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BULLETIN

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TREASURERS REPORT

Assets

Balance:	Savings acct.	2500.00
	Chequing acct.	2528.65
		5028.65
	Outstanding	373.89
	Net Balance	4654.76

Liabilities

Cheques Outstanding	373.89

Receipts

Memberships		
Regular	3261.15	
Student	201.00	
Arrears	24.00	
Advance	12.00	
		3498.15
CJB subscriptions		1407.00
1973 Conf. refund		50.00
Travel Refunds		112.25
1972 Halifax meetings		421.04
Total Income		5498.44

Expenditures

Bulletin	611.10
Postage & Stationery	76.93
Executive travel	1367.91
CJB subscriptions	1434.00
BCC	777.00
Bank charges	2.76
Tempe meetings	500.00
Membership refund	9.00
1973 Conf. refund	100.00
Clerical	94.25
Telephone	130.82
1973 London meetings	200.00
Lawson Medals (1973)	42.80
Total expenditure	5346.57

SUMMARY

Balance last audit (23 May 1973)	4502.89	Balance (22 May 1974)	4654.76
Receipts (23 May '73-22 May '74)	5498.44	Expenditures (23 May'73-22 May'74	5346.57
	10001.33		10001.33

THE GEORGE LAWSON MEDAL

Each year the C.B.A./A.B.C. invites its entire membership to make nominations for the George Lawson Medal. The purpose of the award is "To provide a collective and formal expression of the admiration and respect of botanists in Canada for the excellence of the contribution of an individual to Canadian Botany". Any botanist working permanently in Canada or having spent the greater part of his career here is eligible.

In any year, a maximum of two awards may be made, one in each of the two categories outlined below, although only a single award or no award need be made as the Awards Committee judges appropriate. The two categories are:

1. A single contribution to botanical knowledge of outstanding distinction. Commonly this would take the form of a published paper, a series of papers, a monograph or a book by a botanist at any stage in his professional career. The contribution should be of singular significance to the discipline at large.
2. Recognition of the cumulative, distinguished contributions of a senior investigator and/or teacher and/or administrator who has worked in Canada for the greater part of his career, and whose influence has contributed notably to the advancement of Canadian Botany.

In order that the Awards Committee may learn of botanists who are eligible for these awards, all members of the Canadian Botanical Association are invited to submit nominations and to consult with their colleagues for suggestions. Nominations should be accompanied by a clear statement of the nominee's contribution and appropriate documentation including biographical information, list of publications and letters by others who support the nomination. Nominations should be sent to me as Chairman of the Awards Committee by February 15, 1975.

J. K. Morton Department of Biology
University of Waterloo
Waterloo, Ontario N2L 3G1

PLEASE CONSIDER NOMINATING COLLEAGUES WHOM YOU CONSIDER TO BE WORTHY OF RECOGNITION

WHAT IS THAT?

Members may have noted the hieroglyphics which have appeared in the top right hand corner of this and the previous two issues of the Bulletin. These represent the International Standard Serial Number (ISSN 0008-3046) assigned to the Bulletin by the National Library of Canada. Its purpose is to enable an up-to-date record of world serial publications to be compiled and to facilitate identification, location and ordering.

THE ROYAL BOTANICAL GARDENS, HAMILTON

The Outreach Ontario Programme was devised by the Cultural Affairs Division of the Ontario Ministry of Colleges and Universities in an attempt to decentralize the cultural resources of the Province by extending the services of certain educational institutions to outlying communities.

Through "Outreach", the Royal Botanical Gardens, Hamilton, has been allotted an increase in operating funds which has resulted in expansion of the technical staff and the offering of several new services to other parts of Ontario.

The new staff members include a naturalist, a horticulturalist and a graphics artist.

On invitation from sponsoring community groups, the Outreach staff will travel throughout the Province to conduct lectures, field trips, demonstrations and workshops in natural history, horticulture and botanical art.

Also, a range of exhibits and audio-visual displays will be available on loan to libraries, museums and other appropriate educational centres.

At the Gardens' Headquarters, staff will be available for consultation on a variety of topics and, beginning this fall, "special interest" courses will be offered in horticultural therapy, horticultural exhibits and judging, and leadership training in nature interpretation.

A detailed brochure explaining these services is available free of charge from the Royal Botanical Gardens, Box 399, Hamilton, Ontario. L8N 3H8.

CONFERENCES

BIOLOGY AND CHEMISTRY OF THE COMPOSITAE

An international symposium, with the above title, will be held at the University of Reading, England, on 14th-18th July, 1975. The programme, which is being organized by Professor V. H. Heywood, Dr. J. B. Harborne and Professor B. L. Turner, will comprise some twelve formal review lectures, interspersed with thirteen informal discussion sessions. In the symposium lectures, speakers will review in depth various biological and chemical topics in the family as a whole. In each of the discussion sessions, an expert systematist will present an outline of the taxonomy of a tribe, a chemist will follow with a brief account of the chemistry relevant to the systematics and there will then follow contributions from the floor and general discussion.

