Original Research Article

Seasonal Abundance and Distribution of Freshwater Snails in Different Beels of Gopalganj District, Bangladesh

ABSTRACT

In Bangladesh, there are thousands of beels *(*a deep depression) of different sizes. Most of these large beels have become shrunken quite considerably in recent decades. Those beels are the main source of snails. Gopalganj district of Bangladesh has lots of beels from where people collect huge amount of Mollusca species from the time immemorial. But currently, the abundance is become decreasing drastically due to uncontrolled catch. It is important to know the seasonal abundance and distribution of Mollusca species in selected beel areas. Surveys had been conducted at summer (May-June), rain (September-October) and winter (December-January) season throughout the year based on the observations and sampling in each six points (each of 16m^2 area per point) of a beel, As such six selected beels in each upazila of Gopalganj district have been considered under study. Sampling was done with the help of sieves (0.2 mm, 2.0 mm and 4.75 mm), cast nets, small hand nets and hand-picking methods and count. In this study, five snail species were found throughout the survey period where Lomba shamuk (*Lymnaea stagnalis*) was found the highest in number than others. The highest average number (600 no/16m^2) of snail was found in in Gopalganj sadar upazila at rainy season and species comprised of lomba shamuk (*Lymnaea stagnalis*). In case of Chakti shamuk (*Macrochlamys indica*), the highest average number (519 no/16m^2) was also found in Gopalganj sadar upazila at the same period. The abundance of average no of Ghecho shamuk (*Lymnaea luteola*) was found low for all studied upazila and in Muksudpur this species was totally absent. These findings may help the concern authority to take proper decisions on meaningful steps and the right time of taking steps. Ultimately these findings may help the nature from the extinction of Mollusca species.

Keywords: Beel, Mollusc, Abundance, Distribution

INTRODUCTION

Bangladesh is truly a riverine as well as a maritime country, which is situated at the largest delta containing the finest mangrove and longest continuous sea beach in the world. Most of the rivers in Bangladesh are either tributaries or distributaries of the Ganges, or the Brahmaputra, or the Meghna River. In Bangladesh, the word 'beel' means a lake with static water. Beel, a large surface water body that accumulates surface runoff water through internal drainage channels, these depressions are mostly topographic lows produced by erosions and are seen all over Bangladesh. Beels are small saucer like depressions of a marshy character. Many of the beels dry up in the winter but during the rains expand into broad and shallow sheets of water, which may be described as fresh water lagoons. Beels can be formed due to many causes.

In the active floodplains of the Surma-Meghna, the Brahmaputra-Jamuna and the Ganges-Padma river systems, there are several large and small beels. In Bangladesh, there are thousands of beels of different sizes. Some of the most common names are Chalan beel, Gopalganj-Khulna beel and Arial beel. Most of these large beels have shrunk quite considerably in recent decades.

Gopalganj is a district of Dhaka division of Bangladesh. It is bounded on the north by Faridpur district, on the east Madaripur and Barisal districts, on the south by Pirojpur and Bagerhat districts and on the west by Narail district. It lies between 22º 50' and 23º 01' north latitudes and between 89º 40' and 90º 02' east longitudes. The total area of the district is 1,468.74 sq. km. (567.00 sq. miles). Gopalganj-Khulna Beel occupies a number of low-lying areas between the Ganges Floodplain and the Ganges Tidal Floodplain. The major two beels of the Gopalganj district are Baghia beel and Chanda beel. Thick deposits of peat occupy perennially wet basins, but they are covered by clay around the edges and by calcareous silty sediments alongside ganges distributaries crossing the area. This is the largest peat basin of Bangladesh. The basins are deeply flooded by clear rainwater during the monsoon. In the basin close to Khulna, the floodwater is somewhat brackish. Subsiding process is still active in this physiographic unit. Idowu (2004) observed that shallow Lake often with a well-developed littoral vegetation are often more productive than

deep lakes and particularly in the tropics, they are important source for fisheries and other aquatic fauna products.

Gopalganj district of Bangladesh has lots of beels with shallow water area from where people collect huge amount of Mollusca species from the time immemorial. For the huge demand of snail in the area, the abundance of Mollusca species is decreasing day by day. This is happened due to uncontrolled catch. But the current abundance and distribution of Mollusca's species yet to know. That is why it is a novel approach to know the seasonal abundance and distribution of Mollusca species in selected beel areas.

