A SELECTED ANNOTATED BIBLIOGRAPHY ON AQUATIC AND MARSH PLANTS AND THEIR MANAGEMENT

by

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PREFACE

This is a report of research initiated by the Coastal Engineering Research Center (CERC) for the Waterways Experiment Station (WES) through Contract DACW72-74-C-0010. Mr. Donald W. Woodard (CERC) served as the Contracting Officer's Technical Representative. John A. Kadlec was principal investigator and W. Alan Wentz and Rachel L. Smith served as research associate and research assistant, respectively.

At the time of publication, Colonel James L. Trayers was Director of CERC.

TABLE OF CONTENTS

A SELECTED ANNOTATED BIBLIOGRAPHY ON AQUATIC AND MARSH PLANTS AND THEIR MANAGEMENT

PART I: INTRODUCTION

The list of references on which this bibliography is based was originally compiled for an investigation of marsh and aquatic plant establishment (Kadlec and Wentz 1974, see listing in bibliography). In order to make available extensive references not cited in that work, this annotated bibliography was prepared. The two volumes together provide a rapid index to much of the literature on the ecology and management of aquatic and marsh plants.

Since the original intent of the literature search was restricted, coverage of some important areas, such as control of nuisance plants, was limited. Some additional references have been included in this bibliography, but it is still not exhaustive in all areas. Thus, this bibliography represents a fairly comprehensive review of the pertinent literature, but it is by no means complete. We have attempted to concentrate on papers which will be useful for researchers and managers, and because of this many peripheral papers were not included. We should also note that the intent of the original report led to a concentration on coastal, Great Lakes, and riverine marshes. As a consequence, work in the Great Plains and Intermountain West did not receive full attention.

For details of our methods of literature search and the sources searched, see Kadlec and Wentz (1974).

Newsletters which are especially helpful for anyone interested in current information on aquatic vascular plants include: Newsletter of the Association of Aquatic Vascular Plant Biologists (edited by Dr. C. P. McRoy, Institute of Marine Sciences, University of Alaska, Fairbanks, 99701), and La Seiba (edited by Dr. P. B. Tomlinson, Harvard University, Harvard Forest, Petersham, Mass., 01366).

PART II: USE OF THE BIBLIOGRAPHY

The bibliography is arranged alphabetically by author and the entries are consecutively numbered. Each reference includes a full citation, a list of key words, and a short annotation. Each reference is listed, by number, in the index of key words. Thus, an individual who is interested in reviewing papers on the genus Spartina should consult all references listed under the key word Spartina in the key word index. Similarily, a general interest in any other genus or topic will necessitate checking all references listed under the appropriate key word(s). If, however, references on more specific topics are required, a combination of key words should be used. For example, if information on planting Spartina is required, only those references which appear under both key words (planting and Spartina) need be checked.

The user is cautioned to check all potential key words on a topic since relevant material may occasionally not be indexed under every applicable key word. This is especially true for generic names since a paper was listed under a particular genus only when members of that genus were discussed in some detail in that paper. Whenever a single paper dealt with a broad range of genera or species, the paper was indexed under appropriate general key words, such as emergents, floating plants, or submergents.

1. Adams, D. A. 1963. Factors influencing vascular plant zonation in North Carolina salt marshes. Ecology 44(3):445-456.

   KEY WORDS: communities, Distichlis, emergents, iron, salinity, salt marsh, Spartina, substrate, succession, tides, zonation.

   Plant species composition and environmental conditions in the various plant communities of North Carolina salt marshes are described. Statistical analysis of species associations resulted in a classification of the marsh into two zones, low and high marsh, based primarily on salinity and iron levels.

2. Adams, F. S. 1969. Winterbud production and function in Brasenia schreberi. Rhodora 71:417-433.

   KEY WORDS: Brasenia, freezing, hibernacula, life history, planting, propagule sources, turions, vegetative reproduction, viability.

   Brasenia schreberi form large numbers of winterbuds. Those that remain attached to the parent plant account for most new plants the following year. The majority of winterbuds (60%) die. The formation of winterbuds appears to be essential for the continuation of a population.

3. Addy, C. E. 1947. Germination of eelgrass seed. J. Wildl. Manage. 11(3):279.

   KEY WORDS: germination, planting, propagule storage, seeds, site preparation, Zostera.

   Methods and materials involved in gathering and storing Zostera marina seed are described. Seed matures by 1 August and seedlings are established by September or October.

4. Addy, C. E. 1947. Eel grass planting guide. Maryland Conservationist 24:16-17.

   KEY WORDS: equipment, planting, seeds, Zostera.

   Limited experiments (to date) have shown that under proper conditions eelgrass can be successfully transplanted by transporting shovelfuls of soil and plants intact. Sowing of individual roots or plants is very time consuming. Seeds can be harvested in some years and sown in the spring or fall. Details of these planting methods are given.

5. Addy, C. E. and D. A. Aylward. 1944. Status of eelgrass in Massachusetts during 1943. J. Wildl. Manage. 8(4):269-275.

KEY WORDS: diseases, geography, phenology, planting, propagule storage, seeds, waterfowl, Zostera.

Zostera marina populations are apparently recovering after destruction by "wasting disease" associated with Labyrinthula. Various waterfowl (especially Canada geese, Atlantic brant, and black ducks) utilize eelgrass for food. Zostera can be successfully transplanted by moving whole plants and attached soil. Survival of plantings was good on soft to firm sandy-mud sites which were not exposed at low tide.

6. Addy, C. E. and L. G. MacNamara. 1948. Waterfowl Management on Small Areas: I. Ponds and marshes for waterfowl, II. Methods of pond and lake construction. Wildl. Manage. Inst., Wash., D. C. 80pp.

KEY WORDS: control, drawdown, erosion, equipment, fishes, flooding, geography, harvest, mowing, pH, planting, rootstocks, salinity, seeds, site preparation, substrate, tubers, turbidity, vegetative propagation, weeds.

Part I of the pamphlet discusses general improvements of ponds for ducks, planting programs, weed control, and a discussion of factors unfavorable to waterfowl management such as erosion, rough fish, livestock, and turbidity. Part II outlines the influence of topography, the use of water control structures, dike construction, and other methods of improving waterfowl habitat.

7. Aldrich, J. W. 1943. Biological survey of the bogs and swamps of northeastern Ohio. Am. Midl. Nat. 30(2):346-402.

KEY WORDS: bogs, communities, fire, flooding, substrate, succession, swamp.

A descriptive study of species complexes with notes on plant invasion after fire and flooding. Some information on the influences of soil type and geologic history on communities is presented.

8. Allan, P. F. 1956. A system for evaluating coastal marshes as duck winter range. J. Wildl. Manage. 20(3):247-252.

KEY WORDS: communities, ecological range, emergents, salinity, salt marsh, substrate.

A classification of coastal marshes was developed based on salinity data correlated with the presence of various plant species.

Salinity Range	Dominant Plants
very salty, 4.0-4.5%	Spartina alterniflora
salty, 3.6-4.0%	Distichlis spicata
moderately salty, 1.5-3.6%	
high sites	Phragmites australis
	Spartina cynosuroides
low sites	Spartina patens
	Distichlis spicata
slightly salty to fresh, 1.0-1.5%	Typha domingensis
	Scirpus californicus
moderately fresh to fresh, 0.5-1.0%	Cladium jamaicense
fresh, 0.0-0.5%	Zizaniopsis mileacea
	Panicum hemitomon

9. Allen, G. W. 1964. Estuarine destruction . . . a monument to progress. N. Am. Wildl. Conf., Trans. 29:324-331.

KEY WORDS: salt marsh.

The encroachment upon and destruction of estuaries and coastal marshlands by government agencies, industry, and commercial and residential concerns is discussed.

10. Allenby, K. G. 1966. The manganese and calcium content of some aquatic plants and the water in which they grow. Hydrobiologia 27:498-500.

KEY WORDS: Alisma, calcium, Elodea, nutrients, Sparganium.

The manganese and calcium contents of Elodea canadensis, Alisma, plantago, and Sparganium ramosum were determined. It was found that wide variation occurred within different plants of the same species from the same habitat. All three plants showed a high manganese content with Elodea containing the greatest amounts.

11. Allenby, K. G. 1967. The manganese and calcium content of some aquatic plants and the water in which they grow. Hydrobiologia 29:239-244.

KEY WORDS: calcium, Carex, Lemna, nutrients, Potamogeton, Sagittaria.

Data on the calcium and manganese contents of nine species of aquatic plants are given. As found in a previous test (Allenby 1966), the calcium/ash ratio of these plants was less than that of their habitat. There appears to be no correlation between the amount of manganese in the plant and the water in which the plant grows.

12. Allsopp, W. H. L. 1960. The manatee; ecology, and use for weed control. Nature 188:762.

KEY WORDS: control, floating plants, submergents.

Manatees (Trichechus manatus) are voracious feeders on submergent and floating aquatic plants and, as such, are excellent means of control in problem areas. However, they reproduce slowly and must be handled with care since they are easily bruised.

13. Amen, R. D., G. E. Carter and R. J. Kelly. 1970. The nature of seed dormancy and germination in the salt marsh grass Distichlis spicata. New Phytol. 69:1005-1013.

KEY WORDS: afterripening, chloride, Distichlis, dormancy, germination, habitat, nitrate, seed production, seeds, temperature.

Distichlis spicata sets dormant seed which exhibit a low-temperature afterripening requirement. Stratification, localized scarification, and nitrate promote seed germination. Dormancy and germination appear to be hormonally controlled.

14. Anderson, H. G. 1940. Studies preliminary to a waterfowl habitat restoration program along the Illinois River. N. Am. Wildl. Conf., Trans. 5:369-373.

KEY WORDS: drawdown, flooding, waterfowl.

Most species of plants that are favorable as waterfowl foods depend on stabilized water levels during their growing season. Fluctuating water levels often promote growths of less desirable species.

15. Anderson, R. R., R. G. Brown and R. D. Rappleye. 1965. Mineral composition of Eurasian watermilfoil, Myriophyllum spicatum. Chesapeake Sci. 6(1):68-72.

KEY WORDS: bicarbonate, ecological range, Myriophyllum, nutrients, pH, salinity, temperature.

Myriophyllum spicatum is capable of existing in a wide range of environmental conditions. It is known to tolerate temperatures of 0.2 to 30.0 C, pH of 5.8 to 9.5, and salinities of 0.07 to 16.4 ppt.

16. Anderson, R. R., R. G. Brown and R. D. Rappleye. 1966. The mineral content of Myriophyllum spicatum L. in relation to its aquatic environment. Ecology 47(5):844-846.

KEY WORDS: dispersal, Myriophyllum, nutrients, physiology, salinity, vegetative propagation.

Myriophyllum spicatum is capable of maintaining cellular concentrations of various ions independent of environmental concentrations. New plants can grow from a single node and plants are probably dispersed by fragments.

17. Anonymous. 1933. Waterfowl food plants. More Game Birds in America. 28pp.

KEY WORDS: emergents, habitat, planting, salinity, submergents, waterfowl.

Tables listing numerous aquatic plant species, their optimal growth conditions, distribution, and remarks as to their value to wildlife are presented. Generalized rules for planting many aquatic species are also given.

18. Anonymous. 1942. Natural plantings for attracting waterfowl to marsh and other water areas. U. S. Fish & Wildl. Serv., Wildl. Leafl. 223. 4pp. mimeo.

KEY WORDS: emergents, submergents, waterfowl.

To aid in improving areas suitable for the establishment of permanent stands of marsh and aquatic vegetation attractive to ducks, this leaflet presents a brief discussion of three types of marsh and water areas and lists the principal species of wild plants best adapted to them. These types are: 1) areas characterized by muddy, fluctuating water; 2) coastal marshes and marshland ponds; and 3) miscellaneous areas.

19. Anonymous. 1952. Manual For Testing Agricultural and Vegetable Seeds. U.S.D.A. Agricultural Handbook 30. Wash., D. C. 440pp.

KEY WORDS: bibliography, germination, machinery, physiology, propagule storage, seeds.

This handbook includes sections on identification, methods of cleaning and separating seed, testing for viability, and a literature cited section on several topics including physiology and germination.

20. Anonymous. 1963. Wildlife Research: problems, programs, progress. Bur. Sport Fish. & Wildl. Circ. 188. 80pp.

KEY WORDS: Alternanthera, control, herbicides, Myriophyllum, salinity, weeds.

Research on Myriophyllum revealed information on salinity tolerances and the effectiveness of 2,4-D herbicide treatment on this weed in the Chesapeake Bay. A brief statement on the use of 2,4-D on Alternanthera is also included.

21. Anonymous. 1964. Wildlife Research: problems, programs, progress. Bur. Sport Fish. & Wildl. Circ. 220. 86pp.

KEY WORDS: bogs, growth, habitat, iron, phosphorus, Ruppia, salinity.

Short articles on 1) the habitat and growth of Ruppia, 2) waterfowl food plants which could be planted on lowgrade sites, and 3) the availability of phosphorus in iron-rich soils are included in this report on current research.

22. Anonymous. 1965. Wildlife Research: problems, programs, progress. Bur. Sport Fish. & Wildl. Resour. Pub. 23. 102pp.

KEY WORDS: control, herbicides, Myriophyllum, submergents, tides, weeds.

A section of this publication on aquatic plants describes application proceedures for the herbicides 2,4-D and diquat as control measures for Myriophyllum in coastal areas.

23. Anonymous. 1965. Expanded project for aquatic plant control. Printed by the Committee on Public Works, Wash., D. C. for the Army Corps of Engineers. 145pp.

KEY WORDS: adventive spread, Alternanthera, control, Eichornia, floating plants, habitat, herbicides, life history, machinery, physiology, weeds.

The problem of aquatic weed control, primarily of Eichornia and Alternanthera, in North Carolina, South Carolina, and the Gulf States is reviewed. The geographical extent of infestations are recorded, the accomplishments of control operations performed and research conducted by cooperating federal agencies are discussed. The eleven appendices are a series of reports on life history, physiology, herbicides, and spray machinery as related to aquatic weed control.

24. Anonymous. 1972. Proceedings of the seminar on planning and coastal engineering in the coastal zone. Seminar Ser. 2, Coastal Plains Center for Marine Development Services. 141pp.

KEY WORDS: dredging, equipment, erosion, pollution, salt marsh, site preparation, substrate, tides, turbidity.

Four main topics of the seminar notes are: 1) physical processes, coastal erosion and protection, 2) environmental considerations, 3) legal aspects and legislation in the coastal zone, and 4) aerial surveillance techniques applied to the coastal zone. Some pertinent information on disposal of dredged materials is discussed.

25. Anonymous. 1972. Techniques handbook of the waterfowl habitat development and management committee. Atlantic Flyway Council. 218pp.

KEY WORDS: bibliography, drawdown, planting, salinity, seeds, site preparation, substrate, turbidity, waterfowl.

General principals of drawdowns, planting, and management for waterfowl foods are discussed. Site selection and preparation for aquatic plantings are discussed as well.

26. Anonymous. 1973. Symposium on environmental biochemistry: abstracts. Nat. Sci. Found. - Ecology Center; Utah State Univ. - O.G.D.; Geochemical Soc. 50pp.

KEY WORDS: flooding, iron, pH, phosphorus, substrate, water-logging.

A series of abstracts from symposium papers discussing various chemical processes and biogeochemical cycles in marine sediments is presented.

27. Anonymous. 1974. Research to determine the environmental response to the deposition of spoil on salt marsh using diked and undiked techniques. Final Project Rep. submitted to U.S. Army Corps Engineers by Skidaway Inst. Oceanogr. 96pp.

KEY WORDS: fertilizer, invertebrates, planting, seedlings, Spartina, viability.

The first section of the report deals mainly with marsh building with Spartina seedlings and transplants. Only 12% seedling survival was obtained as compared to 40% survival of transplants.

28. Arber, A. 1920. Water Plants. A Study of Aquatic Angiosperms. Cambridge Univ. Press, London. 436pp.

KEY WORDS: aeration, dispersal, emergents, fruits, geography, life history, morphology, physiology, rhizomes, seedlings, seeds, submergents, turions.

A standard compendium of information on the aquatic flowering plants. Water plants as a biological group are considered in relation to certain typical life histories, a discussion of the vegetative and reproductive organs, physiology, and phylogenetics.

29. Ashby, E., E. Wangermann and E. J. Winter. 1949. Studies in the morphogenesis of leaves. III. Preliminary observations on vegetative growth in Lemna minor. New Phytol. 48:374-381.

KEY WORDS: floating plants, Lemna, morphology, vegetative reproduction.

Under conditions of adequate light, temperature and mineral nutrition: 1) Lemna fronds live not more than 5 to 6 weeks, 2) each Lemna frond of a clone gives rise to a characteristic number of daughter fronds, 3) the areas of successive daughter fronds produced from one mother frond progressively diminish, and 4) these fronds are smaller because of a fewer number of cells.

30. Attaway, D. H., P. Haug and P. L. Parker. 1971. Sterols in five coastal spermatophytes. Lipids 6:687-691.

KEY WORDS: Halodule, Halophila, nutrients, physiology, Ruppia, Syringodium, Thalassia.

The sterol composition of seagrasses was measured to determine if these plants are building highly organic lagoonal deposits such as those which once produced oil.

31. Babcock, K. M. 1967. The influence of water depth and salinity on wiregrass and saltmarsh grass. M. Sc. Thesis, Louisiana State Univ. and Agr. and Mech. College.

KEY WORDS: Distichlis, fire, flooding, salinity, salt marsh, seed production, Spartina, substrate.

The influence of various water depths, burning, flooding, and salinities on Spartina patens and Distichlis spicata were studied at Rockefeller Refuge, Louisiana. Both species appeared to grow best at salinities ranging from 5 ppt (parts per thousand) to 25 ppt. Water depths from slightly below one foot to approximately one foot above the soil surface resulted in the most luxuriant growth. Seed production was affected by both flooding and burning.

32. Baker, W. D. 1965. A study of turbidities caused by re-dredging the intracoastal waterway in Currituck Sound, North Carolina. Spec. Rep., Dingell-Johnson Project F-16-R-1. 6pp. mimeo.

KEY WORDS: dredging, submergents, turbidity.

Wind did not spread turbid waters; the most turbid waters were all within one mile of dredging operations. Light seldom penetrated more than 10 inches into the water within one-half mile of dredging. Wave action resulted in a persistence of turbidity.

33. Baldwin, W. P. 1956. Food supply key to attracting ducks. South Carolina Wildlife 3(1):5-12.

KEY WORDS: drawdown, emergents, floating plants, habitat, submergents, waterfowl.

Food supply is generally considered the key to attracting wild ducks and geese. Desirable waterfowl food plants and undesirable aquatic plants have been grouped in a table under three broad habitat types — coastal and salt marsh, fresh water river delta, and swamps and upland ponds. The plants of these habitats are correlated with water depth.

34. Bamforth, S. S. 1962. Diurnal changes in shallow aquatic habitats. Limnol. Oceanogr. 7(3):348-353.

KEY WORDS: ammonia, carbon dioxide, invertebrates, iron, nitrate, oxygen, pH, phosphate, substrate.

Diurnal changes in the soil and water environment were studied at different times of the year in a variety of Louisiana swamps, ditches, ponds, and streams. pH and oxygen content rose during the day and carbon dioxide, phosphate, and iron declined. Ammonia tended to parallel carbon dioxide patterns; nitrate was not detectable.

35. Barbour, M. G. 1970. Seedling ecology of Cakile maritima along the California coast. Bull. Torrey Bot. Club 97(5):280-289.

KEY WORDS: Cakile, ecological range, germination, growth, seedlings, seed production.

Seed production, growth, and flowering characteristics were determined for Cakile maritima from six scattered locations along the California coast. Requirements for successful germination and establishment of seedlings are also discussed.

36. Barbour, M. G. and C. B. Davis. 1970. Salt tolerance of five California salt marsh plants. Am. Midl. Nat. 84(1):262-265.

KEY WORDS: Distichlis, Salicornia, salinity, salt marsh, substrate, waterlogging.

Five species of California marsh plants (Distichlis spicata, Frankenia grandifolia, Jaumia carnosa, Mesembryanthemum chilense, and Salicornia virginica) were grown in sand culture for four weeks. Survival percentages are recorded for several strengths of salt solutions. All species grew best in lowest salt concentrations and none survived at 2.2% salinity.

37. Barton, L. V. 1961. Longevity of seeds of aquatic plants, etc. pp. 91-98. In: L. V. Barton. Seed Preservation and Longevity. Leonard Hill Books, London. 216pp.

KEY WORDS: dormancy, propagule storage, seeds, viability.

Long preservation of seeds of aquatic plants in water is primarily dependent on dormancy of the seeds and persistence of a temperature which will not permit germination. The literature on dormancy and storage requirements for several aquatic species is reviewed.

38. Barton, L. V. and J. E. Hotchkiss. 1951. Germination of seeds of Eichhornia crassipes Solms. Contrib. Boyce Thompson Inst. 16: 215-220.

KEY WORDS: Eichornia, germination, propagule storage, seeds, weeds.

From the data presented it appears that a combination of high temperature and light is needed for complete germination of dormant seeds of water hyacinth. However, periods of 8 hours a day at a temperature as low as 5 C did not impair germination in the greenhouse and daily alternating temperatures permitted some germination in the dark.

39. Batchelder, C. H. 1926. An ecological study of a brackish-water stream. Ecology 7:55-71.

KEY WORDS: brackish, succession.

Bunker's Creek, New Hampshire, includes 9½ acres of brackish water at full tide. Communities in this creek are rather definitely distributed with respect to substrate, falling into either an eroding shore or depositing shore classification. Species composition of Bunker's Creek flora is briefly described.

40. Bauersfeld, R., R. R. Kifer, N. W. Durrant and J. E. Sykes. 1969. Nutrient content of turtle grass (Thalassia testudinum). Int. Seaweed Symp., Proc. 6:637-645.

KEY WORDS: biomass, commercial uses, harvest, nutrients, Thalassia.

Yields of Thalassia testudinum range from 2.9 to 30 tons dry weight per acre. T. testudinum appears to be suitable as a feed supplement in a range type of diet for sheep.

41. Bayly, I. L. and T. A. O'Neill. 1972. Seasonal ionic fluctuations in a Phragmites communis community. Can. J. Bot. 50:2103-2109.

KEY WORDS: calcium, community, growth, magnesium, nutrients, phosphorus, Phragmites, potassium, sodium.

Calcium, magnesium, potassium, sodium, and phosphorus concentrations were measured in the shoots of a Phragmites communis (= P. australis) community and its natural substrates during the growth season of 1969. Of the ions studied, calcium apparently increased in the shoot tissue, and magnesium, potassium and phosphorus apparently decreased in shoot tissue during the course of the growing season. Some speculations regarding the direction of net nutrient flow in this community are advanced.

42. Bayly, T. L. and T. A. O'Neil. 1972. Seasonal ionic fluctuations in a Typha glauca community. Ecology 53(4):714-719.

KEY WORDS: calcium, communities, iron, magnesium, phosphorus, physiology, potassium, sodium, substrate, Typha.

Seasonal fluctuations of calcium, magnesium, potassium, sodium, iron, and phosphorus were found in the environment and in Typha glauca parts. Substrate concentrations of calcium and possibly magnesium were inversely related to plant tissue concentration. Potassium and phosphorus in floral stalks and leaves were inversely related to rhizome concentration, but not to substrate concentration. There was no apparent correlation between changes in sodium and iron concentrations in plant tissues and the soil.

43. Beal. E. 1960. The Alismataceae of the Carolinas. J. Elisha Mitchell Sci. Soc. 76(1):68-79.

KEY WORDS: Alisma, flora, habitat, keys, morphology, pH, salinity, Sagittaria, taxonomy.

Three genera of the Alismataceae are recognized as occurring in the Carolinas: 1) Alisma, 2) Echinodorus, and 3) Sagittaria. A summary of the habitats and environmental conditions is presented. A key to the genera of Alismataceae and a key to the taxa of Sagittaria is given.

44. Beal, E. O. and P. H. Monson. 1954. Marsh and aquatic angiosperms of Iowa. State Univ. Iowa Stud. Nat. Hist. 19:1-95.

KEY WORDS: emergents, flora, habitat, keys, submergents.

This publication consists of a key to the marsh and aquatic angiosperms of Iowa with habitat notes and maps show the distribution of the various species in the state.

45. Beard, T. D. 1969. Impact of an overwinter drawdown on the aquatic vegetation in Murphy Flowage, Wisconsin. Wisc. Dep. Nat. Resour. Rep. 43. 16pp.

KEY WORDS: control, drawdown.

Drawdowns resulted in a significatn reduction in the distribution, relative abundance, and acreage of aquatic vegetation.

46. Beard, T. D. 1973. Overwinter drawdown, impact on the aquatic vegetation in Murphy Flowage, Wisconsin. Wisc. Dep. Nat. Resour. Tech. Bull. 61. 14pp.

KEY WORDS: control, drawdown, freezing, seed production, submergents, temperature.

Some major changes in the vegetation pattern of Murphy Flowage after a five foot overwinter drawdown are recorded. Species most affected were Potamogeton robbinsii, Nuphar sp., Najas flexilis, Myriophyllum spp., Potamogeton amplifolius, and Ceratophyllum demersum. The adverse effect of the drawdown on several species of water dependent animals is noted.

47. Bedish, J. W. 1967. Cattail moisture requirements and their significance to marsh management. Am. Midl. Nat. 78:288-300.

KEY WORDS: flooding, germination, growth, propagule storage, seedlings, seeds, Typha.

Typha latifolia X T. angustifolia seed grown in the greenhouse required flooding for germination. Germination occurred in water 1 to 6 inches deep. Dry storage for one year at room temperature reduced germination by 50 %. The fastest rate and greatest amount of growth occurred in 1 inch of water, but there were few overall differences at depths up to 6 inches.

48. Beetle, A. A. 1943. A key to the North American species of the genus Scirpus based on achene characters. Am. Midl. Nat. 29: 533-538.

KEY WORDS: keys, Scirpus, seeds.

A key to 45 North American species of Scirpus based on achene characteristics is presented.

49. Belonger, B. J. 1969. Aquatic plant survey of major lakes in the Fox River (Illinois) watershed. Ill. Dep. Nat Resour., Res. Rep. 39.

KEY WORDS: depth, emergents, floating plants, flora, submergents.

Water level relations are examined for a wide variety of aquatic plants in several Illinois lakes. Emergent species were confined to water depths of less than 3 feet. Floating leaved plants were found mostly in waters less than 4 feet deep. Submersed vegetation grew in waters up to 30 feet deep.

50. Bernard, J. M. and J. G. Macdonald, Jr. 1974. Primary production and life history of Carex lacustris. Can. J. Bot. 52(1):117-123.

KEY WORDS: biomass, Carex, life history, productivity.

Shoots of Carex lacustris live for one year or less, emerging in Autumn, overwintering, and then dying sometime during the next summer.

51. Bernatowicz, S. 1969. Macrophytes in the lake Warniak and their chemical composition. Ecologia Polska - Seria A 17(27):447-467.

KEY WORDS: emergents, nutrients, submergents.

The chemical composition and water level relations of the aquatic plants in a Polish lake are given.

52. Beshears, W. W., Jr. 1959. Survey of waterfowl areas. Alabama Pittman-Robertson Rep. W-33-R-C, Workplan V, Job V-A. 8pp. mimeo.

KEY WORDS: exotics, flora, succession, waterfowl, weeds, zonation.

Primarily an inventory of plants of the Mobile Delta with comments on management and natural changes in the plant communities.

53. Beshears, W. W., Jr. 1970. Mobile Delta vegetative study. Alabama Pittman-Robertson Rep. W-35-R-16, annual rep. 6pp. mimeo.

KEY WORDS: emergents, flora, submergents, waterfowl.

An inventory of the Mobile Delta plant species with some comments on management.

54. Bjork, S. 1967. Ecological investigations of Phragmites communis. Studies in theoretic and applied limnology. Folia Limnologica Scandinavica 14, (Lund). 248pp.

KEY WORDS: bibliography, biomass, commercial uses, culture, ecological range, life history, nutrients, phenology, Phragmites, pollution, productivity, rhizomes, root systems, seed production, vegetative reproduction.

This book includes extensive discussions of the life history and overall ecology of Phragmites communis (= P. australis) populations in South Sweden.

55. Blinn, D. W. 1971. Dynamics of major ions in some permanent and semi-permanent saline systems. Hydrobiologia. 38(2):225-238.

KEY WORDS: bicarbonate, calcium, chloride, magnesium, pH, potassium, salinity, sodium.

High concentrations and seasonal shifts in cations caused by evaporation result in extreme osmotic stresses on aquatic organisms.

56. Blomquist, H. L. and J. H. Pyron. 1943. Drifting seaweed at Beaufort, North Carolina. Am. J. Bot. 30:28-37.

KEY WORDS: dispersal, geography, Rhizophora, submergents, Thalassia.

The role of wind and currents in the dispersal of several algae and aquatic angiosperms, and the plants' points of origin are discussed. Rhizophora mangle and Thalassia testudinum are wind and current transported over long distances. Storms often drive the flotsam into shore.

57. Blum, J. L. 1968. Salt marsh Spartinas and associated algae. Ecol. Monogr. 38:199-221.

KEY WORDS: aeration, colonization, communities, habitat, life history, mowing, photosynthesis, productivity, radioactive isotopes, root systems, salinity, salt marsh, Spartina, substrate, succession.

The development of the Spartina patens community is outlined in great detail. In newly forming Spartina communities, algae are abundant and are significant in decomposition and nutrient cycling. In mature S. patens stands (which have extensive root mats) algae are almost non-existent. Mature S. alterniflora stands tend to be open and have high algal populations. It is hypothesized that the S. patens community serves as a trap for detritus and allochthonous nutrients.

58. Bock, J. H. 1969. Productivity of the water hyacinth Eichornia crassipes (Mart.) Solms. Ecology 50(3):460-464.

KEY WORDS: adventive spread, colonization, dispersal, Eichornia, exotics, floating plants, offsets, productivity, vegetative reproduction.

The ecology of water hyacinth vegetative reproduction on the California coast is discussed. Stolons and offsets are broken off by wave action and act as colonizers. This species is one of the most productive of the photosynthetic organisms.

59. Bolen, E. G. 1964. Plant ecology of spring-fed salt marshes in western Utah. Ecol. Monogr. 34:143-166.

KEY WORDS: bicarbonate, calcium, communities, depth, ecological range, emergents, magnesium, pH, phenology, phytosociology, salinity, salt marsh, sodium, submergents, substrate, succession, vegetative reproduction, zonation.

Vegetational zonation in this inland, saline marshland is controlled by soil salinity. The vegetation has distinct community boundaries, few species within each community, and the lack of pioneer species. Succession is static and there is no active progression toward a terminal stage.

60. Bond, G. 1971. Fixation of nitrogen in two African species of Myrica. New Phytologist 70:1-8.

KEY WORDS: germination, Myrica, nitrogen, physiology.

Root nodules of Myrica spp. can fix nitrogen and therefore allow the plants to survive in a nitrogen free medium.

61. Boorman, L. A. 1967. Limonium vulgare Mill. and L. humile Mill. J. Ecol. 55(1):221-232.

KEY WORDS: competition, germination, habitat, life history, Limonium, morphology, seedlings, tides.

Complete life history accounts of Limonium vulgare and L. humile are given.

62. Boorman, L. A. 1968. Some aspects of the reproductive biology of Limonium vulgare Mill. and Limonium humile Mill. Ann. Bot. 32:803-824.

KEY WORDS: carbon dioxide, dispersal, germination, light, Limonium, oxygen, propagule storage, salinity, salt marsh, seed production, seeds, substrate, temperature, tides, vegetative reproduction, zonation.

The seeds of Limonium spp., which are dispersed by the sea, require fresh water for germination. The striking zonation exhibited by salt marsh plants is primarily a result of germination and seedling establishment requirements since mature plants can usually be successfully transplanted to areas not normally occupied by the species.

63. Boorman, L. A. 1971. Studies in salt marsh ecology with special reference to the genus Limonium. J. Ecol. 59(1):103-120.

KEY WORDS: communities, floras, habitat, Limonium, salt marsh.

Limonium vulgare and L. humile are plants of the middle and upper salt marsh in open habitats. They are sensitive to competition and grazing. Long periods of immersion and high salinities are detrimental.

64. Borhidi, A. 1970. Ecology, competition, and canology of the ditch reed (Phragmites communis L.) and systematics of the reed growing in brackish waters. Acta. Bot. Acad. Sci. Hung. 16(1-2): 1-2. (abstract only in English).

KEY WORDS: anaerobiasis, competition, ecological range, life history, Phragmites, physiology, salinity, Typha.

The effects of osmotic pressure and anaerobic processes in the water on the character of Phragmites, and competition between Phragmites and Typha are discussed. Typha is more tolerant of anaerobic conditions.

65. Bourn, W. S. 1932. Ecological and physiological studies on certain aquatic angiosperms. Contrib. Boyce Thompson Inst. 4:425-496.

KEY WORDS: carbon dioxide, disease, marine, physiology, pollution, salinity, submergents, substrate, turbidity.

Ecological studies were made of the conditions responsible for the destruction of aquatic seed plants in the Back Bay-Currituck Sound area of North Carolina from 1918 to 1926. The destruction of these aquatic plants was attributed to the chemical, physical, and biological alterations in the marine environment caused by the opening of a canal which carried polluted sea water into these areas. Physiological studies were performed under controlled conditions to determine the influence of light, carbon dioxide, oxygen, nutrients, salinity, and substrate on certain aquatic plants.

66. Bourn, W. S. 1934. Sea-water tolerance of Vallisneria spiralis L. and Potamogeton foliosus Raf. Contrib. Boyce Thompson Inst. 6:303-308.

KEY WORDS: ecological range, growth, Potamogeton, salinity, seed production, Vallisneria.

Vallisneria could not tolerate salt concentrations greater than 0.42%. Potamogeton foliosus withstood concentrations greater than 1% with optimum growth below 0.5%.

67. Bourn, W. S. 1935. Sea-water tolerance of Ruppia maritima L. Contrib. Boyce Thompson Inst. 7:249-255.

KEY WORDS: ecological range, growth, Ruppia, salinity.

Ruppia maritima grew best in solutions of 5 to 60 percent of sea water. A solution of sodium chloride isotonic with sea water is fatal to Ruppia, but sufficient amounts of other salts may counteract the toxic effects.

68. Boyce, S. G. 1954. The salt spray community. Ecol. Monogr. 24: 29-67.

KEY WORDS: communities, nitrogen, physiology, salinity, substrate.

Low growth forms of plants along coasts appear to be due to selection by salt spray. Low available nitrogen results in an increase in tolerance to salt spray.

69. Boyd, C. E. 1968. Some aspects of aquatic plant ecology. Reservoir Fishery Res. Symp., Athens, Georgia. pp. 114-129.

KEY WORDS: bibliography, nutrients, substrate.

The literature on the chemical composition of aquatic plants is reviewed and the uptake of nutrients from the substrate by their root systems is duscussed. Aquatic angiosperms contain large amounts of macro- and micronutrients. Values for productivity rates and vegetative yields in pure stands of macrophytes often equal or exceed those for non-aquatic herbaceous vegetation. Ecological data indicate that distribution and growth of many macrophytes are related to characteristics of the substratum.

70. Boyd, C. E. 1968. Fresh-water plants: a potential source of protein. Econ. Bot. 22(4):359-368.

KEY WORDS: commercial uses, emergents, floating plants, harvest, nutrients, weeds.

The requirements which an aquatic plant should meet in order to be economically feasible as a source of food protein are discussed. Chemical analysis is given for about 15 species of aquatic plants.

71. Boyd, C. E. 1968. Evaluation of some common aquatic weeds as possible feedstuffs. Hyacinth Control J. 7:26-27.

KEY WORDS: commercial uses, control, emergents, nutrients, weeds.

Samples of 43 species of aquatic plants were obtained from various areas in Alabama and Florida and their crude protein and tannin content analyzed. Crude protein values for aquatic weeds were similar to those reported for high quality forages on a dry weight basis.

72. Boyd, C. E. 1969. The nutritive value of three species of water weeds. Econ. Bot. 23(2):123-127.

KEY WORDS: commercial uses, Eichornia, floating plants, Hydrilla, nutrients, Pistia, weeds.

Chemical analysis of crude protein, cellulose, carbohydrate, ash, caloric content, and five inorganic nutrients (P, S, Ca, Mg, K) is given for Eichornia crassipes, Hydrilla sp., and Pistia stratiotes.

73. Boyd, C. E. 1970. Factors influencing shoot production and mineral nutrient levels in Typha latifolia. Ecology 51(2):296-300.

KEY WORDS: biomass, growth, nutrients, productivity, substrate, Typha.

Standing crops of Typha communities in the southeastern United States ranged from 428 to 2252 g dry wt/m^2 with the highest frequency of values between 500 and 900 g/m^2. Few nutrients were correlated with standing crop.

74. Boyd, C. E. 1970. Production, mineral accumulation, and pigment concentration in Typha latifolia and Scirpus americanus. Ecology 51(2):285-290.

KEY WORDS: biomass, nutrients, productivity, Scirpus, seeds, substrate, Typha.

Typha produced a much higher standing crop than Scirpus. Standing crops and nutrient uptake are not constant throughout the growing season.

75. Boyd, C. E. 1971. A bibliography of interest in the utilization of vascular aquatic plants. Econ. Bot. 25:74-84.

KEY WORDS: bibliography, commercial uses, emergents, submergents, waterfowl.

A bibliography of 233 sources which contains a brief summarization of the various uses of aquatic plants to man and waterfowl. Also listed are other bibliographies and where to obtain them.

76. Boyd, C. E. 1971. The limnological role of aquatic macrophytes and their relation to reservoir management. Reservoir Fish. & Limnol., Am. Fish. Soc., Spec. Pub. 8. pp. 153-166.

KEY WORDS: control, culture, emergents, life history, nutrients, phosphorus, pollution, productivity, submergents, weeds.

Aquatic macrophytes produce large standing crops and are important in aquatic food webs. Macrophyte communities accumulate large quantities of inorganic nutrients and compete with phytoplankton for nutrients. Phosphorus concentrations are important for macrophyte growth and vascular plants are significant factors in phosphorus cycling.

77. Boyd, C. E. and W. W. Walley. 1972. Production and chemical composition of Saururus cernuus L. at sites of differing fertility. Ecology 53(5):927-932.

KEY WORDS: biomass, pH, phosphorus, Saururus, substrate.

Total and shoot standing crops of Saururus cernuus increased with increasing phosphorus in soils and with increasing pH (due to increased phosphorus availability). The degree of shading is important to production.

78. Boyd, C. E. and D. H. Vickers. 1971. Variation in the elemental content of Eichhornia crassipes. Hydrobiologia 38(3-4):409-414.

KEY WORDS: biomass, commercial uses, Eichornia, nutrients, pollution.

The elemental composition of Eichornia crassipes falls within the range of elemental values reported for other aquatic and terrestrial plants. Concentrations of macronutrients in water hyacinth biomass were not correlated with environmental levels of these nutrients.

79. Boyd, M. B., R. T. Saucier, J. W. Keeley, R. L. Montgomer, R. D. Brown, D. B. Mathis and C. J. Guice. 1972. Disposal of dredge spoil. U. S. Army Engineer Waterways Exp. Sta., Vicksburg. Tech. Rep. H-72-8. 121pp.

KEY WORDS: bibliography, dredging, machinery, pollution, turbidity.

Four areas of study on dredged material are discussed: 1) problem identification and assessment, 2) new or improved disposal practices, 3) accomplishment of needed research, and 4) field evaluation of new or improved disposal practices. Effects of various techniques of dredge spoil disposal and subsequent deposition on aquatic vegetation are only generally reviewed.

