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Coping With Drought on California Rangelands

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On the Ground

- Rangeland livestock producers were among the first agricultural communities affected by California's multiyear drought.
- Rancher surveys and in-person interviews have identified key strategies for coping with and adapting to drought.
- Increasing flexibility, resource valuation, and information sharing are important components of building adaptive capacity.
- Web-based communication systems have provided new tools for peer-to-peer learning, public education, and extending knowledge to larger audiences.
- Insights from managers experiences are important for adaptation planning to enhance resilience of rangeland social-ecological systems to climate stresses.

Keywords: adaptive capacity, climate change, decision-making, livestock production, ranching, working landscapes.

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The statewide drought that has gripped California since late 2012 has had severe impacts on both agriculture and the environment. At the start of the 2015 to 2016 water year, California's largest reservoir, Lake Shasta, held just 35% of its capacity (59% of historic average).[1] Other federal Central Valley Project reservoirs were in worse shape—Folsom Lake at 18% capacity and New Melones at 11%.[1] Statewide costs have been estimated at $2.2 billion and 17,100 jobs for the 2014 drought, and $2.7 billion and 21,000 jobs for the 2015 drought.[2]

California has experienced five large-scale, multiyear droughts since 1960; however, the current event is considered the state's most severe drought in at least 500 years.[3] Each year of the current drought has presented different challenges; for example, much of California received no measurable precipitation December 2013 through late January 2014 (Fig. 1).[4] In the following year, the Sierra Nevada snowpack was just 5% of normal. As California ranching is largely dependent on rain-fed systems, as opposed to groundwater or stored water, it is very vulnerable to drought. In fact, rangeland livestock ranchers were among the first affected by the abnormally warm, dry winters at the beginning of the current multiyear drought.

In this article, we highlight lessons learned so far from past droughts, as well as California's unprecedented and ongoing multiyear drought. We draw on ranchers' perspectives and experiences, including research results from a statewide mail survey of 507 ranchers[5] and semistructured interviews of 102 ranchers, as well as our own experiences. The mail survey (the California Rangeland Decision-Making Survey[5]) included questions on operator and operation demographics, goals and practices, information resources, and rancher perspectives. Semistructured interviews are part of a larger ongoing project (the California Ranch Stewardship Project) examining rangeland management for multiple ecosystem services.

First Impacts

California's estimated 34 million acres of grazed rangelands provide the backbone of support for many livestock commodities in the state, including cattle and calves ($3.3 billion annually) and sheep and goats ($92 million annually).[6] These biologically diverse working lands also preserve open space and critical wildlife habitat. Ranchers in California's large Mediterranean climate zone are already challenged by

Figure 1. Extreme drought on Californias annual rangelands (Sutter County, California). At the time of this photo (January 2014), drought conditions were extreme to exceptional for 67% of the state.[4] Photo courtesy of T.K. Schohr.

characteristically long, hot, and dry summers during which dryland forage quality declines over the season. Escalating drought frequency and severity compound this challenge, delaying or eliminating the fall, winter, and spring rains that lead to renewed green forage. Long-term drought poses significant, cumulative challenges to sustaining ranching operations and the ecosystem goods and services they provide. Severe and widespread drought can trigger undesirable ecological shifts, which can have long-term impacts on forage and livestock production and directly threaten livelihoods of families and communities.

In 2011—immediately prior to California's historic multiyear drought—we surveyed 507 ranchers across the state to gain insight into factors driving their decision making, perspectives on effective management strategies, and use of information sources (methods and details provided in Roche et al. 2015).[5] Many ranchers reported experiencing drought-driven impacts more severe than expected during the previous drought (median date of last perceived drought was 2009), with lost grazing capacity (77%), profit (55%), and weaning weights (44%) most severely affected.[7] Furthermore, over 74% of the 443 ranchers surveyed before the onset of the 2012 drought indicated that a new drought would impact their operations "as severely" or "worse" than past droughts.[7]

In early 2104, record-breaking water shortfalls—resulting in a drought state of emergency—received extensive media coverage and wide public attention. However, at the onset of this now unprecedented drought, California ranchers had already been facing regionally dry conditions across the state. Between spring 2013 and fall 2014, we conducted semi-structured interviews with 102 experienced ranchers across the state. Interview participants were identified via local Cooperative Extension, and face-to-face interviews (ranging 2–6 hours in length) were conducted by the senior author.

