Co-funded by the Erasmus+ Programme of the European Union

CMU No _____/..... Place, Date __15__/_12_/_2022__

Course Syllabus

1 Program

Title of the study programme: Biology (BSc program)

2 Course details

Course name: Restoration Ecology

Course code: 202484

Number of credits (hours/week): 3 credits (2 hours per week of lectures and 3 hours per week of labs)

Course type (tick the appropriate box): ☐ Required, ☒ Elective, ☐ Other, if other please explain:

Prerequisites courses: Ecology (202371)

Semester, in which the course is taught:

Year 1		Year 2		Year 3		Year 4	
Semester 1	**Semester 2**	**Semester 1**	**Semester 2**	**Semester 1**	**Semester 2**	**Semester 1**	**Semester 2**
☐	☐	☐	☐	☐	☒	☐	☒

3 Responsible unit

3.1 Department: Biology

Names and affiliations of lecturer(s): All staff members of Biology Department, Science, Faculty CMU

1) Stephen Elliott

2) Dia Panitnard Shannon

3) Pimonrat Tiansawat

4) Prasit Wangpakapattanawong

4 Course description

This course addresses the problem of tropical deforestation and the need to restore tropical forest ecosystems for biodiversity conservation, environmental protection and to support rural livelihoods. It is aimed at undergraduates to stimulate interest in applied ecology and conservation. The course presents the fundamental principles of restoration ecology, focusing on the concept of ecological succession, the effects of anthropogenic disturbance on forest regeneration and broad strategies to catalyze recovery of tropical forest ecosystems in response to various levels of degradation. Students are introduced to basic restoration techniques, including planting stock production, tree planting, maintenance and monitoring. The success/failure of such techniques are illustrated by case studies, before considering broader issues, such as links between restoration and climate change and the socio-economic impacts of restoration. Lectures are complemented with labs and field trips, as essential course components.

5 Course objectives

Knowledge: ecological restoration principles, tropical forest ecological succession, global implications of restoration

Skills: analyze how natural and anthropogenic disturbances affect the potential for regeneration and how to select appropriate restoration approaches; how to grow planting stock. how to plant trees, perform direct seeding and maintain and monitor tree performance and biodiversity recovery—by both conventional methods and by using drones.

Application of theories to practice: use fundamental ecological principles to evaluate and compare an array of tropical forest restoration methodologies responding to biophysical and socioeconomic conditions.

Social knowledge and skills: understand the drivers of deforestation and incentives for forest ecosystem restoration, socio-economic, political implications both local and global.

5.1 Learning objectives of particular modules

If the course is divided into sections or modules, please state the learning objectives for the specific sections/modules taught within the course

6 Course teaching methods

6.1 Lectures – PPT, interactive discussions, follow-up home exercises

6.2 Labs – hands-on data collection, hands-on skills learning, computer lab data analysis and observational trips

7 Teaching plan

Lectures

Week	Content	Method/activity	Hours
1	History and fundamental concepts of ecological restoration - reference systems and the move towards international standards	Lecture	2
2	Forest ecosystem succession — successional guilds, seed dispersal and reproductive forest dynamics	Lecture	2
3	The effects of natural and anthropogenic disturbance on forest regeneration—arrested succession, novel ecosystems	Lecture. Home **assignment**: online forest change tracking (Global Forest Watch)	2
4	Strategies to catalyze forest regeneration in the tropics - active and passive forms of restoration along a spectrum of degradation/deforestation	Lecture Home **assignment**: preset reading for Tutorial 1.	2
5	Tutorial 1: discussion of preset reading—forest degradation and restoration approaches	Interactive group discussion	2
6	Restoration planning, costing and design - stakeholder engagement, FLR, corridors and nuclei etc.	Lecture	2
7	Restoration and biological invasions **Mid-term exam**	Lecture. Home **assignment**: online invasive plant recognition	2
8	Propagating planting stock—seed collection/banking and principles of tree-nursery planning and management	Lecture	2
9	Practical implementation —rapid site surveys, tree planting and maintenance, direct seeding—use of drones	Lecture	2
10	Monitoring and evaluation - ground and drone surveys of biomass and carbon accumulation and biodiversity recovery.	Lecture. Home **assignment**: preset reading for Tutorial 2	2
11	Tutorial 2: discussion of preset reading—towards international standards for assessing the impact of forest restoration	Interactive group discussion	2

Week	Content	Method/activity	Hours
12	Restoration case studies - examples of successful and unsuccessful restoration projects; interactions with tourism.	Lecture	2
13	How global-climate change affects restoration strategies and how restoration contributes towards its mitigation.	Lecture	2
14	Socio-economic and political aspects of restoration—monetizing forest values to incentivize restoration; governance and long-term financing. Impact on traditions and culture. The role of demographics.	Lecture. Home **assignment**: preset reading for Tutorial 3	2
15	Tutorial 3: discussion of preset reading—legal, social, policy and economic implications of forest ecosystem restoration.	Interactive group discussion	2

