

CC1: ['Comment on bg-2023-19'](#), Gianluigi Ottaviani, 03 Aug 2023

The manuscript entitled "**Remote sensing reveals fire-driven facilitation of a C4 rhizomatous alien grass on a small Mediterranean volcanic island**" by Guarino et al. presents an interesting case study about the short-term impacts of, and changes caused by a fire event on the vegetation of the Mediterranean island of Stromboli (Aeolian archipelago); in 2022, ~50% of the vegetated area was affected by fire, with variable intensity.

I consider the research topic relevant to the readership of the Journal and of the Special Issue. The authors used remote sensing methods and indices suitable to capture the short-term changes associated with the fire (pre- and post-event).

Thank you for carefully reading the manuscript and for all your suggestions and observations.

However, I remain quite skeptical about the way the authors link to the dynamics (especially in relation to possible future scenarios) of the invasive species *Saccharum biflorum*. I am afraid that I do not share their positive view about a possible/desirable decline of this species on Stromboli over time. *S. biflorum* is extremely competitive thanks to a variety of functional strategies (e.g. large resource allocation belowground into clonal and bud-bearing organs which can boost a quick resprouting and local spread/space occupancy/resource uptake) under current and probably also under predicted conditions (likely more disturbed) which could affect and define different ecosystems on Stromboli. Along this line, I would be more careful.

Thank you, we will try to be more nuanced on this point (but see Richter and Lingenhöhl, 2002). You are right, *Saccharum* behaves like a very competitive species on Stromboli. But the fire frequency could make the difference. We cannot ignore the decreased *Saccharum* area of occupancy shown in the vegetation maps of Stromboli published by Richter and Lingenhöhl (2002, Fig. 4), comparing the vegetation cover in 1984 and in 2002, after 18 years of no destructive fires. This is in agreement, for example, with the demographic boom shown by *Cytisus aeolicus* during the last decades (Zaia et al., 2020).

Also, if I am not mistaken, there is no reference/inference related to the analysis and results showed in Fig. 3 reporting the variability of *S. biflorum* stem density under different field experimental treatments, which can be instead interesting to discuss (alternatively, this analysis and associated results could be removed from the story, if the authors consider them marginal).

We will add some sentences in the discussion about *Saccharum*'s ability to resprout immediately after fire, with a density of green stems only slightly lower than that of unburnt patches, thanks to the large resource allocation belowground.

All analyses related to fire-induced changes are interesting, yet quite descriptive without any statistical testing – quite an unusual decision for a regular research article. At the same time, I tend to agree with the authors when they acknowledge that *S. biflorum* may also play positive functional roles, such as in slope and soil stabilization against erosion.

We will test the homogeneity of variance and the correlation between vegetation types and the fire intensity.

At last, the tone of the language used is sometimes too colloquial, and I encourage the authors to consistently use a more formal language throughout (I spotted a few cases, suggesting alternatives below in the specific/line numbered comments).

we will do our best to use more formal language

Specific comments

L1: in the title, the reference to facilitation may be misleading/misplaced in the context of this paper. This term comes with a clear connotation in community ecology, e.g. facilitation of cushion-like plants tending to facilitate the germination and persistence of herb species in alpine environments. I would therefore avoid this term throughout.

Ok, we will replace this term with “regeneration”

L25: replace “arson” with “fire”

Ok

L28: “recurrent” – is fire really recurring with a predictable regime on Stromboli?

Not really predictable... We will replace this term with “repeated”

L30: “complex” - I am not a big fan of using this term (i.e. we tend to use this adjective when we are not able to disentangle and grasp what is behind a pattern), yet all is complex in ecology! Here, for example, using “multifaceted” or “dynamic” would do

Ok

L32-33: is this a hypothetical trajectory or you have reference/evidence to back this claim up? Of course, this could be eventually elaborated in the Discussion and Conclusion (but see my related comment there)

As we wrote in the text, there are reasonable indications that, if the vegetation is not affected by fire too frequently, *Saccharum* could be gradually be replaced by native vegetation within a few decades, as captured in the maps published by Richter and Lingenhöhl (2002, Fig. 4).