The main lecture topics will be: broad classification, fossil history and geography, anatomy, caryology, palynology, adaptational features, evolution of capitula, general chemistry, sesquiterpene lactones, polyacetylenes, flavonoids, economic and pharmaceutical uses. There will also be a general introductory lecture and the symposium will conclude with three summary lectures.

It is hoped that the speakers will include Dr. J. B. Harborne, Professor V. H. Heywood, Prof. Dr. H. Merxmuller, Prof. P.H. Raven, Prof. G. L. Stebbins, Prof. B. L. Turner, etc.

Anyone interested in attending should contact Prof. V. H. Heywood, Department of Botany, University of Reading, Whiteknights, Reading RG6 2AS, England.

13TH PACIFIC SCIENCE CONGRESS will be held in Vancouver on the U.B.C. campus, August 18-30, 1975. The theme of the Congress will be Mankind's Future in the Pacific. Fuller information will appear in the January issue of the Bulletin or may be obtained from W. S. Hoar, Secretary General, 13th Pacific Science Congress, University of British Columbia, Vancouver 8, British Columbia.

PERSONALIA

Dr. Vladimir Krajina was honoured by the Hawaiian Botanical Society on the occasion of their Fiftieth Anniversary in May of this year. Dr. Krajina was presented with a Certificate of Recognition for his contributions to the objectives of the Society which include advancing the science of botany and encouraging botanical research in all its phases. Our congratulations to Dr. Krajina!

Dr. Ernest Small, Biosystematics Research Institute, Agriculture Canada, Ottawa, was presented with the George R. Cooley Award for the best paper given in the joint sessions of the American Society of Plant Taxonomists and the Systematic Section of the Botanical Society of America, at the AIBS Meetings, Arizona State University, Tempe, 16-21-June, 1974. Ernie's paper entitled, "The Systematics of Cannabis" was judged the best of the sixty-three papers presented and eligible for the Cooley Award.

Michael Corlett

Dr. Rolf Sattler

Dr. Roy Taylor writes as follows:- I noticed in Press Notes from the University of Toronto Press, April 1974, that two books of the U. of T. Press were selected by the American Institute of Graphic Arts for the annual exhibition of 50 books of the year chosen from the production of book publishers all over North America. One of these two books is "Organogenesis of Flowers", written by Rolf Sattler. I think it would be nice to note this in the next issue of the Bulletin as it is not often that a Canadian botanist's publication wins recognition such as this.

Congratulations Dr. Sattler! - Ed.

AUSTRALIAN SYSTEMATIC BOTANY SOCIETY

The Australian Systematic Botany Society was formed at a meeting of botanists in Melbourne, on 7th April, 1973.

The aims of the Society are:-

(i) to promote the study of systematics;

(ii) to encourage and facilitate the dissemination and exchange of information among all those interested in the taxonomic botany of the Australian region;

(iii) to stimulate and assist systematic research and teaching in the Australian region.

Membership of the Society is open to all those interested in Systematics. Persons wishing to become a member may do so by sending a subscription to the Treasurer, Dr. A. Kanis, Herbarium Australiense, C.S.I.R.O., P.O. Box 1600, Canberra City, A.C.T. 2601. The subscription is set at A$3, or U.S.$5 for overseas members. A news bulletin, issued approximately three times a year, is planned for circulation to members.

The CBA/ABC organized two symposia at the joint Tempe meetings. As abstracts of these were not published with those of the papers presented at the other joint meetings, it was decided by the Executive Committee that they should be published in the Bulletin.

Symposium on Wide Ranging Species (Chairman J. K. Morton)

CLIMATIC ADAPTATION IN WIDELY DISTRIBUTED BRYOPHYTES

R. E. Longton, (Department of Botany, University of Manitoba, Winnipeg, Canada)

The Division Bryophyta contains many widely distributed species, including several that can be regarded as more truly cosmopolitan than any of the flowering plants. Detailed studies of the environments occupied by some of these taxa have indicated that distant populations may experience strongly contrasting microclimatic regimes. Climatic adaptation in selected widespread bryophytes is being investigated at the University of Manitoba through a combination of microclimatic recording for widely separated populations, regular sampling to determine the seasonal pattern and success of growth and reproduction in the monitored colonies, and experimental comparisons of the behavior of plants from different populations under controlled conditions. From the results of these and other studies it is tentatively concluded that some widely distributed species owe their success to the occurrence of multipurpose genotypes, while others may exhibit pronounced genecological differentiation. Results for the Moss Bryum argenteum, which ranges from tropical lowlands to high polar regions, suggest the former situation.

