Provision of Analyses of Scottish Fire and Rescue Service (SFRS) Incident Reporting System (IRS) Data in Relation to Wildfire Incidents

Research Summary

March 2022

Scottish Government
Riaghaltas na h-Alba
gov.scot

Provision of Analyses of Scottish Fire and Rescue Service (SFRS) Incident Reporting System (IRS) Data in Relation to Wildfire Incidents

RESEARCH SUMMARY

Prepared for the Scottish Government

Authors:

Zisis Gagkas[1], Grant Campbell[1], Jason Owen[1], Matt Davies[2]

[1]The James Hutton Institute

[2]The Ohio State University

RESEARCH SUMMARY

Wildfires in Scotland can be destructive for seminatural habitats as they can be severe in nature and occur extensively across landscapes. Increased wildfire occurrence driven by more frequent droughts, especially in remote upland areas and peatlands, will be costly to fight, cause great damage to ecosystems and can require costly restoration. Understanding how upland wildfires start and identifying geographical and seasonal trends of wildfire occurrence is needed to inform research and policy priority areas, such as assessing climate change impacts on natural capital assets and integrating wildfire danger and risk in the design of nature-based solutions (e.g., peatland restoration and new tree planting) to maximise their potential for climate change mitigation and adaptation.

In this context, the project entitled: "Provision of Analyses of Scottish Fire And Rescue Service (SFRS) Incident Reporting System (IRS) Data In Relation To Wildfire Incidents" aimed to identify wildland fire incidents affecting seminatural habitats recorded in the IRS and use them to a) improve the understanding of how upland wildfires start; b) investigate if wildfire occurrence differs between geographical areas; and c) describe how wildfires exhibit seasonal and temporal trends. The project also aimed to use findings to make recommendations on any improvements that could be made to enhance the IRS dataset's usefulness for the above purposes.

The project methodology used a combination of statistical and geospatial methods to analyse information from 132,829 outdoor fire incidents recorded in the SFRS IRS from April 1st 2009 to December 31st 2020. We also analysed additional information extracted at the locations of IRS fire incidents from readily-available spatial layers of explanatory variables of fire occurrence (e.g., fuel type/land use, bioclimatic, topographical, accessibility and socioeconomical factors) and from burnt area polygons delineated from satellite imagery. These spatial relationships between IRS fire incidents and various variables were used to investigate patterns of wildfire occurrence, assess how accurately wildfire location, size of burnt area and fuel type composition were recorded in the IRS, and model ignition risk and investigate causative factors of wildfire ignition in a test area (Highland Local Authority).

We devised a semi-automated filtering process that was based on harmonising land uses and fuel types recorded in the IRS with those extracted at IRS locations from land use and habitat maps and on checking whether fire incidents were located within or outside settlement boundaries. This process identified 9,725 wildfires, i.e., wildland fires affecting semi-natural vegetation (7.3% of all outdoor IRS fires processed). It was difficult to run an automated filtering of IRS records for extracting wildfires due to uncertainties in the recording of fire incident locations, ambiguities in the description of fuel types and absence of important land or fuel types (e.g., the IRS does not include a 'Bogs and peatlands' land category). Hence, we used extensive visual inspection of satellite imagery to complement

the filtering process and verify wildfire selection. Using this approach, we succeeded in identifying within the IRS several big wildfires that were known to have caused extensive damage to seminatural habitats in remote rural areas, which indicates that the IRS is a good resource for identifying important wildfire incidents in Scotland, even in the most remote areas.

IRS and other related information for the identified wildfires were used to investigate patterns of wildfire occurrence at National and Local Authority (LA) levels related to a) time and seasonality; b) vegetation and fuel types; c) size of burnt areas; d) motives of ignition along with causes of ignition, ignition source and items causing ignition and spreading fire (the latter where available for 919 wildfire incidents) and e) accessibility and proximity to urban areas. This analysis was conducted for all identified wildfires and for a subset of 1,325 wildfires with damage area greater than 1,000 m^2 that were most likely to be bigger wildfires with significant impacts on seminatural habitats. We also used cluster analysis to identify groupings of LAs with similar wildfire occurrence patterns and compared wildfire occurrence patterns in Scotland with respective patterns in other Northern European countries to detect similarities.

