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Learning from DNA in dirt: Use of sedimentary DNA (sedDNA) in reconstructing the history of freshwater fish settlement in lakes in the Alberta Oil Sands Region

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Environmental DNA (eDNA) studies have proliferated over the last decade, with promising data generated to describe the diversity of macro- and micro-organisms in most environments. The recovery of DNA preserved in the sediment of aquatic systems (sedDNA) has provided short-term and long-term data on biological groups (e.g., bacteria, phytoplankton, zooplankton, and fishes) and has advanced our understanding of how environmental changes have affected aquatic communities. Herein, we demonstrate the utility of fish sedDNA from lake sediment cores in reconstructing the paleolimnological history of fish settlement in selected lakes within the Oil Sands region in Alberta. Eight targeted qPCR-based eDNA assays for freshwater fish species were rigorously designed and validated. We also applied a coupled precipitation and column-based approach to effectively isolate and detect sedDNA. With these tools and methods in hand, we detected sedDNA from native and non-native freshwater fish species in sediment cores spanning over a century, which corroborated historical records of human-mediated introductions. The use of fish sedDNA provided greater temporal resolution into the historical fish faunal records, bridging the knowledge gap that spanned from 100- to 150-year-old data. The present study also provides confirmation of native fish species presence in different lakes through sedDNA detection, predating human-mediated introductions in each lake. Our findings enabled the refinement of native freshwater fish ranges and clarification of the effect of human-mediated introductions in fish diversity in aquatic bodies within the Oil Sands region providing critical baseline information for environmental impact assessments.