

# THE STATE OF THE MOUNTAINS REPORT

*The Impacts of Climate Change on the Alpine  
Environment and Glaciers of Southern  
Alberta and British Columbia*

**Meghan J. Ward**



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**Cover photo:** Mount Assiniboine (2010). Photo: Courtesy of the Mountain Legacy Project.

**Inset photo:** Mount Assiniboine (1913). Photo: A.O. Wheeler, courtesy of the Mountain Legacy Project.

## FOREWORD

In many ways, Canada's history is a story of our relationship with mountains. From the explorations of David Thompson, to the construction of our national railway, to our identity as a nation and a people, Canada's mountains are iconic.

Yet today our mountains are changing in ways that are alarming.

As Canada's national mountain organization, the Alpine Club of Canada (ACC) has a commitment and responsibility to act as a steward of our mountains—to bear witness to the things our members see and experience in the high places we love so much. In this report, through the observations of many of our most experienced members, we have attempted to act on this commitment and “speak for the mountains.”

More than a century ago, our founders recognized the unique role that mountains play in shaping Canada. The Club was created so that Canadians could better experience the alpine environment, and so that we might help to advance mountain science, literature and art. Many of our founders and earliest members played a central role in developing an understanding of the Alpine environment, from the Vaux family, to Arthur Wheeler himself. Contributing to a greater understanding of the alpine environment remains an important Club goal, and the reason why *The State of the Mountains* report was developed.

The story presented here is a cautionary one. Our mountain spaces are changing. Ice is melting. The snowpack is becoming more erratic. Tree lines are rising. There are rapid shifts in mountain ecology. The very rhythm and character of each season are becoming less familiar.

As ACC members we share a profound connection to mountain places. In a very real sense, we rely on the mountains to change us, to inspire us, to be a source of wonder and awe. Yet we now see that, at a collective level, we have begun to change the mountains. This is not the natural order of things, and it is deeply disturbing. It is also a story we must tell.

I want to thank Meghan Ward for her tireless work on this very challenging project—it is a complex subject that has been given life through her efforts. I also want to thank the ACC's Suzan Chamney and the many other Club volunteers and contributors who made this project possible.

Moving forward, the ACC will continue in its efforts to assist the many scientists and researchers who are working to gain a more complete understanding of the environmental forces affecting our mountains. We will continue to love the mountains, and cherish our time in them. That will never change.

—David Foster  
Vice President, Access & Environment  
Alpine Club of Canada  
April, 2011





## NOTE FROM THE AUTHOR

"It's like the mountains are being undressed," Glen Boles said in response to the changes he has seen in the Canadian Rockies. Boles, a well-known mountaineer, member of the famed "Grizzly Group" and esteemed mountain artist, could not have put it better. Just one interview into the research for *The State of the Mountains Report* and it became obvious that those who agreed to participate in the project had a special connection to the alpine environment.

*The State of the Mountains Report* is a result of two years' worth of intermittent research, interviews, phone calls, emails, data collection, writing and editing on behalf of the Alpine Club of Canada. Consequently, what began as a vast nation-wide study about the impact of climate change on alpine regions very quickly turned into a more focussed study on the impact that climate change is having on the alpine environment (primarily glaciers) in southern Alberta and British Columbia.

This shift occurred for two reasons, the first being that the scope needed to be narrowed to make this a paper and not a book, and secondly, because glacial recession has come to be known as the "poster child" of climate change, as one scientist put it. It was simply the best way to communicate the state of the mountains. The report also focuses on the mountains of southern Alberta and British Columbia, in particular the Canadian Rockies, primarily because this is where the majority of the contributors are based.

The process of preparing this paper was fairly straightforward: first, a series of mountaineers were interviewed and their anecdotal evidence was recorded. From there, a new set of questions were developed for the scientists, who provided information that could help fill in the holes and begin to answer the "why" behind the changes mountaineers had witnessed. Then, other forms of data (graphs, photographs and other visuals) were collected to fill in any remaining holes as much as possible and to provide the reader with some context. The final product results from a long process of sifting through a large volume of information and organizing material into a coherent story that would speak clearly and meaningfully to readers. I hope I've done my job.

It was delightful to be able to meet and correspond with such passionate and experienced outdoor enthusiasts and dedicated scientists, all of whom will be introduced throughout the report (there is also a list of contributors at the end). All in all, twelve mountaineers, four scientists and one natural historian were interviewed for *The State of the Mountains Report*. Throughout the report, they are more generally referred to as "the mountaineers" and "the scientists." Furthermore, the author's voice is referred to as "we," in order to represent each person who contributed to the process of *The State of the Mountains*. These people are named in a "Thank You" list at the end.

Throughout the process of gathering data for *The State of the Mountains Report*, I received many gracious recommendations of mountaineers, guides or scientists I should speak to. Many of these recommendations resulted in interviews, pieces of which appear in this report. At some point, however, the line had to be drawn on how much additional information would be collected. I realized at one point that additional data or information would not dramatically change the outcome of the report.

There will be gaps and flaws in the data you find in this report. In some cases I was asking a mountaineer to recount his or her experiences from as far back as sixty years ago. I ask that you see the general trend amidst the blurred memories and the challenge of consolidating this volume of information.

Of greatest interest to me is how the voices of those interviewed for *The State of the Mountains Report* sang with resounding unity on the subject. And while there is no doubt the alpine environment is changing, the true significance of these changes and the current state of the mountains is a question that remains to be answered.

—Meghan J. Ward  
Banff, Alberta  
March 2011

## INTRODUCTION

In the grand scheme of things, there is actually very little we know about the full effects of climate change on the alpine environment. The scientists who were interviewed for this report often spoke to the lack of consistent measuring techniques, the relative newness of the research being done and the big gaps that remain in their findings. Still, they are hard at work, on the ground, camping out on glaciers and researching at high elevations in an effort to answer some of their most pressing questions.

In many regards, the activity and changes we have seen in the alpine environment are completely natural and cyclical—part of nature’s way of regulating herself. What each of our scientists have noted, however, is that the rate at which these changes are occurring is quite startling:

“There is no question that the majority of glacial geologists would agree there is cyclicity going on,” remarked Brian Menounos, Associate Professor in Geography at the University of Northern British Columbia, “but the magnitude of glacier recession now is concerning. The general consensus is that the 20th century recession is really outside of the envelope of statistical random fluctuations.” This one fact in itself is driving much of the research in climatology, glaciology and hydrology today.

Likewise, all of our mountaineers, ranging in age from their early thirties to early eighties, have noted dramatic changes in the alpine environment during their lifetimes. Fascinatingly, all four of the scientists mentioned that, in many cases, the anecdotes of mountaineers are the best evidence of climate change that they have.

## VALUE OF ANECDOTAL EVIDENCE

Years, sometimes decades, of hiking and climbing through remote, mountainous places have turned some mountaineers into involuntary experts on climate change. “In most cases, mountaineers know more than scientists,” explained Shawn Marshall, glaciologist and Canada Research Chair in climate change at the University of Calgary. “We’ve got a bit of hard data, but not from very many places and not usually for long enough periods to put it in the context of climate change.”

The long-term wanderlust of mountaineers is integral in providing scientists with the longevity and variety of observations they require. “Scientists can study only one to two places if they want to study them very well,” he said. “To actually get reinforcing evidence or conflicting evidence from other places is really helpful.”

John Pomeroy, Canada Research Chair in Water Resources and Climate Change and Director of the Centre for Hydrology at the University of Saskatchewan, spoke of the same value in anecdotal evidence of mountaineers. Pomeroy mentioned that once mountaineers have provided their observations, scientists can then follow up on what these mountaineers have seen.

Despite the insignificance of a few decades in the geological time scale, when it comes to gathering this evidence, “there is nothing to replace someone who has been travelling out there for 40 or 50 years,” Pomeroy said.



Columbia Glacier (2009). Photo: R.W. Sandford.

## A CHANGING ALPINE ENVIRONMENT

When we asked *whether* the mountaineers had seen evidence of climate change in the mountain environment, they immediately began giving examples of *what* they had seen. Their examples were plentiful and robust, both in terms of the extent of the changes and their geographic locations.

