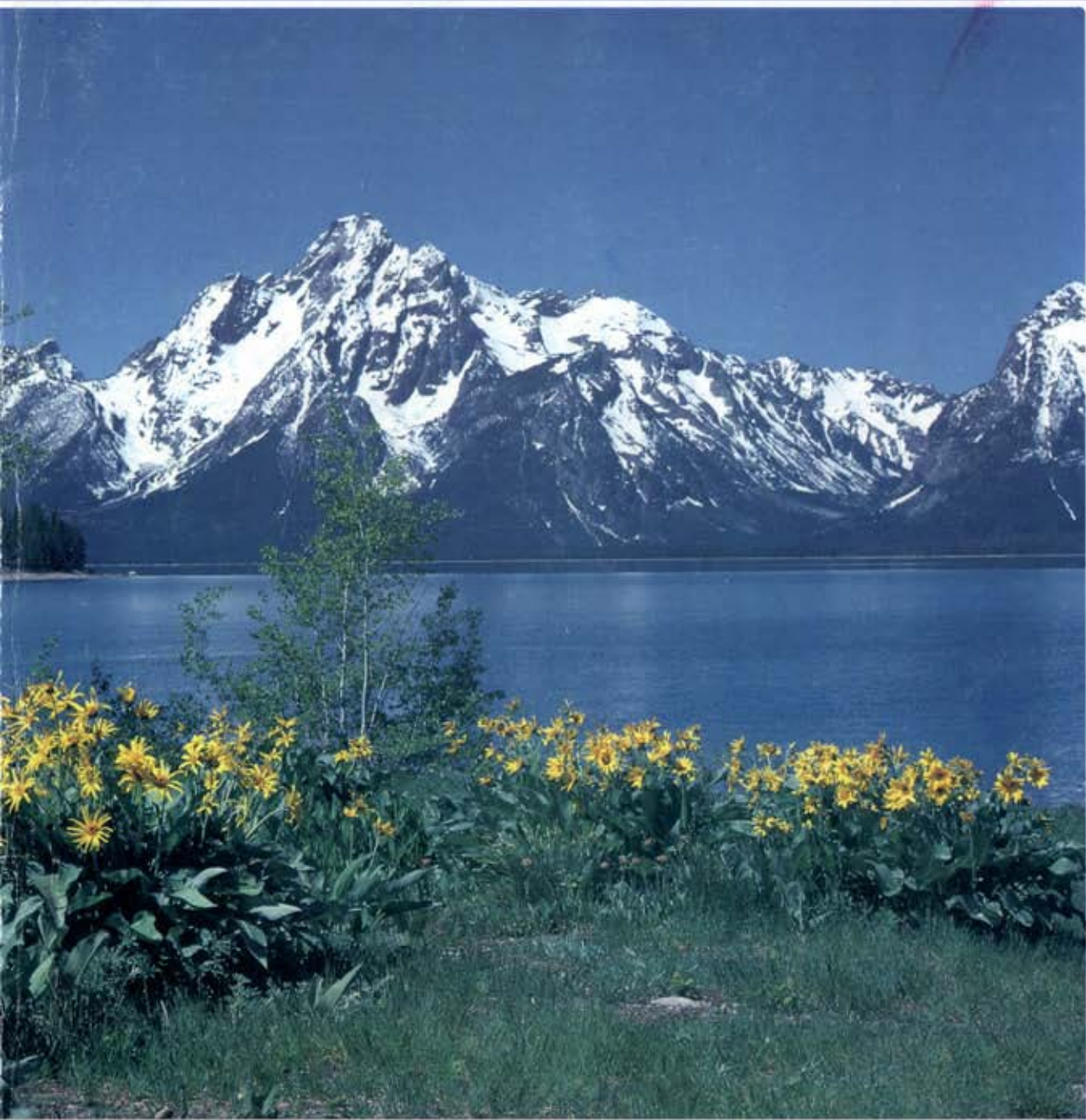




# NATIONAL PARK SERVICE RESEARCH CENTER



22<sup>ND</sup> & 23<sup>RD</sup> ANNUAL REPORTS  
1998 & 1999

COVER PHOTO COURTESY: WYOMING DIVISION OF TOURISM  
GRAND TETON NATIONAL PARK ♦ JACKSON LAKE ♦ WYOMING

LAYOUT AND DESIGN: UW GRAPHIC ARTS SERVICE

RECEIVED

JUL 23 2001

SDSU Agricultural  
Experiment Station



# NATIONAL PARK SERVICE RESEARCH CENTER



**22nd ANNUAL REPORT 1998**

EDITED BY

