International Tundra Experiment Update - February 2000 (No.10)

Edited by Philip Wookey & Gabrielle Stockmann

Welcome

By Philip Wookey (Chair)

Welcome to the ITEX Update. Never mind The Millennium, there are some good reasons why now - nearly 10 years after initiating planning for ITEX - is a good time to reflect upon past achievements and, more importantly, on the challenges to come. Please allow me to be blunt here also: The very fact that ITEX has contributed so effectively to the debate on terrestrial ecosystems and environmental change brings with it the danger that the scientific community concludes we have fulfilled our objectives and can thus pack up our experiments and move on to something new. Yes, we *have* fulfilled several key objectives, but we also know from the ITEX meta-analysis activities (see below) and our individual experience that we do not want to stop now, just as things are getting really interesting. We are gaining added value from each year that passes, and new hypotheses are flowing from the synthesis activities we have been engaged in. What I would say, therefore, to those in positions of influence, is: *please, judge ITEX on the basis of the output and not age*. Many good things improve with age (like a good whisky) and I place ITEX into this category!

Highlights from last year included the 9th ITEX meeting "*Plant Response to Climate Change; Integration of ITEX discoveries*", hosted at Michigan State University from 5-9 January by Pat Webber and Bob Hollister (and sponsored by the US National Science Foundation Office of Polar Programs). This meeting was attended by 41 delegates representing 13 countries, and worked on the format of keynote presentations from invited speakers - dealing with "ITEX Discoveries" and "Widening the Picture" - followed by plenary debates and a day of break-out groups "Building on the Investment". The aim was to synthesize progress and to develop firm plans for the further development of ITEX, with a greater emphasis on community and whole-ecosystem processes, modelling activities, meta-analysis and mapping: For this reason we were delighted to welcome Torben Christensen and Martin Sykes to the meeting to offer some independent perspectives. If you have not already done so I strongly urge you to obtain a copy of the meeting proceedings, available from The Arctic Ecology Laboratory, Dept. of Botany and Plant Pathology, MSU, East Lansing, MI 48824, USA.

Another high point of 1999 was publication of the ITEX meta-analysis paper in *Ecological Monographs*, by Anna Arft et al. (the 'al.' being 28 other ITEXers, thus, I believe, making it the longest author list in the journal's history - highlighting the integrative nature of the work). This paper demonstrates how ITEX has branched-out from the earlier focus on data collection in the field, and analysis at individual sites, to an increasing emphasis on synthesis and interpretation of information on a multi-site basis (a process that began with the ITEX special issue of *Global Change Biology* in 1997). This meta-analysis paper is a keystone publication placing ITEX at the forefront of international research on terrestrial ecosystems and environmental change. The results of the meta-analysis have strengthened the argument for maintaining ITEX, broadening the spatial coverage and placing increased emphasis on plant community characteristics, soil properties and processes.

So, we have many good reasons to be upbeat about ITEX. There are also, however, some unwelcome undertones. Many of us are seemingly spending more and more time chasing research funding, or going to research planning meetings, or engaging in other 'networking' activities aimed at establishing new long-term monitoring programmes or in-

ternational networks. Such activities are mostly necessary, definitely valuable, and sometimes even fun, but I occasionally (and increasingly) have the uncomfortable feeling that the balance is wrong, or that the wheel is being reinvented. In ITEX we have already built up a highly successful network of scientists and research sites, and we are already engaged in 'observatory' (the new politically correct term for 'monitoring') activities as well as experimental research: In other words, we have achieved, in significant measure, some of the things that apparently are valued so highly in the current scientific and policy debates. Our problem is that ITEX - 10 years on, and at the dawn of the 3rd millennium - is 'old news': We work in a scientific society that is driven by western economic and cultural values, by novelty, and by 'sexy' new techniques and methodologies. These values sometimes eclipse the quality of the actual science itself, and they also tend to work strongly against the maintenance of longer-term research initiatives, particularly when funding opportunities are limited.

ITEX, to my mind, is thus becoming polarized geographically into three regions with very different working conditions, political constraints and potential funding opportunities. First, we must remember that the tundra biome is heavily dominated by Russia, but I am saddened to report that, due to funding and logistical constraints, ITEX activities there are extremely difficult to maintain (even though the human resources - expertise and willingness to participate - are plentiful). Second, a little further west, in the European region (including politically linked areas such as Greenland), there are several ITEX sites that have an uncertain future due mainly to funding problems. An issue here is that researchers face the problem of convincing national funding agencies that the work is 'novel' (which clearly is often not the case if it entails maintaining monitoring and manipulation experiments), or trying to twist the nature of the research to fit the increasingly 'directed' model of international funding opportunities (e.g. the European Union). We have to be honest with ourselves about this, although it is a bitter pill to swallow. It is currently in North America that ITEX is truly thriving, and being given opportunities to evolve. The National Science Foundation has recognized the scientific excellence of ITEX, and programmes evolving from it, and also recognizes the place of ITEX within an international context. I am delighted that ITEX is secure in the US and Canada, through the establishment of NATEX (the North American Tundra Experiment), although it will be entirely wrong if ITEX contracts to just North America. The programme has provided both excellent science and value for money. The truly international nature of ITEX has also clearly provided synergy and added-value (the programme is greater than the sum of its parts).

