1967-2017

50

years of plant science in Umeå

Umeå Plant Science Centre

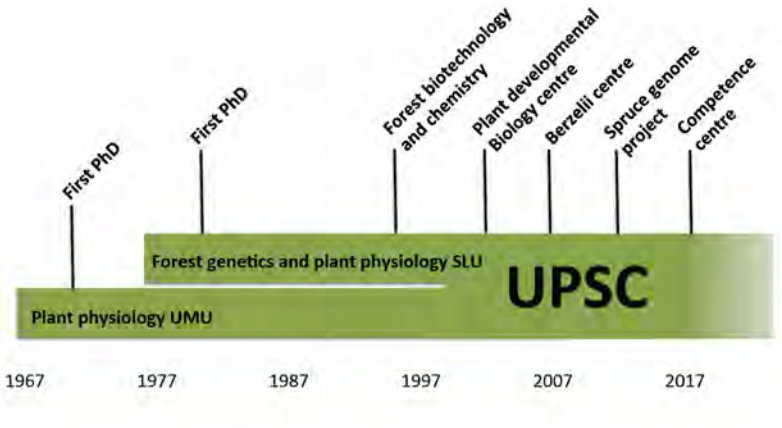
Umeå University
Umeå, Sweden 2021

Evolution into a world-leading plant research centre

The history of Umeå Plant Science Centre (UPSC) and its two components, *Fysbot* and *Genfys*, is remarkable. It is a story of development from a new university starting from scratch, and a tiny group consisting of just one professor and three eager students, to a major institution with a global reputation. Today, UPSC has about 200 researchers of 47 nationalities. These scientists publish results in the highest-ranked journals, and many of their innovations are marketed for both commercial and social benefit.

The unit was formed in 1999 by merging research groups from two universities: the Department of Plant Physiology at Umeå University (colloquially called *Fysbot*), established in 1967, and the Department of Forest Genetics and Plant Physiology (*Genfys*) of the Swedish University of Agricultural Sciences, which started a decade later. Over the years the two departments have maintained tight, fraternal connections and acted more as siblings than competitors.

This is the story of 50 years of plant science research in Umeå.



Some key events in the history of UPSC and its two departments.

Initial steps

The 1960s was a period of rapid restructuring of Swedish education, science, industry and economic strategy. The number of students at higher education institutes rose from 37 000 in 1960 to 124 000 in 1971. Science was recognized as having key roles to play in solving complex problems related to welfare, security and the environment. The decades after World War 2 have been called "the golden age of higher education". Numerous new educational institutes were established or upgraded both in Sweden and globally. The only Swedish universities before this period were Lund and Uppsala, but institutes in Gothenburg and Stockholm were respectively awarded university status in 1954 and 1960. Then, in 1965, Umeå University was inaugurated as the fifth university in Sweden, and the first in the northern part of the country.

Initially, Umeå University was established to meet the society's needs for highly educated personnel in northern Sweden, such as dentists, doctors, teachers and social workers. The university was also intended to be an engine for regional development. Its establishment coincided with a trend to establish open, flexible and more dynamic facilities than the rigid, stuffy, old, conservative and elitist academic institutions. Thus, Umeå University was not supposed to copy the structure of the 500-year old southern universities but to develop more freely as an open academy, with collaboration and interdisciplinary research as integral parts of its DNA.

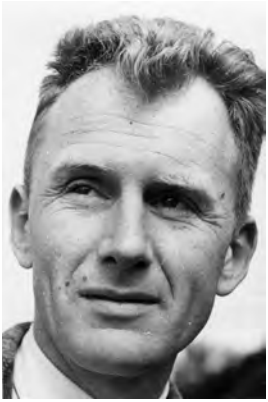
Science should be useful

The current policy at that time was that science should help society and be of practical use. This was particularly relevant to plant science. Previously there had been a strong emphasis on the traditional fields of botany: morphology and taxonomy (strongly rooted in the contributions of the great Swedish taxonomist Linnaeus). However, from the start it was decided that plant science in Umeå would focus on physiological and ecological aspects that could help attempts to solve real-world problems. Moreover, the problems should be addressed experimentally rather than by descriptive approaches.

This shift was part of broader trends, as "modern biology" and "new biology" emerged in the early 1960s. Molecular research was rapidly developing. The Nobel Prizes in both chemistry and physiology in 1962 were awarded for milestone efforts in molecular biology: elucidation of the structures of haemoglobin and myoglobin by Kendrew and Perutz, and the structure of DNA by Watson, Crick and Wilkins. The Swedish government saw both possibilities and a need for Sweden to engage in modern biology as an arena where the country could productively compete in the international science market.

The links between molecular biology and the practical problems biologists were supposed to address were far from clear at that time, but more understanding of plant physiology was clearly required. Thus, several strong advocates, e.g. Nils Fries and

Arne Tiselius (respectively Professors of Botany and Biochemistry at Uppsala University) championed a focus on plant physiology in Umeå. There were also stout defenders of classic taxonomic botany, but following an intense debate "new biology" triumphed, and it was decided that a Professorship should be established in plant physiology.



Per Halldal (1922 - 1986)
Professor at *fysbot* 1967-1972

The first holder was Per Halldal, docent and lecturer at Gothenburg University. In 1967, he started to establish a plant physiology group as part of the *Department of Biology*, thus forming the main root of the *Department of Plant Physiology* and UPSC.

Pioneer period 1967-1973

Starting from scratch, but with generous and permanent grants together with great freedom, was both a dream situation and highly demanding. The first classes in plant physiology started in the autumn of 1967, and everything had to be set up quickly by the small group headed by Professor Halldal. This little group – initially one Professor, three graduate students (Gunnar Öquist, Sune Linder and Örn Taube) and one lector (Karl-Ragnar Sundström) – had to unpack and install all the laboratory equipment, take care of the first undergraduate students and start the experimental research. Öquist, Linder and Taube all became doctors, continued as researchers and subsequently became Professors.

The group's research focused on photosynthesis, an interdisciplinary field where physiologists, physicists and chemists were striving to understand the mechanisms involved in the light-driven transformation of carbon dioxide into plant biomass. This seemed an obvious starting point for a new collaborative group seeking to extend knowledge of plant physiology, given its fundamental importance. So, they examined various aspects of photosynthesis, for example adaptation to different light levels in cyanobacteria and responses to UV-damage in green algae. Sune Linder later moved on to larger organisms and started to measure photosynthesis and transpiration in Norway spruce and Scots pine.

King Alfred and the Plant Stress Meter to study photoinhibition

Örn Taube measures photosynthetic action spectrum on "King Alfred"

From an early stage, the development of instruments was a hallmark of *Fysbot* and the first Professor, Per Halldal, was the initial instigator. Even during its first year, the department recruited an instrument maker, a technician and an engineer.

A fluorometer and a spectrometer were developed, as well as equipment for automated algae culture and appliances for 14C-based measurements of photosynthesis (the Shimshi method). However, the most advanced instrument in early stages was a spectrophotometer that delivered the same amount of photons at each wavelength between 400 and 750 nm. This instrument crowned the work, and was therefore named *King Alfred*. Naturally, with these accomplishments, *Fysbot* acquired a reputation for high competence in building instruments.

Many other instruments were also built. Part of the group established *Umeå Instrument AB* to commercialise the inventions. The FM3 fluorometer and QSM 2400 Quants spectrophotometer were produced under subcontracts, and in the mid-1970s this business was taken over by *Techtum Instrument AB*. This company is still active and successful on the national level.

Another important instrument was the *Plant Stress Meter,* developed to measure fluorescence associated with photoinhibition and (thus) plant stress, as described in the "Broadening period" section.

The plant physiology group's research portfolio March 1968

Photosynthetic action spectra • Prof. Per Halldal

Studies of B1 synthesis in Exobasidium • Fil. Dr Karl-Ragnar Sundström

Investigations of the differentiation of Dictyostelium • Fil. Dr Kerstin Gezelius

Studies of photosynthesis in pine and spruce • assistant Sune Linder

Studies of fluorescence in plants • assistant Gyöngyér Nilsson

Algal synchronisation: effects of ultraviolet irradiation • assistant Örn Taube

Adaptation of photosynthetic machinery • assistant Gunnar Öquist

Measuring photosynthesis requires specialised instruments, many of which are not commercially available. So, inventing instruments was an important part of the daily work, which subsequently resulted in patents and commercialisation of various technical devices.

