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Zurich-Basel Plant Science Center

Final Report

Annex I: Scientific Report AGORA / PSC Plant Science

Family Program, CRAG-3_139921, 01.05.2012 to 31.10.2015

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1 Progress of the PSC Plant Science Family Program

1.1. Objectives of the program

Our future depends on rising the next generation of plant scientists. PSC Plant Science Family Program is a family-oriented outreach program that the Zurich-Basel Plant Science Center (PSC) initiated to engage with families and children between 2013 – 2015. The program aims to make the research of our network accessible, to inspire young people to pursue a scientific career and to raise awareness for plant-relevant issues and their importance for everyday life. With the PSC Family Program, the PSC wanted to cumulate its various outreach activities in a format that is dedicated towards a target group with large multiplier effect for the future: the younger generation. In 2013 and 2014 the PSC organized **PSC Plant Science Family Expeditions with the themes “Plant Breeding for the Future” and “Dealing with Global Change in the Swiss Alps”** to raise awareness about current trends and challenges in plant science research. Additionally we organized family workshops, youth workshops, classroom trainings, teacher’s trainings with large multiplier effect, lab visits with workshops for youth, and family excursions. We wanted to show youth (age 10 – 16) and their families how plant scientists work. **From 2013 - 2014 the PSC carried out 7 expeditions and 8 workshops and 7 classroom / teacher trainings with a number of participants of +520.**

Additionally the PSC also contributed within the program to International **Fascination of Plant Days (2012, 2013, 2014)**. The successful launch of the Fascination of Plant Day in 2012 justified for repetitions in 2013 and 2014. Due to the high awareness of the public towards this day we used the opportunity to link our family workshops and high school classes within this channel focusing on both AGORA topics: plant breeding and global change.

The main conceptual deviation from the original concept was the development of “Pflanzen und Technik Workshops” for teens and pre-teens. These were developed with the same main aim of engaging youth with plant sciences but the format was adapted to meet their preferences and interests and to reach a wider socio-economic group. Educated, middle-class (but ethnically diverse) parents attended the family expeditions with children mostly under 12; there were a few 13-14 year olds. The “Pflanzen und Technik Workshops” conceived with the Tüftellabor and marketed and co-financed through the Stadt Zürich Schul- und Sportamt facilitated participation from a wider social group and 12-16 year-olds participated as it was with their social cohort. An additional reason for developing this format was to take a long-term perspective by embedding the PSC activities in an

[Detailed Reporting in Section 6.3]	researchers the young people formulate their concern and their expectation towards plant science research	5 participant (planned 120, -94%) 1 supervising researchers (100%) Documentation and summary of the workshops at webpage (not implemented yet)	
Geocaching Trail [Detailed Reporting in Section 6.4]	The geocaching trail will link the activities of the expedition on global change with the surrounding landscape	1 Geocaching trail (100%) 1 permanent earth cache registered at: www.swissgeocache.ch 470 visitors (100%)	2013 – 2014
Workshops: “Pflanzen und Technik “ [Detailed Reporting in Section 6.5]	Tinkering for Teens and Preteens at the interface between plant sciences and technique	4 workshops, 43 participants	2013 – 2014
Scientifica [Detailed Reporting in Section 6.6]		1 installation 1 science café (+100%), +3000 participants	2013
SCNAT Forschung Live	City walk with botanists on the subject of invasive plants	2 Walks in Basel and Zürich 100%	2015
Webpage	Webpage with feedback and summaries from the expeditions	1 Webpage (100%) 1 Facebook Page with 213 likes, 735 top posts reach (21.5.13) (+100%)	2013 - 2014
Booklets	Booklet with children’s drawing Booklet with the experiments and all didactic material to carry out the activities at home or in school classes and at science fairs	2 editions: 500 print (100%) Will be published in Feb 2015 (100%)	2012 2015

2 Achievements

The main aims of the Plant Science Family Expeditions as stated in the proposal was to engage families with 10-16 year old children with plant sciences and to facilitate a dialogue with scientists about “Plant Breeding for the Future” and “Dealing with Global Change in the Swiss Alps”. In implementing the program the aims were not deviated from. The methods were adapted and re-designed to more accurately achieve those aims in a way that would maintain long-term support from scientists and embed the program in a network of other events and partners, thus setting it on the path to sustainability. From expert advice it was decided that a science-fair parcour was not

conducive to the intense level of exchange we aimed at between scientists and families. In order to achieve this aim we refined the expedition concept whereby the families and scientists were together for a whole day or in the case of the Furka an overnight expedition. As a consequence participation numbers per expedition needed to be smaller, with repetitions to compensate for the numbers. By August 2014 we have carried out 7 (instead of 2) expeditions, 8 family workshops and 7 high school classes/teacher trainings each of 1-3 days, with the number of participants of +520.

Participation in Scientifica 2013 with a science café on “Von Neophyten bis GMOs, Risikopflanzen?” and the “ETHZ und UZH Info-Tage für Gymnasiasten” with a dialogue facilitating exhibition and Science Cafés directly engaged a further 500-600 people. +3000 visitors visited the accompanying installation.

Altogether 27 researchers and 11 students got the opportunity to present their research to young people, or engage with the public at science cafés (Table 3).

The intensive marketing campaign such as the distribution of ca. 20,000 flyers, the inclusion in the city of Zürich “Fit und Ferien” program 3 times which each time had a circulation of 28,000 and linking and advertising on social media has ensured a high secondary impact. **The Plant Science Expeditions Facebook page currently has 213 likes and in May 2013 posts reached up to 735 persons.** Events were also created to advertise workshops and expeditions and these were shared on the pages of for example Lola Brause (2462 likes), Pro Juventute (9666 likes), Single mit Kind (4000 likes) Infoklick (2188 likes) WWF Schweiz (27,000 likes) and many more. In May 2013 we paid advertising to boost posts and likes and although the posts reached a specific target audience of over 600,000 (parents of 6-18 year olds, who liked nature/gardening/science, lived in Switzerland, spoke German), however, the paid advertising did not significantly boost likes or attendance at events. Therefore, these marketing channels were replaced in 2014 towards a more targeted marketing in the most successful channels.

1.1 Delays

There was an unavoidable delay to the start of the program as the science communicator was not hired until July 2012 and a year’s lead time was required to set up the expeditions. Therefore, the program was extended to October 2014.

1.2 Schedule and Milestones

Overview of the milestones derived in the project 2012 – April 2014. An extension of the project from May until October 2014 allowed all milestones to be reached.

Table 2 Milestones reached within the program duration

Milestone Description	Due date
Milestone 1 Set up and carry out "Fascination of Plants Day"	2012, May 18 2013, May 18 2014, May 18
Milestone 2 Expedition "Plant Breeding for the Future"	2013, June 29
Milestone 3: Expedition "Alpine Pflanzen im Wandel - Invasiven Neophyten auf der Spur"	2013, July 6 and 14 2014, July 6
Expedition "Dealing with Global Change in the Swiss Alps"	2013, July 20-21 2014, August 9-10
Milestone 4: Advertisement and promotion of events	Continuously – see section 5 in this report
Milestone 5: Further Outreach Activities <ul style="list-style-type: none"> • Training – how to communicate with young people • Publication of book: Die faszinierende Welt der Pflanzen • Publication of book: Pflanzenwissenschaftliche Experimente für Familien, Schulklassen und Wissenschaftskommunikatoren • Set up of Geocaching trail • Additional Workshops "Pflanzen und Technik" for young people • Participation in Scientifica 	2014, July 7 2012, Dec and 2013, May 2015, Feb (<i>proposed: Oct 2014</i>) June – October 2013; June – October 2014 2013: April 24 – 26., September 21 –23 2014, February 21- 23, October 15-17 2013, August 26 – September 5

3 Sustainability of the Program after October 2014

Another reason for extending the program was to enable its sustainability. Non-academic Partners outside the research institutions find it important that partnerships extend beyond the short funding opportunities of the SNF. If we are to create a culture of science in Switzerland then outreach programs need to be funded for more than 2 years as it takes time to build up "brand" recognition with the audience and a network of strong partners.

As we started the marketing for the expeditions it became clear that families go to trusted and well known programs (“Fit und Ferien” or Pro Juventute Ferienplausch) so we linked the expeditions to existing outreach platforms with a large multiplier effect.

We have received co-funding from the Stadt Zürich Schuldepartment for the youth workshops and 3 year funding 2014-2016 from the Gebert Rüt Stiftung for the new summer camps (Camp Discovery) with Science et Cité which developed from the expeditions concept. We received supplementary funding from the SGG for the 2014 Expedition “Global Change in the Swiss Alps” with Prof. Christian Körner. In order to create strong partnerships it is desirable to extend the Agora program to ensure a smooth transition to sustainability. The continuation of the Family Expedition to the research station ALPFOR on the Furkapass is a sustainable outcome of the project. It was held again this year, led from Basel and we aim to continue running it every year, subject to funding. The Geocache trail is also still installed on the Furkapass for the foreseeable future.

