MODULE SYLLABUS 2026–2027

Conservation, Restoration and Remediation

Syllabus for the Conservation module

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MSc in Environmental Sustainability and Education



How can we use ecological evidence to choose, justify and adapt conservation actions as environmental pressures, climate and societal priorities change?

Module calendar

Class: 10:30 to 13:30, Room RI, Complesso A. Vallisneri (Biology).

The 19 October visit has separate meeting and travel times, to be announced on Moodle.

Mon 28 Sep	1 What is conservation science?	No assigned article
Wed 30 Sep	2 Biodiversity, functioning and benefits	Hua et al. (2022)
Mon 05 Oct	3 Reference conditions and ecological change	Hobbs et al. (2009)
Wed 07 Oct	4 Pressures, interactions and causal evidence	Carmichael et al. (2025)
Mon 12 Oct	5 People, values and conservation choices	Pascual et al. (2023)
Wed 14 Oct	6 Populations in a changing climate	Pörtner et al. (2023)
Mon 19 Oct	Field visit	No assigned article
Wed 21 Oct	7 Habitats, fragmentation and connectivity	Haddad et al. (2015)
Mon 26 Oct	8 Protection and conservation alternatives	Wauchope et al. (2022)
Wed 28 Oct	9 Invasions and changing communities	Roy et al. (2024)
Mon 02 Nov	10 Monitoring, evidence and adaptation	Haase et al. (2023)
Wed 04 Nov	11 From evidence to a defensible decision	Langhammer et al. (2024)

What you will learn

1 Explain conservation science in the Anthropocene, linking biodiversity, ecosystem functioning, human values and decisions under changing climate and reference conditions;

2 Identify drivers, interacting pressures, feedbacks, ecological thresholds and regime shifts across terrestrial, freshwater and marine ecosystems;

3 Assess species, population and habitat vulnerability, evolutionary potential and extinction risk, and explain the assumptions behind minimum viable population estimates;

4 Evaluate scientific articles by separating claims, methods, evidence, limitations and implications for practice;

5 Compare conservation actions and priorities across terrestrial, freshwater and marine ecosystems, considering effectiveness, feasibility, equity and future uncertainty;

6 Propose measurable objectives and monitoring indicators that can trigger an adaptive response;

7 Explain a conservation decision to a manager.

Class structure

Interactive lecture	80 min	Lecturer-led teaching with questions, short exercises and student discussion.
Journal club	50 min	Critically discuss the assigned scientific article.
Project	30 min	Develop group project.
Class discussion	20 min	Share one decision, its evidence, and an uncertainty.

Group Project

In Lesson 1, each group receives the Conservation Decision handbook with instructions for the group project. Each group selects one real conservation case from any ecosystem. The case should have a defined ecological concern, a managing body, and referenced evidence. Each group will develop a Conservation Management Plan to be discussed in class.

What your group will submit

1. A Conservation Management Plan. Explain the case, main pressures, scientific evidence, proposed strategy, and its feasibility. Describe the ecological outcomes realistically expected after ten years, the evidence supporting those expectations, and the main assumptions and uncertainties, including climate change. Propose monitoring indicators and explain how conservation success can be assessed. Add the reference list and a short statement of each member’s contribution.
2. An eight-minute group presentation, followed by questions: case and objective; ecological evidence; proposed strategy; expected outcomes after ten years; monitoring and revision.

1 LESSON

Monday 28 September 2026
10:30–13:30

What is conservation science?

What are we conserving, for whom, and in what future?

INTERACTIVE LECTURE

Instructor and student introductions (30 min), followed by a participatory lecture (90 min). Conservation science in the Anthropocene: from species protection to ecosystem conservation and social–ecological decisions. Climate change and moving baselines, uncertainty and adaptation. Connections with Restoration and Remediation.

REQUIRED JOURNAL CLUB READING

No article to read before this class. The course, reading approach and project handbook will be introduced together.

