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REVIEW ARTICLE

REVISITING DIVERSITY AND GEOGRAPHICAL DISTRIBUTION OF EIGHT MINOR FAMILIES *VIZ.,* ANOPLODISCIDAE, AXINIDAE, CAPSALIDAE, CICHLIDOGYRIDAE, HETERAXINIDAE, HEXABOTHRIIDAE, BOTHITREMATIDAE AND TETRAONCHOIDAE OF CLASS MONOGENEA

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ABSTRACT

Members of class monogenea are widely distributed all over the world in diverse ecosystems. Based on their relatedness they are assigned to respective families. Based on global diversity majority of representation comes from some main or major families. These major families accounted for most of the diversity of the class around the globe. Most of the contemporary study revolves around major families dealing various aspects including taxonomic explorations or molecular explorations. Present investigations is an attempt to revisit diversity and geographical distribution of few minor families of this class which are somewhat ignored in major contemporary studies. Based on global representation and species diversity eight minor families *viz.,* Anoplodiscidae, Axinidae, Capsalidae, Cichlidogyridae, Heteraxinidae, Hexabothriidae, Bothitrematidae and Tetraonchoidae were selected for the further investigation. A systematic effort was made towards understanding diversity, distribution and milestone chronology of the family

KEY WORDS: Monogenea, Anoplodiscidae, Axinidae, Capsalidae, Cichlidogyridae, Heteraxinidae, Hexabothriidae, Bothitrematidae and Tetraonchoidae.

INTRODUCTION

Monogeneans are widely distributed all over the world and are represented as the most dominating forms of helminth group parasitizing the external surface of fish. Monogeneans represent a diverse group with several thousand species recorded in many database, books and various literatures (Rohde, 1976; Pandey and Aggarwal, 2008). The class is diverse, not only in terms of number of species but in morphology, ecology, adaptation and host switching. Monogenea are the only class among the parasitic flatworms to have undergone an adaptive radiation (Brooks and McLennan, 1993). Due to radial diversification they seem to have developed a large number of species. Moreover, this diversification has caused them to expand and colonize the internal as well as external organ of amphibians and fishes. In their life cycle, Monogeneans also represent alternation of generation and are hermaphrodite that makes them to have a direct life cycle. Due to such an alternating life strategies and adaptations to parasitic life, they have been regarded as very successful parasites. Monogeneans comprise two very distinct groups, the Monopisthocotylea and Polyopisthocotylea. The two groups differ considerably, with important implications for morphology, mode of infection, pathogenicity, treatment and host response. Three major Monogenean families were recently studied in details mainly for their prevalence, rich diversity, versatile ecological behavior and multiple forms of evolution (Fozail *et al.,* 2015a). In order to elaborate the evolutionary aspect, in addition to origin and ecological situations, species need to be accounted for totality and existence in various geographical zones.

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Since, monogeneans are widespread across globe, each geographical zone have been occupied by their occurrence that provide easy platform to explore diversity of parasites (Fozail *et al.*, 2015b). A particular environment definitely impacts over the survivability of individual and prompt to adapt the present condition. Each geographical zones possess a characteristic features wherein species get to adapt a specific and particular mode of survival. Adaptation can be regarded as the change in morphology, genetic composition and extent of parasitism.

Almost all monogeneans comprise such versatile nature. In many cases, species get to extinct due to unfavorable ecological conditions and many a times it vanishes from a particular region. In contrast to these situations, monogeneans manage to survive even if they are forced to change their specific host. The widespread prevalence of monogenean species indicates that most of parasite families are resilient to the changing environment and may exist in varying ecosystem. In the present work we have summarized the minor monogenean families with a focus on description of geographical distribution, their discoveries, identification and diversity.

MATERIALS AND METHODS

Minor families of the class were selected for the study based on quantification of diversity of genus in the family. Anoplodiscidae, Axinidae, Capsalidae, Cichlidogyridae, Heteraxinidae, Hexabothriidae, Bothitrematidae and Tetraonchoidae were identified as less studied members of the class monogenea having lesser number of corresponding genera and species. These families are accounted in terms of validity, host specificity and diversity.

