

# Caitriana Steele, PhD

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## EDUCATION

B.Sc. Geography (1<sup>st</sup> Class Honours), Kings College London, Department of Geography 1994  
Ph.D. Geography, Kings College London, Department of Geography 2000

## RESEARCH FOCUS

- Remote sensing of vegetation
- Geographic Information Systems for natural resource management
- Climate change and agriculture
- Climate change vulnerabilities in agroecosystems
- Snowmelt hydrology

## RESEARCH AND PROFESSIONAL EXPERIENCE

**College Assistant Professor** 2004 - present  
*Jornada Experimental Range, New Mexico State University (NMSU)*

**Coordinator** 2015 - present  
*USDA Southwest Climate Hub*

**Post-doctoral fellow** 2000 - 2004  
*Department of Geography, University of Southampton, U.K.*

**Assistant administrator** 2000  
*Computing in the Humanities, King's College London, U.K.*

**Volunteer Fieldwork Assistant** 1999  
*Environmental Science for Social Change, Philippines*

**Graduate Teaching Assistant** 1995 - 2000  
*Department of Geography, King's College London, U.K.*

**Research Assistant,** 1994  
*Monitoring and Assessment Research Centre (MARC), King's College London, U.K.*

## TEACHING EXPERIENCE

### Graduate Faculty

*Department of Plant and Environmental Sciences, NMSU*

2009 - present

### Adjunct Faculty

*Department of Geography, NMSU*

2016 – present

*Department of Fish, Wildlife and Conservation Ecology, NMSU*

2008 – 2016

## GRADUATE STUDENT COMMITTEES

Martin Moses, MS	Fish, Wildlife and Conservation Ecology	2010
Robert Lonsinger, MS	Fish, Wildlife and Conservation Ecology	2010
Krisin Hestir, MS	Geography	2011
Salman Al-Kofahi, PhD	Plant and Environmental Sciences	2011
Allison Leimer, MS	Fish, Wildlife and Conservation Ecology	2012
Helena Deswood, MS	Plant and Environmental Sciences	2014
Mohammed Sawalhah, PhD	Animal and Range Sciences	2014
Robert Sabie, MS	Geography	2016
Christopher Coxen	Fish, Wildlife and Conservation Ecology	2015
Kenneth Peterson, MS	Geography	2014
Eboni Duke	Fish, Wildlife and Conservation Ecology	2014
Yahia Othman, PhD	Plant and Environmental Sciences	2014
Daniel Lusk, MS	Fish, Wildlife and Conservation Ecology	2015
Cody Bear Sutton, MS	Fish, Wildlife and Conservation Ecology	2016
Cantekin Kivrak, MS	Civil Engineering	2017
Renee Pardee, MS	Geography	2017
Stephanie Mundis, MS	Biology	2017
Shelemia Nyamuryekung'e, MS	Animal and Range Sciences	2017
Matthew McIntosh, MS	Animal and Range Sciences	2018
Shelemia Nyamuryekung'e, PhD	Animal and Range Sciences	current
Fatima Continanza, PhD	Animal and Range Sciences	current
Matthew McIntosh, PhD	Animal and Range Sciences	current

## PUBLICATIONS

**Steele**, C.M., Elias, E., Rango, A., Reyes, R., in preparation. Cascading impacts of climate change on Southwestern U.S Agriculture, Climatic Change special issue.

**Steele**, C.M., Rango, A., and Elias, E., 2017. Evaluating MODIS snow products for modelling snowmelt runoff: case study of the Rio Grande headwaters, International Journal of Applied Earth Observation and Geoinformation, 63, pp 234-243. DOI: 10.1016/j.jag.2017.08.007

Harpold, A. A., Kaplan, M. L., Klos, P. Z., Link, T., McNamara, J. P., Rajagopal, S., Schumer, R., and **Steele**, C. M., 2017. Rain or snow: hydrologic processes, observations, prediction, and research needs. Hydrology and Earth System Sciences, 21(1), 1 - 22. DOI: 10.5194/hess-21-1-2017

