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**Lecture Notes for the  
Module  
“Monitoring  
of Forest Resources”**

by

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## Preface

These lecture notes were compiled as supporting material to the lecture “Monitoring of Forest Resources” as delivered at the Faculty of Forest Sciences and Forest Ecology at Georg-August-Universität Göttingen. Selection of topics follows, therefore, largely the structure of that course. That does also mean that these lecture notes cover above all the topic of field based monitoring, touching only marginally on remote sensing techniques – which is the subject of other lectures for which other material is available.

These lecture notes started by my students Mr. Thzeng Yih Lam and Mr. Netra Bhandari during my lectures in winter semester 2004/2005, covering all subjects that had been lectured in that semester. Mr. Haijun Yang did a further review and Mr. Hendrik Heydecke did a thorough editorial check. They did a great job and I am very grateful to them for their efforts!

In the course of the years, various updates have been made, some topics added and some eliminated. Numerous students and research associates of the Chair of Forest Inventory and Remote Sensing at Göttingen University, and also many students taking the course contributed to this never-ending optimization work. Great thanks to all these two colleagues !

Of course, there may still be mistakes in the text. You are very much welcome and encouraged to explicitly search for them and let the authors know, so that we can continue gradually improving this learning material: any observations on structure, style, etc. of these lecture notes are very welcome!

This collection of materials is thought to accompany the lectures. I doubt that it can replace attending lectures and tutorials on a regular basis and / or reading further texts and articles, as recommended.

You may also wish to visit our “AWF Wiki”, the first Wiki that deals specifically and comprehensively with the fields of forest mensuration, forest inventory and forest monitoring and which is globally intensively accessed in the meantime. The AWF Wiki has been established in 2009 at the Chair of Forest Inventory and Remote Sensing (“AWF” = Abteilung Waldinventur und Fernerkundung) as an initiative of Dr. Lutz Fehrmann: <http://wiki.awf.forst.uni-goettingen.de/wiki> (or search for „AWF Wiki“ in any internet search machine).



I hope that this material proves useful and helps you getting even more interested in the exciting topic of monitoring techniques for forests and natural renewable resources.

Christoph Kleinn  
and the team at the Chair of Forest Inventory and Remote Sensing  
(= AWF = Abteilung Waldinventur und Fernerkundung)

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# Table of Contents

<b>1. INTRODUCTION</b>	<b>1</b>
<b>1.1 BACKGROUND AND OBJECTIVES</b>	<b>1</b>
<b>1.2 BRIEF COMMENTS ON THE HISTORY OF FOREST INVENTORY</b>	<b>2</b>
<b>1.3 GEOGRAPHICAL LEVELS</b>	<b>2</b>
1.3.1 FOREST INVENTORIES AT LOCAL LEVEL	2
1.3.2 FOREST INVENTORIES AT NATIONAL LEVEL	3
1.3.3 FOREST ASSESSMENTS AT GLOBAL LEVEL	3
<b>1.4 INFORMATION</b>	<b>3</b>
1.4.1 DATA AND INFORMATION	3
1.4.2 FOREST INVENTORIES AS ELEMENT OF DECISION PROCESSES	4
<b>2. FOREST MENSURATION RECAP</b>	<b>7</b>
<b>2.1 DEFINITIONS IN FOREST INVENTORY</b>	<b>7</b>
2.1.1 INTRODUCTION	7
2.1.2 DEFINITION OF “TREE”	7
2.1.3 DEFINITION OF “FOREST”	8
2.1.3.1 General observations	8
2.1.3.2 Components of a forest definition	8
2.1.3.3 “Forest” definition of FAO	9
2.1.3.4 Examples of forest definition	9
2.1.3.5 Minimum crown cover	11
2.1.3.6 Some discussion points referring to forest definitions	13
2.1.4 FOREST BOUNDARY	14
2.1.5 SPECIES COMPOSITION	14
<b>2.2 MEASUREMENT OF DIAMETER</b>	<b>15</b>
2.2.1 INTRODUCTION	15
2.2.2 THE DIAMETER AT BREAST HEIGHT	15
2.2.3 INSTRUMENTS FOR MEASURING DIAMETER AT BREAST HEIGHT	17
2.2.3.1 Caliper	18
2.2.3.2 Diameter tape	18
2.2.4 CALIPER VS. DIAMETER TAPE	19
2.2.5 MEASURING UPPER STEM DIAMETERS	20
2.2.5.1 Why measuring upper diameters?	20
2.2.5.2 Finn caliper	20
2.2.5.3 Optical caliper (parallel beams)	21
2.2.6 THE PRINCIPLE OF MEASURING UPPER DIAMETERS WITH ANGLE MEASUREMENTS	22
2.2.7 MEASURING UPPER DIAMETERS WITH THE RELASCOPE	23
<b>2.3 MEASURING HEIGHT</b>	<b>24</b>
2.3.1 GENERAL COMMENTS	24
2.3.2 DIRECT MEASUREMENT OF TREE HEIGHT	24
2.3.3 THE TRIGONOMETRIC PRINCIPLE OF MEASURING TREE HEIGHT	25
2.3.4 THE GEOMETRIC PRINCIPLE OF MEASURING TREE HEIGHT	26
<b>2.4 MEASURING DISTANCE</b>	<b>27</b>
<b>2.5 MEASURING SLOPE</b>	<b>28</b>
<b>2.6 SOME FEW FURTHER ATTRIBUTES</b>	<b>28</b>
2.6.1 GENERAL OBSERVATIONS	28
2.6.2 BARK THICKNESS	29

