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Online Education of Public Participants in the Data Collection Process for the Monitoring of Giant Hogweed in Latvia

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ONLINE EDUCATION OF PUBLIC PARTICIPANTS IN THE DATA COLLECTION PROCESS FOR THE MONITORING OF GIANT HOGWEED IN LATVIA

by

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ABSTRACT

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Utilization of Public Participation with Geographic Information Sciences is a method intended to document the locations and spread of poisonous, invasive Giant Hogweed in Latvia. To reach students in an international setting, a website and tutorials trained participants about the characteristics of the plant, GPS concepts, and the data collection process. To ensure safe and accurate data collection, students were tested on their mastery of educational materials, evaluated on their ability to collect data in the field, and were questioned about their experience with the project. The results determined that students who take the online tutorial become better research partners, while also exposing issues with the educational and instructional components and overall flow of the project.

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CHAPTER 1

INTRODUCTION

Giant Hogweed is an invasive species that not only threatens native plant populations, but also causes physical harm to humans that come in contact with it. In hopes of contributing to the management of this poisonous, invasive weed, a research team from the University of Memphis is working to document the locations of Giant Hogweed in Latvia by utilizing public participation with Geographic Information Systems (PPGIS) in high schools and with other interested individuals. The research team plans to incorporate high schools throughout Latvia by training high school geography and biology teachers to lead students both in taking online education tutorials and in collecting coordinates of Giant Hogweed locations. Team members created a publicly accessible website where online PowerPoint tutorials (Appendix A) help participants to learn about the project, the characteristics and dangers of Giant Hogweed, and about the geographic tools and methods by which locations of this plant can be documented. On the website, PPGIS protocol training teaches participants to use a compass and Garmin eTrex GPS unit to pinpoint Giant Hogweed locations, and these coordinates are uploaded into the website to create a Giant Hogweed distribution map. A beta test was performed at Vidzeme University in Latvia, where a group of high school students enrolled in summer school participated in a trial run-through. Some adjustments were made to the tutorials before they were administered to a test group and a control group in the United States for further study.

For students to collect accurate data, it is necessary to adequately prepare them for the data collection process. Therefore, understanding the methods and techniques that are most successful in helping students become effective research partners is vital to the success of this international project. This study investigates the effectiveness of the online education component and training process to prepare individuals for successful GPS point data collection of Giant Hogweed locations in Latvia, as well as the effectiveness in educating the research partners.

Basic Summary/Focus

Because data integrity is essential to good scientific research, it is pertinent that individuals participating in PPGIS programs understand the project with which they are involved. Students and individuals who are not well versed in geographic concepts could affect the end results of a project. In order to provide a concise, yet thorough and effective training in an international setting, it is important to understand student perception of and response to different learning methods in relation to online education in geography and GIS, technology, invasive species, and fieldwork. Participants were evaluated by test and fieldwork performance, and surveys conveyed how participants felt about their experiences. This thesis explores the effectiveness of an educational component in a beta test so that an effective, large scale data collection process can be implemented across Latvia.

Background

Online education. Since the development of the World Wide Web, there has been an increase in computer-based learning. Supporters of online education recognize its many benefits. This form of learning allows students to move at their own pace in a comfortable setting, while also providing them with the benefits of collaborative interaction with other students (Hurley, Proctor, & Ford, 1999; Volery & Lord, 2000).

Online programs allow educational institutions to reach distance learners outside of the traditional classroom setting, helping students who have difficulty with proximity and work schedules. Such institutions are not only able to capitalize on these extended, virtual classrooms, but they help manage budget and classroom capacity issues (Volery et al., 2000). While computer-based education has grown in many disciplines, it has been particularly beneficial to the field of geography, where the computer easily manages mass amounts of data that is presented to the user in a compact, recognizable form (Osodo, Indoshi, & Ongati, 2010; Volery & Lord, 2000). Despite the benefits, there are those concerned with the integrity of the discipline and the professional and ethical commitment to provide students with a proper education (Dibiase, 2000; Gober, 1998). Different methods of incorporating geography education are important to a well-rounded learning experience (Dibiase, 2000; Gober, 1998).

GIS/PPGIS/fieldwork education. A component of geography education that also fosters education in technology is Geographic Information Systems (GIS). While there is no concise or official definition for GIS, it can be summarized as a computer-based information science that allows processing of spatial data to be stored, manipulated, and analyzed through human interaction (DeMers, 2005). GIS is a practical medium for finding solutions because it offers effective visual communication. Through pictorial representation, spatial relationships are visible instantaneously. Instead of trying to piece together long lists of facts and numbers, the user sees a final product and can recognize its real world characteristics. GIS offers a truly dynamic investigation, unlike more primitive forms of mapping that used paper maps and pushpins. Interaction with layers, queries, and charts offers the user a personal connection with his project.

Valuable time and resources are spared because extensive databases become manageable and are conveyed in a concise and efficient manner. They can be changed quickly and efficiently, evaluated, and changed again if necessary. In addition, the information is easily passed from one desk to another and among departments. In some cases, this information could be shared with a community in order to address the particular needs at the local level. For example, police departments in many cities, such as Los Angeles, California, now promote crime awareness by maintaining basic, interactive maps that allow citizens to monitor crime in their area (Los Angeles Police Department, 2011).

While geography-based technologies are growing in popularity, the underlying science and techniques by which they function are often overlooked by many. The development of Google Earth in 2005 is one example of a popular mapping program used by the general public, and many of its users have never heard of GIS (Goodchild, 2006). With so many interacting and contributing to the online mapping community, it seems necessary to promote "spatial literacy" as a part of the basic education program (Goodchild, 2006). It is rare that students are exposed to fundamental GIS concepts through general curriculum requirements, as compared with the research-based duties of many graduate students in geography and related fields (Sinton, 2009). By incorporating GIS education in school and related activities, understanding of the technology and the relationship and importance of space and place will provide students with better perspective of their world (Sinton, 2009).

Public Participation Geographic Information Systems (PPGIS) can offer the general public hands-on involvement in community issues, such as neighborhood planning and development. For example, a redevelopment project in the United

Kingdom allowed residents to flag and add comments on a computer-based map of their community, which was used by the planning committee to determine the best course of action (Kingston, Carver, Evans, & Turton, 2000). Participants are often community stakeholders, but the promotion of such involvement in the classroom setting can allow students to gain better understanding of GIS technology and science questions that can be answered using GIS. Furthermore, the incorporation of fieldwork as a component of PPGIS allows students to gain a well-rounded perspective of the different technological components of the GIS process. The PPGIS approach is likewise beneficial to researchers who take on projects of large size, often with budget constraints.

Invasive species - Giant Hogweed. Giant Hogweed is a poisonous, invasive weed that causes ecological and human health problems. Not only does it shade out native species, therefore causing ecological imbalance, but its sap contains photosensitizing furanocoumarins, toxins that causes skin inflammation that is intensified with sun exposure (Nielson, Ravn, Nentwig, & Wade, 2005). This phototoxic sap causes reddening and swelling of the skin (Nielson et al., 2005). A reaction may take as little as 15 minutes to develop, but can last for months (Nielson et al., 2005). Affected areas may be sensitive to ultraviolet rays for years, and may also cause permanent scarring (Nielson et al., 2005). Additionally, furanocoumarins have been associated with cancer in humans and birth defects in developing embryos (Nielson et al., 2005). Eye contact may result in permanent blindness, and ingestion can be fatal (Nielson et al., 2005).

Understanding Giant Hogweed's characteristics and distribution is important for its management and eradication. Giant Hogweed belongs to the genus *Heracleum*. Over 20 of these species have been documented throughout Europe (Nielson et al., 2005).

Two species of *Heracleum* that inhabit Latvia fall into the category Giant Hogweed, known for their large leaves and flower clusters. These are *Heracleum mantegazzianum* and *Heracleum sosnowskyi*. Found in temperate climates of the northern hemisphere, the plants were first introduced to Europe in the early 1800s as a garden plant, and were used as silage for livestock until anise-flavored milk and meat ended the practice (Kabuce & Priede, 2010; Nielson et al., 2005). There is some debate about the differences between *H. mantegazzianum* and *H. sosnowskyi* – some scientists suggest that *H. sosnowskyi* is simply a slightly smaller hybrid of the *H. mantegazzianum*, while some suggest there are other hybrid varieties in existence (Obolevica, 2009). Regardless, these two species share hazardous traits and are known to inhabit the country of Latvia. Eradication of both would create a safer and better balanced environment.

There are many biological characteristics that contribute to the invasiveness of Giant Hogweed. Because it germinates earlier than native plant species, its fast growth and large size cause considerable overhang that shades out other plants (Klingenstein, 2007). Once hogweed plants are established, their mortality rate is very low (Klingenstein, 2007). They can remain in immature stages for 3 – 5 years until soil conditions are conducive to seed production (Klingenstein, 2007). Due to this ability, a substantial proportion of the population is seed-producing (Klingenstein, 2007). One plant can produce anywhere from 20,000 – 100,000 seeds, and each of the seeds have long survival periods (Klingenstein, 2007). During this time, water, wind, animals, and humans can aid in their dispersal (Klingenstein, 2007). Water is a large factor in seed dispersal, as hogweed thrives along waterways, and rivers and streams facilitate widespread diffusion (Nielson, Ravn, Nentwig, & Wade, 2005). Seeds can survive in the soil up to two years or more, and can be blown by the wind, particularly over frozen ground (Klingenstein, 2007). Seeds may be transported upon the fur of animals, clothing, and tires, as well as by human-assisted horticultural and outdoor activities (Klingenstein, 2007). Furthermore, while plants can cross-pollinate, a single plant has the ability to self-pollinate, meaning that one plant can produce an entire population (Klingenstein, 2007). In areas where landscape maintenance is lacking or non-existent, such as abandoned agricultural fields or natural areas, hogweed is more likely to flourish (Nielson, Ravn, Nentwig, & Wade, 2005).

Public participation with Giant Hogweed. While some satellite image products may provide a good overview of grouped Giant Hogweed distribution, small clusters and single plants may be undetectable by many satellite sensors. The utilization of public participation will help pinpoint the locations of these small clusters and single plants. Public involvement is a major benefit to researchers in conducting a project of this size. The collaborating students will allow the research team to reach many areas of Latvia that would be otherwise too time-consuming and costly. This approach also allows researchers to take advantage of participants' local knowledge of Giant Hogweed locations. Additionally, through anecdotal evidence from fieldwork in Latvia in summer of 2010, it is clear that many Latvians deal with Giant Hogweed in their everyday lives, have their own unfortunate experiences with the plant, and are eager to see its eradication. With the incorporation of geographic education and technology, students will be able to work collaboratively to combat a health risk in their local community. Working together on an issue that bears great significance in their community will give relevance to the science and will therefore enhance their learning experience (Hurley, Proctor, & Ford, 1999). The project will encourage people to learn about and use current geographic technology to solve problems in their local environment, while also opening international dialogue about these shared ecological problems.

Research Questions:

1. What are the benefits and challenges of providing an educational component to a PPGIS project to monitor Giant Hogweed in Latvia? Does the education component make students better research partners?

2. What benefits and challenges do students find with the integration of GIS/GPS education in the monitoring of Giant Hogweed?

3. How can researchers structure an online course that effectively incorporates a fieldwork training component in an international setting?

CHAPTER 2

METHODOLOGY

STUDY POPULATION

Latvian students for this beta test were recruited through a voluntary summer school program at Vidzeme University in Valmiera, Latvia. The group consisted of twelve high school girls, with ages ranging from 16 – 18, which are ages representative of ages intended for future project implementation. No boys attended the summer school programs for reasons unknown to the author. The beta tests were performed simultaneously by all Latvian participants during a one-day period. While not including boys in the study population is a limitation of this study, this was beyond the control of the author and any bias introduced can be established and remedied in the on-going implementation of the larger research project. The sample may also present bias because the group was based on students who chose to attend summer school, and were not representative of the whole population of Latvian high school students. While the sample is small, some statistical tests still proved significant. Results indicated best point estimates and directions of effects. However, future work should include increased sample sizes. It is noted that all students took tutorials and tests in English. Latvian translation of the tutorials was not available at the time of the beta test due to funding. English is taught to students each year in Latvian public schools, beginning in primary schools. These Latvian students were proficient in English when they took part in the beta test, but students were not fluent. Students who signed up for the beta test completed a four day, pre-college summer science school in English, though no English test was given to attendees.

