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Characterizing 12 Years of Wildland Fire Science at the U.S. Geological Survey: Wildland Fire Science Publications, 2006–17

Open-File Report 2019–1002

U.S. Department of the Interior
U.S. Geological Survey

USGS scientists Jeff Cordova and Fletcher Brinkerhoff set up the LiDAR and GPS equipment to survey a burned watershed within the Yarnell Hill Fire. Photograph by Brandon Forbes, U.S. Geological Survey

Controlled experiments that simulate fire environments provide critical information for understanding how fire intensity and duration impact archaeological resources. Photograph by Rachel Loehman, U.S. Geological Survey

Fireweed after fire in Alaska. Photograph by Florian Maldonado, U.S. Geological Survey

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DAVID BERNHARDT, Acting Secretary

U.S. Geological Survey
James F. Reilly II, Director

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Abbreviations

DOI	Department of the Interior
RIS	Research Information System
USGS	U.S. Geological Survey

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Introduction

Wildland fire characteristics, such as area burned, number of large fires, burn intensity, and fire season duration, have increased steadily over the past 30 years, resulting in substantial increases in the costs of suppressing fires and managing damages from wildland fire events (National Academies of Sciences, Engineering, and Medicine, 2017). Wildland fire management could benefit from sound decision making based on reliable scientific information. Fire scientists produce data, tools, and information to support fire and land management decision making. With ever-changing land use scenarios, environmental conditions, and emerging technological capabilities, new assessments and studies are continually needed. Established by Congress in 1879, the U.S. Geological Survey (USGS) is the primary science branch of the Department of the Interior (DOI), which manages more than 400 million acres of public lands in the United States (Vincent and others, 2017). The USGS has more than 100 scientists across seven Mission Areas that help address the wildland fire science needs of DOI bureaus and their stakeholders. The diverse expertise of these scientists allows them to address complex interdisciplinary challenges (Coloff and others, 1998; Coffelt and Livingston, 2002; Livingston, 2004). In this report, we identify and characterize scientific literature produced by USGS scientists during 2006–17 that addresses topics associated with wildland fire science. Our goals were to (1) make the most complete list possible of product citations readily available in an organized format, and (2) use bibliometric analysis approaches (Cronin, 2001; Hirsch, 2005) to highlight the productivity of USGS scientists and the impact of contributions that the Bureau has provided to the scientific, land management, and fire management communities.

Methods

We used the USGS Publications Warehouse (https://pubs.er.usgs.gov/) to search for research products that are thematically associated with wildland fire. The Publications Warehouse serves as the primary online index of research products developed by USGS scientists and provides citations to more than 150,000 publications written by USGS scientists over the history of the bureau. Searches were performed using four wildland fire-related key words (“fire,” “fuel,” “carbon,” and “burn”) and restricted to the publication dates of 2006–17. Search results for each keyword were exported from the Publications Warehouse as a text-based file using the Research Information Systems (RIS) format. The four separate RIS files were imported into the Mendeley citation management software package (https://www.mendeley.com) and combined into a single bibliography by screening for duplicate entries that may have appeared in the searches using the four separate key words. Each citation was then evaluated to ensure its direct relevance to wildland fire science as opposed to other topics that may contain identical key words (for example, fire ants, nuclear fuel, coal-burning electrical plant, and so forth). Publication abstracts were also examined when additional information was required to ascertain relevance.

We then summarized the overall body of work by characterizing individual research products based on whether they dealt with topics before fires, during fires, or after fires and if they were associated with one or more of four additional wildland fire science themes:

1. Wildland fire history and management, including fire risk, fuels treatment, and fire-adapted invasive species as fuels;
2. Effects of wildland fire on plants, wildlife, and ecosystems, post-fire recovery, and restoration;
3. Post-fire risks of water, debris flow, smoke, and ash; and
4. Remote sensing and geospatial data and products to support decision making by fire and land managers.

Note that individual products may not fall into one specific science theme or temporal category and that assignment to multiple categories may be possible (for example, effects of a pre-fire fuel treatment may be assessed during or after wildfires). Results of these characterizations were summarized in a 3 × 4 matrix (3 time points by 4 science themes) to provide a quantitative overview of topics addressed by the USGS wildland fire science program.

The broader impact of USGS wildland fire science publications on literature produced by the larger scientific community (academia, other Federal agencies, nongovernmental organizations, and so forth) was assessed by collating citation metrics for individual USGS products. The number of times that each USGS product has been cited in other literature was obtained using the search functions from Google Scholar (https://scholar.google.com/). Google Scholar was manually searched from February 27 to March 9, 2018, for each item in this bibliography, and the total number of references to USGS wildland fire science products was summed for each year to provide a snapshot of the cumulative impact of work produced by the USGS since 2006. Google Scholar was chosen as the source of citation information over other databases such as Scopus (https://www.scopus.com/) or Web of Science (https://clarivate.com/products/web-of-science/) because these latter resources focus primarily on scientific journal articles. By contrast, Google Scholar indexes diverse types of scientific products (Falagas and others, 2008; Harzing and van der Wal, 2008), including both journal articles and peer-reviewed reports published by government agencies such as USGS series publications.

Using the citation data from Google Scholar, we also calculated Hirsch's (2005) h index to characterize the broader impacts of USGS wildland fire science. The h index is defined as the largest number of manuscripts in a set such that h manuscripts have been cited h or more times. This measure has been broadly used to quantify the scientific impact of individual researchers (Hirsch, 2007; Bornmann and Daniel, 2009) as well as to characterize the output of research groups (van Raan, 2006; Hirsch, 2007).

