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Rum National Nature Reserve

April 2018 Wildfire Report

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
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Contents

1. Wildfire Description

A wildfire broke out on the Isle of Rum National Nature Reserve (NNR) at approximately 13:00 on 4 April 2018 in the North West of the Island. The fire was started accidentally, not by SNH staff, from a discarded cigarette that had not been completely extinguished. Due to the unusual period of dry conditions preceding the event and a moderate wind on the day the fire quickly caught and spread. Details on the initial stages were obtained from the individual involved.

Figure 1 - Rum wildfire around Sgaorishal and north side of Glen Shellesder. Taken from Canna around 15:00, two hours after ignition.

The fire initially moved south towards Sgaorishal and Loch Sgaorishal, driven by a north-westerly wind. Figure 1 above, taken from Canna just before 15:00, shows smoke originating from the north side of Glen Shellesder and around Sgaorishal and blowing over to Fionchra. The fire is thus approximately 1km from the origin, giving a rate of spread of at least 8m per minute. This is not a particularly fast rate of spread for a wildfire, but is faster than would expected for a controlled burn in recommended conditions (0.5 to 5m per minute). It would therefore be difficult to control at this stage.

By around 17:00 the head fire had reached the Shellesder burn, a further 400m away (although actually a somewhat greater distance on the ground due to the slope), giving a rate of spread of just over 3m per minute, reflecting the expected slower speed of a fire moving downhill. The fire did not cross the lower reaches of the Shellesder burn, but did cross upstream where the burn narrowed. By 21:00 the fire had crossed Minishal some 1.25km away and was heading south towards Malcolm's Bridge, giving a rate of spread of approximately 5m per minute. The fire then burnt approximately another 450m towards the SE. Meanwhile, flanking and backing fires moved more slowly towards the N, W and E, as can be seen in Figure 2.

Figure 2 - Rum wildfire from Canna after dark. Backing fires moving N, W and E, smoke travelling towards the SE. More intense fire appears to be burning around the summit of Minishal on steeper slopes with greater cover of dwarf-shrub vegetation, in accord with observations on the ground during and after the fire.

Due to the remote location, and dry conditions, the fire quickly became established and difficult to control. In conversation with the Scottish Fire and Rescue Service, an assessment of fire intensity and direction of travel concluded there was a low risk to people and property, and combined with the scale of the fire, no ground control was employed. A helicopter using a 'bambi' bucket was deployed along Glen Shellesder late on the afternoon of the day of the fire. Although this may have slowed the spread of the fire below Loch Sgaorishal, it didn't extinguish it.

A marked drop in rate of spread and fire intensity was noted after dark, and the fire self-extinguished during the night. At night fire generally becomes less intense due to falling temperatures and wind speed, and higher relative humidity. There was also some rainfall during the night.

In some areas extinction was probably aided by other factors. Although fire crossed burns in some circumstances (e.g. the upper, narrower reaches of the Shellesder Burn), at other points spread was prevented by burns 0.5-1m wide or wider, or by wetter dips in the ground adjacent to burns.

2. Assessment of intensity and spread

Fire intensity and spread, as shown by the pattern and degree of consumption of fuel, varied according to vegetation type and topography.

Broadly, areas of dry heath, with a higher proportion of woody fuel and principally found on thinner, rockier, more free-draining soils on steeper slopes, showed more complete combustion of dwarf-shrubs, with sometimes complete consumption of the litter and bryophyte layer and exposure of mineral soil. Burning or scorching of soil was however uncommon.

Wet heath, with lower cover of dwarf-shrubs on gentler, wetter slopes had more unburnt material with a more intact litter layer, while dense tussock grassland on flat or gently-sloping ground showed almost complete consumption of dry dead leaf material arranged fairly openly and thus able to dry out, while dense tussocks and matted wet leaf litter remained unburnt.

Figure 3 illustrates patchy intensity of fire according to topography and vegetation type: black or dark brown patches represent areas of more intense fire on steep rocky ground with dry heath; more moderate slopes with wet heath have burnt less intensely and retain significant unburnt vegetation; intensity has been lower on flatter areas, and an unburnt *Molinia*-dominated area on deep peat can be seen in the centre foreground.

