

Technical Guidelines for the genetic monitoring of *Pinus nigra* Arn.

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Illustrations by Klara Jager

INTRODUCTION

European black pine (*Pinus nigra* Arn.) is a wind-pollinated, monoecious, mainly outcrossing, high elevation, circum-Mediterranean conifer, that also grows in Austria, Crimea, and the Black Sea. Due to the species extensive distribution in a broad spectrum of environments, that led to its morphological and genetic differentiation, five interfertile sub-species can be recognized across its natural distribution. Moreover, numerous populations of the species can be considered as geographically or ecologically marginal and are thus of great interest for genetic monitoring in the face of climate change. Black pine is a valuable key-stone species of high economic and ecological importance, producing wood of high quality and natural durability. It is characterized by its tolerance to abiotic stresses. For all the reasons above the species is extremely suitable for genetic monitoring. The technical guidelines provide all the detailed information needed for its genetic monitoring, and specifically on the topics of species ecology, reproduction, threats, genetic monitoring plot establishment and maintenance, as well as detailed protocols for recording genetic monitoring verifiers and indicators at the basic, standard, and advanced monitoring levels.

MONITORING PLOT ESTABLISHMENT

Pinus nigra is a stand forming species for the genetic monitoring of which plots should be established following the selection of the appropriate forest stands. Following stand selection, a random point within stand needs to be selected, and the adult tree closer to that point will represent the central tree of the monitoring plot. After selecting the central tree, 49 additional trees being located in concentric circles with radius difference of 30m. need to be selected. The distance also among trees should also be 30 m between the trees. The establishment of natural regeneration (NR) subplots (up to 20) should be based on the seedlings produced from the germinated seed of a mast year.