Finally, ITEX is more than an experiment in the natural sciences; it is also a vehicle for bringing researchers together, for learning from each other and for helping one another to attain some common and personal goals. The philosophy of ITEX is definitely one that other international programmes can learn from. There should also be room in the scientific community for a diversity of approaches to global change issues: natural gradient ('transect') studies, with their concept of 'space-for-time' substitution, palaeoenvironmental research, and environmental manipulation experiments, monitoring and modelling activities. None of these approaches, singly, can provide all the answers, and we would be deluding ourselves if we thought that they did: Let's be honest, they all have their limitations. The use of only natural gradients, for example, is equivalent to returning to the scientific Dark Ages: it is often impossible to 'tease apart' the influences of co-varying factors, and the timescales of system response to change, together with the dynamics of the processes involved, are also potentially very difficult to assess ('space-for-time' substitution has severe limitations when trying to predict rates of change and system sensitivities). So my own perspective on environmental manipulation experiments (of the ITEX variety) is that they, together with gradient studies and palaeoenvironmental investigations, provide a powerful combination of approaches. I thus see every reason to keep going with ITEX, although the programme needs to be responsive to the ways in which our own experiments, and developments in the broader research community, have highlighted new directions. Our next big corporate opportunity to explore the future will be in Swedish Lapland in September (see item below): I look forward to seeing you there.

Please note: As usual, news items published in the Update do not summarize all ITEX activities.

Philip Wookey
ITEX Chairman
Uppsala University
Department of Earth Sciences
Villavägen 16
S-752 36 Uppsala
SWEDEN

Tel: +46 18 471 25 21
Fax: +46 18 55 59 20
Philip_Andrew.Wookey@natgeog.uu.se

http://www.natgeog.geo.uu.se/cv-er/+phil/phil.html

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10th ITEX workshop: "From Decade to Millenium" 22-25 September 2000

Organizing Committee
(contact itex@systbot.gu.se): Ulf Molau, Ingibjörg S. Jónsdóttír, Annika Jägerbrand, Karin Lindblad, Urban Nordenhäll, Anna Stenström, Olga Khitun

The workshop will be held at the Abisko Scientific Research Station, Swedish Lapland, 22-25 September 2000. This is an anniversary event, since ITEX was created ten years ago as a MAB initiative at Kellogg Biological Station, Michigan, in December 1990.

The 10th ITEX workshop aims at adapting ITEX for new tasks at higher levels of complexity as well as consolidation as a basic world-wide monitoring programme.

Further information available from the Organizing Committee at:

http://www.systbot.gu.se/research/ITEX/meeting.html

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Community Change Synthesis Meeting Planned

By Marilyn Walker

Leader, Boreal Ecology Cooperative Research Unit
United States Forest Service Pacific North West Research Station and Univ. of Alaska
School of Agriculture and Land Resources Management
P.O. Box 756780
University of Alaska Fairbanks
Fairbanks, AK 99775-6780
USA

Tel: +1 907-474-2424
Fax: +1 907-474-6251
mwalker@lter.uaf.edu

A data synthesis meeting on community responses to the ITEX manipulation will be held in February or March 2001 in a yet to be determined location in North America. The outcome of this meeting will be one or more co-authored manuscripts quantitatively summarizing the community responses. I hope that we can also provide a mechanism for sites to synthesize their own data in ways that could result in site-based analyses. In order to take full advantage of the Abisko meeting for planning, I need some information about possible attendees. Funds are limited, but it is possible additional funds can be found if I can document interest and data. Please let me know if you have interest in participating and I will send you a planning questionnaire.

Thanks, in advance, for taking the time to participate in the planning for this exciting event (from Marilyn).

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Individual Site/National Reports:

ITEX in AUSTRIA

By Brigitta Erschbamer

Botanical Institute
University of Innsbruck
Sternwartestr. 15
A - 6020 Innsbruck
AUSTRIA

Tel: +43 (0)512 507 5954
Fax: +43 (0)512 507 2715
brigitta.erschbamer@uibk.ac.at
http://www.uibk.ac.at/c/c7/c717/erbr.html

A modified ITEX-experiment is being carried out on the glacier foreland of the Rotmoosferner (Oetztal Alps, Tyrol, Austria) to study the effect of enhanced temperatures. The main aim of study is to analyse the growth and biomass production of an early and a late-successional species under the present natural conditions and under experimentally-altered microclimatic conditions.

In 1996, 10 open top chambers (OTC's) and 10 control plots were established on the moraine of the 1971 glacier stage at 2400 m above sea level. Five open top chambers and 5 control plots were planted with seedlings of *Trifolium pallescens* (an early successional species). Another 5 open top chambers and 5 control plots were planted with ramet groups *of Carex curvula* (a late-successional species). Leaf and ramet growth have been monitored in each subsequent growing season.

Preliminary results show that *Trifolium pallescens* develops significantly more leaves under enhanced temperature conditions. The *Carex curvula* ramet groups decreased in size in the OTC's as well as in the controls. The final results of the five-year study are expected in August 2000.

