

Supplementary material for

Reconstructing Long-Term Changes in Avian Populations Using Lake Sediments: Opening a Window Onto the Past

Matthew P. Duda^{1*}, Kathryn E. Hargan², Neal Michelutti¹, Jules M. Blais³, Christopher Grooms¹, H. Grant Gilchrist⁴, Mark L. Mallory⁵, Gregory J. Robertson⁶, John P. Smol¹

¹Paleoecological Environmental Assessment and Research Lab (PEARL), Department of Biology, Queen's University, Kingston, ON, Canada

²Department of Biology, Memorial University of Newfoundland, St. John's, NL, Canada

³Department of Biology, University of Ottawa, Ottawa, ON, Canada

⁴Environment and Climate Change Canada, Wildlife Research Division, Ottawa, ON, Canada

⁵Department of Biology, Acadia University, Wolfville, NS, Canada

⁶Environment and Climate Change Canada, Wildlife Research Division, Mount Pearl, NL, Canada

*** Correspondence:**

Matthew P. Duda

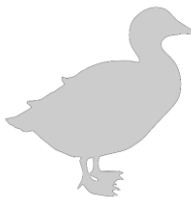
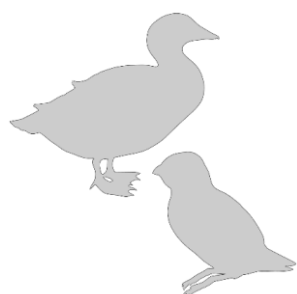
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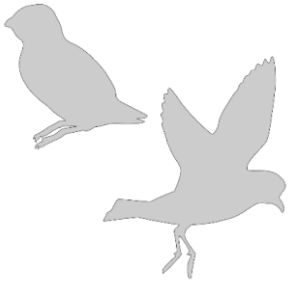
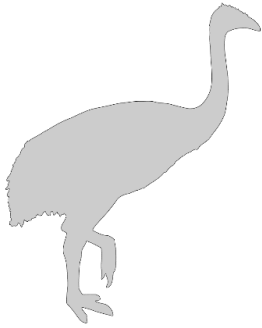
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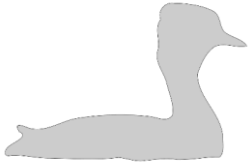
Supplementary Table 1

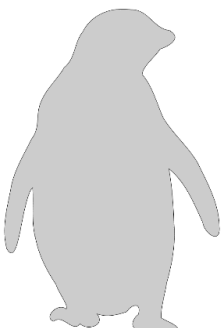
Supplementary References

Supplementary Table 1: List of the primary literature reviewed in this paper that used paleolimnological approaches to make inferences about past bird populations. This is not a full list of all such studies. LOI is loss-on-ignition and includes the roasting temperature. MS is magnetic susceptibility. VNIRS is visible and near-infrared spectroscopy. “Nutrients” includes total organic carbon, total nitrogen, and C:N ratios.

Order	Species	Region	Proxies used	Reference
Anseriformes 	Pink-footed goose (<i>Anser brachyrhynchus</i>); brant goose (<i>Branta bernicla</i>)	Europe (Svalbard)	Chironomids, ostracods, <i>Daphnia</i> ephippia, MS, LOI ₅₅₀	Luoto et al. (2014)
	Common eider (<i>Somateria mollissima borealis</i>)	North America (Canadian Arctic)	$\delta^{15}\text{N}$, sterols and stanols	Hargan et al. (2019)
Anseriformes; Charadriiformes 	Barnacle goose (<i>Branta leucopsis</i>); Arctic tern (<i>Sterna paradisaea</i>); glaucous gull (<i>Larus hyperboreus</i>)	Europe (Svalbard)	$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, nutrients	Yuan et al. (2010)
	Barnacle goose; little auk (<i>Alle alle</i>); Arctic tern	Europe (Svalbard)	MS, LOI ₅₅₀ , nutrients, water content, chironomids, Cladocera	Luoto et al. (2015) ^a
	Barnacle goose; little auk	Europe (Svalbard)	MS, nutrients, $\delta^{15}\text{N}$, $\delta^{13}\text{C}$, chironomids, Cladocera, diatoms	Luoto et al. (2019)
	Common eider; little auk; thick-billed murre (<i>Uria lomvia</i>)	North America (Greenland)	$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, bio-elements, nutrients	Davidson et al. (2018) ^b