Figure 3 - Patchy fire spread and severity. Higher impact (darker) on steeper slopes, unburnt patch in centre ground.

Within the overall fire boundary, a number of areas remained completely unburnt. These included some flat areas of former bog which, although supporting almost complete cover of tussocky *Molinia* and a high fuel load, clearly remained sufficiently wet to resist ignition.

The extent was calculated as approximately 750ha from Copernicus Sentinel 2 data (Figure 4). These are European Space Agency satellites which produce high resolution imaging (10 or 20m) used for land monitoring of, for example vegetation, soil and water cover.

Figure 4 – Satellite images from before (bottom) and after (top) the fire on Rum. Dark areas show extent of fire (NB some dark areas are from cloud shadow)

3. Assessment of severity

Initially the severity was assessed by an on-the-ground Impact Assessment in the days following the fire. In addition to the fire extent, the Sentinel data was also used to quantify the severity of the fire.

Ground Impact Assessment

Impacts on different habitat types were assessed at selected sample points using; the Habitat Impact Assessment (HIA) methods for burning (Macdonald et al. 1998), species composition assessments of some burnt and unburnt areas, and examination of sample points previously used in Site Condition Monitoring survey (Haycock & Jay 2014).

Most impacts recorded fell within the Low to Medium range, with one dry heath plot scoring High for Phase 1 impacts. Broadly, these assessments confirm observations that the pattern is one of lower impacts on Tussock grassland and Blanket bog habitats, with increasingly higher impacts on wet heath and then dry heath.

At these levels of impact recovery of vegetation cover and vegetation composition can be expected in the short to medium term (within 1 -2 decades for blanket bog, 5-10 years for dwarf-shrub heaths – MacDonald *et al*. 1998), but the presence of *Molinia caerulea* in much of the area burnt means that recovery of species composition is at risk due to the potential for this species to increase at the expense of others (see section 4 below). Recovery of the structural features will take longer. **It is important to note that achieving recovery is heavily dependent on post-fire impacts (particularly grazing and trampling) being appropriate, and the rate of recovery can be strongly influenced by weather conditions in the years after fire**.

