



Northern Wild Sheep and Goat Council



PROCEEDINGS OF THE 22nd BIENNIAL SYMPOSIUM

**NOVEMBER 3-5, 2020
VIRTUAL MEETING, ALBERTA, CANADA**

Symposium Chair: Beth MacCallum

**Symposium Coordinating Committee Members: Anne Hubbs, Mike Jokinen,
Jon Jorgenson, Margo Pybus, Kathreen Ruckstuhl, Kirby Smith**

Sponsorship Conference Program Development: Kathreen Ruckstuhl

Solicitation: Kirby Smith and Kevin Hurley

Financial Management: Jon Jorgenson

Chair of Business Meeting: Kevin Hurley

Online Registration and Conference Logo:

Mike Jokinen (Alberta Conservation Association)

**Proceedings Editors: Kathreen Ruckstuhl (coordinator), Marco Festa-Bianchet,
Anne Hubbs, Jon Jorgenson, Margo Pybus, and Kirby Smith**

Technical Support: Alberta Environment and Parks

Proceedings Assembly: Jon Jorgenson and Alice Paquet

Current and past NWSGC proceedings available from:

<http://www.nwsgc.org/proceedings.html>

**Hard Copies Available: Northern Wild Sheep and Goat Council
c/o Kevin Hurley, NWSGC Executive Director**

Wild Sheep Foundation

412 Pronghorn Trail

Bozeman, MT 59718 USA

(406) 404-8750

khurley@wildsheepfoundation.org

The Northern Wild Sheep and Goat Council is a non-profit professional organization developed in 1978 from the Northern Wild Sheep Council. Proceedings may also be downloaded from the NWSGC website. www.nwsgc.org

Recommended Citation:

Author(s). 2020. Title. Proceedings of the Biennial Symposium of the Northern Wild Sheep and Goat Council 22: starting page – ending page.



Northern Wild Sheep and Goat Council



The 2020 Proceedings of the Biennial Symposium of the Northern Wild Sheep and Goat Council are dedicated to:

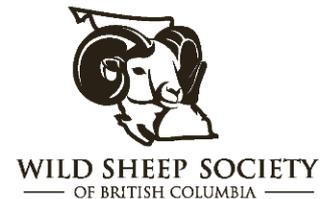
Valerius Geist



Northern Wild Sheep and Goat Council



We would like to thank our many sponsors for their generous contributions and support. Their willingness to stick with us in the face of the challenges with the Covid pandemic that required the holding of the first virtual symposium in the history of the Northern Wild Sheep and Goat Council is greatly appreciated. We in turn can show our appreciation through our patronage and thanks.





