UNIVERSITÀ DEGLI STUDI DI PADOVA

DIPARTIMENTO DEL TERRITORIO E SISTEMI AGRO-FORESTALI

CORSO DI LAUREA IN TECNOLOGIE FORESTALI E AMBIENTALI

Application of biodiversity parameters in Veneto foothills environment

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ABSTRACT

This paper deals with biodiversity and how it has evolved over the years. Moreover, it deals with forest certification methods, two types of forest certifications are compared: PEFC and BIOΔ4. It is then analyzed the level of biodiversity according to the indicators of the above mentioned certifications, in the area of Crespano del Grappa, more precisely in the property of the Chiavacci Lago Center.

The results obtained from the application of the BIOΔ4 indicators showed very low biodiversity because several indicators did not reach the minimum score. As a result, a score table has been created that is more suitable for the area being analyzed.

The study of the structure of the two areas revealed values that confirmed the expected results: a medium-high biodiversity but using threshold parameters lower than those used in Cansiglio.

RIASSUNTO

Questo elaborato tratta della biodiversità e di come si evoluta negli anni. Inoltre, tratta di metodi di certificazione forestale, in particolare vengono paragonate due tipologie di certificazioni forestali: PEFC e BIOΔ4. Viene poi analizzato il livello di biodiversità secondo gli indicatori delle certificazioni sopra citate, nell'area di Crespano del Grappa, più precisamente nella proprietà del Centro Chiavacci Lago.

I risultati ottenuti dall'applicazione degli indicatori BIOΔ4 hanno evidenziato una biodiversità molto bassa perché diversi indicatori non hanno raggiunto il punteggio minimo. Di conseguenza è stata creata una tabella di punteggi più adatta all'area analizzata.

Dallo studio della struttura delle due aree sono emersi valori che hanno confermato i risultati attesi: una biodiversità medio-elevata ma utilizzando parametri soglia più bassi di quelli utilizzati in Cansiglio.

1. INTRODUCTION

1.1. Importance of biodiversity conservation

Biodiversity strengthens every ecosystem, and this is the main feature we need to preserve. In fact, our planet ecosystems may seem like permanent fixtures, but they are vulnerable to collapse. In the last few decades data analysis show a dangerous change in ecosystem's structure and, consequently, affecting biodiversity. "A change in an ecosystem necessarily affects the species in the system, and changes in species affect ecosystem processes." ("1. How have ecosystems changed? - GreenFacts")
Ecosystem assessment is an instrument for the analysis of environmental change and its impact on biodiversity. The ecosystem's structure is the key for our understanding of how species interact with each other and their abiotic environments, and how these interactions are affected by human activities.
Ecosystems contain a multitude of living organisms that have adapted to survive and reproduce in a particular physical and chemical environment. Anything that causes a change in the physio-chemical characteristics of the environment has the potential to change an ecosystem's condition and its biodiversity. Any activity that changes the organisms, can change the functionality of an ecosystem.
Ecosystems are defined in the Convention on Biological Diversity (CBD, UN, 1992) as "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit". ("Mapping and Assessment of Ecosystems and their Services (MAES)")

What makes an ecosystem strong or weak on the face of change is biodiversity. Biodiversity is built out of three elements: ecosystem diversity, species diversity and genetic diversity. Every ecosystem is filled with other smaller ecosystems, each packed with interconnected species and every links provides stability to the next. The strongest is the genetic biodiversity within individual species, the better is their ability to cope with changes. Species that lack genetic diversity due to isolation or low population numbers, are much more vulnerable to fluctuation, caused by climate change, disease, or habitat fragmentation. Whenever a species disappears because of its weakened gene pool, parts of the net disintegrate. Even if in a forest, for example, the volume of species, the genetic diversity and the complexity of the ecosystems form such rich biodiversity, that one species gap in the weave won't cause it to unravel we should really preserve the forest so it can stay resilient and recover from change. Anyway, commitment to conservation and maintenance of biodiversity levels are essential to protect potentially endangered species.

1.2. Extinction rates

Extinction is a natural part of Earth’s history; but over the past few hundred years humans have dangerously increased the species extinction. Most estimates of the total number of species today lie between 5 million and 30 million, although the overall total could be higher than 30 million. We should also consider groups such as deep-sea organisms, fungi, and microorganisms including parasites that have more species than currently estimated. Species present today only represent 2–4% of all species that have ever lived.

The general engine of species extinction is human population growth and the increase in per capita consumption. How long these trends will continue, where and at what rate, dominate species extinction scenarios and challenge efforts to protect biodiversity.

Before the last decade, many studies have developed extinction scenarios from simple hypotheses of changing land use as the primary engine of biodiversity loss, employing the species-area relationship. For example, Pimm and Raven (2000) predicted 18% extinction by 2100 due to deforestation to date in tropical forest hotspots and 40% extinction if these regions maintained natural habitat only in currently protected areas.

Studies now allow detailed assessments of the current state of species by cutting available range maps, using remote sensing estimates of altitude and remaining habitats and connecting directly to the meta-population models of fragmented ranges.

