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IMPACT OF WATER QUALITY AND AVIFAUNA WITH SPECIAL REFERENCE TO ORIENTAL DARTER

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Abstract:

Water quality is a critical factor affecting the health and abundance of aquatic ecosystems and the wildlife that depends on them. Avifauna, in particular, is highly sensitive to changes in water quality, as they rely on water bodies for various aspects of their life cycles. This study investigates the impact of water quality on avifauna, with a special focus on the Oriental Darter (*Anhinga melanogaster*), a waterbird species commonly found in Asia. The Oriental Darter is an indicator species that reflects the health of freshwater ecosystems due to its sensitivity to water quality parameters such as dissolved oxygen levels, turbidity, pH, and nutrient concentrations. This study reviews existing literature on the ecological requirements of the Oriental Darter and its habitat preferences. Field data collection methods, including water sampling and bird observation, were employed to quantify water quality parameters and the presence of Oriental Darters in selected study sites. Preliminary findings reveal a strong correlation between water quality parameters and the presence and behavior of Oriental Darters. Higher levels of pollution and decreased water quality were associated with reduced Oriental Darter populations and altered foraging behavior. These changes in avian behavior may have cascading effects on the ecosystem dynamics of the water bodies they inhabit.

Keywords: Water Quality, Avifauna, Oriental Darter, Indicator Species, Anthropogenic Activities, Ecosystem Conservation.

Introduction:

Water is one of the most essential resources on our planet, not only for human survival but also for the countless ecosystems and species that depend on it. Among these ecosystems, aquatic environments are particularly sensitive to changes in water quality, which can have profound effects on the health and biodiversity of these systems. Avifauna, the bird species that inhabit and rely on aquatic ecosystems, are especially vulnerable to alterations in water quality, as they are intricately linked to these habitats for various aspects of their life cycles [1].

This study delves into the intricate relationship between water quality and avifauna, with a specific focus on the Oriental Darter (*Anhinga melanogaster*), a distinctive waterbird species predominantly found in the Asian continent. The Oriental Darter is of particular interest in this context because it serves as an indicator species, reflecting the overall health of freshwater ecosystems due to its high sensitivity to various water quality parameters. These parameters include dissolved oxygen levels, turbidity, pH, and nutrient concentrations, among others. The presence, abundance, and behavior of Oriental Darters can provide valuable insights into the ecological conditions of the water bodies they inhabit [2].

To gain a comprehensive understanding of the intricate web of interactions between water quality and avian species, this study embarks on a multi-faceted investigation. First, we conduct a thorough review of existing literature to elucidate the ecological requirements and habitat preferences of the Oriental Darter [3]. This information serves as a foundational knowledge base for the subsequent stages of the study.

Next, our research assesses the influence of anthropogenic activities, such as industrial pollution, agricultural runoff, and urban development, on water quality in areas inhabited by Oriental Darters. These human-induced alterations to water quality are of particular concern, as they pose a significant threat to the survival of both the bird species and the aquatic ecosystems, they call home [4].

Field data collection methods form a crucial component of our research, involving water sampling and extensive bird observation in selected study sites [5]. These field studies aim to quantify various water quality parameters and concurrently record the presence and behavior of Oriental Darters in their natural habitats.



Collecting water sample from a site of keetham lake Fig.1-5. Oriental Darter Bird, Monitoring Catchment Area of Lake by Research Scholar

Preliminary findings from our research have already indicated a compelling correlation between water quality parameters and the presence and behavior of Oriental Darters. Notably, higher levels of pollution and deteriorating water quality have been associated with reduced populations of Oriental Darters and alterations in their foraging behavior [6]. These changes in avian behavior have the potential to set off a chain reaction of consequences within the ecosystem dynamics of the water bodies they inhabit.

In conclusion, this study underscores the pivotal role played by water quality in the conservation of avifauna, with a special emphasis on the Oriental Darter as a representative species. The findings of this research are expected to highlight the urgent need for integrated water management practices that prioritize the preservation of healthy freshwater ecosystems [8,9]. Such measures are crucial not only for the protection of sensitive bird species like the Oriental Darter but also for the overall well-being of aquatic environments. Ultimately, this research aims to provide valuable insights for policymakers, conservationists, and environmentalists working tirelessly towards the preservation of avian biodiversity and the broader aquatic environment [10].

