RECREATION & TOURISM

Changes to Aspen's winter-based tourism

In the 2006 Aspen Study, Snowmelt Runoff Model (SRM) and SNTHERM results projected deteriorating skiing conditions on Aspen Mountain over the course of the 21st century among high, medium, and low emissions scenarios. For the highest emissions scenario considered, an end to skiing in Aspen was projected by 2100. So far the world continues to follow this high emissions pathway.[37]

In 2006, modeling assessed by AGCI projected an end of skiing in Aspen by 2100 under high emissions scenario. World emissions still continue along this pathway.

Historical observations and projected future changes in the Aspen area reinforce findings from 2006. These observed and projected changes pose significant challenges to winter recreation, based on the sensitivity of natural snow abundance and quality to changes in temperature and precipitation.

A survey conducted by the National Resources Defense Council (NRDC) showed that snow conditions do influence statewide demand for skiing in Colorado. The NRDC study found an 8% variance in skier days between high and low snowfall years. Although this variance was less than in other states' surveys, in Colorado 8% translates to 1.86 million fewer skier visits during a low snowfall year as compared to high snowfall year.[38]

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[37] Sanford 2014; IPCC 2013.

[38] Burakowski, E. and M. Magnusson. 2012. Climate Impacts on the Winter Tourism Economy in the United States. *National Resources Defense Council*, (December).

For decades, ski areas have adapted to natural variability by altering their opening and closing dates and by developing and expanding snowmaking capacity.[39] Snowmaking in Aspen, in its existing form, enables resort managers to achieve target conditions in time for a Thanksgiving opening and to sustain conditions through a springtime closing date. In recent years the Aspen Skiing Company has moved to reduce operational constraints from energy and water associated with snowmaking.[40]

However, climate-related barriers to snowmaking remain beyond the control of ski resort managers. One fundamental challenge due to climate change is the likely reduction of cold temperatures required for adequate snow production.[41] A still unexplored component of a shift to increased snowmaking is consumer reaction to increased dependence on snowmaking.[42]

Additionally, observations suggest that precipitation coming as rain instead of snow during the skiing season will be increasingly common, as was discussed in the 2006 Study. Knowles, Dettinger, and Cayan conducted a study on trends in the fraction of winter (Nov-Mar) with precipitation falling as rain versus snow in the Western United States for 1949-2004. Of the 261 sites analyzed, 74% showed the water content from snow as a smaller fraction of total precipitation.[43] In addition to managed downhill terrain, these types of impacts may also affect the safety and desirability of other winter recreation activities like cross country skiing and back country skiing.

In Colorado, 1.86 million fewer skier visits occur during a low snowfall year as compared to high snowfall years.

As demonstrated in the 2006 Study using economic base analysis, winter recreation has been the magnet and economic engine for numerous related components of Aspen's culture and economy—from restaurants, outfitters, and professional services to sizable real estate transactions, home remodels, and home building. Some of the visitors in the winter may not ski but come for other reasons associated with the ski culture. All of these things considered, changing future winter climatic conditions in Aspen and relative winter conditions in other resort communities may affect, positively or negatively, the overall allure for visitors to Aspen

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[39] Bark, R. H., B.G., Colby and F. Dominguez. 2009. Snow days? Snowmaking adaptation and the future of low latitude, high elevation skiing in Arizona, USA. *Climatic Change* 102 (3-4): 467–491. doi:10.1007/s10584-009-9708-x

[40] Interview with Rich Burkley, Aspen Skiing Company, January 17, 2014

[41] UN World Tourism Organization, & UN Environmental Programme. 2008. Climate Change and Tourism: Responding to Global Challenges. Madrid, Spain. Retrieved from http://sdt.unwto.org/sites/all/files/docpdf/climate2008.pdf

[42] Bark et al. 2009

[43] Knowles, N., Dettinger, M., & Cayan, D. 2006. Trends in Snowfall versus Rainfall in the Western United States. *Journal of Climate*, 4545–4559. Retrieved from http://journals.ametsoc.org/doi/abs/10.1175/JCLI3850.1

Box 4.1 Recreation and tourism summary

Climate-related changes:
- Increasing wintertime temperatures
- Reduced fraction of precipitation falling as snow
- Increasing stream temperatures
- Alterations to timing and quantity of stream runoff

Future Potential Impacts
- Difficulty meeting target ski area conditions during existing season
- Reduction in suitable weather conditions for snowmaking
- Alterations to timing of ideal summer and winter recreation conditions
- Degraded aesthetic quality of environment; increasing hazards posed to visitors

Potential Responses
- Increased reliance on snowmaking
- Marketing and communication to attract visitors at non-traditional times
- Diversification of tourism in relation to economic base
- Extension of summer season events and activities
- Development of long term plans among providers of recreation and tourism services

Opportunities
- Expanded time period for summer season activities
- Reduction of shoulder season lull

Lingering Uncertainties
- Future trends in overall snowfall
- Adaptability and preferences of visitors
- Cascading effects of climate change on Aspen's economy

throughout the entire year. It is not possible to predict in this study how specific conditions may play out for local economy and future investment, but potential scenarios could be considered with the help of additional research and engagement with stakeholders. As pointed out in the 2006 study, because of Aspen's relatively high and cold ski mountain terrain relative to many other resorts, its skiing conditions may be superior to many other resorts as climate change progresses.

