FORESTS FOR UNIVERSITY EDUCATION: EXAMPLES AND EXPERIENCES

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PREFACE I

The SILVA Network aims to improve forestry and forest science education through facilitating discussions between teaching institutions, teachers and learners in these fields. The SILVA Network uses mainly two means to reach its aim: annual conferences and the proceedings based on them.

A relatively large number of members of the SILVA Network participated in this meeting in Prague, Czech Republic, in June 2017. Also three East Asian universities and two potential members from Europe participated. This resulted in quite a number of presentations and in intensive discussions. Not only in-forest education in university forests was presented, other solutions presented showed the creative thinking of universities to ensure in-forest education. We, the editors, are sure every participant learned about aspects that are useful when active in teaching and organising teaching at home.

The excursion to Kostelec na Černými Lesy, a small town where the centre of the Prague University forest estate was educative, showing its broad activities in forestry and forest based industry. The visit to the castle belonging to this forest estate was the cherry on the cake of the excursion.

Thanks and tribute to the Faculty of Forestry and Wood Sciences at the Czech University of Life Sciences, Prague, and its staff members for hosting this meeting and for organising the excursion to Kostelec na Černými Lesy.

Thanks also to Martin Ziesak, Mika Rekola and Gerhard Müller-Starck, who, in cooperation with the editors, reviewed the papers presented here.

The third party we would like to thank are the authors of these papers. Without these speakers, authors and the reviewers these proceedings would not exist.

The editors

PREFACE II

Forests play a crucial role in preserving terrestrial biodiversity, producing renewable raw materials, and in reducing the scale and impact of climate change. Proper forest management is therefore crucial for today's society.

For these reasons, forestry education is no less important because its aim is to educate highly qualified professionals capable of meeting current challenges. Forestry education has already had a relatively rich history, in many European countries over 100, even 200 years.

A very important role in forestry education has always been played by the forest itself, which has been the place of teaching and the largest research laboratory. However, given the rapid advances in science and technology development, it is necessary to redefine the place and importance of the forest for university forestry education at present.

A very important opportunity was the annual conference of the SILVA Network, which took place in June 2017 at the Czech University of Life Sciences Prague. Forestry education has a long tradition in Prague; regular forestry lectures were started at the Polytechnic University already in 1848. The independent school for Master's in Forestry was established in 1919. Nowadays the Faculty of Forestry and Wood Sciences provides a comprehensive forestry education system, encourages and supports by research rational forest management and sustainable use of its huge natural resources. The faculty has become a respected international research centre.

It was great honor for us to organize this important conference, gain valuable insights and experience from colleagues from different countries of Europe, China, Mongolia and Japan. We were pleased to present to our colleagues the University Forest Enterprise that is the basis for practical teaching as well as forestry research.

Jiří Remeš
Vice-Rector for Education
Czech University of Life Sciences Prague

Participants of the annual conference of the SILVA Network in Prague, Czech Republic, in June 2017.

CONTENTS

SUMMARY

PIETER SCHMIDT

In-forest education, i.e. learning and teaching in the forest, plays an important role in forestry education at both universities as well as at universities of applied sciences. We make the statement that forestry education can not really exist without in-forest education. Universities have solved this problem in quite a number of ways. Some own forests themselves, some have arrangements with forest owners, some sought and fond other solutions. SILVA Network judged it important enough to dedicate an annual conference to this theme. A summary of the thirteen papers presented on this topic is given below.

Introduction

For academic education in forest science a direct access to forests is essential. According to MARTIN ZIESAK, this is likewise true for both universities and universities of applied sciences. SILVA Network had during their conferences touched this simple but important fact often and in various ways. Moreover, very often the excursions, an essential part of the SILVA Network conferences, were conducted at university forests or were visiting forest stands, where universities would realise their education. However, up to no now, the various ways how universities realise and manage their access to forests was not yet made a subject of discussion. Martin Ziesak expects that the wide field of questions under this topic is very well reflected in the contributed presentations.

Teaching forests owned by universities

In their paper, GERHARD MÜLLER-STARCK, STEFAN FRIEDRICH and THOMAS KNOKE depict the situation at the Technische Universität München (TUM), which uses during its forestry education two forest sites[1] owned by the Ludwig-Maximilians-Universität, München, to which institution these forests were originally donated. They summarize the site conditions and the forest inventory, partly based on students' contributions, as well as guidelines for current and future forest management. Actually, a chairholder at TUM is responsible for the management.

[1] PS: The excursion organised during the SILVA Network Annual Conference 1996 in Freising visited one of these two forests.

The authors conclude from their experience that university forests can supply manifold opportunities for teaching and training. In addition, they can be utilized efficiently for corresponding research projects. These forests bridge the gap between academic educational targets and actual practice. Interdisciplinary issues, research networking and links to the job market are significant requirements as well. Direct ownership by the respective university or by any other educational institution helps substantially to realize objectives in teaching and research. In the case of external ownership, long-lasting contracts and flexible management regulations, which grant scientific and educational liberties, are essential.

JIŘÍ REMEŠ describes the situation at the Faculty of Forestry and Wood Sciences of the Czech University of Life Sciences Prague. This university owns since 1935 a Forest Enterprise[2], including a castle. After describing the natural conditions and the forest composition, he discussed the organizational structure of the enterprise and the main activities. The director of the forest enterprise is subordinated to the Vice Chancellor of the University. The faculty can influence management decisions, especially the ones relevant for teaching and research in forestry. The enterprise comprises specialized centres, such as a Forest Management Centre, a Wood Processing Centre, a Nursery Activity Centre, an Aquaculture and Game Keeping Centre, and the Castle (for services – accommodation, conferences, social events etc.). These facilities have sometimes public functions, too. However, the number of these activities is stagnating or declining in recent years. Therefore it is necessary to seek a new financing model and start work on the modernization of the facilities and equipment.

In Slovakia, the University Forest Enterprise (UFE) is, according to ZUZANA PAROBEKOVÁ and MILAN SANIGA, a special-purpose facility at the Technical University in Zvolen (TUZVO). The forest land fund is composed of state-owned forest land as well as forest properties of other owners. Forest plant communities of the UFE belong to five altitudinal vegetation zones. Due to varied natural conditions, it is possible to apply several silvicultural systems, among which shelterwood and selection systems are pre-dominant.
The UFE is aimed at the practical education of students, scientific research associated with all forestry activities, demonstration objects, and management of the forest fund. It is thus possible to demonstrate several aspects of forestry such as forest management, management of forest reproductive material, silviculture, logging operations, forestry constructions

[2] PS: The excursion organised during the SILVA Network Annual Conference 2017 in Prague visited this enterprise.

and ameliorations, landscape management, game management, fishery, and beekeeping. To follow these goals, 67 permanent research plots, 18 temporary plots, and 103 demonstration objects are currently maintained at the territory of the enterprise, all connected to the network of excursion and demonstration paths.

VAIKE REISNER, HARDI TULLUS and TANEL PIIR consider it essential to combine the theoretical part of forestry education with practice in a natural environment. Hence, practical training, which is carried out at the Foundation Järvselja Experimental and Training Centre[3], is included in a number of courses at the Estonian University of Life Sciences. The centre covers about 10,500 ha, of which is about 6,500 ha is forest (2700 ha is protected) and 3,100 is bog. It has a complete infrastructure for accommodation and catering.
Every year Estonian forestry students have various practical training courses in Järvselja, sometimes in summer, but also in winter. Also every year some graduation theses are defended on themes done in Järvselja forests. Forests in Järvselja are used to carry out several research projects, too. The big challenge here is the large distance from any town, causing problems to find personnel and the meagre possibilities for the entertainment of students being educated here.

According to TOSHIAKI OWARI, NAOKI YASUMURA, SEIJI ISHIBASHI, SHIGEHIRO KAMODA and HARUO SAITO, the University of Tokyo (UTokyo) owns the oldest university forest, established in 1894. The University of Tokyo Forests (UTF) has an own mission statement: to provide in-forest education for forest science, and to promote advanced research in forestry. The UTF consist of seven branch stations with a total area of over 32,000, ha spread over Japan to cover ecological and social and forest management conditions.
The authors describe the forestry education at UTokyo, both at BSc, MSc and PhD level with special attention to courses given at UTF. Recently, UTF offers its educational activities to all students from UTokyo by holding university-wide hands-on experience seminars combined with field studies. The seminars involved often create a favourable impression of forest science in students, who then pursue studies in the Faculty of Agriculture. The Hands-on Activity Programme is another university-wide educational activity offered by UTF. The programme was initiated in 2012 at UTokyo and is a specially designed project whose basic principle is to expose

[3] PS: The excursion organised during the SILVA Network Annual Conference 2016 in Tartu visited this centre.

undergraduate student to lifestyles and sets of values different from their own.

In a separate paper, NAOTO KAMATA describes the possibilities the University of Tokyo Forests (UTF) can offer to Japanese and foreign students for thesis' research. A large dataset accumulated since the start in 1894 in the seven forests owned by UTF under various conditions and in a number of forest management options, and quality teachers engaged by UTF are the 'environment' for these students. Students can stay at UTF lodges for a modest fee. Traditionally, students from neighbouring countries in Asia came to UTokyo and UTF, but recently students from Europe are participating as well. The unique culture of Japan – with its traditional features and more modern ones, like manga – are fascinating for European students.

In-forest teaching not in university forests

According to PIETER SCHMIDT, increasing attention for wood production in the Netherlands lead to the necessity for owners of forest and nature areas to renovate the knowledge and experiences in silviculture and forest management among their staff and work force. Contacts between the main forest owner (the State Forest Service, SBB) and education institutions on three (vocational, applied science university and university) levels led to an agreement concerning the long-term use of three forest areas as educational forests. Important considerations were the fact that forestry is a long-term activity and that students should be able to test the topics taught in reality. These forest should be used to educate forest owners and their personnel, too. SBB is responsible for the management (how free are the schools to study new treatments?) and for the management costs, schools are responsible for the costs of education and research. Both SBB and the schools have to get used to this situation and invest more energy, manpower and thus funding into this recent cooperation.

Although the School of Agricultural, Forest and Food Sciences (HAFL, Hochschule für Agrar-, Forst- und Lebensmittelwissenschaften) in Zollikofen (Switzerland) uses in-forest education extensively, HAFL does neither possess own forest area nor does it have a land-lease or other long-lasting contract providing forest access. HAFL uses other strategies to solve this problem. MARTIN ZIESAK, CHRISTIAN ROSSET and JEAN-JACQUES THORMANN describe a number of them. For the marteloscope near the

university[4] exists an oral agreement with the forest owner (Bern Township) to leave it without intervention for the next three years. Moreover, HAFL established more than 35 plots again in the Bern forests for silvicultural permanent plots. Additionally a training trail for tree measurements was arranged, all based on oral agreements. For teaching forest operations and work science agreements with private or state forest enterprises are used.
The authors conclude that this approach is successful, however, it may be advisable for the future, to put these oral – hence more or less non-official – agreements into bilateral permanent (written) agreements.

According to JUNCHANG LIU, university forests in the People Republic of China play an important role in forestry education and scientific research as well as in public education for people to gain knowledge of forests. These university forests can also provide social services, such as camping site and recreation facilities. People can walk into the university forests to enjoy nature and relax.
Beijing Forestry University (BFU), the largest university aimed at forestry education in P.R. China, is described in detail. To cover ecological variation in this large country, it cooperates with more than ten 'educational forest bases' in a number of cooperation formats. One tree farm is owned and managed by the university, two forests are contracted by the university, which is paying for the services supplied. Moreover, more than ten forests are contracted without funding but with technical support by the university.
The problem for BFU is that managers of contracted and paid forest bases are more interested in and hence taking decisions in favour of earning money on the market than in education aspects of BFU. Also even the forest bases are not interested any more in making these contracts. The author proposes to establish a union of university forests, to strengthen the relation with the forest bases and to strengthen the relationship between Academia and the industry.

Other possibilities for in-forest education

SIEGFRIED LEWARK describes the situation at the University of Freiburg (Germany). Although this university owns and manages a university forest Mathislewald[5] in the Black Forest, he concentrates on forestry education in the direct environment of Freiburg with its great forest diversity. These

[4] PS: The excursion organised during the SILVA Network Annual Conference 2014 in Bern visited this forest.
[5] PS: The Mathisle-Mühle in this forest was the location of the SILVA Network Annual Meeting in 1992. The other forests mentioned were visited during the SILVA Network Annual Conference 2007.

forests, one of the reasons to select Freiburg as location for forestry education, today mostly belong to the City of Freiburg and the State of Baden-Württemberg. They are suitable for learning experiences in virtually all subjects of the forest related study programmes and have been extensively used all the time. Good relationships have been maintained between the staff of the forest management and the teaching personnel of the university and are a pre-requisite for good teaching and learning possibilities. Based on his personal experiences as student and teacher, the author concludes that for in-forest learning it does not necessarily need university owned forests.

As part of the programme BA Forest Engineering at Hochschule Weihenstephan-Triesdorf (University of Applied Sciences), Department of Forestry, a Forest Training Trail (FTT) was established. This trail is located in the nearby training forest, owned by the Bavarian State Forest, to complement the curriculum with a strong focus on applied training in the field.
According to CARSTEN LORZ and MARTIN HECKNER, the core of the FTT are (i) the trail itself with several sites with different focus and (ii) a questionnaire. Every semester a new trail at a new site within the training forest is set up. Usually, the trail encompasses four to six stations, each station representing a thematic focus of the training in the BA "Forest Engineering", vegetation, silviculture, hunting, environmental protection, soil or other aspects. The students form teams of three and walk the FTT with a questionnaire and a map of the trail. After the deadline for handing in the questionnaires a sample solution of the FTT task is published on the faculty homepage in order to give students an opportunity for a self-feedback.
The results of the regular evaluation show a high acceptance by the students. The authors' conclusion after four years of experience with the FTT is that the design as competition and game including a trophy resulted in a very high acceptance and participation with joy.

Presentation of universities

DAVID SÍS stated that the Mendel University in Brno has a rich, 100 years old history. From the beginning two main faculties, the Agricultural Faculty and the Forestry Faculty, existed. During the following century, among other things influenced by political developments, faculties were added to or separated from the central core of agriculture and forestry. In 1995 this university adopted the name of Mendel University. Nowadays the Faculty of Forestry and Wood Technology is the centre for forest, wood, furniture

university education and research. There is rich cooperation with foreign faculties. The faculty contributes a Master study programme European Forestry, completely taught in English. Important parts of the in-forest training are given at the Training Forest Enterprise Masaryk Forest Křtiny.

Evaluation of in-forest teaching

A Helsinki University field course "Forest and peatland ecology", organised in June 2017 at the Hyytiälä field station of the university, was subject of a study using qualitative text analysis of students' learning diaries as a main source of data. According to MIKA REKOLA, students' self-regulative knowledge was explored and found rather limited which is in line with some earlier literature. Teaching methods during the course were evaluated very positively by students. One of the main results was that the more activating teaching methods were perceived more positively. Learning diaries included a few negative evaluations and these can be seen as a valuable source of feedback. It is concluded that the field course is an extremely relevant method in order to achieve professional knowledge in forest sciences. The recommendations for future teaching planning are that more emphasis should be put on communicating learning aims, modern learning technology, and finally, critical self-regulation knowledge.

Concluding remarks

With thirteen different presentations a good overview of the possibilities and extensive considerations of this topic were given. According to MARTIN ZIESAK in the concluding remarks the importance of educational forests for academic forest science institutions was very distinctly accepted, without choosing between the great number of legal, managerial and organizational solutions.

INTRODUCTION

MARTIN ZIESAK

For academic education in forest science a direct access to forests is essential. This is likewise true for both universities and universities of applied sciences. SILVA Network had touched this simple but important fact often and in various ways. Conference topics indicated a loose link to this element, such as in our symposia in Wageningen (2005, “Forestry education between science and practice”. See Schmidt and Bartelink, 2006), Zollikofen (2014, “Practice orientation in forestry curricula in universities and universities of applied sciences. See Schmidt *et al*., 2016b)) or in Vienna (2015, “Should all forestry students learn the same? Generalist or specialist approaches”. See Schmidt *et al*., 2016a). Moreover, very often the excursions, an essential part of the SILVA Network conferences, were conducted at university forests or were visiting forest stands, where universities would realise their education.

However, up to no now, the various ways how universities realise and manage their access to forests was not yet made a subject of discussion. The wide field of questions under this topic is very well reflected in the contributed presentations. A first group of presentations will cover the question on how to get access to forests. This includes situations, where universities are legal owners of forest areas of very different size classes, but also incorporates situations, where universities must get along without having property and must realise other solutions. A second group of presentations focuses on how the education itself can utilise and valuate such forests, like the establishment of “training circuits” or marteloscopes. Finally, in a third group, several management questions around these forests are discussed.

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Schmidt, P., Hasenauer, H. and Lewark, S. (Eds.), 2016a: Should all forestry students learn the same? Generalist or specialist approaches. SILVA Network Publications 13

Schmidt, P., Lewark, S., Müller-Starck, G. and Ziesak, M. (Eds.), 2016b: Practice orientation in forestry curricula in universities and universities of applied sciences. SILVA Network Publications 12

THE FOREST OF THE LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN: SERVING TEACHING AND RESEARCH

GERHARD MÜLLER-STARCK, STEFAN FRIEDRICH, THOMAS KNOKE

Abstract
In this study, the historical peculiarities and the site conditions of the forest of the Ludwig-Maximilians-Universität, München, Germany, are surveyed. Results from an extended forest inventory, which includes students' contributions, are summarized. Guidelines for current and future forest management are also discussed.
The university forest supply manifold opportunities for teaching and training. In addition, they can be utilized efficiently for corresponding research projects. These forests bridge the gap between academic educational targets and actual practice. Interdisciplinary issues, research networking and links to the job market are significant requirements as well.
Direct ownership by the respective university or by any other educational institution helps substantially to realize objectives in teaching and research. In the case of external ownership, long-lasting contracts and flexible management regulations, which grant scientific and educational liberties, are essential.

Keywords: University forest, in-forest training, forest inventory, forest management, teaching, internship, research projects, ownership.

History and site

During secularization, the forests of the Monastry of Seligenthal (Landshut) were assigned to the Ludwig-Maximilians-Universität München (LMU) by the Elector Maximilian Joseph, ("Kurfürst") in the year 1802. During the 19th century, parts of this university forest were sold. The remaining area amounts to a total of 478 ha (432.5 ha woodland).

This university forest today serves as a learning tool for students, particularly of the Study Program Division Forest Science & Resource Management, Technische Universität München (TUM). It is also utilised for research projects. The forest (see Figure 1) consists of two parcels, i.e. "Bocksberg" (87.8 ha woodland), and "Klosterholz" (344.7 ha woodland), situated 6 km from each other. Even after the transfer of the Faculty of Forest Science from LMU to TUM, this forest is still owned by LMU and managed independently from the State Forest Service. It is

supervised by personnel of the Study Programme Division Forest Science & Resource Management, currently Prof. Dr. Thomas Knoke, (TUM).

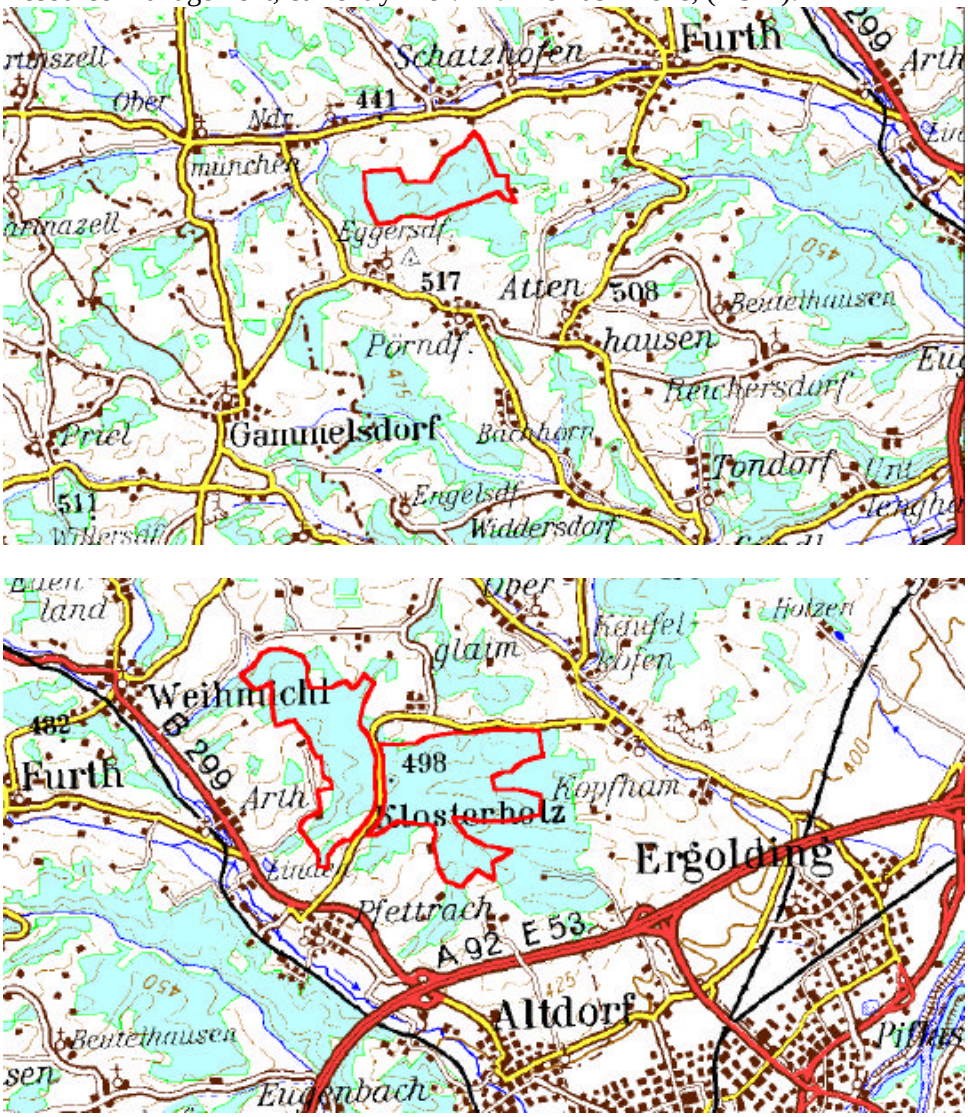

Figure 1: Location of the forest sections “Blocksberg” (above) and “Klosterholz” (belowright), 50 km northeast of Munich nearby the town of Landshut. Forests are encircled in red.

The university forest geographically belongs to the zone of the “Tertiäres Hügelland“. The regional natural forest vegetation is part of the Fagus-Abies forest zone. There, temperatures are slightly higher than the Bavarian mean values and precipitation is lower: average annual temperature is 7.8 °C (15.7 °C during vegetation period), annual precipitation is 700 mm (280 mm during vegetation period). On sandy soils, water can become a minimum factor. Still, site conditions offer excellent growing conditions for Norway spruce.

Forest inventory and management

In both districts, the university forest consists of stands of various deciduous and coniferous tree species, among which Norway spruce (Picea abies) is the predominant species (see Figure 3). Most of the species are represented in a large variety of age classes. In Figure 2, the complexity of stand structures is illustrated by the example of “Klosterholz”.

In most of the operations which deal with the inventory and the management of this complex university forest, students are involved. This input is a significant part of in-forest training of students (see subsequent chapter).

The impacts of forest management on the species composition are substantial. These impacts are illustrated by contrasting the results of an inventory in the year 2002 with those of the subsequent one in 2016 (see Figure. 3).

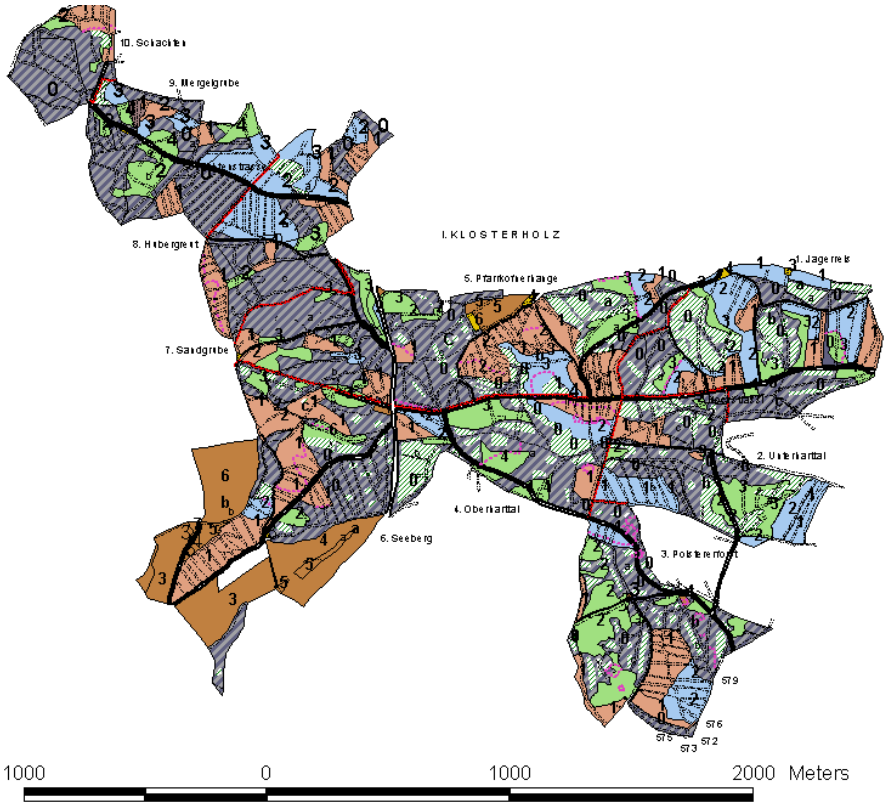

Figure 2: Forest planning map of the “Klosterholz” illustrating the small scale treatment units. Hatching indicates the oldest units.