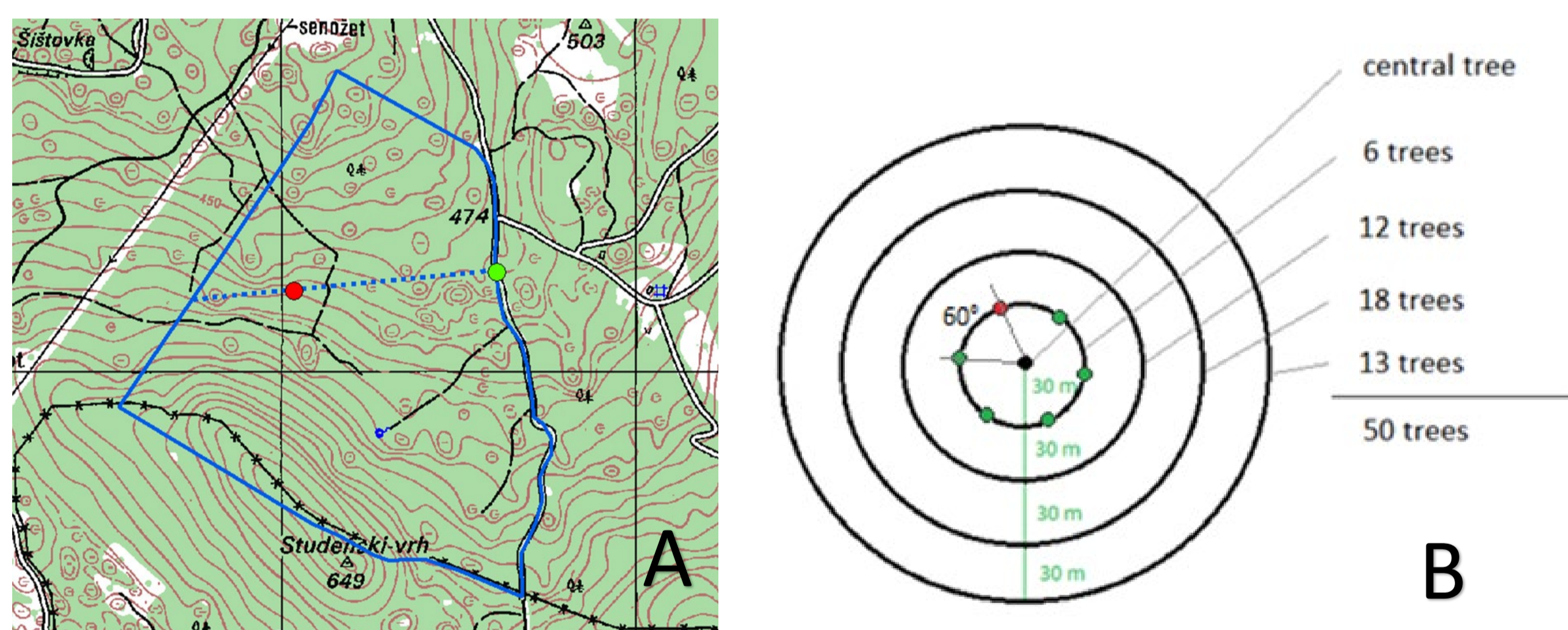


FIGURE 1A: Selection of a random point on the map to identify the central tree of the monitoring plot in the forest stand (left) and 1B: identification of trees to be monitored in concentric circles.



FIGURE 2: Example of selecting adult trees to be monitored in a *Pinus nigra* Arn. stand.

DESCRIPTION OF VERIFIERS

The verifiers recorded in the field are falling within the indicator Selection. The Table below presents the verifiers, short description for their three monitoring levels and the background information monitored.

	Name	Basic level	Standard level	Advanced level
Verifiers	Mortality / survival	Counting of remaining marked trees every 10 years and after every extreme weather event/disturbance	Same as basic level	Same as basic level
	Flowering	Stand-level estimate, every year	Individual tree level observation, during two major flowering events per decade, ideally equally spaced*	Individual tree level observation, during two major flowering events per decade, ideally equally spaced*
	Fructification	Stand-level estimate, every year	Individual tree level observation, the same year as the assessment of the flowering at the standard level (regardless of the fructification intensity)*	Counting of fruit, during the same years as the assessment of flowering at the advanced level, regardless of the fructification intensity * Seeds are collected for laboratory analyses every assessed fructification event at the advanced level
	Natural regeneration abundance	Stand-level estimate, every year	Counting of seedlings 1st and 6th year after every assessed fructification event	Counting of seedlings 1st, 6th, 11th, 16th year after every assessed fructification event
Background information	DBH class distribution	/	Measurement every 10 years	Same as standard level.
	Height class distribution	/	Measurement every 10 years	Same as standard level.
	Bud break	/	Individual tree level observation, every 5 years	Individual tree level observation, every year
	Flowering synchronization	/	/	Individual tree level observation, at each assessed major flowering event

EXAMPLE: MONITORING PHENOPHASES

The phenophases for recording the progress of female conelet flowering, male strobili flowering and bud break of *Pinus nigra* Arn. are presented in the following Figures 3, 4, and 5.

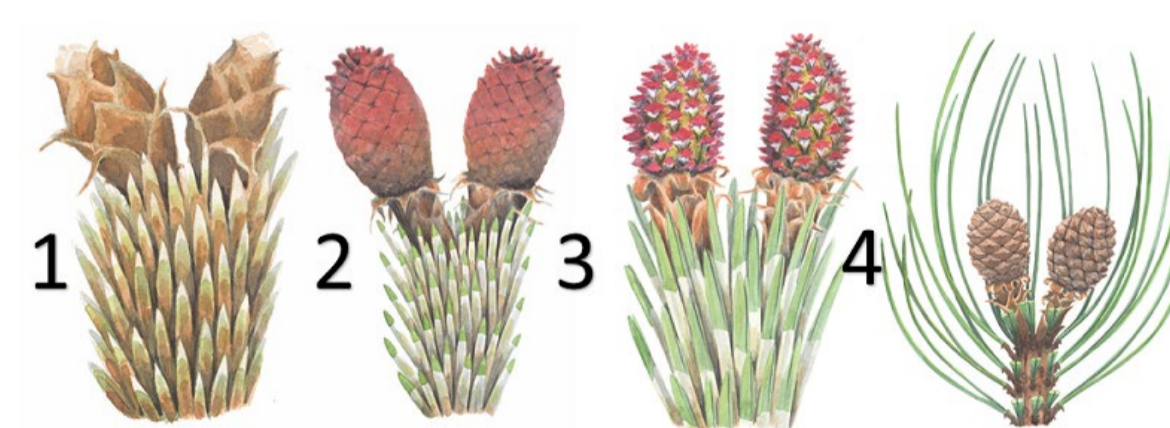


FIGURE 3: Female conelet flowering phenophases.