Family Anoplodiscidae

One of the monotypic families, Anoplodiscidae (Tagliani, 1912) of monogenean parasite occurs on sparid fishes from Australian, Mediterranean and Japanese waters. The only genus of this family *Anoplodiscus* (Sonsino, 1890) accommodates the only species *Anoplodiscus cirrusspirali* collected from Mediterranean Sea. Four more species were described over the period of time, identified as *A. australis* (Johnston, 1930), *A. spari* (Yamaguti, 1958), *A. cirruspiralis* (Roubal, Armitage and Rohde, 1983) and *A. tai* (Ogawa, 1994). During a survey of marine fishes in Brazil, Ogawa and Egusa (1981) exclusively studied the systematic position of the genus and provided validation of *A. australis* and *A. spari* from the host *P. pargus*.

Family Axinidae

First described by Monticelli (1903). The family is represented by four genera and seven species; *Allopseudaxine katsuwonis* (Ishii, 1936) Yamaguti, 1943 on *Katsuwonus pelamis* (Linnaeus) (gills) from Arecibo (Williams and Bunkley-Williams 1996), *Axine yamagutii* (Meserve, 1938) form open sea off coast (Meserve 1938), Mexico, *Axinoides jimenezi* (Caballero & Bravo-Hollis, 1969) on *Tylosurus crocodilus* (Caballero and Bravo-Hollis 1969), Mexico, *Axinoides oceanicum* (Caballero, Bravo-Hollis & Grocott, 1953) on *Tylosurus crocodilus* from Oceano Pacifico del Norte (Caballero *et al.,* 1953), Panama, *Axinoides raphidoma* (Hargis, 1956) on *Tylosurus crocodilus* (Caballero and Bravo-Hollis 1969), Mexico, *Chlamydaxine resplendens* (Caballero, Bravo-Hollis & Grocott, 1954) on *Tylosurus crocodilus* from Oceano Pacifico del Norte (Caballero *et al.,* 1954), Panama and *Oligapta kruidenieri* (Crane, Kritsky & Kayton, 1979) on *Thyrinops pachylepis* (Crane *et al.,* 1979), El Salvador.

Family Capsalidae

The first described Capsalid by Muller (1776) was *Entobdella hippoglossi* from the skin of *Hippoglossus hippoglossus.* Presently Capsalidae comprises approximately 200 described species in 9 subfamilies and 45 genera. Elasmobranchs, teleosts and primitive sturgeons are identified as the host of identified species. Some of them can affect host fishes due to their direct life cycle. Few of them are found to be adversely affecting their host in aquaculture and are even causing epizootic events, whereas some are among the largest monogeneans, concealing onto the host. Paradoxically one of the species is the most studied and known of all parasites. Graham Kearn (1998) represented a very meticulous report on the life of *Entobdella soleae* from the skin of *Solea solea* in Europe. In fact, more can be known about *E. Soleae* than any other monogenean (life cycle, migration, geographical distribution, host specificity etc.) as the species is represented as a typical parasitic flatworm. In contrast to *E. Soleae*, *Neobenedenia melleni* is very infamous in infecting number of teleost species in aquaculture. As it known that most of the monogenean species show legendary feature for their strict-host specificity, but *Neobenedenia melleni* is famous for the broadest host-specificity of any monogenean parasite; recorded from more than 95 species in more than 32 families from 5 order of wild and captive teleost. One of the legendary species of capsalids is known to be the *Benedenia seriolae*, a long standing parasite *Seriola* species in Japan.