A substantial reduction of the portion of Norway spruce is clearly indicated, when the value of 46.3% from 2016 is compared to the value of 59.3% from 2002 (Friedrich *et al*., 2017). This is a remarkable change within a time interval of only 14 years. Pine and Larch species reveal only small reductions in their respective areas, whereas Douglas fir (Pseudotsuga menziesii) and Silver fir (Abies alba) have a higher share of the forest area. Generally, deciduous tree species benefit from the reduction of the portion of Norway spruce. This is especially true for European beech (Fagus sylvatica).

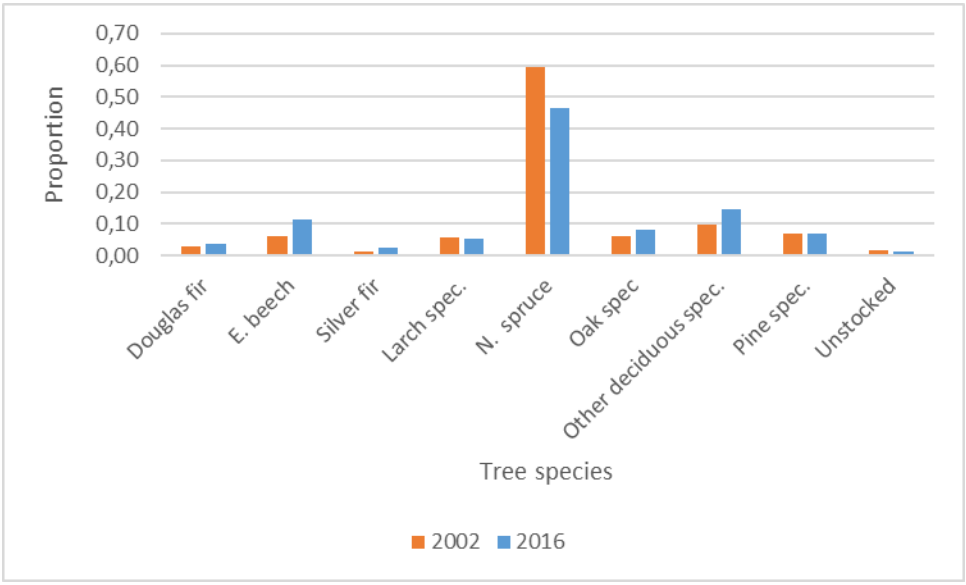

Figure 3: Proportions of tree species in the university forests ("Blocksberg" and "Klosterholz" together) in the years 2002 and 2016 (adapted from Friedrich *et al*., 2017).

Figure 3 demonstrates the change in the silvicultural treatment of the university forest. There an abandoning of a management strategy concentrating on spruce towards one which is intended to adapt to climate change with a broader portfolio of tree species is evident. Two strong drivers behind these changes were the high volumes of unplanned harvests due to storm damages and the ensuing bark beetle infestations.

Another trend concerning forest management in the university forest pertains to the distribution of the age classes of the forest stands. Again, the situations of 2002 and 2016 are taken into consideration. Figure 4 illustrates dynamics with respect to seven age classes, each of which is comprised of 20 years. Within the total of 140 years, changes are evident in terms of a decreasing representation of classes six and seven (100-140 years) and an increasing representation of the middle age classes, following utilization.

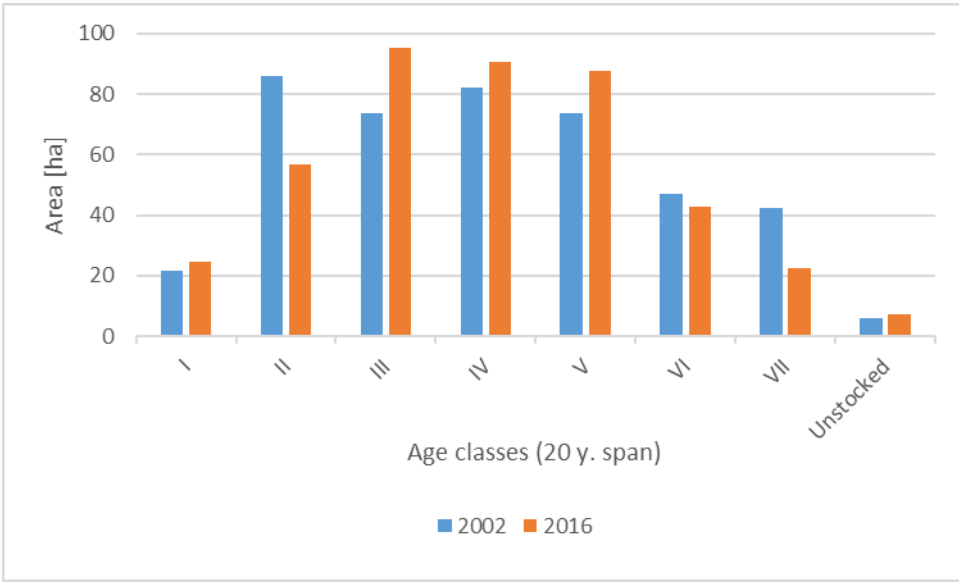

Figure 4: Distribution of age classes in the university forest (“Blocksberg” and “Klosterholz” pooled) in the year 2002 in contrast to 2016 (Friedrich and Knoke, 2017).

In more detail, the increment and mode of forest utilization within the time interval of 2002-2016 was assessed as follows (timber without bark):

- Change in standing volume: -52 m^3ha^{-1} to a total standing volume of 333 m^3ha^{-1}
- Extraction and natural losses: 13,4 m^3 ha^{-1} year-1
- Increment: 9,6 m^3ha^{-1} year-1

The financial situation is beneficial for LMU because of extensive wood extraction, even despite the high volume of unplanned harvests. The financial yield since 1978 is 4.4 m. Euro, i.e. on average 277 Euro per ha per year. The corresponding value for the interval 2003-2015 is 405 Euro per ha per year. In the year 2015, 970 Euro per ha were achieved.

The investments in regeneration are low because Silver fir and Norway spruce are regenerated naturally. European beech and Douglas fir are planted only for completion of stands (actions taken in response to severe damages following windthrow and bark beetle infestation).

Teaching and research

The university forest is utilized in various ways:

Excursions and training courses
Regularly, students of the TUM School of Forest Science and Resource Management make themselves familiar with the silvicultural challenges, caused by

a small scaled forest structure with uneven aged stands of different deciduous and coniferous species. When taking related fields such as hunting into consideration, Forest Management is often a major topic of discussion. Excursions and training courses form significant elements of in-forest teaching and thus underline the necessity of the practice of incorporating forest curricula as claimed by Schmidt *et al*. (2016). Consequently, the access to training grounds provided by universities and demonstration forests is essential. For corresponding perceptions of the TUM School of Forest Science and Resource Management see Weber and Müller-Starck (2016).

Involvement of students in forest inventory and planning
In most of the actions which deal with the inventory and the management of this complex university forest, students are involved. The forest inventory was conducted by professionals and assisted by students. Management strategies are developed with input from Master's and Bachelor's theses. These actions play a significant role in the in-forest training of students.

Examinations and theses (Bologna Cycles 1-3: BSc, MSc, PhD)
Exams are regularly held in the subject of "Forest management" twice per year. Silvicultural courses are given five times per year.
Four recent Bachelor´s theses deal with forest operations like thinning or regeneration (1), an economic analysis of the stock of dead wood (1) and with tending strategies in stands of Fagus sylvatica (2).
Four ongoing Master´s theses address the enhancement of forest inventory methodology and one completed thesis tested regression models for regeneration on the inventory's data set. Currently, three PhD theses deal with this university forest, using data gained from the permanent and intensive forest inventory in economic models.

Research and corresponding networking
The owners and managers of the university forest provide open access to information concerning natural and financial data for research. This is done especially well in comparison to other public or private forest enterprises where data will not be released. Researchers therefore find good prerequisites for studies in the university forest. One example is the potential of carbon sequestration in existing forests (Knoke and Weber, 2006).

Current research projects deal with seeding experiments (Fagus sylvatica in cooperation with the University of Göttingen) and the testing of non-indigenous tree species (Cedrus libani, Juglans spec.). In addition, percolating water in forest soils is a focus in this research (cooperation with TUM/Hydrology). Research networks deal with renewable energy projects (wind). The results from research projects and monitoring data are communicated to representatives of governmental and non-governmental institutions and forest management collectives such as the Bavarian Forest Society and the German Forest Society.

Conclusions

The university forest, which consists of two parcels, is relevant for teaching in various ways: TUM study programs benefit from its peculiarities (species richness, small scaled structure) and the opportunities it presents for in-forest teaching. Thus, the practical relevance of forestry curricula is underlined. Moreover, forest management is flexible, therefore challenging silvicultural concepts such as modification of the species composition and the age class distribution can be tested. Corresponding research projects are expected to stimulate teaching and to increase the benefits of this forest for the university. During the near future, more effective and less time consuming methods of forest management planning will be the focus.

The uncommon arrangement of ownership by the LMU and management by the TUM does not interfere with the benefits of this forest for teaching and research. In this forest, management is granted a large amount of liberty by the university forest's owner (represented by the financial board) and is not restricted as could be the case when the ownership of a university forest delegates management to a second party. The LMU/TUM forest constellation supplies the necessary degree of freedom in order to optimize the utilization of this university forest for students, researchers and people who are included in corresponding networks.

University forests must be efficient in order to connect academic educational targets with practice. Criticism from forestry practice is well known. It includes statements such as: teaching and the resulting competence of graduates is too theoretical and too far removed from the practical situations of working life. In-forest teaching and active participation in forest management tasks will efficiently help to close such gaps. In addition, contact with representatives of governmental and non-governmental institutions and enterprises, respectively, via the university forest will promote links to the job market.

Generally, any constellation of ownership and management of university forests needs long-lasting contracts and flexible management regulations.

Acknowledgements
We greatly appreciate the proof reading by Michael Du.

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THE UNIVERSITY FOREST ENTERPRISE IN KOSTELEC NAD ČERNÝMI LESY – A BASIS FOR PRACTICAL EDUCATION AND RESEARCH AT THE FACULTY OF FORESTRY AND WOOD SCIENCES IN PRAGUE

JIŘÍ REMEŠ

Abstract
The paper presents the University Forest Enterprise, established in 1935, as an important part of the Czech University of Life Sciences Prague. The contribution also describes the natural conditions of the enterprise (altitude, climate, geological and soil condition) and the species composition of the forests. Attention is also paid to the organizational structure of the enterprise and to the main activities, being carried out there. These are focused on education and research. However, the number of these activities is stagnating or declining in recent years. Therefore it is necessary to seek a new financing model and start work on the modernization of the facilities and equipment.

Key words: University Forest Enterprise, Kostelec nad Černými lesy, Czech University of Life Sciences Prague, forestry practical, education, research.

History of the University Forest Enterprise in Kostelec nad Černými lesy

The University Forest Enterprise (UFE) was founded in 1935 as a facility of the College of Agricultural and Forestry Engineering of the Czech Technical University in Prague. The state forest administration of Kostelec nad Černými lesy, originated from Liechtenstein's estate in 1933, became the base of this school enterprise. The forests of Kostelec n. Č.l. was chosen for their variegated natural conditions and healthy forests (Šrámek, 1985).

At present, the University Forest Enterprise is run as a self-supporting enterprise and forms one of the two similar facilities of the University of Life Sciences Prague. The present state of its forest area originates from the changes after 1990 as consequence of the restitution processes. The University Forest Enterprise covers an area of 5,700 ha of forests, detailed land data are shown in Table 1.

Location
The region of the University Forest Enterprise, situated 25-50 km from Prague in SE direction, forms a part of the Středočeská pahorkatina geomorphology system (in an area 6,328 km2 situated in the middle and northern parts of South Bohemia along both banks of the Vltava River. The area is located at an altitude of 250 to 729 meters), bordering on the lowland of Polabí in the north, which is part of Česká křídová tabule. The forests are situated in the natural forest region Středočeská

pahorkatina (Central Bohemia Upland), only an inconsiderable area in the north is part of the natural forest region Polabí (Lowland). The altitude of this area varies between 300 and 527 m.

Table 1: Land data review of the UFE (area in ha, state in 2015)

	Agricultural land	**Forest land**	**Ponds**	**Build-on area**	**Total**
State forest (CULS Prague)	38	5681	77	40	5835
Of which classified as Natural Reserve		674		2,5	677
Rented private and municipal forests	3	852			854
Total	41	6533	77	40	6690

Climate conditions
The locality is characterised as warm climate region (B), slightly warm, slightly humid upland climate district, with a mild winter (B3), with average temperatures 8.5-9°C, mean annual precipitation 650 mm. The vegetation season lasts 150-160 days. However, in recent years very dry periods negatively affected the vitality of the forests. Annual precipitation reached only 563 mm (2014), 451 mm (2015) and 509 mm (2016).

Natural conditions
The geology of this region is very manifold. Perm and Carbon are prevailing – conglomerates, arkoses, sandstone, bony coal, shale, breccia. The Central-Bohemia pluton forming bedrock of the south-western part of the University Forest Enterprise is also present in many places represented. It is mainly biotite-porphyric granodiorite. Large grains of orthoclase are typical for this rock. Pleistocene's clays, mostly loess, are less important, nevertheless they are good bedrock from the soil forming viewpoint.

The soil – result of weathering of the rock mentioned above – are very varied in physical aspects – from the large boulder detritus to clay-sand and clay soils, mostly acid, lower nutrient supply, Chemically favourable soils are situated in the valley at the base of slopes , often with gley soils. The mesotrophic cambisol representing about 33.6 % of the forest soil is the most frequent type in the UFE, followed by oligotrophic cambisol (brown forest soil – 28.3 %), and pseudogley (15.2 %); whereas alluvial soils (3.0 %), eutrophic cambisol (2.6 %) and podzol (1.1 %) are less important. Other soil types represent less than 1 %.

The present tree species composition is very different from the natural one. In the last two centuries forest management affected the tree species composition in favour of the most-productive tree species (Norway spruce and Scots pine, see Table 2).

The natural conditions can be described by classifying the forests into forest vegetation zones (Table 3). Most sites belong to the second, third and fourth

vegetation zones which were dominantly formed by oak and beech. In addition, silver fir had earlier a significant presence in the local forests, especially on the water-affected sites.

Table 2: Present species composition of the UFE forests

Species	%%
Norway spruce	49.78 %
Scots pine	18.15 %
European larch	4.35 %
Silver fir	1.64 %
European beech	11.65 %
Oaks	8.86 %
European hornbeam	1.12 %
Black alder	1.04 %
Other species	3.41 %

Table 3: The forest vegetation zones and their characteristics in the UFE forests

No.	**Name**	**Altitude m a. sea level**	**Average temperature**	**Annual precipitation**	**Growing season (days)**	**Presence in UFE (%)**
0	Pine					0.7
1	Oak	< 350 m	> 8 °C	< 600 mm	> 165	0.3
2	Beech-Oak	350-400	7.5-8 °C	600-650 mm	160-165	21
3	Oak-Beech	400-550	6.5-7.5 °C	650-700 mm	150-160	53.8
4	Beech	550-600	6.0-6.5 °C	700-800 mm	140-150	24.2
5	Fir-Beech	600-700	5.5-6.0 °C	800-900 mm	130-140	-
6	Spruce-Beech	700-900	4.5-5.5 °C	900-1050 mm	115-130	-
7	Beech-Spruce	900-1050	4.0-4.5 °C	1050-1200 mm	100-115	-
8	Spruce	1050-1350	2.5-4.0 °C	1200-1500	60-100	-
9	Mountain Pine	> 1350	< 2.5 °C	> 1500 mm	< 60	-

Structure of the enterprise

A director, who is directly subordinated to the Vice Chancelor of the Czech University of Life Sciences, heads the University Forest Enterprise. The faculty can indirectly influence the forest management at the UFE. Specifically in the forest stands which were selected as demonstrative and research objects for specific kind of forest management and scientific experiments. The enterprise comprises specialized centres, such as a Forest Management Centre, a Wood Processing Centre, a Nursery Activity Centre, an Aquaculture and Game keeping Centre, and the Castle (services – accommodation, conferences, social events etc.). The enterprise employs 154 workers and 41 THP (technical and managerial staff in 2017).

Activities and missions of the enterprise

Education and research
The main original purpose of the University Forest Enterprise was to demonstrate methods and practical exercise for students of the forestry faculty. Now the mission is wider, i.e. to support all education and research activities which are offered by the university.

The University Forest Enterprise prepares objects for demonstration and practical illustrations for forestry, environmental and fish management courses. It includes also student practicals –common practicals of students in the Forestry Bachelor study programme (about 70 students every year) and individual practicals (about 5-10 students every year).

Field exercises, organized as whole or half-day blocks due to a greater distance from the university campus, are very important activities. Approximately 1.300 students from the whole university are involved every year. For example, exercises in silviculture are completely organised directly in the forests.
Students' final these are also prepared in the territory of the University Forest Enterprise (about 15 per year). Students can evaluate different methods of forest management including economic efficiency.

Excursions to the university forests and fish management sites are also very popular. The annual number of participants can be estimated at 500 of which 250 are visitors from abroad. As mentioned before, the University Forest Enterprise owns a castle in Kostelec n. Č.l. The castle provides facilities for conferences, seminars and social events including the needed accommodation capacity (see Figure 1, 2).

The UFE is also used for research; be it directly in the context of research projects (permanent research and experimental plots established in university forests) or for PhD theses.
The costs of these educational and research activities are around 300,000 Euro per year. They are covered by faculty budgets and partly by the yield of forest management. However, the current financial model is not optimal, especially for the faculty, as the UFE weighs heavily on the faculty budget. This is one of the reasons, along with the growing orientation of the university to basic research, why the use of SFE has not increased in recent years, but rather stagnated.

Complementary activities
Forest management in the university forests, wood processing (ca 25,000 m3/year), plant production (ca 400,000 plants per year, 10 % is sold to customers from outside the UFE and game and fish management are complementary activities of the enterprise.

Figure 1 and 2: Participants of the 2017 SILVA-Network annual meeting in Prague in front of the castle owned by the University Forest Enterprise.

The university forests are managed using a clearcutting silvicultural system in combination with a shelterwood system. The importance of both is evident from the proportions of regeneration when 35 ha forest are regenerated artificially and about 15 hectares naturally. On specific sites conversion to the selection (selective cutting) system is also applied.

The total annual amount of timber harvesting is between 40-50,000 m3. The annual company's income is around 6 mill. Euro, the annual net profit is approximately 400,000 Euro.

Conclusion

The University Forest Enterprise has been an important part of the Czech University of Life Sciences for more than 80 years. It provides a basis for the practical education of university students and creates conditions for research activities of academic staff as well. For its further development, we need to find a new model of financing educational activities, including employee involvement (positive motivation like more independency, better payments etc.). Furthermore, it is necessary to modernize the facilities and equipment so as to be attractive for students and teachers and to correspond to the current state of knowledge and

technical development. At the same time, study structures or the university need to be adapted to the greater use the enterprise's potential for practical lessons.

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THE ROLE OF THE UNIVERSITY FOREST ENTERPRISE OF THE TECHNICAL UNIVERSITY IN ZVOLEN

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Abstract
The University Forest Enterprise (UFE) is a special-purpose facility at the Technical University in Zvolen (TUZVO). The UFE is aimed at the practical education of students, scientific research associated with all forestry activities, demonstration objects, and management of the forest fund. It is thus possible to demonstrate several aspects of forestry such as forest management, management of forest reproductive material, silviculture, logging operations, forestry constructions and ameliorations, landscape management, game management, fishery, and beekeeping. To follow these goals, 67 permanent research plots, 18 temporary plots, and 103 demonstration objects are currently maintained at the territory of the enterprise, all connected to the network of excursion and demonstration paths. The UFE manages the forest land fund (9,729 ha) according to the needs of the Technical University, and with respect to the purpose of the enterprise, 80% of the forest area managed by the enterprise is classified into the category of special-purpose forests. The forest land fund is composed of state-owned forest land as well as forest properties of other owners. Forest plant communities of the UFE belong to five altitudinal vegetation zones (298–1035 m above sea level). Broadleaved tree species evidently predominate. Due to the special focus of management, the UFE uses as much as possible the concepts of the close-to-nature silviculture. Due to varied natural conditions, it is possible to apply several silvicultural systems. The application of shelterwood and selection systems with maximum utilisation of the natural potential of indigenous tree species is strongly preferred.

Key words: special-purpose facility, practical education, close-to-nature silviculture

The focus of the Technical University in Zvolen and the Faculty of Forestry

The Technical University in Zvolen (TUZVO) is the only university in Slovakia providing education in the field of forestry, wood sciences, ecology as well as environmental and manufacturing technology. It follows up a rich and very old tradition of technical university studies in Slovakia, which dates back to the establishment of the Mining Academy in Banská Štiavnica in 1762, where the Forestry Institute was established in 1807. In 1952 the University College of Forestry and Wood Technology was founded in the town of Zvolen and in 1991 the name of the university was changed to the Technical University in Zvolen (Anonymous, s.a.).
Currently, the university has four faculties, with different study branches and study programmes:

- Faculty of Forestry;
- Faculty of Wood Sciences and Technology;

- Faculty of Ecology and Environmental Sciences;
- Faculty of Environmental and Manufacturing Technology.

The main mission of the TUZVO is to provide university education in accredited study programmes as well as to develop scientific research in different fields and to introduce it into practice. The aim of the educational process is to provide graduates with a broad competence in forestry, wood science and technology, ecology and environment, environmental and manufacturing technology.

The Faculty of Forestry is a top forestry educational institution in Slovakia with the main mission to provide university education in the following study programmes:

- BSc programmes – Forestry, Applied Zoology and Game Management;
- MSc programmes – Forestry, Forest Ecology, Applied Zoology and Game Management, Geoinformatic and Mapping Technologies in Forestry;
- PhD programmes – Applied Zoology and Game Management, Forest Management, Forestry Phytology, Forestry Ameliorations, Silviculture and Forest Protection, Technique and Technologies of Forestry Production.

All mentioned programmes require field training and close contact with nature. The practical education of students should allow exploring of scientific, ecological, economic and social principles concerning forests and forest management and the acquisition of practical skills. For this reason, the UFE was established.

Characteristics of University Forest Enterprise

The University Forest Enterprise (UFE) is a specialized facility of the Technical University in Zvolen. It was established on January 1st, 1958, as an independent economic entity. It serves mainly for the practical education of students, and also as a basis for research activities of the university academic staff. In addition to these main duties, it also fulfils tasks in the management of forest management plans. From the legal point of view, it forms a part of the public university and its management is financed through the sources created by its own business activities, while the practical education is financed through Ministry of Education subsidies (Saniga and Ivan, 2014). At the present time, the enterprise includes the headquarters, one forest district, and one service unit. The average number of employees is 54.

The University Forest Enterprise manages forests in three separate geographical units in the immediate vicinity of the city of Zvolen. All these mountain ranges have a stratovolcanic structure, formed of andesite and pyroclastic parent rocks. Their relief is considerably eroded and denudated. A great variation of parent rocks, climatic and vegetation conditions determines the diversity of plants ranging from thermophile and xenophile species on extremely dry sites over the communities on nutrient-rich sites up to the elements of the montane flora.

Forest plant communities belong to five vertical vegetation zones, altitude from 298 to 1035 m. The number of broadleaved tree species clearly exceeds that of conifers. Based on growing stock, the predominant broadleaved species is European beech (55%), which is supposed to be a stabilizing element of Slovak forests also in the future, considering the expected climate change. Beech forests with an admixture of valuable hardwoods (maples, ash, elm…) and silver fir create conditions for stable stands with the possibility of increasing their value production. Among the conifers, Norway spruce is the most represented (8%).

From a total area of the managed forest land of 9,729 ha, the state-owned forests represent 9,111 ha. With respect to the purpose and main tasks of the enterprise, 80% of the forests managed by the enterprise are classified into the category of special-purpose forests.

The practical tasks of the enterprise comprise education, including practical training of the students of the university faculties, development and maintenance of the demonstration objects as well as development of the used forests so that the following activities might be demonstrated: forest management, management of forest reproductive material, silviculture, logging operations, forest machinery, forestry constructions and ameliorations, game management and fishery, beekeeping etc. To follow these goals, 67 permanent research plots, 18 operating plots and 103 demonstration objects are provided within the enterprise. A network of excursion and demonstration paths is a natural component of education and scientific events (Macko and Šulek, 2008).

Special objects are three National Nature Reserves under different environmental conditions which serve especially for the teaching of environmental science:

- Boky – vegetation zone of oaks – thermo and xerophilous communities;
- Mláčik – vegetation zone of fir and beech.

The principal target of forestry activities under the conditions of the UFE is an active application of the principles of silviculture based on natural processes. Professional employees of the enterprise, in a close cooperation with the teachers and scientists from the Faculty of Forestry, directly participate in the preparation of ten-year forest management plans in order to support the application of shelterwood and selection systems along with a maximum utilization of the natural potential of indigenous tree species. This strategy of the management of forests is based on the ecosystem perception of the forest with all ecological links. Through an optimal utilization of natural forces and ecological laws, it is aiming at forming the forest in such a way, that it will permanently be capable to fulfil all the required functions.
The average annual extent of tasks concerning main forestry activities is as follows:

Regeneration of forests:	40 ha
Tending:	60 ha
Thinning:	350 ha
Timber logging:	60,000 m^3

The share of natural regeneration ranges from 75 to 80%. In artificial regeneration, the enterprise focuses on a precise record-keeping and care about seed sources including gene reserves and seed orchards. The total area of gene reserves for beech as the main broadleaved species in the UFE is 483 ha. The total productive area of three forest nurseries amounts to 2.45 ha and is used especially for growing of seedlings from seeds collected in the own approved seed forest stands (their area amounts to 722 ha), own seed orchards or from seed trees (74 trees) (Macko and Šulek, 2008).

Management of hunting ground together with game management is based on the special purpose of the enterprise – it is realized in accordance with the needs of the Department of Forest Protection and Hunting, in association with the education of professionals in the study field of Applied Zoology and Hunting.

The University Forest Enterprise thus provides a wide range of options and students come into contact with almost all aspects of the usual forestry operations but also new approaches.