Ranchers interviewed reported an average of 4 years out of the previous 10 years as "drought years." Seventy-six percent of the 60 ranchers we interviewed in 2013 stated they expected to see impacts to their operations if the then-emerging, severe drought conditions persisted into the coming year, and 35% of those interviewed expected devastating impacts to the viability of their operations if drought conditions persisted. Early in our interview process, several ranchers interviewed noted that a statewide severe drought would exacerbate the effects of earlier consecutive droughts in their regions. As one rancher stated in early 2013, "I've never seen one like this before—this is the worst we've ever experienced in our area. I hope we don't see another one like this in our lifetime."

Soon after, 2012 through 2014 went down in the record books as the driest 3-year period ever documented (Fig. 2). Central and southern regions of the state experienced the most dramatic impacts.[8] For example, the San Luis Obispo County Agricultural Commissioner's Office estimated an 80% forage production loss across 1 million acres of rangeland for 2014 to 2015, amounting to more than $7.3 million in estimated loss revenue (M. Settevendemie and R. Larsen, personal communication). At the time of interviewing, many ranchers did note the record high cattle prices differentiated the current drought from the last severe drought of the mid-1970s. One rancher stated, "Fortunately the cattle market's been really good in the last couple of years… that's been one thing that's saved us."

Planning For and Coping With Uncertainty

California's rangelands exhibit great heterogeneity due to strong interannual weather variability, regional rainfall and temperature gradients, and local soil and topographic diversity. This tremendous variability is a constant management challenge across sites and from year-to-year within a single site, which will only be exacerbated by expected increases in extreme weather events. For example, rangeland managers generally set critical dates to make destocking decisions between 1 March and 1 April; however, in 2014, local Cooperative Extension livestock and natural resource advisors found that the proactive critical date was much earlier