The test and control groups in America were volunteers from the University of Memphis, Auburn University, and Rhodes College. Each group consisted of ten college male and female students with ages ranging from 20 – 28. Both the test and control groups had 6 males and 4 females in the sample population. The author used college-age, male and female participants because they were more accessible than high school students. These volunteers were recruited at the end of the semester of a Weather and Climate laboratory course taught by the author, and through a friend's stepson. This may present bias because the group was not representative of high school students in Latvia and because the students were acquainted with the author, though they were not acquainted with the research project. The small sample group was chosen to reflect the size of the sample in Latvia. The beta tests were performed by each individual during a one-day period, but the beta test took two weeks to complete for the American groups.

Educational Framework

A three-part educational component was created to teach participants about the three topics: the PPGIS Project Overview, Giant Hogweed, and GPS concepts. These educational components are available online at the web address http://sites.google.com/site/gianthogweedproject/. A PPGIS protocol training, which teaches participants how to use a compass and the Garmin eTrex unit, was created by another member of the research team and is also available at this address.

The tutorials were created by the author based on graduate-level GIS coursework, academic research, and online materials. The author used notes based upon information received in the following graduate-level courses taken at the University of Memphis: Introduction to GIS, Advanced GIS, and Seminar in GIS. For information regarding characteristics of Giant Hogweed, the author referenced the following articles: *The Giant Hogweed Best Practice Manual: Guidelines for the Management and Control of an Invasive Weed in Europe* by Nielsen, et al., *Invasive Alien Species Fact Sheet: Heracleum sosnowskyi* by Kabuce and Priede, *Invasive Alien Species Fact Sheet – Heracleum Mantegazzianum* by Klingenstein, and *Hogweed and its Distribution in Latvia* by Obolevica.

The educational components were placed in a sequence that seemed most logical to the author. First, the PPGIS Project Overview oriented students to the project by explaining the components and purpose of the project. Second, the Giant Hogweed section discussed the unique characteristics of the plant which contribute to its distribution, and also focused on student safety. Third, the GPS concepts section works to familiarize students with the technology with which they will be working.

These components were established, distributed, and reviewed in a manner that reflects some of the "levels of instructional methods" described by Hokanson and Hooper (Hokanson & Hooper, 2004). First, the students received the online materials in the most sequential and efficient manner possible (Hokanson & Hooper, 2004). Second, students were asked to apply this knowledge through the "drill" and "repetition" associated with answering test questions, which required them to think further about the information received (Hokanson & Hooper, 2004). Further application of knowledge took place when students used GPS units in the field for data collection and applied concepts received in tutorials (Hokanson & Hooper, 2004). Third, students were encouraged to generate ideas for control and eradication of Giant Hogweed (Hokanson & Hooper, 2004). Furthermore, the online method of delivery reflects the "pillars of quality online education," where effective student learning is achieved through application of knowledge in the field and through collaboration with other students (Hurley, Proctor, & Ford, 1999; Lorenzo & Moore, 2002). Additionally, exposure to online education satisfies the increasing desire for computer-based learning in a technologically competitive world (Hurley et al., 1999; Lorenzo & Moore, 2002).

Section 1: answering. "What are the benefits and challenges of providing an educational component to a PPGIS project to monitor Giant Hogweed in Latvia? Does the education component make students better research partners?"

As shown in Table 1, these educational components, in addition to the PPGIS protocol training, were given to a group of high school students in Latvia in summer of 2010. In addition, a group of study participants in America was instructed to complete the PPGIS protocol training: half of these Americans (test group) completed both the educational component and the PPGIS protocol training, and the other half (control group) completed only the PPGIS protocol training along with an oral orientation to the project. During the orientation, the author discussed all concepts relating to the project, the characteristics and dangers of Giant Hogweed, and the functions of GPS technology as thoroughly as possible, and answered questions and provided discussion, as prompted by each individual. The verbal orientation given to students in the control group was intended to represent the lecture that Latvian teachers would give in lieu of the education component. Each group was not allowed to access help from outside sources. All students taking the tutorials were not timed and could complete the tutorials at a pace desired by each individual student. All students were given two untimed, closed-note tests to evaluate their understanding of the project and its components (see Appendix B and C). Because the PPGIS Project Overview tutorial was brief, one test was given to cover the two tutorials PPGIS Project Overview and Giant Hogweed. Due to the dangerous characteristics of Giant Hogweed, this test included safety questions, which were marked with an asterisk. Students were required to pass the safety portion of the test to participate in fieldwork and could miss no more than one safety question. A second test was given to evaluate student understanding of the tutorial on GPS concepts.

Table 1
Project components as completed by each group

	Latvia	**United States**	
Group Type	**12 Students**	**Test Group (10 Students)**	**Control Group (10 Students)**
Tutorials	Yes	Yes	
Verbal Orientation			Yes
Overview/Giant Hogweed Test	Yes	Yes	Yes
GPS Test	Yes	Yes	Yes
Data Collection	Live	Simulated	Simulated

Higher test scores imply that students may be better research partners because they mastered more information regarding the project in which they are participating. Therefore, scores for the Overview/Giant Hogweed test, safety questions, and GPS test were averaged for each individual and then averaged and reported for each group as a whole. To test differences in scores between pairs of groups, standard t-tests were run. The number of individuals permitted to participate in the data collection process (because no more than one safety question was missed) was listed and compared for each group. To evaluate the impact of the educational component on understanding of the PPGIS project and safety, test scores were compared between the test group and control group, and the students were evaluated on their performance on a scale of 1 to 5 in a simulated data collection trial by the author. In the simulation, students were asked to collect data points of objects (for example, a tree or telephone pole) because Giant Hogweed is not found in the location of the American beta test. Students given a 1 were completely dependent on the author in the simulated data collection process, whereas students given a 5 were completely independent. A qualitative discussion was provided for the group of Latvian students, whose individual data collection ratings were not available.

Section 2: answering. **"**What benefits and challenges do students find with the integration of GIS/GPS education in the monitoring of Giant Hogweed?"

To identify any participant troubles with the incorporation of GIS and GPS education in this project, student test results were summarized to determine if there were particular concepts with which they had difficulty so that any necessary adjustments could be made. Additionally, students were questioned in a survey (see Appendix D) about their comfort levels when dealing with the tutorial (where applicable), test, and fieldwork. Survey results, in addition to anecdotal information from personal interactions and comments in a 2010 project that documented this research on film, were recapped and summarized.

Section 3: answering. **"**How can researchers structure an online course that effectively incorporates a fieldwork training component in an international setting?"

Investigation of student perceptions of both the educational tutorials (Project Overview, Giant Hogweed, and GPS concepts) and the GPS training allowed the author to identify any issues with the flow of the website instruction, course content, and fieldwork content. Students' perceptions of website, course flow, and fieldwork were summarized based on answers given to the American groups in a survey (see Appendix E). A qualitative discussion of training that occurred between the author and students in Latvia in the summer of 2010 was summarized, in addition to qualitative discussion between the author and American participants in 2011.

CHAPTER 3

RESULTS

Section 1: Answering

"What are the benefits and challenges of providing an educational component to a PPGIS project to monitor Giant Hogweed in Latvia? Does the education component make students better research partners?"

Test results, summarized in Tables 2 and 3, are as follows: 12 Latvian students, given both the PPGIS protocol training and the educational component in the form of PowerPoint tutorials, made an average score of 72% on the Overview/Giant Hogweed test. The high score was 96%, the low score was 42%, and the standard deviation was 15.83%. Within this test, the students answered 72% of the required safety questions correctly. Only 5 out of 12 students met the requirements to participate in fieldwork, meaning they missed no more than one safety question. Participation in fieldwork was not individually evaluated, but the students correctly entered the data they obtained into the online website after receiving initial assistance with the compass and Garmin eTrex GPS unit. The Latvian group scored an average of 85% on the GPS Test. The high score was 100%, the low score was 60%, and the standard deviation was 16.24%.

Table 2
Student test results and rating of field work simulation

	GPS Test	Overview/Giant Hogweed Test			Field Work Rating
Group Type	Total Correct	Total Correct	Safety Correct	Fieldwork Participants Permitted	(1-5)
Latvia	85%	72%	72%	5 of 12	NA
US Control	61%	49%	66%	0 of 10	2.5
US Test	86%	86%	95%	10 of 10	3.4

Table 3
High and low scores of GPS and Overview/Giant Hogweed tests

	GPS Test			Overview/Giant Hogweed Test		
Group Type	High Score	Low Score	Standard Deviation	High Score	Low Score	Standard Deviation
Latvia	100%	60%	16.24%	96%	42%	15.83%
US Control	80%	40%	11.97%	57%	25%	10.79%
US Test	100%	60%	13.5%	100%	68%	10%

Ten students in the U.S. control group, given the PPGIS protocol training and a detailed oral orientation about the project and its components, made an average score of 49% on the Overview/Giant Hogweed test. The high score was 57%, the low score was 25%, and the standard deviation was 10.79%. Within this test, the students answered 66% of the required safety questions correctly. None of the ten students met the requirements to participate in fieldwork, meaning everyone missed more than one safety question. Participation in a simulated Giant Hogweed data collection process earned the group an average of 2.5. The U.S. control group scored an average of 61% on the GPS Test. The high score was 80%, the low score was 60%, and the standard deviation was 13.5%.

Ten students in the U.S. test group, given both the PPGIS protocol training and the educational component in the form of PowerPoint tutorials, made an average score of 86% on the Overview/Giant Hogweed test. The high score was 100%, the low score was 68%, and the standard deviation was 10%. Within this test, the students answered 95% of the required safety questions correctly. All ten students met the requirements to participate in fieldwork, meaning they missed no more than one safety question. Participation in a simulated Giant Hogweed data collection process earned the group an average of 3.4. The U.S. test group scored an average of 86% on the GPS Test. The high score was 100%, the low score was 40%, and the standard deviation was 11.97%.

A statistical analysis of test score significance between U.S. test and U.S. control groups. On the Overview/Giant Hogweed test (Table F-1). , the Levene's test was not significant, and it was assumed that the variances were equal between the two groups. The p-value for the t-test was .000. Therefore, the null hypothesis was rejected and a significant difference in scores between U.S. test and U.S. control groups was found. On safety questions, the Levene's test was not significant (Table F-2), and it was assumed that the variances were equal between the two groups. The p-value for the t-test was .001. Therefore, the null hypothesis was rejected and a significant difference in scores between U.S. test and U.S. control groups was found. On the GPS test (Table F-3), the Levene's test was not significant, and it was assumed that the variances were equal between the two groups. The p-value for the t-test was .000. Therefore, the null hypothesis was rejected and a significant difference in scores between U.S. test and U.S. control groups was found.

A statistical analysis of test score significance between Latvian and US Test groups. On the Overview/Giant Hogweed test (Table F-4), the Levene's test was not significant, and it was assumed that the variances are equal between the two groups. The p-value for the t-test was .026. Therefore, the null hypothesis was rejected and a significant difference in scores between Latvian and U.S. test groups was found. On safety questions (Table F-5), because the Levene's test was significant, it could not be assumed that the variances were equal between the two groups. The p-value for the t-test was .026. Therefore, the null hypothesis was rejected and a significant difference in scores between Latvian and U.S. test groups was found. On the GPS test (Table F-6), the Levene's test was not significant, and it was assumed that the variances were equal between the two groups. The p-value for the t-test was .878. Therefore, the null hypothesis was accepted, and no significant difference in scores between Latvian and U.S. test groups was found.

Section 2: Answering

"What benefits and challenges do students find with the integration of GIS/GPS education in the monitoring of Giant Hogweed?"

As shown in Table 4, twelve Latvian students missed an average of 7.3 out of 26 questions on the Overview/Giant Hogweed test, and within that test, the students missed an average of 2 out of 10 safety questions. The same group missed an average of 1.5 out of 10 questions on the GPS concepts test. Over both tests, 9 questions were found to have been missed by at least half or more of the group (Appendix G). These questions comprised of both general and safety questions. No patterns were observed in students' incorrect answer selections. However, all but one Latvian student expressed concern and/or listed words with which they had trouble understanding. Note that the Latvian students took this test in English, which has since been translated to Latvian for Latvian students in the future.

Table 4
Number of questions missed and number of students who mentioned language difficulties

	GPS Test	Overview/Giant Hogweed Test			Both Tests
Group Type	**Total Missed**	**Total Missed**	**Safety Missed**	**Questions Missed by Half or More of the Group**	**Word Difficulty Complaints**
Latvia	1.5 of 10	7.3 of 26	2 of 10	9	11 of 12
USA Control	3.9 of 10	14.3 of 28	3.1 of 9	21	0 of 10
USA Test	1.4 of 10	4 of 28	0.5 of 9	1	0 of 10

Ten students in the American control group missed an average of 14.3 out of 28 questions on the Overview/Giant Hogweed test, and within that test, the students missed an average of 3.1 out of 9 safety questions. The same group missed an average of 3.9 questions on the GPS concepts test. Over both tests, 21 questions were found to have been missed by at least half or more of the group. These questions comprised of both general and safety questions. No patterns were observed in students' incorrect answer selections, and no surveys in the control group mentioned language issues.