4 Achievements of Members of the Project Team

The program was initiated by Dr. Melanie Paschke and Dr. Manuela Dahinden, managing directors of the Zurich-Basel Plant Science Center and Prof. Ueli Grossniklaus from University of Zurich. They jointly managed this project. Melanie lead the project team, developed the didactical concepts of all contents and designed the impact analysis; Manuela was responsible for communication activities and supervised Juanita Schläpfer. Juanita Schläpfer worked as science communicator and coordinated the activities, encouraging and embedding the activities of the PSC scientists. The program was supported by the effort of PSC staff members: Dr. Franziska Humair (former PSC member until 2012, afterwards ETHZ), Luca Wacker (PSC and University of Basel until 2013), Dr. Carole Rapo (PSC). Dr. Jeffrey Clary (former PSC member until 2014, now University of California) and Dr. Liselotte Selter (former staff member of the PSC now SNF). All these scientific staff members contributed into the organization and contents of the events. Kathrin Ruprecht, PSC was assisting in the organizing of the expeditions in 2013, Dominik Ruprecht was helping in preparing some of the contents of the handbook in 2013. Scientific collaborators including PhD students that supervised the workshops in Table 3. Other collaborators from the communication or science education interface can be found in the Output data.

Table 3: Achievement of the participation researchers

Name	Activity
Dr. Jake Alexander, Institute of Integrative Biology, ETHZ	Expeditions 2013 and 2014: Alpine Pflanzen im Wandel –Invasiven Neophyten auf der Spur: Leading the Neophyte trail at Ibergeregge and in Zurich
Prof. Dr. Andreas Erhardt, Botanical Institute, University of Basel	Fascination of Plant Day 2012: Leading Guided Tour
Dr. Werner Lehmann, Botanical Institute, University of Basel	Fascination of Plant Day 2013: Leading tour of Herbarium
Prof. Dr. Christian Körner, Botanical Institute, University of Basel	Expeditions 2013/ and 2014: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen, Furka: developing concept, contents and

	experiments, presentation to families
Dr. Christophe Randin, Botanical Institute, University of Basel	Expeditions 2013/ and 2014: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen, Furka: leading a workshop
Dr. David Basler, Botanical Institute, University of Basel	Expeditions 2013/ and 2014: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen, Furka: leading a workshop
Dr. Nicole Inauen, Botanical Institute, University of Basel	Expeditions 2013/ and 2014: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen, Furka: leading a workshop
Dr. Erika Hiltbrunner, Botanical Institute, University of Basel	Expeditions 2013/ and 2014: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen, Furka: developing concept and leading a workshop
Dr. Eva Spehn, Botanical Institute, University of Basel	Expedition 2014: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen, Furka: leading a workshop
Jonas Arnaiz, Botanical Institute, University of Basel	Expedition 2014: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen, Furka: leading a workshop
Prof. Dr. Ueli Grossniklaus, Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? developing concept, contents and experiments, presentation to families
Prof. Dr. Beat Keller, Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? developing concept, contents and experiments, presentation to families
Dr. Simon Krattinger, Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? leading a workshop
Dr Rainer Messmer, Forschungs Station Eschikon	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? leading a workshop, developing several experiments
Dr. Christoph Grieder, formal Institute of Plant Biology, UZH, now: Forage Crop Breeder, Agroscope, Zürich	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? leading a workshop
Dr. Hannes Vogler, Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? leading a workshop
Anna Nestorova PhD Student Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? Doing experiments with the young people in the workshops
Heike Lindner, PhD Student Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? Doing experiments with the young people in the workshops
Evelin Zürcher, PhD Student Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? Doing experiments with the young people in the workshops
Christian Sailer, PhD Student Institute of Plant Biology, UZH	Expedition 2013: Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot? Doing experiments with the young people in the workshops
Dr Markus Kellerhals, Forschungsgruppenleiter Apfelmzüchtung und Genressourcen Obst Agroscope, Wädenswil	Expedition 2013 - Pflanzenzüchtung für die Zukunft: Apfelforschung zum Anbeissen: Entwicklung des Konzepts, Durchführung eines Workshops, Durchführung verschiedener Experimente, Vortrag
Dr Andrea Patocchi, Research leader mycology pome- and stonefruits, Agroscope, Wädenswil	Expedition 2013 - Pflanzenzüchtung für die Zukunft: Apfelforschung zum Anbeissen: Entwicklung des Konzepts, Durchführung eines Workshops, Durchführung verschiedener Experimente, Vortrag
Dr. Melanie Jänsch, Group mycology pome- and stonefruits,	Expedition 2013 - Pflanzenzüchtung für die

Agroscope, Wädenswil	Zukunft: Apfelforschung zum Anbeissen: helping in the workshops
Dr Danilo Christen, Group Leader Fruit crops in the Alpine space, Agroscope	Expedition 2013 - Pflanzenzüchtung für die Zukunft: Apfelforschung zum Anbeissen Zukunft Workshop
Seraina Beeler, Student USYS, ETHZ	Scientifica 2013
Moritz Rövekamp, Student USYS, ETHZ	Scientifica 2013
Nadia Schneider, Student UZH	Scientifica 2013
Dr Christoph Küffer, Institute of Integrative Biology, ETHZ	Scientifica 2013: Von Neophyten bis GMOs - Risikopflanzen?, Science Café – Presentation and Discussion
Dr Angelika Hilbeck, Institute of Integrative Biology, ETHZ	Scientifica 2013: Von Neophyten bis GMOs - Risikopflanzen?, Science Café – Presentation and Discussion
Dr Andreas Fischlin, Institute of Integrative Biology, ETHZ	Scientifica 2013: Von Neophyten bis GMOs - Risikopflanzen?, Science Café – Presentation and Discussion
Dr. Marc Hall, University of Zurich	Scientifica 2013: Von Neophyten bis GMOs - Risikopflanzen?, Science Café – Presentation and Discussion
Dr. Giovanni Broggini, Institute of Integrative Biology, ETHZ	Scientifica 2013: Von Neophyten bis GMOs - Risikopflanzen?, Science Café – Presentation and Discussion
Dr Carole Rapo, PSC	Scientifica 2013 developing concept and leading a workshop
Isabel Müller, Student USYS, ETHZ	Frühlings Fest, Bot Garten 2013
Dr. Liselotte Selter, PSC	Frühlings Fest, Bot Garten 2014
Dr Burgi Liebst, UZH	Neophyten Auf der Spur, Zürich 2015
Dr Hans-Peter Rusterholz, Uni Basel	Weiche Landung: wie nicht-einheimische Pflanzen die Stadt erobern, Basel 2015

5 Impact Analysis and Evaluation

Aims

The aim of the expedition evaluations was to assess level of participant satisfaction with the format and level of engagement with scientists (short-term outcome after the expeditions matched with benchmark values defined before expeditions) and to find out if the knowledge transfer goals were achieved and to establish if the events were a good opportunity for intergenerational (social) learning for both: short-term outcomes after expeditions matched to long-term impact 10 – 12 months after expeditions.

Summary

The surveys showed a high level of satisfaction with the design of the expeditions and the amount of information presented. The explanations of the scientists were rated highly understandable for the majority of adults and youth over 12. There was a lower level of comprehension for the under 12's but they nevertheless enjoyed interacting with the scientists. This was shown by their comments.

The overall learning objectives were attained for the expeditions. The lowest level of learning was for the children under 12 in the topic of plant breeding. However from the interviews it was apparent that the children and youth over 12 had learnt a lot more about wheat breeding than the survey had indicated. This could be due to survey design, or that face-to-face interviews prompted a more thorough response.

During the interviews the majority of participants agreed or strongly agreed that the practical activities during the expeditions had helped them to better understand plant science. An analysis of the comments and

keywords showed that youth had an excellent recollection of the activities and instruments such as thermal cameras that are very visual. Hands-on activities which took some time to do and were novel, such as the apple tree grafting or gluten experiment, flower specimen collecting or digging out plant clones, were recalled more often than shorter activities such as looking at stomata with the cellscope or longer activities that they had likely encountered before such as vegetable DNA extraction, neither of which were recalled.

In the time available we were able to convey some concepts and methods from plant-breeding and alpine plant research, to raise awareness of plant science, but not necessarily details of individual research projects. The expeditions were a positive experience for participants and on the whole a good format, if somewhat intensive. Participants from the Furka expedition were particularly effusive and would highly recommend the expedition to their friends.

Methods used for Analysis of Outcomes and Impacts

Our evaluation follows a logic framework that links the project plan and its defined activities directly with outputs (table 1), measurable short-term outcomes (table 4) and long-term impacts (table 5).

Short-term outcomes

1. Satisfaction of visitors with the expeditions and interactions with scientists
2. Achieving the learning objectives (Learning of plant-science related concepts and scientific terms)
3. Awareness of Plant Science Research and whether their opinion/perception of plant science had changed as a result of participation in the event

After each expedition participants were asked to fill in a questionnaire with a set of individual questions. There were surveys for participants 12 years and over and for below 12 years.