In microclimatic studies, the mean day and mean night temperatures within the moss turfs during summer ranged from 22°C and 17°C at a site near the southern boundary of the boreal forest zone in Manitoba, Canada, to only 4°C and 0.5°C at an antarctic site. However, the relationships between temperature and net photosynthesis and respiration in the antarctic material resembled those for temperate plants of other species, with an optimum temperature for net assimilation of around 25°C. Moreover, the growth rates of antarctic, subarctic and boreal strains showed similar responses to a range of experimental temperature regimes. All three strains maintained optimum growth at 17°C night and 22°C day, and the antarctic strain resembled the others in showing very slow growth at 1°C night and 9°C day. There were few significant differences in morphology between experimental plants of the three strains.

In contrast, the bipolar moss Polytrichum strictum shows apparently inherent topoclinal variation in morphological features. There is a progressive decrease in leaf length, and in the length, leaf number and dry weight of the annual stem segments, passing from temperate to polar localities in both hemispheres. This results in the development of shorter, more compact colonies at polar sites, possibly with beneficial effects on the temperature and moisture regimes within the turfs. Experimental studies showed that all four characters are subject to environmentally induced variation, but inter population differences in leaf length and in the rate of stem elongation persisted under standard conditions, suggesting that these differences are in part genetically determined.

These preliminary results thus suggest that, despite certain distinctive features of their breeding systems, widely distributed bryophyte species may employ similar mechanisms of climatic adaptation to those reported in flowering plants.

ECOLOGICAL STRATEGIES OF WIDE-RANGING POPULUS TREMULOIDES MICHX.

J.S. Maini, (Canadian Forestry Service, Environment Canada, Ottawa, Ontario. K1A OH3)

Populus tremuloides (trembling aspen), the most widely distributed tree species in North America, grows over a wide range of ecological conditions. The species spans 110° of longitude and 47° of latitude, ranging from Newfoundland and Labrador to Western Alaska and from the northern limit of trees (beyond the arctic circle) to the mountains of western United States and Northern Mexico.

Trembling aspen is a pioneer species producing abundant seed crop annually throughout its distribution range. The seeds with hair are light (2.5 million/lb.); a single tree may produce over 1.5 million seeds in an average seed year. In spite of abundant seed production, establishment by seedlings is rare in nature. In a 750-mile long, north-south transect in central Canada, traversing grassland, forest-grassland transition, forest and forest-tundra transition, the species reproduced asexually under conditions of stress, i.e., northern and southern limits of distribution. However, in the boreal forest, under optimum growing conditions, trembling aspen may reproduce sexually as well as asexually. This alternate reproductive strategy appears to provide a distinct advantage to this widely distributed species.

Repeated vegetative reproduction results in the formation of clones of various sizes, and intra- clonal root connections that persist for a very long time, are active, translocate water-soluble dyes and retain vegetative reproductive capacity. Clones vary greatly in reproductive capacity, growth, morphology and disease resistance. Occurrance of photo period ecotypes has also been reported. Up to 40,000 suckers/acre may be formed following devastation of an aspen stand by fire and moderate browsing does not effect sucker growth adversely.

Features such as alternate reproductive strategies, tremendous reproductive capacity occurrence of clones and clonal variation and of photo period ecotypes, resilience to repeated disturbances (fire, browsing) contribute towards the species ability to survive under a wide geographic range and habitat conditions.

ADAPTATIONS SHOWN BY A WIDESPREAD COLONIZER, XANTHIUM STRUMARIUM

Calvin McMillan, (Department of Botany, The University of Texas at Austin)

Xanthium strumarium L. has exploited ecosystems disturbed by man on all continents by virtue of a vast array of morpho-physiological differentiation (Table 1). It has maintained successful adaptations through self-fertilization but has produced new morpho-physiological combinations through hybridization of sympatric indigenous and/or introduced variants. The range of populational differentiation can be placed into eight fairly distinct groups or complexes, slightly modified after those of Love and Dansereau (1959). Of these only the strumarium complex is probably indigenous to the Old World. Stumarium plants have the smallest burs and most populations have photoperiodic adaptation narrowly separated from day neutrality. Many of the Old World populations in other complexes probably represent various intergrades between the indigenous strumarium and the introductions despite partial genetic incompatibility between strumarium and the other complexes. Chinense and italicum (including pennsylvanicum, in part) are the major indigenous complexes of North America but both are widely introduced on other continents and both include broad latitudinal differentiation of photoperiodic response. The cavanillesii complex, indigenous to South America, includes variation of photoperiodic response but it is not widely represented on other continents. Introductions of cavanillesii have been detected only in southern Australia, Portugal, and southern Spain but probably occur in northern Africa. Echinatum and oviforme are two complexes photoperiodically adapted to higher latitudes of North America and are possibly local variants of the widespread italicum complex. Echinatum has been studied as an introduction in northern Europe, but oviforme was not detected outside North America. The californicum complex (pennsylvanicum, in part) is a variant largely confined to northern California but has been studied as an introduction in southern Australia. The californicum complex may be an intergrade between chinense of North America and cavanillesii of South America, possibly arising from their sympatric introduction to Spain or to California. The orientale complex is morphophysiologically diverse but is represented only among wild populations in Europe. Orientale may have arisen from italicum or echinatum of North America and may have involved hybridization with strumarium. Among the eight morphophysiological groups, the chinense populations are the most successful introduction at lower latitudes and the italicum populations at higher latitudes. As successful colonizers of unstable habitats of river floodplains and lake and oceanic beaches at diverse latitudes and in various climates, New World populations were pre-adapted to habitats disturbed by man in other parts of the world. The indigenous plants of the Old World due to their depauperate adaptive potential have been less successful than American plants as colonizers. In various parts of the Old World, such as India, the American introductions are the conspicuous populations and strumarium plants are rare, but the genetic influence of strumarium persists through hybridization with the aggressive colonizers from the New World.