What developed through the research and the writing of this report is a “call and response” between mountaineers and scientists. First, we introduce the mountaineers’ observations and anecdotes followed by the scientists’ explanations of the changes these mountaineers had witnessed.

### Glaciers

“Most noticeable are the glaciers,” responded Boles, “which have receded not only in length, but in volume.” Boles recounted that at one time, the Freshfield Glacier came down almost into the forest, and in the 1940s it was probably a mile or so to the glacier’s snout. Now there is a mile long lake even farther up the valley, he said.

Sean Isaac, a guide, *Canadian Alpine Journal* editor and author of *Mixed Climbs in the Canadian Rockies*, brought up the example of the North Face of Mount Fay:

“It was a big snow summer in 1993 and we kicked steps up the whole way at the end of August. It was a really wide route and the central ice bulge route was a big serac. But then I did it again in 2006 and there has been a loss in width. The ice bulge is no longer an ice bulge. The whole thing has changed. There is a lot more exposed rock without ice on it.”

Mountain guide Jen Olson echoed Isaac’s observations about Mount Fay, adding that what is happening on the North Face of Mount Fay is “really consistent amongst all mountains, which are getting drier.”

While glaciers are retreating, formerly perennial snow patches are beginning to melt away completely at certain times of the year. Long-term Coast Mountain climber, Don Serl, explained that in his research for his book, *The Waddington Guide*, people in the 1940s and 1950s climbed routes on snow in the Waddington Range of the Coast Mountains. “By the publication of the guide, the faces were much, *much* leaner, or snow faces were gone entirely,” he explained. “Now that the snow is gone, most of the old snow lines are now unattractive rock routes.”

Brad Harrison, ACC General Mountaineering Camp Manager, and Helen Sovdat, internationally certified

### WHAT IS A GLACIER?

A glacier is a mass of ice that forms where the accumulation of snow exceeds melting. This snow eventually compacts into ice, which slowly flows downhill like a frozen river. The top layer of the glacier can fracture (and create crevasses) when it flows over uneven terrain.



Vowell Glacier (1990). Photo: Brad Harrison.



Vowell Glacier (2008). Photo: Brad Harrison.



mountain guide, spoke of the Neptune Peak area in the Selkirk Mountains. “Two to three peaks have significantly changed,” Harrison said. “They are still doable, but now climbing involves really bad scree.” Sovdat mentioned that from the years 2000 to 2009, she had observed changes on both Neptune Peak and Trident Peak that were significant enough to make the climbing harder because ice is being exposed where you could previously walk on snow.

The mountaineers gave additional examples of glaciers that had demonstrated a significant retreat, including the Peyto Glacier, Bugaboo Glacier (specifically leading up to the toe of the Kain Route), Opabin Glacier in the Lake O’Hara area, Angel Glacier on the North Face of Mt. Edith Cavell and the Snowbird Glacier on Mt. Patterson. Numerous other glaciers throughout Western Canada could be added to this ever-growing list.



The current glacier bus parking lot at the Athabasca Glacier as viewed from the elevation of the former parking lot. As the glacier has receded, buses can now only access it from lower down. Photo: Meghan Ward.

“It’s sad because you see the environment that you love disappearing before your eyes. It’s a place I care about and it seems it is changing fast and not in a way that’s healthy. Maybe it’s good we take people there and show them these things. Maybe it will make a difference in their own lives at home.”

—Helen Sovdat



Haig Glacier (1982). Photo: Gillean Daffern.



Haig Glacier (1989). Photo: Gillean Daffern.

“I almost didn’t recognize the Saskatchewan Glacier when I walked in there a few years ago. Soon you won’t have to walk on ice at all to reach Castleguard Meadows. It’s just unbelievable. To someone who sees a glacier for the first time it seems massive and permanent, but they are melting back very, very fast if viewed year-to-year. My kids might not see glaciers in the Rockies when they are my age if the current trend keeps up.”

—Will Gadd

## Glacial Recession Explained

"Glacial recession is such a poster child of climate change," remarked Marshall. It makes sense, therefore, that it was the first example that the mountaineers gave as evidence.

But, glacial recession goes far beyond just being a poster child. "One thing that we know quite well is that glaciers are sensitive indicators of climate," Menounos explained. "They add mass during the winter time and they lose mass during the summer. If you were to change the temperature or precipitation pattern, they will respond."

We measure the "health" of a glacier by measuring the mass balance, which is essentially just a bank budget on the money, or water, going in and out. Additionally, as Michael Demuth, a glaciology and cold regions research scientist with the Geological Survey of Canada, explained, "Currently, we are losing more and more of our principle," referring to the storage, or savings account, that glaciers represent. Menounos attributed the current state of glaciers to a warmer surface air temperature, which has caused enhanced or increased melting in summer. Marshall clarified that glaciers are never in equilibrium—they are always advancing and retreating. "But, this is clearly a retreat that is unusual in the context of the last 3000 years," Marshall said, with reference to the Canadian Rockies.

Demuth, who has been studying mass balance for 30 years, noted that it is not just about melting and that nourishment is a very important factor. "To make up for one degree of temperature warming," Marshall explained, "you need a 70% snowfall increase." But,

"A lot of these glaciers are so out of equilibrium, that there is no snow left anymore in August in the accumulation areas of the glaciers. This means that it doesn't belong in the landscape anymore. It's just a relic of previous colder climates. The Alberta Government calls it "fossil water" because it accumulated during colder climates and it's no longer renewable. Over the next century we'll use it up."

—Shawn Marshall

in addition to the warmer surface air temperature, Menounos said there has been a reduction in precipitation in Western Canada, though he added that precipitation change is more spatially variable than temperature.

"Furthermore, the glaciers, like the Saskatchewan and Dome glaciers, are melting out enough that they are exposing old growth forest," said Marshall. Stumps dating back 3300 years ago have been exposed in these areas, providing evidence that the glaciers are further back than they have been in the last 3000 years. "This tells us that this is not just a usual warming cycle," Marshall concluded.



Athabasca Glacier (2010). Photo: Paul Zizka.

### IN CASE YOU WERE WONDERING...

Definitions from *Mountaineering: Freedom of the Hills* (7th Edition):

**Bergschrund** – Giant crevasse found at the upper limit of glacier movement, formed where the moving glacier breaks away from the ice cap or snowfield above.

**Moraine** – Mounds of rock and debris deposited by a glacier.

**Scree** – Loose slope of rock fragments smaller than talus.

**Serac** – Tower of ice on a glacier.

Above all, the Athabasca Glacier, one of six toes coming off the Columbia Icefield, came up in every single interview as the typical example of glacial retreat. "You used to be able to park your car where the bus tours take off from," remembered Boles. "It used to be a 50 foot hike down to the glacier and now it is more like 200 feet." The Athabasca Glacier has receded more than 1.5 km and lost half its volume in the past 125 years.



## In the Field: Monitoring Mass Balance

Because glacial mass is an integration of the long-term variability of precipitation, mean temperature, and cloud cover, changes in glacial mass are considered among the most robust indicators of climate change. Glacier mass balance is measured at a number of official reference observing sites in the Arctic Islands and the mountain West by the Geological Survey of Canada, Glaciology Section, in partnership with Parks Canada and various university collaborators. This long-standing initiative, which had its origins during Canada's contribution to the International Hydrological Decade beginning in 1965, is called *The State and Evolution of Canada's Glaciers*. In the mountain West, observing sites are located in the southern and northern Coast Mountains, the Interior Ranges and Rocky Mountains and in the Selwyn Mountains of the Northwest Territory.

The results of these mass balance studies are contributed periodically with those obtained from other mountain regions of the World to the Global Climate Observing System under Canada's commitments to the United Nations Framework Convention on Climate Change.

Mass balance, while a simple concept, is a very complex phenomenon to measure. Some of the research conducted at the reference observing sites includes developing better methods (including remote sensing) with which to measure mass balance, particularly for: i) larger icefields such as the Columbia Icefield; ii) where internal accumulation of refrozen melt water may occur and; iii) debris-covered glaciers which are a fast evolving phenomenon in some regions like the eastern slopes of the Rockies.



