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Article

Threatened Wildlife for an Instructional Approach about Biodiversity Conservation

Antonio J. Mendoza-Fernández [1,2,*], Leticia Arnao [3], Candelaria Carretero [3], Fabián Martínez-Hernández [2], José M. Sánchez Robles [4]

[1] Department of Botany, University of Granada, Granada, Spain
[2] Department of Biology and Geology, CECOUAL, CEI·MAR, University of Almería, Almería, Spain
[3] CEIP Nuestra Señora del Milagro, Almería, Spain
[4] Department of Education, University of Almería, Almería, Spain

*Correspondence: Antonio J. Mendoza-Fernández (amf788@ual.es)

Abstract: Biodiversity is related to a global problem: its destruction, a fact supported by scientific authorities. It is not trivial that educational dimension has been contemplated as one of the strategies for its conservation. Since 1992 global initiatives such as the Convention on Biological Diversity postulates concepts that linked education and nature conservation. The main objective of this research work is to test the level of assimilation of extracurricular scientific knowledge by primary school pupils. The method chosen for the content was, on the one hand, a master class intervention with an interactive presentation on a digital whiteboard. Third cases were chosen. Each case consisted of a presentation of the current status of a species of fauna present in Spain. On the second part, students were asked to write an essay and to illustrate the experience during the presentation. Regarding the essays, students showed that they were more attracted to the first species that was presented (Iberian lynx) in a proportion of over 45% of cases. The "Endangered species" concept appeared in more than 77% of the texts reviewed. In terms of drawings, almost 55% of the responses seem to devote more attention to the second species described (*Testudo graeca*). An attempt was made to offer rigorous, structured information related to different aspects of natural reality in order to contemplate the broadest possible vision. The example of an instructional intervention presented here aims to be an alternative to other transmissive teaching models. Likewise, the linking of abstract concepts with socio-cultural reality proved to be a successful strategy to reinforce knowledge about natural biodiversity, endangered species or threat factors.

Keywords: Education; Global Change; IUCN; Red List; Scientific Culture; Wildlife

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1. Introduction

Since the 1980s, the term biodiversity, popularized by Professor Edward O. Wilson [1], has gained worldwide recognition and acceptance. Biodiversity is closely related to a fundamental problem: its destruction, a fact supported by scientific authorities [1,2]. The biodiversity crisis in the planet is one of the biggest difficulties we face, and as Ceballos and Ehrlich [3] point out that the future of life on Earth, including the well-being of humans, depends directly on actions taken over the next two decades to reduce the disappearance of populations and the extinction of species. Biodiversity conservation is a well-known and established concern in the international scientific community, and the International Union for Conservation of Nature Red List represents the most comprehensive, objective and global tool for assessing the conservation status of plant and animal species [4]. It is not trivial that education has been contemplated as one of the strategies for biodiversity conservation. In 1992 the Convention on Biological Diversity [5]

postulates the concept of "Education and Public Awareness". Other global organizations such as UNESCO link this concept to that of "Education for Sustainable Development", highlighting the inherent dimension of sustainability [6]. For this reason, the European Commission, in the approach of the Biodiversity Strategy for 2030, proposes among the different actions to be developed in this plan, the improvement of knowledge, education and competences in biodiversity, through the integration in educational centers, both in Pre-school, Primary and Secondary education stages, as well as in higher education and vocational training. To achieve this goal, it establishes the promotion of cooperation and support in education for the development of environmental sustainability, between the different schools and teaching staff [7]. In Spain nature preservation and the knowledge of biological diversity are fundamental topics within the education curriculum. In fact, the Spanish Organic Law 2/2006 on Education, modified by the Organic Law 3/2020, on 29 December, mentions among its principles the need to work on knowledge of environmental values, habitats and nature.

On the other hand, one of the goals of scientific literacy should be to empower people to exercise informed, responsible and critical citizenship [8,9], and for biodiversity-related content, an education that considers the conceptual, procedural and axiological dimensions in the school environment should be considered [10]. The necessary competence in species knowledge goes beyond simple recognition of species; it also involves knowledge of their origin and evolution, as well as understanding the relationships between species and their environment, observing them and applying this knowledge. Knowledge of species helps to recognize the richness of biodiversity, the need for its conservation and the fact that humans are totally dependent on nature [11-13]. However, the school atmosphere often offers an oversimplified, fragmented treatment, centered on the simple description of living beings, sometimes lacking an ecosystemic vision and often disconnected from the socio-cultural reality [14-17]. These factors can lead to a general societal disaffection with science [18]. If teachers are unaware of the complexity of the concept of biodiversity, it is difficult for them to promote scientific and ecological competence among their pupils [19].

The instructional proposal presented is based on the premise proposed by Lindemann-Matthies et al. [20] about the need to strike a balance between teachers' development of basic knowledge, information of the pedagogical content to be taught and the implementation as teachers of meaningful and innovative sequences of activities that increase their confidence. So, the main objective to be achieved with the development of this curriculum evaluation study is to propose and test an activity to test an activity to engage primary school students in learning conservation science. New concepts are introduced in the classroom, such as the international institutions for the conservation of nature, the global biodiversity crisis, invasive species or Global Change [21]. Through the analysis of the results obtained in the test, the degree and perception of these concepts is measured.

The key competences to be worked on during the experience will be:

1. Linguistic communication competence, essential to interpret all the oral and written information of the activity, as well as to express opinions, doubts, etc.
2. Digital competence, using computer resources for scientific purposes.
3. Social and civic competence, necessary for exercising democratic citizenship in defense of environmental values.

2. Materials and Methods

2.1. Sample population

The sample population group consisted of 46 pupils aged between seven and eight years old. From the third year of primary school of the CEIP (primary and secondary school) Nuestra Señora del Milagro in the city of Almería, located at Plaza Virgen del Mar nº 2, p.c. 04001. The activity took place on 3rd and 4th April 2013 as part of another series of school activities held to mark the commemoration of the year of endangered wildlife, and each session lasted six hours.

