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The Role of Wildlife Education in Conservation Biology: Can awareness change Locals` Attitudes towards the Endangered African Wild Dog (*Lycaon pictus*) ?

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Master of Science in Conservation Biology and Ecology

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Abstract

Knowledge of nature has been shown to be important in the conservation of large carnivores. In this study, I investigated how an education project with focus on ecosystems, ecology, biodiversity and endangered species such as the African wild dog (*Lycaon pictus*) can influence on the local students' attitudes and knowledge. I predicted that through an education project, the students would learn and gain knowledge about nature, how the food web and ecosystem interact and how predators are crucial for the balance and regulation of the ecosystem. Two hypotheses were tested:

1) Due to education about the ecosystem the students will gain an increased knowledge about nature, large carnivores and ecology.
2) Education will cause more positive attitudes towards the endangered African wild dog. I also predicted that with increased knowledge the students would answer more frequently that wild dogs are important for nature and that they would gain more positive attitudes towards large carnivores.

These predictions turned out to be supported by the data. A total of 355 questionnaires were answered and six villages were visited in the Ngorongoro region in northern Tanzania, north east of the Serengeti National Park. My results pinpoint that the education project had a major effect on the answers the students were giving before the education project started and after it ended. With increased education in ecology and biology people tend to be more positive to the African wild dog. A significant higher number of students were able to give more educated answers; they named the carnivores correctly, their view on wild dogs changed significantly, their view on why carnivores are important in nature changed, and finally treatments of wild dogs and threats to wild dogs changed significantly from their initial answers before the education project. My results demonstrate that it is crucial to have biology education as early as possible in school in order to benefit the large carnivores and help to conserve the ecosystem. In this master thesis I

tried to involve the locals and show how an education project can be done, in order to increase the attention on the conservation of nature.

Summary in Norwegian

Verden står ovenfor mange globale utfordringer. Noen av de viktigste er klimaendringer, vannmangel, fornybar energi, og sist men ikke minst, den økende populasjonsveksten, spesielt i den tredje verden. Som art er mennesket dårlig på å dele de begrensede ressurser vi har. Den rike verden blir rikere mens den fattige bare blir fattigere. Nøkkelen til endring av våre holdninger for å bevare naturen er mer kunnskap. Det er viktig for alle mennesker å kunne forstå viktigheten av det biologiske mangfoldet og hvordan de ulike artene gjensidig påvirker hverandre i kompliserte økosystemer.

Gjennom min masteroppgave innen Bevaringsbiologi har jeg studert hvordan Masai befolkningen i Tanzania forvalter naturen, hvordan deres natursyn preger deres holdninger, og lært om de på samme måte som mange andre folkeslag lett kommer i konflikt med dyr som påvirker dem økonomisk og emosjonelt. Den største utfordringen vår generasjon står ovenfor er å forvalte og bevare naturen på en bærekraftig måte. Vi må utvikle kunnskap til å forvalte og bevare naturen på en slik måte at våre etterkommere kan få samme glede og nytte av den som vår generasjon har hatt.

For å utvikle en generell forståelse for hvordan menneskets holdninger til bevaring av biologisk mangfold utvikles og endres, er det viktig å forstå for eksempel hvordan Masaienes syn på naturen eventuelt kan endres med økt naturkunnskap.

De fleste mennesker vet lite om de utfordringer vår generasjon står ovenfor og det trengs derfor faglig påfyll for å kunne handle. Dette er fokus i min masteroppgave. Det er viktig at det undervises i dette temaet på skolen, slik at de som nå er barn kan utvikle en grunnleggende forståelse for hvordan naturen skal kunne bevares på en bærekraftig måte for framtidige generasjoner. Hvordan kan vi rettferdiggjøre at vår generasjon skal kunne avgjøre hva våre etterkommere skal få se, lære eller oppleve?

Jeg var i Tanzania på et to måneder langt forskningsopphold fra 20. januar til 30. mars der jeg blant annet utviklet et skoleopplegg til Masai barn og ungdom om generell biologi, økologi og spesielt om den truede afrikanske villhunden. En spørreundersøkelse ble besvart av 355 elever til sammen og de samme elevene besvarte spørreundersøkelsen før og etter skoleprosjektet. Dermed kunne vi teste endringer i svarene deres relatert til kunnskapsnivå og holdninger til naturen og villhunden. Vi diskuterte blant annet den innvirkning det kunne ha på resten av økosystemet om denne sjeldne arten, og mest effektive rovdyret i Afrika, faktisk dør ut. Den afrikanske villhunden kan sammenlignes med forholdet mange i Norge har til vår "kjente og kjære" ulv. Et velkjent spørsmål i Norge er; "Hvorfor i all verden skal vi bevare ulven?". Mange av argumentene mot ulven baseres på lite kunnskap. Gjennom min mastergrad ved NTNU har jeg blant annet gjennom vårt prosjekt i Tanzania utviklet kunnskap og bygget opp en forståelse for at "økt naturkunnskap vil kunne være avgjørende for at våre holdninger endres til et mer positivt natursyn i de fremtidige generasjoner". Hypotesen min om at økt naturkunnskap vil være med å endre holdninger til de lokale barna, ble støttet av resultatene jeg fikk etter skoleprosjektet. Resultatene fra dette masterstudiet viser at et kort skoleprosjekt har stor effekt på hva elevene svarer etter de er gitt kunnskap om temaet, i forhold til før de har hatt undervisning. Elevenes svar viser en signifikant positiv økning ved navngiving av rovdyr og forståelse for villhund i naturen og økosystemet, både med tanke på kunnskapsnivå og holdninger til rovdyr.

Alt henger altså sammen med alt… om en art dør ut får det konsekvenser for andre arter - som igjen får konsekvenser for oss mennesker, og for våre fremtidige generasjoner. Den kjente svenske professor Hans Rosling uttrykte det slik i et nylig foredrag i Oslo; "Vi mennesker har en tendens til å ikke reagere før det ikke fins mer kylling i butikken, før alt drikkevann er forurenset – eller før all nødvendig medisin er oppbrukt". Som fremtidig realfagslektor ønsker jeg å utvikle et mer nyansert syn på hvordan vi forvalter vår jord og være med på å ta vare på det biologiske mangfoldet slik at våre fremtidige generasjoner får mulighet til ha glede av en intakt natur. Løsningen er mer kunnskap! Det er min fremtidige visjon i samfunnet.

Table of Contents

Introduction

Background

The development of our modern western civilisation has shown that maintaining the standard of living, as we know it today, cannot be continued without unsustainable utilisation of nature (Primack, 2010). Research over the last 50 years has clearly illustrated that we cannot continue our overexploitation of resources as we have done up till now, gaining all we desire without negative consequences for the planet. As far as we can judge, our way of living has negative impact on our surroundings, both close to our doorstep, but also far away. Without our immediate awareness it may be too late to do something about it (Bongard and Røskaft, 2010). Some "realistic and wise or pessimistic persons" have indicated that the human race is not able to react to its negative environmental behaviour until the problems reach our neck (Low and Røskaft, 2000). This may in turn result in the collapse of civilizations and societies, a struggle for survival, and be a source to an unstable world with wars as a devastating outcome (Diamond, 2005). It is here knowledge comes in, at a stage where we still may have a possibility to change our development in a way that does not harm nature to the extent that we have done in the past. A sustainable and prosperous future depends on knowledge being transferred and distributed to people who are able to push in the right direction (Primack, 2010). The world faces many global challenges. Some of the most important ones are how to combat climate changes, how to supply clean fresh water to people, and how to generate enough energy without polluting the environment. Finally there is the challenge of increasing population growth, especially in the third world, and how this population growth affects the conservation of biodiversity.

There is a famous saying "If you give a man a fish you feed him for a day, if you teach the man to fish you feed him for a lifetime". An understanding of the dynamics of nature provides people with an awareness of their behavior that will actually affect the ecosystem, and also influence the attitude to the way local people think about conservation biology. Conservation biology is the knowledge about how we can utilise nature in a sustainable way (Primack, 2010). The term is comprehensive, but this thesis focuses on a small part, namely to investigate the role of

education and the impact it may have on people's behaviour and attitudes towards the African wild dog (*Lycaon pictus*) in particular, and large carnivores in general. Increased knowledge and understanding of nature provides a more positive attitude towards carnivores (Bjerke et al., 1998). Higher levels of education and a greater perception on the ecosystem have positive effects on the way humans feel about protecting the environment (Kellert and Berry, 1987). *"Changing political attitudes and views of nature have shifted the goals of carnivores management from those based on fear and narrow economic interests to those based on a better understanding of ecosystem function and adaptive management"* (Treves and Karanth, 2003). With a better understanding of how ecosystems function the people will develop a more sustainable way of conserving nature and get a motivation for wanting to help. There is a strong relationship between level of education and attitudes towards large carnivores. People with high education is most positive to carnivores (Røskaft et al., 2007).

In this master thesis, I focus on the increasing interest in the research field of conservation biology, and what it can do to contribute to turn the future development in a more sustainable direction for a local community. One aspect of particular interest within this study is the interaction between nature, represented by the African wild dog and humans – an interaction called human-wildlife (carnivore) conflict (Jackson et al., 2012, Treves and Karanth, 2003). Many activities performed by human beings may have long-term consequences. Humans behave rather selfishly when it comes to sharing available limited resources. The rich world is becoming increasingly richer while the poor countries remain poor (Bongard and Røskaft, 2010). The key to changing our attitudes to the preservation of nature could be more knowledge (Røskaft et al., 2007). People also tend to be more positive to large carnivores if they do not live close to them (Røskaft et al., 2007). It is crucial for everyone to understand the importance of biodiversity and how the different species are mutually interrelated in complex ecosystems (St John et al., 2010, Kideghesho et al., 2007).

One needs to get the local communities to believe in what they are being taught. It is easy to go for a selfish, narrow-minded short term solution, (exterminate the wild dogs) not thinking of what the long term implications might be. Knowing the nature in which you are living together

4

with both other people, livestock and wild animals, creates a positive attitude towards conservation biology (Bjerke et al., 1998). However, forming a positive attitude to preservation biology requires that a reward be envisaged at the end. It is this reward that is important to identify in a correct and honest way. Conservation biology also needs to be supported by national authorities, and local politicians. Funds may be required to compensate for loss of livestock in case wild dogs kill some. It is also important to be aware that a negative attitude can be formed from misleading, false and incorrect information about how to deal with the diversity of our nature depending on the purpose (hidden agenda) to those who educate and inform the inhabitants of a local community. We live in an information technology age, and strong and specific interests may easily distribute false information and convince locals what is 'best' to do (in their own interest) if locals have no basic or independent knowledge about the issue being argued for. Hence, specific knowledge is the best way for local people to make the best decisions for them and for their community.