Figure 1 provides an example of the extent to which species' ranges have been lost and fragmented by deforestation and when this has occurred. It also shows where the forest remains outside protected areas, how it has been lost from within them and the potential for crowd-sourced data to monitor species distributions.

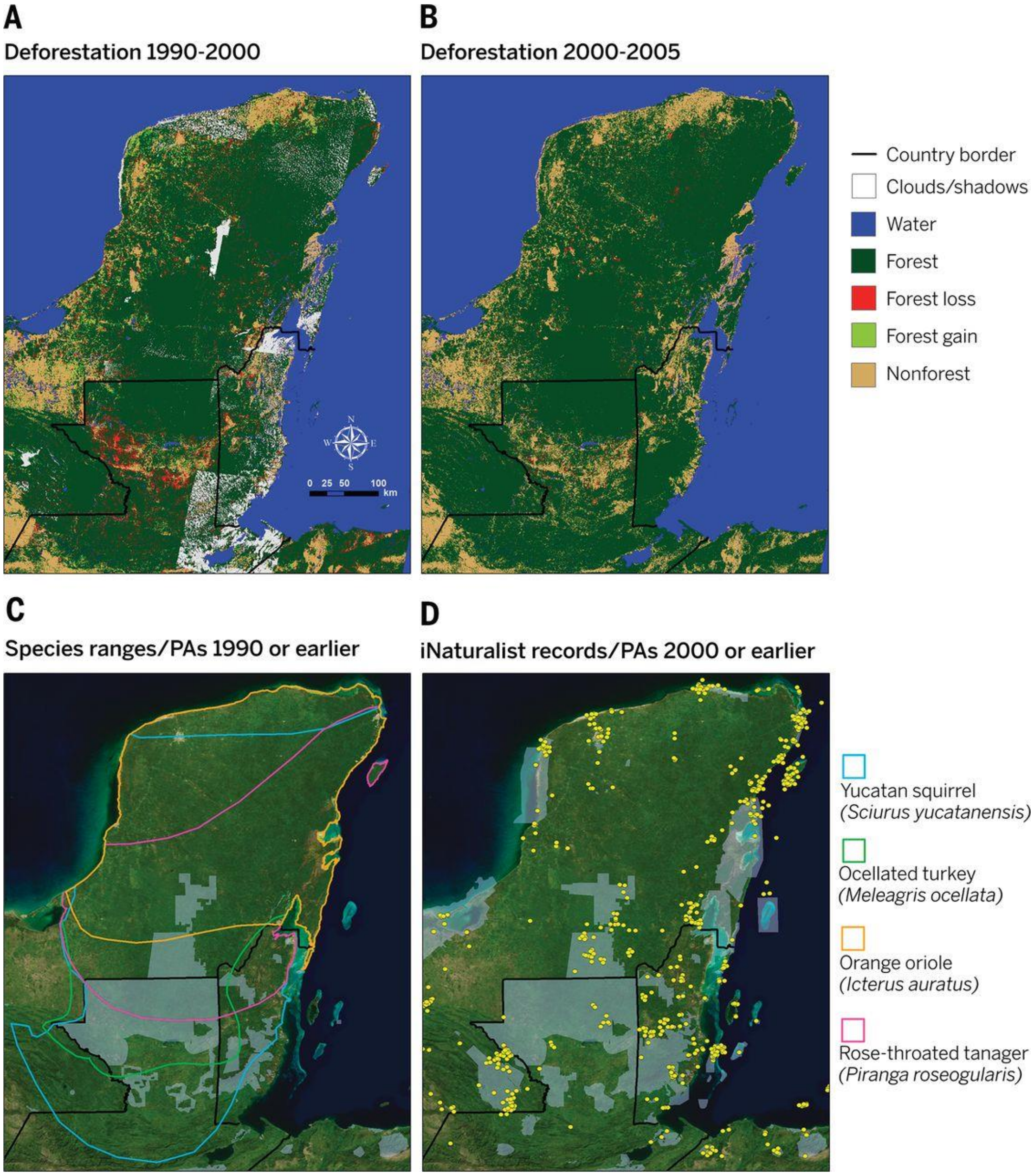

Fig. 1: Combining databases to assess the changing status of biodiversity. Thomas Brooks via Research Gate (https://www.researchgate.net/publication/262787160_The_biodiversity_of_species_and_their_rates_of_extinction_distribution_and_protection/figures?lo=1)

Maps (A) and (B) show the change in land cover in the Yucatan Peninsula of Central America. Although protected areas have increased over time, there has been extensive deforestation in the Guatemalan plain from 1990 to 2000 (shown in red), some in protected areas. Forest loss slowed from 2000 to 2005. (C) Deforestation has reduced and fragmented the ranges of four endemic specimen species of Yucatan. (D)

The combination of these sources anticipates the ability to continuously evaluate biodiversity and provide a model on which crowd-sourced data could validate predictions of changing species distributions. Global biodiversity monitoring can now move on to combining databases of increasing scope and certainty at regular intervals. These next steps will increasingly enable scientists and policymakers to understand the state, trends, and threats to terrestrial biodiversity and to act accordingly to protect it.

