

# From “Forest Fires” and “Hunting” to Disturbing “Habitats” and “Food Chains”: Do Young Children Come up with any Ecological Interpretations of Human Interventions Within a Forest?

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**Abstract** This study aims at highlighting young children’s reasoning about human interventions within a forest ecosystem. Our focus is particularly set on whether preschoolers are able to come up with any basic ecological interpretations of human actions upon forest plants or animals and how. Conducting individual, semi-structured interviews with 70 preschoolers (age 4–5), we first tested their ability to consider the forest as a habitat and recognize simple food chains in it, and then we traced their reasoning about the consequences that human actions upon plants or certain forest animals may possibly have for other animals that also live in the forest. The analysis of our qualitative data with “NVivo” software *does* reveal an ecological aspect in preschoolers’ reasoning, which is thoroughly discussed in the paper.

**Keywords** Ecological reasoning · Early year education · Environmental education · Habitat · Food chain

## Introduction to the Study

Research in Didactics of Biology (Bailey and Watson 1998; Katsiavou et al. 2000; Leach et al. 1996), as well as in Environmental Education (Ballantyne and Packer 1996; Palmer 1993; Palmer 1994; Palmer and Suggate 1996), is concerned with young learners’ understanding of basic ecological concepts. Children’s conceptualizations of the dynamic relationships of organisms with others and with their abiotic environment, as well as their ideas about the consequences of human interventions upon nature are among the research topics of these domains.

Being a rather representative instance of the dynamic interactions that characterize all ecosystems and at the same time being quite familiar to children, the idea of food relationships between different groups of organisms seems to provide a potentially

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promising starting point for the development of ecological reasoning in early years (Andriotou et al. 2006). Exploring how young children cope with this idea within specific food chains and food webs, Katsiavou et al. (2000) showed that although most of their informants *did* recognize the organisms that take part in the examined food chains and webs, almost 50% of them needed help in order to recognize the food relationships within the food webs. According to the same study, young children were not able to follow the disturbance taking place on a specific trophic level, to the very next level or levels. In particular, preschoolers appeared to have serious difficulties in recognizing that reducing the plants of an ecosystem may have consequences upon those animals that are directly connected to the plants (herbivores), as well as upon those that are not (carnivores).

Research on young children's conceptions about environmental issues such as the human-invoked destruction of forests, the green-house effect and the ice melting at the earth poles, the management of garbage and the idea of recycling, shows that preschoolers *do* encounter difficulties in recognizing an ecological dimension in all these (Palmer 1993, 1994; Palmer and Suggate 1996). More specifically, according to Palmer (1994) who worked with children from both the USA and the UK, 60% of her sample found it hard to recognize the forest as the "*animals' home*", while 47% did not come up with *any* ecological consequence of the extensive wood-cutting by humans. Nevertheless, it should be noted that Palmer *did* locate in her sample informants who were able to connect wood-cutting with floods by recognizing that trees take in water. She also located informants who were able to connect wood-cutting with animals' unfavourable environmental conditions by recognizing that trees offer sun-protection to the forest animals. Moreover, the same study reported that when looking for the consequences of other human interventions upon nature (forest fires, increase of garbage, green-house effect), some young children *did* think of animals, humans or atmosphere. For instance, some of Palmer's informants appeared to recognize a relationship between the rise of earth temperature and ice melting at the earth poles or even floods, as well as to understand the idea of recycling on a basic level.

As already shown, the concept of dynamic interaction within ecosystems seems to raise difficulties for young children. Nevertheless, in the light of the notion of early competence that has been emphasized since the late 70s (Inagaki and Hatano 2002), it can be claimed that it would be useful to explore *further* the idea that reaching a basic understanding of this ecological concept is *within* the range of young children's potential accomplishments. To provide a warrant for this claim, we need to draw upon contemporary research in the domain of developmental psychology.