Nitrogen fixation and air pollution

In the early 1970s, Karl-Ragnar Sundström extended research on key biological fixation processes by studying nitrogen fixation in free bacteria, and later lichens. New methodology based on acetylene reduction, enabling activity measurements of the crucial enzyme nitrogenase, was heavily exploited in these investigations. In addition, Kerstin Huss-Danell was recruited as a PhD student and moved on to studies of nitrogen-fixing bacteria of the genus *Frankia* and grey alder.

A topic that was high on the political agenda of the time, and required urgent attention, was air pollution. So, another recruit (Jan-Erik Hällgren) addressed its effects on lichens, and these studies were subsequently expanded to examine effects of fluorine and sulphur dioxide on pine.

Thus, the pioneering time was characterised by research on fixation of carbon (photosynthesis) and nitrogen, supplemented with increasing attention to effects of environmental stresses on plants.

Publish or perish

Per Halldal stressed the need for international cooperation and publication, asserting that work is not complete until it is published, and it should be in English (although researchers in the 1960s often wrote their dissertations as monographs, often in Swedish). He also organised annual trips to plant physiology institutes throughout the Nordic countries. Halldal's ideas about publication have guided the teams ever since. The guidelines have even been tightened, and now each scientist strives to publish in the most highly-ranked journals such as *Science* and *Nature*, as described in the section about UPSC.

In 1972, his first students graduated as doctors, and Per Halldal moved on to his Alma mater, the *University of Oslo*. Karl-Ragnar Sundström became acting Professor until a permanent successor was appointed, marking the start of a new period in which plant science at Umeå rapidly grew and matured.

Maturation period 1973-1982

Lennart Eliasson became the new Professor and leader of the plant physiology group in 1973. His research extended the group's studies from plants' acquisition of biomass (through carbon fixation) to the internal controls of their growth and development: their hormone physiology and the mechanisms involved in regulation of their life cycles. Particular interests, which seemed natural given the importance of forestry in Sweden, were the roles of hormones in root and bud development in trees.

Arne Dunberg and Göran Sandberg, at that time PhD student, joined the hormone group, which was to expand

over time. However, Lennart Eliasson still strongly supported the established work on photosynthesis and nitrogen fixation. Indeed, at this time the photosynthesis research, led by Gunnar Öquist, was moving on from single-

Lennart Eliasson (1925–2009)
Professor at fysbot 1973-1981

celled algae to trees (an important project, *Photosynthesis mechanisms in conifers*, started in 1973). Plant physiologists at other institutes were more inclined to work with simpler model species, such as spinach, and few were attempting to measure photosynthetic parameters in trees in the 1970s. This was to change in the 1980s, but by then the researchers in Umeå already had an important head start.

The practical importance of physiological understanding

The importance of physiological knowledge for understanding fundamental mechanisms of wood production, and addressing related problems, was becoming increasingly apparent. Sune Linder, who had moved to the *Swedish University of Agricultural Sciences* (SLU) in Uppsala, played a leading role in a giant project called *Barrskogsland-skapets ekologi* (The ecology of conifer forest landscapes). The project involved field measurements of gas exchange and carbon allocation, through intensive collaboration with *Fysbot*.

Moreover, forest decline and acidification had risen on the political agenda in the late 1970s and early 1980s, so more financial resources were allocated to efforts to address these environmental problems. The *Fysbot* group were deeply engaged in these efforts, notably in studies of the effects of sulphur dioxide on photosynthesis in Scots pine. The investigations of trees in the field (rather than simpler plants in the laboratory) also raised major challenges and needs to develop new equipment. A pioneering advance was the development of cuvettes that could be used to measure gas exchange rates of complete branches.

Hormone group moves to SLU

The 1970s was a transitional period for the hormone research group. The group (including PhD students Göran Sandberg and Per-Christer Odén, who worked together with Arne Dunberg on growth-regulating hormones such as auxin and gibberellin) was transferred to SLU's *Forestry Faculty* in 1978. This greatly diminished the hormone physiology research at *Fysbot*, which stopped completely when Lennart Eliasson left for a Professorship in plant physiology at *Stockholm University* in 1981.

The period 1973-1981 can be summarised as a maturation period. The researchers developed techniques

to study detailed aspects of photosynthetic processes, from subcellular levels to entire plant and tree levels. An impressive array of laboratory equipment was purchased or developed, and *Fysbot* had a growing international reputation.

Broadening period 1981-1999

By the time Lennart Eliasson left *Fysbot*, much had happened. Jan-Erik Hällgren and his group working on tree physiology had moved to SLU, as well as the hormone research group. What was left was the photosynthesis group, led by Gunnar Öquist, the enzyme research under Kerstin Gezelius, and nitrogen fixation research headed by Kerstin Huss-Danell. Gunnar Öquist was formally appointed Professor in 1982, and had to decide *Fysbot*'s future orientation. The chosen strategy was to broaden and deepen the established research on plants' adaptation to their environments.

Capacity to investigate more physiological aspects and components of plants was extended. Notably, the recruitment of Eva Selstam enabled studies of lipids and their roles in photosynthetic membranes, photoinhibition and the associated fluorescence (a hot topic at this time). A device was developed for measuring fluorescence and calculating the photochemical exchange of photosystem II. Following recognition of its utility for measuring stress in plants this was further developed, then produced and commercially marketed as the *Plant Stress Meter* (PSM) by *High Tech S.C.I. AB* in Malmö, and subsequently *Biomonitor* in Umeå. About 80 instruments were produced and sold between 1988 and 1994.

Molecular biology – gearing up…

Structures of DNA and several proteins may have been elucidated in the 1960s, but more than a decade passed before techniques were developed that began to permit dissection of the links between specific DNA sequences and physiological processes. However, Gunnar Öquist fully grasped their importance, as such techniques were emerging during a sabbatical year at *Carnegie Institution of Plant Biology*, Stanford, in 1980. Molecular biology was going to massively expand possible avenues of research, and *Fysbot* had to be involved. Petter Gustafsson was initially recruited to lead these efforts, in studies on genetic regulation of photosynthesis in cyanobacteria, which led to three doctoral dissertations between 1986 and 1988. The studies culminated in the 1990s with Rishikesh Bhalerao's revelation of genes encoding the light regulation machinery.

The importance of plant molecular biology was also recognised by the funding bodies. In 1986, grants were given to Umeå's first Professor in the field, Petter Gustafsson, and molecular techniques were extended to studies of more complex organisms when Jonas Lidholm and Stefan Jansson started to analyse the Scots pine genome. At this time, *Fysbot* and *Genfys* at SLU were in the forefront of plant molecular biology in Sweden.

DNA sequencing from Sanger to Illumina

Techniques to identify genes have rapidly developed in the last 20-30 years. One of the earliest was the *Maxam-Gilbert method*, developed in the mid-1970s, but the *Sanger method* was used by researchers at fysbot in the 1980s. In 1986, when Stefan Jansson started his PhD studies, the first goal of his project was to obtain the sequence of ONE gene in Scots pine. Nowadays, one run with a modern high-throughput instrument (like the *Illumina systems* used during the spruce genome project) generates much more sequence data in a second than a student produced during an entire PhD project in the 1980s.

… and scaling up

Following these early stages, *Fysbot*'s genomics activities were soon scaled up (although the term genomics was rarely used until the late 1990s). Petter Gustafsson's group moved in to new and better customised premises, a post-graduate course in plant molecular biology attracted new PhD students, and the research was extended (particularly in the 1990s) to two model systems: *Arabidopsis* and *Populus*.

Building up the infrastructure and personnel resources for successful molecular biology research requires money, a lot of money. Fortunately, this was a period, again particularly in the 1990s, when research councils and foundations increasingly understood the potential of genomics. The *Department of Plant Physiology* became a leading institution in this field, and attracted large donations from foundations such as the *Knut and Alice Wallenberg Foundation* and *Kempestiftelserna*, as well as grants from research councils. See below for more details about the funding.

An integrated part of plant physiology

At first, there was some resistance from traditional plant physiologists to the modern molecular biology. For example, Gunnar Öquist suggested that the journal *Physiologia Plantarum* (published by the *Scandinavian Plant Society*) should actively invite articles on molecular biology. There were protests from those who wanted plant physiology to be a pure field, and thought that molecular biology should be regarded simply as a suite of technological methods. With time, however, molecular biology and genomics have been accepted as integral parts of plant physiology. *Fysbot* played a leading role in this process in Sweden, and *Physiologia Plantarum* has provided an increasingly important platform. *Fysbot* has also played a major role in the development of this showcase, as two of its employees have been editor-in-chief (Per Gardeström from 1998 to 2006, and Vaughan Hurry since then), and Stefan Jansson has been president of SPPS, that owns the journal, since 2015.