Northern Wild Sheep and Goat Council

NORTHERN WILD SHEEP AND GOAT COUNCIL SYMPOSIA

Date	Symposium	Location	Symposium Coordinator/Chair	Proceedings Editor(s)	NWSGC Executive Director
May 26-28, 1970	NWSC 1	Williams Lake, BC	Harold Mitchell		
April 14-15, 1971	NAWSC 1	Fort Collins, CO	Eugene Decker/Wayne Sandfort	Eugene Decker	
April 11-13, 1972	NWSC 2	Hinton, AB	E.G. Scheffler		
April 23-25, 1974	NWSC 3	Great Falls, MT	Kerry Constan/James Mitchell		
Feb. 10-12, 1976	NWSC 4	Jackson, WY	E. Tom Thorne		
April 2-4, 1978	NWSGC 1	Penticton, BC	Daryll Hebert/M. Nation	Daryll Hebert/M. Nation	
April 23-25, 1980	NWSGC 2	Salmon, ID	Bill Hickey		
March 17-19, 1982	NWSGC 3	Fort Collins, CO	Gene Schoonveld	James Bailey/Gene Schoonveld	
Apr. 30-May 3, 1984	NWSGC 4	Whitehorse, YK	Manfred Hoefs	Manfred Hoefs	Wayne Heimer
April 14-17, 1986	NWSGC 5	Missoula, MT	Jerry Brown	Gayle Joslin	Wayne Heimer
April 11-15, 1988	NWSGC 6	Banff, AB	Bill Wishart	Bill Samuel	Wayne Heimer
May 14-18, 1990	NWSGC 7	Clarkston, WA	Lloyd Oldenburg	James Bailey	Wayne Heimer
Apr. 27-May 1, 1992	NWSGC 8	Cody, WY	Kevin Hurley	John Emmerich/Bill Hepworth	Wayne Heimer
May 2-6, 1994	NWSGC 9	Cranbrook, BC	Anna Fontana	Margo Pybus/Bill Wishart	Kevin Hurley
Apr. 30-May 3, 1996	NWSGC 10	Silverthorne, CO	Dale Reed	Kevin Hurley/Dale Reed/Nancy Wild (compilers)	Kevin Hurley
April 16-20, 1998	NWSGC 11	Whitefish, MT	John McCarthy	John McCarthy/Richard Harris/Fay Moore (compilers)	Kevin Hurley
May 31-June 4, 2000	NWSGC 12	Whitehorse, YK	Jean Carey	Jean Carey	Kevin Hurley
April 23-27, 2002	NWSGC 13	Rapid City, SD	Ted Benzon	Gary Brundige	Kevin Hurley
May 15-22, 2004	NWSGC 14	Coastal Alaska	Wayne Heimer	Wayne Heimer/Dale Towell/Kevin Hurley	Kevin Hurley
April 2-6, 2006	NWSGC 15	Kananaskis, AB	Jon Jorgenson	Margo Pybus/Bill Wishart	Kevin Hurley
Apr. 27-May 1, 2008	NWSGC 16	Midway, UT	Anis Aoude	Tom Smith	Kevin Hurley
June 7-11, 2010	NWSGC 17	Hood River, OR	Craig Foster	Vern Bleich	Kevin Hurley
March 12-15, 2012	NWSGC 18	Kamloops, BC	Steve Gordon/Steve Wilson/Mari Wood	Steve Wilson/Mari Wood	Kevin Hurley
June 2-5, 2014	NWSGC 19	Fort Collins, CO	Janet George	Bruce Watkins, Ricki Watkins	Kevin Hurley
May 9-12, 2016	NWSGC 20	Moscow, ID	Hollie Miyasaki/Rich Harris/David Smith	Rich Harris	Kevin Hurley
May 21-24, 2018	NWSGC 21	Whitefish, MT	Brent Lonner/Bruce Sterling/Caryn Dearing	Justin Gude	Kevin Hurley
November 3-5, 2020	NWSGC 22	Alberta (virtual)	Beth MacCallum	Kathreen Ruckstuhl	Kevin Hurley



Northern Wild Sheep and Goat Council



GUIDELINES OF THE NORTHERN WILD SHEEP AND GOAT COUNCIL

The purpose of the Northern Wild Sheep and Goat Council is to foster wise management and conservation of northern wild sheep and goat populations and their habitats.

This purpose will be achieved by:

- 1) Providing for timely exchange of research and management information;
- 2) Promoting high standards in research and management; and
- 3) Providing professional advice on issues involving wild sheep and goat conservation and management.

I. The membership shall include professional research and management biologists and others active in the conservation of wild sheep and goats. Membership in the Council will be achieved either by registering at, or purchasing proceedings of, the biennial conference. Only members may vote at the biennial meeting.

II. The affairs of the Council will be conducted by an Executive Committee consisting of: three elected members from Canada; three elected members from the United States; one ad hoc member from the state, province, or territory hosting the biennial meeting; and the past chairperson of the Executive Committee. The Executive Committee elects its chairperson.

III. Members of the Council will be nominated and elected to the executive committee at the biennial meeting. Executive Committee members, excluding the ad hoc member, will serve for four years, with alternating election of two persons and one person of each country, respectively. The ad hoc member will only serve for two years.

The biennial meeting of members of the Council shall include a symposium and business meeting. The location of the biennial meeting shall rotate among the members' provinces, territories and states. Members in the host state, province or territory will plan, publicize and conduct the symposium and meeting; will handle its financial matters; and will prepare and distribute the proceedings of the symposium.

The symposium may include presentations, panel discussions, poster sessions, and field trips related to research and management of wild sheep, mountain goats, and related species. Should any member's proposal for presenting a paper at the symposium be rejected by members of the host province, territory or state, the rejected

member may appeal to the Council's executive committee. Subsequently, the committee will make its recommendations to the members of the host state, territory or province for a final decision.

The symposium proceedings shall be numbered with 1978 being No. 1, 1980 being No. 2, etc. The members in the province, territory or state hosting the biennial meeting shall select the editor(s) of the proceedings. Responsibility for quality of the proceedings shall rest with the editor(s). The editors shall strive for uniformity of manuscript style and printing, both within and among proceedings.