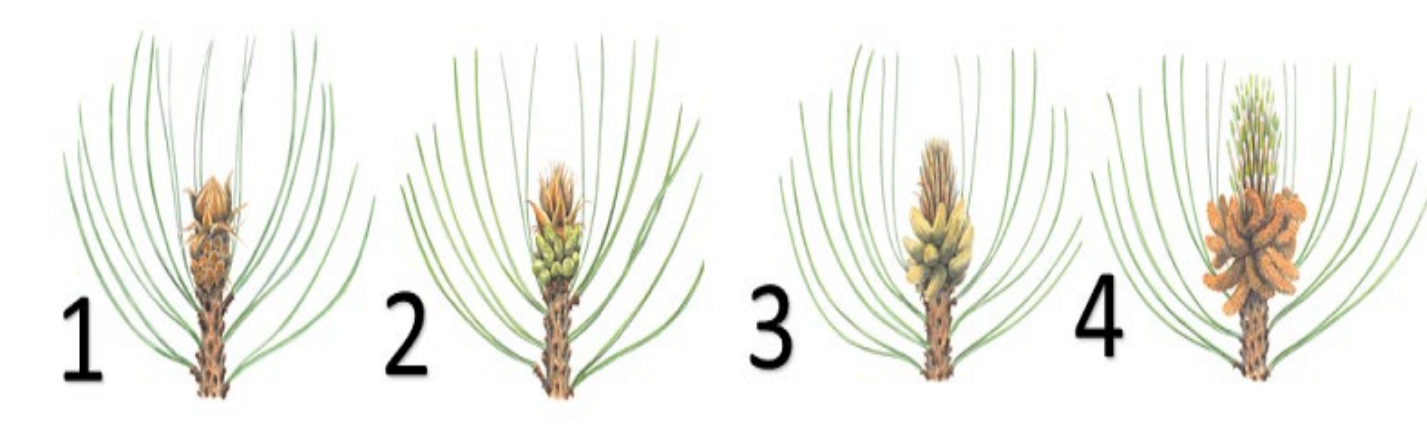


FIGURE 4: Male strobili flowering phenophases.

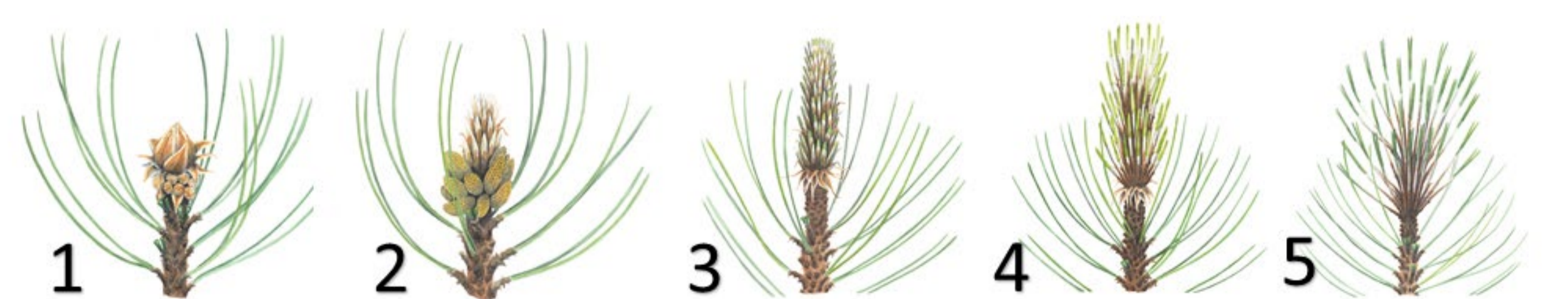


FIGURE 5: Bud break phenophases

Acknowledgments

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