Coastal Zone Management Program

Botanical and Ecological Aspects of Coastal Raised Peatlands in Maine

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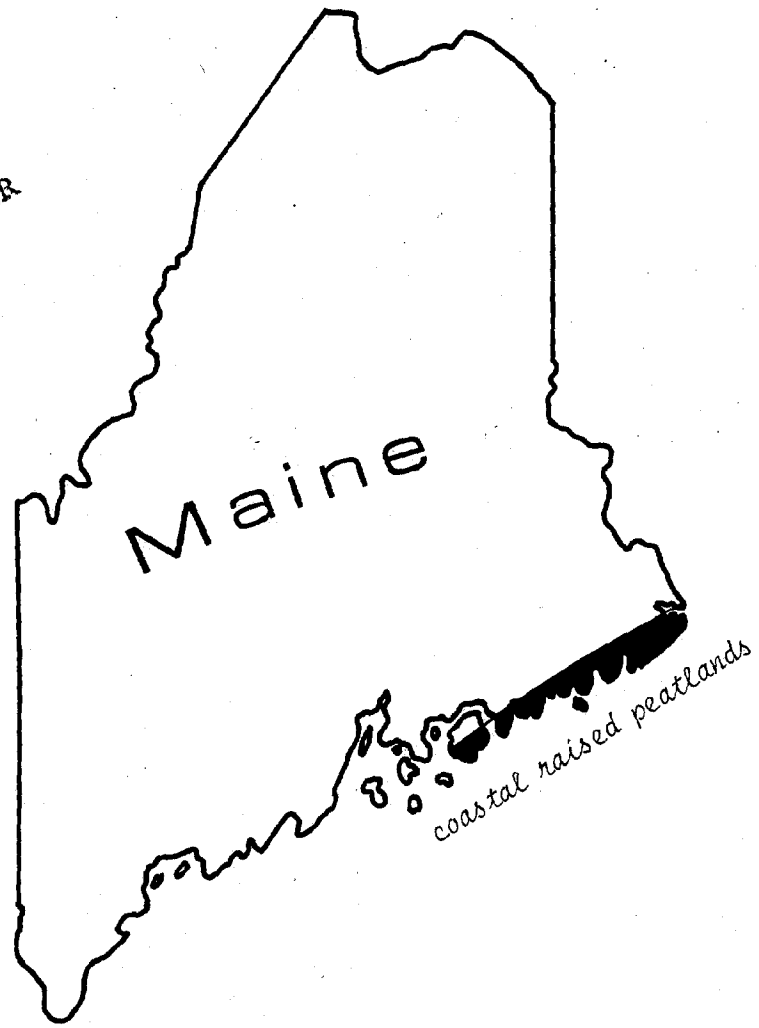

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Maine State Planning Office

January 1982

BOTANICAL AND ECOLOGICAL ASPECTS OF COASTAL RAISED PEATLANDS IN MAINE

and

THEIR RELEVANCE TO THE CRITICAL AREAS PROGRAM

of

THE STATE PLANNING OFFICE

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FOREWORD

The following draft report on coastal raised peatlands was prepared for Maine's Critical Areas Program, and is being circulated for review. This program was established by an act of the Legislature in 1974 which directed the State Planning Office to develop an official Register of Critical Areas and to encourage and coordinate the conservation of such areas as part of its overall responsibility for comprehensive statewide planning and coordination of planning activities. The Act defines Critical Areas as natural features of statewide importance because of their unusual natural, scenic, scientific, or historical significance.

The Act also created the Critical Areas Advisory Board to advise and assist the State Planning Office in the establishment of the Register and the conservation of critical areas. The program established by the Act is not regulatory, with the minor exception that notification of proposed alterations of critical areas is required of the landowners thereof. The program is primarily one of identifying critical areas and providing advice to and coordinating the voluntary activities of landowners, state and local government organizations, conservation groups and others to the end of encouraging the conservation of critical areas. The Critical Areas Program further provides a specific focus for the evaluation and coordination of programs relating to critical areas in Maine. The program also serves as a source of information on critical areas and their management.

The purpose of these reports is to present the results of thorough investigations of subject areas chosen for consideration in the Critical Areas Program. The reports are an intermediate phase in a systematic registration process which starts with the identification of subjects for consideration and concludes with the analysis of each potential critical area individually and, if appropriate, inclusion of areas on the Register.

In addition to the specific task they are intended to fulfill in the registration process, it is my hope that these reports will be useful in a more general sense as a source of information on the various topics they cover. This report on coastal raised peatlands covers a topic which is important for the Critical Areas Program to investigate at this time. Competition for the peat resource is expected to increase dramatically in the years ahead. There are several alternative uses for peat, namely 1) horticulture - as a soil conditioner, 2) agriculture - as a soil for crops, 3) as an energy source, and 4) preservation of unusual ecological habitats. Each of these uses has a place in meeting our needs. We should seek a balance between the various uses of peatlands. The most unusual or exemplary peatlands should be maintained in a natural condition while others are carefully utilized. There are several private and public organizations working to identify commercially valuable peat deposits. To complement this work the purpose of the Critical Areas Program is to identify those areas which have unusual natural values and hence should be preserved. To minimize conflict or misunderstanding the Critical Areas studies and recommendations will be shared with known private and public interests concerned with our peat resource. For more information, and to return comments on coastal raised peatlands or other aspects of the Critical Areas Program, feel free to contact me or other members of the staff at the State Planning Office.

R. Alec Giffen, Assistant Director
Natural Resources Planning Division

ABSTRACT

The coastal raised peatlands of Maine are ecologically, scientifically, educationally, and aesthetically significant natural features restricted to a very narrow strip of Maine's eastern coast from the tip of Mount Desert Island to West Quoddy Head. Rare in North America, these peatlands are most similar, in vegetation and morphology, to coastal plateau peatlands in extreme southwestern New Brunswick, coastal Nova Scotia, and western Newfoundland.

This report defines criteria by which the scientific, scenic, and natural attributes of the coastal raised peatlands can be assessed, and recommends peatlands for evaluation under the Maine Critical Areas Program based upon such an assessment. An inventory of all coastal raised peatlands in Maine was performed based upon a literature search and field work. Two hundred twenty nine peatlands were considered, 159 overflown, and 59 visited. Eighteen sites, including 21 peatlands, are recommended for evaluation for inclusion on the Register of Critical Areas. Eighteen additional sites are likely of similar significance, and these areas should be field checked for possible evaluation for inclusion on the Register of Critical Areas as soon as field work is possible. The Shrub Slope peatlands of extreme outer islands and points are recommended for study by the Critical Areas Program. At least 53 additional coastal raised peatlands are in an essentially unaltered natural state; should additional features of significance be discovered at some future time, some of the sites may be considered then for evaluation as potential Critical Areas. Immediate protective management at high use peatlands, notably Big Heath in Acadia National Park, peatlands on Great Wass Island, and Carrying Place Cove Bog is strongly recommended.

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Thank you A. W. H. Damman, Charles Richards, Radcliff Pike, Jenny Cirone, Les Eastman, Fay Hyland and Paul Favour for sharing your botanical expertise and favorite peatlands, and Janet Sullivan and Mark Rooks for visiting many peatlands with me. The local peatland knowledge provided by Mr. Gordon Kelley of Jonesport and Mr. Robert Ackley of Cutler are especially appreciated. Expert reviewing by Harry Tyler, Jr., and Liz Thompson have made the report readable, and it is the vision of Hank that has made it a reality.

This report is presented in celebration of the long life of Mrs. Jenny Cirone of South Addison whose years in that community and on Nash Island typify the human heritage of this coast. To Paul Favour of Northeast Harbor this report is dedicated, in honor of his wisdom of the natural landscape, his many years of devoted work in Maine and the Northeast, and the especial love he has for Mt. Desert Island's Big Heath.

