Reproductive Science and Integrated Conservation

Reproduction is essential to the continuation and evolution of life on this planet and is therefore a centrally important process in the conservation of wildlife. However, reproductive mechanisms are well understood in only a handful of vertebrate species, mostly the human, domestic livestock and laboratory animals. This means that attempts to develop and implement management policies for wildlife conservation, and especially for endangered species that, by definition, are difficult to study, are often based on poor data or no data at all. In *Reproductive Science and Integrated Conservation* leading authorities provide glimpses of reproductive diversity in fishes, amphibia, reptiles, birds and mammals. Conservation plans are founded on the assumption that reproduction will be successful, but what if it fails? This book reviews the many factors that influence reproduction, including genetics, behaviour and nutrition, and experts assess the potential conservation relevance of the recent rapid advances in reproductive technology and medicine.

This book is based on a symposium that the editors convened at the Zoological Society of London in November 2000 to make the New Millennium. Here, the speakers have the opportunity to present their vision of Reproductive Sciences and Integrated Conservation to a wider audience.

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Conservation Biology

Conservation biology is a flourishing field, but there is still enormous potential for making further use of the science that underpins it. This series aims to present internationally significant contributions from leading researchers in particularly active areas of conservation biology. It focuses on topics where basic theory is strong and where there are pressing problems for practical conservation. The series includes both single-authored and edited volumes and adopts a direct and accessible style targeted at interested undergraduates, postgraduates, researchers and university teachers. Books and chapters should be rounded, authoritative accounts of particular areas with the emphasis on review rather than original data papers. The series is the result of a collaboration between the Zoological Society of London and Cambridge University Press. The series editors are Professor Morris Gosling, Professor of Animal Behaviour at the University of Newcastle upon Tyne, Professor John Gittleman, Professor of Biology at the University of Virginia, Charlottesville, Dr Rosie Woodroffe of the University of California, Davis and Dr Guy Cowlishaw of the Institute of Zoology, Zoological Society of London. The series ethos is that there are unexploited areas of basic science that can help define conservation biology and bring a radical new agenda to the solution of pressing conservation problems.

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Reproductive Science and Integrated Conservation

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Marsupial CRC

CAMBRIDGE UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK
40 West 20th Street, New York, NY 10011-4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa

http://www.cambridge.org

First published 2003

Printed in the United Kingdom at the University Press, Cambridge

Typeface FF Scala 9.75/13 pt. *System* LaTeX 2_ε [TB]

A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication data

Reproductive science and integrated conservation / edited by William V. Holt . . . [et al.].
p. cm. – (Conservation biology ; 8)
Includes bibliographical references.
ISBN 0 521 81215 1 (hb) – ISBN 0 521 01110 8 (pbk.)
1. Conservation biology. 2. Reproduction. I. Holt, W. V. II. Conservation biology series
(Cambridge, England) ; 8.
QH75 .R458 2003 573.6 – dc21 2002067375

ISBN 0 521 81215 1 hardback
ISBN 0 521 01110 8 paperback

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Grateful thanks go to North of England Zoological Society, for contributing to the cost of producing this book.

Foreword

RICHARD STONE

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By playing a role in the near-annihilation of a species, Theodore Roosevelt, the president of the United States at the turn of the twentieth century, unwittingly laid the groundwork for the most dramatic triumph yet in the use of artificial insemination (AI) to rescue a species from extinction.

In the early 1900s, waves of immigrants from Europe settled in the American Midwest. As humans transformed the land, they declared war on a perceived pest: the prairie dog. That might have seemed an affront to Roosevelt, an ardent conservationist who was once quoted as saying, 'When I hear of the destruction of a species, I feel as if all the works of some great writer had perished.' Apparently, however, Roosevelt didn't think much of the literary aspirations of prairie dogs. Delighted at the booming agricultural productivity in the country's heartland, his administration donated poison and other weapons to the farmers. By World War I, only two prairie dogs were left for every hundred alive when Roosevelt had assumed the presidency in 1901.

An innocent victim of the eradication campaign was the black-footed ferret, which preyed on the prairie dogs. By 1979, there were no more of these weasel-like raiders to be found. The species rose from the dead two years later, when 130 black-footed ferrets were discovered in a quiet corner of a Wyoming ranch. Calamity struck in 1985, when canine distemper and sylvatic plague wiped out all but 18 individuals. Scientists trapped the survivors and whisked them to a breeding facility for a last-ditch attempt to save the species. Through dogged research on the animal's reproductive biology, researchers over the last decade have learned how to get black-footed ferrets to mate successfully, as Howard and her co-authors explain in this volume.