L33-35: as for the previous sentence – is this your inference/speculation backed up by your data or contextualized with other studies? It may or may not be the case. Also, consider replacing "beds" with "patches" throughout

We have intentionally used the conditional, but the possibility of a relatively fast decline of Saccarum if local vegetation is no more affected by frequent fire is not pure speculation. As we wrote in the text, this has been already postulated by Ferro & Furnari (1968), and captured by the maps published by Richter and Lingenhöhl (2002, Fig. 4). The use of "beds" is commonly used to describe the layer formed by tall grasses (see, for instance, "reedbeds")

L39: "frequency" – not only that, but also intensity/severity which together shape the fire regime in an area

Ok

L43: "functional diversity" – of what? Plants, animal, soil microbiome, etc?

Of the soil microbiome

L45: "human habitat" – replace with "open-canopy space available for human activities"? Human habitat seems a bit too strong to me. In the same line, "foraging"; this relates to both humans and animals as well, right?

Ok

L48: "scrub" – while I acknowledge that this is a stylistic choice/taste, I would prefer "shrub" and "shrubland" - this is the terminology used in many biome-focused global studies, and relates directly to the main growth form defining Med-ecosystems. Also, maybe better stating "woody plant" as not only shrubs may have been advantaged by abandonment?

Ok, we will replace "scrub" with "woody plant" (L48) and with "shrub" elsewhere else

L53: "Climate change scenarios indicate rising temperatures and decreasing amounts of precipitation" – this is right, and may cascade to lower aboveground biomass production, which may therefore limit fuel availability (while being drier and easier to ignite). Such types of feedbacks, sometimes with opposing effects, are increasingly addressed by climate-change modelers (e.g. Baudena et al. 2020 New Phytol for a study on post fire-aridity interactions) and may play a key role in shaping vegetation dynamics on Stromboli as well

Thanks for the suggestion. We will implement it in the text.

L56: "shorter" – not only shorter fire intervals but potentially also more intense fires? Also, in the same line, I would say "potentially followed by alien" instead of "alien" only

Ok

L58: "unidirectional change" – not sure I am grasping what "unidirectional" may mean/imply here; please, specify

We specified that unidirectional change in invaded ecosystems means that invasive species able to sustain an increased fire frequency and intensity may generate favourable conditions for their self-perpetuation.

L62-63: hence, especially exposed to a variety of disturbances, including fires induced by eruptions?

Exactly

L65-66: i.e. following classic predictions of the Theory of Island Biogeography (as for the seminal work by MacArthur & Wilson 1963, 1967)

This is explicitly mentioned in the reference mentioned at the end of the sentence (Chiarucci et al., 2021)

L69: "volcanic ash" – this being a source of nutrients which this alien species can exploit more readily than native species (because strong competitive [C-strategy according to Grime's CSR model])? I put it out here, yet it may be handy when doing inferences

Thank you for this suggestion. As a matter of fact, it would be interesting to test whether the clear preference of *Saccharum* for thick deposits of volcanic ash depends on nutrient availability, on reduced mechanical resistance to the fast elongation of rhizomes or on a combination of both.

L70: "arson" – being caused by volcanic activity, this is not an arson (man-made). I would also replace or specify in the following wording "paroxysmal activity"; perhaps, better saying "volcanic eruption" as more directly related to/describing the natural phenomenon

Ok

L76: "quadrants" – "sides" or "slopes"?

Ok

L77-80: the scope of this work is fine and clear, however, the authors may frame the aim of this study as e.g. 2 questions with related hypotheses instead of keeping it fully "explorative"?

Thank you for this suggestion. We will substantially rewrite the final part of the introduction also following the suggestions of Reviewer 1

L84: I would say "maximum elevation"

Ok

L107: "due to recklessness during the filming of a television drama" – I would simply refer to a human-generated fire (or arson directly, which carries this connotation)

Sorry, but we believe that it is interesting to give a little detail on how such a large fire begun.

