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New society – diagnosis of knowledge about crucial ecosystem services – pollination

Nowadays nature protection requires many different solutions to be effective. Wide range of social engagement is needed as legal acts, such as bans are inefficient. The former nature conservation methods were focused on the social system – ecosystem relationship. Forms of protection of this kind are important, however, given the functioning of the real world, they cannot be fully effective. It is therefore necessary to argue in such a way as to convince farmers or entrepreneurs, for example, of a slightly different way of doing business and investing money in nature conservation (Manfredo, 2008, Żylicz, 2010). Degradation of the environment leads to many hazards, including food scarcity, extreme natural phenomena and, consequently, severe social tensions or even armed conflicts (Homer-Dixon and Blitt, 1998, Vince, 2003, Wagner, 2004). People need the resources and functions of nature – agricultural products, clean water and air, climate regulation, elemental circulation, etc. Environmental degradation leads to changes, the reversal of which is very expensive or even impossible. It is easy to specify the benefits provided by a well-functioning environment. Access to nature is one of important elements of quality of life and the determinant of human well-being (E. van den Berg, et al., 2010). It turns out that effective protection of nature should also include the relation of nature-social system interactivity consciousness and appreciation for natural values. That is the difference between society and 'new society' in context of protection of environment. New society is a group of people of different age who interact with one another and share similar characteristics: this kind of society is well educated, knowledge-based and aware of global problems and human impact on global environment.

Public support for environmental protection is needed as establishing protected areas has emerged as one of the key aims in global end European Union policy (Pietrzyk-Kaszyńska, et al., 2012). A good example is Natura 2000 – it is a network of rare and natural habitat types and breeding and resting sites for rare and threatened species. It stretches across most European countries, both on land and at sea. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats.

We need new society to make sustainable decisions about environment, from which we obtain a lot of benefits. To measure the benefits humankind receives from the environment, the ecosystem services concept (ES) is very helpful. Ecosystem services concept includes both socio-economic and conservation objectives, that is, all natural goods and processes that allow for various benefits (e.g. wild fruits, pollination, pest control). Many species that provide ES are associated with rural areas and depend largely on traditional, extensive land management. Consequently, as a result of intensive land use, the size of the population of many animal species and plants providing ecosystem services has been greatly reduced. There are examples that a high level of biodiversity positively affects agricultural production and enhances people's quality of life (Chapin, et al., 2000).

Pollination is one of the ecosystem services. The idea of ecosystem services combines economics and environmental protection. The concept of ecosystem services includes all natural goods and natural processes that exist and that we benefit from. Ecosystem services are involved in the provision of clean drinking water and decomposition of wastes. Ecosystem services are grouped into 4 broad categories:

1. Supporting services
2. Provisioning services
3. Regulating services
4. Cultural services

Provisioning services – they include clean drinking water obtained from ecosystems – freshwater supplies, food – plant species and wild animals, as well as pollination and mineral resources.

Supporting services – they include processes that are necessary for the existence of all other ecosystem services. They include: nutrient recycling, soil formation, photosynthesis, habitat formation and biodiversity.

Regulating services – they take part in climate regulation through carbon storage, purification of water and air, flooding control and waste decomposition.

Cultural services – nonmaterial benefits that people obtain from ecosystems through cognitive development (scientific discovery and education), recreation or aesthetic experience. Functioning of one group of ES influences another one.

For our study we chose pollination as it is a very important global process that is globally endangered. More than 200,000 species of animals are pollinators. 80% of plant species need pollination (Ollerton, 2011). Economic value of pollination is 100 billion dollars per year (Losey and Vaughan, 2006). Social awareness is very important in conservation of pollinators. The question is when in human life is the best, the most sensitive moment to educate about value and meaning of environmental protection. Many authors indicate that the best moment is at preschool and early school age (Davis, 1998, Hart, 2008). And what is more – schoolchildren can act as educators – they have indirect influence of environmental education on their parents and grandparents.

