42) while maximum value obtained in the paddy filed during retreating monsoon (0.54-1.63) and **Phosphate:** the minimum value obtained in the river of pre-monsoon (0.22-0.26) while maximum value obtained in the paddy filed during retreating monsoon (0.66-1.64).

Soil texture and Constituents:

Soil texture : Mostly clay and sandy loamy

The following are the various soil parameters viz. Organic carbon, P^H: Nitrate (mg/100), Sulphate (mg/L), Calcium (mg/100gm), Magnesium (mg/100gm) and Organic matters (%) where from ***M. assemensis*** were collected.

Organic matter (%): the minimum value was obtained in the river of monsoon period (2.8-6.9) and maximum value was obtained in the paddy filed during retreating monsoon (6.8-8.1); **P^H:** the minimum P^H found in the river of pre monsoon (5.3-6.2) and maximum is the swamp of monsoon and river of retreating monsoon (6.4-7.2); **Nitrate(mg/100gm):** the minimum amount obtained in the river of pre-monsoon (0.15-0.31) and maximum amount obtained in the paddy filed during monsoon (0.56-0.78); **Sulphate :** the minimum amount obtained in the beel of pre-monsoon (2.2-3.2); **Calcium (mg/100gm):** the minimum amount obtained in the pond of monsoon (36.5-72.2) and maximum amount in the paddy filed of monsoon (49.2-96.1); **Magnesium (mg/100gm):** the minimum amount obtained in the pond of pre-monsoon (20.8-32.2) and the maximum amount obtained in the paddy filed during monsoon (35.1-63.4) and **Organic matter (%):** the minimum amount obtained in the pond of pre-monsoon (5.5-12.4) while maximum obtained in the swamp of monsoon (6.6-15.2).

Plankton:

Both the phyto and zooplankton are identified where from the species collected.

Phytoplankton

The following are the related phytoplankton (Algae, Diatoms and Desmids).

(I)	**Chlorophycea**	:	*Spirogyara* spp., *Cosmarium* spp., *Oscillatoria* spp., *Edurina* spp.,
(II)	**Diatom**	:	*Fragilaria* spp., *synednra* spp., *Navicula* spp., *Pinnularia* spp,
(III)	**Desmids**	:	*Cosmarium* spp., *Closterium* spp., *Euastrum* spp., *staurastrum* spp.,
Zooplankton		:	The related *zooplankton* (*Protozoa, Rotifera, Cladoceran, Copepoda* etc.) are the following ones.
(I)	**Protozoa**	:	*Paramoecium* spp., *Volvox* spp., *Euglena* spp.,
(II)	**Rotipera**	:	*Euclinis* spp., *Filinia* spp., *Brachionus* spp., *Keratella* spp., *Trichocera* spp., *Asplancha* spp.,
(III)	**Cladocera**	:	*Eurycerus* spp., *Bosmina* spp., *Moina* spp.,
(IV)	**Copepoda**	:	*Mesocyclop, Neo-diaptomus* spp.

(V)	**Crustaceans**	:	*Daphnia* spp., *Cyclops* pp., *Cypris* spp., *Zoea* and *Protozoea larva.*
	Aquatic Vegetation	:	The following related macrophytes are observed.
i.	**Flaoting**	:	*Azolla* spp., *Salvinia* spp., *Pistia* spp., *Eichornia* spp., *Wolffia* spp., *Spirodella* spp., *Nepturua* spp., *Trapa* spp.
ii.	**.Semi submerged**	:	*Nelumbo naucifera, Nymphaea* spp., *Neptunea* spp., *Nymphoidus* spp., *Nepturia* spp., *Sagittaria* spp.
iii.	**Submerged**	:	*Ceratophyllum* spp., *Hydrilla* spp., *Vallisaneria* spp., *Ottleria* spp., *Najas* spp., *Potamogeton* spp., *Myriophyllum* spp.
	(d) Rooted emergent hydrophytes	:	*Alsma plantago* spp., *Colocasia* spp., *Alocasia* spp., *Aeschynomese* spp., *Orize* spp., *Ammania* spp.

Macrobrachium altifrons (Hendrson)

1895. Palaemon altifrons Henderson, Trans, Linn. Soc. London (Zool). 5 (2): 444, Pl. 40, Figs. 4-6

Mophometry and Bionomics :

Taxonomy :

Colouration : From young to adult, the body colour is light white but very few fine light yellowish coloured pigments sparcely found in the carapace. **Rostrum :** Body is not highly muscular and the rostrum is also not very stout in comparism to body size. Spines in the dorsal surface of rostrum showed maximum number (starting from its base and end at the apex) in comparison to that of ventral side. Lack of both convexity and concavity in the rostrum is indicated that the rostrum is almost straight from base to apex. **Rostral formula :** 10-12/3 **Carapace** : Smoothed carpace is transluscent and little bit hard. Presence of one pair of indistinct, less developed spine antero laterally on either side of carapace. **Eye stalk** is smaller in size in comparisom to the size of compound eye. The length of eye stalk ranged from 2.4-2.8mm (2.6mm $\pm$ 0.141421). the Girth is 0.4-11mm (0.81mm $\pm$ 0.22361). **Antennule :** pre coxa>coxa< basis and all are non pigmented. But with few bunches of setae towards their bases. Less developed single spine in pre-coxa antro laterally towards inner side. **Antenna:** Coxa< basis and they are muscular. The feeler of endopodite is not well developed. Exopodite is thin and to some extent transluscent where, towards its periphery setae are not uniformly

PLATE - 8

M. altifrons *(Dorsal view)*

M. altifrons *(Dorso - lateral view)*

distributed. **First pareopod:** All segments are eylindrical but with loose joints. The surface is not very smooth. Carpus, propodus and dactylus showed thin distribution of wart like projectlion. Coxa = basis, ischium ⩽ merus, carapus > propodus = dactylus, Chela is delicate and not very pointed. Almost all segments are cylindrical and laterally compressed. Sparce distribution of hair like structure in dactylus and in between carpus & merus and merus & is chium. **Second pareopod:** Chela is not very strong. All segments are cylindrical and except ischium, they are laterally compress coxa ⩾ basis, ischium = merrus, carpus < propodus > dactylus. Few minute spine like projection are thinly distributed in the chela. Surface is altogether is smooth. It is muscular but less developed. **Non-Chelate:** Coxa ⩽ basis, ischium < merus, carpus ⩽ propdus > dactylus. Dactylus is hairy. Coxa and basis muscular, all joints are loosely arranged. They are cylindrical and almost straight. **Finger:** Both in male and female, few spines are sparcely distributed.

Maximum Size – 48mm

Food and Feeding:

This species is collected from small to moderate sized river and they are purely carnivorous in habit. Larva of various crustacean and insects, fragments of earthworms, decayed flesh and shell of many mollusca and fine sand gravel grains are the favourite food. Circusnstace may compel them to adapt omnivorous habit.

Fecundity:

In *M. altifrons* egg is yellow in colour and each egg is almost equal in size to that of a sand particle. The total number of eggs in both the ovaries are counted as 5,000 – 10,000.

Sex Ratio:

Though the sex ratio of this species is not critically observed due to less abundant condition of the species, from certain spot, sex ratio is found as 2 to 3 (♂) : 1 (♀) in natural condition.

Fisheries:

(a) Marketing and Economic status:

In *M. altifrons*, the price and economic status could not be ascertained, because the species is found to totally endangered.

(b) Fishing gears : Fishing gears used in beels of Assam –

Information available and gathered from various fisherman of rivers and beels, there is no specific gear used for freshwater Prawns. Prawns are harvested along with the other fishes of beels and rivers. But from the information it was observed that some beels use specific fishing gears and there are some seasonal variation in the use of fishing gears (Table -9)

The fishing gears can be categorized as –

a) **Impaling Gears** – includes Jongar, Tiara, Pokora, Kol or Kati.

b) **Traps** – Includes, Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Cherka, Torka, Bamidhora, Khoka, Tuna, Dori etc.

c) **Entangling gear** – Langijal, Phansijal,

d) **Encircling gear** – Musarijal, Berjal, Polo, Juluki, Jhupri, Khewalijal, and Angthajal.

e) **Scooping gear** – Dharmajal, Dhenkijal, Thelajal. Jakoi.

f) **Trawling gear** – Moijal, Horhorijal, Shanglajal.

Following are the different fishing gear used in the beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table -9 are also used in different beels depending upon the water depth, water current and vegetations through out the years.

Biochemical composition:

The following are the important biochemical parameters of this species because these have some direct impacts on the nutritional aspects of the human beings.

Carotenoid:	**In muscles (µg/g)**	**In carapace (µg/g)**
	1.97 – 3.58	14.37 – 18.89
	2.98 ± 0.60827	16.07 ± 1.363818
Total Ash	1.12 – 3.35	
	2.35 ± 0.78344	
Dry Matter	14.42 – 19.58	
	17.30 ± 1.833589	

Crude Protein	36.32 – 36.68
	37.55 ± 0.819421
Crude Fat	0.63 – 0.76
	0.70 ± 0.046690
Crude Fibre	0.77 – 1.99
	1.39 ± 0.355190
Calcium	2.21 – 4.68
	3.45 ± 0.844867
Phosphorous	0.81 – 1.91
	1.39 ± 0.377584

Habitat ecosystem:

The following parameters are studied where from *M. altifrons* (Henderson) collected.

Physio-chemical results:

The following are the various water parameters of different water bodies where from *M. altifrons* was collected viz. Temperature (^{0}C), Transperancy (cm), Conductivity (unho), pH, Dissolved Oxygen (mg/L), Free Carbondioxide (mg/L), Total alkalinity (mg/L), Total hardness (mg/L), Chloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L) **Atmospheric temp (^{0}C):** the minimum atmospheric temp recorded in the river of retreating monsoon (25.9-29.5) and the maximum recorded in the river of monsoon (33.4-34.3); **Water temperature(^{0}C):** the minimum water temp. recorded in

the beel of retreating monsoon (23.1-26.1) and the maximum temp. recorded in the river of monsoon (32.5.33.1); **Transparency (cm):** the minimum transparency value was obtained in the beel of monsoon (36.5-38.8) and the maximum recorded in the river of retreating monsoon (43.8-78.1); **Conductivity (μnho):** the minimum value recorded in the river of pre-monsoon (61.5-107.5) and the maximum value recorded in the beel of monsoon (168.3-212.3); **P^H:** the minimum P^H value found in the river of pre-monsoon (5.8-7.5) and the maximum recorded in the beel monsoon (7.4-8.3); **Dissolved oxygen (mg/L):** the minimum amount recorded in the river of monsoon (5.2-7.0) and the maximum value recorded in the beel of retreating monsoon (7.2-11.2); **Free Carbondioxide (mg/L):** the minimum amount recorded in the river of pre-monsoon (3.1.-5.8) and the maximum amount recorded in the beel of monsoon (6.7-6.9); **Alkalinity(mg/L):** the minimum amount observed in the river of monsoon (38.2-72.1) while the maximum amount recorded in the beel of pre-monsoon (68.7-98.9); **Total Hardness(mg/L) :** the maximum amount recorded in the beel of pre-monsoon (18.3-127.6) and the maximum amount recorded in the beel of retreating monsoon (122.1-134.8); **Chloride (mg/L):** the minimum amount detected in the river of pre-mónsoon (12.4-18.6) and the maximum amount detected in the river of monsoon (16.2-24.8); **Nitrate (mg/L):** the minimum amount found in the river of pre-monsoon (0.02-0.42) and the maximum amount recorded in the beel of pre-monsoon (0.03-0.48) and **Phosphate:** the minimum amount detected in the river of pre-monsoon (0.22-0.27) while the maximum amount in the beel of monsoon (0.34-0.42).

Soil texture and Constituents:

Soil texture : Mostly clay and sandy loamy

The following are the various soil parameters investigated from the different water bodies where from the *M. altifrons* was collected viz. Organic carbon (%), P^H, Nitrate (mg/100), Sulphate (mg/L), Calcium (mg/100gm), Magnesium (mg/100gm) and Organic matters(%). **Organic Carbon (%):** the minimum amount recorded in the river of monsoon (2.8-6.9) and the maximum amount recorded in the beel of retreating monsoon (5.6-7.6); **P^H:** the minimum P^H value recorded in the river of pre-monsoon (5.3-6.2) and the maximum value recorded in the river of retreating monsoon (6.4-7.2); **Nitrate(mg/100gm):** the minimum amount recorded in the river of pre-monsoon (0.15-0.31) and the maximum amount recorded in the beel of monsoon (0.42-0.53); **Sulphate :** the minimum amount recorded in the beel of pre-monsoon (2.2-3.2) and the maximum amount recorded in the beel of monsoon (3.2-7.8); **Calcium (mg/100gm):** the minimum amount recorded in the beel of monsoon (38.4-76.2) and the maximum amount recorded in the river of monsoon (48.5-83.4); **Magnesium (mg/100gm):** the minimum amount recorded in the beel of pre-monsoon (21.2-36.4) and the maximum amount recorded in the beel of monsoon (24.8-54.2) and **Organic matter(%):** the minimum amount recorded in the beel of monsoon (6.2-11.3) and the maximum amount recorded in the beel of pre-monsoon (6.6-14.3).

Plankton:

Both the phyto and zooplankton are identified where from the species collected.

Phytoplankton: The following are the related phytoplankton (*Algae, Diatoms* and *Desmids*).

(i)	**Chlorophycea**	:	*Spirogyra* spp., *Cosmarium* spp., *Oscillatoria* spp., *Edurina* spp.
(ii)	**Diatom**	:	*Fragilaria* spp., *Synendra* spp., *Nivicula* spp., *Pinnularia* spp.
(iii)	**Desmids**	:	*Cosmarium* spp., *Closterium* spp., *Euastrum* spp., *Staurastrum* spp.
Zooplankton		:	The related *zooplankton* (*Protozoa, Rotifera, Cladoceran, capepoda* etc.) are the following ones.
(i)	**Protozoa**	:	*Paramoecium* spp., *Volvox* spp., *Euglena* spp.
(ii)	**Rotifera**	:	*Euclinis* spp., *Filina* spp., *Brachionus* spp., *Keratella* spp., *Trichocera* spp., *Asplancha* spp.
(iii)	**Cladocera**	:	*Eurycerus* spp., *Bosmina* spp., *Moina* spp.
(iv)	**Copepoda**	:	*Nauplii* spp., Neo – *diaptomus* spp.
(v)	**Crustaceans**	:	*Daphnia* spp., *Cyclops* pp., *Cypris* spp., *Zoea* and *Protozoea larva.*
Aquatic Vegetation		:	Very few aquatic vegetations were found where from the species was collected as – *Lemna* spp., *Pistia, Nymphaea, Utricularia, Hydrilla* spp., *potemogeton* spp., *Hygrorrhza* spp., *Ludwigia* spp., and very few *Nelumbo* spp., *Euryale* spp., *Nyriophyllum* spp. are collected from big beels.

Macrobrachium tiwari (Agarwal)

Morphometry and Bionomics:

Taxonomy:

Colouration : The body colour is mainly white but with slight light pigmentation at the base of carapace. **Rostrum :** The rostrum is not of uniform size because of unequet sized teeth both dorsally and ventrally. The rostrum is slightly bent and gradually inclined towards apex. Ventrally the rostral edge is almost straight from base to apex. The first three spines, dorsally in the rostrum are arranged keeping it free towards apex. Ventrally rostral spines are equidistant from each other (thinly arranged) from base to apex. **Rostral Formula :** $^{5\text{-}7}/_{2\text{-}5}$. **Carapace :** Carapace bears one pair of small minute delicate spines antero-laterally. Carapace is very smooth, transparent and delicate. Paired long stalked with larged distinct compound eye. Length of **Eye stalk:** is varied from 1.9 – 2.6mm (2.3mm ±0.24495) and diameter 0.5 – 1.0mm (0.75mm ± 0.173205). **Antennules :** Pre coxa > coxa = basis. Absence of hair like structure in pre-coxa, coxa and basis. Devoid of pigmentation Indistinct spine in Pre coxa. **Antena :** Devoid of pigmentation. Exopodite without uniform distribution of setae towards periphery. Antero – laterally almost two third of exopodite towards inner side from the base showed without setae. Coax ⩽ basis. Both are muscular. **First Pareopod :** coxa ⩾ basis, ischium = merus, carpus > propodus > dactylus. Only merus

PLATE - 9

M. tiwari *(Dorsal view)*

M. tiwari *(Dorso - lateral view)*

and carpus laterally compressed but ischium, merus, carpus are cylindrical. Base of coxa, basis and ischium is provided with very minerte delicate thinly arranged hairlike structures. Surface is smooth. **Second Pareopod :** Not muscular in comparism to body. Coxa > basis, ischium = merus, carpus < propodus ⩾ dactylus. All segments are almost straight and cylindrical. Surface is slightly rough. Chela is thinly arranged few wart like projections. **Non – chelate legs:** All segments are very delicate and joints are not tightly arranged (as in *M. lamarrie*). Coxa = basis, ischium < merus, carpus < propodus > dactylus. Ischium and merus laterally compressed; ischium, merus, carpus and propodus are cylindrical with joints. Surface is smooth. **Fingers :** In both male and female very few minute spines like projections are irregularly arranged. In immobile fingers presence of tubercular with 3 equal teeth; 1-2 teeth on mobile finger.