2.2. Presentation of the content of the explanation

The method chosen for the content was a master class intervention with an interactive presentation on a digital whiteboard. The irruption of new digital technologies in the teaching-learning process is postulated as an effective tool in the cognitive process [22]. The digital whiteboard was chosen in order to make the presentation of the contents more dynamic and attractive and to capture the curiosity of the group of students to a greater extent.

The presentation consisted of a speech lasting approximately 45 minutes. The speech was supported by a presentation consisting of photographs of the cases explained, maps and diagrams to clarify and make the explanation more visual. Special consideration was paid to the aesthetic details of the exhibition. Few texts were shown and a very large font size was chosen, up to 72 points in some sections. The backgrounds of the slides were white with touches of soft blue (Figure 1). The images shown tried to be very clear. Concept maps were very simple and illustrative photographs took up most of the explanation.

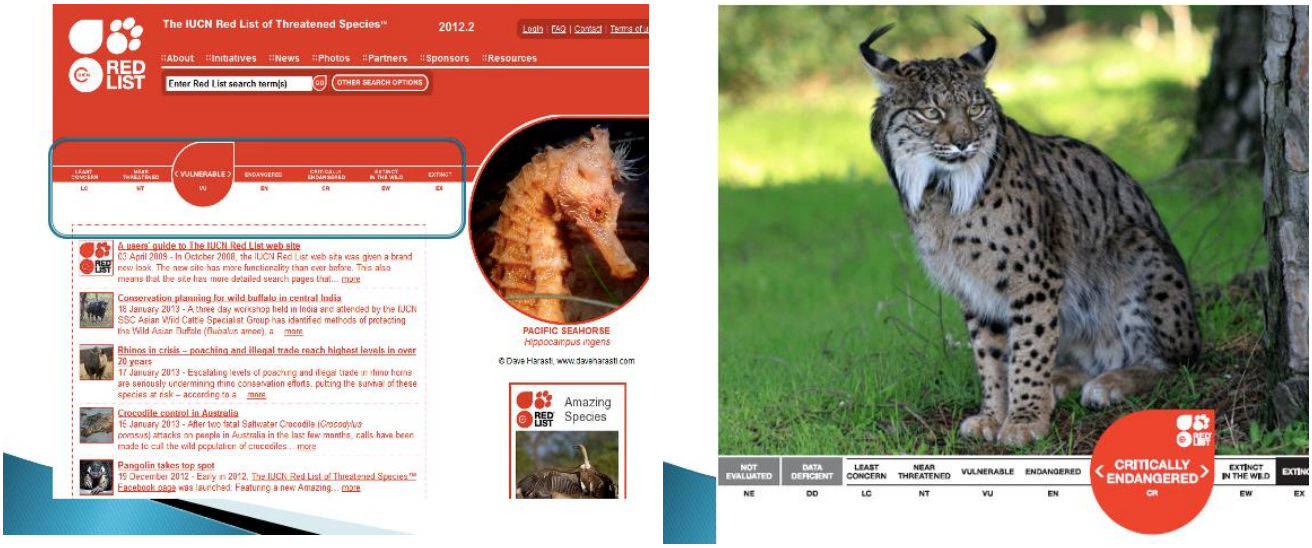

Figure 1. Example of the design of the presentation slides used (https://www.iucnredlist.org).

2.3. Content of the presentation

The presentation was basically divided into two sections. The first part was introductory, and the second part dealt with specific examples of Iberian fauna, through which the aim was to explain several concepts, so that each case used has its own idiosyncrasies.

1- Introduction: where some very basic concepts about threatened biodiversity, the main causes of global biodiversity loss and the methods for assessing and cataloguing this threatened biodiversity were presented [23-25]. As an introductory case and to illustrate an environmental issue, a peculiar case was explained: A species of which the students had probably never heard, but which has represented a serious environmental problem,

very close to home, in terms of the location of the damage caused by this species. The red palm weevil ('picudo rojo' in Spanish) (*Rhynchophorus ferrugineus* Olivier) was chosen, which has been a devastating plague in South and East of Spain and specifically in the province of Almería. The example was illustrated with images of infected palm trees in the Nicolas Salmeron Park, an urban park very close to the primary school where the activity took place.

Item 0: Introduction to the concept of invasive species and the effects that an allochthonous species can have on an ecosystem.

2- Selection of the cases: Three cases were chosen. The first covered the group of large mammals. The second focused on herpetofauna. The third case showed an example of avifauna. Each case consisted of a presentation of the current status of a species of fauna present in Spain. Data were shown on the conservation status, the threat factors that exert pressure on their populations, the IUCN category with which they are catalogued, how the distribution of their populations has changed, management and/or conservation plans for these species. Each slide was illustrated with images, graphs or maps to support the explanation (Figure 2).

a. First case: A flagship species for the conservation of endangered fauna in Spain. The concept of flagship species has been used in environmental education [26]. The 'Iberian lynx' (*Lynx pardinus* Temminck) was chosen as a flagship species because of its special role for nature in Spain and Andalusia. This species was chosen on the premise that it could be particularly interesting for the group of students as the vast majority of the students would be familiar with this species.

Item 1: Concept of endangered species: through the existence of the most endangered feline on the planet, declared by the IUCN, and which is becoming almost extinct in Andalusia. At present, the recovery plans for this feline are still very active and specimens of this species have recently been reintroduced in the province of Granada [27,28].

b. Second case: The 'spur-thighed tortoise' ('tortuga mora' in Spanish) (*Testudo graeca* L.) was chosen because it is an endangered species of fauna present in the province of Almería [29] and with which they would surely have had some kind of relationship. Either because they had seen specimens in captivity or in the field.