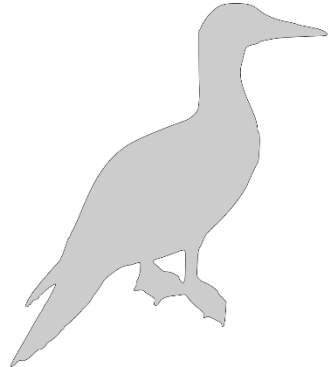
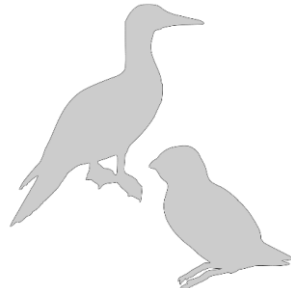
Charadriiformes 	Little auk	North America (Greenland)	$\delta^{15}\text{N}$, bio-elements, sterols and stanols, diatoms	Ribeiro et al. (2021)
Charadriiformes; Procellariiformes 	Little auk; thick-billed murre; black guillemot (<i>Cepphus grylle</i>); Atlantic puffin (<i>Fratercula arctica</i>); black-legged kittiwake (<i>Rissa tridactyla</i>); northern fulmar (<i>Fulmarus glacialis</i>)	North America (Greenland)	Pollen, bio-elements, nutrients	Wagner and Melles (2001)
Dinornithiformes; Gruiformes; Psittaciformes 	South Island takakē (<i>Porphyrio hochstetteri</i>); kakapo (<i>Strigops habroptilus</i>); South Island giant moa (<i>Dinornis robustus</i>); heavy-footed moa (<i>Pachyornis elephantopus</i>); upland moa (<i>Megalapteryx didinus</i>); coastal moa (<i>Euryapteryx curtus</i>)	Oceania (New Zealand)	<i>Sporormiella</i> spores	Wood et al. (2011)

Podicipediformes				
	Slavonian grebe (<i>Podiceps auritus</i>)	Europe (Great Britain)	Chironomids, diatoms, pigment analysis, LOI ₅₅₀	Brooks et al. (2012)
Procellariiformes	Northern fulmar	North America (Canadian Arctic)	bio-elements	Brimble et al. (2009)
			$\delta^{15}\text{N}$, VNIRS-inferred chlorophyll- <i>a</i> , chironomids, bio-elements, contaminant concentration	Michelutti et al. (2009)
			$\delta^{15}\text{N}$, chironomids, <i>Daphnia</i> ephippia	Griffiths et al. (2010)
			$\delta^{15}\text{N}$, diatoms, nutrients, VNIRS-inferred chlorophyll- <i>a</i> , pigment analysis	Keatley et al. (2011)
			$\delta^{13}\text{C}$, $\delta^{15}\text{N}$, sterols and stanols	Cheng et al. (2021)
	Leach's storm-petrel (<i>Hydrobates leucorhous</i>)	North America (Atlantic Canada)	$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, diatoms, chironomids, bio-elements	Duda et al. (2020a)
			Pollen, sterols and stanols	Duda et al. (2020b)
			$\delta^{15}\text{N}$, diatoms, chironomids, bio-	Duda et al. (2020c)

			elements, VNIRS-inferred chlorophyll- <i>a</i> , sterols and stanols	
Sphenisciformes 	Adélie penguin (<i>Pygoscelis adeliae</i>)	Antarctica	bio-elements	Zale (1994); Xu et al. (2020)
			bio-elements, nutrients	Huang et al. (2009a, 2011)
			bio-elements, nutrients, sterols and stanols, <i>n</i> -alkyls	Huang et al. (2010)
			Sterols and stanols, nutrients, <i>n</i> -alkyls	Hu et al. (2013)
			VNIRS-inferred chlorophyll- <i>a</i> , pigment analysis, phosphorus	Chen et al. (2013)
			$\delta^{13}\text{C}$, nutrients, bio-elements	Liu et al. (2013)
			Rare earth elements, nutrients	Nie et al. (2014a)
			Water content, nutrients, $\delta^{15}\text{N}$, $\Delta^{15}\text{N}$	Nie et al. (2014b)
			Bio-elements, grain size analysis, MS, pigment analysis	Nie et al. (2015)
			$\Delta^{199}\text{Hg}/\Delta^{201}\text{Hg}$	Zheng et al. (2015) ^c
			Bio-elements, nutrients, acid soluble	Gao et al. (2018a)