80. Boylen, C. W. and R. B. Sheldon. 1973. Biomass distribution of rooted macrophytes in the littoral zone of Lake George. Renssalaer Fresh Water Inst. Rep. 73-21. Troy, N.Y. 11pp.

KEY WORDS: biomass, communities, depth, emergents, photosynthesis, productivity, submergents, substrate, temperature.

This study is concerned with the distribution and abundance of rooted macrophytes in the littoral zone of Lake George and their contribution to the overall aquatic ecosystem. The experimental approaches included biomass determinations, productivity estimates by radioactive CO_2 fixation (photosynthetic growth rate), and an ecological survey of fifty major littoral zones. General trends are discussed as interpreted by a superficial examination of the data collected from both the ecological survey and the macrophyte biomass.

81. Bray, J. R. 1962. Estimates of energy budgets for a Typha (cattail) marsh. Science 136:1119-1120.

KEY WORDS: light, photosynthesis, productivity, respiration, Typha.

The mean net above ground production of oven-dry organic matter over a 3 year period in Minnesota was 1360 g/m^2/year. The energy content of this amount of material was 4340 g-cal/g. Utilization of light energy is discussed.

82. Brereton, A. J. 1971. The structure of the species populations in the initial stages of salt marsh succession. J. Ecol. 59(2): 321-338.

KEY WORDS: communities, salinity, salt marsh, seed production, substrate, succession, tides, waterlogging, zonation.

Successional stages in salt marshes are determined by the degree of soil waterlogging, which in turn is related to height above mean sea level. Within successional "phases", local waterlogging and salinity variations controlled species distributions. These variations were also associated with soil texture. Salicornia tends to occur in saline non-waterlogged areas; Puccinellia occurs in non-saline waterlogged areas.

83. Brooker, M. P. and R. W. Edwards. 1973. Effects of the herbicide paraquat on the ecology of a reservoir. I. Botanical and chemical aspects. Freshwater Biol. 3:157-175.

KEY WORDS: biomass, herbicides, Myriophyllum, nutrients, oxygen, Potamogeton, productivity, submergents.

The application, effects, and fate of paraquat in a lake in Wales are discussed.

84. Broome, S. W., W. W. Woodhouse, Jr. and E. D. Seneca. 1973. An investigation of propagation and the mineral nutrition of Spartina alterniflora. Sea Grant Pub. UNC-SG-73-14, North Carolina State Univ., Raleigh. 121pp.

KEY WORDS: afterripening, germination, nutrients, propagule storage, salinity, seeds, site preparation, Spartina, vegetative propagation, viability.

The main areas of research detailed in this report are 1) the propagation of Spartina alterniflora from seed, 2) the nutrient status of plants and soils in natural stands of Spartina, and 3) the effects of N, P, K, and Fe fertilizers on Spartina. Increased growth of S. alterniflora in response to N and P fertilizers indicated that the productivity of some salt marshes is limited by the supply of nutrients. High salinities, a shortage of N and/or P, and unfavorable water regimes are possible factors resulting in the short growth form of S. alterniflora.

85. Brown, E. and C. S. Scofield. 1903. Wild rice — its uses and propagation. U.S.D.A. Bur. Plant Indus. Bull. 50. 30pp.

KEY WORDS: commercial uses, depth, germination, habitat, harvest, life history, morphology, phenology, propagule storage, seed, substrate, Zizania.

A complete life history of Zizania aquatica.

86. Brown, W. S. and C. Cottam. 1950. Some biological effects of ditching tidewater marshes. U. S. Fish & Wildl. Serv., Res. Rep. 19.

KEY WORDS: emergents, invertebrates, mosquitoes, salt marsh, succession, tides.

The destruction of marshes because of ditching for mosquito control is described. Water level requirements relative to mean sea level are given for several species of emergent marsh plants.

87. Brunner, B. W. 1959. Propagation of Cryptocorynes of seed. The Aquarium 28(4):111-113.

KEY WORDS: Cryptocoryne, exotics, fruits, germination, ornamentals, seedlings, seeds, vegetative propagation.

Descriptions of flowering, seed development, and germination are presented. It is concluded that Cryptocoryne spp. is best propagated by vegetative means.

88. Buell, M. F. and R. L. Cain. 1943. The successional role of southern white cedar, Chamaecyparis thyoides, in southeastern North Carolina. Ecology 24:85-93.

KEY WORDS: Chamaecyparis, fire, germination, seedlings, substrate, succession.

The patterns of vegetation associations which are eventually climaxed by the white cedar swamp are outlined and the ecological conditions necessary to maintain Chamaecyparis thyoides are listed.

89. Burgess, H. H. 1969. Habitat management on a mid-continent waterfowl refuge. J. Wildl. Manage. 33(4):843-847.

KEY WORDS: drawdown, Echinochloa, flooding, habitat, Polygonum waterfowl.

Drawdowns of a waterfowl impoundment from 1 July to 15 September resulted in good stands of millet (Echinochloa spp.) and Polygonum (P. pensylvanicum and P. coccineum).

90. Burkhalter, A. P., L. M. Curtis, R. L. Lazor, M. L. Beach and J. C. Hudson. 1974. Aquatic Weed Identification and Control Manual. Florida Dep. Nat. Resour. Bur. Aquatic Plant Res. and Control. 100pp.

KEY WORDS: commercial uses, control, emergents, equipment, floating plants, geography, habitat, herbicides, keys, life history, submergents, weeds.

Control techniques, life histories, photographs, and the value of many aquatic plant species are included in this manual.

91. Burkholder, P. R. 1956. Studies on the nutritive value of Spartina grass growing in the marsh areas of coastal Georgia. Bull. Torrey Bot. Club 83(5):327-334.

KEY WORDS: commercial uses, nutrients, salt marsh, Spartina.

Samples of Spartina alterniflora were collected for proximate analyses and determination of ten B vitamins and ten essential amino acids. The B vitamins appear to be present in adequate amounts for growth of guinea pigs and heterotrophic microorganisms. The ten amino acids constitute 15 percent of the protein of Spartina. Biological value of the protein is calculated to be deficient as a nitrogen supply for marine animals, and it is suggested that microbial conversion of the grass may act as a transformer to step up the potential value of the pool of protein in the sea.

92. Burkholder, P. R., L. M. Burkholder and J. A. Rivero. 1959. Some chemical constituents of turtle grass, Thalassia testudinum. Bull. Torrey Bot. Club. 86:88-93.

KEY WORDS: biomass, nutrients, Thalassia.

Turtle grass is abundant in the shallow, well illuminated waters of Puerto Rico and other tropical areas. The standing crop of Thalassia, ranging from 2.4 to 32.9 tons per acre, provides shelter for many species of animals and contains large amounts of basic foodstuffs. Protein, crude fiber, carbohydrates, fat, ash, and amino acid content were assayed. Bacteria associated with Thalassia initiate one marine food web.

93. Caines, L. A. 1958. The phosphorus content of some aquatic macrophytes with special reference to seasonal fluctuations and applications of phosphate fertilizers. Hydrobiologia 25: 289-301.

KEY WORDS: fertilizer, Myriophyllum, phosphorus, Potamogeton, productivity.

Increased phosphate uptake was demonstrated for Myriophyllum alterniflorum and Potamogeton praelongus after addition of a super phosphate fertilizer to an unproductive Scottish Loch.

94. Cairns, J., Jr. and K. L. Dickson. 1973. The effects of waste discharges from Radford army ammunition plant on the biota of the New River, Virginia. Va. Polytech. Inst., Water Resour. Res. Center Bull. 57. 57pp.

KEY WORDS: biomass, emergents, fishes, invertebrates, nutrients, pollution, submergents.

The effluents from an ammunition plant initially decreased species and biomass by 1/2 at the point of discharge. About 5 miles downstream the vegetation had apparently recovered. An increase in biomass over base levels was noted several miles downstream from the effluents and was probably due to nutrient enrichment. Effects of the effluents on bottom fauna, algae, and fishes are also discussed.

95. Caldwell, P. A. 1956. The spatial development of Spartina colonies growing without competition. Ann. Bot. (n.s.) 21:203-214.

KEY WORDS: growth, morphology, rhizomes, root systems, Spartina, zonation.

Enlargement of auxaclones of Spartina is accompanied by a change in shoot density distribution and development of a concentric pattern. A particular shoot density is characteristic of a particular diameter. The morphology of Spartina is discussed in relation to ring growth. Five other species of plants which seem to show concentric growth are also briefly described.

96. Carl, G. C. 1940. Some ecological conditions in a brackish lagoon. Ecology 21:65-74.

KEY WORDS: brackish, oxygen, salinity.

A study of oxygen concentrations, salinity, and other environmental characteristics of an impounded tidal inlet in British Columbia which remained brackish. Rooted aquatic plants accounted for high oxygen levels.

97. Carlson, R. A. and J. B. Moyle. 1968. Key to the common aquatic plants of Minnesota. Minn. Dep. Cons., Div. Game & Fish, Spec. Pub. 53. 64pp.

KEY WORDS: emergents, keys, submergents.

A reprint of a key by J. B. Moyle and N. Hotchkiss as modified to conform with the eighth edition of Gray's Manual of Botany.

98. Carpelan, L. H. 1957. Hydrobiology of the Alviso salt ponds. Ecology 38:375-390.

KEY WORDS: ponds, Ruppia, salinity.

The vegetation and general biology of the Alviso salt ponds in San Francisco Bay, which are ussd for evaporative salt production, are described. Ruppia maritima appeared in one pond where the salinity was 28.2 ppt. Zostera marina did not establish in the ponds.

99. Chabreck, R. H. 1972. Vegetation, water and soil characteristics of the Louisiana Coastal Region. Louisiana Agr. Exp. Sta. Bull. 664. 72pp.

KEY WORDS: brackish, emergents, floras, geography, nutrients, pH, salinity, salt marsh, submergents, substrate, tides.

The vegetation, soils and waters of the Louisiana coastal marshes were sampled in August 1968. The coastal region was subdivided into several geographical units for descriptive purposes and the area of specific surface features (i.e. swamp, marsh etc.) was determined. Thirty-one tables containing a wide variety of physical and chemical data are presented.

100. Chabreck, R. H. and A. W. Palmisano. 1973. The effects of Hurricane Camille on the marshes of the Mississippi River delta. Ecology 54:1118-1123.

KEY WORDS: colonization, emergents, ponds, salt marsh, submergents, succession.

The plant species composition of several Mississippi marshes and ponds are described before and after the destructive influences of a hurricane; rates of recolonization of denuded areas are discussed.

101. Chamberlain, E. B., Jr. 1948. Ecological factors influencing the growth and management of certain waterfowl food plants on Back Bay National Wildlife Refuge. N. Am. Wildl. Conf. 13: 347-356.

KEY WORDS: submergents, substrate, turbidity, waterfowl.

The causes and effects of turbidity on submergents in impoundments on the Back Bay management area are noted. The degree of turbidity is related to substrate texture. Established plant communities help to decrease turbidity.

102. Chambliss, C. E. 1922. Wild rice. U. S. D. A. Circ. 229. 16pp.

KEY WORDS: commercial uses, geography, habitat, harvest, morphology, phenology, planting, propagule storage, seedlings, seeds, Zizania.

Zizania aquatica is a fresh-water plant that will not grow in water that is appreciably salt to taste. Its best growth is on mudflats where seasonal water levels are fairly stable, tidal fluctuations excepted. New patches of wild rice may be readily established by transplanting young plants. The harvest, storage, and shipping of seed is also described.

103. Chambliss, C. E. 1941. The botany and history of Zizania aquatica L., ("wild rice"). Ann. Rep. Smithsonian Inst. 1940:369-382.

KEY WORDS: habitat, harvest, morphology, phenology, Zizania.

Field notes on the habitat and morphology of Zizania aquatica are assembled together with some historical data on the species, and methods of harvest and use by the native Americans are discussed.

104. Chapman, C. 1968. Channelization and spoiling in Gulf Coast and south Atlantic estuaries. pp. 93-106. In: J. D. Newsom (Ed.). Proc. Marsh and Estuary Manage. Symp. T. J. Moran's Sons, Inc., Baton Rouge. 252pp.

KEY WORDS: dredging, fishes, salinity, turbidity.

The two basic methods of channel dredging are mechanical and hydraulic; the former provides good spoil control on small areas while the latter is used on larger areas and requires greater effort to contain the spoil. Areas damaged on the Gulf Coast by spoil are listed. Both benefits and problems involved with channelization and spoil deposition are discussed and recommedations for future planning are made.

105. Chapman, V. J. 1936. The halophyte problem in the light of recent investigations. Quart. Rev. Biol. 11:209-220.

KEY WORDS: emergents, physiology, salinity, substrate.

The literature concerning halophyte physiology and pertinent experimental data on several aspects of halophyte ecology is reviewed.

106. Chapman, V. J. 1937. A note on the salt marshes of Nova Scotia. Rhodora 39:53-57.

KEY WORDS: emergents, mowing, phytosociology, salt marsh, Spartina, succession, zonation.

The vegetation of the permanent associations in several zones of Nova Scotia marshes is described. The effect of mowing on Spartina patens is considered destructive.

107. Chapman, V. J. 1938. Studies in salt marsh ecology. Sections I to III. J. Ecol. 26(1):144-179.

KEY WORDS: aeration, drainage, root system, salinity, salt marsh, substrate, tides.

Sections I to III of Chapman's salt marsh studies consider the physiography and environmental factors, the tides, and the water table, soil aeration and drainage. Ten principal factors which interact in the ecology of Norfolk salt marshes are discussed. Tides are thought to be the major factor in the environment influencing the distribution of vegetation. The water movements during a diurnal tidal cycle in the soil near a creek are diagrammed in figure 18.

108. Chapman, V. J. 1939. Studies in salt marsh ecology. Sections IV and V. J. Ecol. 27:160-201.

KEY WORDS: calcium, chloride, communities, emergents, salinity, salt marsh, sodium, zonation.

The total chloride content of the lower marsh levels fall to a minimum in early spring when germination is occurring. High salinity values were recorded in several of the marsh zones later in the season. This was thought to be a deterrent to colonization. Various other factors affecting calcium distribution and moisture are discussed. Part V correlates the known physical factors with the distribution of species.

109. Chapman, V. J. 1940. Studies in salt marsh ecology. Sections VI and VII. Comparison with marshes on the East Coast of North America. J. Ecol. 28:118-152.

KEY WORDS: aeration, carbon dioxide, colonization, communities, emergents, germination, light, oxygen, salinity, salt marsh, submergents, tides, waterlogging.

Chapman relates the oxygen and carbon dioxide content of the substrate, the mechanical and chemical influence of the tides and the texture of the substrate to the presence of certain species of vegetation and to problems of colonization. Part VII is primarily a listing of plant associations in the salt marsh.

110. Chapman, V. J. 1941. Studies in salt marsh ecology. Section VIII. J. Ecol. 29(1):69-82.

KEY WORDS: communities, salt marsh, succession, zonation.

The general ecology of the salt marshes of the British Isles is investigated; inferred successional patterns based on community structure are described.

111. Chapman, V. J. 1942. The new perspective in the halophytes. Quart. Rev. Biol. 17:291-311.

KEY WORDS: emergents, germination, physiology, salinity, substrate, tides.

The term halophyte may be used in a general sense to include all plants which can tolerate more than 0.5 percent sodium chloride, but evidence is slowly accumulating that indicates that the majority of plants grow better in salinities lower than in the environment where they are found naturally. The terminology associated with halophytes is listed and defined. Experimental results correlating several aspects of physiology with salinity tolerance are presented, and the influence and character of the substrate on plant growth are discussed.

112. Chapman, V. J. 1947. Suaeda fruticosa Forsk. J. Ecol. 35:303-310.

KEY WORDS: dispersal, germination, life history, salt marsh, seeds, Suaeda, substrate, zonation.

A life history account of the small shrub Suaeda fruticosa.

113. Chapman, V. J. 1947. Suaeda maritima (L.) Dum. J. Ecol. 35: 293-302.

KEY WORDS: dispersal, habitat, life history, seed production, Suaeda, substrate.

The habitats, phenology, and reproduction of Suaeda maritima are discussed.

114. Chapman, V. J. 1950. Halimone portulacoides (L.) Aell. J. Ecol. 38(1):214-222.

KEY WORDS: germination, habitat, Halimone, life history, salt marsh, substrate.

The habitat, growth, and reproduction of Halimone portulacoides, a salt marsh undershrub with short, creeping rhizomes, is discussed.

115. Chapman, V. J. 1959. Studies in salt marsh ecology. IX. Changes in salt marsh vegetation at Scolt Head Island. J. Ecol. 47(3): 619-639.

KEY WORDS: colonization, emergents, salt marsh, Spartina, submergents, succession, zonation, Zostera.

The salt marshes of Scolt Head Island in Norfolk, Great Britain, were revisited and remapped in 1957, to be compared with maps prepared in 1932 and 1933. Changes in vegetation can be compared with rates of accretion and the vertical extent of the different communities. The most spectacular change occurred in an old marsh which transformed from a Zostera dominated marsh to a Spartina dominated marsh.

116. Chapman, V. J. 1960. Salt Marshes and Salt Deserts of the World. Plant Science Monographs, Leonard Hill Ltd., London. 392pp.

KEY WORDS: aeration, brackish, chloride, colonization, commercial uses, emergents, geography, germination, growth, nutrients, physiology, phytosociology, planting, salinity, salt marsh, seeds, submergents, substrate, succession, tides.

A general picture of salt marshes and related tracts, and an interpretation of the communities, physiology, and autecology of the species, with physical analyses of the areas of concern is presented.

117. Chater, E. H. and H. Jones. 1957. Some observations on Spartina townsendii H. and J. Groves in the Dovey estuary. J. Ecol. 45 (1):157-167.

KEY WORDS: salt marsh, seedlings, Spartina, vegetative propagation.

The radial spread and seedling establishment of Spartina townsendii studied on permanent salt marsh quadrats, is recorded. Radial increase may equal 15-20 cm/year on sand and 27-32 cm/year on mud.

118. Chitty, N. and C. W. Davis (Eds.). 1972. The effects of the discharge of secondarily treated sewage effluent into the Everglades ecosystem. Sea Grant Spec. Bull. 6, Univ. of Miami. 123pp.

KEY WORDS: communities, drainage, flooding, marl, pollution, substrate.

South Florida's water supply crisis and the continuing environmental degradation by present sewage treatment methods have prompted consideration of recycling treated sewage into the Florida Everglades watershed. This paper examines the biological, geophysical, engineering, and socioeconomic considerations and consequences of recycling secondarily treated sewage into the Everglades. There are grave and probably prohibitive problems involved in the recycling of sewage to this ecosystem.

119. Choudhuri, G. N. 1966. Seed germination and flowering in Vallisneria spiralis. Northwest Sci. 40(1):31-35.

KEY WORDS: dormancy, geography, germination, life history, seeds, Vallisneria, vegetative propagation.

Vallisneria occurs from tropical to cool temperate areas. Eighty-three percent germination was obtained by a three minute treatment in concentrated sulfuric acid. Rhizomes often perennate and produce new plants. Thirty to thirty-five degrees centigrade is the best temperature for germination.

120. Christiansen, J. E. and J. B. Low. 1970. Water requirements of waterfowl marshlands in northern Utah. Pub. 69-12, Utah Div. Fish & Game. 108pp.

KEY WORDS: drainage, germination, growth, marsh, Potamogeton, salinity, Scirpus, substrate, transpiration, tubers, Typha.

Salt tolerance studies on marsh plants showed that germination, growth, and seed and tuber production decreased as salinity increased; substantial reductions in growth were observed at substrate levels exceeding 12 mhos. Freshwater produced the best growth in all plants except Potamogeton pectinatus which showed greatest growth at 3000 ppm salinity. Suggestions for water management practices include recommendations on quality and quantity of water, drainage, desirable water levels, and desirable plants.

121. Chrysler, M. A. 1938. The winter buds of Brasenia. Bull. Torrey Bot. Club 65:277-283.

KEY WORDS: Brasenia, growth, hibernacula, morphology, temperature.

In autumn Brasenia schreberi produces condensed apical buds which have a heavy coating of gelatinous material. The buds form and fall to the bottom of the pond where they overwinter. The form and internal structure of these organs are described.

122. Clark, N. A. 1926. Plant growth-promoting substances, hydrogen ion concentration, and the reproduction of Lemna. Plant Physiol. 1:273-279.

KEY WORDS: culture, Lemna, nutrients, pH.

Lemna major can grow indefinitely in purified inorganic salt solutions at an optimum pH of 4.7-4.8; however, this optimum pH varies when a soil solution is used. The paucity of bacteria in the growth medium did not have any visible negative effect on growth.

123. Clausen, R. T. 1936. Studies in the genus Najas in the northern United States. Rhodora 38:333-345.

KEY WORDS: geography, keys, Najas.

The distribution of five species of Najas found in the northeastern U. S. is discussed, and a key to their identification is provided.

124. Compton, R. H. 1916. The botanical results of a Fenland flood. J. Ecol 4(1):15-17.

KEY WORDS: drainage, emergents, flooding, succession.

The growth and survival of vegetation in a diked and drained peatland were analyzed after a four month reflooding. Trees and shrubs with branches out of the water survived. Salix produced adventitious roots from submerged trunks.

125. Conard, H. S. 1924. Second survey of the vegetation of a Long Island salt marsh. Ecology 5:379-388.

KEY WORDS: brackish, communities, emergents, salt marsh, succession.

A follow-up survey of a salt marsh, twelve years after the original study, recording vegetation shifts resulting from the encroachment of fresh water is presented. Juncus gerardi extended its range at the expense of Spartina patens.

126. Conard, H. S. and G. C. Galligar. 1929. Third survey of a Long Island salt marsh. Ecology 10:326-336.

KEY WORDS: brackish, communities, salt marsh, succession.

A continuation of the study of fresh water encroachment on the vegetation of a salt marsh; salt marsh communities changed to freshwater communities.

127. Conover, R. J. 1961. A study of Charlestown and Green Hill ponds, Rhode Island. Ecology 10:326-336.

KEY WORDS: control, emergents, nutrients, ponds, productivity, salinity.

An ecological study of coastal salt pond vegetation to determine ways of decreasing macrophytes and increasing phytoplankton production for oyster food is considered. Macrophytes accounted for most of the primary productivity of the pond. Phosphates and nitrates appear to be limiting factors.

128. Conway, V. M. 1940. Growth rate and water loss in Cladium mariscus R. Br. Ann. Bot. 4:151-164. n.s.

KEY WORDS: Cladium, growth, light, physiology.

Habitat restriction in Cladium mariscus is a result of its "physiological" anatomy. The vascular supply to the leaves is so limited that not enough water can pass upward from the roots to allow for both transpiration and cell extension at the same time even when the roots are in standing water. This phenomenon occurs because the basal leaf meristem does not cease activity until flowering begins.

129. Conway, V. M. 1942. Cladium P. Br. J. Ecol. 30(1):211-216.

KEY WORDS: habitat, life history, seeds, substrate, sudd.

The life history of Cladium especially as related to water levels and substrate conditions is recorded.

130. Cook, A. H. 1958. Waterfowl marshes and menus. The Conservationist (N.Y.) 12(4):16-18,40.

KEY WORDS: flooding, Polygonum, Potamogeton, site preparation, substrate, vegetative propagation, waterfowl.

Methods and information concerning propagation of a few of the most common pondweeds, smartweeds, grasses, and sedges for waterfowl food are given.

131. Cook, A. H. and C. F. Powers. 1958. Early biochemical changes in the soils and water of artificially created marshes in New York. N. Y. Fish & Game J. 5(1):9-65.

KEY WORDS: aeration, drawdown, flooding, habitat, iron, marsh, nutrients, submergents, substrate.

Numerous changes occur in soil and water chemistry of an area following impoundment. Marshes on good soils are the most productive and are normally more productive than the surrounding land. High concentrations of iron and manganese in the soil could be detrimental to plant growth.

132. Cook, C. D. K. 1962. Sparganium erectum L. (S. ramosum Hudson, nom. illeg.) J. Ecol. 50(1):247-255.

KEY WORDS: fruits, germination, habitat, life history, productivity, Sparganium, seeds, turbulence, vegetative reproduction.

A life history study of Sparganium including information on growth habit, substrate and salinity requirements, fruit and seed production, and vegetative growth.

133. Cooper, A. W. 1970. Proceedings of the coastal processes and shore protection seminar, Series 1. Coastal Res. Prog., North Carolina State Univ., Raleigh. 48pp.

KEY WORDS: Ammophila, erosion, planting, Spartina, vegetative propagation.

Geologic background, meterology, ecology of the North Carolina coast, erosion and methods of hindering it, dune stabilization, design of coastal structures to prevent erosion, and legal aspects of the coastline ownership are the topics considered in these proceedings.

134. Cooper, W. S. 1926. Vegetational development upon alluvial fans in the vicinity of Palo Alto, California. Ecology 7:1-30.

KEY WORDS: communities, geography, salt marsh, succession.

The community structure of the vegetation of salt marshes is at least partially dependent on the nature of the substrate found in alluvial fans.

135. Correll, D. S. and H. H. Correll. 1972. Aquatic and Vascular Plants of the Southwestern United States. U. S. Gov't. Printing Office, Wash., D. C. 1777pp.

KEY WORDS: emergents, floras, keys, submergents.

Corrells' book is an extensive, descriptive key to the aquatic plants of the southwestern United States with illustrations of many of the taxa.

136. Cottam, C. 1934. Past periods of eelgrass scarcity. Rhodora 36:261-264.

KEY WORDS: diseases, Zostera.

From all available evidence, Zostera marina largely disappeared over a major portion of the U. S. Atlantic coast in 1893 and 1894; after several years it had come back to normal abundance. Local eelgrass scarcity has been experienced a number of times along the American and European coasts. The future of the eelgrass population in light of the (then) current scarcity could not be predicted.

137. Cottam, C. 1935. Further notes on past periods of eelgrass scarcity. Rhodora 37:269-271.

KEY WORDS: diseases, Zostera.

Evidence from a variety of sources indicated that the Zostera marina dieoff of the early 1930's was more severe than any previously experienced. As of 1935, however, some local areas were beginning to support normal growths of eelgrass. The cause of the dieoff was still undetermined at this time.

138. Cottam, C. 1939. The eelgrass situation on the American Pacific coast. Rhodora 41(487):257-260.

KEY WORDS: diseases, submergents, Zostera.

The extent, cause, and distribution of the wasting disease of Zostera marina are briefly outlined.

139. Cottam, C. and D. A. Munro. 1954. Eelgrass status and environmental relations. J. Wildl. Manage. 18(4):449-460.

KEY WORDS: ecological range, geography, planting, temperature, tides, Zostera.

The extensive geographical and physical habitat ranges of Zostera marina are described and records of attempted plantings of this seagrass are listed. Z. marina can survive widely fluctuating temperatures in northern tidal zones. Few of the extensive attempts at planting rootstocks and seeds have been successful.

140. Cowardin, L. M. and D. H. Johnson. 1973. A preliminary classification of wetland plant communities in north-central Minnesota. U. S. Bur. Sport Fish. & Wildl., Spec. Sci. Rep. - Wildl. 168. 33pp.

KEY WORDS: bogs, communities, depth, marsh, nutrients, pH, swamp.

Potholes, bogs, and swamps are classified in this publication, based on plant species composition, pH, water conductivity, organic matter, and total dissolved solids.

141. Craighead, F. C. and V. C. Gilbert. 1962. The effects of Hurricane Donna on the vegetation of southern Florida. Quart. J. Fla. Acad. Sci. 25(1):1-27.

KEY WORDS: anchorage, colonization, communities, dispersal, erosion, substrate, succession, swamp.

This primarily descriptive study records a number of biological observations on the changes in plant communities caused by hurricanes. Damage was greatest in the mangrove belt and on the Florida Keys.

142. Crail, L. R. 1951. Viability of smartweed and millet seed in relation to marsh management in Missouri. Pittman-Robertson Rep. 13-R-5, Missouri. 16pp. mimeo.

KEY WORDS: dormancy, drawdown, Echinochloa, harvest, planting, Polygonum, propagule sources, propagule storage, seeds, viability.

The conditions affecting viability of Echinochloa spp. and Polygonum pensylvanicum seed in the soil and in storage were determined. Suggestions for planting techniques are given. Viable seeds were abundant in shallow areas and near shore. Drawdowns were the most effective method of producing plant growth.

143. Crocker, W. 1907. Germination of seeds of water plants. Bot. Gaz. 44:375-380.

KEY WORDS: dormancy, germination, seeds.

Ripening, dormancy, and natural and induced germination of seeds of several fresh water marsh plants are discussed. Seed coats often delay germination. Rupturing the seed coat results in rapid germination.

144. Crocker, W. and W. E. Davis. 1914. Delayed germination in seed of Alisma plantago. Bot. Gaz. 58(4):285-321.

KEY WORDS: Alisma, dormancy, germination, growth, oxygen, seeds, viability.

Several mechanical and physiological reasons are postulated for the dormancy of Alisma plantago seeds. Dormancy in Alisma is apparently due to the mechanical restraint of the seed coat. The seeds of aquatic plants are able to survive under water for years without losing viability.

145. Crossland, C. 1903. Note on the dispersal of mangrove seedlings. Ann. Bot. 17:267-270.

KEY WORDS: dispersal, seedlings.

Mangrove seedlings were observed growing in the tidal zones of east Africa on hard coral limestone substrates. The peculiar growth habit of mangrove seedlings and their adaptations for becoming established in small crevices in this rock are described.

146. Crowell, R. F. 1969. Quantitative and qualitative measurement of aquatic vegetation. Dingell-Johnson Rep. F-16-R-4, Job I-A, North Carolina. 2pp. mimeo + tables.

KEY WORDS: adventive spread, ecological range, Myriophyllum, salinity.

Raw sea water, representing an increase in salinity, did not appear to have any adverse effect on aquatic vegetation when pumped into Back Bay by Virginia City. A note is included on the rapid spread of Eurasian watermilfoil.

147. Curtis, W. M. 1937. The floral morphology of Spartina Townsendii. New Phytol. 36:26-32.

KEY WORDS: germination, morphology, phenology, seed production, Spartina.

In England, Spartina townsendii flowers from July to November with the maximum produced in September. Seed collected in October produced 77.5 percent germination and one year old seed gave 64 percent germination.

148. Dabbs, D. L. 1971. A study of Scirpus acutus and Scirpus validus in the Saskatchewan River delta. Can. J. Bot. 49:143-153.

KEY WORDS: depth, ecological range, geography, hybrids, marsh, morphology, oxygen, Scirpus, taxonomy.

Scirpus acutus and S. validus populations in the Saskatchewan River delta are morphologically and ecologically distinct and should be considered different species. S. acutus populations tolerate water depths of 60 to 150 cm while S. validus occurs only at depths less than 65 cm.

149. Dale, H. M. 1965. Influence of soil on weed vegetation on a drained river millpond. II. Can. J. Bot. 43(5):557-561.

KEY WORDS: colonization, communities, nutrients, substrate.

A re-drained river bed in Ontario, Canada developed the same four plant communities as on a previous occasion. The favored community was the one richest in species and the one associated with the substratum highest in organic matter, potassium, and magnesium. All four communities could be associated with specific substrates; soil textures and organic content were most significant.

150. Dane, C. W. 1959. Succession of aquatic plants in small artificial marshes in New York State. N. Y. Fish & Game J. 6:57-76.

KEY WORDS: drawdown, flooding, marsh, succession, turbidity.

Twenty-two marshes in the Southern Tier and Genesee-Niagara regions of New York were evaluated as to successional change. The two regions in which the marshes were studied possessed basic differences in water level fluctuations, soil fertility, watershed slopes, and water chemistry. Those factors affecting succession of marsh vegetation were evaluated on the basis of vegetational differences between the two regions. Water level during the growing season was the single most important factor controlling succession.

151. Dansereau, P. 1954. Studies on central Baffin vegetation. I. Bray Island. Vegetatio 5-6:329-339.

KEY WORDS: floras, geography, habitat, marsh, phytosociology, ponds, salt marsh, substrate.

The phytosociology of vegetation of salt marshes, schist ridges, heaths, marshes, ponds, and rivulets of Bray Island is detailed. Some general information on substrate types is included.

152. Darnell, R. M. 1961. Trophic spectrum of an estuarine community based on studies of Lake Ponchartrain, Louisiana. Ecology 42: 553-568.

KEY WORDS: brackish, lakes, productivity.

Marsh vegetation is the primary source of organic matter in Lake Ponchartrain. The major plant species present are listed.

153. Daubs, E. H. 1965. A monograph of Lemnaceae. Ill. Biol. Monogr. 34. Univ. Ill. Press, Urbana. 118pp.

KEY WORDS: fruit, geography, keys, Lemna, morphology, Spirodela, Wolffia.

This monograph provides a key to 17 species (4 genera) of Lemnaceae based chiefly on the readily observable vegetative characters, distribution maps, descriptions of flowers and fruits, and line drawings showing features useful in identification.

154. Davis, L. V. and I. E. Gray. 1966. Zonal and seasonal distribution of insects in North Carolina salt marshes. Ecol. Monogr. 363: 275-296.

KEY WORDS: communities, dredging, invertebrates, phenology, salt marsh, succession, zonation.

Included as a part of the discussion of insect habitat is a brief description of salt marsh plant associations in North Carolina, especially those on dredged material.

155. Davison, V. E. 1947. Water weeds for sale. J. Wildl. Manage. 11(1):95-96.

KEY WORDS: emergents, escapes, exotics, planting, propagule sources, submergents, waterfowl.

Planting of marsh plants for food and habitat improvement should be restricted to those species which are known to be useful; a list of several marsh plants is given and their value noted.

156. Davison, V. E. and W. W. Neely. 1959. Managing farm fields, wetlands, and waters for wild ducks in the South. U.S.D.A. Farmer's Bull. 2144. 14pp.

KEY WORDS: Echinochloa, fire, Najas, planting, Polygonum, Potamogeton, waterfowl.

The advantages, disadvantages, and management of 23 kinds of wild and domestic plants for use as duck foods are discussed.

157. Dean, J. L. 1969. Biology of the crayfish Orconectes causeyi and its use for control of aquatic weeds in trout lakes. Bur. Sport Fish. & Wildl., Tech. Pap. 24. 15pp.

KEY WORDS: control, invertebrates, lakes, submergents, weeds.

Crayfish have been successfully used to control submergent plants in shallow lakes in the Southwest, and thus preserve their usefulness as trout habitat. Species of plants controlled by the crayfish are listed.

158. Deane, W. 1915. Floral changes in a salt marsh during reclamation. Rhodora 17(203):205-222.

KEY WORDS: colonization, flooding, salinity, salt marsh, succession.

The construction of a dam excluded salt water from the Charles River in Massachusetts and resulted in the invasion of 130 species of plants over a five year period.

159. Debell, D. S. and A. Q. Maylov. 1972. Some factors affecting germination of swamp tupelo seeds. Ecology 53(3):504-506.

KEY WORDS: germination, Nyssa, seeds, temperature, waterlogging.

Seeds of swamp tupelo (Nyssa sylvatica var. biflora) were collected and germination experiments carried out under three temperature conditions and four moisture regimes. Warm temperatures and moisture were required for germination.

160. Demaree, D. 1932. Submerging experiments with Taxodium. Ecology 13:258-262.

KEY WORDS: aeration, dispersal, floods, germination, habitat, seedlings, Taxodium.

Taxodium distichum seeds must be exposed to the air to germinate and seedlings must grow to sufficient height during the first year to stay above floods except for a very few days during the second year. Older trees must not be inundated for extended periods.

161. Denny, P. and D. C. Weeks. 1968. Electrochemical potential gradients of ions in an aquatic angiosperm, Potamogeton schweinfurthii (Benn.). New Phytol. 67:875-882.

KEY WORDS: calcium, chloride, phosphate, physiology, Potamogeton, submergents, sulfate.

The concentrations of the major ions present in the mature leaves of Potamogeton schweinfurthii, and the membrane potential differences between the leaves and the ambient pond water were measured.

162. DePoe, C. E. and E. O. Beal. 1969. Origin and maintenance of clinal variation in Nuphar (Nymphaeaceae). Brittonia 21(1): 15-28.

KEY WORDS: morphology, Nuphar.

Natural populations of Nuphar luteum in the coastal plain of North Carolina present a morphological and geographical cline. Variability is considered the result of adaptation to environmental selection pressures.

163. deVlaming, V. and V. W. Proctor. 1968. Dispersal of aquatic organisms: viability of seeds recovered from the droppings of captive killdeer and mallard ducks. Am. J. Bot. 55(1):20-26.

KEY WORDS: dispersal, geography, submergents.

The resistance of seeds to avian digestion depends on both the seed and the species of bird. Experiments show that internal transport of some seeds by some birds is possible.

164. deWit, H. C. D. 1960. Introduction to aquarium plants and some remarks on Proserpinaca palustris L. The Aquarium 29(4):103-108.

KEY WORDS: habitat, geography, Proserpinaca.

The geographical range and habitat of Proserpinaca or mermaid weed are discussed; some information on morphology of the leaf and seed capsule is included.

165. deWit, H. C. D. 1961. Cabomba or "fish grass". The Aquarium 30:86-88.

KEY WORDS: Cabomba, dispersal, geography, oxygen, seeds, taxonomy.

Cabomba caroliniana has increased its geographic range by dispersal by man. C. caroliniana is a good oxygenator of water and requires direct light for growth. The species can be easily raised from seeds or cuttings.

166. Dexter, R. W. 1944. Ecological significance of the disappearance of eel-grass at Cape Ann, Massachusetts. J. Wildl. Manage. 8(3): 173-176.

KEY WORDS: commercial uses, diseases, invertebrates, life history, salinity, Zostera.

The disappearance of Zostera marina resulted in the disrupting of an entire biotic community and resultant economic losses of fish and shellfish.

167. Dickson, R. E. and T. C. Broyer. 1972. Effects of aeration, water supply, and nitrogen source on growth and development of tupelo gum and bald cypress. Ecology 53(4):626-634.

KEY WORDS: aeration, fertilizer, germination, growth, nitrogen, Nyssa, seedlings, Taxodium, waterlogging.

Saturated-aerated soil was the best medium for seedling growth of tupelo gum and bald cypress. Nitrate fertilization was less effective than urea fertilization.

168. Dill, H. H. and G. A. Greenwell. 1948. Improvements in efficiency in harvesting smartweed seed. J. Wildl. Manage. 12(3):324-325.

KEY WORDS: machinery, Polygonum, propagule sources, propagule storage, seed production, viability.

Care of combine machinery and treatment and storage of Polygonum seed are reviewed. Seed must be cleaned and dried rapidly to prevent decomposition and loss of viability.

169. Dineen, C. F. 1953. An ecological study of a Minnesota pond. Am. Midl. Nat. 50(2):349-376.

KEY WORDS: Potamogeton, submergents, substrate.

Water chemistry and substrate deposits are discussed in relation to several species of aquatic plants.

170. Dirschl, H. J. 1972. Evaluation of ecological effects of recent low water levels in the Peace-Athabasca Delta. Can. Wildl. Serv. Occ. Pap. 13. 28pp.

KEY WORDS: colonization, emergents, seeds, substrate, succession.

The germination of seeds contained in the silt or distributed by wind has resulted in rapid colonization of exposed lake bottoms by herbaceous species, such as Calamagrostis and Phragmites, and Salix.

171. Dix, R. L. and R. E. Smeins. 1967. The prairie, meadow, and marsh vegetation of Nelson County, North Dakota. Can. J. Bot. 45(1): 21-58.

KEY WORDS: colonization, drainage, emergents, floras, geography, phytosociology, Scirpus, succession.

The general phytosociological structure of the native prairies, meadows, and marshes of Nelson County was determined and relationships between this structure and factors of the physical environment were established. The drainage regime proved to be the most important factor affecting the plant communities.