Item 2: Since the populations of the 'spur-thighed tortoise' are in serious decline in the Iberian Peninsula, an attempt was made to raise awareness of the negative aspects of certain anthropic activities, such as the breeding of wildlife as pets in private homes. In addition to the fact that nature protection legislation penalizes the capture of endangered wildlife.

c. Third case: A species not as well-known as the two previous ones, but brought up because of the attractiveness of its appearance and its scientific and common name, the 'bullfinch' ('camachuelo trompetero' in Spanish) (*Bucanetes githagineus* Lichtenstein).

Item 3: This species also served as a hinge to introduce the concept of Global Change into the explanation, through that of Climate Change, since, unlike the two previous ones, bullfinch populations are progressively spreading in the Iberian Peninsula, going from being a migratory bird, which only spent the summer period in Spain, to a bird with stable populations in south-eastern Spain.

3.- Presentation: In order to make the exhibition more attractive, each slide displayed had at least one large photograph. The same structure was followed for each species presented: brief introduction, scientific name, where they live, what they eat and their threats to be considered endangered. In addition, an attempt was made to avoid a single slide design, which helped to make the explanation more dynamic and capture the students' interest.

Figure 2. Example of slides used with content on where they live, how they feed and their threats.

2.4. Activities carried out after the presentation and analysis of data

During the second part of the activity, students were asked to write an essay on the previous day's presentation. In this case the activity was carried out under the supervision of their teacher.

Writing and drawing of each of the students was reviewed in order to obtain a set of data that would allow the analysis of the effectiveness of the instructional intervention. Particular attention was paid to various parameters described in the exercises carried out: (1) descriptions of all the species and cases, any reference to the items explained above was recorded: Item 0. Invasive species; Item 1. Endangered species; Item 2. Species in captivity; Item 3. Global Change; (2) the species to which most interest was devoted in the text. In addition to the text, they were asked to include children's drawings of the examples seen in the previous day's session through children's drawings there is an interpersonal communication, voluntarily or involuntarily, and it is transmitted through a non-verbal language that can be hidden and silent, therefore children's drawings give information not only about their maturity, and they has been used to determine conceptions about environmental issues and perceptions in several studies [30,31]. The results of the analysis were organized according to their level of presence in all iconographic representations: (3) mention of the species to which most curiosity was devoted in the drawing; (4) whether plants or vegetation are also depicted in the drawing. Finally, emotional aspects experienced during the activity were assessed: (5) descriptions of the duration of the activity and what kind of emotions were experienced during the activity.

3. Results and discussion

Regarding the length of the text devoted to each of the species described during the writing process, students showed that they were interested to the first species that was presented (Iberian lynx) in a proportion of over 45% of cases, slightly over 40% in the case of the second species, and over 13% in the case of the last species (Figure 3). The concept `Endangered species´, which appeared in more than 77% of the texts reviewed, was the item evaluated that clearly prevailed over the others. In fact, the term `protected´ was mentioned in almost all the titles of the texts. This result makes sense since throughout

the intervention, ideas related to this dimension were reiterated: Red Lists, degree of threat, risk factors, etc... On the other hand, the references to the risk factor involved in practices related to `Species in captivity´ were also very interesting. These references represented the second most cited item in the texts but with 18% of mentions. It seems that pupils may have little connection with the risk to nature posed by depriving a wild species of its freedom. The concepts "Global Change" and "Invasive species" appeared in 4% each of them on students' answers. These terms could have introduced the two more abstract ideas presented in the presentation. It is quite complicated to explain them on their own, and they could be diluted when linked to the explanation of the risks to biodiversity (Table 1, Appendix A).

Moreover, in terms of drawings, almost 55% of the responses seem to devote more interest to the second species described (*Testudo graeca*). These results may be due, on the one hand, to the order in which the contents of the presentation were presented, which was the same as the order in which the essays were structured, which would explain why the majority of students devoted more effort to writing about the lynx. On the other hand, the proximity of a species of fauna found in the province of Almería, and which in many cases formerly can form part of the group of domesticated fauna, would explain the greater dedication to the drawings about the tortoise. It was also surprising that more than 90% of the drawings showed plants or vegetation of a similar size or entity to the fauna depicted. This is significant data and could support the connection between the concept of natural space and the presence of plants. It should be noted that no reference was made to flora or vegetation, except in cases where this was part of some of the aspects dealt with for animals described (Where do they live? How do they feed? etc.) (Appendix B).

Table 1. Answers screened according to the concepts included in the presentation.

Item evaluated	Concepts	Percentage of responses
Item 0	Invasive species	4.55%
Item 1	Endangered species	77.27%
Item 2	Species in captivity	18.18%
Item 3	Global Change	4.55%

Only 12.5% of the students included in their summary that the presentation was too long, but that it was nevertheless worthwhile. In terms of the emotions experienced during the intervention 50% of the students expressed that they found the activity was fun, 37.5% found it interesting and 12.5% were also impressed.

In terms of understanding the biological world, the concept of biodiversity has a structuring character, so that it forms the framework on which other relevant content is built and can enable learners to acquire new knowledge coherently [32]. It is necessary to be aware of the fundamental reasons why it is essential to ensure the conservation of biodiversity. In this sense, environmental education is an extremely useful tool in the training of students, and a subject of exceptional relevance for all citizens in a changing environment such as the one in which we are immersed [33]. The transmission of knowledge about threatened biodiversity, not only about large macro-vertebrates - flagship species for conservation - but also about the natural wealth that exists in areas close to urban areas, can be considered an optimal educational resource for personal development and for raising public awareness of nature conservation. In addition, instructional activities about environmental education allow students to become more aware about the responsibility linked to the conservation of environmental heritage of a region [34,35].

According to this experience, instructional sequences of activities related to the natural environment are probed as a good resource for motivating students and as a

complement of science subjects; and at the same time, they are able to lay the foundations for nature-protective behavior [36-38].