Children of preschool age seem to possess a system of biological knowledge, the so-called "naïve biology" (Hatano and Inagaki 1997; Keil 1994). This involves the identification of biological entities and processes by young children, as well as certain causal devices through which they are able to come up with coherent explanations for the biological world (Inagaki and Hatano 2006).

The biological causality that young children seem to prefer is claimed to be "teleological - vitalistic" (Inagaki and Hatano 2006). This means that young children attempt to explain biological phenomena such as life-sustaining processes in living organisms, on the basis of the assumption that living organisms can remain active and healthy by taking "vital power" from food and water and circulating it to the internal organs, the "goal" of which is to sustain the organism's life. Apart from the "intrinsic teleology" which seems to lie at the heart of young children's vitalistic explanations and assumes that parts or properties of living entities exist for the benefit of *these very* entities, there is also the so-called "extrinsic teleology" according to which parts, properties or whole entities exist for the benefit of

*others* (Inagaki and Hatano 2002). Although, according to Kelemen (1999), young children seem to apply “extrinsic teleology” not only to living things but also to artifacts and non-living natural entities (i.e. mountains exist so that people can go climbing), it seems plausible that this reasoning device may support the development of ecological explanations. More specifically, it seems plausible that since a “goal-driven” causality is claimed to be activated within children’s naïve biology, preschoolers may be able to recognize that human actions upon *certain* organisms of an ecosystem can have some *indirect*, long-term consequences for *other* organisms as well. For instance, reasoning through a teleological device, children may be able to recognize that hunting and eliminating the rabbits of a forest may have a long-term impact on the forest’s rabbit-eating foxes, by assuming that rabbits which are directly affected by the action of hunting will *not* be able to accomplish their “goal” to serve as foxes’ food.

Following the conceptualizations of this line of research, the present study aims at highlighting the ways in which young children understand human interventions within a forest ecosystem. The objective of the study is to ascertain whether preschoolers are able to come up with ecological interpretations of human actions upon plants or animals that live in the forest. More specifically, the objective is to shed light on whether preschoolers are able to appeal to the destruction of the habitat or to the destruction of the food relationships among certain organisms, while they are engaged in producing reasoning strands about such actions.

The research questions addressed here are the following:

- What kind of criteria do young children invoke while attempting to justify their opinions about a primarily *plant*-oriented human intervention within a forest, such as a forest fire?
- Do young children realize that such a human intervention which directly affects the forest *plants* may have consequences for the forest *animals* as well? And if so, what kind of consequences do they seem to recognize?
- Do young children realize that a human intervention within a forest, such as predation that directly affects *certain animals* of the forest, may have consequences for *other* forest animals as well? And if so, what kind of consequences do they seem to recognize?

It is worth noticing that gathering such evidence, might be useful in developing learning environments within the theoretical framework of constructivism (Driver and Oldham 1986; Hedegaard 1990; Ravanis and Bagakis 1998; Zogza 2006), in order to support young children towards reaching a better understanding of the idea of dynamic interaction in nature, as well as towards developing responsible attitudes in regard to the environment.

## Methods

The present study is mainly located within the qualitative research paradigm. Thus, although it could possibly be considered as a small-scale survey of preschoolers’ ideas about a series of human actions upon forest plants or animals, it may be better described as an exploratory case study which investigates in detail how young children may reason about the human actions in question (Gilbert et al. 1985; Opie 2004). Among the different techniques that this line of research uses for eliciting young children’s ideas — such as their drawings (Osborne et al. 1982) and their utterances within semi-structured interviews about

certain events (Osborne and Gilbert 1980) or within peer-group discussions (Tunnicliffe and Reiss 1999) — we chose the semi-structured interview as the tool for gathering our own data on preschooler’s reasoning in the context of ecology.

Seventy children from public kindergartens in rural areas of Attiki, Greece (35 four-year olds and 35 five-year olds) were interviewed by one of the researchers after she had become familiar to them through her participation in classroom activities. The semi-structured interviews took between 8 and 20 min each.