Mt. Rhondda and research on the Peyto Glacier. Photo: Michael Demuth.

## Major results over the time period include:

1. a better understanding of the role of glaciers in a water resources sense (i.e. they regulate stream flow when other sources are absent or in decline)
2. that mass balance can be as much controlled by nourishment in Winter as melting and ablation in Summer
3. that we have been witness to large swings in the north-south distribution of Winter glacier nourishment (and snowpack in general) as a result of the pulsing of the Pacific Decadal Oscillation—a sea surface temperature fluctuation that affects the circulation of moisture into the mountain West—at times starving the southern mountain West in preference to the northern Cordillera
4. that glacier mass balances have become increasingly negative in the last few decades reflecting globally synchronous temperature increases and their manifestations
5. that for some regions in the southern mountain West, late season stream flows are in decline as long-term glacier diminution takes hold (i.e. increasingly less glacier area in response to long-term negative mass balance trends is not compensated for by warming in terms of melt water generation)
6. that glaciers and icefields are becoming increasingly fragmented in the landscape, and that this is having a considerable effect on ecosystem functioning—for example a shift from river dynamics and water temperatures to which many river-borne species are highly adapted



Peyto Glacier: Mount Rhondda (left), Peyto Lake (centre), 1923.  
Photo: Whyte Museum of the Canadian Rockies (V263/NA  
-1799, Byron Harmon Fonds).

—Michael Demuth

## Snowpack and Precipitation

In the Bow Valley of Alberta, it's quite common to hear people say, "We just don't get the snow we used to." Long-term residents think back to the glory days when snow would fall in heaps and area ski hills would be well covered for the season. When we spoke to mountaineer, historian and author, Chic Scott, he said, compared to 40 years ago, there is a lot less snow in the Canadian Rockies. Scott, who did the first winter ascent of Mount Assiniboine, said that mountain "can become almost completely bare of snow, which was likely not the case in the past." Scott also mentioned that his formative years in the mountains were during big snow years, like 1971. "Nowadays, when people say 'this is a big snow year' it is actually an average year," he explained. Scott also spoke to the negative impact the lack of snow has had on ski hills in Banff National Park, particularly Mt. Norquay, which receives much less snow than the Lake Louise Ski Area and Sunshine Village.

Serl explained that, in the Coast Mountains of British Columbia, the snow pack is not necessarily lighter or less, it is just found at higher elevations:

"In the moderate high peaks (6000 to 8000 feet), in the Vancouver area for example, it used to be that by May the snow pack was at a maximum and extended below tree line (4000 or 5000 to 6000 feet away from Coast). So, early in the season was a good time to be travelling because the snow covered the bush and got you into the alpine early in the year. Even in July, there was still a lot of snow around, which made for good mobility and a decent boot skiing! We got around in the hills more easily and quickly. Higher altitudes (greater than 6500 feet) probably still have a similar snow pack as before, but snow line is higher than before, which means a lot of the terrain that used to be buried in summer is not covered and approaches are bushier and more arduous."

Roger Laurilla, photographer and guide, mentioned that in the 20 to 25 years he has been involved in snow science, the actual complexity of the snowpack has changed. According to him, there is more wind in the mountains than previously observed (more scouring and more movement of snow in the early season). Persistent weak layers in the snowpack have become the norm, resulting in huge avalanche cycles that are taking out older growth trees.



Youngs Peak in Rogers Pass (1982). Photo: Roger Laurilla.



Youngs Peak in Rogers Pass (2009). Photo: Roger Laurilla.



Illicillewaet Glacier in Rogers Pass (1982). Photo: Roger Laurilla.



Illicillewaet Glacier in Rogers Pass (2009). Photo: Roger Laurilla.



Ommo Glacier in Battle Range (1983). Photo: Roger Laurilla.



Ommo Glacier in Battle Range (2009). Photo: Roger Laurilla.

## Understanding Snowpack and Precipitation

From our scientists' perspective, it has already been concluded to some degree that there is less precipitation in the mountains. But what is the impact of this on the mountain environment, apart from bad skiing?

It is important to acknowledge that, in some regards, scientists are not able to fully assert the impact of the changes in precipitation because, according to Menounos, they have a real lack of high elevation stations in Western Canada to track these fluctuations on a long-term basis. Pomeroy explained that while they do not have good measurements at high elevations to say that the snow pack is going down, they can investigate it through modelling.

However, Marshall said that the modelling is telling them that the snowpack at high elevations should be increasing. He doesn't believe it because everything the glaciers tell us is the opposite. The fact that glaciers are thinning and retreating so much is the best evidence that the snowpack in the high mountains is actually diminishing.

"There is less snow in late spring," explained Pomeroy, "and less snow blowing because the snow is wetter." Blowing is important to the health of glaciers because it needs this distribution of snow throughout the season.

"Snow blows most easily when it is cold, dry and fluffy," Pomeroy said. "In warmer weather the snow is stickier and you get fewer cornices, which usually feed small glaciers." As of the time of our interview, Pomeroy was just starting to investigate this effect a bit more.

According to Pomeroy, the blowing effect of snow on a glacier is also important because snow on a glacier will reflect over 80% of the solar radiation on it and glacier ice will reflect only 30%. If you lose the snow, the ice will melt faster, and the earlier the ice gets exposed, the greater the melt rate on the glacier.

So, was Don Serl correct in his observation that the snowpack in the Coast Mountains? If the glaciers give any indication, Marshall said that parts of British Columbia have healthier glaciers because the snowpack is not diminishing as much. Satellite imaging is showing that between 1985 and 2005, Alberta saw a 25% reduction in glaciers while it was only an 11% reduction in British Columbia.





## Other Evidence

### Warmer Temperatures

In addition to receding glaciers and changes to the snowpack, most of the mountaineers said that they felt like temperatures had been warming over the years. Boles elaborated a bit more and said that in summer during the late 50s and early 60s, they would put their crampons on in the morning because the surface of the snow was hard. In the 70s and 80s, however, it was rare that they would do that. In fact, they would be post-holing and would have to give up on some nice snow climbing because it was just too soft early in the day.

Is it true that the temperatures are warming? According to the scientists, yes. If you were to look at the mean temperature, the largest changes in temperature are in the winter and spring months. This is quite consistent with the Northern Hemisphere in general, Menounos said.

According to both Menounos and Marshall, the consequence of this is that when there is a warmer spring season, the snowpack will melt earlier than it would otherwise, thus exposing the ice to a longer melt season. Taking into consideration the mass balance equation, if the ice has a longer melt season and isn't fed enough new snow to balance this, we will see the glaciers continue to shrink.

### Rock Fall

A few mountaineers mentioned they had seen an increase in rock fall hazard in the mountains, describing certain routes as "shooting galleries." While some attributed this to permanent snow or ice patches melting and releasing rocks, many were unsure if this was true.

Menounos said that in terms of a conceptual model of why increased rock fall might happen, they sometimes observe slopes "de-buttressing," a situation whereby a glacier starts to recede and get smaller, exposing slopes that may then undergo failure. In general, however, rock fall remains an area to be studied more intensely by scientists. At this point, most evidence is anecdotal observation only and has no ratings attached.

While rock fall is not a topic being studied in Western Canada, it is being studied in Europe. "In Switzerland, so much of their tourism is coming from the Alps, so this is a great concern to them," explained Michael Demuth, a glaciology and cold regions research scientist with the Geological Survey of Canada. "They have been observing their glaciers for a longer time, mainly through paintings, which have been depicting the mountain landscape since the late 1700s." Demuth said that we can learn from other parts of the world even though the geology of the mountains of Western Canada is different.

## ARE CHANGES ACCELERATING?

Between the mountaineers' observations and the scientists' explanations of changes in the alpine environment, we have thus far established that the current changes are unusual in light of the patterns of the last 3000 years. Beyond this, we were curious to know if the changes in the glaciers, in particular, are accelerating. We asked both the mountaineers and scientists for their thoughts on this question.