PATTERNS OF ECOTYPIC VARIATION IN PERENNIAL GRASSES

James A. Quinn, (Rutgers University, New Brunswick, New Jersey) and Richard T. Ward (Colorado State University, Fort Collins, Colorado)

A series of studies at Colorado State University, all designed to examine ecotypic responses in perennial grasses, have now been completed. Their purpose was to provide data on additional species and to examine previously reported broad patterns by undertaking an intensive geographic and habitat sampling within Colorado and adjacent areas. Species studied were Andropogon scoparius (by R.V. Miller), Bouteloua gracilis (by R.V. Miller), Deschampsia caespitosa (by R.W. Pearcy and R.T. Ward), Koeleria cristata (by P.A. Robertson), Panicum virgatum (by J.A. Quinn), Sitanion hystrix (by W.P. Clary), and Sporobolus cryptandrus (by J.A. Quinn).

Very briefly, patterns of variation in selected responses for each species are as follows:

Deschampsia caespitosa--The patterns of response could be closely related to elevational gradients and differences in length of growing season at the original habitat. Populations from higher elevations with short growing seasons were earliest in phenological development, had shorter periods of growth, and were shorter in height than those from low elevations. Thus, all responses showed a similar pattern of direct relationship to length of growing season. Although populations from similar habitats were not significantly different, no particular groupings were present, suggesting that variation was clinal rather than of discrete ecotypes.

Andropogon scoparius--Also showed a well-defined pattern in which phenological development, period of active growth, production, and heights were all directly related to length of growing season. Variation among populations was clinal as demonstrated by frequency distribution curves of individual plant responses.

Bouteloua gracilis--Phenological development, production, and heights showed some relationship to length of growing season in the former habitat on a broad latitudinal scale, but this pattern was poorly defined in the more intensive sampling within Colorado. Miller concluded that the absence of any well-defined pattern had probably resulted from a strong dependence on vegetative reproduction and poor seed-producing ability, i.e., plants are close descendents of those first colonizing site.

Panicum virgatum--The patterns of phenological development, period of active growth, production, and heights were similar and generally (not always) coincided with the length of the growing season in the former habitat. Flowering was earliest in northern and high elevation plants, while period of active growth, production, and heights increased from north to south and from high to low

SOCIETY PRESIDENTS AT THE PLENARY SESSION OF THE JOINT MEETINGS HELD AT TEMPE, ARIZONA IN JUNE 1974 UNDER THE AUSPICES OF THE AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES

LEFT TO RIGHT:-

Standing

Dr. Jose Sarukhan, President
Sociedad Botanica de Mexico
Universidad Nacional Autonoma de Mexico
Mexico, D.F.

Dr. Rolla M. Tryon
President, American Fern Society
Gray Herbarium
22 Divinity Avenue
Harvard University
Cambridge, Massachusetts 01238

Dr. Bruce Wallace
President, Society for the Study of Evolution
Section of Genetics
Cornell University
Ithaca, New York 14850

Dr. William W. Scott
President, Phi Sigma Biological
Sciences Honor Society
Head, Department of Botany
Eastern Illinois University
Charleston, Illinois 61920

Dr. Robert L. Shaffer
President, Mycological Society of America
University Herbarium
University of Michigan
Ann Arbor, Michigan 48104

Dr. Paul B. Cavers
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Dr. David M. Gates
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Ann Arbor, Michigan 48104

Dr. George Sprugel, Jr.
President, AIBS
Illinois State Natural History Survey
179 Natural Resources Building
Urbana, Illinois 61801

Seated

Dr. E. D. Rudolph
President, American Bryological and
Lichenological Society
Department of Botany and Plant Pathology
Ohio State University
Columbus, Ohio 43210

Dr. Theodore Delevoryas
President, Botanical Society of America
Department of Botany
University of Texas
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Dr. Frederick Smith
President, Ecological Society of America
Harvard School of Design
University of Harvard
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Dr. Robert W. Hoshaw
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Phycological Society of America
Department of Biological Sciences
University of Arizona
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Dr. John D. Briggs
President, Society for Invertebrate Pathology
The Ohio State University
1735 Neil Avenue
Columbus, Ohio 43210

elevations of origin. A complicating effect of the nature of the original genome or segment of the gene pool available, upon the selective action of the geographic area was indicated by two populations in which phenological response had become differentiated as to length of growing season whereas heights had not. Variation among populations was clinal.

