

## EDUCATION, AWARENESS AND CONSERVATION OF ROMANIA'S BIODIVERSITY

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### **Abstract**

*Romania's biodiversity is a natural treasure, offering a vast array of species and ecosystems, but faces increasing threats from human activities and climate change. Education, awareness and conservation of biodiversity are key to protecting this priceless biological diversity. In this article, through statistical methods of analysis, we aim to explore the role of education and awareness in the conservation of Romania's biodiversity, highlighting initiatives and efforts to promote public understanding and commitment to protecting the environment and unique species. This analysis allowed us to identify relevant patterns, trends and conclusions related to biodiversity education, awareness and conservation in Romania. Protecting Romania's biodiversity is therefore not only a necessity for the environment, but also for society, the economy and human well-being. Biodiversity conservation is essential for our well-being and the health of the planet, and it is our responsibility to act on it. We will explore the importance of education in schools and universities, the role of NGOs and government actions, and their impact on biodiversity conservation in the country.*

**Key words:** biodiversity, vast nature, continuous process, essential practices, oxygen

### **INTRODUCTION**

Global environmental problems have begun to become prevalent and have created the need for additional actions to raise public awareness, leading the international community to take timely and functional action, both internationally and nationally. Assessing the effects of these "new" environmental issues has led to the recognition that too little progress has been made in integrating environmental protection into development policies and activities [2].

Soil, water, air, biodiversity and all together form the areas - ecosystems - the biosphere [4].

Romania's biodiversity is a priceless natural treasure, with a heritage of extremely varied species and ecosystems. From the Carpathian Mountains and their impressive forests to the Danube Delta and its rich habitats, Romania is home to an impressive range of life forms. However, this exceptional biological diversity is increasingly threatened by pressures from human activities such as rapid urban

development, extensive deforestation and climate change. In this context, education, awareness and conservation of biodiversity become imperative to protect and prolong the existence of this natural wealth for future generations.

Biodiversity conservation, even in small areas, can lead to the reconstruction of ecosystems and agro-ecosystems in the event of major man-made or natural disasters [4].

The favourable conditions of the environment and of the climatic factors have influenced the inhabitation since ancient times [9].

This paper is intended as an exploration of the complex relationship between education, awareness and biodiversity conservation in Romania. The purpose of this paper is to highlight the fundamental importance of education and awareness in biodiversity conservation efforts, and to examine how these aspects interact and support each other in the specific context of our country.

Education is the backbone of any informed society committed to environmental conservation. However, in Romania and other

countries, biodiversity education has not always received the attention it deserves. This paper will explore how education in schools and universities can promote a deeper understanding of biodiversity, cultivate a love of nature and shape future generations as responsible citizens of the planet.

In addition, we will examine the active role of non-governmental organisations (NGOs) and government institutions in promoting public awareness and citizen involvement in concrete conservation actions. We will also examine how local communities can play a vital role in protecting biodiversity in rural and urban areas.

Rural space plays an important role in preserving the landscapes which are a treasure of the splendours of nature. Also, in the rural areas, the environmental factors: air, water, soil are much better conserved than in the cities.

The large range of plant species either belonging to the wild flora or to the cultivated crops, and the great number of animal species from the wild fauna and farms which emphasize the key role of the rural areas in preserving biodiversity [11].

This paper is intended to be a journey through Romania's efforts, achievements and challenges in biodiversity education, awareness and conservation. By bringing these issues to the fore, we aim to highlight the urgent importance of protecting this biological diversity and ensuring that future generations will continue to enjoy Romania's natural wealth.

This goal involves:

Education - the provision of relevant and accessible knowledge and information related to biodiversity within the education system and in communities, with the aim of developing a deeper understanding of the importance of environmental conservation and awareness of the impact of human actions on the environment.

Awareness raising - raising awareness of biodiversity and conservation issues through awareness campaigns, events and effective communication.

Promoting nature tourism - exploiting the tourism potential of biodiversity-rich areas to financially support conservation and develop the local economy.

One of the great current challenges at the global level is represented by finding sustainable production systems that ensure both social, economic and environmental sustainability, while at the same time pursuing the optimal provision of production, trade or consumption indicators [6].