In this thesis I will test if young 13-year old students (from Maasai and other Tanzanian tribes) through a questionnaire and an education project becomes more positive to nature and wild dogs, and if they know more about them after the project. In order to develop a general understanding on how people's attitudes towards the conservation of biodiversity change and develop, it is of interest to understand how the Maasai's view on nature may be changed with increased knowledge about their surroundings. In general, knowledge about nature among the Maasai and Tanzanian tribes is high (Clamsen and Røskaft, 2013). However, most people know little about the challenges our generation faces, and therefore lack professional competence to act according to such challenges. For the coming generation to understand how their behaviour affects nature, conservation of natural resources needs to be taught in the schools so that those who presently are students can develop a basic understanding of how nature should be preserved in a sustainable manner for future generations. The people living today have a responsibility for our descendants. Knowledge is therefore the key to achieve change.

Attitudes and knowledge

"What counts is what we really do, not what we say" (van Marion, 2008). What makes us deal with different things? Why do we do what we do? Are our actions affected by our attitudes? An attitude can be defined as "*the reaction way we usually meet people, issues or situations" (van Marion, 2008)*. Or in The Psychology of Attitudes, an umbrella-definition is "*a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour"* (Gawronski, 2007)*.* The more specific an attitude is to something, the greater is the chance that it will lead to actions. By developing this further it is possible to show how increased knowledge and positive attitudes are linked together (Røskaft et al., 2007, Kellert and Berry, 1987). But how are attitudes formed? They are partly formed through observation and discussions with people around us, and from what we learn and read (Karlsson and Sjöström, 2007). What peers, friends, families and enemies think strongly affect a person`s attitudes (Bonninger et al., 1995, Petty et al., 1997). "*Walk the talk"* is a phrase commonly used. If people around you do not care about the nature, it is likely that your attitude will be affected accordingly (Gawronski, 2007).

If you want people to be more positive to large carnivores it is crucial to provide them with more knowledge about the subject (Kideghesho et al., 2007, Kellert and Berry, 1987). It has been shown that increased knowledge of biology and higher education can change attitudes (Clamsen and Røskaft, 2013). As stated by Clamsen and Røskaft (2013), "*an understanding of local peoples` ability to recognize selected bird species may help management authorities to focus on important species in their conservation programs by including species that are not well known to the people"*. Learning and obtaining knowledge about nature is important for conservation (Kellert and Berry, 1987). If people learn about wolves and bears they tend to be more positive to large carnivores (Røskaft et al., 2007). Education is therefore important in shaping peoples` attitudes (Kideghesho et al., 2007).

One part of the attitude aspect is people's fear of animals. It has been shown that people's fear of carnivores decreased with education level (Røskaft et al., 2003, Bjerke et al., 1998). "*A good management strategy is to develop educational programs where people learn about the biology and habits of the large carnivores and are encouraged to gain first-hand outdoor experience in areas with large carnivores*" (Røskaft et al., 2003). In this thesis I use "education project" as a similar description for "environmental education" (EE) (Barthwal and Mathur, 2012). Barthwal and Mathur (2012) successfully improved local people's understanding of ecosystems, their functions, and the effect of human actions on them (Barthwal and Mathur, 2012). The Tanzanian children have different experiences than the western children, due to the way of living, about nature and knowledge about ecology, which is important to take into consideration before starting the lessons in an education project.

Aim of study

The aim of this study is to test how *"education can influence local people`s knowledge about nature and their attitudes towards the endangered African wild dog"*.

To investigate the interactions between African wild dogs and people, a rural area located at the north east of the Serengeti National Park (close to the new road construction, as a part of "The Tanzania Road Project" was used as the study area (Figure 1). The fieldwork was carried out as a part of an education project related to the endangered African wild dog for Maasai children and other tribes. The main aim was to test what impact such acquisition of knowledge had on the local school children and assess their change in attitude to the African wild dog, and show why this species actually seems to go extinct in many of its habitats. Large carnivores have a high local extinction risk and it is important to understand people's attitudes towards these predators (Winterbach et al., 2013). A positive attitude does not necessarily translate into tolerance for large carnivores, and therefore, the importance of understanding nature and increase the knowledge of the ecosystem are key factors for more acceptances. The end result might be that humans decrease the killing of large carnivores (Winterbach et al., 2013). The African wild dog

issue has many similarities to the Norwegian wolf issue *"Why should we protect the wolf when it is dangerous to humans and kills our sheep?"* Answering such a question is difficult and challenging, and is influenced by personal interests of the people who express their view, their level of knowledge, and inherent fear of large wild animals. People become more negative with age and concern for their own and family`s safety (Røskaft et al., 2007). Farmers who have experienced financial loss have also more negative attitudes, while people living far from the wolf territories and with higher education tend to be more positive (Røskaft et al., 2007).

Through this thesis program, and partly through the project "Dynamics of Large Infrastructure Development in Conservation of the Serengeti Ecosystem – the Case Study of a Road through Serengeti National Park" in Tanzania, focus was given to developing local knowledge through education about the ecosystem, with the aim of increasing students` knowledge about nature, large carnivores and ecology. Education will also cause more positive attitudes towards the endangered African wild dog. It is also predicted that with increased knowledge the students would answer more frequent that wild dogs are important for nature. The students would gain more positive attitudes towards large carnivores and hopefully a positive view on nature in general.

Methodology

Study area

The Serengeti National Park (SNP) is located in northern Tanzania. The Serengeti ecosystem encompasses the Serengeti National Park and several surrounding game reserves of 30 000 km^2. Altitudes range from 920 m to 1850 m and cover the elevated plains, grassy woodlands and mountainous hills. The study was conducted in six villages in Loliondo and Ngorongoro districts Ololosokwan (1), Soitsambu (2), Sukenya (3), Oldonyowas (4), Maalon (5) and Engaresero (6) (Figure 1). All villages were along the planned route for the new proposed road (Røskaft et al., 2012, Fyumagwa et al., 2013)
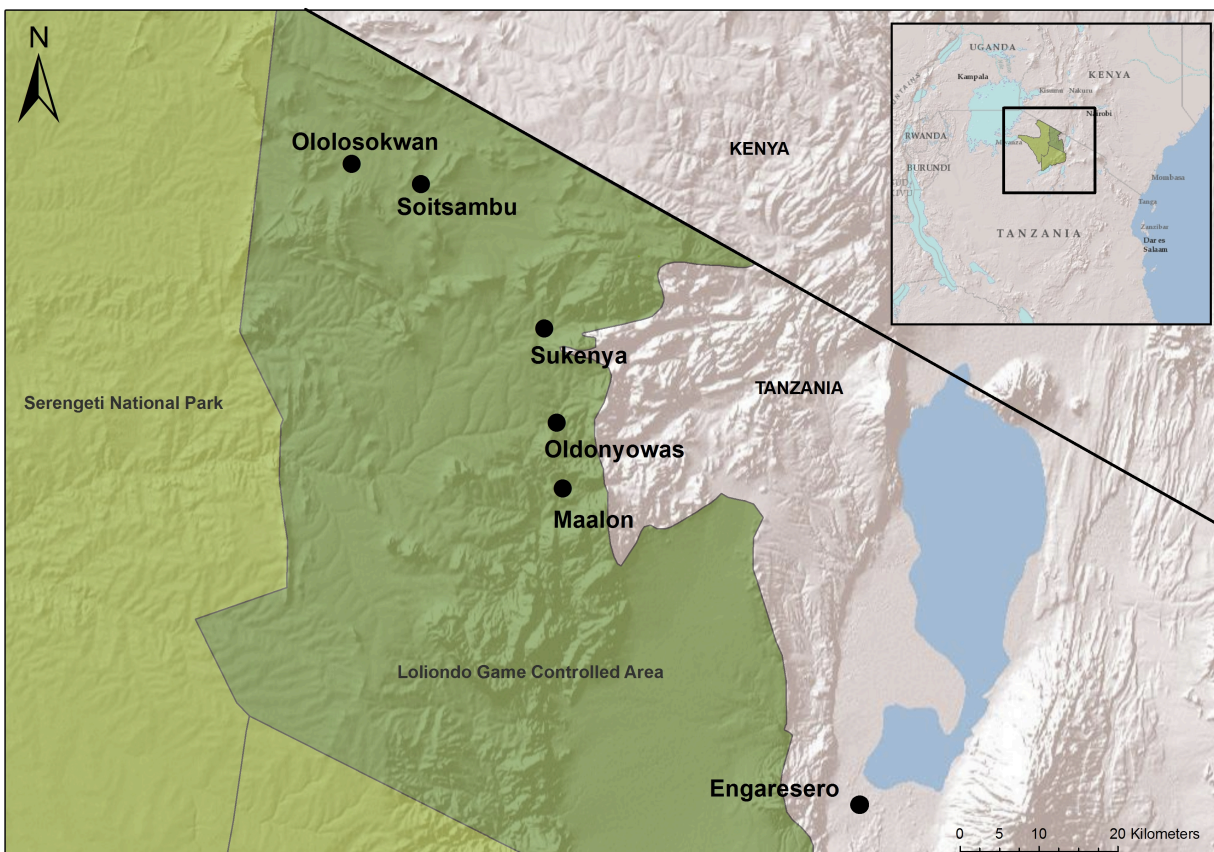
Figure 1: *Map of the Loliondo Game Controlled Area in Tanzania. The villages where the questionnaire survey and education project was conducted are indicated by names and black dots.*

Study species; The African wild dog (*Lycaon pictus*)

The African wild dog`s scientific name is derived from Lycaon (=Greek 'wolf') and Pictus (=Latin 'painted') (Creel and Creel, 2002). The wild dog is an animal built for hunting with huge ears, light body weight and with long thin legs, and it has a tricoloured coat pattern acting like a camouflage (Aldridge, 2011). The African wild dog is an endangered carnivore (Winterbach et al., 2013), which was historically distributed throughout much of sub-Saharan Africa (Creel, 1996, Creel and Creel, 2002). Due to direct persecution and habitat loss, the species has been extirpated from 25 of the 39 countries they initially inhabited (Creel, 1996, Creel and Creel, 2002). It is estimated that 60% of adult wild dog mortalities are linked to human activities (Creel, 1996, Creel and Creel, 2002). These may be deliberate, such as burning dens with young, poisonings, shooting adults, or unintentionally, such as when wild dogs are caught in snares or killed by road traffic. Humans therefore play a major role in the conservation of the species. The education project focused on large carnivores, and especially African wild dogs and their role in the ecosystem. One of the reasons why wild dogs should be conserved is because they are a top predator and more selective in its prey choice than lions and other large carnivores. As a predator it is therefore an important part of the ecosystem as it regulates ungulate populations (see Figure 2). It is also ethically right to save this animal from extinction (Primack, 2010). Understanding local people's knowledge and attitudes towards wild dogs is consequently of great importance to conservation strategies, and may play an import role in the conservation of the species (Woodroffe, 1998, Woodroffe, 2001).