This species may occur anywhere in the world. The family Capsalid comprises several members that claim to fame within the monogenean diversity; the first of it, camouflage to conceal, longest host range etc. This family also possesses the longest generic names courtesy of Yamaguti (1966) *Lagenivagino pseudobenedenia.*

Family Cichlidogyridae

Cichlidogyridae occur in West Africa, Madagascar, Asia and Neotropics. African species of Cichlids harbor monogenean parasites representing only those of *Cichlidogyrus* Paperna (1960), *Scutogyrus* Pariselli and Euzet (1995), *Onchobdella* Paperna (1968), and *Gyrodactylus* Nordmann (1832) are found on the gills of these fishes. Among these the genus *Cichlidogyrus* represents the most diverse group with 85 nominal species recorded from 75 host species. This genus also displays species richness ranging from 1 to 22 species per host species. The host-specificity of this family is also very different in terms of infecting single host that accounts for 50 members of them to be *oioxenous* and 35 members are accounted for being *stenoxenous* (infesting two or more host species). These features of members in the family had provided that, after performing phylogenetic analyses, their specificity was greater than was initially supposed and thus present diversity of monogenean species parasitizing explained just because of existence of cryptic species.

Family Heteraxinidae

Identified by Price (1962) this family has the smallest number of member as one species, *Cemocotyle trachuri* from a single genus *Cemocotyle*. During a study of monogenean parasite from the Swan River Estuary, a large collection of parasite of related family Microcotylidae was made. There found to be a close resemblance between Heteraxinidae and Microcotylidae and thus collected parasites were placed in later one. Most of the work has underestimated this family.

Family Hexabothriidae

The first hexabothrid was discovered by Kuhn (1829), over 70 species have been identified from almost as many host species. The Hexabothriidae Price (1942) comprises of polyopisthocotylean members exclusively parasitic on the gills of chondrichthyan fishes. At present, taxonomy of the family is in a state of convulsion; Kristky and Boeger (1989) have gone through only comprehensive revision and recognized 13 genera with few suspected species for recognition. It has been difficult to determine species relationship on the basis of selection of appropriate characters for the family, it further adds on to make proper classification much more tedious.

Family Bothitrematidae and Tetraonchoidae

Identified by Bychowsky (1957), Bothitrematidae comprises of only one species, *Bothitrema bothi* MacCallum, 1913. Previously, Bothitrematidae was considered a super family of Dactylogyridae Yamaguti (1963). Later concurrence with Bychowsky and his associates placed the family into Tetraonchoidae as both families share close similarities. This super family Tetraonchoidae includes genera *Paratetraonchoides* and *Pseudotetraonchoides,* Bychowsky (1965), *Tetraonchoididae*.

DISCUSSION

The eight families are revisited in the paper provided a scenario of all families of monogenean parasite wherein observation over minor families may be elaborated in context of geographical distribution. All families equally, by means of geographical distribution showing a lower degree of occurrence in a particular area. As per the high density of species in a specific area is concerned, it is the family Cichlidogyridae that strictly occur in South Africa, and with small number in Madagascar. We have mentioned in the previous work that richness of a particular member from a particular area (geographical area/location) is an indication of its origin. And definitely, taxonomic and phylogenetic status, from across the globe fall into the same geographical zone, confirming their classification into the updated record. More detail molecular investigation is required to establish relative evolutionary linkage/lineage of these families. This study may give a motivation to take up detailed molecular investigation for establishing relative evolutionary tree for all the members in the class.

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REFERENCES

Finlayson, J.E. 1982. The alleged alternation of sexual phases in Kuhnia scombri, a monogenean of Scomber scombrus. *Parasitology;* (8): 4, 303.

Fozail, A., Singh, D. and Arya, P.V. 2015a. A combination study in some members of Monocotylidae (Monogenea) in molecular phylogeny employing 28S RNA along with geographical distribution. *International Journal of Science and research;* 4(8): 1292-1299.

Fozail, A., Singh, D. and Arya, P.V. 2015b. *In silico* phylogenetic study on Ancyrocephalidae (Class: Monogenea) using 28S RNA extending geomapping in search of evolutionary cues. *Biocem. Cell. Arch.;* 15(2) : 391-399.