Twenty lands, 22 freshwater and 437 marine and brackish water mollusks species belonging to 210 genera, 105 families and 23 orders under 4 classes have been recorded in Bangladesh (Siddiqui et al., 2007). The shallow water bodies like beels are the major harbour of mollusks species in Bangladesh. Next to the insects the second large and most successful invertebrate are snails as stated by Abbot, 1989; Hapman, 2009. Considering the number of the species that have been described, the non-marine molluscs become the second most diverse Phylum in Kingdom Animalia. The Mollusks are found to be one of the most diverse groups, yet there are only a few scientists who are aware of their importance and are working on these creatures. One of the most important and effective approach to the biodiversity conservation and management is the compilation and publication of the Red Data Book as stated by Bouchet (1997). According to a survey conducted in 2002 by the IUCN there are total 708 freshwater and 1222 terrestrial mollusks, out of which 42% of the 693 extinctions from the animal species are mollusks, comprising 260 gastropods and 31 bivalves as reported in Red List of Threatened Species by Baillie et al. (2004). Invertebrates are not generally noticed by the biologists and conservation agencies as most of the work is being done on terrestrial vertebrate regarding their extinctions and has been well documented by Lydeard et al. (2004).

This important part of every aquatic ecosystem, many species act as food sources to many animals as well as human beings (species like *Filopaludina bengalensis*, *Pila globosa* and *Brotia costula*). Other helps in nutrient cycle and are also used as bio indicator of their ecosystem's pollution, hence play a pivot role in ecological studies (Sharma et al., 2013; Kumar et al., 2018) of aquatic ecosystems.

Muslim humans' community of Bangladesh are not consumed Snails (Saha ,1998). However, identified 29 groups of tribal people that consume snail flesh. But, now a days different delicious snail meat food items is serving in different hotels of tourist city of Bangladesh like Cox's Bazar, Khulna, and Chittagong. Snail flesh is instead more extensively used in freshwater prawn (*Macrobrachium rosenbergii*) farming in the south-western part of the country (Baby et al., 2010), which is one of the major exports earning sectors in Bangladesh (DoF, 2011). The average application of snail meat to prawn ponds is 66.5 kg $ha^{-1}day^{-1}$ during June to October (Ahmed et al., 2008). Snail meat is also utilized as supplementary feed in indigenous catfish (*Clarius batrachus*) farms and domestic ducks throughout the year (Banglapedia, 2006). Snail shell is used to produce lime and animal feed additive due to its rich $CaCO_3$ content (Nath et al., 2008). Freshwater Mollusca populations have been declining for decades and are among the most seriously impacted aquatic animal's worldwide (Bogan et al., 1993 & Williams et al., 1993).

The present study is the first attempt to identify the malaco-diversity in a district of Bangladesh along with understanding their diversity and abundance fluctuations in different seasons.

2. MATERIALS & METHODS

2.1 STUDY AREA

Survey was conducted in six *beels* of each upazila of Gopalganj district, Bangladesh (Fig-1). List of beels are given below in Table-01.

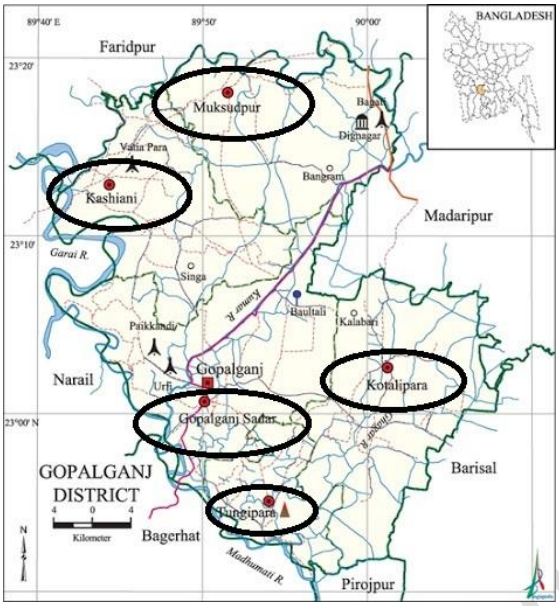

Fig. 1: Maps of the Gopalganj district.