172. Donnelly, J. A. 1968. Marsh resources investigation — experimental waterfowl food culture. Pittman-Robertson Rep. W-6-R-27, Job 8-B, North Carolina Wildl. Resour. Comm. 2pp. mimeo.

KEY WORDS: brackish, planting, Potamogeton, Ruppia, salinity, salt marsh.

Experimental plantings of several species of aquatic plants were introduced into salt marsh impoundments; only Ruppia maritima and Potamogeton became well established. Planting techniques and salinity are briefly discussed.

173. Dore, W. G. 1969. Wild-rice. Can Dep. Agr. Pub. 1393. 84pp.

KEY WORDS: bibliography, commercial uses, diseases, habitat, harvest, hybrids, light, life history, morphology, planting, propagule storage, seeds, substrate, taxonomy, viability, Zizania.

A complete life history of Zizania aquatica; the pamphlet includes a description of the structure of the plant, a taxonomic review, history of the plant in Canada, habitat requirements, seed germination and viability, natural enemies, production and use, and storage and cultivation.

174. Duff, S. and J. M. Teal. 1965. Temperature change and gas exchange in Nova Scotia and Georgia salt marsh muds. Limnol. Oceanogr. 10(1):67-73.

KEY WORDS: oxygen, respiration, salt marsh, substrate, temperature.

Variations in oxygen uptake with variations in temperature were measured on undisturbed salt marsh muds taken from Georgia, the Bay of Fundy, and the eastern shore of Nova Scotia. In all marshes studied, seasonal changes of respiration in the muds were correlated with changes in energy supply and temperature.

175. Duncan, T. and R. L. Studkcy. 1970. Changes in the vascular flora of seven small islands in western Lake Erie. Mich. Bot. 9:175-200.

KEY WORDS: adventive spread, colonization, dispersal, erosion, floras, succession.

Annual species are apparently more successful at colonizing disturbed gravel bar islands than perennials. Extensive changes in floristic composition occurred on the islands during a 30 year period. The percentage of species new to any island was higher on small gravel bar islands and lower on larger islands. Floristic changes were attributed to the influences of wave erosion, ice action, fluctuating water levels, bird inhabitation, succession, and man.

176. Durant, C. J. and R. J. Reimold. 1972. Effects of estuarine dredging of toxaphene contaminated sediments in Terry Creek, Brunswick, Ga. 1971. Pesticides Monitoring J. 6(2):94-96.

KEY WORDS: dredging, pollution, substrate.

Sediments in the estuary of Terry Creek, Georgia, near a toxaphene plant outfall, were found to contain approximately 2,000 ppm toxaphene. Analysis of oysters and sediment before and after dredging operations revealed no significant increase of toxaphene residues resulting from the dredging and resultant runoff.

177. Duvel, J. W. T. 1905. The storage and germination of wild rice seed. U.S.D.A. Bur. Plant Indus. Bull. 90, Part I. 13pp.

KEY WORDS: aeration, germination, propagule storage, root systems, temperature, Zizania.

A document containing an early account of the harvest, transportation and storage of wild rice seed. Some information on planting is also included.

178. Earle. T. T., K. Riess and J. Hidalgo. 1951. Tracer studies with alligatorweed using 2,4-D-C^{14}. Science 114:695-696.

KEY WORDS: Alternanthera, control, herbicides.

Eighty-two Alternanthera philoxeroides plants were treated with radioactive 2,4-D-C^{14} in a greenhouse simulating field conditions. The results of exposure for 1 to 9 days showed no marked differences in absorption in plants exposed for short intervals as compared with those exposed for longer periods. The entire absorption pattern apparently reached its steady state within 24 hours. A second set of tests showed that 2,4-D-C^{14} reached its maximum distribution in about 8 hours.

179. Eaton, R. J. 1952. Status of Phragmites communis Trin., var. berlandieri (Fourn.) Fernald along the Sudbury River in eastern Massachusetts. Rhodora 54(641):135-137.

KEY WORDS: growth, nutrients, Phragmites, pollution.

A marked increase in the abundance of Phragmites was attributed to an increase in nutrients from pollution.

180. Edwards, T. I. 1933. The germination and growth of Peltandra virginica in the absence of oxygen. Bull. Torrey Bot. Club 60:573-581.

KEY WORDS: germination, Peltandra, seeds.

The seeds of Peltandra virginica are able to germinate in an almost complete absence of oxygen and under these conditions the coleoptile may elongate to two or three times its original length. Of 757 Peltandra seeds examined, 719 were one seeded, 34 were two seeded, and 4 contained 3 seeds.

181. Eggler, W. A. 1953. The use of 2,4-D in the control of water hyacinth and alligator weed in the Mississippi delta with certain ecological implications. Ecology 34:409-414.

KEY WORDS: Alternanthera, control, Eichornia, growth, habitat, herbicides, Najas, Potamogeton, sudd, weeds.

Eight pounds of amine salts of 2,4-D per acre were necessary to control water hyacinths. The dead plants sink rapidly enough that minimum regrowth occurred. If the area to be treated is shallow, it is useless to apply this herbicide. Treatment in late summer or fall when the rate of growth is slow is preferable. Elimination of Eichornia from a shallow lake resulted in great increases of Potamogeton and Najas.

182. Egler, F. E. 1952. Southeast saline Everglades vegetation, Florida and its management. Vegetatio 3(4-5):213-265.

KEY WORDS: communities, fire, floras, phytosociology, salinity, zonation.

The saline Everglades and vicinity is described as consisting of seven belts of vegetation each with its own aggregation of past, present, and potential communities, and its own possibilities of management.

183. Eleuterius, L. 1972. The marshes of Mississippi. Castanea 37 (3):153-168.

KEY WORDS: colonization, communities, dredging, emergents, Juncus, marsh, pollution, productivity, salinity, zonation.

This descriptive study outlines plant community composition, zonation, productivity, and man-induced changes. Some observations on plant colonization on spoilbanks and landfills are presented.

184. Ellis, L. L. 1955. Preliminary notes on the correlation between alkalinity and the distribution of some free floating and submerged aquatic plants. Ecology 36:763-764.

KEY WORDS: bicarbonate, carbonate, floating plants, nutrients, submergents.

A habitat characterized by low bicarbonate and no hydroxides or carbonates supported great numbers of Myriophyllum and Proserpinaca. Another habitat, characterized by a medium bicarbonate content, low carbonates, and no hydroxides appeared to be in the range of tolerance of the greatest number of aquatic plants.

185. Emerson, F. B., Jr. 1961. Wild rice — a native aquatic and a valuable one. The Conservationist (N.Y.) 16(2):8-9.

KEY WORDS: habitat, planting, Zizania.

General information regarding essential habitat requirements for the establishment of wild rice is given.

186. Emerson, F. B., Jr. 1961. Experimental establishment of food and cover plants in marshes created for wildlife in New York State. N. Y. Fish & Game J. 8(2):130-144.

KEY WORDS: Butomus, marsh, planting, propagule sources, rhizomes, Scirpus, seeds, substrate, Zizania.

Zizania aquatica was the most successful species planted and showed the greatest promise in the experimental plantings made. Sixty-four percent of all plantings failed to survive and grow. Failures were attributed to hard substrates, unfavorable chemical conditions, muskrat depredations, and natural competition from other plants. Planting should not be a primary consideration in marsh management. Substrate management will result in useful plant growth without planting.

187. England, W. H. and R. J. Tolbert. 1964. A seasonal study of the vegetative shoot apex of Myriophyllum heterophyllum. Am. J. Bot. 51:349-353.

KEY WORDS: growth, morphology, Myriophyllum.

The seasonal study of the vegetative shoot apex and its direct derivatives in Myriophyllum heterophyllum during the production of 3 leaf types revealed a great similarity in the anatomy of the apex which produced them.

188. Ermacoff, N. 1968. Marsh and habitat management practices at the Mendota wildlife area. Calif. Dep. Fish & Game, Game Manage. Leafl. 12. 11pp.

KEY WORDS: colonization, control, fire, flooding, habitat, machinery, marsh, planting, seeds, weeds.

Desirable and undesirable marsh plants are listed with suggestions on control; water level relations are discussed. Areas previously in marshland will not require seeding because seeds are available in the soil. Very shallow water (less than 1 inch) or mud flats are conducive to the establishment of Echinochloa, Eleocharis, and Scirpus.

189. Evans, A. C. 1963. The grip of the water hyacinth. New Scientist 19:666-668.

KEY WORDS: adventive spread, control, Eichornia, floating plants, habitat, herbicides, navigation, seed production, vegetative reproduction, weeds.

Water hyacinth poses a major problem in many tropical and subtropical rivers. Africa is having difficulty controlling the expansion of this weed, as are other areas where the species has been artificially introduced. Several aspects of life history, i.e., growth habit, flowering, seed production, vegetative reproduction, and habitat preferences, are discussed. A section on other alien weeds briefly mentions Salvinia auriculata, Elodea canadensis, and a blue green alga.

190. Evans, C. D. and K. E. Black. 1956. Duck production studies on the prairie potholes of South Dakota. U. S. Fish & Wildl. Serv., Spec. Sci. Rep. — Wildl. 32. 59pp.

KEY WORDS: depth, drawdown, emergents, submergents, waterfowl.

Twenty-eight species of aquatic plants commonly found in the prairie pothole region are listed and cover maps of several potholes are shown. The effects of drawdowns and farming practices on marsh vegetation are briefly discussed.

191. Eyles, D. E. 1941. A phytocociological study of the Castalia-Myriophyllum community of Georgia coastal plain boggy ponds. Am. Midl. Nat. 26:421-438.

KEY WORDS: Castalia, emergents, habitat, Myriophyllum, phytosociology, ponds, submergents, substrate.

More than a dozen ponds, mostly large (up to 30 acres) and shallow, were observed to be characteristic of the Georgia coastal plain. All seemed to be remarkably similar in vegetation, physical and chemical properties of the water, and substrate. The greater portion of the ponds was found to be covered by a single layered growth with Castalia odorata and Myriophyllum pinnatum dominant.

192. Eyles, D. E. and J. L. Robertson, Jr. 1963. A guide and key to the aquatic plants of the southeastern United States. U. S. Bur. Sport Fish. & Wildl., Circ. 158. 151pp. Reprint of Publ. Health Bull. 286, 1944).

KEY WORDS: emergents, floras, keys, mosquitoes, submergents.

A key, with some illustrations, to the aquatic plants in Tennessee, North and South Carolina, Mississippi, Alabama, Georgia, and Florida. It was written primarily for the field worker with little knowledge of botany to identify those fresh water plants with which mosquito breeding is associated.

193. Fairbrothers, D. E., E. T. Moul, A. R. Essbach, D. N. Riemer and D. A. Schallock. 1965. Aquatic vegetation of New Jersey. Part I. Ecology and identification. Part II. Problems and methods of control. College Agr. Ext. Bull. 382. Rutgers State Univ., New Brunswick, N.J.

KEY WORDS: control, emergents, herbicides, keys, mowing, submergents, weeds, zonation.

The problems and methods of control (mechanical and chemical) and relationships between plants and their environment are discussed. Keys, line drawings and descriptions of the common aquatic plants in New Jersey are given to aid in identification.

194. Fassett, N. C. 1924. A study of the genus Zizania. Rhodora 26(308):153-159.

KEY WORDS: keys, morphology, Zizania.

A study establishing the differences between Zizania aquatica and Z. latifolia with a short artificial key and information concerning the type specimens.

195. Fassett, N. C. 1925. Notes on Distichlis. Rhodora 27(316):67-72.

KEY WORDS: Distichlis, geography, morphology.

The geographical distribution and general morphology of Distichlis spicata and D. stricta are discussed.

196. Fassett, N. C. 1951. Callitriche in the New World. Rhodora 53:137-155, 161-194, 209-222.

KEY WORDS: Callitriche, fruits, geography, keys, morphology, taxonomy.

The morphology, distribution and taxonomy of the numerous species of Callitriche are described in detail. Plates of fruit structure and distinctive plant parts are shown for many species.

197. Fassett, N. C. 1957. A Manual of Aquatic Plants. With Revision Appendix by E. C. Ogden. Univ. Wisc. Press, Madison. 405pp.

KEY WORDS: emergents, keys, submergents.

A key (with revised nomenclature) to aquatic plants in the region from Minnesota to Missouri and eastward from the Gulf of St. Lawrence to Virginia; over 200 drawings and photographs illustrate the work.

198. Fellows, N. W., Jr. 1951. Results of a waterfowl food planting survival study in Maine. Game Div., Maine Dep. Inland Fish. & Game. 23pp.

KEY WORDS: emergents, germination, planting, propagule sources, propagule storage, seeds, submergents, tubers, waterfowl.

The results of 1231 plantings of 16 species of aquatic plants during 1939 to 1943 was evaluated during 1948. Success of the plantings was extremely poor.

199. Ferguson, R. L. and R. B. Williams. 1974. A growth chamber for the production of ^{14}C labelled salt marsh plants and its application to smooth cordgrass Spartina alterniflora. J. Exp. Mar. Biol. & Ecol. 14(3):251-259.

KEY WORDS: biomass, carbon, planting, productivity, Spartina.

The smallest plants were least tolerant to transplanting into an artificial growth chamber, and to trimming. Subsequent increase of Spartina biomass indicated a whole plant production of 713 g dry weight/m^2/year.

200. Fernald, M. L. 1925. The maritime plantains of North America. Rhodora 27(318):93-104.

KEY WORDS: geography, habitat, morphology, Plantago.

A description of the distinguishing characteristics, habitats, and distribution of the three maritime species of Plantago is given.

201. Flowers, M. G. 1973. Vegetational zonation in two successional brackish marshes of the Chesapeake Bay. Chesapeake Sci. 14(3): 197-200.

KEY WORDS: brackish, emergents, marsh, salinity, salt marsh, Scirpus, Spartina, substrate, succession, tides, Typha, zonation.

Two brackish marshes on a tributary of the Patuxent River were studied relative to soil depth, water salinity, tidal influences, and vascular plant distribution. Transect surveys showed a general zonation of Spartina alterniflora -- Scirpus olneyi-- upland vegetation in the more stable of the two marshes, and a Spartina alterniflora, Scirpus robustus -- Typha angustifolia pattern in the developing marsh.

202. Forbes, J. R. 1943. The effects of salts and other substances on the respiration of Elodea canadensis Michx. New Phytol. 42:127-138.

KEY WORDS: Elodea, nutrients, physiology, planting, respiration, salinity, substrate.

Elodea was most successfully cultivated in Scotland when planted during the growing season. The kind of substrate used and the effects of nutrients on respiration are described.

203. Fornes, A. N. and R. J. Reimold. 1973. The estuarine environment: Location of mean high water — its engineering, economic, and ecological potential. pp. 938-978. In: Proc. Am. Cong. Survey & Mapp.

KEY WORDS: commercial uses, communities, fishes, marsh.

This paper discusses methods of determining the extent and location of salt marsh environments using photographic and remote sensing methods.

204. Forsberg, B. and C. Forsberg. 1961. Fresh water environment for Najas marina. Svensk Bot. Tidskrift 55(4):604-612.

KEY WORDS: brackish, habitat, Najas, physiology.

Two new freshwater localities for Najas marina were discovered in Sweden in lakes of high electrolyte concentration. Reasons for elimination of N. marina from freshwater habitats are discussed.

205. Forsberg, C. 1965. Sterile germination of oospores of Chara and seeds of Najas marina. Physiol. Plant. 18:128-137.

KEY WORDS: Chara, dormancy, germination, Najas, seeds.

Germination of Chara oospores and Najas seeds did not occur in pure water with redox potentials between +400 and +500 mV. Reducing agents promoted germination. The oospores of 5 species of Chara and the seeds of Najas were dormant for 1 to 3 months. Light promoted the germination of Chara while Najas germinated best in the dark.

206. Frank, P. A. 1966. Dormancy in winter buds of American pondweed, Potamogeton nodosus Poir. J. Exp. Bot. 17(52):546-555.

KEY WORDS: auxins, dormancy, life history, Potamogeton, propagule storage, temperature, turions, vegetative propagation.

Winterbuds of Potamogeton nodosus were found to be strongly dormant at maturity. Under normal conditions, the dormancy lasted for several months. Cold treatment decreased the dormancy period required and exposure to 32C for three days caused the buds to grow in two weeks. Removal of bud scales in light and treatment with gibberellic acid, sucrose, -naphthylacetic acid, and fenac aided in breaking dormancy. Treatment with indole-3-acetic acid at 1000 ppm for 18 hours broke dormancy in all buds, indicating that low levels of this substance may be the primary cause of dormancy in this species.

207. Freeman, T. E., R. Charudattan and F. W. Zettler. 1973. Biological control of water weeds with plant pathogens. Water Resour. Res. Center, Univ. Florida, Pub. 23. 52pp.

KEY WORDS: control, diseases, exotics, weeds.

Surveys were made for pathogens to control Eichornia, Alternanthera, Hydrilla, and Myriophyllum spicatum. Thus far, 5 useful pathogens have been found.

208. Freudenthal, L. E. 1922. Cattail as a feed. Science 55:456-457.

KEY WORDS: commercial uses, nutrients, Typha.

Sixty head of hogs were kept in good flesh for three months by feeding in a three acre cattail swamp. Because of the similarity in composition, cattail rhizomes may be used as a substitute for corn.

209. Fryer, J. D. and S. A. Evans (Eds.). 1968. Aquatic weed control. pp. 308-318. In: Weed Control Handbook. Vol. I. Principles. Blackwell Sci. Publ., Oxford. 494pp.

KEY WORDS: control, weeds.

Control of aquatic weeds in Britain's navigational channels and recreation areas has been practiced for centuries. Control must be tailored to the growth habits of individual species of plants. This discussion briefly defines the categories of vegetation to be treated, their growth habit, degree of control required, and the various techniques available.

210. Fryer, J. D. and S. A. Evans (Eds.). 1968. Aquatic weeds. pp. 210-221. In: Weed Control Handbook. Vol. II. Recommendations. Blackwell Sci. Publ., Oxford. 325pp.

KEY WORDS: control, equipment, herbicides, weeds.

At the present time herbicides, while increasing in usefulness for aquatic plant control, are not suitable for all situations, thus a brief account of mechanical methods of weed control is also given. Recommendations for the use of the herbicides dalapon, 2,4-D, maleic hydrazide, diquat and chlorine are made.

211. Fuss, C. M., Jr. and J. A. Kelly, Jr. 1969. Survival and growth of sea grasses transplanted under artificial conditions. Bull. Mar. Sci. Gulf & Caribb. 19(2):351-365.

KEY WORDS: Halodule, planting, rhizomes, Thalassia.

Thalassia testudinum and Halodule wrightii were transplanted into artificial tanks of several sizes; survival rates, and subsequent shoot and rhizome growth and described. Good long-term survival was obtained with H. wrightii.

212. Gaevskaya, N. S. 1966. The role of higher aquatic plants in the nutrition of the animals of fresh-water basins. Academy of Sciences of the U.S.S.R., 3 Volumes, English Transl. by National Lending Library for Science and Tech. 629pp.

KEY WORDS: bibliography, communities, habitat, fishes, invertebrates, life history, productivity, waterfowl.

The higher aquatic plants are the most important producers in the freshwater habitat. Additional research is needed to determine the specific role of the many species of aquatic plants in the food web. This three volume work represents primarily a literature review and an analysis of published data on the role of aquatic plants in freshwaters.

213. Ganong, W. F. 1903. The vegetation of the Bay of Fundy salt and diked marshes: an ecological study. Bot. Gaz. 36:161-186,280-302, 349-367, 429-455.

KEY WORDS: bogs, commercial uses, communities, emergents, habitat, mowing, nutrients, salinity, salt marsh, substrate, tides.

The ecological plant geography of the Bay of Fundy is studied in relation to the physics of the environment, physiological properties of the plants, and cooperation and competition among adjacent vegetation forms.

214. Garbisch, E. W., Jr., P. B. Woller, W. J. Bostian and R. J. Mc Callum. 1973. Biotic techniques for shore stabilization. Second. Intl. Estuarine Res. Conf., Myrtle Beach, S.C. 28pp.

KEY WORDS: erosion, fertilizer, growth, planting, rhizomes, salt marsh, Spartina.

The effects of vegetative establishment on substrate stabilization and sediment accretion were examined at several sites on the Eastern Atlantic coast. Substrate characteristics did not appear to limit vegetative establishment although periodic fertilization may be essential on some substrates and in areas subject to a high degree of physical stress. Animal utilization of virgin artificial marsh areas for feeding may be extensive for a specific plant and may lead to their permanent removal unless natural seeding has previously occurred.

215. Gates, F. C. 1948. Colonization of certain aquatic plants on an open shoal. Ecology 29:205-208.

KEY WORDS: colonization, Eleocharis, marl, Phragmites, planting, Scirpus, vegetative reproduction.

In the western part of Douglas Lake in northern Lower Michigan there is a mud flat quite devoid of emergent vegetation except on its extreme southern edge where a 2 to 3 m fringe of Phragmites communis (P.australis) and Scirpus acutus exists. Plantings on a similar flat exposed to storm waves were always unsuccessful, but plantings of Eleocharis macrostachys and Scirpus acutus on top of this more protected area showed rapid vegetative growth over a 20 year period.

216. Geise, M. J. 1934. The Indiana species of Cyperus. Am. Midl. Nat. 15(3):241-291.

KEY WORDS: Cyperus, habitat, keys, morphology.

A key to the species of Cyperus; some description and habitat notes are included.

217. Geller, M. S. 1972. Phragmites; life preserver of the salt marsh. Underwater Naturalist 7(3):4-11.

KEY WORDS: commercial uses, life history, Phragmites, salt marsh, substrate, succession.

A popularized article on the ecology of Phragmites. Its role in succession and substrate stabilization are also discussed briefly.

218. Generosoff, V. 1934. Propagation of food and cover plants for waterfowl. (Transl. from the Russian by B. Rodzianko). Unpubl. mimeo. Univ. Mich., School Nat. Resour. 107pp.

KEY WORDS: emergents, habitat, planting, site preparation, submergents, substrate, waterfowl, zonation.

The general soil, water, physiography, and zonation conditions necessary for development of aquatic plants are described. Mapping, inventory, and evaluation of waterfowl areas, and propagation of food and cover species are also discussed.

219. George, H. A. 1963. Planting alkali bulrush for waterfowl food. Calif. Dep. Fish & Game, Manage. Leafl. 9. 9pp.

KEY WORDS: dormancy, germination, planting, propagule sources, salinity, Scirpus, seeds, site preparation.

Techniques for preparation of sites and for planting of Scirpus robustus seeds in California are detailed. S. robustus is highly salt tolerant once established but it is sensitive to salt at germination. Water level control is necessary for maximum production.

220. Giglioli, M. E. C. and D. F. King. 1966. The mangrove swamps of Kenaba, Lower Gambia river basin. III. Seasonal variations in the chloride and water content of swamp soils. J. Appl. Ecol. 3:1-19.

KEY WORDS: chloride, life history, substrate, swamp.

Great variations in chloride concentrations were encountered in the mangrove swamps; possible explanations for this phenomenon are given.

221. Giglioli, M. E. C. and I. Thornton. 1965. The mangrove swamps of Kenaba, Lower Gambia river basin. J. Appl. Ecol. 2:81-103.

KEY WORDS: geography, substrate, succession, swamp.

The climate, swamp halosere, and physical composition of the swamp soils of the Lower Gambia are described. Apparent succession of vegetation from mangrove to grasses is outlined.

222. Gilly, C. L. 1943. A preliminary investigation of the North American canes (Arundinaria). Bull. Torrey Bot. Club 70(3): 297-309.

KEY WORDS: Arundinaria, genotype, geography, morphology.

Probably the two kinds of cane which are now designated as different species are actually ecotypes. Description of habitat, morphology and distribution of the two types is given.

223. Giltz, M. L. and W. C. Myser. 1954. A preliminary report on an experiment to prevent cattail die-off. Ecology 35(3):418.

KEY WORDS: fishes, marsh, site preparation, Typha.

Likely explanations for the die-off of large cattail stands on Lake Erie are given. The possibility of experimentally fenced off areas to preserve some cattail stands while keeping open areas of water for waterfowl is discussed.

224. Givens, L. S. and T. Z. Atkeson. 1957. The use of dewatered land in southeastern waterfowl management. J. Wildl. Manage. 21(4): 465-467.

KEY WORDS: drainage, drawdowns, emergents, habitat, planting, site preparation, waterfowl.

The production of natural waterfowl food through water manipulation, rotation disking, and sow unprepared flats to various food plants is sometimes possible, but not very dependable. Actual farming, using upland crops, provides the most dependable waterfowl food supply.

225. Godwin, H. 1923. Dispersal of pond floras. J. Ecol. 11:160-164.

KEY WORDS: dispersal, geography.

This paper suggests that plant distribution may be essentially a matter of chance and that land barriers are very effective in slowing down the rate of dispersal of water plants. In the case presented here, the result is a dispersal so slow that the age of an area can be taken as a measure of the dispersal of plants to it.

226. Godwin, H. and F. R. Bharucha. 1932. Studies in the ecology of Wicken Fen. II. The fen water table and its control of plant communities. J. Ecol. 22(1):157-191.

KEY WORDS: communities, flooding, Phragmites.

The management of fen water levels was demonstrated to control shrub growth and coverage of several other aquatic species. Flooding for a few weeks each year keeps shrubs from invading the wet fen plant communities which are dominated by Cladium and Phragmites.

227. Goering, J. J. and P. L. Parker. 1972. Nitrogen fixation by epiphytes on seagrasses. Limnol. Oceanogr. 17(2):320-323.

KEY WORDS: epiphytes, Halodule, nitrogen, physiology, Ruppia Syringodium, Thalassia.

Evidence that epiphytes of seagrasses fix nitrogen is presented. It is suggested that this process may play an important role in the nitrogen economy of seagrass communities.

228. Golley, F., H. T. Odum and R. F. Wilson. 1962. The structure and metabolism of a Puerto Rican red mangrove forest in May. Ecology 43(1):9-19.

KEY WORDS: photosynthesis, respiration, substrate, tides.

Data concerning photosynthesis, leaf respiration, tidal export of particulate matter and respiration of soil organisms are presented.

229. Good, R. 1924. The germination of Hippuris vulgaris L. J. Linn. Soc. (Bot.) 46:443-448.

KEY WORDS: dispersal, germination, Hippuris, seeds, viability.

Fertilization and seed-set in Hippuris vulgaris is apparently rare, and viable seed is produced only during suitable years. Ripe fruits float for variable periods of time allowing for water dispersal.

230. Good, R. E. 1965. Salt marsh vegetation, Cape May, New Jersey. New Jersey Acad. Sci. Bull. 10(1):1-11.

KEY WORDS: biomass, communities, flooding, productivity, salinity, salt marsh, Spartina.

A study of 49 stands of vegetation at Goshen Creek salt marsh indicated that high estimates of standing crop were found primarily in Spartina colonies along creek banks and were associated with frequent floodings and moderate salinities while low standing crop was associated with infrequent floodings and wide ranges of salinity.

231. Goodman, P. J. 1960. Investigations into "die-back" in Spartina townsendii Agg. II. The morphological structure and composition of Lymington sward. J. Ecol. 48(3):711-724.

KEY WORDS: morphology, productivity, rhizomes, Spartina, substrate.

The morphology of Spartina townsendii from various sites on an English sward was examined, especially those parts which were subject to "die-off". Indirect evidence indicated that die-back is due to cessation of accretion of substratum.

232. Goodman, P. J. and W. T. Williams. 1961. Investigations into "die-back" in Spartina townsendii Agg. III. Physiological correlates of "die-back". J. Ecol. 49(2):391-398.

KEY WORDS: hydrogen sulfide, oxygen, physiology, rhizomes, Spartina.

After examining the soil chemistry and the rhizomes and other plant parts for oxygen, carbon dioxide, and alcohol content, it was concluded that "die-back" was probably due to some toxic reduced inorganic ion.

233. Goodman, P. J., E. M. Braybrooks and J. M. Lambert. 1959. Investigations into "die-back" in Spartina townsendii Agg. I. The present status of Spartina townsendii in Britain. J. Ecol. 43(3): 651-677.

KEY WORDS: colonization, drainage, ecological range, Spartina, substrate, waterlogging.

Spartina townsendii was found to be still thriving thoughout most of it ecologically wide range, the "die-offs" apparently being local and limited and at least partly due to impeded drainage.

234. Goodman, P. J., E. M. Braybrooks, C. J. Marchant and J. M. Lambert. 1969. Spartina X townsendii H. and J. Groves sensu lato. J. Ecol. 57(1):298-313.

KEY WORDS: hybrids, life history, morphology, Spartina.

The life history and morphology of British hybrids of Spartina are described.

235. Gorham, E. and W. H. Pearsall. 1956. Production ecology. III. Shoot production in Phragmites in relation to habitat. Oikos 7:206-214.

KEY WORDS: biomass, growth, nutrients, Phragmites, productivity.

Data for the shoot weight and the standing crop of Phragmites communis (= australis) in a range of habitats in Northern Britain are analyzed. The evidence suggests that in the sites examined the size of the shoot is most commonly determined by mineral nutrition, though the summer water level may become important when more than a certain distance below ground level.

236. Goss, W. L. 1925. The vitality of buried seeds. J. Agr. Res. 29:349-362.

KEY WORDS: depth, propagule sources, propagule storage, seeds.

In addition to the many terrestrial weed seeds studied, several wetland plant seeds were considered as to viability and depth of burial. Most seeds remain viable for many years (up to 20 years) when buried.

237. Gosselink, J. G. 1970. Growth of Spartina patens and S. alterniflora as influenced by salinity and source of nitrogen. pp. 97-110. In: Coastal Studies Bull. 5. Louisiana State Univ., Spec. Sea Grant Issue.

KEY WORDS: growth, nitrogen, salinity, Spartina.

Spartina alterniflora and S. patens are facultative halophytes whose growth is inversely related to the salinity of the nutrient solution.

238. Gosselink, J. G., R. J. Reimold, J. L. Gallagher, H. L. Windom and E. P. Odum. 1973. Spoil disposal problems for highway construction through marshes: I. Evaluation of spoil disposal techniques. II. Revegetation techniques for spoil areas. Inst. Ecol., Univ. Georgia. 57pp.

KEY WORDS: colonization, dredging, emergents, salinity, salt marsh, substrate.

Methods of dredging marshlands in the building of highways are described, and their cost and importance discussed. Three goals which should be accomplished prior to revegetation of dredged spoil are: 1) uniform mixture and deposition of dredged material, 2) leaching should be encouraged to remove salt, and 3) soil acidity should be reduced by limestone application. Side casting of dredged material is the best method of spoil handling to date. Recommendations on techniques for revegetation are listed; salinity tolerances for numerous species are given.

239. Gossett, D. R. and W. E. Norris, Jr. 1971. Relationship between nutrient availability and content of nitrogen and phosphorus in tissues of the aquatic macrophyte, Eichornia crassipes (Mart.) Solms. Hydrobiologia 38(1):15-28.

KEY WORDS: Eichornia, floating plants, nitrogen, phosphorus.

There is a positive correlation between the nitrogen and phosphorus content of Eichornia crassipes tissue and the environment. Luxury uptake of nitrogen and phosphorus may be stored in the plant's floats.

240. Goulder, R. and D. J. Boatman. 1971. Evidence that nitrogen supply influences the distribution of a freshwater macrophyte Ceratophyllum demersum. J. Ecol. 59(3):783-791.

KEY WORDS: Ceratophyllum, nitrogen, nutrients, weeds.

In an attempt to explain the uneven distribution of Ceratophyllum demersum among several flooded gravel ponds in England, the authors suggest that C. demersum may require high inorganic nitrogen levels in the surrounding water for at least part of the year. This suggestion that Ceratophyllum is a nitrophilous plant may explain why it reaches nuisance levels in waterways which drain agricultural land.

241. Grace, N. H. 1945. Liberation of growth stimulating materials by rooting Salix cuttings. Can. J. Res. (Bot.) 23:85-93.

KEY WORDS: culture, dormancy, physiology, root systems, Salix, vegetative propagation.

Physiologically active substances liberated by rooting Salix cuttings were found to stimulate or inhibit root growth depending on concentration, and dormancy of the roots.

242. Grainger, J. 1947. Nutrition and flowering of water plants. J. Ecol. 35(1-2):49-64.

KEY WORDS: light, nutrients, phenology, submergents.

The influence of foliage carbohydrate and light on dates of flowering is discussed.

243. Gray, A. J. 1970. The colonization of estuaries following barrage building. pp. 63-67. In: F. Perring (Ed.). The Flora of a Changing Britain. Bot. Soc. Brit., I. and E. W. Classey, Ltd., Middlesex. 157pp.

KEY WORDS: colonization, drawdown, salinity, succession.

The response of local populations of aquatic plants to diking of estuaries in the creation of fresh water reservoirs is discussed. Alterations in salinity, nutrients, depth and turbidity of the water are likely to produce some major changes as are wave disturbance and fluctuations in water level. Primary invasion of weedy species on bare areas is also discussed.

244. Gray, A. J. 1972. The ecology of Morecambe Bay. V. The salt marshes of Morecambe Bay. J. Appl. Ecol. 9:207-220.

KEY WORDS: salt marsh, tides, zonation.

As part of a study to determine the feasibility of creating fresh water reservoirs in Morecambe Bay, England, the history, topography, tidal relations, and management of the salt marshes were examined.

245. Gray, A. J. and R. G. H. Bunce. 1972. The ecology of Morecambe Bay. VI. Soils and vegetation of the salt marshes: a multivariate approach. J. Appl. Ecol. 9:221-234.

KEY WORDS: colonization, salinity, salt marsh, substrate.

Complex statistical analyses of marsh soils chemistry are recorded and data on the relationship of the major vegetation types to the four classifications of soils are discussed.

246. Greely, J. R. 1960. Eurasian watermilfoil — a new threat to our waterways. The Conservationist (N.Y.) 14(6):10-11.

KEY WORDS: adventive spread, geography, Myriophyllum, submergents, weeds.

The spread of Myriophyllum spicatum in U. S. waters is documented.

247. Griffith, R. 1948. Improving waterfowl habitat. N. Am. Wildl. Conf., Trans. 13:609-618.

KEY WORDS: Cyperus, machinery, planting, rootstocks, site preparation, tubers, vegetative propagation.

Using a double-disk harrow, soil preparation and sowing of Cyperus tubers can be accomplished in a single operation.

248. Griffeth, W. L. and C. M. Harrison. 1954. Maturity and curing temperature and their influence on germination of Reed Canary grass. Agron. J. 46:163-167.

KEY WORDS: afterripening, germination, harvest, Phalaris, propagule sources, propagule storage, temperature.

Germination is reduced by a combination of high moisture and high temperature during curing. Seed which matures on the plant usually has a high germination rate.

249. Griffiths, B. H. 1932. The ecology of Butterby Marsh, Durham. J. Ecol 20(1):105-127.

KEY WORDS: depth, flooding, marsh.

The ecology of an oxbow marsh is described; data on relations of marsh plants to water levels are given.

250. Grizzell, R. A., Jr. and W. A. Neely. 1962. Biological controls for waterweeds. N. Am. Wildl. Conf., Trans. 27:107-113.

KEY WORDS: control, fishes, waterfowl, weeds.

Two genera of algae are often serious problems in southeastern U. S. ponds: Pithophora, and Cladophora, which smother widgeongrass (Ruppia). No suitable chemical has been found to control either one. However, biological reduction of Pithophora was obtained by stocking infested ponds with Israeli carp, and Cladophora was effectively controlled by mullet. Duckweed can be controlled by removal of windbreaks and/or use of 6 or more muscovy ducks per acre.

251. Gunn, C. R. and J. V. Dennis. 1973. Tropical and temperate stranded seeds and fruits from the Gulf of Mexico. Contrib. Mar. Sci., Univ. Texas. 17:111-121.

KEY WORDS: dispersal, seeds, viability.

Seeds from 34 tropical and 24 temperate species of plants were collected from several beach areas. Dissemination by ocean currents and storms is discussed.

252. Hall, T. F. 1940. The biology of Saururus cernuus L. Am. Midl. Nat. 24(1):253-260.

KEY WORDS: depth, dispersal, habitat, life history, Saururus.

A life history account of Saururus cernuus including information on habitat, vegetative growth, and seed ecology.

253. Hall, T. F. 1961. Principles of aquatic plant control. pp. 211-247. In: R. L. Metcalf (Ed.). Advances In Pest Control Research. vol. 4. Interscience Publ., Inc., N.Y. 347pp.

KEY WORDS: adventive spread, control, emergents, exotics, floating plants, herbicides, submergents, weeds.

Control of aquatic plants is discussed in relation to the native habitat of introduced species, the growth form of the plant, and the nature of compounds which are capable of penetrating leaf cuticles and cells. Methods of control which are considered include chemical, mechanical, physical, and biological treatments. Guidelines are given for consideration by the field worker before treatment begins to insure successful control of the pest species.

254. Hall, T. F. and W. T. Penfound. 1939. A phytosociological study of a cypress-gum swamp in southeastern Louisiana. Am. Midl. Nat. 21:378-395.

KEY WORDS: habitat, phytosociology, substrate, swamp.

Site characteristics and vegetation composition data from a cypress-gum swamp are studied in this article.

255. Hall, T. F. and W. T. Penfound. 1944. The biology of the American lotus, Nelumbo lutea (Willd.) Pers. Am. Midl. Nat. 31(3):744-758.

KEY WORDS: control, dispersal, fruits, growth, habitat, life history, Nelumbo, seeds, tubers, vegetative reproduction.

The American lotus is an emergent aquatic herb of wide distribution in North America. Rapid colonization of new areas by lotus is accomplished by the elongated rhizomes and to a lesser extent by tubers and fruits. Complete innundation of lotus colonies for a continuous period of two weeks or dewatering for one month destroyed all leaves and flowers and many of the rhizomes and tubers. The general morphology, habitat, rate of growth, control, and several other aspects of life history are considered.

256. Hall, T. F., W. T. Penfound and A. D. Hess. 1946. Water level relationships of plants in the Tennessee Valley with particular reference to malaria control. J. Tenn. Acad. Sci. 21:18-59.

KEY WORDS: depth, emergents, flooding, germination, mosquitoes, seeds, submergents.

Information on seed germination, sprouting, survival, and growth form of littoral plants in relation to water levels is presented from observations on eleven reservoirs, three ponds, and two pools in the Tennessee Valley over a four year period. Water level management for controlling the larvae of Anopheles mosquito is discussed.

257. Halstead, E. H. and B. T. Vicario. 1969. Effect of ultrasonics on the germination of wild rice (Zizania aquatica). Can. J. Bot. 47:1638-1640.

KEY WORDS: afterripening, dormancy, germination, Zizania.

Seeds of Zizania aquatica were subjected to treatments of ultrasonic vibration, warm water, and ethanol to induce early germination. Treatment with ultrasonic vibrations resulted in the highest percentage of germination with the other treatments producing respectively less germination.

258. Hammond, B. 1937. Development of Podostemon ceratophyllum. Bull. Torrey Bot. Club 64:17-36.

KEY WORDS: depth, growth, habitat, morphology, Podostemon, seed production.

In addition to a description of the embryonic and cellular development of Podostemon, general information is given on its riverine habitat, growth, and reproduction.

259. Hampson, M. A. 1967. Uptake of radioactivity by aquatic plants and location in the cells. II. Uptake of cerium-144 by the freshwater plant Nitella opaea. J. Exp. Bot. 18:34-53.

KEY WORDS: absorption, life history, Nitella, pH, physiology, submergents.

The uptake of cerium-144 by Nitella from pond water at pH 7.7 without an added carrier was recorded over a period of 207 days. Equilibrium was reached after about 100 days, with the plant having 20,000 times the activity of the water.

260. Hannan, H. H. and T. C. Dorris. 1970. Succession of a macrophyte community in a constant temperature river. Limnol. Oceanogr. 15:442-453.