Practical education at the University Forest Enterprise

In general almost all the universities across the World offers both theory and practical exercises in their academic education. Practice orientation has been and still is a traditional attribute and strength of forestry curricula (Eid, 2016; Lewark, 2016). Practical education are more effectively, making the student understand better with a lot deeper and longer-lasting impact (Slobodová Nováková and Giertlová, 2016). Just by reading or hearing about a phenomenon, it will not get straight into mind even though it may be explained in the best manner. Also, training and exercise are meant to improve student skills which cannot be obtained just by theoretical knowledge. Practical experiments or interactive exercises are important features of education which ensure the involvement of students, making them learn and understand more. At the Technical University in Zvolen, a lot of the activities involve also team projects or courses where students are required to work in a team (Figure 1). On one hand, it improves a student’s ability to interact with his/her fellow students and encourages them all for teamwork, which will be very important in their future professions. On the other hand, it also makes the learning process more fun as students are able to grasp more while learning it in a group.

The Information Technology (IT) may expand communication and the way in which group members work together. When used effectively, technology can bring students together in cooperative efforts and enhance student experiences. Accessing information through the Internet can broaden the curriculum deepen students' learning (Johnson and Johnson, 2014). IT can provide students with immediate feedback. Teachers can use new approaches to track the work of students and cooperative groups and create learning communities both within the classroom and the university. For example, at the Technical University in Zvolen, students can

even communicate directly with the dean through projects like “Dean on Twitter” or SMS Gateway to share their views and experiences (Anonymous, s.a).

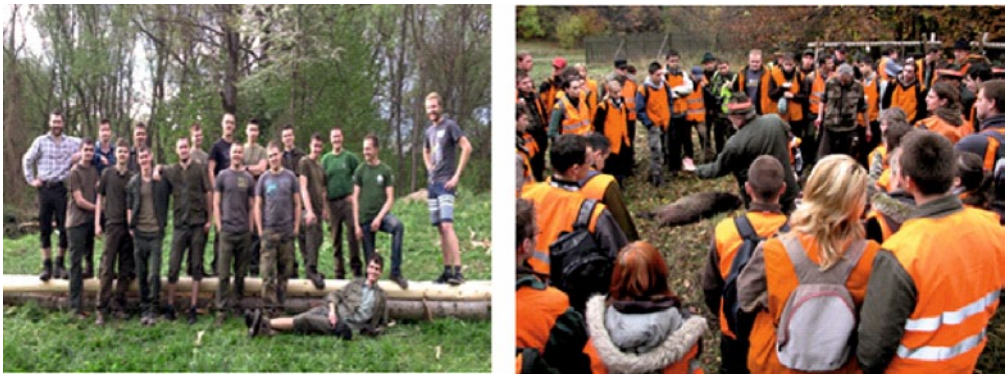

Figure 1: Teamwork of students.

The practical education in the UFE is done through a way of excursions and practical exercises. Excursions represent demonstrations of different objects and phenomenon which are important to see, always accompanied by professional commentary. In the area of the UFE, these objects are thematically connected and they create a complex system of excursions in order to provide the most comprehensive information. The student’s duty is to take part in the excursion, but their participation is not evaluated. Excursion only helps students to better understand and remember what will be reflected in the final student's assessment. Practical exercises require participation on the real work in forest stands or research plots. The obtained partial assessment for practical exercises is an important part of the final student's assessment (usually around 20%). For practical exercises, students are transported by school buses which are provided freely by the University Forest Enterprise.

A total of 107 courses mostly related to the forest management, silviculture, logging operations, forestry constructions and ameliorations, and game management are realized yearly in the area of the UFE, which is 67,300 hours for all students yearly (Anonymous, s.a.). Forests of the UFE are most often used for silvicultural courses. As an example, therefore, the course “Silviculture 1” is selected. The fact sheet of the course is given in Table 1.

Theoretical lectures (22 hours per semester) are given usually by teachers in the lecture rooms of the Technical University. Almost exclusively the practical education is provided through outdoor exercises and it is usually provided by university staff. The UFE staff and occasionally external experts also participate in the practical education. Practical exercises (22 hours per semester) include practical demonstrations or execution of forestry interventions, or scientific measurements and observations (Figure 2). Students are required to perform specific forestry interventions and/or to measure and evaluate them. The aim of these exercises is not

only a better understanding a theoretical knowledge but also gaining of practical skills and experiences.

Table 1: Shortened factsheet on the course "Silviculture 1" which uses mainly in-forest seminars for education (Benčať *et al.*, 2004).

University:	Technical University in Zvolen
Faculty:	Faculty of Forestry
Supervising department:	Department of Silviculture
Course unit code:	PEL1
Course unit title:	Silviculture 1.
Planned learning activities and teaching methods:	
lectures	2 hours weekly 22 hours per semester of study
practical exercises	2 hours weekly 22 hours per semester of study
all-day practical exercises	24 hours per semester of study in 3 days
Credits allocated:	6
Level of study:	bachelor
Prerequisites for registration:	none
Assessment methods:	
Continuous assessment of students in terms of ECTS is based on the students or class projects evaluation (preparation and defence of the project).	
Learning outcomes of the course:	
The result of student education in this course is understanding of growth relationships and processes which work in forest ecosystems. Based on the ecosystem approach, in this level of study student should be able to apply the basic knowledge and practical experiences regarding the issues of silviculture in forest management.	
Course contents:	
The basic knowledge of management of the young forest stands (cleaning, thinning methods), forest stand regeneration, management of selection forests, conversion of forest stands	

During each semester students have to solve several semester projects on the different topics. The all-day practical exercises take three days. It is a demonstration of the existing knowledge in the field of close-to-nature silviculture. Below there is a list of some semester work topics that were given to students in the academic year 2017/2018:

- The effect of different intensity and type of thinning on the diameter and height structure of the spruce small-diameter stand;
- Structure analysis of the beech selection forest;
- Analysis of natural regeneration of the beech stand in the performing of shelterwood strip system;
- The effect of increment thinning on the diameter structure of target oak and beech trees.

Figure 2: Teamwork during the course Silviculture.

Conclusions

Facilities like the University Forest Enterprise have a long tradition in forestry education system in our territory. The functioning of the UFE is in line with the long-term strategic plan of the Technical University in Zvolen whose mission aims are:

- Acceptation in the national and international context;
- High quality of educational and research activities;
- Graduates employable in practice;
- Supporting the development of knowledge and innovative economy;
- Effective and environmentally-friendly utilising natural resources.

For these reasons, it is important to keep the direction of the UFE with the incorporation of new challenges given by society and changing environmental conditions. Thanks to a special focus and efforts to promote close-to-nature silviculture, demonstration objects have become the real treasure and pride of the university (Saniga and Ivan, 2014). At the same time, the UFE produces surpluses that greatly support the running of the university and the state is not interested in changing this well-run system of financing. Therefore, there is no risk that the state forest will take these resources back and the UFE will provide practical education for next generations of students.

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FORESTS FOR UNIVERSITY EDUCATION: THE EXAMPLE OF ESTONIA

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Abstract
Teaching methods change during times. The authors consider it essential to anchor the theoretical part of studies with practice in the natural environment. Therefore, to ensure the achievement of learning outcomes, practical training is included in a number of courses in Estonian academic forestry education.

The history of academic forestry education in Estonia starts in 1920. The Experimental Forest District at Järvselja was established in 1921. Since 1997 its name is the Foundation Järvselja Experimental and Training Centre and it belongs to the Estonian University of Life Sciences.

The Järvselja Center's total area is 10 553 ha. Forest land comprises 6 626 ha, of which 2 723 ha are protected. Bogs form 3 147 ha of the Järvselja Centre's land. Järvselja Experimental and Training Centre is the only one in Estonia which has complete infrastructure for accommodation and catering.

Every year Estonian forestry students have various practical training courses in Järvselja. In most cases, practical training is held in summer, but some courses are offered in winter (e.g. forest and timber measurement) as well. Also every year some graduation theses are defended on themes done in Järvselja forests. Forests in Järvselja are used to carry out several research projects, too.

Keywords: Estonia, forestry, practical training, field practice base.

Introduction

Previously the main focus has been on lectures and seminars, new methods include e-learning, project-based studies etc. Although e-learning is an important part of the teaching process, it does not replace "old-fashion" part of higher forestry education – practical training. The need for practical training as a part of higher forestry education has been a topic for discussion. While without doubt forest workers need practical experience which is provided by vocational education through more hands-on practice, the authors have seen that most of the universities in Europe offering higher forestry education involve practical training in their curricula. The authors don't know any university in Europe offering higher forestry education not involving practical training. They can not imagine it is possible to obtain basic forestry knowledge or deeply understand the processes in forestry only by learning theory. Traditionally theory is supported by practical training. When the first year

BSc forestry students in Estonia were asked at enrolment, whether or not they plan to continue in a MSc programme or start working, 71% of all respondents did not know their future plans (Teder and Reisner, 2017). During studies the students are expected to find their way. According to Rekola *et al.* (2017) the expectations of students have developed for a greater diversity of experiences and skills. Therefore students have to have a wide variety of possibilities based not only on theory but also on practical aspects of the possible future profession.

So it is usual that practice in an enterprise is included in the curriculum. To provide that, quite often there is a special location outside of university campus. For example in the case of the University of Applied Sciences Weihenstephan-Triesdorf in Freising, Germany, the forest faculty can use a 1500 ha teaching forest, starting at a distance of 500 m from the faculty. The forest is managed by the Bavarian State Forest Company (Rothe, 2014). In Estonia there is the Järvselja Training and Experimental Forest Centre/Järvselja Õppe- ja Katsemetskond, which is used in higher forestry studies. Having such centre ensures that the forestry curricula in Estonia respond to the needs of the labour market (Tullus, 2013).

History and management

The history of the Järvselja Training and Experimental Forest Centre goes back to 1921. With a decision of the Government of the Estonian Republic in April 1921, the former Kastre-Peravalla forest area was given to the University of Tartu to be used as an independent training forest district (Kusmin and Kusmin, 2013). In 1951 this training forest district was transferred to a new university – the Estonian Agricultural Academy, comprising the “rural” departments of the University of Tartu and granted the right to teach higher education in forestry. The training centre has had several names and belonged to different owners, but since 1997 its name has been the Foundation Järvselja Experimental and Training Centre and it belongs to the Estonian University of Life Sciences (EMU, Eesti Maaülikool). The University is the owner of the land, the forest and infrastructure belong to the Järvselja Training and Experimental Forest Centre. The Järvselja Centre is a self-financed enterprise without any financial support from the University. The head of the Järvselja Centre is the Chief Forester who reports to the Council of the Järvselja Centre. The Council is formed by the director of the Institute of Forestry and Rural Engineering and consists of representatives of the Institute (four members), the Ministry of Environment (one member) and the State Forest Management Centre (one member). The Board of the Järvselja Centre consists of only one member who is also its Chief Forester.

Description

The aim of the Järvselja Training and Experimental Forest Centre is to guarantee opportunities for training and experiments, mainly in forestry. The total area of the Järvselja Centre is 10 553 ha. The forest land area is 6 626 ha, from which 2 723 ha

are more or less protected. Bogs form 3 147 ha of the Järvselja Centre's total area. Approximately 4 000 ha of forest land area are for timber production. In Järvselja, most of the Estonian forest site types are represented. Also there are some of the tallest trees in Estonia – birch (Betula pendula), aspen (Populus tremula), black alder (Alnus glutinosa), grey alder (Alnus incana) and bog birch (Betula pubescens). In 1924, 12,8 ha of the forest land area was designated as nature protection area and since then no cuttings, cleaning of dead wood or non-timber use of forest have taken place. Nowadays the forest land area, on which the human activity is absolutely forbidden, is already 187 ha.. In Järvselja there is also the Agali arboretum (established in 1968) with 80 tree and shrub species.

The average annual increment of the forests is 7 $m^3.ha^{-1}$. The distribution of the standing volume of the main tree species in Järvselja is shown in Figure 1.

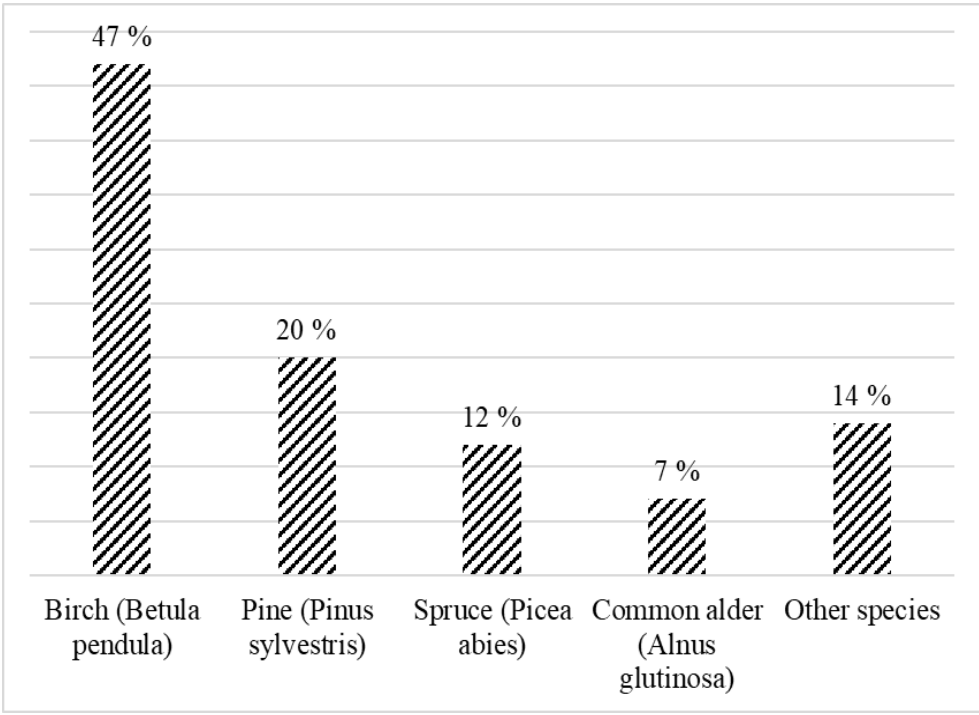

Figure 1. The distribution of the standing volume of the main tree species in Järvselja.

Nowadays there is a complete infrastructure in Järvselja to carry out practical forestry-related trainings. There are hostels for 100 students, a room for seminars, a computer class and a dining room. For 30 professors and guests there is a special building called "Hunting house". Also there are two saunas.

Forest Management

As the Järvselja Experimental and Training Centre is self-financed, it has to find its own ways to cover all expenses. The main income is received from cuttings. The

average cutting volume is 16 000 m3 from clearcuttings and 4 000 m3 from thinnings. The average price for all assortments at the wood mill was 37 €/m3 in 2017. A small income is generated from the nursery and from recreation management. Every year the Järvselja Centre reforests about 30 ha of land, mainly by planting (spruce, pine and birch). As the main income is received from forest management activities, the main expenditure is also connected with these. In addition to that, in accordance with the aim of the Järvselja Centre, it covers almost all costs of students' field practices and it supports various experiments.

Field practices and students' graduation theses

During spring and summer each year 425 students on average take part in different field practices in Järvselja. For example, Practical trainings are offered in dendrology, forest botany, forest site types, forest entomology and game ecology, silviculture, forest and timber measurement, wood harvesting and machinery, forest pathology, forest tree breeding, forest regeneration, forest ecology etc. All together the number of credit points for field practices held in Järvselja is at Bachelor level 18 ECTS and at Master level 8 ECTS. Not only forestry students have their field practices in Järvselja. The Järvselja Centre is used also by the students of other curricula, for example Environmental Planning and Landscape Design, Land Surveying and Land Management, Nature Based Tourism and Applied Biology of Aquatic and Terrestrial Ecosystems. They all have their basic forestry course and, as a part of the studies, the field practice in Järvselja. All these study programmes are taught by the Estonian University of Life Sciences. Students of University of Tartu, also located in Tartu, use the Järvselja Experimental and Training Centre for their field practices in courses on insects, mushrooms etc. as well.
Not only field practices are held in Järvselja. Many students choose the possibility to do the research for their graduation thesis in Järvselja. Themes cover very broad field, for instance description and analysis of the pruned stands (Prants, 2016; Tirmaste, 2016), growth of various tree species in different conditions (Kusma, 2016; Kaasiku, 2017), damages by insects (Ojalo, 2017) or even visitor load assessment (Lipmeister, 2017).

Experiments

Soon after the establishment of the experimental and training forest district, large forestry experiments were launched. Due to World War II, experimental work at Järvselja was stopped and restarted in 1947 (Kusmin and Kusmin, 2013). Nowadays in Järvselja there are several long-term experiments and demonstration areas, for example the geographical experimental stands and tree selection experiments of Scots pine, comparative experiments of non-native tree species, sample plots to measure the growth and yield of forest stands, permanent sampling plots for thinning, fertilisation sample plots etc. All these are supported in larger or smaller amount by the Järvselja Centre. The support is mainly financial, but sometimes the Järvselja Centre helps with workforce as well. The previously mentioned

experimental plots are all classical types in forest research. In Järvselja two world level modern experiments are going on: FAHM – Free Air Humidity Manipulation (http://fahm.ut.ee/main?lang=en) and SMEAR – Station for Measuring Forest Ecosystem Relations (http://smear.emu.ee/).

Challenges

Some problems related to the Järvselja Experimental and Training Centre should also be mentioned. Comparing its forest management with that of the State Forest Management Centre, the effectiveness is much lower. However, keeping in mind that the aim of the Järvselja Centre is to support both students' field practical training and forest-related experiments, the extra expenditures here are justified and even necessary. The location is one of Järvselja's major problems. For practical training of students it is favourable that there is no other entertainment in Järvselja, so students can focus on their training. But it is difficult to find local workforce because people do not want to live so far away from larger towns. Nowadays not even a school is located in Järvselja. At the moment one of the most important problems is the increasing area of protected lands. There is a strong pressure from society to protect more and more forest land. The Ministry of the Environment, through its subunits, decides on establishing protected areas or protection of key habitats. Therefore the area of managed forest land is decreasing also in Järvselja, diminishing the income of the Järvselja Centre. As the University is not supporting the Järvselja Centre financially, it is a challenge for the Chief Forester to find solutions and guarantee the Järvselja Centre's operation.

The specific value of practical training sites

In spite of the problems mentioned above, all forestry-related researchers and professors consider it very useful to have such a base for experiments and students' practical field training. Everybody is free to make decisions, everything must be coordinated with only one person – the Chief Forester. In a study on forestry training in 23 countries (Bernasconi and Schroff, 2011) it is pointed out that many of the forestry and forestry-related training courses are cost-intensive, whereas the market for these courses is small (small number of students in comparison with other courses). In Estonia, where some of these costs are covered by the Järvselja Experimental and Training Centre, it is somewhat easier to continue giving higher forestry education, even if the number of students is continuously decreasing.
Even years after graduation, students who have had weeks of practical training in Järvselja come back with pleasure to Järvselja, to hold their course reunions there. Järvselja is a place where foreign foresters are shown the experimental plots and discuss further cooperation possibilities. This is a place not only for students, but for all whom forestry concerns – pupils, private forest owners and also politicians.

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THE UNIVERSITY OF TOKYO FORESTS AND FOREST SCIENCE EDUCATION IN JAPAN

TOSHIAKI OWARI, NAOKI YASUMURA, SEIJI ISHIBASHI, SHIGEHIRO KAMODA, HARUO SAITO

Abstract
In-forest teaching is a vital element of forest science education at university level, and university forests play a critical role in this. In Japan, the University of Tokyo (UTokyo) owns the oldest university forest, which was established in 1894. This paper outlines how the University of Tokyo Forests (UTF) provide in-forest education for forest science. The UTF consist of seven branch stations with a total area of over 32,000 ha. Third- and fourth-year undergraduate students majoring in forest science attend field courses in these forests. Some undergraduate and graduate students are affiliated with the UTF, where they conduct field studies for their graduate theses. Since 2005, the UTF have expanded their educational activities by offering university-wide hands-on experience seminars with field experience for first- and second-year undergraduate students, although these courses are open to all students studying at UTokyo.

Keywords: field course, forest science education, graduate thesis, university forest, university-wide hands-on experience seminar

Introduction

In-forest teaching is an essential component of university-level education in forest science. Field-based training in many forestry programmes typically offers opportunities for experiential learning (Bragg and Tappe, 2015; Hix, 2015; Kanowski, 2015), and many students are excited about the ability to acquire practical skills in the field (McGown, 2015). Field programmes reinforce cognitive classroom concepts (i.e. better retention of information), while they also build skills (i.e. personal development) (Easton and Gilburn, 2012; Hoagland *et al*., 2017). In-forest learning and teaching deliver hands-on experiences, which cannot be replaced by other teaching tools, such as virtual reality (SILVA Network, 2017b).

University forests play an important role in in-forest education. The term “university forest” refers to large forested areas owned or controlled by a university and devoted primarily to its teaching and research programmes in forest science (Straka, 2010). In the United States, university forests are an integral component of most forestry schools, and they are distinguished features of many forestry programmes (Burkhardt *et al*., 1988). University forests also facilitate in-forest learning and teaching in Europe (SILVA Network, 2017b).

In Japan, a university having a forestry-related department must have a university forest (Enshu-rin in Japanese) as an attached facility for education and research, as prescribed in Article 39 of the Standards for the Establishment of Universities, an Ordinance of the Ministry of Education, Science, and Culture (Ministry of Education, Science and Culture, 1956). Currently, 75 university forests with a total area of ca. 130,000 ha are operated by 27 national, public, and private universities in Japan (Japanese Association of University Forests, 2017).

The oldest university forest in Japan was established in 1894, when the Imperial University, the predecessor of the University of Tokyo (UTokyo), established its University Forest in Chiba as an institution attached to the Faculty of Agriculture[6]. The land was transferred to UTokyo by the Ministry of Agriculture and Commerce for field practices and research in forestry (The University of Tokyo Chiba Forest, 2012). Dr Seiroku Honda, former Professor of Silviculture at UTokyo, initiated its establishment. He studied at the Forstliche Hochschule Tharandt and the University of Munich between 1890 and 1893, where he received his PhD. His experiences in Germany inspired him and he pushed for the establishment of university forests in Japan.

Following Chiba, additional branch stations of the University Forest have been established, and they are collectively called 'The University of Tokyo Forests (UTF).' As a site for education and research, the mission of UTF is to develop technology and human resources for the next-generation forests: (1) to provide suitable locations for forest education for undergraduate and graduate students; (2) to promote advanced research on the relationship between the natural environment and humans in forests; (3) to circulate environmental data to other research institutes; and (4) to establish an education system and practical field area for a wide variety of people outside the university, such as children, the elderly, and ordinary persons.

This paper describes how UTF provide in-forest education in forest science. First, we briefly introduce the branch stations of UTF and undergraduate studies in forest science at UTokyo. Then, we describe the educational activities at UTF for our students (field courses, graduate theses, and university-wide hands-on experience seminars). While the SILVA Network primarily aims to stimulate and facilitate educational co-operation in forestry in Europe (SILVA Network, 2017a), we also strive to contribute to cross-border discussions of how to strengthen the role of university forests by sharing our information and experiences through this paper.

[6] All information about curricula and university forests given below is from The University of Tokyo Forests (2017), if no other reference is given.

Introduction to the University of Tokyo Forests

UTF has seven branch stations in central and northern Japan (Figure 1), with a total area of 32,339 ha. Most of the area is directly owned, managed and financed by the university. As of December 2017, 26 faculty members (4 professors, 3 associate professors, 5 lecturers, 13 assistant professors, and 1

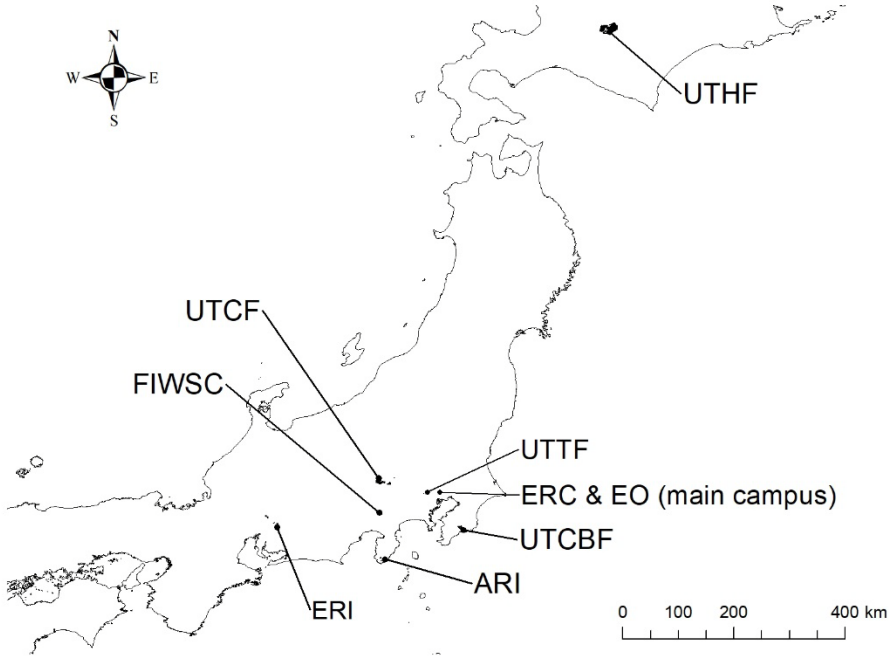

Figure 1: Locations of the University of Tokyo Forests. UTCBF: The University of Tokyo Chiba Forest, UTHF: The University of Tokyo Hokkaido Forest, UTCF: The University of Tokyo Chichibu Forest, UTTF: The University of Tokyo Tanashi Forest, ERI: Ecohydrology Research Institute, FIWSC: Fuji Iyashinomori Woodland Study Center, ARI: Arboricultural Research Institute, ERC: Education and Research Center, EO: Executive Office. Source: Geospatial Information Authority of Japan and the University of Tokyo Forests.

project assistant professor) and 58 technical staff were affiliated with UTF. The directorship of UTF is taken by a professor in the Department of Forest Science, and the senior faculty of UTF is appointed as Director of each branch station. They are responsible for the management and operations of UTF.

