

BOOK OF ABSTRACTS

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I. SESSION DESCRIPTION

ID: T12

Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management

Hosts:

	Title	Name	Organisation	E-mail
Host:	Dr.	Jose V. Rocés-Díaz	College of Science, Swansea University, UK	j.v.roces@swansea.ac.uk
Co-hosts:	Dr.	Adrian Regos	Universidade de Santiago de Compostela & Universidade do Porto	adrian.regos@usc.es
	MSc.	Judit Lecina-Díaz	CREAF	j.lecina@creaf.uab.cat

Abstract:

A wide variety of natural and anthropogenic disturbances affect terrestrial ecosystems with remarkable impacts on services and disservices that they can provide to society. Ecological disturbances may include wildfires, extreme climatic events such as droughts, insect outbreaks and diseases, or windstorms episodes; while human-induced disturbances refer to the human impacts on the environment such as clearcutting, forest clearing or the introduction of invasive species. From a socio-ecological perspective, both ecological and human-induced disturbances interact, adding up more challenges to understand the effects of global disturbances in terrestrial ecosystems.

Disturbances cause profound and abrupt changes in ecosystems. For example, wildfires, insect-outbreaks, drought events and windstorms can increase tree mortality rates, with consequences on the structure and functions of the ecosystems, as well as on their services. Wildfires can negatively affect services such as soil fertility regulation, erosion control, or water provision and flow, but also enhance others such as pollination or biodiversity-related services. Drought



episodes affect ecosystem functioning with side-effects on multiple regulating and provisioning services.

Although several authors have explored individual effects of these disturbances at the local/landscape scales, literature often neglects their interactions with other drivers of global change such as land use change and climate warming. Although some ecosystems are well adapted to disturbance regimes, global change is altering the frequency and intensity of these disturbances, so that their effects on structure, functions and services are still unknown.

Landscape planning and adaptive forest management are the most common strategies to mitigate the impacts of disturbances on ecosystem services. Further research exploring integrative management policies is needed to thus proactively increase adaptive capacity and resilience of ecosystems, as well as to reduce their susceptibility and vulnerability to future global change disturbances.

Goals and objectives of the session:

This session calls for contributions aimed at (i) improving our understanding on how disturbances and extreme events, and their interactions with other global change drivers (such as land-use change or climate warming), can affect ecosystem services and disservices; (ii) improving predictions on their impacts under climate and land-use change scenarios, and thus (iii) identifying land-use policies and management strategies to proactively reducing damage while ensuring the long-term supply of ecosystem services and biodiversity.

Planned output / Deliverables:

Although outputs and deliverables of this session will depend on the number (and quality) of contributions, we expect to use social-media (e.g. live-tweeting *#EcosystemServices*, *#ESP2020*, *@ESPartnership*) to advertise the outcomes of the session. In addition, we plan the following outcomes:

- i) To write a collaborative paper, including the organizing team, the contributors of the session and other potentially interested people. This article will be based on the main findings, conclusions and take-home messages derived from the session, and could also provide some descriptive examples (derived from the contributions) about the main impacts of studied disturbances on ecosystem services in the face of global change.
- ii) Finally, and only if the number of contributions is high and their quality remarkable, we can consider the possibility to coordinate a special issue in a journal related to the topic of session (e.g. *Ecosystem Services*, *Journal of Environmental Management*, *Ecosystems*, *Forests*, *European Journal of Forest Research*, *International Journal of Wildland Fire*, etc.).

We expect an intermediate number (5–10) of contributions that can be presented as oral presentations (10–12 minutes). In addition, we would expect some poster-type presentations. Finally, we would briefly discuss (around 30 min) the main findings obtained in the session, as well as future collaborative research on this specific context of forest ecosystems and global change disturbances.