CRITICAL DISCUSSION

Introduce your background and one conservation question. Compare the ecological targets and human values behind different examples.

PROJECT STUDIO AND CLASS UPDATE

Project launch (60 min). Form groups, receive the assignment, and select a real case from any ecosystem. Define a provisional decision question, a management body, and the evidence needed. Share the initial idea with the class.

2 LESSON

Wednesday 30 September 2026
10:30–13:30

Biodiversity, functioning and benefits

Do biodiversity, ecosystem functions and human benefits always align?

INTERACTIVE LECTURE

Genetic, species and functional diversity; ecosystem functioning, natural capital and ecosystem services. Complementarity and trade-offs among biodiversity conservation, ecosystem functioning and ecosystem services.

REQUIRED JOURNAL CLUB READING

Article 1 · Hua et al. (2022). Forest restoration approaches, biodiversity and ecosystem service trade-offs.

CRITICAL DISCUSSION

Which outcomes are compared, and against what reference? Identify a benefit that would be missed by a single indicator. Discuss how context and study design affect the comparison.

PROJECT STUDIO AND CLASS UPDATE

Choose a focal conservation target and distinguish it from the benefits people seek. Propose monitoring indicators. Discuss any conflict between objectives.

3 LESSON

Monday 5 October 2026
10:30–13:30

Reference conditions and ecological change

When should the past guide a future conservation target?

INTERACTIVE LECTURE

Historical baselines, degradation, resilience, ecological thresholds, regime shifts and novel ecosystems. Compare gradual change with abrupt transitions in forests, grasslands, lakes and wetlands. Distinguish ecological constraints from value judgements when choosing desired conditions.

REQUIRED JOURNAL CLUB READING

Article 2 · Hobbs, Higgs & Harris (2009). Novel ecosystems. Murcia et al. (2014) provides an optional counterargument.

CRITICAL DISCUSSION

What evidence would justify changing a reference condition? Test whether the novel ecosystem concept helps a decision or risks accepting avoidable degradation.

PROJECT STUDIO AND CLASS UPDATE

Specify the baseline and spatial boundary for your case. Set a measurable conservation objective for the next ten years and distinguish the desired outcome from what the evidence suggests is realistically achievable.

4 LESSON

Wednesday 7 October 2026
10:30–13:30

Pressures, interactions and causal evidence

Why can the same pressure produce different ecological responses?

INTERACTIVE LECTURE

Overexploitation, pollution, habitat loss and fragmentation, invasive species, urbanisation and climate change as interacting drivers of biodiversity loss. Additive, synergistic and antagonistic responses, feedbacks and scale. Use experiments with freshwater bacteria to examine how stressor intensity changes the combined response.

REQUIRED JOURNAL CLUB READING

Article 3 · Carmichael, Warfield & Yvon-Durocher (2025). Multiple stressor effects and environmental performance curves.

CRITICAL DISCUSSION

How do the chosen stressor levels change the interaction observed? Identify the expected response used to detect an interaction. Discuss what experiments on isolated bacteria can tell us about populations, communities and conservation decisions.

PROJECT STUDIO AND CLASS UPDATE

Draw a causal model linking underlying drivers, direct pressures and objectives. Mark evidence and assumptions separately. Present one interaction that could change your action.

5 LESSON

Monday 12 October 2026
10:30–13:30

People, values and conservation choices

Whose values enter a conservation decision?

INTERACTIVE LECTURE

Socio-ecological systems, intrinsic, instrumental and relational values. Land use, urbanisation, livelihoods, unequal access to nature and governance. Compare who gains, who bears costs, and who can influence an intervention.

REQUIRED JOURNAL CLUB READING

Article 4 · Pascual et al. (2023). Diverse values of nature for sustainability.

CRITICAL DISCUSSION

How could recognising different values alter a decision? Contrast monetary valuation with other approaches. Identify whose knowledge or interests a proposed assessment might omit.