UTokyo Chiba Forest (UTCBF) was established in 1894 and is the oldest university forest in Japan. It is located in the south-eastern part of the Boso Peninsula, approximately 70 km southeast of Tokyo, and has an area of 2,226 ha. Although the area was initially mostly coppice forests comprising evergreen broad-leaved trees, two major plantation conifers (*Cryptomeria japonica* and *Chamaecyparis obtusa*) have been introduced since its establishment. The planted forests range from young

to very old stands. The Forest also contains various experimental plots, protected forest, and demonstration forests of indigenous and exotic tree species.

UTokyo Hokkaido Forest (UTHF) was established in 1899. It is located in central Hokkaido approximately 860 km north of Tokyo and has an area of 22,715 ha. It is situated in the Pan-mixed forest zone (Tatewaki, 1958), which is a transitional area from deciduous forests in the cool-temperate zone to coniferous forests in the sub-boreal zone. To study theories and methods of sustainable and adaptive forest management in the region, a business-scale study of a stand-based silvicultural management system (Rinbun Segyo-ho in Japanese) has been conducted for nearly 60 years, having started in 1958. The main silvicultural system in the Forest is a single-tree selection system and approximately 26,000 m^3 of trees are harvested annually.

UTokyo Chichibu Forest (UTCF) was established in 1916. It is located in the upper reaches of the Arakawa River watershed approximately 70 km northwest of Tokyo and has an area of 5,812 ha. The Forest is situated in the cool temperate zone and is surrounded by mountains over 2,000 m high. Since the Forest covers a wide range of elevations from montane to sub-alpine vegetation zones, a variety of tree species grow there. The Forest enables rapid and easy access to various natural forest stand types with diverse elevations and landforms, which is a great advantage for education and research in ecology.

UTokyo Tanashi Forest (UTTF) was established in 1929 as the Department of Forestry Tanashi Nursery for practical training courses in silviculture. It is located in the western part of metropolitan Tokyo and has an area of 9 ha. The demonstration forest and arboretum include a total of 244 tree species. It is approximately one hour from the main campus of UTokyo. Consequently, professors and students frequently visit it for educational and research purposes. The forest also provides a valuable green oasis in the city for the general public.

The Ecohydrology Research Institute (ERI) was established in 1922 as the University Forest in Aichi to conduct research and training in forest hydrology and erosion-control engineering. ERI has three research forests in Aichi Prefecture (approx. 250 km west of Tokyo), with a total area of 1,292 ha. When it was established, almost all of the research forests were degraded hill regions. As a result of restoration work over many years, the area is now covered with vegetation, with secondary and plantation forests. ERI currently focuses on interdisciplinary studies of the interactions between water cycle and ecosystems.

The Fuji Iyashinomiri Woodland Study Center (FIWSC) was established in 1925 as the University Forest at Yamanakako. It is located near Lake Yamanakako (approx. 90 km west of Tokyo), one of the most popular resort areas in Japan, and covers 38 ha. The forest is located in the upper cool temperate forest region. The area is partly covered by stands dominated by larch in the canopy layer, although the larch trees

are being replaced by native broad-leaved trees. FIWSC is used mainly for studies of the recreational and healing functions of forests.

The Arboricultural Research Institute (ARI) was established in 1943 to study the use of tropical and sub-tropical trees for non-wood forest products. It is located at the southern end of the Izu Peninsula, approx. 150 km southwest of Tokyo, and has an area of 247 ha. ARI includes an experimental forest and a greenhouse. The forest is situated in the warm-temperate evergreen broad-leaved forest zone, where *Castanopsis* and oak (*Quercus*) species dominate. Some areas have been planted with useful broad-leaved trees, such as *Cinnamomum*, *Eucalyptus*, *Acacia*, and *Vernicia* species. The greenhouse is heated by water from hot springs.

The Education and Research Center (ERC) and Executive Office (EO) are located on the main campus of UTokyo. The ERC functions as a human resources centre that supports future forests and forest science. Students affiliated with UTF are based there for their studies and to conduct research. The EO coordinates various activities in the seven branch stations and ERC and promotes cooperation among the branch stations and other organizations.

Undergraduate studies in forest science at the University of Tokyo

UTokyo has 10 Faculties, 15 Graduate Schools, 11 affiliated Institutes, 13 university-wide centres, and 2 special institutes (The University of Tokyo, 2017). A key feature of the undergraduate education system at UTokyo is that students spend their first two years (Junior Division) studying a broad spectrum of liberal arts courses in order to acquire fundamental skills. Then, they select one of the 10 Faculties for their third and fourth years (Senior Division) based on their preferences, aptitude, and performance. This basic educational strategy is referred to as “late specialization”.

In the Faculty of Agriculture, the educational curriculum is designed as a three-layered structure with one faculty, three programmes, and 14 majors (The University of Tokyo, 2017). The three programmes offered are the Applied Life Science Programme, which covers the biological and life sciences; the Environmental and Resource Science Programme, which is concerned with field environmental sciences; and the Veterinary Medical Sciences Programme, which covers the medical treatment of animals (Figure 2). These three programmes are further divided into 14 specializations.

Undergraduate students who wish to study forest science typically major in Forest Life Science, one of the Applied Life Science Programme, or in Forest Environmental and Resource Science, one of the Environmental and Resource Science Programme (Department of Forest Science, The University of Tokyo, 2017). Students can also study forest science by majoring in Field Science (Laboratory of Forest Ecosystem Studies) or International Sustainable Agriculture

Development (Laboratory of Global Forest Environmental Studies), which are the Environmental and Resource Science Programme.

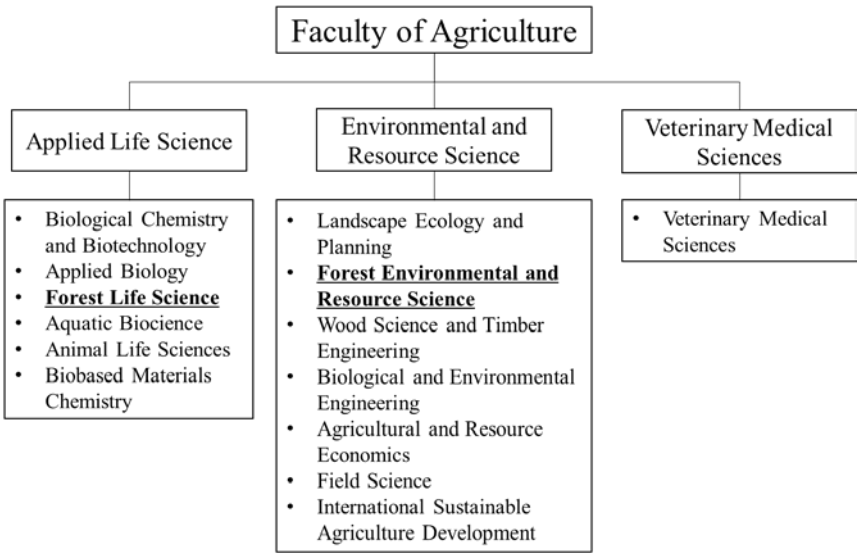

Figure 2: Undergraduate programmes and majors at the Faculty of Agriculture, the University of Tokyo. Source: Faculty of Agriculture, the University of Tokyo (2017).

The Department of Forest Science is responsible for most of the forest science education at UTokyo (Department of Forest Science, The University of Tokyo, 2017). The Department consists of eight laboratories (Forest Botany, Forest Zoology, Silviculture, Forest Management, Forest Policy, Forest Utilization, Forest Hydrology and Erosion Control Engineering, and Forest Landscape Planning and Design) (Figure 3). There are also two cooperative courses under the Department (UTF and Asian Natural Environmental Science Centre). Undergraduate students majoring in Forest Life Science or Forest Environmental and Resource Science are affiliated with one of the eight laboratories or two cooperative courses and complete a Bachelor thesis under the supervision of professors and associate professors.

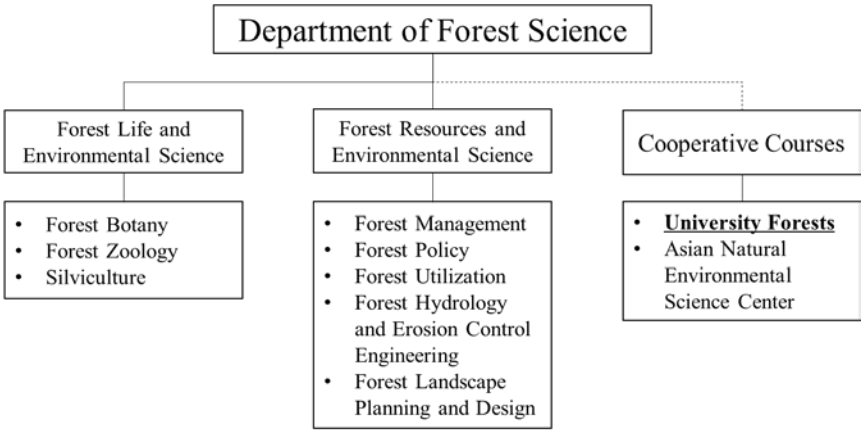

Figure 3: Laboratories and courses in the Department of Forest Science, the University of Tokyo. Source: Department of Forest Science, the University of Tokyo (2017).

Forest science education in the University of Tokyo Forests

Field practice courses for students majoring in forest science

The third- and fourth-year undergraduate students majoring in Forest Life Science or Forest Environmental and Resource Science visit UTF every year to take part in field practice courses. Currently, UTF offers ten such courses, of which seven courses are compulsory electives[7] and 3 courses are electives (Table 1). Each course lasts 2–5 days. Although the faculty in the Department of Forest Science are in charge of these courses, the faculty of UTF are jointly responsible as the course teachers. The technical staff of UTF support the coursework by students in the field.

In addition, undergraduate students majoring in Field Science and International Sustainable Agriculture Development can take three field practice courses offered at UTHF, FIWSC and ARI every year. The faculty of UTF also offer a number of courses (lectures, seminars, and field practice courses) for post-graduate students (Master's and Doctoral candidates) in three Departments (Forest Science, Ecosystem Studies, and Global Agricultural Sciences).

Bachelor, Master's, and Doctoral theses

A fundamental function of the university forests is to provide study sites for student theses (SILVA Network, 2017b). Some undergraduate students are affiliated with UTF and use them as study sites for Bachelor's theses (Table 2; Figure 4). These students are supervised by the faculty of UTF, and the technical staff can assist with on-site data collection. Post-graduate students are also affiliated with UTF. They conduct field research for their Master's and Doctoral theses in a variety of academic disciplines, such as botany, ecology, entomology, genetics, pathology, physiology, chemistry, silviculture, hydrology, management, informatics, landscape

[7] At least 6 courses (12 credits) have to be taken from 8 courses. One course (Practice in Forest Utilization) is offered outside of UTF.

planning, policy, and economics (Table 2; Figure 4). Many students affiliated with other departments, faculties or graduate schools, and even other universities may use UTF for their study sites with the support of the faculty and technical staff of UTF.

Table 1: Field practice courses offered at the University of Tokyo Forests in 2017.

Year	Course	Credit[8]	Location	Date	Duration
3	Experiments in Silviculture	2	UTCBF	5–9 Jun	5 days
	Experiments in Forest Botany	2	UTCBF UTCF	9–11 Jun 25–27 Jul	3 days 3 days
	Experiments in Forest Zoology	2	FIWSC	1–3 Aug	3 days
	Seminar in Forest Policy	2	FIWSC	28–30 Aug	4 days
	Practice in Surveying	2	ERI	21–25 Aug	5 days
	General Practice in Forest Science	1	UTHF	4–7 Sep	4 days
3/4	Practice in Forest Management	2	UTCBF	5–8 Dec /5–8 Jun	4 days
4	Experiments in Forest Soil Science	2	UTCF	12–14 Apr	3 days
	Practice in Forest Conservation	2	ERI	13–16 Jun	4 days
	Practice in Environmental Design	2	FIWSC	22–23 Jun	2 days

Table 2: Graduate theses completed by students affiliated with the University of Tokyo Forests in 2016.

Degree	Title
Bachelor	Regeneration of Phyllostachys bambusoides and tree species in a bamboo-felled site with different rhizome conditions
	Seedling dynamics in a cool temperate forest of Okuchichibu Mountains: An evaluation of deer fences for vegetation recovery
	Relationships between catchment topography and flood concentration time in mountain rivers
Master	Seasonal fluctuation of ambrosia beetles and factors influencing on colonization of ambrosia beetles
	Determinant factors affecting community assembly for folivorous Lepidoptera in a cool-temperate deciduous broad-leaved forest
	Actual use of firewood and forests as a source of firewood procurement in Yamanakako village, Yamanashi prefecture: From a viewpoint of differences in household attributes
Doctor	Influences of ambrosia beetle (*Platypus quercivorus*) attacks on evapotranspiration in a secondary warm-temperate forest

University-wide hands-on experience seminars and activities

Increasingly, forestry educators are reaching out to less traditional audiences, including some with very little formal forestry background (Bragg and Tappe, 2015). In Japan, UTF has expanded its educational activities since 2005, by holding

[8] One credit in Japan is equivalent to 45 hours of workload (Ministry of Education, Science and Culture, 1956).

university-wide hands-on experience seminars combined with field studies (Table 3; Figure 5). These seminars target first- and second-year undergraduate students and are open to students in all Junior Division Streams (Humanities and Social Sciences I, II, and III, and Natural Sciences I, II, and

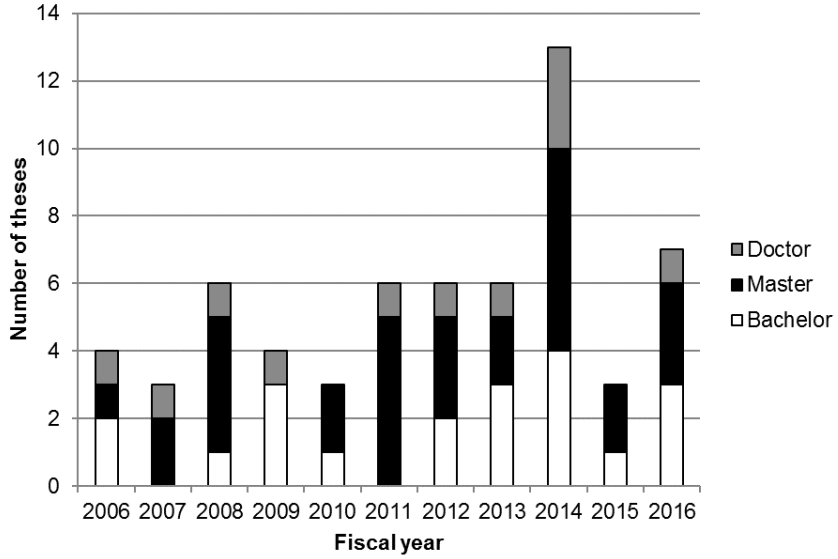

Figure 4: Number of graduate theses completed by students affiliated with the University of Tokyo Forests between 2006 and 2016. The fiscal year in Japan begins from April 1st and ends on March 31st.

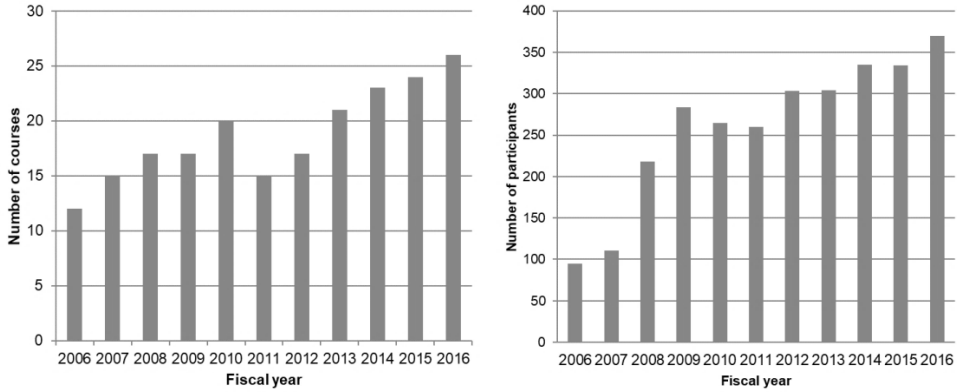

Figure 5: Number of courses and participants in the university-wide hands-on experience seminars offered by the University of Tokyo Forests between 2006 and 2016.

III). They are considered to play a strong role in building bridges between lower- and upper-level undergraduate courses and to offer opportunities for students to become familiar with specialized topics, while learning about a wide range of topics (The University of Tokyo, 2017). The faculty of UTF devote considerable effort to the seminars to promote basic understanding of forests and forestry through various

experiences in the field. The seminars often create a favourable impression of forest science in students, who then pursue studies in the Faculty of Agriculture.

The Hands-on Activity Programme is another university-wide educational activity offered by UTF. The programme was initiated in 2012 at UTokyo and is a specially designed project whose basic principle is to expose undergraduate student to lifestyles and sets of values different from their own (The University of Tokyo, 2014). In 2017, five branch stations (UTCBF, UTHF, ERI, FIWSC, and ARI) offered hands-on field work activities to undergraduate students.

Table 3: University-wide hands-on experience seminars offered by the University of Tokyo Forests in 2017.

Subject	**Location**	**Duration**
Knowledge of Dangerous Creatures (Spring)	FIWSC	2 days
	UTCBF	1 day
Excursion in Spring Oku-Chichibu	UTCF	2 days
		2 days
Forest Created and Managed by Human; from a Viewpoint of Forestry and Landscape Planning	ERI	2 days
Training Interpreters of Urban Green; Teach Children Nature Experience	UTTF	1 day
		1 day
		1 day
Do You Really Know about Cedar and Cypress?	UTCBF	2 days
Recreational Forest and Local Society (Summer)	FIWSC	3 days
Forest Environment Resource; Dam and Forest, Forest and Amenity, Final Stage of Forest	ERI	2 days
	FIWSC	2 days
	UTCBF	2 days
Considering Protection and Management of Wildlife at the Field	UTCBF	4 days
Feel, Think and Act in Izu[9] (Summer) 1	ARI	5 days
Feel, Think and Act in Izu (Summer) 2	ARI	5 days
Feel, Think and Act in Izu (Summer) 3	ARI	5 days
Feel, Think and Act in the Forest	UTHF	5 days
Knowledge of Dangerous Creatures (Autumn)	UTCBF	2 days
	FIWSC	2 days
Excursion in Autumn Oku-Chichibu	UTCF	2 days
		2 days
Mapping Fascinations of Forest; Creating Original Maps using GPS	FIWSC	3 days
Recreational Forest and Local Society (Winter)	FIWSC	3 days
Make Full Use of Forest Energy	UTTF	1 day
	FIWSC	3 days
Study about Forest and Life of Boso	UTCBF	4 days
Study at Snow Forest; the University of Tokyo Hokkaido Forest	UTHF	3 days
Dam, Sediment and Ocean	ERI	3 days
Feel, Think and Act in Izu 1	ARI	5 days
Feel, Think and Act in Izu 2	ARI	5 days
Feel, Think and Act in Izu 3	ARI	5 days
Feel, Think and Act in Izu; Tropical Plants Version	ARI	5 days
Feel, Think and Act in the Forest 2	UTHF	2 days

[9] The area in Shizuoka Prefecture, central Japan, where ARI is located (see Figure 1).

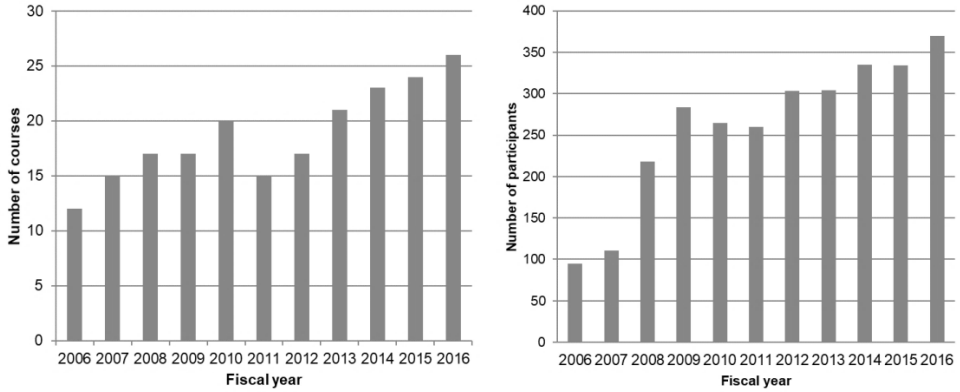

Figure 5: Number of courses and participants in the university-wide hands-on experience seminars offered by the University of Tokyo Forests between 2006 and 2016.

Discussion and conclusion

Throughout its 120-year history, UTF has served as an indispensable site for university-level forest science education in Japan. In close cooperation with faculty in the Department of Forest Science and other departments, each branch station of UTF offers students distinct in-forest teaching programmes that effectively use its natural and human resources. The experiential opportunities at UTF through field practices and graduate thesis fieldwork have provided both cognitive and affective learning outcomes to students majoring in forest science.

At UTokyo, the university forest is no longer an educational ground exclusively for forestry students. The Forest is open to all students with diverse academic interests. Although most incoming students have little to no understanding of forestry (McGown, 2015), UTF has been successful at attracting students to major in forest science through university-wide hands-on experience seminars. The field programmes offered at UTF have enabled students to develop personally and emotionally and to improve their communication skills (Hoagland *et al*., 2017).

We, UTF, are willing to serve as an international educational ground for forest science (Kamata, 2018). We hope to exchange further information and experiences with the SILVA Network member universities in Europe and to conduct collaborative teaching programmes in the future.

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USING UNIVERSITY FORESTS FOR INTERNATIONAL FOREST SCIENCE EDUCATION ACTIVITIES: THE EXPERIENCES OF THE UNIVERSITY OF TOKYO FORESTS, JAPAN

NAOTO KAMATA

Abstract
The University of Tokyo (UTokyo) is one of the leading Asian universities. The University of Tokyo Forests (UTF) was established in 1894 as the first university forest in Asia. To date, UTF owns seven forests and has accumulated long-term data regarding forest ecosystems, conifer plantations, and selection cutting with natural regeneration, in addition to data regarding meteorology and hydrology. In terms of quantity and quality, this longitudinal dataset is among the best available in the world of forest science. A teaching staff of 26 people belongs to UTF. The advantages of studying under the supervision of UTF staff members are as follows. First, students have the opportunity to gain broad disciplinary knowledge from the 26 members of the teaching staff. Second, they can use UTF as a context for their research fieldwork, relying on good research facilities supported by a 50-strong technical staff. Third, they can utilize longitudinal data accumulated by UTF over a period of more than 100 years. Students from at least ten countries have been supervised at UTF. Students are selected, in particular, from China, Thailand, Indonesia, Myanmar, and Sri Lanka. UTF has also provided fieldwork classes for students of foreign universities, such as Universiti Malaysia Sabah and the National Taiwan University. These students gain experience in disciplines such as forest vegetation and forest management, where Japanese practice differs from that of their own countries. Students can stay at UTF lodges for a modest fee. Students from European universities are also welcome to undertake fieldwork courses at UTF. We accept interns from overseas. Recently, interns from European universities have been increasing in number. The unique culture of Japan - with its traditional features and more modern ones, like the Japanese comics manga - are fascinating to European students. UTF provides the best environment for forest education in Asia.

Keywords: The University of Tokyo, international exchange programme, university forest, research training, fieldwork, internship

Introduction

Owari *et al*. (this volume) introduced The University of Tokyo Forests (UTF) and the education in forest science that it delivers. This chapter introduces the international educational activities offered by UTF.
The Department of Forest Science, now a part of Graduate School of Agriculture and Life Sciences, The University of Tokyo (UTokyo), was established as the

Tokyo College of Forestry in 1882, while the College of Agriculture was established in 1878. Both institutions were governed by the Ministry of Agriculture and Commerce, and were combined to form the College of Agriculture and Forestry in 1886. In that same year, The Imperial University, Japan's first university, was established under the governance of the Ministry of Education. The College of Agriculture and Forestry was absorbed by The Imperial University in 1890 and changed its name to the College of Agriculture of The Imperial University, operating at that time under the governance of the Ministry of Education. It was designated the "College of Agriculture, The Tokyo Imperial University" in 1897, the "Faculty of Agriculture, The Tokyo Imperial University" in 1919, the "Faculty of Agriculture, The University of Tokyo" in 1949, and the "Graduate School of Agriculture and Life Sciences, The University of Tokyo" in 1994.

The University of Tokyo Chiba Forest (UTCBF) was established in 1894 as the first university forest in Japan. Consequently, UTokyo runs the oldest higher education institution for forestry or forest science and owns the oldest university forest in Asia.

At present UTF owns seven regional forests (The University of Tokyo Forests, 2017), each with a unique aim. UTCBF is focused on the management of conifer plantations. The University of Tokyo Hokkaido Forest (UTHF) aims to develop sustainable forest management by employing selection logging in a naturally mixed environment of conifers and broadleaf trees. The University of Tokyo Chichibu Forest (UTCF) focuses on research relating to the ecosystems of deciduous, broadleaf forests in the cool temperate zone. The University of Tokyo Tanashi Forest (UTTF) focuses on studies relating to urban forests and nurseries. The

Table 1: The number of staff affiliated to The University of Tokyo Forests in 2017.

Regional Forest	**Faculty staff [P-AP-L-A]***	**Technical staff**	**Administration**	**Total**
Headquarters & Education and Research Center (main campus)	4 [1-1-0-2]	3	0 (+2)**	7 (+2)**
Chiba Forest (UTCBF)	3 [1-0-0-2]	9	3	15
Chichibu Forest (UTCF)	4 [1-1-0-2]	24	5 (+1)**	33 (+1)**
Hokkaido Forest (UTHF)	4 [1-0-2-1]	9	3	16
Tanashi Forest (UTTF)	3 [0-0-2-1]	2	0 (+1)**	5 (+1)**
Ecohydrology Research Institute (ERI)	3 [0-0-1-2](+1)**	4	1	8 (+1)**
Arboricultural Research Institute (ARI)	2 [0-1-0-1]	3	0 (+1)**	5 (+1)**
Fuji Iyashinomori Woodland Study Center (FIWSC)	2 [0-0-0-2]	2	0 (+1)**	4(+1)**
Total	25 [4-3-5-13](+1)**	56	12 (+6)**	93 (+7)**

*: P, Professor; AP, Associate Professor; L, Lecturer; A, Assistant Professor.
**: Numbers in parentheses indicate the number of staff employed on particular projects.