INTRODUCTION

This report has two major sections. In the first there is a rather lengthy description of the raised peatlands of the most coastal portion of eastern Maine. This section highlights the distinctive features of these peatlands and why they are different from other kinds of peatlands that one might encounter in eastern North America or elsewhere in the world. The second section evaluates the significancy of these peatlands and recommends that several be considered for inclusion on the register of Critical Areas. A glossary appears at the end of the report.

Throughout this report the term "peatland" is used for all portions of the vegetated landscape underlain by partially decomposed organic material (peat); many persons employ the term "bog" in exactly this way. There is an immense diversity of types of peatlands, and many are elevated, raised mounds of peat above adjacent terrain. A common technical use of the word "bog" refers only to raised peatlands. Since nearly all peatlands with which this report deals are raised, "bog" appears commonly in this report.

Within this part of Maine "heath" is commonly used for peatlands that are treeless or that have only scattered trees. For many residents of the region the term "heath" is unconsciously reserved for raised peatlands. This report often employs this usage, especially in place names.

A final introductory note: this report is concerned with the raised peatlands (or raised bogs) of eastern coastal Maine. The principal features of these peatlands are

(a) the several plant species and communities that inhabit raised peatlands only in eastern Maine immediately adjacent to the sea, and

(b) the specialized plateau topography (three-dimensional shape) of some of the coastal raised peatlands.

Not all peatlands have distinctive plateau topography. Most of the raised peatlands, including all with plateau topography, have the coastal species and communities.

GENERAL METHODOLOGY

The general planning report on peatlands (Worley 1980a) in conjunction with Worley and Sullivan (1979) provide a classification scheme for the peatland types of Maine. Coastal Raised Bog is one type recommended for study by the Critical Areas Program. The Coastal Plateau Bog, and type of Coastal Raised Bog was recognized and described by Damman (1977), and his work (see also Damman 1979a,b) forms the basis for much of this report.

After a thorough review of Damman's (1977) conclusions in the light of other literature pertaining to the same section in Maine, a study area (Figure 1) was chosen that would include all of Maine known to have Coastal Plateau Bogs, and that would include some adjacent area in order to confirm the location of the Coastal-Inland boundary. For ease of documentation, the study area boundary follows U.S.G.S. quadrangle boundaries.

As an earlier investigation in 1977 to ascertain the diversity of Maine peatlands had taken me to a number of these peatlands in the study area, it was possible to compile an initial listing of all peatlands and potential peatlands from U.S.G.S. topographical quadrangles. Fortunately most of the quadrangles are of the 7½' series, because the 15' series proved to be too large a scale and too filled with inaccuracies with the designation, placement, and size of wetlands. The master list was cross-referenced with existing literature for each site.

Once the master list was compiled, aerial photos, ranging in scale from about 1:12,000 to 1:80,000 of the study area, were examined at the Maine Bureau of Geology. At that time many photos of large peatlands were absent. After a further annotation of the master list from the aerial photo inspection, sites for field checking in July and September, 1978, were selected to include:

a) all sites well documented in the literature

b) some sites on both sides of the supposed boundary between Coastal and Inland peatland regions

c) sites at the easternmost and westernmost ends of the study area

d) a thorough representation of sites in extreme maritime settings

e) a large representation of sites mentioned in the literature

f) most large sites

g) roughly the same proportion of all possible peatlands within different regions of the study area

h) a total of approximately 50 sites

It was recognized that some potential Critical Areas might go unvisited due to the limitation of contractual resources.

At each visited site locations, if any, were sought for overall views. Most sites were crossed on foot in at least two directions with three to several portions of the lagg (the margin of the peatland) visited. Information was recorded on hand-held tape recorder and in field notebooks; photographs of salient features were taken. Small sites might receive a visit of less than one hour's duration, most site visitations were 1½-3 hours long, with a few, at large peatlands, being several hours. Several sites were visited more than once.

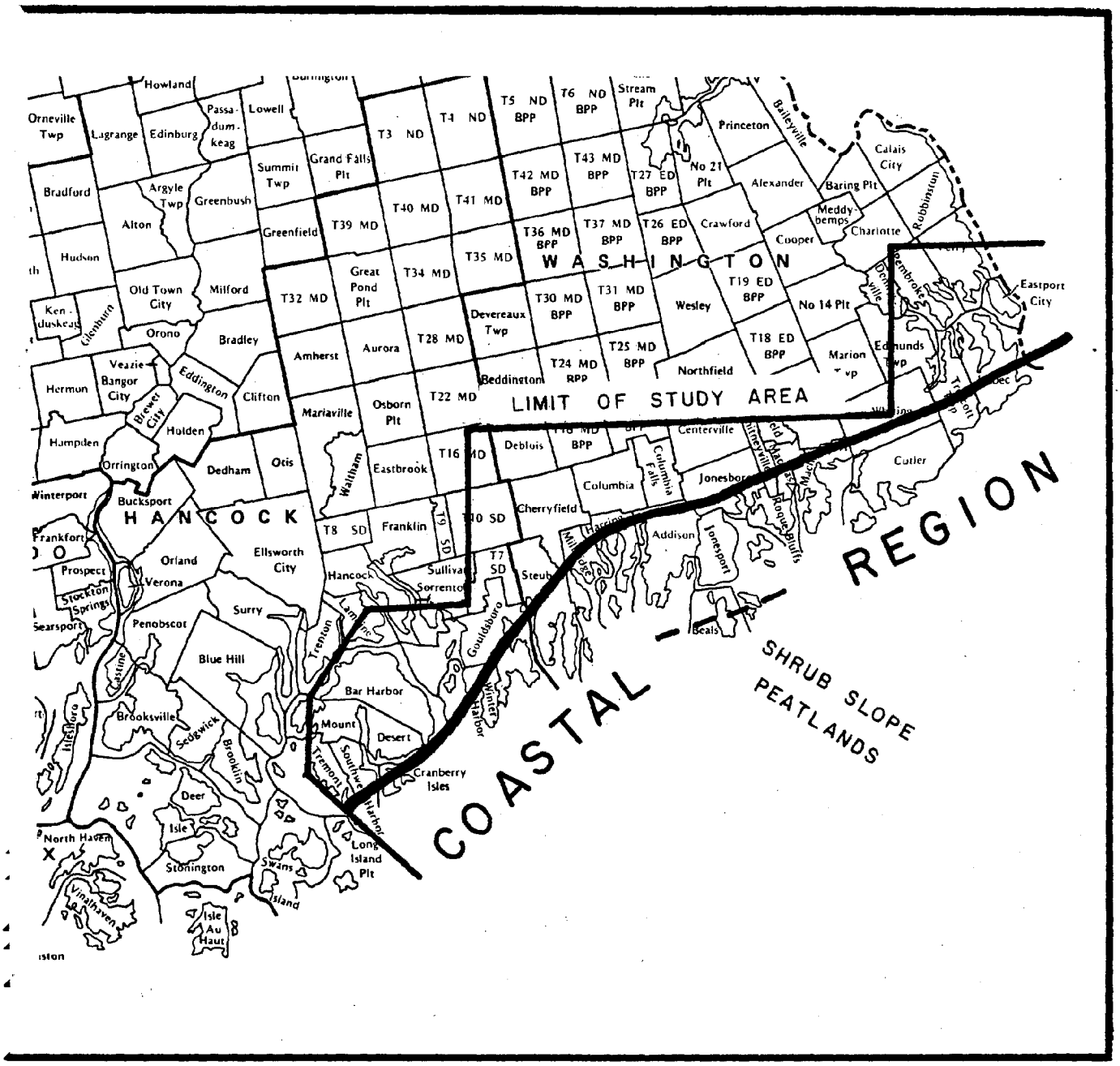

Figure 1. Location of the study area and the Coastal Region of raised peatlands in eastern Maine. The area known to contain Shrub Slope peatlands lies seaward of the dashed line.

