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## Attitudes of university students of biology towards bees and their protection

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### ABSTRACT

By the number of species, insects are the most numerous group of invertebrates. They play an important role in nature, in ecosystems. Especially important are insect pollinators that provide survival for plants and other species. Among them, bees are extremely important and effective pollinators. Today, there is a global decline in the number of pollinators, especially bees. Taking into account the aforementioned facts in relation to the attitudes of students towards bees and other invertebrates, at different levels of education, the analysis of student attitudes at the University of Belgrade - Faculty of Biology, in relation to this problem has been done. The aim of this study was to determine students' attitudes on bees and their protection, and to analyze them from the perspective of several factors, such as gender, knowledge of bees, place of residence and attending a course Biology of bees with beekeeping. For this purpose, the survey questionnaire has been constructed and distributed. By analyzing the results of the questionnaire, it was found that students' knowledge and attitudes were correlated in the sense that a higher level of knowledge correlates with more positive attitudes. Students who attended the course Biology of bees with beekeeping showed more positive attitudes towards bees than students who didn't attend this course. It was also noticed that gender and place of residence affected the attitudes (fear, disgust) toward bees. Almost all students expressed an attitude that bees are an important part of nature. A large number of students have knowledge about global bees decline. Almost all students expressed that bees have to be protected, especially students who have been completed the course Biology of bees with beekeeping. These students also have a more positive attitude that it should be more learning about bees. Based on the results obtained in this study, programs of university biology courses further will be enriched with educational content about bees, their importance/roles in nature and ways for their protection.

**Key words:** pollination, bees, attitudes, university education

## Introduction

There is notable variation in human attitudes towards animals. Evolutionary pressures are the most common causes responsible for people's attitudes towards animals. Human attitudes are influenced by rarity and population distribution of animals, being more favorable toward rare animals (Herzog & Burghardt, 1988; Prokop et al., 2009). Domestic animals are frequently favored, as are aesthetically pleasing species (Stokes, 2006). Species with utility or monetary values are favored, such as trout and honey bees (Batt, 2009).

Study of rearing experiences on children's factual knowledge and alternative conceptions about animals showed very strong bias towards rearing vertebrates and a general ignorance of invertebrates. The misclassification of invertebrates was not influenced by children's experiences of

keeping animals. There are proposes that science activities with animals should be more focused on rearing invertebrates and improving children's attitudes and knowledge about them (Prokop et al., 2008).

It is generally presumed that humans will prefer species' that are perceived to be similar to their own. Although the invertebrates are a diverse and influential group that compose more than 90% of the estimated 10 million-plus animal species (Kellert, 1993), many invertebrates are so dissimilar from humans and there is no real identification with them. Taking these differences into account, they may remain generally disliked (Plous, 1993). Also, it could be concluded that general dislike and aversion toward invertebrates are connected to their potential risk to humans (Kellert & Berry, 1987). Although invertebrates perform many beneficial and essential ecological services for humans, the general public tends to

view them negatively (Carere et al., 2011; Wagler & Wagler, 2011). Despite these importances, there is also a general lack of concern for the treatment of invertebrates, in comparing to vertebrates. So, they are often maintained with minimal animal care and oversight (Elwood et al., 2009; Horvath et al., 2013).

An ambitious public education program is needed to enhance the recognition of invertebrates' positive values, and indeed, of all biological diversity (Black et al., 2001).

Among the invertebrates, spiders are traditionally considered to be least popular of animals (Prokop et al., 2010). Current evidence suggests that a negative attitude towards spiders could be influenced by both cultural and evolutionary pressures. Some researchers suggest that science education activities could positively influence students' perceptions of spiders.

In addition to spiders, insects are also untamed animals. The external morphology of an insect is a causal factor that can negatively affect pre-service elementary teacher's attitudes toward insects and beliefs concerning the likelihood of incorporating insects into future science education settings (Wagler & Wagler, 2012).

By the number of species, insects are the most numerous group of invertebrates. They play an important role in nature, in ecosystems. Especially important are insect pollinators that provide survival for plants and other species. Among them, bees are extremely important and effective pollinators. Today, there is clear evidence of declines pollinators, and parallel declines in the plants that rely upon them. Bees as pollinators are particularly vulnerable today. There are many causes for this such as changes in land-use and management intensity, climate change, pesticides and genetically modified crops, pollinator management and pathogens, and invasive alien species (Goulson et al., 2015; Potts et al., 2016). Pollinator declines can negatively have affected wild plant diversity, wider ecosystem stability, crop production, food security and human welfare (Potts et al., 2010). For this reason, it is necessary that many effective policy and management responses be implemented to safeguard pollinators and sustain pollination services (Potts et al., 2016).