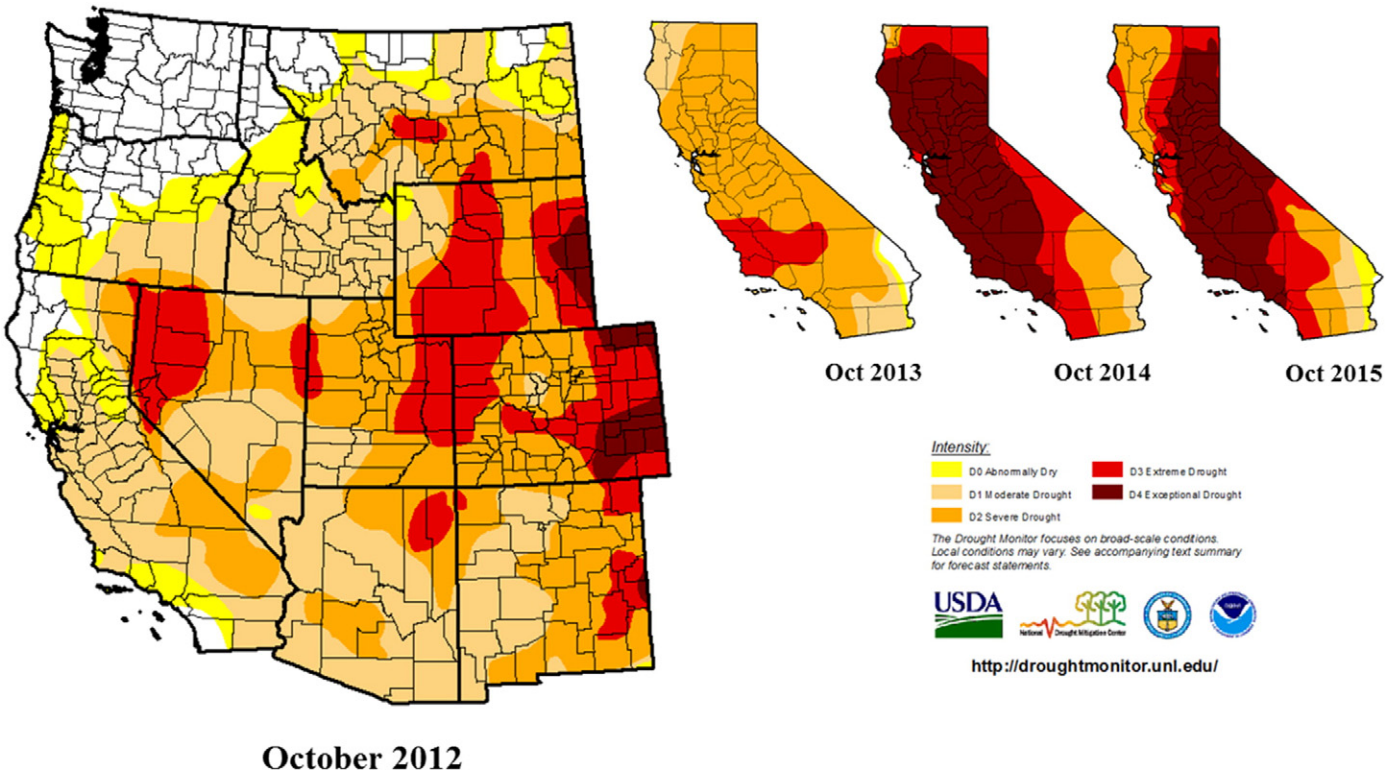

Figure 2. Drought intensity at the start of each water year between 2012 and 2015.[4]

Table 1. Proactive and reactive strategies for drought impact management from the 2011 California Rangeland Decision-Making Survey

	Strategies to Manage for Drought Impact	% (n = 443)
Proactive (Preparing for drought)	Stock conservatively	34
	Rest pastures	23
	Incorporate yearling cattle	21
	Grassbank/Stockpile forage	12
	Use weather predictions to adjust stocking	11
	Add other livestock types for flexibility	3
Reactive (Responding to drought)	Reduce herd size	70
	Purchase feed	69
	Apply for government assistance programs	39
	Wean calves early	39
	Rent additional pastures	26
	Move livestock to another location	24
	Earn additional off-ranch income	23
	Sell retained yearlings	22
	Place livestock in a feedlot	8
	Maintain herd size; allow condition declines	7
	Add alternative on-ranch enterprise	4

for ranchers in most of the state—between 1 January and 1 February.

Many California ranchers have already adapted planning and management strategies to prepare for and respond to extreme weather, particularly drought. From the 2011 mail survey, more than half of ranchers surveyed stated they had a drought management plan in place during the last drought. We found that 64% of the 443 ranchers we surveyed reported using forward planning and management practices to prepare for potential future drought (*proactive* practices; Table 1). The most popular proactive practices focused on maintaining flexibility and minimizing potential vulnerability to reduced forage availability. During the 2013 to 2014 semistructured interviews, many ranchers stated they were planning to develop livestock drinking water resources to enhance future forage-use efficiencies.

Nearly all ranchers surveyed (99% of 443) in 2011 reported they had used at least one management practice in response to drought (*reactive* practices; Table 1). The most popular reactive practices centered on reducing forage demand (destocking) and supplementing forage supply (purchase feed).

At the onset of the current multiyear drought, ranchers began facing unmatched conditions. When comparing this multiyear drought to the extreme drought of the mid-1970s, one rancher stated, "We're past supplement [now], we're in a drought… you need to include replacement when you're talking about feed because we're not supplementing anymore… we're in a full feedlot situation." Indeed, some ranchers who had already destocked were buying hay just to maintain base herd investments. Ranchers interviewed during the core of the state's historic multiyear drought reported they had or were planning to significantly reduce their herd numbers, especially those in central and southern regions of the state. In fact, ranchers in the hardest hit regions of the state had already made substantial herd reductions (30–50% reductions, with some completely liquidating) following previous local droughts in their regions. In interviews, many ranchers recalled the common axiom that you cannot feed your way out of a drought; one experienced rancher specifically noted "that is a road to nowhere." Throughout the interviews, many also noted that there is no one solution for coping with a drought; rather, managers need a strategy composed of many practices, and they need to make hard decisions and act on those decisions.

