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Eighth International Symposium on Arctic-Alpine Mycology (ISAM 8), Beartooth Plateau, Rocky Mountains, USA 2008

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Abstract: The eighth International Symposium on Arctic-Alpine Mycology (ISAM 8) was held on the Beartooth Plateau, Rocky Mountains, USA, August 3-10, 2008. A report on this symposium is given along with a list of participants, the group's preamble, and references for proceedings of previous symposia published as a series of volumes on Arctic and Alpine Mycology 1-7. The contributions that follow in this volume of *North American Fungi* are the complete proceedings for ISAM 8 published here as Arctic and Alpine Mycology 8 (editors Cathy Cripps and Joe Ammirati). We dedicate this volume to two mycologists who worked in Arctic-Alpine Ecosystems: Meinhard Moser, Austria (1924-2002) and Orson K. Miller, Jr, U.S.A. (1930-2006).

Key words: Arctic and Alpine Mycology, Beartooth Plateau, fungi, ISAM, Rocky Mountains

Introduction: International Symposia on Arctic-Alpine Mycology (ISAM) have been held every four years since initiation in 1980, a span of almost 30 years (Table 1). The goal of these symposia is to promote Arctic-Alpine Mycology as a discipline with international interactive 7-10 day workshops in appropriate locations. Participant numbers are restricted to 25-30 individuals due to the difficulties of transporting and hosting large groups in remote sites. An attempt is made to vary locations between arctic and alpine habitats and among continents when possible. Invited participants typically have experience in Arctic-Alpine (AA) Mycology and are expected to contribute a professional paper to the proceedings (Laursen and Ammirati 1983, Laursen et al. 1987, Petrini and Laursen 1993, Muhkin and Knudsen 1998, Boertmann and Knudsen 2006, Høiland and Økland 2008). A historical list of over 100 participants can be found in Gulden & Høiland (2008). A set of guidelines for the organization is contained in the ISAM preamble (Box 1).

The study of cold-dominated ecosystems in relation to climate change has become a priority in recent years due to the sensitivity of this biome which covers 8% of the earth's surface (Körner 2003). ISAM is a forum that allows for detailed examination of the taxonomy, physiology, and ecology of AA fungi which contributes to the larger discipline of arctic-alpine biology. Knowledge of fungi in cold-dominated systems still lags behind that for temperate and boreal systems and the challenge of studying AA fungi is left to those who thrive (like the fungi) in these harsh environments.

Table 1. ISAM Symposia locations.

1980	1. Barrow, Alaska
1984	2. Fetan, Switzerland
1988	3. Svalbard, Norway
1992	4. Lanslebourg, France
1996	5. Labytnangi, Russia
2000	6. Kangerlussuaq/Sisimut, Greenland
2005	7. Finse, Norway
2008	8. Beartooth Plateau, Rocky Mts, USA

The difficulties and disadvantages of holding ISAM in the Rocky Mountain alpine were significant. There is no long history of AA Mycology in the Rocky Mountains and no significant data existed for "true" alpine fungi in the Rocky Mountains prior to our own studies which began in 2000 (Cripps & Horak 2008, 2009). As we discovered during preparations for the first ISAM in the U.S. since its inception at Barrow in 1980, field stations with convenient access to the alpine and sufficient appropriate habitat are rare in the lower Rocky Mountains. However, a paved highway built across the Beartooth Plateau in 1936 provides access to a unique alpine area on the border of Montana and Wyoming. We were fortunate to find a geology field camp near the base of the plateau appropriate for our use. In addition, collecting conditions are very unpredictable and two years previous the Beartooth Plateau was "browned out" by drought in August. Collecting in the Rocky Mountain alpine zone is generally "high risk" and in some years virtually no fungi can be found. There are no weather stations on the Beartooth Plateau and data for abiotic conditions are mainly in older papers. Also, this is the southern-most ISAM located hundreds of miles from the Arctic Circle. An advantage is that little is known of alpine fungi in this region and ISAM VIII provided a venue to advance knowledge of these organisms. Other than our reports (listed in Cripps & Horak 2008) and a brief paper by Moser and McKnight (1987), virtually nothing is published for fungi of the plateau except for lichens (Eversman 1995).

ISAM 8

The 8th ISAM was held at the Yellowstone Bighorn Research Association Field Camp at the base of the Beartooth Plateau (Rocky Mountains, U.S.A.) August 3rd-10th, 2008. Twenty participants from 11 countries attended the symposium (Fig.1). Participants were lodged in various small rustic cabins at the camp, meals were served at the lodge and two workroom

Box 1. ISAM preamble.