Questions can be classified in the categories “General Satisfaction and Expectations” (2 questions), “Experience of social learning and dialogue with scientists” (2 questions), “Understanding of Scientific Terms”, (2-4 questions), “Awareness of Plant Science Research” (1 question) and opinion of the event theme and desire to learn more whether it had changed as a result of participation in the event, i.e. “Perception” (1 question).

Answers to questions in the categories of “General Satisfaction and Expectations” and “Experience of social learning and dialogue with scientists”, “Awareness of Plant Science Research” and “Perception” could usually be done on a 4-point scale with items ranging from “Strongly agree” (=1) to “Strongly disagree” (=4). For these questions in the analysis neighboring categories were merged, i.e. strongly agree, agree /disagree; strongly disagree. Responses in these categories have been pooled over all expeditions and giving percentages based on filled in surveys per question.

In these categories some questions had different item scales, from too long, just right, too short for length of event for example.

For questions regarding the understanding of scientific terms free text answers were possible. These questions were specific for each expedition as matched to the content and learning objectives of the respective expedition. The evaluator rated answers with 1 point for a correct answer. Percentage of respondents that achieved = 1 point was calculated with data pooled for the expeditions on Plant Breeding (2 expeditions at Agroscope Wädenswil and ETHZ –Eschikon/University of Zurich), for the 2013 expedition on neophytes (1 expedition) and for the expeditions at the Furka research station (2 expeditions). Percentages were calculated based on filled surveys for these questions and for each pooled set of data.

Surveys were created with SelectSurvey.net and completed online after the events, via a link sent to participants.

In total N=102 questionnaires were completed (from 151 participants, 68% feedback rate), with N=73 for adult respondents (= adults and youth >12) and N=29 for children (youth < 12 respondents). However response rate per question was lower, ranging from N=59 to N=28 for adults in the categories “General Satisfaction and Expectations”, “Experience of social learning and dialogue with scientists”, “Awareness of Plant Science Research” and “Perception”. For children response varied between N=15 to N=11. Responses in the category “Understanding of Scientific Terms” ranged for N=24 to N=11 for adults and from N=7 to N=2 for children.

Interviews – long-term impacts

Ten to 12 months post event we carried out 24 face-to-face interviews with expedition participants. This was not part of the original evaluation plan but we became interested in the long-term impacts (if any) of the expeditions and how these could be assessed.

Seven adults and seventeen youth were asked 8 (youth) or 11 (adults) questions with scale answers from strongly agree (=1) to strongly disagree (=5). In the analysis neighboring categories were merged, i.e. strongly agree, agree /disagree; strongly disagree. For questions see Appendix 3.

The first question tried not to lead and asked what came to mind when they thought about the expedition. “When I think about the expedition the following words come to mind”. The second question asked about recollection of keywords “The following words or concepts are familiar to me”. The matching of recollection was then self-graded by the interviewee from 1-5 depending on how well they remembered the words.

The next four questions were about the learning experience: if they had learnt from the practical or hands-on activities, if they could recall any experiment and if participating in the expedition had prompted them to think more about plant science since then. We then asked if they recalled learning with their families and with other families as a positive experience. Have they looked for more information in the media or done anything similar at school (made conceptual connection)?

Most interviews were in German, some were asked in German and youth responded in English, hence some comments are mixed. 11 youth interviews were in German, 4 English and 2 mixed. Five adult interviews were in German and 2 in English.

The interviewees made several comments that were not quantifiable with the scale 1 – 5 but nevertheless showed concept, activity or other keyword recollection. These were evaluated by giving a point for every person who recalled one or more concepts or activities.

Summary of the logic framework results in Table 4, 5.

Table 4 Overview of the results of the logic framework – outcomes from 5 expeditions in 2013. Percentage of agreement for the indicators to be fulfilled was defined before the expeditions by a benchmark value of 45%. Results for satisfaction and awareness show the percentage of participants that strongly agreed or agreed with the statements. Absolute numbers are in brackets. Responses have been separately analyzed for adults and youth; and children below 12 years. Responses to questions about learning objectives were free text and were separately analyzed (see Methods).

Description	Indicators (measurable)	Source of Verification	Percentage of Responses
Outcomes			
✓	45% of participants strongly agreed, agreed that the	σ ρ ω	Adult/Youth: 77% (34)

	expeditions had the right length		responses) Children: 60% (9)
	45% of participants strongly agreed, agreed that the expeditions met my expectations		Adult/Youth: 86% (37) Children: 47% (7)
	45% of participants strongly agreed, agreed that the information provided by the scientists was understandable		Adult/Youth: 85% (35) Children: 87% (13)
	45% of participants strongly agreed, agreed that learning with children/adults was a positive experience		Adult/Youth: 95% (38) Children: 100% (15)
Achieving the learning objectives	45% participants give correct answers to questions regarding concepts and scientific terms (no pre-test / post-test design implemented).		
	Smart Breeding: What are molecular markers? What are molecular markers used for in apple breeding? <i>Learning objectives: knowing methods to study the function of genes and how to find the genes responsible for traits</i> What is a gene? What is DNA?		Adult/Youth: 83% (10) Children: 83% (5)
	Plant Breeding: What do you understand by conventional breeding in plant science? What do you understand by "smart breeding" in plant science? <i>Learning objectives: knowing the principles of modern breeding techniques, What is the difference between conventional breeding and biotechnology?</i>		Adult/Youth: 82% (9) Children: 17% (1)
	Alpine regions and global change: Why is the alpine area so rich in biodiversity? Why is biodiversity important? Alpine regions as storehouses of biodiversity <i>Learning objectives: Get a feeling for the amount of biodiversity in alpine grasslands. Understand how biodiversity is important for ecosystem services. What is biodiversity? Why is it important?</i>		Adult/Youth: 88% (21) Children: 71% (5)
	Alpine regions and global change: monitoring ecosystem changes: Invasive plants as model for climate change What are the effects of land use changes on biodiversity? How are invasive plants used as a model system for climate change research? <i>Learning Objectives: Understand how plant scientists can monitor ecosystem changes due to global change using the vegetation as proxy. Understand that this data can be used for modeling long-term changes in ecosystems. What are the effects of land use changes on biodiversity?</i>	Questionnaire	Adult/Youth: 77% (10) Children: - (number of responses to small)
Awareness of Plant Science	45% of participants rated plant science research as very important, important after participating in the expeditions	Questionnaire	Adult/Youth: 97% (36) Children: 100% (11)

45% of participants strongly agreed, agreed that their perception of plant science had changed as a result of the expedition

Adult/Youth: 61% (27)
Children: no question available on this item.

The below benchmark response of the youth under 12 that the expeditions did not meet their expectations can be explained by their comments, in that they did not know what to expect beforehand so their expectations could not be met.

After expeditions 61% of adults said their perception of plant science had changed as a result of the expedition. This question was possibly not elegantly formulated, as several comments were that they already had a positive perception of plant sciences. Unequivocal was the importance of plant science for society with 97% of adults and youth expressing it as important or very important.

Results for Impact

When interviewed 12 months post-event the 17 youth showed a good recollection of activities and concepts but this was not necessarily reflected in their recollection of keywords which were read to them. (Konventionelle Pflanzenzüchtung, Molekulare Pflanzenzüchtung/"Smart breeding", Neophyten, Archaeophyten, Artenvielfalt, Globale Änderungen in den Alpen). For all expeditions 64% did not recall any of the keywords and 36% did. If we look at the recollection of concepts or activities from the expeditions recollection of one or more concepts was 100%.

One comment from an 11 year old was: "I was interested in concepts, not vocabulary. I learned about plants receiving heat, cloning as reproduction of plants". A 14 year old said she did not remember any of the keywords but then went on to say: "Climate change affects plants, plants evolve according to climate. We did an experiment with a heat camera (cool), and looked at plant clones — don't get genetic diversity you get when a plant reproduces with pollen". Another 14 year old said: "(The scientists) change the characteristics of wheat that it grows bigger and better, they take one and then change what they want (by breeding)".

For adults interviews showed that they had a reasonable recollection of the vocabulary used during the expedition: 71% said the terms biodiversity and global change in the alps were familiar to them, but only two recognized the term "Neophyten" and one knew conventional or molecular plant breeding. If we look at the recollection of concepts or activities or other keywords from the expeditions, recollection of one or more concepts was 100%.

41% of the young people and 43% of the adults agreed or strongly agreed that they had thought or researched about plants after the expedition. 35% of the youth said that since the expedition they had done something similar in school, but a few comments mentioned links such as "something about plants in school" or "In der Schule: Alte Steinzeit, wir haben Körner gemahlen", "in der Schule sind wir auf einen Bauernhof und haben uns Aepfel angeschaut". None – neither adults nor youth — had specifically sought out or attended further events about plant science, this was expressed with regret.

The majority (76%) of youth agreed or strongly agreed that the practical activities had helped them to better understand plant science. An analysis of the comments and keywords shows that youth had an excellent recollection of the activities and instruments such as thermal cameras that are very visual. Hands-on activities which took some time to do and were novel, such as the apple tree grafting or dough washing, flower specimen collecting or digging out plant clones (Furka), were recalled more often than shorter activities such as looking at stomata with the cellscope or longer activities that they had likely encountered before e.g. Vegetable DNA extraction, neither of which were recalled.

