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Trophic Interactions Between Birds and Aquatic Prey at North Campus Open Space

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Introduction

- North Campus Open Space (NCOS) is a large-scale restoration project focused on reestablishing native ecosystems.
- Avian predators are especially key connectors because they interact with prey species across different habitats, linking multiple parts of the food web.
- The goal of this project was to to better understand ecosystem function and inform restoration management by summarizing potential trophic links between bird species observed at NCOS and their aquatic prey taxa and representing these relationships as an ecological network.



Image credit: Jeremiah Bender, Cheadle Center

Methods

- After Devereux Slough restoration was complete at NCOS in 2017 monthly bird surveys were conducted (2017–2025) as well as quarterly aquatic invertebrate sampling (since 2018)¹ and annual fish seining surveys (Table 1).
- To construct trophic networks (Figs. 1 & 2), I compiled and filtered data from monthly NCOS bird surveys (2017-2025) into two groups:
 - (1) birds that feed on aquatic invertebrates, primarily including ducks and shorebirds
 - (2) piscivorous birds, including both wading and diving species.
 - These groupings were used to organize the trophic networks; however, some species utilize multiple foraging strategies and are therefore included in both networks.
- Information on avian diets was gathered from published literature, primarily using the Cornell Lab of Ornithology’s Birds of the World ².

Table 1. Categorization of larger prey.

Large Prey Network Categories	Species at NCOS
Large Fish 12-30cm	Mississippi silverside (<i>Menidia audens</i>)
	Topsmelt (<i>Atherinops affinis</i>)
	Longjaw mudsucker (<i>Gillichthys mirabilis</i>)
	Pacific staghorn sculpin (<i>Leptocottus armatus</i>)
Small Fish <12cm	Mosquitofish (<i>Gambusia affinis</i>)
	Tidewater Goby (<i>Eucylogobius newberryi</i>)
	California killifish (<i>Fundulus parvipinnis</i>)
	Arrow goby (<i>Clevelandia ios</i>)
Crayfish	Red swamp crayfish (<i>Procambarus clarkii</i>)
	
Amphibians	Pacific Chorus Frog (<i>Pseudacris regilla</i>)
	

Results

Bird-Invertebrate Network

Chironomidae (midges) was the most highly connected group in this network with 23 connections, making up 24% of total links.