1. Invitation for the next assembly are considered and determined at each ISAM. The session should accept one invitation and indicate a second priority.
2. A representative of the inviting nation is selected as President for the next ISAM period. He/she has the responsibility for making all arrangements.
3. The ISAM is open only by invitation. Persons invited shall constitute a qualified group with broad expertise in arcto-alpine mycology. No past ISAM members may claim the privilege of an invitation.
4. It shall be the right of members of the last ISAM to suggest participants to the next assembly.
5. The President will draw up a list of potential participants from nations participating in arcto-alpine research in mycology, keeping in mind geographical distribution. He/she shall consult with previous presidents on matters of principle or major importance.
6. Definitive invitations shall be issued not later than nine months before the ISAM assembly.
7. If the President must cancel the arrangement, then he/she shall inform the two previous Presidents before definitive action is taken. He/she shall inform a representative of the nation that extended the second priority. The country in question shall then appoint a President who shall assume the above responsibilities.
8. ISAM members shall submit a relevant paper to be printed in a special ISAM publication in accordance with the decisions and arrangements made by the President. To facilitate this, the President may appoint an editorial committee.

cabins were provided with electricity and internet access just before our group's arrival.

Microscopes and other supplies were brought in from Montana State University, as were projectors for talks. The exceptional snowfall of the previous winter pushed back the field season and only a few early fungi fruited the week prior to ISAM. Several days before the start of the symposium, a forest fire contributed smoke to the area. However, skies cleared on everyone's arrival so that the spectacular alpine plateaus could be viewed. We managed to "thread the eye of the needle" for collecting (Horak comment) and it should be noted that the area dried up after ISAM. Those unfamiliar with Rocky Mountain conditions found new meaning in the words "hunting for mushrooms" but conditions were typical for our area.

The Beartooth Plateau is one of 11 plateaus situated along the Montana-Wyoming border. The plateau itself is about 20 km long and 10 km wide at lat. 45°N and long. 109°W. Annual precipitation is estimated at near 1000 mm/yr and the average annual temperature around -3.8°C. The top of the plateau consists of gently rolling alpine tundra interspersed with rock outcroppings and small lakes. The rock consists of coarse-grained granites, gneisses, and schists formed about 3.3 billion years ago. Igneous intrusions punctuate the landscape. The

Beartooth Plateau was heavily glaciated about 100,000 years ago and small mountain glaciers remain today. These lingering seasonal snowbanks indicate some of the more reliable areas for fungal fruiting.

Alpine plant communities include meadows, shrubby wetlands, grasslands and fell fields dispersed in mosaic fashion across the plateau. The alpine flora is richer than that of most other North American mountain ranges and over 422 species of plants are listed for this plateau above timberline from 3,000 to 3,400 m (Lackschewitz in Anderson 1994). Woody alpine plants include dwarf willows *Salix artica* Pall. and *S. reticulata*, shrub willows *S. planifolia* Pursh. and *S. glauca* L., and *Dryas octopetala* L. The collecting season runs from mid July (at the earliest) to the end of August (rarely into September). Periodic drought is characteristic of the area and can detrimentally affect fungal fruiting.

Summary of Results

Previously we catalogued over 200 species for the Rocky Mountain alpine, including the Southern Rockies of Colorado that appear much more diverse in habitat and fungi. The tentative list for five days of excursions on the Beartooth Plateau included 65 Basidiomycota (primarily agarics and 8 species of rust on *Bistorta*, *Caltha*, *Polygonum*, *Potentilla*, *Ranunculus*, and *Salix*), 7

Ascomycota (primarily Discomycetes), and 3 protistian species of Myxomycota (*Diderma* and *Didymium*). The previous checklist for the Beartooth Plateau (Cripps and Horak 2008) was primarily extended by species of *Cortinarius* (*Telemonia*), *Hebeloma*, *Arrhenia* (*A. peltigerina*, *A. griseopallida*) and *Calvatia*. Species still need to be confirmed, however, these collections add to our knowledge of the fungi of the Beartooth Plateau. Some of these fungi are reported on in subsequent papers in this volume. A list of excursions follows in Addendum 1.