Figure 2: *The African wild dogs have caught a wildebeest calf. Photo: Per H. Olsen*

The wild dog is Africa`s most efficient carnivore and also one of the most endangered animals. It is important to know its biology in order to conserve this species for successful management (Woodroffe, 1998). The pack size of the wild dog is around 2-30 animals, but the average pack size is normally around ten individuals. It is important for them to be many so that they can hunt and breed successfully and also provide protection and rearing of the young (Aldridge, 2011). That means that the wild dog is a very social animal with a social structure and hierarchy. The dominant female and male usually reproduce. When it comes to home range the wild dog needs a huge area and they frequently roam long distances, maybe to avoid areas used by larger carnivores. They normally need larger areas than lions (*Panthera leo*), spotted hyenas (*Crocuta crocuta*) or leopards (*Panthera pardus*). The wild dogs rest in high areas to avoid encounters with lions (Creel and Creel, 2002). They can chase after its prey at 60 km/h for up to 5 km. Hence, they have high stamina and they are quick eaters to avoid competitions with other predators like lions and hyenas (Creel and Creel, 2002).

Data collection and the questionnaire

During the two-month education project, data was collected from a questionnaire survey interviewing 30 students (chosen by the teachers at the school) aged 6-25 years (mean 13 years), in each class from all six study villages (Figure 1). The questionnaire survey included 25 questions and the structure was divided into five categories (Appendix 1). The questionnaire was sent to the Tanzania Wildlife Research Institute (TAWIRI), the project group in Tanzania, and approved before we started the education project. The intention by the questionnaire is to test if increased knowledge affected attitudes and general knowledge. We emphasized the role the wild dog has in the ecosystem, and the importance of large carnivores in the food web (Appendix 2 and 3). The questionnaire was prepared in English, so at every school two Swahili-English-translators translated the questions from English to Swahili. All the questions were well explained to translators and read by the translators before we entered the classroom. Every Monday 30 students were interviewed using the questionnaire (Appendix 1) to test their general knowledge before the education project started. The terms "before" or "after" are used to indicate differences in knowledge and attitudes before and after the education project. The aim of

the education project (Tuesdays and Wednesdays) was to spend time with the students teaching them about general biology and biodiversity, and provided some specific knowledge about large carnivores general biology, specifically African wild dogs (see Appendix 2). Every Thursday (the day after the education project) the same 30 students were taken out for an interview and given the same questions as on Monday. The same questionnaire was used, to test if increased knowledge affected attitudes and general knowledge.

The education project

The education project was planned in detail before travelling to Tanzania. We planned to spend around 4-5 hours per day during the two days, but after meetings in Ngorongoro district we agreed that the education project in all school classes should last from 14.00 to 16.30, Tuesdays and Wednesdays, or 5 hours of teaching altogether. We brought the necessary equipment with us including power point, generator and projector. This was a new experience for the children. The black board was used to explain details and two different posters (Appendix 4) were used as supplementary material. Notebooks were given to all children, so they could draw and write during the presentation and when they were given tasks. A film of the African wild dog hunting an impala (*Aepyceros melampus*) was shown. In addition games were prepared for the children where they would interact in a food web and pretend to be different animals and plants, like large carnivores, herbivores, grass and eat what they needed (Figure 3).

Figure 3: *Playing "Food web" with the author as an African wild dog hunting a school child as impala. Photo: Per. H. Olsen*

Analyses and statistics

All analyses were carried out in Statistical Package for Social Science (SPSS) version 19. Because the data represent categories like "name animals", and answering yes or no to different questions, we used numbers to represent the answers and mostly chi-square tests.

However, logistic regression analyses were used to identify the relative importance of different independent variables explaining *knowledge* and *attitudes*.

Ethical note

The study was approved by NTNU and TAWIRI. The teachers and children agreed to join the education project and taking the questionnaire. They were also informed that photos would be taken and looked forward to it. They thought it was fun to look at photos of themselves. We promised to send some photos to the District Officer and the Education school leader and different Head Officers in Ngorongoro/Loliondo after finishing the project.

Results

The number of interviewed children was 355 with a gender balance of 51.1 % males. The average age was 13 years old, but many of the children were unable to estimate their own age. I therefore had to guess/estimate their age. The most numerous tribe was Maasai (75.2 %). The other tribes (Mwiraki, Mmeru, Msjonjo, Mvoirak, Mkumbu, Mchaga, Mkenya, Mzava/Mbava) were pooled due to sample size and referred to as "Other tribes". Most of the students (88.5 %) had livestock at home.

Animal knowledge

Almost three quarters (73.9 %) of the students identified the jackal correctly before the education project in contrast to 96.0 % who identified the jackal correctly after the project; a statistically significantly increase (Table 1). Hyena was named correctly by 59.4 % before and 86.9 % after the education project (Table 1). Similar statistically significantly increases in knowledge were found for all other carnivore species as well (Table 1). The students better knew all the species after the education project.

Table 1: *Percentage of the students who identified a photograph of six different carnivore species correctly before and after the education project.*

Photo	Before % correct	After % correct	N	% increase	χ^2	P $^=$
Jackal	73.9	96.0	355	24.1	33.6	0.000
Hyena	59.4	86.9	355	27.5	33.8	0.000
Wild dog	63.3	87.4	355	24.1	27.6	0.000
Cheetah	37.6	57.2	355	19.4	13.5	0.000
Leopard	42.9	57.6	349	14.7	7.45	0.006
Lion	80.3	89.0	351	8.7	5.07	0.024

Almost one quarter (23.7 %) of the students answered the correct names on all six carnivores before the project compared to almost half (49.7 %) after the project; a statistically significantly increase in knowledge (Table 2). Finally the number of students who knew very few (0-2) of the carnivore species was reduced from about 30 % before the education project, to about 9 % after the project (Table 2).

Table 2: *Frequencies of students knowing all or some of the carnivores before and after the education project (χ^2 = 46.8, N = 355, df = 6, P < 0.0001).*

Knowledge: Number of species correctly identified	Before %	After %
Six	23.7	49.7
Five	8.5	8.2
Four	21.5	27.5
Three	16.4	5.3
Two	11.9	2.3
One	15.8	6.4
Zero	2.3	0.6
Total	100	100

There was a statistically significant increase in number of students who correctly claimed that an average wild dog pack consists of at least ten dogs after compared to before the education project (Table 3).

Table 3: *Answers to the question "How many wild dogs live in a pack?" before and after the education project (χ^2 = 51.7, df = 2, P < 0.0001).*

How many wild dogs live in a pack?	Before education project %	After education project %
1-2	24.9	7.5
About 5	29.4	9.8
About 10	45.8	82.7
Total	100	100

Before the education project, 56.5 % of the students claimed to have seen a wild dog in nature, while after the project this number had increased to 72.4 % (Table 4). To the question "Have you ever seen a wild carnivores in your area/village?", 72.2 % answered that they had seen wild carnivores in the nature before the project started. However, the frequency of students who answered yes to that question increased to 87.8 % after the education project, a statistically significantly increase in frequency (Table 4).

Table 4: *Students answering, "yes" to the question "Have you ever seen wild dogs in your area of residence?" or "Have you ever seen wild carnivores in your area/villages?"*

Question	Before %	After %	N	χ^2	P $^=$
Seen wild dogs	56.5	72.4	351	9.69	0.002
Seen large carnivores	72.2	87.8	348	13.2	0.000

Wild dog information

67.4 % of the students answered yes before the education project to the question "Do you think wild dogs prefer game animals (wild) instead of livestock?". However, after the education project 77.9 % of the students answered yes to the same question; a statistically significant increase (Table 5).

Seeing a wild dog in the wild made 49.2 % of the students happy prior to the education project, while 59.2 % answered yes to the same question after the education project; a statistically significantly increase (Table 5).

There was no change in the frequency of answers to the question "Seeing a wild dog in the wild makes you scared and afraid" (Table 5), or to the question "Do you think wild dog is a big threat" (Table 5).

Almost half (49.7 %) answered yes to the question "Do you think wild dogs are important for the nature?" before the education project. However this frequency increased statistically significantly to 83.2 % after the project (Table 5).

There was 63.3 % answering yes to the question "Do you think wild dogs kill wild animals?" before the education project, but after it had statistically significantly increased to 87.9 % answering yes (Table 5).

When asking "Do you think wild dogs kill livestock?" 73.7 % answered yes before the project. However after the project 89.7 % answered yes, a statistically significantly increase (Table 5).

To the question "Is killing livestock a threat?" 76.7 % of the students answered yeas before the education project, while after the project 86.3 % answered yes. A statistically significantly increase (Table 5).

Table 5: *Percentages of students answering yes to the following questions about wild dogs.*

Question	Before %	After %	N	χ^2	P =
Do you think wild dogs prefer game animals instead of livestock	67.4	77.9	347	4.79	0.029
Seeing a wild dog in the wild makes you happy	49.2	59.2	351	3.56	0.059
Seeing a wild dog in the wild makes you scared and afraid	66.5	69.6	350	0.39	0.533
Do you think wild dog is a big threat	56.1	59.1	351	0.31	0.576
Do you think wild dogs are important for the nature	49.7	83.2	348	43.8	0.000
Do you think wild dogs kill wild animals	63.3	87.9	354	28.9	0.000
Do you think wild dogs kill livestock	73.7	89.7	353	15.2	0.001
Is killing livestock a threat	76.7	86.3	355	5.42	0.020

Threats

Of the students who were asked the question "Is the road construction a threat to the wild dogs" 41.6 % answered yes before the education project, in contrast to 88.6 % after the education project (Table 6).

Almost three quarters (72.3 %) of the students were answering yes to the question "Is poisoning and killing by humans a threat to wild dogs" before the education project. However, after the education project 89.7 % answered yes (Table 6), a statistically significantly increase.

To the question "Is diseases a threat to wild dogs" 53.7 % of the students responded yes before, while after the education project the students answering yes had increased to 81.0 %; a statistically significantly increase (Table 6).

56.4 % of the students answered yes to the next question "Is splitted landscape (fragmentation) of their habitat a threat to wild dogs?" before the education project. However, after the education project 88.9 % answered yes; a statistically significantly increase (Table 6).

When asking "Are snares a threat to wild dogs", 59.7 % answered yes before the education project, while after the project 91.9 % answered yes; a statistically significantly increase (Table 6).