Related to ESP Working Group/National Network:

Thematic working group: TWG 12 – ES & Disaster Risk reduction (DRR)

II. SESSION PROGRAM

Date of session: Monday, 7 June 2021

Time of session: 13:30 – 17:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
13:30 13:45	Maria	Felipe-Lucia	Helmholtz Centre for Environmental Research, German Center for Integrative Biodiversity Research	Land-use intensity alters networks between biodiversity, ecosystem functions and services
13:45 14:00	Marcela	Prokopova	Global Change Research Institute of the Czech Academy of Sciences	Assessment of land sensitivity to degradation at habitat level
14:00 14:15	David	Barnes	British Antarctic Survey	Emergence, growth and value of polar blue carbon sinks in hotspots of the climate crisis
14:15 14:30	Burnice Karimi	Ileri	Egerton University	Anthropogenic activities impacting on water ecosystem services supply in Kapingazi catchment, Embu County, Kenya
14:30 14:45	Ana	Stritih	ETH	Integrating disturbance risk into mountain forest ecosystem service assessments
14:45 15:00	Judit	Lecina-Diaz	Centro de Investigação em Biodiversidade e Recursos Genéticos & Bellaterra	Drought-induced risk of losing forest ecosystem services: the role of exposed values, hazard magnitude, susceptibility and lack of adaptive capacity

Time	First name	Surname	Organization	Title of presentation
15:30 15:45	Jose V.	Roces-Diaz	Swansea University	Forests and woodlands, fires and ecosystem services: exploring some of the multiple relationships
15:45 16:00	Philip	Roche	INRAe, UMR RECOVER	Ecosystem resilience and vulnerability to forest fires, changes in the production of ecosystem services in northern Provence, France
16:00 16:45	Ângelo	Sil	Centro de Investigação em Biodiversidade e Recursos Genéticos	Evaluation and application of a fire regime modelling tool to characterize fire-related functions and services in a fire-prone Mediterranean mountain landscape
16:15 17:00	Jose Adrian Judith	Roces-Diaz Regos Lecina-Diaz	Swansea University Universidade de Santiago & do Porto CREAF	Discussion

III. ABSTRACTS

Abstracts are ordered based on the session program. The first author is the presenting author unless indicated otherwise.

1. Type of submission: Abstract

T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management

Land–use intensity alters networks between biodiversity, ecosystem functions and services

First author: Maria Felipe–Lucia

Other author(s): Eric Allan, Biodiversity Exploratories Consortium

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Land-use intensification can increase provisioning ecosystem services, such as food and timber production, but it also drives changes in ecosystem functioning and biodiversity loss, which may ultimately compromise human wellbeing. To understand how changes in land-use intensity affect the relationships between biodiversity, ecosystem functions and services, we built networks from correlations between the species richness of 16 trophic groups, 10 ecosystem functions and 15 ecosystem services. We evaluated how the properties of these networks varied across land-use intensity gradients for 150 forests and 150 grasslands. Land-use intensity significantly affected network structure in both habitats. Changes in connectance were larger in forests, while changes in modularity and evenness were more evident in grasslands. Our results show that increasing land-use intensity leads to more homogeneous networks with less integration within modules in both habitats, driven by the belowground compartment in grasslands, while forest responses to land management were more complex. Land-use intensity strongly altered hub identity and module composition in both habitats, showing that the positive correlations of provisioning services with biodiversity and ecosystem functions found at low land-use intensity levels, decline at higher intensity levels. Our approach provides a comprehensive view of the relationships between multiple components of biodiversity, ecosystem functions and ecosystem services and how they respond to land use. This can be used to identify overall changes in the ecosystem, to derive mechanistic hypotheses, and it can be readily applied to further global change drivers.

Keywords: BEF, ecosystem function–service relationships, land management intensification, co-occurrence network, Biodiversity Exploratorie

2. Type of submission: Abstract

[T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management](#)

Assessment of land sensitivity to degradation at habitat level

First author: Marcela Prokopová

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Landscapes are disrupted by a whole range of both, natural and anthropogenic disturbances causing land degradation. One of the most serious impacts is the loss of production capacity, associated with the loss of a wide range of ecosystem functions and services. Revealing the sensitivity of landscapes helps to plan protective measures effectively. Because drivers don't occur in isolation but rather in a complex, comprehensive assessment approach is necessary. The paper presents the results of environmental sensitivity assessment (ESA) in the range of entire Czech Republic. The ESA index (ESAI) defines different levels of land sensitivity based on combinations of drivers which are grouped into four 'environmental quality' dimensions related to climate, soil, vegetation quality and human pressure, considered the major underlying causes of land degradation. Each ESA variable was transformed using a standardized score system taking account of (i) the ecological and socioeconomic characteristics of the Czech Republic and (ii) the estimated degree of correlation between each individual variable and land degradation. The most accurate, detailed and updated layers of habitats at a resolution of 1:10,000 in the Czech Republic were used for regional- and local-level assessment. Results of analyses suggests how climate (aridity index) and vegetation (crop intensification) are the most significant factors of land sensitivity to degradation in the Czech Republic. Eight variables out of 15 indicate a substantial polarization in areas classified at high sensitivity to land degradation (districts of South-eastern Czechia gravitating on Brno and districts of North-Western Czechia mostly gravitating on Prague) and areas classified at low sensitivity to land degradation (hilly and mountainous districts located elsewhere in Czechia). The index is assessed for administrative units, municipalities with extended powers (MEU) as they have the tools and legislative options to adopt and implement mitigation measures within the spatial planning documentation.