KEY WORDS: biomass, colonization, dredging, productivity, substrate, succession.

The relationship of "community metabolism" to community structure was studied during a period of autotrophic succession after a dredging operation on the San Marcos River, Texas. Plant biomass increased throughout the study period. Diversity initially increased, but then decreased as the community grew older. The influence and utilization of light energy on community productivity and biomass are considered.

261. Hannon, N. and A. D. Bradshaw. 1968. Evolution of salt tolerance in two coexisting species of grass. Nature 220:1342-1343.

KEY WORDS: ecological range, Gramineae, salinity, salt marsh, substrate, zonation.

The considerable variation in salt tolerance of plants within the same species but growing in different habitats is discussed.

262. Hanson, H. C. 1918. The invasion of a Missouri River alluvial flood plain. Am. Midl. Nat. 5(7-8):196-201.

KEY WORDS: colonization, dispersal, flooding, seeds, substrate, succession.

The species of plants and seeds found on an area of recently deposited alluvial soil are recorded. Seeds were deposited in debris piles by floodwaters.

263. Harms, W. R. 1973. Some effects of soil type and water regime on growth of tupelo seedlings. Ecology 54(1):188-193.

KEY WORDS: depth, growth, nutrients, Nyssa, seedlings, substrate, swamp.

The growth rate, height, and dry weight of two year old swamp and water tupelo seedlings was determined under three water regimes and two soil types. While stagnant water reduced growth, this was partially overcome by good nutrient conditions.

264. Harris, S. W. and W. H. Marshall. 1960. Experimental germination of seed and establishment of seedlings of Phragmites communis. Ecology 41(2):395.

KEY WORDS: germination, Phragmites, propagule storage, seeds.

No germination was obtained from any seeds of Phragmites stored under 4 different environmental conditions for 3 to 6 months. Seeds stored wet for 7 months gave no germination either. However, seeds stored 7 months at room temperature gave nearly 50 percent germination; 30 percent germination was recorded after 8 months storage. Germination of Phragmites seed in nature is documented.

265. Harris, S. W. and W. H. Marshall. 1960. Germination and planting experiments on softstem and hardstem bulrush. J. Wildl. Manage. 24(2):134-139.

KEY WORDS: drawdown, germination, harvest, machinery, planting, propagule sources, propagule storage, Scirpus, seeds, site preparation.

Several types of seed storage and germination experiments, recommendations for manual and machine plantings, and harvest of the softstem and hardstem bulrush are discussed.

266. Harris, S. W. and W. H. Marshall. 1963. Ecology of water level manipulations of a northern marsh. Ecology 44(2):331-343.

KEY WORDS: colonization, drawdown, emergents, germination, seeds, site preparation.

A program of water level manipulation resulted in the successful establishment of emergent vegetation on Agassiz National Wildlife Refuge.

267. Harshberger, J. W. 1916. The origin and vegetation of salt marsh pools. Proc. Am. Philos. Soc. 55:481-484.

KEY WORDS: colonization, salt marsh, zonation.

Large rafts of debris carried into the salt marsh by high tides or storms create depression pools which are quickly revegetated by a variety of pioneer species.

268. Hartog, C. den. 1970. The Sea Grasses of the World. North Holland Publ. Co., London. 276pp.

KEY WORDS: bibliography, geography, Halodule, Halophila, keys, marine, submergents, Syringodium, taxonomy, Thalassia, Zostera.

The taxonomy, distributions, and ecology of the sea grasses throughout the world are discussed.

269. Hartog, C. den. 1971. The dynamic aspect of the ecology of sea grass communities. Thalassia Jugoslavica 7(1):101-112.

KEY WORDS: communities, Halodule, marine, submergents, Thalassia.

General discussions of the ecology of sea grass communities around the world are given.

270. Harvill, A. M., Jr. 1967. The vegetation of Assateague Island, Virginia. Castanea 32(2):105-108.

KEY WORDS: flora, geography, habitat.

The plants of Assateague Island, the northern-most of the barrier islands, are listed with brief habitat descriptions.

271. Haslam, S. M. 1968. The biology of the reed Phragmites communis in relation to its control. Brit. Weed Control Conf., Proc. 9:392-397.

KEY WORDS: control, growth, mowing, Phragmites, rhizomes, root systems, weeds.

The root system of Phragmites communis (= P. australis) is diagrammed and an effective schedule of cutting for control purposes is discussed.

272. Haslam, S. M. 1969. Stem types of Phragmites communis Trin. Ann. Bot. 33:127-131.

KEY WORDS: brackish, growth, Phragmites, rhizomes.

Four different types of stems occur in Phragmites communis: horizontal rhizomes, vertical rhizomes, aerial shoots, and legehalme (long runners). The first three can be arranged in a maturational sequence and are found in all viable stands. Legehalme occur in comparatively few communities, mainly in new ones, or those in brackish water.

273. Haslam, S. M. 1969. The development and emergence of buds in Phragmites communis Trin. Ann. Bot. 33:289-301.

KEY WORDS: depth, fire, growth, mowing, phenology, Phragmites, substrate, vegetative propagation.

The cycle of bud formation and emergence in Phragmites is discussed in connection with many of the factors that influence this process (i.e. age, temperature, fire, mowing, and water levels).

274. Haslam, S. M. 1970. The performance of Phragmites communis Trin. in relation to water supply. Ann. Bot. 34:867-877.

KEY WORDS: depth, nutrients, Phragmites, substrate, vegetative propagation.

The water level relations of Phragmites communis are described and the factors which influence these relations, i.e. nutrients, competition, substrate, etc., are discussed. Phragmites grows in areas where the water level is between 2 m above ground and 1 m below. Within this wide range, growth is affected by a large variety of factors.

275. Haslam, S. M. 1971. The development and establishment of young plants of Phragmites communis Trin. Ann. Bot 35:1059-1072.

KEY WORDS: colonization, depth, germination, habitat, phenology, Phragmites, seedlings, substrate.

Young Phragmites plants were studied in Great Britain to determine the rather limited conditions for their initial colonization. Phragmites requires wet soil with less than 1 cm of standing water for germination and establishment.

276. Haslam, S. M. 1972. Phragmites communis Trin. J. Ecol. 60:585-610.

KEY WORDS: competition, ecological range, germination, life history, nutrients, Phragmites, planting, seed production, substrate.

A complete life history account and discussion of the environmental requirements and tolerances of Phragmites communis.

277. Hayes, F. R. and J. E. Phillips. 1958. Lake water and sediment. IV. Radio-phosphorus equilibrium with mud, plants, and bacteria under oxidized and reduced conditions. Limnol. Oceanogr. 3(4): 459-475.

KEY WORDS: fertilizer, lakes, phosphorus, substrate.

The distribution, fate, and rate of utilization of a phosphorus fertilizer added to a lake is investigated. Phosphorus fertilizers are rapidly incorporated into lake systems.

278. Hellquist, C. B. 1972. Range extention of vascular aquatic plants in New England. Rhodora 74(797):131-140.

KEY WORDS: adventive spread, Egeria, exotics, geography, Myriophyllum, Nymphaea, pollution, Potamogeton.

Range extensions for four species of introduced aquatic plants (Potamogeton crispus, Egeria densa, Nymphaea tuberosa, and Myriophyllum heterophyllum) are documented.

279. Hems, J. 1959. Hairgrass. The Aquarist and the Pondkeeper 24(1):4.

KEY WORDS: Eleocharis, fishes, life history, root systems, substrate.

The life history of Eleocharis acicularis is briefly described.

280. Henderson, N. C. 1962. A taxonomic revision of the genus Lycopus (Labiatae). Am. Midl. Nat. 68:95-138.

KEY WORDS: keys, Lycopus, morphology, taxonomy.

A total of 14 species and one hybrid of the genus Lycopus are examined morphologically and indexed in an artificial key.

281. Hermann, F. J. 1941. The genus Carex in Michigan. Am. Midl. Nat. 25:1-72.

KEY WORDS: Carex, geography, keys, taxonomy.

The total number of Carices known from Michigan as of 1941 was 181. Many of these are distinctly boreal while another small group is restricted to the Great Lakes shores. A key to all the species and varieties in Michigan is given.

282. Hermann, F. J. 1951. Additions to the genus Carex in Michigan. Am. Midl. Nat. 46:482-492.

KEY WORDS: Carex, geography, keys.

Range extensions and additional varieties of Carex are given to supplement the previous listing of 169 species.

283. Hestand, R. S., B. E. May, D. D. Schultz and C. R. Walker. 1973. Ecological implications of water levels on plant growth in a shallow water reservoir. Hyacinth Control J. 11:54-58.

KEY WORDS: drainage, drawdown, emergents, fishes, submergents.

An integrated management plan of water level fluctuation and chemical and/or biological control will be required to maintain maximum fish production.

284. Hicks, L. E. 1932. Ranges of pH tolerance of the Lemnaceae. Ohio J. Sci. 32:237-244.

KEY WORDS: ecological range, growth, Lemna, pH, Spirodela.

The pH concentration, though not always a limiting factor, is often an important one in affecting growth and distribution of several species of the Lemnaceae. pH ranges recorded for 7 species of Lemnaceae are classified as accompanying good, fair or poor growth. Alkaline waters were found to increase pigmentation in Spirodela polyrhiza and Lemna minor.

285. Higginson, F. R. 1965. The distribution of submerged aquatic angiosperms in the Tuggerah Lakes system. Linn. Soc. New South Wales, Proc. 90:328-334.

KEY WORDS: brackish, depth, Halophila, lakes, nutrients, Ruppia, salinity, substrate, Zostera.

The distributions of Ruppia maritima, Zostera capricorni, and Halophila ovalis are correlated with substrate type, salinity, and water levels. Chemical analyses of these species and the substrates they grow on are given.

286. Higginson, F. R. 1971. Ecological effects of pollution in Tuggerah Lakes. Ecol. Soc. Aust., Proc. 5:143-152.

KEY WORDS: brackish, lakes, nitrogen, nutrients, phosphorus, pollution, Ruppia, substrate, turbidity.

Concentration of organic matter, nitrogen, nutrients, phosphorus, and all major plant nutrients increased markedly with an increase in the fine particle content of the sediments in Lake Tuggerah.

287. Hill, E. J. 1889. Zizania as found by the explorers of the Northwest. Bull. Torrey Bot. Club 18(2):57-60.

KEY WORDS: geography, Zizania.

The original geographic distribution of wild rice in the Great Lakes area is briefly described.

288. Hill, T. G. 1908. Observations on the osmotic properties of the root hairs of certain salt marsh plants. New Phytol. 7:133-142.

KEY WORDS: physiology, Salicornia, salinity, seedlings, Suaeda.

Root hairs of Salicornia herbacea and Suaeda maritima are able to adjust their internal osmotic pressure to that of the environment and thus are able to survive salt concentration fluctuations easily.

289. Hill, T. G. 1909. The Bouche D'erquy in 1908. New Phytol. 8:97-103.

KEY WORDS: colonization, germination, planting, Salicornia, salt marsh, site preparation, Suaeda, substrate, succession.

A continuation of a series of papers dealing with the ecology of Brittany salt marshes. Successional trends, planting techniques for Salicornia and Suaeda, and site preparation are discussed.

290. Hillman, W. S. 1961. The Lemnaceae, or duckweeds. A review of the descriptive and experimental literature. Bot. Rev. 27:221-287.

KEY WORDS: auxins, culture, flowering, growth, habitat, Lemna, life history, morphology, root systems, seeds, taxonomy, turions.

This paper is a comprehensive literature review to serve as a guide to future research on the Lemnaceae, and calls particular attention to their valuable characteristics as organisms for developmental, physiological, and biochemical investigations.

291. Hinde, H. D. 1954. The vertical distribution of salt marsh phanerogams in relation to tide levels. Ecol. Monogr. 24:209-225.

KEY WORDS: communities, depth, Distichlis, emergents, Salicornia, salt marsh, Spartina, substrate, succession, tides, zonation.

The plant communities and distribution of species according to tide levels is described for a relatively undisturbed marsh on San Francisco Bay. The vertical distribution of the salt marsh plants is controlled by the degree of tidal emergence and submergence to which they are subjected. Changes in elevation and disturbance by man results in changes in plant communities.

292. Hitchcock, A. E., P. W. Zimmerman, H. Kirkpatrick, Jr. and T. T. Earle. 1949. Water hyacinth: its growth, reproduction, and practical control by 2,4-D. Contrib. Boyce Thompson Inst. 15: 363-401.

KEY WORDS: control, Eichornia, equipment, germination, herbicides, seeds, temperature, weeds.

2,4-D spray treatments and methods of applying them to Eichornia crassipes in Louisiana at all seasons of the year proved to be very effective in killing and sinking water hyacinth. The experimental and practical results in controlling water hyacinth by 2,4-D were the same for experimental plants in pits as for wild plants growing under a variety of natural conditions. Methods of application and results of several seed germination tests are discussed.

293. Hitchcock, A. E., P. W. Zimmerman, H. Kirkpatrick, Jr. and T. T. Earle. 1950. Growth and reproduction of water hyacinth and alligatorweed and their control by means of 2,4-D. Contrib. Boyce Thompson Inst. 16(3):91-130.

KEY WORDS: Alternanthera, control, Eichornia, floating plants, germination, herbicides, seedlings, weeds.

An 8 pound/acre dose of 2,4-D was effective throughout the year in causing Eichornia crassipes to sink in 2 to 3 months; the esters of 2,4-D were of about equal effectiveness as compared to the amine salt. It was difficult in practical control operations to contact all plants with one 2,4-D spraying and a second spraying had to be applied to surviving plants before any substantial reinfestation had occurred. Treatment and ecology of Alternanthera are also described.

294. Hodgson, R. H. 1966. Growth and carbohydrate status of sago pondweed. Weeds 14:263-268.

KEY WORDS: growth, herbicides, Potamogeton, tubers, vegetative reproduction.

Unsprouted Potamogeton pectinatus tubers, grown artificially, were found on the average to contain 74 percent (of the dry weight) carbohydrate. Studies of the abundance of carbohydrate in tubers as related to growth sequence are useful in determining application periods for herbicide treatments.

295. Hoese, H. D. 1967. Effect of higher than normal salinities on salt marshes. Contrib. Mar. Sci., Univ. Texas Mar. Sci. Inst. 12:249-261.

KEY WORDS: brackish, ecological range, salinity, salt marsh, Spartina.

Salt marshes currently exist in water of about 10 to 30 ppt salinity; an increase in salinity to about 50 ppt would destroy all Spartina alterniflora salt marsh systems.

296. Holcomb, D. and W. Wegener. 1971. Hydrophytic changes related to lake fluctuation as measured by point transects. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 25:570-583.

KEY WORDS: drainage, drawdown, emergents, site preparation.

As a result of dewatering, littoral vegetation advanced lakeward. Water stage duration determined the distribution of annual and perennial plants.

297. Holm, L. G., L. W. Weldon and R. D. Blackburn. 1969. Aquatic weeds. Science 166:699-709.

KEY WORDS: adventive spread, control, dispersal, ecological range, Eichornia, exotics, floating plants, geography, herbicides, irrigation, Myriophyllum, navigation, seed production, submergents, sudd, transpiration, turions.

An accounting of man's carelessness in transporting aquatic weed species throughout the world, the problems that result, and the concurrent loss of commercial and recreational acreage and revenue is presented. The importance of water hyacinth is discussed at length, as well as some other nuisance species. Information is given on several effective herbicides and their application, and on biocontrol.

298. Hotchkiss, N. 1964. Pondweeds and pondweed-like plants of eastern North America. U. S. Fish & Wildl. Serv., Circ. 187.

KEY WORDS: keys, Potamogeton.

Twenty-seven pondweeds and thirteen non-pondweed species are described and drawn to aid in field identification.

299. Hotchkiss, N. 1965. Bulrushes and bulrush-like plants of eastern North America. U. S. Fish & Wildl. Serv., Circ. 221.

KEY WORDS: keys, Scirpus.

Nineteen bulrushes and four bulrush-like plants are described and drawn to aid in field identification.

300. Hotchkiss, N. 1967. Underwater and floating leaved plants of the United States and Canada. U. S. Bur. Sport Fish. & Wildl., Resour. Pub. 44. 124pp.

KEY WORDS: emergents, keys, submergents.

A description of the wild flowering plants, ferns, liverworts, and Characeae in the continental U. S. in which the foliage is habitually underwater or floating, for purposes of field identification.

301. Hotchkiss, N. and H. L. Dozier. 1949. Taxonomy and distribution of N. American cat-tails. Am. Midl. Nat. 41(1):237-254.

KEY WORDS: geography, habitat, keys, life history, taxonomy, Typha.

General discussions on the life history, ecology, and taxonomy, of Typha glauca, T. domingensis, T. angustifolia, and T. latifolia are presented.

302. Howard, H. A. and W. T. Penfound. 1942. Vegetational studies in areas of sedimentation in the Bonnet Carre floodway. Bull. Torrey Bot. Club 69(4):281-289.

KEY WORDS: colonization, communities, flooding, geography, habitat.

The colonizing species and subsequent vegetation associations of alluvial mudflats in a New Orleans floodway are described as being quite sumilar to that on Mississippi sandbars.

303. Howard, H. W. and A. G. Lyon. 1952. Nasturtium officinale R. Br. (Rorippa nasturtium — aquaticum (L.) Hayek. J. Ecol. 40(1): 228-238.

KEY WORDS: germination, habitat, life history, morphology, Nasturtium, seeds, substrate, vegetative reproduction, viability.

A life history of Nasturtium officinale.

304. Howes, W. J. 1957. The pond-side Iris. The Aquarist and the Pondkeeper. 22(1):9.

KEY WORDS: Iris, life history, vegetative reproduction.

A brief life history of Iris pseudoacorus, a plant native to Britain.

305. Hubbard, J. C. E. 1970. Effects of cutting and seed production in Spartina angleica. J. Ecol. 58(2):329-334.

KEY WORDS: germination, mowing, propagule storage, seed production, Spartina.

Mowing Spartina angleica repeatedly in 1962 led to earlier flowering in 1963. Information on seed storage and germination is given.

306. Hubbard, J. C. E. and R. E. Stebbings. 1967. Distribution, dates of origin and acreage of Spartina townsendii (s. l.) marshes in Great Britain. Bot. Soc. Brit. Isl., Proc. 7(1):1-7.

KEY WORDS: colonization, salt marsh, Spartina.

Approximately 30,000 acres of intertidal mudflats were covered with Spartina townsendii in 1967, much of the growth due to introduction by man. The topography, a distribution map and the dates of planting of the marshlands in Britain are given.

307. Hudson, J. H., D. M. Allen and T. J. Costello. 1970. The flora and fauna of a basin in central Florida Bay. U. S. Fish & Wildl. Serv., Spec. Sci. Rep. — Fish. 604. 14pp.

KEY WORDS: flora, habitat, Halodule, substrate, Thalassia.

The importance of shallow beds of seagrasses in a nursery area for pink shrimp is discussed; the substrate on which the sea grasses were found growing is noted.

308. Hughes, R. H. 1951. Observations of cane (Arundinaria) flowers, seed, and seedlings, in the North Carolina coastal plain. Bull. Torrey Bot. Club 78(2):113-121.

KEY WORDS: growth, life history, phenology, root systems, seedlings, seeds, substrate.

Arundinaria spp. is the only true grass in North America with a perennial woody stem. Due to its erratic flowering habits, seed production, and slow growth of natural seedlings, it revegetates an area slowly. Cultivated seedlings, however, develop at about twice the rate of natural seedlings. The culm and supporting rhizome apparently die after fruiting and a high percentage of the seed may be destroyed by insect larvae.

309. Humm, H. J. 1956. Sea grasses of the northern Gulf Coast. Bull. Mar. Sci. Gulf & Caribb. 6(4):305-308.

KEY WORDS: depth, geography, Halodule, Halophila, keys, productivity, Ruppia, salinity, submergents, Thalassia.

The distributions, water level relations, and primary productivity of Gulf Coast seagrasses are discussed. The various sea grasses are very abundant from Mississippi to Florida and probably have a continuous distribution around the Gulf Coast. The depth to which they grow is determined by light penetration and the stability of the substrate.

310. Hunt, G. S. 1963. Wild celery in the lower Detroit River. Ecology 44(2):360-370.

KEY WORDS: habitat, pollution, Vallisneria, waterfowl.

Many of the factors affecting distribution of wild celery are described; part of the paper deals with the effects of pollution on aquatic macrophytes.

311. Hunt, G. S. and R. W. Lutz. 1959. Seed production by curly-leaved pondweed and its significance to waterfowl. J. Wildl. Manage. 23(4):405-408.

KEY WORDS: depth, drawdown, Potamogeton, seed production, waterfowl.

Although Potamogeton crispus rarely produces seed naturally, a planned drawdown can be used to initiate fruiting.

312. Hutchings, S. S. 1932. Light in relation to the seed germination of Mimulus ringens L. Am. J. Bot. 19(7):632-643.

KEY WORDS: dormancy, germination, light, Mimulus, propagule storage, substrate, temperature.

Bright light is an important requirement of Mimulus ringens for germination. The effects of substrate, temperature, and moisture conditions on germination are discussed.

313. Hutchinson, G. E. 1970. The chemical ecology of three species of Myriophyllum (Angiospermae, Haloragaceae). Limnol. Oceanogr. 15(1):1-5.

KEY WORDS: bicarbonate, calcium, ecological range, Myriophyllum, pH.

The distribution of Myriophyllum alterniflorum, M. verticillatum, and M. spicatum is correlated with hydrogen ion, calcium, and bicarbonate content of the ambient water.

314. Jacobs, D. L. 1947. An ecological life history of Spirodela polyrhiza (Greater Duckweed) with emphasis on the turion phase. Ecol. Monogr. 17:437-469.

KEY WORDS: dispersal, geography, germination, growth, life history, morphology, Spirodela, turions.

This study consists of field observations and controlled experiments to obtain precise data on the influences of environmental factors on most phases of the life history of Spirodela polyrhiza. Information on the status of S. polyrhiza in local duckweed communities, morphology and anatomy, turion formation and germination and growth rates is presented.

315. Jefferies, R. L. 1972. Aspects of salt marsh ecology with particular reference to inorganic plant nutrition. pp. 61-85. In: R. S. K. Barnes and J. Green (Eds.). The Estuarine Environment. Applied Science Publ, Ltd., London. 133pp.

KEY WORDS: germination, nitrogen, phosphorus, physiology, Plantago, productivity, salinity, succession, salt marsh, Triglochin.

A review of the physiologic mechanism of salt tolerance, growth of halophytes in relation to the availability of N and P, and general ecology and productivity of salt marshes.

316. Jenkins, R. 1972. Ecosystem restoration. Third Midwest Prairie Conf., Proc. Kansas State Univ. 5pp.

KEY WORDS: communities, culture, marsh, planting, Spartina, salt marsh.

Manipulation and restoration of disturbed areas is necessary to preserve all ecosystem types as reservoirs of biological species, genetic diversity, and as benchmarks of naturalness. Examples of salt marsh restoration projects are given.

317. Jessen, R. L. and J. H. Kuehn. 1960. A preliminary report on the effects of the elimination of carp on submerged vegetation. Minn. Dep. Cons., Div. Game and Fish, Fish Ser. 2. 12pp.

KEY WORDS: colonization, control, fishes, ponds, Potamogeton, submergents, substrate, turbidity, waterfowl.

An account of the changes which took place in seven shallow southern Minnesota ponds following the natural exclusion of carp. A list of plant species which subsequently invaded some of the ponds is given.

318. Joanen, J. T. 1964. A study of the factors that influence the establishment of natural and artificial stands of wigeongrass, Ruppia maritima, on Rockefeller refuge. M. Sc. Thesis, Louisiana State Univ. and Agr. and Mech. College. 85pp.

KEY WORDS: depth, flooding, germination, growth, productivity, Ruppia, seed production, turbidity, waterfowl.

Physical factors such as turbidity, fluctuations in water levels, and water depth were found to be controlling factors in the establishment and maintenance of wigeongrass stands.

319. Joanen, J. T. and L. L. Glasgow. 1966. Factors influencing the establishment of wigeongrass stands in Louisiana. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 19:78-92.

KEY WORDS: drawdown, germination, Ruppia, turbidity.

Physical factors, such as turbidity, fluctuating water levels, and water depth, were found to be controlling factors in the establishment of new stands of Ruppia maritima and also to the development and production of mature stands. Soil salinities higher than 1.12 percent were found to inhibit germination. Algae overshadowed and crowded out Ruppia by reducing the available light.

320. Johnson, F. A. 1970. A reconnaissance of the Winyah Bay estuarine zone, South Carolina. S. Carolina Water Res. Comm. Rep. 4 prepared by U. S. Geol. Surv., Water Resour. Div. 36pp.

KEY WORDS: salinity, substrate, tides.

A detailed account of the movements and interactions of salt and freshwater in this particular estuary system is given.

321. Johnson, D. S. and A. F. Skutch. 1928. Littoral vegetation on a headland of Mt. Desert Island, Maine. I. Submersible or strictly littoral vegetation. Ecology 9:188-212.

KEY WORDS: geography, life history, tides.

The emphasis of this study was the determination of the exact vertical distribution, with reference to tide levels, of the plants found on a rocky, exposed area on the shore of a Maine island.

322. Johnson, D. S. and A. F. Skutch. 1928. Littoral vegetation on a headland of Mt. Desert Island, Maine. II. Tide pools and the environment and classification of submersible plant communities. Ecology 9:307-337.

KEY WORDS: tides, zonation.

Tidal pools created by breaker action are described and the associated vegetation, primarily algae, classified.

323. Johnson, D. S. and A. E. Skutch. 1928. Littoral vegetation on a headland of Mt. Desert Island, Maine. III. Adlittoral or non-submersible region. Ecology 9:429-433.

KEY WORDS: salinity, substrate, zonation.

The vegetation and ecological conditions of the salt spray zone of the rocky shore of Mt. Desert Island are described.

324. Jones, J. A. 1928. Overcoming delayed germination of Nelumbo lutea. Bot. Gaz. 85:341-343.

KEY WORDS: germination, Nelumbo.

Mechanical abrasion and/or chemical erosion of the seed coat of Nelumbo lutea resulted in much earlier germination than was obtained without treatment.

325. Jones, V. and P. W. Richards. 1954. Juncus acutus L. J. Ecol. 42(2):639-650.

KEY WORDS: germination, habitat, Juncus, life history, propagule storage, substrate.

A life history of Juncus acutus including habitat, soil conditions, growth, and reproduction is presented.

326. Jordon, H. S. 1964. The relation of vegetation and soil to development of mangrove swamps for rice growing in Sierra Leone. J. Appl. Ecol. 1:209-212.

KEY WORDS: drainage, pH, Rhizophora, substrate.

It was found that soils which at one time supported African species of mangrove (Rhizophora racemosa) contained large amounts of fibrous root material and were likely to become extremely acid and toxic to other plants.

327. Justice, O. L. 1946. Seed production, viability, and dormancy in the nutgrasses Cyperus rotundus and C. esculentus. J. Agr. Res. 73:303-318.

KEY WORDS: Cyperus, dormancy, germination, seed production, temperature.

Seeds of Cyperus rotundus and C. esculentus collected in Alabama were found to require an afterripening period. Maximum percentage of germination obtained from C. rotundus in a variety of test regimes using a minimum of 100 seeds was 18 percent. There was an apparent correlation between the number of seeds with large embryos and the percentage of germination. Germination of the heavy fractions of two seed collections of C. esculentus from N. Y. State was approximately 90 percent; seed from Maine yielded 95 percent germination, and seed from Alabama resulted in 50 percent germination.

328. Kadlec, J. A. 1962. Effects of a drawdown on a waterfowl impoundment. Ecology 43(2):267-281.

KEY WORDS: drawdown, emergents, germination, nutrients, submergents, substrate, succession, waterfowl.

A definite increase in soil nutrients was noted following drawdown of a waterfowl pond. Effects of drawdown on vegetation and waterfowl usage of the area are also discussed.

329. Kadlec, J. A. and W. A. Wentz. 1974. State-of-the-Art Survey and Evaluation of Marsh Plant Establishment Techniques: Induced and Natural. Contract Report U. S. Army Waterways Exp. Sta. 230pp. + App.

KEY WORDS: adventive spread, afterripening, bibliography, brackish, colonization, communities, control, culture, dispersal, dormancy, drawdown, dredging, ecological range, emergents, ecotype, equipment, exotics, fertilizer, floating plants, floras, fragmentation, gemmipary, genotype, geography, germination, growth, hibernacula, machinery, marine, marsh, nutrients, phenotype, planting, pollution, ponds, Potamogeton, productivity, propagule sources, propagule storage, rhizomes, rootstocks, root systems, salinity, salt marsh, seedlings, seeds, seed production, site preparation, Spartina, submergents, substrate, succession, swamp, tides, tubers, turbidity, turions, vegetative propagation, vegetative reproduction, viability, waterfowl, waterlogging, weeds, zonation.

Planting of aquatic and marsh plants may be necessary under certain circumstances. Much of the time, however, environmental management can be used to promote the natural establishment of such plants. This paper presents a comprehensive review of the literature on this topic.

330. Karstiau, C. F. 1924. Natural regeneration of southern white cedar. Ecology 5:188-191.

KEY WORDS: Chamaecyparis, fire, germination, habitat, seed production, substrate, succession, swamp, viability.

Environmental requirements and reproductive capacity of Chamaecyparis thyoides are reviewed in connection with regeneration of swamplands.

331. Kassas, M. and M. A. Zahran. 1967. On the ecology of the Red Sea littoral salt marsh, Egypt. Ecol. Monogr. 37:297-316.

KEY WORDS: chloride, communities, geography, salinity, salt marsh, substrate, succession, zonation.

The vegetation of Red Sea salt marsh communities are correlated with salinity and alkalinity of the substrate.

332. Kearney, T. H. 1900. The plant covering of Ocracoke Island; a study in the ecology of the North Carolina strand vegetation. Contrib. U. S. Nat. Herb. 5(5):261-319.

KEY WORDS: communities, emergents, habitat, morphology, salt marsh, zonation.

The plant covering of Ocracoke Island including background information on climate, physiography, and soils is presented. Four major plant groups are defined and environmental characteristics correlated to the species of plants found on the island. The groups are: 1) sand-strand, 2) salt marsh, 3) pastures and ruderal plants, and 4) cultivated plants. The salt marsh vegetation is further defined as 1) creek-marsh formation, 2) dune-marsh formation, and 3) the tidal flats. Adaptations of anatomy of several salt marsh and strand plants are discussed on the cellular level.

333. Keefe, C. W. and W. R. Boynton. 1973. Standing crop of salt marshes surrounding Chincoteague Bay, Maryland-Virginia. Chesapeake Sci. 14(2):117-123.

KEY WORDS: biomass, nutrients, productivity, salt marsh, Spartina.

Standing crops of Spartina alterniflora ranged from 427 to 558 g dry matter per meter square and 335 to 470 g organic matter per meter square based on 20 samples taken during August, 1970. . Phosphorus and potassium were rapidly leached from dead plants while magnesium tended to be retained.

334. Keller, M. 1963. The growth and distribution of eelgrass (Zostera marina L.) in Humboldt Bay, Calif. M. Sc. Thesis, Humboldt State College.

KEY WORDS: geography, growth, life history, tides, turions, Zostera.

The eelgrass beds of the Humboldt Bay area were mapped and the distribution and density compared for the north and south portion of the bay. Eelgrass density is partly determined by hours of tidal coverage. Production increased with decreasing elevation.

335. Keller, M. and S. W. Harris. 1966. The growth of eelgrass in relation to tidal depth. J. Wildl. Manage 30(2):280-285.

KEY WORDS: biomass, depth, growth, tides, turions, Zostera.

The upper limit of Zostera marina growth was at or slightly above +1.0 foot below mean low tide. Over 90 percent of the total eelgrass biomass at this location and about 60 to 70 percent of eelgrass acreage occurred at or below mean lower-low tide.

336. Kelly, J. A., Jr., C. M. Fuss, Jr. and J. R. Hall. 1971. The transplanting and survival of turtlegrass, Thalassia testudinum, in Boca Ciega Bay, Florida. Fish, Bull. 69(2):273-280.

KEY WORDS: growth, morphology, planting, rhizomes, Thalassia, vegetative propagation.

Field experiments determined that use of the short shoots of Thalassia testudinum (without rhizomes) dipped in a solution of naphthalene acetic acid was the best method of transplanting. Other aspects of planting, care, and growth of the plsnts are considered.

337. Kennedy, C. 1924. The nutritive properties of wild rice. J. Agr. Res. 27:219-224.

KEY WORDS: commercial uses, nutrients, Zizania.

Wild rice has a greater food value than cultivated, polished rice because of better quality proteins and adequate amounts of vitamin B. It is, however, low in vitamin A and its overall food value is too low to warrant this grain as a staple food item.

338. Kennedy, D. and R. H. Mohlenbrock. 1963. Botanical observations and collections on a sandbar in the Ohio River. Castanea 28(2): 58-62.

KEY WORDS: colonization, habitat, succession.

The species, abundance, and habitat of aquatic vegetation on an 80 acre sand bar in the Ohio River are described. All stages of plant succession occurred on the continually moving sandbar.

339. King, L. J. 1966. The control of aquatic plants. pp. 372-378. In: Weeds of the World, Biology and Control. Plant Sci. Monographs, Leonard Hill Publ., London. 526pp.

KEY WORDS: control, herbicides, submergents, weeds.

The various techniques available for control of aquatic weeds are discussed and the important literature reviewed in this book. Specific data on rates of application of aromatic solvents and Acrolein are given for several species of submergent water weeds.

340. Klee, A. J. 1965. Light in the aquarium. II. The Aquarium 34(2):16-19,37.

KEY WORDS: light, seedlings, vegetative propagation.

Artificial lighting systems beneficial for aquatic plants (especially seedlings) are described.

341. Klugh, A. B. 1909. Excretion of sodium chloride by Spartina. Rhodora 11:237-238.

KEY WORDS: physiology, salinity, Spartina.

Field and laboratory observations show that Spartina glabra alterniflora has the ability to excrete salt from its leaves.

342. Kormondy, E. J. 1969. Comparative ecology of sandspit ponds. Am. Midl. Nat. 82(1):28-61.

KEY WORDS: invertebrates, succession.

Descriptions of the vegetation of sandspit ponds of varying ages at Presque Isle, Pennsylvania are given; limnology, plankton, and invertebrates are also discussed.

343. Krummes, W. T. 1940. The muskrat: a factor in waterfowl habitat management. N. Am. Wildl. Conf., Trans. 5:395-398.

KEY WORDS: growth, marsh, planting, site preparation, waterfowl.

Control of muskrats is essential to prevent damage to dikes and to recent plantings. After plants have become established, muskrats should be encouraged to maintain open areas.

344. Kubichek, W. F. 1940. Collecting and storing seeds of waterfowl food plants for propagation. N. Am. Wildl. Conf., Trans. 5: 364-368.

KEY WORDS: harvest, propagule storage, seeds, waterfowl.

Collection and storage of seeds, times and costs of plantings, and yields of the more important waterfowl foods are discussed. Methods of harvesting seed and whole plants and construction plans for a wet-storage cellar are detailed.

345. Laing, H. E. 1941. Effect of concentration of oxygen and pressure of water upon growth of rhizomes of semi-submerged water plants. Bot. Gaz. 102:712-724.

KEY WORDS: depth, emergents, oxygen, respiration, root systems, substrate.

Adaptation of the different species of emergent water plants to various depths of water is at least partly due to different oxygen requirements for maximum growth of the young shoots.

346. Lambert, J. M. 1945. The distribution and status of Glyceria maxima (Hartm.) Holmb. in the region of Surlingham and Rockland Broads, Norfolk. J. Ecol. 33(2):230-267.

KEY WORDS: communities, Glyceria, Phragmites, phytosociology, succession, tides.

Plant communities and successional patterns in peat areas with tidal activity are described. Glyceria and Phragmites are primary invaders on such areas.

347. Lambert, J. M. 1947. Glyceria maxima (Hartm.) Holmb. J. Ecol. 34(2):310-344.

KEY WORDS: dispersal, germination, Glyceria, growth, habitat, life history, seed production.

A life history study of the grass Glyceria maxima in England.

348. Larimer, E. J. 1969. An investigation of possibilities for creating salt marsh in the estuaries of the Atlantic and Gulf coasts. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 22:82-88.

KEY WORDS: colonization, planting, salt marsh, succession.

Survey of available literature and consultation with biologists and ecologists produced very little useful information on the establishment of salt marshes on unstable substrates.

349. Larson, J. S. 1973. A guide to important characteristics and values of freshwater wetlands in the northeast. Water Resour. Res. Center, Univ. Mass. at Amherst, Pub. 31. 35pp.

KEY WORDS: bogs, commercial uses, drainage, floods, marsh, waterfowl.

This publication defines the wetlands of Massachusetts for use in legislation and discusses various aspects of their formation and usage. These aspects include: wetlands and groundwater, visual-cultural values of wetlands, wildlife and wetlands, wetlands and floods, and the economics of preserving wetlands.

350. LaRue, C. D. and G. S. Avery, Jr. 1938. The development of the embryo of Zizania aquatica in the seed and in artificial culture. Bull. Torrey Bot. Club 65(1):11-21.

KEY WORDS: afterripening, dormancy, germination, morphology, seeds, Zizania.

It was found that mature, but unripe, Zizania seeds required no rest period for germination when planted immediately, but when the seeds were fully ripened, they did require a period of dormancy.

351. Lathwell, D. J., H. F. Mulligan and D. R. Bauldin. 1969. Chemical properties, physical properties and plant growth in twenty artificial marshes. N. Y. Fish & Game J. 16(2):158-183.

KEY WORDS: growth, iron, marshes, nutrients, productivity, substrate.

Additions of organic matter to the bottom soils of marshes resulted in increased plant growth early in the study but in later years had little affect. Rates of increase and decrease for iron, manganese, and alkalinity are given. At the conclusion of this stage of study, factors controlling productivity in these marshes were still uncertain, but greater plant growth was noted to occur in the shallower marshes.

352. Lathwell, D. J., D. R. Bouldin and E. A. Goyette. 1973. Growth and chemical composition of aquatic plants in twenty artificial wildlife marshes. N. Y. Fish & Game J. 20(2):108-146.

KEY WORDS: biomass, calcium, emergents, iron, magnesium, nitrogen, nutrients, phosphorus, planting, potassium, productivity, submergents.

Measurements of growth and chemical composition of aquatic plants from 20 artificial marshes were made 10 years after construction. Standing crops ranged from 800 g/m^2 in shallow marshes to 300 g/m^2 in the deepest marshes. Standing crops of emergent vegetation were 3 to 5 times greater than those of submerged vegetation. Submergents had a high ash content. There was little difference in nitrogen and phosphorus content of emergents and submergents.

353. Lawrence, D. B. 1949. Self-erecting habit of seedling red mangroves (Rhizophora mangle L.). Am. J. Bot. 36:426-427.

KEY WORDS: germination, Rhizophora, seedlings.

The germination of Rhizophora mangle seeds takes place on the parent tree; upon falling, seeds lie horizontally until they eventually turn vertically with the development of roots.

354. Lazenby, A. 1955. Germination and establishment of Juncus effusus L. I. The effect of different companion species and variation in in soil and fertility conditions. J. Ecol. 43(1):103-119.

KEY WORDS: fertilizer, germination, growth, Juncus, nutrients, seedlings, substrate, weeds.

The importance of Juncus effusus as an agricultural weed is discussed. Substrate type and fertility had little affect on on initial establishment, but high fertility resulted in greater total growth.

355. Lazenby, A. 1955. Germination and establishment of Juncus effusus L. II. The interaction effects of moisture and competition. J. Ecol. 43(2):595-605.

KEY WORDS: competition, germination, Juncus, waterlogging.