ITEX in CANADA

By Greg Henry

Dept. of Geography
University of British Columbia
Vancouver BC
V6T 1Z2 CANADA

ghenry@geog.ubc.ca

Current status: ITEX in Canada continues to grow, with strong links developed between Canadian ITEX researchers and sites and the Ecological Monitoring and Assessment Network (EMAN), administered by the federal Department of Environment (Environment Canada). This year saw the establishment of the Canadian Tundra Monitoring Network (CANTEM-Net) which is connected to EMAN and largely based on monitoring variables established in ITEX. CANTEM-Net will hold its second workshop in January 2000. In this report, I will present some of the ITEX highlights of the past year in Canada, and outline new research underway or planned.

There are 5 ITEX sites in Canada with at least Level 1 studies: Alexandra Fiord, Baker Lake, Bylot Island, Churchill, Tanquary Fiord (Northern Ellesmere National Park). In addition, there are a number of Sites with ITEX-related research, including: Kluane National Park (David Hik, University of Alberta), Northern Yukon Park (Parks Canada, Inuvik), and Daring Lake (Karin Clark, Yellowknife) and Iqaluit (Jamal Shirley, Nunavut Research Institute).

Alexandra Fiord, Ellesmere Island:

1999 represented the 8th year for the warming experiments in four of the major plant communities at this high arctic oasis. Monitoring has been scaled back to include only dates of snow melt, and growth, phenology and flower density at mid-season. There continue to be significantly greater growth, and increased rates of development and flowering in the OTCs relative to the controls. However, there do not appear to be any cumulative effects of the warming on these variables. Warming has begun to alter the abundance (cover) and diversity of vascular plants, with increases in both cover

and species density in the four major plant communities on the Alexandra Fiord lowland.

This was also the eighth season for a snow melt manipulation experiment in a snow bed community. Snow is removed, added or unaltered in plots arranged along the snow bed. One of the most striking changes has been a dramatic increase in flower density in the early snow melt plots. However, neither species density nor cover has been significantly changed by the snow manipulations.

A set of warming + snow manipulation experiments has been established in a *Cassiope* heath community since 1995. Although full analyses of these experiments are not yet complete, preliminary analyses show that there may be an additive effect of early snow melt and warming. There are greater flower densities in those plots with OTCs in which snow is removed, relative to those with only OTCs or with snow removed. As in the snow manipulation plots at the snow bed community, there does not appear to be a significant effect of snow addition and delay of the start of the growing season on growth and reproductive effort in the major species.

A study of the effects of warming on C:N ratios in tissues of major vascular species was completed over the last year with Dr Anne Tolvanen, University of Oulu. The dwarf shrub species showed an increase in C:N ratios, while there was no effect on forbs or graminoids. Given that plant growth was increased in the OTCs, the increased C:N in dwarf shrubs is likely due to inadequate absorption of N. Forbs and graminoids are able to increase their absorption of N to maintain the C:N ratios in the warmed plots. These results may have important implications for community diversity and ecosystem nutrient dynamics.

New ITEX research at Alexandra Fiord began this past summer in collaboration with Dr Keith Egger, University of Northern British Columbia. Dr Egger began a study of the effects of the warming experiments on the mycorrhizae associated with roots of the major vascular species in each of the communities at Alexandra Fiord. A new PhD student will examine the mycorrhizae diversity in and out of the OTCs next year. She will also determine the mycorrhizal associations in those vascular species with the highest ecological amplitude across all habitats. The mycorrhizae may be different in different communities, indicating that the vascular species may have the ability to use more than one fungal partner.

Alexandra Fiord also became the high arctic end of a transect of sites from Toolik Lake and Barrow in Alaska. The new study is funded by NSF and is the North American extension of ITEX, dubbed "NATEX." We will examine the responses of common species and community and ecosystem traits along the transect. Collaborative research began at Alexandra Fiord this past summer with Dr Jeff Welker, University of Wyoming, on effects of warming on net ecosystem production (NEP). Carbon dioxide flux measurements were made from large flux chambers (ca. 75 cm x 75 cm x 50 cm) temporarily installed on permanent bases established in OTC and control plots. In the short term measurements from the middle of the season, warming increased NEP in a wet sedge community but lowered NEP in a dry willow community. Measurements of nitrogen mineralization and soil carbon should help to explain the contrasting results. These studies will be carried on by a postdoctoral associate over the next two years. Over-winter losses of CO_2 will also be measured in CO_2 traps and in snow-depth profiles.

Tanquary Fiord and Baker Lake, Nunavut, and Churchill, Manitoba:

By Josef Svoboda,

University of Toronto
jsvoboda@credit.erin.utoronto.ca

Phenology data continue to be recorded at Tanquary Fiord, Baker Lake and Churchill. Data from Tanquary Fiord continue to be collected by the Parks Canada staff at the site (since 1994), and the data from Churchill are recorded by Diane and Bill Eriksons, long time residents of the community. Josef Svoboda continues to maintain Baker Lake site (established in 1992), and there is now a continuous 8 year record of data. Josef also has two additional, ITEX-related projects at Baker Lake: 1) the two kilometre long (6m high) snow fence depositing large snowdrift on tundra around the village. He has monitored the retreat of the drift and the date of its complete

disappearance in late summer. Furthermore, he has measured the impact of the drift on the affected tundra, which includes delayed phenology and species dieback. 2) Monitoring the Active layer/ upper permafrost temperature throughout the year. The ground temperature profile is measured every two weeks in four 3 m deep holes from permanently placed cables equipped with thermistors spaced 50 cm along the cable. The holes, drilled in the granitic bedrock, are approximately 100 m apart. The project is registered with CALM (Circumpolar Active Layer Monitoring program) which receives the annual 'deepest active layer' readings from an array of sites internationally.