Hahn, C., Fromm, B. and Bachmann, L. 2014. Comparative genomics of flatworms (platyhelminthes) reveals shared genomic features of ecto- and endoparastic neodermata. *Genome Biol. Evol.;* 6: 1105–1117.

Jayabalasingham, B., Bano, N. and Coppens, I. 2010. Metamorphosis of the malaria parasite in the liver is associated with organelle clearance. *Cell Res.;* 20: 1043–1059.

Mendlová, M. and Šimková, A. 2014. Evolution of host specificity in monogeneans parasitizing African cichlid fish. *Parasit. Vectors;* (7): 69.

Mladineo, I. and Marsić-Lucić, J. 2007. Host switch of Lamellodiscus elegans (Monogenea: Monopisthocotylea) and Sparicotyle chrysophrii (Monogenea: Polyopisthocotylea) between cage-reared sparids. *Vet. Res. Commun.;* (31): 153–160.

Mladineo, I., Šegvić-Bubić, T., Stanić, R. and Desdevises, Y. 2013. Morphological plasticity and phylogeny in a monogenean parasite transferring between wild and reared fish populations. *PloS One;* (8) e62011.

Mollaret, I., Jamieson, B.G. and Justine, J.L. 2000. Phylogeny of the monopisthocotylea and Polyopisthocotylea (Platyhelminthes) inferred from 28S rDNA sequences. *Int. J. Parasitol.;* (30): 171–185.

Pandey, K.C. and Agrawal, N. 2008. An encyclopedia of Indian Monogenoidea. Vitasta Publishing Pvt Ltd., New Delhi, 522pp.

Park, J.K., Kim, K.H., Kang, S., Kim, W., Eom, K.S. and Littlewood, D.T.J. 2007. A common origin of complex life cycles in parasitic flatworms: evidence from the complete mitochondrial genome of Microcotyle sebastis (Monogenea: Platyhelminthes). *BMC Evol. Biol.;* (7): 11.

Pichelin, S., Whittington, I. and Pearson, J. 1991. Concinnocotyla (Monogenea: Polystomatidae), a new genus for the polystome from the Australian lungfish Neoceratodus forsteri. *Syst. Parasitol.;* (18): 81–93.

Ponge, J.F. 2013. Disturbances, organisms and ecosystems: a global change perspective. *Ecol. Evol.;* (3): 1113–1124.

Rohde, K. 1976. Species diversity of parasites on the Great Barrier Reef. *Parasitenkd Parasitol. Res.;* (50): 93–94.

Shaw, M.K. 1979. The development of the clamp attachment organs of the monogeneanGastrocotyle trachuri. Z. *Parasitenkd. Parasitol. Res.;* (59): 277–294.

Šimková, A., Serbielle, C., Pariselle, A., Vanhove, M.P.M. and Morand, S. 2013. Speciation in Thaparocleidus (Monogenea: Dactylogyridae) Parasitizing Asian Pangasiid Catfishes. *Bio Med Res. Int.;* 1–14.

Trujillo-González, A., Constantinoiu, C.C., Rowe, R. and Hutson, K.S. 2015. Tracking transparent monogenean parasites on fish from infection to maturity. *Int. J. Parasitol. Parasites Wildl.;* (4): 316–322.

Uecker, H. and Hermisson, J. 2015. The Role of Recombination in Evolutionary Rescue. Genetics; 10.1534/genetics.115.180299. pp 1-29.

Whittington, I.D. and Kearn, G.C. 2011. Hatching Strategies in Monogenean (Platyhelminth) Parasites that Facilitate Host Infection. *Integr. Comp. Biol.;* (51): 91–99.

Wood, C.L., Micheli, F., Fernández, M., Gelcich, S., Castilla, J.C. and Carvajal, J. 2013. Marine protected areas facilitate parasite populations among four fished host species of central Chile. *J. Anim. Ecol.,* (82): 1276–1287.

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