Using artificial insemination, Howard's team has brought the species out of the extinction red zone. Today, instead of poor reproduction, the most pressing threat to the black-footed ferret's re-establishment in the wild is a shortage of 'spare' prairie dog communities to be sacrificed for the sake of the predator's survival.

This story offers three crucial lessons. The first is that no species can be managed in isolation. Last century, the black-footed ferret was 'collateral damage' in the war on prairie dogs. Today, species management demands an enlightened ecosystem-wide approach, including balancing the population dynamics of predators and prey. That balancing act can be particularly daunting when attempting to reintroduce a species into a degraded habitat. But scientists have shown that it can be done, and not only with a single species. In Western Australia, three mammals – the woylie, the tammar wallaby, and the quenda – are being reintroduced successfully into the wild, thanks to a remarkable fox and cat control programme that Fletcher and Morris outline in this volume.

Returning to our black-footed ferret friends, the second lesson they give us is to expect frustration when trying to get a little-known animal to breed in captivity. As David Wildt and his colleagues point out in this volume, only 14 species – including humans, cattle and other domesticated livestock, and lab animals such as mice and cats – have received nearly all the attention of reproductive biologists. 'We have scarcely begun to investigate the most fundamental reproductive science in virtually all vertebrate species on Earth', they write. The problem is that this trove of knowledge about the reproductive predilections of any of these 14 familiar species rarely, if ever, corresponds to the predilections of wild animals. To cite a well-known Wildt epigram, a cheetah is not a cow. AI instruction manuals must be written species by species.

The third lesson is more heartening: 'high-tech' approaches to getting a species to procreate can work. Only a handful of radical thinkers would argue that AI and other techniques are a substitute for setting aside habitat and leaving wild animals to reproduce according to their own rhythms. But in instances where a species is imperilled because its habitat is severely fragmented or destroyed, AI and other eleventh-hour heroics not only have a place in conservation biology, but also may be vital to sustaining enough genetic diversity to keep a species afloat. As a population dwindles, so does its gene pool. As Thomas J. Foose put it eloquently in *Riders of the Last Ark*, 'The problem is that gene pools are being converted into gene puddles as the populations of species are reduced and fragmented. Gene puddles are vulnerable to evaporation.'

Because this evaporation is occurring all around us, the need is more urgent than ever to stockpile sperm, eggs, and other tissues of threatened or endangered species. While efforts to establish genetic resource banks (GRBs) have been under way for more than half a century, only recently have these projects started being coordinated to standardise their protocols. And too few GRBs are linked with managed breeding programmes. Such alliances would put cryopreserved gametes to the best use to '. . . prevent the decline of small populations of rare and threatened species by extending the population size, and allowing founders and ancestors to continue contributing to the gene pool,' as Holt and his colleagues note in this volume.

Although currently playing a limited role in species preservation, GRBs will assume greater importance as the technology of nuclear transfer, or cloning, matures. But as Critser and his colleagues warn in this volume, the potential success of cloning hinges on the depth of knowledge of a target species' reproductive biology. To make matters even more complicated, if a cloned embryo is implanted in a surrogate mother of a closely related species, the surrogate too must not be a reproductive black box to maintain any hope of success. Still, for a species down to its last few individuals – beyond the point of no return for natural mating or assisted breeding – cloning may offer the *only* hope of salvation. Clones resurrected from GRB samples could restore valuable genes to a population, replenishing genetic diversity. The dream of using cloning to bring back an extinct species like the woolly mammoth, meanwhile, will (and should) remain a fantasy until the technology matures such that several mammoth individuals – a breeding population – might be resurrected and introduced into suitable habitat.

Some experts argue that media attention on the possibility of using cloning to preserve endangered species is premature, feeding '. . . a myth that we are on the edge of using this sophisticated technology on a grand scale,' as Loskutoff notes in this volume. If so, wildlife biologists should speak up loudly and clearly to ensure that the public is getting a consistent message. Perhaps that message would emphasise that there is absolutely no substitute for conserving habitat and allowing animals to live in peace in the wild. But the message – geared both to the public and to funding agencies – might also emphasize that some imperilled species need not vanish from the Earth if resources are devoted to building a knowledge base in wildlife reproductive biology that will nurture high-tech approaches to conservation.