Our oldest mountaineer, Glen Boles, was quite affirmative in his response that the changes are "speeding up all the time." Most mountaineers, though, were quite hesitant to say either way and suggested we ask the scientists for their input. Mountaineers, such as Laurilla, who have a good understanding of snow science and what is occurring with the glaciers, were able to deduce that the changes are, in fact, accelerating. "When glaciers become thin," explained Laurilla, "melting actually accelerates than it would at a greater thickness."

As it turns out, Boles and Laurilla are correct. "For many of the glaciers we have studied in Western Canada," Menounos responded, "it appears that glacial thinning and frontal retreat have accelerated in the late 20th century."

"In the case of some glaciers," Menounos continued, "they shrink to a critical size where the glaciers become several smaller ice masses. Studies show that this glacier fragmentation accelerates ice loss. This process is much like crushing an ice cube—since many more sides are now exposed, melting accelerates."

Annual records at the Peyto Glacier and a few, more heavily studied glaciers indicate that the rate of glacial recession is indeed accelerating. Overall, however, each scientist said that the topic of acceleration is difficult to discuss because there simply aren't records on an annual timescale for the multitude of glaciers in Western Canada.

## CONSEQUENCES OF CLIMATE CHANGE FOR MOUNTAINEERS

Changes in the mountain landscape and glaciers, in particular, are an interesting and rather startling phenomenon to witness. But for the people who are passionate about climbing the peaks of Alberta and British Columbia, the impacts are more than aesthetic. These changes have had profound consequences on their lives as mountaineers and guides.

### *Route and Access Changes*

"Routes may not necessarily be inaccessible, but certain features and routes have changed," said Boles. For routes that are still accessible, however, hazards along the way don't make them very appealing.

Harrison, Isaac, Hansen, Scott and Olson all spoke of the impact that the changes in the alpine have had on northern aspects in the mountains. "North Faces have to be done earlier in the season," explained Harrison. "Before you had to depend on ice. Now you have to depend on the winter snowpack."

"The North Face of Forbes and Edith Cavell are just about unclimbable now," responded Isaac. Olson added The Dolphin on Mount Temple to this list. "The Mountain Conditions Report, [contributed to almost daily by guides who are members of the Association of Canadian Mountain Guides], doesn't really report a lot about people climbing the North Face of any peaks later on in the season," Isaac explained.

Further West, Serl said he doesn't bother going out ice climbing until January now. "It never freezes anymore," he said. "Ice in the Coast Mountains is restricted to higher altitudes."

"Probably the biggest difference is that you just can't plan on a route staying the same from year to year anymore when on glaciers," said Will Gadd, all-around

"It is a shifting landscape—unpredictable. Some places are safer, while others are completely inaccessible. Bergschrunds are opening up, widening and disappearing. Changing glaciers make it tricky for mountaineering. A guidebook from 10 years ago is now out of date. The biggest changes are up in the accumulation areas where there should be snow year round. Sometimes this is melting completely, so it is opening up hazards that we've never seen before."

—Shawn Marshall

"It's sad to see the mountains looking more and more like the American Rockies. As they are now, our mountains are known around the world."

—Chic Scott



Bow Glacier from Bow Lake, 1924. Photo: Whyte Museum of the Canadian Rockies (V263/NA -2443, Byron Harmon Fonds).



Bow Glacier (2010). Photo: Paul Zizka.

"People will look at the North Face of Mt. Fay and think, 'wow people used to climb that.'"

—Sean Isaac

mountain and extreme sport athlete. “It’s just an epidemic of fast changes that make even ‘known’ routes or places very different.”

Sovdat concurred. “You need to approach things fresh every time,” she responded. “In the last 10 years, the ACC’s General Mountaineering Camps have been returning to the same locations. Disappearing glaciers mean more time consuming approaches and tedious walking on loose boulders. It’s less aesthetic for people and just feels like more of a grind.”

In general, as glaciers have receded, accessing routes has involved a longer hike or some difficult terrain. Retreating ice reveals sheer faces and cliffs in some areas where it otherwise would have been covered by a glacial ramp.

“Some routes in the Bugaboos and Adamants have exposed, polished granite when the ice melts,” Isaac gave as an example. “Either you can’t even get to the start of the route or there is a pitch added to routes on the approach.”

## Safety Issues

As we alluded to earlier, mountaineering routes have not only become inaccessible; mountaineers are also finding an increase in objective hazards. “Safety has certainly been impacted, particularly when on glaciers,” responded climber, photographer and filmmaker Pat Morrow. He said many of the climbs he did before are now too dangerous to access, such as Skyladder on Mt. Andromeda and the Bugaboo Col approach to Pigeon Spire. There is just too much rock fall, and now a risk of getting rocks sent down from other parties above.

“Some climbing routes, such as the North Faces of Mt. Temple and Edith Cavell, have a much shorter season due to increased rock fall hazard,” Hansen said. “Due to the melt-freeze cycle,” Demuth explained, “it is safer to climb earlier in the season to avoid additional rock fall that is released as snow and ice melt.”

Isaac explained that there has always been rock fall in the Rockies, but now you have to be especially careful. “There are routes you just wouldn’t do now because of the exposed choss,” he said. “The ice is exposing this rubble that has been sitting there since the uplift and it’s sitting there ready to come down on your head.”

Scientists had equal concern for what the changing landscape means in terms of increased hazards and difficult access for mountaineers. “Your knowledge from the past may not help you,” Pomeroy explained. From a scientist’s perspective, the models they create are based on what they have already observed, not on what they have never encountered. So, mountaineers need to be careful not to assume that features in the terrain, such as snow bridging on glaciers, remain the same.

Demuth concluded that while the mountain environment is dynamic and ever-changing, the rate of change has been occurring over shorter time periods, in some cases two to five years. Demuth made a reference to Skyladder on Mt. Andromeda, which was once a route that people aspired to climb, but “now looks horrible.”

“The approach to the Kain Face on Mount Robson has been severely altered. Now there is an icefall you can’t negotiate. This used to be a steep snow slope.”

—Roger Laurilla



Skyladder on Mt. Andromeda (2008). Photo: Bill Corbett.

Laurilla recounted how the changes to the glacier accessing Abbot Pass at Lake Louise, known as the Death Trap, mean that it is much more broken up with rock and icefall hazard. He explained that, as a result, climbers now go up the Lake O’Hara side to the same pass.

“In the 1920s, people used to access the pass by horse,” Laurilla explained. In the building of Abbot Hut in 1922, for example, supplies would be brought across the Lower Victoria Glacier by horses and finally carried to the crest of the pass by guides.



## What is the Future for the Next Generation of Mountaineers?

**Nancy Hansen:** *I believe that people will continue to climb and explore the alpine, but that future mountaineers will not be able to climb many of the “classic” routes that are disappearing already. There will still be plenty for mountaineers and skiers to do—the larger icefields are not going to melt away in the next couple of decades. But some of the steeper faces in the Canadian Rockies will simply become too hazardous to be reasonable. Doom and gloom? Perhaps. But I also believe that people are very good at making the best of a situation, and future mountaineers will no doubt do just that.*

**Helen Sovdat:** *We will adapt. Are we going to be able to stop these changes? Maybe. But we will adapt. The high mountain experience will be there, but our Rockies could look like Colorado. They will still be great challenges, but the aesthetic and the glacier travel will be lost—almost like a dying species that can't be recovered. We'll have to go to the St. Elias Range to get the glacier experience.*

**Brad Harrison:** *Future mountaineers had better get good at travelling on scree because that is where they will be spending most of their time. There are more hazards to be aware of and more awareness required when trekking in the backcountry.*

## Barry Blanchard and Mount Athabasca

Barry Blanchard, international mountain guide, has made about one hundred ascents of Mt. Athabasca. Initially, he said he climbed on the mountain as a young man learning to be an alpinist, but the vast majority of his ascents have been as a professional mountain guide. Blanchard has seen a lot of changes in the peak over the last thirty years.

