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Annelid Diversity of Kashmir valley

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Abstract:
A study was undertaken in different areas of Kashmir valley for understanding the annelid diversity in 2021. Different species of annelids that were investigated and their diversity and distribution was observed across some districts of Kashmir valley. Especially *clitellata class like E. fetida* have almost similar distribution in various districts like Kupwara, Sopore, Bandipora and Baramullah. Same is the case of *E. octoculata* that was found mostly in stagnant water bodies and crop fields. *E. octoculata* found in rice fields and have adapted themselves from black to brownish colour due to the different temperature conditions. Further studies are needed to investigate the impact of various factors that impact the diversity of annelids in the valley.

Keywords: Annelid, Kashmir, Fertilizers, leech , rivers

Introduction

Jammu and Kashmir is famous for its natural beauty since time immemorial and has been aptly described as 'heaven on earth'. The valley of Kashmir occupies the topmost position in the map of India. Kashmir, along with the region of Jammu, Ladakh and Gilgit forms the state of Jammu and Kashmir. From the numerous valleys situated in the state, Kashmir valley is the biggest one, spread over an area of 105sq.km located approximately 1730m above the sea level. Jammu and Kashmir location is located between 32.17″ and 36.58″ north latitude and east to west, the state lies between 73.26″ and 80.30″ longitude. The geographical location of Kashmir is such that it is surrounded by a number of foreign countries. This makes the Kashmir valley very important from strategic angle. Kashmir is said to be nature's ground finale of beauty. In this masterpiece of earth's creation, seasons in strong individuality vary with one another in putting up exquisite patterns of charm and loveliness. Nature has bestowed the valley of Kashmir with plenty of gifts like snow mountains, rivers lakes etc. The valley is famous throughout the world for its waters both lentic and lotic. All these water bodies support many and varied forms of freshwater life including diversified phylum *Annelida.*

Water in the water bodies of Kashmir is cold, crystal clear and provide habitat for peculiar types of *Annelid* faunas .The high altitude valley of Kashmir existing in the greater Himalaya abounds a vast array of freshwater bodies such as lakes, ponds, wetlands, streams and rivers. These varied freshwater ecosystems are of great aesthetic, cultural, socio-economic and ecological value playing an important role in the conservation of genetic resources of both plants and animals.The lakes have become the greatest tourist attraction in Jammu and Kashmir due to their exceptional beauty and astounding serenity. Not only are the lakes charming but they also serving as the source of livelihood for the people of Jammu and Kashmir. As major population depends on the marine life and the vegetation, they have also played an important role in pushing up the tourism in the state hence contribution in the national income of India. Some of the major lakes of Kashmir valley are Wular lake, Dal lake and Mansbal lake.

Annelida is a ubiquitous, common, and diverse group of organisms that can be found on land, in freshwater, and in the sea. Despite significant efforts to resolve the evolutionary relationships of these and other Lophotrochozoa, as well as the delineation of the group's basal nodes, these questions remain unanswered. Following Arthropoda, Mollusca, Vertebrata, and possibly Platyhelminthes as the Metazoa species with the most phyla, Annelida has a vast range of morphologies and biological methods, with a significant number of species . When taxonomic categories are updated due to synonymies and new species descriptions, the number of currently recognised annelid species varies quickly. The application of molecular taxonomy methods, which allows the definition of entities inside species complexes, has also resulted in a recent increase in species counts for the group. This review attempts to provide a concise overview of the state-of-the-art in annelid diversity, as well as a summary of the group's major systematic modifications. It should also be regarded as an introduction to the papers that make up this Special Issue on Annelid Systematics and Biodiversity.Capa (2021)

Annelids have evolved a variety of morphological, physiological, and behavioural adaptations to live with settings that are either inappropriate for, or on the edge of, survival for most animals. They mostly used primary literature to gather information on polychaetes (excluding sipunculans and echiurans) and clitellates (oligochaetes and leeches).They discovered many alterations that are common to both polychaetes and clitellates, as well as some that are unique to one group or the other. Certain land-adapted polychaetes, for example, have fewer nuchal organs, epidermal ciliation, and receptor cells, while other coastal polychaetes use adhesive glands and glue-reinforced tubes to keep their position in surf zones, while oligochaetes appear to be 'pre-adapted' to life underground due to their simple body plans. The ability to build protective cocoons, make cryoprotective substances like antifreeze and heat shock proteins, develop gills, transform their bodies into a home for symbiotic chemoautotrophic bacteria, metabolise contaminants, and display avoidance behaviours are all modifications shared by both groups. Annelids have been able to move from salt water to freshwater, from sea to land via beaches, from freshwater to soil, and from surface water to underground water thanks to convergent evolution in both directions. Because of their deceptively simple worm-like body and primarily benthic/burrowing lifestyle, annelids have spread throughout the world, making them one of the most common and diverse animal groups on the planet (Glasby et al. 2021)