1.3. Genetic diversity

Genetic diversity has declined globally. The extinction of species and loss of unique populations has resulted in the loss of unique genetic diversity contained by those species and populations. For wild species, there are few data on the actual changes in the magnitude and distribution of genetic diversity, although studies have documented declining genetic diversity in wild species that have been heavily exploited. If genetic diversity gets too low, species can go extinct and be lost forever. This is due to the combined effects of inbreeding depression and failure to adapt to change. In such cases, the introduction of new alleles can save a population. This is called genetic rescue.

A conservation strategy, new individuals are moved into a population to increase genetic diversity and improve population health.

We hear a lot about the loss of species in the world, but we are also seeing a loss of genetic diversity within species. The increasing number of people on Earth and our increasing use of natural resources has reduced space and resources for wild species. Over time, many wild animal and plant populations have become smaller or more isolated. Many species have also gone through local extinctions. This has led to a global loss of genetic diversity (Meyer, R., and Purugganan, M. 2013. Evolution of crop species: genetics of domestication and diversification).

Scientists think that the genetic diversity within species may have declined by as much as 6% globally since the Industrial Revolution. This means that many species are less able to adapt when facing new challenges, like climate change, pollution, and new diseases. If too much genetic diversity is lost, more and more species could become unhealthy and in need of conservation actions. However, there are steps we can take to conserve and restore genetic diversity across many species.

We must preserve and protect genetic diversity. This can be done through the conservation of our remaining wild populations. We can use nature reserves and wildlife bridges to reconnect wild populations that have become separated by our cities and highways. Could be also possible restore habitats because this will allow wild populations to get bigger. Sometimes we can even remove harmful stressors and pests so that populations can naturally regrow. We can also reintroduce species that have been lost from habitats they used to live in. Taken together, these strategies can help stop genetic diversity loss. It is important to protect genetic diversity because it is the foundation for healthy species that are necessary for human's health and, consequently, the whole planet.

A model we have talked so far is this idea that the earth provides life support for the society of humans which is driven by economy. Now economics is the choices that we are making but economy, if we put a monetary value on it is going to be really large number. It is 75 trillion dollars. That is the world gross product. That is what we make, products; and, what we do, the services. It is a huge number, but it is actually small compared on what is called ecosystem services. This is what the planet does, what the planet makes and what the planet does for us. And it does that for free. In other words, it makes oxygen, it makes soil, it recycles nutrients, and it filters water. And so, it is doing that for free. And it is more efficient the more diverse the ecosystems on our planet are. The more diversity we have the better it is for ecosystem services. And as we degree ecosystems we are going to have to take on some of that cost.
Biodiversity is a measure of the variety of life in our planet. One way to measure that is the variety of species. The only way to increase the number of species is through speciation. The mechanism by which that occurs is evolution by natural selection. The opposite, to decrease the number of species, is through extinction.

1.4. Objectives

The aim of the thesis is to compare the BIOΔ4 study of calculation of the level of biodiversity, tested and studied in Cansiglio area, with the area of Pieve del Grappa. The biod4 project is focused on an area populated by white fir, spruce, and beech, unlike the area studied for the thesis, that is Veneto foothills with stands mainly broad-leaved trees. Since the BIOΔ4 project was tested on an area other than the foothills, we want to highlight how the indicators used in the first study must be recalibrated for an area other than the one used in the first place.

BIOΔ4 indicators, such as PEFC indicators, are already used at both international and national level for the assessment of biodiversity.

2. STUDY AREA: Crespano, Pieve del Grappa

Pieve del Grappa is in the context of the Venetian Pre-Alps and appears bounded to the East and West respectively from the Piave Valley and the Brenta Valley (Valsugana). In the North, however, is a typical structural depression, the "Sinclinale Bellunese" that separates it from the Alps of Feltre.

Structurally, the area can be defined as an asymmetric anti-clinal fold, with a southwest - northeast axis, axis that passes roughly through Cima Grappa; this is the reason why the slope rises quite gently from the north, while it is rather abrupt contact with the Venetian plain to the South. The analyzed area is reduced to the "Don Paolo Chiavacci" property (Fig. 2)