Koeleria cristata--Temperature and growing season records could not be correlated with phenological and other growth responses. In fact, contrary to past studies involving elevational gradients, the highest populations (receiving much greater precipitation) were latest in development. The moisture regime of the native habitats seemed a more important selection force than length of growing season; plants from the northern Colorado plains and from the plainsfoothills of eastern Colorado (effective precipitation similar for both areas) were comparable in phenology and morphology. The more common relationship of phenology and growth to temperature and length of growing season were evident only if the mountain-grassland populations were excluded from consideration.

Sitanion hystrix--Phenology was not correlated with latitude or length of growing season but nicely related to an "effective growing season" (period during which neither moisture nor temperature are limiting). Populations with a longer egs were later in flowering, while those with the egs limited either by heat or drought or cold temperatures flower much earlier in the year. Plant size and production were not so well predicted. Populations showed clinal variation in phenological and physiological responses, although a certain amount of regional discreteness in morphology was evident.

Sporobolus cryptandrus--Phenological development and flowering (although significantly different among populations) showed poor correlation with latitude, elevation, or length of frost-free growing season; however, the period of active growth, production, and heights increased directly with increased length of growing season in the original habitat! Phenological development also failed to correspond with calculations of "effective growing seasons" or to regional groupings. Just as for Sitanion, the pattern varied according to the character being considered. There was an almost continuous gradation in length of active growth period, heights, and production while morphological differences among the populations were much more discrete.

With the exception of Deca and Ansc, it would be difficult to justify the lumping of any of these species response patterns! Of several initial attempts, a characterization of the species on the basis of three attributes (season of growth, primary means of reproduction, and response to disturbance) seems to best agree with the different response patterns. It also highlights the gaps in our information and understanding and suggests types of species requiring further study.

(The abstract of the paper by Dr. Robert P. Adams of Colorado State University entitled "Population differentiation in two species of Juniperus" is not available for publication.)

Symposium on Plant Population Dynamics
(Introductory remarks by the Chairman, Paul Cavers, University of Western Ontario, London, Ontario.)

Up to five years ago it was fashionable for senior botanists when attempting an overview of their discipline, to bemoan the lack of knowledge and interest in the population level of their subject. They could point with pride to exciting and extensive discoveries being made at the cellular and sub-cellular levels; in whole plant physiology and in the description of plant communities and associations. At each of these levels of organization botanists have made important contributions to man's knowledge.

Many of these same senior botanists recognized the importance of plant population studies also, but they often dismissed the topic because it was too difficult. They believed that there were a number of serious complications to such studies and that these could not be readily overcome.

For example:

(a) In many vegetatively - reproducing species it is impossible to determine the extent of an individual plant without at least partially excavating that plant and thus destroying both the plant and the habitat in which it grows.

(b) A second problem, often stated, is that plants unlike animals are exceedingly plastic in growth response; depending on the microhabitat (nutrient, light, water and other supplies) a plant could remain very small or could grow to a large individual with a hugely increased capacity for reproduction.

(c) A third problem for the potential student of plant population dynamics is that an individual plant of many important species could live for hundreds of years. Even many beginning investigators feel that they cannot follow the dynamics of the population for a long enough time to contribute significantly to an understanding of that population.

Add to these difficulties the very pertinent fact that good studies of population dynamics must involve the repeated censusing of individual plants; a boring, laborious task. This might be the real reason for the paucity of information on plant populations!

You will find that there are two main areas of concentration in the talks this afternoon. The first is weed population dynamics and it is a subject which has been as well researched as any in the field. Studies on weed populations are basically practical in nature. They are designed to answer questions such as:

(a) When, and under what conditions can populations of individual weed species be maintained? Or eliminated?

(b) If you can prevent seedling establishment and/or vegetative reproduction, how long can the population persist? (i.e., what is the average life span of individuals in that population?)

(c) What is the reproductive strategy of the weed species? If one means of reproduction such as seed production is prevented by weed control measures, then will a second means (e.g. vegetative production) be favoured? Or, if seed production is prevented in one year will the plant become larger the following year and produce even more seeds?
(d) At what time of the year and under what conditions does successful seedling establishment occur? The answer to this question will tell you when seedlings should be destroyed (eradicated).
(e) What is the lifespan of an individual plant and how often does it reproduce during its lifetime?

This type of study with weeds and colonizing species is now so popular that fully 1/3 of the articles in the current issue of the Journal of Ecology deal with this topic.