Maximum Size = 60mm.

Food and Feedings :

This species is collected from small to moderate sized river and they are purely carnivorous in habit. Larva of various crustancean and insects, fragments of earthworms, decayed flesh and shell of many mollusca and fine sand gravel grains are the favourite food. Circumstance may compell them to adopt omnivorous habit.

Facundity:

In *M. tiwari* egg is yellow in colour and each egg is almost equal in size to that of a sand particle. The total number of eggs in both the ovaries are counted as 5,000-10,000.

Sex Ratio:

Though the sex ratio of this species is not critically observed due to endangered condition from certain spot, sex ratio is found as 2 to 3 (♂) : 1(♀) in natural condition.

Fisheries:

(a) Marketing and Economic status:

In *M. tiwari,* the price and economic status could not be ascertained, because the species is found to totally endangered.

(b) Fishing gears: Fishing gears used in beels of Assam –

Information available and gathered from various fisherman of rivers and beels, there is no specific gear used for freshwater Prawns. Prawns are harvested along with the other fishes of beels and rivers. But from the information it was observed that some beels use specific fishing gears and there are some seasonal variation in the use of fishing gears (Table -9)

The fishing gears can be categorized as –

a) **Impaling Gears** – includes Jongar, Tiara, Pokora, Kol or Kati.

b) **Traps** – Includes, Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Cherka, Torka, Bamidhora, Khoka, Tuna, Dori etc.

c) **Entangling gear** – Langijal, Phansijal,

d) **Encircling gear** – Musarijal, Berjal, Polo, Juluki, Jhupri, Khewalijal, and Angthajal.

e) **Scooping gear** – Dharmajal, Dhenkijal, Thelajal. Jakoi.

f) **Trawling gear** – Moijal, Horhorijal, Shanglajal.

Following are the different fishing gear used in the beel fisheries of Assam –

Musarijal, Berjal, Khewalijal, Phansijal, Langijal, Dolijal, Parangijal, Ghatjal, Horhorijal, Dhenkijal, etc. are very commonly used fishing gears in different beel fisheries of Assam. But the fishing gear given in the Table -9 are also used in different beels depending upon the water depth, water current and vegetations through out the years.

Biochemical composition:

The following are the important biochemical parameters of this species because these have some direct impacts on the nutritional aspects of the human beings.

Carotenoid:	**In muscles (µg/g)**	**In carapace (µg/g)**
	2.23 – 4.73	15.47 – 19.05
	3.17 ± 0.853913	17.63 ± 1.30384
Total Ash	1.21 – 3.12	
	2.11 ± 0.640312	
Dry Matter	14.68 – 20.05	
	17.59 ± 1.870829	

Crude Protein	36.05 – 37.41
	36.74 ± 0.449344
Crude Fat	0.61 ± 0.74
	0.68 ± 0.046690
Crude Fibre	0.77 – 1.89
	1.35 ± 0.400699
Calcium	2.25 – 4.71
	4.82 ± 1.41545
Phosphorus	0.79 – 1.89
	1.37 ± 1.1704699

Habitat ecosystem:

The following parameters are studied where from *M. tiwari* collected.

Physico – chemical results:

The following are the various water parameters of different water bodies where from ***M. tiwari*** was collected viz. Temperature (^{0}C), Transperancy (cm), Conductivity (unho), pH, Dissolved Oxygen (mg/L), Free Carbondioxide (mg/L), Total alkalinity (mg/L), Total hardness (mg/L), Chloride (mg/L), Nitrate (mg/L) and Phosphate (mg/L) **Atmospheric temp (^{0}C):** the minimum atmospheric temp recorded in the river of retreating monsoon (25.9-29.5) and the maximum recorded in the river of monsoon (33.4-34.3); **Water temperature(^{0}C):** the minimum water temp. recorded in the beel of retreating monsoon (23.1-26.1) and the maximum temp. recorded

in the river of monsoon (32.5.33.1); **Transparency (cm):** the minimum transparency value was obtained in the beel of monsoon (36.5-38.8) and the maximum recorded in the river of retreating monsoon (43.8-78.1); **Conductivity ($_{q}$nho):** the minimum value recorded in the river of pre-monsoon (61.5-107.5) and the maximum value recorded in the beel of monsoon (168.3-212.3); **P^{H}:** the minimum P^{H} value found in the river of pre-monsoon (5.8-7.5) and the maximum recorded in the beel monsoon (7.4-8.3); **Dissolved oxygen (mg/L):** the minimum amount recorded in the river of monsoon (5.2-7.0) and the maximum value recorded in the beel of retreating monsoon (7.2-11.2); **Free Carbondioxide (mg/L):** the minimum amount recorded in the river of pre-monsoon (3.1.-5.8) and the maximum amount recorded in the beel of monsoon (6.7-6.9); **Alkalinity(mg/L):** the minimum amount observed in the river of monsoon (38.2-72.1) while the maximum amount recorded in the beel of pre-monsoon (68.7-98.9); **Total Hardness(mg/L) :** the maximum amount recorded in the beel of pre-monsoon (18.3-127.6) and the maximum amount recorded in the beel of retreating monsoon (122.1-134.8); **Chloride (mg/L):** the minimum amount detected in the river of pre-monsoon (12.4-18.6) and the maximum amount detected in the river of monsoon (16.2-24.8); **Nitrate (mg/L):** the minimum amount found in the river of pre-monsoon (0.02-0.42) and the maximum amount recorded in the beel of pre-monsoon (0.03-0.48) and **Phosphate:** the

minimum amount detected in the river of pre-monsoon (0.22-0.27) while the maximum amount in the beel of monsoon (0.34-0.42).

Soil texture and Constituents:

Soil texture : Mostly clay and sandy loamy

The following are the various soil parameters investigated from the different water bodies where from the *M. tiwari* was collected viz. Organic carbon (%), P^H, Nitrate (mg/100), Sulphate (mg/L), Calcium (mg/100gm), Magnesium (mg/100gm) and Organic matters(%).

Organic Carbon (%): the minimum amount recorded in the river of monsoon (2.8-6.9) and the maximum amount recorded in the beel of retreating monsoon (5.6-7.6); **P^H:** the minimum P^H value recorded in the river of pre-monsoon (5.3-6.2) and the maximum value recorded in the river of retreating monsoon (6.4-7.2); **Nitrate(mg/100gm):** the minimum amount recorded in the river of pre-monsoon (0.15-0.31) and the maximum amount recorded in the beel of monsoon (0.42-0.53); **Sulphate :** the minimum amount recorded in the beel of pre-monsoon (2.2-3.2) and the maximum amount recorded in the beel of monsoon (3.2-7.8); **Calcium (mg/100gm):** the minimum amount recorded in the beel of monsoon (38.4-76.2) and the maximum amount recorded in the river of monsoon (48.5-83.4); **Magnesium (mg/100gm):** the minimum amount recorded in the beel of pre-monsoon (21.2-36.4) and the maximum amount recorded in the beel of monsoon (24.8-

54.2) and **Organic matter(%):** the minimum amount recorded in the beel of monsoon (6.2-11.3) and the maximum amount recorded in the beel of pre-monsoon (6.6-14.3).

Plankton :

Both the phyto – and zooplankton are identified where from the species collected.

Phytoplankton	:	The following are the related phytoplankton (Algae, Diatoms and Desmids)
(I) Chlorophycea	:	*Spirogyra* spp., *Oscillatoria* spp., *Edurina* spp.,
(II) Diatom	:	*Fragilaria* spp., *Synendora* spp., *Navicula* spp., *Pinnularia* spp,
(III) Desmids	:	*Cosmarium* spp., *Closterium* spp., *Euastrum* spp., *staurastrum* spp.,
Zooplankton	:	The related zooplankton (*Protozoa, Rotifera, Cladoceran, copepoda* etc.) are the following ones.
(I) Protozoa	:	*Paramoecium* spp., *Volvox* spp., *Euglena* spp.,
(II) Rotipera	:	*Euclinis* spp., *Filinia* spp., *Brachionus* spp., *Keratella* spp., *Trichocera* spp., *Asplancha* spp.,
(III) Cladocera	:	*Eurycerus* spp., *Bosmina* spp., *Moina* spp.,
(IV) Copepoda	:	*Nauplii* spp., *Mesocydop*, *Neo-diaptomus* spp., *Eucydop* spp.,

(V) Crustaceans : *Daphnia* spp., *Cyclops* pp., *Cypris* spp., *Zoea* and *Protozoea* larva.

Aquatic Vegetation : Very few aquatic vegetations were found where from the species was collected as *Lemma* spp., *Pistia, Nymphaea, Ultricularia, Hydrilla.*,spp., *Pistia, Nymphaea, Utricularia, Hydrilla*, spp., *Potemogeton* spp., *Hygrorrhiza* spp., Ludwigia spp., and very few *Nelumbo, Euryale* Spp. *Nyrioptryllum* Spp are collected from big beals.

Table 1: Comparative study of the Body sizes. Rostral Formulae and Eye Stalks of different species of the Genus – *Macrobrachium*

Name of Species	Body Size	Rostral Formula (RF)	Eye Stalk (mm)	
			Length	Breadth
M. dayanum (Henderson)	25 – 93 mm	7 – 11 / 5 – 9	2.5 – 3.3 mm (2.75 ± 0.5123 mm)	0.5 – 1.2 mm (0.85 ± 0.3548 mm)
M. assamensis (Tiwari)	30 – 78.6 mm	9 – 11 / 3 – 6	1.4 – 2.2 (1.8 ±	0.7 – 1.2 mm (0.95 ±
M. brimanicum choprae (Tiwari)	68 – 180 mm	11 – 12 / 4 – 5	2.8 – 3.3 mm (3.05 ± 0.00163)	0.8 – 1.4 mm (1.1 ± 1.02927)
M. malcolmsonii (Milen Edward)	48 – 162 mm	8 – 10 / 4 – 7	0.4 – 0.6 mm (0.5 ± 0.063245)	0.16 – 0.23 mm (0.20 ± 0.025099)
M. menoni	32 – 95 mm	15 – 16 / 7 – 8	2.1 – 2.5 mm (2.3 ± 0.079057)	0.8 – 1.2 mm (1.0 ± 0.79056)
M. lamarrie	20 – 55 mm	7 – 12 / 4 – 8	0.6 – 0.9 mm (0.75 ± 0.1010544)	0.18 – 0.21 mm (0.195 ± 0.076551)
M. altifrons (Henderson)	41 – 48 mm	10 – 12 / 3	2.4 – 2.8 mm (2.6 ± 0.141421)	0.4 – 1.1 mm (0.81 ± 0.22361)
M. tiwari	54 – 60 mm	5 – 7 / 2 – 5	1.9 – 2.6 mm (2.3 ± 0.24495)	0.5 – 1.0 mm (0.75 ± 0.173205)

Table 2: Comparative Study of the various parts of the Antennules and Antenna of different species of the Genus – *Macrobrachium*

Name of Prawn Species	Antennules	Antenna
M. dayanum	Pre coxa > coxa ⩽ basis	Coxa is < of basis
M. assamensis	Pre coxa > coxa < basis	Coxa < basis
M. birmanicum choprae	Pre coxa > coxa ⩽ basis	Coxa < basis
M. malcolmsonil	Pre coxa > coxa ⩾ basis	Coxa < basis
M. menoni	Pre coxa > coxa ⩽ basis	Coxa ⩽ basis
M. lamarrie	Pre coxa > coxa < basis	Coxa ⩽ basis
M. altifrons	Pre coxa > coxa ⩽ basis	Coxa < basis
M. tiwari	Pre coxa > coxa = basis	Coxa ⩽ basis

Table 3 : Comparative study of the various part of the First Pareopod (chelate leg) of different species of the Genue – *Macrobrachium.*

2 pairs of chelate legs – for pray catching

5 pairs of non – chelate legs – walking.

Name of the Prawn species	First Pareopod
M.. dayanum	Coxa = basis, ischium ⩽ merus, carpus < propodus > dactylus
M. assamensis	Coxa⩽ basis, ischium = merus, carpus < propodus ⩾ dactylus
M. birmanicum choprae	Coxa = basis, ischium < merus, carpus < propodus > dactylus
M. malcolmsonil	Coxa ⩽ basis, ischium = merus, carpus < propodus > dactylus
M. menoni	Coxa = basis, ischium < merus, carpus < propodus > dactylus
M. lamarrie	Coxa⩾ basis, ischium > merus, carpus < propodus ⩾ dactylus
M. altifrons	Coxa = basis, ischium ⩽ merus, carpus > propodus = dactylus
M. tiwari	Coxa ⩾ basis, ischium = merus, carpus > propodus > dactylus

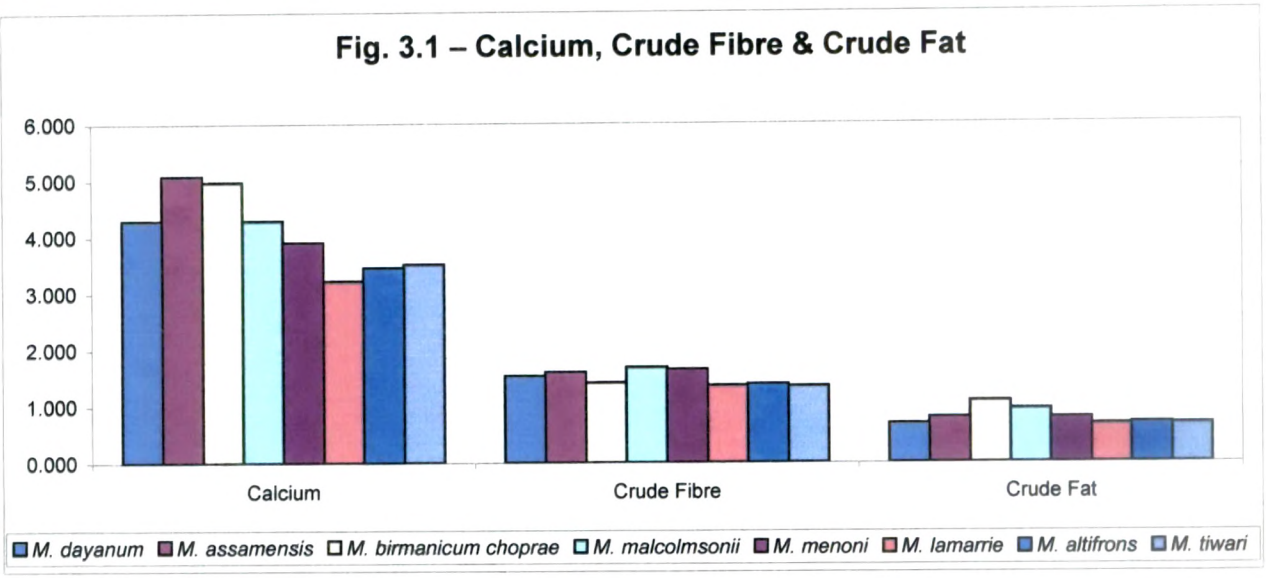
Table 4 : Comparative study of the various part of the Second Pareopod (chelate) of different species of the Genue – *Macrobrachium.*