The diversity of Annelids in the Kashmir division was studied, with a focus on earthworms, leeches, and *Tubifex tubifex*. The study aimed to look into the wide range of services they offer, such as improving soil health, increasing blood circulation, and providing fish food. The research was conducted over the course of two seasons, summer and winter. The research was carried out at six representative study sites that were spatially separated and covered different administrative areas of the valley. The most essential aspect of rice field biota is that it has developed over hundreds of years to adapt to the highly controlled, eutrophic, and transitional circumstances of these distinct ecosystems. Tons of artificial fertilisers and several agro-chemicals, such as weedicides and insecticides, are applied to rice paddies during each crop cycle. As a result, the hydrological and sedimentary conditions fluctuate dramatically, putting a great deal of stress on the ecosystem. Earthworms and leeches, on the other hand, have adapted to these dynamic shifts and have effectively colonised rice fields. Within the rice field, which is the most managed and frequently disturbed ecology, a strange mix of earthworms and leeches can be seen. *Tubifex*, on the other hand, is widely recognised as a bioassessment tool due to their limited mobility, comparatively extended life cycles, and differential sensitivity to pollution of various types and they adequately depict the influence of cultural eutrophication on aquatic ecosystems. They are mostly aquatic; some are marine or freshwater, burrowing

or tubicolous, sedentary or free-living, and some are commensal and parasitic. The body is elongated, triploblastic, bilaterally symmetrical, and vermiform.. Annelids, also known as segmented or ringed worms, can be found in both the soil and the water. There are over 9000 different species of annelids. For a variety of reasons, they are economically and environmentally significant. Burrowers and those that live on the surface are the two main types of annelids found in soil. Burrowers loosen the earth, making it easier for water and oxygen to penetrate. As a result, annelids help to keep soil aerated and fertile. Both hasten the decomposition of organic substances as well as mineral decomposition. This makes it easier for other organisms and plants to consume. They also aid soil development by combining minerals and organic matter. As a result, annelids are beneficial to agricultural production. Man's economic dependence on earthworms is substantial. They play an essential part in agriculture and are the best buddies of farmers, ploughing and manuring the soil on a regular basis. Earthworms aerate the soil by digging burrows. They raise the lower dirt up to the surface on a regular basis. They are supposed to be capable of filling the entire surface of the earth up to 5 cm in ten years. Long before man, earthworms were ploughing the Earth. The soil becomes loose and permeable as a result of their digging and soil feeding habits. Their burrows let air and moisture to penetrate the permeable soil, enhance drainage, and facilitate root growth downward. Worm faeces is a good source of manure. They enhance the soil by burying the dead and rotting debris. The worms' excretory wastes and other secretions enrich the soil by supplying nitrogenous materials, which is essential for plant growth. Earthworm faeces contain nitrate, calcium, phosphorus, potassium, and magnesium, which are crucial components of humus, which is necessary for plant growth. They also lower the soil's alkalinity and acidity. In many places of the world, earthworms are utilised as fishing bait. They are eaten by a variety of species, including frogs, moles, lizards, tiny snakes, centipedes, and birds. Earthworms are eaten by uncivilised people in various places of the world. Earthworms are the ideal meal for aquarium fish and laboratory tiny animals.

Annelids are a wonderful source of material for studying regeneration. Their comparatively basic structure allows for easier analysis of regenerative processes, and they also have a high regeneration capacity. Numerous researchers have studied the various facets of these processes as revealed in experimental regeneration and various mechanisms of asexual reproduction since the turn of the century (Berrill et al., 1952).