In the 2013 to 2014 semistructured interviews, we asked ranchers if their current management strategies would be sufficient to deal with more frequent drought events (e.g., an increase from 5–8 drought years out of a 10-year period). The vast majority (82%) of ranchers did not think their current strategies would be sufficient, and more than half indicated they would need to permanently reduce their base herd size. As one rancher said, "It's been pretty difficult, economically and just emotionally." Some ranchers interviewed were looking to new strategies to cope with the devastating conditions, including considering shipping livestock to out-of-state partners, trucking drinking water to livestock,

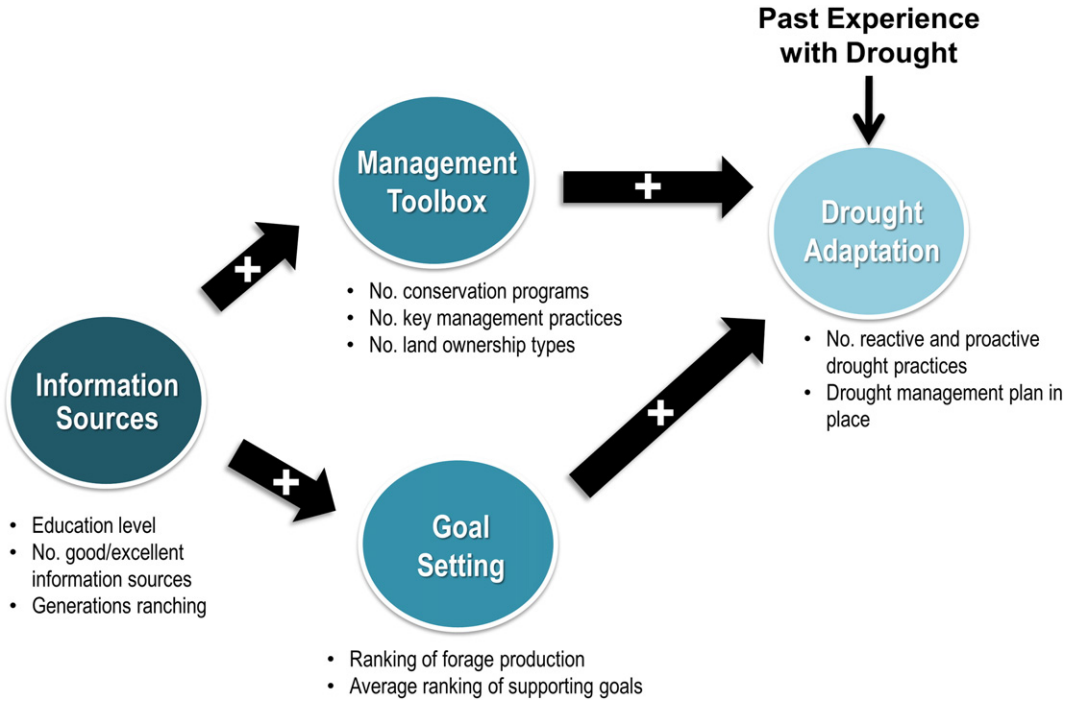

Figure 3. Overview of results from structural equation modeling analysis of mail survey data. Ovals represent latent variables, which were estimated by observable indicators (listed as bullets). Experience, learning, and access to diverse resources, strategies, and tools on resilience to drought and adaptive capacity all positively influenced drought adaptation capacity.

using alternative feed sources (rice strawlage, distillers by-products, almond hulls, etc.), and working with technical and financial assistance programs for the first time.

Continuing to Build Adaptive Capacity

Because of the recurrent nature of drought on rangelands, coping with and adapting to drought is critical to sustaining these landscapes and the ecosystem services they provide. Strategies and tools that have been successfully used by ranchers in past drought years are invaluable sources of information for researchers, policy makers, and other land managers. By learning which approaches have been effective in the past, we can work with ranchers, land managers, and policy makers to share information, develop response strategies, and implement solutions.

The 2011 mail survey highlighted several characteristics of operations that have adapted strategies and tools to prepare for and respond to drought. Via structural equation modeling of the survey data, we found past experiences with drought positively influenced operations' in-place drought adaptation strategies (i.e., active drought plan in place, number of proactive and reactive drought practices used; Table 1; Fig. 3) (Roche *In Prep*).[5] We also found that drought adaptation strategies were positively influenced by valuations of future resources ("goal setting", Fig. 3)—specifically, prioritization of forage production and supporting goals (i.e., weed management, water quality, soil health, riparian health, wildlife).[7] The management toolbox—indicated by number of conservation programs used, number of key management practices used, and diversity of land resources[7]—also positively influenced drought adaptation. As an example, an operation with multiple grazing land resource options offers potential flexibility to move livestock between locations to meet forage demands during drought. Finally, information resources—including multigenerational place-based learning, rich information access (i.e., number of good or excellent information sources used), and level of formal education—positively influenced both the management toolbox and individual goal setting. These results highlight the importance of information sharing, networking, and extension education in building individual capacity.