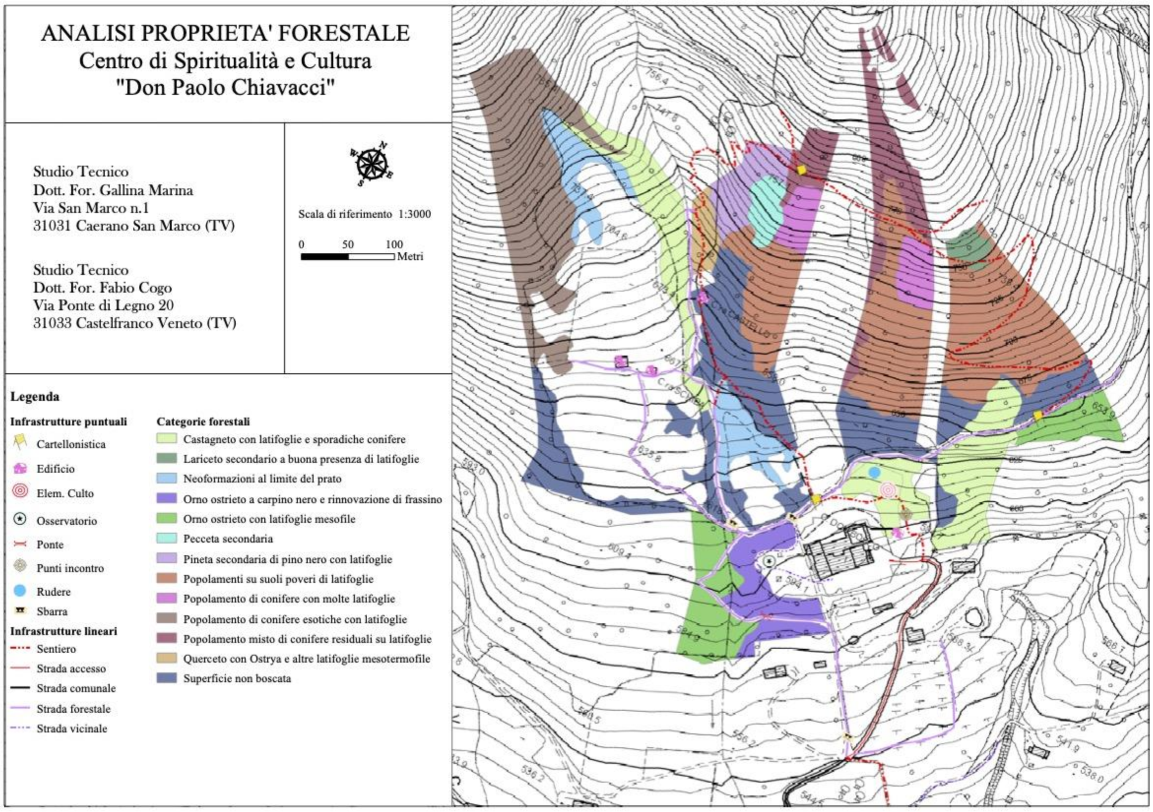

Fig. 2: forestry property analysis by Dott. For. Fabio Cogo

2.1. Climate assessment

The Pre-Alps form a geographical barrier between the Po Valley and the Alps; they are in practice a true orographic outpost that is also expressed as a "genetic bank of precipitation". The masses of humid air rise these mountain ranges, cool down, condense thus giving rise to precipitation. Therefore, associated with the heavy rainfall of the prealpine arc, we find less rainfall in the area immediately north of this mountain range.

2.2. Protected area, ZPS

In the environmental field the term is used to define an area:

- which contributes significantly to the maintenance or restoration of one of the habitat types or to the satisfactory conservation of one of the species of the Habitats Directive;
- which can contribute to the coherence and connectivity of the “Natura 2000 Network”;
- and/or contributing significantly to the maintenance of biodiversity in the region in which it is located.

The ZPS together with the SICs constitute the “Natura 2000 Network” designed to protect European biodiversity through the conservation of natural habitats and animal and plant species of Community interest.

3. MATERIAL AND METHODS

The campaign of field surveys was the turning three months of May June 2022. The measurements were carried out within two test areas for a surface area of 500 m^2 (Fig. 3). The areas were traced one within an area governed by coppice and the second in an area subjected to a form of government in a high forest. In each test area the number of trees per species was counted and the following dendrometric measurements were performed, initially reported in the field sheet and then on an Excel worksheet:

- • Structure of the forest
- Necromass on the ground
- Necromass on feet
- Dendromicrohabitat

In addition, a detection for PFC certification based on BIOΔ4 indicators was simulated during the surveys. There were two operators and for each particle the maximum detection time was 40 minutes; the metric string is used, and all 12 indicators are observed. In this way it has also been tested economically if it is an environment for which the proposed set of indicators can be suitable or not.