History:

The history of studying the impact of water quality on avifauna, with a special reference to the Oriental Darter (*Anhinga melanogaster*), is rooted in the broader field of environmental science and ecology [11]. Understanding the historical context of this research helps us appreciate the evolution of our knowledge in this area.



Oriental Darter stock photo human fig.1-3. - Nidhi Picture

Early Observations and Natural History: Early observations of birds and their habitats date back centuries, but systematic studies on avifauna and their interactions with water quality began to gain prominence in the late 19th and early 20th centuries. Naturalists and ornithologists documented the behaviors, distributions, and habitats of various bird species, including those associated with aquatic environments [12].

Emergence of Environmental Science: The mid-20th century saw the emergence of modern environmental science and ecological research. Researchers began to recognize the importance of water quality in shaping ecosystems [13]. The effects of pollution and habitat degradation on aquatic life, including birds, started to become more evident.

Indicator Species Concept: The concept of indicator species, like the Oriental Darter, emerged during this period. Indicator species are organisms that are particularly sensitive to environmental changes and can be used to assess the health of ecosystems. The sensitivity of certain bird species, including the Oriental Darter, to water quality parameters like dissolved oxygen, pH, and nutrient levels, was recognized [14].

Rise of Conservation Biology: In the latter half of the 20th century, the field of conservation biology gained prominence. Researchers and conservationists became increasingly concerned about the decline of bird species and the degradation of their habitats due to human activities. This period marked a significant shift towards applied research aimed at conserving avian biodiversity [15].

Advancements in Monitoring Technology: Advances in technology, including remote sensing, GIS (Geographic Information Systems), and telemetry, have facilitated the monitoring of avian populations and their habitats. These tools have allowed for more comprehensive and precise assessments of the impact of water quality on bird species [16].

Globalization of Research: As environmental issues became global concerns, research on avian species and water quality expanded beyond regional studies. International collaborations and data-sharing networks have helped scientists understand how changes in water quality affect migratory bird populations, including the Oriental Darter, as they move between different regions [17].

Policy and Conservation Initiatives: The findings of research on the impact of water quality on avifauna, including the Oriental Darter, have informed policy decisions and conservation initiatives. Various international agreements and local conservation efforts have been developed to protect waterbird habitats and improve water quality.

Today, research on the impact of water quality on avifauna continues to evolve with advancements in ecological science, technology, and environmental awareness. The historical context of this research highlights the growing recognition of the intricate relationship between water quality and bird species and underscores the importance of conservation efforts to safeguard both avian biodiversity and the health of aquatic ecosystems [18,19].

Water Quality:

Water quality is a fundamental factor in determining the health and viability of aquatic ecosystems, and it has a direct impact on avifauna, including the Oriental Darter (*Anhinga melanogaster*). Water quality refers to the chemical, physical, biological, and radiological characteristics of water, which collectively influence its suitability for various uses and its ecological function within aquatic habitats [20].

Below are key aspects of water quality and its significance in relation to avifauna, with a focus on the Oriental Darter:

Dissolved Oxygen (DO): The level of dissolved oxygen in water is crucial for the survival of aquatic organisms, including fish that many waterbirds, like the Oriental Darter, rely on as a food source. Low DO levels can result from pollution, excess organic matter, or high temperatures and can lead to fish kills, reducing the prey base for avian species [21].

Turbidity: Turbidity is a measure of water clarity and indicates the presence of suspended particles. High turbidity can reduce visibility in water, making it difficult for fish-eating birds like the Oriental Darter to hunt effectively. It can also impact the distribution of aquatic vegetation, which influences nesting and foraging habitats [22].

pH Levels: Water pH affects the solubility of chemicals and nutrient availability in aquatic ecosystems. Extreme pH values can be harmful to aquatic life, including the Oriental Darter. For example, acidic waters can harm fish populations, which, in turn, affect the birds that feed on them [23].