Material and methods

In years 2015–2016 we performed our study on 74 children aged 4–6 and 68 parents and 11 grandmothers. We constructed a questionnaire and tested the knowledge on pollination. We concentrated particularly on correct identification of pollinating insects and understanding of the process itself. We also checked what is the attitude towards pollinating insects.

Survey among children

The questionnaire survey covered children aged 4–6, who attend three pre-school institutions located in the center of Krakow. Ten children aged 4, 36 children aged 5 and 28 children aged 6 participated in the questionnaire, which gives a total of 74 respondents. Surveys among children were conducted by their parents or teachers in order to minimize the stress factor, which could significantly impair the credibility of the responses. The purpose of the questionnaire was to provide information on children knowledge on insects, with particular emphasis on pollinating insects. Choosing a pre-school age group allowed us to estimate the level of awareness of children before they became school-bound.

Questionnaires were designed to diagnose the interest of the subjects, their attitude towards pollinating insects, knowledge of the fauna of the local pollinators and their importance in nature. A part of the questionnaire was an open question, in response to which the children themselves formulated their answers. The other part of the questionnaire contained multiple-choice questions.

In the first task a child referred to the nine animal photos shown. Nine species were presented in the photos: honey bee, bumblebee, European peacock, trout, frog, red ants, spider, leather beetle, and Emperor Dragonfly. Then the child's task was to mark all the animals that are insect. Next two questions referred to pollinating insect species with flowering plants. Another question concerned the subject of books available for children in the home environment. The child determined whether the insects could be found in the literature available at home. If the answer was yes, they were asked to give the name of the animal. Then the child answered the question whether he/she reads books about insects. Next question was designed to diagnose the child's attitude towards insects by assessing their reaction toward the bee. In the last question, the child was supposed to determine whether the occurrence of insects in nature is needed and to justify their response. The analysis of the answers given to this question allowed us to assess the state of knowledge of children about the importance of pollinating insects.

The survey results were grouped into three categories according to questions. The first category includes identification of animals. The second category consists of questions that tested the knowledge about the ecological importance of insects in nature. Final group of questions making up the third category verifies the attitude of children towards insects.

Adult survey questionnaire

The questionnaire also included children's caregivers – parents of children aged 4–6 who attended three pre-school institutions located in the center of Krakow.

The survey was taken by 68 people: 51 mothers, 17 fathers. Parents were chosen as respondents because they are the main decision-makers in terms of books purchased for children.

The questionnaire was designed to assess the state of knowledge about insects and their importance in the environment, the attitude to insect pollinators, the knowledge of the local pollinating fauna. The questionnaire consisted of 10 questions of varied form. In the first question, the respondents were expected to declare their interest or lack thereof in entomological content. The answers given later in the questionnaire allowed us to assess the knowledge of adults about insects and their importance in nature. In the fifth point, the respondent was asked to determine the veracity of five sentences about pollinating insects. The sixth question was a multiple-choice question, in which the respondent should indicate the groups of insects involved in plant pollination. In the seventh point, the respondent was asked to link the species names with the pictures of the following insects: honeybee, bumblebee, hoverfly, butterfly (European peacock), wasp, beetle. The first five insects were selected for their high incidence in the environment, which increased the probability of being observed by the respondents. The beetle presented in the questionnaire is an insect that is less common. The next question verified the knowledge about insect morphology. Respondents were asked to list insect characteristics. The ninth question was determining the attitude of respondents towards pollinating insects. There were four answers, with one of them – "other" – giving the possibility of response that did not match any of the three suggested. In the last question, the respondents were asked to evaluate the importance of insects in nature by selecting one of the answers provided.

The results of the questionnaire were divided into three categories according to the questions. The first category (questions 5, 6, 7, 8 and 10), as in the case of the children survey, verifies adult ecological awareness of insects. Second category of questions (questions 1 and 9) defines the attitude of parents to pollinating insects.