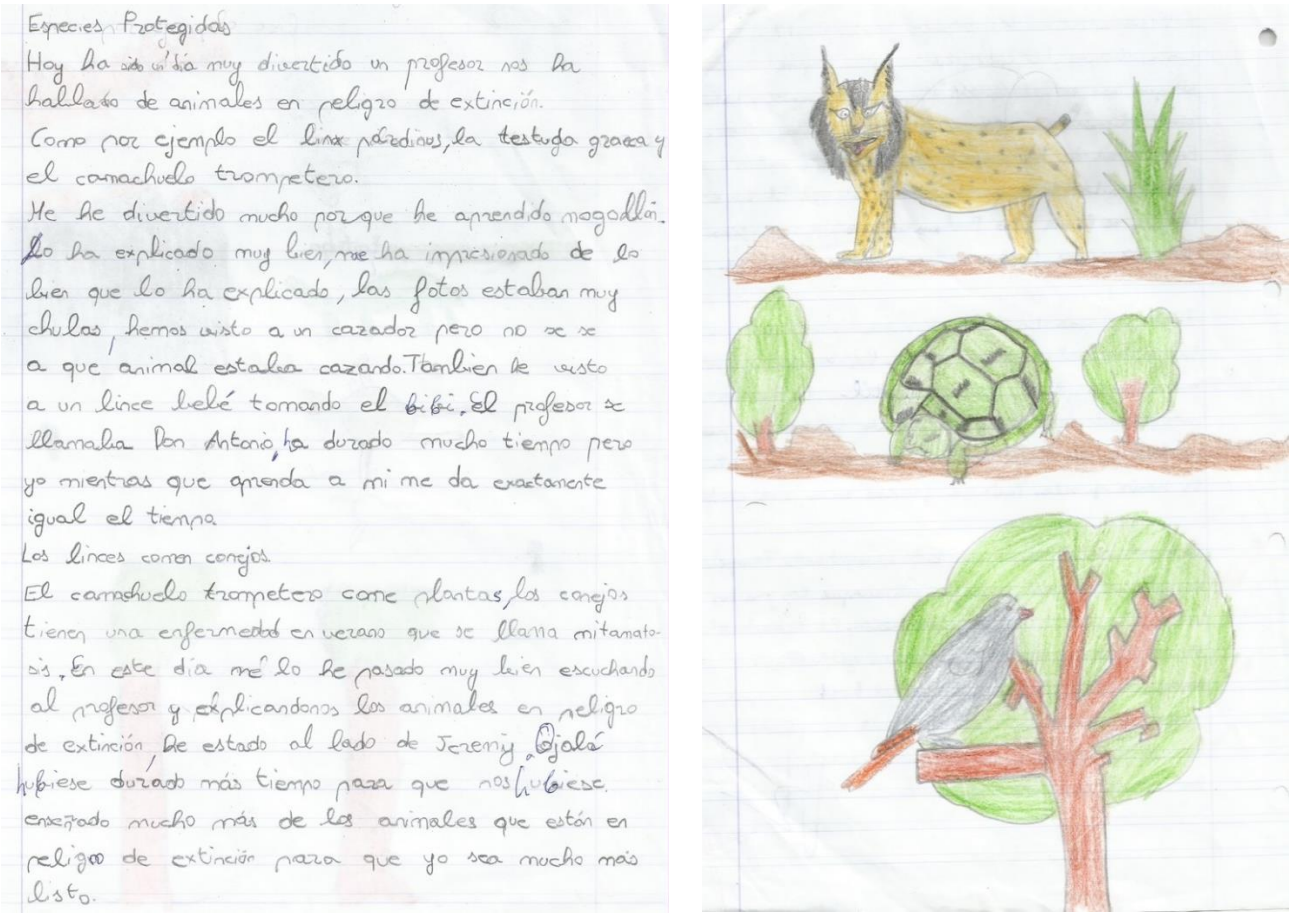

Figure 3. Example of responses of students during the activity.

4. Conclusions

The example of an instructional intervention presented here aims to be an alternative to other transmissive teaching models that use the textbook as a fundamental resource. Although the group with which the proposal was tested is at primary school level (eight years old), an attempt has been made to offer rigorous, structured information related to different aspects of natural reality in order to contemplate the broadest possible vision.

Likewise, the linking of abstract concepts with socio-cultural reality proved to be a successful strategy to reinforce knowledge about natural biodiversity, endangered species or threat factors. This didactic transposition covers aspects related to animals, bearing in mind the use of examples of fauna in contextualized environments, close to the students and in line with their reality.

Author Contributions: Conceptualization, A.M. and C.C.; methodology, A.M., L.A., and C.C.; validation, A.M.; formal analysis, A.M.; investigation, A.M. L.A., and C.C.; resources, L.A., and C.C.; data curation, A.M.; writing—original draft preparation, A.M.; writing—review and editing, A.M., L.A., C.C. and J.M.S.R.; visualization, C.C., J.M.S.R. and F.M.H.; supervision, A.M. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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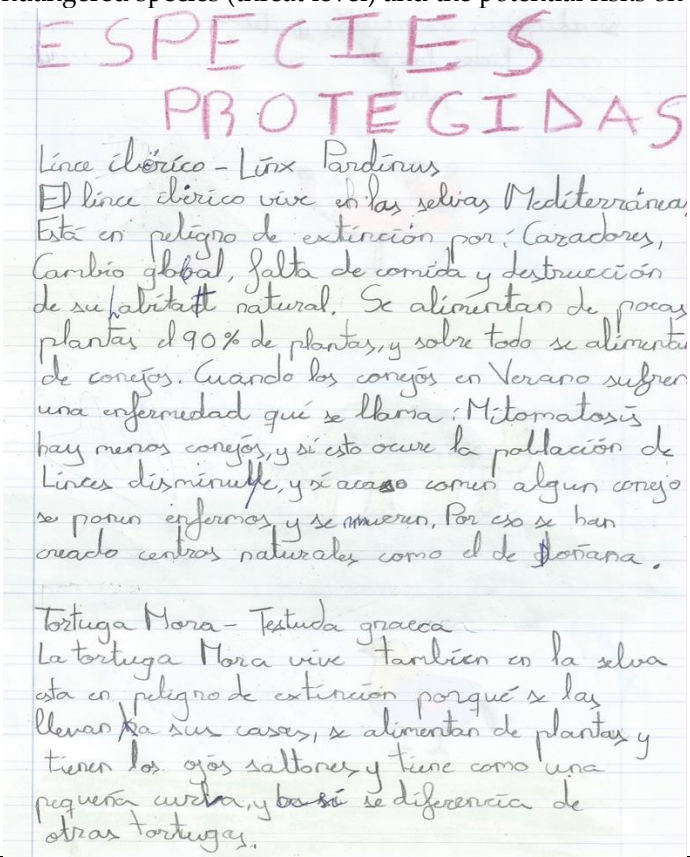
Appendix A

