Abstract template for the conference "A century of national forest inventories – informing past, present and future decisions"

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On page two, you are asked to fill in your abstract in the format and font size indicated. Please remember to include authors affiliation information in the footer section of page two. The length of the abstract may not be more than one page including references.

Abstract title:		**Design-based mapping of forest resources from two-phase inventories**
Take-home message:		An important step in the scenario of enlarging inventory goals is to perform spatially explicit estimation in order to construct forest maps for geographically depicting resource location. Here we show a design-based spatial prediction that ensure design-based consistency of the resulting maps.
Presenter name:		Piermaria Corona & Lorenzo Fattorini
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General topic, see website: (please double click on the check box and activate the relevant one)	☐	Improving future NFIs by learning from the past
	☐	NFIs today and in the future
	X	Cutting edge and futuristic inventory techniques and technologies
Preferred presentation form:	X	Oral presentation
	☐	Poster
Abstracts will be reviewed by members of our scientific committee and you will be given information on decisions in due time after the submission deadline has passed.		

Design-based mapping of forest resources from two-phase inventories

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Introduction: Large-scale forest inventories are usually performed in two phases. In the first phase, a collection of points are located throughout the study area usually in accordance with the systematic grid sampling, or, more recently, in accordance with the tessellation stratified sampling (e.g. the national inventories in Italy and USA). Then, these points are classified as forest and non-forest by means of satellite or aerial information and, in a second phase, a sample of points is selected, usually by means of a stratified design with strata determined by administrative districts and forest types. Finally, plots are centered at any second-phase points and forest attributes are recorded within. The strategy allows for design-unbiased estimation of descriptive summaries such a forest cover and total tree volume and basal area with an, at least, conservative estimation of the design-based variances. However, an important next step in the scenario of enlarging inventory goals is to perform spatially explicit estimation in order to construct forest maps for geographically depicting resource location. That can be done adopting model-dependent predictors, such as kriging, therefore abandoning the design-based scenario in which inference from forest inventory has been traditionally performed. Recently, Fattorini et al. (2018) have proposed a design-based spatial prediction that, under some conditions, ensure design-based consistency of the resulting maps.
Materials and methods: The use of systematic grid sampling or tessellation stratified sampling and the nature of the data collected by plots are sufficient to achieve the consistency of the maps that would be obtained if plots were centred in all the points selected in the first phase. This paper extends the consistency results from one- to two-phase sampling, giving sufficient conditions that must be shared by the scheme adopted to select points in the second phase for achieving consistency of the maps. The exploitation of auxiliary remote sensing information, when available for the whole study area, is also considered. A simulation study is performed from artificial populations to check the mapping performance and a real case study in a forested area of Italy is reported.
Results: The most common schemes adopted in the second phase of forest inventories satisfy the consistency conditions.
Conclusion: A complete design-based framework for spatially explicit estimation in order to construct forest maps from forest inventory data is provided. As pointed out by Särndal et al. (1992, p. 21), the main attraction of the design-based approach is that "Design-based inference is objective, nobody can challenge that the sample was really selected according to the given sampling design. The probability distribution associated with the design is real, not modelled or assumed".
References:
Fattorini, L., Marcheselli, M., Pisani, C., Pratelli, L. (2018) Designed-based maps for continuous spatial populations. Biometrika, 105, 2: 419-429.
Särndal, C.E., Swensson, B., and Wretman, J. 1992. Model Assisted Survey Sampling. Springer, New York.

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