Table 6: *Percentages of the respondents answering yes to the following questions related to threats to wild dogs.*

Question	Before %	After %	N	χ^2	P <
Is the road construction a threat to wild dogs?	41.6	88.6	353	85.5	0.0001
Is poisoning and killing by human a threat to wild dogs?	72.3	89.7	351	17.1	0.0001
Are diseases a threat to wild dogs?	53.7	81.0	349	29.6	0.0001
Is fragmentation of their habitat a threat to wild dogs?	56.4	88.9	343	45.5	0.0001
Are snares a threat to wild dogs?	59.7	91.9	349	49.2	0.0001

Livestock

Students with livestock at home answered more frequently yes (85.0 %) to the question "Do you think wild dogs kill livestock?" than students without livestock at home (56.8 %) (Table 7).

Table 7: *Frequency of answers to the question; "Do wild dogs kill livestock?" in relation to the question "Do you have livestock at home?" (χ^2 = 17.9, P < 0.0001).*

Do Wild dogs kill livestock?		Do you have livestock at home?		
		YES %	NO %	Total %
YES		85.0	56.8	82.0
NO		15.0	43.2	18.0
	Total (N)	313	37	350

Factors explaining attitudes to the African wild dog

The logistic regression with "Do you think wild dogs are important for nature?" as a dependent variable, and using tribe, total knowledge of the six carnivores, before or after the education project, village, age and sex as independent variables turned out to be statistically significant (Wald = 36.27, df = 1, P < 0.001). Although three of the independent variables were initially statistically significant (total knowledge of the carnivores, village, before/after the education project; only two (before/after education project; Wald = 37.73, P < 0.001), and village (Wald = 9.61, P = 0.002) were significant in the total analysis. These two variables explain 23 % of the variation of the wild dogs importance for nature (Nagelkerke r² = 0.230) (Table 8).

Table 8: *Independent variables in a logistic regression analysis with "Are wild dogs important for the nature?" (yes/no) as a dependent variable.*

Independent variables	t-value	df	P =
Before/After education project	46.81	1	0.000
Knowledge of all carnivores	8.79	1	0.003
Village/school	8.31	1	0.004
Age	0.472	1	0.492
Sex	0.024	1	0.876
Tribe	0.003	1	0.960
Overall statistics	56.26	6	0.000

Factors explaining attitudes to "the road" as a threat

The logistic regression with "Is the road construction a big threat to the wild dogs?" as dependent variable and tribe, total knowledge of the six carnivores, before or after the education project, village, age and sex as independent variables turned out to be statistically significant (Wald = 27.74, df = 1, P < 0.001) (Table 10). Although two of the independent variables were initially statistically significant (total knowledge of the carnivores, before/after education project), only one (before/after education project; Wald = 63.88, P < 0.001) was significant in the final analysis. However village; (Wald = 3.64, P = 0.056) was almost statistically significant in the total analysis. These two variables explain 34.5 % of the variation of the wild dogs importance for nature (Nagelkerke; r^2 = 0.345) (Table 9).

The education project before/after the questionnaire was the most important variable, followed by the second most important variable "knowledge of the carnivores". Gender, age, village and tribe were not significant contributors in explaining the variation in the variable (Table 9).

Table 9: *Independent variables in a logistic regression analysis with "Is the road construction a big threat to wild dogs?" (yes/no) as a dependent variable.*

Variables	Wald	df	P =
Before/After education project	85.133	1	0.000
Knowledge of all carnivores	9.610	1	0.002
Village/school	2.655	1	0.103
Age	0.652	1	0.420
New tribe	0.380	1	0.538
Sex	0.038	1	0.845
Overall statistics	89.121	6	0.000

Knowledge

A linear regression with "total knowledge of the six carnivores?" as dependent variable, and with tribe, before or after the education project, village, age and sex as independent variables turned out to be statistically significant (F = 17.86, df = 1, P < 0.001). However, only three of the independent variables (before/after education project, sex and tribe) were statistically significant in the total analysis (Table 10). These three variables explain 20.1 % of the variation of the total knowledge of the carnivores importance for nature (adjusted r^2 = 0.201).

Table 10: *Linear regression with "total knowledge of the six carnivores?" as the dependent variables and with five independent variables.*

Model	Unstandardized coefficients	t =	P =
	Beta		
Constant	10.67	12.43	0.000
Before and after education project	-1.216	-7.11	0.000
Tribe	-0.893	-4.33	0.000
Sex	.610	3.48	0.001
Age	-0.092	-1.74	0.083
Village	.090	1.77	0.077

Discussion

History has shown that the level of knowledge, poor or good, to many aspects of life; politically, socially and environmentally, has influenced our behavior, and formed the attitude to the way we treat our surroundings (Kellert and Berry, 1987, Røskaft et al., 2007). By using different methods in the education project over almost two months in Tanzania, some interesting results were obtained related to how children acquire knowledge, and how such knowledge may change attitudes to nature and large carnivores. Based on specific variables such as before/after the education project, level of knowledge, village/school, age, tribe and gender, I tested which one of them had the highest impact on the results. I found out that "before/after education project", being the most important parameter and had the highest impact on changing attitudes, as was also predicted. Similar studies have argued that increased knowledge about nature will make people think and act more positive towards large carnivores (Winterbach et al., 2013, Kellert and Berry, 1987). It is important to inform the people living close to the carnivores to conserve wildlife-dominated ecosystem (Treves and Karanth, 2003). Throughout the world, there is an increased focus on how to solve the climate crisis, limit human population explosion, and help endangered species (Primack, 2010). Different solutions have been suggested in earlier studies. In this master thesis, however, focus has been given to how the field of conservation biology education and increased wildlife knowledge, may help young children change their conservation attitudes. This study also shows that education increases their knowledge and they gain a more positive attitude towards nature and large carnivores through education. Røskaft et al. (2007) discuss how the key in changing our attitudes about preserving nature could be more knowledge, and this is supported by the results in this master thesis.

Animal knowledge

As anticipated and predicted, the results of this study show that significantly more students were able to identify the carnivores after the education project than before. These results are supported by other studies, and show that education increases the knowledge level (Barthwal and Mathur, 2012). The students` answers to the question "How many wild dogs live in a pack?" indicate a

significant increase of the awareness of the wild dog`s behaviour and to the environment in which they live. The students understood that the African wild dog was a social animal. A study in India showed that it is important to make children in school understand the ecosystem; *"Environmental education (EE) has recently been included in school curricula in India to improve understanding of ecosystems, their functions, and the effect of human actions on them. The need for EE is more pronounced in Ladakh, in the Indian Trans-Himalaya, where recent development activities pose challenges for the fragile mountain ecosystem and for traditional livelihoods"* (Barthwal and Mathur, 2012). When asking the students if they had seen a wild dog or large carnivores there was a significant increase in number of students who understood that they had already seen such animals and therefore answered "yes" after the education project.

Wild dog information

When asking about wild dog information there was as predicted a strong increase in numbers who replied "yes" to all questions after the education project. A majority of the students answered that even though wild dogs kill wild animals, knowledge about the wild dogs indicated that the students got a more positive attitude towards the African wild dogs. They also became happier, and they understood that the wild dogs are important for the nature. Except for the questions whether wild dogs make them scared or afraid, and asking if wild dog is a big threat, the answers indicated no change after the project. The African wild dog will still be a threat and a scary animal no matter what they were told.

Rozzi et al. (2006) supports this thesis when explaining that; *"Although there is general agreement among conservation practitioners about the need for (1) social involvement on the part of scientists; (2) interdisciplinary approaches; (3) working on local, regional, and global levels; and (4) implementing international agreements on biodiversity and environmental protection, a major challenge we face in conservation today is how to integrate and implement these multiple dimensions. Few researchers have actually offered hands-on examples for showing in practical terms how such integration can be accomplished"* (Rozzi et al., 2006). We

therefore tried to include and involve the locals and show how a conservation education project can be accomplished in an education project, in order to increase the attention on the subject. From the documented results it may be concluded that an education project as in this thesis helps to increase knowledge about the carnivores and the attitudes to African wild dogs.

It is interesting to note that many students changed their answer to the question; "Do you think wild dogs are important for the nature?" after they had been taught about the wild dog's behavior and way of living. When people live close to carnivores they are normally more negative (Naughton-Treves et al., 2003) when they have no knowledge about the animals. But when they are given knowledge about this subject they tend to be more positive and see why the carnivores belong to nature and what important effect large carnivores have on the ecosystem.

Threats

With regard to threats, the students had to answer five different statements with a simple yes or no. All of the statements were related to the road being a threat to different aspects of the wild dog's life. All the questions about threats were more frequently answered "yes" after the education project. The students learned that humans have a huge effect on African wild dogs mortality. This is supported by different studies: biodiversity loss is, to a large extent, the result of human behaviours (St John et al., 2010). Similar studies have discussed that "The ecosystem currently suffers due to conflict between conservationist and local communities" (Hofer et al., 1996). Local people are still the most important reason why large carnivores go extinct. High levels of human-caused mortality may disrupt the social systems of large carnivores to the extent that it impacts negatively on population size (Winterbach et al., 2013). After the education project more students understood the reasons for why the African wild dog is threatened and also what kind of threats they are exposed to. Moreover, they also learned how humans can help.

Livestock

As predicted, a majority of the students who had livestock at home answered that wild dogs killed their animals. It is likely that they have experienced loss of livestock and financial loss (Agarwala et al., 2010). If one wants people living close to large carnivores to conserve them, knowledge has to be given about the nature at large (Røskaft et al., 2007), through for example an education project.

Some researchers in India and USA have found that there were no significant differences in attitudes of any particular segment of the population, but those losing high value livestock applied for compensation (Agarwala et al., 2010). Thus attack from large carnivores affects the local people, both financially and emotionally (Kaltenborn and Bjerke, 2002), as indicated by my results.

Factors explaining attitudes to the African wild dog

The answers before and after the education project differed significantly in relation to the African wild dog, and their attitudes related to the wild dog. Such an increase in knowledge would potentially change the local student`s attitude about the nature.

It has previously been shown that peoples` fear of carnivores decrease with increased education level (Røskaft et al., 2003, Kellert and Berry, 1987). Røskaft et al. (2003) furthermore found that the fear of animals was related to age. One reason is negative presentation from mass media with negative attitudes towards large carnivores, which influenced attitudes negatively. In Tanzania there is very little influence from mass media, but more likely rumors that travel from village to village (Røskaft et al., 2003). People might become more negative if the neighbor-village has had an attack from large carnivores on their livestock (Clamsen and Røskaft, 2013, Bjerke et al., 1998).

Factors explaining attitudes to "the road" as a threat

More students answered "yes" to the question "Is the road construction a big threat to wild dogs?" after the education project. The knowledge-level increased as predicted, and is supported by other studies. Research shows that attitudinal studies are important in evaluation peoples understanding of nature and acceptance for conservation of wildlife (Kideghesho et al., 2007). By teaching about threats and why different threats may exterminate the wild dog, people become more aware of the situation. Also as predicted, the most important variable explaining the attitudes to the road as a threat was the variable "before/after education project".

