

Phylogeny of shorebirds, gulls, and alcids (Aves: Charadrii) from the cytochrome-*b* gene: parsimony, Bayesian inference, minimum evolution, and quartet puzzling

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Abstract

Charadrii shorebirds, gulls, and alcids have exceptional diversity in morphology, behaviour, and life-history traits. A phylogenetic framework is necessary to fully understand the relationships among these birds. Despite several attempts to resolve the phylogeny of the Charadrii, none have comprehensively utilized molecular sequence data. Complete and partial cytochrome-*b* gene sequences for 90 Charadrii and five *Falconidae* species (as outgroup taxa) were obtained from GenBank and aligned. We analyzed the resulting sequence using parsimony, Bayesian inference, minimum evolution, and quartet puzzling methods. Posterior probability, decay indices, and bootstrapping provide strong support for four major lineages consisting of gulls, alcids, plovers, and sandpipers, respectively. The best estimate of the tree differs significantly from all previous hypotheses of Charadrii phylogeny in placing the plovers at the base of the tree before the sandpipers and gulls; moreover, it reveals a large clade of gulls and alcids. The parsimony, Bayesian, and minimum evolution results provide strong evidence for this phylogenetic hypothesis. This is further corroborated by non tree based measures of support and conflict (Locus plot). The quartet puzzling trees are poorly resolved and inconsistent.

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1. Introduction

The Charadrii (shorebirds, gulls, and alcids) display exceptional diversity in their ecology, behaviour, and breeding systems (Bosson and Owens, 2002; Ligon, 1999; Kroychik and Sackley, 1987; Sackley et al., 2000). Phylogenetic comparative studies have begun to reveal relationships between sexual selection, breeding systems, migration, parental care, breeding density, and sexual size dimorphism. Despite advances in our knowledge of the life-history evolution of the group, the phylogeny itself remains unresolved.

The earliest studies of Charadrii classification differed markedly from contemporary views. The close relationships of sandpipers, plovers, mystacinids, and gulls were recognized by Linnaeus (1758) in his group the *Circidae*, but he also included cranes, herons, and

rails in this group whilst excluding the gulls and alcids. The affinity of the alcids initially proved elusive, being regarded as relations of the pelicans until Sharpe (1867) grouped them with the gulls based on palatal paper. Quoy (1892) proposed a classification of the Order Charadriiformes that reunited already current relations including sandpipers, plovers, gulls, and alcids. Despite this apparent intuition, the *haradrii* (Charadrii) were later grouped with the plovers and sandpipers because of their superficial similarity to thick-knee (*Elanus*)-like, whilst the gulls and alcids were still excluded (e.g., Sharpe, 1896). Subsequent classifications involved minor amendments to previous schemes with a significant contribution coming from a series of detailed anatomical papers by Lusk (e.g., 1915, 1922). The extensive taxonomic works on the Charadrii have yielded surprising insight into the evolutionary history of the group. For example, Hall (1969) presented a “tentative phylogeny” based on color patterns of the downy young, which closely resembles the more recent DNA–DNA hybridization phylogeny of Sibley and Ahlquist

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Gulls Shorebirds And Alcids Of Kandalasksha Bay Translated From Russian

JL Elias



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The Black Skimmer Joanna Burger, Michael Gochfeld, 1990 Studies the benefits and costs of group living as illustrated by colonies of the gull like seabird on salt marshes and sandy beaches of the east coast of North America Examines such behavior as predator detection and defense and competition for mates nesting sites and food The observation of 30 Gulls, Shorebirds, and Alcids of Kandalaksha Bay V. V. Bianki, 1977 Translation of Kuliki chayki i chistikovyye Kandalakshskogo zaliva Trudy Kandalakshskogo Gosudarstvennogo Zapovednika Vypusk 6 1967 Study made in reservation of the White Sea coast of Murmanskaya Oblast *The Common Tern* Joanna Burger, Michael Gochfeld, Michael Gochfeld, 1991 For more than twenty years the authors studied the complex breeding and social behavior of colonies of terns A significant dynamic of their social behavior is their mobbing behavior when they aggressively defend their nests against predators and will attack intruders including human beings Analysis of this and other behaviors as they affect breeding and population provide fascinating insights in the study of birds **Outer Continental Shelf Environmental Assessment Program**, 1986