Results

Knowledge and species identification – children

Out of nine animal species presented in the pictures, only one was named correctly by all respondents in the 4-, 5- and 6 years old group (Fig. 1). This animal was a frog. The second (in terms of correctness) identified animal was a butterfly. Almost all respondents of the examined age groups gave a correct systematic name for the insect of rank order. The exception was a 5-year-old who could not name the insect. The third species of animal that was identified by all 5- and 6-year-olds was a trout – identified as a fish. Only one 4-year-old gave the wrong name – "shark".

Another animal species most commonly identified by children was a spider. Identifying the spider was easy for all 4-year-olds (100% correct answers). Four-, five-, and six-year-olds identified ants with at least 90% accuracy. The correct answer was given as a general name. The most frequently used wrong name was a "worm". Older children did not specify wrong names for the ant, but they said "I do not know".

Different results were obtained in the case of a dragonfly. The best knowledge to identify dragonfly had 5-year-olds (94.5%), then 6- and 4-year-olds (71.5% and 60% respectively). The correct answer was given as systematic order name. Among wrong answers children described the dragonfly as a "worm" and once as a butterfly. The honey bee was identified by the group of 4-, 5- and 6-year-olds with a probability close to 60%. Most of the errors in the identification of this insect were committed by the youngest respondents – most frequently a honeybee was confused with a wasp.

The results indicate that the most difficult task for children was to identify two insects – the bumblebee and the beetle. Only one 5-year-old and one 6-year-old have identified the first as a bumblebee. The remaining respondents could not name the presented insects or gave incorrect answers. The most common incorrect answers were "bee", "wasp" or "fly". Only two 6-year-olds have correctly identified the insect as a beetle. The rest of the children surveyed gave the wrong answer, calling it "spider" or "bee". One 5-year-old considered the beetle a "crab".

Another task to verify the children's ability to identify the animals was to indicate insects from the nine species presented in the pictures (Fig. 1). None of the children classified frog or fish as an insect, while the indications were related to the spider (spider is not an insect). The majority of incorrect answers were provided by 6-year-olds (46.5%) and at 4-year-olds (20%) gave the least incorrect answers. At least 80% of 5-, and 6-year-olds correctly qualified the honeybee as an insect while only 40% of 4-year-olds did it appropriately. Bumblebee was classified as an insect by the 6- and 5-years-old group (82% and 78% respectively), and the least correctly among the 4-year-olds. Similar results were obtained with respect to a butterfly that was identified as an insect by 70% of 5-year-olds, 68% of 6-year-olds, and 60% of 4-year-olds. The most correct indication of the dragonfly species as an insect appeared in the group of 6-year-old children (78.5%), while in 5-years old it reached 69.5%. Fewer respondents answered correctly among the 4-year-olds, representing 40% of respondents in these age groups. The ants and beetle are characterized by a low number of correct indications. These animals have the highest number of correct answers among 6-year-olds (46.5%) and the lowest among 4-year-olds (20%).

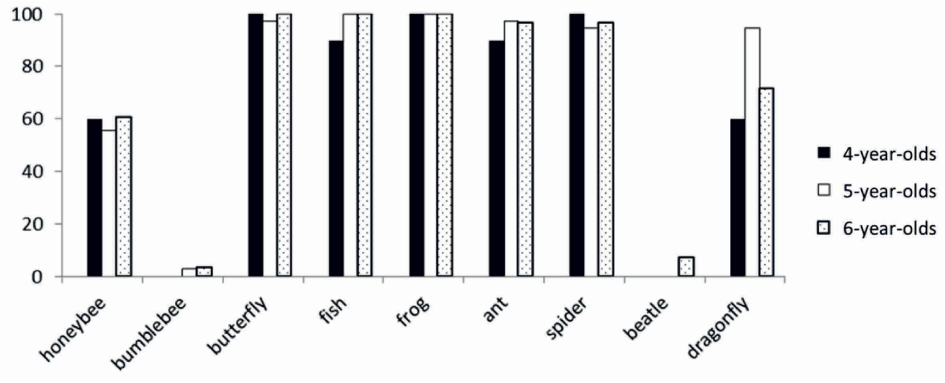

Fig. 1. Correctness (%) of species identification among pre-school children.

