INTRODUCTION:

The project I undertook in summer 1997 was different from the one described in my application to the James Rennie Bequest.
The original project had two aims:

1- To investigate the relationship between temperature and tree growth for three conifer species growing at the treeline in the Alps.
2- To predict the effects of global climatic change on the treeline through the development of a computer model.

Before the work could start, however, the researchers of the University of Padua with whom I was doing the project, decided to expand the aims and the scope of the whole project and to spread the data collection over a longer period of time.
My new contribution to the project would have been to study the water relations of the three conifer species at the treeline.
The data that I would collect would have later been included in the model on tree growth and the impact of global climate change that will be developed next year.
Even though alpine vegetation is well adapted to cope with environmental variations in the case of rapid and small scale changes of climatic and soil conditions, the effects of global climatic change may be very pronounced due to strong influence of abiotic factors (such as temperature, wind and precipitation) on the physiological responses of trees at treelines.
Water status in trees at treeline is an important factor and there is evidence that water controls distribution of species at local level in the alpine zone.
Tree species found at treeline show a well developed water saving behaviour probably determined by the low soil water content due to the shallow mountain soils. Moderate water deficit may lead to a strong reduction of transpiration due to their high stomatal sensitivity to drought.

Thus the redefined objective of my project was to investigate how environmental factors such as rainfall and temperature affect different physiological processes (water potential and sap flux) in three conifer species at the treeline.

METHODS:

Treeline at the site was composed of relatively young (50 to 60 years old) stands of *Larix decidua*, *Pinus cembra* and *Picea abies*. Two trees per species were monitored at the site.

- Xylem water potential was measured weekly with a pressure chamber on one-year-old shoots for each of the species. Samples were collected on each tree just before dawn and until sunset at two-hour intervals.
- Xylem sap flux density was measured in each tree using 2 cm long continuously heated sap flowmeters. These sensors were inserted into the xylem at 2 meters height and protection from high solar radiation was ensured by insulating shields placed over the sensors and for *P.abies* and *P.cembra* by the dense canopy that reaches to the ground. Measurements were taken automatically every minute, averaged and stored in a datalogger every 15 minutes.

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- Furthermore, in order to assess whether osmoregulation in *L. decidua* occurs during the vegetative period, pressure-volume curves were derived from shoots at the end of June and at the end of July.
- Standard meteorological factors were monitored by a meteorological station installed near the selected trees.
- Soil water content was measured with two water content reflectometers in the upper 30 cm and 20 cm of soil at the site.

RESULTS:

Most of the data I collected will be collated with data that is still being collected at the site. For this reason it is very difficult to draw conclusions from it.
However, figure 1 below shows the trend of the water potential at the turgor loss point (WPTLP) as derived from 10 pressure-volume curves.

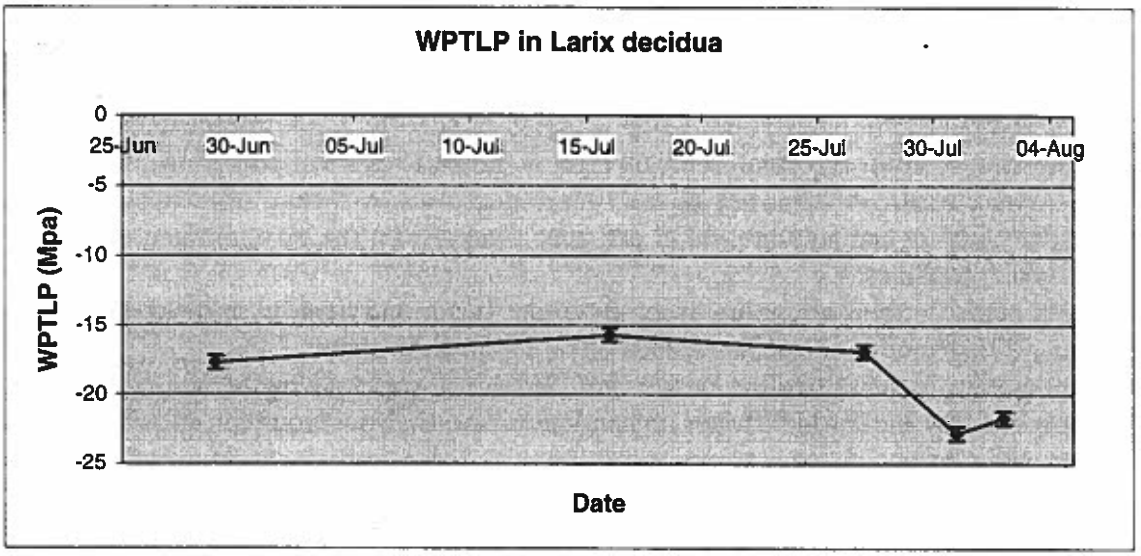

Figure 1: Trend of the Water Pressure at Turgor Loss Point (WPTLP) during the month of July 1997 in Larch (*Larix decidua*).

The reduction of the WPTLP may be due to the reduction in soil water availability as summer proceeds.
The data collected seems to suggest that larch (*L. decidua*) is able to cope better than the other species (*P. abies* and *P. cembra*) with these moderate water deficits. However further study is needed to fully understand the relation between rainfall and temperature in the Alps and therefore to understand the extent of potential assimilation reductions before scenarios can be drawn up. It seems plausible, however, that higher summer temperature will lead to a change in the composition of treeline forests due to the different drought avoidance strategies developed by alpine treeline species.
The project is still going on and hopefully in the near future these questions will be answered.

PERSONAL EXPERIENCE:

The project proved to be challenging and very interesting. I had to work to a tight schedule and had to regulate my life on the basis of the measurements I had to take. I had to wake up at 3.30 am at least once a week and work until evening at the treeline to take the measurements of the water potentials (see pictures attached to my previous letter). During other phases of the project I had to work up to 10 hours in a row in the laboratory to derive the pressure-volume curves from shoots collected the day before at the treeline. During the time I spent at the centre I learnt how to use various ecophysiological techniques (such as the pressure chamber and the heat flowmeters) which will certainly prove useful in the future. More generally I feel I have gained a better insight in this particular branch of ecology.

Even though I worked alone on the water relations aspect of the project – therefore being responsible for the management of my time to achieve the set objective – I was part of a larger team working towards a common goal.

Overall working on this project was a very rewarding experience and I encourage other students to take the same path.