One or two 14 year-olds were dismissive or negative at first but then remembered a number of activities; "it was raining and we had to look at wheat... geeignete Weizenarten. Stadium camera, heat camera, different

techniques needed to make crops, breeders of wheat try to make better plants from domesticated varieties of wheat – we looked at how they got them.

100% of the adult participants felt that the hands-on activities gave them a better understanding of plant science but they were on the whole less specific about recalling individual experiments than the youth.

Table 5: Impact analysis is based on interviews with 7 adults and 17 youth 12 month after the expeditions in 2013. Responses have been separately analyzed for adults and youth (below 12 years).

Description	Indicators (measurable)	Source of Verification	Results
Impact 1	Is the learning during the expeditions sustained after 12 months? 45% of participants recollected one or more individual concept	Interview	Adult: 100% (7) Youth: 100% (17)
	45% of participants recollected one or more scientific term from the expeditions.		Adult: 71% (5) Youth: 65% (11)
Impact 2	Is the positive intergenerational (social) learning experience sustained? 45% participants strongly agreed, agreed about learning between generations.		Adult: 100% (7) Youth: 76% (13)
Impact 3	Is the awareness of plant sciences and plant relevant issues, i.e. sustainability in food production, management of the environment, and ecosystem services provided by plants sustained? E.g. awareness in media, visit of other science-related events, joining activities in school. 45% participants named one activity or school activity that they have joined or one media news item that they became aware of after the expeditions.		Adult: 43% (3yes, 3 no, 1 don't know) Youth: 41% (7)
Impact 4	Participants attended another science event in the 12 months after the expedition. Youth: 45% participants did something with plants at school. Adults and youth: 45% of participants attended another scientific event.		Youth: 35% (6 yes or maybe) Adult: 0 Youth: 0
Impact 5	Participants felt that the interactive, hands-on activities had helped them learn about plant science 45% could recall on experiment or hands-on activity that they carried out during the expeditions	Adult: 100% (7) Youth: 76% (13)	

Lessons learnt about visitor evaluation

The online surveys were on the whole too long for the participants. Towards the end of the questions responses tailed off and particularly the under 12s skipped questions. There were written comments in the surveys and verbally stating that responders felt “abgefragt” or interrogated. One mother felt that too much learning measurement was done in relation to the length and context of the expedition. For example “I just wanted to do something fun and educational with my children and it changed the experience (negatively) having to fill out a 20+ question survey” (M.B).

The survey design was too imprecise for the learning objectives “Plant breeding Message 1: What are the traits we want to breed?” and “Message: Why we need to monitor ecosystem changes from local to regional scale“. This is an important lesson to very closely match learning objectives and survey questions.

The interviews in contrast were not perceived as a burden. The interviewer travelled to the expedition participants so it did not cost them time, only 10-15 minutes per interview. The experience was pleasant and natural and even the teenagers who were at first not engaged became more animated as the interview progressed.

From this experience we would recommend a short (max 10 questions) interview or survey to be filled out on site with an interviewer post event, and when desired, a face-to-face interview 10-12 months post event.

6 Detailed Description of Activities

6.1 International Fascination of Plant Day (Target group – the general public)

The goal of these activities was to get as many people as possible around the world fascinated by plants and enthused about the importance of plant science for agriculture, in sustainably producing food, as well as for horticulture, forestry, and all of the non-food products such as paper, timber, chemicals, energy, and pharmaceuticals. The International Fascination of Plant Day is organized by EPSO. In Switzerland the activities are coordinated by the Swiss Plant Science Web with support of the PSC.

Our engagement in these activities within the PSC Plant Science Family Program was two-fold: we intended to raise awareness and fascination of plants and plant-relevant issues among school children and high school students (GymnasiastInnen), as well as using these events as a promotion platform for the following PSC family expeditions.

International:

Summary of 2013 activities (no numbers available for 2012 and 2014):

- 689 institutions in 54 countries participated, more than 1000 events were organized
- 87.600 unique visitors at the website: www.plantday12.eu
- 1084 followers on Twitter, 1782 tweets
- 697 likes and 1023 postings on facebook

The 2012 Fascination of Plant Day was finished with a publication:

- **Dahinden, M. Humair, F.** (Hrsg.) (2012). Die faszinierende Welt der Pflanzen, Idea Verlag (Booklet with children drawings)

May 2	workshop for secondary teacher	University of Lausanne, Rapo, PSC		
2014, May 6	Plant Ecophysiology, workshop for secondary teacher	Goldschmidt-Clermont; University of Geneva, Rapo, PSC	University of Geneva	11
2014, May 13	Plant Phylogeny, workshop for secondary teacher	Nyffeler, University of Zurich, Rapo, PSC	University of Zurich	12
2014, May 16 & 28	Vom Protein zum Stammbaum; 2 workshops for high school classes	Rapo, PSC	University of Basel and University of Zurich	50
2014, May 18	„Pflanzen Cyanotypie: Fotogramm mit Sonnenlicht“ and „Auch Pflanzen lieben Zucker – experiements for families“	Rapo, Schläpfer, PSC	University of Basel	50
2015 August 15	Neophyten auf der Spur	Dr Burgi Liebst, Juanita Schläpfer, PSC	Zürich, Limmat	3
2015 Sept 16	Weiche Landung: wie nicht-einheimische Pflanzen die Stadt erobern	Dr Hans-Peter Rusterholz, Uni Basel, S. Martinez, PSC	University of Basel	3

6.2 Plant Science Expeditions (Target group – Families, youth, general public)

Our special programs gave families a chance to spend time with plant scientists, both in the laboratory and out in nature.

2 Expeditions carried out: Plant Breeding for the Future

Plant breeding is the most important tool to improve our crop plants in order to adjust their traits to the changes in environment and in human needs. Plant breeding has been done since thousands of years. The tools of plant breeding have continuously been improved in order to develop better varieties and to produce high-quality seed. Many consumers have no idea about how plant breeding is performed and what work researchers do to improve our food.

Two expeditions were designed and carried out in 2013 to engage young people with plant breeding methods. At three different locations in Zurich area the families could experience how plant breeding works and had the opportunity to discuss their questions with scientists.

Date	Description of Activity	Scientists / Science Communicator	Location(s)	Nr. Part.
2013, June 8	Pflanzenzüchtung für die Zukunft: Apfelforschung zum Anbeissen	Kellerhals, Patocchi, Agroscope, Bolliger-Flury, Biohof Rigi, Schläpfer, PSC	Forschungsanstalt Changins-Wädenswil	20
2013, June 29	Pflanzenzüchtung für die Zukunft: Gute Gene – gutes Brot?	Keller, Grieder, University of Zurich, Vogler, ETH Zurich	Institute of Plant Biology, University of Zurich and Forschungsanstalt Lindau-Eschikon, ETH Zurich	15

Within these expeditions the participants followed lectures and guided tours or carried out hands-on activities that were designed to transport the following messages and learning objectives.

Messages and Learning Activities	Type of Activity, description	Scientists that carried out the activity / SNSF or other research project that is basis of this activity
Message 1: What are the traits we want to breed? Learning objectives: knowing methods to study the function of genes, how to find the genes responsible For traits, interpret results of experiments.	Expedition to research center Eschikon and Botanical Garden, Zürich. Talk on wheat evolution, garden visit, lab visit with microscopy of plant mutations, wheat evolution activities – gluten washing, sediment test, heat camera, field visit.	Keller, Christoph Grieder, University of Zurich, Vogler, ETH Zurich p3.snf.ch/project-115598
Conventional vs. Message 2: molecular breeding. Learning objectives: knowing the principles of modern breeding techniques, understanding the differences between conventional breeding and biotechnology.	Expedition to research center Agroscope Wädenswil: Talk about smart breeding, experiment DNA from tomatoes extraction, lab visit, field visit, apple tree grafting.	Kellerhals, Patocchi, Agroscope ARAMIS Project 14.13.3.1 “Breeding high quality disease resistant fruit varieties and description and use of fruit genetic resources”

For the detailed programs please refer to Appendix I.

5 Expeditions carried out: Dealing with Global Change in the Swiss Alps

Alpine regions are storehouses for global biodiversity (Spehn et al. 2010). However, they are also the most vulnerable ecosystems for global changes. (Plant) biodiversity and provision of ecosystem services in alpine regions are linked, for example the continuous supply of drinking water or energy, prevention of soil erosion and hazard, climate modulation, but also the provision of cultural services. Plants scientists and interacting research disciplines try to understand/mitigate the impact of global changes in these regions.

3 expeditions were designed and carried out in 2013, and two in 2014 to sensitize young people and their families to the effects of global changes in alpine areas and to investigate how non-native plants can be used as models in climate change research.