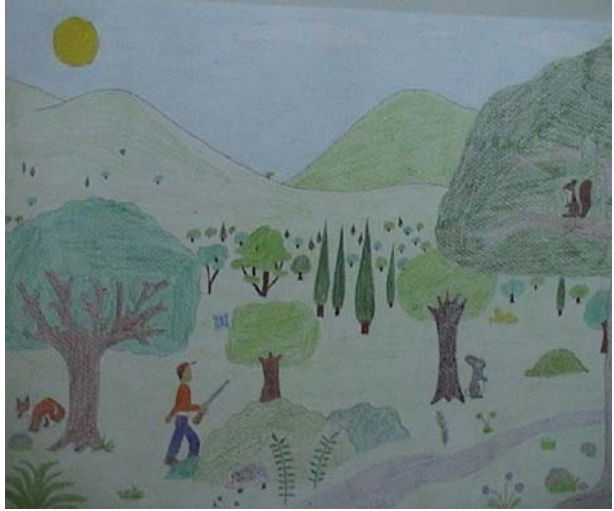
The discussion between each child and the researcher was stimulated by using a series of pictures drawn for this purpose and it was organized in four main parts: **(a)** Introduction: the forest and related experiences or feelings, **(b)** Key ideas of “habitat” and “food chains”: “forest-as-a-home-for-animals” and “B is fed upon A”, **(c)** Human actions upon forest plants: a “forest fire”, **(d)** Human actions upon forest animals: three cases of “animal predation” (hunting all the forest rabbits, collecting all the forest snails and fishing all the fish within the lake of the forest). It is noted that forest fires and hunting or fishing are considered as quite familiar to young children since all these are often met within everyday stories or fairytales. Moreover, we chose to use extreme versions of predation leading to elimination of certain animals in order to probe more effectively the ecological aspect possibly present in children’s reasoning.

In this paper, we are particularly concerned with the last two parts of the interview. So, after having introduced the topic of discussion and traced the children’s ability to understand the idea of “forest-as-a-home-for-animals” and to recognize three simple food chains in it (“grass → rabbit → fox”, “leaves → snail → hedgehog” and “fish → bear”), we attempted to highlight their reasoning about a forest fire. Each child was presented with a picture of the forest *flora* on fire (Fig. 1) and was asked to describe what they saw happening in the picture. Then children were asked to think whether what was happening in the picture was a good or a bad thing (state an “opinion”) and also explain their reasons for thinking so (provide the “criteria”). Finally, children were *explicitly* required to explain whether the forest fire could affect the *animals* that were suppose to live there (predict “consequences” upon the forest animals).

In the last part of the interview, we attempted to highlight children’s reasoning about the three cases of predation with the aid of three relevant pictures. So, presented with a picture of a hunter shooting rabbits within the forest (Fig. 2), each child had to describe what they

**Fig. 1** The forest fire



**Fig. 2** Hunting forest rabbits

saw in the picture and predict what would happen to the *foxes* of the forest if the hunter shot *all* the rabbits.

Similarly, the children were required to predict what would happen to the *hedgehogs* if the visitors shown in the picture collected *all* the snails. Finally, observing and describing a picture with a fisherman fishing at the lake of the forest (Fig. 3), children were required to predict what would happen to the *bears* of the forest if the fisherman left *no* fish in the forest lake.

The 70 recorded interviews were transcribed and prepared for coding into the environment of “NVivo”, a software for the analysis of qualitative data. Our coding was performed upon two main axes. The first one concerns the “criteria” that lead children to their opinions about a human action; that is to say, the reasons they prefer to use for justifying these opinions. The second one concerns the “consequences” of a human action that children — when *explicitly* asked — seem to recognize in regard to the organisms of the ecosystem which are *not* directly affected by the action itself.

**Fig. 3** Fishing lake fish in the forest-lake

## Results

Starting with students' reasoning about a *plant*-oriented human intervention within a forest ecosystem such as a forest fire, we note that nearly all the informants of our study expressed the opinion that a forest fire is a bad thing (Table 1).

