Case Study: Climate Study in Antarctica

Evidence is strong that global climate has changed appreciably in the past decades. Many global circulation models predict that the changes are most pronounced in the polar region. For example, weather records indicate that mean summer air temperatures along the Antarctic Peninsula have risen more than 1°C over the past 45 years. In addition to this warming trend, springtime depletion of stratospheric ozone over the Antarctic results in well-documented, and enhanced ultraviolet-B (UV-B) is reaching the earth's surface. These rapid changes in regional climate provide a unique opportunity to assess the impacts of changing climate on vascular plants.

In the past four years, Dr. Day, an associate professor of plant biology at Arizona State University (ASU), led his team, research associate Dr. Fusheng Xiong, C.T. Ruhland and several other graduate students trekked down to the Antarctic, where they manipulated ambient solar UV radiation and air temperature around naturally growing Antarctic pearlwort (Colobanthus quitensis, a cushion plant) and Antarctic hair grass (Deschampsia antarctica, a tussock grass), the only two vascular species native to the Antarctic. The main aim of their research is to investigate how these Antarctic vascular species respond to the changing climates: warming and increased solar UV radiation.

The research was funded by the National Science Foundation over a total of six years (1995-2000). Their field site is located on Stepping Stones, a group of small islands near the Palmer Station, one of three American scientific research stations . At the beginning of each field season (mid-October), ASU researchers manipulated ambient UV radiation by placing filters that either transmitted UV (Aclar filter), absorbed UV-B (Mylar filter) or absorbed both UV-B and UV-A (Press polish filter) on frames over naturally growing plants. These filters covered frames over the whole field season (mid-October-mid-March). The warming treatment was achieved passively by entirely wrapping filters around the frames. This resulted in diurnal air temperatures in the fully-filtered frames 2°C higher and day temperatures were 1°C higher than those under the partially-filtered frames. Microclimate under the filtered frames was monitored and collected using Quantum sensors and the Skye UV-B and UV-A sensors.

The experiment has provided evidence showing that warming improved reproductive growth on both species by producing more viable seeds. Warming also improved vegetative growth of Antarctic pearlwort but tended to reduce vegetative growth of Antarctic hair grass, probably due to competition between two species. Enhanced ambient UV-B showed deleterious effects on the two species, which included damaging DNA, impairing photosynthetic activity, and reducing plant growth and biomass production.

Acknowledgements and Contacts

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