Novel Social Networking and Information Sharing

Over the past decade, the rapid expansion of communication technologies has opened up new ways for ranchers and farmers to interact and share information. An increasing number of farmers and ranchers are accessing information via multiple venues, with the use of communications technologies increasing among younger generations.[9] In the 2011 mail survey, we found 100% of respondents under 41 years of age used the Internet, with 54% using a smartphone to access the Internet. In comparison, 87% of respondents 50 to 70 years of age used the Internet, with only 14% using a smartphone to access the internet. These technologies are providing growing opportunities for innovative outreach and extension strategies, and are changing the way knowledge systems operate.[9]

As California's historic drought intensified, the rangeland management community looked to new opportunities and

tools to share information and grow knowledge networks. To meet this demand, the University of California Cooperative Extension conducted a series of workshops focused on ranching and California's drought, including a statewide workshop that was webcasted to 16 locations across California.[i] In addition to sharing relevant research and local expert knowledge, these workshops highlighted how modern social media (Facebook, Twitter, blogging, etc.) can be used to share information with the public and connect with other farmers and ranchers.

Working with partners across the rangeland community, we established multiple platforms to facilitate knowledge sharing across broad audiences. First, we created the Farmer-Rancher Drought Forum, which is a closed, moderated Facebook group for agricultural producers and professionals to share information about drought management strategies.[ii] As of December 2015, this group included more than 800 ranchers, farmers, and agricultural professionals. Because the Farmer-Rancher Drought Forum is a closed group (limited to agricultural producers and professionals), it has specifically facilitated a common space for peer-to-peer information sharing, discussion, and interaction with technical experts. Several farmers and ranchers have indicated that this historic drought prompted their use of social media sites. One rancher stated, "Facebook has given me a chance to share ideas, learn from other ranchers, and frankly, to commiserate. It's kind of like a virtual coffee shop."

We also provided opportunities for farmers and ranchers to share their stories with a broader public audience. The first public platform is an open Facebook page—Farmer and Rancher Voices from the Drought—that includes multiple farming and ranching contributors.[iii] Additionally, we established a story archive via the SoundCloud audio platform that enables farmers and ranchers to record their individual experiences throughout California's historic multi-year drought.[iv] Thus far, the public Facebook page has more than 1,350 "likes" and the SoundCloud site has archived more than 40 drought stories from farmers and ranchers. While traditional outreach and extension models—including repeated face-to-face interactions via workshops and field days—remain critical, new communication tools can provide opportunities to expand learning, as well as reach broader audiences.[9]

State of the Historic Multi-Year Drought and Implications for the Future

Early in the 2015 to 2016 water year, climate modelers predicted the oncoming El Niño weather event would be among the strongest on record, bringing above average precipitation and warmer-than-usual winter temperatures. However, experts warned that California would need twice the average precipitation to erase the state's four year rainfall deficit. The net effects of the 2015 to 2016 El Nino event have been a nearly average year for many parts of the state, with Sierra Nevada snowpack levels at 77% and statewide reservoir storage at 87% of historic averages.[1] While there has been some drought relief with improved conditions in northern California, many parts of the state—particularly central and southern areas—are still experiencing extreme to exceptional drought[4] and several reservoirs remain at less than 50% of historic storage.[1] Even with the return of above average precipitation in many areas, ranchers across the state are taking a conservative approach to rebuilding. With short-term impacts still reverberating and long-term impacts yet to be seen, we still have much to learn from this historic multiyear drought. To that end, we are currently conducting follow up surveys with 200 beef and sheep producers across the state to better understand which strategies they found to be effective, as well as learn about their current outlooks and recovery strategies.