Changes to Aspen's summer-based tourism

Climate-dependent recreational activities during the summer include water-based activities, such as rafting and fishing, and activities in the forest, such as hiking and biking. Changing conditions within the forest may result in indirect impacts to activities such as hiking and mountain biking. This section addresses the more direct and significant potential impact on recreation from alterations to the hydrograph.

The 2006 Study presented runoff modeling results that projected substantial alteration in the timing of peak flows of the Roaring Fork River at Woody Creek. Subsequent to this, a statewide study by Clow analyzed data from 70 SNOTEL stations and dozens of gauge stations across the state. This research found that in the past 29 years there has been a 2-3 week timing shift in snowmelt and runoff. These types of changes, along with low flow years, may in the

future cause the timing of rafting demand to go out of sync with ideal rafting conditions on the upper Colorado River.[44]

Climate change could also significantly alter recreational fishing, a summer tourist attraction in the Aspen area. Warming stream temperatures have the potential to impact success of trout and other cold water sport fish by altering timing of growth and development and changing availability of food supplies.[45] Along with impacts directly associated with warmer temperatures, aquatic habitat attributes such as dissolved oxygen and stream depth are affected by temperature and streamflow.[46] Simple climate-related snowmelt modeling of the upper Roaring Fork indicates a likelihood of reduced snowpack with earlier peak runoff and greater seasonal flow variability during the 21st century.[47]

As recent observations (see Figure 2.6 on frost-free days) and future projections (see Chapter 3) suggest, the length of Aspen's warm season is elongating. This presents an opportunity for expanded summertime recreational activities during what has typically been considered an "off season" or "shoulder season." However, expanded summertime recreation will present new challenges for water and land resource managers, who will have to plan for new demand and potential impacts from increased resource use.

Another component of climate-related change to summer tourism is the potential for wildfire risk to increase with drier conditions and higher temperatures. The risk of fire, as well as other extremes such as drought and flood, may affect both the logistical ability as well as the desire to engage in summertime activities before, during, and/or after these type of sudden events. In addition sudden changes such as fire and even more prolonged, gradual changes from drought can significantly affect the aesthetic character of the landscape, a notable attraction of the area for tourists.[48]

Response strategies

The response strategies undertaken by providers and users of recreational services will vary according to existing capacity to adapt, the magnitude of change anticipated or experienced, and the overall sensitivity to actual or projected changes. For instance, ski area operators are experienced with and have many existing options at their disposal to respond to climate and

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[44] Clow, D. W. 2010. Changes in the Timing of Snowmelt and Streamflow in Colorado: A Response to Recent Warming. *Journal of Climate* 23 (9): 2293–2306. doi:10.1175/2009JCLI2951.1

[45] Reiman, Bruce and Dan Isaak. 2010. Climate Change, Aquatic Ecosystems, and Fishes in the Rocky Mountain West: Implications and Alternatives for Management. General Technical Report for the U.S. Department of Agriculture and U.S. Forest Service November 2010.

[46] Ptacek et al. 2003.

[47] AGCI 2006; IPCC 2007.

[48] See Chapter 4 sections on Ecosystems and Public Health and Safety for more on fire risk.

weather-related changes. On the other hand, service providers such as lodging operators likely have fewer options to consider when contemplating significant operational changes on the basis of climate and weather patterns.

Responses may involve proactive or reactive actions in coordination with broader community planning guidance (e.g., Aspen Area Community Plan) or climate-specific policy actions undertaken independently. Collaborative planning—incorporating broad-based stakeholder involvement—may help to devise responses that address specific concerns, while flexibility in discussion and planning structure accommodates the evolving nature of available climate information and risks.

Scientific discussion of climate change impacts typically involves timescales between 30-100 years into the future. However, in our assessment of literature and stakeholder interviews, we found that planning within the recreation and tourism sector, particularly among private enterprise, occurs over much shorter, more near-term timescales.

For example, at the Aspen Skiing Company, long term planning consists of capital investment planning typically in 10-year increments for significant investments, such as ski lift development and snowmaking equipment.[49] Rafting and fishing guide companies typically respond to conditions at seasonal or day-to-day timescales. One constraint to long-term planning is that operational forecasts of climate or hydrologic conditions are typically unreliable beyond the current water year. While the skill of ski area operators to manage frequently changing forecasts and surprise shifts in weather is a valuable human resource for dealing with change, this embedded culture may lead to somewhat of a barrier when future changes depart from existing ranges of variability and require longer term planning and novel strategies.

Overcoming the barrier to thinking long-term may be facilitated by the support of governmental entities, such as the City of Aspen, that have mandates to consider and plan for potential risks to the community over more distant time scales. Scenario planning where specific futures are not predicted but multiple potential outcomes are considered is one approach.[50] An example of long range planning is the City of Aspen and Pitkin County's Aspen Area Community Plan that presents a vision and policies to support community development over a 10-year time span.[51]

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[49] Interview with Rich Burkley, Jan 17, 2014

[50] Peterson, G. D.,G.S. Cumming, and S.R. Carpenter. 2003. Scenario Planning : a Tool for Conservation in an Uncertain World, *Conservation Biology* 17 (2): 358–366.

[51] City of Aspen & Pitkin County. 2012. Aspen Area Community Plan. February 27, 2012. http://www.aspencommunityvision.com/media/uploads/FINAL_AACP_2272012_reduced.pdf