A water table at the soil surface was found to be nearly essential for the growth of Juncus effusus. Plants survived 16 weeks with the water table at -2 inches, but a lower water table resulted in no survival.

356. Leach, J. H. 1971. Hydrology of the Ythan Estuary with reference to distribution of major nutrients and detritus. J. Mar. Biol. Assoc. U. K. 51:137-151.

KEY WORDS: carbon, drainage, nitrate, nutrients, phosphate, salinity, tides.

A short, shallow estuary in northeastern Scotland was surveyed over a two year period. Flushing time for mean tides, horizontal salinity gradients, channel salinities, mean temperatures, and nutrient gradients were some of the factors analyzed as related to horizontal and vertical gradients in the estuary.

357. LeBarron, R. K. and J. R. Neetzel. 1942. Drainage of forested swamps. Ecology 23:457-465.

KEY WORDS: drainage, growth, swamp, Thuja.

Thuja occidentalis showed a marked increase in growth after drainage ditches were created on either side of the stand.

358. Lesko, G. L. and R. B. Walker. 1969. Effect of sea water on seed germination in two Pacific atoll beach species. Ecology 50(4):730-734.

KEY WORDS: germination, salinity, seeds.

The germination of most halophyte seeds is inhibited by a 1.0 to 1.5 percent salt solution. Seeds of Scaevola taccada and Messersclamidia argentea were investigated for germination properties.

359. Levin, M. H. (Ed.) no date. Ocean County tidal wetlands, ecological management and the law. Environmental Res. Assoc., Devon, Pa. 57pp.

KEY WORDS: germination, planting, salt marsh, Spartina, tides.

This general discussion of salt marsh problems (primarily loss to expanding activities of man) presents some discussion of Spartina ecology and planting.

360. Lewis, W. M. and M. Bender. 1961. Effect of a cover of duckweeds and the alga Pithophora upon the dissolved oxygen and free carbon dioxide of small ponds. Ecology 42:602-603.

KEY WORDS: aeration, carbon dioxide, Lemna, oxygen, ponds.

Extensive coverings of duckweed on ponds can cause severe depletion of dissolved oxygen and a corresponding increase in carbon dioxide based on a survey of six ponds.

361. Linde, A. F. 1969. Techniques for wetland management. Wisc. Dep. Nat. Resour., Res. Rep. 45. 156pp.

KEY WORDS: bibliography, communities, control, culture, depth, drainage, drawdown, dredging, emergents, equipment, fire, germination, herbicides, machinery, marsh, nutrients, planting, seeds, site preparation, submergents, substrate, waterfowl, weeds, zonation.

Wetland management techniques for waterfowl are discussed in great detail. Particular emphasis is given to Wisconsin and northern Great Lakes areas.

362. Lindsey, A. A., R. O. Pettly, D. K. Sterling and W. Van Asdall. 1961. Vegetation and environment along the Wabash and Tippecanoe Rivers. Ecol. Monogr. 31:105-156.

KEY WORDS: colonization, communities, dispersal, flooding, substrate, succession, turbidity, zonation.

Pioneer plant communities on river islands of local sediment accumulations are described as to species composition and water level relations.

363. Linduska, J. P. (Ed.). 1964. Waterfowl Tomorrow. U. S. Fish & Wildl. Serv., Wash., D. C. 770pp.

KEY WORDS: bogs, control, depth, drainage, drawdown, emergents, flooding, herbicides, nutrients, planting, seeds, submergents, substrate, succession, waterfowl.

At least five chapters in this book deal with marsh plants, especially as related to waterfowl useage. Methods of planting, the function of drawdowns, research in water chemistry, control by herbicides, and general information on plant species uses are discussed.

364. Linthurst, R. A. and R. J. Reimold. 1973. Existing aerial photographic resources of coastal Georgia and a brief listing of interpretive aids. Georgia Mar. Sci. Center, Tech, Rep. Ser. 73-4. 41pp.

KEY WORDS: dredging, salt marsh.

Recent interest and examination of remote sensing has demonstrated that it is undoubtedly pertinent in assessing the primary productivity of salt marsh areas, assisting in the location of the least detrimental prospective highway sites across wetlands, and recommending dredge spoil disposal sites along coastal waterways. This report summarizes the available reservoir of photographic information of the Georgia coast.

365. Lippert, B. E. and D. L. J. Jameson. 1964. Plant succession in temporary ponds of the Willamette Valley, Oregon. Am. Midl. Nat. 71(1):181-197.

KEY WORDS: depth, emergents, flooding, succession, zonation.

Plant zones of temporary ponds, their relation to depth of water, flooding, and traditional successional patterns are described.

366. Low, J. B. and F. C. Bellrose, Jr. 1944. The seed and vegetative yield of waterfowl food plants in the Illinois River Valley. J. Wildl. Manage. 8(1):7-22.

KEY WORDS: competition, drawdown, emergents, equipment, flooding, growth, seeds, seed production, submergents, turbidity, waterfowl.

Seed production rates and the general ecological relations of important waterfowl food plants are discussed.

367. Loveless, C. M. 1959. A study of the vegetation in the Florida Everglades. Ecology 40:1-9.

KEY WORDS: communities, emergents, fire, flooding, succession.

The plant communities of the Everglades are described. Some discussion of factors controlling plant communities is given.

368. Lundegardh-Ericson, C. 1972. Changes during four years in the aquatic macrovegetation in a Flad in N. Stockholm archipelago. Svensk Bot. Tidskrift 66(3):207-225.

KEY WORDS: emergents, habitat, Lemna, Najas, Phragmites, rhizomes, substrate.

The distribution and distributional changes of 16 aquatic species in a shallow Swedish bay are discussed in relation to water chemistry, water level relations, and substrate.

369. Lyford, J. H., Jr. and H. K. Phinney. 1968. Primary productivity and community structures of an estuarine impoundment. Ecology 49(5):854-866.

KEY WORDS: communities, productivity, salinity, succession.

Primary productivity, community metabolism, and community structure (mostly algae) were studied in an impounded estuary with relation to salinity, and temporal and seasonal succession.

370. Lynch, J. J., T. O. O'Neil and D. W. Lay. 1947. Management significance of damage by geese and muskrats to Gulf Coast marshes. J. Wildl. Manage. 11(1):50-76.

KEY WORDS: dispersal, dormancy, fire, flooding, germination, marsh, rhizomes, seeds, site preparation, succession, vegetative propagation, waterfowl.

The effects of wildlife damage, salinity, and water level fluctuations on various marsh plants is outlined. Dispersal and germination requirements for several kinds of seed, and vegetative growth are discussed.

371. MacNamara, L. G. 1949. Salt-marsh development at Tuckahoe, New Jersey. N. Am. Wildl. Conf., Trans. 14:100-117.

KEY WORDS: drawdown, flooding, marsh, seed production.

Typical salt marshlands on the coast of New Jersey were diked and 7 freshwater impoundments created. Management of these areas by complete and partial drawdowns resulted in varying degrees of cover by waterfowl food plants. A complete drawdown produced the greatest amount of aquatic vegetation. Eight inches of water over an impoundment resulted in poorer waterfowl food production but was more satisfactory as muskrat habitat. An inventory of plants on two of the experimental areas is given.

372. Maddox, D. M., L. A. Andres, R. D. Hennessey, R. D. Blackburn and N. R. Spencer. 1971. Insects to control alligatorweed. Bioscience 21(19):985-991.

KEY WORDS: adventive spread, Alternanthera, control, exotics, floating plants, geography, herbicides, weeds.

A discussion of the undesirable results of uncontrolled growth of Alternanthera, the usefulness of herbicides, and the selection and effectiveness of certain insects for use in control is presented.

373. Madhok, M. B. and Fazal-Uddin. 1945. Losses of nitrous nitrogen from soils on desiccation. Nature 156:49-50.

KEY WORDS: drawdown, nitrogen, substrate.

Nitrogen escapes from desiccating soils upon decay of organic nitrogen.

374. Mall, R. E. 1969. Soil-water-salt relationships of waterfowl food plants in Suisun Marsh of California. Calif. Dep. Fish & Game, Wildl. Bull. 1. 59pp.

KEY WORDS: emergents, nutrients, salinity, submergents, substrate, waterfowl, zonation.

Length of soil submergence was the most important factor influencing plant distribution and competitive ability. Soil salinity ranked second. Multiple regression curves showing the functional relationships between these factors and competitive ability were developed for six plant species.

375. Mandossian, A. and R. P. McIntosh. 1960. Vegetation zonation on the shore of a small lake. Am. Midl. Nat. 64:301-308.

KEY WORDS: communities, emergents, pond, submergents, substrate, zonation.

The vegetation composition and distribution on two different types of substrates (sand and muck) were examined after a lowering of the water table in a snall Michigan lake. Near the water's edge the vegetation became increasingly dissimilar as the transects progressed toward land (former shoreline).

376. Mann, K. H. 1973. Seaweeds: their productivity and strategy for growth. Science 182:975-981.

KEY WORDS: biomass, growth, light, phenology, productivity, submergents, zonation.

Growth at the base of the kelp blade was found to be almost equalled by erosion at the tip. All three species of kelp studied renewed the tissue in their blades between one and five times a year. Also increase in biomass was roughly proportional to the square of the increase in length, hence the biomass of new tissue was up to 20 times the initial biomass of the blade. The productivity of Thalassia, Zostera, Spartina, and Rhizophora are compared to the kelps.

377. Marchant, C. J. 1970. Chromosome pairing and fertility in Spartina caespitosa. Can. J. Bot 48:183-188.

KEY WORDS: hybrids, seed production, Spartina.

A detailed study of meiosis and breeding behavior in Spartina X caespitosa has revealed regular meiotic pairing, relatively high pollen stainability, and a low seed set in the hybrid when backcrossed.

378. Marchant, C. J. and P. J. Goodman. 1969. Spartina alterniflora Loisel. J. Ecol. 57(1):291-295.

KEY WORDS: depth, habitat, life history, rhizomes, Spartina.

A life history of Spartina alterniflora in Europe.

379. Marchant, C. J. and P. J. Goodman. 1969. Spartina glabra Muhl. J. Ecol. 57(1):295-297.

KEY WORDS: habitat, life history, rhizomes, seeds, seed production, Spartina.

A life history account of Spartina glabra including information on moisture and temperature relations, seed germination and viability, and morphology.

380. Marchant, C. J. and P. J. Goodman. 1969. Spartina maritima (Curtis) Fernald. J. Ecol. 57(1):287-291.

KEY WORDS: depth, life history, morphology, rhizomes, seed production, Spartina.

A life history of the only native European Spartina.

381. Marsh, A. S. 1915. The maritime ecology of Holme next the Sea, Norfolk. J. Ecol. 3(2):65-93.

KEY WORDS: communities, emergents, salt marsh, substrate, succession, tides, zonation.

A descriptive study of an area in England on the North Sea; shingle formation, sand dune formation, and salt marsh formation are described in relation to physical processes and vegetation. Information on the mechanical analysis of salt marsh soils is included.

382. Marsh, G. A. 1973. The Zostera epifaunal community in the York River, Virginia. Chesapeake Sci. 14(2):87-97.

KEY WORDS: biomass, epiphytes, growth, invertebrates, Zostera.

A total of 112 invertebrate species was collected over 14 months from 3 different Zostera marina beds in different water depths. A discussion of growth characteristics and biomass measurements of Zostera is included. Standing crop biomass determinations of Zostera were made in all but the first 3 collecting periods; the peak of biomass was reached in June and subsequent exfoliation caused a decline through December. New growth began about March. A species list of invertebrates of the Zostera communities is given.

383. Martin, A. C. 1951. Identifying pondweed seeds eaten by ducks. J. Wildl. Manage. 15(3):253-258.

KEY WORDS: keys, Potamogeton, seeds.

Twenty-one species of Potamogeton seeds are shown. Written descriptions are also provided.

384. Martin, A. C. 1954. Identifying Polygonum seeds. J. Wildl. Manage. 18:514-520.

KEY WORDS: keys, Polygonum, seeds.

Twenty-two species of Polygonum seeds are illustrated. Keys to the species are provided.

385. Martin, A. C. 1955. Another waterchestnut infestation. J. Wildl. Manage. 19(4): 504-505.

KEY WORDS: adventive spread, dispersal, exotics, geography, germination, habitat, seed production, Trapa.

The spread of Trapa natans in New England is documented and some life history information is given, especially on reproduction.

386. Martin, A. C. and F. M. Uhler. 1939. Food of game ducks in the United States and Canada. U. S. D. A. Tech. Bull. 634. 157pp.

KEY WORDS: bibliography, control, emergents, harvest, planting, propagule sources, propagule storage, seeds, submergents, substrate, tubers, turions, vegetative propagation, waterfowl, weeds.

This classic volume discusses all aspects of the food habits of waterfowl, and the propagation of duck food plants.

387. Martin, W. E. 1959. The vegetation of Island Beach State Park, New Jersey. Ecol. Monogr. 29:1-46.

KEY WORDS: communities, emergents, habitat, salinity, salt marsh, zonation.

Six plant communities of a New Jersey barrier beach are described. The topography is the major controlling factor in this zoned mosaic of plant communities. While salt spray intensity is responsible for the existence of herbaceous, shrubby, and arborescent zones on the beach, tidal action and ground water salinities are the primary factors influencing the marsh zones.

388. Mason, H. L. 1957. A Flora of the Marshes of California. Univ. of Calif. Press, Berkeley. 878pp.

KEY WORDS: geography, habitat, keys, taxonomy.

Keys, descriptions, habitats, and geographic ranges of the aquatic and marsh plants of California and the western U. S. are provided in this book.

389. Mason, H. L. 1973. Marsh Studies: San Francisco Bay and estuary dredge disposal study use of dredged material for marshland development. San Francisco Bay Mar. Res. Center, Lafayette. 87pp.

KEY WORDS: aeration, auxins, bibliography, costs, disease, dredging, germination, harvest, nutrients, planting, propagule storage, Salicornia, salt marsh, seeds, Spartina, substrate, succession, zonation.

The importance of Spartina in the salt marsh and the correlation of salt marsh productivity with fisheries is discussed. Propagation methods of Spartina and Salicornia on 4 different substrates and the raising of plants from seed for transplanting were investigated. The biotic and physical features of a typical salt marsh were described in order to serve as baseline information for the building of salt marshes.

390. Matheson, R. 1930. The utilization of aquatic plants as aids in mosquito control. Am. Naturalist 64(690):56-86.

KEY WORDS: Azolla, Chara, floating plants, Lemna, mosquitoes, Utricularia, Wolffia.

Carnivorous plants such as Utricularia vulgaris may aid in the control of mosquitoes by engulfing larvae; Azolla filiculoides, Lemna spp., Wolffia spp. and similar plants which form a dense water covering are a deterrent to mosquito egg laying. Members of the Characeae are strong deterrents to both oviposition and larval development of several mosquito species; reasons for this are discussed.

391. Mathiak, H. A. 1971. Observations on changes in the status of cattails at Horicon Marsh, Wisconsin. Wisc. Dep. Nat. Resour., Res. Rep. 66. 17pp.

KEY WORDS: control, drawdown, floodings, Typha.

Major die-offs of cattail, which had become established during periods of drawdown, were attributed to continuous flooding of new cattail growth and the destructive activities of muskrats.

392. Matthews, J. R. 1914. The White Moss Loch: a study in biotic succession. New Phytol 13:134-148.

KEY WORDS: communities, emergents, lakes, submergents, substrate, succession, zonation.

The species of plants in several zones of a mid-Scotland lake are described and the successional patterns of communities diagrammed.

393. Maurer, L. G. and P. L. Parker. 1967. Fatty acids in sea grasses and marsh plants. Contrib. Mar. Sci. 6:113-119.

KEY WORDS: marine, nutrients, submergents.

The composition of the fatty acids in nine species of seagrasses and marsh plants was determined. None were found to differ much from the fatty acid patterns of terrestrial plants, but definite differences in composition between plant parts were noted.

394. Mayer, F. L. and J. B. Low. 1970. The effect of salinity on wigeongrass. J. Wildl. Manage. 34(3):658-661.

KEY WORDS: germination, Ruppia, salinity, seeds, seed production.

Ruppia maritima seeds germinated best in fresh water. Seed production and growth were greatest in water with salinities up to 12,000 ppm.

395. McAtee, W. L. 1939. Wildfowl Food Plants, Their Value, Propagation, and Management. Collegiate Press, Inc., Ames, Iowa. 141pp.

KEY WORDS: brackish, control, depth, emergents, habitat, light, nutrients, planting, pollution, productivity, propagule storage, salinity, submergents, turbidity, waterfowl.

Aquatic plants have much to offer both man and wildlife due to high productivity and good nutrient content. Many aquatic plant families are described as to habitat and morphology, the more important species are shown in photographs. Environmental limitations on growth are discussed and planting techniques outlined.

396. McAtee, W. L. 1947. Distribution of seeds by birds. Am. Midl. Nat. 38:214-223.

KEY WORDS: bibliography, dispersal, seeds, waterfowl.

Dissemination of seeds by waterfowl due to the seeds adhering to their feathers is far more common than these birds transporting seeds in mud on their legs. An annotated references section to literature concerned with seed dispersal by birds is given.

397. McCombie, A. M. and I. Wile. 1971. Ecology of aquatic vascular plants in southern Ontario impoundments. Weed Sci. 19:225-228.

KEY WORDS: Chara, communities, Elodea, habitat, Potamogeton.

The growth of aquatic vascular plants in 19 ponds and lakes is related to several environmental factors: conductivity, fertility, turbidity, and depth of the water. Data on habitat preference are listed for Chara spp., Elodea canadensis, and Potamogeton spp. The species composition of plant communities are related to local differences in the watershed; certain aquatic species are specified as indicator organisms of local conditions.

398. McCrea, R. H. 1926. The salt marsh vegetation of Little Island, Co. Cork. J. Ecol. 14:342-346.

KEY WORDS: emergents, salinity, salt marsh.

The vegetation of Little Island in Britain is listed and correlated with salinity and vertical distribution.

399. McCully, M. and H. M. Dale. 1961. Heterophylly in Hippuris, a problem in identification. Can. J. Bot. 39(5):1099-1116.

KEY WORDS: geography, habitat, Hippuris, rhizomes, salinity.

Hippuris vulgaris was collected from several locations in Canada; the ecology of both the aerial and underwater habit of this plant is described.

400. McDonald, M. E. 1955. Cause and effects of a die-off of emergent vegetation. J. Wildl. Manage. 19(1):24-35.

KEY WORDS: colonization, emergents, habitat, marsh, submergents, succession, Typha.

A die-off of Typha stands allowed the tracing of the patterns of reinvasion by submergents and emergents. This Lake Erie marsh was rapidly invaded by many species.

401. McGahee, C. F. and G. J. Davis. 1971. Photosynthesis and respiration in Myriophyllum spicatum L. Limnol. Oceanogr. 16(5): 426-429.

KEY WORDS: light, Myriophyllum, photosynthesis, respiration, salinity.

The depression of photosynthesis at high salinities is assumed to play a part in controlling the natural distribution of Myriophyllum spicatum in estuaries.

402. McGilvrey, F. B. 1964. Effects of elimination of alligatorweed on certain aquatic plants and the value of these plants as waterfowl foods. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 18:73-79.

KEY WORDS: Alternanthera, floating plants, herbicide, waterfowl, weeds.

The effects of elimination of alligatorweed (Alternanthera philoxeroides) by granular silvex on the abundance of 12 species of aquatic plants were studied in South Carolina from 1961 to 1964. Three hundred and sixty duck stomachs were collected from hunters during the 1961 hunting season to determine the importance of these 12 plants as waterfowl food.

403. McMahan, C. A. 1968. Biomass and salinity tolerance of shoalgrass and manateegrass in Lower Laguna Madre, Texas. J. Wildl. Manage. 32(3):501-506.

KEY WORDS: biomass, Diplanthera, growth, salinity, submergents, Syringodium.

Diplanthera wrightii has a salinity tolerance of 3.5 to 70.0 ppt. Syringodium filiforme is less tolerant and dies in water above 52.5 ppt.

404. McMillan, C. 1959. Salt tolerance within a Typha population. Am. J. Bot. 46(7):521-526.

KEY WORDS: germination, salinity, seeds, Typha.

Typha angustifolia occupies drier sites and has greater salinity tolerance than T. latifolia. Seeds withstood 4 months submergence in a 2 percent salt solution and germinated on immersion in tapwater.

405. McMillan, C. 1970. Environmental factors affecting seedling establishment of the black mangrove on the central Texas coast. Ecology 52(5):927-930.

KEY WORDS: Avicennia, depth, salinity, seedlings, temperature, turbulence.

Salinity was determined not to be the chief factor limiting Avicennia germinans establishment. Water turbulence, however, inhibited root and seedling development, and high temperatures were fatal to stemless seedlings. Seedlings did not become established until water depth was reduced to 5 cm or less.

406. McMillan, C. and F. N. Moseley. 1967. Salinity tolerances of five marine spermatophytes of Redfish Bay, Texas. Ecology 48(3): 503-506.

KEY WORDS: Halodule, Ruppia, salinity, Syringodium, Thalassia.

Transplants indicated that salinity tolerances of the seagrasses follow the order of (highest tolerance to lowest): Halodule, Thalassia, Ruppia, and Syringodium.

407. McNaughton, S. J. 1966. Ecotype function in the Typha community type. Ecol. Monogr. 36:297-325.

KEY WORDS: biomass, colonization, communities, geography, germination, growth, phenology, physiology, productivity, salinity, seeds, Typha, vegetative reproduction.

Plants of Typha angustifolia, T. domingensis, and T. latifolia were collected from 33 sites in the United States for garden and controlled environment studies. Studies of salt tolerance, germination requirements, and morphological, phenological, biochemical, and production characteristics were completed. The studies indicate that the "physical and botanical components of the Typha ecosystem type vary synchronously in space to maintain an efficient integration of the two components."

408. McNaughton, S. J. 1966. Oxidase activity in ecotypic populations of Typha latifolia L. Nature 211:1377-1379.

KEY WORDS: ecotype, physiology, planting, rhizomes, Typha, vegetative propagation.

Changes in rhizome growth and biochemical activities were noted as transplanted cattail acclimatized to greenhouse conditions.

409. McNaughton, S. J. 1968. Autotoxic feedback in relation to germination and seedling growth in Typha latifolia. Ecology 49(2):367-369.

KEY WORDS: genotype, germination, invasion, seedlings, substrate, succession, Typha.

Seed germination of Typha latifolia was completely inhibited by an aqueous extract of cattail leaves but was only partially inhibited by extract treated with polyclar AT to remove phenolic compounds. Seedling growth was slightly inhibited by water from cattail marshes, was highly inhibited by water squeezed from soil in which cattails were growing, and was stimulated by water obtained from a Sphagnum bog. Cattail populations, once established, may thus preclude invasion by alien Typha genotypes.

410. McNaughton, S. J. 1973. Comparative photosynthesis of Quebec and California ecotypes of Typha latifolia. Ecology 49(2):367-369.

KEY WORDS: ecotype, oxygen, photosynthesis, physiology, Typha.

Typha latifolia was found to have relatively high photosynthetic rates; physiological differences between geographically separate ecotypes are discussed.

411. McRoy, C. P. 1970. Standing stocks and other features of eelgrass (Zostera marina) populations on the coast of Alaska. J. Fish. Res. Bd. Canada 27(10):1811-1821.

KEY WORDS: biomass, community, photosynthesis, productivity, turions, Zostera.

Zostera marina forms the major sea grass community along the coast of Alaska. Standing stocks varied from 65 to 1510 g dry wt/m^2. Caloric content averaged 4211 cal/g in the leaves and 3571 cal/g in roots and rhizomes. Chlorophyll a averaged 0.513 mg/g fresh weight. Population densities ranged from 599 to 4576 turions/m^2. Flowering plants accounted for 3 to 4 percent of the total population. Mean leaf length varied from 13 to 48 cm and width from 2.4 to 5.1 mm. The differences in the eelgrass populations appeared to be related to local conditions rather than a large geographical gradient.

412. McRoy, C. P. 1973. Seagrass Ecosystems: research recommendations of the International Seagrass Workshop. Intl. Seagrass Wkshp., Leiden, The Netherlands. 62pp.

KEY WORDS: decomposition, marine, physiology, planting, pollution, productivity, seedlings, submergents, substrate, taxonomy, turions.

Additional research is needed into all aspects of the biology of the seagrasses. Seagrass communities are especially valuable as primary producers and substrate stabilizers in coastal areas.

413. McRoy, C. P. and R. C. Phillips. 1968. Supplementary bibliography on eelgrass, Zostera marina. U. S. Bur. Sport Fish. & Wildl., Spec. Sci. Rep. — Wildl. 114. 14pp.

KEY WORDS: bibliography, chloride, diseases, ecological range, productivity, submergents, waterfowl, Zostera.

This second bibliography on Zostera marina adds 204 references to the earlier list by R. C. Phillips and brings the listing of literature current to 1966.

414. McRoy, C. P. and J. J. Goering. 1974. Nutrient transfer between the seagrass Zostera marina and its epiphytes. Nature 248:173-174.

KEY WORDS: carbon, epiphytes, nitrogen, Zostera.

The results of several carefully controlled experiments to determine the role of algal epiphytes on Zostera marina plants in Alaska indicate a direct transfer of carbon and nitrogen from Zostera to the epiphytes. Labelled N and C were absorbed from solution by the root-rhizome system of the plant and the labels were subsequently transported to all parts of the plants and to the algal (mostly diatom) epiphytes. Transfer probably occurs by leakage of organic or inorganic compounds from the eelgrass and subsequent uptake by the algae.

415. McRoy, C. P., J. J. Goering and B. Chaney. 1973. Nitrogen fixation associated with seagrasses. Limnol. Oceanogr. 18(6):998-1002.

KEY WORDS: nitrogen, Syringodium, Thalassia, Zostera.

The nitrogen fixing ability of three species of seagrasses — Thalassia testudinum and Syringodium filiforme from Florida and Zostera marina from North Carolina and Alaska — was examined. Rates of nitrogen fixation were extremely low or undetectable. Due to variability in experimental techniques and the condition of the eelgrass plants, the question of nitrogen sources in eelgrass beds is not yet adequately answered.

416. McRoy, C. P. and R. J. Barsdate. 1970. Phosphate absorption in eelgrass. Limnol. Oceanogr. 15(1):6-13.

KEY WORDS: absorption, phosphate, physiology, Zostera.

Absorption of phosphate by eelgrass was greatest in the light and occurred in both leaves and roots; some was returned to the surrounding water through the leaves.

417. McRoy, C. P., R. J. Barsdate and M. Nebert. 1972. Phosphorus cycling in an eelgrass (Zostera marina L.) ecosystem. Limnol. Oceanogr. 17(1):58-67.

KEY WORDS: absorption, phosphorus, substrate, Zostera.

Rates of uptake and excretion of phosphorus by both root and leaves of eelgrass were dependent on the orthophosphate concentration of the medium.

418. McVaugh, R. 1957. Establishment of vegetation on sand flats along the Hudson River, New York. II. The period 1945-1955. Ecology 38:23-29.

KEY WORDS: colonization, communities, dredging, substrate, succession.

No distinct pattern of succession of herbaceous species was discernible on sand flats formed by dredging 20 years previously in the Hudson River. Thickets of Robinia, Rhus, and Salix formed the major vegetation communities of the sand bars.

419. McVean, D. N. 1959. Ecology of Alnus glutinusa (L.) Gaerth. VII. Establishment of alder by direct seeding of shallow blanket bog. J. Ecol. 47:615-618.

KEY WORDS: Alnus, bog, fertilizer, planting, site preparation.

Alder can be successfully established by direct sowing methods (on glacial till substrate) where there is some irrigation with peat-free water. Phosphate fertilizer is essential and the use of an inoculum of crushed nodules is advisable on the more acid sites. Ground preparation is not required.

420. Meeks, R. L. 1969. The effect of drawdown date on wetland plant succession. J. Wildl. Manage. 33(4):817-821.

KEY WORDS: drawdown, emergents, succession, waterfowl.

Seven years of experimental drawdown on a waterfowl management unit revealed that annual drawdowns tend to change the species composition from semi-aquatic to annual weeds, and that May drawdowns produced the best results for wildlife foods.

421. Meyer, B. S., F. H. Bell, L. C. Thompson and E. I. Caly. 1943. Effect of depth of immersion on apparent photosynthesis in submerged vascular aquatics. Ecology 24:393-399.

KEY WORDS: depth, light, Najas, submergents, Vallisneria.

The compensation point for submergent aquatic plants collected in the western end of Lake Erie was found to be less than 2 percent of full sunlight except for Najas flexilis. Vallisneria americana can survive at the lowest light intensities of the species examined.

422. Meyer, B. C. and A. C. Heritage. 1941. Effect of turbidity and depth of immersion on apparent photosynthesis in Ceratophyllum demersum. Ecology 22:17-22.

KEY WORDS: Ceratophyllum, depth, light, photosynthesis, turbidity.

Maximum and minimum compensation points were determined for Ceratophyllum demersum in the western end of Lake Erie during 1938-39. On clear summer days the rate of apparent photosynthesis decreases with depth of submergence. No indications were found that the rate of photosynthesis was ever less in plants just under the surface than in plants at greater depths. Turbidity causes a marked reduction in photosynthesis at all depths. With minimum turbidity, the compensation point was between 8 and 10 meters; during maximum turbidity, the compensation point was between 1 and 2 meters.

423. Millar, J. B. 1969. Observations on the ecology of wetland vegetation. pp. 49-56. In: Saskatoon Wetlands Seminar. Canadian Wildl. Serv., Dep. Indian Affairs and Northern Dev., Rep. Ser. 6. 262pp.

KEY WORDS: colonization, depth, germination, habitat, salinity, Scirpus, site preparation, substrate, succession, Typha, zonation.

Because of violent fluctuations in pothole moisture regimes it is not surprising that rapid and extensive changes in vegetation are common. The effects of availability of seed, chemistry of the basin soil, climatic factors, mode of reproduction, competition, and human influences are discussed. Vegetation is also an indicator of pothole permanence and thus water levels. Development of techniques to reduce water loss by evaporation and seepage from reservoirs and the effects on aquatic vegetation are considered.

424. Millar, J. B. 1972. Vegetation changes in shallow marsh wetlands under improving moisture regime. Can. J. Bot. 51:1443-1457.

KEY WORDS: communities, control, emergents, flooding, germination, ponds, submergents, substrate, waterlogging.

Changes in species composition and plant cover were studied in relation to moisture regime over a 10 year period in 71 shallow marsh wetlands in the grassland and parkland regions of Saskatchewan. Two or more years of continuous flooding were required to eliminate emergent cover and convert the wetlands to open water.

425. Miller, A. W. and P. H. Arend. 1960. How to grow watergrass for ducks in California. Calif. Dep. Fish & Game, Game Manage. Leafl. 1. 16pp.

KEY WORDS: depth, Echinochloa, germination, growth, planting, site preparation, waterfowl.

The site requirements, planting, water level relations, and growth of Echinochloa crusgalli are discussed in relation to management. This species is useful as a waterfowl food plant and can be grown for relatively low costs. The plant tolerates moderately alkaline soils and can mature in 60 to 80 days. It prefers moist soil and mud flats, but can stand considerable flooding after establishment.

426. Miller, G. S. and P. C. Standley. 1912. The North American species of Nymphaea. Contrib. U. S. Nat. Herb. 16:1-109.

KEY WORDS: geography, morphology, Nymphaea, seeds.

Numerous species of Nymphaea are described as to growth habit and geographical distribution. Plates of leaf form and fruiting structures are included for most species.

427. Miller, W. B. 1962. Waterfowl habitat improvement in California. Ann. Conf. Western Assoc. State Fish & Game Comm., Proc. 7pp.

KEY WORDS: control, depth, drainage, fire, fishes, hybrids, mowing, ponds, salinity, Scirpus, site preparation, substrate, weeds, waterfowl.

Water level manipulation and subsequent control of salinities are the major wetland management tools in California and other hot western states where evaporation is high and water is expensive. However, drainage and cultivation are often used in the control of Typha spp. and Scirpus acutus, sometimes in connection with mowing and burning. Fire is used primarily to reduce the excessive accumulation of emergent plant material. Planting experiments then in progress are discussed.

428. Miller, W. R. and F. E. Egler. 1950. Vegetation of the Wequetequock-Pawcatuck Tidal Marshes, Connecticut. Ecol. Monogr. 20:143-172.

KEY WORDS: bibliography, communities, drainage, emergents, Iva, Juncus, mosquitoes, Panicum, Ruppia, salinity, salt marsh, Spartina, substrate, succession, tides, zonation.

The vegetation of this tidal marsh is a complex mosaic of many communities, correlated with tidal effects, average salinities, extreme salinities, surface levels, soil acidity, and peat development, compaction and disintegration.

429. Millspaugh, C. F. 1893. Pink water lilies. Bull. Torrey Bot. Club 22(1):21.

KEY WORDS: Castalia, tubers, viability.

Small tubers of Castalia odorata were brought to the surface by a plow on bottom land in West Virginia. The tubers grew quite well despite the fact that they were probably over 100 years old.

430. Milton, W. E. J. 1939. The occurrence of buried viable seeds in soils at different elevations and on a salt marsh. J. Ecol. 27(1):149-159.

KEY WORDS: salt marsh, seeds, substrate.

Samples collected in various community types contained seed primarily from the vegetation present at the time of collection. Some zones contained seed from other areas. Bare areas contained very little seed.

431. Minshall, W. H. 1959. Effect of light on the extension growth of roots of grogbit. Can. J. Bot. 37(5):1134-1136.

KEY WORDS: control, floating plants, growth, Hydrocharis, light, photosynthesis, root systems, vegetative propagation.

The rate of root growth in Hydrocharis morsus-ranae L. was examined under light and dark conditions. It was concluded that photosynthesis within each root produced growth.

432. Minshall, W. H. and G. W. Scarth. 1952. Effect of growth in acid media on the morphology, hydrogen-ion concentration, viscosity and permeability of water hyacinth, and frogbit root cells. Can. J. Bot. 30(2):188-208.

KEY WORDS: Eichornia, floating plants, growth, Hydrocharis, morphology, pH, root systems, temperature.

Roots of Eichornia crassipes and Hydrocharis morsus-ranae when grown in solution cultures adjusted to pH 3.5 to 6.5 and did not suffer decidedly direct adverse effects except below pH 4.

433. Misra, R. D. 1938. Edaphic factors in the distribution of aquatic plants in the English Lakes. J. Ecol. 26(2):411-451.

KEY WORDS: emergents, growth, lakes, nutrients, submergents, substrate.

Detailed analysis of the distribution and chemical nature of organic matter in an English Lake is correlated with the chemical composition of the aquatic plants growing therein.

434. Mitchell, D. S. 1969. The ecology of vascular hydrophytes on Lake Kariba. Hydrobiologia 34(3-4):448-464.

KEY WORDS: emergents, habitat, lakes, succession, sudd.

The main events in the development of the vascular hydrophyte flora of Lake Kariba are reviewed on the basis of the growth forms present in the lake. Salvinia auriculata is the dominant free floating plant and a characteristic community of plants has been found colonizing Salvinia sudds.

435. Mitchell, R. S. 1971. A guide to aquatic smartweeds (Polygonum) of the United States. Virginia Polyt. Inst., Water Resour. Res. Comm. Bull. 41. 52pp.

KEY WORDS: geography, germination, hybrids, keys, life history, planting, Polygonum, vegetative propagation.

Proper conditions for optimum growth and planting of Polygonum are discussed. Research is needed for the development of hybrids for better waterfowl food.

436. Modin, R. F. 1970. Aquatic plant survey of Milwaukee River watershed lakes. Wisc. Dep. Nat. Resour., Res. Rep. 52.

KEY WORDS: emergents, lakes, light, marl, submergents, substrate.

Factors affecting the distribution of aquatic plants in several Wisconsin Lakes are determined. In general, situations of extensive shallows, clear water, and muck bottoms supported the highest densities of plants.

437. Mohlenbrock, R. H., G. E. Dillard and R. S. Abney. 1961. A survey of southern Illinois aquatic vascular plants. Ohio J. Sci. 61(5): 262-273.

KEY WORDS: emergents, floras, geography, habitat, lakes, submergents, swamp

A short discussion with reference to aquatic plant habitats is followed by a checklist.

438. Monk, C. D. 1966. An ecological study of hardwood swamps in north-central Florida. Ecology 47(4):649-654.

KEY WORDS: communities, calcium, magnesium, pH, substrate, swamp.

The hardwood swamps of north-central Florida may be divided into two groups: mixed swamps, and bayheads. The former is characterized by deciduous species and the latter by evergreen species. Mixed swamps occupy sites which are usually higher in Ca, Mg, Ca/Mg ratios, pH, and depth of maximum flooding.

439. Moore, D. R. 1963. Distribution of the sea grass, Thalassia in the United States. Bull. Mar. Sci. Gulf & Caribb. 13(2):329-342.

KEY WORDS: geography, habitat, ecological range, salinity, Thalassia, turbidity.

Thalassia testudinum is limited in the north by low temperatures. Optimum growth occurs in a salinity range of 25 to 40 ppt. Turbidity and desiccation are not tolerated and Thalassia is rarely found in depths greater than 8 meters.

440. Moore, E. 1913. Potamogetons in relation to pond culture. Bull. Bur. Fish., vol. 33, Doc. 815, issued July 1915 by G.P.O.

KEY WORDS: bibliography, growth, habitat, life history, morphology, Potamogeton, seed production, submergents, substrate, taxonomy, tubers, vegetative propagation.

Included in this bulletin is a review of the literature, a general survey of life conditions of the species, a summary of these plants' value to man, methods of propagation, and about 75 plates of the species and various morphological features of Potamogetons.

441. Mooring, M. T., A. W. Cooper and E. D. Seneca. 1971. Seed germination and evidence for height ecophenes in Spartina alterniflora from North Carolina. Am. J. Bot. 58(1):48-55.

KEY WORDS: ecotype, germination, growth, propagule storage, salinity, seedlings, seeds, Spartina, temperature, viability.

Seeds of Spartina alterniflora connot withstand drying at moderate temperatures. Cold storage at 43 F is adequate to prevent desiccation up to 40 days, but after 8 months viability is lost. Viability is retained at least 8 months when seeds are stored in sea water at 43 F. Germination response was good in a 65-95F alternating diurnal thermoperiod, but poor at a constant 72F. High salinities inhibited germination. The maximum tolerance limit for germination is between 6 and 8 percent NaCl. Seeds from different growth forms responded similarly in storage and temperature studies. Seedlings grew taller in both 0.5 and 1.0 percent NaCl than in 0 percent NaCl. The height forms of S. alterniflora in North Carolina salt marshes are best described as ecophenes.

442. Morss, W. L. 1927. The plant colonization of merse lands in the estuary of the River Nith. J. Ecol. 15:310-343.

KEY WORDS: aeration, colonization, emergents, pH, salinity, substrate, tides, waterlogging, zonation.

The salt marshes of the Nith estuary, southwest Scotland, are mapped and five vegetation zones classified according to species composition and environmental conditions. Substrate composition is analyzed, and colonization of mud flats is also described.

443. Moyle, J. B. 1944. Wild rice in Minnesota. J. Wild. Manage. 8(3):177-184.

KEY WORDS: depth, germination, planting, propagule storage, seeds, sulfate, Zizania.

Zizania aquatica tolerates all ranges of alkalinity (in Minnesota, 5 to 250 ppm), but is intolerant of sulfates. For survival, plantings require clear water, organic soil, some water movement, little water level fluctuation, and the absence of carp.

444. Moyle, J. B. 1945. Some chemical factors influencing the distribution of aquatic plants in Minnesota. Am. Midl. Nat. 34(2):402-420.

KEY WORDS: culture, emergents, lakes, submergents, substrate.