Taking into account the above facts, it is very important to examine the attitudes of biology students toward bees, primarily in terms of their importance, protection and belonging to the groups of insects and invertebrates.

## Materials and Methods

### Key objectives, research design and methodology

The aim of this study was to determine students' attitudes towards bees and their protection, and to analyze them from the perspective of several factors, such as: gender, knowledge about bees and place of residence. Fear and disgust are also aspects that have been considered. For this purpose, the survey questionnaire has been constructed and distributed.

The study included a total of 167 students from the Faculty of Biology, University of Belgrade (undergraduate academic study level) divided into two groups. The first group of 146 students (Group 1) attended the first year, and the second group (Group 2) of 21 students completed the elective course *Biology of bees with beekeeping* (attended the second year).

As a research instrument, a questionnaire was used that consisted of two parts, questions (Q) and statements. In the first part of the questionnaire were questions Q1-Q4, which concerned gender, place of residence, the average grade in studies and the sources of information about bee declines, respectively. The second part of the questionnaire consisted of 10 statements about bees (Table 1) modified by Silva and Minor (2017). Students evaluated each statement using 5-point Likert-type scale responses that were ranged from "strongly disagree" (1) to "strongly agree" (5). Individual's attitudes toward bees by averaging responses (range 1 to 5) to all statements were assessed (Silva & Minor, 2017).

**Table 1.** The statements that were set for students to express their opinion relating to evaluation of their knowledge about bees. A copy of the complete questionnaire can be obtained from the corresponding author upon request.

Statements about bees
Bees are dangerous.
Bees are beneficial for humans.
Bees are an important part of nature.
Bees are interesting animals.
Bees need to be protected by humans from disappearing.
When a bee comes near me, I feel fear.
When a bee comes near me, I feel disgust.
If I found a bee inside of my home, I would want to kill it.
I would want to destroy a bee's nest built very close to my backyard, home or public park.
It is necessary to learn more about bees.

For the test reliability, the data were analyzed, and results were obtained by using Cronbach alpha coefficient. Cronbach's alpha is one of the most widely reported measures of internal consistency.

Despite the large dataset, not all variables were normally distributed. Rather than transform variables for analysis, non-parametric tests were used when it was appropriate. Mann-Whitney U-test was used instead *t*-test and Kruskal-Wallis test instead the analysis of variance - ANOVA. After Mann-Whitney U-test, Bonferroni correction (multiple-comparison post-hoc correction) was used to perform many independent or dependent statistical tests at the same time.

All these analyses were performed using the software package Statistica 6.

## Results and Discussion

An individual's attitudes toward bees by averaging responses (range 1 to 5) to all statements were assessed. Negatively formulated statements (i.e., "Bees are dangerous") were scored in reverse order to maintain a unidirectional scale. A high average attitude score indicated positive attitudes toward bees, while a low score indicated negative attitudes (Silva & Minor, 2017).

An overall Cronbach's alpha coefficient of 0.75 was calculated for the attitude-related items, which indicated their acceptable level of internal consistency, and thus reliability (Nunnally, 1978). Cronbach's  $\alpha$  values  $\geq 0.7$  or  $0.8$  indicate good reliability (Kline, 1999).

The overall students' attitudes were neutral toward bees. Males (N=37; M=3.11) demonstrated slightly more positive attitudes than females (N=130; M=3.10). For the statement: "When a bee comes near me, I feel fear", there were significant more negative attitudes by females (M=2.52) than males (M=1.84), (U=1702,  $p < 0.01$ ). For the statement: "When a bee comes near me, I feel disgust", there were negative attitudes by males (M=1.22) and females (M=1.14), but there was no significant difference (U=2396,  $p > 0.05$ ).

For the statement: "When a bee comes near me, I feel fear", it was proven that students which place of residence is city, significantly have fear, more than students from suburban area/countryside (city: N=120; M=2.52, suburban/countryside: N=47; M=2 and U=2156,  $p = 0.014$ ).

Source of information about global bee declines can be different (Table 2). Most of the students are informed about this via the media (television/internet). It is a very worrying number of those students who do not know about this problem (19.9%). More than fifty percent of students (52.4%) met with this fact on studies, on the course *Biology of bees with beekeeping*.