Results and Discussion

Our analysis of relevant research products in the USGS Publications Warehouse identified 970 papers released from 2006–17 that were associated with the general theme of wildland fire science (table 1). On average, USGS scientists produced 81 scholarly publications each year (range of 39–116), and these research efforts span diverse conceptual themes (table 2). A complete list of citations for all wildland fire science publications (organized alphabetically by year for clarity) is available in appendix 1.

In addition to producing information that is relevant to land managers, USGS wildland fire science products are also highly cited by the scientific community at large (table 1). Since 2006, products published by the USGS wildland fire science community have been referenced and cited 42,436 times (mean of 43.7 citations per publication and range of 0–3,483) with an h index of 85 (85 publications have been cited 85 times or more). Fifty-five publications have been cited more than 100 times, and 9 have been cited more than 500 times (fig. 1). These numbers represent a snapshot of the impact that USGS wildland fire scientists have in their field. These values will likely increase over time as new publications get disseminated among the scientific, land management, and fire management communities and become familiar to a wider audience.

Although this document illustrates the existence of a productive and influential USGS wildland fire science program, the analysis of citations presented in this report highlights only one facet of the impact that USGS has in the field of wildland fire science. In the future, investigations that document ways that USGS science has been used to make management or policy decisions could also be initiated to further characterize the outcomes of research programs within the bureau. Such investigations may provide clear links between science and management in the field (Hunter, 2016) and can highlight practices that may help facilitate the use of science in decision making processes.

Table 1. Number of publications and citation metrics for publications associated with the U.S. Geological Survey wildland fire science program from 2006 to 2017.

Publication year	Number of publications	Number of times publications have been cited
2017	65	115
2016	91	732
2015	82	1,123
2014	71	1,321
2013	98	4,470
2012	88	2,703
2011	116	7,704
2010	39	4,383
2009	83	8,055
2008	106	2,284
2007	74	3,009
2006	57	6,537
Total	970	42,436

Table 2. Number of U.S. Geological Survey science products and the wildland fire science themes addressed relative to three temporal phases of wildland fire.

Science theme	Number of products		
	Before fire	During fire	After fire
Wildland fire history and management, including fire risk, fuels treatment, and fire-adapted invasive species as fuels	169	9	149
Effects of wildland fire on plants, wildlife, and ecosystems, post–fire recovery, and restoration	174	5	312
Post-fire risks of water, debris flow, and smoke and ash	40	2	114
Remote sensing and geospatial data and products to support decision making by fire and land managers	57	7	114

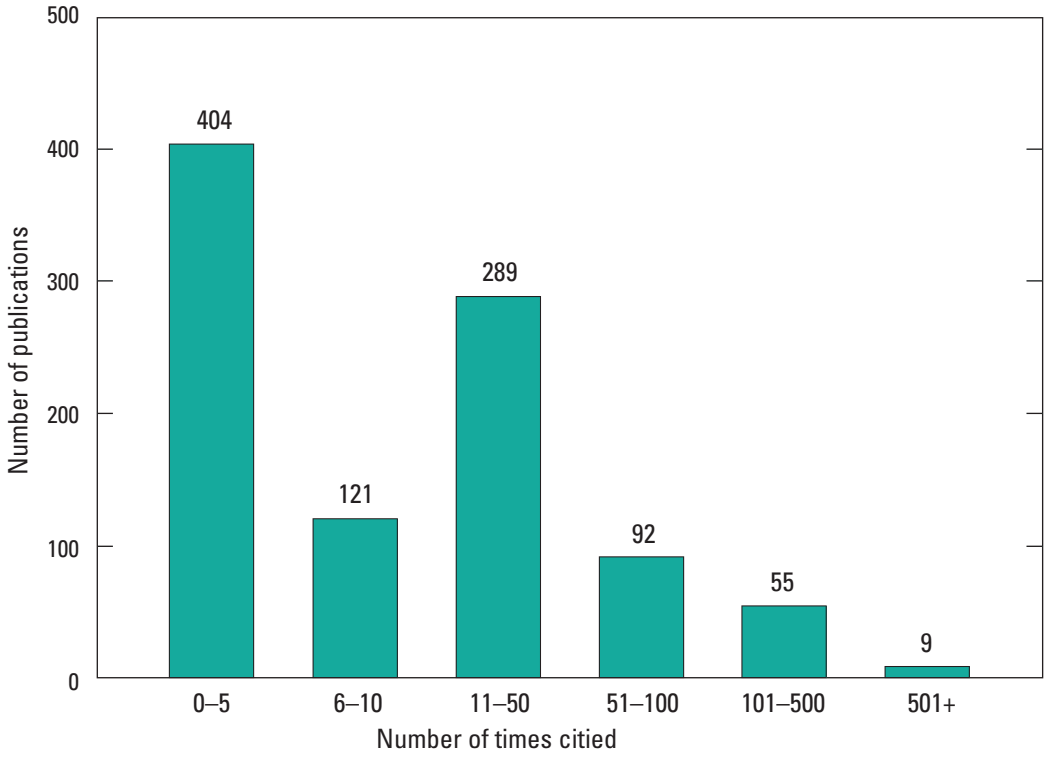

Figure 1. Histogram illustrating the distribution of citation counts for U.S. Geological Survey wildland fire science publications.

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