The Minnesota aquatic flora can be separated on the basis of water quality tolerance and preference into three major groups: the soft-water flora, the hard-water flora, and the alkali- or sulfate-water flora. Vegetation species most characteristic of these types of water are discussed. Substrate type and physical characteristics of the water body greatly influence the local distribution of a species within its range of chemical tolerance.

445. Moyle, J. B. 1956. Relationships between the chemistry of Minnesota surface waters and wildlife management. J. Wildl. Manage. 20(3):303-320.

KEY WORDS: emergents, submergents, sulfate.

Aquatic vegetation in lakes of low total alkalinity (below 40 ppm) is usually sparse and is characterized by such species as Lobelia dortmanna, Eriocaulon septangulare, and Myriophyllum alterniflora. Najas marina, Ruppia maritima, and Scirpus palustris are generally limited to waters with a sulfate ion concentration greater than 50 ppm; best growth is in 200+ ppm.

446. Moyle, J. B. 1958. Review of literature on plant growth and water levels. Minn. Fish & Game Investig., Fish Ser. 1. pp. 35-45.

KEY WORDS: aeration, flooding, germination, growth, root systems.

The position of the water table as a factor in determining the distribution of plant cover types is discussed. Three general groups of plants are distinguished (aquatic, marsh and upland) and the water level tolerances of each are given.

447. Moyle, J. B. and N. Hotchkiss. 1945. The aquatic and marsh vegetation of Minnesota and its value to waterfowl. Minn. Dep. Cons., Tech. Bull. 3.

KEY WORDS: emergents, fishes, planting, propagule sources, substrate.

The soil, water, and other physical factors which affect the distribution and abundance of aquatic plants in Minnesota are discussed. Information on planting techniques and propagule collection for the more important wildlife food species is included.

448. Muenscher, W. C. 1936. The germination of seeds of Potamogeton. Ann. Bot. 50:805-822.

KEY WORDS: germination, hibernacula, Potamogeton, propagule storage, seeds, vegetative reproduction, viability.

High germination rates were obtained from water-stored seeds of all 18 species of Potamogeton tested. Seeds that had been air dried for 2 months or longer gave almost no germination.

449. Muenscher, W. C. 1936. Storage and germination of seeds of aquatic plants. N. Y. (Ithaca) Agr. Exp. Sta. Bull. 652. 17pp.

KEY WORDS: emergents, germination, propagule storage, seeds, submergents, temperature, viability.

Freshly harvested seeds of 43 species of aquatic plants were subjected to 4 storage treatments. The results of germination tests made on seeds of each species indicate that storage in water at a temperature just above freezing is the best of the treatments to insure viability and quick germination.

450. Muenscher, W. C. 1944. Aquatic Plants of the United States. Comstock Publ. Co., Inc., Ithaca, N. Y. 374pp.

KEY WORDS: emergents, floras, keys, submergents.

This monograph is a key with illustrations and descriptions of vascular aquatic plants based on field studies in most of the United States. Submersed and emersed species of fresh, brackish, and salt waters are treated.

451. Munro, W. L. 1967. Changes in waterfowl habitat with flooding on the Ottawa River. J. Wildl. Manage. 31(1):197-199.

KEY WORDS: colonization, depth, emergents, flooding, submergents, succession.

The colonization of a newly flooded riparian area (formerly forest) by herbaceous and woody species is recorded. No aquatic vegetation grew beneath standing trees.

452. Murray, D. F. 1970. Carex podocarpa and its allies in North America. Can. J. Bot. 48:313-324.

KEY WORDS: Carex, key, taxonomy.

Carex podocarpa R. Br. and five other species in the section Atratae, genus Carex (Cyperaceae), are discussed: C. macrochaeta, C. microchaeta, C. nesophila, C. paysonis, and C. spectabilis. The distinction of phyllopodic and aphyllopodic fertile culms is stressed as a primary dichotomy in this complex. Drawings of perigynia and scales are included for each taxon. A key to species is provided, and a new combination C. microchaeta ssp. nesophila, is proposed.

453. Neely, W. W. 1956. How long do duck foods last underwater? N. Am. Wildl. Conf., Trans. 21:191-198.

KEY WORDS: depth, emergents, seeds, viability, waterfowl.

Field measurements of comparative rates of deterioration were made by exposing samples of seeds underwater in trays or plastic screen envelopes. Percentage of deterioration was calculated by weighing the sample before and after exposure. Percentage deterioration after 90 days was highest in large seeded agricultural species and lowest in the rushes and other hard coated seeds.

454. Neely, W. W. 1962. Saline soils and brackish waters in management of wildlife, fish and shrimp. N. Am. Wildl. Conf., Trans. 27: 321-335.

KEY WORDS: brackish, emergents, planting, salinity, waterfowl.

Methods have been developed for the management of brackish water impoundments for shrimp and fish production and to grow duck foods. By means of repeated changes of water it is possible to reclaim some areas where catclays have become a problem. A listing of salinity tolerances of selected agricultural crops, native duck food plants, and other native plants is included.

455. Neely, W. W. 1967. Planting, disking, mowing, and grazing. pp. 212-219. In: J. D. Newsom (Ed.) Proc. Marsh and Estuary Management Symp. Louisiana State Univ., T. J. Moran's Sons, Inc., Baton Rouge. 250pp.

KEY WORDS: drawdown, emergents, flooding, machinery, mowing, planting, salt marsh, substrate, sulfate, waterfowl.

The history of diked and drained coastal marshlands and the problems encountered with this type of management are given. The use of about eight species of aquatic emergents as waterfowl foods on these areas is discussed.

456. Nelson, N. F. 1954. Factors in the development and restoration of waterfowl habitat at Ogden Bay Refuge, Weber County, Utah. Utah State Dep. Fish & Game, Pub. 6. 87pp.

KEY WORDS: Chara, colonization, emergents, flooding, germination, marsh, planting, Potamogeton, salinity, succession.

Completion of a dike system gave an opportunity for the study of plant development on newly flooded areas. Subsequent heavy silt load and shifts in stream flow produced changes in the vegetation cover as shown in a series of profile diagrams. Irrigation systems provided shallow water with slight fluctuations which favored the germination of emergent marsh plant seeds. Those ponds and stream areas covered permanently by water during the growing season produced stands of Chara and Potamogeton.

457. Nelson, A. and J. M. Munro. 1934. The germination of Spartina townsendii. Notes Edinburgh Roy. Bot. Garden 18:173-180.

KEY WORDS: germination, propagule storage, seeds, Spartina.

Seed lots of Spartina townsendii were stored up to four months in desiccators at room temperature either 1) dry, or 2) over fresh water, or 3) over salt water. Subsequent germination tests showed a marked superiority of the fresh and salt water methods over dry storage. Seeds stored over brine showed less fungal growth than those stored over fresh water.

458. Nielson, E. L. and J. B. Moyle. 1941. Forest invasion and succession on the basins of two catastrophically drained lakes in northern Minnesota. Am. Midl. Nat. 25(3):564-579.

KEY WORDS: drainage, substrate, succession, waterlogging.

The succession of plant species on a drained lake bottom depended partly on soil texture, water content of the soils, and species which were nearby to act as a seed source.

459. Nixon, S. W. and C. A. Oviatt. 1973. Ecology of a New England salt marsh. Ecol. Monogr. 43:463-498.

KEY WORDS: communities, depth, emergents, life history, oxygen, productivity, salt marsh, Spartina, succession.

The annual ecological energy budget indicates that inputs of organic detritus from marsh grasses are necessary to support animal populations. Production of above ground emergent grasses on the marsh equaled 840 g/m^2 for tall Spartina alterniflora, 432 g/m^2 for short S. alterniflora, and 430 g/m^2 for S. patens. Community energy flow was estimated and a model of diurnal dissolved oxygen levels was constructed.

460. Nordhogen, R. 1954. Studies on the vegetation of salt and brackish marshes in Finmark (Norway). Vegetatio 5-6:381-394.

KEY WORDS: brackish, communities, phytosociology, salt marsh, substrate.

A phytosociological account of salt marshes at the bottom of fiords including, in some cases, a description of soils.

461. Northcott, T. H. 1972. Water lilies as beaver food. Oikos 23: 408-409.

KEY WORDS: Nuphar, rhizomes, substrate.

A description of the substrate on which 2 species of Nuphar were found growing and the gross morphology and habitat of each species. The author concludes that, because of conditions existing on the bottom, a mass of water lily leaves does not necessarily indicate a bountiful supply of food beneath. Dimensions of some rhizomes and leaves are given.

462. Odum, E. P. 1961. The role of tidal marshes in estuarine production. The Conservationist (N. Y.) 15(6):12-15,35.

KEY WORDS: depth, productivity, salinity, salt marsh, Spartina.

Primarily a descriptive article on salt marsh productivity, but some information is included on water level relations and salinity tolerances of the main emergent species.

463. Odum, H. T. 1963. Productivity measurements in Texas turtle grass and the effects of dredging an intracoastal waterway. Pub. Mar. Sci. Inst. Texas 9:48-58.

KEY WORDS: Diplanthera, dredged material, productivity, Thalassia.

Silts released as a result of dredging caused a marked decrease in productivity of Thalassia testudinum and Diplanthera wrightii immediately after dredging. However, growht the following year was increased due to nutrients suspended during dredging.

464. Odum, W. E. 1970. Pathways of energy flow in a South Florida estuary. PhD. Thesis, Univ. of Miami.

KEY WORDS: communities, nutrients, productivity, Rhizophora.

The importance of organic detritus as a nutritional source to the heterotrophic community of a Florida mangrove estuary is discussed. The principal source of food for the aquatic animal community was determined to be the leaves of Rhizophora. Pathways of energy flow are described.

465. Ogden, E. C. 1943. The broad-leaved species of Potamogeton of North America north of Mexico. Rhodora 45:57-105, 119-163, 171-214.

KEY WORDS: geography, hybrids, keys, morphology, Potamogeton, seeds.

Diagnostic characteristics of fruits, flowers, spikes, stipules, leaves, and other plant parts of the broad-leaved Potamogetons are described. The problems in identification resulting from ecotypic variation and hybridism are discussed, and an extensive key to the species is provided. Locations of collections throughout North America are listed and some maps of distribution are shown.

466. Ohga, I. 1926. Longevity of the fruit of Nelumbium. J. Bot. 64(762):154-157.

KEY WORDS: Nelumbium, propagule storage, seeds, viability.

As long as seeds of Nelumbium are not attacked by molds, they will remain viable for upwards of 150 years if stored in air or soil.

467. Ohga, I. 1926. The germination of century-old and recently harvested Indian lotus fruits with special reference to oxygen supply. Am. J. Bot. 13(10):754-759.

KEY WORDS: germination, Nelumbo, propagule storage, seeds.

Nelumbo spp. have impervious seed coats and can remain viable for many years. Environmental factors conducive to germination and growth are discussed.

468. Oliver, F. W. 1907. The Bouche D'Erquy in 1907. New Phytol. 6:244-252.

KEY WORDS: colonization, ecotype, emergents, planting, salt marsh, substrate, succession.

This paper is one of a series of papers on the ecology of a Brittany salt marsh. The colonization of sand dunes is described. A number of reciprocal transplanting experiments were carried out.

469. Olsen, S. 1950. Aquatic plants and hydrospheric factors I. Aquatic plants in southwest Jutland, Denmark. II. The hydrospheric types. Svensk. Bot. Tidskrift 44(2):332-373.

KEY WORDS: chloride, emergents, geography, habitat, life history, pH, submergents, substrate.

The significance of physical and chemical factors in the water and substrate on aquatic plant distribution is discussed. Part II. defines the hydrospheric types and gives details on locality and habitat for each of the species.

470. O'Neill, E. J. 1972. Alkali bulrush seed germination and culture. J. Wildl. Manage. 36(2):640-652.

KEY WORDS: germination, harvest, planting, propagule storage, Scirpus, seedlings, seed production.

Procedures on how to prepare seeds of Scirpus paludosus and S. robustus for planting are detailed. Seeding rates, methods, harvest, and value to wildlife are also discussed.

471. Oosting, H. J. 1933. Physical-chemical variables in a Minnesota lake. Ecol. Monogr. 3:493-534.

KEY WORDS: emergents, lakes, marl, substrate, succession.

The relation of marl and organic deposits to species of colonizing plants involves a number of interdependent chemical factors which are herein discussed.

472. Oosting, H. J. 1945. Tolerance to salt spray of plants of coastal dunes. Ecology 26:85-89.

KEY WORDS: ecological range, emergents, salinity.

Spartina patens and Atriplex arenaria were unaffected by salt spray whereas Leptilou canadense was injured by a single spraying. Other plants tested resulted in a gradation of tolerances between these two extremes.

473. Oosting, H. J. 1954. Ecological processes and vegetation of the maritime strand in the southeastern United States. Bot. Rev. 20:226-262.

KEY WORDS: salinity, substrate, succession, temperature, zonation.

Sand strands of the southeastern United States have a certain unity regarding origin, physiographic features, and vegetation. Aside from the generally functional coastal plain factors, such as deep sand and recurring fires, the communities of this maritime zone are undoubtedly affected by oceanic amelioration of temperature extremes as well as by winds, salt spray, shifting sands, and storms.

474. Orpurt, P. A. and L. L. Boral. 1964. The flowers, fruits, and seeds of Thalassia testudinum Koenig. Bull. Mar. Sci. Gulf & Caribb. 14(2):296-302.

KEY WORDS: dispersal, fruits, germination, growth, morphology, salinity, seeds, Thalassia.

The development of flowers and fruits of Thalassia testudinum and the subsequent dispersal and germination of the seeds, and establishment of the seedlings are discussed in detail.

475. Owens, M, M. A. Learner and P. J. Maris. 1967. Determination of the biomass of aquatic plants using on optical method. J. Ecol. 55(3):671-676.

KEY WORDS: biomass, control, floating plants, herbicides, light, submergents.

Determination of the effect of herbicides on aquatic plants is one example of a practical application of this method.

476. Palmisano, A. W. 1972. The effect of salinity on the germination and growth of plants important to wildlife in the Gulf Coast marshes. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 25:215-223.

KEY WORDS: emergents, germination, salinity, salt marsh.

All ten species of marsh plants tested except Sesuvium portulacastrum exhibited a significant reduction in germination with increasing salinity.

477. Palmisano, A. W., Jr. and J. D. Newsom. 1968. Ecological factors affecting the occurrence of Scirpus olneyi and S. robustus in the Louisiana Coastal marshes. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 21:161-172.

KEY WORDS: communities, depth, Distichlis, germination, salinity, Scirpus, Spartina.

Scirpus olneyi was associated with slight depressions in the interior of marshes where minimum water levels ranged from -3.0 to + 2.0 inches. The maximum soil salinity recorded in these communities was 16,000 ppm and the minimum was 10,000 ppm. S. robustus tolerated higher salinities and greater water level fluctuations than S. olneyi. Optimum seed germination of both species was at temperatures which fluctuated on a daily cycle from 20 to 35 C. Submergence by one inch of water inhibited germination as did salinities above 4,000 ppm for S. olneyi and above 8,000 ppm for S. robustus.

478. Patriquin, D. G. 1972. The origin of nitrogen and phosphorus for growth of the marine angiosperm, Thalassia testudinum. Marine Biology 15:35-46.

KEY WORDS: anaerobiasis, growth, nitrogen, nutrients, phosphorus, root systems, substrate, Thalassia.

All nitrogen and most of the phosphorus used for leaf used for leaf growth by Thalassia testudinum are derived from the substrate. Growth appears to be limited by the availability of nitrogen. Anaerobic conditions in the root zone appear to be necessary for promoting the fixation of nitrogen by anaerobic bacteria.

479. Patriquin, D. G. and R. Knowles. 1972. Nitrogen fixation in the rhizosphere of marine angiosperms. Marine Biology 16:49-58.

KEY WORDS: Halodule, nitrogen, nutrients, root systems, Syringodium, Thalassia, Zostera.

Nitrogen fixation in the root zone is the primary source of nitrogen for sea grasses.

480. Patten, B. C., Jr. 1955. Germination of the seed of Myriophyllum spicatum L. Bull. Torrey Bot. Club 82(1):50-56.

KEY WORDS: afterripening, germination, Myriophyllum, viability.

Seed of Myriophyllum spicatum requires an afterripening period. Afterripening can be enhanced by removal of the stony endocarp, scarifying, freezing, alternate freezing and drying, exposure to high H-ion and OH-ion concentrations, and prolonged exposure to low temperature. Germination in nature is prompted by the warming of waters during the spring.

481. Patten, B. C., Jr. 1956. Notes on the biology of Myriophyllum spicatum L. in a New Jersey lake. Bull. Torrey Bot. Club 83(1): 5-18.

KEY WORDS: dispersal, fragmentation, germination, habitat, lakes, life histroy, Myriophyllum, phenology, seedlings, substrate, vegetative reproduction.

The habitat, growth and reproduction, and general life history of Myriophyllum spicatum are reviewed.

482. Pearsall, W. H. 1917. The aquatic and marsh vegetation of Estwaite Water. J. Ecol. 5(3-4):180-202; 6(1):53-74.

KEY WORDS: communities, emergents, habitat, submergents, substrate.

Major plant associations are described as to species compsition which is related to substrate, geography of the area, and dynamic processes of nature.

483. Pearsall, W. H. 1920. The aquatic vegetation of the English Lakes. J. Ecol. 8(3):163-201.

KEY WORDS: light, nutrients, submergents, substrate, succession, temperature.

Considerable data on analysis of aquatic substrates are presented. It is concluded that the substrate is the main controlling factor in the distribution of aquatic plant species. Light intensity, temperature, and nutrients also are important. Changes in plant communities by succession cause changes in the substrate.

484. Peltier, W. H. and E. B. Welch. 1970. Factors affecting growth of rooted aquatic plants in a reservoir. Weed Sci. 18:7-9.

KEY WORDS: growth, lakes, Najas, nitrogen, phosphorus.

The nitrogen content of an Alabama reservoir was found not to be related to year-to-year plant growth over three years. It was determined from physical and climatic data that available light was controlled by the amount of rainfall and the reservoir water depth during the critical plant growth period in April and May.

485. Penfound, W. T. 1940. The biology of Achyranthes philoxeroides (Mart.) Standbey. Am. Midl. Nat. 24(1):248.

KEY WORDS: Achyranthes, dispersal, floating plants, growth, habitat, life history, weeds.

General comments on the establishment, habitat and reproduction of alligatorweed are presented.

486. Penfound, W. T. 1940. The biology of Dianthera americana L. Am. Midl. Nat. 24(1):242-247.

KEY WORDS: Dianthera, depth, germination, growth, life history, substrate.

Dianthera americana grows in water up to four feet deep on a wide variety of substrates. Vegetative growth, and reproduction are also briefly described.

487. Penfound, W. T. 1952. An outline for ecological life histories of herbaceous vascular hydrophytes. Ecology 33:123-128.

KEY WORDS: life history, phenology, taxonomy.

In the interests of those workers who are engaged in life history studies of herbaceous, vascular hydrophytes, this outline describes information that should be included in such a study. Definition of herbaceous hydrophytes, general ecology, phenology, economic value, classification, distribution, habitat etc. are some of the categories discussed.

488. Penfound, W. T. 1952. Southern swamps and marshes. Bot. Rev. 18:413-446.

KEY WORDS: communities, emergents, salt marsh, succession, swamp.

The area under consideration in this review includes all the states from Virginia to Florida and west to eastern Texas and eastern Oklahoma. The species composition of several aquatic plant plant communities are described and their habitats defined. Most of the areas occur in the coastal plain or in the Mississippi alluvial plain. Plant succession, habitat factors, relations to sea levels, and several other environmental factors are discussed.

489. Penfound, W. T. and T. T. Earle. 1948. The biology of the water hyacinth. Ecol. Monogr. 18:447-472.

KEY WORDS: adventive spread, control, Eichornia, exotic, floating plants, germination, habitat, life history, light, phenology, rhizomes, seeds, succession, sudd, vegetative reproduction.

Eichornia crassipes is a wide spread aquatic weed that causes millions of dollars worth of damage every year. This paper discusses all aspects of the plant's life history and methods of control.

490. Penfound, W. T. and T. F. Hall. 1939. A phytosociological analysis of a tupelo gum forest near Huntsville, Alabama. Ecology 20: 358-364.

KEY WORDS: germination, habitat, Nyssa, phytosociology, seedlings, swamp, waterlogging.

The ecology of a tupelo gum swamp is described. Fruiting, seedling establishment, and water level relations of Nyssa aquatica are discussed.

491. Penfound, W. T., T. F. Hall, and A. D. Hess. 1945. The spring phenology of plants in and around the reservoirs in north Alabama with particular reference to malaria control. Ecology 26:332-352.

KEY WORDS: control, depth, drawdown, emergents, germination, mosquitoes, phenology, submergents, temperature, vegetative propagation.

Phenological events in the life cycle of plants was controlled by temperature and water levels. Proper manipulation of water levels delayed or prevented aquatic plant development and thus resulted in control of mosquitoes.

492. Penfound, W. T. and E. S. Hathaway. 1938. Plant communities in the marshlands of southeastern Louisiana. Ecol. Monogr. 8:1-56.

KEY WORDS: brackish, commercial uses, communities, depth, marsh, nutrients, phenology, salinity, salt marsh, substrate, succession, zonation.

The presence and relative abundance of plant species in 7 marsh transects within 70 miles of New Orleans is documented. Probable successional patterns and relations of the vegetation to edaphic and biotic factors is discussed.

493. Penfound, W. T. and M. E. O'Neill. 1934. The vegetation of Cat Island, Mississippi. Ecology 15:1-16.

KEY WORDS: communities, marsh, salt marsh, succession.

The vegetation of both fresh and salt water marshes on Cat Island is described and relative species abundance noted.

494. Perraton, C. 1953. Salt marshes of the Hampshire-Sussex border. J. Ecol. 41(2):240-247.

KEY WORDS: colonization, hybrids, salt marsh, Spartina, succession.

A general description of the location, ecology, and plant communities of these English marshes. Some discussion on the growth habits of Spartina is included.

495. Pettet, A. 1964. Seedlings of Eichhornia crassipes: a possible complication to control measures in the Sudan. Nature 201:516-517.

KEY WORDS: Eichornia, floating plants, seedlings, weeds.

The seedlings of Eichornia crassipes are a source of new and continual infestation of waterways throughout tropical and subtropical areas.

496. Phillip, C. C. and R. G. Brown. 1965. Ecological studies of transition-zone vascular plants in South River, Maryland. Chesapeake Sci. 6(2):73-81.

KEY WORDS: brackish, emergents, salinity, submergents, substrate, succession, tides, zonation.

Two sites on the South River, a tributary of the Chesapeake Bay, were studied relative to dominant plant species, tidal influences, and geomorphology. The distribution of 52 species of aquatic macrophytes are correlated with the substrate, position in the water, and salinity.

497. Phillips, J. 1970. Wisconsin's wetland soils, a review. Wisc. Dep. Nat. Resour., Res. Rep. 57. 27pp.

KEY WORDS: commercial uses, nutrients, substrate, succession.

Literature dealing with wetland soils was reviewed. Sections on soil morphology and classification, soil chemistry, interrelationships between soil and various plant communities, and soil properties in relation to land use are presented. The plants involved in early succession are the hydrophytic emergents, such as Typha. By invading open water areas, they tend to reduce wave turbulance, favor peat deposition, and initiate soil building processes. Progressive succession results in an increase in acidity, increase in base exchange capacity, increase in the carbon-nitrogen ratio, and a decrease in total bases.

498. Phillips, R. C. 1960. Environmental effect on leaves of Diplanthera. Du Petit-Thomas. Bull. Mar. Sci. Gulf & Caribb. 10(3):346-353.

KEY WORDS: Diplanthera, morphology, rhizomes, salinity, submergents, taxonomy.

Environmental factors were found to affect leaf length, leaf width, rhizome internode lengths and other aspects of morphology. Thus, there is no valid criteria for separation of two species of Diplanthera in Florida waters.

499. Phillips, R. C. 1960. Report on the hydrography and marine plants of the Caloosahatchee River and adjacent waters, Florida. Fla. State Bd. Cons., Mar. Lab., Spec. Sci. Rep. 5.

KEY WORDS: salinity, submergents.

On the basis of the data collected to date it was concluded that fresh water releases, at least up to amounts of 2580 c.f.s. or less, do no significant damage to marine plants in the Caloosahatchee River basin.

500. Phillips, R. C. 1964. Comprehensive bibliography of Zostera marina. U. S. D. I. Spec. Sci Rep. — Wildl. 79.

KEY WORDS: bibliography, life history, Zostera.

A bibliography of several hundred sources on many aspects of the life history, ecology, and taxonomy of Zostera marina.

501. Phillips, R. C. 1967. On species of the seagrass, Halodule, in Florida. Bull. Mar. Sci. Gulf & Caribb. 17(3):672-676.

KEY WORDS: Halodule, morphology, taxonomy.

Wide variation of three vegetational characteristics of a single species of Halodule have removed the previous basis for classification into three species so that Halodule wrightii is the only legitimate species.

502. Phleger, C. F. 1971. Effect of salinity on growth of a salt marsh grass. Ecology 52(5):908-911.

KEY WORDS: culture, growth, habitat, salinity, salt marsh, seeds, sodium, Spartina.

Spartina foliosa was grown in nutrient solution at different salinities (0 to 125 percent sea water; sea water = 33 ppt) for 8 weeks. Growth and survival was greatest in fresh water although the plant grows in sea water in its natural habitat. Protein (17.9 percent dry wt.) and lipid (16 percent dry wt.) were higher in fresh water cultured plants than in sea water cultured plants (12.4 percent protein, 3 percent lipid). Fresh water plants contained less sodium (0.25 percent) and more potassium (3.52 percent) than sea water plants (4.82 percent sodium, 1.8 percent potassium).

503. Pigott, C. D. 1969. Influence of mineral nutrition on the zonation of flowering plants in coastal salt marshes. pp. 25-35. In: I. H. Rorison, (Ed.). Ecological Aspects of the Mineral Nutrition of Plants. Blackwell Scientific Publ., Oxford. 484pp.

KEY WORDS: fertilizer , germination, nitrogen, nutrients, phosphorus, Salicornia, salinity, salt marsh, seedlings, tides, zonation.

Many attempts have been made to discover the underlying cause for vegetational zonation in coastal communities. Variation in tides, water table levels, salinity differences, and evapotranspiration rates have usually been held responsible. However, Pigott suggests that a nitrogen-phosphorus deficiency might actually be the controlling factor in determining zonation in the salt marsh.

504. Pirnie, M. D. 1935. Chapter IX. Planting programs. pp. 186-218. In: Michigan Waterfowl Management. Franklin DeKleine Co., Lansing. 328pp.

KEY WORDS: emergents, nutrients, planting, pollution, submergents, substrate, waterfowl, weeds.

Specific information on planting times and techniques for numerous waterfowl food plants is given. Habitat preferences, and pro and con features of many of the more common aquatic plants are discussed.

505. Poggie, J. J., Jr. 1963. Coastal pioneer plants and habitats in the Tampico Region, Mexico. Coastal Studies Ser. 6, Louisiana State Univ. 62pp.

KEY WORDS: colonization, dispersal, zonation.

Information on the totally unprotected coastal pioneer zone, especially as to physical and chemical nature of the substrate and patterns of vegetation, is presented.

506. Pomeroy, L. R. 1970. The strategy of mineral cycling. pp. 171-190. In: R. F. Johnston, P. W. Frank, and C. D. Michener (Eds.). Annual Review of Ecology and Systematics. Vol. I. Annual Reviews, Inc., Palo Alto, Calif. 406pp.

KEY WORDS: bibliography, nitrogen, nutrients, phosphorus, productivity.

The essential nature of an element in an ecosystem is a direct result of its necessary role in the structure and function of the cells that make up organisms. The pathways of certain of these essential elements in the biological and physical world are discussed for both the marine and terrestrial realms. Productivity and eutrophication of marine systems are related to ecosystem structure and stability.

507. Pomeroy, L. R., L. R. shenton, R. D. H. Jones and R. J. Reimold. 1972. Nutrient flux in estuaries. Am. Soc. Limnol. & Oceanogr. Spec. Symp. Vol.1, Nutrients and Eutrophication, pp. 274-291.

KEY WORDS: fertility, phosphorus, pollution, salinity, turbidity, nutrients, substrate.

The seasonal cycle of phosphorus in estuaries is controlled primarily by shifting rates of metabolic processes that move phosphorus from sediments to water. Streamflow has a negative effect on the concentration of phosphorus. Simulated perturbations of the system verify the importance of nutrient reserves in the sediments but suggest that estuaries with much smaller reserves than those in Georgia will be equally stable and productive.

508. Provost, M. W. 1948. Marsh blasting as a wildlife management technique. J. Wildl. Manage. 12(4):350-387.

KEY WORDS: colonization, succession, waterfowl.

Species of plants which invaded an area recently blasted clear of vegetation are identified and their value discussed.

509. Purer, E. A. 1942. Plant ecology of the coastal salt marshlands of San Diego County, California. Ecol. Monogr. 12(1):81-111.

KEY WORDS: aeration, Atriplex, communities, Distichlis, dredging, emergents, habitat, light, Limonium, phenology, Salicornia, salinity, Spartina, substrate, succession, temperature, tides, vegetative propagation.

Anatomical adaptations of the principal salt marsh plants of San Diego County to their habitat are described. Detailed descriptions of 12 marsh study areas are also included. Fluctuations of soil salinity and water levels are examined as possible limiting factors.

510. Rajan, A. K., B. Betteridge and G. E. Blackman. 1971. Changes in the growth of Salvinia natans induced by cycles of light and darkness of widely different duration. Ann. Bot. 35:597-604.

KEY WORDS: culture, growth, light, Salvinia.

Salvinia natans, a water fern, was readily cultured under continuous illumination. Other conditions of the culture medium and equipment are described.

511. Ransom, E. R. 1935. The inter-relations of catalase, respiration, after-ripening, and germination in some dormant seeds of the Polygonaceae. Am. J. Bot. 22(10):815-825.

KEY WORDS: afterripening, dormancy, germination, Polygonum, respiration.

Seeds of most species of Polygonum were found to be dormant at maturity; the degree of dormancy varied not only in seeds of different species but also in individuals of the same species. Optimal conditions for afterripening seed were saturation with moisture and temperatures of 3 to 6 C. Catalase activity and the rate of respiration in fruits and seeds of Polygonum were found to follow similar patterns in relation to the rate of afterripening and germination.

512. Ranwell, D. S. 1964. Spartina salt marshes in southern England. III. Rates of establishment, succession, and nutrient supply at Bridgewater Bay, Somerset. J. Ecol. 52(1):95-105.

KEY WORDS: nutrients, salt marsh, seedlings, Spartina, substrate, succession.

The rate of establishment or spread of Spartina onto bare mud at the seaward edge of a marsh is recorded. Measurements of the rate of establishment of new species, and sucession at the upper limits of the marsh are given together with some information about the rate of nutrient supply to the marsh. Changes in species from Spartina to Scirpus/Phragmites began when the marsh was about 22 years old.

513. Ranwell, D. S. 1967. World resources of Spartina townsendii (sensu lato) and economic use of Spartina marshland. J. Appl. Ecol. 4:239-256.

KEY WORDS: commercial uses, control, geography, planting, Spartina, substrate.

The economic uses of Spartina spp. around the world are reviewed. S. townsendii is very useful for stabilizing coastal mudflats and is useful for a variety of agricultural purposes.

514. Ranwell, D. S., E. C. F. Bird, J. C. E. Hubbard and R. E. Stebbings. 1964. Spartina salt marsh in southern England. V. Tidal submergence and chlorinity in Poole Harbour. J. Ecol. 52(3):627-641.

KEY WORDS: depth, germination, Phragmites, salinity, Spartina, tides.

Water level relations and chlorinity of the habitat of Spartina and Phragmites are discussed in relation to germination and zonation.

515. Redfield, A. C. 1972. Development of a New England salt marsh. Ecol. Monogr. 42:201-237.

KEY WORDS: colonization, dispersal, drainage, dredging, erosion, germination, growth, rhizomes, salt marsh, seeds, substrate, succession, tides, vegetative propagation.

A salt marsh at Barnstable, Massachusetts occupies an embayment into which it has spread during the past 4000 years. Observations and measurements on all stages of its formation and development are presented. The geomorphology of the marsh is considered in relation to the factors which have influenced its development, i.e., the ability of halophytes to grow at limited tide levels, the tidal regime, the process of sedimentation, and the contemporary rise in sea level.

516. Reed, J. F. 1947. The relation of the Spartinetum glabrae near Beaufort, North Carolina, to certain edaphic factors. Am. Midl. Nat. 38(3):605-614.

KEY WORDS: root systems, Spartina, substrate, succession, tides, zonation.

Distinct zonation characterizes the vegetation of the tidal marshes along the North Carolina coast, but the factors controlling this zonation are not yet documented. Spartina marshes in North Carolina are characterized by a well developed mat of subterranean organs existing at an average depth of 10 cm in a muck soil overlain by a thin layer of sand. When accretion buries this mat to a depth of 18 cm other mid-littoral species can invade and overrun the Spartina. Leaves and culms of the deeper-lying Spartina must penetrate 15 cm or more through the tangle of roots and rhizomes formed by the new invaders.

517. Reimold, R. J. 1972. The movement of phosphorus through the salt marsh cord grass, Spartina alterniflora Loisel. Limnol. Oceanogr. 17(4):606-611.

KEY WORDS: nutrients, phosphorus, productivity, Spartina, substrate.

Spartina can serve as a nutrient pump and translocate measurable quantities of phosphorus from the salt marsh sediment to the leaves. With tidal inundation, an average of 9.84 mg-atom P/m is released into the marsh waters at each tidal cycle. Seasonal data indicate the flux of phosphorus through this system is closely associated with the productivity of the plant material in the marsh.

518. Reimold, R. J. and C. J. Durant. 1973. Toxaphene content of estuarine fauna and flora before, during, and after dredging toxaphene contaminated sediments. Univ. Georgia Mar. Inst., Sapelo Isl., Contrib. 30. 18pp. mimeo.

KEY WORDS: dredging, pollution, Spartina.

The concentration of toxaphene found in selected estuarine fauna, flora, sediments, and dredge spoil prior to, during and after the dredging of Terry Creek is reported. Toxaphene content in dredge spoil, fauna, and flora was higher during dredging than before or after. Spartina alterniflora and Fundulus heteroclitus (killifish) were determined to be the best indicator species.

519. Reimold, R. J. and F. C. Daiber. 1970. Dissolved phosphorus concentrations in a natural salt-marsh of Delaware. Hydrobiologia 36(3-4):361-371.

KEY WORDS: nutrients, pH, phosphorus, salinity, salt marsh.

Seasonal concentrations of dissolved phosphorus reached a maximum during the summer months and a minimum during the winter months.

520. Reimold, R. J. and R. A. Linthurst. 1973. Ecological importance of wetlands. Am. Cong. Survey. & Mapp., Proc. pp.200-204.

KEY WORDS: commercial uses, communities, fishes, marsh.

This paper describes the value of wetlands, especially coastal marshes, to wildlife and man.

521. Reimold, R. J. and R. A. Linthurst. 1974. Remote sensing wetlands. Am. Soc. Civil Engin. Natl. Mtg. Water Res. Engin., Mtg. preprint 2143. 19pp.

KEY WORDS: commercial uses, emergents, salt marsh, tides.

A summary and examination of multiple uses of remote sensing of wetlands. Low level (1:5000 scale) color infared photography was determined to be most useful to delineate plant species and/or plant primary production differences. Photography can also be used to document water movement, land form and vegetation changes per unit time, water pollution, and simply baseline conditions.

522. Reimold, R. J., J. L. Gallagher and D. E. Thompson. 1972. Coastal mapping with remote sensors. Coastal Mapping Symp., Proc., Am. Soc. Photogrammetry, Wash., D. C. pp. 99-112.

KEY WORDS: biomass, commercial uses, productivity, Spartina

Living plant dry weight biomass figures from ground truth observations at the time of flowering, were combined with infared photograph interpretations to compute agronomic yield estimates for a Spartina alterniflora marsh. This paper summarizes the techniques employed and the information obtained in a new approach to mapping coastal resources via remote sensing.

523. Reimold, R. J., J. L. Gallagher and D. E. Thompson. 1973. Remote sensing of tidal marsh. Photogrammetric Engineering 39(5):477-488.

KEY WORDS: biomass, commercial uses, salt marsh, Spartina.

Remote sensing can provide quantitative data on primary production in tidal marsh ecosystems, and on differentiation of vegetative types, on assessment of primary production between each vegetative type and within the dominant species, Spartina alterniflora.

524. Rich, P. H., R. G. Wetzel and N. Van Thuy. 1971. Distribution, production, and role of aquatic macrophytes in a southern Michigan marl lake. Freshwater Biol. 1(1):3-21.

KEY WORDS: emergents, lakes, marl, Potamogeton, Scirpus, submergents.

A typical marl lake of the Great Lakes region has very few quantitatively important macrophytes. Potamogeton spp. and Scirpus subterminalis were the only significantly abundant species.

525. Richards, L. A. (Ed.). 1954. Diagnosis and Improvement of Saline and Alkali Soils. U.S.D.A. Agricultural Handbook 60. 160pp.

KEY WORDS: Distichlis, drainage, irrigation, Salicornia, salinity, Suaeda.

A practical guide for those who are confronted with soil, plant, and water problems involving salinity and alkalinity. The first five chapters provide a basis for the evaluation and interpretation of measurements; procedures and measuring methods are given in chapters 6 through 8. A section is included on using plants as indicator species.

526. Richards, P. W. 1943. Juncus filiformis L. J. Ecol. 31(1):60-65.

KEY WORDS: geography, habitat, Juncus, life history, propagule storage, seeds, substrate.

A life history of Juncus filiformis including information on plant growth, habitat, dispersal, and reproduction is given.

527. Richards, P. W. 1943. Juncus macer S. F. Gray (J. tenuis auct. mult. non Willd.) J. Ecol. 31(1):51-59.

KEY WORDS: germination, habitat, Juncus, life history, propagule storage, seeds, substrate.

A life history of Juncus macer.

528. Richards, P. W. and A. R. Clapham. 1941. Juncus inflexus L. (Juncus glaucus Ehrh.) J. Ecol. 29(2):369-374.

KEY WORDS: germination, habitat, Juncus, life history, propagule storage, seeds, substrate.

A life history of Juncus inflexus.

529. Richards, P. W. and A. R. Clapham. 1941. Juncus effusus L. (Juncus communis, B. effusus E. Mey). J. Ecol. 29(2):375-380.

KEY WORDS: dispersal, germination, growth, habitat, Juncus, life history, pH, seeds, substrate.

A life history of Juncus effusus.

530. Richards, P. W. and A. R. Clapham. 1941. Juncus conglomeratus L. (J. communis conglomeratus E. Mey; J. Leersii Marsson). J. Ecol. 29(2):381-384.

KEY WORDS: dispersal, germination, growth, habitat, Juncus, life history, pH, seeds, substrate.

A life history of Juncus conglomeratus.

531. Richards, P. W. and A. R. Clapham. 1941. Juncus submodulosus Schrank (J. obtusiflorus). J. Ecol. 29(2):385-391.

KEY WORDS: dispersal, germination, growth, habitat, Juncus, life history, pH, seeds, substrate.

The life history and ecological conditions for growth of Juncus submodulosus are described.

532. Riemer, D. N. and R. D. Ilnicki. 1968. Reproduction and overwintering of Cabomba in New Jersey. Weed Sci. 16(1):101-102.

KEY WORDS: adventive spread, Cabomba, geography, germination, growth, habitat, hibernacula, life history, seeds, sterility, vegetative propagation.

The introduction and spread of Cabomba caroliniana into the eastern U. S. is briefly discussed. Development of winter buds at the end of the growing season is outlined; all seeds found were sterile.