Ten students from the American test group missed an average of 4 out of 28 questions on the Overview/Giant Hogweed test, and within that test, the students missed an average of 0.5 out of 9 safety questions. Only one question was missed by exactly half of the group. Five of 10 participants chose the incorrect answer to the question

"How many years will Giant Hogweed remain in the rosette stage before flowering?" This question was the only question missed by all three groups. It was a general question, and did not affect the safety requirement. No surveys in the test group mentioned language issues.

As a whole, participants enjoyed the tutorials. With the exception of translation difficulties, students said they felt comfortable taking the tests based on the tutorials and without the presence of an instructor. Students claimed they did not mind the use of PowerPoint as a source for information. They liked the bullet-style presentation of information that was clear and avoided lengthy explanation. Students liked working at their own pace and in the PowerPoint style. No student issues with delivery sequence in these educational components were reported. Each student said they clearly understood the dangers of Giant Hogweed and would not touch it. When asked about their confidence in the ability to identify Giant Hogweed, students specifically noted concern about identifying plants in the rosette stage. Three students noted that a picture in the presentation shows a girl standing very close to Giant Hogweed.

Section 3: Answering

"How can researchers structure an online course that effectively incorporates a fieldwork training component in an international setting?"

Students who read the PowerPoint tutorials liked the presentation, felt confident with the project (see Table 5). They liked the presentation and understood the presentation material enough to feel comfortable taking the tests. The students felt comfortable without an instructor available for questions. Students felt that they would feel comfortable using the GPS unit after they were trained to do so. Students said they understood the dangers of Giant Hogweed and felt fairly certain they could identify the plant without problem. Due to similar scores and low sample sizes, variance between groups is insignificant.

Table 5
Survey responses

Survey Question	**Latvia**	**Test**	**Control**
How did you feel about the presentation?	4.5	5	N/A
How well did you understand the material in this presentation?	4	4.5	N/A
Based upon the information given in the tutorial, how comfortable did you feel take the test?	4	4.5	N/A
How comfortable did you feel learning this information without an instructor present?	4.5	5	N/A
Once you learn how to use the GPS unit, how comfortable do you feel to participate in this project?	4	4.6	N/A
How well do you understand the dangers of contact with Giant Hogweed?	5	5	N/A
How well do you feel that you can correctly identify Giant Hogweed?	4	4	N/A

As shown in Table 6, only 4 of 20 students said they would feel comfortable using the Garmin unit and compass in the field based on the website instructions alone. Eighteen of 20 said they would feel more comfortable using these items in the field once someone demonstrated how to use them on an individual basis. When asked if students would prefer to have these instructions in a format similar to the PowerPoint tutorials (instead of navigating through several web pages, as in the current format), 18 of 20 students said they would prefer it (the control group was permitted to look at the tutorials for reference in the survey only). Thirteen of 20 students noted that they were able to navigate through the website without confusion. Students frequently commented that the menu column was cumbersome. Due to similar scores and low sample sizes, variance between groups is insignificant.

Table 6
Student opinions of website and fieldwork

Survey Question	**Number Responding Yes from Test Group**	**Number Responding Yes from Control Group**	**Total Number Responding Yes**
Would you feel comfortable using the Garmin and compass based upon your readings on the website alone?	2 of 10	2 of 10	4 of 20
Would you feel more comfortable using the Garmin and compass once someone showed you how?	9 of 10	9 of 10	18 of 20
Would you prefer to have the Garmin and compass instructions in a PowerPoint format similar to the tutorials?	8 of 10	10 of 10	18 of 20
Were you able to navigate through the website without confusion?	6 of 10	7 of 10	13 of 20

CHAPTER 4

DISCUSSION AND RECOMMENDATIONS

Section 1: Answering

"What are the benefits and challenges of providing an educational component to a PPGIS project to monitor Giant Hogweed in Latvia? Does the education component make students better research partners?"

The test group, which read the PowerPoint tutorials, was clearly more prepared than the control group, which received a verbal orientation, when taking both tests and when participating in the data collection simulation. The test group scored 37 % higher on the Overview/Giant Hogweed test, 29% higher on the safety questions, and 25 % higher on the GPS concepts test. When standard t-tests were run, there was a significant difference in scores between groups on the Overview/Giant Hogweed test, safety questions, and GPS concepts test. These results were expected, and indicate that the students who learned from PowerPoint tutorials benefitted by gaining a better understanding of concepts related to this project better than students who learned from discussion alone. The author recommends that future participants use the tutorials to promote better understanding of the concepts related to this project.

An increase of 29% in safety score indicates that the test group students would participate in live fieldwork with less probability of incident, which is extremely important when considering the dangerous characteristics of Giant Hogweed. In the test group, all 10 students correctly answered the safety questions and met the requirements which permitted them to participate in fieldwork, as compared with zero of 10 students in the control group. This would have an effect on the overall project because under the recommended safety requirements, none of the control group would be allowed to participate in fieldwork and/or would have to retake the safety portion until a satisfactory score was met. Repeated attempts to pass safety questions could prove time-consuming and could delay, deter, or prevent students from participating in the fieldwork portion of the project. Failure to master the appropriate number of safety questions would negatively impact the project by reducing both the number of participants and also the amount of data collected for the research team. Because the evidence indicates that the students who learn from PowerPoint tutorials benefit by gaining increased awareness of safety topics, the author highly recommends that future participants use the tutorials to promote safe data collection, not only for the safety of the participants, but also to avoid any potential hindrance to the continuation of this project that may be caused by injury of any participants.

In the simulated data collection process, the test group scored 3.4 out of 5, as compared with the control group's score of 2.5 out of 5. This evidence suggests that the education component helps students become better research partners. The higher rating in fieldwork performance by the test group may perhaps be explained as confidence resulting from knowledge gained in the tutorials. However, it is noted that 2 of the 10 students in the test group had previous experience with Garmin GPS units. The author recommends that students use the tutorials to promote confidence and accuracy in the data collection process. These improved scores will mean better data for the research team.

The test group, which read the PowerPoint tutorials, was also more prepared than the Latvian group, which also read the PowerPoint tutorials, when taking both the

Overview/Giant Hogweed and GPS tests. The test group scored 14% higher on the Overview/Giant Hogweed test, 23% higher on the safety questions, and 1% higher on the GPS concepts test. When standard t-tests were run, there was a significant difference in scores between groups on the Overview/Giant Hogweed test and safety questions, but there was no significant difference in scores on the GPS test. This evidence indicates that the test group benefits more from PowerPoint tutorials than Latvian students on the Overview/Giant Hogweed test and safety questions. The most likely reason for this is the language barrier Latvian students faced when reading all materials in English, which is not their native language. The author recommends that Latvian students be tested based on the new translations to determine if scores improve. In addition, the Latvian group consisted of high school students, while the American groups consisted of adults and college students, which may account for some of the better scores among the American groups.

An increase of 23% on the safety questions indicates that the test group students would participate in live fieldwork with less probability of incident than Latvians, which is cause for concern for Latvians when considering the dangerous characteristics of Giant Hogweed.   In the test group, all 10 students correctly answered the safety questions and met the requirements which permitted them to participate in fieldwork, as compared with 5 of 12 Latvian students. This would have an affect on the overall project because under the recommended safety requirements, less than half of the Latvian students would be allowed to participate in fieldwork and/or would have to retake the safety portion until a satisfactory score was met. If students continued to fail these requirements, it would negatively impact the number of participants collecting data for the research team. This evidence indicates that the test group benefits more than Latvian students when learning from PowerPoint about safety topics. Again, this is mostly likely due to language conflict presented to Latvian students who took the test in English, and can be investigated with further testing based on the newly translated materials.

An explanation for higher test scores by the test group on Overview/Giant Hogweed and safety questions is supported by the fact that Latvians took the PowerPoint tutorials in English, which is not their native language. When standard t-tests were run, there was no significant difference in scores found on the GPS test. This and the small, one percent difference in GPS scores may be due to the more illustrated nature of the GPS concepts tutorial, and its lack of difficult words, none of which were named on the surveys.

Section 2: Answering

"What benefits and challenges do students find with the integration of GIS/GPS education in the monitoring of Giant Hogweed?"

In the survey, Latvian students listed several words they found confusing which could likely have affected their answer selections (for example: distinguish, invasive, sap, reforestation, plowing). Many of the incorrectly answered test questions were related to concepts in the tutorials that contain words listed by the students. Students discussed word translations in the classroom. Furthermore, all but one Latvian student either mentioned word confusion or recommended the translation of the tutorials into Latvian. Note that the Latvian students took this test in English, and translation was accomplished after this test project in Latvia in July 2010. This should positively affect the performance of future Latvian students on test and safety questions, and it is expected that further testing would support this idea. In personal interactions, students seemed to understand the purpose and their role in the project, and many were eager not only to gain knowledge and technological experience, but also to help their community. On the Overview/Giant Hogweed test, two picture identification questions were added to the test before it was given to the control and test groups in America. Also, a question on the GPS test asking students to list GPS uses was deleted before it was given to the control and test groups in America because it was deemed difficult to determine if answers to this short-answer question were correct or incorrect.

Many in the control group correctly answered questions that could easily have been remembered from the verbal orientation, and/or answered through process of elimination and educated guess. A problem with using only a verbal orientation to the project is that the Latvian high school teachers may give variable verbal orientations to different groups of students. In this project, the author gave the verbal orientations, and in this study represents the teachers when the project will be implemented in high schools throughout Latvia. Incorrect answer selections were likely due to inconsistent orientation from one participant (or set of participants) to the next. Students generally seemed more confused about what was expected of them and did not seem overly interested or involved in the subject matter. The test group, however, seemed very interested in the subject material, despite distance from Latvia and the inability to directly participate in the map-making process. It appeared as though their access to information generated curiosity, stimulated conversation, and allowed them to form educated questions (for example: Is there Giant Hogweed in the United States? Is it possible for us to contribute to its eradication?).

The fact that only one question was missed by half of the test group supports the idea that students did not show overwhelming trouble with a particular concept and that the questions missed were related to individual participants. Comparisons between students in the test and Latvian groups, in combination with Latvians' frequent note of difficult words, illustrate that issues with the educational component stem from language barriers, not content issues. This evidence supports the need for translation of the PowerPoint tutorials from English to Latvian, and this can be tested further. With the exception of the one question which confused students in the test group, this evidence supports that students feel comfortable with the current textual content in the education component and in the tests, and that no revisions are needed.

The question "How many years will Giant Hogweed remain in the rosette stage before flowering?" appears to have unintentionally tricked half of the participants in the test group due to having two correct answers. It is possible that students read one correct answer selection (b. 1 – 5 years) and selected this option without noticing the second correct answer selection (c. until it is ready). The correct answer was d (both b and c). When a particular participant was shown that he missed this question and asked if he had any comments, he stated that answer selections were confusing and seemingly intended to trick the test taker. The author suggests that the answer selection to this question be reworded to provide straightforward, less convoluted answer choices that will focus more on students' understanding and less on students' ability to decipher cryptic wording.

Students repeatedly complimented the concise bullet-style approach of the PowerPoint, the pictures, and the overall design of the presentation. It is the author's opinion that this style of conveyance helps students maintain focus and helps important points stand out to the reader. Students preferred the PowerPoint tutorials over lecture by instructor because the former approach allowed them to spend time on more difficult concepts and gave them the chance to go back to particular topics for clarification. However, many emphasized that despite liking the ability to work on their own, they felt strongly that access to an instructor would be beneficial in the event that questions arise or further discussion is needed. The picture of a girl standing "too close" to Giant Hogweed in the background appears only to be an optical illusion, but the author believes that because three students cited this without being questioned directly about it, the picture should be replaced to avoid any confusion. The PowerPoint clearly states to stay far from the plant and not to leave the path at any time, and any deviation from this rule should be avoided.

Students in Latvia expressed concern in identifying plants in the rosette stage due to their drastic difference in appearance, as compared with a mature Giant Hogweed plant. The author was aware of this concern when beginning fieldwork with the students. Once the author located and identified plants in the rosette stage, students immediately responded with confidence in the ability to identify young plants in the future. The author recommends that more photographic examples of plants in the rosette stage be added to the tutorials. Additionally, the author recommends that trained teachers provide an example of Giant Hogweed in rosette stage in the field, if possible.

Section 3: Answering

"How can researchers structure an online course that effectively incorporates a fieldwork training component in an international setting?"