Table-1: List of beels where survey conducted

Name of upazila	Name of Beel
Kotalipara	Dhara Vashail, Baikkar, Shuagram, Unsia, Hiron, Modhur Nagra
Kashiani	Tetulia, Domrakhandi, Orakhandi, Rahuthor, Shinga, Bongkur
Tungipara	Sonakhali, Gopalpur, Mohiser, Dumuria, Korpara, Tarail
Gopalganj Sadar	Mollahr, Ulpur, Padma, Raut Khamar, Chandar, Tuamandar
Muksudpur	Uzani, Bashbaria, Bohugram, Nonikhir, Chalcha

2.2 Survey Season and Sample collection:

Surveys were conducted at summer (May-June), monsoon (September-October) and winter (December-January) season. throughout the year based on the observations and sampling in each selected beels. Random sampling of species were done from the six points of each 16m^2 areas in the selected beels. Samples were collected, sorted and counted with the help of sieves, cast nets, small hand nets and hand-picking methods.

2.3 Identification of Species

Species were identified based upon morphological characteristics of the shell, the taxa and habit recognized by Encyclopedia of Flora and Fauna of Bangladesh (Ahmed, 2007).

3. Results and Discussion

3.1 Species Diversity and Seasonal Distribution

Five snail species were found available throughout the survey period (Table-2). From five species Lomba shamuk (*Lymnaea stagnalis*) was found highest amount than others.

Table-2: Name of snail species found in different beels of Gopalganj districts

Sl No.	Local Name	English Name	Scientific Name
1	Apple shamuk/ Bara shamuk	Common Apple snail	*Pila globosa*
2	Chakti shamuk	Disk snail	*Macrochlamys indica*
3	Guli shamuk	Banded pond snail	*Bellamya bengalensis*
4	Lomba shamuk	Lymnaeid snail	*Lymnaea stagnalis*