Acknowledgments: Appreciation is extended to the Yellowstone Bighorn Research Association for hosting ISAM and to YBRA president Jinny Sissoo and Jeanette Reinhart (our wonderful cook). The Red Lodge Museum hosted a prior talk given by Cathy Cripps on Arctic-Alpine Fungi for locals. We thank Kent Houston soil scientist for the Shoshone National for his support. ISAM 8 did not have outside financial support and the small, dedicated organizing committee consisted of myself, Don Bachman, Egon and Almut Horak.

Fig. 1. ISAM VIII participants on the Beartooth Plateau. In front: Leo Jalink (The Netherlands) and Steen Elborne (Denmark). Kneeling: Anna Ruotsalainen (Finland), Ellen Larsson (Sweden), Marieke Nauta (The Netherlands), Esteri Ohenoja (Finland), Anna Ronikier (Poland), Pierre-Arthur Moreau (France). Standing: Robert Antibus (USA), Almut Horak (Austria), Egon Horak (Austria), Henry Beker (Belgium/UK), Henning Knudsen (Denmark), Cathy Cripps (USA), Taiga Kasuya (Japan), Mikako Sasa (Denmark), Michal Ronikier (Poland). Not shown Joanne Antibus (USA) and Don Bachman (USA). Photo by D. Bachman.

The Horaks are also acknowledged for numerous collecting trips over the years to help with the National Science Foundation Biotic Surveys and Inventories Program grant to study alpine fungi in the Rocky Mountains. Their visit to the field station in 2007 prior to the ISAM meeting and suggestions are greatly appreciated. Bob and Joanne Antibus stepped in to assist with airport logistics and driving, both of which would have been difficult without their help. Finally, we thank our co-editor Joe Ammirati at *North American Fungi* for enthusiastically agreeing to publish our proceedings as a volume. Joe (with Gary Laursen, an initiator of ISAM) edited the first two proceedings of ISAM; we are grateful our volume was in his capable hands. We acknowledge Dean Glawe for his assistance in preparing the final copy of these proceedings. Last, but certainly not least, my husband Don Bachman gave hours of his time for numerous trips to the plateau in all kinds of weather to look for those elusive, tiny fungi that knit alpine habitats together with their mycelium.

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Addendum 1

Aug. 2nd, participants arrived at the Billings International Airport in Montana and transferred to the Crown Plaza Hotel. Dinner was hosted by Egon & Almut Horak and Bob and Joanne Antibus.

Aug. 3rd, participants arrived at the field camp and President Cathy Cripps provided an introduction to the area. Time was spent exploring the subalpine area around the camp for interesting plants that included Indian paintbrush (*Castilleja* species, Scrophulariaceae). Fungi of interest, apparently absent from Europe included the giant western puffball (*Calvatia booniana*) and the covered polypore (*Cryptoporus volvatus*).

Excursions to alpine areas at 3,000-3,400 m were accessed by passenger vans driven up the Beartooth Highway 212 by our competent drivers Bob Antibus and Don Bachman.

Aug. 4th, was the first excursion was to the “Birch site/Quad Creek” at the Northeast end of the Beartooth plateau, named for the *Betula* shrub in the area. It is the lowest elevation site selected for participant altitude acclimation and early fruiting fungi. The wet area supports a low alpine/subalpine habitat with a krummholz zone of *Pinus albicaulis*, *Picea engelmannii* and *Abies lasiocarpus*. An extensive area of “dry” *Dryas* is located near the road and wet areas support willows. The one *Betula* typically hosts *Leccinum* sp. and *Lactarius glyciosmus*. Mossy stream banks support saprobic *Galerina* and *Mycena* species and willows host ectomycorrhizal *Russula*, *Cortinarius* and *Inocybe* species. *Agrocybe*, *Clitocybe*, *Gymnopus* and *Melanoleuca* spp. are found in the dry meadows. Fruitings of *Amanita groenlandica* were abundant near the small snowfield at the head of the stream; *Morchella* was found in dwarf willows.

Aug. 5th, excursion was to “Highline Trail” at the MT/WY border on the plateau. This included the immediate ‘valley’ below and a hike to small alpine lakes. The area is covered with extensive shrub and dwarf willows. *Amanita groenlandica*, *Russula nana* and *Entoloma alpicola* were evident long stream banks, but the *Hygrocybes* (rare for the Rocky Mountain alpine) known to exist here were not observed.

Aug. 6th, excursion was to Wyoming Creek near the MT/WY state line accessed by a traverse to the collecting area below a large persistent snowbank (Fig. 2). Beds of dwarf willow *Salix reticulata* at the base of the snow hosted the most prolific fruitings of the foray with a diversity of *Cortinarius*, *Hebeloma* and *Inocybe* species. Also in the area were moss associates *Arrhenia lobata*, *Rickenella fibula*, and *Hypholoma elongatum*.