Knowledge

"Everything is connected to everything else in nature" (Bongard and Røskaft, 2010): If one species is exterminated this will in turn have consequences for other species, which again will have consequences for humans in some way or another, both in the short term, but also for future generations. An education project is a good way of helping, conserving and paying attention to the ecosystem and endangered animals.

Young children usually have limited life experience and may not be able to recognize how to react to different environmental issues. It is often the adults who decide on their behalf based on their own interest, and without adequate knowledge. By providing 'correct' information, this may influence people in such a way that whatever decisions they make will be inspired by a drive to do *"environmentally correct"* choices (Barthwal and Mathur, 2012, Sjøberg, 2009). We aim to test students on how acquiring knowledge will change their attitudes and level of knowledge. However, when the term: *"acting for a sustainable development"*, is considered, we need to look for realistic options within the inhabitants surroundings. Through an education project the children have the possibility of influencing to their families and consequently have an

effect on decisions made in a sustainable manner. Children learn at school and tell about this at home.

During the last decades several studies on conservation that considered attitudes towards conservation have been undertaken (Winterbach et al., 2013, St John et al., 2010, Clamsen and Røskaft, 2013). Conservation scientists therefore need to be interested in the factors that motivate human behaviour (St John et al., 2010). In the results we found the same trend, which is that the dependent variable "before/after education project" had the biggest impact when it comes to total knowledge of the six carnivores. When the children found the subject interesting and became more positive, the total knowledge of the six carnivores increased after the education project. The greatest challenge our generation may face is to manage and conserve natural resources in a sustainable way (Primack, 2010). We need to develop the knowledge to manage and conserve nature in such a way that future generations can have the same opportunities as our generation has had.

Possible biases on the results

One influence on the result could be the language-problem. The first language of the children is their tribal-language, the second is Swahili and English is their third language. I was teaching in English, and the translator translated to Swahili, but the children know their tribe-language best. Therefore some of the translations during the education project could have led to confusion.

We also noticed that when asking the children "tick one answer"/or "tick only one answer" at every animal in the first question about large carnivores, many of the children ticked the *first* alternative for every question and therefore ticked Black backed jackal (*Canis mesomelas*) correctly without knowing the animal (see Appendix 1). Hence, a misunderstanding about one/first/only one got mixed at the first school visited. This might explain why so many students got the answer to Black backed jackal correct before they had had the education project.

At the fourth school there were attacks by African wild dog on many of the locals` livestock right before we arrived. Hence, we had to explain very carefully about the `food web` and what African wild dog actually preferred as their prey. However, the children found it hard to believe that African wild dog preferred wild animals like impala instead of livestock so when they draw the food web they pictured the prey as livestock, such as goat and sheep instead of impala. This may explain some of the results related to the questions about what African wild dog prefers to eat.

It is important to understand whether attitudes actually reflect what behavior or actions people will have. If the students all get positive attitudes and correct answers after the education project, it shows that they learned and have an increased understanding of the balance in the ecosystem. When asking them, they may even say that they like wild dogs more, or have a more positive attitude towards the dog. But if the wild dogs attack their livestock… we might ask ourselves if they will keep their newly acquired, good attitude towards the wild dogs – and not kill them? We cannot be sure, of course, and this is one of the big challenges related to this kind of conservation work – making people change their behavior, as this is what ultimately makes or breaks conservation programs.

Conclusion

After this short education project the children's attitudes were changed. The education project had a positive effect on their knowledge about nature, and the children showed more positive attitudes towards the African wild dog. The level of knowledge increased significantly after the education project. Due to education about the ecosystem there was a change in the students` knowledge about the nature. The students were more positive to African wild dogs after having been given some general information about biology, and specifically about large carnivores. As also predicted a majority of the students answered that the African wild dog was important for the nature and became more positive to large carnivores in particular.

Perspectives

It is recommended to include education conservation projects in places where it is important to sustain large carnivores and endangered animals. This education project shows a way to make people understand nature, species and their importance in the ecosystem. We will recommend similar education projects to other places and countries. After the education project the relative increase in knowledge and attitude positively changed. The local people learned a lot and now understand the threats to large carnivores and the role of the African wild dog in the ecosystem and nature.

This thesis`s aim was to contribute to the development of a more balanced view on how we can manage our nature without destroying the natural environmental balance and at the same time preserve biodiversity. A key parameter to obtaining this is to increase knowledge among all people. "The western world is the great polluter and the third world is the great sufferer" (Conversation with the Tanzanian Ambassador). We therefore have a responsibility to spread our knowledge, so that the local people living close to nature can learn how things could be done, or not done, -and consequently learn from each other's as well as our own mistakes.

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Appendix

Appendix 1: The questionnaire

<div align="center">

TANZANIA WILDLIFE RESEARCH INSTITUTE PROJECT
P.O.BOX 661 ARUSHA

SERENGETI WILDLIFE RESEARCH CENTRE

</div>

1: RESPONDENT GENERAL INFORMATION

a. District …………………… Village ....
b. GPS – location……………………………………………………..
c.   Age …………………………Sex…………………………………
d. Tribe…………..
e. Date……………………………………………………………

2: WHAT DO YOU KNOW ABOUT WILD DOGS

a. Can you put name on these animals

Black backed jackal ☐	Black backed jackal ☐	Black backed jackal ☐
Spotted hyena ☐	Spotted hyena ☐	Spotted hyena ☐
African wild dog ☐	African wild dog ☐	African wild dog ☐
Lion ☐	Lion ☐	Lion ☐
Cheetah ☐	Cheetah ☐	Cheetah ☐
Leopard ☐	Leopard ☐	Leopard ☐

Black backed jackal ☐	Black backed jackal ☐	Black backed jackal ☐
Spotted hyena ☐	Spotted hyena ☐	Spotted hyena ☐
African wild dog ☐	African wild dog ☐	African wild dog ☐
Lion ☐	Lion ☐	Lion ☐
Cheetah ☐	Cheetah ☐	Cheetah ☐
Leopard ☐	Leopard ☐	Leopard ☐

b. Have you ever seen African wild dog in your area of residence?   Yes ☐ No ☐
c. Have you ever seen any wild carnivores in your area/village?   Yes ☐ No ☐

3: BEHAVIOR OF AFRICAN WILD DOGS

a. Do you have livestock at your home?   Yes ☐ No ☐
b. How many wild dogs live in a pack?   1-2 ☐ 5 ☐ more than 10 ☐
c. Do you think wild dogs prefer to eat game animals (Wild) instead of livestock? Yes ☐ No ☐

4: STATEMENTS

a. Seeing a wild dog in the wild makes you happy.   Yes ☐ No ☐
b. Seeing a wild dog makes you scared and afraid.   Yes ☐ No ☐
c. Do you think wild dog is a big threat?   Yes ☐ No ☐
d. Do you think wild dogs are important for the nature?   Yes ☐ No ☐
e. Do you think Wild dogs kill wild animals?   Yes ☐ No ☐
f. Do you think wild dog kill livestock?   Yes ☐ No ☐
g. Is statement (f) a threat to our livestock?   Yes ☐ No ☐

5. WHAT ARE THE MAIN THREATS TO WILD DOG POPULATIONS

a. The new road construction and road kills…….   Yes ☐ No ☐
b. Poisoning and killing by humans…………..   Yes ☐ No ☐
c. Diseases ….   Yes ☐ No ☐
d. Splitted landscape (fragmentation) Encroachment of their habitat   Yes ☐ No ☐
e. Snares   Yes ☐ No ☐

6. SCHOOL

a. Why do you go to school?   Because my parents say I should go   ☐
Because I want to   ☐
Others   ☐

- Thank you for your cooperation and good answers

Appendix 2: Structure of the education project

What?	How?	Why?
Introduction 10 minutes	Who I am, where I come from, about Norway etc., distance from Norway-Tanzania, African map, the world, where is Tanzania, Norway, general biology, and ask them name different animals, the tree of life and how things are related in nature.	When the children know the teacher a bit they will be more confortable about the situation, ask more question, more dialog, make a frame. I will also get an impression on their level of knowledge and how things work in each class.
Introduction African wild dog 10 minutes	Ask what they know about African wild dog, witch animal is related to the African wild dog, Carnivore pedigree, explain & ask about the behavior of African wild dog, and about the distribution of African wild dog.	It is interesting to know what some of the children know and let them speak load in the class, also tell them about the behavior of the wild dog. I like to include the children in a dialog, instead of only monolog.
Ecology and the ecosystem 10 minutes	Explain about ecology; the study about all organisms and their surroundings and how they interact in nature. I got inspiration from Cappelendamm teacher page and asked them about individual, a population, specie, a society, an ecosystem and the biosphere.	So they get an understanding of that everything is connected to everything else in nature.
Food web	Closer explanation of the food	So the students will understand why

10 min	web, and how species interact in a food web. Give out some tasks and ask question	every species is important. I let them draw, and ask questions to include them.
Challenges 10 min	Explain about the ecosystem is changes; more desert, human growth, global warming. Discuss	Learn that the humans affect other species than themselves. The humans have a major influence witch important to understand.
Short break		
Draw The wild dog 10 min	The students shall draw the African wild dog and include what they think this large carnivore eats and drink. Let them finish tomorrow and also as homework.	Give them colors and let them start to draw and write. It is a practical task and I will let the children think by themselves and be creative. I give them homework to make them have time to talk to the families at home.
2 min Examples of a African wild dog food web	Let them see an examples of the African wild dog food web, and tell them that we will continues with it tomorrow also	Give them some examples of what the African wild dog eat and drink. Then they learn about it and hopefully remember better about it.
5 min Population size	Ask the students what they think affect/influence the population size of the African wild dog… ex. Birth, death, emigration, immigration.	It is important to understand how a population increase and decrease, why, and how can we help this endangered carnivores!
15 min Threats to The African wild dog	Explain and discuss some of the threats and some of the reasons why the African wild dog population size decrease; habitat fragmentation, diseases/illness, competitions with other animals and carnivores, reputations, poaching and bycatch, road	You need to know what is threatening the wild dog to be able to help. It is crucial to be aware of that we, humans, is one of the biggest threats and we can help.

	accidents.	
5-10 min Conservation	Ask; Why is it important to conserve the African wild dog, why should it live?	Then they will understand how the predators help to regulate the ecosystem.
10 min Behavior	Explain about wild dog behavior, social structure with hierarchy, pack size	They need to get to know the wild dog to be able to know what they think about the animal.
5 min Film	Show a film about how the wild dogs behavior and how they hunt in a group for impala	Films are a good variation in the method, and also show them the behavior of African wild dog.
DAY 2		
10 min Repeat	Repeat about us, and what they remember from yesterday; biology, ecology, food web, pedigree, distribution, population size, threats to wild dog and the behavior.	Make them be confortable by talking about familiar topics, and repeating is important so they remember.
5 min Challenges to the wild dog	Discuss some challenges to the decrease of wild dog, and challenges related to human growth.	Then the children feel included in the challenges to wild dog, and maybe feel that they can help.
10-15 min Finish the wild dog food web	Draw wild dog, and include the wild dog in a food web.	The students will see how things in nature are related, and the importance of large carnivores.
10 min African wild dog behavior	Explain about conservation of wild dogs and what are the challenges. Ask what they think? Home range size, Habitat fragmentation, Social structure, Prey availability, Husbandry, Economy	Then the students can tell what they think, why we could conserve the wild dog. Maybe they have some other thoughts? No answer is stupid and I want them to really say what they think and feel.