5	Ghecho shamuk	Lymnaeid snail	*Lymnaea luteola*

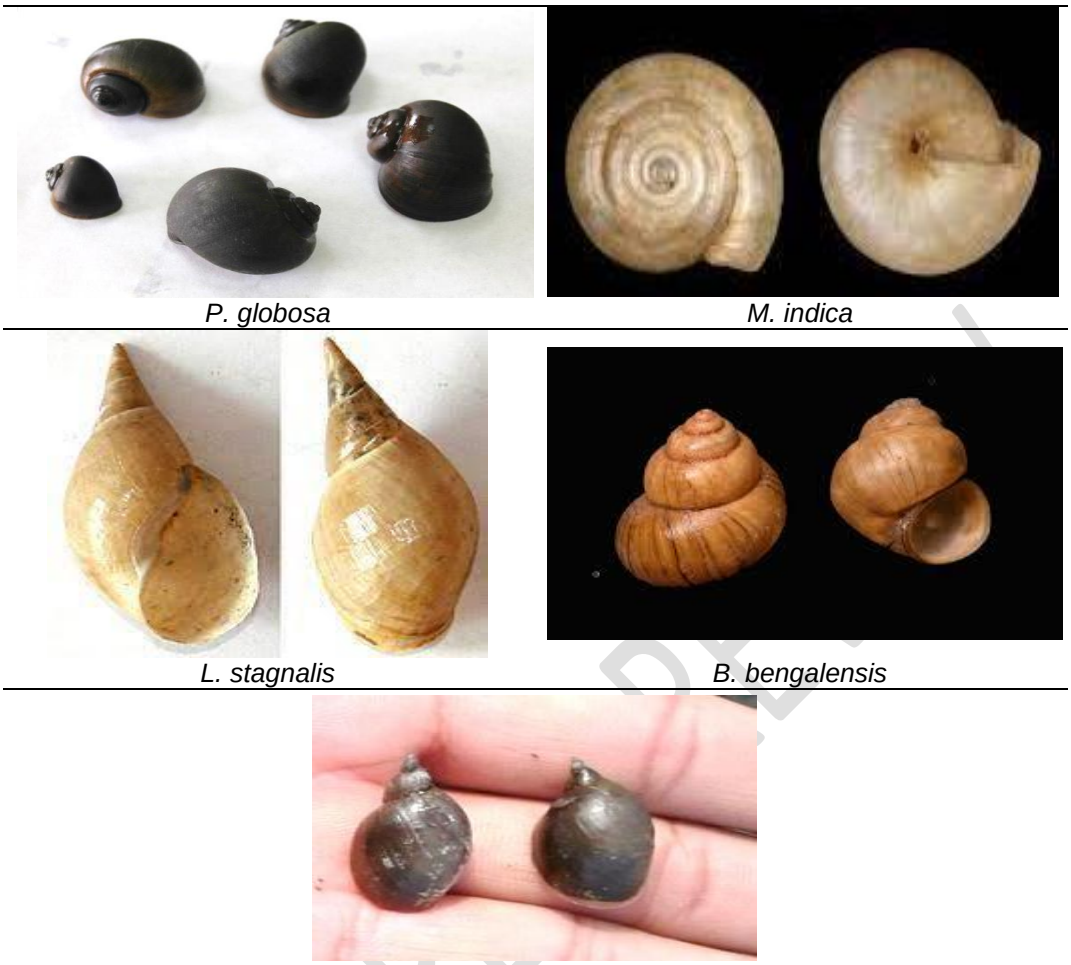

Fig. 2: Snail species found in Gopalganj districts

Worldwide very few numbers of manuscripts was published on density fluctuations of freshwater snails. From that, Monthly and seasonal fluctuations in densities of freshwater snails were recorded in six different sites at Qena Governorate Upper Egypt during the period of March 2009- February 2010, the study revealed the occurrence of 13 species of freshwater snails belonging to 9 families of class Gastropoda (Hussein *et al* 2011). Hossain *et al* (2014) altogether 10 gastropod species were recorded in the river Brahmaputra, Mymensingh, Bangladesh. Among gastropoda *Melanoides tuberculata* (Muller), *P. globosa, L. luteola* and *B. begalensis* were most dominant species recorded, that findings totally matches with the present findings.

The highest average number (600/16m^2) of snail found in whole survey period in Gopalganj sadar upazila at rainy season and species was Lomba shamuk (*L. stagnalis*). In case of Chakti shamuk (*M. indica*), the highest average number was 519/16m^2 also found in same upazila at rainy season.

On the other hand, in case of Apple shamuk/Bara shamuk (*P. globosa*) the highest average number was 50.6/16m^2 found in Tungipara upazila at rainy season. Abundance of Guli shamuk (*B. bengalensis)* was recorded the highest average number (193.4/16m^2) in Kashiani Upazila at winter season. Average number of Ghecho shamuk (*L. luteola*) was found very low in all upazila and in Muksudpur upazila, this species was totally absent (Fig. -3). On the other hand, the abundance (%) of different species in different season under different Upazila describes in figure 03.

3.2 Snail Diversity and Seasonal Distribution

Total abundance of snails from different beels of Gopalganj districts were shown in Table-2, where no of average recorded snails shown under different seasons with standard deviation (Mean ± SD).

Fig. 3: Species wise abundance (%) of snails in different seasons under different Upazila.

Table-3 shown the abundance of snails in 30 surveyed beels of Gopalgonj district, it is evident from the table that total abundance of snails in all beels were found higher in rainy season than summer and winter. The lowest abundance was found in winter season for all beels. From where it is revealed that during rainy season the snail abundance becomes more than the other two seasons for all beels under different Upazila.

In Gopalganj sadar Upazila, beels became dried during summer and winter seasons than other Upazila, that's why the abundance of snails in these seasons were recorded the lowest number, on the other hand, in Kashiani and Muksudpur Upazila, water of beels remain for a longer period than other upazila's beel, that's why the abundance (%) of snails prevailed there higher number in winter as like rainy season (Table-3& Fig. 5).

Table no-3: Snails found under different beels of Gopalgonj district in different seasons.