### July 1979

Ron Humble and I meander through a swath of aquamarine serac debris. The cauldron of the North Face is austere and magnificently alpine, a sweep of steel coloured ice originates at the rock of the northeast ridge, arcs past the line of the North Face, beyond where Ron and I stand nervously looking up to the Hourglass route. To our right, a ten-storey high serac overlies the ice face; it is the frontage of a pocket glacier that clings to the Silverhorn. The breadth of the ice face is 500 meters and 90 meters above us stands its sole island of rock. The outcrop is about the size of a Volkswagen Beetle and it is the only rock to break the surface of the ice face. My legs are vibrating with exertion when I hobble onto the rock island and it is my salvation because my calves are failing.

Ron and I are in so far over our heads that it is laughable. We've rented primitive ice gear and I've strapped my crampons onto hiking boots because I don't own mountaineering boots. Ron does, and he's wearing wool knickers while I climb in blue jeans. Best of all are the half a dozen small diameter red ice screws that we found in a cardboard box at an Army/War surplus store in Calgary. We're about to abandon the climb when Dick Mitten and Carl Oustram catch us up. They have a dozen Chouinard ice screws, rigid crampons with curved front points (my rentals have inclined ones) and they advance up the brittle concrete hard

ice using the *piéd troisième* technique. They are in control and encourage me and Ron to follow them up, graciously offer to leave their screws in for us to clip and clean.

The Hourglass is named for a narrow gully squeezed tight between the far right hand edge of the North Face rock band and the bulkhead of the Silverhorn serac. It is so wild to be in it, the swirling tension of the glacier touchable on my right and looking like rock strata exposed in a road cut. Less than ten feet to my left, black limestone rises sheer. Several body lengths of vertical water ice form the crux. Climbing it is an act of desperation for Ron and me, armed with one long piolet and one short alpine hammer apiece. Carl and Dick “haul” us up. Recovering at the belay I gaze off to the serac. It is so alien and breathtaking to me—the first one that I have been close to. Its leading edge cuts away to my right for hundreds of feet. Several more rope lengths and, along with Dick and Carl, Ron and I stand on top of Mt. Athabasca for the first time.

### Summer 1993

Troy Kirwan, a fellow guide, and I hike up the moraine approach on the north side of the mountain in the company of Ray, a National Geographic photographer. We traverse the glacier to a bulge cross-hatched with crevasses. We pass the morning climbing in and out of the fairy tale

icescape of azure blue. Ray has never been inside a glacier and snaps off several hundred pictures. I grab his camera and shoot a couple of him gawking out from a keyhole in the blue.

That part of the glacier is gone. It is glacially scoured bedrock now and the crevasses we played in don't exist anymore. Over the next decade I saw them thin out and flatten like a deflating air mattress. Their ripples were at the edge of the glacier, and then they were gone.

### Summer 2003

Kootenay Park is burning and torched pine needles and ash lie on the surface of the Central Rockies glaciers. For the first time in my memory, the ice border that coats the traverse leading from the Silverhorn to the summit of Mt. Athabasca melts. There is an old trail embossed in the underlying scree! At some point in the last century it must have melted and climbers walked in on trail, but that was before my time.

### July 16, 2008

The last time that I climbed the North Face route I was guiding. Several rock islands now protrude from the ice face. The crux is no longer a few moves on 5.5-feeling rock. Time has pulled the upper edge of the ice face further downhill and there are now a number of metres more rock climbing. The top edge of the ice face has also become thinner and it is harder to get good medium length ice screws into the face. Now, it is short screws drilled into increasingly fragmented patches of ice. The lost ice has left behind steeper rock and the crux now feels like 5.8/9 mixed climbing and it is tricky to protect. The exit ice is getting harder to reach all the time, although this is largely due to climbers swinging hard and shattering it away. I would not solo the crux without a self-belay now, not that I solo at all anymore.

Loose rock is exposed on the ledges of the rock band where I remember bands of snow and ice. Rock fall is a problem on hot days and I don't remember that being an issue in the '80s.

### May 2009

These days I seem to make it into the cauldron of the North Face several times a year. It saddens me to see the changes, even though I now know

that mountains, especially glaciated ones, are not static. Motion is constant and most of the time imperceptible. Sometimes it is explosive. The serac debris on this crossing was the biggest I can remember seeing; some chunks are as big as trucks. It ran a kilometre down the glacier over numerous large crevasses passing two icefalls, yet the ice cliff itself has shrunk. It is not as tall as it used to be, and it now looks like the Silverhorn Glacier, the glacier that creates it, is buckling, folding in half. It is no longer the saw cut linear edge that I clawed my way past in 1979. Upslope it is cracking and the stress of gravity is visible in a broken and jumbled surface. The rock island that saved Ron and me is now a buttress of crumbling shale coloured rock, and from it sweep strata of newly exposed rotten rock. It is also light in colour for having melted out so recently. The ice face that we climbed is now a ribbon with more rock coming out every year. Like a plate of ice set into water, the ice face is melting away on all of its surfaces simultaneously.

I've seen a picture of the North Face of Athabasca from the 30s or 40s. A small hanging glacier clings to the face. It fell off before I was born, yet its silhouette is still visible on the ice of the North Face. Glaciers advance and retreat, though seldom so significantly over the course of a human's life—this human's life. I can indulge in melancholy. Things have changed and, to borrow from my friend Bob Sandford's lexicon, I feel a personal loss in my sense of place.

—Barry Blanchard, Mountain Guide  
May 2009



Mt. Athabasca North Face from Wilcox Pass (2008). Photo: Bill Corbett.

## A CHANGING APPROACH: MOUNTAIN GUIDING

For many alpine guides, changes to the mountain landscape, glaciers, snowpack, routes and safety hazards have created new challenges for their work with clients. The guides we interviewed were able to give specific examples of how they approach their work differently as a result of climate change.

“Because the melt freeze cycles are mixed up, as a guide you need to give yourself lots of space,” Sovdat explained. Mountaineers need to approach things with a fresh eye, not assume they know the terrain and be prepared to do more technical climbing because there is less snow to walk on. Finally, Sovdat said, “You often have to explain to clients that certain routes aren’t in condition and then offer them an alternative.” But, for the most part, climate change is always a sidebar in Sovdat’s guide/client relations. “I don’t think any of the mountaineers think that global warming is a myth,” she said. “Everyone notices.”

While he admits he’s only been alpine guiding for just over five years, Isaac agreed that as a guide you need to

offer a lot of alternatives. “August is a hard time to guide now,” he said. While it used to be the alpine season in the Canadian Rockies, Isaac wouldn’t suggest clients come in August, but rather July, because conditions are better then.

“There are going to be new classic routes,” Isaac remarked, as guidebooks and photographs become obsolete with the changes in the alpine environment. Clients often come to him with a route they have in mind, not knowing the changes that have occurred. Over time, the changes will begin to alter which routes clients will request to do.

Laurilla mentioned that the changes he has had to make to his guiding are not all bad. On the positive side, he said there is a lot more to talk about with people he takes outdoors. Having evidence of climate change and areas where he can show things gives guiding additional value. “There is much more satisfaction in being able to show people the mountains and not just take them up the mountains,” Laurilla said.

## CONSEQUENCES OF CLIMATE CHANGE ON WATER FLOW

Apart from the impact the changes in the alpine has on the lives and experiences of mountaineers, likely more important is the impact climate change has had on aspects of the ecosystem and mountain environment. A vast amount of research and study is being conducted in this area—more than we will include in this report. In terms of *The State of the Mountains Report*, we took the lead from the mountaineers, who primarily brought up or asked about water flow should the glaciers disappear. This is a common question in public discussion, and one that was worth highlighting in this report.

“What will happen to the river flows in the Bow, Athabasca, Fraser and other rivers that are glacially fed?” asked Gadd. “Are farmers downstream going to have irrigation water?”

As Pomeroy explained it, “a healthy glacier has no annual effect on the water supply because its input equals the output. It is the *things that cause* deglaciation that affect the water supply, not the melting of the glaciers themselves. In that regard, glaciers are the canary in the coal mine.

