The International Journal of Conservation

Published for Fauna & Flora International www.oryxthejournal.org

October 2019 · Volume 53 · Number 4

Carnivore conservation

The International Journal of Conservation

ISSN 0030-6053 Fauna & Flora International A company limited by guarantee registered in England 2677068 Registered Charity 1011102

A non-profit charitable institution ABN 75132715783 in Australia A non-profit organization EIN #81-3967095 in the USA

Twitter @FaunaFloraInt @OryxTheJournal

Editor

Dr Martin Fisher FFI, UK

Managing Editor

Julia Hochbach FFI, UK

Editorial Assistant Emma Muench FFI, UK

Senior Editors

Professor Bill Adams University of Cambridge, UK Professor Andrew Balmford, FRS University of Cambridge, UK Dr Porter P. Lowry II Missouri Botanical Garden, USA and France Dr Mike Maunder Eden Project, UK Professor Jeffrey A. McNeely Thailand Professor E. J. Milner-Gulland University of Oxford, UK Dr John G. Robinson Wildlife Conservation Society, USA Professor William Sutherland University of Cambridge, UK

International Board of Editors

Dr Elizabeth L. Bennett USA Professor Neil Burgess Denmark Professor Lisa Campbell USA Dr Liana Chua UK Dr Jenny Daltry UK Dr Aparajita Datta India Dr Abigail Entwistle UK Dr Joice Ferreira Brazil Dr Brendan Fisher USA Professor Brendan J. Godley UK Professor Rhys Green UK Dr George Holmes UK Professor Zhigang Jiang China Professor Julia Jones UK Dr K. Ullas Karanth India Professor Gustavo Kattan Colombia Professor Sandra Knapp UK Ashish Kothari India Professor Sarah Legge Australia

Dr David Mallon UK Sara Oldfield, OBE UK Dr Kent H. Redford USA Dr Jon Paul Rodriguez Venezuela Dr Anthony B. Rylands USA Professor Philip Seddon New Zealand Dr Noah Sitati Kenya Dr Bob Smith UK Dr Paul Smith UK Professor Rashid Sumaila Canada Dr Matt Walpole UK

Fauna & Flora International Patron

Her Majesty The Queen

President

HRH Princess Laurentien of The Netherlands

Vice Presidents

Lisel Alamilla Baroness Amos Sir David Attenborough, OM, FRS Professor David Bellamy, OBE The Lord Browne of Madingley, FR Eng Lindsay Bury Dee Caffari Charlene de Carvalho-Heineken Field Marshal Sir John Chapple, GCB, CBE, DL Viscount Philippe de Spoelberch Giles Clark Dame Judi Dench Dr Lee Durrell Hugh Fearnley-Whittingstall Dorette Louise (Dielle) Fleischmann Stephen Fry Rupert Goodman Edward Hoare Anders Johansson The Lady Emma Kitchener LVO Rove McManus Justin Mundy Blaine T. Phillips

Sir John Randall Dr Lisbet Rausing Dr Claudio Segré The Rt Hon Mark Simmonds Hugh Sloane Victoria Stack Jon L. Stryker Charles Whitbread Dr Adrian Wilson James Wong The Rt Hon Baroness Young of Old Scone

Council Chair Andrew Sykes Vice Chair Dr Mike Maunder Treasurer Paul Baldwin

Iochen Zeitz

FFI, The David Attenborough Building, Pembroke St,

FFI Australia, PO Box R697, Royal Exchange, NSW 1225, Australia

FFI USA, 1720 N Street NW, Fourth Floor, Washington, D.C. 20036,

Tel: +44 1223 571000; Fax: +44 1223 461481

E-mail ffiaustralia@fauna-flora.org

USA. E-mail ffiusa@fauna-flora.org

E-mail info@fauna-flora.org fauna-flora.org

Cambridge CB2 3QZ, UK

Anna Gavazzi David Gibson Andrew Joy Professor Sandra Knapp Annette Lanjouw Richard Plackett Sir Gareth Rhys-Williams Edward van Cutsem Diana van de Kamp Professor Bhaskar Vira Hugo van Vredenburch Richard Walker

Chief Executive Officer Mark Rose

US Board of Directors

President Professor Sandra Knapp Secretary Diana van de Kamp

Diane Alfano Dorette Louise (Dielle) Fleischmann

Australian Board of Directors Chairman Michael Forsdick

Nick Bubb Dr Angela Dwyer Mark Rose

Institutional subscription Oryx (ISSN 0030-6053) is published four times per year (one volume per annum) in January, April, July, and October. The 2019 sub-scription price (excluding VAT) of a volume, which includes print and electronic access, is £784.00 (US \$1411.00 in USA, Canada and Mexico). The electronic-only price available to institutional subscribers is £622.00 (US \$1115.00 in USA, Canada and Mexico). Orders, which must be accompanied by payment, may be sent to any book seller, subscription agent or direct to the publisher: Cambridge University Press, Journals Fulfillment Department, UPH, Shaftesbury Road, Cambridge CB2 8BS, UK; or in the USA, Canada and Mexico: Journals Fulfillment Department, Cambridge University Press, 1 Liberty Plaza, Floor 20, New York, NY, 10006, USA. EU subscribers (outside the UK) who are not registered for VAT should add VAT at their country's rate. VAT registered members should provide their VAT registration number. Japanese prices for institutions (including ASP delivery) are available from Kinokuniya Company Ltd, P.O. Box 55, Chitose, Tokyo 156, Japan. Prices include delivery by air. Periodicals postage paid at New York, NY, and at additional mailing offices. Postmaster: send address changes in USA, Canada and Mexico to: Oryx, Cambridge University Press, 1 Liberty Plaza, Floor 20, New York, NY, 10006, USA. Claims for missing issues should be made immediately on receipt of the subsequent issues.

FFI member subscription Membership of Fauna & Flora International starts from £45 a year for concessions and £85 for other members (or equivalent price in dollars/euros). For more information about FFI membership visit fauna-flora.org/membership. Enquiries about back issues for members should be addressed to the Membership Secretary at FFI (members@fauna-flora.org).

Back volumes Copies of the current volume and two previous volumes can be obtained from Cambridge University Press at the above address. Requests for previous volumes should be directed to the Membership Secretary at FFI (members@fauna-flora.org).

Copyright and permissions Permission to copy (for users in the USA) is available from Copyright Clearance Center (copyright.com), email: info@copyright.com. Organizations authorized by the UK Copyright Licensing Agency may also copy material subject to the usual conditions. For all other use, permission should be sought from Cambridge University Press. No part of this publication may otherwise be reproduced, stored or distributed by any means without permission in writing from Cambridge University Press, acting for the copyright holder.

Internet access This journal is included in Cambridge Core, which can be found at cambridge.org/oryx. For further information on other Press titles access cambridge.org

Paper Oryx is printed on FSC-certified paper and cover board. FSC (fsc.org) is an independent, non-government, not-for-profit organization established to promote the responsible management of the world's forests.