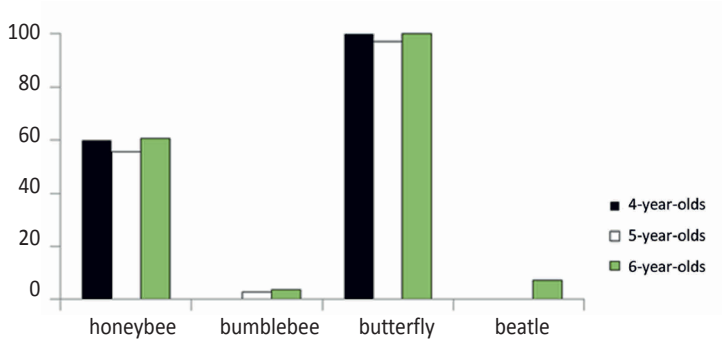

Fig. 2. Correctness (%) of insects qualification as pollinators among children.

Most commonly identified pollinators are honeybees and butterflies, while all insect groups presented in Fig. 2 are involved in pollination. We also wanted to verify if children correctly understand pollination as a process. The question was: "why do some insects sit on flowers?". Most children gave incomplete answers but with correct part including: pollen collecting, honey collecting, insects sit on flowers to pollinate them, that they help to develop new seeds, plants and flowers. All answers including correct example of interaction between plant and pollinator were considered as correct (Fig. 3).

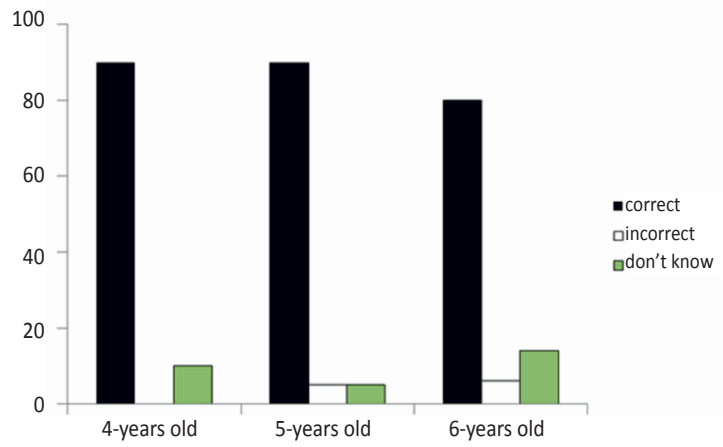

Fig. 3. Answers (%) explaining pollination process.

Attitude towards pollinating insects differs between children at different age (Fig. 4). Younger children are more afraid of bees. Most frequently, the attitude of children is negative or neutral. Answers classified as negative attitude included: -screaming, -shouting, -escaping and crying, -killing an insect. Answers classified as neutral attitude included: -standing still, -observing an insect, -behaving in a normal way, -informing an adult. Answers classified as positive attitude included: -observing an insect because it is doing is interesting, -opening window to let the insect go, -calling someone to catch a bee and let it go, -giving sugar/honey to a bee.

