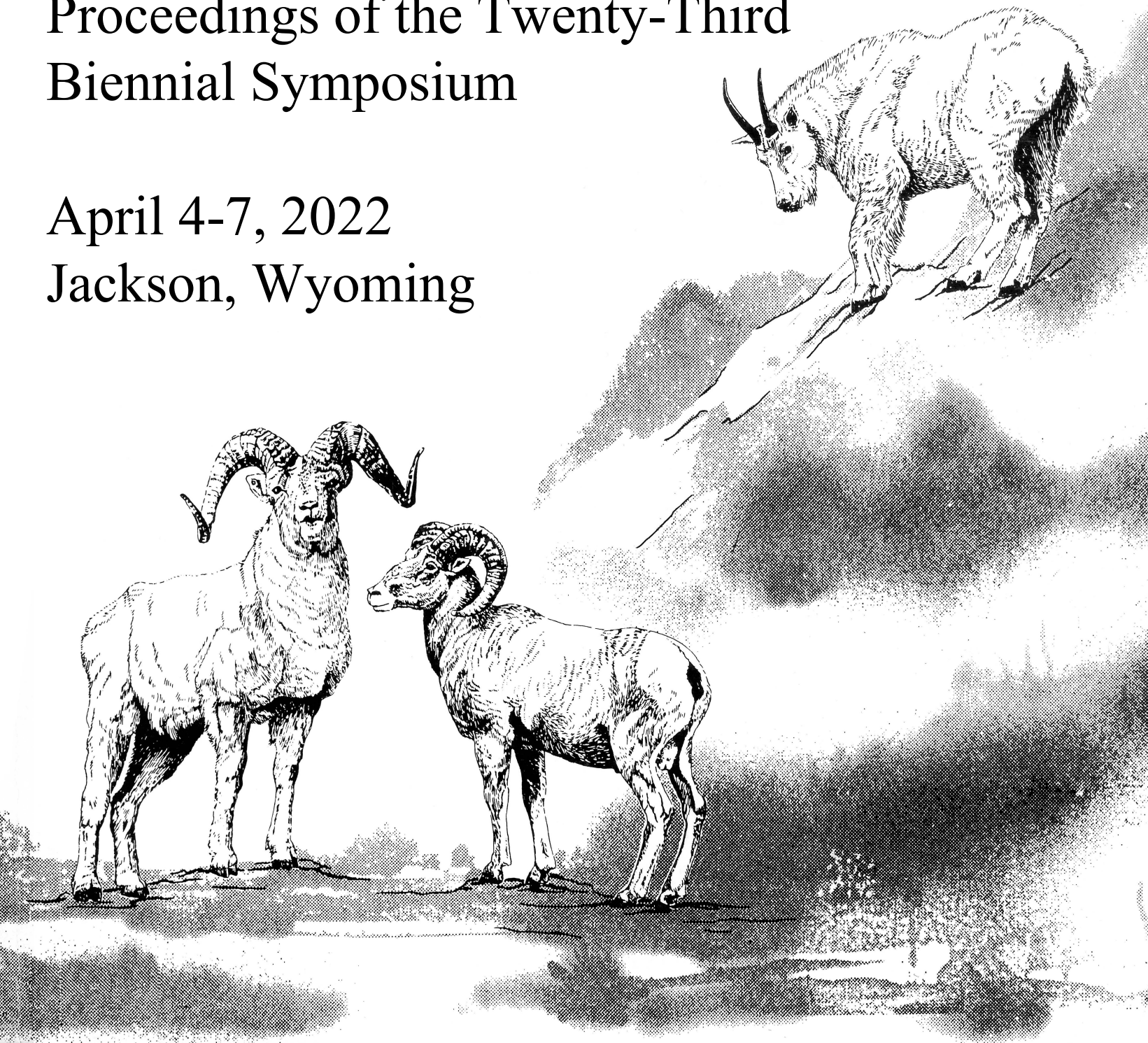


Northern Wild Sheep and Goat Council

Proceedings of the Twenty-Third
Biennial Symposium

April 4-7, 2022
Jackson, Wyoming





Northern Wild Sheep and Goat Council



PROCEEDINGS OF THE 23rd BIENNIAL SYMPOSIUM

**APRIL 4-7, 2022
JACKSON, WYOMING**

Symposium Chair: Doug McWhirter

Symposium Coordinating Committee Members: Doug McWhirter, Ben Wise, Alyson Courtemanch, Melanie Barnum

Financial Management: Melanie Barnum, Kevin Hurley

Chair of Business Meeting: Kevin Hurley

Online Registration: Melanie Barnum

Proceedings Editors: Doug McWhirter, Alyson Courtemanch, Peach Van Wick

Virtual Hosts/Technical Support: Wayne Cotton, Samuel Jackson

Proceedings Assembly: Doug McWhirter, Alyson Courtemanch

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**

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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

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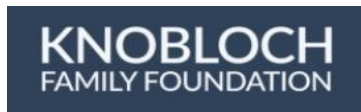
We would like to thank our many sponsors for their generous contributions and support of this symposium! Some were donors from 2020 who allowed their sponsorship to carry over to 2022!



Jackson Hole Chapter



Teck





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 Schooneveld	
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 Toweill/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



Northern Wild Sheep and Goat Council



NORTHERN WILD SHEEP AND GOAT COUNCIL SYMPOSIA (Cont'd)

Date	Symposium	Location	Symposium Coordinator/Chair	Proceedings Editor(s)	NWSGC Executive Director
May 9-12, 2016	NWSGC 20	Moscow, ID Pullman, WA	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
April 4-7, 2022	NWSGC 23	Jackson, WY	Doug McWhirter	Doug McWhirter, Alyson Courtemanch, Peach Van Wick	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 manuscripts and abstracts included in these proceedings were presented during the 23rd Biennial Symposium of the Northern Wild Sheep and Goat Council, held April 4-7, 2022 at the Snow King Resort and Hotel in Jackson, Wyoming.

Thanks and appreciation must be given to symposium sponsors and participants. In addition, Conference Chair Doug McWhirter, and Coordinating Committee members Melanie Barnum, Alyson Courtemanch, and Ben Wise, and Session Moderators Sarah Dewey, Peach Van Wick, Tony Mong, Hank Edwards, Carson Butler, Alyson Courtemanch, Ben Wise, and Doug McWhirter must be recognized for their contributions. Thanks must also be given to Grand Teton National Park Chief of Staff Jeremy Barnum, and Chief of Science and Resource Management Gus Smith, as well as U.S. Fish and Wildlife Service/National Elk Refuge Manager Frank Durbian, and Wildlife Biologist Eric Cole.

All manuscripts were peer-edited by Doug McWhirter, Alyson Courtemanch, and Peach Van Wick prior to publication. 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. In instances where data presented at the symposium is, or will be published in other peer-reviewed journals, only the presentation abstract has been presented here.

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 requirement, or thresholds of statistical analyses 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
September 1, 2023