L109: delete "by chance"

Ok

L139: "some soil conditions" – meaning, bare rock outcropping/scorched after fire?

According to Lentini et al. these include charred organic material (litter, duff, and dead wood), bare mineral soil, and ash.

L180: delete "somewhat"

Ok

L183-184: when & where (e.g. plots were randomly distributed)?

We will add methodological details on the fieldwork and the location of the sampling sites

L185: "in order to" – this formulation is used very often but simply using "to" can suffice in most cases

Ok

After L187 before Results: related to one of my general comments/concerns; there is not a section dedicated to "Data/Statistical analysis"

We will add it.

L191: "surrounded the Osservatorio Restaurant" – what is the relevance of specifying the name of a restaurant? As abovementioned, such level of colloquialism should be avoided

Ok

L192: "NDVI values were strongly correlated with dNBR values" – to what extent? Any values? Strong correlation could also have deep implications when interpreting results and performances of these parameters (even though the following sentences explain differences between and sensitivities of these two parameters)

We agree that this is relevant: the correlation between differential NDVI values and dNBR was very high: 0.977. As reported, dNBR values appeared more consistent, possibly also

due to the inclusion of a spectral band at 20 m which prevented some false alarms and noisy results.

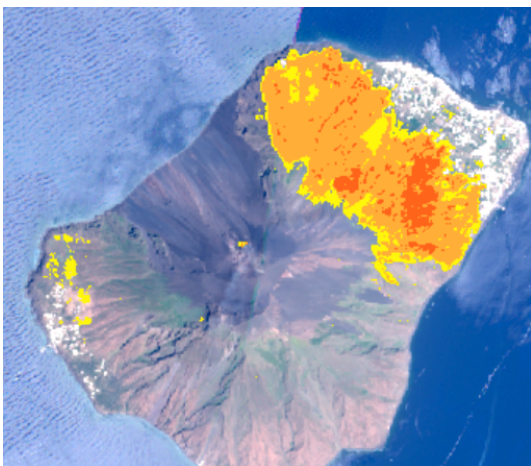
L204: what is the new threshold (previously set > 0.19)? Is this threshold standard in such studies?

We agree this should have been better clarified. We actually started from the widely used definition of burns severity classes from Keeley (2009):

<https://pubs.usgs.gov/publication/70032718>

We used then the following reference to obtain our first map with hard classes (not reported in the paper)

| Severity Level | dNBR Range (scaled by 10^3) | dNBR Range (not scaled) |
|-------------------------------------|--------------------------------|-------------------------|
| Enhanced Regrowth, high (post-fire) | -500 to -251 | -0.500 to -0.251 |
| Enhanced Regrowth, low (post-fire) | -250 to -101 | -0.250 to -0.101 |
| Unburned | -100 to +99 | -0.100 to +0.99 |
| Low Severity | +100 to +269 | +0.100 to +0.269 |
| Moderate-low Severity | +270 to +439 | +0.270 to +0.439 |
| Moderate-high Severity | +440 to +659 | +0.440 to +0.659 |
| High Severity | +660 to +1300 | +0.660 to +1.300 |



As it can be seen, false alarms appear in the urban area and in the west side of the island. As the division in classes of damage should be adapted to the case at hand, we considered that a conservative threshold should be applied, in order to identify an area which was damaged for certain. The value in the middle of the "Low Severity" class and rounded to the second decimal digit, 0.19, was selected as the lowest value without visible false alarms in the results.

L205: "pixels"

Ok

L207-208: "Of these, 44.31 ha showed high severity burning, assigned to a dNBR value higher than 0.45" – is this threshold value standard?

This is the threshold fixed by the European Forest Fire Information Service (EFFIS, 2022). We will mention the reference in the text.

L214: "strong vegetative stress" – what this means/implies?

It implies in this case suffering extreme changes in temperature, possibly humidity and water availability in the area, aspects that can affect the plant's metabolism and development.

