



2020

# Forest Condition in Europe

## The 2020 Assessment

ICP Forests Technical Report under the UNECE Convention  
on Long-range Transboundary Air Pollution (Air Convention)

# ADDRESSING CHALLENGES ASSOCIATED WITH LONG-TERM FOREST ECOSYSTEM MONITORING

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## Introduction

ICP Forests has been a pioneering and successful initiative in transnational long-term forest ecosystem monitoring under the UNECE Air Convention since its establishment in 1985. Its design based on permanent monitoring plots has allowed the study of responses of forest ecosystems to environmental changes and to detect significant temporal and spatial trends. In the last years, however, the intensive (Level II) forest monitoring plots, which were established starting in 1994, have begun to face several practical challenges, and it has become widely acknowledged within the monitoring community that these need to be addressed to ensure a successful continuation of the programme. As the monitoring plots were installed in adult forest stands, many of the investigated stands have become old or disturbed and have started to regenerate or will need to be regenerated in the years to come. This will have a strong impact on the plots and the condition of the investigated ecosystems, and it may even impair the continuation of some survey types.

Unfortunately, the information collected on the design and management of the Level II plots has not been detailed enough in the past to meet these challenges, to evaluate their potential impacts, and to discuss ways to address them consistently at the international scale. To overcome this lack of information, a questionnaire was prepared and distributed to the National Focal Centres (NFCs), which represent the ICP Forests member countries, with the aim to receive feedback and discuss expectations and recommendations for action. This chapter presents the questionnaire's main results from a total of 35 respondents (30 countries and five German forest research institutes representing eight German Bundesländer) between 9 May and 25 June 2019. For a list of complete answers and comments, please refer to the online supplementary material.<sup>1</sup>

## Main results from the questionnaire on the Level II monitoring

### What are the challenges for the long-term practicability of the Level II monitoring network?

Four main challenges were identified and submitted to the NFCs for discussion:

- **Stand regeneration:** Should the monitoring activities be continued in the regeneration stage of forest stands, and

how? Or should the concerned plots be relocated to other adult stands?

- **Stand heterogeneity due to severe disturbances:** Should data collection be continued on severely disturbed plots, e.g., to evaluate the effects of the disturbances and to get insight into the increased spatial variability, or to include additional stand development stages? Or should plots be replaced after severe disturbances?
- **Biases due to monitoring activities:** How can the long-term effects of monitoring activities on the monitored ecosystems be evaluated and how can potential biases be sufficiently minimized?
- **Forest management practices:** Can we assess and document management activities on the plots in order to distinguish their effects from those of environmental factors?

The majority of respondents considered all of these challenges as important or very important for the ICP Forests Level II network except for the challenge "Biases due to monitoring activities" which was rated a little less important (cf. Figure 7-1, Figure S3-2<sup>1</sup>). In general, the presented challenges are perceived as even more important for the international ICP Forests network than for national networks, which shows that some NFCs may worry about the overall consistency of the programme and data quality even if not feeling overly concerned at the national level.

### How many countries have already faced such challenging situations?

Many countries have already faced such challenging situations and have been confronted with the resulting changes in plot condition (cf. Figure 7-2, Figure S3-3<sup>1</sup>):

- About half of the respondents have reported either increasing heterogeneity on Level II plots resulting from severe disturbances (more than 50% of the overstorey destroyed by e.g. wind, fire, or insects) and/or tree regeneration (with a juvenile stand established under or in place of the original adult one).
- A large majority (more than 70%) has reported that their plots are under active forest management, which is consistent with the initial requirement for no difference in the management of the plots and of their surroundings (EU

<sup>1</sup> Online Supplementary Material: <http://icp-forests.net/page/icp-forests-technical-report>



1994), and with the fact that most of the European forest is under management (Forest Europe 2015). Among countries that have never had any plots under active forest management, some had made the explicit decision to install their plots in nature reserves. Others commented that active forest management has been excluded after plot installation to avoid damage to monitoring devices or because of the installation of a fence which makes access more difficult.