Students' essays after the instructional intervention. Several concepts about endangered species (threat level) and the potential risks on each species are cited.

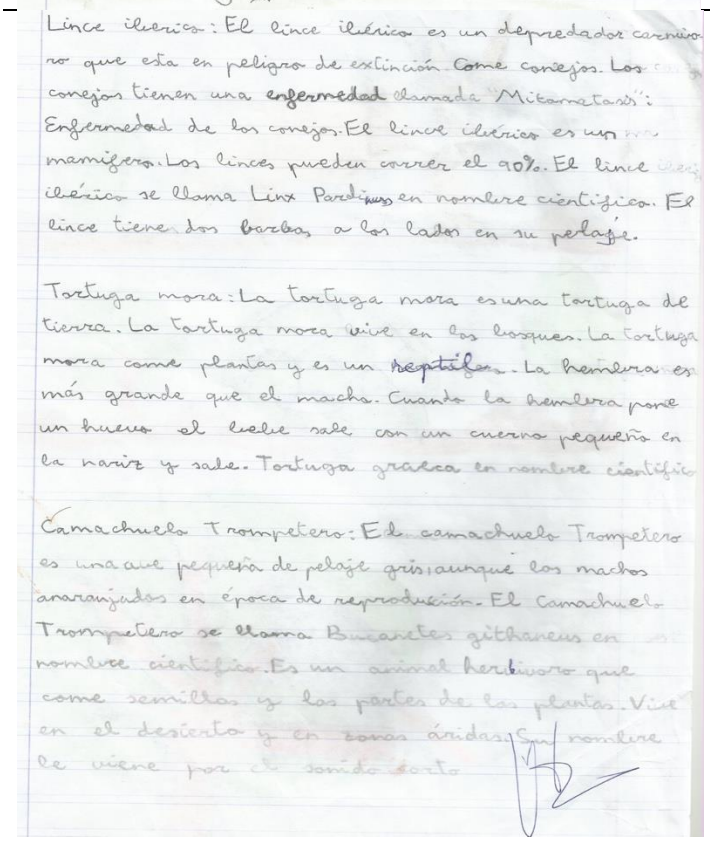


ESPECIES PROTEGIDAS

Lince ibérico - Lynx Pardinus
El lince ibérico vive en las selvas Mediterráneas. Está en peligro de extinción por: Cazadores, Cambio global, falta de comida y destrucción de su habitat natural. Se alimentan de pocas plantas el 90% de plantas, y sobre todo se alimenta de conejos. Cuando los conejos en Verano sufren una enfermedad qué se llama: Mitomatosis hay menos conejos, y si esto ocure la pollación de Linces disminuye, y si acaso comen algun conejo se ponen enfermos, y se mueren. Por eso se han creado centros naturales como el de Doñana.

Tortuga Mora - Testuda graeca
La tortuga Mora vive tambien en la selva esta en peligro de extinción porqué se las llevan a sus casas, se alimentan de plantas y tienen los ojos saltones y tiene como una pequeña curba, y bastá se diferencia de otras tortugas.

PROTECTED SPECIES
Iberian Lynx - Lynx Pardinus
The Iberian lynx lives in the Mediterranean forests. It is in danger of extinction due to hunters, global change, lack of food and destruction of its natural habitat. They feed on few plants, 90% on plants, and mainly on rabbits. When rabbits in summer suffer from a disease called mitomatosis, there are fewer rabbits and the lynx population decreases, and if they eat any rabbits, they get sick and die. That is why nature centres such as the one in Doñana have been created.
Spur-thighed tortoise-Testudo graeca
The spur-thighed tortoise also lives in the jungle, it is in danger of extinction because they are taken to their homes, they feed on plants and they have bulging eyes and have a little curve, so they are different from other tortoises.