Students did not feel confident enough to participate in fieldwork based upon website instructions alone. Most mentioned that step by step directions with illustration would be easier to understand, that bulleted information is clearer, and that long threads of text should be avoided. Students noted that the first page of the website instruction was too verbose and suggested it be condensed to resemble the second and third page of the website instruction. The second and third pages included step by step, concise, and illustrated instructions on how to use a compass. Students suggested the team form a similar instructional approach to demonstrate how to use the Garmin eTrex unit.

After reading the website instructions, students expressed that they would feel more comfortable using the Garmin eTrex unit after someone demonstrated how to use it on an individual basis. Again, it seems that a step by step, concise, and illustrated approach may help ease students' apprehensions about using the device. Additionally, teachers who are trained to use the units may oversee students and help them gain confidence in using the device. A solid instructional foundation, in combination with the availability of this type of technical support, should help students confidently collect accurate data.

Students made various suggestions for condensing information on the website. Less than half of the American participants noted that there was some confusion when navigating through the site. However, note that all twenty students in the test and control groups were physically shown by the author which pages to read and which to skip (some of the website pages did not pertain to the American groups). The majority of students polled said they would prefer the website Garmin eTrex and compass instructions in a format similar to the PowerPoint tutorials. Instructions in PowerPoint form would keep all educational and instructional materials in one place and separated from consent forms, news, etc. Several students suggested that the addition of a language option (perhaps in the form of national flags) at the top of the site's homepage would simplify appearance and navigation by transferring all content to the chosen language at once. This would eliminate the existing, lengthy menu column that lists all headings in both Latvian and English. Another student noticed that the "previous page" and "back page" links were not functioning properly. A survey also revealed that a student felt inundated by text and information at supplementary links, only to find that the same information was covered again, only more concisely, later in the PowerPoint tutorials. The same person thought it would be more logical to move supplementary links from one of the early menu pages to a final menu page, where they would better serve as secondary materials for those who may be interested in seeking additional information.

To improve flow, the author recommends that the research team edit the website page to minimize menu options, reduce excessive text, move supplementary links to the end of the menu, and reduce the number of times students alternate between PowerPoint and website. This will lessen participants' confusion about where it is they are supposed obtain information, and may help improve test scores since the test questions are based upon information found in the tutorials. These improvements will help students navigate without assistance, and ensure that all topics are covered and steps are taken in the correct order.

The author recognizes that the sample sizes were small and that to better test the efficiency and flow of the project components, further tests will be necessary using larger sample groups. Future sample groups should also attempt to better represent both female and male Latvian high school students in the age range of 16-18. Additionally, the newly translated materials should be used. This will allow further analysis which will hopefully validate the results of this research by determining that language issues are the reason for missed questions. The administering of tests with the revised "problem" question (found in the American test group) will hopefully show that the revised question is more straightforward and easily understood by students.

CHAPTER 5

CONCLUSION

While the education component is more time consuming than the verbal orientation, students who read the PowerPoint tutorials were better research partners. These students performed better on general and safety test questions, and they performed with more confidence and accuracy in the data collection process. The implementation of these PowerPoint tutorials will help teachers provide the appropriate information in a consistent manner. Students who completed the tutorials, seemed to better understand the purpose and their role in the project, and many were eager not only to gain knowledge and technological experience, but also to help Latvia address its problem with Giant Hogweed. It is likely that translation of the tutorials into Latvian will have a positive effect on Latvian students' performance and ability to participate in the field. Future studies will allow researchers to determine if the translations result in better test scores for Latvian students.

Students were responsive to self-paced learning by use of PowerPoint tutorials, which enabled them to review difficult topics. However, they stressed the importance of having someone available for questions and for direction when using the Garmin eTrex unit. They liked the appearance and the presentation of important information in a concise, easy to read format. Latvian students had language difficulties in the tutorials and tests, but this has hopefully been corrected through translation. Revisions to a test question perceived as "tricky" will be edited to provide more straightforward answer selections. Photos in the presentation should be edited to maintain students' perceptions of Giant Hogweed as a dangerous and unapproachable plant. Students should be given more photographic examples of Giant Hogweed in the immature, rosette stages, and its presence should be identified in the field.

Participants suggested that the conversion of website instructions into a step by step, illustrated training module in PowerPoint form, which the research team is currently working to create. The website should be edited to amend broken navigational tools, to condense text and menu options, and to clearly separate language options. Supplementary reading should be oriented in manner that is secondary to the success and functionality of the agenda presented by the research team.

While adjustments are needed, this research has contributed significant groundwork for a potentially successful nationwide data collection project in Latvia. Students will gain understanding of geographic technologies and contribute to their local community, while also providing researchers with information that would otherwise be difficult to obtain due to issues of time, money, and distance. Online coursework is an effective way to reach students with consistent materials, but it ideally requires some level of interaction for participants. Therefore, high school teachers will be trained in summer 2011 to lead participants in the project. Further tests will further prepare the research team for implementation of a large-scale, nationwide project to monitor the distribution of Giant Hogweed with the use of online education materials.

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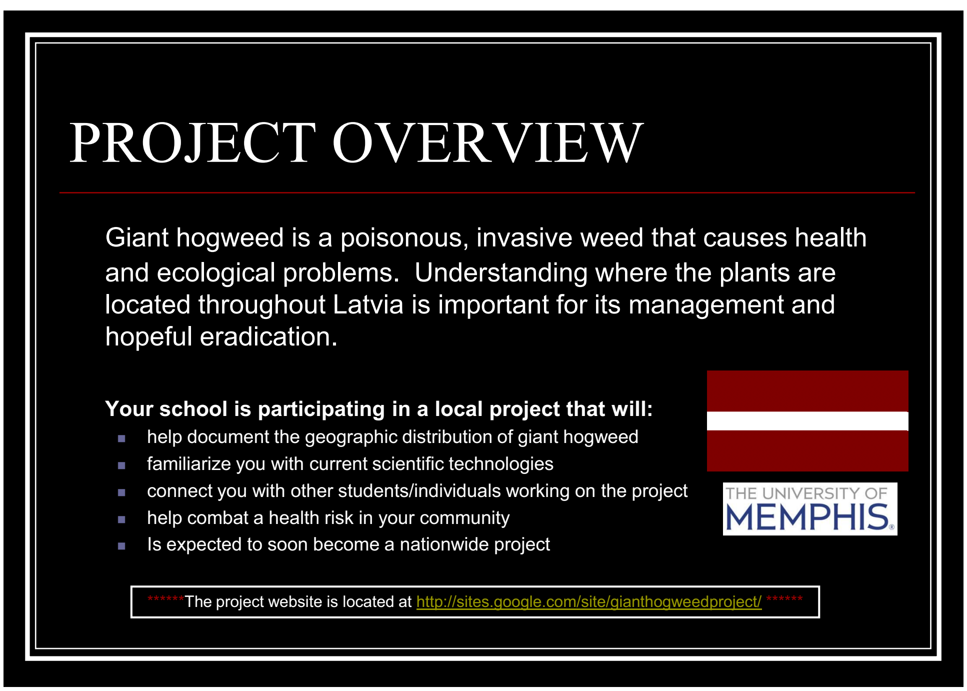
APPENDICES

APPENDIX A



Project Overview - STEPS

1. Each student will complete this tutorial and will be required to pass an exam based on the tutorial.

2. Each student with a passing score and signed consent forms will be lent a Garmin eTrex GPS unit to use for data collection.

3. Students will use the GPS units to **safely** locate and record geographic coordinates of Giant Hogweed in places that students know Giant Hogweed to exist.

Project Overview – STEPS (cont.)

4. Students will upload coordinates and other information to a publicly accessible map at:
   http://sites.google.com/site/gianthogweedproject/gps-input

5. The University of Memphis research team will use the data entry points to create a map of Giant Hogweed distribution, and create models of Giant Hogweed spread.

6. These models will be analyzed in order to assist in management and eradication processes here in Latvia.

7. Students may reference http://sites.google.com/site/gianthogweedproject/ for materials, questions, updates, etc.

PROJECT OVERVIEW

- This tutorial is designed to prepare you for the data collection process. You will learn about:
  - Giant Hogweed characteristics and dangers
  - Global Positioning Systems (GPS)
  - data collection/entry process for you to identify and report where you find Giant Hogweed
- Upon completion of this tutorial, a test will be given to ensure your understanding of materials, processes, and potential dangers.
- A passing test score and signed consent forms are required to allow your participation in the data collection and data entry processes.

GIANT HOGWEED

Giant Hogweed

Photo: http://news.therecord.com/article/561221

What is Giant Hogweed?

- Poisonous, invasive weed
- Found in the northern hemisphere
- Someone first brought it to Europe from the its native territory in the Caucuses (specifically, the region of the Republic of Georgia) in the early 1800s because it was thought to be a pretty garden plant.
- It was used in the Soviet Union to feed cattle during Soviet times, but it made the cattle milk and meat taste like anise. Due to this, Giant Hogweed's use as cattle feed was stopped.

photo: http://www.latvijasdaba.lv/augi/heracleum-mantegazzianum-sommier-et-levier/

Background on Giant Hogweed

Photo: http://www.extension.iastate.edu/CropNews/2008/0511MikeOwen.htm

- Giant Hogweed belongs to a group of plants referred to as *Heracleum.*
- There are about 60 different species of *Heracleum* worldwide.
  - Over 20 of these species have been documented in Europe.
  - Not all *Heracleum* are poisonous, but many are.
- Two **poisonous** species of *Heracleum* that inhabit Latvia fall into the category called Giant Hogweed, and they have large leaves and flower clusters:
  - *Heracleum mantegazzianum*
    - Of the two species found in Latvia, this is the more common.
  - *Heracleum sosnowskyi*
    - less common but still present in Latvia
    - leaves less sharp, more rounded

Identification of Giant Hogweed

- *H. mantegazzianum* and *H. sosnowskyi* are similar in appearance.
  - On average, the appearance of *H. sosnowskyi* is smaller in size and the leaf shape is slightly different.
- Some scientists believe that *H. sosnowskyi* is a smaller hybrid of *H. mantegazzianum* and that there may be other Giant Hogweed hybrids in existence. *(Kabuce 2006)*
- Photos of both Giant Hogweed species found in Latvia are shown throughout this tutorial.
- Due to their physical similarities and dangerous characteristics, it is not necessary to distinguish between the two when you collect and enter data for this project.

Photo: http://news.bbc.co.uk/2/shared/spl/hi/pop_ups/06/sci_nat_top_ten_0wanted0_list/html/4.stm

Identification of Giant Hogweed

- Up to 4-5 m tall when full grown (late June until fall)
- Green stems usually with purple-spot (sometimes solid purple stems) are 5-10 cm in diameter
- Lower leaves up to almost 2 meters across
- White (sometimes pinkish) flowers clustered in umbrella-shaped head, up to 80 cm across
- Each flower cluster holds 30 -150 smaller flower clusters.

(Neilsen, et al 2005)

photo: http://www.psychoshell.narod.ru/HTMLs/Plants.htm

Identification of Giant Hogweed

1. Leaf of *Heracleum* mantegazzianum
2. Flower cluster
3. Leaf of *Heracleum sosnowskyi*
4. Individual flower

Photo: http://dnr.wi.gov/invasives/fact/hogweed_photos.htm

photo: http://www.ecosystema.ru/08nature/flowers/010.htm

Leaves Change Throughout Lifecycle

Early stage of Giant Hogweed growth

Mature stage of Giant Hogweed growth

Giant Hogweed is dangerous to touch at any stage of growth!!

Changes in leaves throughout lifecycle of plant (each of the vertical lines represent s 10 cm)

All images: http://ohioline.osu.edu/anr-fact/hogweed.html

Identification of Giant Hogweed

The "rosette" stage occurs in years before the plant produces flowers. Low-lying, flowerless plants are still poisonous!

Root system of young plant

Purple spotting on stem

Giant Hogweeds have hollow stems.
Note: You should not cut open or even touch these plants!!!

Photos:
http://www.thepoisongarden.co.uk/atoz/heracleum_mantegazzianum.htm
http://ohioline.osu.edu/anr-fact/hogweed.html
http://www.omafra.gov.on.ca/english/crops/hort/news/hortmatt/2006/22hrt06a4.htm
http://www.dowagro.com/uk/nonfood/idpages/gianthogweed.htm

Identification of Giant Hogweed

Mature Giant Hogweed plants are brown in late summer, autumn, and winter, as seen in these photos.

Biological and Reproductive Mechanisms

- Plants may remain in rosette stage for 1-5 years before flowering.
  - However, the plant will not flower in unfavorable conditions (for example: heavy shade, dry conditions, poor nutrients in the soil)
- Some giant hogweed plants may live under the canopy of other plants until they have the opportunity to grow further
- In their final year (directly after the rosette stage), the plant flowers and bears seeds.
- Giant Hogweed can produce over 80,000 flowers per single plant!
- After bearing seeds once, the plant dies.
- About 10% of plants live through an entire life cycle.