- As regard to potential biases due to monitoring activities, more than 60% of the respondents have had at least some of their plots fenced. Fencing can impact forest development in the plot as compared to its surroundings by e.g. excluding ungulates (Boulanger et al. 2018). But it is considered by 65% of the NFCs as useful or sometimes even necessary to prevent a destruction of monitoring devices (cf. Figure S3-8<sup>1</sup>).
- The majority of respondents (54%) who are in charge of the monitoring activities also have a direct influence on the definition of the forest management plans concerning their plots (cf. Figure S3-10<sup>1</sup>). This may be a source of bias as compared to regular management practices but it can also help to maintain and renew the stand according to specific monitoring interests (e.g. by defining the main targeted tree species to be regenerated and subsequently monitored).
- Finally, several respondents reported that they sometimes had to remove small trees, shrubs or deadwood to be able to conduct the monitoring activities (cf. Figures S3-11 and S3-12<sup>1</sup>), e.g. to keep the crown of sample trees visible, to (re-)install probes, or to create and maintain pathways.

#### How have countries so far addressed these challenging situations?

Only a minority (less than 25%) of the respondents have already defined specific rules to address the identified challenges (cf. Figure S3-4<sup>1</sup>). Nearly half of them have reported to have rules addressing the challenge “Forest management”. But comments show in several cases that these include only the application of the same management practices in and surrounding the plot, and not the assessment of the management practices and an evaluation of their potential effects on ecosystem responses.

When a stand enters the regeneration stage either following overstorey removal or severe disturbances, some countries have decided to move the concerned plot to another location, while others have preferred to continue to monitor it at the same location. Survey protocols, however, have rarely been adapted yet by NFCs with the aim to collect data in juvenile and/or heterogeneous stands (cf. Figure S3-5<sup>1</sup>):

- Some of the respondents briefly reported changes in the plot area, in the number of replicates, in the sampled trees, or in the type of samplers or measurements, after plot disturbance, to stay in homogeneous conditions.
- Some indicated when and how they intend to resume surveys after felling.
- Very few reported existing documents about protocols adapted to juvenile and/or heterogeneous stands for at least some of the surveys.

#### How should the identified challenges be addressed by ICP Forests?

To address the two challenges about how to deal with stand regeneration and stand heterogeneity, two-thirds of the respondents would appreciate guidelines from ICP Forests with different options rather than maintain original requirements for stand conditions for Level II plots (cf. Figure 7-3, Figure S3-6<sup>1</sup>).

Indeed, for example, only 6 of the 35 respondents would agree to either relocate or continue to monitor their Level II plots when they enter the regeneration stage, if this would be required by ICP Forests to keep the international network consistent (cf. Figure 7-4, Figure S3-7<sup>1</sup>). As expected, there is no uniform agreement between NFCs about one best option to answer this specific question, because it depends a lot on national needs, strategy and funding resources. Some countries would prefer to continue the monitoring at the same location in order to capitalize on the value of the long time series already collected, to observe ecosystems in early stages of development, or because they have no means to establish new plots. Others would prefer to relocate plots because they cannot take the risk for the regeneration process to fail or wait for decades until all survey types can be resumed, or because the national demand is about the response of adult stands which constitute the largest part of forested areas. Doing both (which implies to increase the number of plots) would be an ideal option to evaluate the effects of the development stages in addition to those of environmental changes, but it appears too costly to most countries. Still this question of relocating or keeping monitoring plots after the end of a stand rotation remains under discussion in many countries. And, even if it is up to national capacities and strategies, comments also reveal some strong concern about the comparability of the data at the international scale, and an interest for international guidelines balancing advantages and disadvantages of each option, and for survey protocols adapted to juvenile and heterogeneous stands.

As regard to forest management history, it appears that consistent information about practices is available in 63% of the countries, at least since plot installation (cf. Figure 7-5, Figure S3-9<sup>1</sup>). In others (34%) only partial information is available. So there is an opportunity to document the stand history in the ICP Forests database, as a potential explanatory factor of the observed ecosystem responses.