Moreover, 67.1% of our informants were able to justify their opinion by invoking certain criteria in favour of it, while 32.9% did not come up with a meaningful justification (Table 2). It is worth noting that 12.9% of the latter remained silent or did irrelevant talking, the remaining 20% developed "tautological" reasoning strands, which did not actually *explain* their judgement about a forest fire but merely *described* what a forest fire is (e.g., a forest fire is a bad thing because "a man sets the forest on fire", "the forest is on fire").

The set of criteria invoked by the 67.1% of our informants was found to be quite rich: The children appeared to employ criteria of three different types while articulating an opinion *against* a forest fire. In particular, they employed criteria that focus upon **(a)** the human beings (coded by us as "anthropo-centric criteria"), **(b)** the forest plants which are supposed to suffer directly because of the human intervention in question (coded by us as "flora-centric criteria") and finally **(c)** the non-directly affected forest animals (coded by us "fauna-centric criteria").

The "anthropocentric criteria" of our informants involved different sub-types, which we coded as "utilitarian", "aesthetic", "personal-sentimental" and "human risk". More specifically:

- The "utilitarian" criterion had to do with the idea that trees are useful to human beings, either by providing us with essential products such as fruit and oxygen or by protecting us from floods: the forest fire is a bad thing because "we will not have trees to give us apples, peaches...fruit", "trees give us the oxygen", "trees will not drink the water of the rain, water will go in the city".
- The "aesthetic" criterion concerned the destruction of the forest aesthetics because of the human intervention in question: the forest fire is a bad thing because "the forest looks nice (we shouldn't destroy something nice)", "the forest isn't clean and nice any more", "trees look ugly".
- The "personal-sentimental" criterion was associated with personal emotions about the intervention in question: the forest fire is a bad thing because "it makes me scared... there was a big fire at the village of my grandfather... I'm afraid of fire".
- The "human risk" criterion focused upon the direct threat that a forest fire poses on human lives: the forest fire is a bad thing because "people may come close and get burnt", "injured" or "die", "people's houses may be destroyed", "the road may be burnt... this is dangerous for people passing by".

Similarly, the "flora-centric criteria" of our informants involved different sub-types, which we coded as "biological - ethical", "anthropomorphic" and "naturalistic". More specifically:

**Table 1** Children's opinions about a forest fire

Opinions	Frequencies	Percentages
Against	69	98.6%
None	1	1.4%
Totals:	70	100%



**Table 2** Children's capability of justifying opinions about a forest fire

Justifying opinions	Frequencies	Percentages
YES	47	67.1%
NO	23	32.9%
Totals:	70	100%

- The “biological - ethical” criterion emphasized the property of plants as living entities and the respect they deserve from us due to this property: the forest fire is a bad thing because “plants can grow like us ... we must let them grow”.
- The “anthropomorphic” criterion considered plants as having human characteristics or even reactions: the forest fire is a bad thing because “plants have a heart down there... they get sad”.
- The “naturalistic” criterion considered plants as part of nature's order and harmony which needs to remain intact: the forest fire is a bad thing because “plants must always be there”, “it will destroy the leaves... trees must have their leaves”.

Finally, the sub-types of the “fauna-centric” criterion of our informants were coded as criteria of “animal risk”, “habitat destruction” and “destruction of food relationships”. More specifically:

- The “animal risk” criterion focused upon the direct threat that a forest fire poses on the lives of the animals that live there: the forest fire is a bad thing because “the animals in the forest will get burnt”, “fall down”, “injured”, “die”.
- The “habitat destruction” criterion drew upon the idea of “forest-as-a-home” for the animals: the forest fire is a bad thing because “the animals will loose their house”, “they will have no place to live”, “it destroys the houses of rabbits...snails... fox”.
- The “destruction of food relationships” criterion had to do with deriving shortage of food resources for the animals: the forest fire is a bad thing because “we must have trees ...and grass for the animals... they have to eat”, “the snail has to eat leaves”. It is worth noting that among all types of criteria we identified, only the last two sub-types of “fauna-centric criteria” may indicate an ecological aspect in children's reasoning.