As an absolute component of water supply, glaciers are not that big. They are good indicators of change, but do not affect water supply in large cities such as Edmonton and Calgary by any significant rate. According to Marshall, however, the Canmore and Banff area will receive 5% less water if glaciers are gone. “The effect on alpine streams and water resources will be much more,” Marshall explained.

According to natural historian and well-known author, Robert W. Sandford, even though glacial melt-off is only a small component of water supply, water allocation has the potential to seriously exacerbate the effects of a decrease in water flow. “For instance, only 1% of the total water supply to Calgary comes from glaciers on an annual basis, and the rest is run-off from other tributaries,” explained Sandford. But, if that water is fully allocated—to irrigation, households, etc.—losing that 1% could have a significant impact.

Essentially the glaciers act as “buffers.” For example, in the month of August, when snow has almost fully melted, the system currently relies on ice melting from



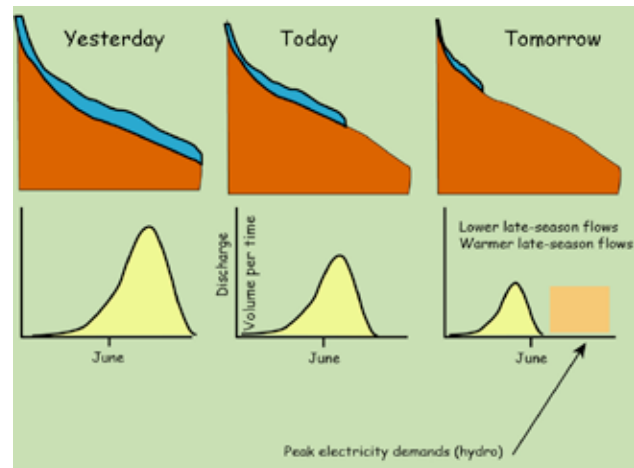
the glaciers. Glaciers can act as a bank account when all other water resources have been depleted. According to Demuth, if the ice is not there, you do not have that contribution and so this changes the shape of the hydrograph (the graph which demonstrates the changes in water flow in a river over a given period of time). It is unclear at this point what kind of impact this will have should the glaciers disappear completely. "We know very little about the ground water in some of these mountain areas," Demuth said.

That being said, there may be certain times of the year that will be adversely affected should the glaciers disappear entirely, or should warming temperatures cause greater run-off from glaciers earlier in the year. According to the scientists, irrigation downstream from these now glaciated areas may face periods of drought and need to find that water resource somewhere else. This creates concerns for certain water resources that have not been previously dammed or trapped in reservoirs. Pomeroy suggested that mountain valleys might come up as potential sites for water storage when it

In terms of the aquatic ecosystem, an earlier run-off season will change the water temperature in the rivers and creeks in the Canadian Rockies. According to Menounos and Pomeroy, some species, such as bull trout, are sensitive to temperature change. Species dependent on cold water could become extinct.

becomes necessary to manage snowmelt. "There will be tremendous pressure on areas within and out of the protected areas," Pomeroy explained.

Overall, the glaciers may disappear, but because of snowmelt, tributaries and perhaps groundwater, the mountain lakes will still be there. "They won't be nearly as beautiful because they won't have the colour that comes from the glacial silt in the water," Marshall said. These lakes, previously filling large depressions in the landscape, will also likely be smaller.



This graph demonstrates that, in the future, water flow levels may peak prior to periods of greatest demand for hydro electricity. Graph: Brian Menounos.

## Recommendations for Research

*While it was not originally part of the interview process for The State of the Mountains Report, all four scientists highlighted some challenges to their research. These challenges significantly affect the extent to which they can conduct their research, especially with regards to how diverse and long-term their studies can be.*

### Lack of High Elevation Research Stations

*There is still a real lack of high elevation research stations. According to Pomeroy, the highest snow station readings for the Canadian Rockies are around Lake Louise. Scientists need these stations to gain an understanding of the weather at these altitudes and also to further their research on glaciers. According to Pomeroy, the density of stations in Canada is far less than other countries with an alpine environment. Environment Canada has only one high elevation weather station, which is located at Nakiska, a ski resort in Kananaskis Country. Pomeroy had a few small stations installed in the Fall of 2010 with Backcountry Energy Environmental Solutions. He has applied for funding to have six high-altitude stations installed but has not yet received that funding.*

### Is Research on Glaciers Representative?

*According to Marshall, certain glaciers are well studied, such as the Peyto Glacier, but studying one glacier extensively is not enough to make conclusive observations and readings. Scientists can hope that the glaciers that are studied are*

representative, but “a glacier is not a glacier is not a glacier,” said Demuth. “Some are protected by a cirque, others get more snow, and weather is different. You can’t lump these together.”

It is not as simple as just studying more glaciers, however. Research is expensive and glaciers are not easily accessed. Even when they are, other challenges exist. For example, “despite its remarkable access,” Marshall said, “the Athabasca Glacier is too busy for scientists to feel confident putting instrumentation and equipment up there to get data.” The Athabasca Glacier is considered the most visited glacier in North America. If anything else, setting up a research station there would provide a provocative contrast to the bus tours running up and down the quickly receding glacier.

### Lack of Funding for Scientific Research

Since the writing of this report began in February 2009, a few key scientific research programs related to the study of climate change have been severely affected by a lack of funding. According to Pomeroy, the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), Canada’s main funding body for university-based research on climate, atmospheric and related oceanic work, is shutting down due to a lack of funding from the Canadian government.

The Western Canadian Cryospheric Network, WC2N, a group of six Canadian universities, two American universities, and government and private scientists who were examining links between climatic change and glacier fluctuations in Western Canada, will eventually shut down. Previously funded by CFCAS, WC2N is currently running on a small supplemental grant until the end of 2011. Some members of the network will continue to work on cryospheric science despite this, Menounos assured. IP3, a research network devoted to improving understanding of cold regions hydrometeorology, has also received no further funding, as it was previously funded by CFCAS.

“In my opinion,” said Menounos, “CFCAS was one of the best run and most efficient funding organizations for climate science that Canada has ever seen. This government simply doesn’t see the environment or understanding the effects of climate change as their priority.”

### Challenges to Methods of Measuring Change

While it would be advantageous if more glaciers could be studied, if anything scientists need to establish how to take better, more consistent measurements. “The method of reading and taking observations has changed over the years,” said Pomeroy. Glaciers need to be chosen strategically and better techniques need to be developed to measure larger glaciers. Snow science, in general, would also benefit from having more consistent ways of taking measurements. As Laurilla said, “changes in the way we determine changes and take readings have made it difficult to compare apples to apples.”



Research station at Peyto Glacier. Photo: Meghan Ward.

## LOOKING AHEAD

With anecdotal evidence and scientific research pointing us in the direction of accelerating changes in the alpine environment due to climate change, many readers will, no doubt, feel inclined to ask “what now?” What can we do to stop the changes to the mountains of Western Canada?

We asked the mountaineers and scientists what they thought people who loved the mountains could do to protect them. This question resulted in some rather

“We need to speak for the mountain landscapes that do not have a voice on the national level,” Sandford responded. “The mountain community could have a strong voice in this because of personal experience. They are trustworthy. They have been out there in the field.”

varied responses that ranged from population correction to recycling or not doing anything at all. Some respondents offered suggestions, such as taking non-mechanized trips into the mountains and consuming less fuel by making more conscious decisions when buying products, carpooling and spending less time on the road. But as Morrow explained, “it’s got nothing to do with being a mountaineer and everything to do with being one of the 6.1 billion people on the planet and the choices we make in our every day lives.”

Menounos suggested that Canadians are stuck thinking that the only way we can stimulate the economy is by relying fully on fossil fuels. To him, this is not the case. “Ignoring the problem is adding a burden to the grandchildren of Canada that they should not have to inherit,” he said.

