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DISTRIBUTION AND SEASONAL ABUNDANCE OF FRESHWATER SNAILS IN SOME EGYPTIAN WATER COURSES

By
HANAA M.M. EL-KHAYAT, KADRIA M.A. MAHMOUD* AND SARA S.M. SAYED
Department of Environmental Research and Medical Malacology, Theodor Bilharz Research Institute, P.O. Box 30, Imbaba, Giza, Egypt
(*Correspondence:kadria11ma@hotmail.com)

Abstract

Mollusca play important role in the public and veterinary health and thus need to be study their distribution continuously. The present clarified the distribution and seasonal abundance of freshwater snails in the River Nile branches, main canals and some drains in eight Egyptian governorates during eight successive seasons. The highest percentage of snails' abundance in the River Nile was 33.6, 23, 22.1 and 20.8 % for *Succinea cleopatra, Lanistes carinatus, Lymnaea natalensis* and *Cleopatra bulimoides* snails, respectively. While Damietta and Ismailia canals were the mostly infested by snails in spring, Giza canals, Damietta branch and River Nile was in summer. During the whole study, the distribution of *Lnatalensis* was larger than *Bulinus truncatus* and *Biomphalaria alexandrina*. Results of correspondence analysis (CA) showed a good relationship between snail species and physical parameters explained 94.77, 94.12, 91.80 and 95.35% of variance in temperature, pH, conductivity and dissolved oxygen, respectively. Values of physical parameters were approximately the same for all stations. In spite of the conductivity was high 1200µmhos/cm in drains, other stations ranged from 200 to 800µmhos/ cm.

Key wards: Egypt, Distribution, Seasonal variation, *Lymnaea natalensis*, *Bulinus truncatus*, *Biomphalaria alexandrina*.

Introduction

The pattern of schistosomiasis snail intermediate hosts distribution and prevalence of infection are among the measurable indicators that reflect the magnitude of transmission (Sayed *et al*, 2004). In Egypt, many investigators study the freshwater snail distribution and their population density especially the medically important ones through the Egyptian governorates. El-Hawey *et al.* (2000) and Mostafa *et al*. (2005) in Kafr El-Sheikh and El-Gharbia Governorates reported that *B. truncatus* snails were not found among 60 examined sites and *Schistosoma mansoni* was completely replaced *S. haematobium*. A moderate to high decline in *B. alexandrina* and *B. truncatus* distribution respectively was observed in other Egyptian governorates; Giza, Dakahlia, Qalyobia and Ismailia (Abdel Kader, 2001; Ragab and Bakry, 2006). On the other hand, Ibrahim *et al*. (2005) studied distribution, ecology and population dynamics of *B. alexandrina* and *B. truncatus* in the River Nile at Greater Cairo from April 2001-March 2002 found that *B. alexandrina* were less abundant than *B. truncatus* in the examined sector. Also, *Biomphalaria* spp. did not maintain stable populations striking fluctuations occur, at times seasonally as a result of human activity (Barbosa and Barbosa, 1994). *Lymnaea* spp.; the intermediate hosts of *Fasciola gigantica* and *F. hepatica* infected a wide variety of domestic animals, wildlife and people causing significant economic losses in African livestock (Mungube *et al*, 2006; Issia *et al*, 2009).

On the other hand, Hora and Pillay (1962) reported that the pH variation of water sources was mostly due to diurnal interplay of photosynthesis and community respiration of the biota and also is one of the most important single factors, which influences aquatic production.

Temperature is a vital parameter for growth of organisms. It plays an important role in physiological behavior of the aquatic system. It also influences the metabolic behavior of aquatic ecosystem (Welch, 1952). Dissolved oxygen could be linked with the self-purification capacity of moving water, aquatic plants' photosynthetic efficiency and airflow…etc (Singh and Tiwari, 1979). Conductivity increases with increasing amount and mobility of ions. These ions come from the breakdown of compounds. Therefore, it is an indirect measure of the presence of dissolved solids such as nutrients and can be used as an indicator of water pollution (Shivayogimath *et al*, 2012).

This work aimed to study distribution and seasonal abundance of freshwater snails *Biomphalaria* spp. *Bulinus truncatus*, (schistosomiasis) and (fascioliasis) *Lymnaea* spp. in different water courses in River Nile branches Damietta and Rosetta, also main canals and drains in some governorates.