Aug. 7th, the group drove over the top of Beartooth Pass to the Frozen Lakes area on the southwest end of the plateau. Unfortunately, this area was the most affected by the late snowpack, Lakes were just recently thawed and brimming with mosquitoes. The willows were just melting out and were still developing leaves in August. The area is usually reliable for meadow fungi such as *Agaricus*, *Calvatia*, *Salix glauca* associates such as *Lactarius repraesentaneus*, and stream-moss species such as *Omphalina rivulicola*. A retreat from the biting insects was made to the remote “Top-of-the-World Store” for refreshments. Moser’s *Cortinarius absarokensis* was found in shrubby willows across from the store.

A stop at the *Pinus albicaulis* forest on the way back netted *Amanita ‘alpina’* that fruits almost entirely underground, *Rhizopogon* species that barely crack the soil, and the semi-sectoid *Thaxterogaster* species. The dry area has little understory beneath the pines and plateau winds can dry epigeous fruitings.

Aug. 8th, saw a return to Wyoming Creek this time accessed from above by upper Wyoming Creek at over 3,200 m. The high open meadows are dotted with small tarns where small alpine species of ascomycota were collected on wet grass and willow twigs, *Galerina* was located in moss, and *Omphalina* in mud flats. A brief stop was made at the Red Lodge Museum to view the local mining history.

Aug. 9th, was reserved to stay in camp for

presentations and a business meeting. Twelve talks were given on arctic-alpine mycology followed by discussions. At the meeting, proposals were made for the next ISAM venue and a vote determined it would be at Kevo, Finland hosted by new presidents Esteri Ohenoja and Annu Ruotsalainen. Saturday evening brought a banquet at the lodge and rainstorms complete with thunder, lightning, and a rainbow.

Aug. 10th, most mycologists returned to Billings for flights home.

Fig. 2. Collecting alpine mushrooms below a large persistent snowbank near Wyoming Creek, Beartooth Plateau, Rocky Mountains, U.S.A. at ISAM VIII.

In Memoriam

Sisimut Greenland, 2000. Cripps photo.

Meinhard Moser, Austria (1924-2002)

Meinhard was born March 24, 1924 in Innsbruck, Austria and lived there most of his life except for the war years. He received his PhD from the University of Innsbruck in 1950, spent a year at Oxford and time at the Federal Forest Institute in Imst, before returning to teach classes at the university. He became a full professor in 1968 and was chair of the Microbiological Institute until his retirement in 1991. His early career focused on mycorrhizal research and later on taxonomy of the Macromycetes, and particularly on the large and difficult genus *Cortinarius*. He contributed over 200 papers including a most useful set of book-keys (1953-1983) which were eventually called "Keys to Agarics and Boletes" (1983) or just "Moser". His extensive "Farbatlas" volumes illustrated many of his 25000 collections. He had a special interest in Arctic-alpine fungi and contributed to *ISAM* volumes I, II, III-IV and VI. His last *ISAM* was in Greenland and his last talk at the Mycological Congress in Oslo, Norway was on Arctic-alpine agarics just before his death from a series of heart attacks in 2002. This gentlemanly scholar led us in his quiet way across the tundra and down many dichotomous paths.

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Barrow, Alaska, ca. 1980.

Orson K. Miller Jr., U.S. (1930-2006)

Orson was born December 19, 1930 and spent his early days near Cambridge Massachusetts where he gained his love of forests eventually attending forestry school at U Mass. He graduated from the University of Michigan with a PhD in 1963 and spent several years as a Forest Service pathologist in Idaho and in Beltsville at the National Fungus Lab. He was a professor and Curator of Fungi at Virginia Polytechnic University in Blacksburg VA from 1970 until 2002. His "Mushrooms of North America" (1972) was a milestone as the first color field guide in North America. He collected over 29000 specimens during his travels across the globe, published over 150 papers and seven books. His wife Hope, the love of his life, co-authored many of these books. He gave over 500 presentations on his research on the higher fungi, which included the family Gomphidiaceae for which he was a world expert. Orson was involved with the initiation of *ISAM* in Barrow, Alaska and published in *ISAMs* I, II, III-IV and V. His untimely death was from a brain tumor. This vibrant leader always found time and energy to engage, teach, listen and encourage, and to make mycology a passionate discipline.

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