Name of Upazila	Name of *Beels*	Name of Season		
		Summer	Rain	Winter
		Snail no. (Mean ± SD)		
Kotalipara	Dhara Vashail	30.33±11.32	82.50±29.85	13±4.95
	Baikkar	31.83±3.44	78.17±46.12	18.5±3.5
	Shuagram	10.17±3.80	80.17±14.16	8±1.63
	Unsia	15±6.19	79.83±19.39	6±1.63
	Hiron	19.5±7.14	162.67±31.24	55.75±54.82
	Modhur Nagra	70.33±51.56	132.17±59.97	-
Gopalganj Sadar	Mollahr	9.5±1.71	141.17±29.17	9±2.16
	Ulpur	8.83±7.19	282.5±64.45	26.33±20.33
	Padma	6.33±2.81	132.17±11.10	11.66±2.86
	Raut Khamar	6.83±1.07	343±82.52	11±2.94
	Chandar	11.17±9.41	83.17±22.84	9.25±5.63
	Tuamandar	7.83±2.61	187.17±29.63	8±2.45
Tungipara	Sonakhali	39.5±11.88	252±49.92	39.5±11.88
	Gopalpur	36±14.79	60±24.75	12±2.94
	Mohiser	57.83±20.28	234.83±122.03	12±4.55
	Dumuria	42.33±13.88	155.17±29.93	24.33±4.99
	Korpara	29.67±14.24	55.17±19.34	23.67±8.38
	Tarail	30.33±12.02	164.5±86.52	30.33±12.02
Kashiani	Tetulia	34.24±4.82	52.5±23.61	69±11.94
	Domrakhandi	21.75±4.32	216.33±96.03	67.25±22.99
	Orakhandi	28±5.89	149.33±35.48	189.5±43.16
	Rahuthor	31±9.03	92.33±16.81	137.25±22.59
	Shinga	23.5±5.32	131.33±26.33	141.25±18.99
	Bongkur	23.5±6.10	119.17±40.43	132.67±29
Muksudpur	Uzani	33.75±6.61	135.17±51.94	133.75±33.83
	Bashbaria	11.66±1.25	108.17±45.29	55.25±30.33
	Bohugram	15.33±5.44	44.33±11.69	95.75±44.72
	Nonikhir	16.5±6.18	95.33±29.23	43±7.35
	Chalcha	9±3	108.17±30.68	40.67±17.97
	Kanuria	15.5±1.5	141.17±37.72	27±0.82

Seasonal variations in terms of their influence on the chance of species abundance rather than complete species replacement in the aquatic systems were reported (Brooks, 2000; Mesa, 2012). The highest gastropod count was recorded during late rainy season (September–October), while the lowest was recorded during early rainy season (June and July) from Eleyele dam. This corresponds with Owojori *et al* (2006) who studied river and ponds in Ile-Ife. This study is agreed with the findings of the aforesaid authors. According to Dillon (2000) mollusca species are more found in spring and rainy season. This information also supports the present findings.

Due to greater evaporation in summer, concentration of salts gets increased so as to show a higher EC; during winter due to precipitation results dilution makes value reduced (Trivedy and Goel, 1984). So that the abundance of snail in summer become reduce. That's findings are match with our current findings.

On the other hand, in Gopalganj district, total abundance of snail was found higher in Gopalganj sadar upazila than other upazila during rainy season. In summer, total abundance of snail was recorded higher in Tungipara upazila than other upazila and in winter season, total abundance of snail was exhibited higher in number in Kashiani upazila than other upazila (Fig. 4).

It is evident from Fig. 5 that the abundance of different species of snails exhibited higher in number in monsoon than summer and winter season. The seasonal variations of molluscs population may provide hints as to the extent of environment perturbation as the populations of an African arid zone

lake were proportionally higher in the rainy season and harmattan season was observed by Idowu et al, (2007). The same strong and pronounced seasonality of macro invertebrates was observed by Dejoux et al, (1971) and Mbagwu (1993) in lake Chad and Tiga, respectively.

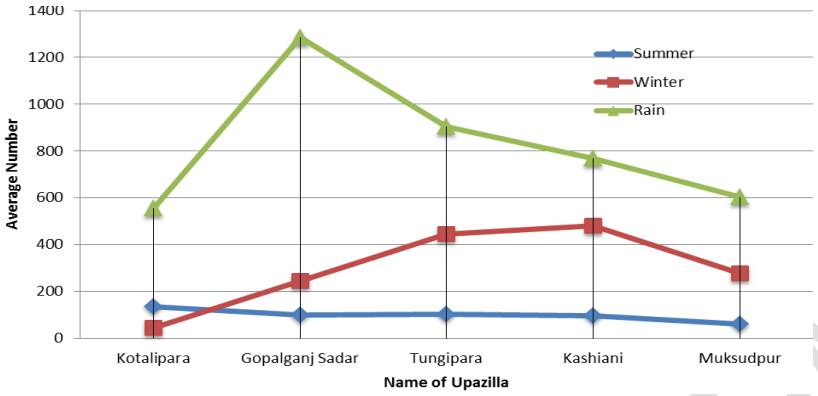

Fig. 4: Abundance of snails under different upazila in different seasons.

