

The black-and-white drawings by Tony Angell are of great quality and illustrate well the points made in the book. The printing, layout, and binding are outstanding. Both the author and the artist deserve congratulations for this excellent work which should

be in the library of any person seriously interested in birds.

HENRI OUELLET

National Museum of Natural Sciences, P.O. Box 3443,
Station D, Ottawa, Ontario, K1P 6P4

A Natural History of Digges Sound

By A. J. Gaston, D. K. Cairns, R. D. Elliot, and D. G. Noble. 1985. Report Series No. 46. Canadian Wildlife Service, Ottawa. 63 pp., illus. \$8.00 in Canada; \$9.60 elsewhere.

Digges Sound lies at the junction of Hudson Bay and Hudson Strait. A Canadian Wildlife Service team studied the large seabird colonies on the Digges Islands and adjacent mainland from 1979 to 1982. These colonies are a conspicuous part of the regional marine and terrestrial ecosystems. Thick-billed Murres dominate the colonies, but several other species are of particular interest because they are at the limits of their ranges. Here, the Iceland Gull is at the southwestern limit of its range, while the Atlantic Puffin and Razorbill are at the northwestern limits of their ranges in Canada. Glaucous and Herring gulls, Black Guillemots, and Arctic Terns also breed at or near the main colonies.

While the CWS team concentrated on seabirds, in particular the murres, they did not limit their investigations to these. The report by Gaston and his associates is indeed a natural history in the traditional sense, and offers a compendium of diverse observations on the flora, fauna, and landscape. They also present a substantial set of detailed data on seabird populations, breeding biology and diet, together with data on the impact of predators on the colonies.

Among the more interesting results of the study was that the low diversity of these colonies compared to High

Arctic colonies, illustrated by the complete absence of Northern Fulmars and Black-legged Kittiwakes, remained inexplicable, despite the apparent availability of suitable feeding areas, prey and nesting sites. The results highlight how little the physical and biological oceanography of Hudson Bay has been studied. This suggests a substantial gap in Canada's ability to understand and manage its coastal waters. It is also unfortunate that the link between research on marine birds and more general marine ecology remains tenuous, in spite of the strenuous efforts of some people. Nevertheless, a useful contribution to information on the distribution of marine organisms of the area is made in this report. By inference from the observations on the distribution of birds at sea, one gains a feel for where concentrations of these organisms may occur.

The report is largely free of errors, apart from some omissions and inconsistencies in the references. The text is relaxed yet informative. There are numerous illustrations, with a couple of quite stunning photographs. Even those with only a passing interest in the intricacies of the lives of murres may find this a diverting account of a beautiful and rather remote part of the country.

J. RODERICK FORBES

Institute of Ocean Sciences, P.O. Box 6000, Sidney, British Columbia V8L 4B2

Biology of the Arctic Charr: Proceedings of the International Symposium on Arctic Charr

Edited by Lionel Johnson and Bonnie Burns. 1985. University of Manitoba Press, Winnipeg. 584 pp. \$60.00.

The Arctic Charr occupies a large range in Canada and reaches about 4000 km from north to south between the northern tip of Ellesmere Island and New Brunswick and covers over 3000 km from west to east between Alaska and Greenland. Since the Arctic Charr is a wide-ranging species of interest as a sport fish, a local source of food, and an item of commerce,

the biology of this fish is of great importance to Canada. This book brings together 43 studies on the Arctic Charr and its relatives in Canada, Iceland, Scotland, England, West Germany, Switzerland, Austria and Norway — the result of the International Symposium on Arctic Charr held in Winnipeg, 4–8 May 1981, on the campus of the University of Manitoba.