Field checks sought to determine the general character of the peatland, and to note the presence, extent, and quality of diagnostic features necessary in establishing the significance of the site. An annotated checklist format was used, deviations therefrom usually were the result of time limitations. One field tape cassette was inadvertently lost after visitations were completed.

Near the completion of the field work, a light aircraft was chartered (September, 1978), and the study area overflown at low altitude. Documentation on this most useful endeavor was by tape, notebook, and photography--the last being a crucial resource for subsequent evaluations and recommendations. The flight sought to include about 60-70 percent of the sites in the study area, including all those likely to be recommended, and many potentially good sites that were not visited. Following, and because of, the flight a few additional sites were visited.

Although the work by Damman (1977) presented distinguishing characteristics for Coastal Raised Bog, as contrasted with Inland peatlands, his study included far fewer sites than this work; furthermore, his concern was with larger sites, whereas all sizes of peatlands were considered here. Consequently, a classification of peatland types, or at least a recognition of variation among peatlands, within the study area was necessary. Using the concepts of Coastal Plateau Bog as given by Damman (1977) as a basis, other types were recognized based upon the field work, and based upon the principles given in the general planning report (Worley 1980).

EXTENT OF KNOWLEDGE

Amazingly little is known about the Coastal Raised Peatlands of Maine. It is only through the recent work of Professor A. W. H. Damman (1977, 1979a, 1979b, 1980) of the University of Connecticut that their ecology has begun to be known. This report adds considerably to the knowledge of the most intriguing peatlands through the synthesis of previous work and the addition of a large amount of new information. Several times the number of peatlands visited by other researchers were field checked. No other workers have employed low elevation over-flights and photography — some 159 peatlands were overflown in this study. Even yet vast gaps exist in our knowledge of these coastal peatland ecosystems.

Numbers and Sizes This study is by far the most complete numerical inventory of peatlands in the coastal region. The Wetlands Inventory of the Maine Bureau of Inland Fisheries and Wildlife (McCall 1972) is sorely incomplete in this part of the state as many to most of the raised peatlands do not appear in the Inventory (Worley 1980a). The National Wetlands Inventory of the U.S. Fish and Wildlife Service is reasonably accurate for larger sites, but since the data base was 1:80,000 aerial photography, the smaller sites are poorly assessed. Vegetation designations are very generalized and lack field checking except in rare instances (Worley 1980a).

Climate Damman (1977, 1979a, 1979b, 1980) and Johnson (1977) have documented the importance of the maritime climatic effect in a general way, but strictly climatic studies, and careful testing of the hypotheses put forth by Damman, Johnson, Thompson (1979), and me (in this report) are lacking. Weather stations within the coastal peatland region are exceedingly sparse, and very incompletely document the maritime climate. Moreover, their records have not been analyzed with peatlands in mind. Past climates have not been determined through peat analysis anywhere in this coastal area.

Geomorphology An understanding of the geomorphic relationship between the underlying and adjacent landscape with the origin, development and maintenance of the coastal raised bogs is almost totally lacking.

Hydrology Damman (1977, 1979b, 1980) has discussed and hypothesized some of the gross physical and chemical hydrological characteristics of the larger coastal peatlands, with limited quantitative measurements. Thompson (1979) noted gross patterns of surficial water flow on Great Wass Island. Otherwise there is a complete void in knowledge concerning the water relations of these coastal peatlands, either as water functions in the life of the peatland or as the peatland functions in the surrounding landscape.

Biota For over 90 percent of the peatlands there apparently exists no biological information. Relatively complete vascular plant species checklists occur only for parts of South Trescott Heath, Carrying Place Cove Bog (both done by Osvald in 1927 and reported in 1955), and the larger Great Wass Island peatlands (Thompson 1979). The species lists of Damman (1977) are not site specific. Fernald and Wiegand (1910) noted some species of interest at a few sites, and Eastman (1978) reports herbarium records of some rare plants that were collected from the region. No thorough enumeration of bryophytes exists, though Osvald (1955), Damman (1977) and the general bryological literature lists several species. No doubt a search of herbaria and the taxonomic literature would add additional species. I am unacquainted with any publications on the algae, fungi or bacteria of the coastal peatlands.

Large mammal surveys and bird counts possibly exist for a few peatlands, but these were not sought out by me. There appear to be no mammal, bird, invertebrate, or microorganism investigations, especially as they relate to the peatland ecology.

Phytosociological analyses, food chain and web determinations, biomass and productivity studies, population analyses, physiological and genetic inquiries, succession studies, and other ecological investigations are completely lacking.

Peat Except for the few cores made by Bastin and Davis (1909), Osvald (1955), and Cameron (1975), and the casual observations made by Osvald (1955), Dachnowski (1926, 1929), Dachnowski-Stokes (1930, 1933), and a few others about the exposed peats at Carrying Place Cove Bog, the scientific examination and inventory of the peats of this coastal region is nil. Possibly the records of mining activity at the Jonesport Heath might add some information.

The three-dimensional shape of the peat deposits, their stratigraphy, and their physical, biotic, chemical and hydrologic characteristics are essentially unknown.

Time To my knowledge not a single radiocarbon date, pollen, fossil, or sediment analysis, or geomorphic determination is available for these peatlands. There has been no dating of origin, development, or specific events in the history of any one of the peatlands. No studies have been made of growth rates, peat deposition and decay rates, recovery times (or modes) after disturbance, etc.

Man Mining activity has never been carefully documented, although some records should be available. For example, peat mining of some sort existed at the Jonesport Heath prior to 1944 (Trefethen and Bradford, 1933), but what kind, on what part of the peatland, and the date of beginning remain to be discovered. Records of other human activity stem mostly from hearsay, and lack documentation. The frequency and severity of fire is unknown, as is the duration of fire history. Wood cutting, sheep grazing (as on southern Great Wass Island), military development, and other past disturbances have not been researched in any way. The contemporary magnitudes and effects of acid rains, hunting, tourism, road building, etc., are totally unassessed. The effects upon the peatlands by past or present legislation concerning water, landscape , energy, wildlife, military, mining, zoning, etc., has not been investigated. Unknown is the relationship of these "heaths" with the sociology of the region or the state, historically or in the future, especially with respect to perceptions of ownership and landscape as they interact with values, mores, and rights.

Future work I feel that at this time the topics most crucially in need of study are: the sociological perceptions of the coastal raised peatlands, vegetation growth rates and peat deposition ecology, post-disturbance recovery modes and rates, and hydrologic relationships with surrounding landscape. That is, how are these coastal raised peatlands viewed and valued, how do they grow, how do they heal, and as wetlands what is their role in the quality and abundance of water in the landscape?

THE SIGNIFICANCE OF COASTAL RAISED PEATLANDS IN MAINE AND THE IMPORTANCE OF THEIR INCLUSION IN THE CRITICAL AREAS REGISTER

Within New England, elsewhere in North America, and the world as well, open peatlands long have attracted interest and curiosity. Especially intriguing are raised peatlands, ecosystems capable of changing a landscape's topography, re-routing streams, elevating water tables, maintaining their own water apart from the ground water table, altering water chemistry, retaining ground frost well into growing seasons, altering local weather patterns such as cold air drainage and wind turbulence, and eliminating other ecosystems, including forests, through drowning or physical invasion. Raised peatlands, by their morphology, topography, vegetation constituents and pattern, and surface water characteristics denote local and regional climatic variation, often more significantly than any other biotic elements.