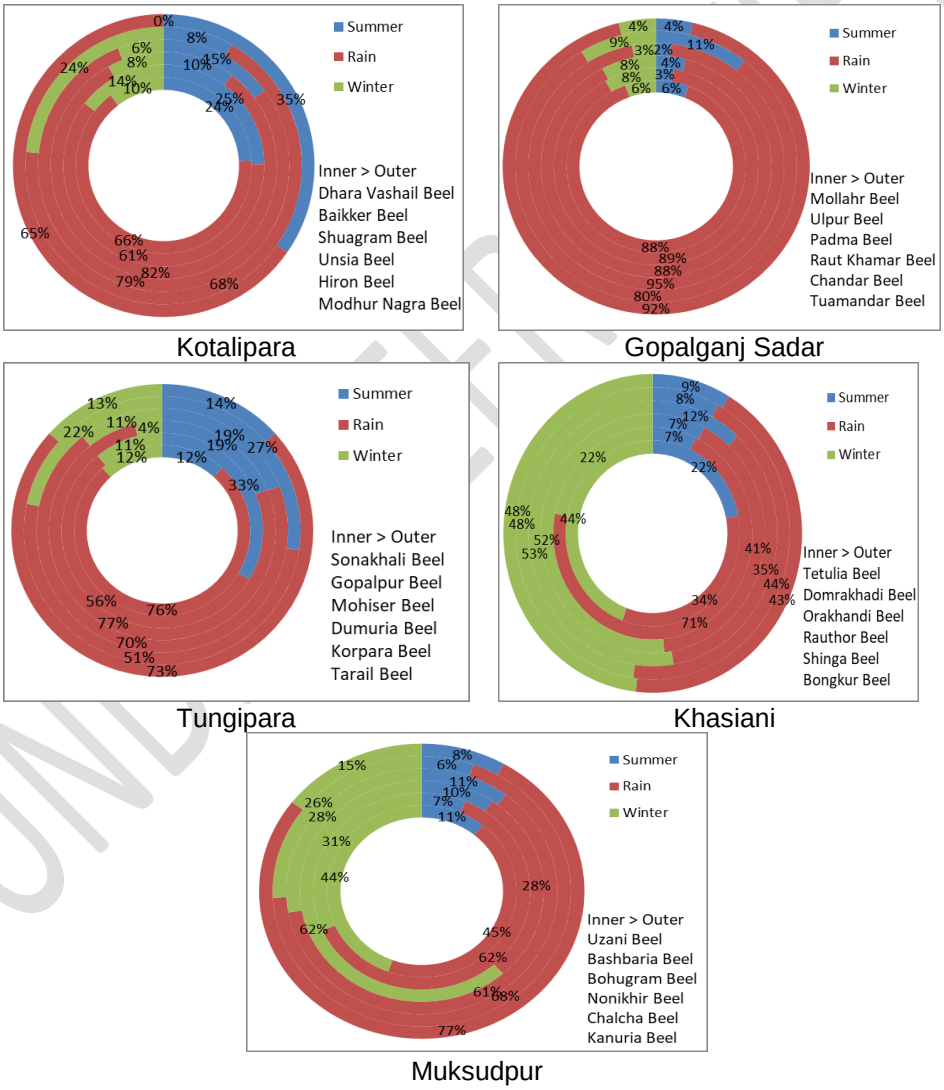

Fig. 5: Abundance (%) of snails in different seasons in different beels under different upazila

The reason behind less abundance in winter season might be hibernation nature of snail. In winter, almost all snails prefer to stay in hibernation, and found very lower in number in aquatic nature.

Research findings told that snails are cool-blooded animals. In dry unfavorable winter season, snails hibernate up to 4 (four) feet below the ground (Dees, 1970). Okafor (2001) also stated that snails hibernates and aestivation especially during dry hot unfavorable seasons.