(Neilsen, et al 2005)

Life Cycle

Seeds germinate

Plants remain in rosette stage for several seasons until suitable conditions for flower production

Plants begin to flower when mature

Flowers in bloom

Seeds are produced

Dead flower stalks remain after seed production

Photos:
http://www.flickr.com/photos/evaekeblad/590821048/
http://www.thepoisongarden.co.uk/atoz/heracleum_mantegazzianum.htm
http://www.naturalbiodiversity.org/biobullies/giant%20hogweed.shtml
http://www.dowagro.com/uk/nonfood/idpages/gianthogweed.htm
http://www.omafra.gov.on.ca/english/crops/hort/news/hortmatt/2006/22hrt06a4.htm
http://www.ufz.de/index.php?en=18001
http://www.mumblingmountain.com/?cat=1&paged=2

Biological and Reproductive Mechanisms

Clusters contain 20,000-100,000 seeds per plant

photo: http://en.wikipedia.org/wiki/Hogweed

- Reproduction occurs exclusively by seed.
- Both male and female parts are in the same flower
  - self-pollination – isolated individual plants can form new populations
  - cross-pollination – seeds can travel to other plants too
- Average plant bears about 20,000 seeds
  - plants bearing 100,000 seeds have been reported
  - A small percentage of seeds germinate
  - seeds can survive in top soil layers for up to 7 years
  - cold, wet conditions needed for germination to occur
  - seeds germinate easily
    - however, 98% are eliminated through competition
  - plants flower mid-June to late-August
  - seeds are released late-August to October

(Neilsen, et al 2005)

Biological and Reproductive Mechanisms

- Giant Hogweed seeds are dispersed through all of the following ways :
  - Water
    - rivers and streams (consider flooding)
  - Wind
    - especially when the ground is frozen
  - Attaches to animal fur
    - wild and domesticated
  - Humans transport
    - attaches to clothing
    - attaches to vehicle tires
    - flower collectors have transported them

Seeds are about 10 mm long, 5 mm wide

photo: http://plantsgallery.blogspot.com/2009/10/heracleum-sosnowskyi-barszcz.html

Why is Giant Hogweed so invasive?

- There are multiple definitions of the term 'invasive species'. Generally speaking, however, plants that are introduced into a new region, pose negative consequences in that region, and whose numbers grow substantially are considered ***invasive***.
- **Why is Giant Hogweed so invasive?**
  - Germination occurs earlier in the spring compared with native plants
  - Fast growth and large overhang of leaves suppress other plants
    - It "shades out" other plants before their leaves can grow in spring
  - Established plants have low mortality (they rarely die before the natural end of their life cycle)
  - Most plants live long enough to produce seeds
  - It stores ample nutrients in its roots and can wait to flower until conditions are favorable
  - Ability to self-pollinate
  - Plants drop 20,000-100,000 seeds, and these can live a long time.
  - Water, wind, humans, and animals aid seed dispersal
  - Grows easily in abandoned agricultural fields (Latvia has many abandoned fields)

(Neilsen, et al 2005)

Known Distribution
in 2005

- *The Giant Hogweed Best Practice Manual*, published in 2005, printed these maps of Giant Hogweed distribution. It was noted:
  - France and Norway distribution may be over-represented due to data collection method, and
  - *H. sosnowskyi* is known to exist in Belarus, Poland, Russia and Ukraine, but the distribution data is not available.

Heracleum mantegazzianum

Heracleum sosnowskyi

Images and text: (Neilsen, et al 2005)

Distribution in Latvia

- Previous work on obtaining the Giant Hogweed distribution in Latvia
  - A survey in 2001 estimated that Giant Hogweed covers approximately 12,000 hectares within Latvia. (Obolevica 2008)
  - Agnese Priede has identified many cases of Giant Hogweed throughout Latvia using GPS.
  - The Latvian Ministry of Agriculture has published a map of known locations of Giant Hogweed on agricultural lands in Latvia on this website: http://karte.vaad.gov.lv/
- Giant Hogweed thrives in natural areas with little or no landscape maintenance (for example, places that are not mown). This is common in areas such as:
  - abandoned agricultural fields
  - natural meadows
  - along the edges of rivers and streams
  - Along the edges of roadways and railways

Methods for Control

- "Giant Alien Project" 2002-2005
  - About 40 scientists from 8 European universities participated (including Latvian Plant Protection Research Centre)
  - Extensive research done to find best methods of control
- *Giant Hogweed Best Practice Manual* (Nielsen et al 2005) suggests Integrated Weed Management System (IWMS). This means a combination of different techniques are recommended to monitor and manage the weed:
  - Monitoring: various mapping approaches:
    - Aerial photography (planes, satellites)
    - Ground survey (GPS, as we are doing in this project)
  - Management: various control methods:
    - Chemical methods – this can be very damaging to the environment, especially in riverbed locations
    - Mechanical – mowing, plowing
    - Grazing
    - Manual – cutting, digging, umbel removal (must be done by professionals, and after removal, areas must be checked for up to 7 years to be sure new plants do not sprout.)
- Success of control depends on accessibility, number of plants in an area, and funding

(Neilsen, et al 2005)

Health Hazard!
DO NOT TOUCH!!!

- Phototoxic sap causes burns that are intensified by sun exposure!!
  - Sap contains furocoumarin (toxins that cause inflammation)**!!**
  - Furocoumarins may cause cancer and birth defects**!!**
- Sap causes inflammation and reddening of the skin**!!**
- Reaction may take up to 3 days, but may last for months. Affected areas may be sensitive to ultraviolet rays for years**!!**
- Eye contact may result in permanent blindness**!!**
- Ingestion can be fatal**!!**
- Sap may be transferred on skin of livestock and other animals**!!**
- BEWARE OF PLANTS IN ROSETTE STAGE WITHOUT BLOOMS!!
- <u>IF contact is made</u>:
  - wash with soap & water immediately, keep area out of sunlight for 48 hours
  - if in eyes, rinse immediately and wear sunglasses
  - apply topical steroids
  - seek medical advice from a doctor immediately**!!!!**

(Neilsen, et al 2005)

photo: http://www.videsprojekti.lv/en/jaunumi/jaunumi49/

Health Hazard!

- DO NOT TOUCH!!!
- DO NOT TOUCH!!!
- DO NOT TOUCH!!!
- STAY ON THE ROAD/ROADSIDE OR PATH AT ALL TIMES!
- DO NOT GET NEAR THIS PLANT FOR ANY REASON!!
- Stay away from small, rosette stage plants that may be nearby and harder to see!!

DO NOT TOUCH!!!!

These individuals were burned by Giant Hogweed:

http://nyis.info/plants/GiantHogweed.aspx

http://invasiveplantsmi.org/hogweed/Hogweed_right.html

http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/giant-hogweed/hogweed-burns.aspx

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GPS

Global Positioning System (GPS)

- A navigational system that uses satellites to pinpoint locations on Earth. The system consists of three segments:
  - satellites (space segment)
  - receivers (user segment)
  - ground stations (control segment)
- A constellation of 24 satellites were sent into orbit for the exclusive purpose of making GPS available.
- Originally developed by the United States military, but civilians began usage shortly thereafter.
- Accuracy of GPS coordinates taken from a GPS receiver can be as high as within 2-3 cm!
- Works anywhere, anytime, without fee (excluding cost of receivers)

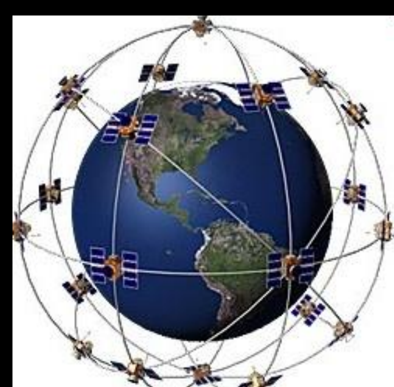


Image and text: http://www8.garmin.com/aboutGPS

GPS – Satellites (space segment)

- 24 GPS satellites are positioned approximately 11,000 miles above the Earth's surface and they each orbit (circle the Earth) every 12 hours.
- Their paths are designed so that at any given time and place on the Earth, there are 4-6 satellites visible above the horizon.
- Each satellite continually sends out a signal that broadcasts its identity and the exact time.
- These satellites are controlled by ground stations around the globe.

Photo: http://www.navigadget.com/index.php/2006/02/28

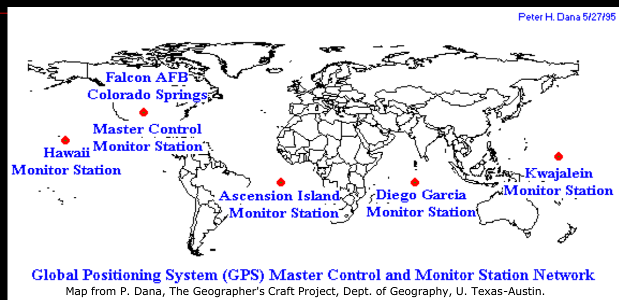
GPS – Receivers (user segment)

- Ground-based GPS devices read and interpret the radio signals from several of the satellites at once.
- The GPS device calculates its distance from each visible satellite based on the time it takes signals from the satellites to reach the hand-held unit (the satellite signals travel at the speed of light).
- Level of accuracy depends on:
  - quality of the receiver
  - user operation of the receiver
  - local & atmospheric conditions
  - current status and location of satellites

Example of a GPS receiver.

Photo: http://www.motogear.co.za/index.php?main_page=product_info&cPath=4&products_id=20

GPS – Ground Stations (control segment)



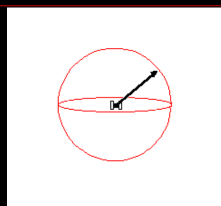
Five control stations

- monitor satellite orbits & clocks
- broadcast orbital data and clock corrections to satellites
- master station at Falcon (Schriever) Air Force Base, Colorado

How it works

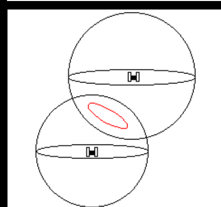
- Each satellite has an accurate clock and transmits the same time signal simultaneously.
- Each satellite signal contains the following information:
  - Satellite number
  - Time transmitted
- The satellite signal is obtained by the receiver and compared with the receiver's internal clock, and thus the receiver can tell how long ago the signal was sent from the satellite.
- It uses this information (and the fact that the signals travel at the speed of light) to calculate the **distance** of the receiver from that satellite.

How It Works (continued)



1 satellite = sphere

When a receiver is *x* miles from a satellite, then it must be somewhere on the sphere with a radius of *x* miles that is centered on that satellite.



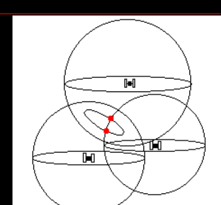
2 satellites = circle

Adding more distance measurements to satellites narrows down your possible position.

When two spheres intersect, a circle is formed. Therefore, when two measurements are taken, your position is now narrowed to a circle.

How It Works (continued)

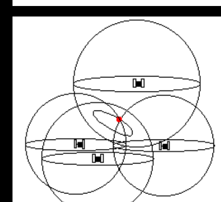
When a third distance measurement is taken, the circle is intersected by a third sphere, leaving the location of the receiver in one of two points.



3 satellites = 2 points

With four satellites and four distances, the previous circle is now one point.

Note: The fourth measurement usually is not needed to determine location. One of the two points most likely is not on the earth's surface. The fourth measurement is important to improve accuracy.



4 satellites = 1 point

GPS Applications

- Vehicle navigation
  - cars, boats, planes
- Geocaching
  - Recreational activity/game that lets players use GPS to locate hidden containers or landmarks:
    - for example: http://www.geocaching.com/
- Other
  - Wildlife tracking
  - Fire/police/medical dispatch
  - Parcel service management
  - Geographic surveying
  - Planning construction
  - Locating Giant Hogweed!

Different GPS receivers

http://en.wikipedia.org/wiki/Global_Positioning_System#Position_calculation_advanced

Example of a geocache containter

http://www.bbc.co.uk/wiltshire/content/image_galleries/wiltshire_05_year_in_pixs_gallery.shtml?6

Garmin eTrex GPS

This is the GPS unit that you will be using to collect data points in the field.

You may refer to instructions for use at http://sites.google.com/site/gianthogweedproject/home/insturctions/how-to-use-the-garmin-etrex-gps

Photo: http://www.biz.nu/

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APPENDIX B

OVERVIEW TEST **NAME**______________________

1. T F Understanding Giant Hogweed distribution is important for its management and control.

2. Which of the following is **NOT** a reason for this project?
   a. help document the geographic distribution of Giant Hogweed
   b. familiarize you with current scientific technologies
   c. connect you with other students/individuals working on the project
   d. help combat a health risk in your community
   e. to help gardeners locate Giant Hogweed for ornamentation

GIANT HOGWEED TEST – Questions marked with a * must be answered correctly to participate in the data collection process. If more than one marked question is answered incorrectly, the student must reread the tutorial and retake the test.