The coastal raised peatlands in Maine occupy an exceedingly narrow band of islands, points, and headlands along the eastern coast of the state (Figure 2), defining a climatic region that extends into neighboring New Brunswick. Similar coastal peatland phenomena also occur on portions of the coasts of Nova Scotia and Newfoundland. Raised, slope, and blanket peatlands in extreme coastal environments are well known elsewhere in North America along the northern Pacific coast, in northern Europe (notably in the British Isles and Scandinavia), and in other similar settings such as southwestern New Zealand and southern Patagonia. Thus, Maine's coastal raised peatlands define a very specialized climatic and ecologic region, a region whose global counterparts are very limited in number and extent.

The most distinctive raised peatland type in Maine's coastal region is the Coastal Plateau Bog. These pronounced plateaus are nowhere common in the world, occur in quite limited numbers in eastern North America, and are unreported from western North America. Thus, the few Coastal Plateau Bogs in Maine are the only representatives of this distinctive peatland type known in the United States.

Amateur and professional botanists and ecologists have been attracted to these peatlands for many decades, being especially interested in the floristic composition with its very distinctive coastal elements, and in the colorful displays of orchids in summer and shrub foliage in autumn. The coastal distributions of species and communities are of state, regional, national, and even continental significance.

Among all ecosystems, peatlands retain more of their antiquity than any others. Maine's coastal raised peatlands may be as much as 9000 or so years old. The remains of plants and animals, including pollen and insect exoskeletons, in peat deposits give clues to past environments and events. Because these coastal peatlands can document the post-Pleistocene coastal environment, they are of regional significance. Moreover, the erosion of peats by tidewater gives important data on past land/sea relationships. Of national significance is the complete cross-sectional exposure of the Carrying Place Cove Bog, which provides an outstanding opportunity for the study of raised peatland development.

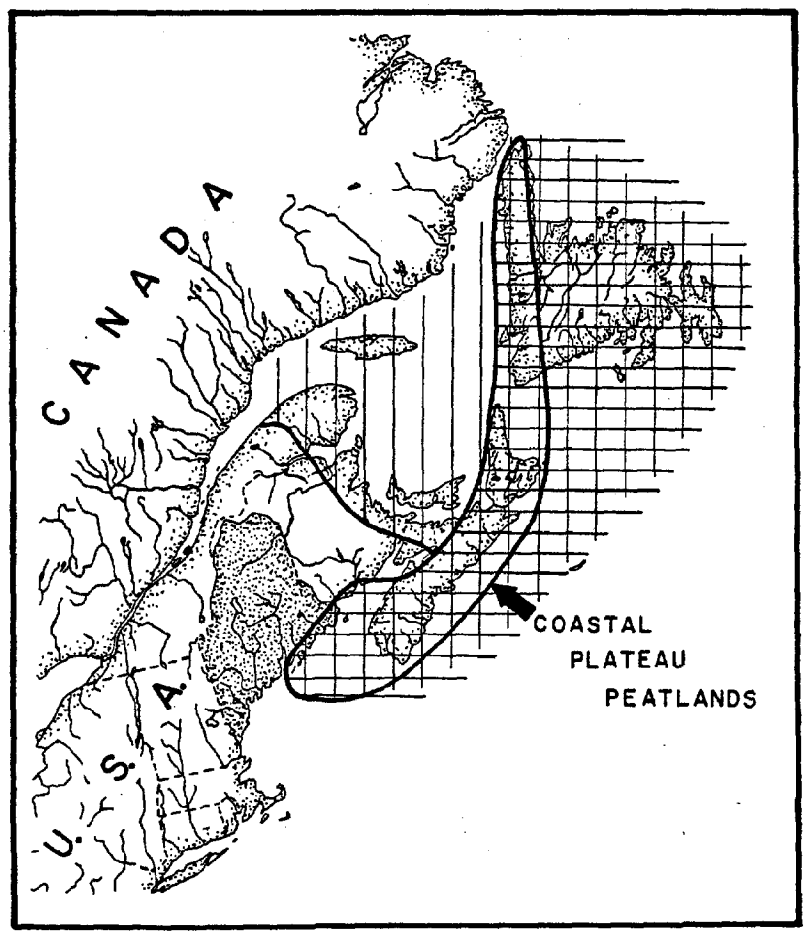

Figure 2. Eastern North American distribution of coastal plateau peatlands, Scirpus lawn communities, and the phenomenon of minerotrophic species on ombrotrophic peats. The area with vertical lines contains Scirpus cespitosus lawns (of the Scirpo-Sphagnetum) on ombrotrophic peatland. The area with horizontal lines has ombrotrophic peatlands containing species restricted to minerotrophic sites in other parts of eastern North America. Adapted from Damman (1977, 1979b, and 1980).

The economic significance of the coastal raised peatlands has taken only two expressions, peat as a commodity, and peatland landscape preserved for its natural qualities. Forest products, berry crops, faunal harvest, wildlife habitat, hydrologic reservoirs, and flood control have not been exploited economically; in some cases there is no potential, in others no interest. The deposits of peat, especially the poorly decomposed Sphagnum peats in the upper layers of the raised peat masses, have been considered and harvested for several uses, including surgical dressings, bedding, insulation, energy, and packaged horticultural peat. Some of the least decomposed, most Sphagnum rich peats occur in the coastal raised peatlands, a phenomenon of state significance. A few deposits are fairly large and have economic significance locally, perhaps at the state level. Sporadic mining has taken place in the past; one mine operates now, several mines are contemplated. Present and anticipated economic return are meager compared with income from peatlands in neighboring Canada and the Lake States.

The monetary value of natural, undisturbed peatlands has increased sharply in recent years. As natural landscape features, several coastal peatlands enjoy considerable protection and recognition. The peatlands of Great Wass Island were significant in the purchasing by The Nature Conservancy of the southern part of the island for $1,000,000. The State of Maine owns Carrying Place Cove Bog which is recommended for National Natural Landmark Registry. The "Big Heath" is maintained as a natural area within Acadia National Park.

The natural landscape of Maine has long been perceived to have distinctive regions, places whose character has strongly shaped local societies and individuals. Coastal eastern Maine is one of the most distinctive of those regions, with its unique dialects, mores, and cultural history so evidently influenced by the extreme oceanic climate, coastal environment, and landscape of coniferous forests broken by open "heaths" and local blueberry barrens. That the coastal raised peatlands (or "heaths") have a subtle but deep significance in the development and maintenance of a local culture is reflected in the common reference to "our heaths".

In areas of the world where peatlands are scarce, the peatlands often receive considerable visitor use. In Maine, because there are so many peatlands, few are heavily visited. Furthermore, many persons do not enjoy the wetness of many sites, the biting insects in season (which, incidentally, are less abundant in coastal peatlands), and the often difficult access. Most scenic appreciation comes from the vistas provided by the openness of the peatlands, and the physiognomic similarity of the peatlands to Arctic ecosystems. Peatlands within the sound or sight of ocean surf hold especial fascination. The coastal raised peatlands are significant at the local, state, and national level in their openness, accessibility, and proximity to open ocean.

In summary, the coastal raised peatlands of Maine are distinctive features of the natural environment and heritage of this state and are most appropriate for inclusion in the Critical Areas Register. These peatlands are highly specialized, have distinct but limited global relatives, and contain the only Coastal Plateau Bogs known in this nation. They contain natural features with local to continental significance. As landscape features they are of interest to scientists and the general public. They are valued as scientific resources, natural classrooms, and as aesthetic wonders for

their uniqueness and beauty. Locally they participate in the maintenance of regional cultural characteristics. The monetary value of their natural features is rising sharply. A few contain deposits of local economic significance.