Materials and methods

Study area: Samples were collected from 80 sites over 8 successive seasons (spring 2008 till winter 2010) from the River Nile, Damietta and Rosetta Branches, El-Tawfiki and El-Beheiry Rayahs, Ibrahimiyah canal, Bahr Youssef in Minya Governorate, El-Gizaweya, El- Khashab and Talkhn canals in Giza Governorate. Basoosiya, Sharkaweya, Abu El-Menagy, and El-Nahas canals in Qalyubia Governorate, El-Salam and Al-Sinanip canals in Damietta Governorate, El-Khandak El-Sharky and Al Mahmudiya cannals in Beheira Governorate, Ismailia canal in Cairo, El-Sharkiya and Port Said canal in Ismailia Governorate were included. The drains were El-Moheet and El-Hood El-Areed in Minya and Giza Governorates, respectively and Abu Dongle and El-Serw drains in Damietta Governorate (Fig 1).

Samples of freshwater snails were collected from each site with a fixed number of five strikes using a standard dip net (Jobin, 1970; Yousif *et al*, 1992). At the same time, water physical parameters were recorded by portable equipment in the field. Dissolved oxygen was registered by dissolved oxygen meter electrode (HANNA HI 9146). Water temperatures and conductivity were measured by using temperature conductivity meter (HANNA instrument, HI 9635). Hydrogen ion concentration (pH) was recorded by pH meter electrode (HI 9124 and HI 9125). In the lab the snails were sorted, identified and counted (Ibrahim *et al*, 1999).

Statistical analysis: Correlation patterns of the distribution of snail species and physical parameters were described by correspondence analysis (CA) using XLSTAT 2016, Statistical software for Microsoft Excel. Paris, France.

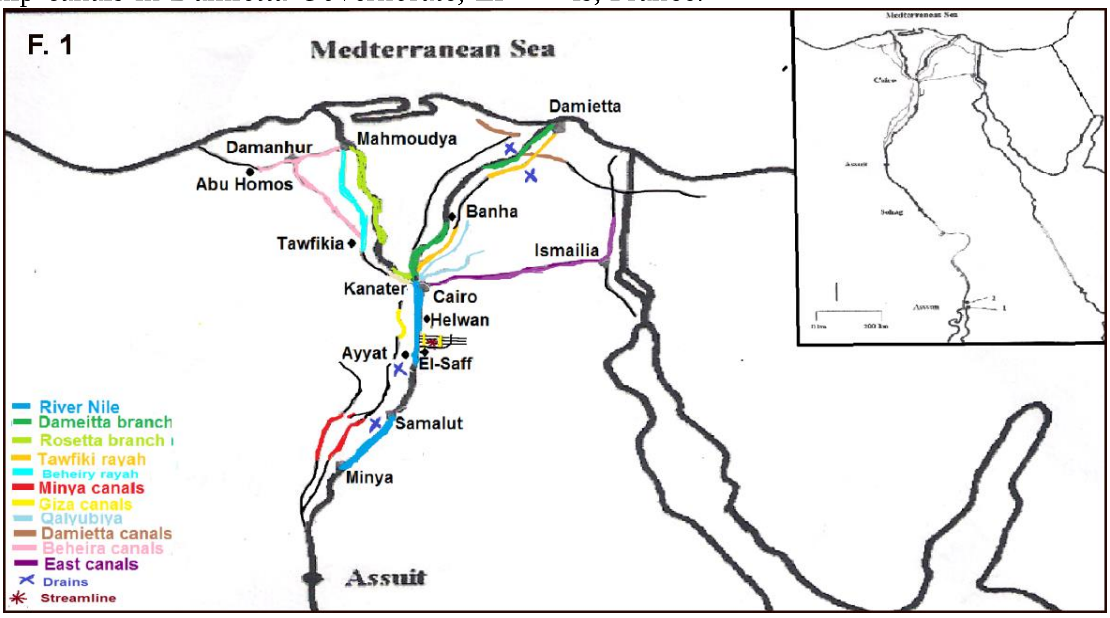

Fig 1: Map showing the studied Egyptian Governorates Cairo, Giza, Minya, Qalyubia, Damietta and Beheira, and Ismailia

Results

The results are shown in table (1) and figures (1, 2, 3, 4 & 5).

Table 1: Distribution percentage of different snail species among the examined watercourses.