In this context, the goal of the paper is emphasizing the role of education and awareness in the conservation of Romania's biodiversity, pointing out initiatives and efforts to promote public understanding and commitment to protecting the environment and unique species.

The study is destined to create a Romania where biological diversity is protected, valued and properly integrated into people's lives, thus ensuring a sustainable future for the environment and Romanian society. It is a vision that involves the collaboration and commitment of all stakeholders to preserve and promote this priceless natural heritage.

## **MATERIALS AND METHODS**

The study is based on a literature search on the topic, carrying out analyses using the comparative method which led to a relevant interpretation of the statistical data.

The statistical data are collected from the official National Institute of Statistics, NIS, website Tempo-Online, the account of the environmental goods and services sector, forestry planning, studies provided for by Order no. 2.525 of 30 December 2016 on the establishment of the National Catalogue of virgin and quasi-virgin forests in Romania (studies carried out on the basis of a public tender), the codes being:

-TQY1552 - Target 5 - Environment - Area of land on which regeneration has been carried out by regeneration category;

-TQY1521 - Target 4 - Environment - Production value of environmental goods and services for biodiversity and landscape protection;

-TQQ1533 - Target 3 - Environment - Area of virgin and quasi-virgin forests.

The research was based on statistical methods and qualitative analyses depending of their type and proposed objectives.

This analysis allowed us to identify the patterns and trends to formulate relevant conclusions in relation to education, awareness and conservation of biodiversity in Romania.

## RESULTS AND DISCUSSIONS

Protecting Romania's biodiversity is of fundamental importance for many reasons, from preserving our natural heritage to ensuring a healthy environment for current and future generations. Identifying some key reasons to protect Romania's biodiversity, we can say that:

**-Romania is a country of remarkable biological diversity, home to many rare or endemic plant and animal species.**

Protecting these species and their unique ecosystems is essential to preserve the country's natural heritage.

-Each species and ecosystem have a unique role in maintaining ecological balance. Reducing biodiversity can disrupt this balance and lead to negative consequences for ecosystems and ultimately for humans.

-Biodiversity provides a range of essential ecosystem services for humans, such as plant pollination, water purification and climate regulation.

-Conserving biodiversity contributes to maintaining human health and well-being.

-Romania's biological diversity is a valuable resource for nature tourism and for the development of a green economy. Wild ecosystems and protected areas attract tourists, generating income and jobs.

-Healthy ecosystems can play a key role in adapting to climate change. Well-managed forests and wetland habitats can help reduce the effects of climate change, such as floods or droughts.

Mountain areas are of a special beauty and greatness, grace to their peaks, valleys and depressions, fairy tale landscapes, virgin

forests of a large tree and shrub diversity, wild flora and animals, water sources, lakes and glaciers, fantastic rainfalls, fascinating caves [10].

Recent research made in the area show the need for detailed study regarding the modelling of local ecosystems functioning, including the grasslands, as database for environmental reconstruction projects and for the increase of ecosystems value and the sustainability of local communities [3].

-Romania is home to many threatened or endemic species, and biodiversity conservation contributes to their survival and to preventing their extinction.

The study of biodiversity provides opportunities for discovering new species and understanding ecological processes. This research can have applications in medicine, agriculture and other fields.

We have a moral responsibility to protect and pass on this priceless natural heritage to future generations [7].

Rural space plays an important role in preserving the landscapes which are a treasure of the splendours of nature. Also, in the rural areas, the environmental factors: air, water, soil are much better conserved than in the cities. The large range of plant species either belonging to the wild flora or to the cultivated crops, and also the great number of animal species from the wild fauna and farms which emphasize the key role of the rural areas in preserving biodiversity [12].

Analysing the data collected from National Institute of Statistics regarding the situation in Romania, in terms of regenerations by land type, an increase in the total area is observed starting from 2022, after a decreasing trend in the period 2019-2021.

The area of land on which regeneration was carried out by regeneration category in the period 2018-2022 is shown in Table 1.

For a good understanding of the analysed phenomenon, we define the main analysed terms:

*Regeneration* is the process by which a new generation of forest trees is established and can be achieved through natural regeneration and artificial regeneration (afforestation) [8].