Winter is an essential part of their life cycle. Snails do not eat food during winter. After winter, when the ambient temperature is normal, the snails come out after wintering. During winter, because of hibernation 10-12% of snails die (Grilla *et al* 2016). On the other hand, in rainy season a new generation is added in the nature. Das *et al* (2020) stated that snails breeding take place in pre-monsoon season. So that the abundance might be increased in the rainy season.

4. CONCLUSION

In Bangladesh, nobody has become interested in snail farming till to-date. Though snail capturing and its utilization as human food, poultry feed and in large scale as supplementary feed for prawn farms are lavishly going on. Especially, over exploitation of *P. globosa* has been occurred each year for prawn farming, which is increasing alarmingly day by day. Highest average snails found in 27.72 in one of the studied upazilla. That's indicate that the ecologically and economically important such a biological resource will become extinct within a very short time if no steps are taken to reproduce of this species immediately. On the other hand, form this research it can be concluded that snails are found high in rainy season than summer and winter season. Considering the above facts, the present research undertook to evaluate the abundance and diversity of snail in Gopalganj district, which is the main source of snail in this south-east region of Bangladesh. These abundance and seasonal distribution related findings may help concern authority to take proper decisions on meaningful steps and the right time of taking steps. Ultimately these findings may help the nature from the extinction of those important species.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

References

1. A.E. Freshwater bivalve extinctions (Mollusca: Unionoida): a search for causes. American Zoologist 1993; 33(6):599-609.
2. Abbot TR. Compendium of land snails. American Malacologists, Inc., Melbourne, Florida, USA. 1989:1-240.
3. Ahmed, N., Demaine, H. and Muir, JF. Freshwater prawn farming in Bangladesh: history, present status and future prospects. Aqua. Res. 2008:39: 806-819.
4. Alena, G., Chloe L. J., Derek, M.M. and David, M. Feasibility of Snail Farming as a Model for Small Urban Farms to Expand into Niche Markets for Increased. Profitability. BSc Dissertation, Worcester Polytechnic Institute, United States. 2016:74pp.
5. Baby, R.L., Hasan, I., Kabir, K.A. and Naser, M.N. Nutrient analysis of some commercially important molluscs of Bangladesh. J. Sci. Res. 2010:2(2): 390-396
6. Baillie J, Hilton Taylor C, Stuart SN. (Eds.). IUCN red list of threatened species: a global species assessment. 2004.
7. Banglapedia, National encyclopedia of Bangladesh. Retrieved September 23, 2011. From http://www.banglapedia.org/httpdocs/HT/S_0437.HTM.
8. Bouchet P. The future of the western Palaearctic mollusc fauna: from scientific evaluation to conservation. Contributions to Palaearctic Malacology, Heldia. 1997: 4(5), 13-18.
9. Bogan, A.E. Global diversity of freshwater mussels (Mollusca, Bivalvia) in freshwater. *Hydrobiologia*, 2008: 595: 139–147.
10. Brooks, RT. Annual and seasonal variation and the effects of hydroperiod on benthic macroinvertebrates of seasonal forest "vernal" ponds in central Massachussets, USA. Wetlands. 2000: 20, 4:707-15.
11. Das R, M. S. Islam, M. Islam and K. K. U. Ahmed. Natural Breeding of Freshwater Apple Snail *Pila globosa* (Swainson) in Pone and Aquarium. Bangladesh Journal of Fisheries, 2020: 32(1): 45-54.
12. Dees, L. (1970). Edible Land Snails in the United States. US Department of the Interior.