Snails species	Nile	D-Branch	R-Branch	T-Rayah	B-Rayah	Minya canals	Giza canals	Qalyubia canals	Damietta canals	Beheira canals	Ismailia Canals
Biomphalaria alexandrina	6.6	0.6	1.8	0.0	0.0	0.0	69.5	3.6	0.0	0.0	15.0
Bulinus truncatus	7.9	16.0	1.4	4.5	7.4	4.1	1.8	1.6	31.4	3.8	19.4
Lymnaea natalensis	22.1	7.8	1.3	6.3	2.3	0.4	5.3	1.0	7.8	6.1	37.0
Lanistes carinatus	23.0	11.3	0.1	4.9	1.0	5.9	1.3	7.7	13.0	6.5	24.7
Cleopatra bulimoides	20.8	11.4	0.2	0.6	1.9	11.6	2.6	1.5	13.7	4.4	30.0
Physa acuta	11.5	1.9	3.3	1.1	1.4	0.7	56.0	4.7	8.8	1.3	7.5
Bellamya unicolor	16.7	10.9	11.3	15.8	0.9	7.2	0.9	2.7	6.3	7.2	19.9
Helisoma duryi	0.7	22.4	2.2	1.0	0.2	0.0	0.0	0.0	0.7	2.7	69.8
Melanoides tuberculata	13.9	9.3	3.7	0.0	0.9	11.1	8.3	1.9	20.4	10.2	20.4
Theodoxus niloticus	16.4	4.4	0.5	0.5	3.0	10.6	0.0	7.3	22.2	6.3	28.4
Succinea cleopatra	33.6	9.0	0.9	5.7	9.0	1.4	9.0	8.1	7.1	3.3	12.3
Planorbis planorbis	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.5	9.1	27.3
Valavat nilotica	0.0	81.3	0.0	0.0	12.5	0.0	0.0	6.3	0.0	0.0	0.0
Species richness	12	12	11	9	11	9	9	11	11	11	12

Discussion

In the present work, *B. alexandrina* was the most abundant in Giza canals (69.5%), then Ismailia canals (15%) and the River Nile (6.6%). While *B. truncatus* found in all water courses with the maximum abundance in Damietta (31.4%) followed by Ismailia canals (19.4%) and (7.9%) in the River Nile. This results agrees with the findings of Ibrahim *et al.* (2005) who studied the distribution of *B. alexandrina* and *B. truncatus* in the River Nile at Greater Cairo and revealed that *B. alexandrina* were less abundant than *B. truncatus*. Also, the present data revealed that *L. natalensis* (22.1%) was more abundant than *B. alexandrina* (6.6%) and *B. truncates* (7.9%) in the River Nile.

Succinea cleopatra and *Lanistes carinatus* recorded high percent in the River Nile (33.6 and 23%) respectively, followed by *L. natalensis* (22.1%) and *C. bulimoides* (20.8%). Also, the present study exhibited that *Physa acuta* showed the maximum abundance in Giza canals (56.0%) then the River Nile (11.5%). *Bellamya unicolor* is distributed in all examined watercourses except drains and dominates in Ismailia canals (19.9%) and the River Nile (16.7%). *Helisoma duryi* was found only in eight watercourses and dominates in Ismailia canals (69.8%). *M. tuberculata* was distributed in the watercourses examined except Tawfiki Rayah and the drains *T. niloticus* maximum abundance was recorded in Ismailia canals (28.4%) and Damietta canals (22.2%), the River Nile (16.4%) and then Minya canals (10.6%). *Succinea cleopatra* was most abundant in the River Nile (33.6%). *Planorbis planorbis* was found only in four watercourses and showed the maximum abundant in Damietta canals then Ismailia canals followed by the River Nile and Beheira canals. *Valvata niloticus* was found only in three watercourses and the most abundant was recorded in Damietta branch then Beheiry Rayah followed by Qalyubia canals.

The present study also showed that the maximum species richness was recorded in the River Nile, Damietta branch and Ismailia canals (12 species), then Rosetta branch, Beheiry Rayah, Qalyubia, Damietta and Beheira canals (11), followed by Tawfiki Rayah, Minya canals and Giza canals (9) and at last the drainages (8). The detected snail species in the present study were recognized by El-Kady *et al.* (2000) in El-Abtal village situated on the east of Ismailia governorate. Also, Fisher and Williams (2006) recorded nineteen species of molluscs at the River Nile from Aswan to Cairo; including all species observed in the present study. This agreed with Abd El-Wakeil *et al.* (2013) who study the River Nile and branches in

Assiut governorate, Egypt who found twenty species of Gastropoda; most of them were detected in the present study except (*Gabbiella senaariensis* ; *Lanistes varicus*; *Pila ovata* (Olivier); *Pila wernei*; *Pseudosuccinea columella*; *Bithynia connollyi* (Gardner); *Hydrobia aponensis* (Martens) and *Gyraulus ehrenbergi*). Ramadan *et al.* (2000) recognized fourteen gastropods species between Esna and El-Kanater El Kharia. Hussein *et al*. (2011) recorded thirteen species in Qena Governorate.