- Havstad, K.M., Brown, J.R., Estell, R., Elias, E., Rango, A. and **Steele**, C., 2017. Vulnerabilities of Southwestern US Rangeland-based animal agriculture to climate change. *Climatic Change*, pp.1-16. DOI: 10.1007/s10584-016-1834-7
- Elias, E., Rango, A., Smith, R., Maxwell, C., **Steele**, C. and Havstad, K., 2016. Climate change, agriculture and water resources in the Southwestern United States. *Journal of Contemporary Water Research & Education*, 158(1), pp.46-61. DOI: 10.1111/j.1936-704X.2016.03218.x
- Elias, E., Rango, A., **Steele**, C.M, Mejia, J., Smith, R., 2016. Assessing climate change impacts on water availability of snowmelt-dominated basins of the Upper Rio Grande Basin, *Journal of Hydrology – Regional Studies*, 3, 525-546. DOI: 10.1016/j.ejrh.2015.04.004.
- Elias, E., Rango, A., **Steele**, C.M., Mejia, J.F., Baca, R., James, D., Schrader, S. and Gronemeyer, P., 2016. Simulated impact of climate change on hydrology of multiple watersheds using traditional and recommended snowmelt runoff model methodology. *Journal of Water and Climate Change* 7 (4): 665-682. DOI: 10.2166/wcc.2016.097.
- Fernald, A., Guldan, S., Boykin, K., Cibils, A., Gonzales, M., Hurd, B. H., Lopez, S., Ochoa, C. G., Ortiz, M., Rivera, J., Rodriguez, S., and **Steele**, C. M., 2015. Hydrological, ecological, land use, economic, and sociocultural evidence for resilience of traditional irrigation communities in New Mexico, USA, *Hydrological and Earth System Sciences*, 19, 293-307. DOI: 10.5194/hess-19-293-2015.
- Elias, E., **Steele**, C., Havstad, K., Steenwerth, K., Chambers, J., Deswood, H., Kerr, A., Rango, A., Schwartz, M., Stine, P. and Steele, R., 2015. Southwest regional climate hub and California subsidiary hub assessment of climate change vulnerability and adaptation and mitigation strategies. Washington, DC: U.S. Department of Agriculture. 76 p.
- Othman, Y., **Steele**, C., VanLeeuwen, D., Heerema, R., Bawazir, S., and St. Hilaire, R., 2014. Remote Sensing to detect moisture status of pecan orchards grown in a desert environment, *International Journal of Remote Sensing*: 949-966; <http://dx.doi.org/110.1080/01431161.2013.87383435>.
- Rango, A., Fernald, A., **Steele**, C., Hurd, B., and Ochoa, C., 2013. Acequias and the effects of climate change. *Journal of Contemporary Water Research and Education*. 151: 84-94.
- Browning, D.M. and **Steele**, C.M., 2013. Vegetation index differencing for broad-scale assessment of productivity under prolonged drought and sequential high rainfall conditions, *Remote Sensing* 5, 327-341, <http://dx.doi.org/10.3390/rs5010327>.
- Steele**, C.M., Bestelmeyer, B., Smith, P., and Burkett, L. and Yanoff, S., 2012. Spatially-explicit representation of state-and-transition models in arid rangelands of southern New Mexico. *Rangeland Ecology and Management* 66: 213-222; <http://dx.doi.org/10.2111/REM-D-11-00047.1>.
- Fernald, A., Tidwell, V., Rivera, J., Rodríguez, S., Guldan, S., **Steele**, C., Ochoa, C., Hurd, B., Ortiz, M., Boykin, K and Cibils, A., 2012. A Model for Sustainability of Water, Environment, Livelihood, and Culture in Traditional Irrigation Communities and Their Linked Watersheds, *Sustainability* 4(11), 2998-3022; <http://dx.doi.org/10.3390/su4112998>.
- Al-Kofahi, S., **Steele**, C., VanLeeuwen, D. and St Hilaire, R., 2012. Mapping land cover in urban residential landscapes using very high spatial resolution aerial photographs, *Urban Forestry and Urban Greening*, 11(3): 291-301; <http://dx.doi.org/10.1016/j.ufug.2012.05.001>.
- Steele**, C.M. and Elliot, L.J., 2011. Unmanned Aircraft Systems for Geospatial Data, in *Introduction to Unmanned Aircraft Systems* (R.K. Barnhart, S.B. Hottman, D.M. Marshall, E. Shappee, eds). CRC Press, Boca Raton, FL. Pp 79-98.
- Laliberte, A.S., Goforth, M.A., **Steele**, C.M. and Rango, A. 2011. Multispectral Remote Sensing from Unmanned Aircraft: Image Processing Workflows and Applications for Rangeland Environments, *Remote Sensing*, 3(11), 2529-2551; <http://dx.doi.org/10.3390/rs3112529>.