10 min Conservation of wild dogs	What efforts are done; Translocation, Reintroduction, captive-breeding programs, Vaccination programs, Maintaining dispersal, Ease human-wild dog conflict and Knowledge	The students will feel that a lot is done and more can be done to help the African wild dog. The students need to know how them can help conserving large carnivores.
5 min Tracking wild dogs	Explain and discuss about why and how to track wild dogs with Radio collars, GPS collars for research, sightings and tracking.	Hopefully the students will understand that there are many methods on tracking and if they or their family kill wild dogs it will be noticed. Maybe this will help preventing it in the future.
10 min Management in Tanzania	Explain and discuss about the management in Serengeti, The Serengeti National Park (SNP), use of natural resource, protected areas, habitat loss and illegal hunting	To inform them about what the status are and what kind of management is done. I think it is important to explain why we have protected areas, and about habitat loss and illegal hunting.
Short break		
10 min Human-wild life conflict	Discuss and ask what they think about Human wildlife conflict, Before and now, Protected areas, Where human activity and hunting are regulated, What do you think about the African wild dog?	What affects the student financially and emotionally is a key factor to understand the human-wildlife conflict. The most important in that case is to include and ask the people that feel touched by the conflict.
5 min The African wild dog in Serengeti	Talk about the situation around wild dogs. In 1992 the wild dogs were gone from Serengeti because of rabies caused small	Then they will know how the project was supported and how the population increased again.

	populations → local extinction, 2005 increased again, Supported	
10-20 min Game/Play about food web	Explain the game and how every child will play different species in the food web and try to catch what they need to eat and drink. Summary of the game in the end	This game shows the food web in praxis and which animal eat which animal. The ecosystem will hopefully be more understandable.
5-10 min	Summary	

Appendix 3: The power point of the education project

From Norway to Tanzania
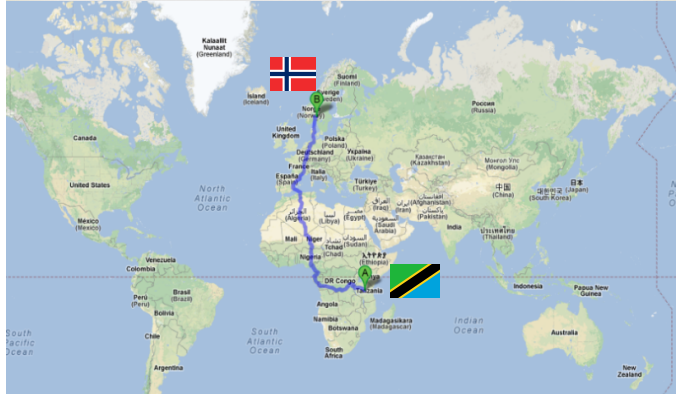
NORWAY

Norway, Trondheim

Biology

The tree of life

- What is life?
- Are you alive?
- What is the difference between you and a dog?

The tree of life

Relationship of
Living Families of Carnivora

Lycaon (Greek for wolf)
pictus (Latin for painted)
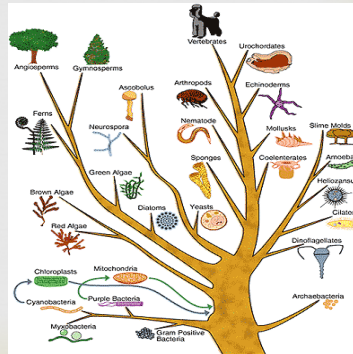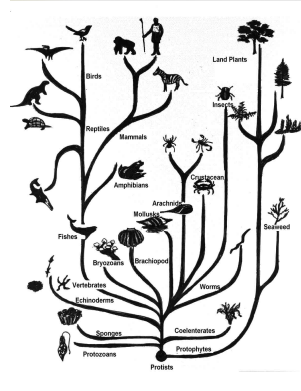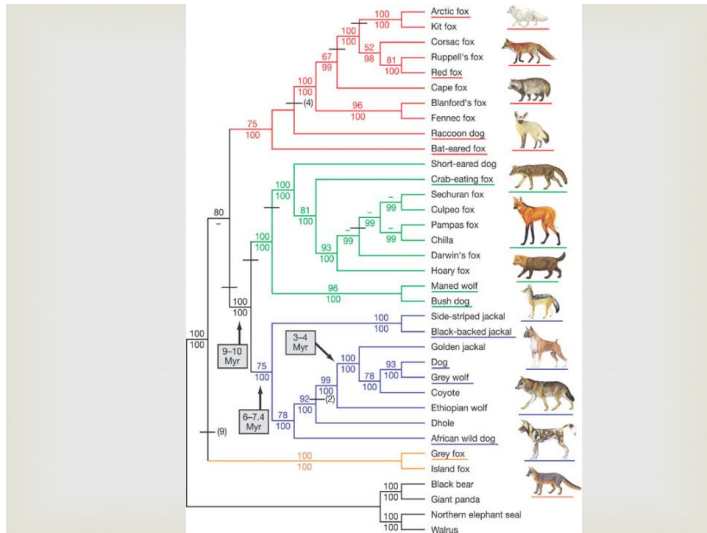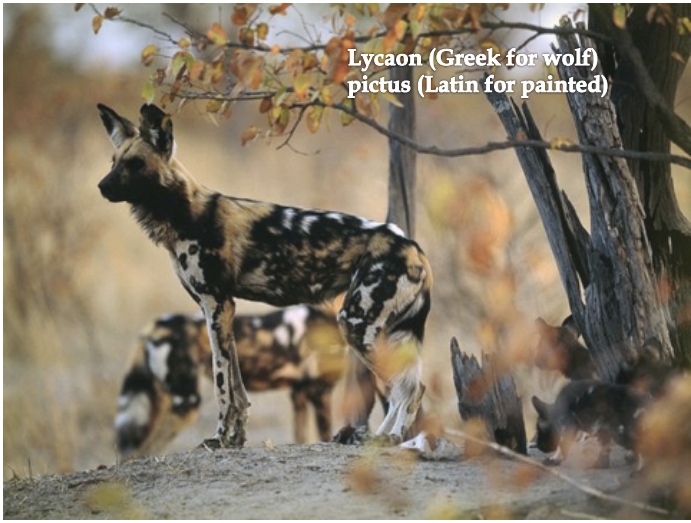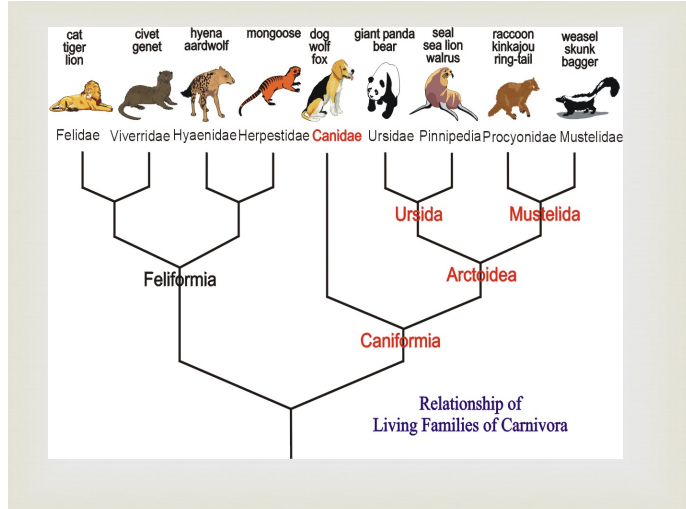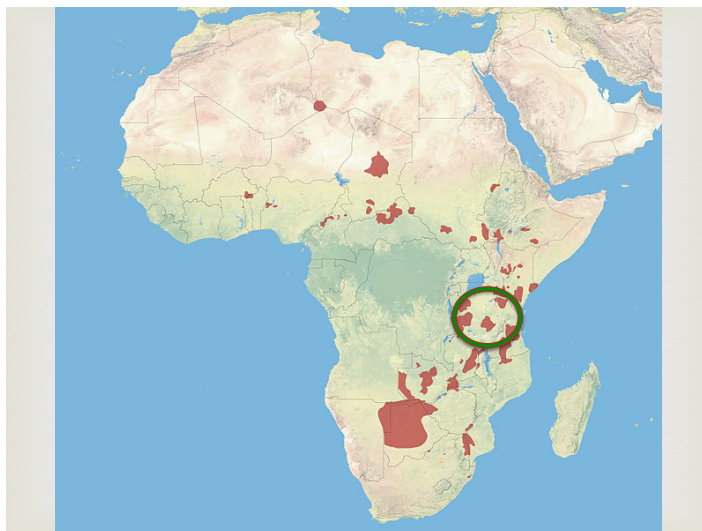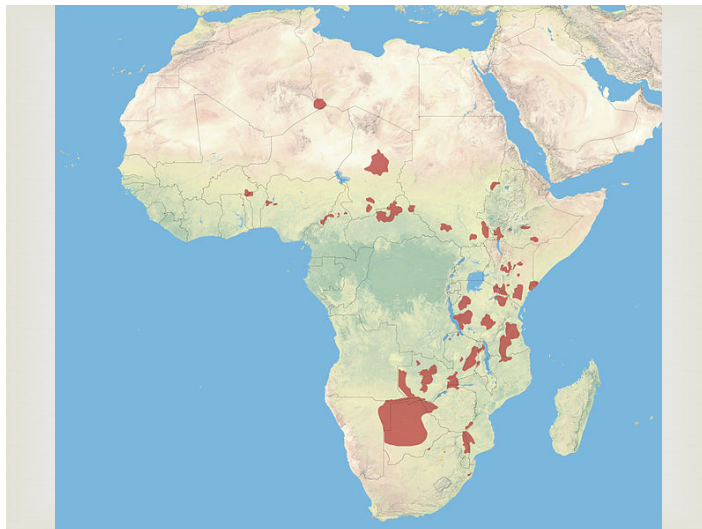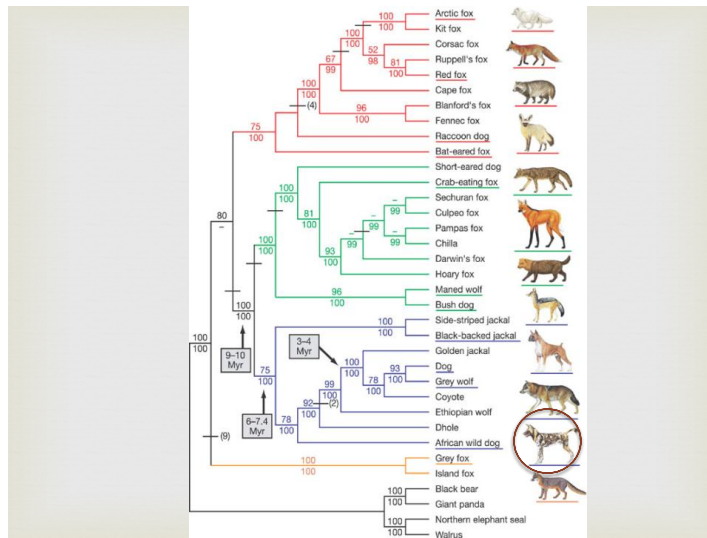
Ecology

Ecology is the study about all organisms and their surroundings and how they interact in nature.