Date	Description of Activity	Scientists / Science Communicator	Location(s)	Nr. Part.
2013, July 6 and 14 2014 July 6	Alpine Pflanzen im Wandel -Invasiven Neophyten auf der Spur - Eine Busreise vom Zürich HB bis Ibergeregg und zurück	Alexander, ETH Zurich, Schläpfer, Rapo, PSC	Zurich, Limmat and Ibergeregg	25
2013, July 20 – 21 2014, August 9-10	Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen	Körner, Hiltbrunner, Randin, Inauen, Basler, University of Basel, Schläpfer, Hofmann, PSC (2013) Rapo, PSC (2014)	Alpine Forschungs- und Ausbildungsstation Furka, University of Basel	25

Within these expeditions the participants followed lectures and guided tours or carried out hands-on activities that were designed to transport the following messages and learning objectives.

Messages and Learning Activities	Type of Activity, description	Scientists that carried out the activity / SNSF or other research project that is basis of this activity
Messages 1/2: Alpine regions as storehouses of biodiversity and provide/secures important services to the	Das Mikroklima entdecken	Christian Körner http://www.swissplantscienceweb.ch/nc/research/home/portfolio/koerner/

<p>urban populations</p> <p>Learning objectives: Get a feeling for the amount of biodiversity in alpine grasslands. Understand how biodiversity is important for ecosystem services.</p>		
<p>Message 3: The dramatic impact of land use changes on biodiversity,</p> <p>Learning objectives: Understand how land use has created the patterns of alpine biodiversity and landscape diversity. Understand the impacts of land use changes on biodiversity in alpine regions.</p>	<p>Artenvielfalt auf einem Quadratmeter</p>	<p>Erika Hiltbrunner „Global Mountain Biodiversity Assessment“ http://p3.snf.ch/project-135726</p>
<p>Message 4: Effects of climate change are already visible - Climate change as bottleneck for highly specialized species in the Swiss Alps,</p> <p>Learning objectives: Understand how climate change might result in a loss of many alpine plant species. Understand that we need to know more about the adaptation potential of plants.</p>	<p>Pflanzenlebensräume vergleichen</p>	<p>Christophe Randin Effects of climate change on past, recent, and future biodiversity of alpine/arctic plants: Integrative evidence from phylogenies, population genetics, ecological niche modeling and new insights for conservation / Grant No. PDFMP3_132471/1</p>
<p>Message 5: Why we need to monitor ecosystem changes from local to regional scale</p> <p>Learning Objectives: Understand how plant scientists can monitor ecosystem changes using the vegetation as proxy. Understand that this data can be used for modeling long-term changes in ecosystems.</p>	<p>Ein Spaziergang zu pflanzlichen Einwanderern</p>	<p>Jake Alexander Alien flora of mountains: global comparisons for the development of local preventive measures against plant invasions. (Published)</p>
<p>Message 6: Plant science can help to understand and mitigate the effect of global change in Swiss alpine ecosystems</p> <p>Learning objectives: learning</p>	<p>General topic of discussion at Furka Expedition and Neophyt Expeditions</p>	<p>All above scientists and PSC staff</p>

about options for protecting mountain ecosystems		
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For the detailed programs please refer to Appendix I.

6.3 Shaping our Future Workshops (Target group – young people)

All events were planned to include a **Shaping our Future Workshop** which aimed to allow the young people to build their own opinions and orientation by:

- Formulating their concerns
- Discussing joint options with the group representatives
- Generating further ideas

Although we had a developed concept for the future workshops in most cases participants voted not to carry them through. After all expeditions everyone was very tired after the days activities and it was too much cerebral activity even for the most enthusiastic participants. During the Furka expedition participants had some interesting conversations with the researchers over dinner. The format of both neophyte expeditions allowed plenty of discussion time in an informal way and at the end when we were distributing the plant collectors' cards. (see experiment book)

In Wädenswil 5 participants came to the future workshop to which we had invited a panel of expert facilitators. Senior members of the communication department from Agroscope attended and we had an interesting discussion about the media and communication of plant research.

In Eschikon the participants said they had had enough by the end of the activities so we just chatted about the day as we had a snack.

The future workshops were a good idea but it was difficult to execute them in the planned format. It was simply too much to pack into the time we had. For future expeditions it might be worthwhile doing a drawing exercise with the participants at the end of the day, so they could reflect on the day's activities in a less tiring and non-verbal format.

6.4 Geocaching Trail (Target group – Expedition participants and the general public)

Geocaching is a modern treasure hunt, using GPS data to find caches hidden in the landscape. The caches are actual objects (plastic container) containing a logbook and whatever else the hider wants to put in there. In our case we put in laminated cards with information about alpine plants and research (see appendix). The Geocaching trail was implemented as part of the family expedition and is open to the general public through www.geocaching.com

The goal was to communicate information about alpine plants and about the botanical and ecology research at the research station ALPFOR on the Furkapass.

Four caches were installed:

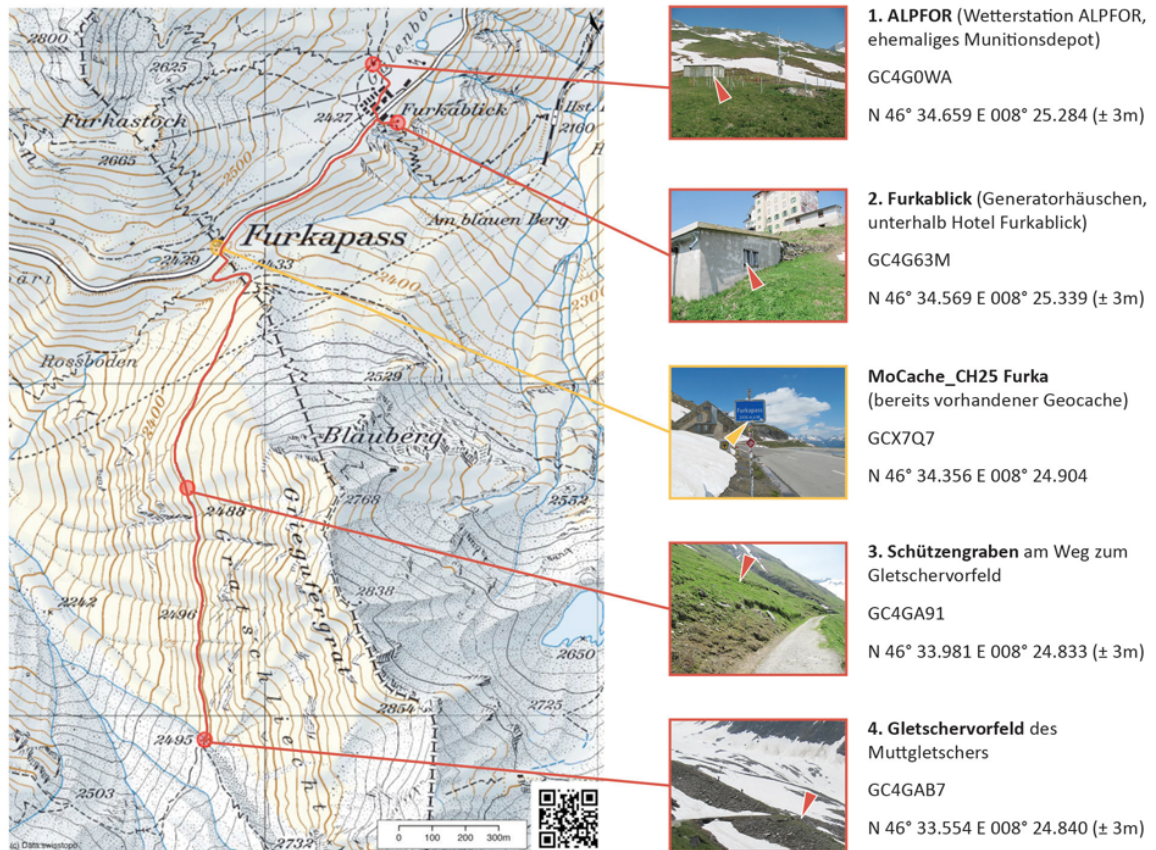


Figure 1 Map of geocaching trail

An advantage for our communication purposes is that the Geocaching website allows cache descriptions and images to be posted by the cache owner, allowing us to introduce the information found in the cache. The website text for the four geocache stations are:

1. ALPFOR

Welcome to the Alpine Research Station (ALPFOR). From your position you have a view over the weather station.

Since 2009 three buildings of the military station "Furkablick" (built in 1917) are used as a center for research and education in high mountains (2430 m ü. M.). On the info cards in the cache you can learn about the measuring equipment at the weather station and about alpine plants.

2. Furkablick

The meadow just below Hotel Furkablick has a high plant-biodiversity. Over 60 different plant species grow there. The wooden pegs in the meadow mark botanical research plots.

In the past all the electricity for the Hotel Furkablick was produced in the small generator hut. The hiking path that passes by, leads down to the train station Furka (2160 m a.s.l.) of the Furka Steam Railway.

On the info cards in the cache you can learn about the large leafy plants that grow close to the terrace of the Hotel Furkablick (**Alpine dock**, *Rumex alpinus*), the **Common house martins** (*Delichon urbicum*) that are breeding on the house wall underneath the roof, and about the history of the Hotel Furkablick.