NATURAL HISTORY AND ECOLOGY OF THE COASTAL RAISED PEATLANDS

THE COASTAL REGION OF RAISED PEATLANDS

Location and Diagnostic Peatland Features

From the southern tip of Mt. Desert Island to Lubec lies a narrow strip of coastal Maine (Figure 1) with peatlands having distinctive features resulting from their immediate proximity to the sea. In this "Coastal Region" are found:

a) clearly raised plateau peatlands with steep margins,
b) sedge lawns of Scirpus cespitosus* occupying the central, upper elevations of the larger, raised plateau peatlands,
c) abundant baked-apple berry (Rubus chamaemorus) and black crowberry (Empetrum nigrum), and their communities, on raised peats,
d) species, such as common juniper (Juniperus communis), that primarily grow in more nutrient-rich sites thriving on the nutrient-poor, ombrotrophic peatlands, and
e) undulating plains, essentially those without hollows, of Sphagnum fuscum** in the upper elevations of the raised peatlands, plains in which shrubs are sparse and diminutive.

Additional diagnostic and characteristic features of the coastal raised peatlands appear in later sections of this report.

Physiography

The coastline of rocky islands, points and peninsulas with intervening bays, coves, and tidal rivers of the Coastal Region extends from West Quoddy Head, the easternmost point of the United States, at least to the southern tip of Mt. Desert Island. Most of the rolling topography lies between 20 and 100 feet in elevation, except near Cutler and on the Schoodic Peninsula where 100-170 feet elevations prevail. The occasional, prominent hills

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* There is no common name for Scirpus cespitosus. One could call it "tufted bulrush" after the Latin scientific name, but I feel this name improperly conveys the lawn habit assumed by this short member of the sedge family. Consequently, rather than invent a contrived common name, none is used.

** There is no common name for Sphagnum fuscum. Restricted to raised peatlands, this medium sized peat moss is the most truly brown of the 30 or so Sphagnum species in the Coastal Region.

rarely exceed 300 feet in elevation, and are commonly less than 220 feet tall. This coastal region is distinguished by its paucity of natural lakes, especially when compared with adjacent inland areas.

Streams vary in size from seasonal to small rivers; gradients are shallow so water flow is relatively slow with white waters and falls essentially absent. Freshwater backwaters, deadwaters, and abandoned meanders are rare, whereas tidal wetlands are locally extensive along streams.

Igneous and metamorphic bedrock prevails, overlain by glacial till and outwash modified by marine activity and overlain by clays and other ocean sediments. All except the highest elevations were inundated by the sea in the early post-glacial period. The coastline is now slowly submerging following its maximum exposure a few millenia ago.

Soils are various and incompletely surveyed (Rourke et al., Ferwerda pers. comm.). Uplands are predominantly Lyman, Scantic, and Peru soils (Rourke et al. 1978) and undifferentiated Histosols (organic soils) fill most lowlands. In extreme maritime environments immediately adjacent to the sea, such as southern Great Wass Island, Histosols also occupy sloping upland terrain. Bedrock outcrops are common, especially near the sea.

Climate

The extreme maritime climate of the Coastal Region is well known for its high rainfall, considerable fog, moderated temperatures, and lack of persistent snow cover. Damman (1977, 1979b), Johnson (1977), and Davis (1965) have considered the ecological effects upon the vegetation.

The maritime climate of the Coastal Region (Anon. 1979) must be generalized since there are very limited records from zone itself (Davis 1965). Variation in a number of climatic factors parallel the Maine coastline. The mean minimum January temperature along the outer tips of the islands is 14°F, and in most of the Coastal Region it is 12°F (in contrast with the northern Maine mean minimum of 0°F). The region has the greatest Normal Annual Precipitation in Maine (perhaps exclusive of a few mountain summits or upper slopes), 48 or more inches per year. Sites less than a mile from the sea may receive substantially more rainfall. Only about 20 days per year does one or more inches of snow fall, and the average period of continuous snow cover is less than 50 days (probably quite a bit less on outer points and islands), which contrasts with greater than 125 days in northern and western Maine.

The mean July maximum temperatures are below 78°, but decrease rapidly eastward to less than 70° at West Quoddy Head, which has the coolest summers of any place in Maine (except, perhaps, for some high mountain summits). The freeze-free season length is greater than 140 days, exceeding 160 days in the eastern-most part of the Coastal Region, contrasting with less than 80 days in northwestern Maine.

Great Wass Island is one of the most exposed sites on the Maine coast according to the Davis marine exposure index (Davis 1966, see also Johnson 1977). Thompson (1979) notes:

> ". . . in summer the temperature is often perceptibly lower at the southern end than at the northern end of the island, there is usually a sea breeze along the southern shore (even when there is none inland), and the area often receives fog when just a few miles inland it is clear."

Great Wass Island has a mean maximum January temperature of 30-32°F, higher than any other Maine area except the central coastal region. Mean maximum and minimum July temperatures (74°-76°F and 52°-54°F) are among the lowest in the state. Precipitation is underestimated since fog drip is not measured. Fog signals operate for about 400 hours during July and August (Fobes 1946, in Thompson 1979), or about 27% of the time. Vogelmann (unpublished data, 1979) has determined (on Camel's Hump Mountain, Vermont) that low vegetation may intercept and drip several times the amount of precipitation that is recorded in conventional rain measuring devices. Thus, the southern Great Wass Island peatlands may have an effective precipitation far over 100 inches per year.

Damman (1977) determined "temperature differences between inland peatlands, some located only 7 km (4.3 miles) from salt water and 25 km (18 miles) from the coast line, and coastal bogs" by the sucrose inversion method:

> "Average temperatures during the vegetative season in the inland bogs are 2.5-3°C (4.5-5.4°F) higher than in the coastal ones, and almost 4°C (7.2°F) higher than in the very exposed bogs of Campobello Island and Quoddy Neck. This is a considerable temperature difference, the magnitude of which is better appreciated if one realizes that this corresponds to an altitudinal change of 500-600 m (1640-1960 ft) and 800 m (2620 ft), respectively."

The average annual temperature at depths 2.5-4.5 cm (1-1.8 in) below the surface of Sphagnum carpets for the period June 8 to September 16 (100 days) for three Coastal Plateau peatlands was (data from Damman 1977, Table 4):

		Carrying Place Cove Bog	Jonesport Heath	Kelley Point Heath
Sphagnum fuscum	1970	15.7°C (60.3°F)	-	16.5°C (61.7°F)
hummock	1971	17.3°C (63.1°F)	18.2°C (64.8°F)	18.1°C (64.6°F)
Sphagnum rubellum				
carpet along	1970	15.8°C (60.4°F)	-	16.9°C (62.4°F)
pool	1971	17.5°C (63.5°F)	-	18.7°C (65.7°F)

Note that hummocks are cooler than hollows, and temperatures increase to the southwest. The former corresponds with the persistance of ground frost; ice beneath some hummocks may persist into at least July in the easternmost portions of the Coastal Region.

PEATLANDS OF THE COASTAL REGION

Discovery of the Coastal Peatland Phenomenon

Although a number of investigators (Shaler 1887, 1890, Ganong 1891, 1897, Bastin and Davis 1909, C.A. Davis 1909, Fernald and Wiegand 1910, Bastin and Williams 1914, Burr 1917, Nichols 1919, Osvald 1928, 1955,1970, Waksman and Stevens 1929, Dachnowski 1929, Dachnowski-Stokes 1930, 1933, Rigg 1940, Trefethen and Bradford 1944, Deevey 1951, Kennedy 1963, Cameron 1975, Johnson 1977, Damman 1977, 1979a,b, 1980, and J. Davis and White 1979) reported that eastern Maine contained New England's only raised peatlands, few recognized or documented variation with distance from the sea.

Among the first to recognize the Coastal Peatland Region were Fernald and Wiegand (1910) who reported

> "In the heaths or raised peatbogs which abound close to the sea in this outermost coastal strip of eastern Maine are many other sub-arctic plants which disappear abruptly when we go inland only a short distance — often only a few yards — from the shores of the Bay of Fundy or the Atlantic. The heath-formation occurs not only in depressions or on plains where the close carpet of Sphagnum, Empetrum, and Rubus arches toward the center into a low dome, but in many places near the sea this heath — or bog — vegetation climbs the rocky hummocks and slopes, thus forming a continuous undulating or even abruptly sloping boggy carpet such as is familiar in the alpine region of many of our mountains. . . . In general this narrow coastal subarctic strip extends along the outer mainland and islands to Great Cranberry Isle."

