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The role of wild birds in the transmission of fish diseases: An overview

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I. Abstract

Wild birds can indeed play a role in carrying various pathogens such as viruses, parasites and bacteria into environment along their migration routes. They can shed these pathogens into the water bodies via their saliva, feces, or other biological fluids. This might be resulting to disease outbreaks and effecting aquatic ecosystem. The role of wild birds in introducing of fish diseases highlights the interconnectedness of terrestrial and aquatic ecosystems. Understanding these interactions is critical for effective controlling and conservation efforts aimed at maintaining the health and integrity of both bird and fish populations. This review highlights the role of water birds for transmission the bacterial and parasitic agents to fish. Also, this paper focused on integrating rules and measures regarding wildlife managing and disease control in aquaculture sites.

Keywords: aquatic environment; parasites; pathogens; zoonosis; migratory birds

I. Introduction

The request to aquaculture operations has been increased due to population growth, reducing natural fish stocks and government aquaculture preferment (1). Intensification alters natural fish ecosystems and new infections arise. The increase of habitat destruction and potential changes to water quality, this could impact the biodiversity. Consequently, can exacerbate to environmental disruption and maximize the risk of disease outbreaks and increase contamination risks with different pollutants (2-12). Wild birds can play a serious role in the transmission of some fish diseases, particularly those caused by pathogens and parasites that can be carried by birds either directly or indirectly. Some water or wild birds can serve as transferors for different parasites (such as trematode and cestoda) that affect fish (13). For instance, birds such as herons, mallard, egrets, moorhen, teal, and cormorants can port parasites like fish lice or certain types of worms in their feet, feathers or digestive systems. When these birds come into contact with aquatic environment occupied by fish, they can discharge parasite eggs or larvae into the water, which can then infect the fish (14). Fecal contamination, birds can introduce viruses, bacteria, or parasites into the water bodies, posing a threat to the health of fish populations (15). Fecal contamination, birds can also deposit fecal material in and around water bodies, which can contain pathogens detrimental to fish. Some bird species, such as herons, ospreys or kingfishers, prey on fish as part of their diet (16). While predation itself may not directly transmit diseases, injured or weakened fish caught by birds may already be infected with pathogens, and the consumption of infected fish can contribute to the spread of pathogens among bird populations (13). On the other hand, migratory birds can act as vectors for disease transmission over long distances. This phenomenon is

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well-recognized and has been detected in various bird species worldwide. As they travel between various habitats, they may pose pathogens to new areas or spread them among interconnected water bodies, potentially affecting fish stocks along their migration routes (13, 14, 17).

Additionally, environmental changes and human activities, such as habitat destruction, climate change or pollution, can affect the behavior and distribution of both wild birds and fish populations (13). All these changes in environments can change the dynamics of disease transmission, making new opportunities for pathogens to spread between fish and birds. Workers, veterinarians, visitors, and people who live on or adjacent to farms, ranches, feedlots, processing plants, and other agricultural endeavors are at risk for transmitting diseases from animals, poultry, or fish (18).

The role of wild birds in the transmission of parasitic infestations

Several studies have been indicated that water birds perceived in various areas worldwide predatory on fish from ponds. These predatory birds are considered the definitive hosts of fish parasites such as, *Gryporhynchidae cestodes, Contracaecum spp. Diplostomum spp* and *Clinostomum spp.* (19-22).
Eustrongylidosis is a parasitic disease that mostly affects paddling birds worldwide; but, the parasites is complex, indirect lifecycle includes other species, such as fish and aquatic worms (23). Furthermore, this disease is considered zoonotic, which means the parasite can transmit disease from animals to humans (24). Eustrongylidosis is named after the causative agent *Eustrongylides*, and classically occurs in eutrophicated waters where levels of nutrients and minerals are high enough to afford ideal environments for the parasite to thrive and persist (25). Because eutrophication has become a common concern due to agricultural runoff and urban development, cases of eustrongylidosis are becoming prevalent and hard to control (26). Furthermore, studying parasites like *Eustrongylides sp.* can provide valuable insights into environmental health and stability. Parasites often serve as indicators of ecosystem dynamics, reflecting changes in host populations, environmental conditions, and anthropogenic influences (27). Understanding the parasite's lifecycle and its effects on predator-prey interactions can inform conservation efforts and ecosystem management practices (25).
The Diplostomum parasite finishes its life-cycle in fish eating- birds, but spends significant time in the eye transparent humor of several freshwater fishes. Its infestation in fish might causes severe ocular lesion and could leads to increased vulnerability to predation (28). A study by Seppala et al. (29) who observed *Diplostomum spathecum* non-encysted in the lens. This causes impaired vision and fish are more susceptible to predation, the adult stages of digenean parasites are perceived in Piscivorous birds (13).