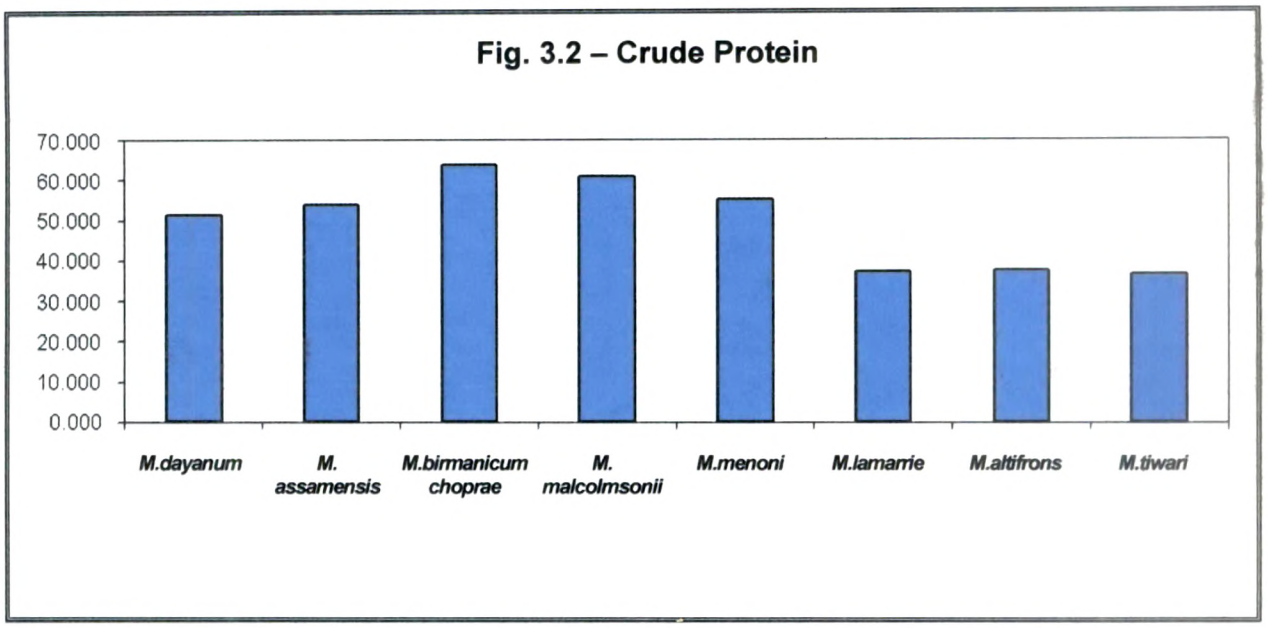
Name of the Prawn species	Second Pareopod
M. dayanum	Coxa < basis, ischium = merus, carpus ⩽ propodus > dactylus
M. assamensis	Coxa < basis, ischium = merus, carpus ⩽ propodus = dactylus
M. birmanicum choprae	Coxa > basis, ischium < merus, carpus > propodus > dactylus
M. malcolmsonil	Coxa = basis, ischium ⩽ merus, carpus > propodus > dactylus
M. menoni	Coxa ⩽ basis, ischium < merus, carpus > propodus > dactylus
M. lamarrie	Coxa > basis, ischium = merus, carpus > propodus < dactylus
M. altifrons	Coxa ⩾ basis, ischium = merus, carpus < propodus > dactylus
M. tiwari	Coxa ⩽ basis, ischium = merus, carpus < propodus ⩾ dactylus

Table 5: Comparative study of the various part of the Non-chelate Leg of different species of the Genue – *Macrobrachium.*

Name of the Prawn species	Non chelate leg
M. dayanum	Coxa = basis, ischium < merus, carpus < propodus > dactylus
M. assamensis	Coxa = basis, ischium < merus, carpus < propodus > dactylus
M. birmanicum choprae	Coxa > basis, ischium < merus, carpus = ½ of propodus > dactylus
M. malcolmsonil	Coxa ⩽ basis, ischium = merus, carpus = ½ of propodus > dactylus
M. menoni	Coxa = basis, ischium < merus, carpus < propodus = dactylus
M. lamarrie	Coxa < basis, ischium < merus, carpus < propodus > dactylus
M. altifrons	Coxa ⩽ basis, ischium < merus, carpus ⩽ propodus > dactylus
M. tiwari	Coxa = basis, ischium < merus, carpus < propodus > dactylus

FIG. 3 – SHOWING BIOCHEMICAL PARAMETERS OF MACROBRACHIUM SPP.





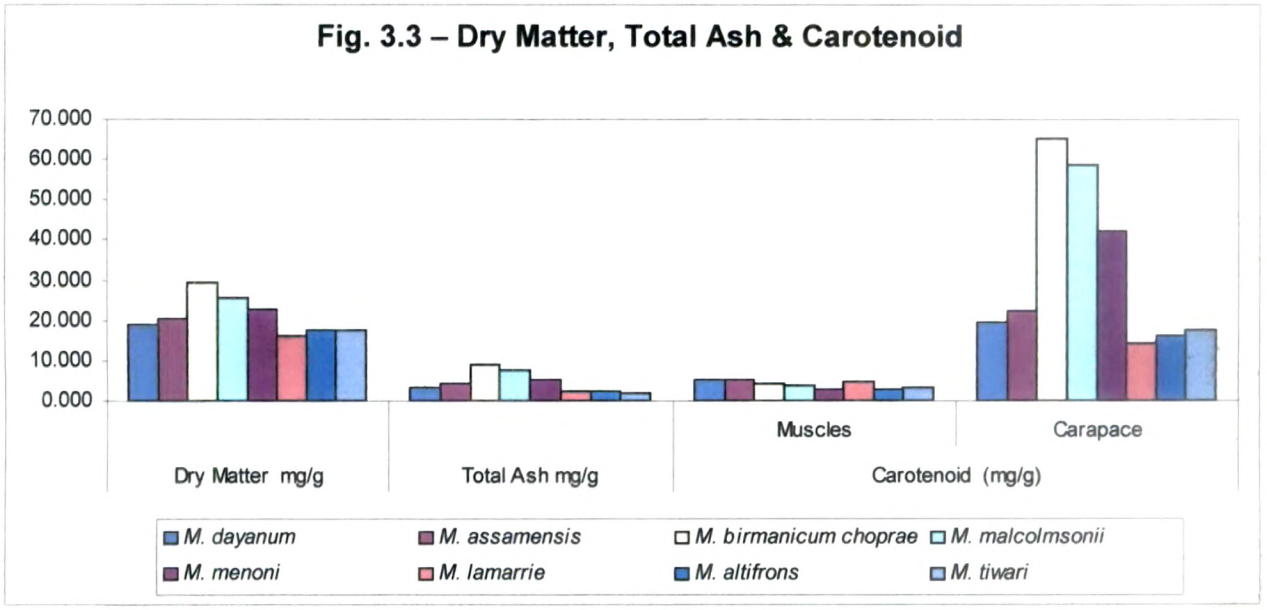


Table 6: Certain important biochemical constituents viz. Carotenoid, Total ash Dry matter, crude Protein, Crude Fat, Crude Fibre, Calcium and phosphorus (µg/g) in the body of various species of the Genus – *Macrobrachium* studied.

Name of Prawn Species	Carotenoid µg/g		Total Ash µg/g	Dry Matter
	Muscles	Carapace		
M dayanum	3.93 – 5.87 4.49 ± 0.8393	17.03 – 21 51 19.91 ± 1.58745	2.73 – 5 45 3.16±0.94339	17 21 – 22.04 19.03±1.66733
M assamensis	4.25 – 6.27 5.12 ± 0.74911	18.92 – 23.21 22.45 ± 1.54747	2.91 – 6.14 4.36±1.21655	18.05 – 24.26 20.32±2.15174
M. birmanicum choprae	3.27 – 5.01 4.413 ± 0.63245	63.25 – 66.77 65.036 ± 1.284523	6.86 – 11.85 9.16±1 70587	26.54 – 32.08 29.18±2.8567
M. malcolmsonii	2.98 – 4.75 3.98 ± 0.60497	56.33 – 60.68 58.99 ± 1.558855	5.25 – 9.42 7.33±1.35647	22.32 – 28.05 25.25±2.14476
M. menoni	2.21 – 3.32 2.98 ± 0 37417	39.17 – 44.04 42.5 ± 1.676305	3.17 – 6.85 5.10 ± 1.32288	19.21 – 25.46 22.61±2.15638
M lamarrie	3.85 – 5.23 4.67 ± 0 47932	12.98 – 15.84 14.15 ± 0.50683	1.02 – 3.48 2.46±0.773175	13 25 – 18.31 16.11±1.81383
M atifrons	1 97 – 3.58 2.98 ± 0.60827	14.37 – 18.89 16.07 ± 1.363818	1.12 – 3.35 2.35±0.78344	14.42 – 19.58 17.30±1.833589
M tiwari	2.23 – 4.73 3.17 ± 0.853913	15.47 – 19.05 17.63 ± 1.30384	1.21 – 3.12 2.11±0.640312	14.68 – 20.05 17.59±1.870829

Name of Prawn Species	Crude Protein	Crude Fat	Crude Fibre	Calcium	Phosphorus
M. dayanum	49.28 – 53.15 51.51±1.3784	0.66 – 0.72 0.69±0.02242	0.98 – 2.23 1.132±0.435889	2.95 – 5.31 4.29±0.842614	0.96 – 1.97 1.45±0.475784
M assamensis	51 63 – 56.45 53 86±2 26121	0.76 – 0.84 0.79±0.0018	0.96 – 2.46 1.56±0.55678	3.04 – 7.12 5.08±1.50997	0.98 – 2.04 1.36±0.43589
M birmanicum choprae	60 42 – 68.28 63.86±2 18927	0.97 – 1.22 1.09±0.01211	1.14 – 2.48 1.32±0.50990	3.86 – 6.08 4.98±0.72111	1.21 – 1.98 1.62±0.26457
M malcolmsonii	58.35 – 63.42 61.11±1.93907	0.82 – 1.05 0.95±0.080311	0.98 – 2 32 1.69±0.5120	3.32 – 5.21 4.29±0.670820	1.02 – 1 73 1.40±0 24495
M menoni	52.31 – 57.41 55.61±1.8735	0.75 – 0.83 0 79±0.028284	0.94 – 2.28 1 65±0.5124	2.92 – 4.85 3 90±0.68556	0 99 – 1 52 1.29±0 173205
M lamarrie	35.21 – 38.56 37 08±1 24096	0.62 – 0.74 0.68±0.044721	0.75 – 1 98 0 68±0.437835	2.05 – 4.12 3.22±0.755943	0.75 – 1.88
M atifrons	36 32 – 38.68 37.55±0.819421	0 63 – 0 76 0 70±0.046690	0 77 – 1.99 1.39±0 355190	2.21 – 4.68 3.45±0.844867	0 81 – 1.91 1.39±0.377584
M tiwari	36 05 – 37.41 36.74±0.449344	0 61 – 0 74 0.68±0.046620	0 77 – 1.89 1 35±0.400699	2.25 – 4 71 4.82±1 41545	0.79 – 1 89 1 37±1 170469

Table 7.1 : Certain important physico – Chemical parameters of water viz. Atmospheric Temp, Water Temp, Transparency, Conductivity, P^H, Dissolved Oxygen, Free-carbondioxide, Total alkalinity, Total Hardness, Chloride, Nitrate and Phosphate where from the various Species of the Genus – *Macrobrachium* collected.

Species of *Macrobrachium*	Habitat	Season	Atmospheric Temp. (^{0}C)	Water Temp. (^{0}C)	Transparency (cm)	Conductivity (µmho)	P^H
M birmanicum choprae	RI	Pre Monson (pm)	31.5 – 33.8	30.2 – 32.8	42.3 – 76.2	82.3 – 107.5	5.8 – 7.5
		Monson (mo)	33.5 – 34.3	32.5 – 33.1	35.8 – 52.4	141.2 – 209.8	6.3 – 7.8
		Retreating Monson (Rm)	25.7 – 29.2	23.1 – 26.2	41.3 – 77.5	137.8 – 165.2	6.5 – 7.9
	BL	Pre monsoon (pm)	29.5 – 30.6	29.7 – 31.2	40.3 – 56.2	95.8 – 109 9	7.2 – 8.1
		Monson (mo)	32.1 – 33 3	31.2 – 31.4	35.2 – 39.5	188.7 – 213.4	7.2 – 8.2
		Retreating Monson (Rm)	26.4 – 28.8	22.8 – 25.6	42.7 – 55.2	103.3 – 132.3	7.8 – 10.2
M malcolmsonii	RI	Pre Monson (pm)	31.5 – 33.8	30.2 – 32.8	42.3 – 76.2	82.3 – 107 5	5.8 – 7.5
		Monson (mo)	33.5 – 33.8	32.5 – 33.1	35.8 – 52.4	141.2 – 209.8	6.3 – 7.8
		Retreating Monson (Rm)	33 5 – 34.3	23.1 – 26.2	41.3 – 77.5	137.8 – 165.2	6.5 – 7.9
	BL	Pre monsoon (pm)	25.7 – 29.2	29.7 – 31.2	40 3 – 56 2	95.8 – 109.9	7.2 – 8.1
		Monson (mo)	29 5 – 30.6	31.2 – 31.4	35 2 – 39 5	188.7 – 213.4	7.2 – 8.2
		Retreating Monson (Rm)	32.1 – 33.3	22.8 – 25.6	42.7 – 55.2	103.3 – 132.3	7.8 – 10.2
M menoni	RI	Pre Monson (pm)	31.5 – 33 8	32 5 – 33 1	35 8 – 52 4	141.2 – 209 8	6 3 – 7.8
		Monson (mo)	33.5 – 34.3	23.1 – 26 2	41 3 – 77 5	137 8 – 165 2	6.5 – 7.9
		Retreating Monson (Rm)	26 4 – 28.8	30.2 – 32 8	42.3 – 76.2	82.3 – 107.5	5.8 – 7.5
	BL	Pre monsoon (pm)	25 7 – 29.2	29.7 – 31.2	40.3 – 56.2	95 8 – 109 9	7.2 – 8.1
		Monson (mo)	29 5 – 30 6	31.2 – 31.4	35 1 – 39 5	188 7 – 213.4	7 2 – 8 2
		Retreating Monson (Rm)	32 1 – 33 3	22 8 – 25 6	42.7 – 55 2	103 3 – 132 3	7.8 – 10 2

Table 7.1.1 : Certain important physico – Chemical parameters of water viz. Atmospheric Temp, Water Temp, Transparency, Conductivity, P^H, Dissolved Oxygen, Free-carbondioxide, Total alkalinity, Total Hardness, Chloride, Nitrate and Phosphate where from the various Species of the Genus – *Macrobrachium* collected.

Species of *Macrobrachium*	Habitat	Season	Dissolved Oxygen (mg/L)	Free Carbondiox-ide (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Chloride (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)
M birmanicum choprae	RI	Pre Monson (pm)	5.4-9.1	3.2-5.9	38.2-75.5	27.9-114.8	12.5-18.4	0.02-0.04	0.22-0 26
		Monson (mo)	5.2-6.9	4.2-6.1	32.3-72.3	37.9-81 3	16.2-24.8	0.16-0.28	0.25-0.38
		Retreating Monson (Rm)	5.7-9.5	4.8-6.5	45.8-80.2	56.1-123.6	13.4-26.7	0.04-0.34	0.24-0.31
	BL	Pre monsoon (pm)	6.7-9.6	3.5-4.3	66.8-94.5	18.2-126.2	17.1-20.4	0.03-0.36	0.25-0 29
		Monson (mo)	5.3-6.7	6.8-7.1	52.1-81 2	54.5-86.2	18.3-22.5	0.18-0.48	0.33-0.41
		Retreating Monson (Rm)	7.1-11.1	4.3-5.2	72.1-86.1	121.8-135.1	14.3-18.7	0.06-0 36	0 31-0.39
M malcolmsonu	RI	Pre Monson (pm)	5 4-9 1	3.2-5.9	38.2-75.5	27.9-114.8	12.5-18 4	0.02-0.04	0.22-0 26
		Monson (mo)	5.2-6.9	4.2-6 1	32.3-72 3	37.9-81.3	16 2-24.9	0.16-0.28	0.25-0.38
		Retreating Monson (Rm)	5.7-9.5	4.8-6.5	45.8-80.2	56.1-123.6	13.4-26.7	0.04-0 34	0.24-0.31
	BL	Pre monsoon (pm)	6.7-9.6	3.5-4.3	66.8-94.5	18.2-126.2	17.1-20.4	0.03-0 36	0.25-0.29
		Monson (mo)	5.3-6.7	6.8-7.1	52.1-81.2	54.5-86.2	18 3-22.4	0.18-0.48	0.33-0 41
		Retreating Monson (Rm)	7.1-11.1	4.3-5.2	72.1-86.1	121.8-135.1	14.3-18 7	0.06-0.36	0.31-0.39
M menoni	RI	Pre Monson (pm)	5.4-9.1	3 2-5.9	38.2-75.5	27.9-114.8	12.5-18.4	0.02-0 04	0.22-0.26
		Monson (mo)	5.2-6.9	4.2-6.1	32.3-72.3	37.9-81.3	16.2-24.9	0.16-0.28	0.25-0 38
		Retreating Monson (Rm)	5.7-9.5	4 8-6 5	45.8-80.2	56.1-123.6	13.4-26 7	0 04-0 34	0 24-0.31
	BL	Pre monsoon(pm)	6.7-9.6	3.5-4.3	66 8-94.5	18 2-126.2	17 1-20.4	0.03-0.36	0.25-0 29
		Monson (mo)	5.3-6.7	6 8-7.1	52.1-81.2	54.5-86.2	18.3-22.4	0.18-0.48	0 33-0.41
		Retreating Monson (Rm)	7.1-11.1	4.3-5.2	72 1-86.1	121.8-135.1	14 3-18 7	0.06-0.36	0.31-0 39

Table 7.2 : Certain important physico – Chemical parameters of water viz. Atmospheric Temp, Water Temp, Transparency, Conductivity, P^H, Dissolved Oxygen, Free-carbondioxide, Total alkalinity, Total Hardness, Chloride, Nitrate and Phosphate where from the various Species of the Genus – *Macrobrachium* collected.