Labs

Week	Content	Method/activity	Hours
1-2	Seed collection	Hands-on seed collection techniques in natural forest	6
3	Seed banking	Hands-on seed banking skills at CMU seed bank. Lab **report**: seed supply for restoration	3
4	Tree nursery — basic horticultural skills: seed banking & germination and seedling morphology, potting & care.	Hands-on skills learning in a tree nursery	3
5-6	Collaborative rapid site assessment (RSA)	Hands-on skills learning in restoration site. Lab **report**: write up results of RSA	6
7-8	The outcome of tropical forest ecosystem restoration along a chronosequence	Observational - at restoration field trial plot system	6
9-10	Strategies and best practices for mine rehabilitation	Observational - at open cast mine	6
11-12	Monitoring performance of trees planted for forest restoration	Hands-on skills learning in restoration site. Lab	6

		report: write up monitoring results	
13-14	Using drones to monitor the results of forest restoration - drone piloting and image acquisition	Hands-on skills learning at mature restoration site	6
15	Using drones to monitor restoration results - image process, 3D modelling and tree measuring	Computer lab data analysis. Lab **report**: use of drones for forest restoration	3

8 Material needs

8.1 Course equipment:

Binoculars, GPS, drones, tablets and GIS software, tree measuring poles, caliper, field generator clinometer (most equipment has been provided by the FRAME project and is in the FORRU-CMU equipment store ready for use).

9 References

9.1 Compulsory reading list

General

1. Elliott, S.D., D. Blakesley and K. Hardwick, 2013. Restoring Tropical Forests: a practical guide. Royal Botanical Gardens, Kew.
2. SER International Science and Policy Working Group, 2004. The SER International Primer on Ecological Restoration. Society for Ecological Restoration International, Tucson, Arizona.
3. Di Sacco, A., K.A. Hardwick, D. Blakesley, P.H.S. Brancalion, E. Breman, L.C. Rebola, S. Chomba, K. Dixon, S. Elliott, G. Ruyonga, K. Shaw, P. Smith, R.J. Smith and A. Antonelli, 2021. Ten golden rules for reforestation to optimize carbon sequestration, biodiversity recovery and livelihood benefits. Global Change Biology, 27: 1328-1348.

Pre-set reading for tutorials

1) Chazdon, R.L., Falk, D.A., Banin, L.F., Wagner, M., J. Wilson, S., Grabowski, R.C. and Suding, K.N. (2022), The intervention continuum in restoration ecology: rethinking the active–passive dichotomy. Restor Ecol e13535. https://doi.org/10.1111/rec.13535

2) Gann, G.D., McDonald, T., Walder, B., Aronson, J., Nelson, C.R., Jonson, J., Hallett, J.G., Eisenberg, C., Guariguata, M.R., Liu, J., Hua, F., Echeverría, C., Gonzales, E., Shaw, N., Decleer, K. and Dixon, K.W. (2019), International principles and standards for the practice of ecological restoration. Second edition. Restor Ecol, 27: S1-S46. https://doi.org/10.1111/rec.13035
3) Elias, M., Kandel, M., Mansourian, S., Meinzen-Dick, R., Crossland, …et al. (2022), Ten people-centered rules for socially sustainable ecosystem restoration. Restor Ecol, 30: e13574. https://doi.org/10.1111/rec.13574

9.2 Suggested reading list

1) D'Antonio C.M. and J. Chambers, 2006. Using ecological theory to manage or restore ecosystems affected by invasive plant species. In Falk D., M. Palmer and J. Zedler (Eds.) Foundations of Restoration Ecology, Island Press, Covelo, California, 260–279.
2) Elliott, S., 2020. Chapter 1 Forest restoration: concepts and its potential for automation. In Elliott S., G. Gale and M. Robertson (Eds.) Automated Forest Restoration: Could Robots Revive Rain Forests? Proceedings of a brain-storming workshop, Chiang Mai University, Chiang Mai, 1-27.
3) Höhl, M., V. Ahimbisibwe, J.A. Stanturf, P. Elsasser, M. Kleine and A. Bolte, 2020. Forest Landscape Restoration – What Generates Failure and Success? Forests, 11(9): 938; doi:10.3390/f11090938
4) Laurance, W.F., 2015. Emerging threats to tropical forests. Annals of the Missouri Botanical Garden, 100: 159–169.
5) Shannon, D.P. and S. Elliott, 2020. Chapter 5 Developing aerial seeding by UAVs: lessons from direct seeding. In Elliott S., G. Gale and M. Robertson (Eds.) Automated Forest Restoration: Could Robots Revive Rain Forests? Proceedings of a brain-storming workshop, Chiang Mai University, Chiang Mai, 74-83.

10 Assessment of students

10.1 Description of assessment

- Midterm and final exams (25% each)
- Lab reports (4 x 10% each): seed supply, RSA and monitoring reports, and use of drones
- Contribution to interactive discussions (10%)

10.2 Grade distribution and student assessment

Grading scale

Grade		Total score	Scale
Symbol	**Verbal grade**		
A	Excellent		91-100
B+	Very good		81-90
B	Good		71-80
C+	Better than satisfactory		61-70
C	Satisfactory		51-60
D+	Less than satisfactory		46-50
D	Barely passing		41-45
F	Failing		<41

Place, Date ...../...../.....