<sup>1</sup> Online Supplementary Material: <http://icp-forests.net/page/icp-forests-technical-report>

## Conclusions and followings

After 35 years of successful activity, the ICP Forests community has acknowledged important challenges to be addressed to successfully continue with the transnational intensive (Level II) long-term forest monitoring. However, the questionnaire also revealed certain contrasts in the initial choices in plot design and management in the different countries, and in their current priorities and available financial resources. In consequence, one-way decisions should not be made and imposed uniformly at the international scale, but recommendations and guidelines are nevertheless highly expected to keep consistency in applying each of several possible monitoring strategies.

As a result of the findings from this questionnaire, the latest update of the ICP Forests Manual adopted in 2020 included some first changes to the basic design principles of the Level II intensive forest monitoring (Part II) and to several specific survey protocols with the aim

- to present possible options on how to handle plots entering the regeneration stage and list their advantages

and disadvantages with regard to strategical and practical considerations;

- to adapt survey protocols to the conditions of juvenile and/or heterogeneous stands;
- to better document the status of each plot (and its potential relocation), and the status of the forest stand (in the plot and in the buffer zone);
- to collect standardized information about the stand history (management practices and natural disturbances) since plot installation or even earlier if available.

Although further discussion will be needed to fully respond to the four identified challenges, the presented information and guidelines can be regarded as a first important step towards maintaining the value of the ICP Forests long-term monitoring system over time, with the aim to successfully continue the evaluation of the effects of air pollution, climate change and other natural and anthropogenic stressors on forest ecosystems throughout the UNECE region.

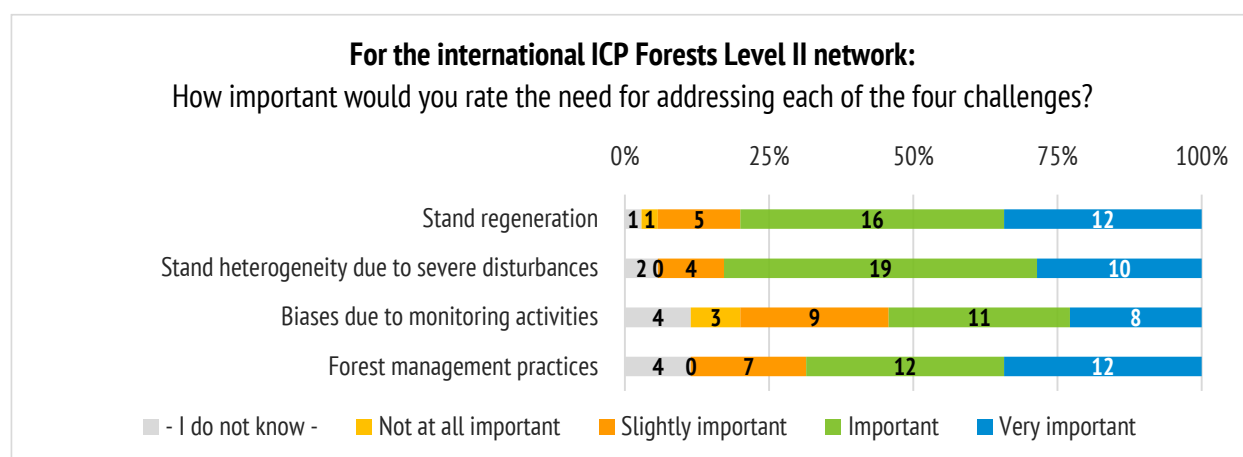


Figure 7-1: Rating of the importance of four challenges associated with long-term forest ecosystem monitoring (Questions 1, 2)