Thus, not only did they recognize the Coastal Region, but they described Shrub Slope peatlands (see later in this report) which were not noted again until the work of Worley (unpublished data, also Worley and Sullivan 1979) and Thompson (1979).

Perhaps because of his knowledge of maritime influences in the peatlands of northern Europe, the British Isles and Scandinavia, Osvald (1928, 1954, 1955, 1970) noted the presence of a maritime peatland phenomenon in Maine, and made a major point of the maritime differences in the Canadian Maritime Provinces. He visited (Osvald 1955, 1970) peatlands in 1927 near Sydney (Sydney Bog), Hermon (Hermon Bog and Hermon Center Bog), Deblois (Denbo Heath and Bog Stream Heath), South Trescott (South Trescott Bog) and Lubec (Carrying Place Cove Bog). Only the last two did he consider coastal, even though the Deblois peatlands are but 20 miles from the sea.

Osvald (1955, p. 110) concluded:

> "In north-eastern Maine, several types of raised bog occur. There is a gradual transition from slightly raised bogs in the middle part of Maine to conspicuously domed inland bogs in northern Maine, and from the fairly wet inland bogs to the rather dry coastal bogs."

He further commented that the coastal peatlands have a greater importance of lichens beneath dwarf shrubs, and may have a "relatively high frequency" of Scirpus cespitosus. Alliance with extreme maritime peatlands of eastern New Brunswick and Cape Breton Island was noted, especial emphasis placed upon the presence of the Scirpus.

Recently, A. W. H. Damman (1977) of the University of Connecticut documented the "strikingly different topography and vegetation cover of the bogs in a narrow coastal belt," and proposed several ecological factors as important causative agents (1977, 1979a,b, 1980). His work is thoroughly discussed in this report.

The Coastal Plateau Peatland

This section gives a brief description of the Coastal Plateau peatland, its shape and plant communities. Additional detail follows in later sections.

The Bay of Fundy region (Damman 1977) of Coastal Plateau Peatlands and Coastal vegetation dominance types extends from the southern tip of Mt. Desert Island to slightly east of the mouth of the St. John River (Damman 1977, 1980; Gemmell and Keys 1979), never more than a few miles from the ocean. This small region of specialized peatlands and communities (Damman 1977, 1979a, 1980) contains a minor proportion of the peatlands and peatland acreage of Maine (Worley 1980a) and New Brunswick (Gemmell and Keys 1979). None of the peatlands are nearly as large as many of the peatlands that occur inland, from east central Maine (Worley 1980a) to the northeastern coast of New Brunswick (Gemmell and Keys 1979).

Coastal Plateau Peatlands occur elsewhere in North America (Figure 2) along the Nova Scotian coast and the west coast of Newfoundland (Damman 1977, 1979b).

The larger peatlands of the Coastal Region are plateaus with a simple, concentric zonation of a few plant communities (Figure 3). Along the margins of the plateaus are well developed laggs or moats with low herbs and Sphagnum (notably the Smilacina-Sphagnum pulchrum community), tall grass meadows of blue-joint grass (Calamagrostis canadensis), thickets of rhodora (Rhododendron canadense), leather-leaf (Chamaedaphne calyculata), and/or sweet gale (Myrica gale), or forests of black spruce (Picea mariana) or larch (Larix laricina) with various understories. The pronounced plateau slope rises abruptly 3-10 feet above the laggs. Overall 1:20-30, this slope locally may be as steep as 1:3-5. The steeper slopes usually have wet depressions, mud bottom communities, and/or occasional small ponds.

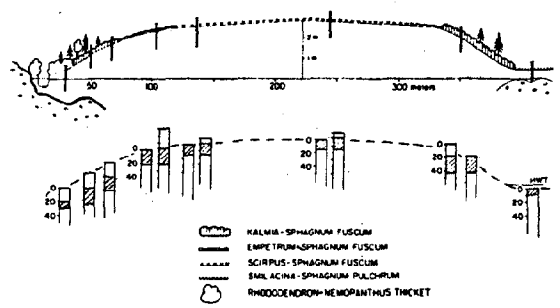

Fig. 4. Water level fluctuations and distribution of plant communities on a transect through Jonesport bog, a large plateau bog in the coastal belt. For communities with an irregular surface the water level extremes are shown with respect to both average hollow and hummock surface.

Figure 3. Distribution of major plant communities and water level fluctuations on a coastal plateau peatland. Reproduced from Damman (1977, Figure 4).

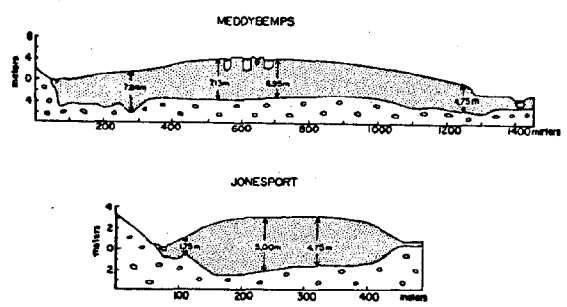

Fig. 2. Cross-section through an convex raised bog (Meddybemps Heath) and a coastal plateau bog (Jonesport bog). Note that the coastal bog has been drawn at twice the scale of the inland bog. The abrupt change in slope on the right side of the profile through Meddybemps Heath is a slump zone resulting from erosion by the brook.

Figure 4. Cross-section of a coastal plateau peatland and a nearby domed peatland. Reproduced from Damman (1977, Figure 2).

The lowest portions of the slope may have leather-leaf and/or rhodora (but generally not nearly as extensively as at some inland peatlands), or open low forest whose trees become much shorter on the upper portions of the slope. The remainder of the slope is dominated by Kalmia-Sphagnum fuscum communities, the sheep laurel (Kalmia angustifolia) being quite abundant.

Instead of the bog slope continuing to rise forming a dome (a common inland phenomenon) it flattens (Figure 4). The larger the peatland the greater proportion of plateau. As the slope levels the hummocky Kalmia-Sphagnum fuscum communities become replaced by the Empetrum-Sphagnum fuscum community. As one approaches the central regions of the plateau, this community may become "hollowless" plains (Figure 5), in which Sphagnum fuscum forms a firm, slightly undulating continuous surface, mostly devoid of discrete hollows, that has very sparse, exceedingly short shrub growth seldom more than 2-5 inches tall. Locally black crowberry (Empetrum nigrum) may achieve 30-50 percent cover.

The central zone of the largest plateaus has nearly continuous Scirpus-Sphagnum fuscum lawns (Figure 6). Hummocks or ridges are virtually absent, as are ponds or discrete ephemeral pools. Wet depressions and mud bottom communities do not exceed 5-10 percent of the area. Commonly the vegetated surface is dominated by Scirpus cespitosus lawns, some areas with carpets of Sphagnum rubellum and S. flavicomans. Sphagnum fuscum varies in abundance, but its low cushions are small and scattered. Very wet most of the time, this central plateau zone is flooded in the spring and after heavy rains, with water levels even during drought within 16 cm (6.3 in.) of the surface (Damman 1977).

The graphically simple plateau topography and vegetation zonation occurs only at the Jonesport Heath, the Kelly Point Peatland Complex and at Carrying Place Cove Bog (which has much natural disturbance). Most other sites have topographic and vegetation variation. Some of the variations are discussed later in this report.

A more complete discussion of the character of the Coastal Plateau Peatland, its topography and vegetation, its differences from inland types, and the ecological factors that cause and maintain its character are given by Damman (1977, also 1979b and 1980).