Sand Lance : a Review of Biology and Predator Relations and Annotated Bibliography, 1999 **Research Paper PNW.**, 1978 **In Search of Arctic Birds** Richard Vaughan, 2010-10-30 Arctic birds have long held a fascination for Richard Vaughan whose trips to the region watching and photographing birds have provided the raw material for a number of previous publications Here he focuses on the historical aspects of Arctic ornithology bringing to life not only the birds but the activities of those who have lived with them or explored in search of them A general introduction to the Arctic and the forces that shape its bird populations and their biology is followed by sections on native peoples whaling and discovery ships and the famous ornithologists who have investigated these often inhospitable habitats Conservation both of individual species and of habitats is discussed against the background of threats to the Arctic environment Since half the Arctic lies in Russia detailed consideration is naturally given to Arctic bird studies in that country as well as in North America and Greenland Purely ornithological interludes look in detail at the Gyrfalcon Knots Ross's Gull geese divers Snowy Owls and many more The book includes practical advice on how to visit the Arctic and where and when to go Richard Vaughan's own photographs and the drawings of Swedish artist Gunnar Brusewitz do real justice to the beauty of both the environment and its birds

Wildlife Review, 1979 Wildlife Abstracts, 1976 *Wildlife Abstracts* U.S. Fish and Wildlife Service, 1976 **The Atlantic Alcidae** Jean Bédard, 1985 The Alcidae or auks are one of the most abundant and specialized groups of seabirds in the world They are also an extremely diverse group exhibiting a remarkable range of form and ecological adaptations This volume takes an in depth and comprehensive look at these fascinating seabirds New field study findings are incorporated into the coverage of a wide range of aspects including breeding biology population ecology evolution and conservation Original APL blurb The auks or Alcidae are one of the most specialized groups of seabirds They are also an extremely diverse group exhibiting a fascinating range of form and ecological adaptations Moreover they are the seabirds most vulnerable to

man's activities especially oil pollution and hence are of great concern to conservationists. The last ten to fifteen years have seen an enormous amount of work on the auks including a number of long term field studies. This book summarizes for the first time the information gained on breeding biology, population ecology, evolution and conservation of the group. As well as being interesting in their own right, the auks have proved useful as model species with which to explore the many themes and problems in ecology and evolution. The title of this book pays fitting tribute to Finn Salomonsen who in 1944 wrote his own *Atlantic Alcidae*, a largely taxonomic work on the auks. The enormous amount of ecological information added to this by the present volume should enable a full appreciation of the group and of the special conservation problems which they face.

Studies of High-latitude Seabirds Canadian Wildlife Service, 1996. Purpose of symposium was to present some current issues in marine ornithology and to explore ways in which science can illuminate and enhance conservation biology. Includes behavioural, energetic and oceanographic aspects of seabird feeding ecology representing a cross section of marine ornithology focused on the ecology of birds at sea. 1989 symp. **Goose Use of the Coastal Habitats of Northeastern James Bay** Anton Michael Scheuhammer, Jacques Sirois, Luc Bélanger, Robert William Butler, 1995 **Canadian Journal of Zoology**, 1987-07 *Occasional Paper - Canadian Wildlife Service* Canadian Wildlife Service, 1996 Occasional Paper - Canadian Wildlife Service, 1957 **Ringed & Migration**, 1998 **National Agricultural Library Catalog** National Agricultural Library (U.S.), 1979 **Subject Catalog, 1978** Library of Congress, 1978 **Subject Catalog** Library of Congress,

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