Species of *Macrobrachium*	Habitat	Season	Atmospheric Temp. (^{0}C)	Water Temp. (^{0}C)	Transparency (cm)	Conductivity (µmho)	pH
M. dayanum	RI	Pre Monson (pm)	31.2-33.4	30.3 – 31.5	41.4 – 74.3	81.2-106.4	5.8-7.3
		Monson (mo)	32.9-33.7	32.5 – 33.1	35.8-53.1	140-208.2	6.4-7.9
		Retreating Monson (Rm)	22.2-24.2	22.5 – 25.8	43.8-77.2	137.5-165.8	6.3-7.9
	BL	Pre Monson (pm)	29.2-31.5	28.9 – 30.7	38.9-54.5	95.3-109.3	7.1-8.2
		Monson (mo)	32.8-33.9	31.4 – 31.6	35.2-39.2	188.3-213.8	7.5-8.1
		Retreating Monson (Rm)	24.8-25.6	23.1 – 26.4	42.5-55.4	103.2-131.5	7.7-10.2
	PN	Pre Monson (pm)	28.9-30.8	28.6 – 30.2	34.6-53.8	53.8-96.7	7.3-7.9
		Monson (mo)	31.8-33.5	30.1 – 31.5	34.6-38.1	125.3-192.5	7.2-7.7
		Retreating Monson (Rm)	26.6-28.3	23.2 – 25.2	58.2-62.7	97.4-114.3	7.2-7.9
	SW	Pre Monson (pm)	28.8-30.3	28.2 – 30.4	28.9-34.5	61.5-101.3	7.2-7.8
		Monson (mo)	32.4-33.1	30.2 – 31.6	18.9-28.5	129.6-178.5	7.6-8.0
		Retreating Monson (Rm)	25.1-29.2	22.8 – 25.1	29.2-34.2	93.5-102.3	7.4-7.9
	PF	Pre Monson (pm)	28.1-30.2	28.0 – 30.1	24.7-38.6	55.8-98.3	7.4-7.6
		Monson (mo)	31.8-33.2	30.8 – 32.1	28.6-33.2	172.4-205.7	7.7-8.4
		Retreating Monson (Rm)	26.4-28.8	24.3 – 26.6	39.6-44.2	90.8-114.2	7.7-8.0
M. assamensis	RI	Pre Monson (pm)	31.2-33.4	30.3 – 31.5	41.4-74.3	81.2-106.4	5.8-7.3
		Monson (mo)	32.9-33.7	32.5 – 33.1	35.8-53.1	140-208.2	6.4-7.9
		Retreating Monson (Rm)	22.2-24.2	22.5 – 25.8	43.8-77.2	137.5-165.8	6.3-7.9
	BL	Pre Monson (pm)	29.2-31.5	28.9 – 30.7	38.9-54.5	95.3-109.3	7.1-8.2
		Monson (mo)	32.8-33.9	31.4 – 31.6	35.2-39.2	188.3-213.8	7.5-8.1
		Retreating Monson (Rm)	24.8-25.6	23.1 – 26.4	42.5-55.4	103.2-131.5	7.7-10.2
	PN	Pre Monson (pm)	28.9-30.8	28.6 – 30.2	34.6-53.8	53.8-96.7	7.3-7.9
		Monson (mo)	31.8-33.5	30.1 – 31.5	34.6-38.1	125.3-192.5	7.2-7.7
		Retreating Monson (Rm)	26.6-28.3	23.2 – 25.2	58.2-62.7	97.4-114.3	7.2-7.9
	SW	Pre Monson (pm)	28.8-30.3	28.2 – 30.4	28.9-34.5	61.5-101.3	7.2-7.8
		Monson (mo)	32.4-33.1	30.2 – 31.6	18.9-28.5	129.6-178.5	7.6-8.0
		Retreating Monson (Rm)	25.1-29.2	22 8 – 25.1	29.2-34.2	93 5-102.3	7.4-7.9
	PF	Pre Monson (pm)	28.1-30.2	28.0 – 30.1	24.7-38.6	55.8-98.3	7.4-7.6
		Monson (mo)	31.8-33.2	30.8 – 32.1	28.6-33.2	172.4-205.7	7.7-8.4
		Retreating Monson (Rm)	26.4-28.8	24.3 – 26.6	39.6-44.2	90.8-114.2	7 7-8.0

Table 7.2.1 : Certain important physico – Chemical parameters of water viz. Atmospheric Temp, Water Temp, Transparency, Conductivity, P^H, Dissolved Oxygen, Free-carbondioxide, Total alkalinity, Total Hardness, Chloride, Nitrate and Phosphate where from the various Species of the Genus – *Macrobrachium* collected.

Species of *Macrobrachium*	Habitat	Season	Dissolved Oxygen	Free Carbondioxide	Total Alkalinity	Total Hardness	Chloride	Nitrate	Phosphate
M. dayanum	RI	Pre Monson (pm)	5.8-9.2	3.3-5.9	42.8-75.9	27.8-114.2	12.2-18.5	0.02-0.04	0.22-0.26
		Monson (mo)	5.2-6.9	4.1-5.8	42.5-71.9	38.5-81.3	16.1-23.8	0.16-0.28	0.25-0.38
		Retreating Monson (Rm)	5.7-9.5	4.5-6.9	46.1-80.5	86.1-123.5	13.5-20.3	0.04-0 34	0.24-0.31
	BL	Pre Monson (pm)	6.5-9.8	3.5-4.6	68.6-110.9	17 9-126.5	17.1-20.3	0 03-0.36	0.25-0.29
		Monson (mo)	5.3-6.7	6.6-6.8	50.8-81.3	54.6-86.8	18.3-22.5	0.18-0.48	0 33-0.41
		Retreating Monson (Rm)	7 2-11.1	4.1-5.2	72.1-86.2	122.3-133.8	14.1-18.3	0.06-0.36	0.31-0.39
	PN	Pre Monson (pm)	8.6-11.4	4.2-5.1	54.2-88.9	30.4-139.2	15.4-19.5	0.05-0.62	0.31-0 51
		Monson (mo)	7.2-7.8	7.1-7.8	40.3-58.8	47.5-89.4	14.1-17.6	0.25-0 43	0.38-0.57
		Retreating Monson (Rm)	9.4-11.5	5.3-6.7	69.2-87.4	82.6-98.5	13.2-19.1	0.08-0.42	0.37-0.54
	SW	Pre Monson (pm)	8.2-8.5	3.7-5.3	62.5-90.3	35 5-137.8	13 2-20.1	0.08-0 91	0.32-0.53
		Monson (mo)	4.4-4.8	6.8-7.6	63.1-82.5	42.6-71.6	14.3-19 4	0.41-0 84	0 40-0.60
		Retreating Monson (Rm)	9.5-10.3	3 8-5.3	62.3-78.2	91 3-123.2	16.0-20.3	0.12-0.85	0.40-0.72
	PF	Pre Monson (pm)	8.1-8.9	4.2-4 7	65.1-92.3	16 2-125.3	16.6-20.4	0.03-0.37	0.36-0 80
		Monson (mo)	5.4-6.3	6.1-7.2	51.3-67.2	44.8-101.5	13.1-16.7	0.77-1.61	0.72-1 78
		Retreating Monson (Rm)	6.4-7.6	3.9-5.2	70.5-91.8	117.2-130 8	17.1-21.4	0.54-1.63	0.66-1.64
M. assamensis	RI	Pre Monson (pm)	5.8-9.2	3.3-5.9	42.8-75.9	27.8-114.2	12.2-18.5	0.02-0.04	0.22-0.26
		Monson (mo)	5.2-6.9	4 1-5.8	42.5-71.9	38.5-81.3	16.1-23.8	0 16-0.28	0 25-0.38
		Retreating Monson (Rm)	5 7-9.5	4.5-6.9	46.1-80.5	86.1-123.5	13.5-20.3	0.04-0.34	0.24-0.31
	BL	Pre Monson (pm)	6.5-9.8	3 5-4.6	68.6-110.9	17.9-126.8	17.1-20.3	0.03-0.36	0.25-0.29
		Monson (mo)	5.3-6.7	6 6-6.8	50.8-81.3	54.6-86.8	18.3-22.5	0.18-0.48	0.33-0.41
		Retreating Monson (Rm)	7 2-11 1	4.1-5.2	72.1-86.2	122 3-133.8	14.1-18.3	0.06-0.36	0.31-0.39
	PN	Pre Monson (pm)	8.6-11 4	4.2-5.1	54 2-88.9	30.4-139.2	15.4-19.5	0.05-0 62	0.31-0 51
		Monson (mo)	7.2-7.8	7.1-7.8	40.3-58.8	47.5-89.4	14.1-17 6	0.25-0 43	0.38-0 57
		Retreating Monson (Rm)	9.4-11.5	5.3-6 7	69.2-87.4	82 6-98.5	13.2-19.1	0 08-0 42	0 37-0.54
	SW	Pre Monson (pm)	8 2-8.5	3 7-5 3	62 5-90.3	35 5-137 8	13 2-20.1	0.08-0.91	0 32-0 53
		Monson (mo)	4 4-4 8	6.8-7.6	63.1-82 5	42 6-71.6	14 3-19.4	0 41-0 84	0.40-0 60
		Retreating Monson (Rm)	9.5-10.3	3 8-5.3	62 3-78 2	91.3-123.2	16 0-20 3	0 12-0 85	0 40-0 62
	PF	Pre Monson (pm)	8.1-8 9	4 2-4 7	65.1-92.3	16 2-125 3	16.6-20 4	0.03-0 37	0 36-0 80
		Monson (mo)	5 4-6.3	6 1-7 2	51.3-67 2	44.8-101.5	13.1-16 7	0.77-1 61	0.72-1 78
		Retreating Monson (Rm)	6.4-7.6	3 9-5 2	70.5-91 8	117 2-130.8	17 1-21 4	0 54-1.63	0 66-1.64

Table 7.3 : Certain important physico – Chemical parameters of water viz. Atmospheric Temp, Water Temp, Transparency, Conductivity, P^H, Dissolved Oxygen, Free-carbondioxide, Total alkalinity, Total Hardness, Chloride, Nitrate and Phosphate where from the various Species of the Genus – *Macrobrachium* collected.

Species of *Macrobrachium*	Habitat	Season	Atmospheric Temp. (^{0}C)	Water Temp. (^{0}C)	Transparency (cm)	Conductivity (µmho)	pH
M. lamarrie	RI	Pre Monson (pm)	31.5-33.8	29.3-30.1	41.3-75.4	61.5-107.5	5.8-7.5
		Monson (mo)	33 4-34.3	32.5-33.1	38.1-51.6	142.1-208.2	6.3-7 8
		Retreating Monson (Rm)	25.9-29.5	23.2-25.8	43.8-78.1	137.2-167.8	6.3-7.9
	BL	Pre Monson (pm)	30.5-32.6	28.8-29.3	40.2-55 3	95.3-109.2	7.2-8.1
		Monson (mo)	32.8-33.8	30.3-31.2	36.5-38 8	168.3-212.3	7.4-8.3
		Retreating Monson (Rm)	26.7-28.8	22.8-26.1	42.5-55.3	104.3-133.1	7.2-8.1
	SW	Pre Monson (pm)	30.1-32.7	28.5-28.9	28.9-33.4	62.8-102.2	7.3-7.7
		Monson (mo)	32.4-33.0	28 5-30.1	18.9-27.8	128.7-176.4	7.5-8.1
		Retreating Monson (Rm)	25.5-29.3	23.3-25.1	29.2-34 5	93.2-101.2	7.5-7.9
M. altifrons	RI	Pre Monson (pm)	31.5-33.8	29.3-30.1	41.3-75.4	61.5-107.5	5.8-7.5
		Monson (mo)	33.4-34.3	32.5-33.1	38 1-51.6	142.1-208.2	6.3-7.8
		Retreating Monson (Rm)	25.9-29.5	23.2-25 8	43.8-78.1	137.2-167.8	6.3-7.9
	BL	Pre Monson (pm)	30.5-32.6	28.8-29.3	40.2-55.3	95.3-109 2	7.2-8.1
		Monson (mo)	32.8-33.8	30.3-31.2	36 5-38.8	168.3-212 3	7.4-8.3
		Retreating Monson (Rm)	26 7-28.8	23.1-26.1	42.5-55.3	104.3-133.1	7 2-8.1
M tiwari	RI	Pre Monson (pm)	31.5-33.8	29.3-30.1	41.3-75.4	61 5-107.5	5.8-7 5
		Monson (mo)	33.4-34.3	32.5-33.1	38 1-51.6	142 1-208.2	6.3-7.8
		Retreating Monson (Rm)	25.9-29.5	23.2-25.8	43.8-78.1	137.2-167 8	6.3-7 9
	BL	Pre Monson (pm)	30.5-32.6	28 8-29.3	40 2-55 3	95 3-109 2	7 2-8 1
		Monson (mo)	32 8-33 8	30.3-31.2	36.5-38 8	168.3-212.3	7.4-8 3
		Retreating Monson (Rm)	26 7-28.8	23 1-26.1	42 5-55.3	104 3-133 1	7 2-8 1

Table 7.3.1 : Certain important physico – Chemical parameters of water viz. Atmospheric Temp, Water Temp, Transparency, Conductivity, P^H, Dissolved Oxygen, Free-carbondioxide, Total alkalinity, Total Hardness, Chloride, Nitrate and Phosphate where from the various Species of the Genus – *Macrobrachium* collected.