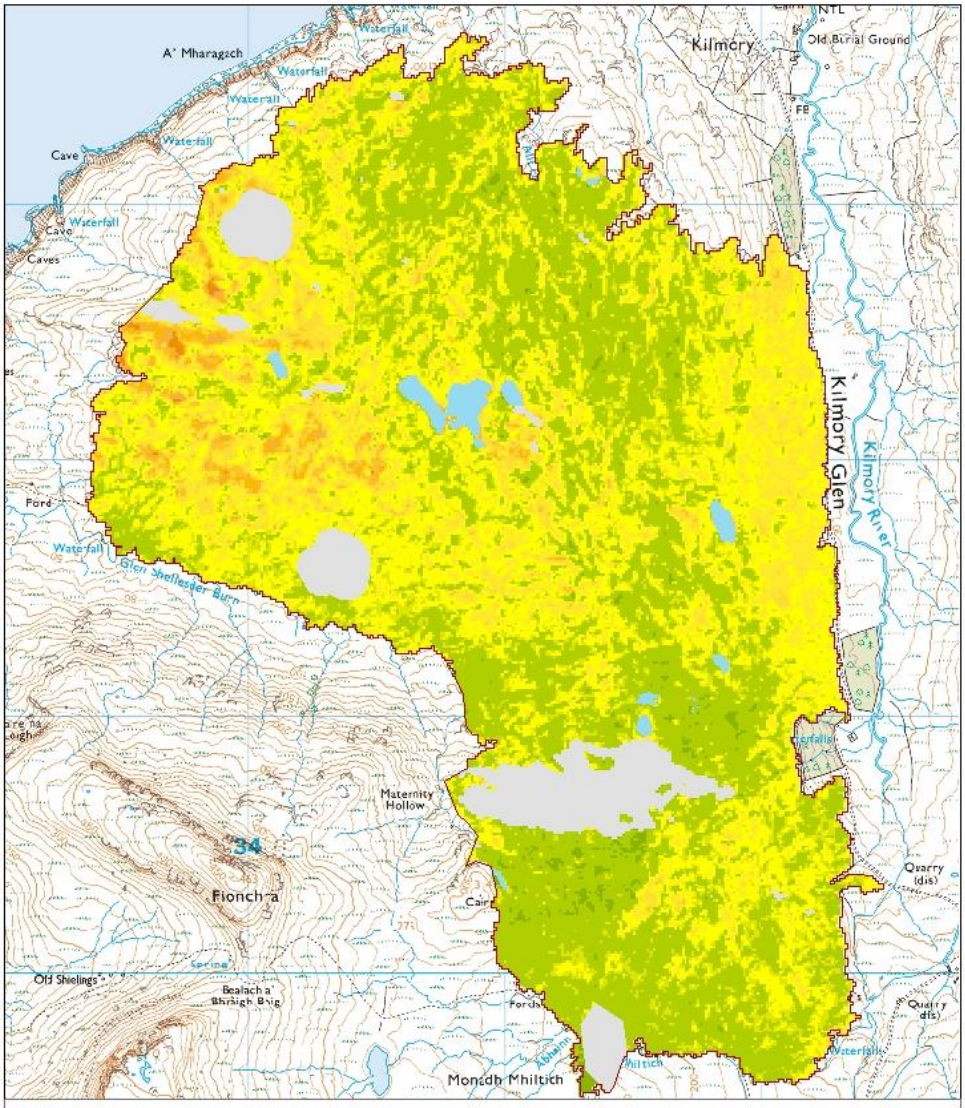
Satellite impact assessment

Copernicus Sentinel data was made available and processed by the Joint Nature Conservation Committee (JNCC) to an 'analysis ready' state. A variety of indices were calculated using this imagery and applied in mapping the extent and severity of the fire. Images from before and after the fire can be compared, which can be used to calculate, for example, the difference in Normalised Burn Ratio (NBR), which was found to be most useful in determining burned and unburned areas. Healthy, unburned vegetation has very high near-infrared reflectance and low reflectance in shortwave infrared portions of the spectrum. Burned areas on the other hand have relatively low reflectance in the near-infrared and high reflectance in the shortwave infrared bands. A high NBR value generally indicates healthy vegetation while a low value indicates bare ground and recently burned areas.

This analysis was based on studies from other areas outside of Scotland (Schepers *et al.* 2014; Fernández-Manso *et al*. 2016), and sometimes from different habitat types. To account for this, field measurements were taken following the fire, to ground-truth the sentinel data and determine which method best indicates severity (Davies *et al*. 2016; Schepers *et al.* 2014).

Recovery can also be measured by analysing Sentinel 2 images captured at later stages and comparing these with previous images, depending on the habitat and severity of fire.

Figure 5 – Prediction of fire severity based on analysis of Sentinel 2 satellite data



The satellite analysis was broadly consistent with the ground impact assessment, in that the fire was low or medium in severity (Figure 5). However, the resolution of the impacts is much more helpful, indicating areas that were more severe, which can help to inform future management.

Severity was also assessed in relation to habitat type (Table 1) which is generally consistent with the ground impact assessment. These are only estimations as there are some limitations as the habitat data were digitised from previous NVC surveys. The total area accounted for in Table 1 is 698ha as it does not include all habitats (for example open water habitats and areas of unknown NVC type have not been included in Table 1.).

Table 1 – Estimated Areas of habitats affected by fire (excluding open water habitats), with breakdown of severity category per habitat type. ("Unknown" category accounts for areas of cloud or topographic shadow on images). Underlying habitat data are originally from NVC surveys.

Habitat Type	Estimated Area	Annex 1 Habitat	Low Severity	Medium severity	High severity	Unknown severity
H4010 Wet heath	313ha	✓	36%	59%	<1%	5%
H7130 Blanket bog	225ha	✓	43%	50%	<1%	7%
Molinia-dominated Tussock Grassland	55ha		18%	76%	<1%	6%
H4030 Dry Heath	52ha	✓	18%	69%	<1%	13%
H8220 Siliceous rocky slope	43ha	✓	42%	54%	<1%	4%
H8110 Siliceous scree	8ha	✓	32%	68%		
H6230 Species-rich *Nardus* grassland	1ha	✓	15%	29%		55%
H6170 Alpine and subalpine calcareous grasslands	1ha	✓	7%	83%	<1%	9%
Relict native woodland	<1ha		4%	92%		4%
Total	699ha		35%	58%	<1%	6%

Currently there is no management burning of habitats on Rum, and a low frequency of wildfire since the island became an NNR (none recorded for over 15 years on the island, and none in the area affected here). It is therefore interesting to note the very low frequency of high severity impacts, despite a possible perception that the hazard of relatively high fuel loads presents a high risk of high severity fire.