*Natural regeneration* is the process of transition to a new generation of trees, which is achieved naturally from shoots or by germinating seeds that have naturally arrived on the ground.

*Artificial regeneration (afforestation)* is the process of planting or seeding an area of land with the aim of creating new stands, both on logged forest land and on land with no forest vegetation.

Table 1. The area of land on which regeneration was carried out by regeneration category (ha)

Regeneration by land type	Types of regenerations	2018	2019	2020	2021	2022
Unit of measurement: Hectare						
Regenerations - Overall	Overall	27,043	24,459	25,189	23,981	27,981
	Natural regeneration	17,972	16,016	17,162	15,904	19,781
	Artificial regeneration	9,071	8,443	8,027	8,077	8,200
In forester fund - Overall	Overall	26,971	24,258	25,083	23,748	27,765
	Natural regeneration	17,970	16,016	17,162	15,898	19,781
	Artificial regeneration	9,001	8,242	7,921	7,850	7,984
On areas covered by regeneration cuts - Overall	Overall	24,764	22,352	23,065	20,748	24,344
	Natural regeneration	17,789	15,882	16,746	15,458	19,129
	Artificial regeneration	6,975	6,470	6,319	5,290	5,215
of which: On areas covered with cuttings breeds of forest trees	Overall	5,655	4,494	4,464	3,434	3,652
	Natural regeneration	1,681	812	1,107	779	910
	Artificial regeneration	3,974	3,682	3,357	2,655	2,742
Replacement and replanting of poorly productive stands	Overall	940	981	1,288	685	703
	Natural regeneration	50	41	320	55	29
	Artificial regeneration	890	940	968	630	674
Unregenerated ponds and hollows	Overall	1,258	911	723	587	590
	Natural regeneration	131	92	94	133	186
	Artificial regeneration	1,127	819	629	454	404

Source: NIS, <http://statistici.insse.ro> [7].

Analysing the statistical data, we observed a variation regarding the surface with regenerations (Fig. 1).

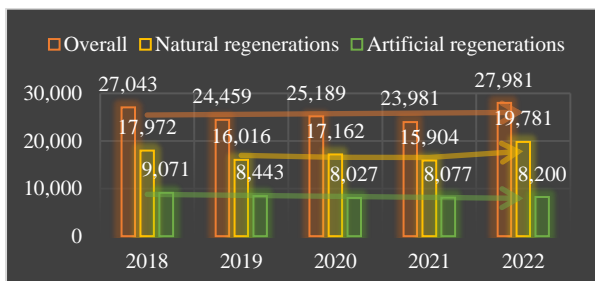


Fig. 1. Dynamics of regenerations in Romania, 2018-2022 (ha)

Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

As can be seen from Fig. 1, the statistics vary from a year to another.

The total number between the years 2018 - 2020 undergoes a decrease (-6.86%) but increases between the years 2020 - 2022 (+9.98%).

In the case of natural regeneration, the imaginary line looks like Gauss's Bell, the data is on an ascending scale between the years 2018 - 2022 (+9.15 %).

Artificial regeneration on the other hand, suffers decreases in percentage (the scale

being a descending one), this being -9.6 % between the reference years 2018 – 2022.

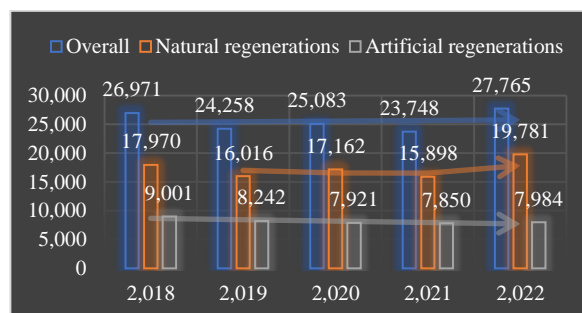


Fig. 2. Dynamics in Romania of the forest fund, 2018-2022 (ha)

Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

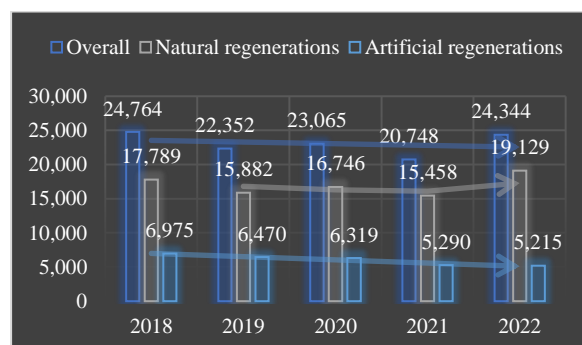


Fig. 3. Dynamics of the areas covered by regeneration cuts in Romania, 2018-2022 (ha)

Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

From Fig. 2 it can be seen that the forest fund, the total number (+2.86 % between 2018 - 2022) and the number of natural regenerations (+9.16 % between 2018 - 2022) are on an ascending scale, but the artificial ones are on a descending scale (-11.3 % between 2018 - 2022). From the data shown in Fig. 3, we may identify that the total number with areas destined for regeneration cuttings are on a decreasing scale (-1.7 % between the years 2018 - 2022 and the lowest number being in the reference year 2021), but in the case of natural regeneration the percentage is increasing (+7.01 % between the years 2018 - 2022) and as in the previous graphs, the number of artificial regeneration decreases in percentage (- 25.23 % between the years 2018 - 2022).

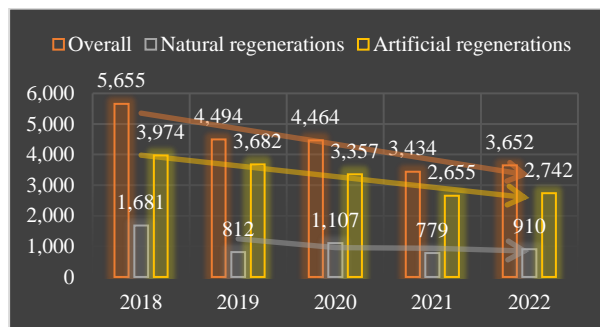


Fig. 4. Dynamics of areas covered with cuttings breeds of forest trees, 2018-2022 (ha)  
 Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

From Fig. 4, the statistical information presents the areas devoted to forest trees, and we may notice that the number of hectares decreases in all respects, and between the reference years 2018 - 2022 they are:

- ⇒ 35.42 % overall.
- ⇒ 45.87 % natural regeneration.
- ⇒ 31 % artificial regeneration.

The forest is of vital importance for Romania for several major reasons:

*Biodiversity conservation* - Romanian forests are home to a wide range of plant and animal species, many of them rare and endemic.

*Ecological role* - forests play an essential role in maintaining ecological balance and natural cycles.

*Natural resources* - Romanian forests provide important resources such as timber,

mushrooms, berries and medicinal herbs.  
*Tourism and recreation* - forests are a major attraction for nature tourism and recreation in Romania.

*Soil protection and flood control* - forests act as a natural shield against soil erosion and help to prevent floods due to their ability to absorb and retain water.

*Protection of agricultural crops and sustaining productivity*, as it was proved that the crops cultivated on surfaces protected by agro-forestry curtains produce yields by 30-40% higher than the crops which are not protected.

*Protection of the ways of communications* (roads etc) is assured by forest curtains.

*Protection of the localities and agricultural fields* against winter storms, favoring the formation of an uniform snow layer benefic for protecting the cultivated crops.

*Cultural and historical aspect* - forests have a deep significance in Romanian culture and history.

*Ecological connectivity* - forests provide crucial habitat for wildlife species and play an important role in maintaining ecological connections between different habitats and protected areas.

*Carbon sequestration* - forests have the capacity to store carbon in the atmosphere, helping to combat climate change.

*Education and research*: Forests provide excellent opportunities for scientific research and education in ecology and conservation.