An acknowledged department

The Federation of European Societies of Plant Physiology (FESPP) held its 1990 congress in Umeå, which was a major accolade for a university outside the capital cities that normally hosted the event. The staff at *Fysbot* organised the meeting, which attracted about 1000 participants. The congress was a success, and Umeå was strongly recognised as an important centre of European plant physiology.

Department of Forest Genetics and Plant Physiology 1977-present

The collaborator that eventually merged with *Fysbot* to form UPSC, is SLU's *Department of Forest Genetics and Plant Physiology*, *Genfys*. SLU was formed in 1977 through merger of the *Royal College of Forestry* with the *Swedish veterinary and agricultural institutes*. The old premises in Stockholm had to be abandoned and the forest scientists were transferred to Uppsala, Garpenberg or Umeå. The rearrangement led to a split in the botany and physiology group. A plant physiology team was formed in Uppsala, a genetics group was installed in Garpenberg, and some researchers accepted movement to the new Forestry Faculty building in Umeå, colloquially called *Skogis*.

Cultural clashes

Research at *Genfys* initially focused on various aspects of forest genetics, seed science, plant resistance to stresses (biotic or abiotic), and plant physiology. The first head of department was Professor Dag Lindgren.

The research was to a large extent applied. The forest sector had high expectations for science, believing that it could (and should) deliver powerful methods to increase forest growth, improve regeneration, solve environmental problems and boost the efficiency of forest operations. Since *Skogis*' staff included both graduate foresters and biologists from *Umeå University*, there were frequent cultural clashes regarding the view and purpose of science. Many researchers with a forest background thought their mission was to solve practical problems of the forest sector, so results should be primarily presented in Swedish, often in monographs. In contrast, the newly recruited researchers from the universities advocated publication in international media, and believed that science should provide deeper understanding of how forests, trees and ecosystems worked. Plant physiology was considered an auxiliary subject by the practically oriented researchers at other departments of *Skogis*.

So, from its inception, *Genfys* addressed both many practical topics (such as provenance research, tree breeding and genetic contamination) and fundamental aspects of physiology related to seed treatment and seedling production.

New researchers

Researchers from *Fysbot* were recruited to *Genfys* at an early stage. The hormone group, with Arne Dunberg and his students Göran Sandberg and Per-Christer Odén, moved into the new premises in 1979. Other notable entrants included Anders Ericsson, who helped to implement a new critical thinking about fundamental aspects of tree growth and regeneration. He was recruited as a plant physiologist in the giant research project *Barrskogslandskapets ekologi*, which fostered a new generation of forest scientists.

Jan-Erik Hällgren joined *Genfys* in 1982 when a 6-year docent position was announced. As already mentioned, his initial research focused, *inter alia*, on acidification and atmospheric pollution.

The genetics efforts at SLU were mostly based on quantitative methods, and there was a focus on biochemical genetics, which heavily relied at the time on isozyme analysis. Geneticists and physiologists at the department were initially reluctant to apply molecular genetics techniques, although some methods were implemented in the mid-1980s. There was cooperation between *Genfys* and *Fysbot* in the sense that some PhD students had supervisors at both departments, but no greater efforts were made to collaborate in their research.

Around this time biotechnological possibilities began to be discussed at SLU. A large donation from the forest company *STORA* (celebrating its 700th anniversary in 1988) provided foundations for a genetic centre. However, the centre was in Uppsala, and only a small proportion of the funds came to Umeå.

Plant physiology solving practical problems

Despite some internal conflicts, *Skogis* was an open research environment with few burdensome academic traditions, and many young, curious researchers. Cooperation between *Genfys* and staff engaged in the more applied disciplines such as silviculture and ecology gradually improved, particularly during the 1980s and 90s.

Progressive forest researchers saw the need for physiological measurements to understand trees' responses to environmental stimuli. Gas exchange, fluorescence and light absorption measurements were increasingly used in their studies. Techniques for testing trees' low-temperature hardiness helped tree breeding and regeneration research efforts. Analyses of water stress in trees and other plants required measurements of other physiological parameters, such as stomatal conductance and water potential. Nutrient uptake was another field where physiologists added new insights. Notably, Torgny Näsholm's doctoral work on amino acid uptake and nitrogen metabolism provided new avenues for both nutrient acquisition research and practical fertilization of plants.

The research funding organizations also acknowledged the links between applied research and fundamental understanding. Young researchers, including those with forest education, saw the blind alleys in the old "trial and error" approaches, and sought deeper explanations. *Kempestiftelserna* played an important role in promoting the department's evolution by providing support for new projects and equipment. They also sponsored a Professorship in conifer physiology, awarded to Jan-Erik Hällgren in 1987. *Skogs- och Jordbrukets forskningsråd* (SJFR) supported the development too, for example by establishing a Professorship in genetics and physiological regulation of morphogenesis in conifers, a position awarded to Göran Sandberg in 1989.

In the early 1990s, the research and facilities established by Göran Sandberg's group were world class. However, not everyone saw the advantage. A leading representative of the university called their efforts "a giant waste of money".

Field experiments

Plant physiology also moved out to the field. Jädraås had been a home for the *Barrskogslandskapets ekologi* project, and *Svartberget Experimental Forest* near Vindeln provided the infrastructure needed to establish practical field research close to Umeå. The experimental forests gave SLU a clear advantage over Umeå University in the growing subject ecophysiology. One famous site at Svartberget is Flakaliden, where Sune Linder established fertilization trials that have been used in studies described in more than 300 scientific papers and over 50 doctoral dissertations.

The field experiments increased the need for, and thus accelerated the development of, new portable devices that could be transported to the field and withstand rain, low temperatures and lightning. Instruments were bought from the USA and Germany, but also from the local, Umeå-based, company *Techtum*.

The quantitative genetics efforts were tightly linked to the organisation responsible for practical tree breeding in Sweden, at that time *Institutet för Skogsförbättring* (later Skogforsk). Moreover, many of the doctoral-level staff at *Skogforsk* were supervised by Dag Lindgren at *Genfys* during their PhD studies.

Molecular biology rapidly develops…

The links between plant physiology and molecular genetics rapidly strengthened. In the late 1980s, *Genfys* had a strong group of hormone researchers, whose investigations included new studies focused on the genetic control of cambium development and wood formation.

Genfys also made pioneering contributions to the genetic transformation of poplars; model taxa with several suitable features for genetic studies. Professor Olle Olsson, who had moved to the department via *Fysbot*, showed that transformed poplars could be produced, initiating intense efforts to apply genetic transformation of trees for diverse purposes.

…cooperation tightens

The links between groups at *Genfys* and *Fysbot* became increasingly tight in the 1990s. PhD students could have supervisors at both departments, and many researchers moved between the departments. Like *Fysbot*, *Genfys* had several researchers who were among the world-leaders in their fields. Further advances required cooperation with experts in other fields, such as chemistry. *The Forest Biology* and *Chemistry research* program started, and the forest industry also recognised the enormous potential of the research.

… and the results are ground-breaking

In the 1990s, *Genfys* wanted to accelerate molecular biology research. The group headed by Göran Sandberg and Olle Olsson grew with re-

cruitment of high-profile scientists such as Rishikesh Bhalerao, and several PhD students joined. One was Ove Nilsson, who published groundbreaking results on flower regulation. Ove presented his studies in *Nature*, this strongly urged researchers at *Genfys* to publish in the most highly ranked journals, just as Per Halldal had done 25 years previously at *Fysbot*, although at an even higher level.

This was far from the only breakthrough research published by the increasingly united departments. Another example (in addition to the achievements of *Fysbot* summarised in previous sections) is the study on nitrogen metabolism presented by Torgny Näsholm and colleagues in *Nature*, showing that plants take up amino acids from the soil, and molecular analyses showing how they are transported and metabolised. The results led to one of many products in *SweTree Technology*'s portfolio (see below). Detailed analysis of the genetic regulation of wood formation, presented by Björn Sundberg, Göran Sandberg and colleagues in *Proceedings of the National Academy of Sciences*, provides a further example of great practical importance. This work highlighted (*inter alia*) the key role of auxin in wood formation.