The extensive investigation of patterns of wildfire occurrence found that, despite differences in fuel type compositions, burnt area sizes, motives of ignition and accessibility, wildfires in Scotland exhibit a clear seasonal pattern with most fire incidents occurring from early to late spring and in particular most fires occurred in April. This temporal pattern was common in other countries with similar bioclimatic conditions and vegetation communities (Republic of Ireland, rest of the UK and the west coast of Norway). There was also a clear indication that seminatural vegetation (grass, heath, scrub) was more likely to be responsible for ignition and fire spread in fires caused by accident, especially for the bigger wildfires, while trees and to a lesser degree straw/stubble were more likely to be responsible for ignition and fire spread in smaller and trivial fires caused by deliberate ignitions. In addition, modelling findings indicated that accessibility is the main driver of wildfire ignition in the Highland area, where most of the bigger wildfires had occurred.

Overall, the combined investigation identified three (3) main types of wildfires occurring in Scotland:

a) Wildfires occurring in very remote and remote rural areas (north and north-western Scotland) affecting mostly heathlands/shrublands and bogs and peatlands that seem to be caused mainly by accidental ignitions; these tended to be bigger and caused by intentional burns that got out of control, which might be associated with traditional land management practices or tourism or other recreational activities.
b) Wildfires in accessible rural areas and close to small settlements (mainly in eastern and south-western parts of Scotland) that affected woodlands and grasslands; these seemed

to be driven mainly by anti-social behaviour or relatively trivial cases of negligence with fire.

c) Small fires close to settlements and urban centres affecting mainly grasslands that seemed to be caused by deliberate ignitions; these seemed to be caused by a mixture of burns getting out of control or careless handling of equipment or other heat sources along with ignitions from anti-social behaviour.

These findings were synthesised to provide recommendations to the SFRS for making the IRS a more reliable resource for wildfire mitigation planning in Scotland and for supporting future wildfire research and analysis. Although the IRS is a very well-structured dataset and a valuable resource for keeping records of various characteristics of fires occurring in Scotland, we suggest that it would greatly benefit from adopting a new, comprehensive system for reporting and describing all fuels causing ignition and fire spread in seminatural systems. This would improve both the identification of wildfires in the IRS, but also its value as a resource for wildfire planning and analysis. The National Vegetation Classification (NVC) Phase 1 system or the European Nature Information System (EUNIS) would be potentially good options for broadly describing fuels within the IRS, as both systems strike a good balance between ecological specificity and moderate training and natural history skill requirements and could be relatively easily adapted for fuels. The new system should also consider differences in fire behaviour across stages of the *Calluna* (heather) cycle that influence fire behaviour in peatlands and heathlands, which are important habitats that provide multiple environmental benefits and support rural communities. We suggest collating all available fuels information from multiple projects and conducting analyses to reliably classify fuels based on structure and predicted fire behaviour, and then compiling this information into an illustrated fuels guide complete with predicted fire behaviours that can be used to support training of SFRS personnel.

In addition, we suggest getting more accurate reads on fire location to assist in determining the ignition point, which could be used to improve understanding of fire causation. At least for the bigger wildfires, it would be helpful to record multiple locations at the fireline or burnt area perimeter that could be used by SFRS staff to quickly draw rough polygons of burns using free and easy to use web mapping tools (e.g., in OpenSteetMap). These burnt area polygons could be used to refine estimates of burnt area size and better inform the Outdoor Damage Area fields in the IRS, which in several cases were found to be either incomplete or partially inaccurate. Improving the recording of IRS locations and spatially relating them to actual burnt areas would greatly help SFRS with its wildfire management and preparedness planning and also provide SFRS and others (e.g., NatureScot staff or researchers) with reliable information for conducting further wildfire-related analysis, such as assessing fire damage and severity and fire impacts on habitats and the provision of their associated ecosystem services.

This publication is available at **www.gov.scot**

Any enquiries regarding this publication should be sent to us at
The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-80435-079-9 (web only)

Published by The Scottish Government, March 2022

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS1033890 (03/22)