4. Application of assessment and management options

General

Following fire the general prescriptions to allow for habitat recovery need to consider:

- Potential alteration of the competitive balance in favour of *Molinia caerulea*.
- Potential further damage to *Sphagnum* mosses, the primary peat forming species.
- Soil erosion following large scale exposure of bare ground.

The presence of *Molinia caerulea* (purple moor grass or flying bent) in much of the area burnt means that recovery of diverse species composition is at risk due to the potential for this species to increase at the expense of others. This species is unpalatable to herbivores for most of the year, is resistant to fire (meristems or growing points remain protected in the centre of dense tussocks), and as it is deciduous it does not lose resources in fires during the dormant season. It thus thrives under more intensive grazing (especially winter grazing) and burning regimes where it gains a competitive advantage over dwarf-shrubs, and once established, can remain at high cover for considerable periods even when a management regime more favourable to other species has been established.

Dwarf-shrubs are an important component of these habitats, and conversely, they are often top killed as they are consumed by the fire. Fresh young, regenerating heather growth, is palatable, digestible and nutritious, and will be very attractive over the winter when other forage is less available. Indeed, due to the palatability of regenerating vegetation this area may become more attractive to herbivores than adjacent, unburnt areas. Therefore the effect of winter grazing will be to increase the post-fire competitive advantage of *Molinia*, and therefore promote an increase in *Molinia* domination of the vegetation. This is the opposite of what we want to achieve in terms of species composition and habitat condition, and in reducing the hazard resulting from high and flammable fuel loads.

Large-scale consumption of *Sphagnum* mosses did not occur, and survival (including regrowth of shoots from below scorched and burnt surfaces) is considered high. However, damage and exposure of moss hummocks, increases the risk of drying out and further damage from trampling.

Managing herbivore grazing post-fire is therefore very important, to allow a diverse flora to regenerate, and to minimise further damage through trampling impacts to sensitive habitats.

Generally, little large-scale continuous exposure of soil was observed on the site, and therefore the likelihood of widespread or large-scale post-fire erosion is low. The main possible exception is where there are steep slopes, often with thin soils, which supported dry heath that has been substantially consumed, including moss and litter layers. Options for action to prevent or reduce erosion are limited. Perhaps the most important action is to ensure that erosion risk is not exacerbated by deer and goat trampling of vulnerable soils.

Although this report deals principally with impacts on vegetation and plant species, clearly there was potential for direct and indirect effects on ground-nesting birds, reptiles and amphibians, mammals, and invertebrates. These impacts are difficult to quantify, however, white-tailed eagles continued to nest in the area close to the fire, and confirmed breeding of red-throated divers in the area was similar to recent years. There obviously has been a loss of habitat for ground nesting birds, which is likely to have displaced some breeding, especially of insect eating birds. However, of the key birds that are monitored, there didn't seem to be a noticeable change in the island-wide breeding, and some birds, such as merlin, had more breeding territories in 2018 than recent years.

Rum NNR

Although the severity of the fire was assessed as being low / medium, the negative effects of the wildfire on the qualifying habitats of the site represent a setback for efforts to improve habitat condition. Additionally, in the context where predicted climate change scenarios anticipate increased frequency and severity of wildfire events, habitat resistance and resilience to fire is of increasing importance. The following measures have been put in place, or will be put in place, to improve the recovery of the habitats and improve resilience to fire;