L215: "fire event"

Ok

L223-225: This sentence could be streamlined as: "The fast recovery of *Saccharum* patches was evident by the stark contrast between the green colour of *Saccharum* and the surrounding black/burned landscape - further emphasised by the particularly hot and dry summer of 2022." Also, please avoid colloquialism ("caught everyone's attention")

Ok

L229-231: this is related to the field-based plots, comparing burned vs. unburned areas; yet, no sum stats of the analyses are reported

We will add some stats

L237: consider rephrasing "to its ground being exposed" as "bare ground exposure"

Ok

L242-244: how can this be related to degradation if recurrent fire is an eco-evolutionary force shaping Med-ecosystems for My (as mentioned in previous part of the sentence)? If the authors are willing to maintain this point, they should elaborate more in depth this nuanced task

Ok

L244-248: surely certain species could be largely and detrimentally affected by fire in the short-term (this study was executed right after fire). However, one should consider the time-scale involved in post-fire regeneration, and fire regime has been greatly altered (e.g. by fire suppression and no prescribed burning as done e.g. in Australia, US). Many Med-species are fire-adapted and require fire with a given regime (in terms of frequency and intensity/severity). Unfortunately, I do not see how the authors can back up their claim –

please, refer to the extensive work by e.g. Pausas, Lamont, Keeley, Bond (among many others) over the last 2-3 decades. Also, while fire on islands can be considered less likely to occur due to milder and more humid conditions associated with a climate buffering effect of sea/ocean than on mainland counterparts (e.g. Burns 2019 book on the Island syndrome), on active volcanic islands fire ignition can occur during volcanic eruptions. Hence, this assumption does not necessary hold here and one could also see a case for the opposite reasoning

Thanks for these suggestions. We will duly consider them in a second, revised version.

L249-264: I like these two sections (L249-263); in my opinion, these do a much better and more balanced job than the previous one to contextualize the results in a sound eco-evolutionary frame

Thank you

L272-277: I struggle to follow the reasoning of this section, and cannot see how the authors can back up their claim. Fire was, is and will be on Stromboli (i.e. complete fire suppression could be even more impacting over mid- and long-terms in the face of the ongoing and exacerbating climate change/warming towards more extreme events), so how can the vegetation (also shaped by a given fire regime) not being affected by fire? I am afraid that the damage caused by the introduction of such a successful invasive species (equipped with many functional strategies making it super-competitive and responding well to fire and other environmental factors) will be long-lasting. I am therefore sorry not to share the authors' positive view on this predictive point

You are right, fire was, is and will be on Stromboli. But the fire frequency could make the difference. Some hints on the speed of the vegetation dynamics are offered by the decreased *Saccharum* area of occupancy shown in the vegetation maps published by Richter and Lingenhöhl (2002, Fig. 4), comparing the vegetation cover in 1984 and in 2002, after 18 years of no destructive fires. This is in agreement, for example, with the demographic boom shown by *Cytisus aeolicus* during the last decades (Zaia et al., 2020).

L287-288: also, being a very good resprouter from rhizomes, *Saccharum* may be even favored by herbivory

Ok

L289: Conclusions – I like the cautious way the authors framed this concluding paragraph, interpreting in a balanced manner detrimental vs positive effects at various levels associated with the presence and spread of *Saccharum* on Stromboli

Thank you

L292: “pioneer role” – for the reasons exposed above, *Saccharum* behaves way more than a pioneer (e.g. an engineer species as exposed further below), and is there to stay unless

time-consuming, long, expensive management practices (such as complete removal of above- and belowground plant parts throughout the island, quite unrealistic) are put in place

Ok, we will consider this

L303: sowing not only native woody species, I guess

You are right.

L304: more specifically, how the proposed rewilding should look like? This term/notion is still hotly debated in the scientific community, and if the authors want to maintain this ground, they should explain this point in more detail

Ok, we will do so.

L487-488: Fig. 3 – as mentioned above, where are these results discussed?

We will add some sentences in the discussion about *Saccharum*'s ability to resprout immediately after fire, with a density of green stems only slightly lower than that of unburnt patches, thanks to the large resource allocation belowground.

Citation: <https://doi.org/10.5194/bg-2023-19-CC1>