3. Schützengraben (Military trench)

The military services have left many traces in this landscape; this trench is one of them. The trenches were used during the First and Second World War by Swiss soldiers to guard the Furkapass.

You can take part in a Citizen Science Project here. Find the three plant species **Alpine clover** (*Trifolium alpinum*), **Spotted gentian** (*Gentiana punctata*) und **Alpine anemone** (*Pulsatilla alpina* subsp. *apiifolia*) in the surroundings of the cache and assess the flowering state of the plants. You can find more information about the Citizen Science Project in the cache.

4. Gletschervorfeld (Glacier fore field)

You are now standing on top of one of the lateral moraines of the Mutt glacier. From here you have a view on the glacier fore field of the Mutt glacier with the springs of the Mutt stream, which flows, into the Rhône.

Discover the plants of the glacier fore field, e.g. the **Glacier buttercup** (*Ranunculus glacialis*) or the **Starry saxifrage** (*Saxifraga stellaris*). These plants are pioneer species, they are the first plants that settle in the gravel of the dynamic glacier fore field.

Results

At the end of the summer 2013 **208** „found it“ notices had been logged on geocaching.com. By the end of October 2014 a total of **470 logs** had been registered. Geocachers also posted photos of the caches and comments about the content: „Bei meinen Ausflug zum Furkapass die Zeit genutzt und mich zu diesen Cache aufgemacht. Die Pflanzenvielfalt hier oben ist wirklich beeindruckend.“ 20.09.2014 or „Nach einer genialen Übernachtung im Belvedere und einem Besuch des Rhonegletschers den kurzen Abstecher zu GC4G63M gemacht. Auf dem Weg die herrlichen Alpenblumen bewundert. Sie sind im Moment einfach wundervoll. Besten Dank fürs Auslegen und Pflegen. Katrol“ 7.8.14



Figure 2 Cache 1 Image of research project uploaded by geocachers to cache log 7.2014



Figure 3 Cache 2 Image of Furkablick uploaded by geocachers to cache log 8.2014

6.5 Workshops for young people: "Pflanzen und Technik Workshops" (Target group – Families, youth)

4 "Pflanzen und Technik Workshops" for teens and pre-teens were carried out between 2013 and 2014.

The goal of these workshops was to engage youth with plants by means of art and technology.

Even the simplest plant is a complex machine that senses its environment, responds to changes, captures energy, grows and reproduces. Thus, we can illustrate the complexity of nature by trying to simulate or measure living plants. We seek to stimulate young peoples' curiosity about the environment and food production by challenging them to use technology to enter the world of plants. Through self-directed projects, we can encourage youth to make connections between nature and technology, and art and science, and thus raise the problem solvers of the future.

“Wet-Hacking” Technologie und Kunst Werkstatt für Teens

The goal of this workshop is to stimulate teens' curiosity about the natural world through technology. We will build small sculptures using microcontrollers connected to bioluminescent algae. As the algae is agitated by the motor it glows in the dark, creating not only a beautiful effect but a catalyst for discussion about plant/machine interactions.

Participants will learn some basics of electronics and creating an interactive artwork. The finished objects can be shown to friends and family on the last afternoon.

Plants as Sensors Workshop (Exotisches Pflänzchen selbstgebaut)

Wir schauen Fleischfressende Pflanzen und Mimosen genau an. Die Mimose zum Beispiel ist eine Tropische Pflanze. Sie reagiert sehr schnell und empfindlich auf äussere Reize wie Berührung, Erschütterung, einen Lufthauch oder auf Lichtveränderungen. Wir beobachten: Wie empfindlich ist sie? Worauf reagiert sie? Wie ist eine solch schnelle Reaktion bei einer Pflanze überhaupt möglich?

Danach entwickeln und bauen wir ein eigenes «Pflänzchen». Wir löten eine elektronische Schaltung mit Sensor und Motor, damit auch unsere Pflanze reagieren kann!

Der Workshop endet mit einer kleinen Vernissage der Objekte für Familie und Freunde am Freitag Nachmittag ab 16 Uhr.

Date	Description of Activity	Scientists / Science Communicator	Location(s)	Nr. Participants
2013, April 24 - 26	April, 24-26: Wet-hacking: Plant, technology and art workshop for teenagers	Schläpfer, PSC	Ferienprogramm Zürich, TüftelLabor	15
2013, September 21 –23	Pflanzen und Technik Workshop "Mimose Selbstgebaut"	Schläpfer, PSC	TüftelLabor und Stadt Zürich, Ferienprogramm	12
2014, February 21-23	Pflanzen und Technik Workshop "Mimose Selbstgebaut"	Schläpfer, PSC	TüftelLabor und Stadt Zürich, Ferienprogramm	12
2014, October 15-17	Pflanzen und Technik Workshop "Exotisches Pflänzchen selbstgebaut"	Schläpfer, PSC	TüftelLabor und Stadt Zürich, Ferienprogramm	4

6.6 Scientifica (Target group – general public)

2013 the PSC was present at the Scientifica of University of Zurich and ETH Zurich with an exhibition on **“Von Neophyten bis GMOs - Risikopflanzen? – Kunstaussstellung und Gespräche mit Forschenden der Universität Zürich und der ETH Zürich”** followed by “science cafes” about Risk-plants and tours for school classes (+ 3000 participants). Although this event was completely financed by Swiss Plant Science Web the PSC staff Carole Rapo and Juanita Schläpfer along with students were present in the exhibition to engage with visitors and answer questions.

The exhibition was a shipping container converted by the artists Gerda Steiner and Jörg Lenzlinger into a greenhouse in which invasive and non-invasive, neophyte and native plants grow together, tangled with artificial plants and plastic objects. The concept was to instigate dialog with the public about what was a risk plant in a non-didactic way. The installation plays with what is real and artificial, what is native and what is non-native and how we as scientists and as a culture categorize living beings.

Science Cafés

The science cafés were very successful with each having about 60 participants who engaged in a lively discussion with the researchers.

Science Café - Risikopflanzen: Eine soziokulturelle Reise

Sa, 31.8.2013 von 13 bis 14.30 Uhr, ETH Zürich, Polyterasse, Bar bQm

Gäste: Dr. Angelika Hilbeck, Institute für Integrative Biologie, ETH Zürich und Dr. Marcus Hall, Institut für Evolutionsbiologie und Umweltwissenschaften, Universität Zürich, Moderation: Prof. Dr. Andreas Fischlin, Institute für Integrative Biologie, ETH Zürich

Science Café -Risikopflanzen: Wo liegen eigentlich die Risiken

So, 1.9.2013 von 11.30 bis 13 Uhr, ETH Zürich, Polyterasse, Bar bQm

Gäste: Dr. Christoph Kuffer & Dr. Giovanni Broggin, Institute für Integrative Biologie, ETH Zürich, Moderation: Prof. Dr. Andreas Fischlin, Institute für Integrative Biologie, ETH Zürich

For more details refer to Appendix II.

Date	Description of Activity	Scientists / Science Communicator	Location(s)	Nr. Participants
2013, August 26 – September 5	Scientifica - Von Neophyten bis GMOs, Risikopflanzen? Installation and science cafes	Fischlin, Hilbeck, Kueffer, Broggin, ETH Zurich, Hall, University of Zurich, Schläpfer, Rapo, PSC	ETH Zurich University of Zurich	60 Science Cafes 3000+ Installation
2013, September 4	Science info days for high school students - Von Neophyten bis GMOs, Risikopflanzen? (Installation in container "From Neophytes to GMOs:	Schläpfer, Rapo, PSC	ETH Zurich University of Zurich	300-500

	Risk plants?"			
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7 Promotional Measures

We announced the program activities at the following communication channels:

- Editorial and announcement of program activities in the PSC newsletter 22 (~500 printed for each issue) (Sept 2012)
- Program Webpage set up and implemented to PSC webpage (~50,000 annual visitors)(February 2013).
- A logo used on posters, brochures, leaflets, flyers, letterheads and all other printed material was established for cooperate identity (2012)
- Flyers (A4, A2) issued and +20'000 printed versions distributed to +30 institutions, the electronic versions to +30 media platforms with publication in projuventute.ch and zueritipp.ch (for flyer see Annex 2).
- A facebook account was created: <https://www.facebook.com/pages/Plant-Science-Expeditions/143035799179457> (from Dec 12) with +30 regular posting on the expeditions and the science related to these expeditions
- This facebook account was linked to +10 facebook event pages with more than 600'000 followers (e.g. Infoklick.ch, Kinder- und Jugendförderung Schweiz, Migros bugnplay and GenerationM, UZH, Uni Basel, ETHZ, SAC, Pro-Natura, Swiss National Park, Agroscope, Science et Cite, Spick, Klipp und Klang, Globe, WWF Schweiz)
- Regular announcements of all events and activities within the expeditions at electronic mailing lists and event calendars (+30).
- Intensive buzz marketing: starting from participating schools, students, researchers, tourist information we distributed the information of the upcoming events with the electronic flyer and short personalized messages
- The program was presented at several conferences, e.g. Science Communication Conference of the SCNAT 2012 and 2013.
- Promotion of the Swiss Plant Day: Information was be provided on the website <http://www.plantday12.eu/> launched by EPSO (some of key numbers of <http://www.plantday12.eu/> for 2013: 87.600 unique visitors at the website: www.plantday12.eu
- 1084 followers on Twitter, 1782 tweets, 697 likes and 1023 postings on facebook)
- 2014, Feb 600 A5 Flyers Familiennachmittag: Experimente mit Pflanzen
- 2014 Mar 1000 A5 Flyers Expedition Furka, advertised through Treffpunkt Science City event, Community centers, museums & libraries
- 2014 Sept 600 A5 Flyers, Plants as Sensors – Workshop - Community centers, museums & libraries, Parent organizations, print and online media
- 2014 Oct Online advertisement Plants as Sensors – Workshop - Eventbooster: Züritipp Events Calendar

- 2015 SCNAT Forschung Live Events were publicized on our website and with 500 A5 flyers. The program was in the Forschung Live app and website and printed program which we distributed to community centers and schools as well as in our institutions.