Seasonal variations in terms of their influence on the change species abundance rather than complete species replacement in the aquatic systems were reported (Brooks, 2000; Mesa, 2012). Impact of seasonal variation in the distribution of snail species among different water courses of the present study showed that Damietta and Ismailia canals was the mostly infested by snails in spring then Giza canals and Damietta branch followed by the River Nile in summer. This agreed with Abd El-Wakeil *et al*. (2013) who stated that the maximum species richness and diversity of molluscan community in spring and summer months.

The present results indicated that *B. alexandrina* exhibited two peaks in spring and autumn 2009, while approximately disappeared in summer and winter seasons. *B. truncatus* and *T. niloticus* was found all around year - 2009 exhibiting two peaks during spring and autumn. *L. natalensis* and *P. acuta* were found around the year exhibiting peaks during spring and winter 2009. This agreed with Marie *et al*. (2015) who exhibited that *B. alexandrina; P. acuta; L. natalensis and B. truncatus* showed the highest peak in spring season. On the other hand, *L. carinatus* and *H. duryi* were found with sharp peak during summer 2009. And *C. bulimoides* showed a high peak during spring 2009. Also, *B. unicolor* was found with two peaks during summer and autumn 2009. Meanwhile, Marie *et al*. (2015) reported that *B. unicolor* showed two peaks in spring and summer seasons. In the present work, *M. tuberculata* was found with high peak in autumn 2008 and summer 2009 and disappeared during spring 2008 &2009. *S. cleopatra* was found with high peak during winter 2008 & 2009. This result is in parallel with previously recorded by Marie *et al*. (2015) who stated that the highest peak of *S. cleopatra* in winter. *Planorbis planorbis* was found with high peak during autumn 2008.

From the total samples of collected snails during the whole study period, *P. acuta* has the highest percentage of representation (24.5%) among different snail species followed by *C. bulimoides* (16.4%), *L. carinatus* (15.2%), *L. natalensis* (9.2%), *B. truncatus* (7.8%), *T. niloticus* (7.5%), *H. duri* (7.1%), *B. unicolor* (3.9%), *S. cleopatra* (3.7%), *B. alexandrina* (3%), *M. tuberculata* (1.2%), *V. nilotica* (0.28%) and at last *P. planorbis* (0.19%) (Fig.4) this is means that the distribution of *B. alexandrina*< *B. truncatus*< *L. natalensis.*

Kloos and David (2002) demonstrated changes in the distribution of *B. truncatus* populations and repopulation of the snails in canals of Damietta and Ismailia Governorates. *Biomphalaria* spp. snails which were previously restricted to the Delta are now being found in Upper Egypt.

In the present study, the water temperature was ranged from 24-29°C during spring, 25-33°C during summer, 21-24°C during autumn and 18-22 °C during winter. pH was ranged from 6.2-7.3 and conductivity was ranged from 284 to 857 μ moh/Cm, while dissolved oxygen was ranged from 2 to 6 mg/L. Generally, the Correspondence Analysis (CA) showed a good relationship between snail species and physical parameters explained 94.77%, 94.12%, 91.80% and 95.35% of the variance in temperature, pH, and conductivity and dissolved oxygen variables data respectively.

Temperature played an important role in the physico-chemical and physiological behavior of the aquatic system (Alaka, 2014).

The present study showed that *B. alexandrina*, *P. acuta* and *V. niloticus* snail species were associated with 25-30ºC temperature. On the other hand, *B. truncatus*, *L. natalensis*, *P. planorbis*, *T. niloticus*, *M. tuberculata*, *S. cleopatra*, *L. carinatus* and *H. duri* snail species were found in water temperature ranged 18-24ºC. Moreover, the most tolerant snail species for high temperature > 30ºC was *Corbicula consobrina* (bivalvaia). Also, temperature plays a key role in determination of other parameters such as conductivity; level of gases and various alkalinity forms (Esmaeili and Johal, 2005; Negi *et al*, 2007). The pH was changed with time due to temperature changes, and therefore is considered to be an important ecological factor. Aquatic organisms are affected by pH because most of their metabolic activities were dependent on pH (Wang *et al*, 2009).