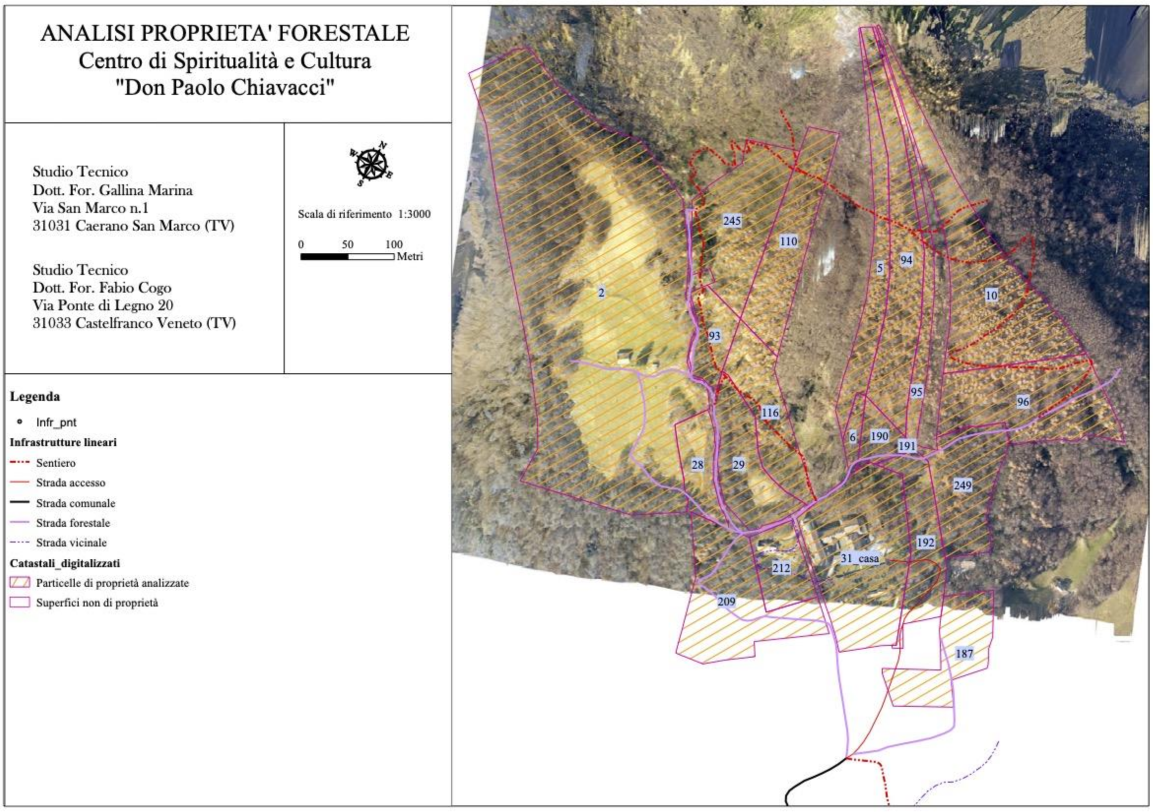

Fig. 3: drone orthophoto by Dott. For. Fabio Cogo

3.1. PEFC and BIOΔ4

At international and national level there are different methodologies for calculating forest biodiversity. In Italy, various certifications are used for this purpose, including

BIOΔ4 and PEFC. They were designed for the same purpose but there are some differences in their application in practice.

A way to protect forests and preserve their biodiversity is the Programme for Endorsement of Forest Certification schemes (PEFC). That is a recognition of the behavior of the owners who manage their forests correctly and, in the end, it gives a label that says, “the forests, or/ and the product, are managed in a sustainable manner”.

On the world scene there are several schemes for forest certification (FAO identifies more than 50). There is a strong growth in certification, but certified areas represent only 9% of the world’s forests. (fig. 4)

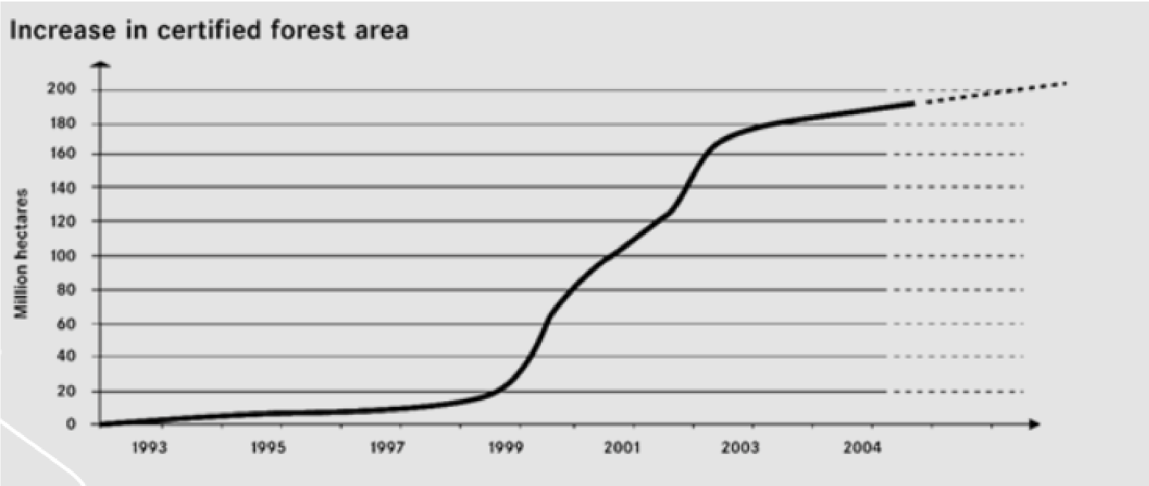

Fig. 4: increase in certified forest area from 1993. https://www.pefc.it

The Forest Management (FM) certification ensures that a forest or forest plantation is managed to strict social and economic environmental standards. These standards are based on the 10 Principles and 70 Criteria (P&C), defined, and maintained by the FSC with the participation of all stakeholders.

The P&C are valid all over the world and applicable to different forest ecosystems and types of management, as well as to different cultural, political, and legislative areas: starting from them the Generic International Indicators have been defined (International Generic Indicators, igis), with the aim of supporting the transfer of the Principles and Criteria to a series of indicators adapted to the national context. The aim is to develop National Standards adapted to the reference context and that are, at the same time, in line with what is established at international level, to ensure greater applicability, credibility and stability of the FSC system.