Bylot Island

By Esther Lévesque

Université du Québec à Trois-Rivières
esther_levesque@uqtr.uquebec.ca

At Bylot Island, the ITEX research is conducted in conjunction with a long-term study of the population dynamics of snowgeese (*Anser caeruluscens caeruluscens*), and the effects of the snowgeese on the vegetation, under the direction of Dr Gilles Gauthier, Université Laval (gilles_gauthier@bio.ulaval.ca). Since the summer of 1995, 10 OTCs, 10 exclosures (chicken wire) and 10 controls have been established in wet peat polygons, which are dominated by sedges and are the main habitat for the snow geese. Microclimate has been monitored for 3 summers and biomass was estimated at the beginning of the study and will be measured again at the end of august 2000. Esther Lévesque will also complete community descriptions using point quadrats. In 1998, a mesic community dominated by *Dryas integrifolia*, *Salix arctica* and *Luzula confusa* was selected to expand the study, and 30 plots were established. Community descriptions were completed in 1999 and phenological measurements were recorded in July of 1998 and 1999 in the 30 plots. During the summer of 2000 the treatments will be initiated by setting up 10 OTCs and 10 exclosures in order to measure the impact of warming and of grazing on this plant community.

In addition, two sites established in 1998 in the eastern arctic are missing to the list: Iqaluit, with *Dryas integrifolia*, and Pangnirtung, where unfortunately there have been some problems and the site may not be viable (due to expansion of the local community and increased pressure from disturbance): There are on-going discussions to move the site somewhere else next year.

CANTEM-Net:

The Canadian Tundra Ecosystem Monitoring Network (CANTEM-Net) was established at the national science meeting of the Ecological Monitoring and Assessment Network of Canada (EMAN) held in Victoria, British Columbia in January 1999. A number of sites across northern Canada had been established by government scientists in response to the need for better information on long-term ecological change, especially in the remote arctic regions. At present there are at least 16 sites, including all of the Canadian ITEX sites and sites established in the arctic national parks. In addition, the three territorial governments in arctic Canada have established environmental monitoring programs. Most of the sites have adopted/adapted ITEX protocols for climate and vascular plants, and many sites also monitor other physical and biological variables. However, there was no formal collaboration among the scientists involved and the synergy, one of the strong positive aspects in ITEX, was missing. About 25 people attended the inaugural meeting and agreed to continue the process of coordinating the activities at each site through development of protocols for measurements, data analyses and management, and to hold annual workshops at the EMAN national science meeting. The second workshop is planned for 17 January 2000, and will be a day-long meeting to review and compare current results, and to establish working groups to discuss variables and protocols for integrated monitoring at and among the sites. Greg Henry is one of the organizers of CANTEM-Net and expects that there will be strong connections and collaborations between it and ITEX over the coming years. For more information contact Greg <ghenry@geog.ubc.ca> and/or visit the CANTEM-Net web page at www.taiga.net.

ITEX in CHINA

Report from the Qinghai-Tibet Plateau

By Julia Klein

University of California
Dept. of Environmental Science
151 Hilgard Hall - #3110
Berkeley
California 94720-3110
USA

jklein@nature.berkeley.edu

In late September 1999 we concluded our second full field season of research examining climate warming and grazing effects on the rangelands of the eastern Tibetan Plateau. This experiment, which includes the use of ITEX conical open top chambers as our temperature enhancement treatment, was set up in September 1997; our 1999 field season began in May and ran through September. This year, we continued to examine the warming, grazing and warming x grazing treatment effects on vegetative biomass, species composition, litter/forage quality, soil carbon content and soil nutrient availability in two different habitats defined by dominant vegetation and season-of-use. This year we closely monitored the micro-climate effects of habitat, site grazing history and warming and grazing treatments on our experimental plots. We connected all 64 plots to Hobo dataloggers that recorded air and soil temperature every half hour throughout the growing season. We also placed gypsum blocks in all plots and manually recorded soil moisture content on the plots on a daily basis throughout the growing season. We recently received funding from the National Science Foundation to support this research project.

ITEX in ICELAND

By Borgthór Magnússon, Ingibjörg S. Jónsdóttir and Thóra Ellen Thórhallsdóttir

Contact: Borgthor Magnusson
Agricultural Research Institute,
Keldnaholt, 112 Reykjavik
ICELAND

Temporary address (Oct 1999-Sept 2000):
Botanisk Institut
Dept. of Plant Ecology
University of Copenhagen
Øster Farimagsgade 2 D
DK-1353 Copenhagen K
DENMARK

borgthor@bot.ku.dk

At the two sites running since 1995 and 1996, Thingvellir and Audkúluheidi (PIs: B. Magnússon and I. S. Jónsdóttir), research activity was kept low in 1999 due to a lack of funding. Measurements of temperature in OTC/Control were carried out from May to September at both sites, and the mean temperature was on average 1.2-1.3 ºC higher within the OTCs over the study period. A phenological study on key plant species was also performed at the sites in June and August. For *Silene acaulis* and *Empetrum nigrum* there was a distinct increase in flowering and seed-set within the OTCs, a slight increase for *Carex bigelowii* and *Thalictrum alpinum* but *Bistorta vivipara* and *Betula nana* showed no response. In vegetative growth, on the other hand, *Betula nana* responded strongly to elevated temperature.