533. Robel, R. J. 1961. Water depth and turbidity in relation to growth of sago pondweed. J. Wildl. Manage. 25(4):436-438.

KEY WORDS: depth, growth, light, Potamogeton, turbidity.

The growth of Potamogeton pectinatus on the Bear River marshes relative to turbidity and water depth is discussed.

534. Robel, R. J. 1962. Changes in submersed vegetation following a change in water level. J. Wildl. Manage. 26(2):221-224.

KEY WORDS: depth, drawdown, flooding, submergents.

Production of submersed vegetation (especially Potamogeton pectinatus, Zanichellia palustris, Ruppia maritima, and Chara spp.) increased with water depth from 3 to 18 inches and then decreased with increasing water depth.

535. Rogalsky, J. R., K. W. Clark and J. M. Stewart. 1971. Wild rice paddy production in Manitoba. Manitoba Dep. Agr. Pub. 527.

KEY WORDS: colonization, depth, diseases, fertilizers, flooding, germination, harvest, machinery, pH, planting, propagule storage, seeds, site preparation, substrate, Zizania.

The introduction of paddy production techniques for wild rice crops may revolutionize this traditional crop. Paddy construction, water level manipulation, and machine harvesting are discussed. Substrate and water requirements for the establishment of wild rice are given.

536. Rollins, G. L. 1973. Relationships between soil salinity and the salinity of applied water in the Suisun Marsh of California. Calif. Fish & Game J. 59:5-35.

KEY WORDS: flooding, marsh, salinity, substrate, waterfowl.

The water management regimes of four duck clubs in the Suisun Marsh area of California resulted in extremely high late-summer soil salinities, ranging from 80 to 146 total dissolved solids in the first foot of substrate in September 1967. Flushing the areas with low salinity water was effective in correcting the salinity problem. The vegetation of the study sites is also briefly described.

537. Ross, W. M. 1972. Methods of establishing natural and artificial stands of Scirpus olneyi. M. Sc. Thesis Louisiana State Univ. and Agr. and Mech. College. 99pp.

KEY WORDS: depth, fire, planting, salinity, Scirpus, site preparation, substrate.

A study was conducted to devise methods of establishing stands of Scirpus olneyi and to determine factors affecting its survival and growth. Clay soil gave the best growth out of 4 soils tested. Growth and survival were also highest when water was 2 and 4 inches above the soil surface; the most favorable water salinities were 10 and 15 ppt. Tilling was found to be the best method of site preparation and burning was the poorest. Nutria damage to new plantings of Scirpus was heavy.

538. Rossbach, G. B. 1939. Aquatic Utricularias. Rhodora 41(484): 11e-128.

KEY WORDS: depth, geography, habitat, keys, Utricularia.

A key to several species of Utricularia with comments on habitat, water level relations, and geographical distribution.

539. Salisbury, E. 1970. The pioneer vegetation of exposed muds and its biological features. Phil. Trans. Royal Soc. London, Part B. 259(829):207-255.

KEY WORDS: dispersal, emergents, germination, fruits, light, seeds, viability.

The characteristic pioneer flora of exposed mud in Britain is comprised of about 50 species. Fruiting periods for these plants, in general, showed a marked late summer or autumn bias, and production of small, easily transported seeds. Seed germination appeared to be mostly light dependent. The importance of using propagules from the same plant in experiments is emphasized.

540. Salisbury, E. 1973. Conservational importance of pioneer vegetation of exposed muds. Biol. Cons. 5(4):1.

KEY WORDS: emergents, germination, seeds, viability.

In Britain, mud flats and their associated plant species are endangered due to nearly 40 percent loss of habitat. The seeds of these mudflat plants are viable for long periods of time, and they germinate rapidly to bind the soil.

541. Salyer, J. C. 1949. Propagation of wild duck foods. U. S. Fish & Wildl. Serv., Wildl. Manage. Ser. 1. 23pp.

KEY WORDS: Cyperus, Echinochloa, light, planting, Polygonum, Potamogeton, propagule storage, rootstocks, Ruppia, Scirpus, seeds, site preparation, turbidity, waterfowl.

Planting instructions for large scale plantings based on field experience are given for twelve of the major groups of important waterfowl foods. Selection of planting site, care of planting stock and propagation are some of the aspects discussed.

542. Sauer, J. and G. Struick. 1964. A possible ecological relation between soil disturbance, light flash, and seed germination. Ecology 45(4):884-886.

KEY WORDS: germination, light, seeds.

It was discovered that a short exposure of seeds of 20 terrestrial plants including Carex sp. to light before planting produced a significantly greater number of seedlings than non-exposed seeds.

543. Sauer, J. D. 1967. Geographic reconnaissance of seashore vegetation along the Mexican Gulf Coast. Louisiana State Univ. Coastal Studies Ser. 21.

KEY WORDS: colonization, communities, geography, habitat, zonation.

Almost 200 species of plants from 58 families were found comprising the pioneer fringe of vegetation in habitats kept open by waves, salt spray, and wind driven sand. Profiles of the study sites show the horizontal and vertical distribution of beach vegetation; a series of 24 photographs demonstrates the variety of geophysical and environmental habitat types.

544. Savage, T. 1972. Florida mangroves as shoreline stabilizers. Florida Dep. Nat. Resour., Mar. Res. Lab., Prof. Pap. Ser. 19. 46pp.

KEY WORDS: Avicennia, freezing, germination, Laguncularia, life history, planting, Rhizophora, root systems, salinity, seeds, substrate.

Of three genera of mangroves (Rhizophora, Avicennia, and Laguncularia) Avicennia was determined to have the best qualifications as a stabilizing plant in dredged areas because of its ability to tolerate a variety of unfavorable environmental conditions (freezing, burying, high salinities, etc.) and its wide distribution.

545. Savage, T. 1972. Florida mangroves: a review. Florida Dep. Nat. Resour., Leafl. Ser.: vol. 7, part 2, no. 1. 15pp.

KEY WORDS: Avicennia, bibliography, growth, Laguncularia, Rhizophora, root systems, seeds, succession, zonation.

This general discussion provides a review of the ecology, life history, and propagation of Florida's mangroves.

546. Scheffer, T. H. and N. Hotchkiss. 1945. Plant food resources for waterfowl in the Pacific. Wash. State Dep. Game, Biol. Bull. 7. 39pp.

KEY WORDS: emergents, fishes, geography, habitat, marsh, planting, seeds, submergents, tubers, turbidity, vegetative propagation, waterfowl.

Species of Potamogeton were eaten far more than any other aquatic species by 10 kinds of waterfowl in the Pacific Northwest. Aquatic plants of many different aquatic habitats are listed. Environmental and man-made factors affecting growth and distribution of aquatic species are discussed. General guidelines for planting are given; planting is considered more reliable than seeding.

547. Schmid, W. D. 1965. Distribution of aquatic vegetation as measured by line intercept with scuba. Ecology 46(6):816-822.

KEY WORDS: depth, lakes, submergents, substrate.

The aquatic vegetation of Long Lake, Minnesota was surveyed underwater. No vegetation was found deeper than 11 m. Plants were more abundant on the southwest facing slope than on the northeast. Some of the significant interspecies correlations which were observed appeared to be related to water depth and texture of the substrate.

548. Sculthorpe, C. D. 1960. Strange habits and floral mechanisms of familiar aquarium plants. The Aquarist and the Pondkeeper 25(4): 76-80.

KEY WORDS: geography, life history, pH, seed production.

Members of the family Hydrocharitaceae (Vallisneria, Hydrocharis, Elodea, and Stratiotes) are discussed primarily with respect to aquarium propagation but the descriptions occasionally include information on pH requirements and seed production.

549. Sculthorpe, C. D. 1963. Water plants that survive the winter. The Aquarist and the Pondkeeper 27(12):226-229.

KEY WORDS: emergents, submergents, vegetative propagation.

Aquatic plants that are most often used in outdoor cement pools (Hydrocharis, Myriophyllum, Utricularia, Stratiotes, Sagittaria, and Potamogeton) are described and means by which these species revegetate an area in spring are noted; cultivation is briefly discussed.

550. Sculthorpe, C. D. 1967. The Biology of Aquatic Vascular Plants. Edward Arnold Ltd., London. 610pp.

KEY WORDS: absorption, adventive spread, aeration, afterripening, ammonia, anaerobiasis, anchorage, apomixis, auxins, bibliography, bicarbonate, biomass, bogs, brackish, buoyancy, calcium, carbon, carbon dioxide, chelaters, chloride, colonization, commercial uses, communities, competition, control, culture, decomposition, depth, diseases, dispersal, dormancy, drainage, drawdown, dredging, ecological range, emergents, epiphytes, equipment, erosion, escapes, exotics, fertilizer, fertility, fire, fishes, floating plants, flooding, floods, floras, fragmentation, freezing, fruits, gemmipary, genotype, geography, germination, growth, habitat, harvest, herbicides, hibernacula, hybrids, hydrogen sulfide, invertebrates, iron, irrigation, keys, lakes, life history, light, machinery, magnesium, marine, marl, marsh, morphology, mosquitoes, mowing, navigation, nitrate, nitrogen, nutrients, offsets, ornamentals, oxygen, perennation, pH, phenology, phenotype, phosphorus, phytosociology, planting, plasticity, pollution, ponds, potassium, productivity, propagule sources, propagule storage, radioactive isotopes, respiration, rhizomes, rootstocks, root systems, salinity, salt marsh, seedlings, seed production, seeds, site preparation, sodium, sterility, stolons, submergents, substrate, succession, sudd, sulfate,

swamp, taxonomy, temperature, tides, transpiration, tubers, turbidity, turbulence, turions, vegetative propagation, vegetative reproduction, viability, waterfowl, waterlogging, weeds, zonation.

This monographic work reviews the research literature on aquatic and marsh plants. The theme of the book is the interaction between aquatic and marsh plants and their environment, as manifested at the various structural, physiological and ecological levels. The relations of structure and function, and comparisons with terrestrial vascular plants are discussed throughout the book. Frequent emphasis is given to possible trends of biological specialization and concepts of affinity and ancestry are outlined. (Paraphrased from book jacket.)

551. Seddon, B. 1967. The lacustrine environment in relation to macrophytic vegetation. pp. 205-215. In: E. J. Cushing and H. E. Wright, Jr. (Eds.). Quaternary Paleoecology. Vol. 7 of the VII. Congress of the Intl. Assoc. for Quaternary Res., Proc. Yale Univ. Press.

KEY WORDS: communities, ecological range, nutrients, submergents.

The hypothesis that solute content of lake waters is a primary factor controlling the occurrence of aquatic macrophytes is supported by the correspondence of a floristic series with the gradation from eutrophic to oligotrophic waters. The solute concentration of a lake may be predicted by a knowledge of its flora.

552. Seddon, B. 1972. Aquatic macrophytes as limnological indicators. Freshwater Biol. 2:107-130.

KEY WORDS: communities, ecological range, emergents, floating plants, nutrients, submergents.

The range and limiting tolerance of solute content for aquatic species are described and related to trophic categories. Restriction towards eutrophic conditions is considered as an obligate relationship reflecting physiological demands. Some dystrophic and oligotrophic species have wide tolerance ranges.

553. Segadas-Vianna, F. 1951. A phytosociological and ecological study of cattail stands in Oakland County, Michigan. J. Ecol. 39(2):316-329.

KEY WORDS: phytosociology, substrate, Typha.

No correlation was found between the type of substratum and the species of Typha or the floristic composition of the stand.

554. Seneca, E. D. 1969. Germination response to temperature and salinity of four dune grasses from the outer banks of North Carolina. Ecology 50(1):45-53.

KEY WORDS: Ammophila, dormancy, germination, Panicum, salinity, Spartina, temperature, Uniola.

The germination responses of Ammophila breviligulata, Panicum amarulum, Spartina patens, and Uniola paniculata to constant temperatures, cold treatment, and salinity are described.

555. Seneca, E. D. 1972. Seedling response to salinity in four dune grasses from the Outer Banks of North Carolina. Ecology 53(3): 465-471.

KEY WORDS: Ammophila, ecotype, growth, Panicum, salinity, seedlings, Spartina, substrate, Uniola.

Based on seedling growth responses, the order of decreasing salt tolerance for the four species of perennial dune grasses studied is Spartina patens, Panicum amarulum, Uniola paniculata, and Ammophila breviligulata.

556. Seneca, E. D. 1972. Germination and seedling response of Atlantic and Gulf Coast populations of Uniola paniculata. Am. J. Bot. 59(3):290-296.

KEY WORDS: ecotype, germination, planting, seedlings, temperature, Uniola.

Uniola paniculata is primarily a dune species but will grow in the salt spray zone along the water's edge. Conditions for germination and optimum seedling growth are considered.

557. Seneca, E. D. 1974. Stabilization of coastal dredge spoil with Spartina alterniflora. In: R. J. Reimold and W. H. Queen (Eds.). Ecology of Halophytes. Academic Press Inc. pp. 525-529.

KEY WORDS: dredging, machinery, planting, salt marsh, Spartina.

Planting of the intertidal zone of dredge spoil with Spartina alterniflora can result in stabilization of the spoil material and the initial development of estuarine salt marsh.

558. Seneca, E. D. in press. Germination and seedling response of Atlantic and Gulf coast populations of Spartina alterniflora. Am. J. Bot.

KEY WORDS: biomass, ecological range, ecotype, genotype, germination, life history, photoperiod, propagule storage, seedlings, Spartina.

Germination response to thermoperiod and seedling response to photoperiod-thermoperiod treatments and to uniform field conditions were compared for 12 populations of Spartina alterniflora from along the Atlantic and Gulf coasts.

559. Seneca, E. D. and S. W. Broome. 1972. Seedling response to photoperiod and temperature by smooth cordgrass, Spartina alterniflora, from Oregon Inlet, North Carolina. Cheasapeake Sci. 13(3):212-235.

KEY WORDS: biomass, ecotype, light, photoperiod, seedlings, Spartina, temperature.

Seedlings biomass increased under both short and long day photoperiods as temperatures of the thermoperiods increased, but was greater in each thermoperiod under long day conditions. Seedlings grown under short day conditions were shorter, contained less biomass, produced more culms and rhizomes, had less shoot moisture, and contained higher chlorophyll concentrations than those under long day conditions at the same temperatures.

560. Seneca, E. D., W. W. Woodhouse, Jr. and S. W. Broome. 1973. Salt water marsh creation. Second Intl. Estuarine Res. Conf., Myrtle Beach, South Carolina.

KEY WORDS: colonization, dredging, planting, propagule sources, propagule storage, salinity, seeds, Spartina, tides.

Methods of seeding and transplanting Spartina alterniflora on dredge spoil sites have been successful.

561. Setchell, W. A. 1920. Geographical distribution of the marine spermatophytes. Bull Torrey Bot. Club 47:563-579.

KEY WORDS: marine, submergents, taxonomy, temperature, Zostera.

Most marine plants live in shallow water down to ten fathoms (60 feet) though some are found much deeper. Distributions of several species (especially Zostera) are related to temperature, substrate, and other environmental conditions.

562. Shannon, E. L. 1953. The production of root hairs by aquatic plants. Am. Midl. Nat. 50:474-479.

KEY WORDS: emergents, root systems, submergents.

A total of 209 species of aquatic plants representing 105 genera and 54 families was examined to determine root hair production. Root hairs were found on 93.3 percent (195 species); 9 species produced neither roots nor root hairs, and 5 plants produced roots without root hairs.

563. Sharp, W. M. 1939. Propagation of Potamogeton and Sagittaria from seeds. N. Am. Wildl. Conf., Trans. 4:351-358.

KEY WORDS: planting, Potamogeton, propagule sources, propagule storage, Sagittaria, seeds.

Collection, storage, and planting of Potamogeton pectinatus, P. zosteriformis and Sagittaria latifolia seeds are discussed.

564. Shearer, L. A., B. J. Jahn and L. Lenz. 1969. Deterioration of duck foods when flooded. J. Wildl. Manage 33(4):1012-1015.

KEY WORDS: flooding, Polygonum, Scirpus, waterfowl.

Eighteen kinds of seeds eaten by waterfowl showed varying degrees in rate and percentage of germination when submerged. While upland plant seeds showed the greatest deterioration, wetland plant seeds showed little.

565. Shepherd, P. H., R. L. Crow and J. N. Crow. 1968. Waterfowl Report, Appendix I. Some effects of the March 27, 1964 earthquake on the ecology of the Copper River Delta, Alaska. Ann. Proj. Segment Rep. Vol. IX. Alaska Dep. Fish & Game, Juneau.

KEY WORDS: colonization, communities, drainage, habitat, salinity, substrate, waterfowl, waterlogging.

During the major 1964 earthquake the Copper River Delta was raised an average of 6.3 feet. It was observed that desalinization was subsequently occurring and previously inundated areas were becoming favorable sites for mesophytic species. Colonization of bare mud and newly formed sloughs is discussed as well as the impact of the eqrthquake on waterfowl habitat.

566. Sifton, H. B. 1959. The germination of light sensitive seeds of Typha latifolia L. Can. J. Bot. 37:719-739.

KEY WORDS: dormancy, germination, light, oxygen, seeds, temperature, Typha.

Germination in Typha latifolia is strongly favored by white light and low oxygen concentrations; optimum temperature for germination is 30 C. Removal or puncturing of the seed coat obviates the necessity of light for germination.

567. Simmonds, N. W. 1945. Polygonum lapathifolium L. (P. tomentosum Schr. of many continental authors). J. Ecol. 33(1):132-139.

KEY WORDS: communities, dormancy, habitat, life history, Polygonum, propagule storage, seedlings, seed production, viability.

The habitat and several aspects of reproduction of Polygonum lapathifolium are described in this life history account.

568. Simmonds, N. W. 1945. Polygonum persicaria L. J. Ecol. 33(1): 121-131.

KEY WORDS: colonization, dormancy, germination, life history, pH, Polygonum, propagule storage, seed production, substrate.

A life history of Polygonum persicaria L. including substrate preferences, community relationships, seed storage, and growth on bare muds.

569. Simmonds, N. W. 1945. Polygonum petecticale (Stokes) Druce (P. maculatum Trimen and Dyer, P. nodosum Persoon etc.). J. Ecol. 33(1):149-143.

KEY WORDS: colonization, dispersal, germination, life history, seed production.

A life history of Polygonum petecticale, a plant peculiarly characteristic of exposed lake or river mud, is given.

570. Simpson, G. M. 1966. A study of germination in the seed of wild rice (Zizania aquatica). Can. J. Bot. 44(1):1-9.

KEY WORDS: afterripening, dormancy, germination, oxygen, pH, propagule storage, seeds, temperature, Zizania.

Dormancy lasted about 6 months in seeds of Zizania aquatica afterripened at 1-3 C. Low oxygen tensions promoted breaking of dormancy. Low constant temperatures favored maximum rates of germination, as did alternating high and low. Air drying of seeds for 90 days caused almost complete loss of viability.

571. Singleton, J. R. 1951. Production and utilization of waterfowl food plants on the East Texas Gulf Coast. J. Wildl. Manage. 15(1):46-56.

KEY WORDS: depth, Echinochloa, Polygonum, Potamogeton, Scirpus, seed production, waterfowl.

A discussion of seed production and value to waterfowl of several important species of marsh plants.

572. Singleton, J. R. 1965. Waterfowl habitat management in Texas. Texas parks and Wildl. Dep., Bull. 47. 65pp.

KEY WORDS: brackish, control, depth, emergents, nutrients, planting, propagule sources, site preparation, submergents, waterfowl, weeds.

Conditions which encourage the growth and production of desirable waterfowl food plants in Texas wetlands are discussed. Plant succession should be arrested at a stage most useful to waterfowl. Several of the more important waterfowl food plants are pictured and their characteristics and management briefly outlined.

573. Skau, C. M. and M. W. Day. 1959. An ecological study of a man-made island. Am. Midl. Nat. 61(1):109-123.

KEY WORDS: colonization, dredging, Phragmites, substrate, succession.

A description, primarily of terrestrial species, of vegetation which invaded a dredge spoil island in St. Mary's River, Michigan is presented. Some data on the abundance of Phragmites communis (= australis) and Equisetum arvense are given.

574. Smith, A. L. 1972. Factors influencing germination of Scolochloa festucacea caryopses. Can. J. Bot. 50(11):2085-2092.

KEY WORDS: germination, Scolochloa, seeds, temperature.

Scolochloa festucacea is an emergent hydrophyte which survives in habitats that fluctuate from total submergence in early spring to a dry substrate in the fall. Germination and seedling emergence increased with increasing caryopses weight in Scolochloa. Maximum seedling survival occurred when caryopses were planted 1 cm deep. Simulation of anaerobic conditions by soaking caryopses increased seedling emergence as did treating imbibed caryopses in a N_2 atmosphere, and soaking caryopses in 95 percent ethyl alcohol for up to 60 minutes. Optimum seedling growth occurred at 20 C.

575. Smith, A. L. 1973. Life cycle of the marsh grass Scolochloa festucacea. Can. J. Bot. 51:1661-1668.

KEY WORDS: fire, freezing, germination, growth, life history, mowing, phenology, Scolochloa, seeds, temperature.

This paper describes the life cycle of Scolochloa festucacea, a dominant species in potholes subjected to regular burning or mowing in parts of the Norther Great Plains. Vernal growth is initiated at very low temperatures; some plants grow in water at the freezing point. Flowers develop in June. Seed may be dropped in July but will not germinate until the following year.

576. Smith, P. B. 1956. Waterfowl management on multiple-use reservoirs in Tennessee. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 9:223-226.

KEY WORDS: control, drawdown, emergents, planting, waterfowl, weeds.

Buttonbush (Cephalanthus) and willow (Salix) have become problem species on mud flat areas in Tennessee which are managed for waterfowl foods. Methods of elimination are briefly outlined. Planting of mud flats with ryegrass and Japanese millet (Echinochloa spp.) in August produced green food and seeds for migrant waterfowl.

577. Smith, R. H. 1939. Wildlife management practices for overflow areas of the lower Mississippi River region. N. Am. Wildl. Conf., Trans. 4:395-399.

KEY WORDS: depth, emergents, fishes, pH, plantings, turbidity.

Experimental plantings in impoundments in the lower Mississippi River region failed due to acidity, excessive water level fluctuations, turbidity from carp activities, and destruction by turtles.

578. Smith, R. H. 1942. Management of salt marshes on the Atlantic Coast of the United States. N. Am. Wildl. Conf., Trans. 7:272-277.

KEY WORDS: brackish, control, emergents, fire, harvest, planting, site preparation, submergents.

The type of management techniques used on an area depends largely on production objectives. Most marsh management includes physical improvements or development, and cultural practices; these techniques include creation of water areas, alteration of salinity levels, damming and kiking, burning, harvest of marsh grasses, and direct planting and seeding.

579. Smith, R. H. 1960. Experimental establishment of food and cover plants in marshes created for wildlife. Pittman-Robertson Rep. W-88-4, New York. 30pp.

KEY WORDS: emergents, fertilizer, planting, site preparation, substrate.

Ten species of aquatic plants were transplanted into 27 marshes created for wildlife in New York State. Of 113 plants only 10 percent showed even fair growth; 64 percent failed completely and 16 percent did poorly. The poor results were attributed to deficiencies in the substrate of both chemical and biological factors. Substrate management rather than planting is recommended.

580. Smith, R. H. 1965. Some marsh and aquatic waterfowl food plants. The Conservationist (N. Y.) 20(1):23-26.

KEY WORDS: emergents, habitat, submergents.

A general description of the habitat of eleven of the more common waterfowl foods and their value to wildlife.

581. Soileau, D. M. 1968. Vegetative reinvasion of experimentally treated plots in a brackish marsh. M. Sc. Thesis, Louisiana State Univ. & Agr. & Mech. College.

KEY WORDS: brackish, fire, growth, herbicides, marsh, Scirpus vegetative propagation.

A combination of burning and tilling was found to be most effective in retarding growth of wiregrass (Spartina patens) and saltmarsh grass (Distichlis spicata) and promoting growth of Olney's three cornered grass (Scirpus olneyi) and leafy three cornered grass (Scirpus robustus). The chemicals Dalapon, Fenuron, Karmex, and Bromacil were also effective in eliminating saltmarsh grass and wiregrass.

582. Spagnoli, J. J. 1971. What's happening to our salt water marshes? The Conservationist (N. Y.) 25(5):22-27.

KEY WORDS: habitat, salinity, salt marsh, substrate, succession, tides, zonation.

A general account of life cycles, water level relations, salinity tolerances, and tidal zones of the vegetation in New York State salt marshes.

583. Spence, D. H. N. 1967. Factors controlling the distribution of freshwater macrophytes with particular reference to the lochs of Scotland. J. Ecol. 55(1):147-170.

KEY WORDS: bicarbonate, depth, lakes, nutrients, succession.

The common fresh water loch in Scotland is low in dissolved bicarbonates and nutrients which along with the physiographic structure of the lake results in poor substrates. These and other factors have resulted in such a slow rate of vegetation change that there are no noticeable differences after 50 years.

584. Spence, D. H. N. and J. Chrystal. 1970. Photosynthesis and zonation of fresh water macrophytes. II. Adaptability of species of deep and shallow water. New Phytol. 69:217-227.

KEY WORDS: depth, photosynthesis, Potamogeton, submergents.

There are significant, inherent differences in the morphological and photosynthetic responses to light of leaves of Potamogeton obtusifolius (mean depth of growth = 130 cm) and P. polygonifolius (mean depth = 9 cm). Since P. obtusifolius has a similar photochemical capacity to P. polygonifolius, the authors concluded that the higher photosynthetic capacity of P. obtusifolius in low irradiances (such as 1 percent daylight) must be achieved by reduction in respiration rate per unit area, by leaf thickness, and by increases in specific leaf area.

585. Spence, D. H. N. and J. Chrystal. 1970. Photosynthesis and zonation of freshwater macrophytes. I. Depth distribution and shade tolerance. New Phytol. 69:205-215.

KEY WORDS: competition, depth, emergents, light, photosynthesis, Potamogeton, submergents, zonation.

It was determined that light may be at least as important as substrate type or competition in influencing the zonation of freshwater macrophytes.

586. Spence, D. H. N., T. R. Milburn, M. Ndawula-Senyimba and E. Roberts. 1971. Fruit biology and germination of two tropical Potamogeton species. New Phytol. 70:197-212.

KEY WORDS: afterripening, buoyancy, depth, dispersal, fruits, germination, light, photosynthesis, Potamogeton, seeds.

Production of gases during photosynthesis enables the fruits of some tropical Potamogetons to float for long periods; the most abundant species of Potamogeton are those which have the longest floating seeds. Germination does not occur until the fruits have sunk. No afterripening period is required, and light appears to be necessary for germination.

587. Stalter, R. 1972. A seed germination method for Spartina alterniflora Loisel. Castanea 37(3):226-227.

KEY WORDS: afterripening, dormancy, germination, harvest, propagule storage, seeds, Spartina.

Seeds of Spartina should be gathered from mid-October to early November in southeastern U. S. Seeds should then be placed in jars of sea water and placed in a cold room at 4 to 6 C for at least 30 days. Paleas and lemmas of the seeds become transparent when they are ripened.

588. Stalter, R. 1973. Factors influencing the distribution of vegetation of the Cooper River estuary. Castanea 38(1):18-24.

KEY WORDS: brackish, emergents, marsh, salt marsh, tides, zonation.

The marshes of the Cooper River estuary were categorized as three units: saltmarsh, brackish, and freshwater marsh. The zonation of vegetation is described for each category; zonation was most pronounced in the salt marshes.

589. Stalter, R. 1973. Seed viability in two Atlantic Coast populations of Spartina alterniflora. Castanea 38(1):110-113.

KEY WORDS: germination, seeds, Spartina, viability.

The seeds from two distinct Atlantic Coast populations (Connecticut and S. Carolina) of Spartina alterniflora were found to have low percentages of viability.

590. Stalter, R. 1973. Transplantation of salt marsh vegetation. II., Georgetown, South Carolina. Castanea 38(2):132-139.

KEY WORDS: ecotype, emergents, planting, Salicornia, salinity, salt marsh, Spartina, substrate, zonation.

Survival and growth rates for transplants suggested that several species can tolerate conditions not found in their normal zones for a year or longer.

591. Stalter, R. and W. T. Batson. 1969. Transplantation of salt marsh vegetation, Georgetown, South Carolina. Ecology 50(6): 1087-1089.

KEY WORDS: growth, planting, salt marsh, substrate, tides.

Salt marsh plants from one of four marsh zones were transplanted to another zone. Data on survival, growth rates, response to moisture conditions, and methods of transplanting are given.

592. Stalter, R. and W. T. Batson. 1973. Seed viability in salt marsh taxa, Georgetown, South Carolina. Castanea 38(1):109-110.

KEY WORDS: emergents, germination, salt marsh, seed production, Spartina, viability.

Seeds from 5 salt marsh species and 2 species growing on the fringe of the marsh were collected during the fall of 1967. Less than 10 percent of the seeds of Spartina patens and S. alterniflora were viable. Borrichia frutescens produced the greatest percentage of viable seeds (97 percent)

593. Stanton, F. W. and H. C. Smith. 1957. Planting food for waterfowl. Oregon State Game Comm, Misc. Wildl. Pub. 1. 16pp.

KEY WORDS: emergents, habitat, planting, propagule sources, rhizomes, seeds, submergents, waterfowl.

General recommendations for waterfowl food plantings in Oregon are given. Agricultural crops are given preference for food sources where land is tillable. The more important wild food plants are listed and described as to habitat, parts used in propagation, and importance to waterfowl.

594. Stapes, M. C. 1903. The colonization of a dried river bed. New Phytol. 2:186-192.

KEY WORDS: colonization, drainage, emergents, submergents, succession.

A small tributary of the Thames was dried up when its source was diverted. The succession of aquatic and terrestrial plants that invaded the bare soil is discussed.

595. Stapf, O. 1914. Spartina townsendii. J. Bot. 46:76-81.

KEY WORDS: dispersal, geography, habitat, hybrids, seeds, Spartina.

Four species of Spartina occur in Europe, two native (S. stricta, S. townsendii) and two introduced (S. alterniflora, S. juncea) from N. America. Hybridization and dispersal of these species relative to geographical location are discussed.

596. Stapf, O. 1914. Spartina townsendii. J. Bot 52:245-247.

KEY WORDS: commercial uses, erosion, geography, habitat, hybrids, life history, planting, root systems, Spartina, tides.

A brief life history of Spartina townsendii is given. Because its principal domain is from 1 to 3 feet below high water mark and because it has a massive root system, this plant is useful along channel banks to maintain the structure of the channel and prevent erosion.

597. Stason, M. 1926. The Marsileas of the western United States. Bull. Torrey Bot. Club 53(7):473-478.

KEY WORDS: ecotype, geography, morphology, taxonomy.

Three species of Marsilea are described and their type locality in the western U.S. given. Several features of morphology are reviewed to determine if the variations are true species or just ecotypes.

598. Steenis, J. H. 1939. Marsh management on the Great Plains Waterfowl Refuge. N. Am. Wildl. Conf., Trans. 4:400-405.

KEY WORDS: depth, emergents, erosion, germination, harvest, planting, propagule sources, propagule storage, rootstocks, Scirpus, seeds, site preparation, tubers, vegetative propagation, waterfowl.

Collection, storage, and planting of aquatic plants are discussed for several important waterfowl food plants. Water level fluctuations, turbidity, erosion and other environmental problems often encountered on refuges are considered with reference to tolerant marsh species.

599. Steenis, J. H. and J. Warren. 1959. Management of needlerush for improving waterfowl habitat in Maryland. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 13:296-298.

KEY WORDS: flooding, herbicides, Juncus, waterfowl.

Southeastern coastal marshlands, dominated by needlerush (Juncus roemerianus), were effectively treated with derivatives of 2,4-D to allow the invasion of aquatic food producing plants and thus increase the value of the area for waterfowl.

600. Steeves, T. A. 1950. A note on the varieties of Zizania aquatica L. Rhodora 52(614):34.

KEY WORDS: ecotype, morphology, substrate, Zizania.

Wild rice plants collected in New Brunswick were up to a meter taller than Zizania aquatica var. angustifolia whose maximum height is 1.5 m as described by Fassett. It appeared that the size was correlated with the ecological surroundings, smaller plants occurring on more sandy soils.

601. Sterling, C. 1949. The primary body of the shoot of Dianthera americana. Am. J. Bot. 36:184-193.

KEY WORDS: Dianthera, growth, rhizomes, root systems, vegetative propagation.

Aerial shoots of Dianthera americana arise annually from a perennating rhizome; these rhizomes may be collected at the end of the growing season and transplanted.

602. Stern, W. L. and G. K. Voigt. 1959. Effect of salt concentration on growth of red mangrove in culture. Bot. Gaz. 121(1):36-39.

KEY WORDS: culture, Rhizophora, salinity, seedling, substrate.

Best survival and growth of Rhizophora mangle seedlings occurred at substrate salinities which approximated natural habitat conditions.

603. Steward, K. K. 1969. Effects of growth regulators and herbicides on germination of Hydrilla turions. Weed Sci. 17(3):299-301.

KEY WORDS: adventive spread, auxins, control, exotics, growth, Hydrilla, herbicides, turions, vegetative reproduction.

Hydrilla verticillata spread approximately 45,000 acres in Florida and also in other states within the first 10 years of its introduction. Several parts of the plant, leteral buds, stolons, and turions, are involved in vegetative growth and reproduction. The effects of several auxins and herbicides on growth are discussed.

604. Steward, A. N., L. R. Dennis and H. M. Gilkey. 1960. Aquatic plants of the Pacific Northwest. Oregon State College, Studies in Botany 11. 184pp.

KEY WORDS: emergents, keys, submergents.

A vegetative key with brief descriptions of morphology.

605. Stewart, R. E. and H. A. Kantrud. 1972. Vegetation of prairie potholes, North Dakota, in relation to quality of water and other environmental factors. U. S. Geol. Surv., Prof. Pap. 585-D. 36pp.

KEY WORDS: communities, depth, drawdown , marsh, salinity, substrate.

Measurement of specific conductance provides an adequate indication of the average salinity of surface water in natural ponds and lakes of the northern prairie region. Salinity of surface water is a major environmental factor affecting establishment of aquatic and marsh vegetation. Plant associations within the major vegetation types of the potholes (i.e. wetland low prairie, wet-meadow, shallow marsh emergent, deep marsh emergent, fen emergent, submerged, and floating), natural drawdown, cropland drawdown, and cropland tillage, are discussed in relation to salinity of surface waters.

606. Stieglitz, W. O. 1972. Food habits of the Florida duck. J. Wildl. Manage. 36(2):422-428.

KEY WORDS: brackish, flooding, Polygonum, Rhynchospora, waterfowl.

Brackish water impoundments should be managed at stable water levels (1 to 3 feet) to promote growth of Ruppia maritima and Najas marina. Excessive turbidity and siltation are harmful to submergents and should be avoided.

607. Stoddard, C. H. 1957. Utilization of waste swamplands for wild rice production. Land Econ. 33(1):77-80.

KEY WORDS: habitat, planting, site preparation, substrate, Zizania.

The growth requirements of Zizania aquatica are outlined and a case of successful planting is described.

608. Stoddard, C. H. 1960. Wild rice production from new wetlands. N. Am. Wildl. Conf., Trans. 25:144-153.

KEY WORDS: habitat, life history, planting, Zizania.

Habitat conditions necessary for the successful establishment of Zizania aquatica are discussed as well as factors adversely affecting plantings.

609. Stoller, E. W. and L. M. Wax. 1973. Yellow nutsedge shoot emergence and tuber longevity. Weed Sci. 21:76-81.

KEY WORDS: Cyperus, depth, germination, temperature, tubers, viability.

Tubers of Cyperus esculentus were buried from 2.5 to 30.5 cm below the soil surface in an Illinois field in 1969 and 1970. In both years, shoots began to emerge the following May and continued emergence until July. Shoots emerged from less than 2 percent of the tubers buried at 2.5 cm; the maximum number of shoots emerged from tubers at the 10.2 and 20.3 cm depths.

610. Strawn, K. 1961. Factors influencing the zonation of submerged monocotyledons at Cedar Key, Florida. J. Wildl. Manage. 25(2): 178-189.

KEY WORDS: drawdown, dredging, submergents.

Exposure of any of the five species of seaweeds to air for long periods results in desiccation and death of the plant. Other unfavorable environmental conditions are also discussed. Proper dredging techniques can restore grass flats and enlarge existing beds.

611. Stuckey, R. L. 1968. Distributional history of Butomus umbellatus (flowering-rush) in the western Lake Erie and Lake St. Clair region. Mich. Bot. 7:134-142.

KEY WORDS: Butomus, geography, dispersal, rootstocks, seeds.

The distribution of Butomus umbellatus in North America is described. Seeds, rootstocks, and bulblets are dispersed by water currents.

612. Stuckey, R. L. 1969. The introduction and spread of Lycopus asper (Western Water Horehound) in the western Lake Erie and Lake St. Clair region. Mich. Bot. 8:111-120.

KEY WORDS: colonization, dispersal, Lycopus, rhizomes, stolons, vegetative reproduction.

The distribution of Lycopus asper in the Great Lakes region is described. The species reproduces vegetatively by short, thick, stolons and runners, with long thick rubers at their tips. It grows well on sandy beaches and may serve to stabilize sand.

613. Stuckey, R. L. 1971. Changes of vascular aquatic flowering plants during 70 years in Put-in-Bay Harbor, Lake Erie, Ohio. Ohio J. Sci. 71(6):321-342.

KEY WORDS: dredging, oxygen, pollution, submergents, succession, turbidity, temperature.

Fifty percent of the aquatic plant species in Put-in-Bay Harbor have disappeared over the last 70 years. Few of the species that remain are common. The probable causes for the change in species composition include: general increase in water temperature, decreases in dissolved oxygen content, increases in turbidity, dredging, physical displacement by piers, marinas, etc., and pollution.

614. Stuckey, R. L. 1974. The introduction and distribution of Nymphoides peltatum (Menyanthaceae) in North America. Bartonia 42:14-23.

KEY WORDS: exotics, geography, Nymphoides, vegetative reproduction.

Nymphoides peltatum becomes easily established in aquatic environments largely due to its ability to readily form new plants at the flowering nodes. A map of the species distribution in the U. S. is included.

615. Stuckey, R. L. and W. L. Phillips. 1970. Distributional history of Lycopus europaeus (European Water Horehound) in North America. Rhodora 72(791):351-369.

KEY WORDS: adventive spread, colonization, dispersal, Lycopus, rhizomes, seeds.

Lycopus europaeus was brought to North America during the 1800's in ship ballast. The species' distribution is associated with water courses, since the seeds float and are carried by water currents. Whole young plants form at the ends of rhizomes and sometimes form long chains of plants. The plants often colonize coarse and wave-washed shores and are found in both fresh and brackish waters.

616. Surber, E. W. 1961. Improving sport fishing by control of aquatic weeds. U. S. Fish and Wildl. Serv., Circ. 128.

KEY WORDS: control, emergents, fertilizers, fishes, floating plants, herbicides.

The control of algae, emergent and floating-leaved aquatic plants, and submersed aquatics via chemicals and biological methods is discussed. Herbicide treatments for the common weed species are detailed as to brand, dosage, and techniques of application.

617. Sutton, D. L. and S. W. Bingham. 1970. Uptake and translocation of 2,4-D-1-^{14}C in parrotfeather. Weed Sci. 18:193-196.

KEY WORDS: herbicides, Myriophyllum.

Root applications of 2,4-D at concentrations of 2.5 X 10^{-8} M or higher inhibit the growth of Myriophyllum brasiliense. There was little upward (acropetal) movement after applications of 1.1 X 10^{-5} M 2,4-D to the roots of emersed parrotfeather. Basipetal (from the apex downward) movement occurred in the phloem after applications of 2,4-D to mature leaves in the shoot center of emersed parrotfeather.