1. T F Giant Hogweed is found in the northern hemisphere

2. T F *H. mantegazzianum* and *H. sosnowskyi* are found only in Latvia.

3. T F All species of *Heracleum* are poisonous.

4. T F It is important to distinguish between *H. mantegazzianum* and *H. sosnowskyi* in the data collection process.

5.* T F Giant Hogweed is only dangerous to touch in the mature stages.

6. T F *Heracleum persicum* is the most common type of poisonous hogweed in Latvia.

7.* T F Giant Hogweed can kill a human.

8.* T F Giant Hogweed *always* has sharp, pointed leaves.

9. T F Lower leaves of a mature Giant Hogweed grow to almost 2m across.

10.* T F It is not dangerous if your clothes touch a Giant Hogweed plant, as long as your skin does not touch it directly.

11. Which of the following is **NOT** true about Giant Hogweed:
   a. Plants wait to produce seeds in favorable conditions.
   b. Plants produce seeds in their final year.
   c. Plants produce seeds every year once maturity is reached.

12. Which of the following is **NOT** true about Giant Hogweed:
   a. Single plants can reproduce without assistance from other plants.
   b. Seeds can travel by water.
   c. Each plant produces about 1,000 – 5,000 seeds.
   d. Giant Hogweed shades out other native plants.

13. What defines an *invasive weed*?
   a. Plants that are introduced into a new region
   b. Plants that cause a negative impact on the environment
   c. Plants whose population grows substantially in number
   d. A combination of all of the above
   e. None of the above

14. Giant Hogweed stems can be
   a. green
   b. green with purple spots
   c. purple
   d. all of the above
   e. none of the above

15. Full grown stems are ____ in diameter.
   a. 2-5 cm
   b. 5-10cm
   c. 11-15cm

16.* Full grown Giant Hogweed can reach ____ tall in Latvia.
   a. 1m
   b. 2m
   c. 3m or higher

17. How many years will Giant Hogweed remain in the rosette stage before flowering?
   a. 1-3 months
   b. 1-5 years
   c. until it is ready
   d. both b and c
   e. none of the above

18. About ___ percent of plants live through an entire life cycle.
  a. 2
  b. 10
  c. 50
  d. 80

19. In Latvia, Giant Hogweed plants flower:
  a. early May to mid July
  b. mid June to late August
  c. late August to October

20. In Latvia, plants release seeds:
  a. early May to mid July
  b. mid June to late August
  c. late August to October

21. Which of the following is **NOT** an attribute of Giant Hogweed that helps it be invasive?
  a. It shades out other plants
  b. The same plant can produce seeds every year.
  c. Only one plant is needed in the reproduction process
  d. Water, wind, humans, and animals help spread seeds
  e. It grows easily in abandoned agricultural fields.

22. Which of the following is **NOT** a method for Giant Hogweed control?
  a. chemical application
  b. mowing/plowing
  c. grazing
  d. cutting and digging
  e. collecting the seeds for household use before they drop
  f. reforestation

23.* Phototoxic sap means:
  a. Plant sap causes burns that are worsened by sun exposure.
  b. Plant sap causes burns that are healed by sun exposure.
  c. None of the above.

24.* Which of the following is **NOT** true about treatment of Giant Hogweed burns?
  a. wash the area with soap and water
  b. apply topical steroids
  c. let the sun dry out the area
  d. stay out of the sun

25. * Which of the following is a photo of Giant Hogweed?

a.  b.  c. 

d. all of the above photos are Giant Hogweed
e. none of the above photos are Giant Hogweed

26.* T F The following is a photo of a mature Giant Hogweed Plant.

______out of 26

______number of * questions missed. This number must not be more than one if the student is to participate in the data collection process.

APPENDIX C

GPS TEST **NAME______________________**

1. T F GPS was originally developed for use of the general public.

2. T F The master control station is at an air force base in Hawaii.

3. T F GPS satellite signals contain only satellite number and time of transmission.

4. T F A GPS unit connects to exactly one satellite.

5. T F Rain clouds can affect GPS accuracy.

6. Distance is calculated
   a. from signals that travel from the satellite at the speed of light.
   b. when the receiver interprets the satellite number and time transmitted from a satellite.
   c. when the Master Control Station releases signals
   d. both a and b
   e. all of the above
   f. none of the above

7. When *one* satellite connects with a receiver and a distance is determined, it implies that the receiver must lie:
   a. somewhere on a sphere centered at the satellite
   b. somewhere on a circle centered at the satellite
   c. on one of two points
   d. at one specific point

8. When *two* satellites connect with a receiver and distances to each are determined, it implies that the receiver must lie:
   a. somewhere on a sphere centered at the satellite
   b. somewhere on a circle centered at the satellite
   c. on one of two points
   d. at one specific point

9. When *three* satellites connect with a receiver and distances to each are determined, it implies that the receiver must lie:

    a. somewhere on a sphere centered at the satellite
    b. somewhere on a circle centered at the satellite
    c. on one of two points, but only one of those is situated on the earth
    d. at one specific point

10. Which of the following is an application that uses GPS technology?

    a. medical dispatch
    b. geocaching
    c. wildlife tracking
    d. all of the above
    e. none of the above

______ of 10

APPENDIX D

WORKSHOP SURVEY **NAME______________________**

Before answering the following questions, please keep in mind that this presentation is meant to teach you and others. We need to know how well it works! Your ideas and opinions will help us make this project successful, so please be honest!!

1. How did you feel about the presentation?
   (1= I did not like it, 5= I liked it)

   1 2 3 4 5

   Comments____

2. How well did you understand the material in this presentation?
(1=not well, 5= very well)

   1 2 3 4 5

   Comments____

3. Based upon the information given in the tutorial, how comfortable did you feel taking the test? (1= not comfortable, 5= very comfortable)

   1 2 3 4 5

   Comments____

4. How comfortable did you feel learning this information without an instructor present?
   (1=not comfortable, 5= very comfortable)

   1 2 3 4 5

   Comments____

5. In general, do you feel comfortable learning on your own and at your own pace, or do you prefer learning in a classroom with an instructor?

   On my own In class with instructor It doesn't matter Other____________

6. Do you prefer to read your class materials from a PowerPoint presentation or from a book?
   PowerPoint Book It doesn't matter Other______________

7. Did you want to ask for help when reading the tutorial?

Yes No

If yes, when?____

8. How well do you think you did on the test?

Bad Fair Good Excellent

9. Once you learn how to use the GPS unit, how comfortable do you feel to participate in this project? (1=not comfortable, 5=very comfortable)

1 2 3 4 5

Comments____

10. How well do you understand the dangers of contact with Giant Hogweed?
(1=not very well, 5=very well)

1 2 3 4 5

Comments____

11. How well do you feel that you can correctly identify Giant Hogweed?
(1= not very well, 5= very well)

1 2 3 4 5

Comments____

12. Are you going to touch Giant Hogweed?!

Yes No Other________________________________

13. Name 2 things you like about the presentation.

____
____
____

14. Name 2 things you did NOT like about the presentation.

____

15. What can we do, if anything, to improve the tutorial and/or test?

16. Please list everything that you did not understand in the **tutorial** (words, sentences, concepts, presentation, slide number, etc.):

17. Please list everything that you did not understand on the **test**.

18. Do you have any other comments?

APPENDIX E

COURSE FLOW SURVEY **NAME______________________**

A. Would you feel comfortable using the GPS based upon your readings on the website alone? Yes___ No_____ Other _______________________________

B. Would you feel more comfortable using the GPS unit once someone showed how to use it? Yes____ No____ Other_____________________________________

C. Would you prefer to have the GPS instructions in a PowerPoint format similar to the other three tutorials?
Yes____ No_____ Other____

D. Were you able to navigate through the website without confusion?
Yes____ No_____ Other____

E. Do you have any comments or suggestions for the website?
____
____
____
____

F. Do you have any comments or suggestions about the project as a whole?
____
____
____
____

APPENDIX F

Table F-1

Overview/Giant Hogweed Test: Test Significance of U.S. Test and U.S. Control

	Levene's Test		t-test for Equality of Means						
								95% C.I. of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances	.07	.79	-8.00	18	.000	-36.90	4.61	-46.59	-27.21
Not equal variances			-8.00	17.86	.000	-36.90	4.61	-46.59	-27.21

Table F-2

Safety questions: Test Significance of U.S. Test and U.S. Control

	Levene's Test		t-test for Equality of Means						
								95% C.I. of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances	4.22	.06	-3.99	18	.001	-28.80	7.21	-43.94	-13.66
Not Equal variances			-3.99	10.24	.002	-28.80	7.21	-44.81	-12.79

Table F-3

GPS Test: Test Significance of U.S. Test and U.S. Control

	Levene's Test		t-test for Equality of Means						
								95% C.I. of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances	1.31	.27	-4.41	18	.000	-23.00	5.22	-33.96	-12.04
Not equal variances			-4.41	16.15	.000	-23.00	5.22	-34.05	-11.95

Table F-4

Overview/Giant Hogweed Test: Test Significance of Latvia and U.S. Test

	Levene's Test		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% C.I. of the Difference Lower	Upper
Equal variances	2.99	.099	-2.41	20	.026	-13.78	5.71	-25.70	-1.86
Not equal variances			-2.51	18.76	.021	-13.78	5.48	-25.27	-2.29

Table F-5

Safety Questions: Test Significance of Latvia and U.S. Test

	Levene's Test		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% C.I. of the Difference Lower	Upper
Equal variances	8.36	.01	-2.31	20	.031	-15.33	6.63	-29.16	-1.51
Not Equal variances			-2.51	13.12	.026	-15.33	6.11	-28.53	-2.14

Table F-6

GPS Test: Test Significance of Latvia and U.S. Test

	Levene's Test		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% C.I. of the Difference Lower	Upper
Equal variances	.56	.46	-.16	20	.878	-1.00	6.45	-14.46	12.46
Not equal variances			-.16	19.99	.876	-1.00	6.34	-14.22	12.22

APPENDIX G

List of Questions: Latvian Group

Which of the following is **NOT** an attribute of Giant Hogweed that helps it be invasive?

a. It shades out other plants
b. The same plant can produce seeds every year.
c. Only one plant is needed in the reproduction process
d. Water, wind, humans, and animals help spread seeds
e. It grows easily in abandoned agricultural fields.

Which of the following is **NOT** a reason for this project?

a. help document the geographic distribution of Giant Hogweed
b. familiarize you with current scientific technologies
c. connect you with other students/individuals working on the project
d. help combat a health risk in your community
e. to help gardeners locate Giant Hogweed for ornamentation

What defines an *invasive weed*?

a. Plants that are introduced into a new region
b. Plants that cause a negative impact on the environment
c. Plants whose population grows substantially in number
d. A combination of all of the above
e. None of the above

Giant Hogweed stems can be

a. green
b. green with purple spots
c. purple
d. all of the above
e. none of the above

How many years will Giant Hogweed remain in the rosette stage before flowering?

a. 1-3 months
b. 1-5 years
c. until it is ready
d. both b and c
e. none of the above

About ___ percent of plants live through an entire life cycle.

a. 2
b. 10
c. 50
d. 80

Which of the following is **NOT** an attribute of Giant Hogweed that helps it be invasive?

a. It shades out other plants
b. The same plant can produce seeds every year.
c. Only one plant is needed in the reproduction process
d. Water, wind, humans, and animals help spread seeds
e. It grows easily in abandoned agricultural fields.

List of Questions Missed: US Control Group

T F It is important to distinguish between *H. mantegazzianum* and *H. sosnowskyi* in the data collection process.

T F Giant Hogweed is only dangerous to touch in the mature stages.

T F *Heracleum persicum* is the most common type of poisonous hogweed in Latvia.

T F Giant Hogweed can kill a human.

T F Lower leaves of a mature Giant Hogweed grow to almost 2m across.

Which of the following is **NOT** true about Giant Hogweed:

a. Plants wait to produce seeds in favorable conditions.
b. Plants produce seeds in their final year.
c. Plants produce seeds every year once maturity is reached.

Which of the following is **NOT** true about Giant Hogweed:

a. Single plants can reproduce without assistance from other plants.
b. Seeds can travel by water.
c. Each plant produces about 1,000 – 5,000 seeds.
d. Giant Hogweed shades out other native plants.