Coastal vs. Inland Peatland Variation

The "principal differences between the bogs in and outside the coastal zone" (Table 1) given by Damman (1977, Table 3) primarily compare the Coastal Region only with the immediately adjacent inland terrain, and refer specifically to the largest peatlands in an area:

> "The differences in the topography of the coastal and inland bogs . . ., as well as those in the vegetation cover, are most clearly expressed in large peat bogs.

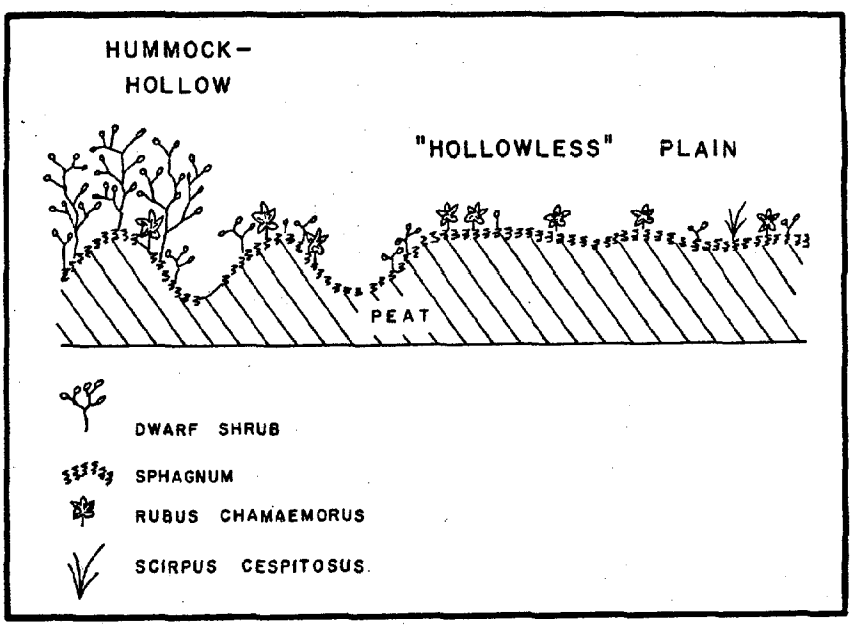

Figure 5. The "hollowless plain" phenomenon of the coastal raised peatlands. Note that the plain is at approximately the same height as the hummock tops.

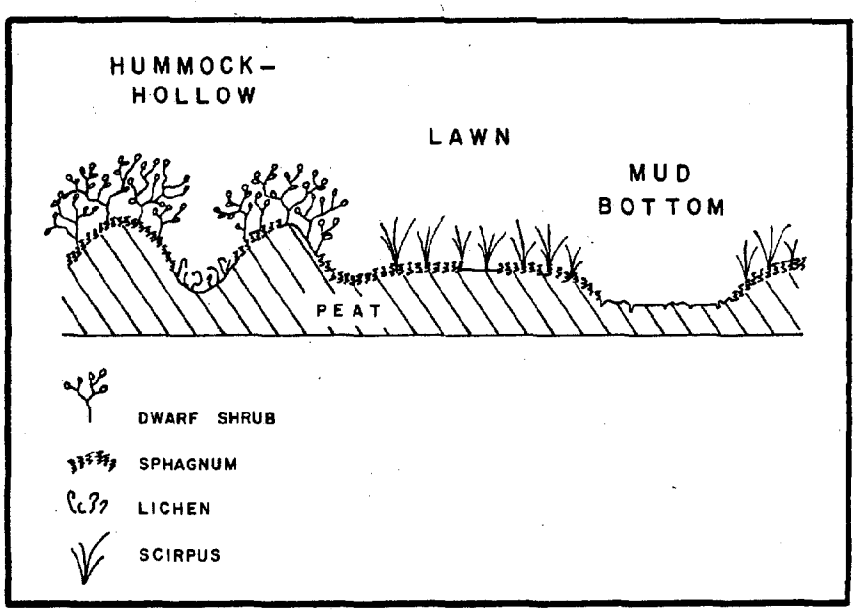

Figure 6. The major physiognomic vegetation units of the coastal raised peatland plain. Note that the mud bottom areas are lower than the hollows and lawns.

Table 3. Principal differences between the bogs in and outside the coastal zone.

	Inland	Coastal
a	Domed but with very gentle barely visible slopes	Clearly raised plateau with obvious bog slope and almost flat central part
b	Trees and patches of forest often present in the central, ombrotrophic parts of the bog (presumably trees covered most of this originally)	Trees restricted to the bog slope
c	Dwarf shrub communities cover almost the entire bog surface	Dwarf shrub communities only on slopes and edge of plateau; *Scirpus cespitosus* lawn communities cover the plateau
d	Bog moat (lagg) poorly defined	Bog moat often well-developed
e	Pools common in bog center. Mud bottom vegetation unimportant and almost restricted to area with bog pools	Bog pools rare. Mud bottoms cover very little area but can occur anywhere on plateau; most common in disturbed areas
f	Gradual change from minerotrophic to ombrotrophic conditions; mineral soil water limit obscure, can only be recognized in floristic composition of vegetation	Mineral soil water limit clearly visible in vegetation and topography
g	*Gaylussacia* community restricted to these bogs	*Scirpus-Sphagnum fuscum* and *Empetrum-Sphagnum fuscum* communities restricted to these bogs
h	*Empetrum nigrum* and *Scirpus cespitosus* occur very locally; *Rubus chamaemorus* absent*	*Rubus chamaemorus*, *Empetrum nigrum* and *Scirpus cespitosus* extremely abundant

*For other floristic differences see section on distribution of individual species.

Table 1. Principal differences between the larger raised peatlands of the Coastal Region and those in nearby inland regions. Reproduced from Damman (1977), marginal letters added.

> Size affects peat depth, the relative importance of minerotrophic water from the surrounding uplands, as well as the direct effect of surrounding hills and forests on wind force and snow drifting. In many small peat bogs, these local environmental factors may overrule the regional factors or confound the vegetation pattern. . . . In general, the small bogs will deviate increasingly from the regional pattern the more rugged the topography, the nutrient-richer the surrounding mineral soil areas, and the higher and more uninterrupted the forest surrounding the bog." (Damman 1977, p. 140)

Thus, the distinctions are derived primarily from a few large sites such as the Kelley Point Peatland Complex (coastal) and the Great Heath (inland), and not the many smaller peatlands in both regions. However, each of the distinctions of Table 1 can be qualified to have broader applicability:

a) Of the inland domed bogs that I have visited, a few locally have an obvious bog slope forming part of their margin. Likewise, some of the coastal plateau peatlands, especially many of the smaller peatlands, have marginal bog slopes with little rise or a barely perceptible slope. As Cameron (1975) notes, plateau-form peatlands occur in both inland and coastal regions., though the inland plateaus have less distinctive rise and lower elevations. Runaway Pond Heath north of Machias is considered a plateau by Cameron (1975) and an inland bog by Damman (1977), whereas Larrabee Heath, south of Machias, is considered a plateau by Cameron (1975) and a coastal plateau by Damman (1977). Both peatlands have quite similar surface topographies, being not large plateaus with central areas that are very shallow domes rather than flat expanses, with Larrabee Heath slightly more elevated (Cameron 1975). Only Larrabee Heath has coastal communities and species.

b) Many of the smaller, coastal peatlands have open canopy tree growth over some or all of their raised surface. The trees are progressively less tall to the center of the peatland, always less than 6 ft. in height (often 3 ft. or less) in the central region. Similarly, although some inland raised peatlands have trees in their central region, there are many devoid of trees except at their margins, as well as many either uniformly covered with trees (closed or open canopies), or partially covered with trees with tree heights and densities less in the central regions. Damman (1977) suggests that open inland peatlands are maintained treeless by fire. Perhaps true for some sites, fire maintained treelessness cannot account for the hundreds of open, inland peatlands.