Another parasites, acanthocephalans infect all of vertebrates classes and are very common in wild birds. Particularly, geese, ducks and swans are well known to be the most commonly infected birds along with some species of passerines and prey (30, 31). Severe disease epidemics have been reported repeatedly from common eiders. Acanthocephalans has been documented throughout the arctic zones of their range and has been owing to food habits rather than to any increased vulnerability of their species. Historical U.S. “Fish and Wildlife Service disease diagnostic records reported heavy infections of acanthocephalans and mortality in trumpeter swans from Montana” (32). Florio *et al.* (33) reported infestations of Tilapia fish with *Acanthosentis tilapia* in East Africa. Infestations of humans

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with acanthocephalans after eating undercooked or raw fish has been recognized (Schmidt, 1971). A study by Murugami et al. (2018) whom indicated that clay pond fish had greater (52%) parasite infestation than those from insert (7%) and concrete ponds. They identified that "parasites of zoonotic importance" such as *Acanthocephala spp, Contracaecum spp* and *Clinostomum spp.* Another study by Gustinelli et al. (22) 2010) who isolated *Clinostomum* species of the *'cutaneum'* group from both fish and grey heron (piscivorous bird).

The role of wild birds in the transmission of viral and bacterial fish diseases

Migratory birds can undeniably serve as route for disease spread directly or indirectly over long expanses. This phenomenon is well-reported and has been perceived worldwide in different bird species. As these birds travel among various habitats during their migrations, they can transmit pathogens such as viruses, bacteria, and parasites with them (14).

Several reports demonstrated that Great Egrets, "*Arde alba* , Double-crested Cormorants, *Phalacrocorax auritus,* American White Pelicans, *Pelecanus erythrorhynchos* and Wood Storks, *Mycteria americana* can important role for transmission and shed viable VAh after consuming fish infected with Vah (15, 22). Avian influenza is naturally via the intestinal tracts of birds. The major routs of transmission of AI among bird species is via feces and secretions". Also, the AI can persist viable in water, especially at colder temperatures. The occurrence of AI varies depending on species. In waterfowl, "AI is most predominant in wild birds during late summer and early fall. Infection rates tend to be lower outside of those periods" (15).

On the other hand, bacteria such as *Edwardsiella ictaluri* and *E. tarda* are considered the primary species of *Edwardsiella* to cause disease outbreaks in North American catfish aquaculture. Genetic analysis has determined that most isolates designated as *E. tarda* were actually a new species, "*E. piscicida*. There has been an increase in *E. piscicida* diagnostic cases in recent years perchance due to an increase in hybrid (Channel x blue) catfish production". A study by Armstrong and Gallagher (36) showed that Great Egrets (*Ardea alba*) shed viable *E. piscicida* when fed catfish infected with the bacteria.

Great Egrets fed infected fish shed viable *E. piscicida* bacteria for multiple days, after last consuming infected fish on day 2 of the study. Great Egrets in the control group did not shed the bacteria. Given that Great Egrets can shed viable *E. piscicida* after consuming diseased fish, we hypothesize that they could also serve as a reservoir for *E. piscicida* and could spread the pathogen while predating fish in catfish ponds. Additional research is needed to determine if this shedding could cause disease in these ponds.

II. Recommendations and future perspectives

Predatory birds mainly ibis, herons and cormorants which had more parasitic infestations were problematic to capture using haze nets in the fairly open areas (22). Therefore, confirm compliance with local guidelines and rules concerning wildlife monitoring and disease control in aquaculture sites. Consumers, farmers and traders and should be recommended on handling and cooking fish to evade

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infection with zoonotic bacteria and parasites. Control and dimensions of predatory birds and other piscivorous birds should be undertaken to increase the productivity of fish farming (13). Also, farmers should be made aware of hazards of parasitic infestations and other pathogenic diseases of fish and the requirement to refer practiced experts in such cases (37). Manage flow and water quality to discourage bird flocks and decrease the attractiveness of aquaculture operations to migratory birds. Biosecurity procedures should be undertaken by implement strict biosecurity methods to avoid transmission of diseases via different vectors, including migratory birds. This could include monitoring human contact, disinfecting tools, equipment and observing disease signs (17, 38, 39, 40, 41. 42, 43).

III. Conclusions

Migratory birds and fish were infected with many pathogenic agents. Earthen ponds were more exposed to bacterial infection and parasite infestations than close system and concrete ponds. To diminish the transmission of diseases by water birds, it requires studying their behavior, observing their movements and employing suitable management approaches are essential. Take account of procedures such as habitat management, disease investigation databases and public training efforts to increase awareness about the threats related with wildlife disease spread. Additionally, continued investigates into the epidemiology, ecology and impact of pathogens are critical for emerging effective control methods and protection the health of aquatic environments and their inhabitant. By expanding our understanding and knowledge of diseases and their biological effects, thereby we can better safeguard biodiversity and support ecological resource management.

Ethical clearance statement

Not applicable.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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