A new grant application for 2000-2002 has been submitted to the Icelandic Research Council. Provided funds become available the activity in the project will be renewed in the year 2000 when the first repeated measurements of the vegetation at both sites will be carried out after four years of experimentation.

At a third site at Thjórsárver, OTCs of the ITEX design have been used since 1997 in a factorial experiment studying the role of temperature regime, pollination and nutrient availability in the reproductive success of *Saxifraga hirculus* (PI: T.E. Thórhallsdóttir). A detailed phenological record is being obtained and ground temperature monitored continuously inside and outside the OTCs. The site also has an automatic weather station (AWS). Nutrient addition increased seed production by raising the probability of an individual flowering and the number of flowers per plant. The OTCs alone have not increased the frequency of flowering, the seed set or percentage germination, but there are indications that they may interfere

with pollinator activity. The results so far also suggest that growing season length may be a more important determinant of seed maturation than an air temperature increase of the magnitude produced by the OTC's: 1.3°C and 1.6°C during the growing seasons of 1997 and 1998 respectively. Species cover was measured by point quadrats in control and OTC replicates in 1998. The experiment is part of a larger project on the reproductive ecology of selected plant species in the central highland of Iceland. The project has been supported since 1997 by the Icelandic Research Council and the Icelandic University Research Fund.

ITEX in JAPAN

Site Report from the Taisetsu Mts.

By Gaku Kudo

Graduate School of Environmental Earth Science
Hokkaido University
Sapporo 060-0810
Japan

gaku@ees.hokudai.ac.jp

Our ITEX related researches using OTCs at the Taisetsu Mts. were concluded in the summer of 1999. During the five-years of observations (1995-1999) we compared changes in leaf traits, phenology, shoot growth, productivity, and vegetation structure of five target species (*Vaccinium uliginosum, V. vitis-idaea, Arctous alpinus, Ledum palustre*, and *Empetrum nigrum*) by setting OTCs. Our short-term (first year) results have been published in the ITEX special issue of *Global Change Biology* (1997), and the manuscript of middle-term (third year) results has been reviewed in an international scientific journal. Now we are preparing a manuscript of long-term (fifth year) results.

Although future research plan using OTC is not clear, researches of alpine ecosystem and monitoring of climate at the Taisetsu Mts. will be continued. Meteorological data from our climatic station (temperature, precipitation, solar radiation) are open for scientific use. Contact G. Kudo for further information:
gaku@ees.hokudai.ac.jp

ITEX in Sweden

By Ulf Molau

Botanical Institute
Göteborg University
P.O. Box 461
SE - 405 30 Göteborg
Sweden

ulf.molau@systbot.gu.se
http://www.systbot.gu.se/research/latnja/latnja.html

ITEX was implemented at its main Swedish site Latnjajaure in May 1993 after a couple of seasons for tests and evaluation of the methods to be employed. Latnjajaure Field Station belongs to the Abisko Scientific Research Station and is situated some 15 km W of Abisko in the mid alpine zone at 1000 m a.s.l. The basic ITEX manipulation, enhancement of surface temperature by passive heating in open-top chambers continued for the seventh year, and long-term effects are now slowly building up (the short- and medium-term effects have been reported in previous publications; see e.g., Henry & Molau 1997, Arft et al. 1999). An example of those long-term effects is the rapid decline of the number of plant individuals of the alpine buttercup (*Ranunculus nivalis*) in the moist meadow site, despite its positive response to the warming treatment in terms of growth and reproduction; this is mainly a result of the competition with even more responsive species, particularly sedges (*Carex* spp.) now outcompeting the herbs for the light resource. In the dry *Dryas*-dominated meadow, *Dryas* itself is still responding positively to the experimental warming, but real arctic specialists such as the purple saxifrage (*Saxifraga oppositifolia*) have declined drastically in numbers. Instead, the legumes (particularly *Astragalus alpinus*) have increased in cover and biomass over the years.

Another ITEX-related manipulation, CLIP (the Community Level Interaction Program), implemented at Latnjajaure in 1995, was continued through the 1999 season and will go on for at least another couple of seasons. In this factorial experiment, two environmental factors reflecting various facets of Global Change are manipulated: surface temperature and nutrient

availability (particularly nitrogen). CLIP has been implemented as randomized blocks of plots in two of the dominant vegetation types at Latnjajaure, viz., a poor heath and a mesic meadow community. The responses are most drastic in fertilized plots in the poor heath were nutrients are the limiting factor to plant growth, and in the combined treatments (temperature + nutrients) a total shift to a graminoid-dwarf birch community has occurred along with a hundred-fold increase in biomass and a loss in biodiversity (Molau & Alatalo 1998; Alatalo & Molau, manuscript; Cornelissen et al., in review). Also in the unmanipulated control plots, the dwarf birch (*Betula nana*) has increased significantly in stature and biomass thanks to the occurrence of two consecutive warm summers (1996 and 1997), a unique hot spell in the region since the Little Ice Age. The impacts of extreme events are perhaps more important than generally realized, and environmental pulses are in some respects perhaps even more important than steady environmental press.