BIOΔ4 works to counteract the loss of biodiversity, preserve the uniqueness and attractiveness of forest habitats in Alpine areas, promoting active and sustainable forest management, also through the enhancement of the ecosystem services that the forest can offer.
The main objective is to define innovative tools that can enhance biodiversity both in terms of the wood product and in terms of ecosystem services. The places where this project has developed are the Cansiglio forest, the Ampezzo forest and the woods belonging to the chamber of commerce of South Tyrol. The objective of the project is twofold: on the one hand, it emphasizes the diversity in terms of promotion and the wood support that can be obtained from these forests where biodiversity is measured. In addition, the ecosystem services of these forest ecosystems produce services and supply of cultural services such as tourist use, wood products, water purification, improvement of air quality, the well-being of the forest. These services can in turn be enhanced by the perception of a biodiversity present in these places.

The goal would be to support and promote the forest. In addition, it is essential to add value to the wood product, which is linked to the perception of a protected forest from the point of view of biodiversity.
The development of this project is based on the creation of sets of indicators that have been defined according to their applicability range in different environments. Each of them has a specific weight on the final determination of the degree of biodiversity. The final number, that is the sum of the scores of the various indicators, determines the level of maintenance of biodiversity of the analyzed area. Timber comes from the forest and that certified area, such as ecosystem services, will have an additional value due to the certification logo.
The targets are making the most of biodiversity,
In line with the EU Forestry Strategy 2020 and the 2050 Vision, the project exploits the biodiversity of cross-border forest ecosystems with new tools, helping to stop the loss of plant and animal diversity and promoting active and sustainable forest management.

3.2. INDICATORS

For the BIO4 certification were evaluated a hundred indices that the University of Padua skimmed in 12, 11 positive indicators and 1 deduction indicator.

Indicators such as presence of key species/indicators allow direct estimates. More often, however, we use indicators for indirect estimates (presence of certain conditions, dendromicrohabitat, hole of peaks): quantification of a potential biodiversity.

An agricultural environment maybe has more biodiversity because it is managed in a certain way, the presence of man has a lot of influence on biodiversity. Not necessarily an ecosystem with high biodiversity expresses levels of naturalness of equal degree. That's why it is important to differentiate naturalness from biodiversity through the indicators.
Some indicators depend on population, others on context. This is an important subdivision as it is only at the level of the former that an owner can act to improve the situation, while those determined by the context are exogenous to management: there are borderline situations.

1	STRUCTURE OF THE FOREST	Counting of the number of layers where the vegetation is vertically articulated. Different configuration, the importance is knowing how many leaves I have available, not of what tree species. We consider the layer present when we have 20% of leaves per shrub and low arboreal; for herbaceous 40%.
2	CONSERVATION INTEREST SPECIES	Counting the number of rare/protected species of flora and fauna.

		In situations where you are in a "protected area" that area has administrative attention. Presence of alien species is an indicator of deduction because they are often very invasive, they are always allochthonous even if naturalized.
3	NUMBER OF SPECIES COMPOSING THE TREE AND SHRUB STATE	Number count of tree and shrub species (excluding non-native). Assessment of species in tree and shrub strata, from 0.5 to 1.5 m.
4	NECROMASS IN FEET	Counting of the number and spread of standing dead drums
5	NECROMASS ON THE GROUND	Spreading number count of dead logs (and/or stumps)
6	NUMBER OF LARGE PLANTS	Counting the number and variety of large trees
7	DENDROMICROHABITAT	Counting the number and variety of dendromicrohabitats on living trees. Dendro-microhabitat, no more than two can be counted for each. It is easier to have a high score in the woods with large plants because there are more cavities, and the plants are statistically more prone to contracting diseases.
8	BREEDING SITES AND FARMING AREAS OF SPECIES OF CONSERVATION INTEREST	Verification of the presence and counting of dens, singing arenas, hatching areas, nests and/or holes of woodpeckers, of qualified fauna species.

9	PRESENCE OF CLEARINGS	Measurement of the incidence of grassy or low-shrubby clearings forming the horizontal structure of the vegetation.
10	HABITATS LINKED TO MORPHOLOGY AND WATER	Verification of presence and estimation of the variety of humid or rocky habitats contributing to the geomorphological articulation of the forest site.
11	AREA WITHIN PROTECTED AREAS OR SUBJECT TO SPECIFIC REGULATIONS OR COMMITMENTS	Impact of areas specifically regulated for environmental protection.
12	DISTURBING FACTORS FOR BIODIVERSITY	Verification of presence of anthropogenic determinism conditions or activities that can significantly limit (directly or indirectly) biodiversity: -Loss of renewal due to excessive burning; -Presence of substitute and/or anthropogenic forest formations or alien species; -Relevance of other anthropogenic disturbances/damage (infrastructure, tourism, etc.)