PROJECT STUDIO AND CLASS UPDATE

Build a stakeholder map and identify an important value conflict. Explain how participation could change the decision criteria. Discuss a practical way to include an underrepresented perspective.

6 LESSON

Wednesday 14 October 2026
10:30–13:30

Populations in a changing climate

What allows a population to persist and adapt as conditions change?

INTERACTIVE LECTURE

Species and population vulnerability, extinction risk, demographic and environmental variability, genetic diversity and evolutionary potential. Minimum viable populations (MVP) and population viability analysis: dependence on time horizon, risk tolerance and future conditions. Climate exposure, sensitivity, adaptation, range shifts and refugia; climate and biodiversity feedbacks.

REQUIRED JOURNAL CLUB READING

Article 5 · Pörtner et al. (2023). The coupled climate and biodiversity crises. Optional: Shaw et al. (2025) extends the discussion of genetic diversity.

CRITICAL DISCUSSION

Where can climate and biodiversity goals reinforce each other or conflict? Use a short population scenario to discuss persistence and why there is no universal MVP number. Distinguish maintaining current conditions from enabling adaptation.

PROJECT STUDIO AND CLASS UPDATE

Assess how climate and other future changes could affect your target and proposed strategy over ten years. Identify a key assumption, an uncertainty and a possible response. Share a revision and prepare three questions for the 19 October field visit.

Field

Monday 19 October 2026
Field visit times on Moodle

7 LESSON

Wednesday 21 October 2026
10:30–13:30

Habitats, fragmentation and connectivity

When does connecting habitats improve conservation outcomes?

INTERACTIVE LECTURE

Habitat vulnerability, habitat loss, fragmentation, edge effects, isolation and extinction debt. Structural versus functional connectivity, dispersal and landscape matrices. Compare terrestrial corridors, freshwater networks and marine dispersal to assess when similar conservation strategies transfer across systems.

REQUIRED JOURNAL CLUB READING

Article 6 · Haddad et al. (2015). Habitat fragmentation and its lasting impacts across ecosystems.

CRITICAL DISCUSSION

Which effects persist over time, and how strong is the causal evidence? Explain why species, spatial scale and the surrounding landscape may change the value of a corridor.

PROJECT STUDIO AND CLASS UPDATE

Debrief Field Visit: one transferable principle, one limit and one project revision. Map habitat patches, barriers and relevant connections in your case, then identify where an intervention could help.

8 LESSON

Monday 26 October 2026
10:30–13:30

Protection and conservation alternatives

What makes an intervention effective beyond its designation?

INTERACTIVE LECTURE

Protected areas, spatial planning and conservation priorities: irreplaceability, vulnerability, representation and connectivity under limited resources. In situ and ex situ conservation, reintroductions, translocations and assisted migration. Compare effectiveness, feasibility, risks and equity, including management beyond reserve boundaries.

REQUIRED JOURNAL CLUB READING

Article 7 · Wauchope et al. (2022). Protected areas, waterbirds and management effectiveness.

CRITICAL DISCUSSION

What is the counterfactual, and why does it matter? Distinguish area designation from management effects. Explain the limits of transferring waterbird results to other taxa or habitats.

PROJECT STUDIO AND CLASS UPDATE

Develop the proposed conservation strategy. Explain what should be done, by whom, and why the evidence supports it. Assess feasibility, resource needs, risks and affected groups.

9 LESSON

Wednesday 28 October 2026
10:30–13:30

Invasions and changing communities

When does community change require a conservation response?

INTERACTIVE LECTURE

Alien and invasive species, introduction and biotic homogenisation. Compare effects on biodiversity, ecosystem functions and people across terrestrial and freshwater systems. Prevention, early detection, eradication and long-term management.

REQUIRED JOURNAL CLUB READING

Article 8 · Roy et al. (2024). Global threats from invasive alien species and options for action.

CRITICAL DISCUSSION

What evidence distinguishes presence from harmful impact? Compare the benefits, feasibility and unintended effects of alternative responses. Consider interactions with land use and climate.