8 Appendix I: Detailed Expedition Programs

Expedition Botanical Garden Zürich and Eschikon and Wädenswil – Detailed Programs

Zeit	Personen	Ort	Experimente
9.30	Eintreffen der Besucher	Foyer	
9.40-9.45	PSC - Schläpfer	Hörsaal, Institute of Plant Biology	Begrüssung und Tagesablauf präsentieren
9.45 - 10.15 Gruppe 1 & 2	Beat Keller	Hörsaal, Institute of Plant Biology	Kurzvorlesung "Plant breeding: past, present and future" History of domestication of wheat and targeted wheat breeding up to present techniques of isolating desired genes. Description: Seit Tausenden von Jahren züchten Menschen Pflanzen, indem sie diejenigen auswählen und weiterführen, welche die gewünschten Eigenschaften vorweisen: Gräser, welche die Samen fest in Rispen halten statt sie zu verstreuen. Mit der Hilfe von neuen (= biotechnologischen) Züchtungsmethoden ist es heute möglich, einzelne Gene in Stammbäumen zu verfolgen. So können Pflanzen, welche die gewünschten Eigenschaften wie z.B. Resistenz gegen Trockenheit oder Pilzbefall haben, schnell aufgespürt werden.
Besucher Gruppe 1: 10.15 - 11.00 Besucher Gruppe 2: 11.15 - 12.00	Gruppe Beat Keller	Botanische Garten: Nutzpflanzen Garten	Begleitete Gartenbesichtigung: Beispiele von gezüchteten Gemüse- und Getreidesorten: Mais, Teosinte, Blumenkohl und Broccoli. Description: Viewing in the garden of examples of the plants.
Besucher Gruppe 2: 10.15 - 11.00 Besucher Gruppe 1: 11.15 - 12.00	Gruppe Ueli Grossniklaus – Hannes Vogler	BOT P2.38	Lab. 1: Vergleich vom Wildtyp Arabidopsis und Mutante: Examples of wild-type Arabidopsis plants and mutants will be scrutinized under the binocular, and differences in appearance will be highlighted. The <i>Arabidopsis</i> mutants shown have an appearance resembling that of cauliflower (<i>ap2/cal</i>) or roses (<i>ag</i>).

			<p>Implications for basic research and for applied agriculture will be discussed.</p> <p>Description: Virtually none of the plants we eat have arisen naturally in their present form. Instead, they are the product of active or coincidental breeding. The basis for breeding is the occurrence of genetic variation in nature, in turn leading to variation in appearance or properties of the plants that can be selected for or against. The two Arabidopsis mutants shown carry single base changes in their genome that cause drastic alterations in their appearance. This can be the replacement of sexual organs by petals like in roses or „filled“ tulips, or then the replacement of entire inflorescences by structures strikingly resembling cauliflower. This simple demonstration shows how genetic variation can be used in agriculture, and it underlines the applicability of findings made with model organisms for modern, knowledge-based agriculture.</p>
	Gruppe Ueli Grossniklaus – Hannes Vogler	BOT P2.38 und BOT P.21B	<p>Lab 2: Herstellung eines „Bhaltis“ zum Nachhausenehmen: Samen der <i>Arabidopsis cuc1/cuc2</i> Mutante mit einem Defekt in der Organtrennung auf Nährmedium pflanzen. Ein Viertel der Keimlinge wird fusionierte Keimblätter haben und nicht weiterwachsen. Die Hintergründe für diese markante Veränderung der Erscheinung sowie deren Auftretenshäufigkeit werden diskutiert.</p> <p>Description: Surface-sterilized seed will be placed on petri dishes containing agar medium with all nutrients necessary for plant growth. The sealed plates can be taken home, along with instructions for care and background information. The genetic difference between plants having a very different appearance can be as little as a single “typographical error” (base change) in the genetic information that is 130 million characters (bases) long. Families have the opportunity to take this home to watch it grow.</p>
12.00 - 12.45	Mittagessen	Café Botanische Garten	
12.45 - 13.30	Busreise nach Eschikon		
13.30 - 14.30 Gruppe 2 14.30 - 15.30	Gruppe Achim Walter - Andi Hund, Christoph Grieder	im Feld	Wärmekamera, um phänotypische Unterschiede im Weizenfeld zu bestimmen.

Gruppe 1			
13.30 - 14.30 Gruppe 2 14.30 - 15.30 Gruppe 1	Gruppe Achim Walter -Andi Hund, Christoph Grieder	im Feld/Scheune	iPhone Cellscope Description: stomatal density of maize leaves under several drought stress treatments could be distinguished by the eye.
13.30 - 14.30 Gruppe 2 14.30 - 15.30 Gruppe 1	Gruppe Achim Walter - Christoph Grieder		NDVI Analysis of wheat Description: looking at stress-resistant capacities of wheat/maize
13.30 - 14.30 Gruppe 1 14.30-15.30 Gruppe 2	PSC Personell	Scheune	Sediment test (SDS test for protein quality) Description: There is a physico-chemical test (used by breeders and the flour industry) to estimate bread making quality of flour. It uses a weakly acidified, dilute solution of SDS to swell and flocculate the glutenins (and other high molecular weight proteins) in the flour. The more sediment there is after a 5-10 minute sedimentation period – the more proteins there are in the flour and the better the flour will be for bread-making.
13.30 - 14.30 Gruppe 1 14.30-15.30 Gruppe 2	PSC Personel	Scheune	Gluten von verschiedene Mehl auswaschen Description: Different types of wheat, and other, flours have different amounts of, or no, glutenins. It is possible to wash out the starch and low molecular weight proteins from dough and retain only (mainly) the glutenins – as a gooey lump. The amount of glutenin left, from different flours, indicates the relative ‘strengths’ of the flours.
15.-30 - 16.30	1 Person von alle beteiligten Forschungsgruppen.	Seminarraum Eschikon	Zukunftsworkshop Description: The aim of the future workshop was to discuss the days events and topics, answer any further questions the participants had and hear their concerns for the future regarding plant breeding.
16.30-17.15	<i>Busreise nach Zürich</i>		

Expedition Agroscope Wädenswil

Gruppe 1	Gruppe 2	Was	Ort
10.00 - 10.45		Intro Apfelzüchtung mit M. Kellerhals	Posten 9
	11.00 - 11.45	Intro Apfelzüchtung mit M. Kellerhals	Posten 9

11.00 - 11.45	12.00 - 12.45	Smart breeding: Labor Experiment	Foyer Labor 4, Labor im Labor 1
12.00 - 13.00	13.00 - 14.00	Mittagessen	
13.00 - 13.45	14.00 - 14.45	Veredelungs- Workshop mit R. Blapp	Obstbau-Scheune
14.00 - 15.30	15.00 - 15.30	Allgemeine Aktivitäten Tag der offenen Tür	Areal
15.30 - 16.30	15.30 - 16.30	Obstzüchtung mit Zukunft: Zukunfts-Workshop	The aim of the future workshop was to discuss the days events and topics, answer any further questions the participants had and hear their concerns for the future regarding plant breeding.

Expedition *Invasiven Neophyten auf der Spur* – Detailed Program

6. Juli, Zürich bis Ibergeregg

Gruppe	Aktivität	Ort	Beschreibung
9.00	Treffpunkt: Jake Alexander und Juanita Schläpfer	Lettensteg / Kloster Fahr-Weg (Neben der Kornhausbrücke)	
9.00 – 10.00	Wir suchen den Limmat entlang nach invasive Pflanzen	Lettensteg bis HB	Die Kinder und Jugendlichen begeben sich auf den Spaziergang – mit Stift und ARBEITSBLATT, auf dem sie die gefundenen Pflanzenarten notieren können.
10.00 – 10.45	Car Reise nach Einsiedeln	Einsiedeln Bahnhof	Welche pflanzlichen Einwanderer wurden wo gefunden?
10.45 – 11.30	Pflanzen suchen Einsiedeln	Dem Fluss entlang	
11.30 – 12.15	Car Reise nach Ibergeregg		Wieso treten diese pflanzlichen Einwanderer gehäuft an von Menschen beeinflussten Standorten auf?
12.15 – 13.15	Mittagessen	Passhöhe picknick oder im Restaurant	
13.15 – 14.00	Pflanzen suchen Passhöhe	Passhöhe	
14.00 – 15.00	Daten diskutieren und Zukunfts-Workshop mit sVeri	Restaurant Ibergeregg	Was können wir tun, um die Ausbreitung invasiver Pflanzenarten zu verhindern?