Earthworms are employed in the Ayurvedic and Unani systems of medicine to reduce the size of bladder stones, jaundice, piles, diarrhoea, and weakness after pregnancy, sexual impotency, and gout. They are now employed in a variety of exotic medications in India, China, and Japan. They are widely used for dissection in zoological laboratories because they are inexpensive and easy to obtain. Leeches are common live bait used by anglers, as any fisherman knows. It's possible that a dozen huge leeches will set you back 3 bucks or more. Although there is no current source of data on the entire economic value of leeches to North American economies, older references claim that leech industries in states like Minnesota are worth several million dollars each year. Commercially sold leeches (typically the Predatory Leech, *Nephelopsis obscura*) are harvested in the wild (as are commercially sold Night Crawlers), and there have been worries about over-harvesting of local populations in some circumstances. A common European leech species (*Hirudo medicinalis*) was historically routinely employed for bloodletting as a medicine. This exercise was thought to bring the body's "humours" back into balance. While it is a dubious method in general, modern medicine has discovered a useful application for leeches. Initially, venous blood flow is often weak in the surgical repair or reattachment of particular bodily components, as well as in skin transplants. Leeches are utilised to remove excess blood from the tissues as new veins and capillaries grow. They

produce a natural anticoagulant as they feed which helps to prevent clotting, which could result in a lack of blood flow to the wounded areas.

MATERIALS AND METHODS

Various seasons in the year 2021 were used to perform random field surveys. During this examination, spatially varying study locations in several administrative zones of Kashmir valley were chosen. The following were among the representative sites:

- **Kupwara** (34°02'N; 74°16'E) in Kashmir's northwestern corner
- **Bandipora** (34°06'N; 74°44'E) is a town in Kashmir's northwestern region.
- **Baramulla** (34.19°N; 74.34°E) is located in north Kashmir,
- **Kulgam** (33°64'N; 75°01'E) is located in south Kashmir,
- **Sopore** (34°28'N; 74°46'E) in North Kashmir, and
- **Anantnag** (33.73°N; 75.15°E) is located in Kashmir's south-east corner.

The above-mentioned districts were used to complete the current work, which mostly entailed field surveys in various localities/areas of Kashmir, as well as the gathering and preservation of annelid collections. The collection was made from the first week of May to the first week of November in 2021.

***Sampling*:**

Annelids, particularly leeches, were caught using an insect collection net with a long handle made of a thick wire ring with a diameter of around 30cm. Earthworms were collected from pits dug with the help of spade. Collected specimens were preserved in 30 percent ethanol in 5 plastic tubes. For proper collection, sorting trays were used (to place the soil on in order to sort through and look for earthworms, alternatives include pots or bin bags). Labels and an alcohol-resistant pen/pencil were used to mark the samples (to label samples and to avoid mixing them up) A notepad and a map were used to note the location, habitat and other important factors. Forceps with a pointed, non-serrated tip and a pair of gloves were used during the collection for better sample collection. A lidded plastic take-out container containing 30 percent ethanol was used for the preservation of the collected samples. During the preservation process, the earthworms were relaxed and straightened to prevent them from being preserved in inconvenient postures. This made it much easy to identify the specimens. The specimens in 30 percent ethanol were allowed to settle for about 5 minutes. The earthworms that had got stuck in the lid's grooves were straightened. The earthworms were then transferred into plastic tubes containing 80% ethanol and then properly labelled

Leeches were also preserved using alcohol. Each animal required a particular concentration of alcohol for preservation. Leeches should not be put in ethanol right away (unless they're going to be used for molecular research), as they shrink. The specimens were washed and destroyed in a mild formalin solution in a shallow dish (1-2 percent). The specimens were then permanently wetted with formalin solution and placed on blotting paper. Alternatively, formalin-imbued cellulose was used to coat the specimens. After the specimens hardened (30-40 minutes), they were transferred into glass vials that were large enough to hold them. Either formalin solution (5%) or ethanol can be used to fill the vials (70-80 percent). Leeches were narcotized in a solution of 5-15 % ethanol until they stopped reacting. Depending on the size and physiological condition of the specimen, it took almost from 6 to 12 hours. Fixation took place in formalin (1:4), ethanol (70%) or formal-alcohol.

Results

Species	*Family*	*Phylum*	*Sites/District*	*Dominancy*
E. octoculata	Erpobdellidae	Annelida	Kehmil Kupwara Khanbal Anantnag Sangam Yaripora	Lolab Valley Sopore Baramullah Bandipora Kulgam
T. tubifex	Naididae	Annelida	Anchar Lake Bandipora	Srinagar Bandipora Baramullah Kupwara
E. fetida	Lumbricidae	Annelida	Kupwara Lolab valley Sangam (Pulwama)	Kupwara Sopore Handwara Bandipora Baramullah Lolab Valley