A second important theme in today's talks; one that is more recent and in some ways more exciting now is tree population ecology. At least 4 of our 6 speakers this afternoon have worked with or are initiating projects on tree populations. Trees present many special problems to the student of population dynamics because of their large size, long lifespan and often, extensive intertwined root systems. An unusual aspect about the new interest in tree populations is that much data is already available. For example Dr. White has found sufficient data on trees in the Harvard Forest to keep him working for several lifetimes. Dr. Hett has pointed out that ecosystem modellers have a particular interest in seeing additional work done on mortality rates, survival rates and establishment rates in tree species; since they require data of this type as the basis for their models. However in the literature, most tree data, collected mainly by practising foresters, is in the form of yields; weight or biomass per unit area. Conversions between these two types of data might be very inaccurate and could lead to serious errors in the models.

There have been a few, excellent studies of plant population dynamics: (a) in Russia several long term, detailed projects have yielded much excellent data; most recently the reports of Dr. Rabotnov and his co-workers have been most informative; (b) a second example would be the elegant, precise work of Dr. Carl Olaf Tamm in Sweden and Norway using herbaceous, woodland perennials; (c) a third example, and a very appropriate one when we consider the location of this conference is the extensive work done on the saguaro cactus in the Sonoron desert. These latter studies have been noteworthy for their use of population age structure to demonstrate how some populations were dying out while others were continuing to thrive.

Much of the impetus for the current interest in plant population dynamics has been provided by one man, Professor John L. Harper of Bangor, Wales. His impact on to-day's program is strong since he supervised the research of two of our speakers plus myself. His forte has been to clearly elucidate many important principles in the subject. Above all, his lectures and his published work have inspired many young able scientists to enter this challenging new field.

And now a word or two about the speakers and the program for this symposium. All of our speakers have been active in the field of plant population dynamics during the past 5 years. None participated in the AAAS symposium on plant population dynamics in Chicago in December 1970 so their work and viewpoints should be novel to most of you.

One of our aims in setting up this symposium was to involve Canadian, Mexican and American Botanists. We have done this and I think that the program will benefit from the many geographical areas that are known to the participants.

AGE-STRUCTURAL DYNAMICS OF SOME FOREST TREES
Joan M. Hett, (Coniferous Forest Biome, College of Forest Resources, University of Washington, Seattle, Washington)

Research on plant populations most often has emphasized life-history studies with little long-term data on the dynamics of the populations. This paper explores a quantitative approach to the dynamics of plant populations throughout a long-life- span, including estimation of vital population statistics and examination of these parameters through time. The objective has been to examine mathematical models describing population depletions in Abies balsamea and Tsuga canadensis and to use the models to interpret mortality rates and other aspects of the biology of these tree species.

The models investigated are the negative exponential, the power function and a negative exponential sine wave. The negative exponential implies a constant mortality rate, and has been used in previous studies to describe age-structure of seedlings and herbs. The power function is one of a family of distributions that could be fitted to populations with a survival pattern following a positively skew distribution, implying a changing mortality rate. The results show that the negative exponential model does not adequately describe age depletions in long-lived species, and that the power function is an adequate model if one overlooks wave-like departures from the straight line fits.

However, all of the balsam fir and hemlock populations showed an oscillation around the straight line form of the first two distributions. A sine wave model developed to determine whether the population distributions could be described more adequately, and whether a characteristic wave length occurred for each species. The sine wave model appears to be the best, but much more data will be needed to provide a complete analysis of the oscillations in age structure of these two species. An explanation of the cycle in terms of gradual changes in survivorship due to changes in stand structure is suggested.

POPULATION DYNAMICS OF TWO TROPICAL TREE SPECIES
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Situated in the tropical wet Atlantic lowlands of northeastern Costa Rica, the Organization for Tropical Studies' La Selva biological station contains more than 600 ha of virgin forest dominated by Pentaclethra macroloba (Willd.) Ktze. (Mimosaceae). In an

attempt to increase our understanding of the structure and evolution of such a complex tropical community, I conducted an ecological life history and demographic study of P. macroloba and an occasional associate, Stryphonodendron excelsum Harms (Mimosaceae). A second objective was to use the demographic data for developing a mathematical model of the population dynamics of P. macroloba and S. excelsum.

On a 4 ha intensive study plot, all trees 10 cm or greater in diameter were permanently numbered, mapped, measured and identified. On the same plot almost 700 juvenile individuals of the two species were observed monthly for growth and mortality over a two-year period. An additional two years of growth and mortality data has been obtained by making annual observations on the tagged individuals.

Both P. macroloba and S. excelsum have reverse J-shaped size-class distributions. Mean annual increments in the La Selva forest are less than 30 cm in height for juveniles up to 300 cm tall and less than 10 mm in diameter for trees between 10 and 80 cm dbh. Approximately half of the seedling and sapling mortality is caused by falling palm leaves, branches and trees. Predatory ants attracted to extra-floral nectaries on the P. macroloba stem and S. excelsum leaves appear to protect the new shoot and leaves from herbivorous insects. The P. macroloba seeds, which contain toxic nitrogenous compounds, are virtually immune to invertebrate and vertebrate predation. S. excelsum seeds are occasionally heavily predated by bruchid beetle larvae.