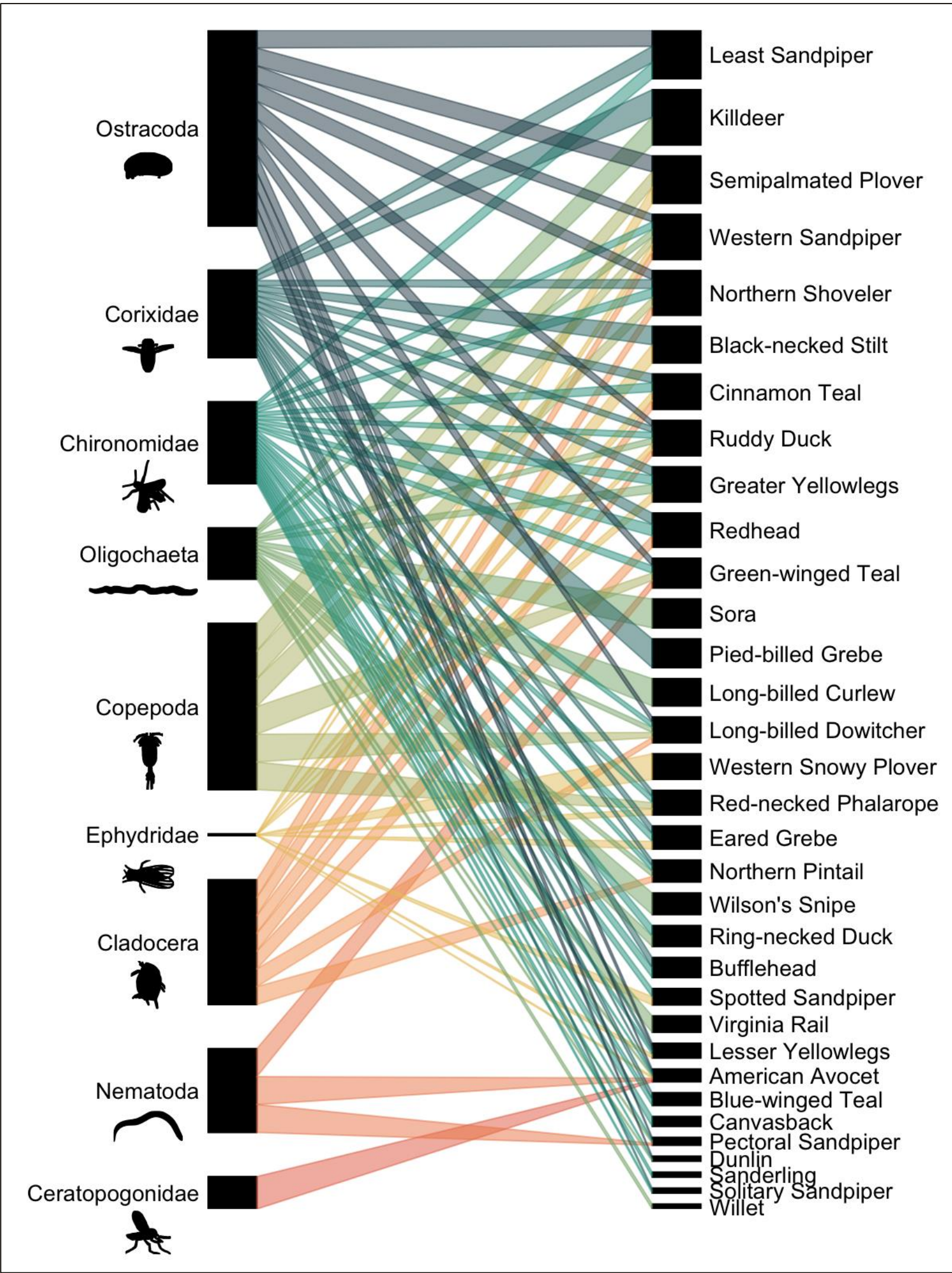


Figure 1: Bipartite trophic network illustrating potential feeding relationships between focal bird species (right) and aquatic invertebrate taxa (left) at North Campus Open Space (NCOS). Node sizes of both prey and predators are scaled according to the log-transformed abundances of each species at NCOS.

Bird-Larger Prey Network

In the larger prey network, small fish were the most connected group in this network with 19 connections, making up 40% of total links.