Ecohydrology Research Institute (ERI) focuses on research in hydrology and the water cycle in relation to the rehabilitation of denuded forest lands. The Arboricultural Research Institute (ARI) focuses on the use of tropical and sub-tropical timber species and of non-wood forest products. The Fuji Iyashinomori Woodland Study Center (FIWSC) focuses on the recreational and healing functions of forests. For further details, see Owari *et al*. (this volume).

The number of faculty members belonging to UTF is 25, making it larger than any of the departments to which it is closely related (Tab. 1 and Tab. 2) (Faculty of Agriculture, The University of Tokyo, 2017). A total of 56 technical staff members support education and research at UTF (The University of Tokyo Forests, 2017).

Table 2: The numbers of faculty staff, undergraduate students, and post-graduate students in departments that are closely related to The University of Tokyo Forests.

Department	Faculty staff [P-AP-L-A]*	UG students (/Academic Year)	PG students (/Academic Year)
Forest Science	16 [6-5-1-4]	24	24
Biomaterial Sciences	16 [7-3-1-5]	24	24
Ecosystem Studies	13 [5-3-0-5]	9	24
Global Agricultural Sciences	16 [7-6-1-2] (+1)**	25	25

*: P, Professor; AP, Associate Professor; L, Lecturer; A, Assistant Professor.
**: Numbers in parentheses indicate the number of staff employed on particular projects.

International education opportunities at The University of Tokyo Forests

Opportunities for international education at UTF are shown in Table 3. UTokyo adopts a system of late specialization, in which students study liberal arts in the Junior Division for their first two years and then advance to two years of specialized studies in the Senior Division.

In the Junior Division, one seminar credit of university-wide, hands-on experience is compulsory for all students (The University of Tokyo, 2014). UTF provides a variety of programmes for gaining this university-wide, hands-on experience (Owari *et al*., this volume).

Four departments of the Faculty of Agriculture and some of UTokyo's graduate schools use UTF for their fieldwork practice courses (Owari *et al*., this volume).

A number of undergraduate and post-graduate students are affiliated with UTF and are supervised by its faculty members. Students from at least ten countries have been supervised at UTF. Students have been drawn, in particular, from China, Thailand, Indonesia, Myanmar, and Sri Lanka. Most of them have used UTF as the context for thesis research (Owari *et al*., this volume). In addition to these students, many undergraduate and graduate students belonging to UTokyo and other universities, and many researchers have conducted research for their theses at UTF. Students and researchers from around the world are welcome to make use of the

forests of UTF as a context for their research. The procedure for making a proposal is available on the Internet (The University of Tokyo Forest, 2017).

Table 3: International educational opportunities provided by The University of Tokyo Forests

Admission to The University of Tokyo for foreign students
Undergraduate
Regular courses: admission in Japanese language
Programmes in English at Komaba (PEAK): Admission and programmes are delivered in English
Research students: Allowed to attend course lectures, Preparing for admission
Post-graduate
Regular courses: Admission in English or Japanese
International Programme in Agricultural Development Studies (IPADS): Admission and programmes are delivered in English
Special Course for Sustainable Agriculture (Doctor Course): Admission and programmes are delivered in English
Field practice courses for foreign universities including summer school
Universiti Malaysia Sabah
National Taiwan University
Internship from foreign universities
France
UK
Canada
Malaysia
Training courses
Provided by Japan International Cooperation Agency (JICA)
Other programmes
Sakura Exchange Programme in Science by Japan Science and Technology Agency (JST)

UTF also provides study opportunities for students from outside Japan. Both professional and research internships have been offered to people from overseas. Summer schools and fieldwork practice courses have been provided for departments of foreign universities. UTF has also provided fieldwork training courses to foreign trainees under the auspices of the Japan International Cooperation Agency (JICA)..

Cooperation with other universities and Japanese associations

A fieldwork course for the School of International Tropical Forestry, Universiti Malaysia Sabah, was carried out at UTCBF, FIWSC, UTCF, and the main campus of UTokyo from April 7 to April 13, 2013. The summer school operated jointly by the National Taiwan University (NTU) and UTokyo/Tsukuba University has been held since 2016. Japanese and Taiwanese students visit each other every other year. In 2016, four students from UTokyo spent two weeks visiting NTU's Experimental Forest.

In 2017, 10 students from NTU, five undergraduate and five post-graduate, visited UTF and the university forests of Utsunomiya University. Several of UTF's regional forests have - regularly, or from time to time - provided fieldwork training courses for JICA projects. Topics have included selective logging in UTHF's

natural mixed forestry, conifer plantation and forest management at UTCBF, and monitoring biodiversity in the forest ecosystems of UTCF. The Japan Science and Technology Agency (JST) supports a Japan-Asia youth science exchange programme known as the "Sakura Exchange Programme in Science." UTF has been involved in a number of projects in this programme. First, the programme supported the NTU summer school in 2017. Second, UTokyo's Asian Natural Environmental Science Center has run a project for several years in which it invites potential graduate students from other Asian countries to study in Japan for a week. UTF offers this group tours of FIWSC and UTTF. Faculty members of UTF have also invited Asian students to join this project. Third, UTHF was involved in a project with a high school in Sapporo, which operates a science exchange programme with a high school in Singapore. UTHF provided a one-day fieldwork course for the high school students from Japan and Singapore.

Internships

UTF has accepted many students from foreign universities for both research and professional internships. Periods of the internship range from three to six months depending on the requirements of the universities in which students are enrolled. Students are not paid for the work during their internship because UTokyo is a not-for-profit educational institute and because we accept internship students as a part of our educational activities..However, they can stay in UTF accommodation for a very low fee.

Suitable faculty members are assigned to each research intern students according to their preferred field of study. This faculty member will teach the student the basic skills necessary for the research undertaken.

Where professional internships are concerned, students work alongside UTF's technical staff. Most of work undertaken in this way supports research and/or forest management.

Concluding remarks

The University of Tokyo Forests (UTF) serves as a rich international educational context for forest science. As a Japanese university forest located in Asia, UTF will strive further to strengthen its links with Asian universities. By taking advantage of its accumulated expertise and capacity, UTF is willing to act as an Asian hub to promote interregional exchange in forest science education with diverse parts of the world. We invite anyone with an idea for a future educational collaboration to contact us without hesitation. We hope that UTF will keep in close contact with the SILVA Network and exchange information on international educational activities relating to forest science.

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EDUCATIONAL FORESTS IN THE NETHERLANDS

PIETER SCHMIDT[10]

Abstract
Increasing attention to wood production lead to the necessity for owners of forest and nature areas to promote the knowledge and experiences in silviculture and forest management among their staff and work force. Contacts between the main forest owner (the State Forest Service) and the education institutes led to an agreement concerning the long -term use of indicated forest areas as educational forests. Here the considerations and relevant points in the agreement are discussed.

Key words: educational forests, State Forest Service, Schools, agreements

Introduction

The Netherlands is a densely populated small country with a growing forest cover of less than ten percent. Conflicting aims (recreation, conservation, timber production, CO2 storage) for forest management require high qualities of the graduates of the forestry schools in this country. In 2015 both the forestry schools as well as the main forest owner, the State Forest Service (Staatsbosbeheer), concluded it would improve the quality of the education if this education could be carried out in a forest permanently available for these schools. Based on this, they decided in 2016 to establish three Educational Forests. The first experiences will be discussed here.

Forestry and forestry schools in the Netherlands

The Netherlands is a small country (37.000 km2) with a growing population. The forest cover is low, less than 10 percent and - during the last year and against the general trend of the last years - diminishing (van den Knaap and von Meijenfeldt, 2018). From 1980 till about 2010 nature policy (including forest policy) was aimed nearly completely on conservation of nature and recreation, whereas wood production was neglected. Forestry education neglected during this period more or less the subject timber production in the curricula and forestry personnel lost their knowledge and experience here (Anonymous, 2016a). The largest forest owner is the State Forest Service (Staatsbosbeheer, further SBB, Anonymous, 2016a)
The education of foresters in the Netherlands is mainly concentrated in three schools (see Schilders and Schmidt, 2016[11]). Helicon Opleidingen (Helicon School, further HELICON (see Helicon, s.a.) offers education at the pre-vocational and

[10] Based on interviews with Harrie Hekhuis (SBB), Maarten Marsman (Helicon), Jan den Ouden (WU) and John Raggers (VHL).
[11] VHL offers actually only a four-year Bachelor degree.

vocational level. Van Hall-Larenstein University of Applied Sciences (further VHL, see VHL, s.a.) educates students at the professional level, whereas Wageningen University (further WU, see WU, s.a.) does the same at scientific level. Cross-over possibilities between the curricula of these three schools are available but only minimally used. These schools are about one hundred years old and offer study programmes changing according to the demands of the society. This means that between 1980 and 2015 in the curricula more attention was given to nature conservation and less to silviculture and forest management.

Around 2010 Dutch nature policy changed and forest and nature owners were made more responsible for their own financing, and thus forced to generate more money out of their estates (personal observation[12]). Timber production became important again. Many forest owners - -including SBB as the largest one - sensed the lack of relevant knowledge and experience. In-forest education and in-company education was started again. Schools should - following the demands of society - pay more attention to silviculture and forest utilization. Moreover, SBB and the forest schools realised again the possibilities and the importance of permanent educational forests.

Cooperation agreement educative forests

On February 17th, 2016 four partners signed an agreement on educational forests. These were SBB as the largest forest owner, making some forests available to the schools, and the three schools mentioned above as the users (see Figure 1). This agreement replaced older, not well implemented ones from the 1980s. I am citing below from a copy of this agreement (see Anonymous, 2116b), which is in Dutch and not published scientifically but archived in the administration of one of the schools (WU).

Figure 1: Signature of the partners on the 'Samenwerkingsovereenkomst'. Photo Jan den Ouden.

[12] The author was at that time member of the society council of Vereniging Natuurmonumenten (Society for Nature Conservation) and member of the editorial board of the Professional Journal Nature Forest Landscape. In both institutions this subject was discussed regularly.)

These partners based their agreement on ten considerations, of which I will cite[13] or paraphrase (in Italics) and discuss the for this paper most relevant ones.

- *Forest management is a long-term activity, during which biological, economical and societal values should be connected to each another continually. This requires professional skills and experiences, which both forests owners (for instance SBB) and forestry schools should take into account.* This is the basis for good forest management, which does not need to be discussed here.
- *It should be possible to test the topics to be taught to students in practice. Hence it is important to make the consequences of management interventions perceptible, possible to be traced and tested in the forest ecosystem. Forestry schools need forests to be able to do that.* Theoretical teaching in the classroom needs to be complemented by in-forest education.
- *The developments in the forests due to management interventions can be illustrated by continually testing in the forest with the aid of on the teaching function aimed at registration of data.* This is of course a large challenge for the schools, but research could profit too.

The other seven considerations concern history, non-adequate implementation of earlier agreements and internal intentions of SBB to enhance the quality of its personnel. They are not relevant here. All these considerations together led to this agreement in 2016 in which SBB made available three forest estates mentioned by name to the three schools as educational forests. In this agreement eleven items are described, of which five are relevant here:

- Cooperation
  - Partners cooperate in the field of education and research in forest management. SBB makes forests available for educational and research aims; schools consider in teaching and research the wishes of SBB and share the results with SBB.
  - No financial dues are generated by this agreement. Each partner bears his own costs; they are, however, obligated to issue the money. Translated from the agreement in Dutch: they have an effort obligation.
- Representatives
  - Each school appoints a contact person; SBB appoints two, one for the daily contacts (the local forester) and one for coordination.
- Aims: To the aims of education, research and cooperation belong
  - Educational environment, i.e. a concrete forest or field.
  - Experiments: interventions in these locations are quite suitable for development of new management strategies by implementing and recording them continually and showing them to students and colleagues.
  - State-of-the-art: on these locations it can be demonstrated how a responsible and sustainable forest company functions.

[13] Translated from Dutch.

  - Possibilities for transfer of new knowledge from schools to practice, both to SBB and other forest companies.
- Registration obligations
  - Schools are obligated to record all characteristics of the site and of the interventions. These records should be accessible for both SBB and schools.
- Responsibilities
  - The terrain has to be a normal part of the Dutch forest estate. SBB is responsible for the management, with SBB objectives - aiming at multiple functions - guiding and taking into account the wishes of the schools.
  - SBB is responsible for formulating and implementing annual plans, including interventions in the framework of education. These interventions could be delegated to the schools.
  - The schools are responsible for the education plans, which should not harm the SBB management aims.
  - Both schools and SBB will try to find funds inside their budget.

Implementation and experiences

Three forest estates were allocated as educational forests. All are situated on the Veluwe, the largest forest area in the middle of the Netherlands. The soils are mainly sandy soils. Of course, not all soil and forest types are available on these locations which can be and is compensated by excursions to other parts of the country.

Educative activities (practicals) were already since the 1960ties organised in these forests, partly in the framework of older agreements. These will continue, an overview is given in Table 1. This holds also for the marteloscope plots (see Poore, 2013) already established in two of these forests.

Excursions will continue too but it is not yet clear who will bear the costs of excursions from outside the schools and SBB.

Research plots existed already and continue to be monitored and new ones are established. WU is appointed as the research coordinator. Likely subjects are enclosures, non-paper administration, silvicultural treatments of *Prunus serotina,* an exotic (North American) tree species considered in the Netherlands as aggressive and invading. Some design work for better arrangements between the schools - for instance WU design level, VHL management level, HELICON (manual) execution level - could facilitate research here, perhaps also reduce costs.

In the agreement, monitoring by the schools is emphasized. They have to involve students here, both in practicals and in BSc-, MSc- and PhD-theses. The quality of monitoring by students, which is of course based on the instructions by teachers, is important. One school included in a textbook a drawing of the development of a

Table 1: Educational items* taught by Helicon, VHL and WU in one of the three educational forests

Title	ECTS
Helicon level 3	
Forest inventory and forest management plan	5
Stand evaluation	1
Tree species	1
Soil science	1
Practical forest practices	1
Helicon level 4	
Forest inventory and forest management plan	5
Stand evaluation	1
Tree species	1
Soil science	1
Practical forest practices	1
Forest inventory special	1
Practical final cutting**	PM
VHL-Bachelor	
Management plan for a part of one of the educational forests	7
Practical soil science	1
Practical thinning, forest development, forest ecology and evaluation function realization	1
Practical forest ecology and forest inventory	1
Forest Exploitation: thinning and rejuvenation	2
Practical Marteloscope	1
Elaborate to management issues based on questions from the forest manager	
WU Bachelor	
Field practical Forest and nature conservation I (mainly ecology)	3
Field practical Forest and nature conservation II (mainly ecology)	2
Minor projects in various courses	1
Short excursions	1

*) These educational items are integrated in larger courses. The number of ECTS is estimated.
**) Helicon tries to organize every year a Practical final cutting in one of the educational forests, but that proves impossible because not every year a final cutting is included in the forest management plan.

Douglas fir tree based on student practicals (see Figure 2): quality enough. On the other hand, teachers from another school are reflecting on new instructions to improve monitoring practicals. Here a better practical can be expected. Students, of course, are learning by doing and making mistakes and having them corrected by teachers. But, can management decisions be taken on the basis of students work? This is still an open question.

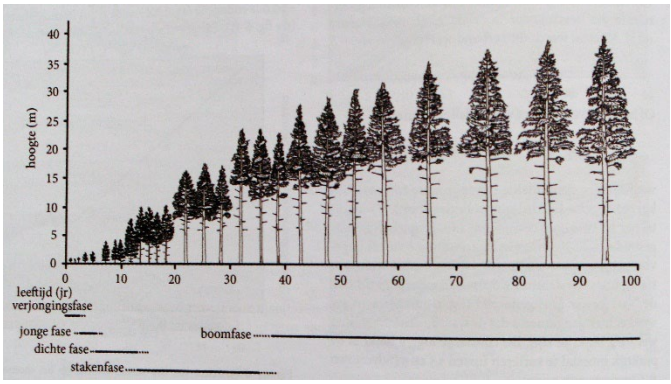

Figure 2: Development of a Douglas fir tree as drawn by students on the basis of their observations in the Speulder- and Sprielderbos. (source: Verheyen *et al*., 2016).

In the interview, SBB mentioned the establishment of some large (>10 ha) plots, each demonstrating one silvicultural management system. This is not yet implemented but will be very useful in future.

Discussion

In the one and a half year of functioning, quite a lot was established and some starting and perhaps running problems emerged. Schools are not involved in the formulation of aims and management guidelines of the educational forests. How free are they, for instance, in the choice of research subjects and how free are they in the choice of the silvicultural systems et cetera to be established? Do they have to comply always to SBB and work inside their aims and ideas? Independence of the schools in their choice of education and research is a great good.

SBB bears the management costs and gets the revenues, not the schools. This is a defendable choice made by the partners, but if schools were (co)responsible, it may be that they would be forced to make a better effort.

Costs of education and research are funded by the schools out of their normal budget or out of external (research) funds. Sometimes, SBB can help for instance by making posts available out of thinnings to be used for enclosures, which are established by students from HELICON in a practical (see Figure 3). On the other hand, it is clear that all partners have to spend more creativity, energy and attention to the educational forests than is possible with the current manpower (teachers, SBB managers) available. Partners have an effort obligation (see above) and for a successful further implementation should make extra funds available.

SBB appointed more than one contact persons, one as coordinator and three at the forester level, each responsible for one of the forest estates. Of course, the visions of these persons should match. Moreover, the foresters were already working in the forest estates and selected as good foresters; SBB is considering for a next appointment here to look for foresters with an affinity to education and research.

Figure 3: Posts for an enclosure being built by HELICON students during a practical. (Photo M. Marsman).

It is the intention of the partners to establish large plots to demonstrate a number of management and/or silvicultural systems. The best approach here would be to develop a broad long-term vision on forestry in the Netherlands, formulated by the four partners. Perhaps other representatives of forestry and nature management should be invited too. Future forestry practice and future forestry research should be included. Based on this vision management interventions and silvicultural systems can be chosen to be included in these demonstration plots. A special paragraph on cooperation between the schools should be included in the agreement to improve this cooperation on both education and research.

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IN-FOREST EDUCATION WITHOUT OWNING A FOREST – THE HAFL APPROACH TO SOLVE THIS CHALLENGE

MARTIN ZIESAK, CHRISTIAN ROSSET, JEAN-JACQUES THORMANN

Abstract
The forest science education at the School of Agricultural, Forest and Food Sciences (HAFL, Hochschule für Agrar-, Forst- und Lebensmittelwissenschaften) uses in-forest education extensively. However, HAFL does neither possess its own forest area, nor does it have a land-lease or other long-lasting contract providing forest access. Therefore, a blended strategy is used to give access to forest areas for teaching purpose. Depending on subject different approaches are used, which are presented here.

Keywords: Forestry, in-field education, university forest.

Introduction and Background

Forestry at the School of Agricultural, Forest and Food Sciences (Hochschule für Agrar-, Forst- und Lebensmittelwissenschaften, HAFL), at the Bern University of Applied Sciences (Berner Fachhochschule, BFH) is a young discipline: the BSc in forestry was established only in 2003. Since then a very positive trend characterises the development of this study programme. We track a permanent positive trend of incoming students (see Figure 1) respectively enrolled students. As a second indicator for this positive trend the addition of two MSc programmes may be mentioned (MSc in Life Sciences – Agricultural and Forest Sciences with either "International Management of Forest Industries" or "Regional Management in Mountain Areas").

One of the many success factors driving this positive trend may lay in the teaching approach. A first contact to forestry as a topic is allowed already in the first semester, our teaching offers "hands-on" experience for students in various ways. An "in-forest" education is firmly integrated into the syllabus and has many forms such as small field trips and extensive excursions, exercises in the forest, and field courses. Finally, the theses, likewise on bachelor and master level, offer or request very often direct access to in-forest sites or experimental forest plots. For all these elements a direct access to forest area is indispensable (see also Rosset, 2016).

However, when the forestry programme was established in 2003, neither forest land was given to HAFL, nor existed land-lease or other access right giving constructs for the university. These facts didn't change since then. So, the question is how do we cope with the challenge of in-forest education without owning a forest?

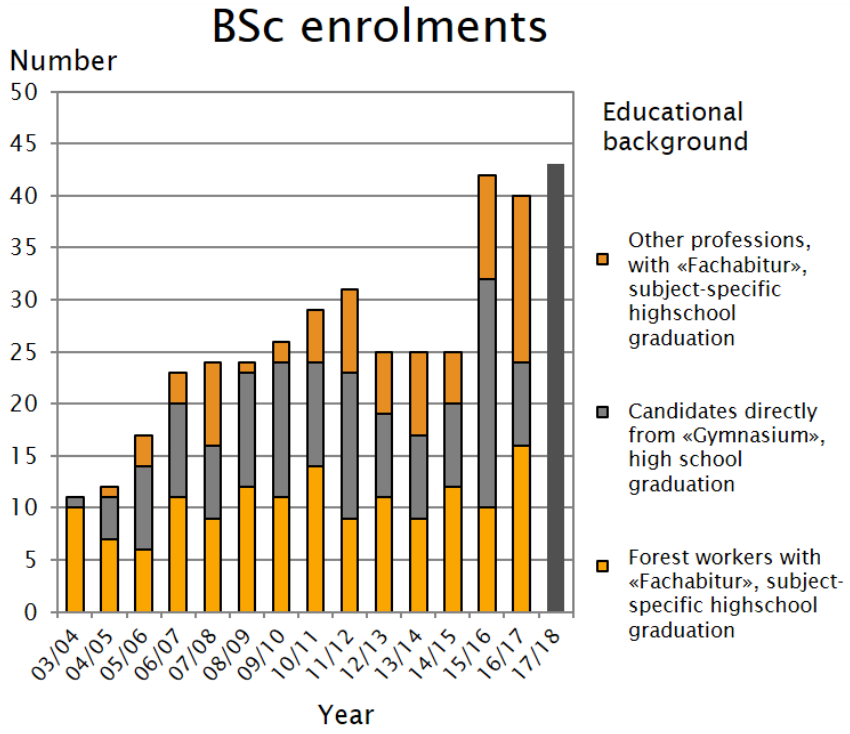

Figure 1: BSc. enrolment figures since 2003.

HAFL follows a heterogeneous strategy to compensate these apparently missing direct access rights to forests. They include installation or establishment of permanent in-forest sites for education purpose, direct agreements between forest owners and HAFL and strategic mixed access rights for a field research station. All of these need to be explained to make the intention understandable. This is given in the following sections.

Marteloscope "Meielewald"

The marteloscope "Meilewald" is located next to HAFL (less than 5' walk) and was established in 2016 by HAFL. It spreads over 2.2 ha, encompasses more than 15 tree species including exotic ones and is used to teach thinning in mixed stands, regeneration with different tree species and conversion in uneven-aged stands (see Figure 2). The principal idea of a marteloscope follows the original idea, to have a permanent plot within a forest for a multipurpose framework for selection and marking of trees under various aspects like forest growth, silviculture, forest operations etc..; this marteloscope idea is accepted and integrated in many educational training concepts (see Poore, A., 2011; Pommerening *et al*., 2015, Soucy *et al*., 2016). The forest owner is the Burgergemeinde[14] of Bern (BGB).

[14] A Burgergemeinde is a statutory corporation in public law in Switzerland (see e.g., https://en.wikipedia.org/wiki/Bü%C3%BCrgergemeinde for additional information).

There exists an agreement with BGB to leave the marteloscope without intervention for the next three years (oral agreement, not in written form).

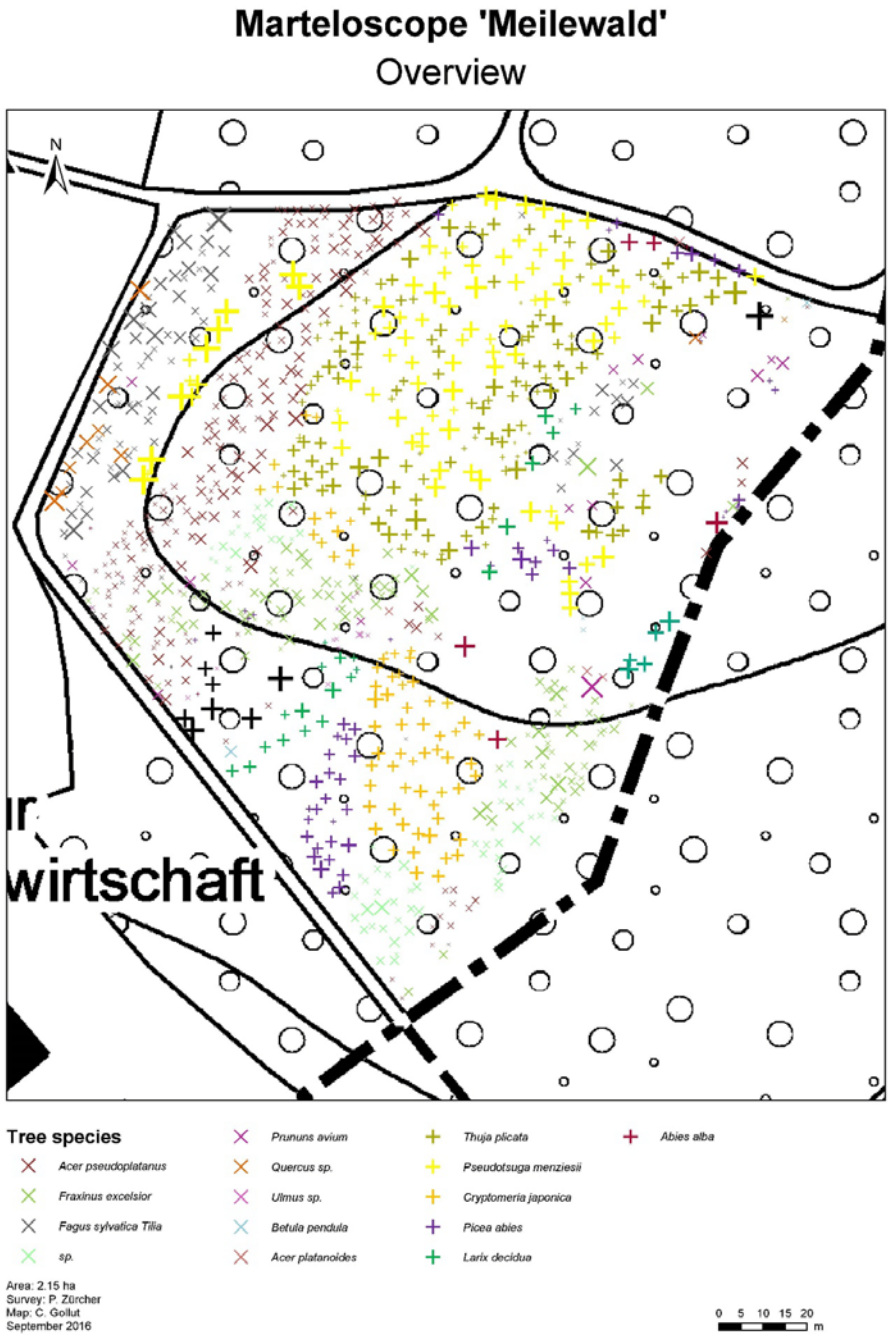

Figure 2: Marteloscope “Meilewald” close to the HAFL.