- Monitoring: we are monitoring browsing impacts in the fire site over the winter to assess herbivore impacts during a time when regenerating dwarf shrubs are vulnerable. Sample points are at the same location as Habitat Impact Assessment locations from 2017, and thus can be compared to the pre-fire state.
- Monitoring: we will consider repeating the analysis of Sentinel 2 data to assess any change in the heather/*Molinia* balance and bare ground cover, if the technology allows.
- Deer management: we will focus our deer management in this area based on the results of the habitat monitoring, to minimise browsing impacts on regeneration of dwarf shrubs, and minimise trampling impacts on *Sphagnum* hummocks and bare ground. Also, through our Habitat Management Plan, we intend to manage deer at densities that increase the structural diversity of vegetation across the island, which will hopefully add to the resilience of these habitats.
- We will re-wet areas of modified blanket bog (e.g. in Kinloch Glen). Bogs that are in good condition with extensive *Sphagnum* are less likely to have fires which penetrate to the underlying peat.
- Reduce the dominance of *Molinia* to improve habitat condition and reduce fuel loads by grazing when palatable in the spring and/or cutting.

As part of our review of the fire we took the opportunity to assess our processes and systems in place to deal with wildfires on the NNR. As a result we will employ a number of measures to improve our preparedness for potential future wildfires. This includes:

- Updated our NNR fire plan.
- Review of fire training for staff and investigate the possibilities for community involvement.
- Fire-fighting equipment review, consideration of new equipment such as a fogging unit and fire fighting PPE.
- New information for visitors on fire risks posted at key locations around the island.
- Incorporate fire risks into our induction for visiting groups.
- Production of incident card for SNH staff and visiting groups, to explain procedure for reporting wildfires.
- Communications: use new equipment to allow for 2-way communication both within and outwith Rum, in areas without mobile reception, or outside of radio contact.

5. Conclusions

At the time of the fire, the spectacular visual impact, especially at night, raised fears about the ecological damage to the habitats on the NNR. Our investigations show that, in terms of the habitats, the fire had a low or medium impact over more than 90% of the burnt area. High impacts were recorded in some isolated areas (<1% of area), mostly of dry heath habitat on steeper drier ground, but these habitats have the potential to recover well after fire. So, despite a relatively high fuel load, the impacts have been less severe than some might have feared. Nevertheless, low and medium impacts are still significant, and this fire is a setback for our objective of moving towards better habitat condition.

The whole area will need substantial time to recover, and short to medium-term recovery is likely to be characterised by a less desirable species composition and a uniform, rather than diverse, structure across a large area. The success of habitat recovery is heavily dependent on post-fire impacts (particularly grazing and trampling) being appropriate, and the rate of recovery can be strongly influenced by weather conditions in the years after fire. Our focus for this area will be appropriate management of herbivores to encourage regeneration of diverse habitats.

The Satellite Impact Assessment has been a helpful tool to highlight impacts and inform future management decisions. The development of the assessment methods is a significant step forwards with potential for wider application across Scotland.

While the wildfire was obviously an unwelcome event, it has prompted us to take the opportunity to review our wildfire preparedness, and take steps to improve this. It has also reinforced our focus on habitat resilience and steps which can be taken to increase this.

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References

1. Fernández-Manso A, Fernández-Manso O, Quintano C. 2016. SENTINEL-2A red-edge spectral indices suitability for discriminating burn severity. International Journal of Applied Earth Observation and Geoinformation 50 170-175

2. Davies GM, Domènech R, Gray A, Johnson PCD. 2016. Vegetation structure and fire weather influence variation in burn severity and fuel consumption during peatland wildfires. Biogeosciences 13, 389–398.

3. Haycock & Jay Associates Ltd. 2014. Site Condition Monitoring Survey of Upland notified Features at Rum SAC. Scottish Natural Heritage Commissioned Report (A1832201).

4. MacDonald, A., Stevens, P., Armstrong, H., Immirzi, P. & Reynolds, P. 1998. A guide to Upland Habitats: Surveying Land Management Impacts. Scottish Natural Heritage.

5. Schepers L, Haest B, Veraverbeke S, Spanhove T, Borre JV, Goossens R. 2014. Burned Area Detection and Burn Severity Assessment of a Heathland Fire in Belgium Using Airborne Imaging Spectroscopy (APEX). Remote Sensing 6 pp1803-1826

Photography: all SNH except p1 (Isebail MacKinnon) and p2 (Donald Mackenzie)

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