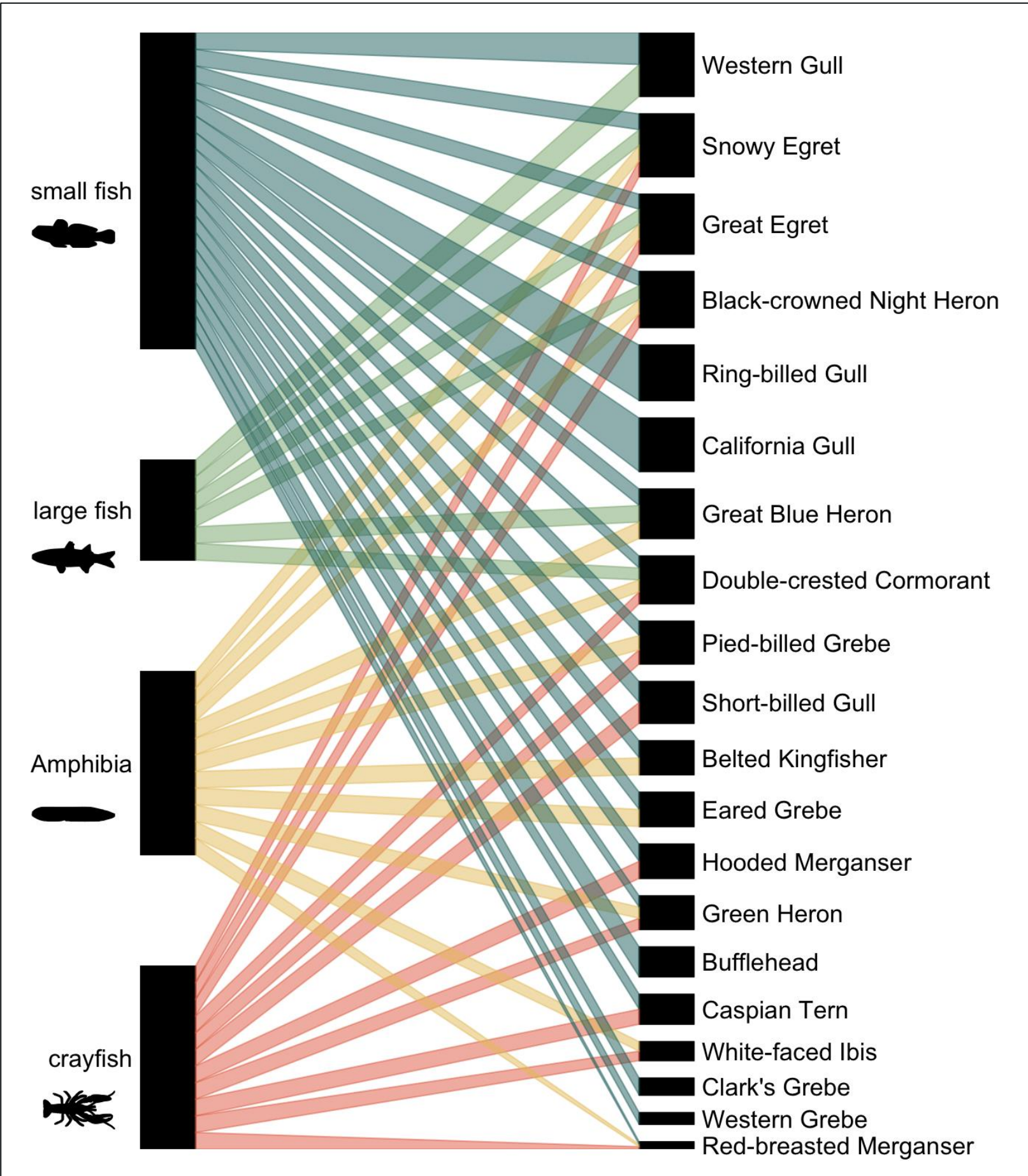


Figure 2: Bipartite trophic network showing feeding relationships between selected bird species and broad categories of aquatic prey at NCOS. Bird node size reflects log-transformed abundance; prey node size reflects number of linkages.

Discussion

- The high degree of connectivity observed in both networks suggests substantial overlap in prey use among bird species.
- Many taxa rely on shared aquatic resources within the system.
- Highly connected prey groups, like Chironomidae and small fish appear to function as key resources supporting multiple avian species.
- Variation in the number of trophic links among bird species indicates differences in foraging strategies.
- Some species exhibit generalist feeding behavior while others show patterns consistent with dietary specialization.

Future Directions

- Because these trophic networks represent potential rather than directly observed interactions at NCOS, some interactions may be missing while others may not occur within this specific region.
- Future field work such as direct foraging observations or diet analyses may help to confirm if interactions proposed are actually occurring at NCOS.

References

1. Senesac, S. (2022). Aquatic Invertebrates of the Devereux Slough; 2018-19. <https://escholarship.org/uc/item/55848339>

2. Billerman, S. M., Keeney, B. K., Kirwan, G. M., Medrano, F., Sly, N. D., & M. G. Smith (Eds.). (2026). Birds of the World—Cornell Lab of Ornithology. Cornell Laboratory of Ornithology. <https://doi.org/doi.org/10.2173/bow>

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