Network of silvicultural permanent plots
A network of silvicultural permanent plots for observation, experimentation and training was established 2017 by HAFL in collaboration with BGB within the framework of a project funded by the Federal Office for the Environment (OFEN). The forest owner again is the BGB. All the plots are located around the city of Bern within 20 km from the city centre. They are used intensively in teaching, mainly for the following topics: forest inventory, application of growth models and tree marking (thinning).

Currently, there are more than 35 plots ranging from several hundred square meters to half a hectare depending on the development stage and the main tree species of the plot (see Figure 3). The number of plots is growing each year, since students also learn to establish such plots for silvicultural monitoring and controlling purposes.

The network is also used by BGB for their own purposes (development of new thinning concepts, staff training). The plots are managed similarly to the rest of the forest area. The data of the plots are freely accessible on martelage.sylvotheque.ch. The web application is also used to train tree marking.

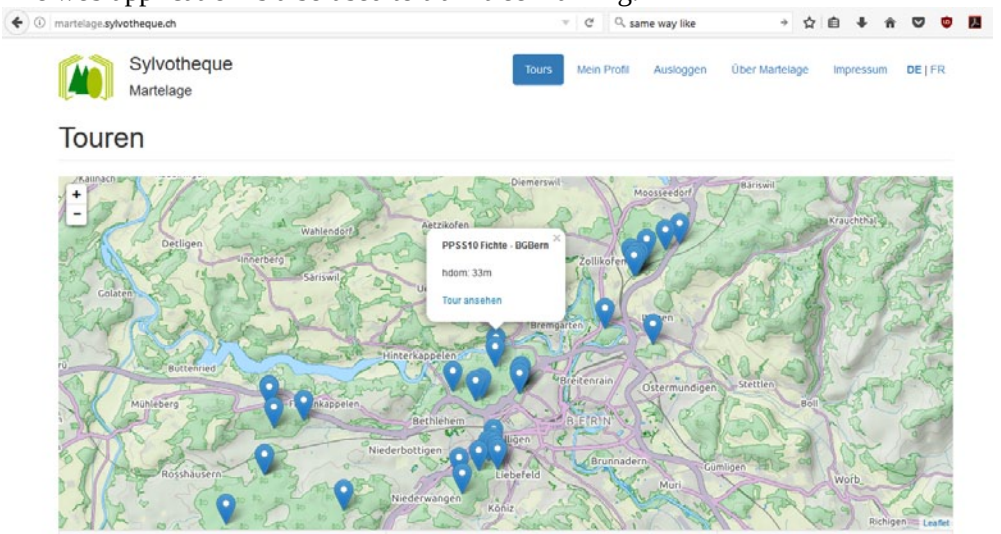

Figure 3: Network of permanent silvicultural sample plots around the city of Bern (screenshot from martelage.sylvotheque.ch).

Training trail for basal area measurement
A training trail for basal area measurement based on the Bitterlich method was established 2016 next to HAFL (less than 5' walk). It encompasses 18 plots with stakes in their centre located every 50 m (see Figure 4). The trail is part of the teaching in forest inventory. The ability of the students to measure the basal area correctly is evaluated with different counting factors.
The forest owner is BGB. The agreement on the part of BGB is in oral form, not written.

Figure 4: One of the training plot for basal area measurement with the Bitterlich method (trees with red circle to be counted with a counting factor of 4, trees with orange circle with k=2).

In-forest education in forest engineering at HAFL

While silviculture may use a kind of semi-permanent sites, i.e. re-usable installations as shown in the above sections, forest operations and work science are facing the need of varying operational spots. Therefore, the approach to compensate

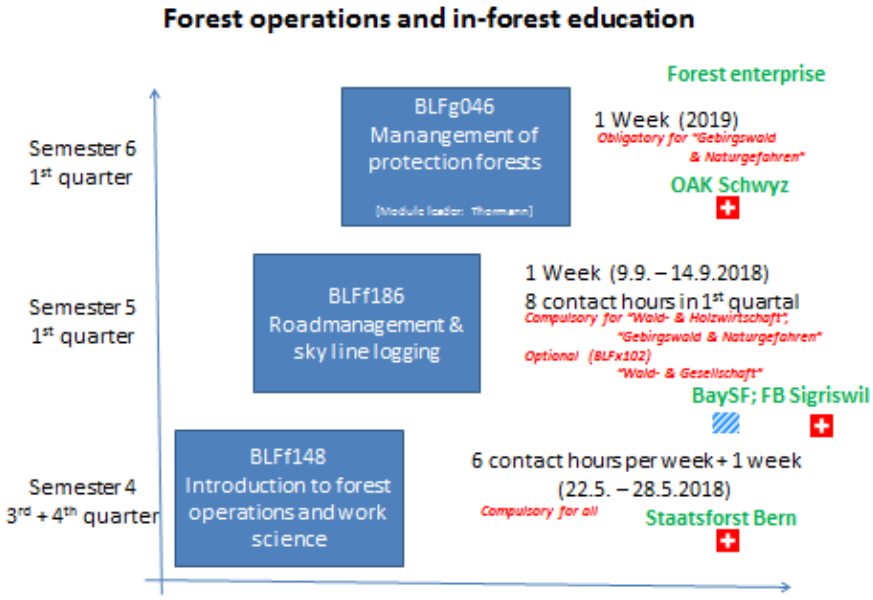

Figure 5: Set-up of forest enterprises, as included in the forest operations syllabus at HAFL.

the lack of having direct access to its own university forest site needs a slightly different strategy.

This approach for forest operations is embedded in the overall study plan as shown in figure 5. For the bachelor education there exist three separate modules, where forest operational topics are centred. As forest operations need to be reflected by the students in the context of forest enterprises, all major field activities are focused around in-forest practicals, block courses and excursions, which are all hosted by different forest owner types (marked in green text in Figure 5). This embedding in forest enterprises is of course dominated by Swiss companies:

- Staatsforst Bern (State forest organisation Berne) is hosting HAFL for a one-week block course, where forest operations in the biggest Swiss forest enterprise are shown and main principals of correct and optimal harvesting type selection is taught.
- The forest enterprise Sigriswil is hosting HAFL for excursions, in order to highlight forest road management principles in the context of a forest enterprise.
- At OAK Schwyz a "capstone course" in protective forest management includes a strong component in mountain forest harvesting and road management.
- An outside Switzerland perspective on forest enterprises and timber markets is given at the forestry education centre Laubau (owned and managed by Bayerische Staatsforsten AöR, Germany); the engineering part during this week is focused on sky line logging. This inclusion of a teaching action, taking place abroad at a different host institution, takes up some of the ideas as placed in the Bologna mobility thoughts, see Ziesak and Müller-Starck (2014).

The big advantage of being hosted by strong partners as mentioned above gives students direct access to a perspective on forest operations under the policy of different enterprises and management cultures. With this set-up the shortcoming of a not-existing university forest is so well compensated, that actually it is not perceived in the disciplines of forest operations and road management. It may be added, that for presenters from these companies respectively the company itself, a lump sum is paid. This helps to ensure a certain stability and reliability for these recurring courses.

Research and education centre "Hospice Chapella"
In collaboration with the foundation of Chapella, the owner of two old houses in the upper Engadine close to S-chanf, HAFL is initiating a centre for mountain forest research and education together with «Bildungswerkstatt Bergwald (www.bergwald.ch)», a foundation of an education network for young people of suburban areas working in forests, the local forest service and the municipality of S-chanf. The centre is close to the Swiss National Park and the tourist area of St. Moritz in the continental mountains of Switzerland (Figure 6). There is an accommodation for groups of a maximum of 32 people in the old hospice and workstations for up to 4 students and researchers in the future to do their field work for a bachelor, master thesis in the region (see also www.ospizchapella.ch).

Figure 6: Ospiz Chapella with the old church tower (Photo Thormann).

The centre is also an important basecamp for the new master course “regional management in mountain areas”, a collaboration with the University of Applied Science HSWT at Weihenstephan in Germany. Chapella is close to the border to Italy (South Tyrol) and Austria (Tyrol). So it is suitable for excursions with topics on regional management (agriculture, forestry, tourism and parks (Swiss National Park, Biosphera Val Müstair CH, Parco dello Stelvio I)), natural hazards and risk management.

Close to the centre, we installed in 2017 a new marteloscope in a spruce forest for training mountain silviculture on bachelor and master level.

Conclusion

It may appear as a major strategic disadvantage, when a university offering study programmes on forest science, does not own its private forest property. The described situation at HAFL, where no direct ownership rights to forest plots exist, shows some approaches, how academic forestry education even can be realised with great success. Some of the presented approaches need bigger effort until being implemented, while others can be realised in a very quick way. Therefore, some of these suggested solutions may also hold value for other universities as additional options in their in-forest education.

Reflecting the overall situation at HAFL two things become evident. The manifold approaches to enable direct forest access for in-forest education without owning the

forest proved to be quite successful over the last 15 years. Therefore, currently there is no tendency at all to aim for forest ownership at HAFL.

However, to secure the very good links with our partners, who provide forest access for HAFL, it may be advisable for the future, to put these links into bilateral, permanent and written agreements. This should secure good in-forest education for the decades to come.

The envisaged solution around the research station in Ospiz Chapella is a very important and helpful approach. This complements our strategy to get access rights and will help to compensate in the future even more the missing own direct access to infrastructure for in-field research and student education.

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THE ROLE OF UNIVERSITY FORESTS IN EDUCATION, SCIENTIFIC RESEARCH AND SOCIAL SERVICES AT BEIJING FORESTRY UNIVERSITY, P.R. CHINA

JUNCHANG LIU

Abstract
University forests are very important in academic forestry education. They are not only used for the in-forest teaching but also serve for scientific research and public education for people to gain knowledge of forests. Besides these functions, the university forests can also provide social services, such as camping and recreation. People can go into the university forests to enjoy the nature and relax.
Taking Beijing Forestry University as an example, this paper will describe the system of university forests in China, their categories, and their roles in forestry education, research and social services. Furthermore, this paper will also explain the development and management system of university forests, and key challenges to the university forests in the future.

Keywords: Tree farm, contracted forest fieldwork bases, university forest

Introduction: Beijing Forestry University

Forests are most important for the forest science education programmes at universities or colleges. They can provide field and research experience for students and professors. Therefore, Chinese universities have paid great attention to the university forests and have developed a university forest system. This paper discusses the general situation of the university forest system in China by taking Beijing Forestry University (BFU) as an example.

BFU is a key national university under the direct administration of the Ministry of Education (MOE) and technically affiliated to the State Forestry Administration (SFA). It is also listed among China's prestigious universities that are entitled to enjoy financial support from the country's educational initiatives like the Innovation Platform for Prioritized Academic Disciplines and the Higher Education Reinvigoration Project 211.

The history of BFU dates back to 1902. Originally known as the Forestry Section of the Agriculture Department of the Imperial University of Peking (Jingshi Daxuetang, the predecessor of Peking University), an independent Beijing Forestry College (BFC) was set up in 1952, which was one of the earliest higher education institutes in the country specializing in forest studies. Thanks to the unrelenting efforts of all the faculty members and students over the past more than sixty years, BFU has developed itself from a specialized college in forestry to its current status

as a comprehensive university with leading positions among its counterparts in disciplines such as forestry, soil and water conservation, desertification control and prevention, landscape architecture, biology, and forest engineering. BFU also offers extensive coverage of additional disciplines in agriculture, science and technology, economics and management, liberal arts, fine arts, law, and philosophy. Around 100,000 forestry professionals and overseas students have emerged from BFU as the builders of the country, including 13 celebrated academicians and a great number of distinguished scientists, researchers and managers.

Currently, BFU is organized into fourteen schools of studies, a Graduate School, a School of Continuing Education and a School of International Studies, offering 57 undergraduate programmes, 116 Master's programmes, 39 PhD programmes and five post-doctoral research stations. With three distinguished academicians in the leading, a highly competent teaching staff provides high-quality education to 32,000 students, consisting of 13,000 undergraduates, 4,100 graduates, 13,000 continuing education students and 1,700 part-time graduate students. Partnerships have also been established between BFU and over 170 higher education institutes, research institutes or NGOs throughout 30 countries and regions to carry out cooperative endeavours in education, scientific research and technologies.

In-forest education has played a very important role in the forestry programmes at BUF. Like the other Chinese forestry universities, BFU has formed its Teaching and Researching Support System which includes a forest tree farm controlled by BFU in Beijing, two contracted comprehensive forest fieldwork bases controlled by forest companies with funding from BFU and more than ten contracted forest fieldwork bases controlled by forest companies without administrative involvement by BFU (Figure 1). A few examples of these bases are: the experimental, demonstrative and promotional base for new forestry technologies in northern China, the comprehensive fieldwork base in the forest regions in southern China (located in Sanming city, Fujian province), the innovation and conversion base for technologies applicable to woody materials, the demonstrative site for quality seeds applicable to afforestation projects on the plains in northern China, and the base for economic forests (Chinese species) breeding and planting. The Teaching and Research Support System has provided strong support for academic forestry education and research projects.

The general description of the university forest system

The forest tree farm of BFU

The tree farm is controlled and managed by BFU. It is located northwest of Beijing, 28 km from BFU campus. The total land area of the farm is 832 ha of which 795 ha is covered by forests (see Figure 2 and 3) and the remaining land is used for management housing, student dormitory, teaching and research facilities, recreation facilities, and guest house. Mixed plantation forest constitute the main forest type of

the farm. The main tree species are Chinese arborvitae (*Thuja orientalis*), Chinese pine (*Pinus tabuliformis*), cork oak (*Quercus variabilis*), larch (*Larix sp*.), and

Figure 1: Location of the more than ten fieldwork bases of BFU in China.

Pinus amandii. Planting was intensive during the 1950s and 1980s. At present, very few plantations are made annually. The estimated total stem volume of the forest is 49 m3.ha-1, and an annual increment of 1 m3.ha-1. The crown coverage is estimated at 96.5%. There are 955 plant species and 536 insect species. Due to prohibition by the local government, there is no commercial logging in the farm. The main silvicultural and forest management operations carried out are forest tending, fire protection, and pest control. All of the cost for the farm is paid by BFU, and consequently, any revenue from the farm should be turned over to BFU. Recreation activities are the primary source of revenue from the farm. Currently, it is about US$ 360,000 each year.

Figure 2 and 3: Forest tree farm of BFU.

The overarching objective of the farm is to support teaching and research in forestry. There are about 30 courses at BFU which use the tree farm for teaching and practice each year. The courses are on plant sciences, entomology, soil science,

surveying, forest management, silviculture, forest fire protection, environment planning etc.

Figure 4 (left): Experts in fieldwork for plant germplasm survey. Figure 5 (right): A meteorological field station.

The forest is also a research place for professors (Figure 4). Currently there are more than ten research projects on the farm that focus on precipitation changes by forest (see Figure 5), technology for soil and water conservation by forests in North China (see Figure 6), a study on species selection by shrub forest, etc.

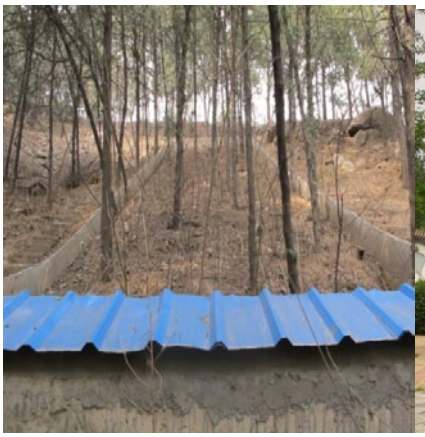

Figure 6 (left): Chinese arborvitae in the sloping land. Figure 7 (right): Recreation activities.

In addition to supporting teaching and research of students and teachers from BFU, the farm also provides several public services due to its proximity to the urban district. The main public services provided by the farm are as follows:

- The university forest accepts students from other universities in Beijing to learn and practice their plant and biology knowledge. For example, in 2015, 3600 students from seven universities in Beijing visited the forest to do their field work.

- The farm is also a practice base of science education for primary school and secondary school students at Beijing. More than 2000 students visit the farm to gain knowledge about trees and forest each year.
- Since its nomination as a National Forest Park in 2003, the forest serves as a forest park for the local people (Figure 7). More than 200,000 persons visit the forest each year.

Contracted forest base with funding from BFU

China is a large country. The climatic and natural conditions vary greatly within the country. As a result, the tree species in North China are different from tree species in the South. Forestry students need to go to different places to do their field practice. Therefore, BFU has developed two contracted forest bases. One is located in South China, Sanming forest experiment base, Fujian province, with 20 ha of nursery, 24 ha for tree species collection, and 2000 ha of forest (see Figure 8). The general office, laboratories, greenhouse and dormitories cover three ha. The distance from Beijing to Sanming forest experiment base is around 2000 km. BFU signed a contract with the local government in 2009. Based on the contract, BFU funded the establishment of the general office, laboratories, greenhouse and dormitories, and the purchase of equipment for teaching and research.

The other forest base, Pingquan forest experiment base, is located in Hebei province in Northeast China with 20 ha of nursery, two ha for tree species collection and 670 ha forest (see Figure 9). Based on the contract, BFU funded the establishment of the general office, laboratories, woodworking shop, the chemical processing shop of forest products and dormitories, and the purchase of equipment for teaching and research. The distance from Beijing to Pingquan forest experiment base is around 300 km. The contract with the local government for this forest base was also signed in 2009.

Figure 8: The comprehensive fieldwork base in southern China (Sanming city, Fujian).

The bases are managed by the local state forest farm. However, the farms take the requirements from BFU and make the forest suitable for university purpose. The

students and professors go to the two bases for field training and forest research projects each year without paying to the local government. The local government bears the management expenses.

Contracted forest base without funding by BFU
Besides the two bases, BFU has also developed more than ten contracted forest bases across China, which are not funded by BFU. The students and professors go to these forest bases for learning and research according to the courses and research project requirements (see Figure 10). BFU is not required to pay for the field study and research work. Nonetheless, the forest companies will receive technical support from BFU.

Figure 9 (left): The comprehensive fieldwork base in northern China (Pingquan County, Hebei). Figure 10 (right): Xiaolongmen Forest Farm in northern China.

The challenges to the university forest system

The university forest of BFU has played an important role in the university education and scientific research for the last several decades. Despite, during the last 40 years, it has faced numerous challenges due to changes in the governance and the economic system. Its main challenges are as follows.

Forest management of the contracted forest bases has become unstable. The contracted forest companies have paid more attention to economic returns. In most cases, the forest management decisions are made to maximize the economic returns from forests. Sometimes, these decisions are not very appropriate for university education or research. Because BFU cannot directly influence the management decisions at the bases under contract, the overall forest management has, in many instances, taken a direction that does not contribute to the study and research objectives of the forest. As the company leadership has changed several times, company vision and management directions have also changed over the course.

The relationship with the contracted university forest bases is not steady. Most contracts were signed during the last 20 years. The oldest one has now expired. While contract renewal might have been a solution, but over the years, some forest companies and tree farms have not honoured the contract. Therefore, BFU is looking to sign new contracts with other forest companies. This change in

management does not particularly benefit the growing education and research needs of the forests.

Recommendations for the future

To improve the university forest system, the university can take the following measures.

- Establishing a union of university forests by all relevant teaching institutes. Currently in China, there are six independent forestry universities, one forest policy college, as well as many forestry colleges or forestry-related majors established in study programmes at other universities, colleges and secondary vocational schools. The universities or colleges are located in different places around China. And all of them have their own university forest. The purpose of all these university forests is identical. Hence, they can form a union and share their forest.
- Strengthen the relationships with contracted forests companies. In the future, the university should strengthen the relationship with the forest companies with more input including funding, technical support and training, etc. In the long run, the university should manage the contracted forests themselves to make the forests meet the university education and research needs.
- Strengthen the Industry-Academia-Research Integration Bases. During the last ten years, BFU has invested considerable efforts to set up a new model which is called Industry-Academia-Research Integration Bases. To facilitate this, numerous fieldwork bases have been set-up throughout the country. A few examples of these bases are:
    - the experimental, demonstration and promotional base for new forestry technologies in northern China;
    - the comprehensive fieldwork bases in the forested regions of southern China (located in Sanming city, Fujian province);
    - the demonstration site for the development and industrialization of fine quality floral seeds;
    - the innovation and testing base for technologies applicable to woody materials;
    - the demonstration site for quality seeds applicable to afforestation projects in the plains of northern China;
    - the base for economic forests breeding and planting.

This new model will help BFU further enhance the forestry education, research and practice.

LEARNING EXPERIENCES IN THE FORESTS AROUND FREIBURG (GERMANY)

SIEGFRIED LEWARK

Abstract
The study programme of forest sciences was established at the University of Freiburg in 1920 – the main reason named for the choice of Freiburg was the diversity of forests around the city, which would serve for learning in the forests as well as for research. These forests today mostly belong to the City of Freiburg and the State of Baden-Württemberg. The forests closest to the university may be accessed on foot, by bicycle or tram.
The forests around Freiburg are suitable for learning experiences in virtually all subjects of the forest related study programmes and have been extensively used all the time. Good relationships have been maintained between the staff of the forest management and the teaching personnel of the university.
It is concluded that for in-forest learning it does not necessarily need university owned forests.
Examples for personal experience of the author as student and as teacher are presented, including courses from the fields of forest utilization, forest work science and forest road construction as well as the ESPRO (First-Semester-Project).

Keywords: University of Freiburg, history of higher forest education, in-forest education, teaching staff.

Historical background

The first professor for forestry at the University of Freiburg was Johann Jakob Trunk, from 1787 to 1792. Afterwards forestry courses were held at different places in parts of Central and South-Western Germany, which today belong to the states of *Hessen* and *Baden-Württemberg* (Hildebrandt, 1971). Nearly 100 years ago higher forestry education was newly established at the University of Freiburg, as described by Hildebrandt (1971) on the occasion of the 50-years-anniversary of forestry education and research, and later in his dissertation by Lickleder (2009). When merging the earlier study programmes from Tübingen and Karlsruhe, there was some argument about the appropriate new location. The main reason for the final decision for Freiburg, apart from political considerations, was the great variety of site conditions and forest stands around the city (Mantel and Botter, 1957).

The broad range of sites begins in the west in the Rhine valley with a climate and soil suitable for wine growing, which was done since Roman times, and includes the mountain of *Kaiserstuhl* with its volcanic past and soils, the warmest regions in Germany with plants otherwise only growing in the Mediterranean area. In a semi-circle east of the city of Freiburg the *Schwarzwald* (Black Forest) extends from

moderate elevations around the city up to the peak areas of the mountains *Schauinsland* and *Feldberg* with elevations well above 1000 m a.s.l.

Utilization of the forests has been connected with the history of the city of Freiburg for nearly 1000 years. Wood was needed for silver mining; fuelwood and construction timber was transported to Freiburg from the Black Forest by water, the facilities used for it are still traceable. The Gothic cathedral still has the original wooden roof frame from medieval ages.

The forests around Freiburg

The forests around Freiburg have been used for in-forest education from the beginning of higher forestry education in Freiburg, and they still are. The forests are owned today on one hand by the state of *Baden-Württemberg*, on the other hand smaller and larger forests are privately owned or municipal. The forest owned by the City of Freiburg is situated around the city, from the Rhine valley up to the 1253 m of the mountain *Schauinsland*, and has a size of more than 5200 ha, more information online as "facts about the forests" (Waldfakten: Anon., no year). The forests closest to the university may be accessed on foot, by bicycle or tram, as the participants of the excursion on foot on the occasion of the SILVA Network conference 2007 experienced.

University-owned Mathislewald
There is also a forest of 112 ha owned by the university through the Müller-Fahnenberg Foundation, named *Mathislewald* (Simon and Reif, 1998), and another forest patch of 15 ha. The *Mathislewald* was inherited by the university in the 1950s and is today managed and used by the Faculty of Forestry respectively its successor, the Faculty of Environment and Natural Resources (unr, no year a)). The forest is situated between 880 and 950 m a.s.l., with a potential natural tree vegetation dominated by beech and fir and some spruce and sycamore maple. A creek is flowing through the forest and there is an artificial pond of 1,9 ha.

Mathisle-Mühle and SILVA Network
In the *Mathislewald* there is a building in traditional Black Forest style, with a tiled stove, from the 18th century, *Mathisle-Mühle* (Photo 1), earlier a water-driven mill (unr, no year b)). Today it is renovated and contains a seminar room and sleeping rooms for up to 19 persons. It is primarily used for seminars within the study programmes of forestry, but also of geo sciences and medicine. There are clear priorities, next to use for teaching it may be rented privately by faculty members.
The *Mathisle-Mühle* is also connected to the history of SILVA Network, as in 1992 one of the early annual meetings took place in this building. The organizer Pieter Schmidt, the then president, and the author took part.

