Autecology and Synecology

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Autecological and Synecological methods

Autecology- A study of the individual species in relation to their environment is known as autecology. It includes the study of its geographical distribution, taxonomic position, morphological characters ,reproduction, life cycle and behavior with reference to ecological factors that might influence these activities.

Synecology- A study of the groups of organisms in relation to their environment is called synecology. Here the unit of study are the groups of species. It comprises population ecology, community ecology and study of the ecosystems.

Useful subdivisions may also be made according to the habitat, taxonomic divisions and level of organizations. Thus, the subject can be studied through following branches of ecology.

- **Population ecology-** It deals with growth, trophic structure , metabolism and regulation of population.
- **Community ecology-** It deals with the ecology of different populations in the same habitat and same environmental conditions.
- **Taxonomic ecology-** It is concerned with the ecology of different taxonomic groups, viz. microbial ecology, mammalian ecology, insect ecology and so on.
- **Habitat ecology-** It includes the study of animals in different habitats.

ECOLOGY TODAY

Ecology is an established science today. It includes not only the life sciences but chemistry, physics, geology, geography, meteorology, climatology, hydrology, paleontology, anthropology, sociology, mathematics and statistics. Many practical applications of this subject are found in agriculture, horticulture, forestry, economics, Immunology, oceanography, fisheries, game management, pest control, public health, pollution and conservation of resources.

Autecological Methods

SYSTEMATIC POSITION, ASSOCIATES AND GEOGRAPHICAL DISTRIBUTION

Systematic position

Ecological study of individual species is called autecology. For those who study plants or plant communities from any angle, except of structure and physiognomy, autecology is of fundamental importance, as it furnishes data on dynamic interrelationships, populations and their distribution. Much stimulus for such studies has come from the economic importance of certain species, and indeed ,agriculture and silviculture are extensions of ecology.

This valuable study, as suggested by Misra and Puri (1954) and Puri (1960) is done on the following general lines , sometimes modified according to life form of plants. Differences in the method for the study of herbaceous plant and a tree will be indicated, where necessary.

SYSTEMATIC POSITION, MORPHOLOGY AND PHENOLOY

The first requisite in any ecological or botanical study is the identification of the plant, morphologically. Species and its variant, if any, are determined and confirmed. The confirmation of correct identification is advisable in a standard regional or central herbarium. The botanical survey of India has developed the following chain of herbaria; Central National Herbarium at Sibpur, Calcutta; Regional Herbaria at Poona, Coimbatore, Shillong, Dehradun and Allahabad. In addition ,a small economic plant herbarium exist at the Central Botanical Laboratory at Calcutta. These herbaria maintain large collections of correctly identified and properly arranged plant specimens and run a plant identification service. Facilities are provided for field and laboratory studies of plants also.

A number of sub regional ecological floras or lists of plants have been prepared on the basis of collections already made and a study of these will be helpful in ecological studies. These floras are: Mahableshwar plateu (Puri and Mahajan,1961); Western Rajasthan (Puri, Sarup, Jain and Kotwal,1960); Cutch (Puri, Jain, Deshpande,1960); Coorg (Arora,1960); N. Kanara (Puri and Arora,19600; Gujarat coast (Toor, 1961).

Mysore (1954) and Puri (1960) have stiil pleaded to stick to the original concept of Clements and use the term association for ‘Climatic climax’. According to them, the Climatic climax community is in equilibrium not only with the climate, but also with the whole complex of the environment. It has fully developed soil compared to the early developmental stages.

Plant community has been defined much the same except that in terms of Clements a plant community signifies any unit of vegetation, whether it is developmental or climax in status. This terminology is suggested for use in India in the absence of full data on the exact ecological status of various types.

Bigger units of vegetation

Formation- It includes groups of association which are characterized by having dominant species of essentially the same growth from e.g. evergreen, moist deciduous , dry deciduous ,thorn scrub etc.

Province- Various associations and formations of a country may be from data to be into provinces which are distinguished by vast differences in environmental factors and plants.

Recognition of plant association or plant communities

Recognition of an association is a difficult task for a beginner who cannot tell whether a particular grouping should be called an association or its part. In case of doubt, it is desirable to deduce and an association from data to be given in the following pages. However, to start with the apparent homogeneity of structure be considered. Special care be taken to avoid local variants from being named as an association

Herbarium should be made and checked with the Kew Herbarium, London . The herbarium of the New York Botanical Garden in the U.S.A has a good collection from the N. W. Himalayas , notably Pakistan, made over the last 50 years by R.R. Stewart of the Gorden College, Rawalpindi. A complete record of phenology is also taken o the new variety or species.

Associates: Associate species indicate the sociability and adaption of a plant. The list of species associated with the plant under study should, therefore, be made in a field, in a number of habitat conditions, to get a proper range of variations.

Geographical distribution- Plasticity and habitat requirements of a species are at best judged by its extent of distribution. It also indicate the degree of seed production, dispersal and further success in germination and growth.

Distributional maps are constructed to indicate the pattern of spread of the species. Plant distribution studies the location or distribution of plants in space, latitudinaly, longitudinally or attitudinally.

Methods of preparation of distribution map- There are a number of methods of preparation of distribution map. The British Ecological Society is following one in preparation of Biological flora of the British Islands. These are being published in a series in the journal of Ecology. In India, no such work has so far been done. Puri's (1960)plant distribution maps were drawn from data available from herbarium sheets. Recently, Gauseen (1959,1960) has suggested plant climate method for use vegetation maps. Gupta (1961) has followed this method in the preparation of vegetation map of the Garwal Himalayas.