- Smith, A.M.S., Falkowski, M.J., Hudak, A.T., Evans, J.S., Robinson, A.P. and **Steele**, C.M., 2009. A cross-comparison of field, spectral, and lidar estimates of forest canopy cover, *Canadian Journal of Remote Sensing*, 35(5): 447-459; doi:10.5589/m09-038.
- Rango, A., Laliberte, A., Herrick, J.E., Winters, C., Havstad, K., **Steele**, C., and Browning, D., 2009. Unmanned aerial vehicle-based remote sensing for rangeland assessment, monitoring, and management, *Applied Remote Sensing* 3, 033542; http://doi:10.1117/1.3216822.
- Bestelmeyer, B. T., K. M. Havstad, B. Damdinsuren, G. Han, J. R. Brown, J. E. Herrick, C. **Steele**, and D. Peters. 2009. Resilience theory in models of rangeland ecology and restoration: the evolution and application of a paradigm. Pp 78-95 in *New Models of Ecosystem Dynamics and Restoration* (R. J. Hobbs and K. N. Suding, eds). Island Press, Covelo, CA.
- Smith, A.M.S, Strand, E.K., **Steele**, C.M., Hann, D.B., Garrity, S.R., Falkowski, M., J., and Evans, J.S., 2008. Production of vegetation spatial-structure maps by per-object analysis of juniper encroachment in multitemporal aerial photographs, *Canadian Journal of Remote Sensing*, 34, 2, S268-S285.
- Rango, A., Laliberte, A., **Steele**, C., Herrick, J.E., Besteleyer, B., Schmutge, T., Roanhorse, A., and Jenkins V., 2006. Using Unmanned Aerial Vehicles for Rangelands: Current Applications and Future Potentials, *Environmental Practice* 8, 3: 159 - 168.
- Curran P.J. and **Steele**, C.M., 2005. MERIS, the re-branding of an ocean sensor, *International Journal of Remote Sensing*, 26, 9, 1781-1798
- Blackburn, G.A. and **Steele**, C.M., 1999. Towards the remote sensing of matorral vegetation physiology: relationships between spectral reflectance, pigment and biophysical characteristics of semiarid bushland canopies. *Remote Sensing of Environment*, 70: 278-292.