**HENRY J. HARLOW**

PROFESSOR

DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY

UNIVERSITY OF WYOMING

DIRECTOR UW-NPS RESEARCH CENTER

**MARYANNE HARLOW**

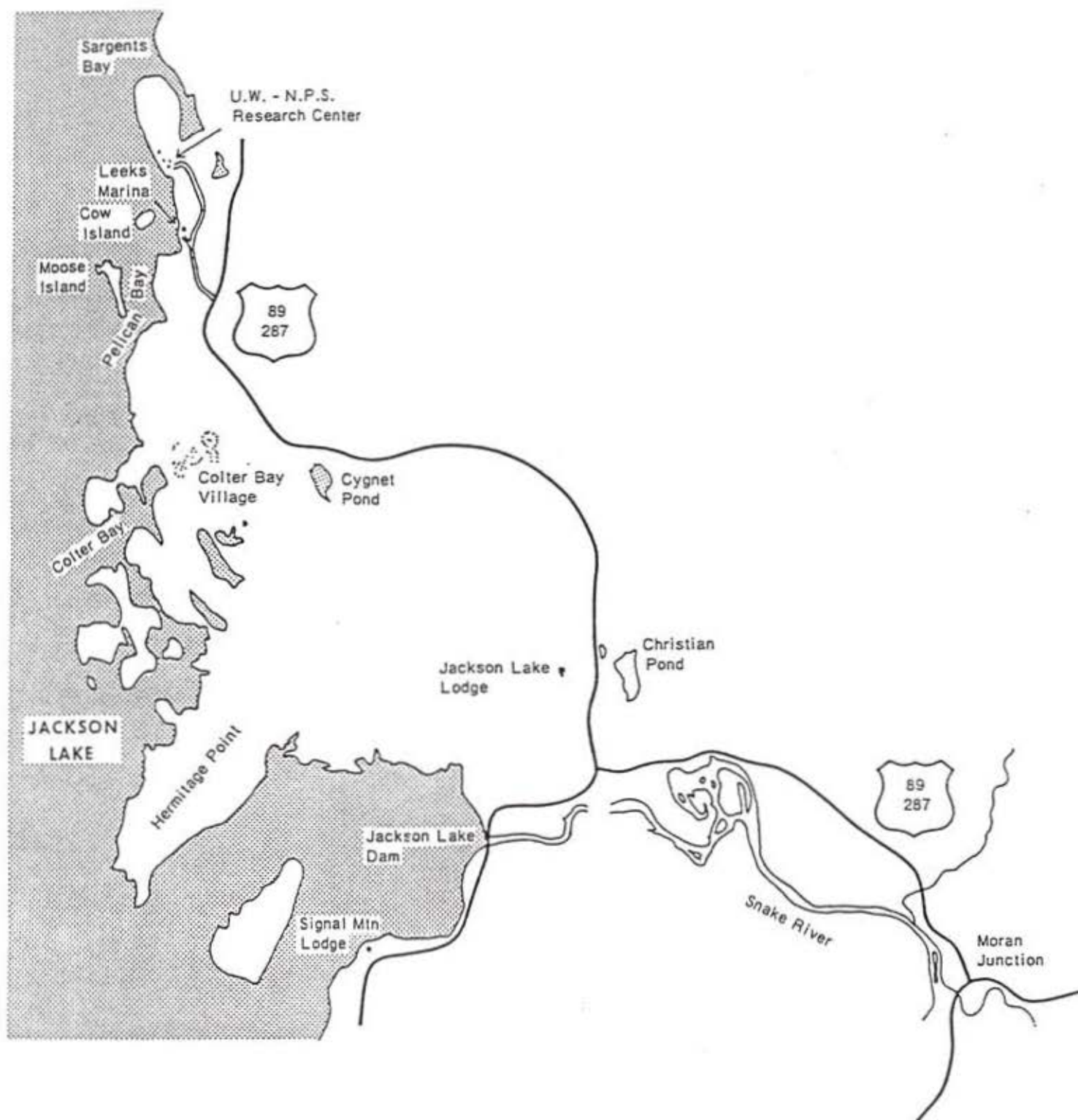
REFERENCE LIBRARIAN

UNIVERSITY OF WYOMING LIBRARIES

UNIVERSITY OF WYOMING







Box 3166 University Station  
Laramie, Wyoming 82071-3166  
Telephone: (307) 766-3321 or 4227