By the end of this century, California is predicted to experience increasingly warmer temperatures and more extreme fluctuation between dry and wet conditions.[10] Therefore, this unprecedented drought is potentially only a harbinger of things to come. Severe drought can serve as a "local" example of changing climate patterns and provides an opportunity to bring the conversation of adapting for future scenarios to the forefront of management, research, and policy. Additionally, by understanding which approaches have been effective in extreme events—and what tools and resources are key to adaptation strategies—we can work more effectively with management communities to develop proactive policy and research and technology solutions.

Conclusions

While drought is nothing new to ranchers, consecutive multiyear droughts increase risk to both economic and rangeland health. More than half of California is still facing extreme to exceptional drought conditions, and the impacts of this historic drought will most likely continue to ripple throughout agricultural and socioeconomic systems in the coming years.

The 2011 statewide mail survey of 507 ranchers and 2013 to 2014 interviews of 102 ranchers have provided important insights into rancher strategies prior to and at the onset of this historic drought. Both proactive (preparing for potential drought) and reactive (responding to drought) approaches have been critical components of past adaptation strategies. We have also learned that access to high quality information sources, peer-to-peer information sharing, place-based experience, enhanced flexibility of management resources, and goal setting for future resources all positively influence drought adaptation capacity. New communication technologies (social media, online webcasts, audio and video archives) have also enhanced our abilities to reach different knowledge networks

[i] For more information, see http://rangelands.ucdavis.edu/outreach/ranching-and-californias-drought-a-workshop-and-webcast/.

[ii] Access Farmer-Rancher Drought Forum Facebook page at www.facebook.com/groups/farmerrancherdroughtforum/.

[iii] Access the Farmer and Rancher Voices from Drought Facebook page at https://www.facebook.com/voicesfromthedrought.

[iv] Access the Farmer and Rancher Voices from Drought SoundCloud page at https://soundcloud.com/groups/farmer-and-rancher-voices-from-the-drought.

and increase outreach impact. Knowledge gained from on-the-ground land managers' experiences is important for adaptation planning to enhance resilience of rangeland social-ecological systems to climate stresses.

References

1. California Department of Water Resources. 2016. Reservoir conditions. Available at: http://cdec.water.ca.gov/cdecapp/resapp/getResGraphsMain.action. Accessed 1 April 2016.
2. Howitt, R.E., J. Medellín-Azuara, D. MacEwan, J.R. Lund, and D.A. Sumner. 2015. Economic analysis of the 2015 drought for California agriculture. Davis, California, USA: Center for Watershed Sciences, University of California, Davis: p. ES-2, 12.
3. Belmecheri, S., F. Babst, E.R. Wahl, D.W. Stahle, and V. Trouet. 2016. Multi-century evaluation of Sierra Nevada snowpack. *Nature Climate Change*. 6:2-3.
4. US Drought Monitor. The National Drought Mitigation Center. Available at: http://droughtmonitor.unl.edu. Accessed 1 April 2016.
5. Roche, L.M., T.K. Schohr, J.D. Derner, M.N. Lubell, B.B. Cutts, E. Kachergis, V.T. Eviner, and K.W. Tate. 2015. Sustaining working rangelands: insights from rancher decision making. *Rangeland Ecology & Management* 68:383-389.
6. National Agricultural Statistics Service. California agricultural statistics, crop year 2012. Available at: http://www.nass.usda.gov/Statistics_by_State/California/Publications/California_Ag_Statistics/2012cas-ovw.pdf. Accessed 30 Nov 2015.
7. Roche, L., and K.W. Tate. 2014. Drought: Ranchers' perspective and management strategies. Policy Brief. 2014-04:1-2 Available at: http://ucanr.edu/sites/UCCE_LR/files/199621.pdf. Accessed 1 April 2016.
8. Larsen, R., M. Horney, and D.K. Macon. 2014. Update of the 2014 drought on California rangelands. *Rangelands* 36:52-58.
9. Lubell, M., M. Niles, and M. Hoffman. 2014. Extension 3.0: Managing agricultural knowledge systems in the network age. *Society and Natural Resources* 27:1089-1103.
10. Yoon, J., S. Wang, R.R. Gillies, B. Kravitz, L. Hipps, and P.J. Rasch. 2015. Increasing water cycle extremes in California and in relation to ENSO cycle under global warming. *Nature Communications* 6:8657.

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