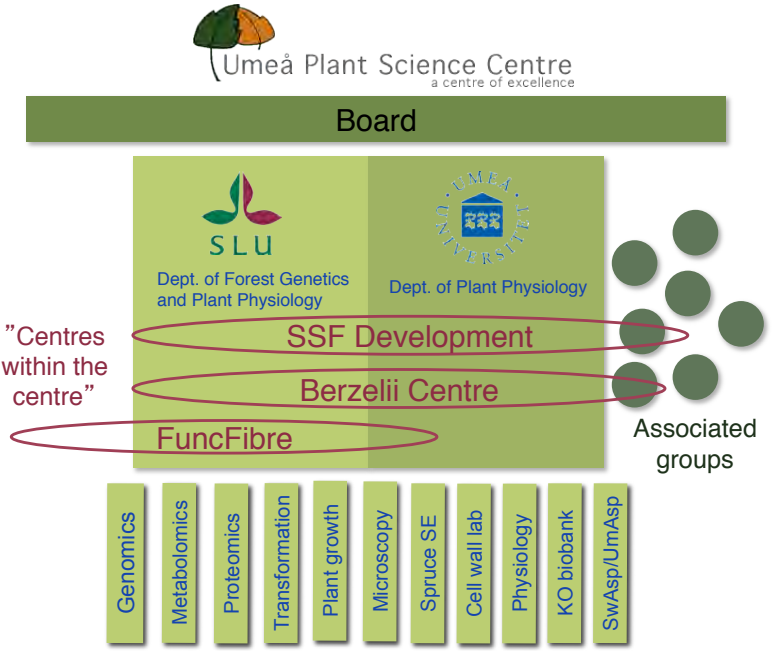
However, although there were close personal bonds between *Genfys* and *Fysbot*, they were still two departments, physically separated on the campus, and with different administrative rules and cultures. More formal cooperation was initiated by the next step – the formation of UPSC.

Populus – a model tree system

Populus trees (poplars and aspen) have several major advantages: they are easy to clone by vegetative propagation, grow quickly and produce flowers at a very early stage (for trees) in the greenhouse. So, they were obvious model systems for molecular genetics. If *Arabidopsis* is the fruit fly of plants, poplar is the *Arabidopsis* of trees.

One poplar was the third plant in the world to have its entire genome sequenced, in an effort where UPSC researchers played a leading role. A *Populus* expressed sequence tag (EST) program had already been started in 1997, before UPSC's establishment, in collaboration between Umeå University and KTH. Researchers in Umeå isolated mRNA from the cambium of aspens and converted it to cDNA stretches (ESTs) for sequencing at KTH. The initiative was successful, as more than 5000 ESTs were detected. Several known and assumed genes were found, but also many previously unknown genes.

Analysis of aspen and other poplars has great potential to increase knowledge of the genetic control of wood formation, resistance, growth rhythms and various other processes. Thus, several projects are currently focusing on *Populus* species at UPSC. Now, they also include analysis of natural variation as a complement to the "biotech approach".



Organigram (from about 2010) depicting the structure of UPSC with its two departments, technical platforms, associated groups (at other departments) and large projects/"centres within the centre" sometimes also including groups not formally associated with the centre

Concluding remarks

An analysis of the EST clones present in the public databases has revealed that the LHC super-gene family of *Arabidopsis* contains >30 members, of which some encode proteins that were previously unknown. Some of these might have a role in high-light acclimation – ongoing studies will clarify this. Do these 30 genes represent the complete super-gene fam-

8 Zhang, H., Hurley, J. and Goodman, H.M. (1994) Isolation, characterization, and chromosomal location of a new cab gene from *Arabidopsis thaliana*, *Plant Physiol.* 96, 1387–1388

9 Zhang, H., Wang, J. and Goodman, H.M. (1994) Differential expression in *Arabidopsis* of Lhca2, a PSI cab gene, *Plant Mol. Biol.* 25, 551–557

10 Jansson, S. (1994) The light-harvesting chlorophyll *a/b*-binding proteins, *Biochim. Biophys. Acta* 1184, 1–19

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First scientific publication with UPSC in the address

Umeå Plant Science Centre (UPSC) 1999-present

As already outlined, during the periods preceding formation of UPSC, research competence increasingly strengthened at both *Genfys* and *Fysbot*. The *Umeå University* branch *Fysbot* had high competence in gene sequencing and genomics, while genetic transformation techniques had been developed at *Genfys*, and the hormone physiology research provided robust foundations for advanced research on plant growth and development.

Both departments were strong, and competing with similar environments in Uppsala, Lund, Stockholm and Gothenburg. However, due to the competences already described, biotechnology (particularly forest-related biotechnology) developed more rapidly in Umeå than elsewhere.

Researchers in Umeå were quick to apply model systems, starting with *Arabidopsis thaliana* – the "fruit fly" of plant genetics, in 1995. *Populus* was the next step. The *Poplar EST-project*, which kicked off in 1997, was a nationally pioneering effort in the exploitation of genomic research.

The two departments clearly had complementary strengths, and discussions on more formal cooperation started in the 1980s. However, despite investigations and formal reports highlighting their synergies, there was little further progress in this direction until the mid-1990s.

Strong cooperation had already been established on personal, research-based levels. The two groups were seen, more or less, as siblings. In 1998, the *Fysbot* group was to be merged into a new *Department of Genetics and Plant Physiology* at Umeå University, against the will of the staff. This motivated intensify discussions with *Genfys*. A management group was organised in 1998 with leading professors at the two departments. In the autumn, plans were concretized. The goals were to create an internationally powerful experimental plant research unit that cooperated in provision of undergraduate and graduate courses and research, as well as to move the staff to the same premises.

Two departments, two universities, one centre

UPSC was formally founded in March 1999. Initially, an external board was established to broaden the Centre's perspectives, which included equal numbers of representatives from SLU and Umeå University. The external board was replaced in 2005 by an internal one.

Creation of an institute affiliated to two universities posed several challenges, such as identifying the principal employer, and staff loyalties. It was decided that staff at the two departments should become members of UPSC and the address should be written "*Umeå Plant Science Centre, Department of…*" depending on the original affiliation. The first scientific publication with this address appeared in 1999.

Hormonal and genetic control of wood formation

At genfys, highly sensitive techniques to quantify plant hormones were developed by Göran Sandberg, Thomas Moritz and colleagues in the 1980s, and techniques for ultra-thin sectioning of trees' wood-forming zones by Björn Sundberg's group. In combination, these techniques revealed high-resolution distributions, interactions and roles of hormones in wood development. The results indicated potential ways to alter quantities and qualities of wood produced by trees, providing important proof-of-concept for forest biotechnology as plant developmental biology became a hot topic in the 1990s.

Moreover, when the first genomics project was launched in 1997 the wood-formation zone was a major target. The first description of gene expression patterns in this zone (in aspen) was published in 1998, and when large-scale Swedish funding of genomics began in 1999/2000, UPSC researchers already had further proof-of-concept, in contrast to scientists working with mice, fruitflies or humans, which was important for funding of the newly formed UPSC. Trees with modified expression of some of the candidate genes identified in the genomics programs have also been analysed in field experiments. A comprehensive tree genomics program emerged from these efforts, and the analytical skills developed to quantify plant hormones provided foundations for development of "proteomic" and "metabolomic" analyses (of organisms' protein and metabolite profiles), and today UPSC hosts the *Swedish Metabolomics Centre**, analysing samples from researchers in diverse scientific and medical fields.

* Metabolomics is the study of large fractions of the small molecules in cells, tissues or organisms, which reflect their physiological state (e.g. healthy, water-stressed, or suffering from a particular disease).

A formal management group was formed in 2000, with Göran Samuelsson as Director. Per Gardeström and Ove Nilsson later succeeded him.

An urgent task now was to prepare a building to house all the staff and equipment. Should the unit move into a new building at SLU, or a building on the university part of the campus? The cheapest alternative was to use premises already available at Umeå University, in the plant physiology building. Among other advantages, this was close to the chemistry department.

Again, *Kempestiftelserna* and the *Wallenberg Foundations* contributed initial funding, and adaptation of the building started in the autumn of 2000. In September 2001, the staff began to move in, and the building was officially inaugurated in the summer of 2002.

International unit

The staff at this time included some 125 persons of numerous nationalities. The working language was to be English. Since 2007, UPSC has recorded rises in nationalities from 32 in 2007 to 47 in 2016. Thus, it is a truly international unit.

Moreover, the international network was already strong before the unit was formed. Since then, the number of post-doctoral researchers has increased, and several major cooperative projects have been established with universities worldwide. Important partners include *INRA* (France), *Golm* (Germany), *RIKEN* (Japan) and *University of British Columbia* (Canada).