2.6.3	CROWN ATTRIBUTES	29
2.6.4	DIAMETER INCREMENT	31
2.6.5	WOOD DENSITY	32
2.6.6	QUALITY	33
2.6.7	TREE SOCIOLOGICAL POSITION	33
2.6.8	CHARACTERIZATION OF STEM SHAPE	34
2.6.8.1	Form of tree	34
2.6.8.2	Form factor	34
<b>2.7</b>	<b>TERRESTRIAL LASER SCANNING – TAKING 3D PHOTOGRAPHS</b>	<b>36</b>
<b>2.8</b>	<b>DETERMINING VOLUME</b>	<b>38</b>
2.8.1	GENERAL OBSERVATIONS	38
2.8.2	CALCULATING VOLUME	38
2.8.2.1	Direct measurement	38
2.8.2.2	Volume calculation by section	38
2.8.2.3	The taper curve	39
<b>2.9</b>	<b>FUNCTIONS AND MODELS IN FOREST INVENTORY</b>	<b>41</b>
2.9.1	GENERAL OBSERVATIONS	41
2.9.2	ON THE TERM "ALLOMETRIC MODELS"	41
2.9.3	SOME NOTIONS OF LINEAR REGRESSION	42
2.9.4	HEIGHT CURVE	44
2.9.5	VOLUME FUNCTIONS	46
2.9.6	BIOMASS FUNCTIONS AND CARBON ESTIMATION	50
2.9.7	OTHER MODELS	53
<b>3.</b>	<b>INTRODUCTION TO SAMPLING</b>	<b>54</b>
<b>3.1</b>	<b>GENERAL OBSERVATIONS</b>	<b>54</b>
<b>3.2</b>	<b>POPULATION VS. SAMPLING FRAME</b>	<b>54</b>
<b>3.3</b>	<b>STATISTICAL SAMPLING</b>	<b>55</b>
<b>3.4</b>	<b>SAMPLING DESIGN AND PLOT DESIGN</b>	<b>56</b>
<b>3.5</b>	<b>STATISTICAL ESTIMATIONS</b>	<b>56</b>
<b>3.6</b>	<b>SAMPLE SIZE</b>	<b>60</b>
<b>3.7</b>	<b>SAMPLING INTENSITY VS. SAMPLE SIZE</b>	<b>61</b>
<b>4.</b>	<b>PLOT DESIGN</b>	<b>63</b>
<b>4.1</b>	<b>INTRODUCTION</b>	<b>63</b>
4.1.1	SPATIAL AUTOCORRELATION	64
<b>4.2</b>	<b>FIXED AREA PLOTS</b>	<b>65</b>
4.2.1	GENERAL OBSERVATIONS	65
4.2.2	THE INCLUSION ZONE CONCEPT	66
4.2.3	THE PLOT EXPANSION FACTOR	67
4.2.4	CLUSTER PLOTS	68
4.2.5	NESTED SUB-PLOTS	68
4.2.6	SLOPE CORRECTION	70
4.2.6.1	Effects of slope correction	72
<b>4.3</b>	<b>FIXED AREA PLOTS AT THE STAND BOUNDARY</b>	<b>72</b>
<b>4.4</b>	<b>BITTERLICH SAMPLING (ANGLE COUNT SAMPLING)</b>	<b>74</b>
4.4.1	INTRODUCTION	74
4.4.2	THE PRINCIPLE OF BITTERLICH SAMPLING	75
4.4.3	CHOICE OF BASAL AREA FACTOR	77
4.4.4	DETERMINING THE BASAL AREA FACTOR OF YOUR THUMB	78