3.3. Indicators sampled on test area

1. Articulation of the forest structure

This indicator gives a score depending on the number of layers in which the vegetation is articulated vertically, meaning by layer the leaf cover between the extremes of the layer height (Tab. 1). The following layers are distinguished:

a) high arboreal: H > 20 m

b) medium arboreal: H = 5 – 20 m
c) low arboreal shrub: H =. 0,5 – 5 m

Tree or shrub layers are considered only those with a leaf cover of 20% of the sample surface (visual estimate). For the herbaceous layer, however, the coverage must be at least 40% of the surface.

n° layers	points
≤2	0
3	2
4	5

Tab. 1: scoring thresholds to be given to indicator 1 - articulation of forest structure

4. Necromass in feet

This indicator gives a base score depending on the number of *snags* with height greater than or equal to 1 m and DBH ≥ 30 cm and gives bonus points depending on their cumulative height (H_{cum}) in the hectare (Tab. 2).

n° *snag*	points	bonus	
		H_{cum} > 15m	H_{cum}> 30m
≤1	0	1	2
2-4	2	1	2
≥5	5	-	-

Tab. 2: scoring thresholds to be given to indicator 4 – Necromass in feet

5. Necromass on the ground

This indicator gives a base score based on the number of logs ≥ 1 m and a diameter ≥ 30 cm and gives bonus points according to their cumulative length (L_{cum}) in the hectare (Tab. 3). Logs traceable to a single tree are considered as a single *log*.

n° *log*	points	bonus	
		L_{cum}> 10m	L_{cum}> 25m
≤2	0	+1	+2
3-4	2	+1	+2
≥5	5	-	-

Tab. 3: scoring thresholds to be given to indicator 5 – Necromass on the ground

7. Dendromicrohabitat

This indicator gives a score (Tab.4) based on the number and variety of *dendromicrohabitats* on trees in the test area, for which identification is referred to Kraus al. (2016). Each type of *dendromicrohabitat* can be contact at most twice and on different trees and one same tree can be counted several times only if it refers to different dendromicrohabitats.

The *dendromicrohabitats* to be considered are:

a) Cavities on the trunk (excluding picid nesting holes)
b) Dendrotelmes and microsols
c) Debarkation/exposed sapwood/leakage of sap or resin
d) Fractures on trunk and crown
e) Cracks and scars
f) Pockets in the bark
g) Cavities in root buttresses
h) Cancers, phytoplasmas
i) Fruit, fungal and myxomycin bodies
j) Phanerogams and cryptogams (minimum coverage threshold of at least 40% of the main trunk)

n° dendromicrohabitat	points
<10	0
10-15	2
≥16	5

Tab. 4: scoring thresholds to be given to indicator 7 – Dendromicrohabitat

3.4.1. Sampled indicators on high forest area

The first area, with the majority of *Ostrya carpinifolia* (L.) and *Fraxinus* (L.) renovation (Fig. 2 areas number 6, 190, 191) is an area managed by five years.

1. **Articulation of the forest structure**

The layers in which vegetation is articulated gave the following results reported in the table (Tab. 5) referred to indicator 1 (Tab. 1)

layers	
a) high arboreal	yes
b) medium arboreal	yes
c) low arboreal shrub	no

Tab. 5: scores attributed to the first test area – articulation of the forest structure

The result of the score, being less than two layers of leaf cover, has as result **0**.

4. **Necromass in feet**

For this indicator the score threshold has been lowered. The Cansiglio area, where the biod4 project was tested, would yield results of low biodiversity because the environment is structured differently being foothills. Consequently, an alternative score table (Tab. 6) has been created that adapts to the analyzed area.

The average diameter of the minimum score threshold has been lowered to ≥ 17.5 cm.

n° *snag*	points	bonus	
		H_{cum} > 10m	H_{cum} > 25m
≤1	0	1	2
2-4	2	1	2
≥5	5	-	-

Tab. 6: modified scoring thresholds to be given to indicator 4 – Necromass in feet

Table (Tab. 7) shows the trees analyzed according to the diameter taken at sampling height (1,30 m).

DBH	UM
10	cm
10	cm
11	cm
11	cm
12,5	cm
13	cm
14	cm
14	cm
16	cm
16	cm
16,5	cm
17,5	cm
18	cm
21	cm
28	cm

Tab. 7: diameter at 1,30 m of standing dead trees

The trees with an average diameter ≥ 17.5 cm are 4, so the final score is **2**. There are no bonus additions because no dead trees have been found on the ground with a length ≥ 15 m.

5. Necromass on the ground

As for the previous indicator, a table of scores has been created different from the one presented initially (Tab. 8). The average threshold diameter is 17.5 cm.

n° *log*	points		
	base	L_{cum} > 10m	L_{cum} > 15m
≤3	0	1	2
4-5	2	1	2
≥6	5	-	-

Tab. 8: modified scoring thresholds to be given to indicator 5 – Necromass on the ground

Below (tab. 9) the diameters of the analyzed trees.

DBH	UM
6	cm
7	cm
10	cm
10	cm
11	cm
12	cm
13	cm
16	cm
18	cm
26	cm

Tab. 9: diameter at 1,30 m of dead trees on the ground

The trees with an average diameter ≥ 17.5 cm are 2, so the score is 0. There are bonus additions because dead trees have been found on the ground with a length ≥15 m (colored). The final score is **1**.