## CONFERENCE CONTRIBUTIONS

- Steele**, C.M., Rango, A., Elias, E. and Reyes, J.J., 2016. Assessing Crop Vulnerability to Climate Change: A Southwest Perspective. 2016 ASA - CSSA- SSSA Conference. November 6-9, 2016, Phoenix, AZ. Abstract #102477.
- Steele**, C.M., 2015. Climate change, diversified agriculture and adaptive capacity in Hawaii, NOAA National Weather Service 13<sup>th</sup> Annual Climate Predictions Workshop, Las Cruces, NM, 24-26 March 2015.
- Steele**, C., Elias, E.H., Bestelmeyer, S., Haan-Amato, S., Deswood, H., Rango, A., Havstad, K.M. 2015. Climate change and the water cycle: A new southwest regional climate hub curriculum unit for 6th-12th grade students (abstract). 2015 American Geophysical Union Fall Meeting, December 14-18, 2015. San Francisco, CA. ED33A-0935
- Steele**, C.M., Smith, A.M.S. and Browning, D., 2014. The NDVI: Back to Basics, Abstract B42C-01 presented at 2014 Fall Meeting, AGU, San Francisco, CA, 15-19 Dec, 2014.
- Rango, A., Elias, E., **Steele**, C.M. and Havstad, K., 2014. USDA Southwest Regional Hub for Adaptation to and Mitigation of Climate Change, Abstract PA51B-4051 presented at 2014 Fall Meeting, AGU, San Francisco, CA, 15-19 Dec, 2014.
- Steele**, C.M., Elias, E., Rango, A. and Mejia, J.F., 2014. Assessing climate change impacts on water availability of snowmelt-dominated watersheds of the Upper Rio Grande Basin, 82nd Western Snow Conference, Durango, CO, 14-17 April, 2014.
- Steele**, C., M., Bestelmeyer, B., Burkett, L., Ayers, E., Romig, K., Slaughter, A., 2013. Mapping Ecological States in a complex environment. Abstract B52D-04 presented at 2013 Fall Meeting, AGU, San Francisco, Calif., 9-13 Dec.
- Rango, A., **Steele**, C.M., Elias, E., and Mejia, J.F., 2013. Potential impacts of climate warming on runoff from snowmelt: a case study of two mountainous basins in the Upper Rio Grande, Abstract H23A-1217 presented at 2013 Fall Meeting, AGU, San Francisco, CA, 9-13 Dec, 2013.