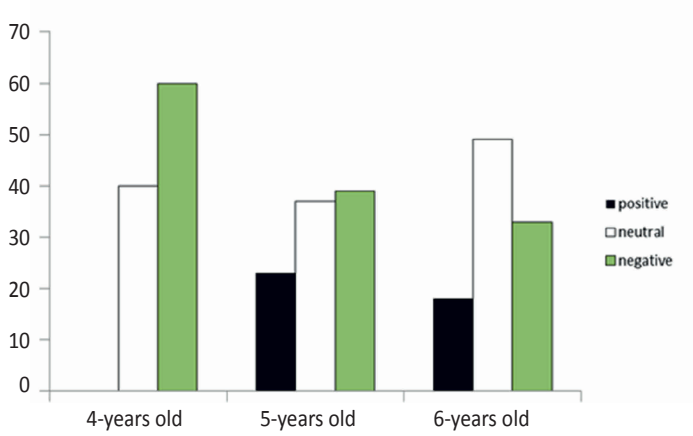

Fig. 4. Answers (%) to the question: How do you behave when you meet a bee?, reflecting children's attitude towards insects.

Knowledge and species identification – parents

Butterflies were the most frequently identified among mothers and fathers in the question of identifying groups of insects involved in pollinating plants (Fig. 5). The second most frequently indicated insects was a bee. The same number of fathers have distinguished fly (hoverfly) and beetle as insect pollinating flower plants. Relatively large proportion of interviewed mothers and fathers mistakenly identified dragonflies as pollinating insects (25.5%, 35% respectively). Only one out of all respondents qualified mantis to a group of pollinating insects.

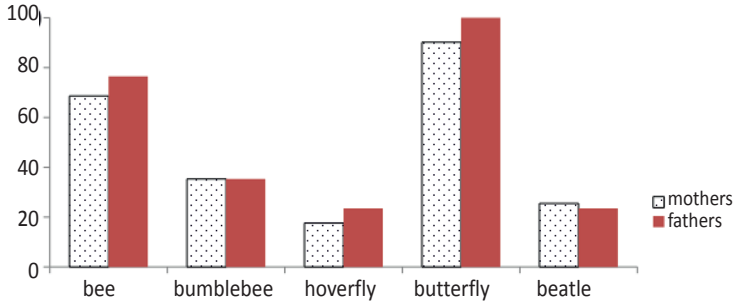

Fig. 5. Correctness (%) of insect qualification as pollinators among parents

To diagnose the level of knowledge about the process of pollination among parents we gave questions concerning the definition of pollination process. What we found is that most (over 80%) parents choose correct definition of pollination (Fig. 6). The answers to the question "Do pollinators play an important role in nature?" clearly indicate that most respondents consider insects to be important organisms. Almost all fathers who participated in the study declared that pollinating

insects definitely have important functions in nature (94%). The same answer was given by 88% of mothers.

However when parents were asked if pollination of plants has an impact on agricultural output – 48% of mothers chose wrong answer (Fig. 7).

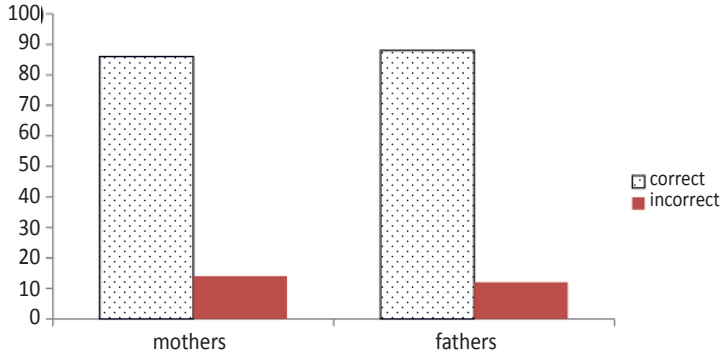

Fig. 6. Answers (%) explaining pollination process – parents

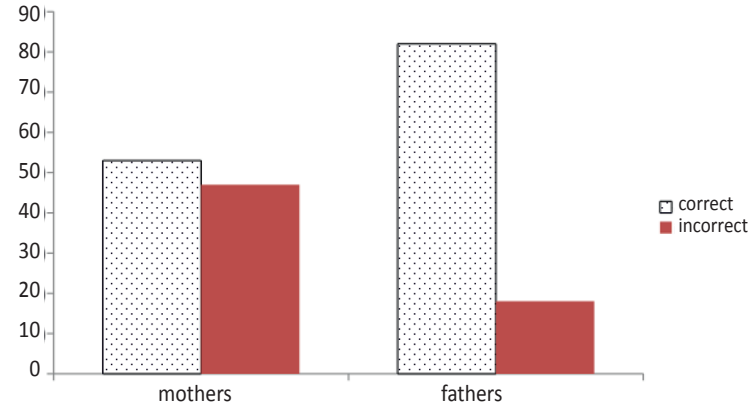

Fig. 7. Answers (%) to a question: does pollination of plants has an positive impact on agricultural output?