7. Dendromicrohabitat

The dendromicrohabitat had the following results, shown in the table: (tab. 10)

Cavities on the trunk	0
Dendrotelmes and microsols	2
Debarkation/exposed sapwood/leakage of sap or resin	2
Fractures on trunk and crown	2
Cracks and scars	2
Pockets in the bark	2
Cavities in root buttresses	0
Cancers, phytoplasmas	2

Fruit, fungal and myxomycin bodies	0
Phanerogams and cryptogams	0
TOT.	**12**

Tab. 10: dendromicrohabitats score

Several indicators, including barking and scars, are due to the high presence of roe deer and deer in the foothills. As a rule, with the PEFC certification and according to the biod4 project, the excessive presence of ungulates is a detracting element that, however, is not considered in this thesis.

3.4.2. Sampled indicators on coppice area

The second area, with the majority of *Fraxinus* (L.) (Fig. 2 area number 187) is a non-managed area. The area is characterized by a form of government of aged coppice.

1. **Articulation of the forest structure**

The layers in which vegetation is articulated gave the following results reported in the table (Tab. 11) referred to indicator 1 (Tab. 1)

layers	
a) high arboreal	yes
b) medium arboreal	yes
c) low arboreal shrub	yes

Tab. 11: scores attributed to the first test area – articulation of the forest structure

The result of the score, being less than two layers of leaf cover, has as result **3**.

4. **Necromass in feet**

Table (Tab. 12) shows the trees analyzed according to the diameter taken at sampling height (1,30 m).

DBH	UM
18	cm
10	cm
17	cm
12	cm

Tab.12: diameter at 1,30 m of standing dead trees

The trees with an average diameter ≥ 17.5 cm are 2, so the final score is **0**. There are no bonus additions because no dead trees have been found on the ground with a length ≥ 15 m.

5. Necromass on the ground

Below (Tab. 13) the diameters of the analyzed trees.

DBH	UM
7	cm
7	cm
10	cm
10	cm
15	cm
17	cm

Tab.13: diameter at 1,30 m of dead trees on the ground

The trees with an average diameter ≥ 17.5 cm are 1, so the score is 0. There are bonus additions because dead trees have been found on the ground with a length ≥15 m (colored). The final score is **1**.

7. Dendromicrohabitat

The dendromicrohabitat had the following results, shown in the table (Tab. 14):

Cavities on the trunk	0
Dendrotelmes and microsols	2

Debarkation/exposed sapwood/leakage of sap or resin	0
Fractures on trunk and crown	0
Cracks and scars	2
Pockets in the bark	2
Cavities in root buttresses	0
Cancers, phytoplasmas	0
Fruit, fungal and myxomycin bodies	2
Phanerogams and cryptogams	2
TOT.	**10**

Tab. 14: dendromicrohabitats score

The difference between the forest analyzed above and the unmanaged one finds differences in microhabitats despite being close areas geographically. The final score is similar but the presence of phanerogams and cryptogams in the second area is much greater.

4. DISCUSSION and CONCLUSIONS

The application of the indicators identified in the framework of the BIOΔ4 project to a forest particle is aimed at expressing an opinion on the level of more biodiversity according to the total score. Being the first particle analyzed a managed forest, also in view of the PEFC certification, the final scores on the analysis of the four parameters gave a result of average biodiversity. The second particle, that is of aged coppice, has reported results of lower level of biodiversity than the high forest. On the contrary, according to other studies (for example Hansen et al. 1991, Kuuluvainen et al. 1996), in which the natural tree stands are structurally more complex and diversified than the managed stands, the first parcel has presented greater characteristics of biodiversity. The purpose with which the interventions were made in the forest was to ensure the highest level of biodiversity allowing the

natural evolution of the forest (leaving necromass standing and on the ground). On the contrary, the particle governed by coppice suffers from some lack of biodiversity, such as the lack of renewal due to the low presence of light.
It is important to note that the BIOΔ4 indicator set has been calibrated to achieve excellence in mixed coniferous and broad-leaved forests, while the test areas are in a different environment. This contributes to a rather low score of indicators despite the table of several indicators has been changed.

In conclusion, the use of indicators BIOΔ4 finds critical if they are used in the Pedemontana area. Having been tested for a different environment, therefore, the level of biodiversity calculated around Pieve del Grappa seems to be very low. Changes can be made to the indicators that allow better adaptation to forest plots characterized by different forms of government and climate.

The study reported the expected results: The absence of some important structural features such as diameter width and height of the necromass on foot and ground clearly reduces the ability of managed stands to support the entire spectrum of potential forest biodiversity. It can therefore be concluded that in the use of the BIOΔ4 parameters in a foothill environment the levels of biodiversity are on average high; however, increasing the complexity and structure of the BIOΔ4 project could be effective for the assessment of biodiversity even in different environments in addition to those of Cansiglio.

5. SOURCES

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6. PHOTO ATTACHMENTS

Attachment 6.1: overview of high forest area

Attachment 6.2: overview of high forest area

Attachment 6.3: dead tree still standing

Attachments 6.4 – 6.5: pockets in the bark (dendromicrohabitat)

Attachment 6.6: microsol (dendromicrohabitat)

Attachment 6.7 – 6.8: resin on the bark (dendromicrohabitat)

CREDITS

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