The Lefkovitch projection matrix, which utilizes unequal stage (or size) groupings, was used to develop the population model. Growth, survival and seed input data for 15 size classes, ranging from seeds to trees more than a meter in diameter, were used to construct the initial matrix of coefficients. Standard matrix algebra procedures were used to determine the dominant latent root (λ_1) of the initial matrix. If λ_1= 1.000, the population neither increases nor decreases in number. The empirically determined values are λ_1= 1.002 for P. macroloba and λ_1= 1.047 for S. excelsum. These are apparently the first valid determinations of r or λ_1 for natural plant populations. Both P. macroloba and S. excelsum populations conform quite well with the predicted or stable size-class distribution.

Sensitivy analyses show that simulated changes in mortality have a much greater effect on population numbers than changes in grwoth or fecundity. Of the 15 stages in the P. macroloba population, the seed stage is the least sensitive to increasing mortality, e.g. introduction of a host-specific predator on P. macroloba seeds would not cause a drastic reduction in the P. macroloba population. For both species, the late prereproductive stages are the most sensitive to increasing mortality.

The population model developed in this study aided immeasurably in the interpretation of the ecological role of these two tree species in the La Selva forest, as well as providing considerable insight into this complex tropical ecosystem.

DYNAMICS OF FOREST TREE POPULATIONS James White, (Harvard University, Petersham, Mass. 01366)

There is an extensive literature in American forestry on the growth and yield of tree populations in pure, or almost pure stands. There have been few synthetic treatments of these data, probably the most comprehensive series of measurements for plant populations. Frequently runs of data are available for 40, 50 years, or longer, which render them even more unique. The present contribution seeks to provide a unified treatment of some of these data.

The frame of reference for the analyses may be stated as follows: Over a wide range of planting densities there is a convergence in time to a constant final yield of biomass per unit area. The formulation of this statement was first proposed for herbaceous plants by Kira et al (1953), as follows: $w=kd^{-1}$, or $Y=wd=kd^{-1}d^{1}=k$ where w is mean plant weight, d is density, Y is yield per unit area, k is a constant. Analyses of spacing experiments in forestry can be shown to conform to this relationship.

However, at high densities at which thinning occurs quite a different relationship exists between mean plant weight and density, as first shown by Tadaki and Shidei (1959). This may be expressed as:

$w=Kd^{-3/2}$ or $Y=wd=Kd^{-3/2}d=Kd^{-1/2}$(the symbols being the same as in the previous equations, but K a different constant). More elaborate treatment of this relationship has been given by Yoda et al. (1963) and by White and Harper (1970), drawing chiefly on herbaceous plants for examples.

Recent analyses of American forestry literature show, repeatedly, that pure stands undergoing thinning conform closely to this relationship. Mean plant volume is always given instead of mean plant weight in forestry literature, but the allometric relationship between volume (v) and weight is very close, as $v=c.w^{a}$, where a is quite close to 1.

The thinning principle, relating volume or weight per plant to density is now reported for about 40 tree species and for some of these species in the works of several authors. Consequently, the principle is probably the best established generality in plant population dynamics. It has important consequences in practical forestry as the relationship $Y=Kd^{-1/2}$ shows.It is generated biologically by differences in starting capital of seeds, differences in emergence time of sown seeds, differences in relative growth rates of seedlings and saplings, which lead in the course of population development to log-normal distributions of plant weights or volumes (though not of heights nor of diameters). The rate of development of such log-normal distributions (few large and many small plants) is a function of initial density and fertility.

Earlier work (Yoda et al., 1963) tended to suggest that there was a common thinning line for populations on sites of varying fertilities. The analyses of tree populations show that in some cases this is so, but that sometimes the value of K varies from site to site depending on fertility - the higher the fertility the greater K becomes. However, the exponent $-3/2$ (the slope of the line) remains invariant.

The analysis of stem numbers and volume in mixed-forest stands observed for over 40 years in permanent plots shows that the stems as a whole conform to the thinning principle. This is the first report of the phenomenon for mixtures of trees. However, individual species in the forest do not necessarily conform to the rule but their behavior seems to be regular and predictable nonetheless.

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DEMOGRAPHIC STUDIES ON PLANT POPULATIONS

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A general overview is made on a demographic study of the three species of buttercups Ranunculus acris, R. repens and R. bulbosus in coastal grasslands in North Wales, which has already been reported in part (Sarukhán and Harper, J. Ecol. 61:675-716, 1973 and Sarukhán, J. Ecol. 62: 151-177, 1974). Emphasis is made on the general patterns of survivorship of plants originating from seed and vegetative means, remarking on the strong linearity of the survivorship of vegetative propagules from very early ages. Other aspects derived from demographic observations are discussed such as age structure and life expectancies related both to stand density and to the age of individuals. Another aspect covered in this study was the seed population dynamics of the three spp. Striking differences were found between the strictly sexually reproducing species and the mainly vegetatively reproducing one, together with marked changes in the states of dormancy under which seeds remain viable in the soil bank. A discussion of the use of mathematical models for the description of the information obtained is made, pointing out their use in investigating population regulation mechanisms. As a colation of the data, population flux diagrams are presented and discussed, contrasting species of different life strategies.