Giant Hogweed stems can be

a. green
b. green with purple spots
c. purple
d. all of the above
e. none of the above

Full grown stems are ____ in diameter.

a. 2-5 cm
b. 5-10cm
c. 11-15cm

How many years will Giant Hogweed remain in the rosette stage before flowering?

a. 1-3 months
b. 1-5 years
c. until it is ready
d. both b and c
e. none of the above

About ___ percent of plants live through an entire life cycle.

a. 2
b. 10
c. 50
d. 80

In Latvia, Giant Hogweed plants flower:

a. early May to mid July
b. mid June to late August
c. late August to October

In Latvia, plants release seeds:

a. early May to mid July
b. mid June to late August
c. late August to October

Which of the following is **NOT** an attribute of Giant Hogweed that helps it be invasive?

a. It shades out other plants
b. The same plant can produce seeds every year.
c. Only one plant is needed in the reproduction process
d. Water, wind, humans, and animals help spread seeds
e. It grows easily in abandoned agricultural fields.

Which of the following is **NOT** a method for Giant Hogweed control?

a. chemical application
b. mowing/plowing
c. grazing
d. cutting and digging
e. collecting the seeds for household use before they drop
f. reforestation

Which of the following is a photo of Giant Hogweed?

a. 

b. 

c. 

d. all of the above photos are Giant Hogweed
e. none of the above photos are Giant Hogweed

T F GPS satellite signals contain only satellite number and time of transmission.

Distance is calculated

a. from signals that travel from the satellite at the speed of light.
b. when the receiver interprets the satellite number and time transmitted from a satellite.
c. when the Master Control Station releases signals
d. both a and b
e. all of the above
f. none of the above

When *one* satellite connects with a receiver and a distance is determined, it implies that the receiver must lie:

a. somewhere on a sphere centered at the satellite
b. somewhere on a circle centered at the satellite
c. on one of two points
d. at one specific point

When *two* satellites connect with a receiver and distances to each are determined, it implies that the receiver must lie:

a. somewhere on a sphere centered at the satellite
b. somewhere on a circle centered at the satellite
c. on one of two points
d. at one specific point

When *three* satellites connect with a receiver and distances to each are determined, it implies that the receiver must lie:

a. somewhere on a sphere centered at the satellite
b. somewhere on a circle centered at the satellite
c. on one of two points, but only one of those is situated on the earth
d. at one specific point

List of Questions Missed: US Test Group

How many years will Giant Hogweed remain in the rosette stage before flowering?

a. 1-3 months
b. 1-5 years
c. until it is ready
d. both b and c
e. none of the above

THE UNIVERSITY OF MEMPHIS

Institutional Review Board

To: Gregory Taff
Earth Sciences

From: Chair, Institutional Review Board
for the Protection of Human Subjects

Subject: **Monitoring the distribution of the invasive, noxious Giant Hogweed (Heracleum mantegazzianum and Heracleum sosnowskyi) in Latvia (H10-81)**

Approval Date: **May 13, 2010**

This is to notify you of the board approval of the above referenced protocol. This project was reviewed in accordance with all applicable statutes and regulations as well as ethical principles.

Approval of this project is given with the following obligations:

1. At the end of one year from the approval date an approved renewal must be in effect to continue the project. If approval is not obtained, the human consent form is no longer valid and accrual of new subjects must stop.
2. When the project is finished or terminated, the attached form must be completed and sent to the board.
3. No change may be made in the approved protocol without board approval, except where necessary to eliminate apparent immediate hazards or threats to subjects. Such changes must be reported promptly to the board to obtain approval.
4. The stamped, approved human subjects consent form must be used. Photocopies of the form may be made.

This approval expires one year from the date above, and must be renewed prior to that date if the study is ongoing.

____

Approved

THE UNIVERSITY OF MEMPHIS

Notice of Human Subject Project Completion

To: Chair, Institutional Review Board
for the Protection of Human Subjects
Administration Building, Room 315

From: Gregory Taff
Earth Sciences

Subject: Monitoring the distribution of the invasive, noxious Giant Hogweed (Heracleum mantegazzianum and Heracleum sosnowskyi) in Latvia (H10-81)

Date:

This is to notify the Board that the above research project is no longer active.

1. The number of subjects finally enrolled in the research;

2. A description of any adverse events or unanticipated problems involving risks to subjects or complaints about the research;

3. A summary of any recent literature findings, or other relevant information associated with the research;

4. Any publications generated from the research project.

____
Gregory Taff, Investigator

____
Date

CONSENT FORM #1: <u>STUDENT</u> (found online here: http://sites.google.com/site/gianthogweedproject/consent-form-for-students-under-age-18)

Dear Interested Participant:

We are conducting a study to create a public online map of locations of Giant Hogweed in Latvia. This study and map can be used to increase awareness in Latvia about Giant Hogweed, and to help plan control and eradication procedures for Giant Hogweed. This study involves research, and we are asking for help from high school students, teachers, college students, and land managers in Latvia.

If you choose to participate in this study, you will be loaned a handheld Global Positioning Systems (GPS) device and a field notebook, and you will use your local knowledge about where Giant Hogweed plants are located to record your geographic coordinates while you are standing near these plant(s). GIANT HOGWEED IS DANGEROUS. YOU SHOULD NEVER TOUCH GIANT HOGWEED. ALWAYS STAND AT LEAST 3 METERS AWAY FROM GIANT HOGWEED.

In your field notebook, you will record the geographic coordinates of your location near the Giant Hogweed plant(s) using the GPS device, in addition to the bearing (direction) and your best estimate of the distance from where you are standing to the Giant Hogweed. When you have completed, you will go online and record this information on this website: http://sites.google.com/site/gianthogweedproject/gps-input.
On this website, you will be able to see a map of the points you and all other participants recorded. This is the first study we know of anywhere that will incorporate the public in using GPS to identify locations of an invasive weed. Participating in this study is expected to take approximately 3 - 5 hours (it will take 2 - 3 hours to collect data, and 1 - 2 hours to enter the collected data online).

<u>CAUTIONS</u>:

- THE SAP ON GIANT HOGWEED IS VERY DANGEROUS. Touching Giant Hogweed can give you serious burns, and potentially permanent scars. If you touch Giant Hogweed sap to your eyes, it may cause blindness! It is absolutely critical that you DO NOT TOUCH THE GIANT HOGWEED. Stay at least 3 meters away from the Giant Hogweed to be safe. You should warn friends and family members about the dangers of Giant Hogweed, since it is all around us in Latvia.
  If you do touch the Giant Hogweed, the Giant Hogweed sap on your skin will make your skin very sensitive to the sun – the sun is what actually causes the burns, and serious burns can develop within 15 minutes. Therefore, if you touch Giant Hogweed, immediately cover your skin in thick clothing until you can wash your skin. Wash your skin with soap and water as soon as possible. Then immediately go to a hospital or consult a doctor, and keep the affected area out of the sun!

- If you choose to walk or bicycle to the Giant Hogweed locations, be aware of traffic, and as always, stay on the sidewalks or shoulders of the roads.

- If you choose to walk to or bicycle to collect the GPS data, to avoid overexposure to the elements, be sure to dress appropriately for the weather.
- The University of Memphis does not have any funds budgeted for compensation for injury, damages, or other expenses.

<u>BENEFITS</u>:
The benefits to you from this study are that you will better understand how to avoid the risks you face every day living in a country where Giant Hogweed is all around you. In addition, you will be a part of an important effort to map and control/eradicate Giant Hogweed within Latvia. The results of this study will be presented to multiple government agencies and non-government organizations to help them plan ways to control/eradicate Giant Hogweed. In addition, the information you and other participants provide will be available online to the public.

The data you record on the website will have your name attached to it. Therefore, anyone in the world may access this information. The Giant Hogweed coordinates you enter, your name, the date you collected data, and any photos or stories you choose to post along with it will *not* be confidential.

If you have any questions about this project, please contact the high school teacher in charge of your class. If you have further questions, have the high school teacher contact Dr. Gregory N. Taff. If your high school teacher is unable to contact Dr. Taff, then you should contact him yourself. If there are any injuries related to this project, please let Dr. Gregory N. Taff know immediately. You may contact him by:

email: gntaff@memphis.edu
mobile phone: +1 (919) 593-4858
address: Department of Earth Sciences.
230 Johnson Hall
University of Memphis
Memphis, TN 38152
USA

If you have any questions regarding the rights of research subjects, you may contact the Chair of the Institutional Review Board for the Protection of Human Subjects at the University of Memphis in Memphis, Tennessee, USA at the phone number: (+1) 901-678-2533, or at the following address:
Chair of Institutional Review Board for the Protection of Human Subjects
Office of Research Support Services
Administration Building, room 315
Memphis, TN 38152

I, the undersigned, have read and fully understand the text in this document. I understand that participation in this study is voluntary; refusal to participate will involve no penalty and I may discontinue participation at any time without penalty. I understand that no grade at school will be affected by my decision to participate or not participate in this study. I assert that I am at least 15 years of age, and physically capable of walking outside for 3 hours without a risk to my health. In addition, I understand the risks of Giant Hogweed, and that touching it could cause permanent scarring and even blindness if my eyes touch it. I understand that I am responsible for dealing with any injuries that may occur related to this study.

CONSENT FORM #2: PARENT/GUARDIAN (found online here: http://sites.google.com/site/gianthogweedproject/home/permission-slip)

Dear Parent/Guardian:

We are conducting a study to create a public online map of locations of Giant Hogweed in Latvia. This study and map can be used to increase awareness in Latvia about Giant Hogweed, and to help plan control and eradication procedures for Giant Hogweed. This study involves research, and we are asking for help from high school students, teachers, college students, and land managers in Latvia.

If you choose to allow your child to participate in this study, your child will be loaned a handheld Global Positioning Systems (GPS) device and a field notebook, and he/she will use his/her local knowledge about where Giant Hogweed plants are located to record his/her geographic coordinates while he/she is standing near these plant(s). GIANT HOGWEED IS DANGEROUS. YOUR CHILD SHOULD NEVER TOUCH GIANT HOGWEED. YOU AND YOUR CHILD SHOULD ALWAYS STAND AT LEAST 3 METERS AWAY FROM GIANT HOGWEED. You may join your child when conducting this project if you wish.

In your child's field notebook, he/she will record the geographic coordinates of his/her location near the Giant Hogweed plant(s) using the GPS device, in addition to the bearing (direction) and his/her best estimate of the distance from where he/she is standing to the Giant Hogweed. When he/she has completed, he/she will go online and record this information on this website: http://sites.google.com/site/gianthogweedproject/gps-input.
On this website, he/she will be able to see a map of the points he/she and all other participants recorded. This is the first study we know of anywhere that will incorporate the public in using GPS to identify locations of an invasive weed. Participating in this study is expected to take approximately 3 - 5 hours (it will take 2 - 3 hours to collect data, and 1 - 2 hours to enter the collected data online).

CAUTIONS:

- THE SAP ON GIANT HOGWEED IS VERY DANGEROUS. Touching Giant Hogweed can give your child serious burns, and potentially permanent scars. If your child touches Giant Hogweed sap to his/her eyes, it may cause blindness! It is absolutely critical that he/she DOES NOT TOUCH THE GIANT HOGWEED. He/she should stay at least 3 meters away from the Giant Hogweed to be safe. You should warn friends and family members about the dangers of Giant Hogweed, since it is all around us in Latvia. If your child does touch the Giant Hogweed, the Giant Hogweed sap on his/her skin will make the skin very sensitive to the sun – the sun is what actually causes the burns, and serious burns can develop within 15 minutes. Therefore, if your child touches Giant Hogweed, he/she should immediately cover his/her skin in thick clothing until he/she can wash his/her skin. He/she should wash his/her skin with soap and water as soon as possible. Then he/she should immediately go to a hospital or consult a doctor, and keep the affected area out of the sun!

- If your child chooses to walk or bicycle to the Giant Hogweed locations, he/she should be aware of traffic, and as always, stay on the sidewalks or shoulders of the roads.
- If your child chooses to walk to or bicycle to collect the GPS data, to avoid overexposure to the elements, be sure he/she dresses appropriately for the weather.
- The University of Memphis does not have any funds budgeted for compensation for injury, damages, or other expenses.

<u>BENEFITS</u>:
The benefits to your child from this study are that he/she will better understand how to avoid the risks he/she faces every day living in a country where Giant Hogweed is all around. In addition, he/she will be a part of an important effort to map and control/eradicate Giant Hogweed within Latvia. The results of this study will be presented to multiple government agencies and non-government organizations to help them plan ways to control/eradicate Giant Hogweed. In addition, the information your child and other participants provide will be available online to the public.

The data your child records on the website will have his/her name attached to it on the website. Therefore, anyone in the world may access this information. The Giant Hogweed coordinates your child enters, his/her name, the date he/she collected data, and any photos or stories your child chooses to post along with it will *not* be confidential.