Keywords: degradation, ESAI, land sensitivity, local scale, spatial analyse

3. Type of submission: Abstract

[T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management](#)

Emergence, growth and value of polar blue carbon sinks in hotspots of the climate crisis



First author: David Barnes

Other author(s): Narissa Bax, Rachel Downey, Christoph Held, Camille Moreau, Bernabe Moreno, Maria Paulsen, Chester Sands

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Global climate change driven by increased greenhouse gas emissions is one of, if not the most important of societal challenges during the Anthropocene. Governments and society now treat emissions reduction much more uniformly, seriously and urgently, with considerable effort invested across technological and nature-based solutions. Nevertheless, natural marine carbon sinks such as the highly efficient coastal mangroves, seagrasses and salt marshes are shrinking in size and many tropical species operate near their physiological limits. In contrast, blue carbon (carbon bound up in marine organisms) on polar continental shelves is booming because (sub)polar organisms are able to translate a moderate temperature increase into higher growth and ice-loss leads to more growth happening in a larger area. The impacts of ice losses are complex but crucially major phytoplankton blooms now occur in place of ice-shelves and marine glaciers, and larger, longer blooms flourish across massive continental shelf areas. Resultant increases in carbon drawdown have doubled growth across long-lived benthos, storing that carbon, over the last 25 years. The unusually deep muds of polar continental shelves should promote high conversion rates of phytoplankton and kelp to genuine carbon sequestration, which the UN values at >\$30 tonne. These carbon sinks are smaller than tropical forests and less efficient than mangroves, seagrass and saltmarshes but unlike all of those their carbon drawdown increases in response to climate change – they are a negative (mitigating) feedback on global warming. High-latitude blue carbon gains are now three of the biggest four natural feedbacks on climate, but despite remoteness, this emergent, highly productive habitat is under potential threat from fishing, tourism, pollution, non-indigenous species establishment and other anthropogenic pressures. How can we best internationally and societally cooperate to evaluate, monitor and protect what is becoming one of the best and most cost effective nature-based climate solutions?

Keywords: Polar blue carbon, negative feedback, nature-based solutions, continental shelf

4. Type of submission: Abstract



T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management

Anthropogenic activities impacting on water ecosystem services supply in Kapingazi catchment, Embu County, Kenya

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Ecosystems provide valuable ecosystem services which are the foundation of man's sustainable development such as water provision. However, when humans exploit ecosystems in providing for their own sustenance, they also affect ecosystem services provision and consequently degrade the environment, endangering man's survival and development. Kapingazi catchment is home to various ecosystem services mainly water provision to downstream users. Kapingazi River flowing from this catchment contributes to Tana River with several national hydroelectric power stations that contribute to 52.1% of hydro-electric power of Kenya's electricity. Destruction of the catchment area through anthropogenic activities, have threatened Kapingazi River with its water flows and quality fluctuating significantly. The aim of this research was therefore to assess the anthropogenic activities impacting on water service provision in Kapingazi catchment in Embu County, Kenya. The study adopted cross sectional research design. Primary and secondary data were collected from Kapingazi catchment. Various anthropogenic activities were analysed based on catchment users who caused them included; cultivation at the riparian area, availability of eucalyptus trees at the riparian area, chemical control of pests and diseases, water abstraction, washing in the river, deforestation, quarrying, soil erosion, poor waste disposal and management. Logistic regression analysis showed that farmers' activities ($p = 0.002$) had significant impact on changes in water quality while farmers' activities ($p = 0.036$) and industrial activities by tea factories ($p = 0.014$) and coffee factories ($p = 0.013$) had significant impact on changes in water quantity at 95% confidence level. Negative impacts weaken water provision ecosystem service through changing ecosystem structure hence the need to reverse them in Kapingazi catchment. This can be achieved through proper waste management, soil and water conservation measures and enforcement of water regulations in order to provide improved water services of Kapingazi River.