If it goes to parent attitude towards pollinators – most parents have positive attitude towards bees. The attitude of the respondents to insects was verified on the basis of the declared attitude towards the bee that flew into their apartment. A large majority of respondents indicated a positive attitude towards insects (Fig. 8). The answer "I help bees to get out" was most frequently found in the fathers group (88%), slightly less in the mothers group (86%). Neutral attitude in the given situation declared 8% of mothers and 12% of fathers. Negative attitude was declared only by mothers (6%). They argue that they are afraid of bees and wasps because of allergies and they prefer to run away or kill an insect. Three mothers did not response to an answer, and one of them admitted that she had never been in the situation.

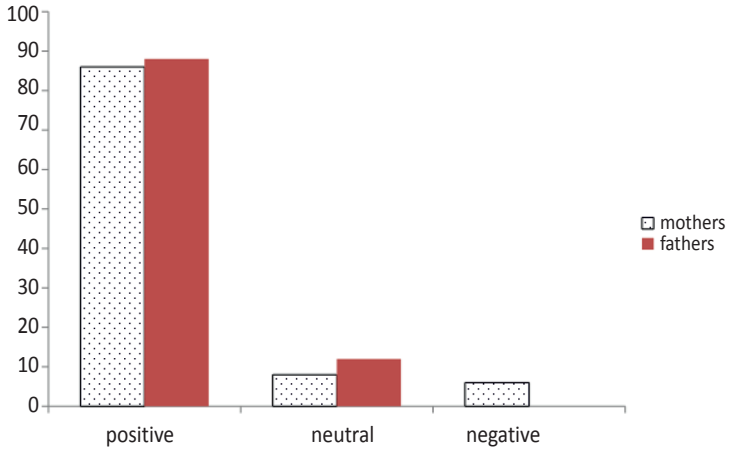

Fig. 8. Answers (%) to the question: How do you behave when you meet a bee?, reflecting parents' attitude towards insects.

Discussion

Insects are the largest group of animals living on Earth. Thus, they play many important functions in ecosystems. One of these is pollination. Most plant species, without pollinating insects, are doomed for extinction. The Earth's biodiversity is getting poorer as a result of human intensive exploitation of environment. Declining numbers also apply to pollinators, whose activity is included in ecosystem services and evaluated at €14.6 billion per year in the European Union. Efficient environmental protection is only possible with the participation of a conscious, pro-environmental society. The purpose of this work was to diagnose knowledge and attitudes towards pollinating insects among pre-school children and their parents.

Nowadays children's knowledge of biodiversity comes mainly from the media. Although many programs on the Internet or TV are dedicated to globally endangered species, they often create misleading images of biodiversity. They present the most spectacular organisms (elephants, lions, tigers), living in extreme conditions and usually in distant areas of the world. Consequently, viewers are unaware of local biodiversity problems, while they know in detail conservation issues considering few animal species living for example in Africa. Ballouard and co-authors (2011) surveyed a group of French students showing that children have a better ability to recognize in photographs exotic than local animals. In addition, the respondents' answers show that children are more likely to protect known species not found in their local environment. Their survey found that species needing protection (in children's opinion) are, among others, great panda and polar bear. On the other hand, common local animal species were recognized less or not at all. As a result, children very rarely identified them as species requiring immediate protective activities.