Grants and centres of excellence

In 2002, the *Swedish Foundation of Strategic Research* approved an application to fund a *Centre of Excellence in Developmental Plant Biology* at UPSC. The grant, amounting to 120 million SEK over a 6-year period, was a milestone for UPSC, enabling recruitment of top scientists and the acquisition of important technical equipment.

In the early 2000s, the Swedish research funding agencies focused on providing grants for large strategic projects, amounting to 10 million SEK per year or so. UPSC's success in attracting such grants has been crucial for further progress. *The Swedish Research Council* (Vetenskapsrådet) and *VINNOVA* are among the most important financers. UPSC became a *Berzelii Centre for Forest Biotechnology* (2007-2016), and from 2016 a *VINNOVA Competence Centre – UPSC Centrum för Skogsbioteknik*. UPSC has also played leading roles in two of 43 centres (*Bio4Energy and TC4F*) supported by government resources committed to strategic research in 2010. Obviously, the organisation of UPSC has been appropriate for attraction external grants.

Private foundations, particularly *Kempestiftelserna* and the *Knut and Alice Wallenberg Foundation*, have been equally important for the success of UPSC. As already mentioned, these foundations had also supported the research at fysbot and genfys long before UPSC was formed. More recent contributions include a 75 million SEK Wallenberg grant for the *Spruce genome project*. This was

used to sequence (in collaboration with *Skogforsk* and the newly established *SciLifeLab* in Stockholm) the complete genome of a spruce tree included in the Swedish breeding program. Publication of the draft assembly of the 20-gigabase genome, in *Nature* in 2013, was an important milestone in the history of genomics, as it was the first map of any gymnosperm's genome.

Commercialisation

Other private actors saw forest biotechnology's potential to improve wood quality and/or quantities, obtain faster-growing or more resistant trees, accelerate breeding programs, and increase regeneration efficiency. Moreover, several of the findings were commercialised.

The spruce genome – a major breakthrough

An article in Nature in May 2013 received enormous attention, from both scientists and the media. For the first time the entire genetic sequence of a conifer had been presented. In addition, it was the largest genome ever sequenced. The Norway spruce has at least 29 000 genes, more than humans.

The project started in 2010 with funding from the Knut and Alice Wallenberg Foundation, and involved collaboration between UPSC and SciLifeLab in Stockholm.

The technology for DNA sequencing had progressed quickly during the early 2000s, and the researchers believed the methods were sufficiently mature to start the gigantic project. When they started the sequencing, using the modern equipment at SciLifeLab, they found they could generate more sequence data in a week than had been managed in 10 years in the huge Hugo project on human DNA.

The first sequencing was restricted to the genome of a single tree, a spruce included in the tree breeding programme supervised by Skogforsk. Today, DNA sequencing is a routine task, and an intention is to map genomes of all trees in the Swedish breeding population (thereby closing the gap that once existed between the operational tree breeding and the molecular biology research at the two departments).

SweTree and Woodheads

Patents and commercialisation were not novel concepts for the researchers at *Fysbot* and *Genfys*. Indeed, as already described, an in-house company had commercially produced instruments in the 1960s. However, the upscaling of gene technology research heralded prospects for substantially greater future profits. UPSC's main research findings are now commercialised by a company called *SweTree Technologies AB* (hereafter *SweTree*) and its main owner *Woodheads AB*. *Woodheads* is an investment company jointly owned by about 50 researchers at UPSC, SLU in Uppsala, Uppsala University and KTH Royal Institute of Technology.

Now (2017) *SweTree* is a forest biotechnology company with a turnover of 40 million SEK. The owners, besides *Woodheads*, include several companies involved in the Swedish forest industry (*Sveaskog, Holmen, Bergvik, Stora Enso*), *Kempestiftelserna,* the *Wallenberg Foundations AB* and holding companies of Umeå University, KTH and SLU.

The innovations currently marketed by *SweTree* per se have applications in poplar breeding, biotechnological modification of trees and somatic embryogenesis. However, others with applications in two fields are spun out into subsidiary companies – *SweTree Nutrition AB* and *Cellutech AB*.

SweTree Nutrition commercialises nitrogen fertilizers based on the amino acid arginine, exploiting findings of Torgny Näsholm and his colleagues that trees absorb nutrients in this form in natural environments. Fertilisation with arginine (using a product called *arGrow®*) has several advantages, such as reducing nutrient leakage in nurseries and improving seedlings' root:shoot ratios.

Cellutech markets innovations originating from the *Wallenberg Wood Science Centre*, which aims to develop new environmentally friendly materials based on cellulose.

Today, *SweTree* operates globally. Two of its customers are *StoraEnso* and *Fibria* in Brazil, where *SweTree* is scaling up transformation of *Eucalyptus* clones.

Somatic embryogenesis is a method for large-scale propagation of clonal material. Such techniques have been available for propagating conifers for more than 30 years, but their automation has been lagging behind. *SweTree* has developed pilot plants to address this problem.

Why start a company?

Several of the researchers at UPSC had felt frustration that the forest industry did not acknowledge the potential of biotechnology. They had seen the rapid progress in the pharmaceutical and agricultural industries since molecular biology was introduced. *SweTree* was needed to promote the new innovations for the sake of the forest industry.

A springboard for its establishment was a meeting in 1999 with Göran Sandberg, Mathias Uhlén at KTH and Ulf Edlund at Umeå University. They

Gene modification – playing God?

UPSC was engaged in research involving genetic transformation during a time of strong protests against "genetic manipulation". There is still strong resistance to genetically modified organisms (GMOs) in Europe, which has stopped not only commercial cultivation but also scientific trials with modified crops. The genetic engineering at UPSC involved trees and lower plants, but there were still protests against the establishment of the first growth chambers. Various UPSC staff members, not least Stefan Jansson as head of the *Fysbot*, have tried to initiate open dialogue about the matter.

When the safe laboratory was to be built at UPSC, there were fears about environmental terrorists. In other parts of the world, field trials and premises had been destroyed by people who were afraid of "monster plants" spreading. Moreover, in Umeå "militant vegans" had burned animal transport trucks and released captive animals. Partly for this reason, the laboratory was built on top of the three-storey university building in Umeå, with safety glass, to minimise risks of people breaking in and ruining the experiments.

A common misconception is that all transgenic trees have genes from other plants or even animals. This is usually wrong; in the most frequent applications of transgenic techniques native genes are switched on or off. Mutations with these effects occur all the time in nature, but the researchers can induce them in a much more controlled fashion.

At UPSC, most of the current research projects involve studies of transgenic trees, and UPSC has made pioneering contributions to large-scale field studies with transgenic trees. Many of these investigations are designed to improve fundamental understanding of tree biology (for which transgenic techniques are essential nowadays), while others have more practical purposes.

discussed the need to build a bridge between the research community and the forest industry. For a few years, there had also been collaboration between Umeå and KTH in the *Poplar Expressed Sequence Tag* (EST)-programme.

SweTree's personnel grew to eight employees in the first five years, and the companies *Sveaskog, Holmen Skog* and *Bergvik Skog* decided to become partners. Today, *SweTree* can be considered as being in an expansionary phase. The portfolio has increased, and the number of employees has risen to 30.

Woodheads – an employee-owned company

As already mentioned, the investment company Woodheads is owned by about 50 researchers, who permit (as a condition of their ownership) the company to exploit all their innovations. The capital they put up is in the form of ideas and innovations rather than money. The patent procedures are handled by *SweTree*.

A foundation of this type of commercialisation is the Swedish principle of *"lärarundantaget"*, meaning that a teacher, researcher or PhD student owns the rights to his/her ideas and innovations, and can freely patent them without informing the employer. This principle is rare in other parts of the world. In the *SweTree* situation, however, it was decided that any future profits should be shared by the researchers and the department, as innovations could not have been developed without the expensive infrastructure provided by the universities,

Brave financers

Building a world-leading centre in forest biotechnology is not cheap. Fortunately, over the years many brave financers have placed trust in the future potential of genomic research in Umeå. Particularly noteworthy is the *Knut and Alice Wallenberg Foundation*, which contributed 500 million SEK to the *Wallenberg Consortium*, a cooperative initiative involving Umeå University, the Karolinska Institute, Stockholm University, KTH, Uppsala University and Linköping University. *The Wallenberg Foundations* have also supported the purchase of various pieces of expensive equipment, projects and scientific positions over the decades.

