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- POSITION PAPER -

Risks associated with the use of invasive alien tree species as a Nature-based Solution to mitigate climate change.

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Background

Over the past 25 years, the Council of Europe has assisted Bern Convention Contracting Parties in designing and implementing control measures for invasive alien species, with the aim of reducing their negative impact on native biodiversity in Europe. The Council has produced a number of reports and policy documents in the field. In the framework of the Bern Convention, the European Strategy on Invasive Alien Species (IAS) was developed and endorsed by the Standing Committee to the Bern Convention in 2003, as well as numerous voluntary codes of conduct addressed to various sectors of activity which are potential pathways for the establishment and spread of invasive alien species in Europe. Recommendation No. 193 (2017) on the European Code of Conduct for Invasive Alien Trees, adopted on 8 December 2017, by the Standing Committee, recommends that Contracting Parties: (1) take the European Code of Conduct mentioned above into account while drawing up other relevant codes - or where appropriate - draw up national codes of conduct on invasive alien trees; and (2) collaborate as appropriate with the actors involved in forestry activities in implementing and disseminating good practices and codes of conduct aimed at preventing and managing of introduction, release and spread of invasive alien trees.

At its last meeting in July 2021, the Bern Convention Group of Experts on Invasive Alien Species discussed the need to raise awareness among policy makers of the risks associated with the usage of invasive alien tree species as a nature-based solution to mitigate climate change. At its 41st meeting (29 November – 3 December 2021) the Standing Committee welcomed the progress in the development of the position paper on possible negative effects of using non-native invasive tree species (i.e., those alien tree species whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services) for climate change mitigation. It instructed the Secretariat, in collaboration with the Group of Experts and the independent consultant, to further elaborate the document during 2022 with the aim of presenting it for discussion and possible adoption by the Standing Committee at its 42nd meeting.

Acknowledging that tree planting can help achieve Net Zero[1], and that alien trees and well-managed planted forests of alien tree species can be useful in providing various forest goods and services and helping to reduce the pressure on natural forests or provide opportunities for adaptation to climate change and global change, this position paper briefly outlines the actual or potential risks associated with the use of invasive alien trees as a strategy to fight climate change under the flag of Nature-based Solutions and ten key policy principles for future action.

Risk associated with invasive alien tree species as a Nature-based Solution to mitigate climate change

The concept of Nature-based Solutions, introduced towards the end of the 2000s by the World Bank (Pauleit et al. 2017) to highlight the importance of biodiversity conservation for climate change mitigation and adaptation, was further developed during the UNFCCC negotiations in 2009, then introduced in the 2013-2016 IUCN Global Programme and defined as follows: "Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (The International Union for Conservation of Nature (IUCN) 2016). Nature-based Solutions support major EU[2] policy priorities, in particular the European Green Deal, biodiversity strategy and climate adaptation strategy, as a way to foster biodiversity and make Europe more climate-resilient. Importantly, the EU (European Union) aims to be climate-neutral by 2050. This

[1] https://www.ipcc.ch/sr15/chapter/glossary/

[2] The European Commission defines nature-based solutions as "Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions."

objective is at the heart of the European Green Deal [COM/2019/640 final[3]; COM/2018/773 final[4]] and in line with the EU's commitment to global climate action under the Paris Agreement.

Furthermore, the UN´s Intergovernmental Panel on Climate Change (IPPC) offers a clear definition of Climate Neutrality and of the term Carbon Neutrality, which is in quite popular usage, mostly in the context of the Net Zero debate. Net Zero carbon dioxide (CO_2) emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals from the atmosphere over a specified period. Net zero CO_2 emissions are also referred to as carbon neutrality.

As the concept of Net Zero emissions requires that carbon dioxide emitted must be offset by an equivalent volume of CO_2 removed from the atmosphere, the two main approaches to taking out carbon, or carbon removal, are through technological methods such as carbon capture and storage and offsetting through natural sinks such as land, including forests and oceans. These are included under the now popular term Nature-Based Solutions (Girardin et al., 2021), natural climate solutions (e.g., Griscom et al. 2017) and ecosystem-based approaches in the framework of the Convention of Biological Diversity[5].

With nations making little progress controlling their carbon emissions, many governments and advocates have advanced plans to plant significant numbers of trees to absorb carbon dioxide from the atmosphere in an attempt to slow climate change. But emerging research suggests that trees might not always help as much as some hope (Popkin, 2019). At the same time, ecosystem transformation is emerging as a global threat under climate change (Jackson, 2021). Planting trees is certainly not a new idea, but what is remarkable is the massive scale and the speed at which tree-planting has gained momentum during the past years (Bond et al., 2019; Fagan et al., 2020; Friggens et al., 2020; Holl and Brancalion, 2020). For example, the European Commission has proposed a dedicated EU Forest Strategy for 2030[6] to improve the quantity and quality of EU forests. The Strategy sets out a pledge to plant at least 3 billion additional trees by 2030 in full respect of ecological principles, based on the overall principle of planting and growing the right tree in the right place and for the right purpose. However, there is a plethora of very poorly designed projects that do not take into account available global guidelines (Brundu et al., 2020; Brundu and Richardson, 2016; Di Sacco et al., 2021) and other biodiversity issues.