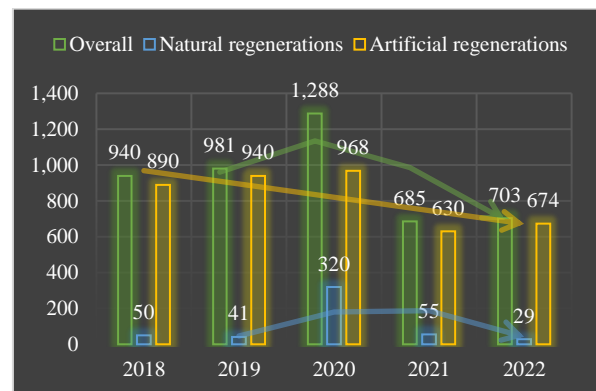


Fig. 5. Dynamics of replacement and replanting of poorly productive stands in Romania, 2018-2022 (ha)  
 Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

Analyzing the information from Fig. 5, poorly productive stand replacement and restocking is significant in reference year 2020 for all categories, but between reference years 2020 - 2022 the percentages decrease significantly in percentages (-45.42 % total, -90.94 % natural, -30.37 % artificial).

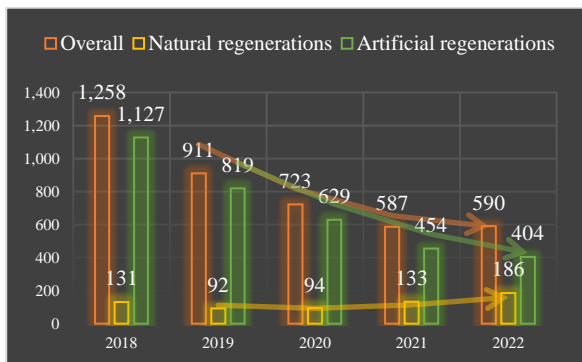


Fig. 6. Dynamics of unregenerated ponds and hollows in Romania, 2018-2022 (ha)

Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

From Fig. 6, it results that the number of hectares of total and artificial unregenerated fallows and hollows decreases in percentages but in the case of natural ones they increase as follows (between the reference years 2018 - 2022):

- ⇒ - 53.1 % overall.
- ⇒ + 29.57 % natural regeneration
- ⇒ - 64.15 % artificial regeneration.

The area of land on which regeneration was carried out by regeneration category in the period 2018-2022 was shown in Table 1.

The value of producing environmental goods and services for biodiversity and landscape protection in the period 2016 – 2020 is shown in Table 2.

Biodiversity and landscape protection refers to measures and activities aimed at the protection and restoration of fauna and

floraspecies, ecosystems and habitats, as well as the protection and restoration of natural and semi-natural landscapes.

Table 2. The value of production of environmental goods and services for the protection of biodiversity and the Romanian landscape (million lei).

2016	2017	2018	2019	2020
Unit of measurement: million lei				
65.53	92.57	96.09	95.43	170.18

Source: NIS, <http://statistici.insse.ro> [7].

Also, the maintenance or establishment of certain landscape types, biotopes, ecological zones and related issues (fences, tree lines to restore "natural corridors") have a clear link with biodiversity conservation [13].

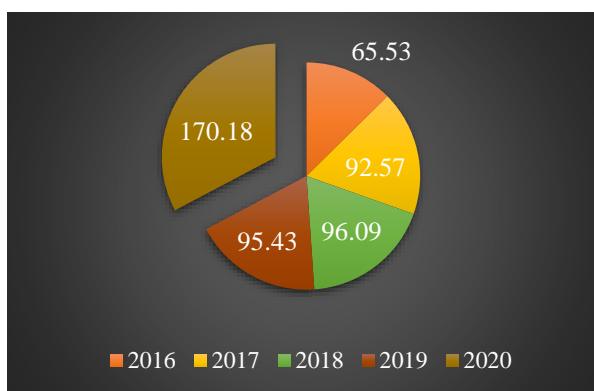


Fig. 7. Dynamics of the value of producing environmental goods and services in Romania, 2016-2020 (million lei)

Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

From existing data in Fig. 7, it appears that services dealing with biodiversity protection are increasingly expensive (due to new trends and technologies), with an increase of +61.49% between the reference years 2016 - 2020. Area of virgin and quasi-virgin forests in 2018-2022 is shown in Table 3.