If you have any questions about this project, please contact the high school teacher in charge of your child's class. If you have further questions, have the high school teacher contact Dr. Gregory N. Taff. If your child's high school teacher is unable to contact Dr. Taff, then you or your child should contact him yourself. If there are any injuries related to this project, please let Dr. Gregory N. Taff know immediately. You may contact him by:
email: gntaff@memphis.edu
mobile phone: +1 (919) 593-4858
address: Department of Earth Sciences.
230 Johnson Hall
University of Memphis
Memphis, TN 38152
USA

If you or your child have any questions regarding the rights of research subjects, you or your child may contact the Chair of the Institutional Review Board for the Protection of Human Subjects at the University of Memphis in Memphis, Tennessee, USA at the phone number: (+1) 901-678-2533, or at the following address:
Chair of Institutional Review Board for the Protection of Human Subjects
Office of Research Support Services
Administration Building, room 315
Memphis, TN 38152

Your child is invited to participate in this project with the consent of their teacher. Before your child can participate in the project, he/she must undertake a training program and give consent indicating that he/she is aware of the risks of Giant Hogweed. We are asking for permission to include your child in this study.

I, the undersigned, have read and fully understand the text in this document. I understand that my child's participation in this study is voluntary; refusal to participate will involve no penalty for me or my child. My child may discontinue participation at any time without any penalty, and I may retract consent for my child to participate at any time without penalty. To retract consent at any time, I will contact my child's teacher and send an email to Dr. Gregory N. Taff (gntaff@memphis.edu) or call him at (+1) 919-593-4858. I understand that my child's grades at school will not be affected by my and my child's decision to participate or not participate in this study. I assert that my child is at least 15 years of age, and physically capable of walking outside for 3 hours without a risk to his/her health. In addition, I understand the risks of Giant Hogweed, and that touching it could cause permanent scarring and even blindness if eyes come in contact with Giant Hogweed sap. I understand that my child and I are responsible for dealing with any injuries that may occur related to this study.

CONSENT FORM #3: HIGH SCHOOL TEACHERS (found online here: http://sites.google.com/site/gianthogweedproject/consent-form-for-teachers)

Dear Teacher:

We are conducting a study to create a public online map of locations of Giant Hogweed in Latvia. This study and map can be used to increase awareness in Latvia about Giant Hogweed, and to help plan control and eradication procedures for Giant Hogweed. This study involves research, and we are asking for help from high school students, teachers, college students, and land managers in Latvia.

If you choose to participate in this study, you will be given a handheld Global Positioning Systems (GPS) device and a field notebook for your class to use, and your students will use their local knowledge about where Giant Hogweed plants are located to record geographic coordinates near these plant(s). GIANT HOGWEED IS DANGEROUS. YOU AND YOUR STUDENTS SHOULD NEVER TOUCH GIANT HOGWEED. YOU AND YOUR STUDENTS SHOULD ALWAYS STAND AT LEAST 3 METERS AWAY FROM GIANT HOGWEED.

If you participate in this study, a GPS device and a field notebook will be given to you. You will be asked to loan the GPS device and the field notebook to eligible students, one at a time. They will record the geographic coordinates of their locations as they stand near the Giant Hogweed plant(s) using the GPS device, and they will also record the bearing (direction) and their best estimates of the distance from where they are standing to the Giant Hogweed. When they have completed, they will go online and record this information on this website: http://sites.google.com/site/gianthogweedproject/gps-input.
On this website, they will be able to see a map of the points they and all other participants recorded. This is the first study we know of anywhere that will incorporate the public in using GPS to identify locations of an invasive weed. Participating in this study is expected to take a few months, as you will oversee your students taking the online course and you will loan the GPS device and field notebook to eligible students, one at a time, to collect data.

To participate in this study, you need to agree to the following requirement to ensure the safety of your students, and to prevent liability problems for your school and the University of Memphis. You must agree to not loan the GPS device and the field notebook to any student unless they have completed the following requirements:

1. the student has passed the test based on the online-course,
2. you have received an electronically-signed consent from the student,
3. you have received an electronically-signed consent form from the student's parent or guardian, and
4. you have received a paper consent form with an original signature from the student's parent or guardian.

To participate in this study, you must also agree that after receiving the paper consent form with an original signature from the student's parent or guardian, you must verify receipt of this form by putting your initials in the appropriate box online on the Project website before loaning the GPS device and the field notebook to any student. This verification will inform the Research Team that you have received the paper parent/guardian consent form. The parent/guardian consent form may be printed from the Study website.

To participate in this study, you must also agree to allow the data collection by your students to be completely voluntary. Student participation (or lack of participation) in the study may not affect their grade in your class.

CAUTIONS:

5. THE SAP ON GIANT HOGWEED IS VERY DANGEROUS. Touching Giant Hogweed can give anyone serious burns, and potentially permanent scars. If one of your students touches Giant Hogweed sap to his/her eyes, it may cause blindness! It is absolutely critical that NO ONE TOUCH THE GIANT HOGWEED. Students should stay at least 3 meters away from the Giant Hogweed to be safe. You should encourage your students to warn friends and family members about the dangers of Giant Hogweed, since it is all around us in Latvia.
   If one of your students does touch the Giant Hogweed, the Giant Hogweed sap on his/her skin will make the skin very sensitive to the sun – the sun is what actually causes the burns, and serious burns can develop within 15 minutes. Therefore, if one of your students touches Giant Hogweed, he/she should immediately cover his/her skin in thick clothing until he/she can wash his/her skin. He/she should wash his/her skin with soap and water as soon as possible. Then the student should immediately go to a hospital or consult a doctor, and keep the affected area out of the sun!
6. If your students choose to walk or bicycle to the Giant Hogweed locations, they should be aware of traffic, and as always, stay on the sidewalks or shoulders of the roads.
7. If your students choose to walk to or bicycle to collect the GPS data, to avoid overexposure to the elements, remind them to dress appropriately for the weather.
8. The University of Memphis does not have any funds budgeted for compensation for injury, damages, or other expenses.

BENEFITS:

The benefits to your student from this study are that they may gain excitement about science by participating in a scientific research study at an early age, and they will better understand how to avoid the risks they face every day living in a country where Giant Hogweed is all around. In addition, your students will be a part of an important effort to map and control/eradicate Giant Hogweed within Latvia. The results of this study will be presented to multiple government agencies and non-government organizations to help them plan ways to control/eradicate Giant Hogweed. In addition, the information your students and other participants provide will be available online to the public.

By participating, you agree to remind the students that the data they record on the website will have their names attached to it on the website. Therefore, anyone in the world may access this information. The Giant Hogweed coordinates your students enter, their name, the date they collected data, and any photos or stories your students choose to post along with the data will *not* be confidential. This information will also be given to the students in the online course.

If you or your students have any questions about this project, please contact Dr. Gregory N. Taff. If there are any injuries related to this project, please let Dr. Gregory N. Taff know immediately. You may contact him by:

email: gntaff@memphis.edu
mobile phone: +1 (919) 593-4858
address: Department of Earth Sciences.
230 Johnson Hall
University of Memphis
Memphis, TN 38152
USA

If you or your students have any questions regarding the rights of research subjects, you or your students may contact the Chair of the Institutional Review Board for the Protection of Human Subjects at the University of Memphis in Memphis, Tennessee, USA at the phone number: (+1) 901-678-2533, or at the following address:

Chair of Institutional Review Board for the Protection of Human Subjects
Office of Research Support Services
Administration Building, room 315
Memphis, TN 38152

I, the undersigned, have read and fully understand the text in this document. I understand that my participation in this study is voluntary; refusal to participate will involve no penalty for me or my students. I may discontinue participation at any time without any penalty. If I do so, no more students in my class will participate in this study. I agree to only loan the GPS device and the field notebook to a student when 1) he/she has passed the test on the online course, 2) he/she has electronically signed an online consent form, and 3) the student's parent/guardian has electronically signed an online consent form. I also agree to allow participating in this research study to be completely voluntary for my students – their participation or lack thereof will not affect their grade or bring them other benefits or punishments in class. If any harm comes to any of my students through this research process, I will contact Dr. Gregory N. Taff as soon as possible by email (gntaff@memphis.edu) or phone (+1) 919-593-4858.

CONSENT FORM #4: OTHER INTERESTED ADULTS (found online here: http://sites.google.com/site/gianthogweedproject/consent-form-for-interested-adults)

Dear Future Research Partner:

We are conducting a study to create a public online map of locations of Giant Hogweed in Latvia. This study and map can be used to increase awareness in Latvia about Giant Hogweed, and to help plan control and eradication procedures for Giant Hogweed. This study involves research, and we are asking for help from high school students, teachers, college students, and land managers in Latvia.

If you choose to participate in this study, you will need to obtain use of a handheld Global Positioning Systems (GPS) device and a field notebook, and you will use your local knowledge about where Giant Hogweed plants are located to record your geographic coordinates while you are standing near these plant(s). GIANT HOGWEED IS DANGEROUS. YOU SHOULD NEVER TOUCH GIANT HOGWEED. ALWAYS STAND AT LEAST 3 METERS AWAY FROM GIANT HOGWEED.

In your field notebook, you will record the geographic coordinates of your location near the Giant Hogweed plant(s) using the GPS device, in addition to the bearing (direction) and your best estimate of the distance from where you are standing to the Giant Hogweed. When you have completed, you will go online and record this information on this website: http://sites.google.com/site/gianthogweedproject/gps-input.
On this website, you will be able to see a map of the points you and all other participants recorded. This is the first study we know of anywhere that will incorporate the public in using GPS to identify locations of an invasive weed. Participating in this study is expected to take approximately 3 - 5 hours (it will take 2 - 3 hours to collect data, and 1 - 2 hours to enter the collected data online).

CAUTIONS:

9. THE SAP ON GIANT HOGWEED IS VERY DANGEROUS. Touching Giant Hogweed can give you serious burns, and potentially permanent scars. If you touch Giant Hogweed sap to your eyes, it may cause blindness! It is absolutely critical that you DO NOT TOUCH THE GIANT HOGWEED. Stay at least 3 meters away from the Giant Hogweed to be safe. You should warn friends and family members about the dangers of Giant Hogweed, since it is all around us in Latvia.
   If you do touch the Giant Hogweed, the Giant Hogweed sap on your skin will make your skin very sensitive to the sun – the sun is what actually causes the burns, and serious burns can develop within 15 minutes. Therefore, if you touch Giant Hogweed, immediately cover your skin in thick clothing until you can wash your skin. Wash your skin with soap and water as soon as possible. Then immediately go to a hospital or consult a doctor, and keep the affected area out of the sun!

10. If you choose to walk or bicycle to the Giant Hogweed locations, be aware of traffic, and as always, stay on the sidewalks or shoulders of the roads.

11. If you choose to walk to or bicycle to collect the GPS data, to avoid overexposure to the elements, be sure to dress appropriately for the weather.
12. The University of Memphis does not have any funds budgeted for compensation for injury, damages, or other expenses.

BENEFITS:
The benefits to you from this study are that you will better understand how to avoid the risks you face every day living in a country where Giant Hogweed is all around you. In addition, you will be a part of an important effort to map and control/eradicate Giant Hogweed within Latvia. The results of this study will be presented to multiple

government agencies and non-government organizations to help them plan ways to control/eradicate Giant Hogweed. In addition, the information you and other participants provide will be available online to the public.

The data you record on the website will have your name attached to it. Therefore, anyone in the world may access this information. The Giant Hogweed coordinates you enter, your name, the date you collected data, and any photos or stories you choose to post along with it will *not* be confidential.

If you have any questions about this project, please contact Dr. Gregory N. Taff. If there are any injuries related to this project, please let Dr. Taff know immediately. You may contact him by:
email: gntaff@memphis.edu
mobile phone: +1 (919) 593-4858
address: Department of Earth Sciences.
230 Johnson Hall
University of Memphis
Memphis, TN 38152
USA

If you have any questions regarding the rights of research subjects, you may contact the Chair of the Institutional Review Board for the Protection of Human Subjects at the University of Memphis in Memphis, Tennessee, USA at the phone number: (+1) 901-678-2533, or at the following address:
Chair of Institutional Review Board for the Protection of Human Subjects
Office of Research Support Services
Administration Building, room 315
Memphis, TN 38152

I, the undersigned, have read and fully understand the text in this document. I understand that participation in this study is voluntary; refusal to participate will involve no penalty and I may discontinue participation at any time without penalty. I assert that I am at least 18 years of age, and physically capable of walking outside for 3 hours without a risk to my health. In addition, I understand the risks of Giant Hogweed, and that touching it could cause permanent scarring and even blindness if my eyes touch it. I understand that I am responsible for dealing with any injuries that may occur related to this study.