The *Kempe Foundations* were early supporters, giving grants (for example) for the long-term project *Photosynthesis mechanisms in conifers*. The Foundations can be regarded as strategic and financial partners in the development of the plant physiological research at both *Fysbot* and *Genfys*.

Research positions were highly important for establishing a relatively permanent staff of qualified scientists. *Naturvetenskapliga forskningsrådet* and *Skogs- och jordbrukets forskningsråd* (SJFR) was one of the councils supporting such positions. *The Swedish Foundation for Strategic Research* is another important source, which has supported (for example) the *Forest Biotechnology and Chemistry programme* in the 1990s, and the *Centre of Excellence in Developmental Plant Biology* at UPSC.

In the early days of *Fysbot*, basic financing was more freely given to the universities to spend as they wished. This provided secure funds for research and much greater freedom to allocate the money to research projects of internal interest. With time, the degree of external financing increased, thereby raising requirements for researchers to become internationally competitive, which was especially challenging for older researchers. Research quality, manifested by publications in high-profile scientific journals, became increasingly important to attract money from the research councils and foundations. Thus, the success of *Fysbot*, *Genfys* and *UPSC* in attracting funds is testimony to the institutions' sustained research quality.

1998-11-30

PM ANGÅENDE BILDANDE AV "UMEÅ PLANT SCIENCE CENTRE"

Sammanfattning

Vår målsättning är att skapa ett centrum i Umeå för experimentell växtbiologi - "Umeå Plant Science Centre" (UPSC). Fundamentet i centrat utgörs av Institutionen för skoglig genetik och växtfysiologi vid Sveriges Lantbruksuniversitet och Fysiologisk Botanik vid Umeå Universitet. Vi avser att verka för en integration och samordning av forsknings- och ut
av institutionerna. Målsättninge
experimentella växtforskningen
högkvalitativ utbildning inom o
sättningar för att centrat skall lig
attraktivt för utländska forskare o

1998

PM with suggestion of the formation of Umeå Plant Science Centre (UPSC)

Målsättningen med detta PM är at
nå detta mål med ett samlokalis
tidsperiod som möjligt (2-3 år). Vår uppfattning är att samlokaliseringen bör ske genom att nya lokaliteter byggs i anslutning till Skoglig genetik och växtfysiologis lokaler på campusområdet. En sådan utbyggnad skall förhoppningsvis i så hög grad som möjligt finansieras med donationsmedel.

Bakgrund

Stora organisatoriska förändringar sker just nu inom den svenska högskole- och universitetsvärlden. De mindre och medelstora högskolornas antal ökar, vilket på sikt kommer att innebära en ökande konkurrens om såväl forskningsmedel som om studenter.

Finansieringen av forskningen har förändrats så att en stor andel av forskningsmedlen finns i de strategiska stiftelserna och EU, vilka huvudsakligen stöder riktade forskningsinsatser, medan en allt mindre del administreras av de forskningsråd och fakulteter vars uppgift är att främja grundforskning.

För att anpassa oss till den ökande konkurrensen och för att kompensera för Umeås geografiska läge måste vi vara öppna för förändringar som leder till att vår forskningsverksamhet och utbildning ytterligare förbättras. Ett intimt samarbete mellan de två växtfysiologiska institutionerna i Umeå kommer att generera betydande fördelar för att bibehålla och vidareutveckla den växtfysiologiska forskningens nationellt och internationellt höga kompetens som finns i Umeå. En centrumbildning kommer att leda till en samlad och bred forsknings- och undervisningskompetens så att vi betraktas som ett såväl nationellt som internationellt ledande centrum inom vårt ämnesområde.

Det bör påpekas att det nedan föreslagna centrat överensstämmer väl med de utvecklingsprogram som redovisats av de båda universiteten. Vidare förbereds det nu, inom matematisk/naturvetenskapliga fakulteten vid Umeå universitet, avsevärda omlokaliseringar på grund av förändringar i institutionsstrukturer. Det är därför angeläget att samlokaliseringen av de två institutionerna synkroniseras med de övriga omlokaliseringar som planeras inom denna fakultet.

Samarbete ska skapa växtbiologiskt centrum

Nu planeras för ännu en centrumbildning mellan Umeå universitet och SLU, Sveriges lantbruksuniversitet. Det finns långt gångna planer på ett växtbiologiskt centrum, som ska bli ett av de största i landet.

När centret startar får vi lära oss betydelsen av ännu en bokstavskombination. UPSC står för Umeå Plant Science Centre, som ungefär kan översättas med Umeå växtvetenskapliga centrum.

Institutionen för fysiologisk botanik vid Umeå universitet samt institutionen för växtfysiologi vid SLU ska samarbeta i centret. Upp emot 130 personer ska arbeta inom centrets ramar.

– Vi är två systerinstitutioner som finns 300 meter från varandra på campus. Institutionerna bedriver var för sig forskning och utbildning, och blir kvar som separata institutioner. Men tillsammans får vi en tyngd i centret, berättar Göran Samuelsson vid fysiologisk botanik.

Har sökt anslag

Bakgrunden till centrumbildningen är den omorganisation av Umeå universitets institutioner som pågick under förra året. Ett förslag fanns om att fysiologisk botanik skulle slås ihop med genetik och zoologisk fysiologi. På fysiologisk botanik ansåg man dock att en sådan organisation skulle försvåra forskningen. I stället vände man blickarna mot kollegorna vid SLU.

Inom kort förväntas styrelserna för de båda universiteten, Umeå och SLU, ta beslut om centrumbildningen. Redan nu har centret sökt anslag med 8 miljoner kronor hos Kempestiftelsen, en större ansökan ska snart ställas till Wallenbergsstiftelsen.

I dag kostar verksamheten vid institutionerna ungefär 50 miljoner kronor, i summan är både löner och forskningsmedel inräknade. Drygt 70 procent av verksamheten bekostas med externa medel, bara knappt en tredjedel är anslag från respektive universitet.

– För oss är det helt nödvändigt att få in pengar utifrån, säger Göran Samuelsson.

UPSC ska bli ett av de största växtbiologiska centren i Sverige, där experimentell växtbiologi kommer att vara huvudinriktningen.

– Vi ser centret som en viktig strategisk handling. Vi kan inte bara acceptera försämringar, det är vår skyldighet att vara aktiva, säger Göran Samuelsson.

CATARINA SAHA

1999

"Cooperation will create plant biology centre"
Newspaper article

Lennart Malmqvist, nyvald ordförande i Umeå
sök i Umeå i går. Björn Sundberg, forskare vid

Miljoner får

Det finns folk som inte nöjer sig med att bara titta på ett träd. De skalar av växten in på bara genen, ja ner på atomnivå. Allt för att skapa förståelse om vad som gör trädet till den planta det är och vad som styr dess liv.

Växtfysiologi heter ämnet och i Umeå finns några av de bästa forskarna i världen. Björn Sundberg, till exempel. Han kikar på hur ved bildas. Målet är att hitta de gener som bildar fibrer. Kanske kan man i framtiden skapa träd som bildar ved snabbare och till bättre kvalité.

Björn Sundberg finns vid Sveriges Lantbruksuniversitet i Umeå. Några hundra meter från hans arbetsrum finns andra växtfysiologer, anställda vid Umeå universitet.

Styrelse och pengar

Nu ska de båda universitets-institutionerna komma närmare varandra genom ett gemensamt projekt, kallat Umeå ence Center.

I somras fick UPSC se. Lennart Malmqvi sor i fysik vid Lunds tet, har utsetts till o På torsdagen besökte gorna i Umeå för först

– Utomlands har ja väning över att Ume sökt samla sin komp gare, säger han.

– Här finns verkligt utsättningar för att b nu bättre forskning.

UPSC har också få Kempestiftelserna ha beviljat 8,2 miljoner skarna är glada:

– Det var första gå sökte och så fick vi rekt. Det känns verk muntrande, säger Gö elsson, prefekt vid nen för Fysiologisk b Umeå universitet s ståndare för UPSC.

Med pengarna kan köpa in ny teknik. bättre grejer kan trånga ännu djupare

FOTO: ROLAND BERGGREN

plant science center, passade på att lära sig mer om aspar som genförändrats, vid sitt be-skoglig växtfysiologi vid SLU, visade upp sina försök.

Göran Samuelsson, föreståndare för det nybildade Umeå plant science center.

Göran Sandberg, forskare vid Sveriges Lantbruksuniversitet i Umeå.