Apart from the difficulty of the 32.9% of our informants in justifying opinions about a forest fire (as traced by the use of tautological “pseudo” criteria and irrelevant comments or silence) the most frequently activated criteria appear to be the “fauna-centric” ones. In fact, these were used by another 32.9%. It is worth noting though, that most of these children (17/70 or 24.3%) justified their opinion by just appealing to the direct threat that a forest fire poses on animals' lives (“animal risk”), whereas a much smaller number (6/70 or 8.6%) produced reasoning strands of ecological character by referring to the destruction of the habitat or the food relationships as criteria against a forest fire. The “anthropocentric” criterion came second in children's judgements (activated by the 27.1% of our informants), while the “flora-centric” ones appeared much *less* frequently (activated only by the 10%) (Table 3).

As already shown, our informants did not seem to produce ecological reasoning strands while attempting to judge a plant-oriented human intervention such as a forest fire. However, was this *also* the case when children were *explicitly* required to think of the *consequences* that a fire might have for the *animals* of the forest?

Starting with children's capability of recognizing any kind of plant-animal interdependence when exploring the case of a forest fire, we noted that this may be attributed to most

**Table 3** Types of criteria *against* a forest fire

Types of criteria <i>against</i> a forest fire	Frequencies	Percentages
Anthropo-Centric <sup>a</sup>	19	27.1%
Utilitarian	5	
Aesthetic	3	
Personal-sentimental	1	
Human Risk	10	
Flora-centric	7	10%
Biological - Ethical	2	
Anthropomorphic	1	
Naturalistic	4	
Fauna-Centric <sup>a</sup>	23	32.9%
Animal Risk	17	
Habitat destruction	4	
Destruction of food relationships	2	

<sup>a</sup>It is noted that 2 of our informants used “anthropocentric” and “fauna-centric” criteria at the same time - “human risk” and “animal risk”

of our informants (Table 4). Thus, although the percentage of the children that spontaneously invoked the animals in their justifications was almost 33% (see “fauna-centric criteria” in Table 3), the percentage of those who were able to consider animals in the context of a forest fire was almost twice that (see “YES” in Table 4).

But more interestingly, how did children incorporate animals within their forest fire reasoning strands? The fire-driven consequences for the forest animals traced within the interviews of the 68.6% of our informants may be grouped in two different types: **(a)** the “short-term” or “direct” and **(b)** the “long-term” or “ecological”. More specifically:

- The “short-term / direct” consequences concerned the immediate “death” or “injury” of animals because of the forest fire (e.g., “the animals are going to die because there is a fire... they cannot run”, “the animals will get burnt and suffer from pain...things are going to be bad for them”), as well as their “migration” from the burning forest in order to be rescued (e.g., “the animals will go to another place to live”, “they can go up to the mountain near my house”, “they will go far away... not come back at the forest”).
- The “long-term / ecological” consequences concerned the “destruction of the habitat” (i.e. the animals cannot stay in the forest because “they will not have a house”, “their land ... their country is all black now”, “how are they going to live among the burnt trees?”), which may be linked to animal “migration” as well (e.g., the animals have to go and live elsewhere because “their house has been burnt”, “they must find a new house”, “they have to go to another country”). Finally, the “destruction of food relationships” within the forest — conceptualized as “food shortage” — is also traced

**Table 4** Children’s capability of recognizing consequences for the animals in the case of a forest fire

Recognizing consequences for animals	Frequencies	Percentages
YES	48	68.6%
NO	22	31.4%
Totals:	70	100%



in children's interviews (e.g., "the animals will not have any food", "the leaves are burnt... there is no food for the snail", "the hedgehog cannot live there because there are not snails to eat").

As shown in Table 5, 28.6% of our informants appeared to recognize only "short-term / direct" consequences for the animals as a result of a forest fire. More interestingly, 40% (27.1% plus 12.9%) of our informants recognized "long-term / ecological" consequences for the animals of the forest, whereas a much smaller proportion (6 children as shown in Table 3, or 8.6%) spontaneously used "fauna-centric criteria" of ecological character, namely "habitat destruction" and "destruction of food relationships".