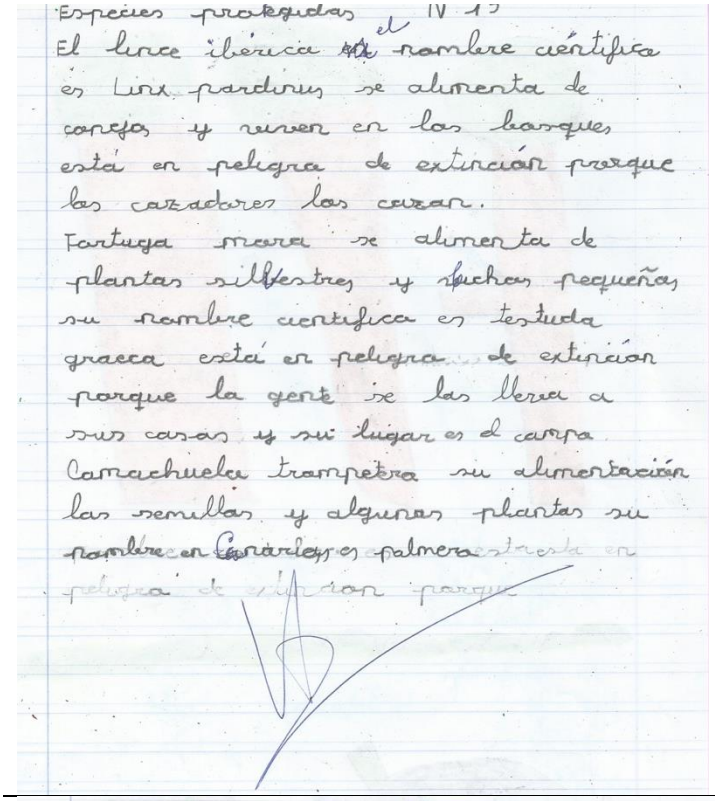


Lince ibérico: El lince ibérico es un depredador carnívoro que esta en peligro de extinción. Come conejos. Los conejos tienen una enfermedad llamada Mitomatosis: Enfermedad de los conejos. El lince ibérico es un mamífero. Los linces pueden correr el 90%. El lince ibérico se llama Linx Pardinus en nombre científico. El lince tiene dos barbas a los lados en su pelaje.

Tortuga mora: La tortuga mora es una tortuga de tierra. La tortuga mora vive en los bosques. La tortuga mora come plantas y es un reptiles. La hembra es más grande que el macho. Cuando la hembra pone un huevo el bebe sale con un cuerno pequeño en la nariz y sale. Tortuga graeca en nombre científic

Camachuelo Trompetero: El camachuelo Trompetero es una ave pequeña de pelaje gris aunque los machos anaranjados en época de reproducción. El Camachuelo Trompetero se llama Bucanetes githaneus en nombre científico. Es un animal herbivoro que come semillas y las partes de las plantas. Vive en el desierto y en zonas áridas. Su nombre le viene por el sonido corto

Iberian Lynx: The Iberian lynx is an endangered carnivorous predator. It eats rabbits. Rabbits have a disease: Mitomatosis: rabbit disease. The Iberian lynx is a mammal. Lynx can run 90%. The Iberian lynx is called Lynx Pardinus in scientific name. the inc e has two beards on the sides of its fur. Spur-thighed tortoise: The spur-thighed tortoise is a land tortoise. The spur-thighed tortoise lives in the forests. The spur-thighed tortoise eats plants and is a reptile. The female is larger than the male. When the female lays an egg, the baby hatches with a small horn on its nose. Tortuga graeca in scientific name. Bullfinch: The bullfinch is a small bird with a grey coat, although the males are orange in the breeding season. The bullfinch is called Bucanetes githagineus in scientific name. It is a herbivorous animal that eats seeds and plant parts. It lives in the desert and arid areas. Its name comes from its short sound.



Especies protegidas IV 15

El lince ibérica el nombre científica es Linx pardinus se alimenta de conejos y viven en los bosques, está en peligro de extinción porque los cazadores los cazan.

Tortuga mora se alimenta de plantas silbestres y bichos pequeños su nombre cientifica es testuda graeca está en peligro de extinción porque la gente se las llevan a sus casas y su lugar es el campo

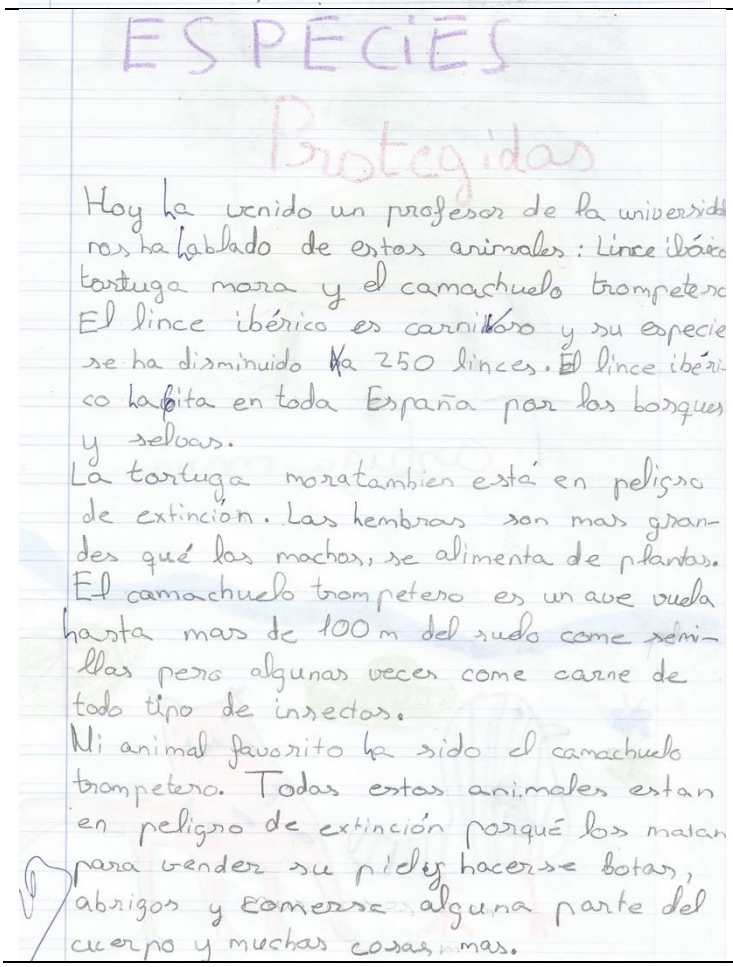
Camachuelo trompetero su alimentación las semillas y algunas plantas su nombre en Canarias es palmera está en peligro de extinción porque

Protected species

The Iberian lynx, whose scientific name is Lynx pardinus, feeds on rabbits and lives in forests, is in danger of extinction because hunters hunt them.

Spur-thighed tortoise feeds on wild plants and small bugs its scientific name is Testudo graeca it is in danger of extinction because people take it home and its place is in the countryside.

