

forest trees increases. From all set of meteorological factors studied in unpolluted zones significant correlation between them and tree-ring widths was detected only for two factors compared with five ones in polluted areas. The cumulative character of weather action on forests leads to decrease of plantation stability and increase of competition relative to limitation factors. At natural conditions the level of potential stability is essentially higher and the competition between plants is minimal. The increased sensitivity of the tree-ring data to climatic influence in polluted areas permits us to suggest that together with three other well-known timber-lines, where the climatic effects in tree-ring growth are maximal, there exists the forth "pollution timberline" in polluted zones where climatic phenomena as well may be effectively studied. It is very important for investigation of modern global change effects: global warming, total ozone depletion etc. Very important that modern climatic changes may be studied rather far from usual timberline areas including middle latitudes where the industry concentration and pollution are maximal.

This work was partially supported by Russian Foundation for Basic Research (RFBR) (grants N 03-04-96168 and N 03-04-48769).

Stravinskienė, Vida

Department of Environmental Sciences, Faculty of Nature Sciences, Vytautas Magnus University, Kaunas, Lithuania.

[L] Dendrochronological indication of anthropogenic environmental trends in Lithuania

Tree-rings can be considered as natural monitors, able to record information on impact of natural and anthropogenic stressors. Nevertheless deciphering of this information is rather complicated task, retrospective tree-ring analysis provides very useful long term information and can serve as an appropriate tool for assessment of

general consequences of anthropogenic environmental changes. As the result of long-term dendroindicational studies on tree annual radial increment in stands of different tree species growing in various Lithuanian forest habitats, affected by different management measures and environmental pollution of varying intensity, as well as having analyzed main tendencies of investigated indices, the following conclusions were drawn.

Having analyzed the anthropogenic changes in Scots pine (*Pinus sylvestris* L.) and Norway spruce (*Picea abies* (L.) Karsten) radial growth in the surroundings of mineral fertilizers plant "Achema" it was found, that until the onset (1965) of pollution tree annual radial increment fluctuations were close to 11 and 22-year Solar activity cycles – increment maximums coincided with favourable for growth warm periods, while minimums – with coolness beginnings of vegetation period, when precipitation is close to norm, as well as with cold and rainy vegetation periods. Since the beginning of pollution three different periods of anthropogenic transformations of tree radial growth were singled out – fertilization, growth depression and recovery period. When "Achema" has started production of mineral fertilizers, emitted nitrogen compounds have a positive impact to tree growth. During the first five-year pollution period tree annual radial increment in the zones of intensive (8-12 km) and moderate (13-24 km) pollution is similar or close to the control, or insignificantly (10-15%) higher. The general impact of increased air pollution became negative and growth depression period started. Permanent negative effect of pollutants on pine and spruce forests, growing nearby the plant started in the second five-year pollution period (1973-1977). The greatest damages to forests were caused in 1977-1981, when in the zone of intensive pollution pine annual radial increment reached only 60-75%, while that of spruce – 50-70%, compared to the control increment. Just then amounts of the plant emissions with prevailing SO₂ were the highest (34-40 thou. tons annually). In 1986-

1988 changes in pine and spruce annual radial increment stabilized at the level of 1980-1982, while in 1989-1995 a tendency of recovery and decreasing increment losses is observed. It was a result of essential reduction of environmental pollution. Studies on drainage efficiency of permanently overmoisted and marshy forests have indicated that tree annual radial increment augmentation after drainage is rather dependant on climatic conditions at the time of draining. In the case of drainage of *Pinetum myrtillo-sphagnosum* and *Pinetum careoso-sphagnosum* forests as well as *Pinetum careoso-calamagrosticosum* and *Pinetum calamagrosticosum* forests at the beginning of dry period, forest stand adaptation to ground water level changes is shorted. This led to tree annual radial increment augmentation already in the first 5-year period after drainage, while the greatest increment effect was attained in the second and third period after drainage. Later drainage effect was decreasing and after 25-30 years has disappeared, while tree annual radial increment corresponded to the increment of control (undrained) stands. Drainage in rainy period caused the significantly changes in level of ground water, stand adaptation to new ecological conditions takes longer time and tree growth increase is achieved 2-3 years later, as compared to drainage in dry period. It is more rational to drain pine and spruce forests growing on permanently overmoistured and marshy habitats at the beginning of dry periods, because then climatic conditions are more favourable for radial growth. Drainage of black alder forests is inefficient: insignificant radial increment rise is observed in young drained *Alnetum carecosum* and *Alnetum careoso-calamagrosticosum* forests. Their radial increment is slightly higher in the 3-5 five-year periods, later it does not differ from the increment of undrained forests; in older drained black alder forests negative drainage effect was ascertained, expressed by tree annual radial increment decrease. Results of dendrochronological studies on tree annual radial increment changes due to

fertilization, carried out in 50-year- old pine forests in the vicinity of "Akmenės cementas" indicate, that annual radial increment of trees fertilised by different mineral fertilisers increased as follows. Having fertilized by carbamide (80 kg/ha of nitrogen active substance), pine annual radial increment in the first year after treatment augmented by 20%, in later years it differed from the control by 10-15%. The greatest fertilization effect according to additional annual radial increment was ascertained after treatment with superphosphate (100 kg/ha of phosphorus active substance) in the 2nd and 4th year after fertilisation, when pine annual radial increment augmented respectively by 46% and 30%, compared to control; positive effect of superphosphate was revealed in dry 1992 and 1994 years, when pine annual radial increment augmented by 46% and 30%. The greatest effect of fertilization by double phosphogypsum dose (10 t/ha) – increment rise by 39-47%, compared to the control. Having fertilized with 5 t/ha of phosphogypsum, pine annual radial increment has grown by 11-30%, while with a mixture of phosphogypsum (5 t/ha) and superphosphate (100 kg/ha of phosphorus) – by 18-23%, compared to the control.

Stravinskienė, Vida, Regina Erlickyte and Asta Simatonyte
Department of Environmental Sciences, Faculty of Nature Sciences, Vytautas Magnus University, Kaunas, Lithuania.

[P] Growth and condition of Scots pine (*Pinus sylvestris* L.) forests in urban and industrial environment

Kaunas city is covered by Scots pine (*Pinus sylvestris* L.) forests. Urban environment is affected by various environmental factors, including air, soil pollution, soil pressure, land use activities, excavation and trenching, mechanical tree damages. Conifers are especially sensitive to environmental pollution. Annual radial increment can be