Keywords: water, catchment, ecosystem, ecosystem services, anthropogenic activities

5. Type of submission: Abstract

T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management

Integrating disturbance risk into mountain forest ecosystem service assessments

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Mountain forests in the Alps are experiencing an increasing rate of natural disturbances, such as windthrow, bark beetle outbreaks, and forest fires. These disturbances affect the capacity of mountain forests to provide essential ecosystem services (ES), such as protection from natural hazards, timber production, and carbon sequestration, thus posing a challenge for forest management. At the same time, disturbances may also have a positive effect on certain services, e.g. by improving habitats for species that rely on dead wood. We integrate forests' susceptibility to natural disturbances into probabilistic models of a set of ES (avalanche protection, carbon sequestration, recreation, habitats, and wood production). The ES models have been developed by integrating information from remote sensing, social media and in-situ data, existing process-based models, and local expert knowledge. We use these models to map the level of the services and the associated uncertainties under scenarios with and without natural disturbances in two case study areas in the Swiss Alps. We use clustering to identify bundles of ES risk, and compare the patterns of risk between the multifunctional landscape of Davos and the strictly protected area of the Swiss National park. The spatial patterns of risk reflect the forest characteristics that drive disturbance susceptibility (such as species composition, vertical structure and land-use legacies) but also the demand for ecosystem services. For example, the level of risk related to avalanche protection is higher in the multifunctional landscape of Davos, where the demand for avalanche protection is high. Using this risk-based approach, we can identify priority areas with



high levels of ES that are particularly susceptible to disturbances, which is valuable information for forest management planning.

Keywords: risk, natural disturbance, mountain forests, Bayesian networks, mapping

6. Type of submission: Abstract

T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management

Drought-induced risk of losing forest ecosystem services: the role of exposed values, hazard magnitude, susceptibility and lack of adaptive capacity

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Forests provide multiple ecosystem services (ES) that are essential for human well-being, but are increasingly under pressure from climate change disturbances such as wildfires, drought, or insect outbreaks. In particular, drought has been promoting forest dieback across all forested biomes. Droughts are expected to increase in frequency, duration, and severity worldwide, compromising the future capacity of forests to mitigate anthropogenic emissions and to provide ES that benefit human society. Hence, evaluating the risk of losing forest ES by drought is becoming an urgent issue to anticipate and adapt to future conditions. In this study, we aim to analyze the spatial patterns of the risk of losing key forest ES and biodiversity (i.e., carbon sink, bird richness, hydrological control, and erosion control) due to drought in Catalonia (NE Spain). To so do, we have applied a general framework that includes all the IPCC components and is readily applicable to the main climate-change related hazards (Lecina-Díaz et al. 2020). Specifically, we have mapped exposed values, hazard magnitude, susceptibility, and lack of adaptive capacity. Exposed values are defined as the ES at risk, whereas hazard magnitude is defined by the climatic water deficit (Potential Evapotranspiration – Actual Evapotranspiration).



Susceptibility is defined by functional indicators (HSM, p50, and rooting depth) as well as the diversity of these indicators (i.e., their Functional Richness). Finally, lack of adaptive capacity is defined using the species regeneration capacity and the site index (which accounts for the external characteristics that promote species recovery). We have combined these components to assess and map the risk of losing forest ES and biodiversity, and we have analyzed their spatial distribution depending on the forest type and climatic characteristics. This study could contribute to future-oriented policies by anticipating conditions associated with particularly high risks that can be used to guide efficient forest management.

Keywords: climatic water deficit, forest drought, Mediterranean, risk, vulnerability

7. Type of submission: Abstract

[T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management](#)

Forests and woodlands, fires and ecosystem services: exploring some of the multiple relationships