The proliferation of ITEX with regard to scale and methods has been manifested at Latnjajaure by the implementation of a new project in 1999, Tundra Landscape Dynamics (TLD). TLD is a GIS-based study in landscape ecology covering the entire catchment area of Lake Latnjajaure. One of the aims of TLD is to compare figures for biodiversity across scales as well as organism groups. Within the catchment area, several permanent grids with mesh sizes of up to 50 x 50 m, have been installed. In 1999, the main grid in the valley bottom was inventoried for a number of variables, e.g., bird territories, bryophyte diversity, and soil properties (moisture, organic content, pH, nutrients). A vegetation map of that grid was produced already in 1998, and a complete vegetation map of the catchment will be completed in 2000. In the physical geography compartment of TLD, the sediment budget for the valley, is established by assessing the rate of sediment transport by wind and water. TLD has a base-line support through a grant fom NFR (the Swedish Natural Science Research Council), guaranteed through 2001.

Another ITEX-related project at Latnjajaure is the study of the seed rain and the seed bank in the tundra. Data from previous seasons are now analyzed, and we see a steady influx of seeds from lower altitudes in the open tundra, e.g. the mountain birch (Molau & Larsson, submitted). This is of particular interest in the context of the EU project DART (Dynamic response of the forest-tundra ecotone to environmental change), which runs from 1998–2002 (see http://www.durham.ac.uk/DART).

The 1999 annual ITEX workshop was hosted by the Michigan State University at East Lansing in early January, and visited by a large Swedish contingent. A major milestone for ITEX is the synthesis paper that was published later in the year (Arft et al. 1999) where data sets from 13 ITEX sites were pooled and response trends identified by meta-analysis. A second synthetic effort in the area of dynamic vegetation modelling was brought up as the next cohesive action to come within ITEX. At the end of the workshop it was decided that the next workshop, the 10th ITEX meeting (”ITEX X”) is going to be held at the Abisko Scientific Research Station in late September 2000. The arctic ecology research group at the Göteborg University has formed an organization committee for the workshop.

The achievements of ITEX at Latnjajaure can be followed at our home page (http://www.systbot.gu.se/research/latnja/latnja.html) from which you will also be linked to other ITEX sites and the ITEX secretariat. The synthetic ITEX paper in *Ecological Monographs* (Arft et al. 1999) can be downloaded (provided you have Acrobat Reader) from the Ecological Society of America's (ESA) web page:

http://esa.sdsc.edu/esapubs/Monographs_main.htm.

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ITEX in the USA - Alaska

Barrow and Atqasuk update

By Pat Webber

Michigan State University
Dept. of Botany and Plant Pathology
100 North Kedzie Hall
East Lansing
Michigan 48824
USA

Tel: +1 517 355-1284
Fax: +1 517 432-2150
webber@pilot.msu.edu

We are about to begin our 7th experimental year at Barrow and our fourth year at Atqasuk. Our preliminary analysis of 6 treatment years at Barrow shows significant positive effects on growth and reproduction over all years. We do not show the fourth year decline in growth and fourth year increase in reproductive effort as picked up by the multiple site analysis reported in the Team ITEX paper in *Ecological Monographs*. It will be interesting to analyze the lengthening record from other sites. We have begun a careful examination of the long-term community change for Barrow and Atqasuk. (27 and 25 y respectively). The dry heaths are remarkably stable while some the moist meadow stands show significant shifts to new communities. We will be comparing our short-term ITEX point frame results with these.

Bob Hollister has successfully completed his PhD Comprehensive Examination and will be busy writing his dissertation this autumn and winter. We just had a small paper on validation of OTCs accepted by *Global Change Biology*.

We have been joined in Lansing by Craig Tweedie. Craig has just completed his PhD dissertation on ITEX studies on Macquarie Island, Antarctica. It is in the hands of the examiners! He will join us at Barrow and Atqasuk for the next several years.

Toolik Update

By Steve F. Oberbauer, Greg Starr, and L. Ahlquist.

Contact: Steve Oberbauer
Dept. of Biological Sciences
Florida International University
11200 SW 8th St
Miami
Florida 33199
USA

oberbaue@fiu.edu

Project: Effects of increased season length and soil warming on tussock tundra plant, community, and ecosystem processes.

We completed our fifth year of extended season and soil warming treatments in tussock tundra at Toolik, Alaska in the summer of 1999. Greg Starr also travelled to Barrow, Alaska, to set up chamber bases in anticipation of collaborating with Pat Webber and Bob Hollister on measurements of ecosystem carbon fluxes in 2000.

Greg Starr's M.Sc. thesis manuscript is coming out in *Global Change Biology* in 2000 (Starr, G., S.F. Oberbauer, and E. W. Pop. In press. Effects of extended growing season and soil warming on phenology and physiology of *Polygonum bistorta. Global Change Biology*).

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ITEX-related developments:

GLORIA

By Dr. Harald Pauli

University of Vienna
Institute of Ecology and Conservation Biology
Department of Vegetation Ecology and Conservation Biology
Althanstr. 14, P.O. Box 285
A - 1091 Wien
AUSTRIA

pauli@pflaphy.pph.univie.ac.at
Tel: +43/1/31336/1419
Fax: +43/1/31336/776
GLORIA web site:
http://www.pph.univie.ac.at/gloria/gloria.html

Feasibility study towards the world wide implementation of GLORIA (Global Observation Research Initiative in Alpine Environments).