4.4.5	BITTERLICH SAMPLING ON SLOPED TERRAIN	78
4.4.6	BITTERLICH SAMPLING: ESTIMATION OF NUMBER OF STEMS	79
<b>4.5</b>	<b>DISTANCE BASED PLOTS</b>	<b>81</b>
4.5.1	CONCEPTS	81
4.5.2	EMPIRICAL APPROXIMATIONS	83
4.5.3	UNBIASED ESTIMATOR	84
<b>4.6</b>	<b>COMPARISON OF THE STATISTICAL PERFORMANCE OF FIXED AREA PLOTS, BITTERLICH PLOTS AND DISTANCE BASED PLOTS</b>	<b>84</b>
<b>4.7</b>	<b>NON-RESPONSE</b>	<b>86</b>
<b>4.8</b>	<b>TWO DIFFERENT APPROACHES TO POPULATIONS OF SAMPLE PLOTS</b>	<b>87</b>
<b>5.</b>	<b><u>SAMPLING TECHNIQUES</u></b>	<b><u>91</u></b>
<b>5.1</b>	<b>SIMPLE RANDOM SAMPLING (SRS)</b>	<b>91</b>
5.1.1	GENERAL OBSERVATIONS	91
5.1.2	RANDOM SELECTION	91
5.1.3	NOTATIONS USED	94
<b>5.2</b>	<b>STRATIFIED SAMPLING</b>	<b>97</b>
5.2.1	INTRODUCTION	97
5.2.2	STATISTICAL CONCEPT	98
5.2.3	NOTATION	99
5.2.4	ESTIMATORS IN STRATIFIED RANDOM SAMPLING	99
5.2.5	SAMPLE SIZE IN STRATIFIED RANDOM SAMPLING	101
5.2.6	SUMMARIZING	103
<b>5.3</b>	<b>SAMPLING WITH CLUSTER PLOTS</b>	<b>105</b>
5.3.1	INTRODUCTION	105
5.3.2	NOTATION	106
5.3.3	ESTIMATORS FOR SAMPLING WITH CLUSTER PLOTS	107
5.3.4	CAUTIONS IN CLUSTER SAMPLING	108
5.3.5	COMPARISON TO SRS	111
5.3.6	SPATIAL AUTOCORRELATION AND PRECISION	113
5.3.7	CLUSTER DESIGN PLANNING CRITERIA	115
5.3.8	AN EXAMPLE OF CLUSTER DESIGN OPTIMIZATION	115
<b>5.4</b>	<b>ADAPTIVE CLUSTER SAMPLING</b>	<b>117</b>
5.4.1	INTRODUCTION	117
5.4.2	GENERAL PROCEDURE OF SAMPLING WITH ADAPTIVE CLUSTER PLOTS	118
5.4.3	TERMINOLOGY	119
5.4.4	ESTIMATORS	120
5.4.5	CHARACTERISTICS OF ADAPTIVE CLUSTER SAMPLING	120
<b>5.5</b>	<b>SYSTEMATIC SAMPLING</b>	<b>123</b>
5.5.1	GENERAL DESCRIPTIONS OF SYSTEMATIC SAMPLING	123
5.5.2	SAMPLE SIZE IN SYSTEMATIC SAMPLING = NUMBER OF OBSERVATION POINTS	124
5.5.3	SOME ADVANTAGES OF SYSTEMATIC SAMPLING	125
5.5.4	SOME PREOCCUPATIONS WITH SYSTEMATIC SAMPLING	126
5.5.5	IMPLEMENTATION OF SYSTEMATIC SAMPLE SELECTION	126
5.5.6	THE VARIANCE ISSUE IN SYSTEMATIC SAMPLING	128
5.5.6.1	Empirical approximation of error variance	128
5.5.6.2	Employing the SRS estimators	128
5.5.6.3	Random differences method	128
5.5.6.4	Pair difference technique	129
5.5.7	CONSEQUENCES OF VARIANCE APPROXIMATION IN SYSTEMATIC SAMPLING	131
5.5.8	COMPARISON OF DIFFERENT GRID SHAPES IN SYSTEMATIC SAMPLING	131