In the present study, the most of the snail species were found in pH range (4-6) and avoid low acidity less than 4 and/or high alkalinity more than eight. Except *S. cleopatra* snails that were found in pH range (6.1-8). In the same pattern, results of conductivity showed that the most snail species distributed in conductivity range (270-400μmhos /cm), while *P. planorbis* snails associated with conductivity range (401-800μmhos/cm). On the other hand, *T. niloticus*, *S. cleopatra*, *L. carinatus*, *C. consobrina* and *V. niloticus* snails found in <270 μmhos/cm conductivity level. Moreover, there were no snail species found in >800μmhos/cm conductivity level. High concentration of acid, base or salt in water increased; Electrical Conductivity (EC) of that water (Arya and Mishra, 2015).

In summer due to greater evaporation, 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). Low content of the dissolved oxygen could be linked with moving water, the aquatic plants' photosynthetic efficiency (Singh and Triweri 1979).

The present study showed that *P. acuta* tolerated low dissolved oxygen below 0.5 mg/L. Meanwhile, *V. niloticus*, *B. unicolor* and *H. duri* associated with (0.5-2mg/L) dissolved oxygen range. The other snail species favorite to associate with dissolved oxygen more than 5mg/l. Reduction of organic matters needed a large amount of DO, usually low DO in summer (Mamta and Ranga, 2012). Investigating ecology of freshwater snails have shown that the distribution of these animals depend on the physical geography of a given region. So, physical, chemical and biological factors can have a significant effect on population dynamics of fresh water snails (Barbosa and Barbosa, 1994).

Conclusion

Generally speaking, the freshwater molluscs are important for medical and veterinary public health authorities. So, studying the seasonal abundance of freshwater snails of medical importance will be helpful in planning for strategies of controlling veterinary and medically important parasitic diseases.

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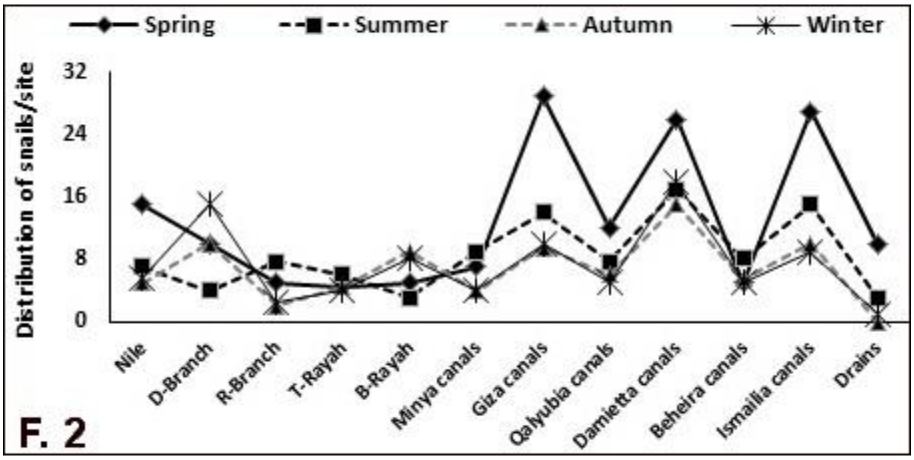

Fig 2: distribution of snail species among different water courses during seasons.