The proceedings shall include edited papers from presentations, panel discussions or posters given at the symposium. Full papers will be emphasized in the proceedings. The editor will set a deadline for submission of manuscripts.

Members of the host province, territory, or state shall distribute copies of the proceedings to members and other purchasers. In addition, funds will be solicited for distributing a copy to each major wildlife library within the Council's states, provinces, and territories.

IV. Resolutions on issues involving conservation and management of wild sheep and goats will be received by the chairperson of the Executive Committee before the biennial meeting. The Executive Committee will review all resolutions, and present them with recommendations at the business meeting. Resolutions will be adopted by a plurality vote. The Executive Committee may also adopt resolutions on behalf of the Council between biennial meetings.

V. Changes in these guidelines may be accomplished by plurality vote at the biennial meeting.



Northern Wild Sheep and Goat Council



FOREWORD

The papers or abstracts included in these proceedings were presented during the 22nd Biennial Symposium of the Northern Wild Sheep and Goat Council, held November 3-5, 2020. While plans had been made to hold this NWSGC Symposium in April 2020 in Canmore, Alberta, the COVID-19 pandemic along with travel restrictions resulted in not only a ~7-month delay, but we were forced into holding a virtual symposium.

Heart-felt thanks are extended to the sponsors of, and all those participating in, this highly successful 22nd biennial symposium. Thanks to all of the session presenters for assembling and sharing relevant new science on wild sheep and goat ecology and management.

Special thanks to Chair Beth MacCallum for leading a dedicated Alberta organizing committee; under very difficult circumstances, Alberta delivered a first-class symposium.

Thanks go to all the committee members who adapted so readily to the fluidly changing timelines caused by Covid-19. Mike Jokinen, Alberta Conservation Association, set up the registration process and oversaw all the refunds when the April date was cancelled; he then started the process again to accept registrations for the November virtual Symposium. The committee made frequent use of the conference call number provided by Anne Hubbs, Alberta Environment and Parks. Anne was instrumental in bringing on Alberta Environment and Parks' IT Team to help run the virtual Symposium and maintaining this vital communication. Rob Harris, Director of Engagement and Education and Jenna Curtis, Engagement and Education Specialist, held training sessions in the use of Zoom for participants and monitored the entire event to ensure technical difficulties were handled smoothly and the program was delivered.

Thanks to Kirby Smith for keeping track of the fund-raising donations and arranging the field trip, BBQ venue and entertainment. When the decision was made to cancel the in-person event the Mount View BBQ and Brewster Bus Lines returned our deposits with no questions. After long negotiations with the Canmore Coast Hotel, Jon Jorgenson finally secured a written agreement to honour our deposit for future bookings, to be used by the NWS&GC or another organization. Thanks to Ken Nowicki for helping with the negotiations. Thanks to Kathreen Ruckstuhl for developing the program, inviting special speakers, and tirelessly updating the draft agenda as the program developed. Kirby Smith's virtual entertainment session was a highlight of the Symposium bringing together musicians from Alaska, Alberta, and Wyoming. Thanks to Jon Jorgenson for arranging for the banking services, tracking expenses, and producing the Proceedings. All committee members were dedicated and a pleasure to work with.

We would like to thank the Alberta Fish and Game Association whose funding went to the printing of these Proceedings.



Northern Wild Sheep and Goat Council



These Proceedings were edited by Kathreen Ruckstuhl. Peer-reviewers included Marco Festa-Bianchet, Anne Hubbs, Jon Jorgenson, Margo Pybus and Kirby Smith. Suggested editorial comments were provided to each senior author; senior authors had opportunity(ies) to accept or reject suggested edits, prior to submission of their final manuscripts. Formatted page proofs were forwarded to respective senior authors prior to inclusion into the final proceedings. Final content, particularly verification of literature citations, is the responsibility of the authors.

While NWSGC strives for professional, scientific presentations at our symposia, followed up with quality manuscripts for our proceedings, NWSGC Guidelines do not rigidly specify format, minimum data requirements, or thresholds of statistical analysis for subsequently-included manuscripts. Thus, NWSGC Proceedings may contain manuscripts that are more opinion-based than data- or fact-based; critical evaluation of information presented in these proceedings is the responsibility of subsequent readers.

Kevin Hurley
NWSGC Executive Director
December 9, 2021