- Steele, C.M., Rango, A. and Mejia, J.F., 2012.** Application of the Snowmelt Runoff Model to explore the effects of climate warming on streamflow in the headwaters of the Upper Rio Grande, Abstract C33A-0634 presented at 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec, 2012.
- Steele, C.M., 2011.** Invited: Climate Change and the Mountain Snowpack Reservoir, Project Guts and the Supercomputing Challenge's 4th Annual Joint Summer Teacher Institute, NM Insitute of Mining and Technology, Socorro, NM, 17-29 July ([http://mode.lanl.k12.nm.us/wiki/index.php/Guest\\_Speakers](http://mode.lanl.k12.nm.us/wiki/index.php/Guest_Speakers))
- Steele, C.M. And Rango, A., 2011.** Challenges encountered while assembling data sets for the analysis of climate and snowpack variability in the Rocky Mountain region, Abstract C23B-0495 presented at 2011 Fall Meeting, AGU, San Francisco, CA, 5-9 Dec, 2011.
- Steele, C.M., and Rango, A., 2011.** Modeling Streamflow from Snowmelt in the Upper Rio Grande Basin, presented at the 2011 Anuual Water Resources Conference, American Water Resources Association, Albuquerque, NM, 7-10 Nov, 2011.
- Al-Kofahi, S.D., Steele, C.M. and Van Leeuwen, D.M., 2011.** Using the knowledge of residential landscape vegetation spatial variability to support water conservation. presented at the 2011 Anuual Water Resources Conference, American Water Resources Association, Albuquerque, NM, 7-10 Nov, 2011.
- Steele, C.M. And Rango, A., 2010.** Performance of the Snowmelt Runoff Model when remotely-sensed estimates of snow covered area are not available, Abstract C33C-0539 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec, 2010.
- Steele, C.M., Rango, A., Hall, D. And Bleiweiss, M., 2010.** Sensitivity of the snowmelt runoff model to underestimates of remotely sensed snow covered area. Paper 1470 presented at the 2010 IEEE International Geoscience and Remote Sensing Symposium, Honolulu, HI, 25-30 July, 2010.
- Steele, C.M., Rango., A. and Bleiweiss M., 2009.** An analysis of MODIS fractional snow cover estimates for snow- melt runoff modeling.. *Eos Trans. AGU*, 90 (52), Fall Meet. Suppl., Abstract U13B-0072. C44A-04
- Steele, C.M., Rango., A. and Bleiweiss M., 2009.** Comparison of snow mapping methods in the upper Rio Grande Basin, New dimensions in Earth Observation, University of Leicester, September 8-11, 2009.
- Steele, C.M., Rango., A., Laliberte., A, Winters, C., Maxwell, C. and Slaughter, A., 2009.** Unmanned aerial vehicle platforms for acquisition of very fine spatial resolution imagery over arid rangelands, University of Leicester, September 8-11, 2009.
- Steele, C.M., Lucero, M. And Silva, A., 2009.** Using GIS to Guide Spatial Sampling of Atriplex Canescens in the Northern Chihuahuan Desert, Annual Meeting of the Rio Grande Branch of the American Society for Microbiology, New Mexico State University, February 27 -28, 2009.
- Steele, C.M., Smith, A., Campanella, A. and Rango, A., 2008.** The contribution of vegetation cover and bare soil to pixel reflectance in an arid ecosystem, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., B32A-02.
- Steele, C.M., Bestelmeyer, B., Rango, A., Smith, P.L. and Laliberte, A.S., 2007.** Remote sensing of threshold conditions in an arid ecosystem, *Eos Trans. AGU*, 88(52), Fall Meet. Suppl., Abstract B43B-1160
- Steele, C.M., 2006.** Invited: Object Oriented Image Analysis with Definiens eCognition, The 13th Australasian Remote Sensing and Photogrammetry Conference, Canberra, Australia, 20 - 24 November, 2006.
- Steele, C.M., B.T. Bestelmeyer, A.S. Laliberte, A. Rango, K.M. Havstad, P. Smith, 2006.** Incorporating multiscale, multisource data in a decision-tree classifier for mapping vegetation states in arid rangelands. Proceedings of the 5<sup>th</sup> International Conference on Ecological Informatics, Santa Barbara, CA, Dec. 4-7, 2006.
- Steele, C.M., A.S. Laliberte, B. Bestelmeyer, J. Herrick, and A. Rango. 2005.** Current and future options for the use of remote sensing for rangeland management and monitoring. II Simposio Internacional de Manejo de Pastizales, Apr. 20-23, 2005, Zacatecas, Mexico. CDROM

- Steele, C.M., Bestelmeyer, B. and Smith, P., 2005, Determining Optimum Spatial Resolution for Monitoring Dryland Vegetation, Geospatial Goes Global: From Your Neighborhood to the Whole Planet, ASPRS 2005 Annual Conference, Baltimore, MD, March 7-11, 2005.**
- Steele C.M., Curran P.J. and Llewellyn G.M., 2003. Optimal band locations for MERIS red edge, The 23rd EARSeL Annual Symposium 2003, Gent, Belgium, 2-5 June, 2003.**
- Curran P.J. and **Steele C.M., 2002. MERIS for terrestrial remote sensing. In Observing our Environment from Space: New Solutions for a New Millennium (ed. G. Bégni). A.A. Balkema, Lisse, The Netherlands: 179-183.**
- Steele, C.M., Curran, P.J. and Wilson, D., 2002. Change vector analysis of multiple date imagery for habitat classification. Natural Environment Research Council's Biannual Airborne Remote Sensing Facility Workshop, Rutherford Appleton Laboratory, 16-17 December, 2002.**
- Curran P.J. and **Steele C.M., 2001. Terrestrial MERIS. In Scanning the Present and Resolving the Future, IEEE Publishing, Piscataway, (CD ROM).**
- Steele, C.M., Blackburn, G.A., Drake, N.A. and Pitman, J.I., 1999, The use of vegetation indices and spectral derivatives in the remote estimation of vegetation canopy properties. RSS 99, Earth Observation - From Data to Information, Remote Sensing Society, Nottingham: 857 - 864.**
- Steele, C.M., and Pitman, J.I., 1999. Remote sensing of bracken canopy transpiration, conductance and photosynthesis, presented at the IVth International Bracken Conference, University of Manchester, 20-26 July, 1999.**
- Steele, C.M., Blackburn, G.A., Pitman, J.I. and Drake N.A., 1997. Empirical evidence of the relationships between canopy reflectance, transpiration and photosynthesis. RSS 97: Observations and Interactions, Remote Sensing Society, Nottingham: 361-366.**
- Steele, C.M., Blackburn, G.A., Pitman, J.I. and Drake, N.A., 1997. A comparison of the use of broad- and narrow-band vegetation indices in the remote sensing of vegetation canopy properties, presented at the Winter Meeting of the British Ecological Society, University of Warwick, 16-19 December, 1997**
- Steele, C.M., Blackburn, G.A., Pitman, J.I. and Drake, N.A. 1997. The remote estimation of vegetation canopy states and physiological rates, presented at the Winter Meeting of the British Ecological Society, University of Warwick, 16-19 December, 1997**
- Steele, C.M., Blackburn, G.A., Pitman, J.I. and Drake, N.A., 1996. The remote sensing of vegetation physiology: A case study of bracken. RSS 96: Remote Sensing, Science and Industry, Remote Sensing Society, Nottingham: 143-150.**