One additional major driver for the introduction and use of alien trees is the impact of climate change on existing forest ecosystems, which is an important contemporary concern. Besides affecting forest productivity, observed effects of climate change on forest ecosystems include changes in tree growth patterns, drought induced mortality and species distribution shifts (Fraccaroli et al., 2021; Lindner et al., 2014), as well as additional effects on water availability, increasing pests and diseases, and the rise of detrimental effects of natural disasters, such as, e.g., mega-fires (Adams, 2013; Natole et al., 2021; Overpeck and Breshears, 2021; Zheng et al., 2021). Recent extreme events such as the most extreme drought and heat wave on record in Central Europe (Brun et al., 2020; Buras et al., 2020) led to widespread tree decline and decreased productivity (Bastos et al., 2020) and pest outbreaks, e.g. in the European spruce bark beetle *Ips*

[3] Communication from the Commission to The European Parliament, The European Council, The Council, The European Economic and Social Committee and The Committee of the Regions. The European Green Deal. COM/2019/640 final.

[4] Communication from the Commission to The European Parliament, The European Council, The Council, The European Economic and Social Committee, The Committee of the Regions and The European Investment Bank. A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy. COM/2018/773 final

[5] Secretariat of the Convention on Biological Diversity (2019). Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and supplementary information. Technical Series No. 93. Montreal, 156 pages.

[6] Communication from the Commission to The European Parliament, The Council, The European Economic and Social Committee and The Committee of the Regions. New EU Forest Strategy for 2030, COM/2021/572 final.

typographus, paving the way for the introduction of alien trees as substitute for native tree species in forestry and urban forest and to a general rethinking of forest/forestry policies and targets.

Furthermore, Anderegg et al., (2020) review the growing evidence that forests' climate mitigation potential is increasingly at risk from a range of adversities that limit forest growth and health. These include physical factors such as drought and fire and biotic factors, including the depredations of insect herbivores and fungal pathogens. Full assessment and quantification of these risks, which are themselves influenced by climate, is key to achieving science-based policy outcomes for effective land and forest management.

Carbon dioxide in the atmosphere fuels plant growth. As carbon levels rise, it's appealing to think of supercharged plant growth and massive tree-planting campaigns drawing down the CO_2 produced by human activities. However, the study from Terrer et al. (2021) suggests that when elevated carbon dioxide levels drive increased plant growth, it takes a surprisingly steep toll on another big carbon sink: the soil. One likely explanation is that trees effectively mine the soil for nutrients they need to keep up with carbon- fueled growth. Extracting the extra nutrients requires an acceleration of microbial activity, which then releases CO_2 into the atmosphere that might otherwise remain locked in the soil.

Large stocks of soil organic carbon have accumulated in the northern hemisphere permafrost region (Mishra et al., 2021), and natural wetlands and peatlands (Beaulne et al., 2021) remove CO_2 from the atmosphere.

In contrast, drainage, wildfires, and land-use change could trigger large CO_2 emissions from these ecosystems. Anthropogenic changes to northern peatlands can be traced back long before the industrial revolution: to crop cultivation, pastures used for grazing, afforestation and forestry, and peat fuel extraction (Grzybowski and Glińska-Lewczuk, 2020; Qiu et al., 2021). It should be noted that during the second half of the 20th century, new planting techniques combined with tax incentives, encouraged commercial forestry across large areas of peat bog in the UK, particularly in the Flow Country of northern Scotland. Such planting was controversial and was ultimately halted by removal of the tax incentives, and policies to prevent new planting (Sloan et al., 2018). Many organisations have now come together under the umbrella of the Peatlands Partnership to implement the management strategy for the peatlands of Caithness and Sutherland[7].

In fact, increasing carbon storage in soil is potentially one of the most cost-effective climate measures, and one that will have a positive impact on aspects such as biodiversity and soil fertility. However, the use of soil as a carbon sink is linked to a range of perspectives and fields of expertise, which creates a complex policy landscape. In addition, because knowledge is developing at a fast pace it is challenging to comprehend what is going on, where, and by whom (IPBES 2019; Nordic Council of Ministers 2021).