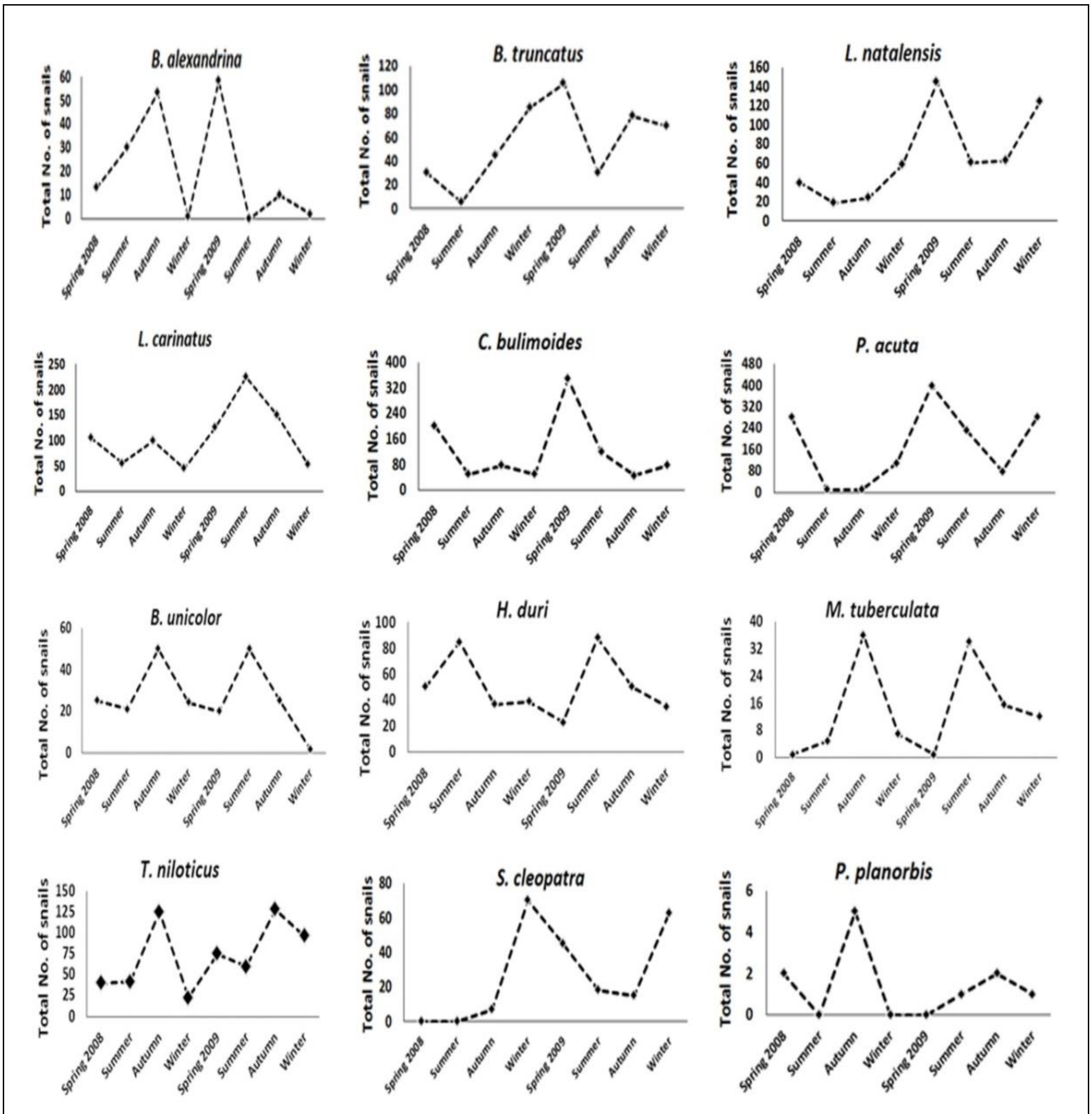

Fig 3: Seasonal fluctuations in abundance of snail species during years 2008/2009 and 2009/2010.

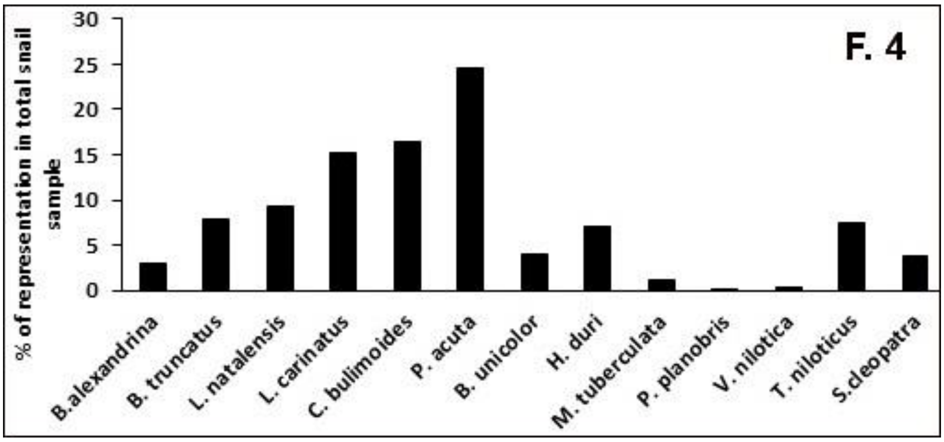

Fig 4: Percentage of representation of different snail species among total sample of snails collected from different watercourses.