Summary: The principal objective of the research initiative GLORIA is to establish a global network of permanent observation sites in high mountain areas. This can provide - for the first time - standardised reference data for a world wide long-term monitoring of climate change-induced effects on natural mountain ecosystems. The initiative is a major research focus resulting from the Austrian climate impact research in plant ecology at the Department of Vegetation Ecology and Conservation Biology at the University of Vienna (Prof. Georg Grabherr and co-workers). Since 1992, this research work, financed from the national IGBP-budget by the Austrian Academy of Sciences and by the Austrian Federal Ministry of Science and Transport, gave essential inputs to the current knowledge on climate change-related influences in high mountain ecosystems. Furthermore, an important outcome of this work is detailed experience of how to monitor and model vegetation in mountain areas. High mountain environments provide good preconditions for a world-wide indicator network for the following reasons: 1) The global distribution - high mountains are present in all major biomes (zonobiomes) on earth. 2) Ecological gradients, crossing narrow vegetation belts, are steep - observation sites can therefore be small. 3) Mountain regions comprise the most natural ecosystems in many countries - therefore, 'masking effects' resulting from direct human land use are minimised. 4) The complexity of ecosystems decreases from the tree line upwards, combined with an increasing importance of abiotic, particularly climatic, ecological factors - therefore, effects of climate change may be more pronounced in high mountain vegetation compared with vegetation at lower altitudes. GLORIA therefore aims to establish a network of Target Regions (TR) in alpine and nival ecosystems of all major zonobiomes from polar to tropical latitudes. Two approaches are suggested for the application in each TR: 1) The Multi Summit-Approach with the focus on the fundamental climatic gradients (altitudinal within each TR, latitudinal and longitudinal among different TRs). This approach can provide a cost- and time-effective method, particularly suitable for the starting period of GLORIA. 2) The Single Mountain-Approach with the focus on transect studies across sensitive ecotones at one selected mountain per TR.

The Austrian Federal Ministry of Science and Transport has launched a feasibility study on how the research initiative GLORIA could be extended to a global observation network. The study was conducted with a half year contract from June to November 1999 to address the following questions:

a) Combined with a call for contribution, is the global scientific community adequately motivated to implement such a network?
b) Are there existing research structures and co-operations to build a network of partner groups?
c) Is the field method, developed for the Multi Summit-Approach, suitable for a global application (according to its dimension, particularly related to time- and cost-effectiveness)?

The exceptionally extensive number of positive responses to the call for contribution clearly emphasises the importance of such an indicator network as an urgently required research matter. In total, 84 leading experts replied in a very positive way. This includes the impressive number of 60 potential partners or partner groups with the intention to actively contribute in a high mountain Target Region (TR). Currently, 64 TRs are in the list - comprising the majority of the earth's zonobiomes. The highest density of TRs was reached in Europe (33 TR) followed by South America (12), Africa (6), North America, incl. Greenland (5), Asia (4), Australia/Pacific (3) and Antarctica (1). GLORIA is closely linked to the IGBP-Mountain Research Initiative as a contribution towards the realisation of the IGBP-Mountain Work Plan. Moreover, it cooperates with the Global Mountain Biodiversity Assessment (MBA, initiated by the Swiss Academy of Sciences within the frame of DIVERSITAS), and with the ESF-project ALPNET (a biodiversity network for the European Mountains). The suggested field method was successfully tested outside of the Alps in a climatically contrasting high mountain environment (Sierra Nevada, Spain) in co-operation with the local experts. The very encouraging result of the feasibility study opened the doors for the next steps forward: In September 2000, an international GLORIA-workshop is planned together with the inauguration conference of the MBA. Before this meeting will take place, a draft concept of detailed suggestions for the field method, on the future organisation structure and the funding strategy will be distributed as a discussion paper. The start of a world wide active GLORIA-network should preferably be the International Year of the Mountain 2002, declared by the UN. Further information from Harald Pauli.

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The ITEX List Server

If you wish to contact subscribers to the ITEX list, and join the List Server yourself, you are very welcome (provided all correspondence is related to ITEX activities and is not of a commercial nature). To write to us all send e-mail to itex@lists.Colorado.edu. To become a member (this is free) send e-mail to < listproc@lists.colorado.edu > with the message: SUBSCRIBE ITEX your name.

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ITEX Secretariat

by Philip Wookey

We now have a new contact point at the ITEX Secretariat: Gabrielle Stockmann has stepped into Thomas Bjørneboe Gomes Berg's place at the Danish Polar Center, the home of the Secretariat. Warmest best wishes to Gabrielle for the present and future work with ITEX, and many thanks to Thomas for his excellent help in the past.

Thomas is now doing PhD research again and can be contacted at the National Environmental Research Institute, Dept. of Arctic Environment, Tagensvej 135, 4th floor, DK-2200, Copenhagen N, Denmark; Tel: +45 3582 1415, Fax: +45 3582 1420, e-mail: tbb@dmu.dk.

Gabrielle Stockmann (ITEX Secretariat) can be contacted at the Danish Polar Center, Strandgade 100H, DK-1401 Copenhagen K, Denmark; Tel: +45 3288 0118,
e-mail: gs@dpc.dk.

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Secretariat's Column

By Gabrielle Stockmann

As the new ITEX Secretariat Contact Person I have a request for all of you receiving this ITEX Update #10. Please check your adress used in mailing the Update and inform me if any changes are needed (e.g. incomplete Zip code). That gives me a chance to get the mailinglist updated as well.