PROJECT STUDIO AND CLASS UPDATE

Check whether invasions or community change affect your proposed strategy or its expected outcomes. Where they are not central, justify that judgement.

10 LESSON

Monday 2 November 2026
10:30–13:30

Monitoring, evidence and adaptation

What evidence would tell us to change course?

INTERACTIVE LECTURE

Indicators of biodiversity, pressure and ecosystem functioning; baselines, sampling and uncertainty. Distinguish a temporal trend from the effect of an intervention. Adaptive management links monitoring, evaluation and a predefined decision response.

REQUIRED JOURNAL CLUB READING

Article 9 · Haase et al. (2023). Long-term change in European freshwater biodiversity.

CRITICAL DISCUSSION

Which measures support the conclusions, and what do we still not know? Assess spatial coverage, time periods and causal inference. Would the same monitoring design answer your project question?

PROJECT STUDIO AND CLASS UPDATE

Link two monitoring indicators to the expected ten-year outcomes. Specify how and when results would be assessed. Peer-review the management plan and start the presentation.

11 LESSON

Wednesday 4 November 2026
10:30–13:30

From evidence to a defensible decision

What counts as conservation success, and how confidently can we claim it?

INTERACTIVE LECTURE

Compare conservation challenges and strategies across terrestrial, freshwater and marine ecosystems: dominant pressures, connectivity, governance and feasible actions. A short synthesis links biodiversity, people and climate with evidence-based conservation, restoration and remediation.

REQUIRED JOURNAL CLUB READING

Article 10 · Langhammer et al. (2024). The positive impact of conservation action.

CRITICAL DISCUSSION

How are actions and outcomes compared? Examine the variation among interventions and gaps in the evidence. What would success mean in your own case?

PROJECT STUDIO AND CLASS UPDATE

Project presentations

Required journal club articles

Read one assigned article before each of Lessons 2–11. The short citations in the lesson descriptions refer to these same ten papers; this is their full reference list. Lesson 1 and the field visit have no assigned article. Use the DOI links to access the papers.

1 LESSON 2 · WED 30 SEP

Hua, F., et al. (2022). The biodiversity and ecosystem service contributions and trade-offs of forest restoration approaches. Science 376, 839–844.

doi.org/10.1126/science.abl4649

2 LESSON 3 · MON 05 OCT

Hobbs, R. J., Higgs, E. & Harris, J. A. (2009). Novel ecosystems: implications for conservation and restoration. Trends in Ecology & Evolution 24, 599–605.

doi.org/10.1016/j.tree.2009.05.012

3 LESSON 04 · WED 07 OCT

Carmichael, H., Warfield, R. & Yvon-Durocher, G. (2025). Reconciling variability in multiple stressor effects using environmental performance curves. Ecology Letters 28, e70065.

doi.org/10.1111/ele.70065

4 LESSON 05 · MON 12 OCT

Pascual, U., et al. (2023). Diverse values of nature for sustainability. Nature 620, 813–823.

doi.org/10.1038/s41586-023-06406-9

5 LESSON 06 · WED 14 OCT

Pörtner, H.-O., et al. (2023). Overcoming the coupled climate and biodiversity crises and their societal impacts. Science 380, eabl4881.

doi.org/10.1126/science.abl4881

6 LESSON 07 · WED 21 OCT

Haddad, N. M., et al. (2015). Habitat fragmentation and its lasting impact on Earth's ecosystems. Science Advances 1, e1500052.

doi.org/10.1126/sciadv.1500052

7 LESSON 08 · MON 26 OCT

Wauchope, H. S., et al. (2022). Protected areas have a mixed impact on waterbirds, but management helps. Nature 605, 103–107.

doi.org/10.1038/s41586-022-04617-0

8 LESSON 09 · WED 28 OCT

Roy, H. E., et al. (2024). Curbing the major and growing threats from invasive alien species is urgent and achievable. Nature Ecology & Evolution 8, 1216–1223.

doi.org/10.1038/s41559-024-02412-w

9 LESSON 10 · MON 02 NOV

Haase, P., et al. (2023). The recovery of European freshwater biodiversity has come to a halt. Nature 620, 582–588.

doi.org/10.1038/s41586-023-06400-1

10 LESSON 11 · WED 04 NOV

Langhammer, P. F., et al. (2024). The positive impact of conservation action. Science 384, 453–458.

doi.org/10.1126/science.adj6598

The following section contains optional background reading: two books (available in Moodle) and eleven additional articles. These support lectures or project research and are not extra assigned journal club readings.