Table 3. Area of virgin and quasi-virgin forests in Romania, 2018-2022 (ha)

Surface of forests	2018	2019	2020	2021	2022
Overall	21,091.52	30,147.43	43,823.36	70,069.03	71,077.44
Virgin forests	5,898.92	6,665.46	7,401.98	8,579.8	8,579.8
Quasi-virgin Forests	15,192.6	23,481.97	36,421.38	61,489.23	62,497.64

Source: NIS, <http://statistici.insse.ro> [7].



The virgin and quasi-virgin forests are those forests formed and developed exclusively under the action of natural factors and in which ecosystem processes in their dynamics occur without any direct or indirect anthropogenic influence and past virgin forests, which, in the meantime, have undergone observable, insignificant anthropogenic changes on ecosystem structure, stature and processes [1].

The area covered by virgin and quasi-virgin forests increased from 21,091.52 ha in 2018 to 71,077.44 ha in 2022, meaning a gain of +236.9 % gain. In the same interval, the area with virgin forests increased by +45.4 %, while the surface with quasi-virgin forests became +4.11 % larger in 2022 versus 2018.

The quasi-virgin forest are dominant in overall forest surface, having a share of 87.92% (Table 3, Fig. 8).

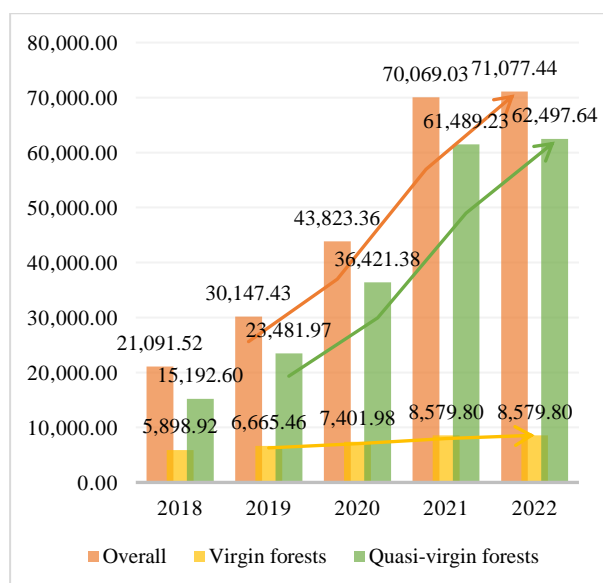


Fig. 8. Dynamics in Romania of the area of virgin and quasi-virgin forests in 2018-2022 (ha)

Source: Own design based on the data from NIS, <http://statistici.insse.ro> [7].

From the data shown in Fig. 8, it appears that the area of virgin and quasi-virgin forests has increased, a good sign for Romania, the increases expressed in percentages being:

- ⇒ 236.99 % total;
- ⇒ 45.44 % virgin forests;
- ⇒ 311.36 % quasi-virgin forests.

There are several non-governmental organisations (NGOs) actively involved in

protecting Romania's biodiversity and promoting conservation practices of which we mention:

*MaiMultVerde Association* - This organization focuses on environmental protection and biodiversity conservation in Romania through various projects and campaigns. They are involved in planting trees, preserving wetlands and promoting a sustainable lifestyle.

*Carpathia Conservation Foundation* - This organisation focuses on protecting biodiversity in the Romanian Carpathians, with a focus on the conservation of mountain ecosystems and wild species. They work closely with local communities to develop sustainable practices.

*Natural and Human Environment (ADEPT)* - ADEPT focuses on biodiversity conservation in the Transylvania region, with a focus on promoting sustainable development and traditional agriculture.

*Foundation for Partnership* - This organisation engages in biodiversity conservation projects and local community development. They work to protect natural areas and fragile ecosystems.

*Association for the Conservation of Biological Diversity (ACDB)* - ACDB focuses on biodiversity conservation through research, education and the development of conservation projects in various areas of Romania.

*Emperor Bird Study Group (GSPI)* - This organisation focuses on the conservation and study of the Emperor Bird (*Pyrrhula pyrrhula*) and its habitats in Romania.

*Save the Zălanului Plains* - This organisation fights to protect the Plain Valleys, an area of rich biodiversity threatened by development projects.