DISCUSSION

The purpose of this study was to determine the variety and distribution of annelids in Kashmir's fresh water bodies. Among the collected specimens, annelids of the clitellata class were found**.** Some oligochaetes, notably tubificid worms like *Tubifex*, are very resistant to low oxygen levels and high levels of organic pollution among annelids. As a result, they are employed as pollutant indicator species and can be used as components of biotic indices to assess ecosystem health.. These species can be found in a variety of freshwater settings around the world, including open water habitats in big lakes, stream sediments, and groundwater habitats, where they feed on small organic particles. The anticoagulants employed during feeding by blood-feeding leeches are being studied for their therapeutic usefulness. Because they have been over-harvested for their function in the last few centuries, some leech species are considered endangered.. The density of earthworms in soil is regarded as a good indicator of soil health because they improve many soil attributes such as structure, water holding capacity, moisture content, and so on, as well as increasing nutrient availability and degrading pesticide residues. As scientists learn more about the 'ecosystem services' provided by earthworms, they realise that the earthworm-farmer friendship is much deeper than previously thought. Tillage and pesticide use are known to have a negative impact on earthworm populations in the soil. These findings emphasise the importance of better understanding the delicate interdependence of an agricultural ecosystem when developing crop management strategies.

In the above mentioned table, different species of annelids that were investigated and their diversity and distribution was observed across some districts of Kashmir valley. Especially *clitellata class like E. fetida* have almost similar distribution in various districts like Kupwara, Sopore, Bandipora and Baramullah. Same is the case of *E. octoculata* that was found mostly in stagnant water bodies and crop fields. *E. octoculata* found in rice fields and have adapted themselves from black to brownish colour due to the different temperature conditions. Earthworms are burrowing organisms that resemble a plough in motion. The brilliant scientist Charles Darwin was the first to investigate these so-called soil producers.

Earthworms come in about 2000 different species all over the world. It is the best-known of the annelids. They have a critical role in enriching and improving the texture of the soil. Ploughing is accomplished by animals eating their way through the soil. They can digest soil, as well as its contents such as dead leaves and any other organic stuff they come upon. They regularly mix and loosen the upper layer of soil in this manner. This allows air and water to percolate through the soil at a consistent rate. Earthworms may carry around 18 tonnes of subsoil to the surface every year across an area of about one acre. Worm droppings also help to improve the soil, making it more fertile.

Leeches have been used in medicines, since ancient Egyptians used it to treat nerve system anomalies, dental difficulties, skin ailments, and infections. They're typically employed in plastic surgery and other types of microsurgery nowadays. Because leeches release peptides and proteins that prevent blood clots, this is the case. Anticoagulants are another name for these secretions. This helps wounds heal by keeping blood flowing to them. Leech therapy is currently experiencing resurgence due to its ease and low cost of use in reducing problems. Three jaws with small rows of teeth are found on medicinal leeches. They use their teeth to penetrate a person's skin and inject anticoagulants into their saliva. The leeches are then permitted to suck blood from the person having therapy for 20 to 45 minutes at a time. This translates to a modest amount of blood every leech, up to 15 millilitres. The most common sources of medicinal leeches are Hungary and Sweden. Leech therapy can be utilised in a variety of circumstances. Those who are at risk of limb amputation due to diabetes complications, those who have been diagnosed with heart disease, and those who are undergoing cosmetic surgery and risk losing some soft tissue may all benefit. Blood clots and varicose veins can also be treated with this therapy. Leech therapy is not recommended for people who have anaemia, blood clotting problems, or have arteries that are damaged. It is also generally advised that children under the age of 18 and pregnant women avoid it. Live leeches attach themselves to the target location and draw blood during a session. They secrete proteins and peptides that thin the blood and help it to clot. This boosts circulation while preventing tissue death. Small, Y-shaped wounds are left behind by the leeches, which normally heal without leaving a scar. Leeches are useful for improving blood circulation and dissolving blood clots. It should come as no surprise that they can be utilised to treat circulation problems and heart disease.

During the current study it was found that there was a decline in the number of Earthworms (farmers friend) due to use of fertilizers rich in nitrogen, phosphorous and potassium (N.P.K) that directly affected the crop production of above mentioned areas as mentioned emphasis.should be laid on the use of manure which to some extent can provide better environment for their survival and thus lead to the fertility of soil. Though chemical fertilisers provide plants with a fast, lush growth boost, but they are quickly exhausted, leaving the soil chemically dependent. On other side if vermicompost is used to boost the soil fertility it introduces living microorganisms to the soil and begins the process of breaking down of organic materials, making it nutritionally available to plants. The surrounding and existing soil becomes viable and sustainable, and neighbouring plants and yards begin to improve as well. Thus manuring and vermicomposting should be adopted to enrich soil, thus yielding better results in the long run, also allowing these species to thrive in their habitats.

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