

OLD NORWEGIAN PHENODATA SERIES IN RELATION TO RECENT ONES

LUNGHE SERIE STORICHE FENOLOGICHE NORVEGESI MESSE IN RELAZIONE CON SERIE PIÙ RECENTI

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Abstract

Observations in Norwegian plant phenology through the last 150 years are analyzed. Generally, earlier first flowering is found in the 1900's than in the mid 1800's, in accordance with increasing temperature since the "Little Ice Age". However, throughout the years 1928-1977 no clear phenological trends are found, although there was a very early flowering of most plants in the beginning of the 1930's (at the high summer temperatures during that period) and about 1950, while late particularly in the mid 1960's and from the mid 1970's (at lower temperatures). Generally, since the mid 1990's, flowering (as well as bud burst of deciduous trees) has been earlier; but in some districts, maybe a little later again during the last couple of years, in accordance with a general 10-15 year oscillation of phenology found by smoothing the curves of flowering dates by Gaussian filtering.

Keywords: Plant phenology, Temperature, Bud burst, Flowering, Gaussian filtering.

Riassunto

Vengono analizzate osservazioni sulla fenologia dei vegetali in Norvegia negli ultimi 150 anni. Prime fioriture più precoci sono in genere reperibili nel 20° secolo rispetto alla metà dell'800, in accordo con l'aumento delle temperature conseguente all'uscita dalla Piccola Era Glaciale. Tuttavia lungo il periodo 1928-1977 non si manifesta un chiaro trend fenologico, benché si assista a fioriture molto precoci di parecchie specie tanto all'inizio degli anni '30 in coincidenza con le alte temperature estive proprie di tale periodo quanto intorno al 1950; al contrario una diffusa tardività conseguente a più basse temperature si è manifestata alla metà degli anni '60 e dalla metà degli anni '70. In genere poi, dalla metà degli anni '90 la fioritura ed il germogliamento delle piante decidue sono più precoci, anche se negli ultimi due anni si assiste ad una maggior tardività in accordo con la ciclicità a 10-15 anni posta in evidenza applicando alle curve di fioritura tecniche di smoothing basate su filtri gaussiani.

Parole Chiave : Fenologia vegetale, Temperatura, Germogliamento, Fioritura, Filtro gaussiano.

Introduction

Norway is a long and narrow country, covering more than 13° of latitude (from 58°N to more than 71°N) but is at the narrowest not more than a few km wide from the innermost bottom fjord at approx. 68°N to the Swedish border (Fig.1). The mountains rise abruptly from the western coast and the many fjords to more than 2000m elevation. In the East of the mainly N-S mountain chains, however, there is a gentle lowering of the elevation again.

About 6000 years ago the mean temperature in Norway was 1-3°C higher than today. Then heat demanding deciduous trees invaded many Norwegian lowlands, particularly in southern Norway (e.g. elm, linden, hazel and oak), and the tree line was considerably higher than today. However, during the "Little Ice Age" from about 600 to about 150 years ago (Fig.2), temperature was very low, precipitation abundant, and the tree line even lower than recently. The tree line today is at about 500m a.s.l. in the far southwest of Norway, increasing to 1300m elevation in central mountains and decreasing to approximately zero near the sea north of 71°N (Aas and Faarlund, 2001).

Both climatic and phenologic variations thus are strong within the country, e.g. the sun remain above the horizon

for 24 hours a day during summer in the north of the Arctic Circle. Unfortunately, there are no continuous phenological scientific observations carried out through centuries in any part of Norway. Scattered data, however, are found from various parts of the country from mid 1800's (Fig.1). Most phenodata were collected in the mid 1900's in the Lauscher and Printz network (Lauscher and Lauscher, 1990). This network lasted from 1928 to 1977 and covered several phenophases of plants and animals located in stations all over the country, however mostly in the southern lowland district (Fig.1). Today there are data available on spring phenology of birch at about 20 stations monitored by the Norwegian Meteorological Institute, from two IPG (International Phenological Garden) sites, and from two fruit research stations (Wielgolaski and Måge, 2008).

Material and methods

Phenological variation on several species for one phenophase and at one site might be studied and presented as in Klaveness and Wielgolaski, 1996. More common are studies of phenological trends in one or more species at several sites, either by smoothing the annual variation