Nutrient Levels: Nutrient concentrations, especially nitrogen and phosphorus, play a critical role in aquatic ecosystem health. Excessive nutrients from agricultural runoff or wastewater can lead to eutrophication, causing algal blooms [24]. These blooms can reduce water quality, harm fish populations, and indirectly affect avian species.

Pollution: Water pollution from industrial, agricultural, and urban sources can introduce a range of contaminants into aquatic ecosystems. Pollutants such as heavy metals, pesticides, and chemicals can accumulate in the food chain, potentially harming both fish and the birds that rely on them for sustenance [25].

Habitat Degradation: Poor water quality often goes hand in hand with habitat degradation. Industrial discharges, deforestation, and urban development can alter the physical characteristics of aquatic habitats, making them less suitable for avian species like the Oriental Darter. Changes in water quality can also disrupt nesting sites and food availability [26].

Climate Change: Climate change can influence water quality by altering temperature regimes, precipitation patterns, and water flow. These changes can impact the distribution and abundance of fish and other aquatic prey species, which, in turn, affect the foraging behavior and reproductive success of waterbirds [27].

Conservation and Management: Recognizing the importance of water quality for avian species like the Oriental Darter, conservation efforts often involve monitoring and improving water quality in critical habitats. This can include measures to reduce pollution, restore wetlands, and maintain riparian vegetation [28].

In summary, water quality is a critical factor affecting the health of aquatic ecosystems and, consequently, the avifauna that relies on them. The Oriental Darter, as an indicator species, provides valuable insights into the impacts of water quality on birds and the broader ecological consequences. Understanding and preserving good water quality is essential for the conservation of avian biodiversity and the maintenance of healthy aquatic ecosystems [29,30].

Avifauna, Oriental Darter:

Avifauna, the bird species associated with aquatic environments, plays a vital role in these ecosystems, contributing to ecological balance and serving as indicators of environmental health. The Oriental Darter (*Anhinga melanogaster*) is a distinctive waterbird species frequently found in Asia, and its presence and behavior are deeply intertwined with water quality and aquatic habitats [31].

In this section, we explore the relationship between water avifauna, with a focus on the Oriental Darter, and how it is impacted by water quality:

Habitat Dependence: Waterbirds like the Oriental Darter are highly dependent on aquatic habitats such as lakes, rivers, ponds, and wetlands. These habitats provide essential resources like fish, amphibians, and aquatic insects for their survival. Consequently, the quality of these habitats, determined by water quality, significantly influences the distribution and abundance of avifauna [32].

Foraging Behavior: Water quality parameters, particularly dissolved oxygen levels, turbidity, and nutrient concentrations, directly influence the availability of prey species in aquatic ecosystems. The Oriental Darter is a

proficient fish hunter, using its sharp beak to spear fish underwater [33]. Reduced dissolved oxygen or increased turbidity can impair fish visibility and mobility, affecting the bird's foraging success.

Breeding and Nesting: Water quality affects not only the availability of food but also the suitability of nesting sites for waterbirds. Many avian species, including the Oriental Darter, build nests in or near water. Changes in water quality, such as habitat degradation or increased pollution, can impact nest site selection and nesting success [34].

Migratory Patterns: Avifauna, including the Oriental Darter, often migrate between different water bodies in search of suitable foraging and breeding sites. Changes in water quality along migration routes can influence the timing and success of migrations, with potential consequences for the survival of these species [35].

Health and Reproduction: Waterbirds can ingest contaminants present in polluted water, leading to health issues and reduced reproductive success. Pollutants like heavy metals or pesticides can accumulate in the tissues of these birds, potentially impacting not only individual health but also population-level sustainability [36].

Indicator Species: The Oriental Darter, as an indicator species, reflects the health of freshwater ecosystems. Its presence, abundance, and behavior can serve as early warning signs of deteriorating water quality, pollution, or habitat degradation [37].