First author: Jose V. Rocés-Díaz

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Fire is one of the most important disturbances affecting to the world terrestrial ecosystems and their ecosystem services (ES). During the last decades many of their environmental effects have been detailed studied, but integrative analyses across ES at different temporal and geographical ranges are still rare. In addition, many studies were designed to find negative impacts, but there is a relevant part of existing literature that highlights the role of fire as a key ecological process and even as a source of ES. Here we present results from a global synthesis focused on forests and woodlands across the world, and also comparing some of our findings with the existing literature about the relationships between fire and ES. To characterise the state of the art, we conducted a systematic search in the Web of Science, and analysed 207 peer-reviewed studies of the last three decades reporting effects >12 months after fire. We included aspects such as the



temporal scope of the studies or the type of events studied (prescribed burns vs. wildfires). Also, we classified the studies according to the type of fire regime or the ecoregion of the area where was located, the type of dominant forests, etc., as well as to the different ES studied. In our results, we found a clear geographical bias, with most of the studies located in a few countries (USA, Spain, etc.), in a few types of forests, or studying specific ES (mainly those related with soil or hydrological cycles). Further research, including wider temporal ranges and larger typologies of forests across ecoregions and biomes, is needed to provide better insights into fire environmental effects.

Keywords: wildfires, prescribed burns, woodlands, environmental impacts

8. Type of submission: Abstract

[T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management](#)

Ecosystem resilience and vulnerability to forest fires, changes in the production of ecosystem services in northern Provence, France

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Forest fires are recurrent in Mediterranean ecosystems zone. Different climate change scenarios show a significant increase in average temperature with a probable increase in the frequency of summer heat waves by 2020, for the next 100 years, leading to an increase in the risk of forest fires in areas on the northern range of Mediterranean climatic area. It is therefore highly likely that the territories of northern Provence, such as the case study site, will find themselves increasingly confronted with potential risk of forest fires. We conducted a prospective diagnosis of a territory's vulnerability to the forest fire. As part of this research we conducted an analysis of the wildfire impact on ecosystem services capacity and its resilience dynamic by combining vegetation succession sequence and an ecosystem capacity matrix. We evaluated the following ecosystem services: timber, energy wood, non-timber products, carbon storage, erosion and run-off control, recreation, cultural values and one disservice «vegetation fire supporting



capacity». Based on the capacity matrix, land cover maps and a dynamic sequence, SE maps were made for periods corresponding to 1 year, 5 years, 10 years, 20 years and 50 years after a fire at a 20m resolution, then average value for each SE were computed according to a 25ha grid. The estimation of the recovery speed of ES (resilience) was carried out on the basis of a sample of 24 virtual fires spread over the territory. For the 7 ES and the disservice, the resilience time was estimated based on the recovery time of 80% of the pre-fire capacity. Depending on the services, the minimum 80% resilience time ranges from 1 year (recreation) to 35 years (energy wood), while the maximum time is 5 years (wild animals) to 60 years (timber).

Keywords: forest fire, Mediterranean, resilience, ecosystem services, capacity matrix

9. Type of submission: Abstract

[T. Thematic Working Group sessions: T12 – Disturbances, extreme events and ecosystem services in the Anthropocene: impacts, challenges and management](#)

Evaluation and application of a fire regime modelling tool to characterize fire-related functions and services in a fire-prone Mediterranean mountain landscape

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Fire modelling at the landscape level is a useful approach to assess the capacity of ecosystems and landscapes to regulate spatiotemporal attributes of fire regime and their contribution to prevent the harmful effects of wildfires on humans and their livelihoods. However, the ability to use fire simulation tools with this purpose remains limited, whether due to uncertainties in their application to a given context or difficulties in integrating fire modelling outcomes from an ecosystem services perspective. In this study, we evaluated the capability of BFOLDS-FRM, a fire regime simulator, to modelling fire regime and support modelling and assessment of fire regulation capacity (FRC) and fire protection ecosystem service (FPES) in a fire-prone



Mediterranean mountain landscape in northeastern Portugal. We carried out sensitivity analysis, calibration, and validation of BFOLDS–FRM after which, based on model outputs, we assessed FRC and FPES. Our results show that, after model evaluation, BFOLDS–FRM adequately emulated the selected fire regime attributes observed in the study area. BFOLDS–FRM was also able to describe FRC and FPES dynamics, which were explained, in part, by the landscape changes that took place in the study area over time but also reflected the influence of fire weather conditions in each year analysed. In addition, we identified potential limitations and uncertainties. The results of this work can improve the application of BFOLDS–FRM to the context of fire regimes of Mediterranean mountain areas, underlining that BFOLDS–FRM provides useful outputs for the characterization of fire–related functions and services, and to support the management of fire–prone landscapes in these regions.

Keywords: model evaluation, fire regime modelling, fire regulating ecosystem services, landscape change, mediterranean mountains