1999

"Millions make science bloom"
Newspaper article

FAKTA • *UPSC*

- UPSC betyder Umeå Plant Science Center.
- Här samarbetar 45 forskare från institutionen för Fysiologisk botanik vid Umeå universitet med 75 forskare från Skoglig genetik och växtfysiologi vid Sveriges Lantbruksuniversitet, SLU, i Umeå.
- Forskarna ägnar sig åt grundforskning.
- Grundforskningen går ut på att i detalj ta reda på hur växterna fungerar.

r forskning att blomma

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nas celler, allt i jakt på ökad förståelse för hur växterna fungerar. Till exempel arbetas det med att ta fram en databas över de gener som finns i blad. Databasen kan användas på många sätt. Till exempel kan den ge ny kunskap om hur fotosyntesen fungerar, det som gör att växten kan omvandla solens energi till socker.

Vill bygga hus

De forskare som är engagerade i UPSC är inte nöjda med att bara ha ett gemensamt namn att använda när de söker pengar ur olika forskningsfonder. De drömmer även om ett gemensamt hus.

– Vi vill samla kompetensen på ett tydligare sätt, menar Göran Samuelsson. Gemenskapen är viktig för att driva forskningen framåt. Det är också viktigt för att locka till sig nya forskare inom område och få dem att stanna i Umeå.

Men ledningen vid Umeå universitet prioriterar inte ett hus till UPSC.

Avancerad utrustning, som en masspektrometer, är en förutsättning för framgångsrik forskning även inom växtfysiologi. Göran Sandberg, och Göran Samuelsson, gläds åt att ha fått nya miljoner att köpa utrustning för.

Inge-Bert Täljedal, rektor vid Umeå universitet, konstaterar att det snart ska invigas ett nytt kemiskt-biologist centrum på campus och att det räcker för en tid framöver.

– Men jag gratulerar verkligen forskarna, som tillhör världseliten inom sitt område, till att ha fått pengar från Kempestiftelserna. Satsningen de gör är viktig för Umeå.

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Största anslaget någonsin

SLU och universitetet får 70 miljoner för att forska inom växtområdet

Det största enskilda forskningsanslaget till Umeå någonsin.
Så beskrivs anslaget på 70 miljoner kronor som tilldelats SLU i Umeå och Umeå universitet för forskning inom växtområdet.
– Det känns väldigt bra. Vi har jobbat målmedvetet i tio år med växtforskning med målet att vara bäst i Sverige, säger professor Göran Sandberg.

Det är Stiftelsen för strategisk forskning som beslutat om anslag till olika forskningsinsatser. Totalt satsas över 900 miljoner kronor, kronor går i forskningscentra ligger skar i utvecklet växtområdet.

Anslaget på nor på sex å motprestatio tet och indus på paketet b ner kronor p

Anslaget h sor Göran Sa tionen för skoglig genetik och växtfysiologi. Han säger att det var stenhård konkurrens om medlen.

– Men man har ju alltid hoppats så klart. Det var ett väldigt viktigt anslag för att kunna fortsätta utvecklas, säger han.

– Forskningscentrat är ett samarbete mellan Sveriges Lantbruksuniversitet och Umeå universitet, och bedrivs i gemensamma lokaler på campus i Umeå. Där jobbar i dag cirka 150 personer med experimentell växtforskning. Anslaget ska gå till att rekrytera nya internationella forskargrupper till Umeå.

I 50 personer

Målsättningen är att rekrytera tio grupper på mellan 15 och 25 personer vardera. Totalt alltså mellan 150 och 250 personer.

– Det här är det största anslaget som delats ut i Umeå någonsin, slår Göran Sandberg fast.

Konkret kommer grundforskning att bedrivas för att förstå hur växter fungerar.

– Vi har en hel del forskning på skogsträd. Så en hel del kan tillämpas på skogsområdet. En

tret, som heter Umeå plant science center. Att beskedet om anslaget kom just nu var en slump.

– Men det passar ju bra, säger Göran Sandberg.

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FOTO: PER LANDFORS

Växtforskare från SLU och Umeå universitet blir sambos i universitetets nya Plant Science center. De nya lokalerna garanterar säkerheten kring växtforskningen vilket gläder Tomas Moritz på SLU.

2002

"Biggest grant ever. SLU and the University gets 70 millions for plant research"
Newspaper article

Tam debatt om forskning

Säkerhetshus, javisst. Men forskarna kommer inte någon vart om de inte får göra fullskaliga studier i fält. Därför lever debatten om genförändrade grödor kvar. Men den är långt ifrån hätsk.

Inför invigningen av Umeå Plant Science Center debatterades riskforskningen. I panelen satt en företagare, en forskare och en representant för Naturskyddsföreningen.

– Vi har råd att vänta på bra riskforskning, poängterade Mikael Karlsson, ordförande för Svenska naturskyddsföreningen. Historiskt sett har vi lärt oss väldigt dåligt av tidigare varningar.

Kristofer Vamling från företaget BASF Plant Science Sweden höll inte riktigt med.

– Hittills har vi sett att det finns nytta med genförändrade växter. Vi har också sett en del risker, men har vi annu sett några skador?

Ove Nilsson, professor i reproduktionsbiologi vid SLU, satt inte med i panelen.

– Det behövs fältförsök under en lång tid för att kunna värdera riskerna. Och nyttan, sa han.

– Det viktiga är att värna industriforskningen. Där händer mest just nu. Om den avstannas på grund av regler kommer akademiska satsningar att falla när staten inte längre ser kommersiella tillämpningar av grundforskningsbidragen. Här är det viktigt att balansera.

Men innan debatten tog slut, var alla ense om att mer forskning kring riskerna behövs.

– Det finns bra och dåliga tillämpningar, framhöll Stefan Jansson, docent i i växtmolekylärgenetik vid Umeå universitet. Det stämmer att vi inte riktigt vet hur vi ska göra riskbedömningar på genförändrade träd.

MARCUS LILLKVIST

Professor Per Gardeström och doktoranden Simon Björklund förklarar att forskarna kan göra vilka växtkonstruktioner de vill.
FOTO: PER LANDFORS

Nytt center för 22 miljoner kronor

Sveriges lantbruksuniversitets och Umeå universitets växtforskare samlas i gemensamma lokaler. På onsdagen invigdes det nya Umeå Plant center (UPSC). Ett hus byggt för den framtida växtgenforskningen.

Växtforskarna flyttar in i ett påkostat och högteknologiskt hus.

Kostnaden för byggprojektet är 22 miljoner konor. Pengarna har finansierat ett bygge som framförallt ska garantera säkerheten kring växtforskningen.

Genmodifiering

Växtforskarna arbetar med genmodifiering av växter, och det är viktigt att pollen och frön inte sprids från laboratorierna ut i verkligheten och allergiker.

Det nya odlingshuset har därför försetts med luftslussar, skyddade avfallstankar och kylanläggningar.

Skyddsnivån ska uppfylla Jordbruksverkets krav på odling av genmodifierade organismer. Tidigare har växtforskningen bedrivits helt utan sådana skydd, men enligt forskarna är forskningen än så länge harmlös och ofarlig för omgivningen.

Planering inför framtiden

De beskriver utrustningen som en del av planeringen inför framtiden.

– På det här sättet får vi nästan friktorl. Så länge vi håller oss här inne kan vi göra vilka konstruktioner vi vill, berättar professor Per Gardeström.