Finally, a brief presentation is made of a long- term project on Comparative Demography of Tropical and Temperate Trees, being carried out in Mexico. The project attempts to gather information on population regulation mechanisms of common species in five major ecosystems in Mexico in the search for general demographic patterns and causes of population regulation. Preliminary information gathered in two sites is presented; these are a Pinus michoabana, P. pseudostrobus and P. herrerai forest in the state of Guerrero and a Low Deciduous tropical forest dominated by Cordia elaeagnoides, in the state of Jalisco.

THE REGULATION OF NUMBERS AND MASS IN POPULATIONS OF PLANTAGO MAJOR AND P. RUGELII

Wayne R. Hawthorn, (Department of Biology, University of Waterloo, Waterloo, Ontario. N2L 3G1)

Field populations of two perennial herbs were monitored during the growing season for three successive years. The data is presented in the form of survivorship curves that show that there are marked differences in half-life of the two species. The curves confirm recent evidence from other sources that the period of mortality occurs during active growth of the survivors rather than during the harsh phases of the physical environment. The probability of survival to the next year, especially by a plant of P. rugelii, is not adversely affected by flowering. Seed viability in the two species vary among plants; viability is decreased after the seeds winter above the soil in contact with supporting reproductive structures. Experimental studies of the behaviour of the two species in mixtures with and without grass provide evidence that there may be ecological complementation between grass and P. rugelii which does not occur between P. major and grass. These field observations and experiments provide a basis for a casual interpretation of the observed field behaviour of the species.

REPRODUCTIVE STRATEGIES OF HIERACIUM

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Hieracium floribundum Wimm and Grab., a native of Europe, became established on the east coast of North America in the latter half of the nineteenth century and has since spread westward as far as the province of Ontario in Canada. It has become a common weed species on land which formerly was cultivated or pastured. This yellow-flowered perennial species is characterized by a short stout rhizome, a rosette of many basal leaves, compound inflorescence of several heads, and by stolons which arise from the axillary leaves and are only produced on rosettes which flower.

The main objectives of the study are to evaluate the relative importance of sexual and vegetative reproduction, to determine the fate of seed and stolons produced by flowering plants, and to compare the allocation of reproductive biomass under a low and high intraspecific density stress and various abiotic stresses.

Seedlings that survived for more than 2 years represented only 1% of the yearly recruitment to a patch of H. floribundum. Even though the potential seed source was about 32 times as great as the vegetative source, 99% of the adult hawkweed rosettes were a result of asexual reproduction by stolons. On the low density margins of hawkweed patches, 50% of the rosettes flowered and each flowering rosette produced 3.4 heads in an inflorescence and 4.5 stolons. In the

high density centre of the patch, 10% flowered and each produced 2.7 heads and 1.5 stolons. Marginal flowering rosettes weighed 2½ times as much as flowering rosettes in the centre of the patch.

The mechanisms for the regulation of seedlings and stolon rosette recruitment in a patch are varied. A large proportion of nonviable seed (42%), the requirement for low soil temperatures (17-22°C optimum) and light for germination, reduction of establishment numbers by heavy vegetation cover, and the high winter mortality of seedlings after a germination flush in the fall were the main reasons for the low seedling input. The difference in the percentage of flowering rosettes and hence vegetatively reproducing rosettes is brought about by density-induced self-regulatory mechanisms within the patch. As a response to increased density, the number of rosettes that flowered and the vegetative reproductive output per rosette was lower.

The proportion of the plant's biomass devoted to sexual reproduction (total inflorescence), based on the standing crop (excluding roots) of flowering plants was a fixed 12% regardless of the density stress or abiotic stress (droughty eroded soil). Five closely related Hieracium species had similar sexual reproductive efforts. The vegetative reproductive effort (stolons) was reduced from 62% to 52% under a high density or abiotic stress. When the reproductive efforts were based on an estimate of the net annual production of flowering plants, the sexual reproductive effort was only 4 - 10% under the various stresses whereas the vegetative reproductive effort was reduced considerably under high density stress and less so under the abiotic stress. Since the percentage of rosettes that flower varies greatly with density, a better indication of how the population partitions its resources is to express the allocation to reproductive tissue in terms of the net production of the population on a per unit area basis. When this is done, the sexual reproductive effort remains fixed at 1% regardless of the stress but the vegetative reproductive effort at high density is only 4.4% and under abiotic stress only 7.4% compared to 33% at low density.

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