<b>5.6 THE RATIO ESTIMATOR</b>	<b>132</b>
5.6.1 INTRODUCTION	132
5.6.2 NOTATION	133
5.6.3 ESTIMATORS	134
5.6.4 EFFICIENCY	135
5.6.5 CHARACTERISTICS OF RATIO ESTIMATOR	137
5.6.6 REGRESSION ESTIMATOR	137
<b>5.7 DOUBLE SAMPLING</b>	<b>138</b>
5.7.1 INTRODUCTION	138
5.7.2 DOUBLE SAMPLING FOR STRATIFICATION (DSS)	139
5.7.2.1 General remarks	139
5.7.2.2 Notation	139
5.7.2.3 Estimators	139
5.7.2.4 Examples of application	140
5.7.3 DOUBLE SAMPLING WITH RATIO OR REGRESSION ESTIMATOR	141
5.7.3.1 General remarks	141
5.7.3.2 Notations	141
5.7.3.3 Estimators	142
5.7.3.4 Overall efficiency	142
5.7.3.5 Examples of application	143
<b>5.8 LINE SAMPLING</b>	<b>143</b>
5.8.1 INTRODUCTION	143
5.8.2 LINE INTERCEPT SAMPLING	144
5.8.3 LINE INTERSECT SAMPLING	145
5.8.3.1 General remarks	145
5.8.3.2 Buffon's needle problem (1777)	145
5.8.3.3 Applications of line intersect sampling	147
5.8.3.4 Using sample lines as sample selection tools	148
<b>5.9 SAMPLING WITH UNEQUAL SELECTION PROBABILITIES</b>	<b>149</b>
5.9.1 INTRODUCTION	149
5.9.2 LIST SAMPLING = PPS SAMPLING	149
5.9.2.1 The Hansen-Hurwitz estimator	150
5.9.2.2 The Horvitz-Thompson estimator	152
5.9.3 BITTERLICH SAMPLING	155
5.9.4 RANDOMIZED BRANCH SAMPLING (RBS)	156
<b>6. SOME SPECIFIC ESTIMATION ISSUES</b>	<b>158</b>
<b>6.1 NOTIONS ON ESTIMATING CHANGES</b>	<b>158</b>
6.1.1 GENERAL OBSERVATIONS	158
6.1.2 PERMANENT PLOTS	159
6.1.3 GROWTH COMPONENTS	161
6.1.4 SAMPLING WITH PARTIAL REPLACEMENT	162
<b>6.2 ESTIMATING FOREST AREA</b>	<b>163</b>
6.2.1 GENERAL OBSERVATIONS	163
6.2.2 AREA ESTIMATION BY SAMPLE POINTS	163
6.2.3 AREA ESTIMATION BY LINES OR CLUSTERS OF POINTS	166
6.2.4 ESTIMATION OF LENGTH FROM THE ESTIMATION OF AREAS	168
<b>6.3 ESTIMATING THE LENGTH OF THE FOREST EDGE</b>	<b>168</b>
6.3.1 GENERAL CONSIDERATIONS	168
6.3.2 MAPPED PLOTS	169
6.3.3 LINE INTERSECT SAMPLING	170
6.3.4 COUNTING THE BORDER PLOTS	170