Conservation Significance: Understanding the interactions between water quality and avifauna, particularly the Oriental Darter, is of paramount importance for conservation efforts. Monitoring changes in water quality can help identify areas in need of protection and restoration to safeguard not only the bird species but also the entire ecosystem [38].

The relationship between water quality and avifauna, with a special focus on the Oriental Darter, highlights the intricate interplay between environmental conditions and the survival of species within aquatic ecosystems. The conservation of avian biodiversity, especially for species sensitive to water quality, necessitates holistic approaches that address both habitat preservation and the mitigation of water quality degradation [39].

Indicator Species, Anthropogenic:

Water quality is a critical factor affecting aquatic ecosystems, and indicator species like the Oriental Darter (*Anhinga melanogaster*) are essential in assessing the health of these ecosystems. Anthropogenic activities, or human-induced activities, have a significant impact on water quality and subsequently affect indicator species like the Oriental Darter [40].

Here, we delve into the concept of indicator species, the role of the Oriental Darter as an indicator, and the influence of anthropogenic activities on water quality:

1. Indicator Species:

Indicator species are organisms that are particularly sensitive to environmental changes and can serve as early warning signs of ecosystem health. In aquatic environments, they are valuable tools for monitoring water quality and the overall condition of ecosystems. The Oriental Darter's sensitivity to water quality parameters, such as dissolved oxygen, turbidity, pH, and nutrient levels, makes it an ideal candidate as an indicator species. Changes in its abundance and behavior can indicate shifts in water quality and ecosystem conditions [41].

2. Sensitivity to Water Quality:

The Oriental Darter is highly sensitive to variations in water quality. For example, it requires clear water with good visibility for successful hunting, and changes in turbidity can impact its foraging efficiency. Dissolved oxygen levels are crucial for the survival of the fish it preys upon. Elevated nutrient concentrations can lead to eutrophication, affecting the availability of prey species. As such, alterations in these water quality parameters can directly affect the presence and behavior of the Oriental Darter [42].

Anthropogenic Activities: Human activities have a profound impact on water quality and, consequently, on indicator species like the Oriental Darter. Several anthropogenic activities can negatively influence water quality in aquatic ecosystems [43].

Industrial Pollution: The discharge of industrial effluents containing chemicals, heavy metals, and pollutants can contaminate water bodies. These pollutants can accumulate in the food web, potentially harming the Oriental Darter and its prey [44].

Agricultural Runoff: Agricultural practices involving the use of fertilizers and pesticides can result in nutrient runoff and chemical contamination of water bodies. This can lead to nutrient imbalances and the proliferation of harmful algal blooms, affecting the Oriental Darter's foraging conditions [45].

Urban Development: Urbanization often leads to increased impervious surfaces, which can lead to stormwater runoff carrying pollutants into nearby water bodies. Habitat destruction associated with urban development can also disrupt nesting and foraging sites for the Oriental Darter [46].

Deforestation: Deforestation can impact water quality by increasing sediment runoff, which can cloud the water and affect the availability of prey for the Oriental Darter [47].

Climate Change: While not directly an anthropogenic activity, climate change resulting from human activities can alter temperature and precipitation patterns, affecting water quality parameters and, subsequently, the distribution and behavior of indicator species [48].

Conservation Implications: Understanding how anthropogenic activities impact water quality and, in turn, the Oriental Darter as an indicator species, is critical for conservation efforts. Efforts to mitigate pollution, protect habitats, and implement sustainable land-use practices are essential for preserving the health of aquatic ecosystems and the species that depend on them [49].

The Oriental Darter's role as an indicator species in assessing water quality underscores the importance of recognizing and addressing the impact of anthropogenic activities on aquatic ecosystems. By studying the Oriental Darter and its responses to changes in water quality, we can gain valuable insights into the health of these ecosystems and the steps needed to conserve them [50].

Ecosystem Conservation

Water ecosystem conservation is a crucial aspect of preserving avifauna, including species like the Oriental Darter (*Anhinga melanogaster*), and maintaining the overall health of aquatic environments. Here, we explore the significance of water ecosystem conservation in the context of avian biodiversity and the Oriental Darter [51].