The most frequent among the ecological consequences had to do with the destruction of the habitat (34.3%), conceptualized by young children as "loss of home" which was followed by "migration", while the destruction of food relationships ("food shortage") was recognized by a much smaller number of our informants (5.7%) (Table 6).

Regarding our last research question on whether young children realize that a human intervention such as predation upon certain forest animals may have consequences for other animals of the forest, we note: The "animal-animal" interdependence within a forest ecosystem appeared to be recognizable by most of the children in each of the three different cases of animal predation which they were asked to explore in sequence (Table 7). Moreover, there was a slight increase of the number of children who *recognized* consequences as they proceeded from the 1st case of predation ("hunting all rabbits") to the 2nd ("collecting all snails") and the 3rd ("fishing all lake fish").

Similar to the fire-driven consequences, the predation-driven ones in regard to forest animals *other* than those directly affected may be characterized as **(a)** "short-term" or "direct" and **(b)** "long-term" or "ecological". More specifically:

- The "short-term / direct" consequences had to do with a possible expansion of certain animals' predation. For instance, the hunter who shot the rabbits might come back to "shoot the fox", or he might threaten the fox which would then have to "hide among the trees", "run fast with its big feet", "bite the hunter" or "hurt him with its nails to be rescued". Similarly, the hunter or even the kids that removed all the snails from the forest might try to "hurt the hedgehog" — which is however protected by its "sharp thorns"— whereas the fisherman couldn't harm the bear even if he tried, since "the bear is very big" and "wild" and "he couldn't kill it".
- The "long-term / ecological" consequences had to do with the "destruction of the food relationships" within certain food chains. Our informants appeared to recognize the consequence of "food shortage" for animals *other* than the ones directly affected by predation and also to link it with "death", "migration" or even "change of eating habits". For instance, the fox "will be hungry", "there aren't any rabbits to catch and

**Table 5** Children's capability of recognizing "long-term / ecological" consequences in the case of a forest fire

Consequences upon the animals if setting a forest fire	Children	
	Frequencies	Percentages
Short-term / direct consequences	20	28.6 %
Long-term / ecological consequences	19	27.1%
Both	9	12.9%
None	22	31.4%
Totals:	70	100%

**Table 6** Types of consequences for the animals in the case of a forest fire

Types of consequences upon the animals if setting a forest fire		Frequencies	Percentages
Short-term / direct <sup>a</sup>	Death	25	35.7%
	Migration	6	8.6%
Long-term / ecological: habitat destruction	Loss of home	17	24.3%
	Loss of home - migration	7	10%
Long-term / ecological: destruction of food relationships	Food shortage	4	5.7%

<sup>a</sup> It is noted that the total occurrences of “short-term / direct” consequences appear to be 31 since 2 of the 29 children that recognize “short-term / direct” consequences as shown in Table 5, appeal to both sub-types - “death” and “migration”- each

eat”, “it will become very thin and then die”, “it will go to another forest to find food”, “it will eat some grass” or “honey” or “it will catch something tasty to eat”. Similarly, the hedgehog “will cry because there is no food”, “the butterflies must bring the hedgehog some snails from another place to eat”, “it will die because when we do not eat we die”, “it will go to another forest”, “there are snails elsewhere”, “it will eat some grass” or “corn” or “it will find something else to eat”. According to the children, the same is valid for the bear in case of fishing all the fish of the lake within the forest.

As shown in Tables 8, 9 and 10 that follow, a significant number of our informants appeared to recognize “long-term / ecological” consequences in the context of the three cases of predation examined. It is also worth noting that this number seems to increase as children proceed from the 1st (see Table 8, 37.2% plus 11.4%, namely 48.6%) to the 2nd (see Table 9, 60% plus 5.7%, namely 65.7%) and 3rd (see Table 10, 74.3% plus 1.4%, namely 75.7%) case of predation in question.