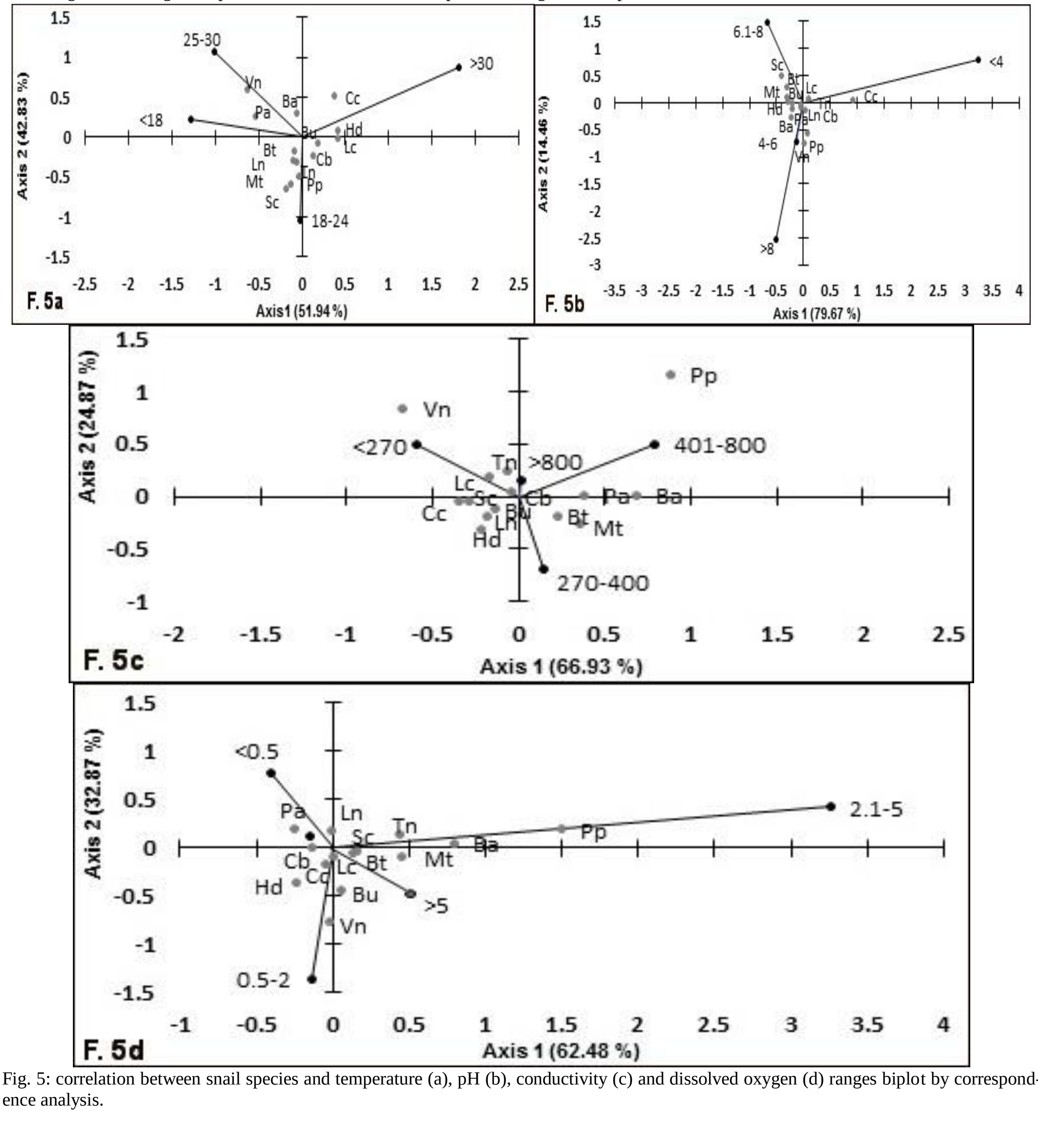

Fig. 5: correlation between snail species and temperature (a), pH (b), conductivity (c) and dissolved oxygen (d) ranges biplot by correspondence analysis.