1. Biodiversity Preservation: Healthy aquatic ecosystems support diverse communities of plants and animals, including fish and aquatic invertebrates that serve as prey for waterbirds like the Oriental Darter. Conserving these ecosystems ensures a sustainable food source for avian species and contributes to overall biodiversity preservation [52].

2. Habitat Protection: Water ecosystem conservation involves safeguarding critical habitats such as wetlands, rivers, lakes, and ponds. These habitats serve as breeding, nesting, and foraging grounds for waterbirds. Maintaining these areas in their natural state is essential for the Oriental Darter's survival [53].

3. Water Quality: Conservation efforts often focus on improving and maintaining water quality. Clean and unpolluted water is vital for the health of both aquatic organisms and waterbirds. Polluted water can harm prey species and directly impact the Oriental Darter's well-being [54].

4. Nesting Sites: Oriental Darters often nest in trees or shrubs near water bodies. Protecting riparian vegetation and maintaining undisturbed nesting sites are essential for successful reproduction. Habitat degradation can disrupt the nesting patterns and success of this bird species [55].

5. Sustainable Management: Sustainable management practices for water resources are integral to conservation. Balancing water use for human needs with the ecological requirements of aquatic ecosystems ensures the availability of suitable habitats and resources for avian species like the Oriental Darter [56].

6. Education and Awareness: Conservation efforts often involve raising public awareness about the importance of water ecosystems and the species that depend on them. Educating communities about the Oriental Darter and its role in ecosystem health can foster support for conservation initiatives [57].

7. Research and Monitoring: Continuous research and monitoring of water ecosystems and avian populations are vital for conservation. These activities provide data on changes in water quality, habitat conditions, and the status of Oriental Darter populations. Such information informs conservation strategies and helps identify emerging threats [58].

8. Legal Protections: Many countries have laws and regulations in place to protect waterbodies and their associated habitats. The enforcement of these legal protections is essential for safeguarding the Oriental Darter and its habitats [59].

9. International Cooperation: Given the migratory nature of many avian species, international cooperation is crucial. Water ecosystems and Oriental Darter populations often span multiple countries. Collaborative efforts are essential to ensure the conservation of these birds throughout their range [60].

10. Climate Resilience: Water ecosystem conservation also involves addressing climate change impacts. Rising temperatures and altered precipitation patterns can affect water quality, habitat availability, and the distribution of prey species. Conservation strategies must account for climate resilience to mitigate these effects [61].

The water ecosystem conservation is intrinsically linked to the well-being of avian species like the Oriental Darter. By protecting and restoring these ecosystems, we not only ensure the survival of these birds but also contribute to the overall health and resilience of aquatic environments. Conservation efforts must be comprehensive, addressing both local and global factors that influence water quality, habitat availability, and the sustainability of avian populations [62].

Conclusions:

Impact of Water Quality and Avifauna with Special Reference to Oriental Darter in the study Water quality is a critical factor affecting the health and abundance of aquatic ecosystems and the wildlife that depends. In this paper water study in briefs introduction and basic historical different changing with reduced populations of oriental data basic- Early Observations and Natural History, Emergence of Environmental Science, Indicator Species Concept, Rise of Conservation Biology, Globalization of Research, Policy and Conservation Initiatives. In the briefly Water Quality different case- Dissolved Oxygen (DO), Turbidity, pH Levels, Nutrient Levels, Pollution, Habitat Degradation, Climate Change, Conservation and Management. This matter is an Avifauna and Oriental Darter is a different case- Habitat Dependence, Foraging Behavior, Breeding and Nesting, Migratory Patterns, Health and Reproduction, Indicator Species, Conservation Significance. In man's Indicator Species and Anthropogenic are different meaning in the matter this Indicator Species, Sensitivity to Water Quality. This paper study Ecosystem Conservation different coextraction- Biodiversity Preservation, Habitat Protection, Water Quality, Nesting Sites, Sustainable Management, Education and Awareness, Research and Monitoring, Legal Protections, International Cooperation, Climate Resilience.

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