From now on the ITEX Update will also be distributed through the ITEX List Server. If you want an electronic version of the Update please subscribe to the ITEX List Server.

ITEX Addresses

ITEX Secretariat
Gabrielle Stockmann
Danish Polar Center
Strandgade100 H
DK-1401 Copenhagen K, Denmark
Phone: +45 32 88 01 18
Fax: +45 32 88 01 01
E-mail: gs@dpc.dk
http://www.dpc.dk

Australia
Dana Bergstrom
Dept of Botany
The University of Queensland
Brisbane
QLD 4072, Australia
Phone: +61 7 3365 2731
Fax: +61 7 3365 1699
E-mail: d.bergstrom@botany.uq.edu.au
http://www.botany.uq.edu.au

Austria
Friedrich Ehrendorfer
Austrian Academy of Science
Dr. Ignaz-Seipelplatz
A-1010 Vienna, Austria
Phone: +43 1 79794 235
Fax: +43 1 79794 131

Canada
Greg Henry
Dept of Geography
University of British Columbia
Vancouver, B.C.
Canada V6T 1Z2
Phone: +1 604-822-2985
Fax: +1 604-822-6150
E-mail: ghenry@geog.ubc.ca
http://www.geog.ubc.ca

Denmark
Per Mølgaard
ITEX Secretary
Danish School of Pharmacy
Universitetsparken 2
DK-2100 Copenhagen Ø, Denmark
Phone: +45 35 37 08 50/ext 335
Fax: +45 35 37 22 09
E-mail: pm@dfh.dk
http://www.dfh.dk

Finland
Kari Laine
Botanical gardens
University of Oulo
FIN-90570, Oulo, Finland
Phone: +358 8 553 1571
Fax: +358 8 553 1584
E-mail: kari.laine@oulo.fi
http://cc.oulu.fi/~biolwww/puutarha/eindex.htm

Iceland
Ingibjörg S. Jónsdóttír
Dept. of Botany, Evolutionary Botany
University of Gotheburg
Carl Skottbergs Gata 22
Box 461
SE-405 30 Gothenburg, Sweden
Phone: +46 31 773 2663
Fax: +46 31 773 2677
E-mail: inga-svala.jonsdottir@systbot.gu.se
http://www.systbot.gu.se

Japan
Hiroshi Kanda
National Institute of Polar Research
9-10, Kaga 1-Chome
Itabashi-KU
Tokyo 173, Japan
Phone: +81 3 3962 4590
Fax: +81 3 3962 5743
E-mail: hkanda@nipr.ac.jp
http://www.nipr.ac.jp

Norway
Ørjan Totland
Botanical Institute,
University of Bergen
Allegaten 41,
N-5007 Bergen, Norway
Phone + 47 55 213370
Fax + 47 55 312238
E-mail: Orjan.Totland@bot.uib.no
http://www.uib.no/people/nboot/main.html

Russia
Vladimir Razzhivin
Department of the Far North Vegetation
Komarov Botanical Institute
Prof. Popov Str. 2,
197376 St. Petersburg, Russia
Phone: +7 403 979 3248
Fax: +7 703 306 0356
E-mail: binran@glas.apc.org

Sweden
Ulf Molau
International Tundra Experiment (ITEX)
Botanical Institute, Evolutionary Botany
PO Box 461
SE- 405 30 Göteburg
Sweden
Phone +46-31-773-2665
Fax +46-31-773-2677
E-mail ulf.molau@systbot.gu.se
http://systbot.gu.se/research/latnja/latnja.html

Switzerland
Felix Gugerli
Division Biodiversity, Swiss Federal Institute for Forest, Snow and Landscape Research
Zurcherstrasse 111
CH-8903 Birmensdorf
Switzerland
Phone: +41 1 739 25 90
Fax: +41 1 739 22 15
E-mail: felix.gugerli@wsl.ch
http://www.wsl.ch/staff/felix.gugerli/

United Kingdom
Philip Wookey (Chair)
Uppsala University
Institute of Earth Science
Physical Geography
Villavägen 16
SE-752 36 Uppsala
Sweden
Phone +46 18 471 25 00
Fax: +46 18 55 59 20
E-mail:
Philip_Andrew.Wookey@natgeog.uu.se
http://www.geo.uu.se/

Terry Callaghan
Sheffield Centre for Arctic Ecology
Department of Animal and Plant Science
University of Sheffield
Tapton Experimental Gardens
R6 Taptonville Road
Sheffield S10 5BR
United Kingdom
Phone: +44 114 285 6101
Fax: +44 114 268 2521
E-mail: t.v.callaghan@sheff.ac.uk

USA
Marilyn Walker
INSTAAR,
University of Colorado
Boulder
CO 80309-0450
USA
Phone: +1 303 492 5276
Fax: +1 303 492 6388
E-mail: mwalker@taimyr.colorado.edu
http://instaar.colorado.edu/

Patrick John Webber
Department of Botany and Plant Pathology
100 North Kedzie Hall
Michigan State University
East Lansing
MI 48824-1031
USA
Phone: +1 517 355 1284
Fax: +1 517 432 2150
E-mail: webber@pilot.msu.edu
http://www.cevl.msu.edu/ael/index.htm

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