Intended consequences statement

Ryan Phelan | Bridget Baumgartner | Stewart Brand | Evelyn Brister | Stanley W. Burgiel | R. Alta Charo | Isabelle Coche | Al Cofrancesco | Jason A. Delborne | Owain Edwards | Joshua P. Fisher | Martin Gaywood | Gregg Hawold | Margaret E. Hunter | Peter Kareiva | Aditi Mankad | Michelle Marvier | Katherine Moseby | Andrew E. Newhouse | Ben J. Novak | Gerry Ohrstrom | Steven Olson | Megan J. Palmer | Stephen Palumbi | Neil Patterson Jr. | Miguel Pedrano | Francisco Pelegri | Yasha Rohwer | Oliver A. Ryder | J. Royden Saah | Robert M. Scheller | Philip J. Seddon | H. Bradley Shaffer | Beth Shapiro | Mike Sweeney | Mark R. Tercek | Delphine Thizy | Whitney Tilt | Michele Weber | Renee D. Wegrzyn | Bruce Whitelaw | Matthew Winkler | Josh Wodak | Mark Zimring | Paul Robbins

1Revive & Restore, Sausalito, California
2Rochester Institute of Technology, Rochester, New York
3National Invasive Species Council, Washington, District of Columbia
4University of Wisconsin-Madison, Madison, Wisconsin
5Emerging Ag, Brussels, Belgium
6U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, Mississippi
7Genetic Engineering and Society Center, North Carolina State University, Raleigh, North Carolina
8Commonwealth Scientific and Industrial Research Organisation, Floreat, Western Australia, Australia
9U.S. Fish and Wildlife Service, Honolulu, Hawaii
10NatureScot, Inverness, UK
11Environmental Defense Fund, Washington, District of Columbia
12Advanced Conservation Strategies, Williamsburg, Virginia
13U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, Florida
14University of California, Los Angeles, California
15Department of Environmental Studies and Sciences, Santa Clara University, Santa Clara, California
16University of New South Wales, Sydney, New South Wales, Australia
17State University of New York, College of Environmental Science and Forestry, Syracuse, New York
18Epicurus Fund, New York, New York
19Association of Zoos and Aquariums, Silver Spring, Maryland
20Stanford University, Stanford, California
21Hopkins Marine Station, Stanford University, Pacific Grove, California
22State University of New York, College of Environmental Science and Forestry Center for Native Peoples & the Environment, Syracuse, New York

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2021 The Authors. Conservation Science and Practice published by Wiley Periodicals LLC. on behalf of Society for Conservation Biology
INTENDED CONSEQUENCES STATEMENT

As the biodiversity crisis accelerates, the stakes are higher for threatened plants and animals. Rebuilding the health of our planet will require addressing underlying threats at many scales, including habitat loss and climate change. Conservation interventions such as habitat protection, management, restoration, predator control, translocation, genetic rescue, and biological control have the potential to help threatened or endangered species avert extinction. These existing, well-tested methods can be complemented and augmented by more frequent and faster adoption of new technologies, such as powerful new genetic tools. In addition, synthetic biology might offer solutions to currently intractable conservation problems. We believe that conservation needs to be bold and clear-eyed in this moment of great urgency.

Proposed efforts to mitigate conservation threats often raise concerns about potentially harmful unintended consequences. For example, better identification and mitigation of risks has resulted in no severe, negative, unintended consequences for conservation translocations and biological control releases over the last 30 years in the United States (Novak et al., this issue).

This progress, especially after the well-publicized harmful interventions from the early history of the field, has been made by improving conservation intervention techniques, scientific understanding of dynamic interactions in complex ecosystems, and early stakeholder engagement. The substantial history of intervention should encourage us to thoughtfully pursue novel approaches to conservation as the technology advances, focusing on the future we want, rather than being daunted by the future we fear.

In June 2020, Revive & Restore convened a group of 57 conservationists, wildlife biologists, restoration specialists, conservation geneticists, ethicists, and social scientists to propose a new framework for the future of conservation, focused on intended consequences. There was broad consensus that developing and employing what might be considered controversial genetic planning produces the intended consequences while avoiding adverse unintended consequences. For example, better identification and mitigation of risks has resulted in no severe, negative, unintended consequences for conservation translocations and biological control releases over the last 30 years in the United States (Novak et al., this issue).
technologies will require a commitment to responsible decision-making that respects the diversity of perspectives, interests, and values among different stakeholders. To encourage working confidently with emerging tools and technologies, we propose a framework that increases inclusivity and embraces conservation innovation.

The participants of the Intended Consequences Workshop agree that:

- Conservationists and other stakeholders should codesign conservation interventions to advance biodiversity goals and achieve intended consequences.
- A broader definition of risk and the development of new risk assessment tools will facilitate appropriate risk identification and mitigation during intervention planning and implementation.
- Inaction and delay also incur consequences. The risks of inaction must also be identified and taken into consideration.
- Being transparent about social and cultural values is essential to success because science alone cannot tell us what we should do.
- Inclusive engagement with communities and stakeholders, including indigenous peoples and marginalized groups, allows for a thoughtful exploration of diverse visions for future ecosystems and the path to a vibrant and resilient nature.
- A code of practice for genetic interventions that weighs ecological and social risks, and potential benefits, will help conservationists, funders and the public make informed decisions for responsible and innovative action.
- The code of practice should evolve with new knowledge, additional experience, and further deliberation via an inclusive process.
- Monitoring results, both positive and negative, will help conservationists design successful interventions, manage uncertainty, and codify lessons learned along the way.

These initial points of agreement, along with an evolving code of practice, can help guide future conservation interventions and inspire confidence in our ability to design for and achieve intended consequences.

The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of: the U.S. Fish and Wildlife Service, CSIRO, NatureScot, Imperial College London, San Diego Zoo Global, and National Invasive Species Council.

ACKNOWLEDGMENTS
The workshop that inspired this statement was supported by Revive & Restore, University of Wisconsin-Madison, The Nature Conservancy of California, Gerry Ohrstrom, and Amy and Mark Tercek. We would like to thank the editor and an anonymous reviewer who read early versions and gave constructive feedback that improved this statement.

CONFLICT OF INTEREST
The authors have no conflict of interest to declare.

AUTHOR CONTRIBUTIONS
All authors have contributed and have given final approval of the version to be published.

DATA AVAILABILITY STATEMENT
No data were collected for this article.

ETHICS STATEMENT
No data were collected for this article.

ORCID
Evelyn Brister https://orcid.org/0000-0001-5077-7692
Stanley W. Burgiel https://orcid.org/0000-0002-6027-0577
Andrew E. Newhouse https://orcid.org/0000-0002-9981-8309
Ben J. Novak https://orcid.org/0000-0003-0699-634X
Yasha Rohwer https://orcid.org/0000-0001-6765-770X
Michele Weber https://orcid.org/0000-0003-1583-7367

REFERENCE
Novak, B. J., Phelan, R., & Weber, M. (this issue). U.S. conservation translocations: Over a century of intended consequences. Conservation Science and Practice.