The most frequent ecological consequence for all three cases of predation appeared to be the “food shortage - death”, while it is also interesting that children proposed “migration” or even “change of eating habits” as possible reactions of the animals to the food shortage that stems from predation. The latter might possibly be considered as an indication that a basic understanding of the idea of food webs *can* be located within the range of children’s potential accomplishments. Tables 11, 12 and 13 present in more detail the types of consequences recognized by our informants in each case of predation.

**Table 7** Children’s capability to recognize consequences of three cases of predation upon animals *other* than the ones under predation

Recognizing consequences of animal predation for <i>other</i> animals	Hunting all rabbits- impact on foxes		Collecting all snails- impact on hedgehogs		Fishing all lake fish- impact on bears	
	Frequencies	(%)	Frequencies	(%)	Frequencies	(%)
YES	51	72.9%	52	74.3%	55	78.6%
NO	19	27.1%	18	25.7%	15	21.4%
Totals:	70	100%	70	100%	70	100%

**Table 8** Children's capability to recognize "long-term / ecological" consequences in the case of hunting all rabbits

Consequences upon foxes if hunting all rabbits	Children	
	Frequencies	Percentages
Short-term / direct consequences	17	24.3%
Long-term / ecological consequences	26	37.2%
Both	8	11.4%
None	19	27.1%
Totals:	70	100%

**Table 9** Children's capability to recognize "long-term / ecological" consequences in the case of collecting all snails

Consequences upon hedgehogs if collecting all snails	Children	
	Frequencies	Percentages
Short-term / direct consequences	6	8.6%
Long-term / ecological consequences	42	60%
Both	4	5.7%
None	18	25.7%
Totals:	70	100%

**Table 10** Children's capability to recognize "long-term / ecological" consequences in the case of fishing all lake fish

Consequences upon bears If fishing all lake fish	Children	
	Frequencies	Percentages
Short-term / direct consequences	2	2.9%
Long-term / ecological consequences	52	74.3%
Both	1	1.4%
None	15	21.4%
Totals:	70	100%

**Table 11** Types of consequences upon foxes if hunting all rabbits

Types of consequences upon foxes if hunting all rabbits	Frequencies (%)	
Short-term / direct <sup>a</sup>	Death	10 14.3%
	Life risk	19 27.1%
Long-term / ecological: destruction of food relationships <sup>b</sup>	Food shortage	7 10%
	Food shortage - death	16 22.9%
	Food shortage - migration	3 4.3%
	Change of eating habits	10 14.3%

<sup>a</sup> It is noted that the total occurrences of “short-term / direct” consequences appear to be 29 since 4 of the 25 children that recognize “short-term / direct” consequences as shown in Table 8, appeal to both sub-types - “death” and “life risk”- each

<sup>b</sup> Similarly, the total occurrences of “long-term / ecological” consequences appear to be 36 since 2 of the 34 children that recognize “long-term / ecological” consequences as shown in Table 8, recognize more than one sub-types each

**Table 12** Types of consequences upon hedgehogs if collecting all snails

Types of consequences upon hedgehogs if collecting all snails	Frequencies (%)	
Short-term / direct	Death	2 2.9%
	Life risk	8 11.4%
Long-term / ecological: destruction of food relationships <sup>a</sup>	Food shortage	16 22.9%
	Food shortage - death	22 31.4%
	Food shortage - migration	5 7.1%
	Change of eating habits	6 8.6%

<sup>a</sup> It is noted that the total occurrences of “long-term / ecological” consequences appear to be 49 since 3 of the 46 children that recognize “long-term / ecological” consequences as shown in Table 9, recognize more than one sub-types each

**Table 13** Types of consequences upon bears if fishing all lake fish

Types of consequences upon bears if fishing all lake fish	Frequencies (%)	
Short-term / direct	Death	– –
	Life risk	3 5.3%
Long-term / ecological: destruction of food relationships <sup>a</sup>	Food shortage	20 28.6%
	Food shortage - death	25 35.7%
	Food shortage - migration	4 5.7%
	Change of eating habits	7 10%