Approaches to maintain carbon within existing natural ecosystems could have large benefits for biodiversity (Thomas et al., 2013). However, many of the ecosystems that act as carbon sink are not currently counted when CO_2 quotas are calculated (in Land Use, Land-Use Change and Forestry - LULUCF) which therefore makes planting trees more alluring even when CO_2 capture is reduced compared to peatland or wetland restoration. Monetary or tax incentives where valuable natural treeless ecosystems are afforested, or which prefer invasive alien trees in forestry and afforestation practices, should be avoided. These types of interventions should not be considered as Nature-based Solutions to climate change mitigation or adaptation.

In fact, over 430 alien tree species worldwide are known to be invasive, and the list is growing as more tree species are moved around the world and become established in novel environments (Rejmánek and Richardson, 2013; van Wilgen and Richardson, 2014). Tree invasion has the potential to negatively affect biodiversity and ecosystems in many ways. For example, a decrease in taxonomic richness is often observed in vascular ground plant species in areas dominated by *Acer negundo* (Veselkin et al., 2021) or *Ailanthus*

[7] https://www.theflowcountry.org.uk/flow-facts/flow-fact-4/

altissima[8] (Brooks et al., 2021), compared to areas dominated by native tree and shrub species. The changes in soil physicochemical parameters, in understory vegetation, and the reduction in microbial and bacterial biomass under *Quercus rubra* may be associated with the type of litter (low N, high C/N) that decomposes slowly and generates a physical barrier, limiting seed germination and seedling growth. Therefore, this invasive alien tree may alter the structure and function of forest ecosystems (Stanek et al., 2020; Stanek and Stefanowicz, 2019).

To reduce the negative impacts of invasive alien trees, management interventions such as control or eradication are usually necessary, costly, and time-consuming. It is often assumed that the impacts of invasive alien trees will diminish immediately after such interventions. However, in some cases the invader can have legacy effects on the soil, which might persist for long periods, as in the case of areas invaded by *Acacia saligna* (Nsikani et al., 2017).

Throughout human history, changing socioeconomic activities have repeatedly resulted in the introduction of new invasive alien species (Kueffer, 2017; Seebens et al., 2017). At present, such introductions are influenced, for instance, by geopolitics, trade agreements, and new technologies such as synthetic biology. Predictions of future tree invasions therefore depend on anticipating emerging uses. A particular emphasis should be given to the precautionary principle[9] when applying risk assessment schemes, as considerable time lags have been observed between alien tree introduction and the starting of the invasive process and range shifts driven by climate change (Wallingford et al., 2020).

Ten key principles

- Ensure transparency, access to information, participation, and the respecting of rights in all tree planting initiatives;
- Prioritise conservation and protection of remaining natural forests, old-growth forest, and other types of wooded and tree-less habitats, such as wetlands, peatlands, grasslands, for the long term and climate change adaptation;
- Protect existing forest and adopt adequate preventive measures to analyse and reduce the risk of negative impact from biotic and abiotic risks, including fire risks;
- Restore degraded natural forest ecosystems, avoiding tree planting in natural non-forested habitats, such as wetlands, peatlands, grasslands, and prioritise areas that improve conservation value;
- Be aware of, and adopt, whenever possible, the Ten Golden Rules - supported by scientists from the Royal Botanic Gardens, Kew (RBG Kew) and Botanic Gardens Conservation International (BGCI) - for reforestation to optimize carbon sequestration, biodiversity recovery and livelihood benefits;
- Apply the precautionary principle and rigorous pre-entry screening or risk assessment for all new alien trees, in particular when these species do not have a documented history of planting with limited risk of escaping from plantation sites, while favour those trees species that are risk assessed in the area where they are to be planted;
- Be aware of the documented existence of a time lag between first alien tree introduction and

[8] *Ailanthus altissima* and *Acacia saligna* are invasive alien species of (European) Union concern according to the Regulation (EU) no. 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014R1143].

[9] The Parliamentary Assembly of the Council of Europe has acknowledged the importance of the precautionary principle as an element of policy-making. It supports the development of a rational framework for its application in situations of scientific uncertainty. In its Recommendation 1468 (2000) on biotechnologies the Assembly recommended that the Committee of Ministers "ask the relevant steering committees to adopt the precautionary principle as a common tenet of decision-making, once its scope has been clearly defined".

invasive behaviours as well as possible range-shift driven by anthropogenic climate-change;

- Apply the precautionary principle and rigorous biodiversity safeguards to all large-scale planting tree projects, and forest restoration initiatives - including those labelled as Nature-based Solutions and under the Bonn Challenge;
- Promote the use of native and threatened tree species in reforestation/afforestation/restoration initiatives and highlight the risks of planting invasive alien tree species in areas rich of native/endemic tree biodiversity;
- Take into account these key principles when designing incentives, subsides, and planning to mainstream the adaptation of forest, urban forest, and forestry to climate change

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