Photo 1: Mathisle-Mühle in 1970 (Photo S. Lewark)

Higher Forestry Education Courses held in Freiburg's forests

The different disciplines today use the forests around Freiburg to varying degrees and in different ways, for course work, excursions and demonstrations as well as for theses on Bachelor, Master and Doctor level.

At the excursion during SILVA Network conference of 2007 in Freiburg the First-Semester-Project (ESPRO) was presented, like it was conducted in many years in the forest of the city (Photo 2). There is a report on ESPRO in the proceedings of the Valencia annual conference 2006 (Lewark *et al*., 2007). The three-weeks project was started in 2002 and after the implementation of the Bologna structures included within several Bachelor and Master programmes at the faculty. ESPRO always starts with an orienting forest excursion where a broad range of issues from a variety of study subjects will be brought up and elaborated in group work. It is not a presentation of teachers' views but a presentation of problems in the forest with the challenge for the students to find possible answers, according to their pre-knowledge and experience. Quite a number of them have pre-university experiences in forestry.

Course work in *Mathislewald* in the natural sciences disciplines within the forestry programmes have been described by Simon and Reif (1998). Descriptions of all courses with their in-forest parts have been included in the course catalogues of the

forest sciences curriculum of 1995<, thereafter in the course catalogues of the multitude of Bachelor and Master programmes, which were introduced according to the Bologna process. The guide of the current teaching modules are available online (unr, no year c).

Photo 2: ESPRO-Excursion 2006: last information before swarming out for group tasks (Photo: S. Lewark)

Courses of forest utilization, forest road construction and forest work science
My own first learning experiences as a forestry student 50 years ago in the forests around Freiburg are still well remembered, starting with e.g. plant collecting for a herbarium and classification of plant societies, insects and soil types, of course accompanied and followed by many individual forest visits, and many visits to *Mathisle-Mühle*, as responsible student (*Hüttenwart*).

As a teacher I participated, except for ESPRO, in the courses of forest utilization, forest road construction and forest work science. Compact courses in these fields have been presented at the SILVA Network annual conference in Bern (Lewark, 2016), including more detailed descriptions of a course of forest road construction and one from forest work science. While the courses of forest utilization were offered already in the 1970s, the courses of forest work science started with the study programme of 1995. Following the idea of learning by doing stress and strain is assessed with students e.g. pruning forest trees, carrying out and evaluating time studies.

The compact courses in forest road construction were started even earlier, by Steinlin in *Mathislewald*, where planning was trained using the same road several times. Later a project approach was established (Becker, 1986): "a task from practical forestry is performed…: the planning of a forest road to be constructed later based on the project results from the course. Forest roads built after earlier courses [are] visited during the course, in order to demonstrate the practical relevance of the task and to help students to imagine the path from their project work to future realisation." (Lewark, 2016).

Cooperation with forest management staff
In many cases course work, assignments and excursions are held or supervised by the staff of the university only. In other cases there is more or less intensive cooperation with the staff members from forestry and also from nearby wood industry, including providing data or demonstrations.
Staff of forest management in state forests or city forests may be selected with respect to interest in this cooperation. Often graduates try to get employment in the vicinity of Freiburg, especially after doctoral dissertations in cooperation between science and practice.

Cooperation with the Forest Research Institute Baden-Württemberg
Some especially qualified forestry professionals continue with scientific work, especially in the Forest Research Institute Baden-Württemberg (*Versuchs- und Forschungsanstalt Baden-Württemberg, FVA*), and some are habilitated by the university. After additional years of scientific work and publications those may get the degree of external professors and then are regularly involved in teaching, with a limited number of teaching hours.

Experiences and Conclusions

There are many courses in the study programmes which include in-forest teaching and learning parts. In-forest learning in the forest related study programmes of the University of Freiburg to a great extent relies on the forests around the city. The university owns only a small forest itself through a foundation. Otherwise the forests used are municipal, private or state owned.
Access to the forests does not pose problems. If data on stands, operations or management decisions are needed, or other background information from the forest management staff, or demonstrations of forest operations, all is provided, within reasonable limits. There are in general good personal relationships between university and forest management staff, certainly partly because many practitioners who have graduated at the university purposefully and successfully tried to get positions in the vicinity of the university.
The experiences in Freiburg's forests demonstrate, that it does not necessarily need university owned forests for extensive and fruitful in-forest learning. But in any case, it needs accessible forests.

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THE TRAINING FOREST TRAIL OF THE DEPARTMENT OF FORESTRY, HOCHSCHULE WEIHENSTEPHAN-TRIESDORF, UNIVERSITY OF APPLIED SCIENCES, GERMANY

CARSTEN LORZ AND MARTIN HECKNER

Abstract
As part of the programme BA Forest Engineering at Hochschule Weihenstephan-Triesdorf, University of Applied Sciences (HSWT), Department of Forestry we introduced a Forest Training Trail (FTT) to complement our curriculum with a strong focus on applied training in the field.
The core of the FTT is (i) the trail itself with several sites with different focus and (ii) a questionnaire. Every semester a new trail at a new site within the training forest is set up. Usually, the trail encompasses four to six stations, each station representing a thematic focus of the training in the BA "Forest Engineering", e.g. vegetation, silviculture, hunting, environmental protection, soil or other aspects. The students form teams of three and walk the FTT with a questionnaire and a map of the trail. After the deadline for handing in the questionnaires a master solution of the FTT is published on the faculty homepage in order to give students an opportunity for a self-feedback.
The results of the regular evaluation show a high acceptance by the students. Our conclusion after four years of experience with the FTT is that the design as competition and game including a trophy resulted in a very high acceptance and participation with joy.

Key words: Forest training trail, self-activation, competition, game.

Introduction

Hochschule Weihenstephan-Triesdorf, University of Applied Sciences (HSWT, s.a) is located in Upper Bavaria north of Munich (Figure 1) with a focus on so called "green disciplines". The university has a unique portfolio of disciplines including agriculture, horticulture, landscape architecture, forestry and food technology. These disciplines are organized in seven departments with a total of 6400 students and nearly 150 full professors. The department of forestry offers a programme "BA Forest Engineering" with a traditional portfolio of subjects, i.e. the core disciplines of forestry, such as silviculture, forest harvesting technology, site ecology, forest economics and nature conservation. The programme aims at students interested in an academic degree with a strong practice context. Graduates will find job opportunities in forest companies, in forest districts in public, corporate or private ownership, in forestry consulting, in wildlife management, in nature conservation or in international forestry. The structure of the programme consists four major

sections, (a) training in basic subjects, e.g. economy, botany, informatics, soil science, law, zoology, ecology, forest harvesting, forestry organization etc. in semester 1 and 2, (b) semester 3 is focused on an internship and a study project, (c) in semester 4 and 5 mostly the specific forestry subjects such forest economics, silviculture, forest harvesting technologies etc. are taught while semester 6 is dedicated to a 6 month internship in a forest company or forest related institution, (d) semester 7 is mostly the bachelor thesis. The minimum study time is 7 semester, the average study time is around 8 semester. The programme accounts as all BA programmes at our university for210 ECTS. For more details see Rothe (2016).

Since the programme is very focused on hands-on training and early first-hand experience for the students, a major part of our programme takes place in the nearby training forest, which is owned by the Bavarian State Forest Enterprise (Figure 1). Field training includes courses in botany, soil science, silviculture, forest harvesting, etc.

Figure 1: The training forest of the HSWT, the Forest Training Trail is located in the training forest and usually less than two km from the department (map from Geoportal Bayern).

The training forest covers an area of 1,488 ha. The prevailing tree species by area are Norway spruce (*Picea abies*, 47 %) and European beech (*Fagus sylvatica*, 11 %). Other tree species are larch (*Larix spec.* 7 %), Common oak (*Quercus robur*, 5 %), Scots pine and Silver fir (*Pinus sylvestris* and *Abies alba* 4 % each) and Douglas Fir (P*seudotsuga menziesii*, 2 %). Smaller areas are covered by valuable hardwood (*Fraxinus, Acer, Tilia*) and other deciduous trees (*Populus, Salix, Alnus, Betula*) with total shares of 12 % and 8 % respectively. Soils are mostly loess influenced and show a high available water capacity and fertility. The mean annual precipitation is around 820 mm and the mean average annual temperature is around

name of team _____

HOCHSCHULE
WEIHENSTEPHAN-TRIESDORF
UNIVERSITY OF APPLIED SCIENCES

Station A

What is the parent material of soil formation in the presenst soil pit?

_____

_____

What are the major processes of soil formation and major horizons?

_____

_____

Give soil type and type of humus!

_____

What are the resulting site characteristics (water, nutrients)

_____

Give the potential natural forest vegetation!

Give the suitability of tree species for this site!

	high	moderate	low	exclude
Silver fir				
Norway spruce				
Scots pine				
Douglas fir				
Eur. beech				
Common oak				
Sycamore				
Wild cherry				
European ash				
Common alder				

Give the name of the grass around the soil pit!

_____

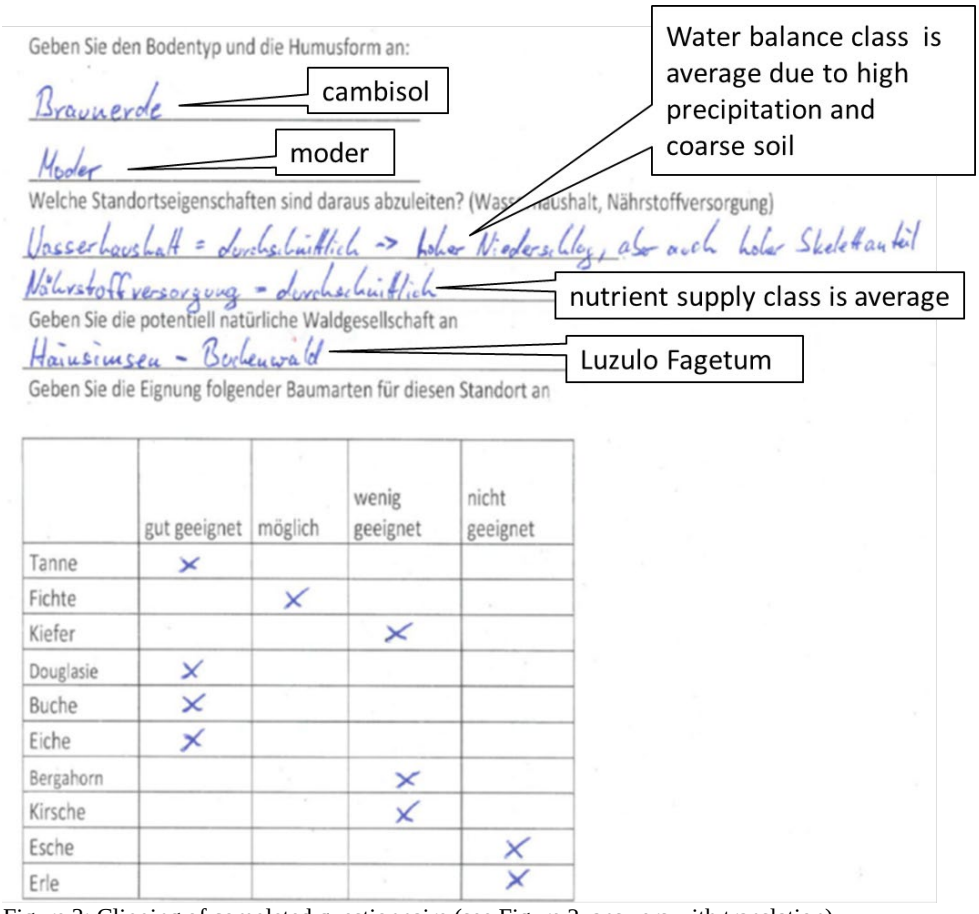
The grass is an indicator for what soil condition? _____

2

Figure 2: Page of the questionnaire (translated from German) dealing with the parent material of pedogenesis, soil forming processes, organic layer, soil type, site quality, vegetation, and suitable tree species.

8° C for the period 1961-1990. The average standing volume per hectare is 396 m^3; and annual increment accounts for 15 m^3ha^{-1}. Annually 15.300 m^3 of timber are harvested.

We introduced the Forest Training Trail (FTT) inspired by a similar trail at a partner university in Finland. The basic idea of FTT is to give the students the opportunity to train and test their skills in all aspects of academic training in a game-like competitive work. We started the FTT in the summer semester 2013 and implemented the FTT in our curriculum of Forest Engineering as an obligatory element with 5.5 credits. There is no specific target semester for the FTT. We encourage lower semester students to participate as training and accept even higher semester students who have already passed the exam.



	gut geeignet	möglich	wenig geeignet	nicht geeignet
Tanne	x			
Fichte		x		
Kiefer			x	
Douglasie	x			
Buche	x			
Eiche	x			
Bergahorn			x	
Kirsche			x	
Esche				x
Erle				x

Figure 3: Clipping of completed questionnaire (see Figure 2, answers with translation).

The core of the FTT is (i) the trail itself with several sites with different focus and (ii) the questionnaire (Figure 2 and 3).

Every semester a new trail at a new site within the training forest is set up. Usually, the trail encompasses four to six stations, each station representing a thematic focus of the training in the BA “Forest Engineering”, e.g. vegetation, silviculture, hunting, environmental protection, soil or other aspects.

The students form teams of three and walk the FTT with a questionnaire and a map of the trail; both are provided through the home page of the department. The questionnaire (Figure 2) encompasses usually five to six pages, i.e. one (1) page per station.

There is only an assessment of the team achievement, i.e. the team achievement is the same for each team member. The idea behind having teams is to encourage students to work together as training for the real world. Students are free to find their team. However, students are expected to work out all tasks of the trail within their team but without any external support. The results are recorded as percentage of the maximum obtainable points for each student. The exam is considered as passed when the student reaches 100 % or more cumulatively in one or more runs. However, only one run per semester is allowed. The result of all runs is cumulated. Usually after the second or third run the requested 100 % are reached. The number of runs is not assessed. All filled questionnaires must be handed in within two weeks from the start of the FTT. After the deadline for handing in the questionnaires a master solution of the FTT is published on the faculty homepage in order to give students an opportunity for a self-feedback.

Figure 4. FTT trophy on display in the entrance area of the department.

The best three teams, out of around 90 teams, will be announced in an award ceremony either in the summer during the Forestry Olympics or in the winter during the departmental Christmas party. The best team is awarded the Forestry Cup with their names engraved (Figure 4). The first three teams receive vouchers sponsored by a forestry outfitter. In addition the best first semester team receives a consolation prize to appreciate their achievements, since usually students of the first semester have not yet the knowledge to answer all the questions correctly.

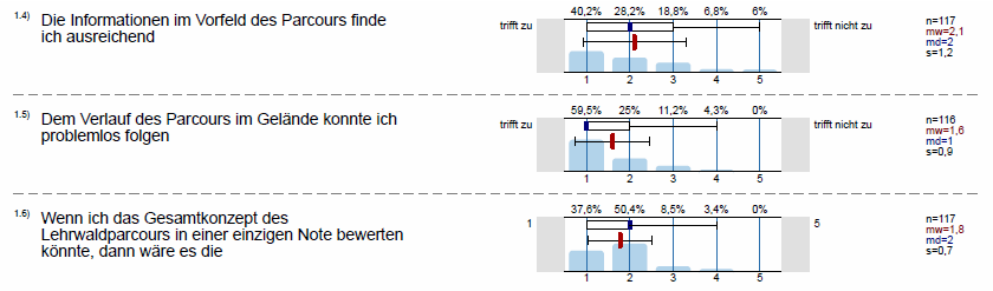


Figure 5: Detail of the Evaluation Report for the FTT (Software EvaSys), upper section "the up-front information on the FTT is sufficient", middle section "the course was easy to locate in the field", lower section "If I would give a total mark of the training trail it would be …".

The student feedback on the FTT course showed every semester very high ratings. The mark given by students for the overall concept was 1.8 (1 = highest approval, 5 = lowest approval) and was above the average mark of all lectures (Figure 5). Another indicator for the very high acceptance is the frequent participation of students who already passed the FTT in the past. For training purposes and competition we allow students a multiple participation in the FTT. In addition, we got an informal very positive feedback from professors, employers and guest of our department - none of them are allowed to participate - on the idea of the FTT. One of the authors (HM) is responsible for the organization of the FTT and involves if necessary relevant colleagues. The working load for the organization, i.e. preparation, assessment etc. is rather moderate (70 working hours per semester) The FTT needs a moderate input of working hours

Our conclusion after four years of FTT is that the design as competition and game including a trophy resulted in a very high acceptance and participation with joy.

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THE MENDEL UNIVERSITY IN BRNO, FACULTY OF FORESTRY AND WOOD TECHNOLOGY, AND ITS MASTER PROGRAMME EUROPEAN FORESTRY

DAVID SÍS

Abstract
Mendel University in Brno has a rich, 100 years old history. From the beginning two main faculties Agricultural Faculty and Forestry Faculty existed. During the following century, among others influenced by political developments, faculties were added or removed from the central core of agriculture and forestry. In 1995 this university adopted the name of Mendel University. Nowadays the Faculty of Forestry and Wood Technology is the center for forest, wood, furniture university education and research. There is rich cooperation with foreign faculties. At the faculty there is master study programme European Forestry, which is completely taught in English language. Important parts of the in-forest training are given at the Training Forest Enterprise Masaryk Forest Křtiny.

Key words: Mendel University in Brno, Faculty of Forestry and Wood Technology, Master programme European Forestry

The Mendel University in Brno

The Mendel University in Brno (see Anonymous 2018a) is the oldest independent specialized university in the Czech Republic. Its founding was preceded, from 1864 onwards, by efforts to establish an agricultural university in Moravia which, however, failed because of obstacles of a political, economic and ethnic character. Its founding was eventually enabled by the declaration of an independent Czechoslovak Republic in October 1918.

The University of Agriculture in Brno (UOA) was established by Act No. 460 as of 24 July 1919 and maintained its name until 1994. The establishment of the university was facilitated greatly by the transformation of the Agricultural College in Tábor into a university, its relocation to Brno and location in a new building of the Regional Institute for the Blind in Brno-Černá Pole. The UOA consisted of two sections: agriculture and forestry. In the academic year 1919/1920, classes were started in the Agricultural Section only, while the Forestry Section was relocated to the Czech Technical University in Prague. The Forestry Section was opened in October 1920 after previous problems with its relocation to Brno.

The post-war financial crisis and efforts to relocate the school to Slovakia threatened the University's existence between the years 1920 and 1924. The University Forestry Training Enterprise in Adamov was assigned to the University

for the Forestry Section in 1923. Two years later, it acquired the University Agriculture Enterprise Žabčice for the needs of the Agricultural Section. In 1930 and 1931, the consequences of the Great Depression led to attempts to dissolve the University. A turning point in the university's life was November 17th 1939 when, like other Czech universities, it was closed by Nazi occupants and subjected to German administration. There were no classes and, subsequently, seventeen institutes for applied research were opened. In the (German) protectorate period, the university suffered major material damage and casualties among members of its academic community.

A successful post-war reconstruction was halted by the events of February 1948 (the Communist coup d'état in Czechoslovakia), when 27.7% of the students did not pass the political vetting. The original sections were dissolved on the basis of a new Higher Education Act of 1950 and the Faculty of Agriculture and the Faculty of Forestry were established. In 1951, the School Horticultural Farm was founded in Lednice for the purposes of horticultural studies. The building of military education in Brno and founding of Slovak agricultural, forestry and veterinary universities interfered with the integrity of the UOA. The Faculty of Agriculture was divided into the Faculty of Agronomy and the Faculty of Animal Husbandry. The Veterinary University in Brno was dissolved, made into the Veterinary Faculty and connected to the UOA in 1952. The Faculty of Forestry was transferred to the Civil Engineering University in Brno, but then returned to the UOA in 1956. Another restructuring of the institute took place in 1959. The Faculty of Animal Husbandry was dissolved and animal husbandry was incorporated into the Faculty of Agronomy. In the same year, the need for qualified management in agricultural production and an increase in its mechanization motivated the establishment of the Faculty of Business and Economics.

Increasing numbers of students and the school's spatial problems led to the establishment of the so-called Jihlava Department in 1964, where tuition of first-year students took place until 1994. The Department of Education was founded to provide additional education studies for teachers of secondary forestry and agricultural schools and vocational schools. The relaxed nature of the 1960s allowed the establishment of the following centres: use of radioisotopes; electron microscopy; computational techniques; scientific and technical information; an editorial centre. By establishing the Department of International Biological Programme, the UOA joined this prestigious UNESCO project. A favourable political atmosphere in 1969 allowed the separation of the Veterinary Faculty and its transfer to the re-established Veterinary University in Brno. After August 1968 (the invasion of Czechoslovakia by the Soviet army), the life of the institute was affected by the subsequent period of normalization, which led to major changes of personnel and forced the departure of some teachers. The 1970's were characterized by construction activities, renovation work and the implementation of new didactic techniques. The 1980s brought interdisciplinary studies, a comprehensive scientific and technical programme and computerization. The Centre for the Development of

Biotechnology was founded. Horticultural fields of studies were detached from the Faculty of Agronomy, and so the Faculty of Horticulture was founded in Lednice in 1985, and thus four-decades worth of efforts came to fruition.

The events of November 1989 (the end of the communist regime) brought about major changes in the life of the University. Following the transformation of the agricultural-food and forestry-wood technology industry, a transformation of the school enterprises took place between 1993 and 1995. After the establishment of the wood technology department, the name of the Faculty of Forestry changed to the Faculty of Forestry and Wood Technology in 1993. In 1995, the UOA was renamed as the Mendel University of Agriculture and Forestry, claiming the legacy of J.G.Mendel. Since 1998, the implementation of the European Credit Transfer System in all study programmes of the University has been under way.

In 2000, the university's agricultural enterprises were combined into a single University Agriculture Enterprise in Žabčice. To ensure continuous development of lifelong education, the Institute of Lifelong Learning was established in 2003; since 2006 it has been a university institute. The Faculty of Regional Development and International Studies was established in 2008 in order to provide preparation for experts in economics in a regional, national and international context.
The University has been using the name Mendel University in Brno (MENDELU) since 2010. In 2011, the establishment of an independent university institute CEITEC MENDELU within the Faculty of Agronomy incorporated the University into an international scientific centre of excellence, the Central European Institute of Technology. At the end of 2012, the University received the prestigious certificates ETCS Label and Diploma Supplement Label from the European Commission, which serves as a confirmation that its study programmes and the examination system are in accordance with the principles of the Bologna Declaration.

Faculty of Forestry and Wood Technology

The Faculty of Forestry and Wood Technology at the Mendel University in Brno (FFWT MENDELU) (see Anonymous 2018b) is one of the major university teaching institutions in the Czech Republic, concentrating on research and academic activities in the areas of arboristics, furniture design and furniture technology, forestry, landscaping, timber structures and wood building construction, wood technology and timber management and furniture. Study programmes are designed on Bachelor, Master and doctoral levels, and on research and expertise in the respective fields. Our mission is to facilitate education, to support scientific research and to nurture creative ecologically sound activities related to land, forests, wood and interior with an emphasis on ecology and aesthetics. Our faculty is a part of the Mendel University in Brno, a public university whose tradition dates back to 1919.

The Faculty of Forestry and Wood Technology of the Mendel University in Brno (Lesnická a dřevařská fakulta, Mendelova univerzita v Brně) is located on the University campus in Brno-Černá Pole and consists of 13 departments. The Faculty employs ca. 200 people including part time jobs, of them 184 teaching and scientific staff (18 professors, 42 associate professors, 80 assistants and 44 research assistants). The total number of students in Bachelor, Master and doctoral study programmes fluctuates around 1,800; the number of doctoral students in all doctoral programmes reaches 200.

The Faculty closely collaborates with the Training Forest Enterprise Masaryk Forest Křtiny (Školní lesní podnik Masarykův les Křtiny), which manages 10,265 ha of forestland, serving with its experimental forest stands, greenhouses, forest nurseries, game preserve, saw mill, mechanised log depot, and other establishments for educational and research purposes of the Faculty of Forestry and Wood Technology.

The Master programme European Forestry

The two-year MSc programme in European Forestry (see Anonymous 2018c) is interesting in both its forms and content. It consists of lectures, field and laboratory exercises, discussion seminars, projects and excursions. The whole programme is taught in English. It focuses not only on traditional forestry, but also on a number of topics related to ecology, nature conservation, and sustainable development, with particular emphasis on the latest progressive trends.

The aim of the programme is to provide students with a general overview of forestry and nature conservation and let them develop theoretical and practical management skills. Knowledge gained in the programme: intensive language training and understanding of contemporary international issues allowing graduates to take up top management positions in the forest based sector (and related fields) both in EU and non-EU countries.

The graduate profiles are based on the acquirement of specific abilities (following the European Qualifications Framework) of forest engineers who are capable of solving biological, technical, economic and managerial tasks in forestry management. Most of all, the graduates will profit from the combination of theoretical knowledge obtained in their preceding Bachelor studies in different national contexts, and new skills developed within the programme. Practice is an integral part of the programme.

The final state examination consists of four themes of questions: Forest Ecosystems and Forest Ecology from a European Perspective, Silviculture and Stress Ecology at a European Scale, European Forest Economics and Policy, Forest Planning and Forest Technologies at the EU and Pan-European Levels. The final state examination includes defending a diploma thesis. The Graduation Diploma

particularly puts emphasis on a broad context of modern forestry and allows graduates to pursue a career in national and supranational forestry organizations and state administration in their home country or abroad.

Graduates may progress to postgraduate (PhD) programmes.

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FOREST SCIENCE FIELD EDUCATION AT THE UNIVERSITY OF HELSINKI: A CASE STUDY ANALYSING LEARNING DIARIES FROM THE FOREST ECOLOGY FIELD COURSE

MIKA REKOLA

Abstract
A Helsinki University field course "Forest and peatland ecology", organised in June 2017, was studied using qualitative text analysis of students' learning diaries as a main source of data. Students' self-regulative knowledge was explored and found rather limited which is in line with some earlier literature. Teaching methods during the course were evaluated very positively by students. One of the main results was that the more activating teaching methods were perceived more positively. Learning diaries included a few negative evaluations and these can be seen as a valuable source of feedback. It is concluded that the field course is an extremely relevant method in order to achieve professional knowledge in forest sciences. The recommendations for future teaching planning are that more emphasis should be put on communicating learning aims, modern learning technology, and finally, critical self-regulation knowledge.