Species of *Macrobrachium*	Habitat	Season	Dissolved Oxygen	Free Carbondioxide	Total Alkalinity	Total Hardness	Chloride	Nitrate	Phosphate
M. lamarrie	RI	Pre Monson (pm)	5.7-9.2	3.1-5.9	37.4-75.4	27.5-114.2	12.3-18.5	0.02-0.42	0.22-0.26
		Monson (mo)	5.1-7.0	4.3-6.0	34.1-72.3	37.8-83.2	16.1-24.8	0.16-0.28	0 25-0.38
		Retreating Monson (Rm)	5.9-9.3	4.8-6.8	45.2-80.6	86.1-123.2	13.8-20.4	0.04-0.31	0.24-0.31
	BL	Pre Monson (pm)	6 5-9.6	3.6-4.3	68.3-96.8	18.4-126.4	17.1-20.2	0.03-0.36	0.25-0 29
		Monson (mo)	5.2-6.8	6.6-6 9	51.5-81.4	55.2-86.9	18.3-22.5	0.18-0.48	0.33-0.41
		Retreating Monson (Rm)	7.1-10.5	4.1-5.1	71.2-85.3	121.1-133.8	14.1-18.8	0.31-0.39	0.31-0.39
	SW	Pre Monson (pm)	8.3-8.5	3.8-5.4	60.5-87.8	35.4-136.4	13.4-20.3	0.08-0.66	0 32-0.53
		Monson (mo)	5.8-6.2	6.8-7.5	63.1-81.5	42.6-78.4	14.2-19.1	0.40-0.82	0.38-0.57
		Retreating Monson (Rm)	9.5-10.3	3.9-5.2	61.4-77.5	90.3-118 5	16.1-20.5	0.15-0.91	0.36-0.50
M. altifrons	RI	Pre Monson (pm)	5.5-9.0	3.1-5.8	38.4-76.5	28.4-115.3	12..4-18.6	0.02-0 42	0.22-0.27
		Monson (mo)	5.2-7.0	4.2-6.0	38.2-72.1	38.6-82.2	16.2-24.8	0.18-0.48	0.28-0 36
		Retreating Monson (Rm)	5.8-9.6	4.8-6.8	46.2-80.6	86.2-124.6	13 8-20.6	0.06-0 36	0.24-0 32
	BL	Pre Monson (pm)	6.8-9.7	3.6-4.2	68.7-98.9	18.3-127.6	17.2-20 3	0.03-0 48	0 26-0.30
		Monson (mo)	5.4-6.8	6.7-6.9	51.8-81.6	55 9-87.2	18.4-22.3	0.22-0.45	0.34-0 42
		Retreating Monson (Rm)	7.2-11 2	4.2-5.0	72.2-86.3	122.1-134.8	14.2-18.5	0.09-0 43	0.32-0.40
M tiwari	RI	Pre Monson (pm)	5.5-9.0	3 1-5.8	38.4-76 5	28.4-115.3	12.4-18.6	0.02-0.42	0.22-0 27
		Monson (mo)	5.2-7.0	4.2-6.0	38.2-72.1	38.6-82 2	16.2-24.8	0.18-0 48	0.28-0 36
		Retreating Monson (Rm)	5 8-9.6	4 8-6.8	46 2-80.6	86 2-124.6	13.8-20.6	0 06-0 36	0 24-0.32
	BL	Pre Monson (pm)	6 8-9.7	3.6-4.2	68 7-98.9	18 3-127.6	17.2-20.3	0 03-0 48	0 26-0.30
		Monson (mo)	5 4-6.8	6 7-6.9	51 8-81.6	55.9-87 2	18.4-22 3	0 22-0 45	0 34-0.42
		Retreating Monson (Rm)	7.2-11 2	4 2-5 0	72 2-86.3	122 1-134.8	14 2-18.5	0 09-0.43	0.32-0 40