## The Mountain Environment of the Canadian Rockies: 50 Years from Now

**Shawn Marshall:** “It will still be beautiful here, but the Canadian Rockies we know won’t be the same. The areas where glaciers were could have flower-filled meadows. In the Rockies, we’ll still have snow and they’ll still be nicely dressed in white in the winter and spring. There will still be a lot of ice, it will take a while to melt away fully. In summer, you could drive down the Icefields Parkway and not see any ice, though the ice could still exist at high elevations. It would look a lot more like Colorado. Rivers and lakes will slowly turn to prairie lake colour.”

**Michael Demuth:** “We’ll continue to see further glacial disintegration. The experience of the mountaineers will change. We’ll have to be slogging through beautiful and interesting terrain but wandering up even more glacial moraine. Some small glaciers will outlast the big glaciers because of the elevation they are at. Some glaciers will last longer because scree landing as debris on glaciers actually has an insulating effect, like a blanket. But what is the hydrological significance of this ice that is not melting as quickly? We need to get past assumptions that it’s all about melting and what you see from the highway.”

**John Pomeroy:** “We’ll still have the ice fields, but they won’t be as big. The glaciers we can usually see from the Icefields Parkway won’t be seen. Mountain snowpacks will



Lake Louise (2010). Photo: Paul Zizka.



Lake Louise 50 Years from Now. Photo digitally altered by Paul Zizka.



*be in bad shape in March and at lower elevations it will be normal not to have snow. We'll start to see vegetation change with tree line moving up and valley bottoms becoming grasslands. It will look a lot more like Montana or Idaho. It will be inevitable that the Canadian Rockies will look like the American Rockies."*

**Brian Menounos:** *"If I had to paint you a picture, the glaciers will be smaller. We will probably still see large icefields like Columbia, but some smaller glaciers will not survive. We will see a snowpack on average thinner than it is today and containing less water. Tree line will be higher. If it was a 100 years from now, I would feel more confident in painting a picture. Again it somewhat depends on the emissions scenarios you believe. The hydrological system will become more intense, leading to an increase in precipitation in the winter for some areas. Even with that slight increase, the warming that is being experienced by the increase of carbon dioxide will overwhelm. In a 100 years from now, the changes will be even more clearly evident."*

## CONCLUSION

Looking back at their mountaineering careers, many of the respondents spoke to how they feel fortunate to have lived in the time that they did. Harrison was particularly thankful to have lived in what he called the "Golden Age of Access," what with routes now becoming so hazardous and inaccessible.

Despite the changes they have seen, most of the mountaineers said they would still continue pursuing their passions in the outdoors, though they would potentially alter some of the ways they do this. Sovdat explained how important it is to use minimum impact travel and camping techniques in the fragile alpine environments. This is something she passes on to her clients as well. "As a guide I am a technical leader," she said, "but also have a responsibility to be an interpreter and steward of the mountains." She also works to strike a balance between getting her clients to the peak and helping them enjoy the beauty and minutiae along the way.

Isaac said we still live in a Golden Age. "We've just got to think of ourselves as lucky that we have these artefacts

of the ice age and we should get out and enjoy them," he said. A glaciated mountain environment is not yet fully lost. And while the state of the mountains will continue to change forever, we currently live in an age where we can experience these glaciers and watch them move in the landscape.

Finally, Marshall reminds us that, in the end, humans will be the ones to deal with the state of the mountains, however that may change. "The Earth can handle it, but we aren't used to it," Marshall concluded. "We've come to think that mountain environments like the Canadian Rockies should look a certain way. But they haven't always looked like that, nor will they continue to."

Thus remains a snapshot of *The State of the Mountains* in the year 2011. All is not lost, but the impacts of climate change on the alpine environment are vast and disconcerting. Only the future will tell us what truly lies ahead, but our actions and choices in the present moment may influence that outcome.



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## CONTRIBUTORS



### Barry Blanchard

Barry Blanchard was born in Calgary on March 29, 1959. He found mountain climbing in the books of his high school library, some of which are still in his possession. A six month trip to the French Alps in 1980 set the course of Barry's life: to climb the steepest and most complicated faces of the world's great glaciated peaks. Barry is an alpinist and full time, internationally certified mountain guide who has spent over 5000 days of his life mountaineering. Barry is an Associate Director with Yamnuska Mountain Adventures. He lives in Canmore with his wife Catherine and two daughters, Rosemary and Eowyn.



### Brad Harrison

Brad Harrison has been managing and outfitting the ACC's General Mountaineering Camp (GMC) for twenty-five consecutive years. His father, Bill Harrison, who shared the trail with the likes of Kain and Thorington, was the camp's packer and outfitter for over thirty years before that. The family ties to the GMC are strong indeed. Brad attended his first camp at the tender age of six and hasn't missed many since. Today, along with his regular duties with the ACC, Harrison serves as the Executive Director of the Backcountry Lodges of British Columbia Association (BLBCA) and is the Canadian Mountain and Ski Guide Coordinator at Thompson Rivers University in Kamloops.



### Brian Menounos

Dr. Brian Menounos is an Associate Professor in Geography at the University of Northern British Columbia. He obtained his undergraduate and Master's degrees from the University of Colorado, Boulder, and his PhD from the University of British Columbia (2002). Brian was the principal investigator of the Western Canadian Cryospheric Network (WC2N), a UNBC representative to the Pacific Institute for Climate Solutions (PICS), and a scientific steering member of the Columbia Basin Trust. Brian also sits on the BC Hydro technical advisory committee for the Pacific Climatic Impacts Consortium. He has strong research links with faculty at Simon Fraser University, the University of British Columbia, the University of Calgary, the University of Alberta and the University of Victoria.



### Chic Scott

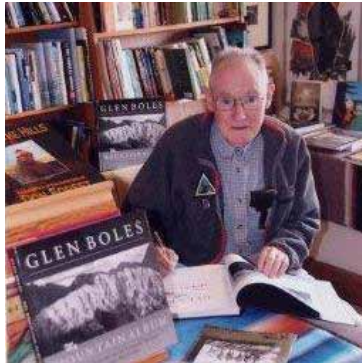
Born in Calgary in 1945, Chic has devoted his life to the mountains since his first ski trip in the Rockies at the age of 17. A cutting edge mountaineer in his time, he did the first winter ascent of both Mount Assiniboine (1967) and Mount Hungabee (1966), and climbed Myagdi Mathi in 1973, the first Himalayan summit reached by a Canadian. Still an avid ski mountaineer, Chic now devotes his life to educating others about mountain history and is the author of many books, including *Pushing the Limits: The Story of Canadian Mountaineering* and most recently, *Deep Powder, Steep Rock: The Life of Hans Gmoser*.



### Don Serl

Don Serl was born in Victoria, British Columbia, in 1947 and grew up in Kamloops. He discovered a love of the mountains in the early 1970s, by which time he was residing in Vancouver. He has spent most of the past thirty five years exploring unfrequented parts of the Coast Mountains of British Columbia, wherein he has contributed nearly 200 first ascents of alpine and rock routes, ice climbs and even the occasional mountain. He is the guidebook author of *West Coast Ice* and *The Waddington Guide*.





### Glen Boles

Born in New Brunswick in 1934, Glen moved to Calgary in 1953 and was eventually persuaded to go climbing with now legendary mountain guide, Heinz Kahl. In his climbing career, he climbed extensively in Canada, summitting over 600 peaks, as well as in Alaska and Europe. A member of the Grizzly Group, now a well-known group of friends and climbers dedicate to first ascents on remote peaks in the Rockies, Glen is also an avid skier. Now living in Cochrane, Alberta, and retired after 36 years with the City of Calgary (as a waterworks planner), Glen has also become a prolific artist and is best known for his sketches. In 2005, Glen received the Summit of Excellence Awards at the Banff Mountain Film Festival for a lifetime of dedication to enriching the mountain community.



### Helen Sovdat

Helen Sovdat is an active IFMGA guide (International Federation Mountain Guides Association) and is currently based in the Canadian Rockies. She is one of seven internationally certified female guides in Canada and has worked in the mountains for over 20 years as a guide and educator. In the winter, Helen is a helicopter ski guide for Canadian Mountain Holidays. Her summers are spent working in the local ranges. She is an instructor with the ACMG guide certification program as well as a guide with the Alpine Club of Canada. Helen leads international expeditions and has visited Peru, Bolivia, Nepal and Mongolia with her groups. Some personal expeditions include Manaslu, Cho Oyu, Ama Dablam and Logan.