**Table 2.** Source of information about global bee declines.

Source of information	Group 1 (%)	Group 2 (%)
Studies	8.2	52.4
Television / Internet	61.6	42.9
Beekeepers	10.3	4.8
I do not know about this problem	19.9	0.0

Students who have been informed about declines of bees during the studies have a more positive attitude in terms that bees are not dangerous animals (U=199.5,  $p < 0.05$ ). Almost all students expressed an attitude that bees are an important part of nature (M=4.87). Almost all students expressed that bees have to be protected (M=4.82), especially those who have completed the course *Biology of bees with beekeeping* (M=4.91).

Students who have not been informed about declines of bees have a less positive attitude in terms that bees need to be protected by humans (U=1091,  $p < 0.01$ ). Students who have been informed about the decline of bees during the studies have a more positive attitude in terms that it should be more learning about bees (U=194.5,  $p < 0.05$ ).

### Differences between groups

The differences between these two groups were determined. Both groups showed a positive attitude that the bees are not dangerous, but the group 1 (first-year students (M = 1.81, Mdn=2)) demonstrated significantly less positive attitudes than group 2: students who finished elective course *Biology of bees with beekeeping* (M = 1.29, Mdn=1), (U=951.5,  $p < 0.01$ ).

Students who finished this course (group 2) have a more positive attitude that it should be more learning about bees (M=4.76, Mdn=5) in comparing with the group 1 (M=4.07, Mdn=4), (U=930,  $p < 0.01$ ; after Bonferroni correction).

According to grade point average (GPA) score from high school, it was noticed that there are no significant differences among student attitudes in both groups toward all statements about bees in the questionnaire.

The results of this study can be compared with the results of other similar studies.

Silva and Minor (2017) indicated that adolescents know something about bee biology and services, but confused bees with other flying insects, especially those with black-and-yellow coloration. They also proved that adolescents regarded bees with a generally neutral attitude. Adolescents' knowledge and attitudes were correlated in a positive manner. Students who engaged in gardening and lawn-care activities demonstrated higher levels of knowledge and more positive attitudes. Males generally held more positive attitudes than females, concurring with previous research about male and female adolescents' attitudes toward invertebrates and insects in general (Silva & Minor, 2017).

Fear and disgust are separate emotions with regard to insects and other invertebrates. Prejudice-based fear and culturally evolved revulsion can be overcome (Breuer et al., 2015).

Perceived disgust and danger of animals negatively correlated with a willingness to protect them. Females show greater fear of animals than males (Prokop & Fančovičová, 2013).

Gender, species knowledge, preferred leisure activities, and family membership of a nature protection organization proved to be significant predictors for children's attitudes toward insects and other invertebrates, in general, and for some specific species in particular (Schlegel et al., 2015).

Comparison of attitudes from pupils (primary and secondary school), students (university) and beekeepers in relation to three major oblique factors: interest, danger and

conservation and usefulness were made. The inter-correlations of these factors were significant. Although all subgroups showed an overall high willingness to protect bees, the perception of danger scored medium (Schönfelder & Bogner, 2017).

## Conclusions

Students' knowledge and attitudes were correlated in terms that a higher level of knowledge correlates with more positive attitudes.

In particular, students who attended the course *Biology of bees with beekeeping* showed more positive attitudes towards bees than students who didn't attend this course.

It was also noticed that that gender and place of residence affected the attitudes (fear, disgust) toward bees.

Almost all students expressed an attitude that bees are an important part of nature.

According to the results obtained in this study, it can be also concluded that many students have knowledge about the decline of bees.

Almost all students expressed that bees must be protected, especially those who have completed the course *Biology of bees with beekeeping*. Students who finished this course have a more positive attitude that it should be more learning about bees.

Based on the results obtained in this study, programs of university biology courses should be enriched with educational content about bees, their importance/roles in nature and ways to protect them. It is very important that these new teaching content contain science activities with animals, especially with invertebrates (insects), in order to improve students' attitudes toward them. For this reason, there is a need for introducing a special learning approach with an effective focus which provides information in emotion-activating formats, because negative emotions like disgust and fear can be reduced by experience with original objects.

All mentioned activities would contribute to increasing popularity of bees and other insects (invertebrates) and public support, in the sense of understanding the necessity of their protection.

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