Optional books and articles for your reference

REFERENCE BOOK

Sodhi, N. S. & Ehrlich, P. R. (eds) (2010). Conservation Biology for All. Oxford University Press.

Publisher and book details

REFERENCE BOOK

van Andel, J. & Aronson, J. (eds) (2012). Restoration Ecology: The New Frontier. 2nd edition. Wiley-Blackwell.

Publisher and book details

LESSON 1 · CONSERVATION SCIENCE

Kareiva, P. & Marvier, M. (2012). What is conservation science? BioScience 62, 962–969.

doi.org/10.1525/bio.2012.62.11.5

LESSON 2 · BIODIVERSITY AND FUNCTIONING

Loreau, M. (2010). Linking biodiversity and ecosystems: towards a unifying ecological theory. Philosophical Transactions of the Royal Society B 365, 49–60.

doi.org/10.1098/rstb.2009.0155

LESSONS 2 & 5 · NATURAL CAPITAL AND SERVICES

Costanza, R., et al. (1997). The value of the world's ecosystem services and natural capital. Nature 387, 253–260.

doi.org/10.1038/387253a0

LESSONS 2 & 5 · CRITIQUES OF ECOSYSTEM SERVICES

Schröter, M., et al. (2014). Ecosystem services as a contested concept: a synthesis of critique and counter-arguments. Conservation Letters 7, 514–523.

doi.org/10.1111/conl.12091

LESSONS 3 & 4 · RESILIENCE AND REGIME SHIFTS

Folke, C., et al. (2004). Regime shifts, resilience, and biodiversity in ecosystem management. Annual Review of Ecology, Evolution, and Systematics 35, 557–581.

doi.org/10.1146/annurev.ecolsys.35.021103.105711

LESSON 3 · COUNTERARGUMENT TO THE ASSIGNED PAPER

Murcia, C., et al. (2014). A critique of the “novel ecosystem” concept. Trends in Ecology & Evolution 29, 548–553.

doi.org/10.1016/j.tree.2014.07.006

LESSON 5 · INEQUALITY AND URBAN ECOLOGY

Schell, C. J., et al. (2020). The ecological and evolutionary consequences of systemic racism in urban environments. Science 369, eaay4497.

doi.org/10.1126/science.aay4497

LESSON 6 · CLIMATE IMPACTS ACROSS BIOLOGICAL SCALES

Scheffers, B. R., et al. (2016). The broad footprint of climate change from genes to biomes to people. Science 354, aaf7671.

doi.org/10.1126/science.aaf7671

LESSON 6 · RECENT EVIDENCE ON GENETIC DIVERSITY

Shaw, R. E., et al. (2025). Global meta-analysis shows action is needed to halt genetic diversity loss. Nature 638, 704–710.

doi.org/10.1038/s41586-024-08458-x

LESSONS 6 & 8 · CONSERVATION INTERVENTIONS

Corlett, R. T. (2016). Restoration, reintroduction, and rewilding in a changing world. Trends in Ecology & Evolution 31, 453–462.

doi.org/10.1016/j.tree.2016.02.017

LESSON 9 · BIOTIC HOMOGENISATION

McKinney, M. L. & Lockwood, J. L. (1999). Biotic homogenization: a few winners replacing many losers in the next mass extinction. Trends in Ecology & Evolution 14, 450–453.

doi.org/10.1016/S0169-5347(99)01679-1