Keywords: Forest education, field course, learning diary, integrative pedagogics, student perceptions, self-regulative knowledge.

Introduction

Teaching forest sciences at higher education institutions is to a great extent professional education where both theory and practice are needed. For this purpose, most universities include some sort of field courses which typically take place in specific university field stations. The University of Helsinki has held courses in Hyytiälä field station since 1910 for teaching academic foresters and doing scientific research. Today, the field station, situated in Southern Finland 200 km north from Helsinki, belongs to the Faculty of Agriculture and Forestry and provides facilities for 20 staff members. Hyytiälä is a field centre for multidisclipinary research. One of the central topics is the role of forests and peatlands in climate change - Hyytiälä being a home for research excellence SMEAR II of the Atmospheric Research Centre (Hyytiälä field station, 2018).

Hyytiälä operates on State Forest Service (Metsähallitus) land, altogether more than 1000 ha. For education purposes, visits to private lands are also made. The largest teaching activities are forest science BSc students' field courses lasting at minimum seven and at maximum 9,5 weeks – depending on the BSc programme – during the summer after the first year of studies in Helsinki. Field education is seen important

by university teachers and stakeholders. Students´ feedback has been essentially positive. One of the elementary aspects of field courses is also to create social cohesion and professional identity (Virtual Hyytiälä, 2018).

Earlier research on university level forest field education is rare. Korjus *et al*. (2015) discusses the aims and methods how an 90 years old field station Jarvselja in Estonia could contribute to research and education especially related to forest management planning. The Estonian context is rather similar to the Finnish one. Whereas, Zahawi and Holl (2010) discussed field education especially under tropical forest restoration in a developing world context. Furthermore, Mammadova (2017) reported field education experiments in biosphere reserves in Japan.

A relevant theoretical model to analyse field education is provided for example by the IP (Integrative Pedagogics) model (Tynjälä and Gijbels, 2012; Tynjälä *et al*., 2014).This model is based on research concerning both, expertise and different forms of intelligence. The main finding of these studies has been that the learning process and thus professional expertise is an integrated entity of theoretical, practical and self-regulative knowledge (Heikkinen *et al*., 2012; Tynjälä, 2008). The latter knowledge includes metacognitive and reflective elements that may be either implicit or explicit, and it includes both, “knowledge” and “skills” (Tynjälä and Gijbels, 2012).

There are a number of processes linking these categories of knowledge (Figure 1). In a transformation process, conceptual or theoretical knowledge is converted and applied in practice. In an explication (conceptualization) process, practical knowledge and experiences are translated into theoretical concepts and models. Transformation is most likely the most frequent process in field education, i.e., students are using the theoretical knowledge gained during lectures to understand their experiences later on in the field course. Students presumably also do a lot explication when they try to understand their field perceptions in theoretical terms. The third element of the IP model, self-regulative knowledge, including metacognitive and reflective skills can be developed through reflection processes. The definition of critical reflection according to Kettula (2012) is in particular referring to an activity that seeks to reveal underlying values and beliefs which guide actions and thinking processes (Kettula, 2010; Reynold, 1998; Mezirow, 1990). Kettula (2012) applied the IP model and found that reflection is not among the most prominent aspects of training in most forest curricula. Therefore, the IP model is applied in this study to find out especially about the self-regulative knowledge that is developed through critical reflection.

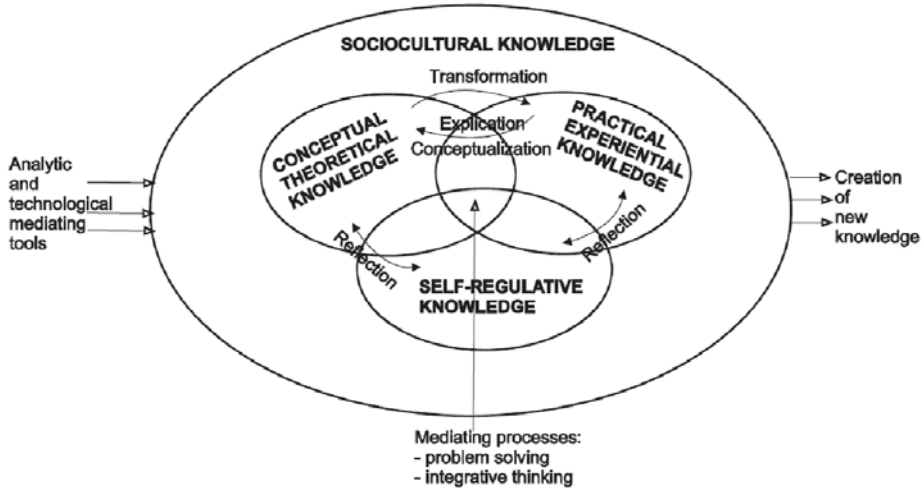

Figure 1. Integrative Pedagogics (IP) model by Tynjälä *et al.* (2014)

Biggs (1996) has introduced the concept of constructive alignment. The idea of the concept is that separate teaching elements or stages – aims, material and methods, and assessment – should be seen holistically and in order to get best possible learning outcomes they have to be aligned. Constructive alignment derives from constructivist theory and cognitive psychology linking learner's memory and earlier experiences. Teachers are responsible for making a purposeful alignment between aims of teaching and learning activities and finally the assessment. They should make a conscious effort to provide students with specified aims, well-designed learning activities, and finally aim oriented assessment.

The model of constructive alignment and the IP model are applied in this paper to analyse a field course "Forest and peatland ecology" taught in the Hyytiälä forest field station in 2017. The aims of this study are specifically as follows:

- analyse students' self-regulative knowledge and
- analyse constructive alignment of teaching.

The detailed questions related alignment of teaching were the following ones:

- How do students perceive and evaluate the aims of their education?
- How do students perceive and evaluate the teaching materials and methods?
- How do students perceive and evaluate the assessments of learning?

Empirical results came mainly from the qualitative analysis of learning diaries. In the following, the data and analysis are introduced, results described and finally some conclusions drawn.

Data and analysis

Data of this study consists mainly of students' learning diaries (n= 21), the secondary data comes from written teaching materials and material produced during the field course "Forest and peatland ecology" (Metsä- ja suoekologian kenttäkurssi, MEK110) at the University of Helsinki. The two and half weeks MEK110 course took place from June, 5th to-21st, 2017 at the University of Helsinki forest field station, Hyytiälä. Topics of the course were the following: Peatland ecology, Soil science and forest site types, Ecophysiology, Entomology, and Old growth forest.

Learning diaries were analysed using a qualitative approach with Atlas.ti7 software. For that purpose, learning diaries made in MSWord document format were first saved as text files thus excluding all graphical elements. Photos and other graphical elements were analysed in quantitative terms using the original Word files. The learning diaries with graphical elements were coded and the number of elements were counted. However, the content, the meaning or the quality of photos were not analysed.

A crucial starting point of this analysis method is to understand that students may have written with very different words about the very same moment of teaching. The coded material of learning diaries thus reflects perceptions of teaching material and methods. Coding was first of all data driven in a sense that most of the codes were not predefined, but they emerged from the data. However, the codes directly related to aims of the study were predefined, such as evaluations of teaching and learning and self-regulative knowledge.

In addition to learning diaries, as secondary material some written instructions and teaching material provided by teachers were analysed. Especially, learning aims, the content of learning and assessment were analysed from following instruction documents provided to students in Moodle platform: main course program presented in PowerPoint presentation (16 pages), learning diary instructions (half page), some teaching materials (mainly PPTs), and course grades (Excel table). The language of instruction was Finnish.

Results

Learning diary analysis

Learning diary instructions were delivered to students at the beginning of the MEK110 course as follows (direct translation from Finnish):

> *"The purpose of the learning diary is to improve learning and critical thinking. The aim is thus to write about both things learnt and reflections concerning learning outcomes and the own learning process. You may also make notes on teaching and use the notes for providing feedback at the end of the course.*

> *Write at maximum a half page per education day (12 pt, line 1) about each topic (SOIL, TREE, PEATLAND, DAMAGES, INVENTORY, FIELD TRIP) as follows:*
> *Topic*
> *Summary of learning outcomes*
> *Feedback from learning outcomes*
> *Use complete sentences; preferably write during every night to make it easier to recall things. Submit your learning diary if possible at the end of the course, at latest June 29, 2017."*

The length of learning diaries varied a lot; the shortest being 4 513 characters (no spaces) with 401 words and the longest being 19 959 characters with 2 768 words. The length in terms of characters and the number of photos and graphical elements of each learning diary is presented in Table 1. Tables, graphs or other graphical elements such as non-letters like emojis were included here when counting the number of graphical elements. In this line also the characters symbolizing feelings such as ":)" were counted.

Photos were found from two out of 21 learning diaries. The student #01 had one and the student #06 10 photos in his or her diary. Students #05 and #14 had one and student #21 had two graphical elements.

Students' self-regulative knowledge
Students' self-regulative knowledge is concerning both, theoretical and practical knowledge as well as knowledge concerning students themselves. When exploring self-regulative knowledge it is thus appropriate to deal with learning outcomes as such and students' metacognition in general. Students wrote text related to self-regulative knowledge on average 7 times per learning diary, minimum being 1 and maximum 15 times. Typical text passages were related to positive evaluations of practical experiences, especially highlighting the contrast between earlier more theoretically or text book oriented studies. An example is about forest entomology:

> *"It was especially nice to go concretely out to nature and bark pine and spruce trunks. In this way I learned much better how various harmful insects are living in the inner bark. One identified things much better in this way than using illustrative pictures." (#16)*

The following quotation related to entomology education emphasized clearly the potential of in-field learning in terms of opening your eyes that is improvement of making perceptions in nature:

> *"It was nice to recognize that pest insects are everywhere – earlier you have just not paid any attention to them." (#07)*

There were also few students who complained that field experiences do not produce learning outcomes in every aspects:

> *"We were looking at many mosses again and those do not stick in my mind when having a look in the forest." (#01)*

Students were also able to recognize that some exercises felt uncomfortable were in fact good for learning expertise:

> *"Good in this course was that we presented our results to an audience, a jury and classmates. I hate talking about new difficult topics but I know that it develops my expertise." (#06)*

At its best students were able to see several connections between earlier education (MEK100B is the first introduction lecture course to Forest ecology and management) and learning outcomes regarding both skills and knowledge and the learning outcomes of field education. :

> *"At the afternoon time was running by doing calculations in computer lab. Even though you have to beat your brains it was interesting to see how numbers stated to describe the forest that you saw earlier the same day. You realized that you have learnt so many things in MEK100B course – for many assignments you have had to invest much more time without that previous knowledge and your improved Excel practice." (#12)*

In the previous quotation, the student was also observing the links between different assignments during the course. It is thus made clear in this quotation that a student was able to find out many linkages between elements of teaching and his/her learning. However, the self-regulative knowledge in general was not that multidimensional, and especially the critical elements were mostly lacking.

Similar to the previous quotations, many of the self-regulative texts passages were commenting teaching. These comments especially related to teaching methods are analysed more in detail in the next section.

Students' perceptions and evaluation of teaching aims

The aims of teaching, and thus learning as well, were explicitly mentioned only a few times in the learning diaries. It is not clear how intensively students have set individual learning aims. These quotations were referring to aims as such – wherever these aims came from – like as follows (bolded added by author):

> *"I learned from today's teaching that the effect of light on the forest ground layer and vegetation may give an impression that site type is poorer than it actually is. For instance, if there is a clear-cut in an adjacent forest slot it affects also the edge vegetation of the site on question because of increased amount of light. I also learned that a certain mountain fern moss is an indicator species for vaccinium but not for calluna soil type.* ***Today I recalled clearly*** *also the horizons of podzol. In spite of rain the day was good and the* ***teaching aims were achieved****." (#15)*

It is interesting that the student #15 did not mention the aims of teaching at the beginning, instead he/she listed the things he/she learned during the day and finally states that the aims were fulfilled. One may ask were these issues that the student learnt also the issues that were aims set by teachers.

Why is there a lack of explicit reflection of teaching and/or learning aims? Is it because of students' learning attitudes and styles or because of teaching instructions? When analysing the literal teaching material gives some evidence pointing to the latter hypothesis. In fact the only written teaching material that explicitly states the aim or purpose of the field education was the written document related to the assignment of ecophysiology period:

> *"The purpose of this assignment is to analyse the effect of forest stand density on the development of yield and tree composition. In the assignment the stand productivity is studied as well as how tree structures and functions are the adapted to resource competition. In particular, the effects of light competition is emphasized. The assignment illustrates and develops the understanding about the effects of stand density and thinning methods on tree growth."*

Some motivational passages of the instructions, and thus related to aims, were also visible here related to peatland education (text taken from a PPT slide), e.g.,:

> *"Why to learn about peatland plants and site types?*
> *-.Peatlands are important natural resources and diverse group of biotopes: knowledge is useful as such."*

Students' perceptions and evaluation of teaching material and methods

The students' learning diaries had quite a big number of text passages related to teaching methods and materials. Altogether, there were on average 26 perceptions related on teaching material and methods per learning diary, minimum being 12 and maximum 39. The variation of perceived methods was also high; during the text analysis, 19 different methods were recognized – including exams. The frequencies of methods are shown in Table 2. Absolutely, the most frequently perceived teaching method was field assignment with 136 perceptions, second being group work (78), third being poster (70 perceptions), and fourth field demonstrations (66 perceptions).

The difference between field assignment and field demonstration was that if students described any own activities the text was coded as "field assignment" and if the text in the learning diary described teaching like "we were shown" it was coded a "field demonstration". This difference, however, was not always clear. That is, some students may have felt that the moment of teaching in the field was just passive following of a demonstration, whereas other students may have seen it an active assignment. In some cases, a student did not mention anything about seeing or doing in the field, instead he/she used words such as "visiting the site" or "making a trip". In these passages of text teaching method was coded as "field trip".

Table 1. Frequencies of teaching methods and materials perceived by students in their learning diaries (n= 21).

Teaching methods and material	**Frequencies**
assistant	14
competition	13
debate	1
discussion with stakeholders	1
exam	55
field assignment	136
field demonstrations	66
field trip	29
group work	78
hakoniwa	26
lab demonstration	8
lecturing	64
photographing	2
portfolio	1
poster	70
reading textbook	5
self-learning (lab)	16
student-centred demonstrations	48
students' PPT	13
TOTAL:	111

Not seen directly in the Table 1 but perceived in diaries was the fact that the most common teaching methods were highly coexisting. It is thus fair to say that the most visible or remarkable teaching method for students during the MEK110 course was a field assignment reported through a poster made by group of students.

There were also a few positive or negative evaluations related to these teaching methods and materials (Table 2). Almost all methods had more positive than negatives evaluations exceptions being “discussion with stakeholders”, “field trip”, and “lecturing”. Very positively evaluated methods were “field assignments”, “hakoniwa”[15], and “student-centred demonstrations”.

A typical positive evaluation of field assignment made in groups was related to the teaching about peatland site types as can be seen in the following quotation:

[15] Hakoniwa assignment was based on the old Japanese tradition to make plant decorations. In this exercise a group of students prepared a small decorative installation so that it contains representative mosses and other plants from a specific peatland site type. Installations were publicly presented, and finally evaluated with multiple criteria by teachers.

”The topic of the day was the recognition of the peatland site types. We went to Lakkasuo mire and students went alone around for identifying site types using a identification form. The form was planned to be used through series of questions so that it ends towards a single site type. I think this was working nicely and I liked a lot learning in small groups. Within a group one can easily ask from teachers and the threshold for asking a question does not grow too high.” (#23)

From the quotation above, it was visible that some students also liked this teaching method because it made it easier for them to ask teachers questions. The active mode of teaching and thus learning was visible in the quotation above. This is not so much the case with field demonstrations and especially field trips, as can be seen from the following quotation. The student described the very same teaching event as above with following words that do not indicate active learning and thus the text passage was coded as “field demonstration”:

”The characteristics of spruce, pine, sedge, and grass mire were got to known. We stared (at) a lot mosses, grasses, and sedges which all are topics in an exam at the end of the week.” (#01)

Table 2. Students’ evaluations of teaching method and material.

Teaching methods and material	**Negative feedback on teaching**	**Positive feedback on teaching**
assistant	2	5
competition	1	4
discussion with stakeholders	1	0
exam	3	6
field assignment	3	21
field demonstrations	4	15
field trip	5	1
group work	6	15
hakoniwa	0	9
lab demonstration	0	3
lecturing	10	7
poster	6	11
reading textbook	0	1
self-learning (lab)	1	1
student-centered demonstrations	1	12
students' PPT	0	0
TOTAL:	44	111

In most cases of ”field trip” quotations there were no positive or negative evaluations. However, when the evaluation was made it was in most cases negative, an example being the following:

> *"In the afternoon we presented our posters after which we went to a mini trip. I did not really get the purpose of the trip, however, it did not take a long time" (#02)*

Students mentioned a large number of lectures in their learning diaries. This is because most often the daily routine during the field course is to get together in the lecture room in the morning to deliver instructions for daily assignments. It is worth of mentioning that most lectures were not evaluated positive or negative as such. However, when the evaluations were made they were in most cases negative which was exceptional among teaching methods. Especially, a few students provided feedback that they have seen lectures being somewhat too long and they proposed that lectures in the field course should be really intensive ones only recalling what was already learnt during the previous winter semesters.

From the analysis above it is clear that the more active mode a student have had the more positive he/she has seen the teaching method. This seems to be true with lecturing as well which is in most cases a rather non-activating teaching method. On the contrary, hakoniwa and student-centred demonstrations were methods activating students and they were seen highly positive (Table 3).

Posters were the third most frequently perceived teaching method and thus worth of a separate analysis. It was also true with this teaching method that in most learning diaries there were no positive or negative evaluations attached to it. Most evaluations made were positive (n=11) the rest (n=6) being negative. Some kind of fatigue is seen in the following quotation:

> *"A group work day. Again the aim was to make a poster, this time about a forest damage." (#08).*

Using posters as a teaching method was heavily used during the course. The comment above related to the 11th day showed that maybe some other methods beside posters would have been good in order to make a variation in working procedures.

Students perceptions and evaluations of assessments of learning

The assessment of learning was based on several methods and criteria (weight of criteria):

- Plant identification exam (30%).
- Site type identification exam (30%).
- Forest damages (25%).
- Trees (7,5%).
- Learning diary (7,5%).

As seen from the criteria, most of the assessment was based on exams. There were four kinds of exams during the course. At the end of the first week concerning the peatlands there were two exams. The first concerning peatland site types was

organized as an individual field test. Students were walking alone from one site to another and they should identify the site type. The second exam, related to mosses, grasses and sedges, took place in the lab. The correct answers to these two exams were told the students during the same day. The site type exam made before noon was disclosed by visiting the very same sites again during the afternoon. This demonstration was boring for some students and the practical challenge for quite a many students was that they did not recall any more their own exact answers:

> *"Today afternoon started with peatland identification exam. I cannot say at all how it went because when we visit the place to find correct answers, I had already forgotten everything." (#02)*

Totally, there were only few evaluations related to exams as a teaching method and most of them were in fact positive (Table 2). Students' perceptions of exams were more often related to self-regulative knowledge and evaluation of learning. Rather many of these perceptions were reflecting stress and uncertainties, for instance:

> *"At this point the amount of sphagnum mosses and learning them – the mind reels at the very thought of them – now when there are no more than two days to exam and all (mosses) look the same." (#07)*

The stress and uncertainties were obvious because students participated in intensive education at minimum 8 hours per day plus the extra time for the self-studying of plants. However, most students felt that they had made a lot of work for the exam but finally it was useful for learning and a rewarding experience.

The third exam was at the end of the course concerning forest beetles, their galleries in the wood, some funguses and other tree diseases. This exam was not seen, perhaps, as stressful as the first two exams. Especially, the schedule for independent learning was considered a positive issue:

> *"Thanks are given (to teachers) because of the time for learning about identification exam and the activities during the previous week by teaching assistants in order to demonstrate the exam." (#06)*

Discussion and conclusions

The results concerning the first aim of the study, i.e. students' self-regulative knowledge, showed a great variation among students. The average number of self-regulative reflections being 7 in learning diaries during a two and half weeks (13 days) course showed not an especially high level of self-regulative reflection among students. Even without having a closer look at the content of those reflections it is not wrong to say that this result is in line with earlier literature about forest students (Kettula, 2012).

The second study aim was to analyse students' perceptions and evaluations related to teaching. It was clear that these were subjective observations and varied from one student to the other. Alternatively, some objective measures of learning outcomes

could have been analysed as well. Thus the question how the perceptions and evaluations of teaching and perceptions of learning and finally objectively measured learning outcomes (course grades) correlate, was not examined in this study. However, the earlier literature has shown that in most cases that there is a correlation: the more positive students have seen the teaching, the more often they have used deep orientation and the better were the learning outcomes (see e.g.Duque, 2014; Duque and Weeks, 2010; Lizzio *et al*., 2002; Trigwell *et al*., 2012).

As seen from the evaluations of learning methods, students evaluated activating methods to be better than methods without own activities. This is in line with earlier literature such as integrative pedagogics model (Tynjälä and Gijbels, 2012; Tynjälä *et al*., 2014). One may speculate if activating methods may also be used to gain generic competencies, e.g. in communication and group working. Furthermore, in the context of forest education there is some evidence for curriculum gaps related to generic skills, especially leadership and management (Rekola, 2017). It is likely that activating methods could be used to acquire these skills, however, such aims should be more explicitly stated in the course descriptions and also in the evaluation according to teaching alignment principles by Biggs (1996).

The analysis using learning diaries has also it caveats. For instance, it seemed that students did not describe their learning in very detail. For instance, communication between students is an important element in the collaborative learning (Arvaja, 2007). However, there was no mentioning of social media such as WhatsApp, in learning diaries. This is despite of the fact that this social media application has been used widely among students participating the field course. So the potential of social media in acquiring generic skills (see e.g. Fiehl, 2012) cannot be analysed from these learning diaries but needs more detailed and specialized data.

Main conclusions from the study can be classified into three categories. First, it seems fair to say that students' overall evaluations of teaching and learning were very positive. This was seen from both quantitative and qualitative analyses.

Second, several more detailed conclusions from teaching methods were drawn. The more activating methods the better were students' evaluations of teaching, for instance field assignments were evaluated better than lectures. Even the strongly activating methods such as making posters were seen sometimes negative because there were too many assignments using this very same learning method. In other words, some students felt boredom with making posters. Therefore a variety of new teaching and learning methods are to be applied during the field course, such as using photos and videos, and including them also with other graphical elements into learning diaries. Exams and demonstrations could also apply online quizzes to be answered by mobile phones. In general, there are a vast amount of potential social media applications for learning (Gigas and Grant, 2013; Tess, 2013).

Third and finally, it seems that in order to meet in a better way the needs from the teaching alignment concept by Biggs (1996), the aims of teaching should be more visible in the field course. The fact that students did not write a lot about aims of the course and about learning is somewhat worrisome. Perhaps, the aim of teaching was orally more emphasized during instructions but it should be also documented in a written format. It can be concluded that the field course analysed has provided an excellent basic structure for learning. In order to develop the course further one only need to add a small amount of new ingredients such as a few new teaching methods here and there.

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CONCLUDING REMARKS

MARTIN ZIESAK

In the preparation of the 2017 SILVA Network meeting it was the hope of the organisers that a wide field of questions should be covered by contributions, representing a comprehensive list of universities. With thirteen different presentations we had a good and extensive consideration of this topic, attracting also participants from the Far East: China, Japan and Mongolia.

Besides the presentations, as published in this volume, a workshop was included in the conference, where in an interactive way the role of educational forests was discussed. The guiding questions, which triggered and extended the presentations were:

- Is “in-forest” education needed at academic level?
- What are the challenges for a successful implementation of “in-forest” education?
- Reactions and suggestions to overcome obstacles
- Are there any minimal institutional requirements?
- What content aspects should be linked to in-forest teaching?
- What teaching methods should be applied in in-forest teaching?

The importance of educational forests for academic forest science institutions was so distinctly accepted, that again a SILVA Network communique was issued. This “Prague communique 2017”, but also the presented SILVA Network proceedings 2017 may help to strengthen the role of educational forests.

SILVA NETWORK PRAGUE COMMUNIQUE 2017

STRENGTHENING THE ROLE OF EDUCATIONAL FORESTS

- In-forest learning and teaching is indispensable for education in forest sciences, because it delivers hands-on experience which cannot be replaced by virtual reality.
- Educational forests are facilitating in-forest learning and teaching.
- Educational forests connect academic educational targets with practice.
- There exist different successful models of managing and utilizing educational forests, as demonstrated during the SILVA Network Meeting in Prague (e.g. university-owned forests, long-term contracts with other forest owners, used with and without financial compensation).
- Sufficient resources (staff, funding) are indispensable for establishment and maintenance of educational forests for securing high-quality education.
- In-forest education may include non-forested areas.
- Educational forests serve learning and teaching about sustainable forest management which includes ecological, economic and social dimensions.
- Students‘ theses (BSc, MSc, PhD) and long-term research are fundamental functions of educational forests.
- Educational forests offer unique opportunities to develop and apply innovative learning and teaching concepts, e.g. project-oriented work, marteloscopes, and involve students in all aspects of forest management, e.g. real world challenges for forest enterprises.
- Within this scope of educational forests, it is important to include long-term and interdisciplinary approaches of learning, teaching and research.

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1998	Joensuu, Finland	Forestry in changing societies in Europe. Information for teaching module. Part I and Part II.	Pelkonen, P., Pitkänen, A., Schmidt, P., Oesten, G., Piussi, P. & Rojas, E.	1999, SILVA Network
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2007	Freiburg im Breisgau, Germany	Design and functioning of international forestry curricula: considerations and experiences	Schmidt, P. & Lewark, S.	2008, SILVA Network Publications 5

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2017	Prague, Czech Republic	Forests for university education: Examples and experiences	Schmidt, P., Lewark S, Remeš, J. & Weber, N.	2018, SILVA Network Publications 15