<sup>a</sup> It is noted that the total occurrences of “long-term / ecological” consequences appear to be 56 since 3 of the 53 children that recognize “long-term / ecological” consequences as shown in Table 10, recognize more than one sub-types each

## Discussion

According to our findings, young children clearly disapproved of the human action of setting a forest on fire. When the children experienced difficulties warranting their opinions, they tended to use tautologies as pseudo-criteria. In contrast, when they articulated meaningful justifications, the children appeared to attend to what they could perceive directly. This tendency was indicated by the “short-term” or “direct” character of the “anthropocentric” and “fauna-centric” criteria that they preferred to invoke. Moreover, the frequent use of “anthropocentric” as well as “flora-centric” criteria of “anthropomorphic” character may be considered as an indication of “egocentric” reasoning on behalf of the children.

Although focused upon the “directly perceived”, “egocentric” or even “tautological”, children’s spontaneous justifications against a forest fire did not seem to lack features either of biological knowledge or of environmental consciousness. The use of “flora-centric” criteria with “naturalistic” character, namely criteria that consider plants as part of the nature’s order and harmony which we are supposed to protect and conserve, may be considered as an indication of “children’s emerging environmentalism” - to borrow from Palmer (1993).

Furthermore, the use of “flora-centric” criteria of “biological - ethical” character (namely criteria based upon plants’ ontological status as living entities and the respect plants deserve from us due to this status) apart from possibly indicating children’s essential knowledge about the “living - non living” distinction, may also be considered as revealing more clearly what Fien (1993) calls “dark green” or “biocentric” world view. This “dark green” environmentalism, which emphasizes that *all* living creatures have rights that human beings are ethically committed to protect, along with a “red green” environmentalism (Fien 1993), which emphasizes the value of social justice within the man-nature relationship, constitute different aspects of a less “anthropocentric” and more “ecocentric” approach to nature, the construction of which is among the aims of the contemporary environmental education (Flogaiti 2006).

More interestingly, it seems that the fact that children did not *spontaneously* produce ecologically-oriented reasoning strands in order to justify their opinion against a forest fire does not necessarily imply that they were incapable of recognizing some “long-term / ecological” consequences that such an intervention might have upon forest animals. A quite significant number of the children (40%) appeared to recognize “long-term / ecological” consequences for the animals of the forest when explicitly asked, although only a much smaller number (8.6%) appeared to use “fauna-centric criteria” of ecological character when spontaneously justifying their opinion against a forest fire.

The ecological consequence that our informants recognized more frequently when reasoning about a forest fire was “habitat destruction”, whereas the “destruction of food relationships” appeared to be dominant in their reasoning about predation. The fact that more children were able to recognize this “long-term / ecological” consequence as they proceeded from the 1st to the 2nd and 3rd case of predation in question, may be considered as an indication of children’s ability to become familiar with the idea of “animal-animal” interdependence rather easily, if provided with the opportunity to apply this idea in similar contexts. Thus, it would also be quite interesting to use longer food chains in order to ascertain whether and how children’s reasoning could proceed one step further and transfer the destruction of a certain food relationship along the whole chain. Moreover, since the “destruction of food relationships” appeared to be conceptualized not only as “food shortage” followed either by “death” or by “migration”, but also as a need of “changing

eating habits”, it seems that the concept of “food web” could possibly be considered for an appropriate didactic transformation within preschool education.

In summary, according to the findings of this study young children are potentially capable of interpreting human interventions within a forest ecosystem in ecological terms. Thus, it would be quite meaningful to develop learning environments with accurately defined objectives in regard to the idea of food relationships and their disturbance along simple food chains, as well as in regard to the idea of the “forest-as-a-home” and the consequences that its anthropogenic disturbance causes for the animals living in it. Such learning environments could also provide a rather promising framework for an early start in developing environmentally responsible attitudes.

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