Bullfinch, its food are seeds and some plants their name in the Canary Islands is palmero



ESPECIES

Protegidas

Hoy ha venido un profesor de la universidad nos ha hablado de estos animales: Lince ibérico tortuga mora y el camachuelo trompetero

El lince ibérico es carnívoro y su especie se ha disminuido a 250 linces. El lince ibérico habita en toda España por los bosques y selvas.

La tortuga mora tambien está en peligro de extinción. Las hembras son mas grandes qué los machos, se alimenta de plantas.

El camachuelo trompetero es un ave vuela hasta mas de 100 m del suelo come semillas pero algunas veces come carne de todo tipo de insectos.

Mi animal favorito ha sido el camachuelo trompetero. Todas estos animales estan en peligro de extinción porqué los matan para vender su piel y hacerse botas, abrigos y comerse alguna parte del cuerpo y muchas cosas mas.

PROTECTED SPECIES

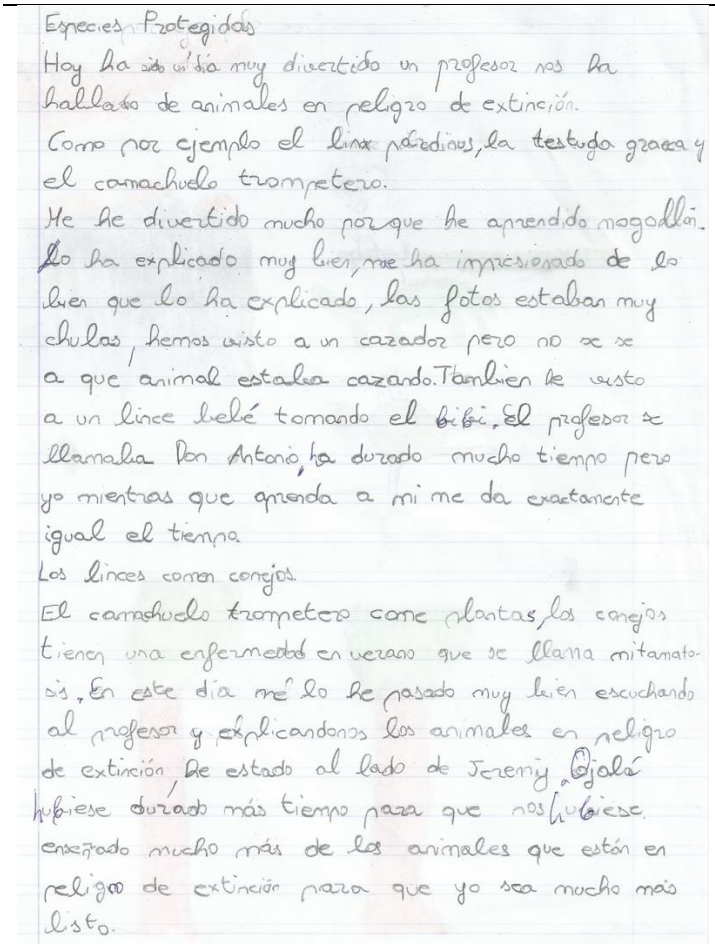
A teacher from the university came here today. He told us about these animals: Iberian lynx, tortoise and bullfinch.

The Iberian lynx is a carnivore and its species has been reduced to 250 lynxes. The Iberian lynx lives all over Spain in forests and jungles.

The Spur-thighed tortoise is also in danger of extinction. Females are larger than males and feed on plants.

The bullfinch is a bird that flies up to 100 metres above the ground and eats seeds but sometimes eats the flesh of all kinds of insects.

My favourite animal has been the bullfinch. All these animals are in danger of extinction because they are killed to sell their skin to make boots, coats and eat some of their body parts and many other things.