SEED AND ITS GERMINATION

Seed output-

Seed output is the potential capacity of a species to reproduce itself. Large variations are found in the seed output of different species. The seed output is measured by the following methods.

Average number of seeds per unit = x

Average number of fruits per plant (for herbaceous plant) = y

Average seed output = (x × y)

Or average number of fruits per branch (for trees or shrubs) = y1

Average number of branches per plant = y2

Average number of fruits per plant = y1 × y2

Average seed output for trees = x (y1 × y2)

Counts for seed output are made from a number of localities where the plant grows. These localities should be as diverse as possible so that an average should give a correct assessment of seed output. The area of investigation should be broad enough to cover limits of distribution of the species.

Seed output in a plant is dependent upon a number of environmental factors of which light, moisture conditions, biotic influences, diseases physiological status and age (specially in a case of a tree) are more important.

Viability of seeds- When seeds are shed, they remain viable for different periods. Viability is tested both under natural conditions and under storage.

Test of viability- Seeds under natural conditions are put for germination in petri-dishes or sawdust every week from the day of maturation.

Dormancy- Seed of a number of plants do not germinate soon after they are shed, even though the conditions for germination may favorable. This may be due to hard and impermeable seed coat for absorption of water and oxygen or presence of chemical inhibitor of growth.

Cause of dormancy under the category can be broken artificially by mechanical means or by acid scarification. However, a number of other treatments have also been used by Misra and Rao (1948), Pandeya (1953) Saksena (1961), and Pandeya and Chauhan (1961). These are given below

A. Physical treatments

a. Mechanical scarification and removal of testa

If the seeds are not too small, their seed coat is carefully removed by first soaking in water for 4 to 5 hours. After removal of testa, seeds are put for germination. This treatment is possible only for seeds whose seed coat is impermeable to O2 and permeable to water. Seeds having coats impermeable to water are scarified with sand paper, carborundum block or gently ground in pestle-mortar

b. Chemical scarification by sulphuric acid

Seeds are placed on a plug of glass wool taken in funnel. Known amount of conc. sulphuric acid is then poured over the seeds and they are immediately washed. Washing is done for sufficient time to remove all acid. The seeds are then put for germination.

c. Temperature

The following alternating temperatures are usually given for breaking dormancy: i) 0º and 10º ii) 30º and 45 ºand iii) 0ºand 45ºC. Higher temperatures in some cases have been found to break dormancy. E.g. *Cassia occidentalis*

d. Radiant Energy:

Gamma rays and x-rays have also been found to break dormancy (Sakcena ,1961) Some seeds are sensitive to visible light; and both red and white light are known to break germination . In certain cases, where phytochrome system is operative, infra-red light prevents germination.

B. Chemical treatments

Seeds are put for germination after soaking them for 12 to 14 hours in any of the following solutions : Copper sulphate, potassium permanganate and hormones

C. Removal of inhibitors

Seeds are washed in running water for varying periods of time and are then placed for germination. If aqueous extract of unwashed seeds is prepared and coleoptile sections are placed in it, there is inhibition of coleoptile growth, as compared to control.

SEED SHAPE, SIZE, WEIGHT AND VOLUME

Morphology of the seeds is an important character in assessing the mode and extent of dispersal .

Shape and size of seeds differ in different species and also between different plants of the same species. The size is measured accurately with the help of vernier or accurate scale under microscope, if seed is very small. Measurements are made of the smallest, largest and medium seeds from number of localities and the figures are tabulated. Average and standard deviations are then calculated.

For the determination of weight, assorted 100 seeds are taken and accurately weighed to four decimal places. Average weight of a single seed is then calculated.

Volume is measured by displacement method. 100 assorted seeds are immersed in water in a measuring cylinder. The amount of water displaced is next divided by 100 to give the average volume of one seed. seeds which are light and do not sink in water and wrapped in glass wool and the whole mass is immersed in water. From the total amount of water displaced the volume of glass wool is subtracted. Volume of single seed is thus calculated.

For more accurate work, size, weight and volume, classes are made. The number of seeds in each class stastically gives the seed status.

Germination Capacity

All viable seeds germinate after a reasonable time in the soil and normally develop into seedlings. For dominant seeds, dormancy has to be broken for successful germination. Even when they are not dormant, seeds respond differently to different external treatment in the laboratory under known conditions of temperature and light. In nature, seed germinate under many factors like soil pressure (mechanical), different light intensities, different wavelengths of radiant energy, pericarp being subjected to various conditions of the soil like pH, chemical etc. including bacterial and fungal attacks. Average seed germination, under all the experimental conditions, is taken to supplicate the germination capacity of a species.

Germination is usually studied in petri- dishes. A batch of 100 seeds is placed in between two soaked filter paper in a petri dish and is covered with another dish. A wet filter paper is also fixed on the inner side of the upper dish. The filter paper should not be allowed to dry ; if needed the dish may be slowly watered by wick arrangements ,

The dish is opened every day and germinate seeds are counted and removed. The dish is also washed with distilled water to avoid fungal contamination. The observations are stopped when there is no further germination for at least ten consecutive days.

For bigger seeds petri dish method is not suitable and rectangular dish method is employed. In a big size rectangular enamel dish, a layer of dispensary cotton is spread. Seeds are kept on it and the whole covered with another layer of cotton.