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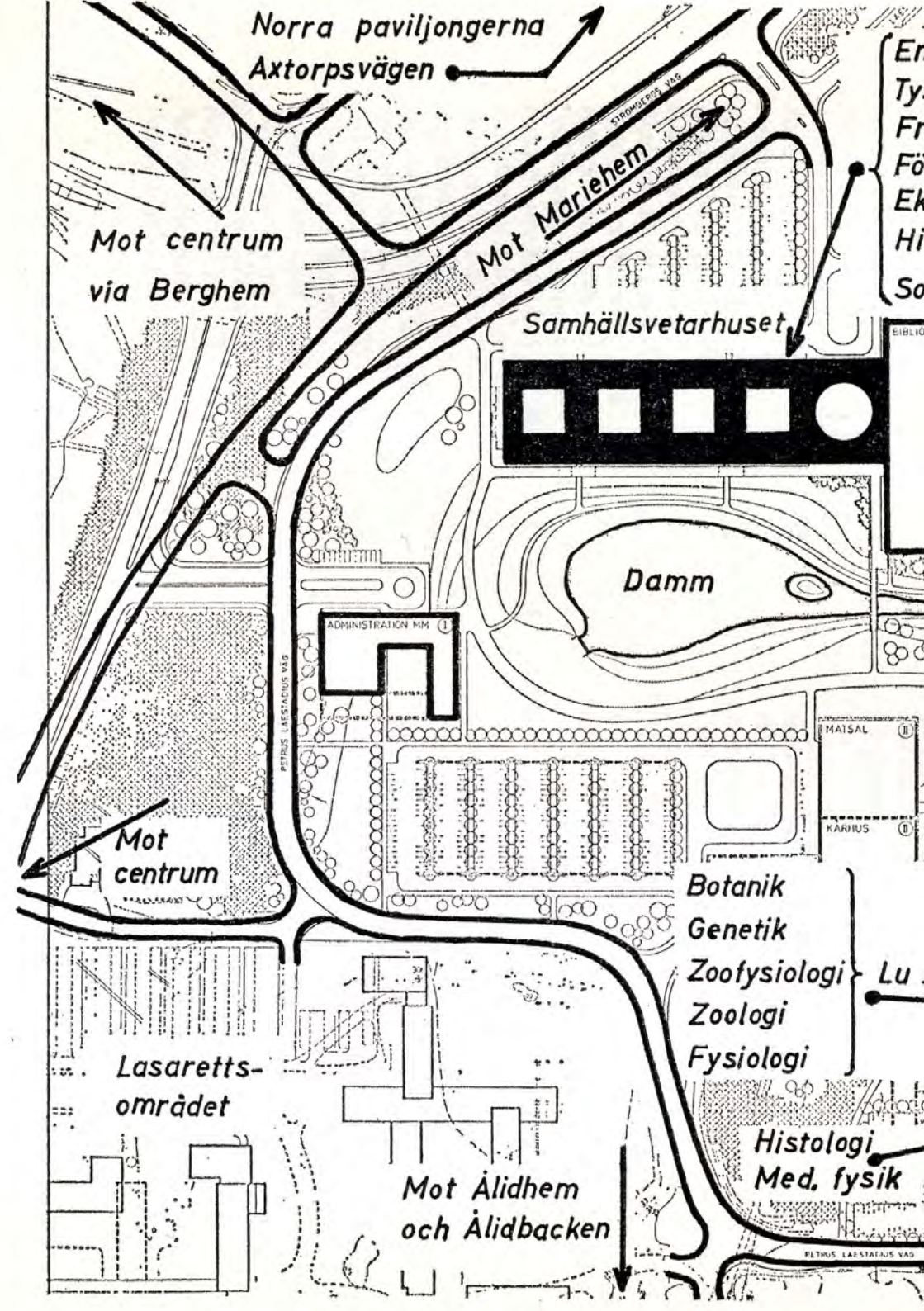
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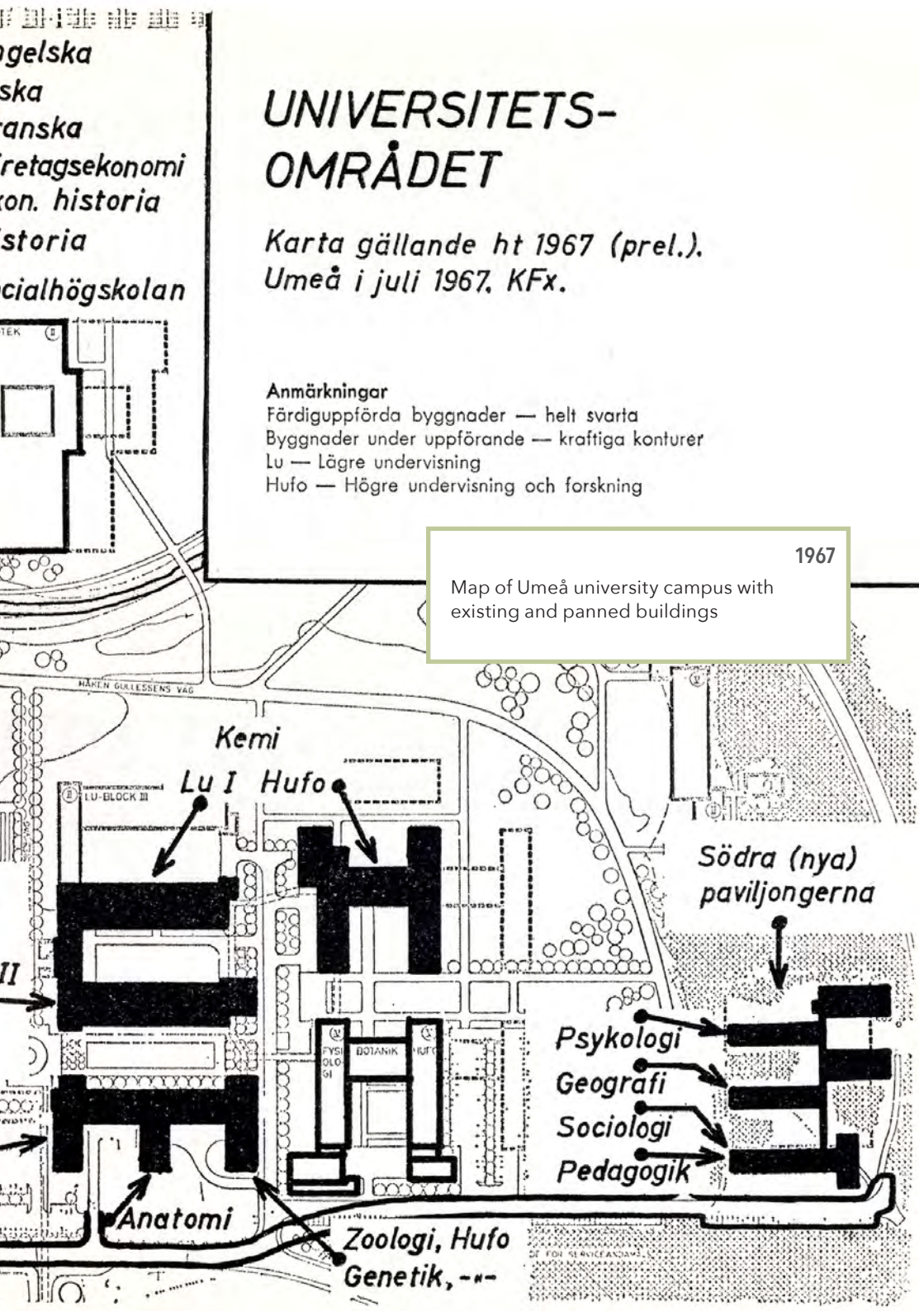
området
Histologi
Med. fysik
Mot Ålidhem
och Ålidbacken
PETRUS LAESTADIUS VÄG



1967

Map of Umeå university campus with existing and panned buildings

På UPSC arbetar 35 nationaliteter.
Siffrorna på kartan anger antal personer från respektive land. De representeras på bilden av längst bak från vänster: Edward Musinge, Uganda, Vaughan Hurry, Australien, Sergey Miroshnichenko, Ukraina, Torgeir R. Hvidsten, Norge, Benedicte Albrectsen, Danmark, Cuong Luong Xuan, Vietnam, Kathryn Robinson, Storbritannien.
Näst längst bak: Lottie Jansson, Sverige, András Gorzsás, Ungern, Christine Ratke, Tyskland, Adele Williamson, Nya Zeeland, Lorenz Gerber, Schweiz, Rupali Bhalerao, Indien, Christina Ortega, Spanien, Anna Petterle, Italien.
Näst längst fram: Naoki Takata, Japan, Rasika Lasanthi, Sri Lanka, Hannele Tuominen, Finland, Bastion Brouwer, Nederländerna, Hannele Tuominen, Finland, Tatiana Shutova, Ryssland.
Längst fram: Melissa Roach, Kanada, Joanna Lesniewska, Polen, Mathieu Castelain, Frankrike, Gaia Geiss, Italien/Frankrike.

2009

"There are 35 different nationalities at UPSC"
Map from newspaper article

Mats Hannerz wrote the text based on draft chapters of the book
Från King Albert till grangenomet: 50 år av växtforskning i Umeå
by Christer Nordlund, Gunnar Öquist, Jan-Erik Hällgren,
Per Gardeström, Stefan Jansson, Ove Nilsson,
Petter Gustafsson and Karl-Ragnar Sundström.

Edited by John Blackwell and Stefan Jansson

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