13. Dejoux, C., Lauzane, L. and Leveque, C. Nature des fords et reportitiondes organisms benthiques don la region de bal (Lac T. Chad) Cahiers ORSTOM series. Hydrobilogia, 1971:5: 213 – 223
14. Dillon, R.T. The Ecology of Freshwater Mussels. Cambridge University Press, Cambridge, 2000: 509 pp.
15. DoF. National Fish Week Compilation. Department of Fisheries (DoF), Ministry of Fisheries & Livestock, Dhaka, Bangladesh. 2011:136 p.
16. Hapman A.D. "Numbers of Living Species in Australia and the World". *2nd edition.* Australian Biological Resources Study, Canberra. 2009.
17. Haque, Z.U. Ahmad, Z.N.T. Begum, M.A. Hassan, M. Khondker, M.M. Rahman. (Eds.) Encyclopedia of flora and fauna of Bangladesh, Vol. 17, Mollusks. Asiatic Society of Bangladesh, Dhaka, 2007:415 pp.
18. Holland, B.S, Cowie, R.H. Land Snail Models in Island Biogeography: A Tale of Two Snails. American *Malacological* Bulletin, 2009: 27(1/2):59-68.
19. Idowu, R. T. Limnological S udies of Lake Alau, Borno State, Nigeria, PhD Thesis, Department of Zoology, University of Nigeria Nsukka, Nigeria 2004:189 pp.
20. Idowu, R. T., Gadzama, U. N., Abbatoir, A. and Inyang, N. M. Molluscan Population of an African Arid Zone Lake; Animal Research International 2007:4(2): 680 – 684.
21. Kumar, R.; Maansi, A. and Wats, M. Abundance And Ecological Relationships of Physa Acuta in Freshwater Bodies of Chandigarh (U.T), India And Its Surrounding Areas. Advance Research Journal Of Multidisciplinary Discoveries. 2018:23.0, C-4: 21-26
22. Lydeard, C, Cowie, R.H., Ponder, W.F., Bogan, A.E., Bouchet, .P, Clark, S.A., Thompson FG. The global decline of non-marine mollusks. Bio Science. 2004:54(4), 321-330.
23. M. M. Hossain and Mohammad, A. B. A preliminary survey of freshwater mollusca (gastropoda and bivalva) and distribution in the river Brahmaputra, Mymensingh, Bangladesh. The Journal of Zoology Studies. 2014:1(3): 19-22.
24. MBAGWU, I. G. Vertical distribution of macrobenthos invertebrates in the profundal sediments of the impoundment of the dammed river Dambe; Australian Journal of Aquatic Science, 1993:5: 19 – 25.
25. Mesa, L.M., Intrannual & seasonal variability of macroinvertebrates in monsoonal climate streams. Brazil. Arch. Biol. Tech. 2012:55:403-10.
26. Mohamed A. H., Ahmad H., Obuid Allah, A. A. Mahmoud, Heba M. Fangary. Population dynamics of freshwater snails (Mollusca: Gastropoda) at Qena Governorate, Upper Egypt. Acad. J. Biolog. Sci., 2011: 3(1): 11 -22.
27. Nath, R.D., Rahi, M.L., Hossain, G.S. and Huq, K.A. Bangladesh status of fresh water snail in Khulna district. Bangladesh Res. Pub. J. 2008:1 (4): 337-347.
28. Okafor, F.C. Edible land sail: A manual of breeding management of Achatima achatina. Simarch Publizahas, Lagos. 2001:72 p.
29. Owojori, O. J., S. O. Asaolu, and I. E. Ofoezie. "Ecology of Freshwater Snails in Opa Reservoir and Research from Ponds at Obafemi Awolowo University Ile-Ife, Nigeria." Journal of Applied Sciences. 2006:6 (15): 3004–3015.
30. Saha, B.K. Ecology and bio-eonomics of the freshwater edible snails of Bangladesh. PhD dissertation. Rajshahi University, Bangladesh. 1998:162 p.
31. Trivedy, RK, Goel, PK, Hand book of Chemical and Biological Methods for Water Pollution Studies: Environmental Publications, Karad, Maharashtra (India). 1984.
32. Williams JD, Warren Jr. ML, Cummings KS, Harris JL, Neves RJ. Conservation status of freshwater mussels of the United States and Canada. Fisheries; 1993:18(9): 6-22
33. Zia Uddin Ahmed, Encyclopedia of Flora and Fauna of Bangladesh. Volume: 17,2007.
34. Sharma, KK., Bangotra, K. and Saini, M. Diversity and Distribution of Mollusca in Relation to the Physico-Chemical Profile of Ghomanhasan Stream, Jammu (Jk). International Journal of Biodiversity And Conservation, 2013:5(4), Pp.240-249
35. Williams, S.T. and D.G. Reid. Speciation and diversity on tropical rocky shores: A global phylogeny of snails of the genus Echinolittorina. Evolution, 1993:58 (10): 2227–2251.