There are too many papers to comment on in the available space, so I will select a sample. R. J. Behnke

discusses taxonomy of the subgenus *Salvelinus* which he divides into the Dolly Varden complex (it includes *S. leucomaenis*, *S. confluentus*, *S. albus* and *S. malma*), and the Arctic Charr complex. Contrary to K. A. Savvaitova, he finds no evidence of intermediacy or hybridization between the Dolly Varden and Arctic Charr, and this is now supported by the recent studies of I. A. Chereshev. Behnke names his northern form of Dolly Varden *S. m. malma*. This form ranges in North America from the Alaska Peninsula to the Mackenzie River, while the southern form is called *S. m. lordi*, and a third subspecies which ranges from Honshu to south of the Amur River is called *S. m. krascheninnikovi*. He divides the Arctic Charr in North America into a western (Bristol Bay to Gulf of Alaska) form, an eastern Arctic form, and an Atlantic form (New England and southern Quebec) that is recognized as *S. alpinus oquassa*. Behnke performs a valuable service in providing diagnoses to and ranges of species, however brief, and in attempting to find the earliest names for each taxon (though without dates). A comparative character table would have been useful.

Nyman reviews the management of allopatric and sympatric populations of land-locked Arctic Charr in Sweden. He emphasizes the importance of taxonomic analysis in enabling effective management. Swedish authors have examined over 25 000 charr samples from hundreds of lakes using life history, electrophoretic, and morphological approaches. An adequately supported similar project is needed in Canada where we are not yet even sure how far the Dolly Varden ranges east in Arctic Canada.

Based on study of blood serum esterases, Klemetsen recognizes three different population groups of Arctic Charr in Norway, and Gydemo similarly found three groups in Iceland. They believed that these corresponded to Nyman's three sibling charr species. However, two distinct spawning groups of charrs from Bear Island could not be separated by serum esterase analysis. Clearly, Arctic Charr taxonomy calls for more than a single diagnostic tool.

A paper by Eugene Balon reminds scientists that they should not consider speciation solely as the action of selection on isolated characters in the adult stage. Altricial and precocial dynamic states may operate continuously in ontogeny. The process of juvenilization may reverse specialization and may permit survival instead of extinction of a stock. He reinterprets "dwarf" and "normal", sunapee and anadromous *Salvelinus alpinus*, Lake Charr and Siscowet, and brook and aurora *Salvelinus fontinalis* as altricial and precocial pairs. Ali and Klyne view the Arctic Charr through its visual system. They consider

that the Arctic Charr has adapted to seasonally very short and very long day lengths and to shallow and deep water through flexibility in rhythmic retinal patterns, rather than specific retinal structures. Selection of a different type was studied by Jensen, who found that gillnet selectivity on Brown Trout, Arctic Charr and whitefish seemed quite comparable: each was more dependent on the condition of the fish than on the species.

Dick studied the value of parasites as biological tags in the management of Arctic Charr. He found they may be of use in some populations to distinguish sea-run from non-anadromous populations but cautions that variance in distribution of parasites requires the tags to be evaluated for each drainage system. Black reports on using *Cystidicola* species as tags marking dispersal of their charr hosts from different glacial refugia and reported on a field study on the biology of *C. cristivomeri*.

Cavender reports that *Salvelinus fontinalis*, *S. namaycush* and *S. leucomaenis* possess a primitive karyotype for *Salvelinus*, while *S. confluentus*, *S. malma*, and *S. alpinus* possess a derived karyotype. Karyotype differences are found between *S. confluentus* and *S. malma* and confirm the distinctness of these two species, but karyotypes of the latter and *S. alpinus* are close. The differences between the southern and northern form of Dolly Varden suggests that they may differ at the species level and that the northern Dolly Varden may have a sister relationship with the Arctic Charr.

Historically, eutrophication in Lake Constance was found by Hartmann to yield an initial increase and then a decrease in yield. Milbrink and Holmgren found that artificial fertilization could be used to increase production of zooplankton and stream bottom fauna and promotion of Arctic Charr. Other historical studies include a 400-year survey on the Lake Windermere charr fishery in England by Kipling and the Inuit Arctic Charr fishery in northern Labrador by Ledrew.

The convenors, editors and participants of the charr symposium are to be highly complimented on producing an intellectually exciting and very informative book on charrs. The reader will learn much, but there is yet much to be learned on this widespread, highly adaptable complex. I wholeheartedly recommend it to all who work with charrs.

DON E. MCALLISTER

Ichthyology Section, National Museum of Natural Sciences,
P.O. Box 3443, Station D, Ottawa, Ontario K1P 6P4



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