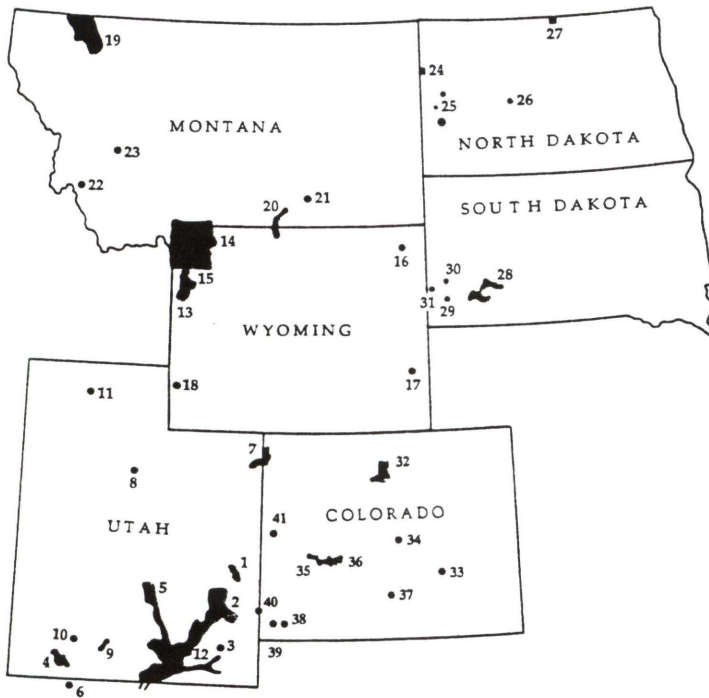
Box 170  
Moran, Wyoming 83013  
Telephone: (307) 543-2463





## NATIONAL PARK SERVICE RESEARCH CENTER

22nd ANNUAL REPORT 1998



### ♦ WYOMING

- 13. Grand Teton National Park
- 14. Yellowstone National Park
- 15. John D. Rockefeller, Jr. Memorial Parkway
- 16. Devils Tower National Monument
- 17. Fort Laramie National Historic Site
- 18. Fossil Butte National Monument

### ♦ MONTANA

- 19. Glacier National Park
- 20. Bighorn Canyon National Recreation Area
- 21. Little Bighorn Battlefield National Monument
- 22. Big Hole National Battlefield
- 23. Grant-Kohrs Ranch National Historic Site

### ♦ NORTH DAKOTA

- 24. Fort Union Trading Post National Historic Site
- 25. Theodore Roosevelt National Park
- 26. Knife River Indian Villages National Historic Site
- 27. International Peace Garden

### ♦ SOUTH DAKOTA

- 28. Badlands National Park
- 29. Wind Cave National Park
- 30. Mount Rushmore National Memorial
- 31. Jewel Cave National Monument

### ♦ UTAH

- 1. Arches National Park
- 2. Canyonlands National Park
- 3. Natural Bridges National Monument
- 4. Zion National Park
- 5. Capitol Reef National Park
- 6. Pipe Spring National Park
- 7. Dinosaur National Monument
- 8. Timpanogos Cave National Monument
- 9. Bryce Canyon National Park
- 10. Cedar Breaks National Monument
- 11. Golden Spike National Historic Site
- 12. Glen Canyon National Recreation Area

### ♦ COLORADO

- 32. Rocky Mountain National Park
- 33. Bent's Old Fort National Historic Site
- 34. Florissant Fossil Beds National Monument
- 35. Black Canyon of the Gunnison National Monument
- 36. Curecanti National Recreation Area
- 37. Great Sand Dunes National Monument
- 38. Mesa Verde National Park
- 39. Yucca House National Monument
- 40. Hovenweep National Monument
- 41. Colorado National Monument