These are just a few examples of organisations working to protect biodiversity in Romania. They carry out various projects, campaigns and actions to conserve ecosystems, protect wild species and educate the public about the importance of biodiversity. This collective effort is crucial to maintaining the country's natural wealth and ensuring a sustainable future for the

environment.

Protecting and sustainably managing forests is essential for Romania's sustainable future, helping to conserve biodiversity, combat climate change and ensure human well-being. Protecting Romania's biodiversity is therefore not only a necessity for the environment, but also for society, the economy and human well-being. It is a commitment to a healthier and more sustainable future for the country and the planet.

### **S.W.O.T. Analysis**

S.W.O.T. analysis is an effective method of assessing the situation for a particular problem or area.

In this case, S.W.O.T. analysis for this diversified issue is presented below:

#### **Strengths:**

*Rich biological diversity* - Romania has a diverse natural environment with many species of plants and animals, which provides a solid basis for conservation.

*Local community engagement* - There are many local communities that are actively involved in environmental conservation and promoting sustainable practices.

*Active NGOs and environmental organisations* - There is a significant presence of NGOs and environmental organisations in Romania, which carry out various conservation projects and educational programmes.

#### **Weaknesses:**

*Environmental education deficit* - Biodiversity education is not always properly integrated into education systems and public awareness.

*Pressure on ecosystems* - Urban development, deforestation and industrialisation can have a negative impact on natural habitats.

*Limited financial resources* - Limited availability of financial resources can make it difficult to implement conservation projects or awareness campaigns.

#### **Opportunities:**

*Increased education and awareness* - There is an opportunity to develop and implement broader education and awareness programmes to increase public engagement in biodiversity conservation.

*Development of ecotourism* - The tourism potential of Romania's natural areas can be exploited for the benefit of conservation and local economic development.

*International cooperation* - Romania can collaborate with other countries and international organisations to benefit from additional expertise and resources in the field of biodiversity conservation.

#### **Threats:**

*Climate change* - Climate change may affect ecosystems and species in Romania, putting additional pressure on biodiversity conservation.

*Over-exploitation of natural resources* - Over-exploitation of natural resources such as timber or minerals can have a negative impact on natural habitats.

*Unregulated urbanisation* - Rapidly increasing urbanisation can lead to loss of natural habitats and destruction of ecological areas [5].

S.W.O.T. analysis reveals that there are many important opportunities and resources for biodiversity conservation in Romania, but continued efforts are needed to overcome challenges and to harness the potential for environmental protection and promotion of biodiversity education [1].

## **CONCLUSIONS**

Education and awareness are fundamental pillars for biodiversity conservation in Romania. Although the country has significant biological diversity, the current level of awareness and education in this area needs to be improved.

Non-governmental organisations, government institutions and local communities play a vital role in biodiversity conservation efforts. Collaboration and coordination between these entities is essential to achieve conservation goals.

Promoting nature tourism and sustainable economic development in biodiversity-rich areas provides opportunities for conservation and awareness raising.

#### **Recommendations:**

-Develop and implement education programs



that cover the importance of biodiversity and promote awareness among students.

-Provide resources and technical assistance to NGOs and local communities involved in biodiversity conservation.

-Implement sound laws and regulations to protect the environment and fragile ecosystems and ensure proper enforcement.

-Continue scientific research to assess the state of biodiversity, identify threats and adapt conservation strategies.

-Organise awareness-raising campaigns and events to encourage the public to become actively involved in environmental and biodiversity conservation.

-Collaborate with foreign organisations and countries to share knowledge and resources on biodiversity conservation.

-Addressing climate change and its impact on biodiversity by developing adaptation strategies.

-Education and awareness-raising campaigns should emphasise the link between lifestyle, consumption and biodiversity conservation.

-Environmental professionals and researchers should play a significant role in developing and implementing conservation strategies.

-Implement monitoring systems to track progress towards conservation goals and adapt strategies to current developments.

By implementing these recommendations and involving all stakeholders, Romania can take important steps towards protecting its unique biodiversity and ensuring a sustainable future for the environment.

Biodiversity conservation is essential for our well-being and the health of the planet, and it is our responsibility to act on it.

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