### Jen Olson

Jen Olson cannot climb enough rock or ice in this lifetime. Born in 1971 and brought up in the foothills of the Canadian Rockies, she started climbing in university through an Outdoor Pursuits degree in Calgary, Alberta. She loves heading out on alpine granite climbing adventures with other females in Alaska, the Himalayas and in the Bugaboos. Jen gets a lot of energy from being a part of all women's climbing clinics, learning and sharing her passion for moving in the vertical world. Jen is also one of seven women who are certified in Canada as IFMGA/ACMG mountain guides. She has guided ski touring and heli-skiing in the Purcells, Selkirks and in the Coastal Range of BC.



### John Pomeroy

Dr. John Pomeroy is the Canada Research Chair in Water Resources and Climate Change, Director of the Centre for Hydrology at the University of Saskatchewan and President of the International Commission for Snow and Ice Hydrology. Born in 1960, he has conducted research for the last 30 years on water, snow and climate in cold and arid regions. He resides in Canmore, Alberta, and divides his time between the University of Saskatchewan campus and research facilities in the Kananaskis Valley of Alberta. He enjoys scrambling, hiking, kayaking and especially travelling over snow by ski or snowshoe.



### Michael Demuth

Dr. Michael N. Demuth is a glaciology and cold regions Research Scientist with the Geological Survey of Canada (GSC) and is currently head of the GSC's Glaciology Section. Clinching Mike's attention to studying changes in Canada's mountain West was his participation in a research expedition to Mount Logan in 1981 where, after climbing the east ridge, the crew recovered an ice core that eventually provided clues as to the nature of temperature and precipitation changes for the region. Mike leads the development of Canada's glacier-climate observing system through a collaborative initiative called "The State and Evolution of Canada's Glaciers." His current research interests are geo-physical investigations of glacier and ice sheet mass balance, glacier-related water resources, cold regions hydrology, and public outreach on climate science, water and the stories that glaciers tell.



### Nancy Hansen

Nancy Hansen is an avid climber whose passion for the sport continues to grow after 17 years of intense involvement. She enjoys every aspect of the sport—rock, ice, alpine climbing and ski touring. In 2003, she became the first female to climb all 54 peaks over 11,000 feet (3350 metres) in the Canadian Rockies. Born in 1968, Nancy holds a B.Sc. with a double major in Geology and Environmental Science. She has been working in various management positions for the Alpine Club of Canada since 1996. She and her husband Doug Fulford have called Canmore, Alberta, home since 1993.



### Pat Morrow

Pat Morrow has led and worked as a photographer or camera operator on over 40 expeditions, 20 of them mountaineering on peaks above 5000 metres, and 20 treks of 30 days or longer in the Himalaya, Karakorum and Kunlun Ranges. Born in 1952, at age 19 Pat joined forces with environmental activists in the East Kootenay region of British Columbia to help establish the Purcell Wilderness Conservancy. Today, he and wife, Baiba, lend their support to Wildsight's conservation and educational efforts aimed at minimizing the destructive forces of industrial tourism development and extractive industries in the Purcell Mountain range and neighbouring Rockies.



### Robert Sandford

Robert "Bob" Sandford is a natural historian and author based in Canmore, Alberta. He has authored a number of books and publications and has become known worldwide as an authority on water conservation and policy. Amongst many positions he holds on advisory boards and panels, he is the EPCOR Chair of the Canadian Partnership Initiative in support of United Nations "Water for Life" Decade, which aims to advance long-term water quality and availability issues in response to climate change. Bob is also the Director of the Western Watersheds Climate Research Collaborative, a not-for-profit research institute that promotes understanding of climate impacts on river systems originating in the Rocky Mountains. Bob is an associate of the Centre for Hydrology at the University of Saskatchewan and was recently appointed a Fellow of the Biogeoscience Institute at the University of Calgary.



### Roger Laurilla

Born in Revelstoke in 1959 and raised in Rogers Pass, Roger remembers a time when there was no highway through this now busy mountain region. While he was in his teens, he became more interested in both mountaineering and photography, and has since pursued both of these fields in a professional manner. In 1979, he began his work with CMH as a construction helper, but gradually took on new responsibilities. He became a certified guide with the ACMG in 1986 and now also works as an internationally certified mountain guide. He has managed the CMH heli-ski operation in the Monashees, and currently still guides there and runs Battle Abbey, a backcountry lodge in The Selkirks. His photographs have been published in *Canadian Geographic*, *Powder Magazine*, *Climbing*, and *Backcountry*, among other publications and books. His photography and guiding have taken him to South America, Eastern Africa, New Zealand, Europe and Asia.



### Sean Isaac

Originally a Maritimer, Sean migrated west from his hometown of Saint John, New Brunswick, when he was 20 years old and has called Canmore, Alberta, home for the past 18 years. Sean spent most of his 20s as a globetrotter climbing bum exploring remote ranges in Patagonia, Peru, Pakistan, Kyrgyzstan, Alaska and Baffin Island. His early 30s were spent delving into the dark art of mixed climbing of which he authored two books: the guidebook *Mixed Climbs in the Canadian Rockies* and the instructional manifesto *Mixed Climbing*. When not working as an ACMG Alpine Guide, he enjoys adventuring with his two young sons and exploring their “backyard”—the Canadian Rockies.



### Shawn Marshall

Dr. Shawn Marshall is a glaciologist and Canada Research Chair in climate change at the University of Calgary. He received his BSc in Engineering Physics at the University of Toronto before realigning his academic pursuits and pursuing his PhD in Geophysics from the University of British Columbia. Shawn studies glacier-climate processes through a combination of modeling and field studies in the Canadian Rockies, the high Arctic, Greenland and Iceland. In his spare time he can be found skiing and running the many trails in the Rockies from his home base in Canmore, Alberta.



### Will Gadd

Will Gadd, son of legendary naturalist and geologist Ben Gadd, grew up in the Rocky Mountains. An all-around athlete, Will is best known for his extreme sports that have landed him on the world stage many times. A world champion paraglider, he has also won major ice climbing and sport climbing competitions and put up the hardest mixed climbing lines in the world. His adventures have led him to climbing bobbing icebergs off the coast of Labrador and down frozen mine shafts in Sweden. He makes a living writing and sharing his extreme experiences.

\*Profile photos come courtesy contributors.



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## ABOUT THE AUTHOR

Meghan J. Ward is an outdoor, travel and adventure writer based in Banff, Alberta. Her work has been published by *Alpinist Magazine*, *Highline Magazine*, *Skiing Magazine*, *Our Canada*, *Travelmag*, *Canadian Alpine Journal*, various *Travel Alberta* publications and Alberta newspapers. She loves any sport that gets her to high elevations, as well as international travel, photography and yoga. As a member of the Alpine Club of Canada, she is an active member of the Mountain Culture Committee and has written for *The Gazette*. In March 2011, she joined the team at *Highline Magazine* as Editor.

For more information, visit [meghanjoyward.com](http://meghanjoyward.com).



*The State of the Mountains Report* takes a unique approach at pulling back the veil on climate change. In this report, twelve of Canada's most well-known mountaineers and guides provide their observations and anecdotes about changes they have witnessed in the mountain environment. A select group of scientists then respond to the observations of those mountaineers. Do the mountaineers' stories line up with scientific research to this point? The end goal was not to produce a scientific paper, but rather a resource that any person who cares about the mountains can understand.

*The State of the Mountains Report* gives Canadians, and all readers alike, the opportunity to hear the voices of people who have spent countless hours researching from glacial moraines and climbing the highest peaks in Western Canada. The contributors in the report have, in one way or another, dedicated their lives to the alpine and have offered their first-hand experiences, expertise and photographs to tell the stories of how climate change has not only affected the mountains, but also their livelihoods.



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