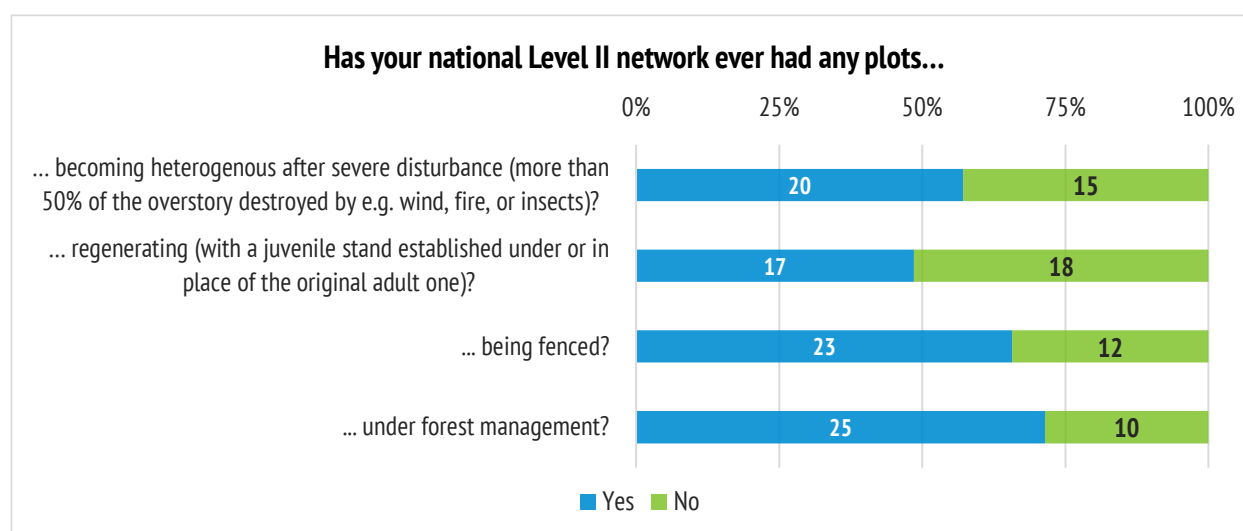


Figure 7-2: Level II plot management and experience with challenges (Question 3)

<sup>1</sup> Online Supplementary Material: <http://icp-forests.net/page/icp-forests-technical-report>

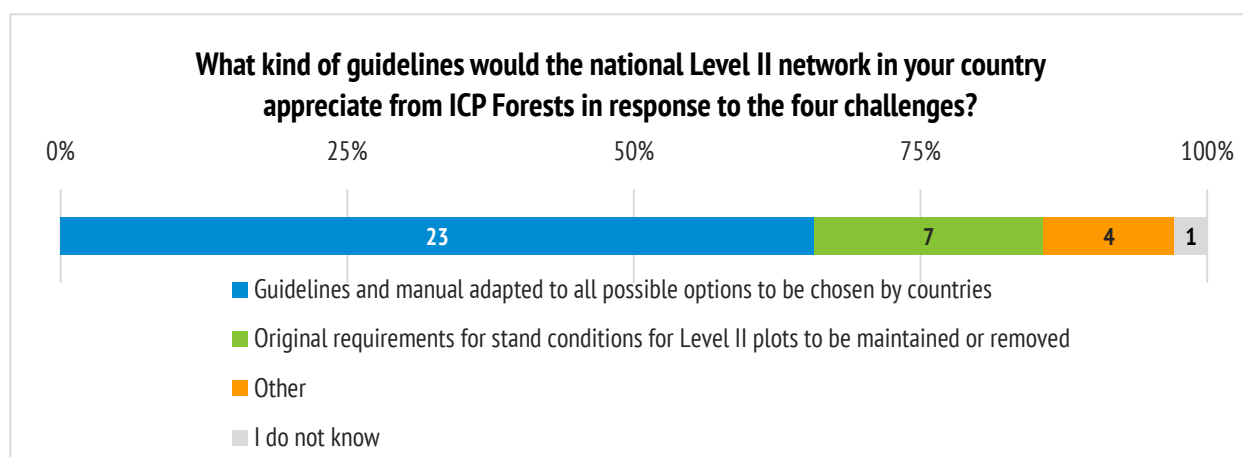


Figure 7-3: Requested guidelines on future Level II plot management addressing these challenges (Question 6)