			Sr, nutrients, sterols and stanols	
			Bio-elements, LOI ₅₅₀	Gao et al. (2018b)
			$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, bio-elements	Gao et al. (2018c)
			Bio-elements, $\delta^{15}\text{N}$	Yang et al. (2018)
			Nutrients, $\delta^{15}\text{N}$, sterols and stanols	Yang et al. (2021)
	Emperor penguin (<i>Aptenodytes forsteri</i>)	Antarctica	Nutrients, bio-elements, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$	Huang et al. (2014, 2016)
	Adélie penguin; emperor penguin	Antarctica	<i>n</i> -alkyls, $\delta^{13}\text{C}$, bio-elements, sterols and stanols	Chen et al. (2020a)
	Gentoo penguin (<i>Pygoscelis papua</i>); Adélie penguin; chinstrap penguin (<i>Pygoscelis antarctica</i>)	Antarctica	$\delta^{13}\text{C}$, bio-elements	Sun et al. (2000)
			Bio-elements	Sun et al. (2004); Liu et al. (2005)
			Geochemistry, $^{87}\text{Sr}/^{86}\text{Sr}$	Sun et al. (2005)
			LOI ₅₅₀ , LOI ₉₅₀ , $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, nutrients, bio-elements	Liu et al. (2006b)
			Bio-elements, VNIRS-inferred pigments	Liu et al. (2011)
			Bio-elements, nutrients, diatoms	Roberts et al. (2017)
			Bio-elements, grain size analysis, LOI ₅₅₀	Yang et al. (2019)

			Nutrients, bio-elements, acid-volatile sulfur (AVS)	Chen et al. (2020b)
			Moisture content, nutrients, LOI ₅₅₀ , sulfur species	Chen et al. (2020c)
	Gentoo penguin; Adélie penguin; chinstrap penguin; southern giant petrel (<i>Macronectes giganteus</i>); Wilson’s storm-petrel (<i>Oceanites oceanicus</i>); black-bellied storm-petrel (<i>Fregetta tropica</i>)	Antarctica	Bio-elements, nutrients	Sun and Xie (2001)
			Bio-elements	Sun et al. (2001); Xie and Sun (2008)
	Penguins (unspecified)	Antarctica	Nutrients, arsenic speciation, δ ¹³ C, pigment analysis	Lou et al. (2016)
		Antarctica	<i>n</i> -alkyls, nutrients, bio-elements	Wang et al. (2007)
			Bio-elements, nutrients, diatoms, pigment analysis	Wasiłowska et al. (2017)
	Penguins (unspecified); skua (unspecified)	Antarctica	Water content, LOI ₅₅₀ , nutrients, bio-elements, ⁸⁷ Sr/ ⁸⁶ Sr, amino acid composition	Liu et al. (2007)
	Suliformes	Red-footed booby (<i>Sula sula</i>)	Asia	Bio-elements

			Bio-elements, grain size analysis, LOI ₅₅₀ , LOI ₉₅₀ , nutrients	Liu et al. (2006c)
			Bio-elements, nutrients	Yan et al. (2011); Xu et al. (2011, 2019)
			VNIRS analysis	Xu et al. (2012)
			Bio-elements, VNIRS analysis	Xu et al. (2016)
			$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, VNIRS analysis	Wu et al. (2017a)
			VNIRS analysis, nutrients, $\delta^{13}\text{C}$	Wu et al. (2017b)
			$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, VNIRS analysis, nutrients	Wu et al. (2018)
Suliformes; Charadriiformes 	Double-crested cormorant (<i>Phalacrocorax auritus</i>); ring-billed gull (<i>Larus delawarensis</i>)	South America (Galápagos Islands)	$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, pollen, nutrients	Conroy et al. (2015)
		North America (Laurentian Great Lakes)	$\delta^{15}\text{N}$, VNIRS-inferred chlorophyll- <i>a</i> , diatoms	Stewart et al. (2015, 2019)
			Bio-elements, $\delta^{15}\text{N}$, chironomids	Hargan et al. (2018); Stewart et al. (2020)

^aSvalbard reindeer (*Rangifer tarandus platyrhynchus*) were also present in the catchment.

^bThis study used a combination of lake and peat deposits.

^cCrabeater (*Lobodon carcinophaga*) and weddell seals (*Leptonychotes weddellii*) were also present in the catchment.

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