Fig. 1.3 – Nitrate

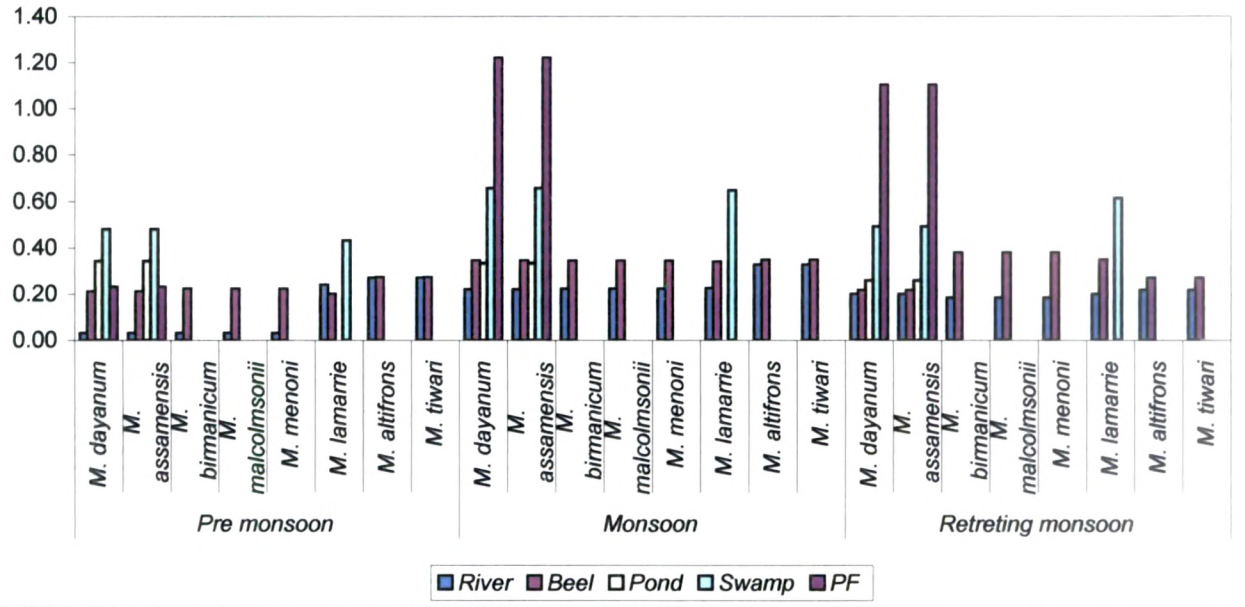


Fig. 1.4 – Chloride

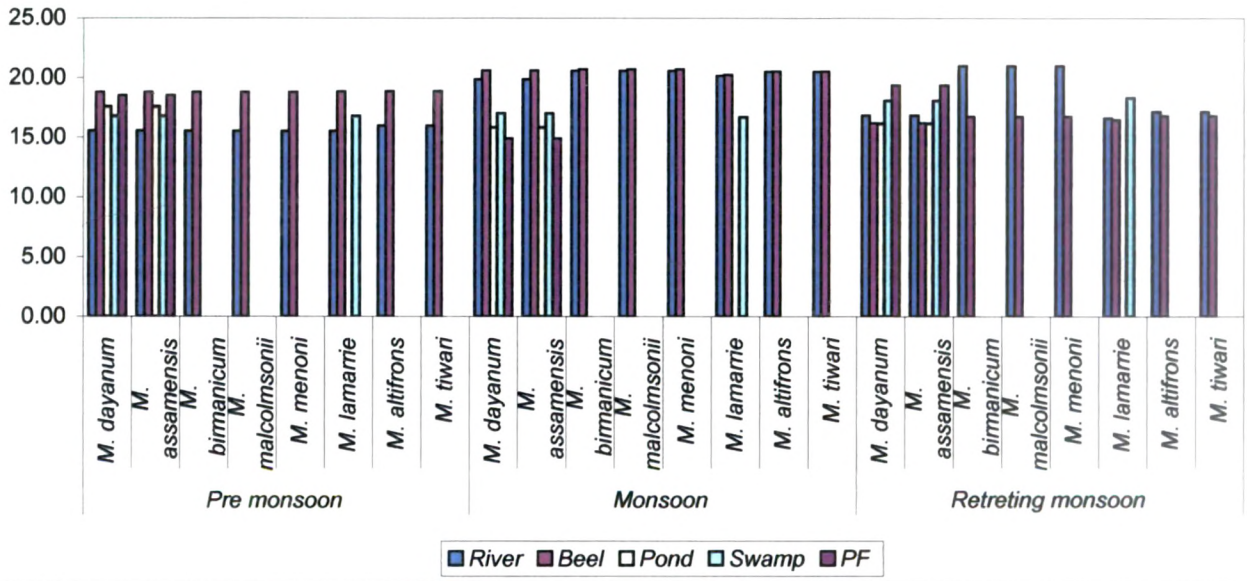


FIG. 1 – SHOWING WATER PARAMETERS

Fig. 1.1 – Water Temperature

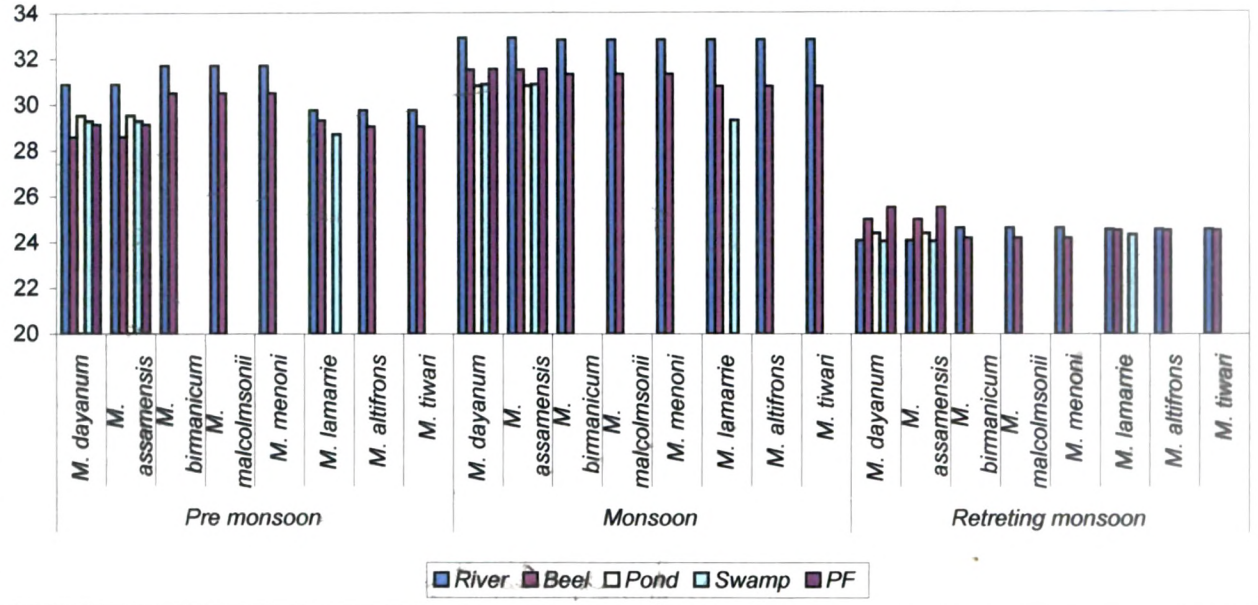


Fig. 1.2 – Air Temperature

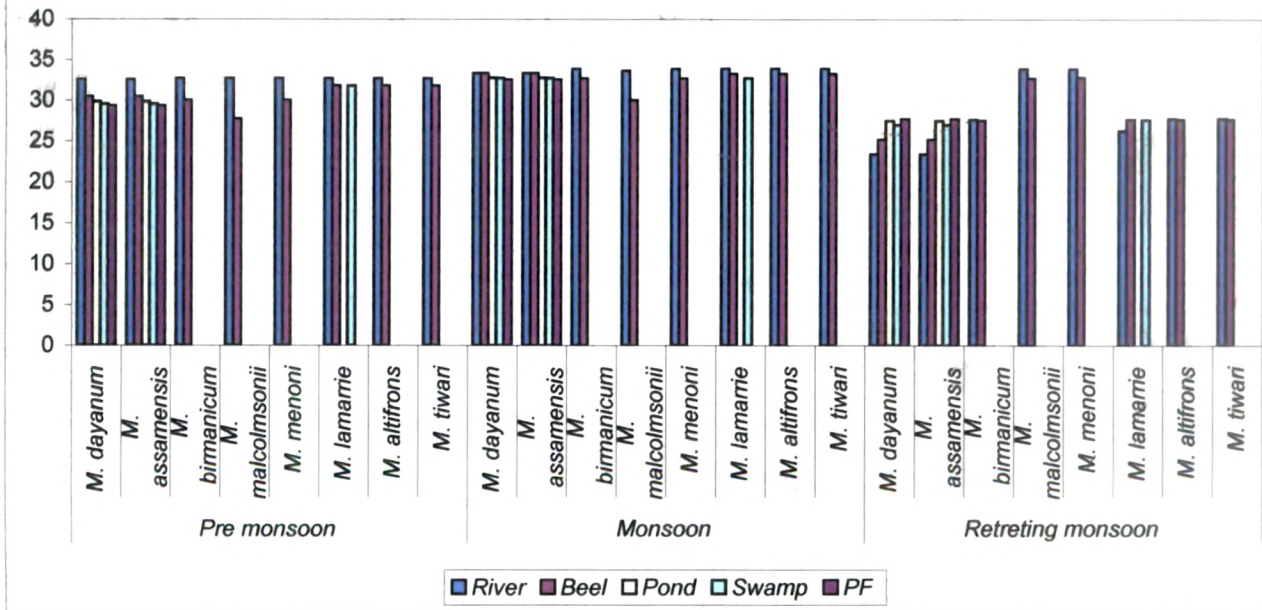


Fig. 1.5 – Total Hardness

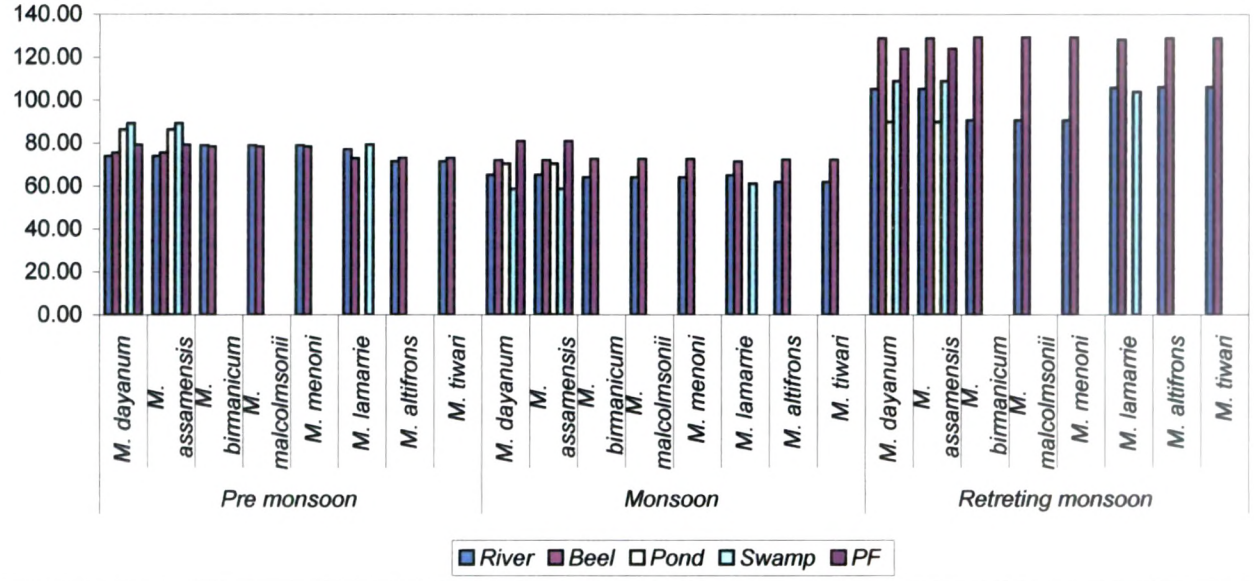


Fig. 1.6 – Total alkalinity

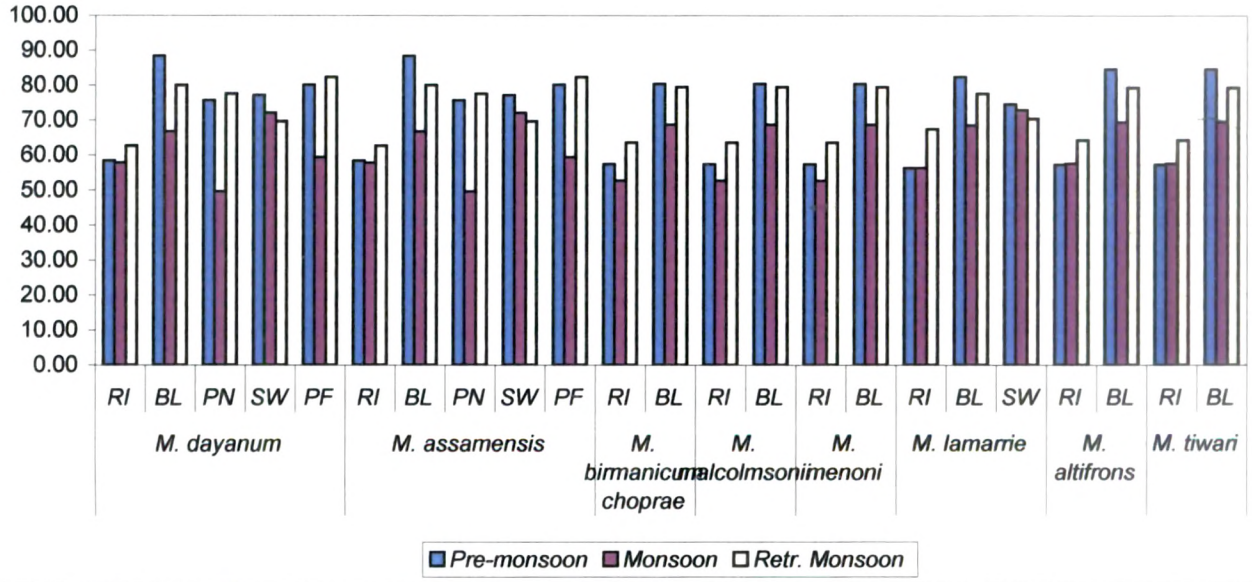


Fig. 1.7 – Free Carbon dioxide

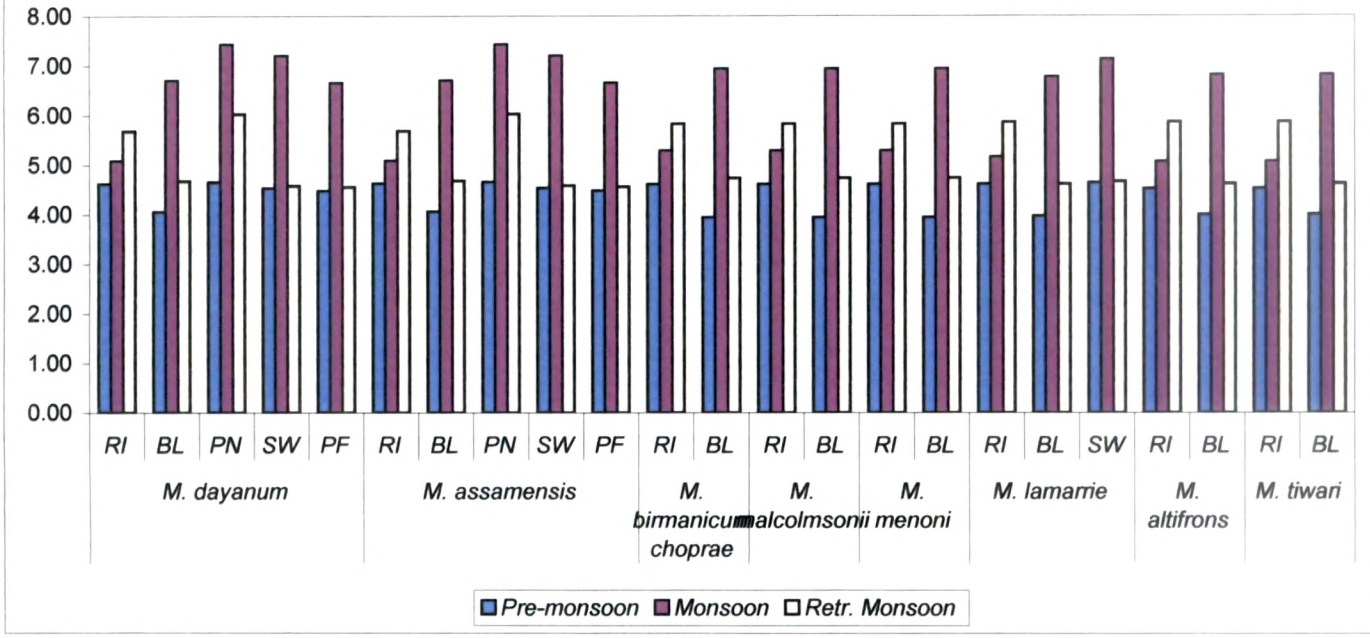


Fig. 1.8 – Dissolved Oxygen

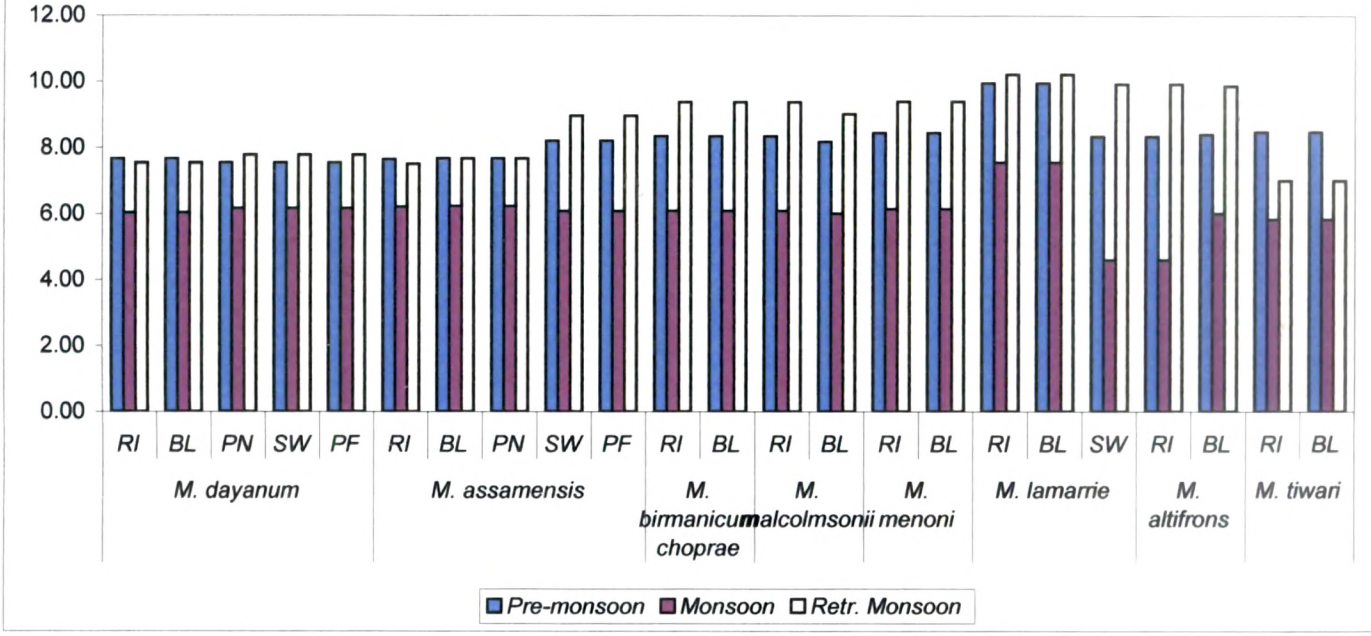


Fig. 1.9 – P^H

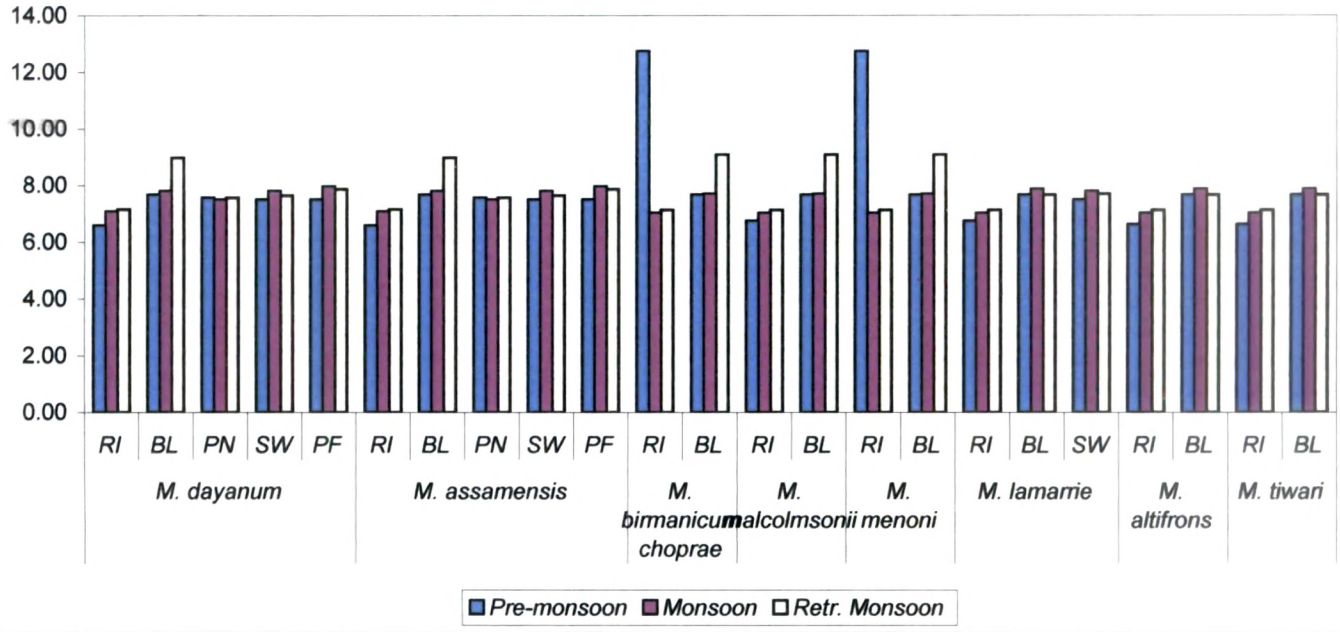


Fig. 1.10 – Conductivity

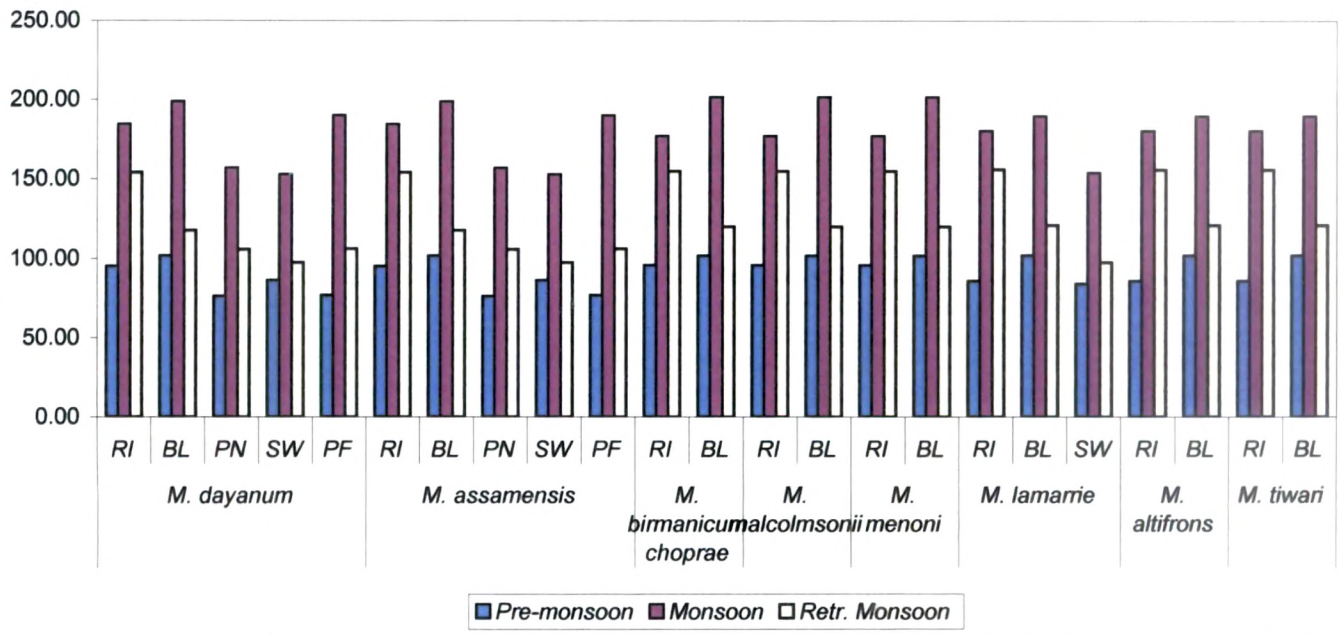


Fig. 1.11 – Transparency

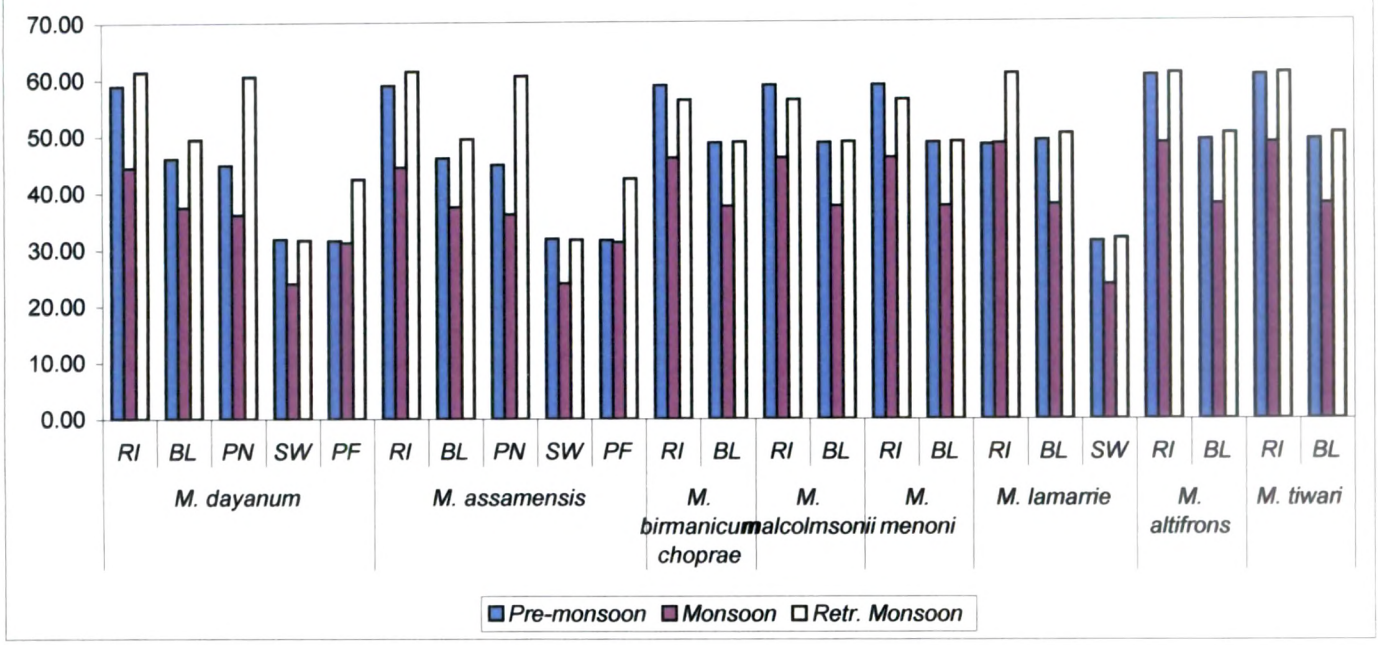


Fig. 1.12 – Phosphorus

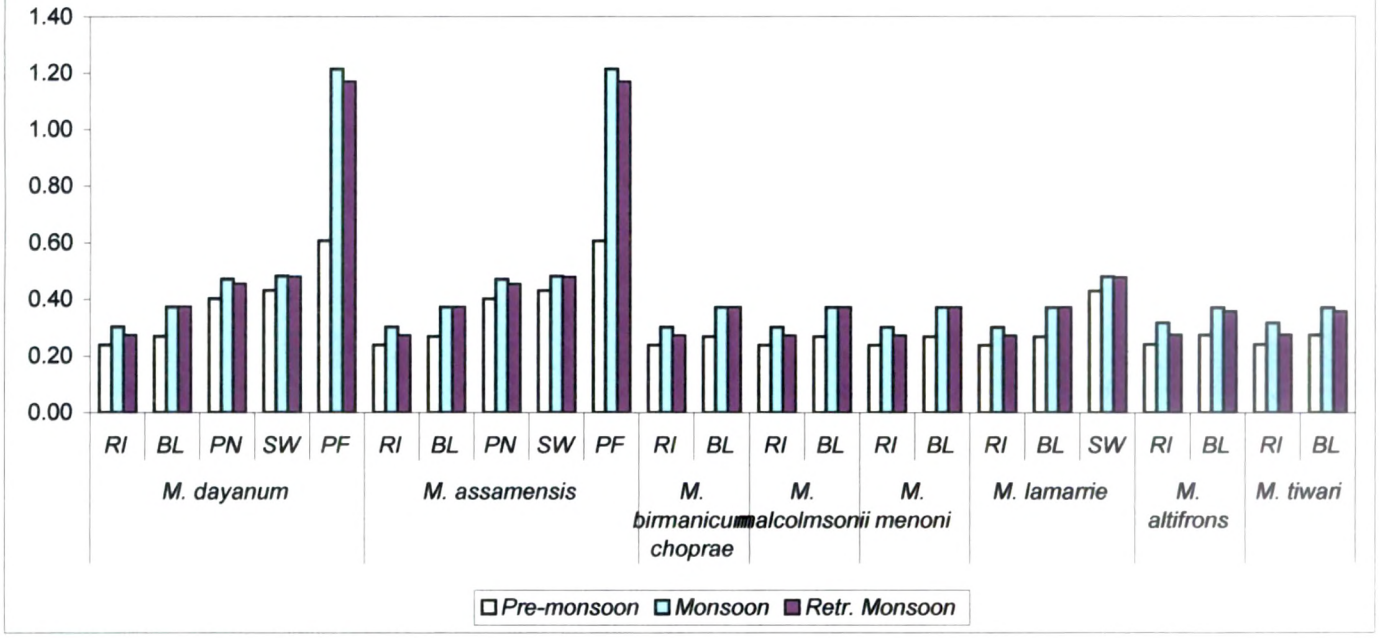


Table – 8.1 . Certain important physico – chemical parameters of Soil viz. Texture, Organic Carbon, P^H, Nitrate, Sulphate, Calcium, Magnesium and Organic matter where from *M. birmanicum choprae, M. malcolmsonii* and *M. menoni* Collected.