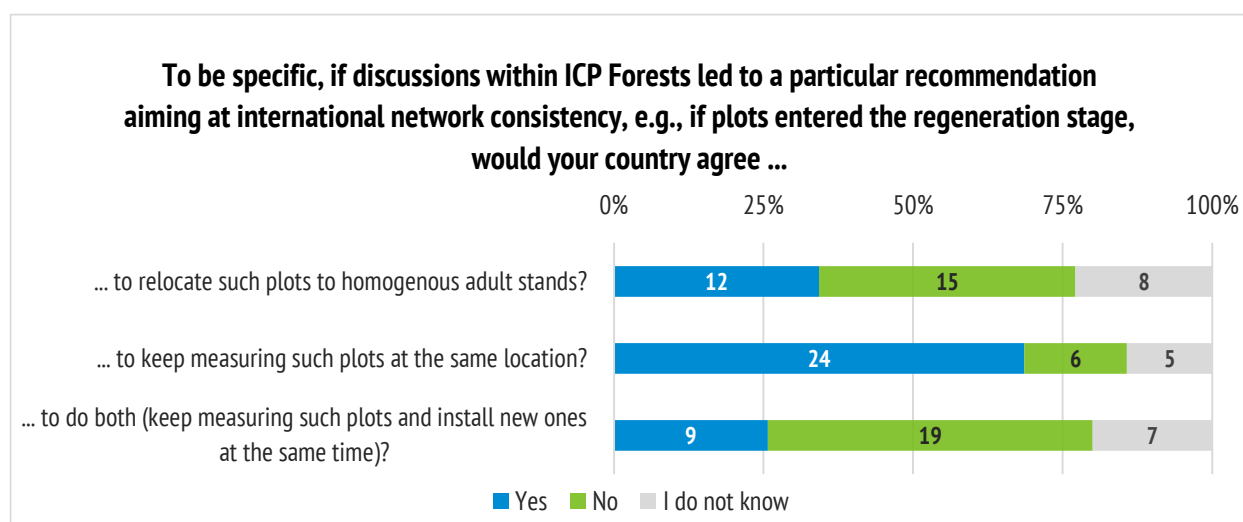


Figure 7-4: Potential acceptance of ICP Forests guidelines after stand disturbance and regeneration on Level II plots (Question 7)

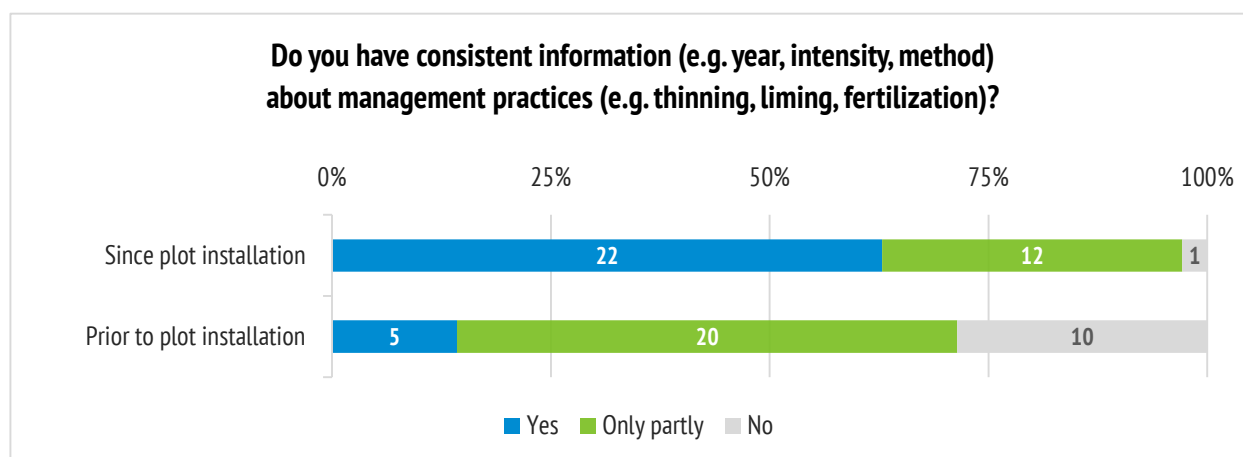


Figure 7-5: Availability of long-term information on management history of Level II plots (Questions 9, 10)

## References

For all written responses to the questionnaire, please refer to the Online Supplementary Material<sup>1</sup>.

<sup>1</sup> Online Supplementary Material: <http://icp-forests.net/page/icp-forests-technical-report>

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