## **CONFERENCE MODERATION**

Symposium session: Climate change impacts on first food and food security: adaptation options for tribal communities, 2017 National Adaptation Forum, St. Paul, Minnesota, May 9-11, 2017.

Special Session: Drought early warning and drought monitoring: planning for scarcity. 2017 Universities Council on Water Resources/National Institutes for Water Resources Annual Conference, Fort Collins, June 13-15, 2017.

GC51B: Connecting Stakeholders with Climate Science: The Role of Climate Programs, AGU Fall Meeting, San Francisco, 14-18 December, 2015

B31K: Identifying and Quantifying Change in Ecological Systems I, AGU Fall Meeting, San Francisco, 5-9 December, 2011

B33E: Identifying and Quantifying Change in Ecological Systems II, AGU Fall Meeting, San Francisco, 5-9 December, 2011

B23C: Detecting Thresholds of Ecosystem Resilience in a Changing Climate I, AGU Fall Meeting, San Francisco, 13-15, December, 2010

B32A: Detecting Thresholds of Ecosystem Resilience in a Changing Climate II, AGU Fall Meeting, San Francisco, 13-15 December, 2010

B41A: Remote Characterization of Vegetation Structure and Biodiversity IV, AGU Fall Meeting, San Francisco, 15-19 December, 2008

B41C: Remote Characterization of Vegetation Structure and Biodiversity V, AGU Fall Meeting, San Francisco, 15-19 December, 2008

## **PEER REVIEW FOR JOURNALS**

Fire Ecology  
International Journal of Wildland Fire  
Journal of Arid Environments  
Transactions in Geoscience and Remote Sensing  
Progress in Physical Geography

Water Resources and Rural Development  
Canadian Journal of Remote Sensing  
International Journal of Remote Sensing  
Journal of Applied Remote Sensing  
Remote Sensing of Environment

## **GRANTS AND AWARDS**

NIFA Resilient Agroecosystems Co-PI; (\$1.1 million; 2018)

NIFA Climate Masters Co-PI; (\$250,000; 2017)

Grant to convene Innovation Working Group meeting, New Mexico EPSCoR (\$9,660, 2011)

Small Grant from the Royal Geographical Society (£1,800; 2001)

Natural Environment Research Council (NERC) (airborne imagery; 2001)

NERC Equipment Pool for Field Spectroscopy (spectroradiometer loan, 1995, 1996; 2001)

King's College Research Scholarship (£18,000; 1995)

## **PROFESSIONAL MEMBERSHIPS**

Fellow of the Royal Geographical Society, London

Member of the American Geophysical Union