15.00	–	Busreise nach Zürich	Bis zum HB	
16.00				

Expedition: Alpine Pflanzen im Wandel: Klima- und Landnutzungsänderungen erforschen – Detailed Program

20-21. Juli 2013

12.00 Bhf Andermatt	Begrüssung der Teilnehmenden in Andermatt, Fahrt auf die Furka
Ca. 13.00 – 13.30	Ankunft Hotel Furkablick, ALPFOR, Bezug der Unterkunft
13.30	Erklärung der Workshops. Einteilung in Gruppen
13.30-17.30	<p>Workshops in Gruppen</p> <ul style="list-style-type: none"> - Christian Körner: Mikroklima, Morphologie (A) - Christophe Randin: Pflanzen in der Landschaft (inkl. Computermodelle) (B) - David Basler: IR Kamera, Blütenbesucher (C) - Erika Hiltbrunner: Artendiversität (Pflanzen, Tiere) (D) - Nicole Inauen: Klone von alpinen Pflanzen (E)
18.00-20.00	Znacht
20.00-20.40 Zukunftsworkshop	Teilnehmende sitzen in Gruppen à 5 Personen (andere Gruppen als am Nachmittag. Die desinteressierten Kinder (Paulina +???) können eine separate Geschichte hören oder zeichnen.
geleitet von Juanita Schläpfer und Dominique Strebel	<p>Erklärung der Arbeiten: Wir versuchen in Gruppen herauszufinden, was uns an der alpinen Welt besonders wichtig ist und was wir für deren Erhalt tun können. Deshalb schreiben Sie zu Beginn auf einen Zettel, was Ihnen an der alpinen Welt besonders wichtig ist. Was Sie also wünschen, dass auch in Zukunft erhalten bleibt. Dies stellen sie dann reihum in Ihrer Gruppe vor.</p> <p>Die Wissenschaftler sind dazu da, Ihnen aufzuzeigen, wie bedroht dies ist. Danach geht es darum herauszufinden, was man konkret in seinem Alltag tun kann, damit diese Bedrohung möglichst klein ist.</p> <p>Für diese Diskussion in der Gruppe haben wir 45 Minuten reserviert. Danach sollte jede Gruppe jene drei Dinge auf je drei Zettel notieren, die unbedingt erhalten bleiben sollen und auf weitere drei Zettel, welches die drei zentralen Dinge sind, die man im Alltag tun kann, damit dies erreicht wird.</p> <p>Die drei Zettel mit den wichtigsten Dingen in der alpinen Welt platzieren sie am Schluss auf dieser Pinwand und jene drei wichtigsten Handlungsstrategien im Alltag platzieren Sie hier.</p>
20.40	Erinnerung: Bitte Zettel an den beiden Pinwänden platzieren
20.45 – 21.00	Die Zettel werden an den Pinwänden in sinnvollen Gruppen angeordnet – in Diskussion mit dem Plenum, so dass eine weitere Reduktion möglich ist: Diese drei Dinge sind uns in der alpinen Welt absolut zentral und diese drei Dinge können wir im Alltag tun, um sie zu erhalten.
21.00 – 21.15	Schluss. Weiterer Ablauf des Abends und Ausblick auf den nächsten Tag (N.B. although the workshop was carefully planned the group were too tired after the days activities to carry it out. Instead we carried out a flash round where people wrote

	down their favourite experience of the day.)
Sonntag 21.	Nach dem Frühstück wird weiter auf Projekte gearbeitet.
10-12 Uhr	Geocaching Trail
12-13 Uhr	Mittagessen
13-15 Uhr	Laufen zum letzten Geocache (Hotel) und weiter zum DFB Station
16 Uhr	Abschied Realp Bahnhof

Furka Expedition Timeplan 2014

The 2014 expedition had the same format as in 2013, except due to the bad weather prognosis it was decided to hold all the workshops on the Saturday afternoon and go for a walk on Sunday morning with the Geocaching trail.

The workshop leaders were:

- Christian Körner: Mikroklima, Morphologie
- Erika Hiltbrunner: Artendiversität (Pflanzen, Tiere)
- Eva Spehn: Geobotanik – Zonen von Pflanzen identifiziert und ausgesteckt
- Jonas Arnaiz: Klone von alpinen Pflanzen

9 Appendix II – Details about Scientifica

Description in German:

Nicht nur Menschen reisen – auch Pflanzen werden über die ganze Welt transportiert – an Schuhen, mit Booten, Flugzeugen und Autos ebenso wie in Containern.

Die Künstler Gerda Steiner und Jörg Lenzlinger haben einen Schiffscontainer in ein Treibhaus umgewandelt, in dem gleiche Lebensbedingungen – Erde, Licht, Wasser und liebevolle Pflege – für alle Pflanzen herrschen. In diesem Treibhaus sind Gemüse, Blumen, Unkraut, Zimmerpflanzen, Kräuter, Schlingpflanzen aller Art, Kunstpflanzen, aussterbende Gräser und wachsende Düngerkristalle in Koffer, Handtaschen und Schuhe gepflanzt. Wir fragen uns, ob die Pflanzen einander auf so engem Raum wohl verdrängen und welche Strategien sie entwickeln werden. Aber offensichtlich geniessen sie die Familiendurchmischung und wachsen wild und kräftig durcheinander.

Unter den richtigen Bedingungen können die Pflanzen da, wo sie landen, heimisch werden. Ökologen versuchen zu ermitteln, wo sie sich am ehesten verbreiten können und bestimmen damit mögliche Bedrohungen. Das sich rasch verändernde Klima fügt diesen Studien neue Dimensionen zu. Neue Pflanzen können aber auch das Produkt von menschlichen Eingriffen sein, wie zum Beispiel durch fortgeschrittene Züchtungsmethoden. Mit genetisch veränderten Pflanzen möchte man die Nahrungsmittelversorgung verbessern und so den Folgen des Klimawandels begegnen.

Die Risiken zu minimieren, die mit diesen Technologien verbunden ist, macht einen wichtigen Teil der wissenschaftlichen Forschung des Zurich–Basel Plant Science Center aus. Pflanzenwissenschaftler und –wissenschaftlerinnen der Universität Zürich, der ETH Zürich und der Universität Basel arbeiten an vorderster Front daran, die Biodiversität und Biogeographie der Pflanzen zu studieren und Kulturpflanzen durch diverse Technologien zu verbessern.



Figure 4 "Les Envahisseurs " Gerda Steiner and Jörg Lenzlinger



Figure 5 Detail inside the container

10 Appendix III - Details about invasive plant city walks

1. Zurich:

The city expedition is a 2-2.5 hour walk along the Limmat guided by a researcher from the ETHZ/UZH and participants search for native and non-native plants and we discuss the concept of archaeophytes and neophytes, enemy-release hypothesis, invasive and non-invasive and how non-native species can be used as model plants to study climate change in the Swiss Alps.

This short expedition engages participants with the concept of invasive plant species in the city and makes a conceptual connection to the effects of invasive plants in alpine regions and current research on species range changes due to climate change.

We collect samples along a transect and enter results on our data sheets. We collect 10 samples of two species and record pest and disease damage to test the “enemy release hypothesis”, creating a graph of results.

At the end of the walk we discuss our findings and children are given a collectors card “Panini Bild” for each plant they have collected; normally a set of 12 cards.

2. Basel:

Das Zurich-Basel Plant Science Center lädt am Mittwoch den 16. September 2015 zu einem Spaziergang durch die Stadt Basel ein. Die Veranstaltung richtet sich an 8 bis 12-jährige Kinder, Jugendliche und ihre Eltern oder andere erwachsene Begleitpersonen.

Familienspaziergang

Weiche Landung – Wie Pflanzen die Stadt erobern

Der weltweite Handel und die gestiegene Reisefreudigkeit der Menschen führen immer häufiger zu einem zufälligen oder gezieltem Einführen fremder Pflanzenarten in neue Gebiete. Viele Arten wurden als Zierpflanzen zur Verschönerung von Parkanlagen, Gärten oder Balkonen eingeführt. Inzwischen findet man diese gebietsfremden Gartenpflanzen in Wäldern, entlang des Rheins oder in Wiesen. Solche Pflanzenarten werden als Gartenflüchtlinge bezeichnet. Mit welchen Mitteln kommen sie dorthin? Im Allgemeinen spielen Samen eine wichtige Rolle für die Ausbreitung von Pflanzenarten. Gilt dies auch für invasive Arten? Zur Beantwortung dieser Frage, sammeln wir Samen von einheimischen und invasiven Arten und suchen Unterschiede.