Species of *Macrobrachium*	Habitat	Season	Organic Carbon (%)	P^H	Nitrate (mg/100gm)	Sulphate (mg/ 100gm)	Calcium (mg/100gm)	Magnesium (mg/100gm)	Organic matter (%)	Texture
M birmanicum choprae	RI	(PM)	3.0 – 7.3	5.3 – 6.2	0.15 – 0.31	2.9 – 5.0	44.2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Sandy
		(MO)	2.8 – 6.9	6.3 – 7.1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26.8 – 52 3	6.5 – 12.7	
		(RM)	2.9 – 7.1	6.4 – 7.2	0.22 – 0.35	4.2 – 7.1	45.2 – 80.0	25.1 – 37.8	7.6 – 13.5	
	BL	(PM)	3.2 – 7.6	6.4 – 6.8	0.18 – 0.32	2.2 – 3.2	42.3 – 71.2	21.2 – 36.4	6.6 – 14.3	
		(MO)	3.5 – 6.4	6.2 – 6.7	0.42 – 0.53	3.2 – 7.8	38.4 – 76.2	24.8 – 54.2	6.2 – 11.3	
		(RM)	5.6 – 7.6	6 0 – 6.8	0.18 – 0.32	3.2 – 6.8	55.2 – 62 4	23.8 – 33.2	9.8 – 13.6	
M. malcolmsonii	RI	(PM)	3.0 – 7.3	5.3 – 6.2	0.15 – 0.31	2.9 – 5.0	44 2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Sandy
		(MO)	2.8 – 6.9	6.3 – 7.1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26.8 – 52.3	6.5 – 12.7	
		(RM)	2.9 – 7.1	6.4 – 7 2	0.22 – 0.35	4.2 – 7.1	45.2 – 80.0	25.1 – 37.8	7.6 – 13.5	
	BL	(PM)	3.2 -7.6	6.4 – 6.8	0.18 – 0.32	2.2 – 3.2	42.3 – 71.2	21.2 – 36.4	6.6 – 14.3	
		(MO)	3.5 – 6.4	6.2 – 6.7	0.42 – 0.53	3.2 – 7.8	38.4 – 76 2	24.8 – 54.2	6.2 – 11.3	
		(RM)	5 6 -7.6	6.0 – 6.8	0.18 – 0.32	3.2 – 6.8	55.2 – 62.4	23.8 – 33.2	9.8 – 13.6	
M menoni	RI	(PM)	3.0 – 7.3	5.3 – 6.2	0.15 – 0.31	2.9 – 5.0	44.2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Sandy
		(MO)	2.8 – 6.9	6.3 – 7.1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26.8 – 52.3	6.5 – 12.7	
		(RM)	2.9 – 7.1	6.4 – 7.2	0.22 – 0.35	4.2 – 7.1	45 2 – 80.0	25.1 – 37.8	7.6 – 13.5	
	BL	(PM)	3 2 -7 6	6.4 – 6.8	0.18 – 0 32	2.2 – 3.2	42.3 – 71.2	21.2 – 36.4	6.6 – 14 3	
		(MO)	3 5 – 6.4	6 2 – 6.7	0.42 – 0.53	3 2 – 7.8	38.4 – 76.2	24 8 – 54.2	6.2 – 11.3	
		(RM)	5.6 -7 6	6 0 – 6 8	0 18 – 0 32	3 2 – 6.8	55 2 – 62 4	23.8 – 33.2	9 8 – 13 6	

Table – 8.2 : Certain important physico – chemical parameters of Soil viz. Texture, Organic Carbon, P^H, Nitrate, Sulphate, Calcium, Magnesium and Organic matter where from *M. dayanum* and *M. assamensis* collected.

Species of *Macrobrachium*	Habitat	Season	Organic Carbon (%)	P^H	Nitrate (mg/100gm)	Sulphate (mg/ 100gm)	Calcium (mg/100gm)	Magnesium (mg/100gm)	Organic matter (%)	Texture
M. dayanum	RI	(PM)	3.0 – 7.3	5.3 – 6.2	0.15 – 0.31	2.9 – 5.0	44.2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Clay and Sandy loamy
		(MO)	2 8 – 6.9	6.3 – 7 1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26.8 – 52.3	6.5 – 12.7	
		(RM)	2.9 – 7.1	6.4 – 7.2	0.22 – 0.35	4.2 – 7.1	45 2 – 80.0	25.1 – 37.8	7.6 – 13.5	
	BL	(PM)	3.2 – 7.6	6.4 – 6.8	0.18 – 0.32	2.2 – 3.2	42.3 – 71.2	21.2 – 36.4	6.6 – 14.3	
		(MO)	3.5 – 6.4	6.2 – 6.7	0.42 – 0.53	3 2 – 7.8	38.4 – 76.2	24.8 – 54.2	6.2 – 11.3	
		(RM)	5.6 – 7.6	6.0 – 6.8	0.18 – 0.32	3.2 – 6.8	55.2 – 62.4	23.8 – 33 2	9.8 – 13.6	
	PN	(PM)	3.4-7.4	6.2-6.7	0.16-0.42	2.4-3.8	36.8-66.2	20.8-32.2	5.5-12 4	
		(MO)	3.8-6.5	6.3-6.8	0.38-0.58	4.2-6.8	36.5-72.2	28.2-57.4	6.4-12.2	
		(RM)	5.7-7 2	6.2-6.9	0.21-0.48	3.8-6.7	58 5-72.3	25.6-34.9	9.6-12.8	
	SW	(PM)	4.2-7 2	5.6-6.5	0.24-0.51	2 8-4.8	46.8-84.2	22.4-38.6	7.2-12.8	
		(MO)	4.2-8.6	6.4-7.2	0 42-0.72	4.8-7.6	53.1-86.2	34.4-48.2	6.6-15.2	
		(RM)	6.4-7.8	6.0-6.8	0.32-0.64	4.2-7.2	54.4-74.2	28.5-33.6	12.2-14.5	
	PF	(PM)	5.0-7.4	5.8-6.9	0.32-0.64	2.7-5.3	48.2-82.1	24.2-43.1	8.6-30.2	
		(MO)	5.3-8 8	6.3-7.1	0.56-0.78	5.4-8.4	49 2-96.1	35.1-63.4	9.0-16.1	
		(RM)	6.8-8.1	6.2-6 7	0.28-0.76	4.4-7.1	60.2-82.6	24.3-28.4	11.2-13.4	
M assemensis	RI	(PM)	3.0 – 7 3	5.3 – 6.2	0.15 – 0 31	2.9 – 5.0	44.2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Clay and Sandy loamy
		(MO)	2.8 – 6.9	6.3 – 7.1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26.8 – 52.3	6.5 – 12 7	
		(RM)	2 9 – 7.1	6.4 – 7.2	0.22 – 0 35	4 2 – 7.1	45.2 – 80.0	25.1 – 37.8	7.6 – 13.5	
	BL	(PM)	3.2 – 7.6	6.4 – 6.8	0.18 – 0.32	2.2 – 3.2	42 3 – 71.2	21.2 – 36.4	6.6 – 14.3	
		(MO)	3.5 – 6.4	6.2 – 6.7	0.42 – 0.53	3.2 – 7.8	38 4 – 76.2	24.8 – 54 2	6.2 – 11.3	
		(RM)	5.6 – 7 6	6.0 – 6.8	0.18 – 0 32	3.2 – 6.8	55.2 – 62.4	23.8 – 33.2	9.8 – 13 6	
	PN	(PM)	3.4-7.4	6 2-6 7	0.16-0.42	2 4-3.8	36 8-66.2	20.8-32.2	5.5-12.4	
		(MO)	3.8-6.5	6.3-6.8	0.38-0.58	4.2-6.8	36.5-72.2	28.2-57 4	6.4-12.2	
		(RM)	5.7-7.2	6.2-6.9	0 21-0.48	3.8-6.7	58.5-72 3	25.6-34.9	9 6-12.8	
	SW	(PM)	4.2-7 2	5.6-6.5	0 24-0.51	2.8-4.8	46.8-84.2	22 4-38.6	7.2-12.8	
		(MO)	4.2-8.6	6.4-7 2	0.42-0.72	4.8-7 6	53.1-86.2	34.4-48.2	6.6-15 2	
		(RM)	6.4-7.8	6 0-6.8	0.32-0 64	4.2-7.2	54.4-74.2	28.5-33 6	12.2-14.5	
	PF	(PM)	5.0-7.4	5 8-6.9	0.32-0 64	2 7-5.3	48.2-82 1	24.2-43 1	8.6-30.2	
		(MO)	5.3-8.8	6 3-7.1	0.56-0 78	5 4-8 4	49.2-96.1	35.1-63.4	9 0-16 1	
		(RM)	6 8-8.1	6.2-6.7	0 28-0.76	4.4-7.1	60 2-82 6	24 3-28 4	11.2-13 4	

Table – 8.3 : Certain important physico – chemical parameters of Soil viz. Texture, Organic Carbon, P^H, Nitrate, Sulphate, Calcium, Magnesium and Organic matter where from *M. lamarrie, M.altifrons* and *M. tiwari* collected.

Species of *Macrobrachium*	Habitat	Season	Organic Carbon (%)	P^H	Nitrate (mg/100gm)	Sulphate (mg/ 100gm)	Calcium (mg/100gm)	Magnesium (mg/100gm)	Organic matter (%)	Texture
M. lamarrie	RI	(PM)	3.0 – 7.3	5.3 – 6.2	0.15 – 0.31	2.9 – 5.0	44.2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Clay and Sandy loamy
		(MO)	2.8 – 6 9	6.3 – 7.1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26.8 – 52.3	6.5 – 12.7	
		(RM)	2.9 – 7.1	6 4 – 7.2	0.22 – 0.35	4.2 – 7.1	45.2 – 80.0	25.1 – 37.8	7.6 – 13.5	
	BL	(PM)	3.2 – 7.6	6.4 – 6.8	0.18 – 0.32	2.2 – 3.2	42.3 – 71.2	21.2 – 36.4	6.6 – 14.3	
		(MO)	3.5 – 6.4	6.2 – 6.7	0.42 – 0.53	3.2 – 7.8	38.4 – 76.2	24.8 – 54.2	6.2 – 11.3	
		(RM)	5.6 – 7.6	6.0 – 6.8	0.18 – 0.32	3.2 – 6.8	55.2 – 62.4	23 8 – 33.2	9.8 – 13 6	
	SW	(PM)	4.2-7.2	5.6-6.5	0.24-0.51	2.8-4.8	46.8-84.2	22.4-38.6	7 2-12.8	
		(MO)	4.2-8.6	6.4-7.2	0.42-0.72	4.8-7.6	53.1-86.2	34.4-48.2	6.6-15.2	
		(RM)	6.4-7.8	6.0-6.8	0.32-0.64	4.2-7 2	54.4-74.2	28.5-33.6	12.2-14.5	
M. altifrons	RI	(PM)	3.0 – 7.3	5.3 – 6.2	0.15 – 0.31	2.9 – 5.0	44.2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Sandy to loamy clay
		(MO)	2.8 – 6.9	6.3 – 7.1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26.8 – 52.3	6.5 – 12.7	
		(RM)	2.9 – 7.1	6 4 – 7 2	0.22 – 0.35	4.2 – 7.1	45.2 – 80.0	25.1 – 37.8	7.6 – 13.5	
	BL	(PM)	3.2 -7.6	6.4 – 6.8	0.18 – 0.32	2.2 – 3.2	42.3 – 71.2	21.2 – 36.4	6.6 – 14.3	
		(MO)	3.5 – 6 4	6.2 – 6.7	0.42 – 0.53	3.2 – 7 8	38.4 – 76.2	24.8 – 54.2	6.2 – 11.3	
		(RM)	5.6 -7.6	6.0 – 6.8	0.18 – 0.32	3.2 – 6.8	55.2 – 62.4	23.8 – 33.2	9.8 – 13.6	
M twari	RI	(PM)	3.0 – 7.3	5 3 – 6.2	0.15 – 0.31	2.9 – 5.0	44.2 – 78.3	23.2 – 39.9	7.9 – 13.8	Mostly Sandy to loamy clay
		(MO)	2.8 – 6 9	6.3 – 7.1	0.40 – 0.51	4.1 – 6.9	48.5 – 83.4	26 8 – 52.3	6.5 – 12.7	
		(RM)	2.9 – 7 1	6.4 – 7.2	0.22 – 0 35	4 2 – 7.1	45.2 – 80.0	25.1 – 37.8	7 6 – 13.5	
	BL	(PM)	3 2 -7.6	6.4 – 6 8	0 18 – 0.32	2.2 – 3.2	42.3 – 71.2	21 2 – 36 4	6.6 – 14 3	
		(MO)	3.5 – 6 4	6 2 – 6 7	0.42 – 0.53	3.2 – 7.8	38 4 – 76 2	24 8 – 54.2	6.2 – 11.3	
		(RM)	5.6 -7.6	6.0 – 6 8	0.18 – 0.32	3.2 – 6.8	55 2 – 62 4	23 8 – 33.2	9.8 – 13 6	