618. Svedelius, N. 1932. On the different types of pollination in Vallisneria spiralis and Vallisneria americana Michx. Svensk Bot. Tidskrift 26(1-2):1-12.

KEY WORDS: physiology, Vallisneria.

A brief comparison of the process of pollination in two species of Vallisneria.

619. Swanson, G. A. and M. I. Meyer. 1973. The role of invertebrates in the feeding ecology of Anatinae during the breeding season. Waterfowl Habitat Manage. Symp. 32pp.

KEY WORDS: emergents, invertebrates, nutrients, waterfowl.

Various factors which influence a duck's choice of foods are discussed. Table 5 lists the proportion of plant and animal foods found in the esophagi of the blue winged teal in North Dakota. Seed from emergent plants in the wet meadow zone constituted approximately 1/3 of the volume of food intake. The protein content of selected plants (and invertebrates) is given in Table 7.

620. Swindale, D. N. and J. T. Curtis. 1957. Phytosociology of the larger submerged plants in Wisconsin lakes. Ecology 38:397-407.

KEY WORDS: marl, nutrients, pH, phytosociology, substrate.

Aquatic plants in a Wisconsin lake are grouped together into a joint-occurrence index to derive an order of species related to the gradient complex of ecological factors.

621. Sypulski, J. L. 1943. The Seny bulrush picker. J. Wildl. Manage. 7(2):230-231.

KEY WORDS: planting, propagule sources, Scirpus, seeds.

Bulrush stands are best established by seed but seed collection is often difficult due to inaccessibility. A hand operated mechanical device which allows fruiting heads to be picked five times faster than without the tool, is pictured and its construction described.

622. Tadros, T. M. 1953. A phytosociological study of halophilous communities from Mareotis (Egypt). Vegetatio 4(2):101-124.

KEY WORDS: communities, emergents, geography, habitat, phytosociology, salt marsh, substrate.

Each vegetation association of these circum-Mediterranean salt marshes occupies a habitat of definite sea levels which show differences in soil texture, salinity, water and organic matter contents.

623. Tadros, T. M. and B. A. M. Atta. 1958. Further contributions to the study of the sociology and ecology of the halophilous plant communities of Mareotis (Egypt). Vegetatio 8(3):137-160.

KEY WORDS: communities, salt marsh, substrate.

Substrates in Egyptian salt marshes were analyzed for moisture content, saturation capacity, particle size, soluable salts, chlorides, sulfates, etc. Salinity was the principal factor to show a consistent effect on the distribution of vegetation but other factors were nearly as important.

624. Taylor, A. R. A. 1957. Studies of the development of Zostera marina I. The embryo and seed. Can. J. Bot 35(4):477-499.

KEY WORDS: dispersal, germination, morphology, seeds, Zostera.

Development of Zostera marina is technically described from proembryo to mature seed. The seeds are heavier than sea water and sink to the bottom where they may be carried away by currents or remain buried.

625. Taylor, A. R. A. 1957. Studies of the development of Zostera marina. II. Germination and seedling development. Can. J. Bot. 35(5):681-695.

KEY WORDS: germination, phenology, propagule storage, salinity, seeds, temperature, viability, Zostera.

The majority of apparently viable eelgrass seeds are formed before mid-August. Germination can occur immediately after shedding but most remain dormant on the sea floor until the following spring. Temperature, salinity, and storage conditions are discussed.

626. Taylor, J. L. and C. H. Saloman. 1968. Some effects of hydraulic dredging and coastal development in Boca Ciega Bay, Florida. Fisheries Bull. 67(2):213-241.

KEY WORDS: biomass, dredging, invertebrates, nutrients, pollution, productivity, substrate, turbidity.

Filling of 1400 hectares of bay by hydraulic dredging has reduced the area of Boca Ciega Bay by about 20 percent since 1950. An estimate of the annual standing crop destroyed is 1133 metric tons (798 kg/ha, dry wt.) of sea grass and about 1812 metric tons (1277 kg/ha, dry wt.) of associated infauna. In terms of annual production, losses are estimated as 25,841 metric tons of sea grass, 73 metric tons of fishery products, and 1091 metric tons of infauna. Worth of the estuarine area already eliminated is $1.4 million annually. Additional, inestimable losses occur from sedimentation, turbidity, and domestic sewage.

627. Taylor, J. L., C. H. Saloman and K. W. Prest, Jr. 1973. Harvest and regrowth of turtle grass (Thalassia testudinum) in Tampa Bay, Florida. Fisheries Bull. 71(1):145-148.

KEY WORDS: growth, nutrients, productivity, substrate, Thalassia.

A comparison of leaf growth and new leaf production in plots of cut and uncut turtle grass indicated that plants suffered no permanent damage when harvested twice during a 6 month growing season in Florida.

628. Taylor, N. 1939. Salt tolerance of Long Island salt marsh plants. N. Y. State Mus. Circ. 23. 42pp.

KEY WORDS: salinity, salt marsh, seedlings.

Eleven species of common salt marsh plants were grown under controlled conditions at various salinities on Long Island. Salt tolerances of these cultivated plants are compared individually with natural salt tolerances of wild plants.

629. Teal, J. M. 1962. Energy flow in the salt marsh ecosystem of Georgia. Ecology 43(4):614-624.

KEY WORDS: productivity, respiration, salt marsh, Spartina, tides.

Spartina alterniflora was judged to be the only higher plant of importance as a producer in a Georgia salt marsh. Tides were of supreme importance in controlling the environment of the salt marsh and thus the productivity of Spartina. Approximately 45 percent of marsh production was "lost" to estuarine waters.

630. Teal, J. M. and J. W. Kanevisher. 1966. Gas transport in the marsh grass, Spartina. J. Exp. Bot. 17:355-361.

KEY WORDS: carbon dioxide, oxygen, physiology, Spartina.

Spartina plants have continuous gas spaces from the leaves to the tips of the roots. Gas transport is sufficient to supply aerobic respiratory needs of the roots as well as to aerate appreciably the reduced mud itself. The authors conclude that gases move in and out of Spartina by diffusion.

631. Teeter, J. W. 1965. Effects of sodium chloride on the sago pondweed. J. Wildl. Manage. 29(4):838-845.

KEY WORDS: germination, Potamogeton, salinity, seed production, vegetative reproduction.

Culture of Potamogeton pectinatus in tap water resulted in maximum vegetative growth and seed production. A NaCl concentration of 3000 ppm stimulated growth and production of tubers, while a 15,000 ppm NaCl concentration proved fatal.

632. Tenore, K. R. 1972. Macrobenthos of the Pamlico River estuary, North Carolina. Ecol. Monogr. 42:51-69.

KEY WORDS: dredging, invertebrates, nitrogen, oxygen, phosphate, salinity, substrate, temperature, turbidity.

The physical and chemical characteristics of the Pamlico estuary are described in detail. The benthos communities are discussed in relation to ecosystem food webs, environmental features, and diversity. Brief mention is made of Ruppia and Potamogeton beds in shallow sandy areas. The possible effects of dredging on water quality, chemistry, and aquatic ecosystems is discussed.

633. Terras, J. A. 1900. Notes on the germination of the winter buds of Hydrocharis morsus-ranae. Bot. Soc. Edinburgh, Trans. and Proc. 21:318-329.

KEY WORDS: floating plants, germination, growth, hibernacula, Hydrocharis, viability.

Hydrocharis morsus-ranae propagates freely by means of subaqueous runners. In autumn the winter buds are formed at the extremities of the last formed runners. Light and temperatures between 10 and 40 C are essential for germination.

634. Terrill, H. V. and G. Greenwell. 1948. Aquatic plants for waterfowl in Missouri. Missouri Cons. Comm., Circ. 141. 8pp.

KEY WORDS: emergents, germination, habitat, planting, propagule sources, submergents, vegetative propagation, waterfowl.

Many important waterfowl food plants are listed and their habitat requirements given. Commercial sources of planting stock are recommended for some species; information on when, where, and how to plant is listed for all species under consideration.

635. Thayer, G. W., S. M. Adams and M. W. LaCroix. 1973. Structural and functional aspects of a recently established Zostera marina community. Second Intl. Estuarine Res. Conf., Myrtle Beach, S. Carolina. pp.15-18.

KEY WORDS: biomass, communities, life history, productivity, Zostera.

A relatively new bed of eelgrass in N. Carolina was studied to determine production of eelgrass, benthic organisms, and associated plants and algae. A positive ocrrelation was demonstrated between sedimentation rate in the bed and distribution of eelgrass. Production and assimilation rates are given for fishes, micro- and macro-benthos, and algae.

636. Thom, B. G. 1967. Mangrove ecology and deltaic geomorphology: Tabasco, Mexico. J. Ecol. 55(2):301-343.

KEY WORDS: brackish, colonization, habitat, life history, Rhizophora, succession.

The vegetation patterns of deltas is determined by geomorphic processes and probably not by succession per se. Mangroves often follow herbaceous species after fresh water channels shift, leaving uncolonized brackish areas. The habitat of deltaic regions is well described.

637. Thomas, A. G. and J. M. Stewart. 1969. The effect of different water depths on the growth of wild rice. Can J. Bot. 47:1525-1531.

KEY WORDS: biomass, depth, morphology, phenology, Zizania.

Three distinct phases in plant height increase and associated morphological changes characterize the life cycle of wild rice in Lake Erie. Water level relations play an important role in supporting young plants, determining flowering time, and influencing biomass.

638. Thomas, P. M., R. O. Legault and G. F. Carpenter. 1968. Durability and efficiency of brush shelters installed in 1937 in Douglas Lake, Michigan. J. Wildl. Manage. 32(3):515-520.

KEY WORDS: lakes, site preparation, submergents.

Shelters ten feet square and 18 inches high formed from branches tied to wire, greatly increased the amount of submergent vegetation and sediment accumulation in a Michigan lake.

639. Thompson, D. E., J. E. Ragsdale, Jr., R. J. Reimold and J. L Gallagher. 1973. Seasonal aspects of remote sensing coastal resources. Univ. Georgia Mar. Inst, Sapelo Isl., Contrib. 263. 48pp.

KEY WORDS: emergents, productivity, salt marsh, Spartina.

The utility of airborne remote sensing areal measurement, and production assessment of estuarine marshes has been proven. Color infrared photography, RF 1:24,000, taken at low tide stage any time of the year is easiest to interpret. Interpretation legends for seasonal variation in photographs of each major marsh species are given.

640. Thompson, P. A. 1970. An analysis of the effect of alternating temperatures on germination of Lycopus europaeus L. J. Exp. Bot. 21(68):808-823.

KEY WORDS: germination, light, Lycopus, temperature.

Germination of Lycopus europaeus seeds in England depends absolutely on exposure to light and fluctuating temperatures. Exposure to 20 C temperatures or higher was necessary for full germination response.

641. Thompson, R. W., A. J. Bedrosian, J. E. Berry, J. W. Kolka, R. B. Ditton, W. O. Bennett and D. Wandersee. 1973. Investigation of a northeastern Wisconsin lake ecosystem: an interdisciplinary approach. Phase II - Management problems and alternatives. Univ. Wisconsin, Water Resour. Center. 44pp.

KEY WORDS: growth, Myriophyllum, nutrients, substrate, turbidity.

A conceptual model used by the research team to integrate several (human) components into a system that could produce a variety of management alternatives to prevent eutrophication, is presented. Preventing the proliferation of submergents, especially Myriophyllum, was the problem under consideration; many aspects of the problem are described.

642. Thorne, R. F. 1954. Flowering plants of the water and shores of the Gulf of Mexico. U. S. Fish & Wildl. Serv., Bull. 89:193-202.

KEY WORDS: bibliography, communities, emergents, floras, geography, habitat, salt marsh, submergents, swamp.

The vegetation of the shallow waters (i.e. less than 100 m) and shores of the Gulf of Mexico includes four principal communities of flowering plants: submarine meadow, mangrove swamp, salt marsh, and sand strand. The vegetation of each of these communities is reviewed.

643. Thornton, I. and M. E. C. Giglioli. 1965. The mangrove swamps of Kenaba, Lower Gambia river basin. II. Sulfur and pH in the profiles of swamp soils. J. Appl. Ecol. 2:257-269.

KEY WORDS: drainage, Rhizophora, substrate, sulfate, swamp.

Because of high sulfur concentrations in mangrove inhabited soils (especially by Rhizophora) these soils are unsuitable for drainage and cultivation. As the soil dries, acids form and the pH drops to as low as 3, thus becoming toxic to vegetation.

644. Thornton, M. St. L., Sr. 1934. The Indiana species of Scirpus. Am. Midl. Nat. 15(3):292-322.

KEY WORDS: habitat, keys, Scirpus.

The location, habitat, and keys to the genus Scirpus in Indiana are given.

645. Timson, J. 1966. Polygonum hydropiper L. J. Ecol. 54(3):815-821.

KEY WORDS: afterripening, depth, germination, habitat, life history, Polygonum, seed production.

The life history of Polygonum hydropiper, including habitat and reproduction, is discussed.

646. Titcomb, J. W. 1909. Aquatic plants in pond culture. Bur. Fish. Doc. 643. 31pp.

KEY WORDS: emergents, fishes, submergents, substrate.

Approximately 30 species of aquatic plants are illustrated and discussed in relation to substrate type and importance to fish, especially for spawning and cover for fry.

647. Toetz, D. W. 1971. Diurnal uptake of NO_3 and NH_4 by a Ceratophyllum - periphyton community. Limnol. Oceanogr. 16(5): 819-822.

KEY WORDS: ammonia, Ceratophyllum, nitrate.

The rate of nitrate assimilation in Ceratophyllum was found to be strongly dependent on light, whereas ammonium uptake was essentially continuous. The significance of these findings is briefly discussed.

648. Toetz, D. W. 1973. The kinetics of NH_4 uptake by Ceratophyllum demersum. Hydrobiologia 41(3):275-290.

KEY WORDS: ammonium, Ceratophyllum, nutrients, photosynthesis, physiology.

The Michaelis-Menten model was examined to determine its usefulness as an expression of the relationship between growth of aquatic plants and their nutrient supply, but was found to be unsatisfactory.

649. Tomlinson, P. B. 1969. On the morphology and anatomy of turtle grass, Thalassia testudinum (Hydrocharitaceae). II. Anatomy and development of the root in relation to function. Bull. Mar. Sci. Gulf & Caribb. 19(1):57-71.

KEY WORDS: morphology, root systems, Thalassia.

Thalassia roots have no water-conducting tissues, except close to their insertion, and are of no special significance in water absorption. The morphology of the tissues is discussed.

650. Tomlinson, P. B. 1969. On the morphology and anatomy of turtle grass, Thalassia testudinum (Hydrocharitaceae). III. Floral morphology and anatomy. Bull. Mar. Sci. Gulf & Caribb. 19(2): 286-305.

KEY WORDS: germination, morphology, phenology, seed production, Thalassia.

Flowering of Thalassia though erratic occurs in April-May (Florida) and the fruits dehisce, releasing seeds in June and July. Germination of seed washed to shore is common.

651. Tomlinson, P. B. 1972. On the morphology and anatomy of turtle grass, Thalassia testudinum (Hydrocharitaceae). IV. Leaf anatomy and development. Bull. Mar. Sci. Gulf & Caribb. 22(1): 75-93.

KEY WORDS: morphology, Thalassia.

The morphogenesis of leaf structures of Thalassia is described on the cellular level.

652. Tomlinson, P. B. and G. A. Vargo. 1966. On the morphology and anatomy of turtle grass, Thalassia testudinum (Hydrocharitaceae). I. Vegetative morphology. Bull. Mar. Sci. Gulf & Caribb. 16(4): 748-761.

KEY WORDS: growth, morphology, rhizomes, root systems, substrate, Thalassia, vegetative reproduction.

Thalassia testudinum is well adapted to substrate erosion by its ability to grow rapidly upward at the rhizome apex. Thalassia does not produce dormant buds, rather, growth is continuous. Growth is totally dependent on active meristem tissue (primarily at the rhizome apices).

653. Tumbleson, M. E. and T. Kommedahl. 1962. Factors affecting dormancy in tubers of Cyperus esculentus. Bot. Gaz. 123(3): 186-190.

KEY WORDS: auxins, Cyperus, dormancy, germination, propagule storage, tubers, vegetative propagation.

Cyperus tubers apparently contain a germination inhibitor which must be destroyed by washing or by cold storage before germination will occur.

654. Tutin, T. G. 1942. Zostera L. J. Ecol. 30(1):217-226.

KEY WORDS: growth, habitat, life history, seeds, substrate, Zostera.

The life histories of Zostera marina and Z. hornemanniana are discussed.

655. Uhler, F. M. 1956. New habitats for waterfowl. N. Am. Wildl. Conf., Trans. 21:453-469.

KEY WORDS: depth, disease, drawdown, emergents, mowing, submergents, swamp, turbidity, waterfowl.

In light of the continual drainage and encroachment of man on waterfowl habitat, Uhler suggests sites for new marshes and ponds and utilization of "waste areas" which contain water. Techniques to establish and promote aquatic plants on these areas are discussed.

656. Ungar, I. A. 1967. Influence of salinity and temperature on seed germination. Ohio J. Sci. 67(2):120-123.

KEY WORDS: germination, Salicornia, salinity, seeds, temperature.

The interaction of salinity and temperature on the germination of Salicornia europaea, Medicago sativa, and Spergularia marina is discussed. Salicornia was able to tolerate both the highest salinities and high temperatures.

657. Ungar, I. A., W. Hogan and M. McClelland. 1969. Plant communities of saline soils at Lincoln, Nebraska. Am. Midl. Nat. 82(2): 564-577.

KEY WORDS: communities, salinity, substrate, succession.

The plant communities of several small, inland saline areas and their relationships to saline soils are described. A relationship is shown between an increase in salinity and a decrease in cover of several species. Field observations indicate that the species which tolerate the highest salinities are capable of growing normally in low to non-saline environments. A theory of tolerance to extreme environments is given.

658. Unni, K. S. 1971. An ecological study of the macrophytic vegetation of the Doodhadhari Lake, Raipur, M. P., India. I. Distribution and seasonal change in aquatic plants. Hydrobiologia 37(1):139-155.

KEY WORDS: depth, emergents, habitat, lakes, submergents, succession.

The distribution of aquatic plants in an Indian lake is related to water level fluctuations and seasonal changes. The pattern of succession for this lake is outlined.

659. Uphof, J. C. T. 1924. Ecological observations on plants of the marshes and swamps of Cuba. Ecology 5:363-371.

KEY WORDS: floras, geography, habitat, marsh, substrate, swamp.

The flora of the ponds, marshes, and swamps of central Cuba is described; habitat information is also included.

660. Valk, A. G., Van der and L. C. Bliss. 1971. Hydrarch succession and net primary production of oxbow lakes in Central Alberta. Can. J. Bot. 49(7):1177-1199.

KEY WORDS: communities, floods, habitat, lakes, productivity, succession, zonation.

Water chemistry and water level fluctuations caused by periodic flooding are the major factors controlling plant distribution and succession in oxbow lakes. Descriptive data on plant communities and their habitats, zonation, and productivity is included.

661. Viosca, P., Jr. 1928. Louisiana wetlands and their wildlife and fishery resources. Ecology 9:216-229.

KEY WORDS: drainage, substrate, swamp

Early drainage of Louisiana swamps and construction of canals altered water levels and salinities drastically resulting in decimating effects on vegetation, substrate, and wildlife.

662. Vogl, R. J. 1966. Salt marsh vegetation of upper Newport Bay, California. Ecology 47(1):80-87.

KEY WORDS: growth, Salicornia, salt marsh, zonation.

The vegetation of a California salt marsh is described as to species composition, zonation, frequency of the species in each zone, and average percent coverage for the common species in each zone. Salicornia virginiana was the most tolerant and most important species.

663. Vogl, R. J. 1973. Effects of fire on the plants and animals of a Florida wetland. Am. Midl. Nat. 89(2):334-347.

KEY WORDS: control, emergents, fire.

A controlled burn was initiated on the north shore of a man-made impoundment near the Georgia-Florida border. The effects of fire on the various species of plants and subsequent use of the area by wildlife is recorded.

664. Vose, P. B. 1962. Delayed germination in reed canary-grass, Phalaris arundinacea L. Ann. Bot. 26(102):197-206.

KEY WORDS: aeration, dormancy, germination, light, Phalaris, propagule storage, seeds.

Dormancy in Phalaris is due to a water soluable inhibitor present only in the caryopsis and not the palea. Dormancy can be overcome by rimoving the palea from the caryopsis, by scarifying the seed, or by pricking the palea with a pin.

665. Walker, B. H. and R. T. Coupland. 1968. An analysis of vegetation environment relationships in Saskatchewan sloughs. Can. J. Bot. 46(4):509-522.

KEY WORDS: colonization, depth, emergents, marsh, rhizomes, substrate.

Soil data showed very little correlation with any pattern of herbaceous species distribution. Most species were affected strongly by water regime and somewhat less by salinity. A few species were restricted to a narrow range of environmental conditions while others flourished in all segments of the environment.

666. Ward, E. 1942. Phragmites management. N. Am. Wildl. Conf., Trans. 7:294-298.

KEY WORDS: competition, depth, growth, Phragmites, waterfowl.

Phragmites is an aggressive grass which often crowds out more valuable waterfowl food plants. It will not grow in permanent water or in temporary water greater than 6 inches deep.

667. Way, J. M., J. F. Newman, N. W. Moore and F. W. Knaggs. 1971. Some ecological effects of the use of paraquat for the control of weeds in small lakes. J. Appl. Ecol. 8:509-532.

KEY WORDS: colonization, control, Elodea, herbicides, Myriophyllum, Potamogeton, submergents, substrate.

Paraquat was added to a 1.16 acre shallow English lake at the rate of 0.5 mg/l of lake water. A complete account of the progressive effects of the herbicide on plant growth, and the distribution and subsequent breakdown of the chemical in the water and substrate are given.

668. Webber, E. E. 1968. Seasonal occurrence and ecology of salt marsh phanerogams at Ipswich, Massachusetts. Rhodora 70:442-450.

KEY WORDS: colonization, communities, erosion, light, phenology, Ruppia, Salicornia, salinity, salt marsh, substrate.

Seasonal development and distribution of macrophytes in a Massachusetts salt marsh may depend on light availability as well as salinity and water levels.

669. Webber, H. J. 1897. The water hyacinth and its relation to navigation in Florida. U.S.D.A., Div. Bot., Bull. 18.

KEY WORDS: adventive spread, control, Eichornia, exotics, floating plants, growth, habitat.

Within several years of its introduction into Florida waterways about 1890, Eichornia crassipes was becoming a nuisance. This report discusses: natural history information including habitat, growth, propagation, and anatomical and physiological characteristics; introduction and spread of the species in Florida; effects of the plants on navigation and commerce; and possibilities of exterminating the plant.

670. Weir, C. E. and H. M. Dale. 1968. A developmental study of wild rice, Zizania aquatica L. Can. J. Bot. 38:719-739.

KEY WORDS: depth, life history, morphology, seed production, Zizania.

The depth of water in which Zizania aquatica grows affects not only the type of leaves produced, but also the height of the plant and its internal structure. The potential yield of grains is determined early in the life of the plant by water levels.

671. Wells, B. W. 1928. Plant communities of the coastal plain of North Carolina and their successional relations. Ecology 9: 230-242.

KEY WORDS: communities, marsh, salt marsh, succession.

Succession in the salt marsh is largely a response induced by aggradation under which process the deep water species give way to shallow water ones. The dominants, subdominants and succession of the major plant communities are discussed.

672. Wells, B. W. and I. V. Shrunk. 1938. Salt spray: an important factor in coastal ecology. Bull. Torrey Bot. Club 65(7):485-492.

KEY WORDS: morphology, salinity.

The marked modification of form of woody plants close to the ocean was shown to be due to the toxic effects of salt spray on new shoots rather than the drying effect of the wind as previously thought.

673. Wentz, W. A. and R. L. Stuckey. 1971. The changing distribution of the genus Najas (Najadaceae) in Ohio. Ohio J. Sci. 71(5):292-302.

KEY WORDS: adventive spread, ecological range, Najas, pollution, temperature, turbidity.

Najas gracillima and N. flexilis, species of northern, cool, clear waters, have disappeared or become reduced in abundance, while N. marina, N. minor, and N. guadalupensis have invaded, spread, and/or become more common in Ohio during the last 70 years. An increase in the numbers of artificial ponds and lakes, an increase in the turbidity of Ohio waters, and a gradual warming and overall general eutrophication of Ohio river and lake waters are responsible for the changes.

674. Westlake, D. F. 1965. Some basic data for investigations of the productivity of aquatic macrophytes. pp. 231-248. In: C. R. Goldman (Ed.). Primary Productivity in Aquatic Environments. Mem. Ist. ITal. Idrobiol., 18. Suppl., Univ. California Press, Berkeley.

KEY WORDS: biomass, emergents, growth, life history, nutrients, productivity, rhizomes, root systems, substrate.

The biomass and annual production of different types of communities are compared. Data on the volume, dry weight, ash, carbon, and energy contents of aquatic plants are reviewed and methods of analysis are discussed. Information on underground parts, losses by death, damage, disease, effects of grazing, and the age of parts persisting for more than one year is reviewed.

675. Wheat, M. C., Jr. 1962. Eelgrass a controversial link in the chain of life in our marine waters. The Conservationist (N.Y) 16(4):28-30.

KEY WORDS: commercial uses, growth, nutrients, Zostera.

A popular review of the food chain value and conversely the nuisance of an overabundance of Zostera marina. On Long Island, 18 species of algae have been found attached to eelgrass leaves, and it is thought that scallops and clams especially use the eelgrass beds as their main habitat. The morphology of eelgrass is discussed in general. It is speculated that the strain of eelgrass which revegetated the Atlantic coast after the dramatic 1930's dieoff is more fragile than the original.

676. Wherry, E. T. 1920. Plant distribution around salt marshes in relation to soil acidity. Ecology 1:42-48.

KEY WORDS: pH, substrate.

The effects of acidity on distribution of terestrial species growing around salt marshes is demonstrated.

677. Wiehe, P. O. 1935. A quantitative study of the influence of tide upon populations of Salicornia europaea. J. Ecol. 23(2): 323-333.

KEY WORDS: germination, Salicornia, seedlings, tides.

Both germination and seedling survival of Salicornia were higher in the spring-tide zone than in the neap tide zone where there is daily submergence and the tides drag young plants out of the mud.

678. Williams, R. B. 1964. Division rates of salt marsh diatoms in relation to salinity and cell size. Ecology 45(4):877-880.

KEY WORDS: culture, salinity, salt marsh.

Fourteen species of diatoms from a Georgia salt marsh were grown in culture with salinities ranging from 1 to 68 percent. All grew well in salinities of 1 to 30 percent and several grew well over the entire range.

679. Williams, R. B. and M. B. Murdock. 1969. The potential importance of Spartina alterniflora in conveying zinc, manganese, and iron into estuarine food chains. pp. 431-439. In: D. J. Nelson and F. C. Evans (Eds.). Second Symp. Radioecol., Proc., U. S. At. Energy Comm.

KEY WORDS: biomass, decomposition, growth, iron, nutrients, productivity, Spartina, substrate.

The potential importance of Spartina alterniflora in conveying radioisotopes of zinc, manganese, and iron into estuarine food chains was evaluated on the basis of annual production, content of the three elements, and annual cycles of growth and decay. Standing crop at maturity and annual production averaged 545 and 650 g dry wt/m^2, or 208 and 248 g C/m^2, respectively. Spartina production approached one-third the total phytoplankton

net production of adjacent estuaries, and was thus important in estuarine food chains. Zinc, manganese, and iron all had markedly higher concentrations in dead Spartina than in live, and averaged 22, 200, and 500 ppm (dry wt.), respectively, in the dead material. The unusually high iron content suggested that Spartina detritus may be important in the movement of iron from water and sediments into estuarine animal production.

680. Willis, D. 1971. Chufa tuber production and its relationships to waterfowl management Catahoula Lake, Louisiana. Ann. Conf. SE Assoc. Game & Fish Comm., Proc. 24:146-153.

KEY WORDS: Cyperus, propagule sources, substrate, tubers, vegetative propagation.

Cyperus esculentus production was high on fine, silty, loam soils in a drained lake bottom and in an area with a long growing season.

681. Willis, D. W. 1965. Factors affecting waterfowl and waterfowl habitat on Catahoula Lake, Louisiana. M. Sc. Thesis Louisiana State Univ.

KEY WORDS: communities, Cyperus, drawdown, planting, tubers.

A natural annual drawdown of a Louisiana lake results in a Cyperus esculentus dominated vegetation. Planting techniques for chufa and Cyperus rotundus are discussed.

682. Wilson, L. R. 1935. Lake development and plant succession in Vilas County, Wisconsin. I. The medium hard water lakes. Ecol. Monogr. 5(2):207-247.

KEY WORDS: biomass, bicarbonate, emergents, lakes, submergents, substrate, succession.

The ecology and vegetation of a series of medium hard and soft water lakes of southern Wisconsin have been investigated on a quantitative basis. Background material on the physiography and soils, development of lakes, and aquatic vegetation in relation to lake types is presented. The abundance of each plant species in the lakes studied was determined on a dry weight basis. Soils from each quadrat were correlated with plant crop, slope of the lake basin, and water movement. Soils of a colloidal organic nature supported the greatest amount of plant growth.

683. Wilson, L. R. 1939. Rooted aquatic plants and their relation to the limnology of fresh-water lakes. pp. 107-122. In: F. R. Moulton (Ed.). Problems of Lake Biology. Pub. of the Am. Assoc. Adv. Sci. 10. 142pp.

KEY WORDS: emergents, lakes, light, productivity, submergents, substrate, temperature.

Rooted hydrophytes come from practically every part of the vascular plant kingdom. A variety of environmental factors which influence growth in the medium of water are considered, i.e., geologic and physio-chemical factors, hardness and alkalinity, light availability, temperature, and substrate quality. Fresh-water lakes are classified with respect to distribution of rooted hydrophytes with an emphasis on lakes in northern Wisconsin. Productivity and economic considerations of hydrophytes are given brief attention. Problems requiring further investigation are reviewed.

684. Windom, H. L. 1972. Environmental aspects of dredging in estuaries. J. Waterways, Harbors, and Coastal Engin. Div., Proc. Am. Soc. Civil Engineers. 98(ww4):475-487.

KEY WORDS: dredging, nutrients, pH, pollution, Spartina.

Chemical response of salt marsh sediments and water quality response to deposition of dredged materials were determined in a salt marsh on the southeastern Atlantic Coast. Chemical changes, especially the distribution of trace elements, endured for at least several months. Water quality impairment was minimal and bore no direct relationship to the composition of the dredged material.

685. Wistendahl, W. A. 1958. The flood plain of the Raritan River, New Jersey. Ecol. Monogr. 28:129-153.

KEY WORDS: colonization, emergents.

The vegetation inhabiting river banks formed by the deposition of sediments is described. Several tree species were abundant as were species of Polygonum.

686. Witts, K. J. 1960. The germination of Polygonum sp. in the field and in the glass-house. J. Ecol. 48(1):215-217.

KEY WORDS: germination, Polygonum, seeds.

Germination of three species of Polygonum seeds was considerably higher in a greenhouse in England than in the field.

687. Woodhead, N. 1951. Lobelia dortmanna L. J. Ecol. 39(2):458-464.

KEY WORDS: depth, germination, habitat, life history, seeds, substrate.

A life history of Lobelia dortmanna in England is presented.

688. Woodhouse, W. W., E. D. Seneca and S. W. Broome. Establishing salt marsh on dredge spoil. World Dredging Conf. 24pp.

KEY WORDS: dredging, machinery, planting, salt marsh, seeds, Spartina, substrate.

Direct seeding of Spartina alterniflora appears to be a practical and relatively inexpensive method of establishment. Direct seeding is restricted to the upper half of the tidal range and to sheltered sites or years in which the April-July period is calm.

689. Woodhouse, W. W., Jr., E. D. Seneca and S. W. Broome. 1972. Marsh building with dredge spoil in North Carolina. North Carolina State Univ., Agr. Exp. Sta. Bull 445. 28pp.

KEY WORDS: biomass, fertilizer, growth, machinery, planting, propagule sources, propagule storage, root systems, salt marsh, seedlings, Spartina, substrate.

Studies on methods of propagation and establishment, growth rates, factors affecting growth, and substrate and elevational effects on Spartina alterniflora were carried out on the coast of N. Carolina. Establishment of Spartina was possible by either seed or transplants; although transplants are adaptable to a much wider variety of conditions, it is also considerably more expensive than propagation by seeds.

690. Woodhouse, W. W., Jr., E. D. Seneca and S. W. Broome. 1974. Propagation of Spartina alterniflora for substrate stabilization and initiation of marsh development. Final contract D.A.C.W.

72-72-C-0012 to U. S. A. Coastal Engin. Res. Center, Ft. Belvoir, Va. 22060.

KEY WORDS: communities, dredging, ecotype, erosion, fertilizer, growth, harvest, life history, manganese, nutrients, phosphorus, planting, productivity, propagule storage, salinity, salt marsh, seedlings, Spartina, vegetative propagation.

Both seeding and transplanting methods were successful in establishing Spartina alterniflora in the intertidal zone of dredge spoil and eroding shorelines. Although transplants were more tolerant of harsh environmental conditions, seeding was much less expensive and, in sheltered areas, produced more plant cover at the end of one growing season. Studies to determine the relationship of mineral nutrition to productivity were made.

691. Wooten, J. W. 1970. Experimental investigations of the Sagittaria graminea complex: transplant studies and genecology. J. Ecol. 58(1):233-241.

KEY WORDS: depth, ecotype, germination, habitat, planting, rhizomes, Sagittaria, seedlings, vegetative propagation.

Different varieties of Sagittaria graminea were shown to be genetically different and not ecotypes dependent on water levels. Seeds were easily collected and germinated and seedlings were true to parental form. Whole plants were easily transplanted.

692. Wooten, J. W. 1973. Edaphic factors in species and ecotype differentiation of Sagittaria. J. Ecol. 61:151-156.

KEY WORDS: ecotype, nutrients, Sagittaria, substrate.

Soils from populations of four ecotypes of two varieties within the Sagittaria graminea complex, a third variety of this complex and from populations of S. cristata and S. platyphylla were analyzed for pH, CaO, MgO, P_2O_5 and K_2O. Significant soil nutrient levels were established that were characteristic for and served to delimit each taxon.

693. Wright, A. H. and A. A. Wright. 1932. The habitats and composition of the vegetation of Okefinokee Swamp, Georgia. Ecol. Monogr. 2:1-232.

KEY WORDS: floras, habitat, swamp.

A flora and description of species habitats in the Okefinokee Swamp are presented.

694. Wright, G. 1958. Experimental establishment of food and cover plants in marshes created for wildlife. M. Sc. Thesis Cornell Univ.

KEY WORDS: planting, Polygonum, Scirpus, substrate, Zizania.

Experimental plantings of Zizania aquatica, Butomus umbellatus, Scirpus acutus, and Polygonum muhlenbergii in 30 wildlife marshes were not all successful. Limiting factors included muskrats, water depth, alkalinity and acidity.

695. Yabuno, T. Biosystematic study of the genus Echinochloa. Jap. J. Bot. 19(2):277-323.

KEY WORDS: competition, Echinochloa, germination, hybrids.

Echinochloa oryzicola and E. crusgalli can germinate in standing water and thus compete effectively with rice. The cytology of Echinochloa and intra-specific hybrids are also discussed.

696. Yeager, L. E. 1949. Effect of permanent flooding in a river bottom timber area. Bull. Ill. Nat. Hist. Surv. 25(2):33-65.

KEY WORDS: colonization, emergents, flooding, submergents, succession.

The effect of water impoundment on timber was studied over an 8 year period, 1939-1946, at the junction of the Illinois and Mississippi Rivers. By 1946 conversion of the flooded bottomland to marsh had begun. Typha, Sagittaria, and various sedges were the most common marsh invaders; Polygonum, Echinochloa, and Leersia oryzoides held a similar position on moist soils. Extremely heavy growth of Ceratophyllum demersum and Potamogeton foliosus often covered in the fall by a mat of Lemna spp. appeared in some areas during the first four years of flooding.

697. Yeo, R. R. 1964. Life history of common cattail. Weeds 12:284-288.

KEY WORDS: flowering, germination, growth, habitat, harvest, rhizomes, root systems, seedlings, seed production, seeds, Typha.

Seed of common cattail (Typha latifolia) germinated 100 percent when the blunt ends of seed coats were ruptured. Seedlings developed primarily while submersed in water, at least to 30 inches deep. A single plant in 6 months developed a network of rhizomes covering an area 10 feet in diameter. Pistillate spikes 7 inches long produced an average of over 222,000 seeds.

698. Yeo, R. R. 1965. Life history of sago pondweed. Weeds 13:314-321.

KEY WORDS: geography, germination, growth, habitat, life history, Potamogeton, seed production, tubers, vegetative reproduction.

A 4 year study of Potamogeton pectinatus was made at Huntly, Montana. Effects of light energy, and air and water temperatures on rate of shoot growth, flowering, propagule development, and death were recorded. Mechanical rupture of the seed coat resulted in 100 percent germination. Development of tubers, density and size of tubers, and depth at which they grew are recorded. An inhibitor substrnce, possibly a mercaptan, was noted to be present in the tubers.

699. Yeo, R. R. 1966. Yields of propagules of certain aquatic plants. Weeds 14(2):110-113.

KEY WORDS: emergents, hibernacula, morphology, phenology, Potamogeton, seedlings, seed production, seeds, submergents, tubers, turions, vegetative reproduction.

Types of propagules of various aquatic plants from Montana and California are described. Most seedlings grown from these propagules did not survive at temperatures below 60 F. Zannichellia palustris produced over 2 million seeds per plant. Potamogeton pectinatus yielded over 36,000 subterranean tubers from a single culture. Over 49,000 and 23,000 turions were produced by P. foliosus and P. crispus, respectively. August, September, and October were the most productive months for the development of propagules.

700. Yocum, C. F. 1951. Waterfowl and their food plants in Washington. Univ. Washington Press. 272pp.

KEY WORDS: emergents, planting, rootstocks, seeds, submergents, waterfowl.

General information on when to plant, what parts to use and which plants are best is given. Transplantings of seedlings or mature plants are preferred over the use of scattered seed. Deep water plantings should be weighted down in clay and shallow water plantings pushed in by hand.

701. Ziemen, J. C., Jr. 1972. Origin of circular beds of Thalassia (Spermatophyta: Hydrocharitaceae) in South Biscayne Bay, Florida, and their relationship to mangrove hammocks. Bull. Mar. Sci. Gulf & Caribb. 22(3):559-574.

KEY WORDS: growth, planting, substrate, Thalassia.

Circular beds of Thalassia occur on peat soils at least 20-25 cm deep produced by mangroves; as depth of the sediments increased both the length and density of Thalassia leaf blades increased.

702. Zimmerman, P. W. and R. O. Berg. 1934. Effects of chlorinated water on land plants, aquatic plants, and goldfish. Contrib. Boyce Thompson Inst. 7:39-49.

KEY WORDS: Cabomba, chloride, Elodea, fishes.

Cabomba caroliniana and Elodea canadensis were grown in five solutions ranging from 0.5 to 3.0 ppm Cl. No injury was observed except in plants at 3ppm, which were slightly chlorotic.

703. Zutshi, D. P. and K. K. Vass. 1971. Ecology and production of Salvinia natans Hoffim. in Kashmir. Hydrobiologia 38(2):303-320.

KEY WORDS: floating plants, light, nutrients, oxygen, productivity, Salvinia.

Salvinia natans grows best in shaded, sheltered water which is high in nutrients. It causes low oxygen concentrations and heavy shade beneath itself if growth covers the surface.

APENDIX A: INDEX