# TABLE OF CONTENTS

## 22<sup>nd</sup> ANNUAL REPORT - 1998

	PAGE
STEERING COMMITTEE -----	ix
INTRODUCTION -----	xi
FEATURE ARTICLE -----	1
"Geographical Analysis of the Distribution and Spread of Exotic Plant Species in Grand Teton National Park, Wyoming" Deborah Kurtz ♦ Richard Aspinall ♦ Katherine Hansen -----	3
RESEARCH PROJECT REPORTS -----	11
Grand Teton National Park	
S. Anderson et al .....	15
K. Chamberlain et al.....	20
H. Harlow et al.. .....	23
A. Pinter.....	28
V. Santucci & W. Wall .....	31
G. Schrott.....	38
Yellowstone National Park	
K. Bowman & G. W. Minshall .....	41
J.W. Laundre.....	48
M. Turner et al.....	53
Greater Yellowstone Ecosystem	
D. Debinski et al.....	59
B. Smith et al.....	65
N. Stanton et al.....	71

## 23<sup>RD</sup> ANNUAL REPORT – 1999

	PAGE
Grand Teton National Park	
K. Chamberlain et al .....	85
M. Cody.....	88
R. Hall, Jr. & J. Tank .....	93
H. Harlow et al .....	98
R. Kelly .....	103



# TABLE OF CONTENTS, CON'T

	PAGE
Grand Teton National Park	
R. Marston & R. Gray .....	119
B. Miller & H. Harlow .....	124
A. Pinter .....	131
C. Weddle et al.....	134
Yellowstone National Park	
A.W. Miller .....	141
M. Turner et al.....	143
Greater Yellowstone Ecosystem	
J. Ammirati et al.....	149
D. Debinski et al.....	152
B. Smith et al.....	159



## UW-NPS RESEARCH CENTER PERSONNEL



HENRY J. HARLOW ♦ DIRECTOR  
KAREN K. NOLAND ♦ OFFICE ASSOCIATE  
RICHARD P. VIOLA ♦ CARETAKER

### 1998 STEERING COMMITTEE

STEVEN BUSKIRK  
DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY ♦ UNIVERSITY OF WYOMING

HENRY HARLOW  
DIRECTOR ♦ UW-NPS RESEARCH CENTER

JASON LILLEGRAVEN  
GEOLOGY & GEOPHYSICS ♦ UNIVERSITY OF WYOMING

FREDERICK LINDZEY  
WYOMING COOPERATIVE RESEARCH UNIT ♦ UNIVERSITY OF WYOMING

RONALD MARRS  
GEOLOGY AND GEOPHYSICS ♦ UNIVERSITY OF WYOMING

ROBERT SCHILLER  
SCIENCE RESOURCE MANAGEMENT ♦ GRAND TETON NATIONAL PARK

JOHN VARLEY  
NATURAL RESOURCE COORDINATOR ♦ YELLOWSTONE NATIONAL PARK





# INTRODUCTION

## 1998 ANNUAL REPORT

---



---

### DIRECTOR'S COLUMN

During the period of this report the University of Wyoming-National Park Service (UW-NPS) Research Center supported and administered research in the biological, physical and social sciences performed in national parks, monuments, and recreation areas in Wyoming and neighboring states. The UW-NPS Research Center solicited research proposals from university faculty or full-time governmental research scientists throughout North America via a request for proposals. Research proposals addressed topics of interest to National Park Service scientists, resource managers, and administrators as well as the academic community. Studies conducted through the Center dealt with questions of direct management importance as well as those of a basic scientific nature.

The Research Center continues to consider unsolicited proposals addressing applied and basic scientific questions related to park management. Research proposals are distributed to nationally-recognized scientists for peer review and are also reviewed and evaluated by the Research Center's steering committee. This committee is

composed of University faculty and National Park Service representatives and is chaired by the Director of the UW-NPS Research Center. Research Contracts are usually awarded by the middle to end of March to early April.

The UW-NPS Research Center also operates a NPS-owned field research station in Grand Teton National Park. The research station provides researchers in the biological, physical and social sciences an enhanced opportunity to work in the diverse aquatic and terrestrial environments of Grand Teton National Park and the surrounding Greater Yellowstone Ecosystem. Station facilities include housing for up to 50 researchers, wet and dry laboratories, a library, herbarium, boats, and shop accommodations. The research station is available to researchers working in the Greater Yellowstone Ecosystem regardless of funding source, although priority is given to individuals whose projects are funded by the Research Center.

Special acknowledgement is extended to Ms. Karen Noland, Office Associate, for her skills and dedication to the Research Center which were a vital contribution to this publication.

### RESEARCH PROJECT REPORTS

The following project reports have been prepared primarily for administrative use. The information reported is preliminary and may be subject to change as investigations continue. Consequently, information presented may not be used without written permission from the author(s).



## FEATURE ARTICLE



