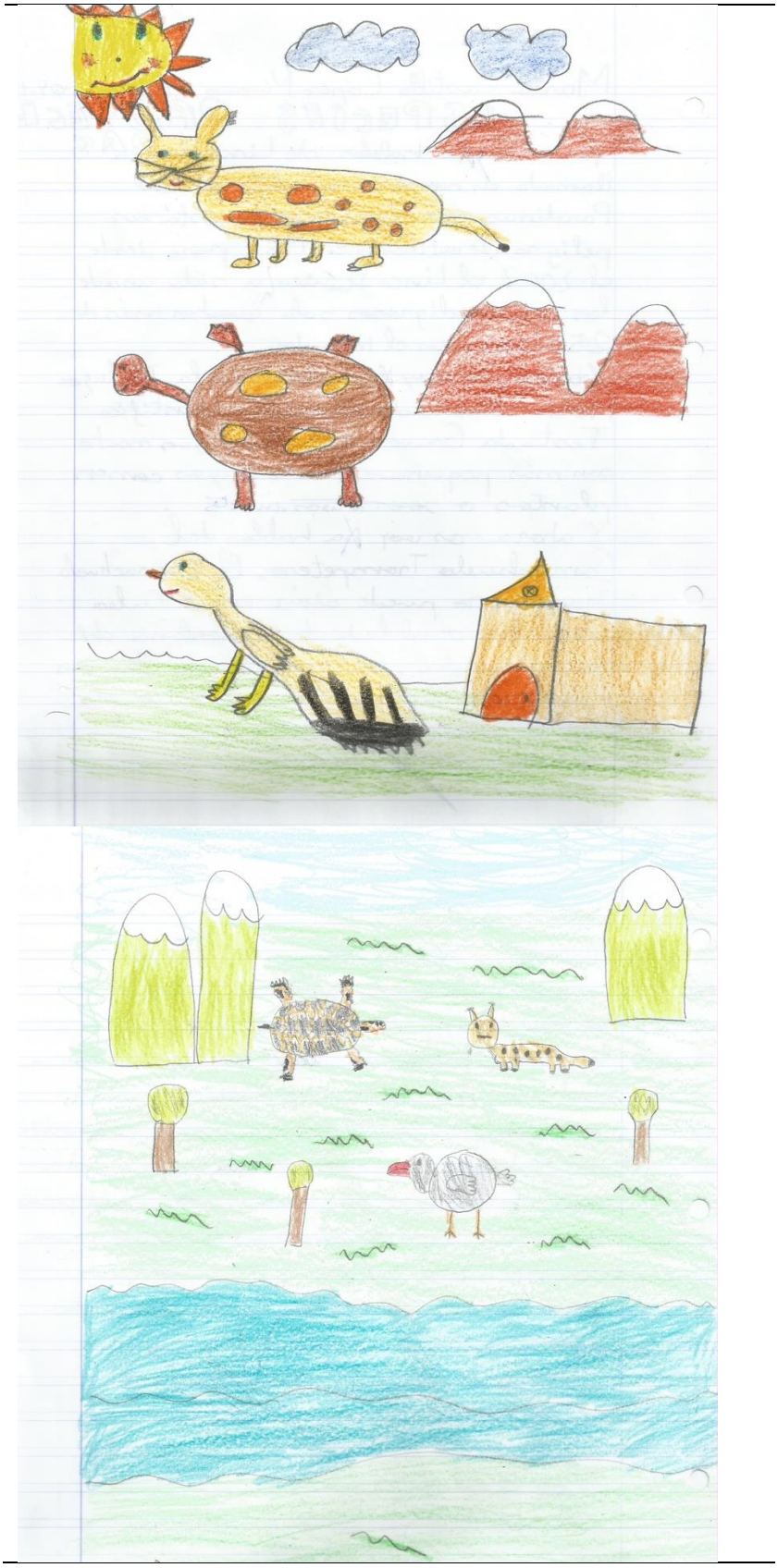


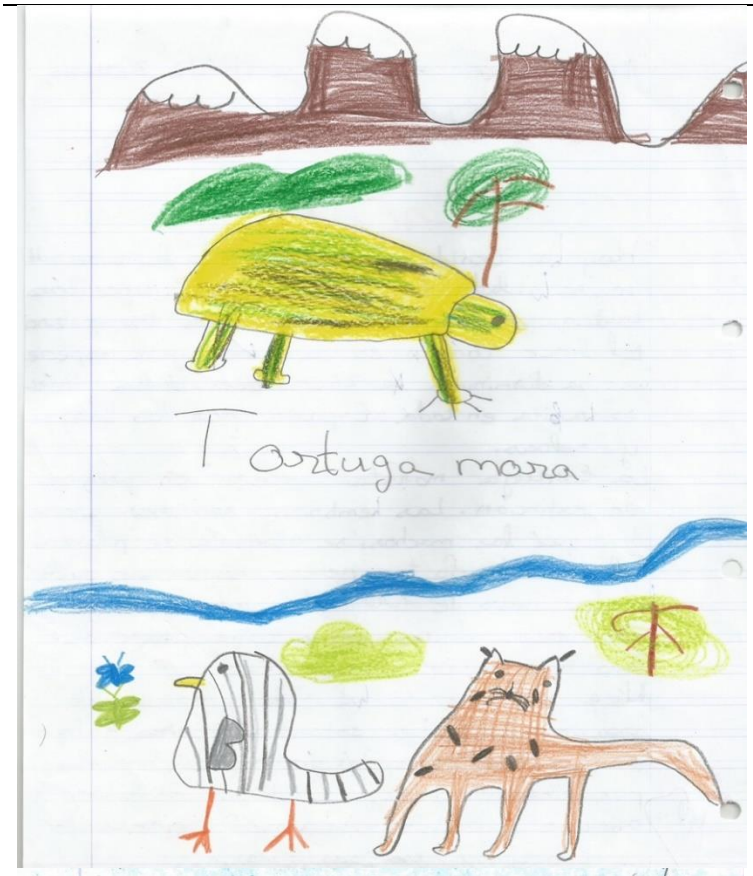
Especies Protegidas
Hoy ha sido un día muy divertido un profesor nos ha hablado de animales en peligro de extinción.
Como por ejemplo el linx pardinus, la testuda graeca y el camachuelo trompetero.
He he divertido mucho porque he aprendido mogollón. Lo ha explicado muy bien, me ha impresionado de lo bien que lo ha explicado, las fotos estaban muy chulas, hemos visto a un cazador pero no se se a que animal estaba cazando. También he visto a un lince bebé tomando el bibi. El profesor se llamaba Don Antonio, ha durado mucho tiempo pero yo mientras que aprenda a mi me da exactamente igual el tiempo.
Los linces comen conejos.
El camachuelo trompetero come plantas, los conejos tienen una enfermedad en verano que se llama mitamatosis. En este día me lo he pasado muy bien escuchando al profesor y explicandonos los animales en peligro de extinción. He estado al lado de Jeremy. Ojalá hubiese durado más tiempo para que nos hubiese enseñado mucho más de los animales que están en peligro de extinción para que yo sea mucho más listo.

Protected species
Today was a very fun day, a teacher told us about animals in danger of extinction.
For example, the link pardinus, the testudo graeca and the bullfinch.
I had a lot of fun because I learned a lot. He explained it very well, I was impressed by how well he explained it, the photos were very cool, we saw a hunter but I don't know which animal he was hunting. I also saw a baby lynx taking a bottle. The teacher's name was Antonio, he lasted a long time but as long as he learns I don't care about the time.
Lynxes eat rabbits.
The bullfinch eats plants, rabbits have a disease in summer called mitomatosis. On this day I had a great time listening to the teacher and explaining the endangered animals to us. I have been next to Jeremy. I wish he would have lasted longer so that he could have taught us a lot more about endangered animals so that I would have been smarter.

Appendix B

Examples of the students' drawings after the essay's writings.




Tortuga mora