FIG. 2 – SHOWING SOIL PARAMETERS

Fig. 2.1 – Nitrate

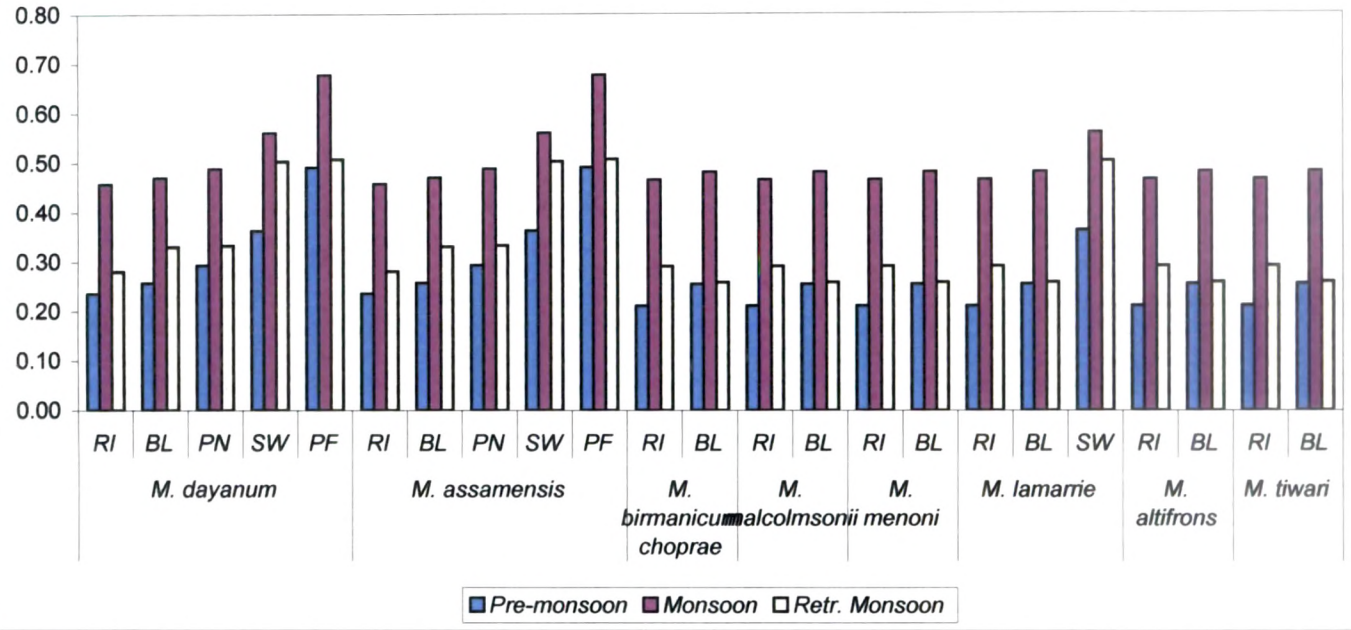


Fig. 2. 2 – P^H

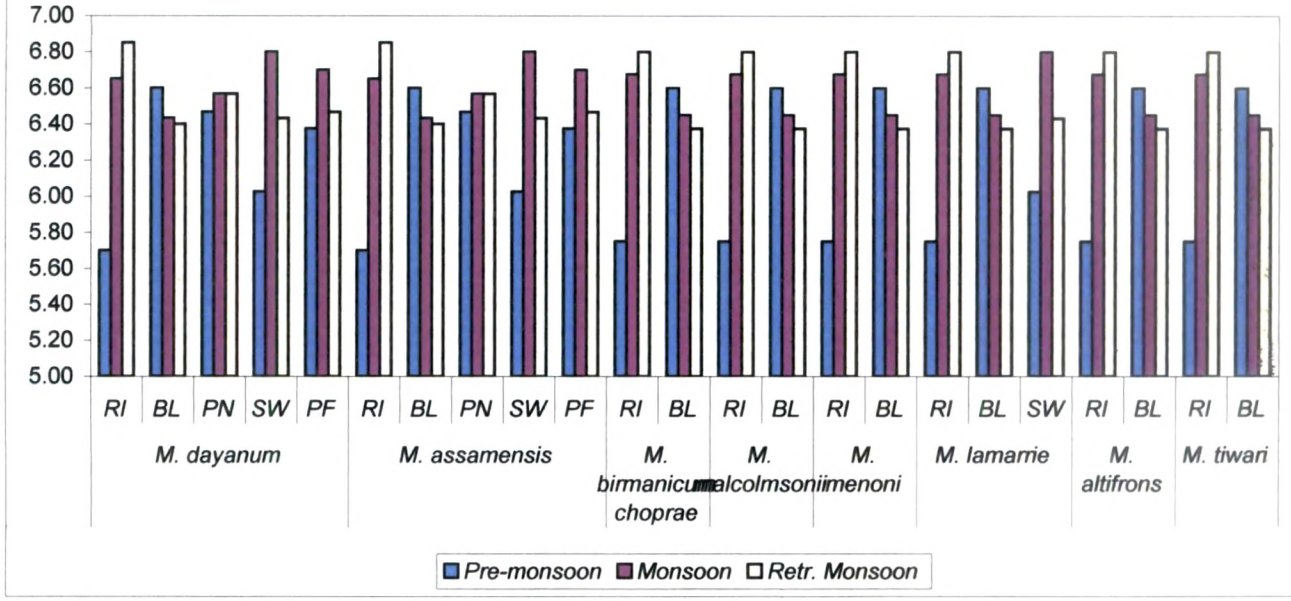


Fig. 2. 3 – Organic carbon

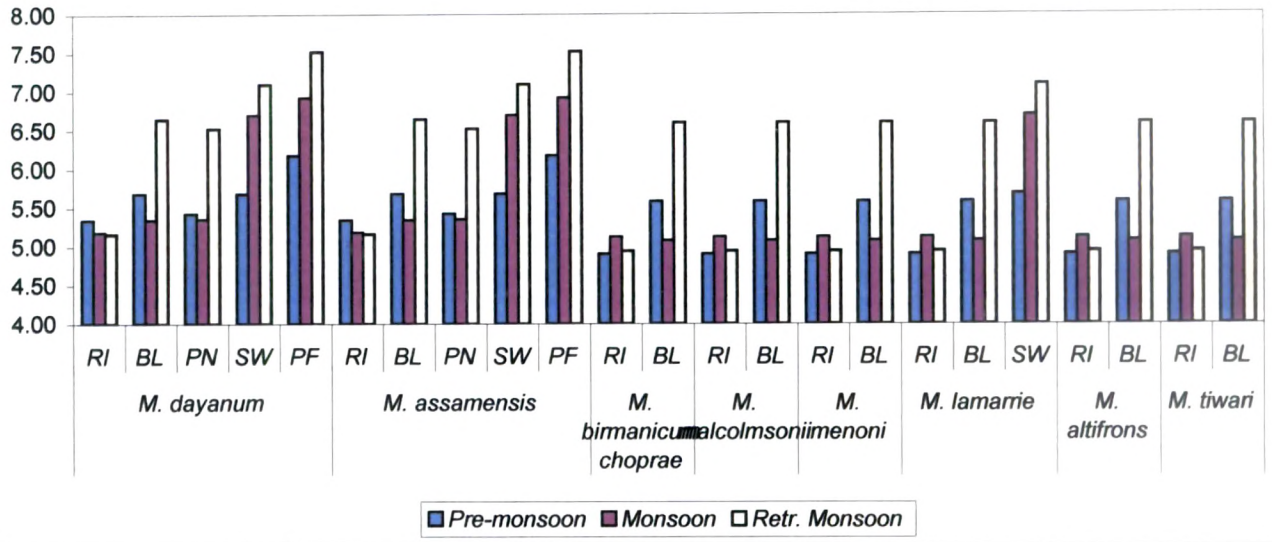


Fig. 2. 4 – Organic matter

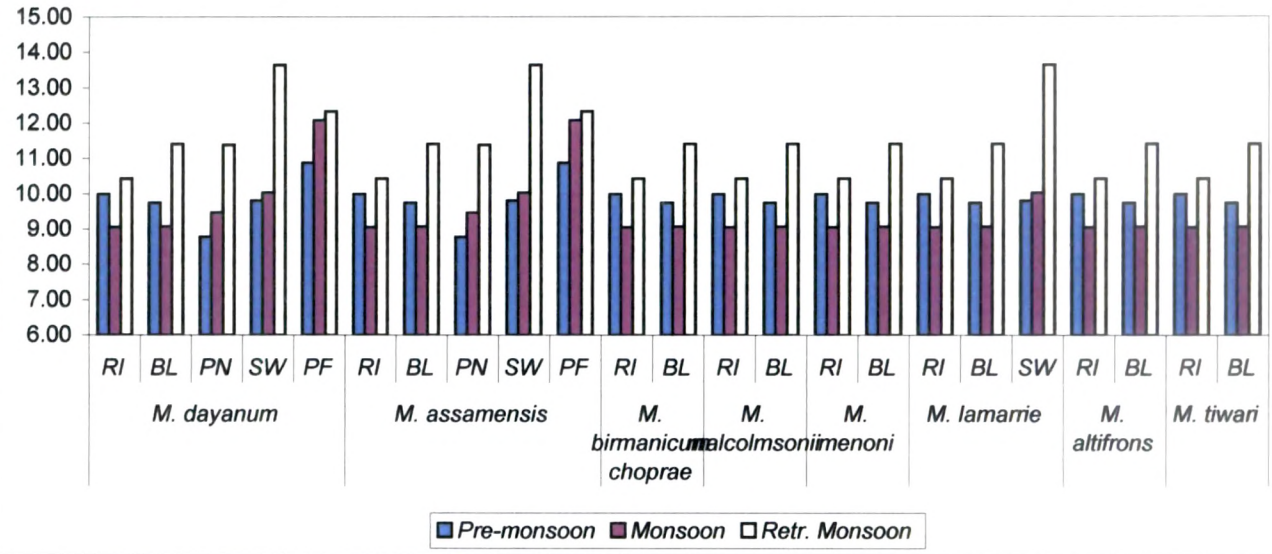


Fig. 2. 5 – Magnesium

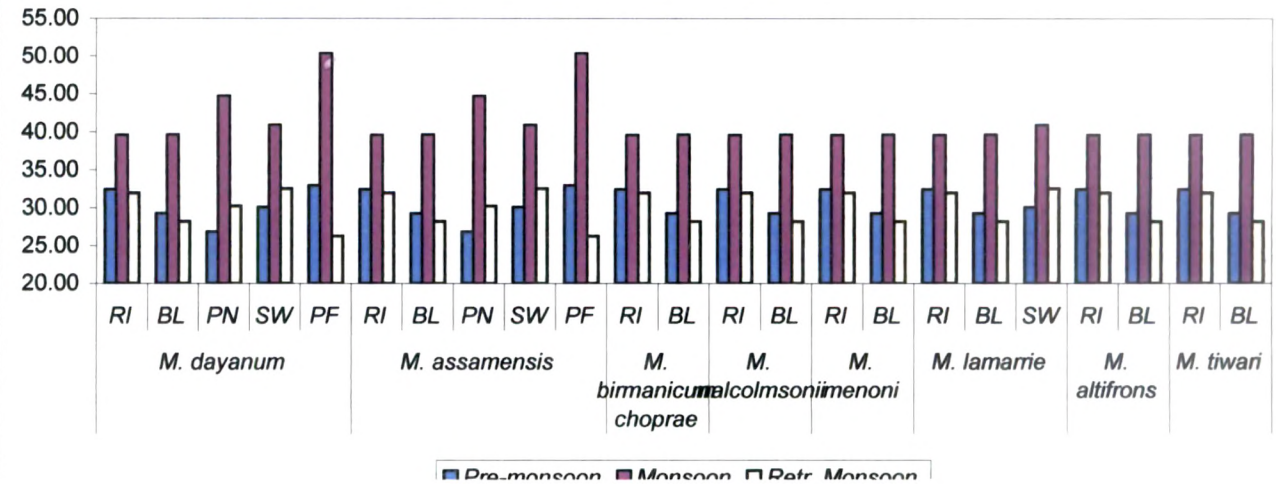


Fig. 2. 6 – Calcium

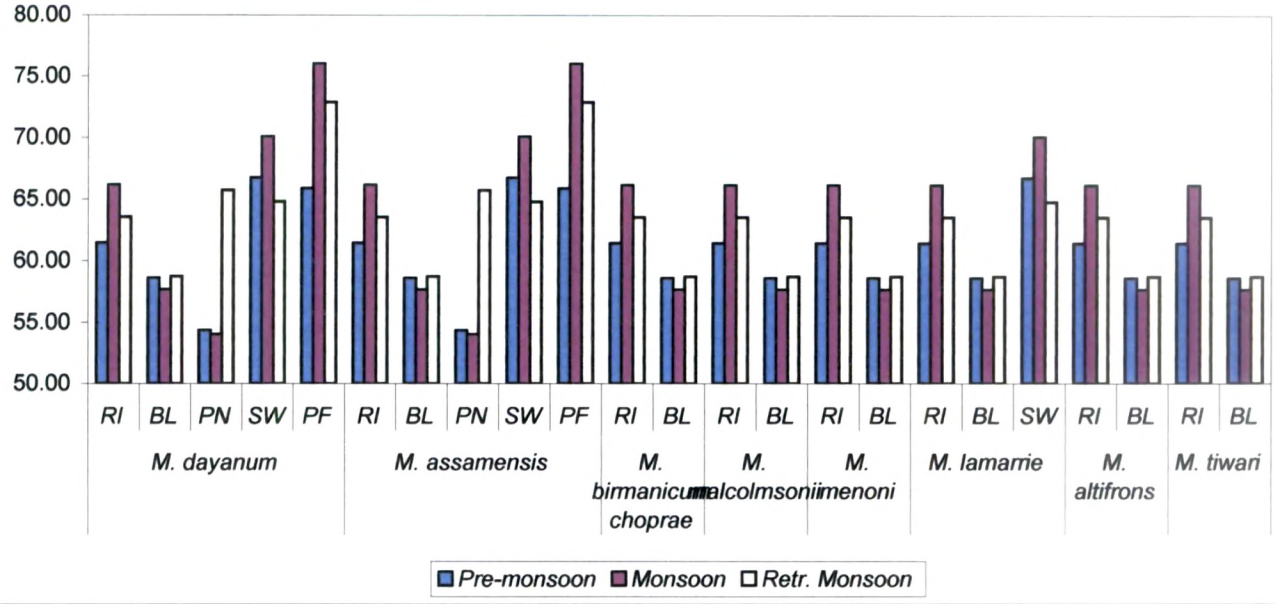


Fig. 2. 7 – Sulphate

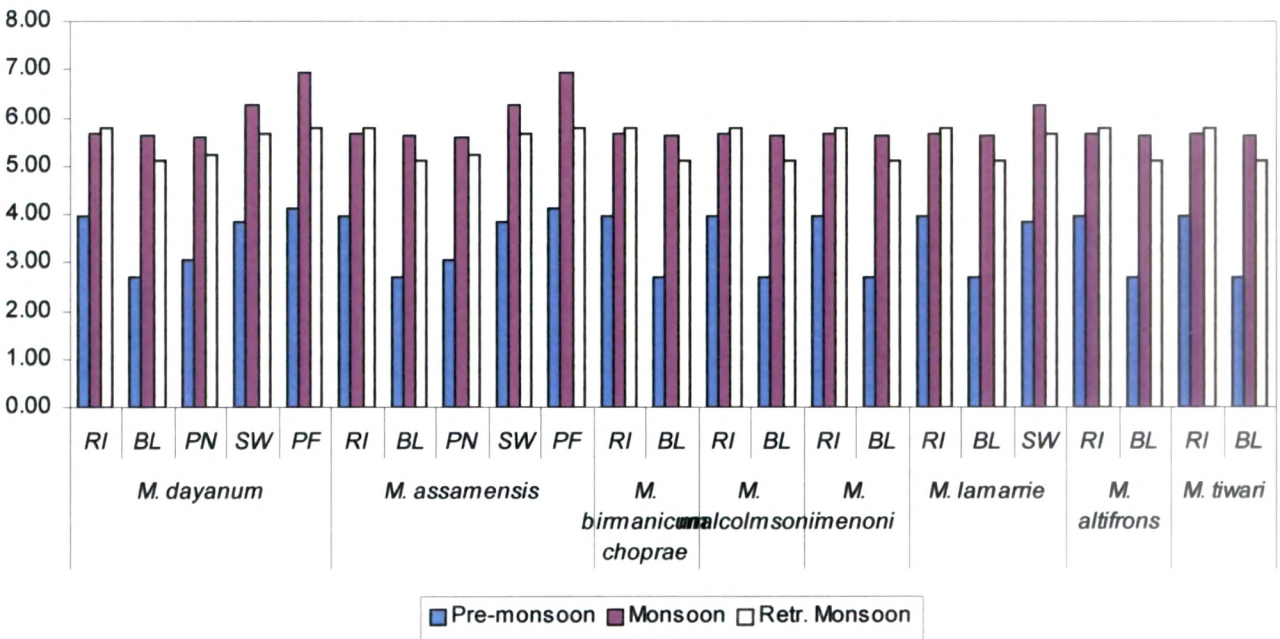


Table – 9 : HYDROPHYTES IN THE HABITAT OF PRAWN

	Scientific Name	Family
I	**Free floating hydrophytes**	
	Azolla pinnata	- Salviniaceae
	Eichhornia crassipes	- Potenderiaceae
	Nepturua ornicate	- Mimosaceaew
	Lemna perpusilla	-Lemnaceae
	Salvinia natans	- Salviniaceae
	Spirodella polyrrhiza	-Lamnaceae
	Pistia stratiotes	-Araceae
	Trapa bispinosa	-Trapaceae
		-Lemnaceae
II	**Rooted submerged hydrophytes**	
	Ceratophyllum demersum	-Ceratophyllaceae
	Hydrilla verticillata	-Hydrocharitaceae
	Myriophyllum indicum	-Haloragaceae
	Najas graminea	-Najaceae
	Ottleria alismodies	-Hydrocharitaceae
	Potamogeton crispus	-Potamogetonaceae
	Vallisneria spiralis	-Hydrocharitaceae
III.	**Rooted hydrophytes with floating leaves**	
	Marsilea minuta	- Marsiliaceae
	Nelumbo nucifera	- Nymphaceae
	Neptunea ornicate	-Mimosaceae
	Nepturia oleracca	- Mimosaceae
	Nymphaea microantha	- Nymphaceae
	Nymphoidus indicum	- Gentianaceae
	Potamogeton octondrus	-Potamogetonaceae
	Sagittaria spp.	- Alismaceae
IV.	**Rooted emergent hydrophytes**	
	Alisma plantago aquatica	-Alismataceae
	Aeschynomene indica	-Fabaceae
	Aeschynomene aspera	-Fabaceae
	Alocasia ornicate	-Araceae
	Ammania spp.	-Lythraceae (ammanniaceae)
	Colocasia esculanta	-Araceae
	Colocasia nymhaefolia	-Araceae
	Oriza Sativa	-Gramineae
	Sagittaria guayanensis	-Alismataceae.

Chart No. A Chart Showing Fishing Gears

Category	Fishing gears
Impaling Gears	Jongar, Tiara, Pokroa, Kol and Kati
Traps	Ghani, Chepa, Dingora, Derki, Dalagni, Changa, Boldha, Chekra, Torka, Bamidhora, Khoka, Tuna, Dori.
Entangling gear	Langijal, Phansijal
Encircling gear	Musarijal, Berjal Polo, Juluki, Jhupro, Khewalijal & Angtajal
Scooping gear	Dharnmajal, Dhenkijal Thelajal, Jakoi
Trawling gear	Moijal, Horhorijal, Shanglajal

Chart – B : Chart Showing Different Fishing Gears of Beel Fisheries of Assam

1	Musarijal	6	Dolijal
2	Berjal	7	Parangijal
3	Khewalijal	8	Ghatjal
4	Phansijal	9	Horhorijal
5	Langijal	10	Dhenkijal