Checklist of marine worms reported from Pakistani marine waters

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Worm is generally used for naming all those animals crawling, wriggling and swarming. Any worm free-living or parasitic that lives in a marine environment is considered a marine worm. Invertebrate worms are important for the functioning of marine ecosystems in nutrient cycling through burrowing in sediment, release nutrients buried in the ocean bottom back to the surface for use by producers, in predator-prey relationships and as important links in food chains.

The Pakistani marine worms are found in several different phyla, including the Platyhelminthes (flat worms), Acanthocephala (thorny-headed worms), Nematoda (round worms), Nemertea (ribbon worms), Echiura (spoon worms), Sipuncula (peanut worms), Annelida (segmented worms), Chaetognatha (arrow worms) and Kinorhyncha (spiny-crown worms).

The biodiversity data base in the country is not organized. In general the Pakistani marine invertebrate fauna is poorly known. Nevertheless there has been good number of attempts to investigate and document the diversity of marine worms. Pakistan possesses a strong tradition in the study of parasites of domestic wildlife and marine vertebrates. For more than 50 years the helminth fauna of these Pakistani hosts has been studied by national parasitologists. This report is an attempt to compile all the worms reported so far from the Pakistan coast. The present annotated list is intended to help the growing number of scientists in and outside Pakistan who are interested in marine fauna, keeping them up to date as to what species are known, their current scientific names. As such, we have tried to keep the data within as current as possible. For the included literature, we have tried to ensure the taxonomic ones have all been included. Papers on other biological aspects are listed only when the species they treat include new records. Also included are pre partition records by the Indian and British workers (Pakistan was under British rule till 1947). Thus, this checklist summarizes information on the Pakistani marine worms contained in the world literature dating from 1866 to the end of 2012. In cases where only generic names were provided, we have chosen to omit these records unless the genus is a new record. We accept no responsibility for the accuracy of these data. Errors in source publications and data-entry do occur. Users are advised to check the original publication.

All the groups are provided with background information briefly at the beginnings. All species citations in the text are cited in full and arranged in chronological and alphabetical order respectively for each group acquired omitting the taxon authorities. A revised classification by Cavalier-Smith (1998) is adopted at Phylum level.

The family classification essentially follows that proposed by the International Taxonomic Information System (ITIS) or (where ITIS was not helpful) World Marine Register of Marine Species (WORMS), also for the authorities and years for most of the taxa, we mainly follow the same sites. In this compilation we present Pakistani records for 571 species included in helminthes (263), in acanthocephalans (15), in nemertians (4), in echiurids (1), in sipunculids (2), in annelids (175), in kinorhynchans (1), in gastrotrichans (1), in nematodes (90) and in chaetognaths (15), presented in phylogenetic order starting with Platyhelminthes, based on research works from Ph.D., M.Phil, M.Sc, MAS these and other manuscripts of the authors and other workers, as

well as those surveyed from the literature. Next we present the information for each species. Each Pakistani record is followed by authority and year, information on size, habitat and geographical distribution when available, Pakistani host(s) with the group to which it belongs in parentheses and within parentheses on the right hand its first reporter from Pakistan in the literature. Symbology used in the list is: A = Aves (sea birds only); F = Fish; R = Reptilia; NA = information on horizontal distribution when not available and questionable identifications of parasites are taken from literature as *sp*., *g. inq*. = *species* and *genus inquirenda*. In case of parasitic species mostly geographical distribution is not available.

The parasites have been proposed as excellent indicators of the biodiversity both on host species and at the ecosystem level (Chambers & Dick, 2005), thus they invite further studies on the zoogeography and speciation of the worms and on the phylogeny of Pakistani hosts, using the parasites as indicators, since the parasites presumably evolves at a slower rate than their hosts.

We have mostly used the name of the Pakistani host as described in the original papers; however we recognize that some of them may have changed after taxonomical revisions or more accurate determination. Finally, we present notes to point out possible taxonomical changes, synonyms and new combinations of names.

In all cases, we tried to consider the inclusion of the most well accepted taxonomical name following authorities. Most records are made from adults, but when larval forms were recorded, almost all in the parasitic species it is pointed out after the parasite name in parentheses.

Phylum Platyhelminthes Gegenbaur, 1859 (Flatworms)

Platyhelminthes are unsegmented, bilaterally symmetrical worms that lack a coelom but that do have three germ layers. Some forms are free living but many are parasitic. Flatworms lack a respiratory or circulatory system; these functions take place by absorption through the body wall.

Nonparasitic forms have a simple, incomplete gut; even this is lacking in many parasitic species.

Most flatworms can reproduce sexually or asexually. Most are monoecious. Most of these have developed ways of avoiding self-fertilization. Development may be direct (eggs hatch into tiny worms that resemble the adults) or indirect (with a ciliated larval form). Marine flatworms include a large number of parasitic forms, some of which are extremely damaging to fish populations (From various sources).

Class Turbellaria Ehrenberg, 1831
Subclass Archoophora Reisinger, 1935
Order Polycladida Lang, 1884 (Freeliving flat worms)
Suborder Acotylea Lang, 1884
Family Stylochidae Stimpson, 1857
Genus *Stylochus* Ehrenberg, 1831
Stylochus sp.

Intertidal rock pools, found on mussels banks under stones, often in swarms (Kazmi, 1996).

Family Leptoplanidae Stimpson, 1857
Genus *Notoplana* Laidlaw, 1903
Notoplana sp.

Common under stones in intertidal region (Kazmi, 1996).