Ecology (Greek oikos, wich means house, and logos, wich means teaching).
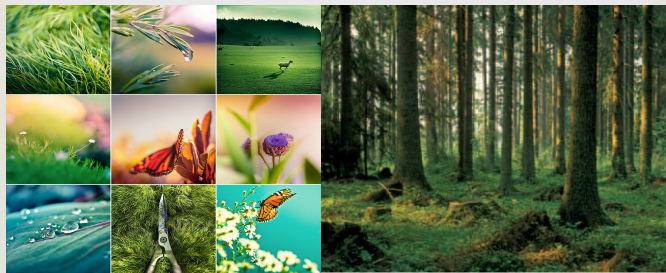
All places on earth where organisms can live is called biosphere. This is often divided into smaller parts that we call ecosystems.
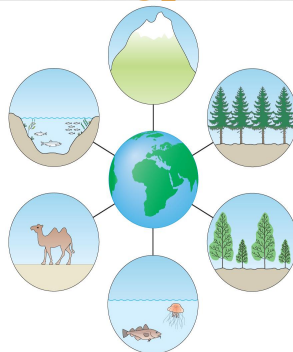
The living(biotic) and non-living(abiotic) in the ecosystem
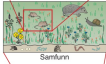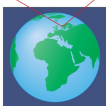
Living	Non-living
Plants	Soils with nutrients
Herbivores	Air with for example Oxygen and carbon dioxide
Carnivores/Predator Eks.African Wild dog	Water with dissolved substances
Mushrooms	Temperature
Microorgansims	Wind, light, waves ...

Everything that lives is dependent on both living and non-living factors

Everything is connected to everything else

	An individual	is a single organism. You are an individual.
	A population = one stock/ a pack	several individuals of the same specie living in an area and able to reproduce with eachother.
	a specie	consists of all individuals. Under natural conditions can reproduce with each other and get fertile offspring.
	A society	are all populations living in an area that can influence each other. We often distinguish between animal communities and plant communities.
	An ecosystem	is a defined area of living and non-living factors that interact. Ecosystems are normally self-sufficient in everything except energy which must be supplied from outside.
	Biosphere	are all places on or near the Earth where organisms are living.

Ecosystem changes

Deserts

Nature is changing! What happend?

AFRICAN WILD DOG

Draw your own food web and include **The African Wild Dog**!
What do you think **The African wild dog** needs to live? What does The African wild dog eat and drink?

Cape Hunting Dog or African Wild Dog
Lycaon pictus

Large ears

Splotchy brown, tan, and black fur

Long, white, bushy tail

Large, sharp, jagged teeth

4-toed feet with pads on the bottom

Front feet wider than hind feet

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Lycaon (Greek for wolf) pictus (Latin for painted)

Senegal Gum Acacia   Bermuda Grass   Elephant Grass   Gum Tree Eucalyptus

Ostrich

Rhinoceros

Grant's Zebra   Gazelle   Giraffe   African Elephant   Cape Buffalo   Warthog

African Wild Dog   Leopard   Cheetah   Hyena   Lion

Bacteria   Mushroom   Worms
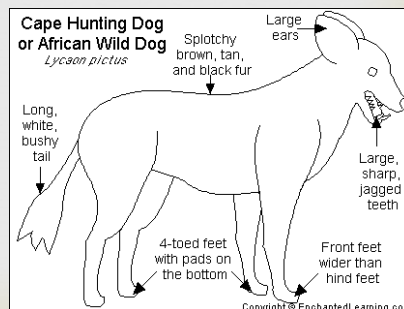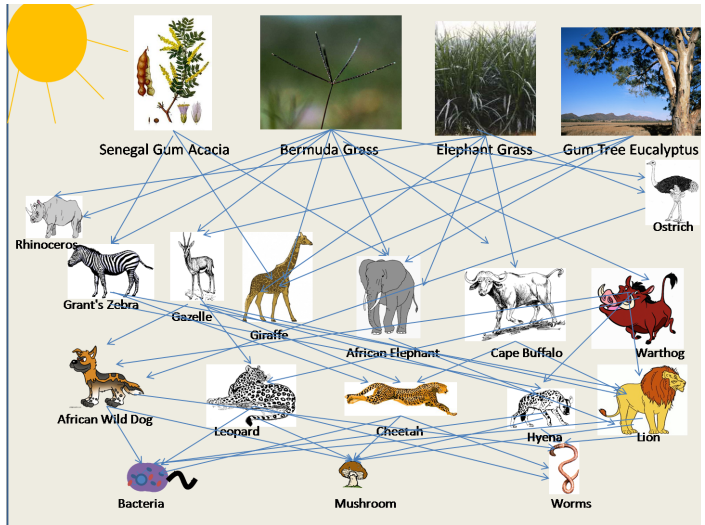
Growth in populations

For a species to be able to hold up the sample size, it must fulfill a new individual for each individual that dies.

Population size changes over time. For example Ladybird, Lion or African wild dog

EMIGRATION

BIRTH

DEATH

IMMIGRATION
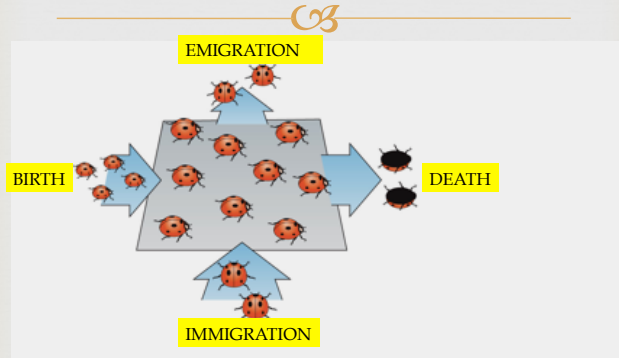
Threats to wild dog

Habitat fragmentation

Threats to wild dog

Diseases /Illness
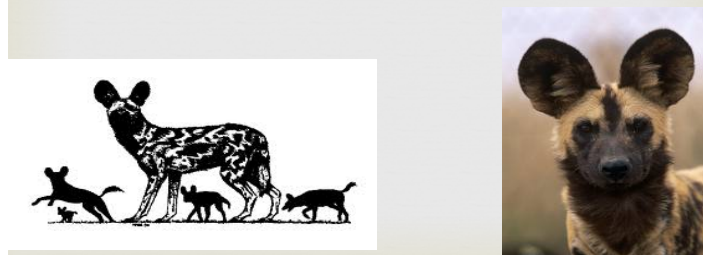
Threats to wild dog

ᘕCompetition

Threats to wild dog

ᘕReputation

Threats to wild dog

ᘕPoaching and bycatch
ᘕRoad accidents

Why conserve wild dogs?

- What do you think?
- Write down all the reasons you can think of for why wild dogs should live!

Behaviour

- **Social structure** with hierarchy
- Pack size 2-30,: hunting, breeding, protection and rearing of young
- Reproduction hierarchy
  - Dominant female and male reproduce
- Home range
- **Wild dog are territorial and tend to remain in a given area.**

Behaviour

- Hunting
- Pack size
- Booster rally
- Flanking prey 60 km/t

A video clip is showed to the students at the end of this first day.

XXII

Day 2

Lycaon (Greek for wolf)
pictus (Latin for painted)

Everything is connected to everything else
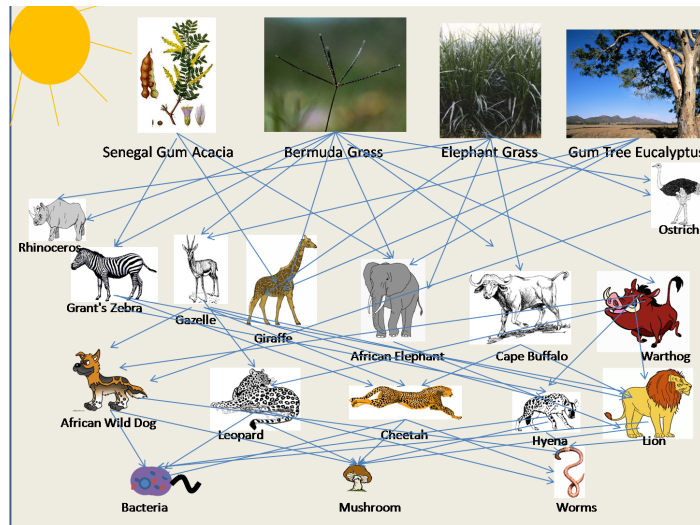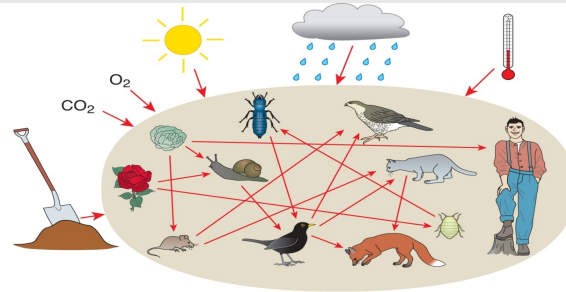
Why conserve wild dogs?

ভ Threats
ভ Behaviour
ভ Challenges

IMPORTANT
FOR THE
NATURE

AFRICAN WILD DOG

Draw your own food web and include **The African Wild Dog**!
What do you think **The African wild dog** needs to live? What does The African wild dog eat and drink?