<b>6.4</b>	<b>ESTIMATING NUMBER OF SPECIES</b>	<b>171</b>
6.4.1	GENERAL OBSERVATIONS ON THE PROBLEM OF ESTIMATING NUMBER OF SPECIES	171
6.4.2	ESTIMATORS	172
6.4.3	THE ISSUE OF SPECIES IDENTIFICATION	173
6.4.4	SPECIES ESTIMATION IN LARGE AREA FOREST INVENTORY	174
<b>7.</b>	<b><u>PLANNING ISSUES IN FOREST INVENTORIES</u></b>	<b>176</b>
<b>7.1</b>	<b>PLANNING A FOREST INVENTORY</b>	<b>176</b>
7.1.1	INTRODUCTION	176
7.1.2	“GOOD” FOREST INVENTORY	176
7.1.3	PROCEDURE OF PLANNING	177
7.1.4	FIELD TEAMS	178
7.1.5	FOREST INVENTORY REPORTING	179
7.1.6	SOURCES OF ERRORS	181
<b>8.</b>	<b><u>THE UN-FCCC AND ITS IMPLICATIONS FOR FOREST MONITORING</u></b>	<b>183</b>
<b>8.1</b>	<b>INTRODUCTION</b>	<b>183</b>
<b>8.2</b>	<b>IPCC</b>	<b>183</b>
<b>8.3</b>	<b>UN-FCCC</b>	<b>184</b>
<b>8.4</b>	<b>CONFERENCE OF PARTIES (COP)</b>	<b>184</b>
<b>8.5</b>	<b>MRV</b>	<b>185</b>
<b>8.6</b>	<b>THE KYOTO PROTOCOL</b>	<b>185</b>
<b>8.7</b>	<b>EMISSIONS TRADING</b>	<b>186</b>
<b>8.8</b>	<b>JOINT IMPLEMENTATION (JI) AND CLEAN DEVELOPMENT MECHANISM (CDM)</b>	<b>186</b>
<b>8.9</b>	<b>ADDITIONALITY AND LEAKAGE</b>	<b>187</b>
<b>8.10</b>	<b>REDUCING EMISSIONS FROM DEFORESTATION AND FOREST DEGRADATION (REDD)</b>	<b>187</b>
<b>8.11</b>	<b>REDD AND REDD+</b>	<b>188</b>
<b>8.12</b>	<b>FOREST MONITORING IN THE UN-FCCC CONTEXT</b>	<b>189</b>
<b>8.13</b>	<b>ROLE OF REMOTE SENSING</b>	<b>191</b>
<b>9.</b>	<b><u>LITERATURE CITED</u></b>	<b>192</b>
<b>10.</b>	<b><u>SELECTED TEXTBOOKS</u></b>	<b>197</b>



# 1. Introduction

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## 1.1 Background and objectives

It is well known that forests play an important role for biodiversity, for livelihoods and for local and national economies. Regardless of whether one looks at forests primarily as an ecosystem or as a resource – planning data is required for “informed decisions” in forest management, forest conservation and forest policies. In general, basic data and information are required when a renewable natural resource – such as forest – is to be managed sustainably. Eventually, there is quite some truth in the saying “If you cannot measure it you cannot manage it”.

*Forest inventory* is the activity of data collection that helps generating the required information base of the forests within a defined area of interest. Commonly, forest inventories are organized as projects with a defined duration.

The term *forest monitoring* is used in a wider sense and does commonly embrace the observation and assessment of status and changes. Forest monitoring systems have a long-term character, are organized as programs and embrace repeated implementations of forest inventories.

Information requirements regarding forests are as manifold as are the interests in forests which may basically be viewed (1) as a resource (people-centered) and (2) as an ecosystem (nature-centered). Parties interested in information on forests are above all decision makers and researchers in forestry and related fields. Forest owners, forest managers and forest politicians are those who demand information about the forest resource, but also regional planners and the wood industry; and conservation biologists, ecologists and tourism managers may be interested in forest ecosystem information. Once the group of actually and potentially interested parties can clearly be identified, it is straightforward to plan an inventory according to their expressed needs and expectations. In some cases – and in particular in large area forest inventories - one needs to plan an inventory in a flexible manner so that many different potentially interested users are addressed – without yet knowing all of them and their needs exactly from the outset.

Experience of the past decades has shown that the expectations towards forest inventories are getting wider and wider. The traditional forest inventory that focuses only and exclusively on timber production is, of course, still in use in forest plantation companies where trees are very intensively managed much like agricultural crops. However, forests are more and more managed for multiple services and functions, which is also reflected in the range of topics that are addressed in forest inventories. In some regions, forest inventories have developed towards tree inventories including also non-forest lands, or even to comprehensive land use assessments.

These lecture notes shall give you an insight into forest inventory from an implementation point of view and also from a research point of view. The major part of the lecture and the lecture notes is on sampling and plot design, which is applied statistics. The principles of statistical sampling are not only relevant in the forest inventory context but in any other empirical discipline as well; it has largely to do with statistical methods of empirical research.

The lecture notes shall help you to understand the principles of forest inventories. You should be able to plan your own inventory in a methodologically sound manner and according to statistical principles. You should know how to write good inventory reports but also how to critically read inventory reports of others, and how to ask the right and relevant questions.

A most important point eventually is that you should never look at a forest monitoring exclusively from the mere technical point of view (on which we are actually focusing in this lecture!), but you should clearly recognize that forest monitoring does always serve a specific goal and is always embedded in decision processes, generating information in order to – in the ideal case – facilitate what is called informed decisions.