Our results indicate that older children have more frequently reported that insects play important role in the environment. A large proportion of children correctly justified why insects visit flowers. But most of them could not explain why plants need insects. The respondents were able to explain the relationship between insects and plants only from the perspective of insects. Explanation of our results can be what Buchcic (2014) stated about the inconsistency of the natural world in the child's perspective who initially consider its components unrelated. Children gradually realize that organisms are not independent but interdependent. Elements of the natural environment previously understood as separate, should create an increasingly coherent image, which goes with increasing interactions of the child with the environment.

Our results showed that the ability to identify pollinating insects among children is similar to the ability of their recognition by their parents. It was also found that ignorance of the local pollinator fauna contributes to negative attitudes of children and adults towards these invertebrates. Older children more often declared positive attitudes towards bees, which they also more frequently identified. Among parents, all respondents from this group stated that insects play an important role in nature. Reduced environmental awareness of parents may result from limited direct contact with nature, which is due to the rapid pace of life in big cities and development of technology.

Thematic villages, apiaries and educational gardens, educational paths and educational activities for organized groups are becoming more and more important in non-formal nature education. An important role is also played by information campaigns and projects (including "adopt a bee" by WWF). Events dedicated to pollinators allow participants to gain basic knowledge about these invertebrates and their importance in the environment. This is possible due to the presence of experienced educators and beekeepers. Many of these events are addressed mainly to children who, through play and physical activity, get to know the natural environment and shape positive attitudes. During educational workshops, both older and younger participants have a chance, for example to observe the behavior of bees, build a hotel for insects, learn the secrets of beekeeping and take part in collection of honey (Kadej and Smolis, 2015). These are valuable experiences, especially for city dwellers who usually do not have the opportunity to live close to nature.

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New society – diagnosis of knowledge about crucial ecosystem services – pollination

Abstract

Ecosystem services are natural processes that allow humankind to reap benefits. Ecosystem services are involved in the provision of clean drinking water and then decomposition of wastes. It includes also pollination and recreation benefits. Many ecosystem services are being assigned economic values as they provide or support processes, that otherwise would be costly. For effective protection of ecosystem services and environment of great importance are law regulations but also social awareness and appreciation of natural values.

Studies involving social understanding of natural processes and functioning of ecosystem services are uncommon. The level of social awareness of functioning ecological processes like pollination was newer studied before. This one-year study focused on the understanding of ecosystem services on the example of pollination. For this purpose entomological knowledge among pre-schoolers (4 to 6 years old) and their parents was studied. The aim of our study was to define the attitude towards pollinating insects and level of knowledge about ecological importance of pollinators among pre-schoolers and their parents. Children were engaged in solving the survey from questionnaire concerning different aspects of entomology, mainly pollinators. Tasks had different level of difficulty. They concerned, among others, the

recognition of insects on the basis of colored illustrations, justifying why pollinating insects can often be found on flowers, declaring how the children or parents behave when they meet a bee at their home. The study was performed on 74 pre-schoolers and their parents.
Findings indicate that pre-school children, regardless of their age, correctly classify from illustrations, representatives of insects, and differ it from other animal groups like fish or amphibians. More difficult for the 4-year-olds was to correctly name representatives of insects. Most recognizable was a honeybee, butterfly and an ant. Older children – five- and six-year-olds were most frequently correctly identifying more insect species than 4-years old. However, among pollinators, bumblebee was a species named incorrectly most frequently. In comparison – most parents identified correctly four out of six insects – including bumblebee. All parents agreed that pollinating insects play an important role in ecosystems, however when they were asked to choose insect orders engaged in pollination they all indicated butterflies, but only less than a half choose hymenoptera, that include bees. Our results indicate, that social awareness among pre-schoolers and their parents about pollination is incomplete. Majority of respondents agreed that pollination is important. However identification of main insect orders and species engaged in pollination is wrong as is the understanding of ecological meaning of the process.

Key words: ecological awareness, pre-school children, parents, entomology

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