Cape Hunting Dog or African Wild Dog
Lycaon pictus

Large ears
Splotchy brown, tan, and black fur
Long, white, bushy tail
Large, sharp, jagged teeth
4-toed feet with pads on the bottom
Front feet wider than hind feet

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Conservation of wild dogs

ভ **Challenges:**
 ভ **WHAT ARE THE CHALLENGES?**
 ভ **Write down what you think ☺**
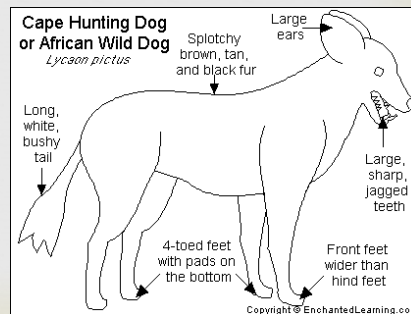
Conservation of wild dogs

- **Challenges:**
  - Home range size
  - Habitat fragmentation
  - Social structure
  - Prey availability
  - Husbandry
  - Economy

Conservation of wild dogs

- **Efforts:**
  - Translocation
  - Reintroduction and captive-breeding programs
  - Vacination programs
  - Maintaining dispersal
  - Ease human-wild dog conflict
  - Knowledge

Tracking wild dogs

- Radio collars
- Gps collars
- Sightings
- Tracking

Wild dogs are popular with tourists

Management in Tanzania (Serengeti)
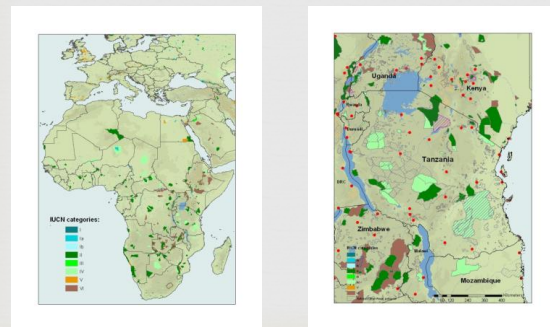
Management in Serengeti

- Serengeti National Park Habitat loss and illegal hunting
- Use of natural resource
- Protected areas
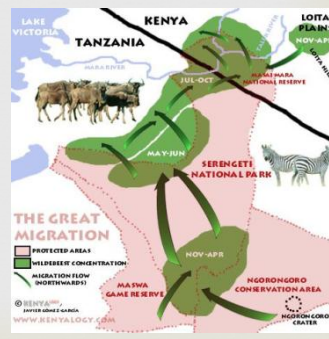
Management in Serengeti

ରଃHuman wildlife conflict

ରଃBefore and now

ରଃProtected areas

ଓଃWhere human activity and hunting are regulated

ରଃWhat do you think about the African wild dog?

ରଃPositive or negative, or in between?

Wild dogs in Serengeti

ରଃ In 1992, gone from Serengeti

ଓଃ Wild dog rabies, small populations → local extinction

ରଃ 2005 increased again

ରଃ Supported

ରଃ The Wild dog project is now also supported by Vodacom

Summary

ରଃ Small population

ରଃ Declining, fragmentation

ରଃ Decreasing suitable habitats

ରଃ Behavior

ରଃ Human-Wild dog conflict

ରଃ Increasing need to compromise

ରଃ Image problem

Appendix 4: The two posters

The African wild dog (*lycaon pictus*)

Introduction
The name African Wild dog (Lycaon pictus) mean 'painted wolf'. Lycaon is Greek for wolf, and pictus is Latin for painted. The wild dog is three coloured(brown, black and white) and the pattern is different on the left and right side(asymmetric). The Wild dog recognize each other in a very long distance and have good sight. They use the pattern to identity different individuals. African wild dog form packs from 2 up to 40 members, each with a dominant breeding pair, that remain monogamous for life.

This is the phylogeny of the family Canidae.
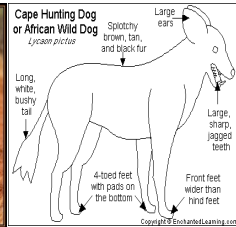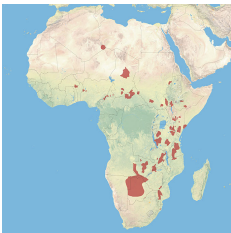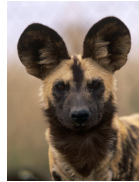
Distribution
This is the current distribution of African wild dog. It used to be spread out all over Africa, but as you can see it starts to be more and more fragmented. Zimbabwe and Botswana have the greatest populations at the moment. The population is declining all over Africa and is now estimated to be around 3000 individuals.

Social hunters
The wild dogs are social and cooperative hunters, relying on sight rather than smell the prey. Hunts tend to occur at dawn and dusk, but on occasion the wild dogs will venture out if there is a full moon. They chase until their prey tires, reaching speeds up to 60 kmph up to 3 miles, and sometimes disemboweling prey it while it is running.

Behavior
The African Wild dog has big ears, a strong jaw and long thin legs due to frequent movement and fast digestion and stamina. Wild dogs need a large area. They avoid other large carnivores, like lion, hyenas and leopards.
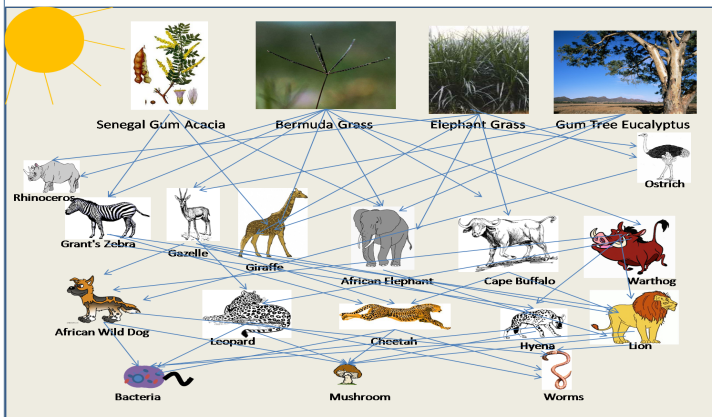

Why conserve African wild dogs?
The wild dog is the most efficient predator in Africa and also very endangered. The wild dog is important for regulation the area and is crucial for the ecosystem. It is also morally right to help these animals so the population increase again. There are few Wild dogs left worldwide, and if there is enough wild prey, like impala, around the wild dogs they will rather catch these instead og livestock. Look at the food web below ☺

Threats to wild dog
- Habitat destruction and fragmentation
- Diseases and Interspecies competition
- Reputation
- Poaching and bycatch
- Road accidents
- Snares

Efforts
- Translocation, reintroduction and captive-breeding programs
- Vaccination programs
- Maintaining dispersal
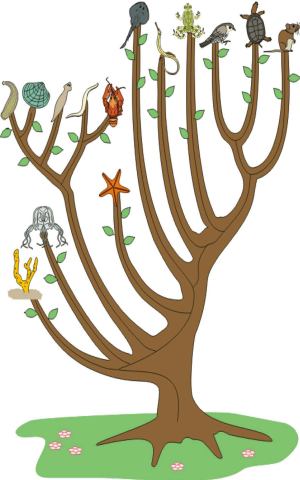- Decrease human-wildlife conflict
- Knowledge

What makes us, humans, in the position to let this animal go extinct? What do you want or think?
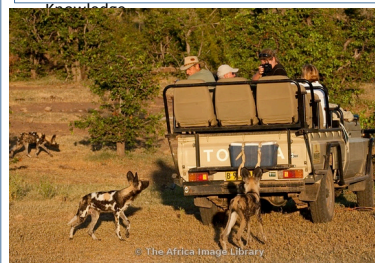
Wild dogs are popular with tourist!

Ecology, Ecosystem & Conservation biology
…and YOU and The African Wild dog!
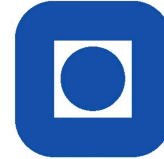
- Ecology is the study about all organisms and their surroundings and how they interact in nature.
- An ecosystem is a complex set of relationships among the living resources, habitats, and residents of an area. It includes plants, trees, animals, water, soil and people. Yes, and you ! ☺
- Conservation biology is the knowledge about how utilize nature in a sustainable way.

Everything is connected to everything else

The world faces many global challenges →→ Some of the most important ones are how to combat climate changes, how to provide clean freshwater supply to the people, and how to provide enough energy without pollution the environment. Finally there is the challenge of the increased population growth.

How will this population growth affects the biodiversity conservation?

As far as we can judge, the impact from our way of living, negatively influence our surroundings, both close to our doorstep, but also far away without our immediate awareness before it may be to late to be able to do something about it!
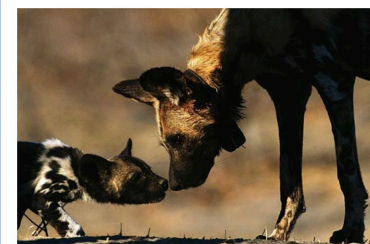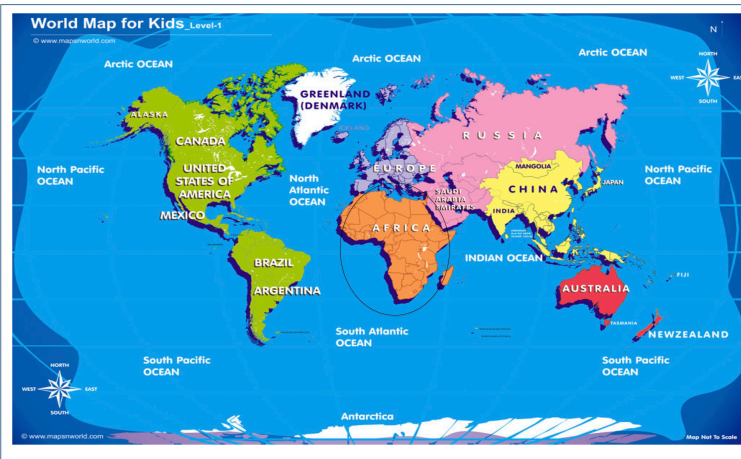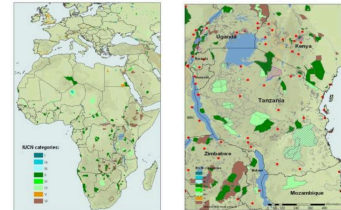

The world faces many global challenges.

Wild dog management in Tanzania
- Protected Areas
- Radio collars and GPS collars
- Tracking
- Supported

The survival of the **African wild dog** is endangered by the growing human populations, which have decreased its habitat, and that also threatening its prey. Road kill and human persecution have also had a negative impact on African wild dog populations. Wild dogs have also proven to be highly susceptible to disease carried by domestic dogs. Conservation of the African wild dog's natural habitat must have the highest priority, as these animals suffer in habitats modified by human intrusion (nature.ce).

Everything is connected with everything else in nature:
If one species becomes exterminated this will in turn have consequences for other species, which again will have consequences for humans in some way or the other, both in a short perspective, but also for future generations…

Appendix 5: Video from the education project

Per H. Olsen (NTNU) shared this link on YouTube from my fieldwork in Tanzania;
http://www.youtube.com/watch?v=xKStMY47NqQ

Lektorutdanning med mastergrad i realfag fra NTNU