c) Damman's (1977) distinction needs qualification for coastal peatlands, for not all coastal peatlands have Scirpus cespitosus lawn communities, nor are dwarf shrub heaths restricted to marginal slopes and plateau edges. In some cases Scirpus dominated lawns occur not centrally on the plateau but marginally at slightly lower elevations. When Scirpus joins beak-rush (Rhynchospora), cotton-grasses (Eriophorum spp.), or sedges (Carex spp.) in soaks, marginal moats, or fens, it is not just a coastal

phenomenon, for such associations are not uncommon in the interior (Osvald 1970; Damman 1977, 1979b, 1980; R. B. Davis and Sawyer 1978; Worley, personal observations). Damman (1977, Table 1) notes Scirpus lawns for interior sites for the Chamaedaphne-Sphagnum rubellum vegetation unit, which occupies large depressions and filled-in pools, as well as along some pool margins. This phenomenon occurs sporadically in the Coastal Region in the fens that drain some raised peatlands, either along the raised peatland margin, or directly away from the raised peatland. In most coastal peatlands dwarf shrub communities extend over the entire raised peatland. However, shrub height and density are often lower to very much lower at the highest elevations of the peatland. Characteristically the Empetrum nigrum - Sphagnum fuscum community becomes most prominent there. At times there may be broad expanses of hollowless Sphagnum fuscum with scarce dimunitive black crowberry (Empetrum nigrum) and scattered baked-apple berry (Rubus chamaemorus) which is either robust or subdued.

Regardless of coastal or inland location, the distinctiveness of laggs varies primarily with the character of the adjacent topography and hydrology. At many peatlands there will be areas of well-defined laggs, and other areas of poorly defined laggs. Throughout Maine there are a great number of lagg types, and their widths vary immensely.

e) Inland sites vary considerably, many have no pools, some have over 50. Mud bottom communities similarly may be absent, abundant and patterned, or limited and associated with pools. Bog pools are indeed rare in the Coastal Region, being small and restricted to the plateau margins or to marginal soaks, drains, or fens. There are two noteworthy exceptions, occurring at the extremes of the region. Big Heath at the southern tip of Mt. Desert Island has a well-developed pond system quite unlike any other peatlands of the region, possibly similar to those at Duck Pond Heath on Campobello Island, New Brunswick, adjacent to the Maine border. The ponds at the shoulders of the Carrying Place Cove Bog plateau are distinctive and persistent, having been described and photographed in 1927 by Osvald (1955). At coastal peatlands mud bottom communities are infrequent and scattered, except they are common at disturbance sites (such as trails or mining scars), in laggs, fens and drainageways, and along the steepest part of some marginal slopes of plateaus.

f) The mineral soil water limit distinctions seem most applicable to the largest raised peatlands and some of the more abruptly raised, smaller, coastal peatlands. At other large systems and many of the smaller systems, regardless of the coastal-inland position, for vegetation and/or topography, the recognition of mineral soil water varies from obvious to obscure.

g) The restrictions of communities to inland or coastal peatlands have minor exceptions. Osvald (1970) does report the Empetrum nigrum-Sphagnum fuscum community at Denbo Heath, an inland site. Black huckleberry (Gaylussacia baccata) occurs locally on some of the most maritime and exposed peatlands (e.g., Damman, 1977, Table 1, records the species at a coastal site; Thompson, 1979, records the species on Great Wass Island peatlands). At peatlands very near the sea, both black huckleberry and dwarf huckleberry (Gaylussacia dumosa) grow on ombrotrophic peat, the latter commonly as distinctive circular clones. Thompson (1979) recorded dwarf huckleberry at seven of eight, and black huckleberry at three of eight, locations in the six principal peatlands of Great Wass Island. At the sites sampled dwarf huckleberry had cover values ranging from 1 to 13 percent, and black huckleberry ranged from 1 to 5 percent. Both species can form nearly pure stands, sometimes as very distinctive circular clones.

h) Note that many coastal sites may have scarce or no Scirpus cespitosus. Also, the abundance of black crowberry and baked-apple berry varies considerably from peatland to peatland, though they are seldom scarce. Damman (1977, Table 1) also lists other species "showing an affinity for oceanic conditions": Sphagnum imbricatum, Icmadophilum ericetorum, bog goldenrod (Solidago uliginosa), Cladonia terrae-novae, Sphagnum flavicomans and common juniper (Juniperus communis). Because of their ease of recognition, the goldenrod and juniper are especially useful indicators. Bog goldenrod is common to relatively abundant on most coastal peatlands, whereas common juniper appears restricted as a peatland species to only exposed sites in the most oceanic peatlands (a similar circumstance exists for the species in the coastal peatlands of southeastern Alaska — Worley 1980c).

Some of the conclusions of Osvald (1955, 1970) should be compared with Damman's (1977, 1979b), recognizing that Damman's work is the more recent and thorough.

Osvald (1955) and Damman (1977) contradict each other with respect to site wetness. Osvald's observations ("fairly wet inland bogs . . . rather dry coastal bogs") were limited and casual, whereas Damman's results ("in contrast to the inland bogs, the coastal bogs are wettest in the center") were quantitative, although primarily restricted to two sites (Meddybemps Heath and Jonesport Heath). No quantitative measurements of water levels were made in this study, but I visited considerably more peatlands in the coastal and inland regions than either Osvald or Damman. Damman's conclusions appear generally correct (especially at the largest sites), if allowances are made for considerable variation among peatlands within each zone. The variations are likely due not only to the climatic differences noted by Damman, but also (especially for smaller sites) to the hydrogeomorphic setting of each individual peatland, the height of the peatland above the regional water table, the areal dimensions and configuration of

the peatland, the absolute slopes of the upper and marginal surfaces, and the prominent vegetation types and character of the hummock and hollow topography as they affect evapotranspiration.

Consequently, overall peatland wetness cannot be used to distinguish coastal peatlands from inland peatlands, although it seems clear that for the largest sites, at the highest elevations of the peatland, there is less lowering of the water table seasonally at coastal sites, as documented by Damman (1977).

Osvald's second distinction is the greater importance of lichens beneath dwarf shrubs in coastal peatlands. Damman (1977, 1979b, 1980) makes no comment concerning Maine in this regard, noting lichens in dwarf shrub communities at all sampled locations. From his Table 1 (Damman 1977) can be calculated a mean lichen cover in dwarf shrub communities at coastal peatlands of 40.4%, and 34.4% at inland sites, thus supporting, though just barely, Osvald's observation. At coastal sites Damman lists a range of 5 to 85% lichen cover per sample, whereas at inland sites the range is 10 to 65%. In this study no quantitative determinations were made, but I have no disagreement with Osvald or Damman. The lichen distinctions are likely more distinctive than recorded, but confirmation awaits further research. With such little difference between inland and coastal sites, and with such variation among sites, lichen cover cannot be used as a differentiating criterion.

Osvald's third distinction, the abundance of Scirpus cespitosus in coastal peatlands is a major point of Damman's (1977, 1979b, 1980), noting its diagnostic importance for the peatland type.

Another investigator, Johnson (1977), used 19 raised bogs in Washington County, all within 40 miles of the coast, as data sources for a mathematical analysis ("principal components, multi-variate analysis") of the niches of plant populations. Eight of these sites are coastal raised peatlands. His study sought to identify environmental factors that best correlated with vegetation composition variation, observing geographical correlation should it exist. His results correspond well with the conclusions of Damman.

Two environmental factors were discovered, titled "salinity-snow cover" and "ombrotrophy-mesotrophy." The first appears to be a coastal-inland gradient, having good correlations with distance from the coast and with the Davis (maritime) exposure index (R. B. Davis 1966). Exchangeable metal ions increase in concentration towards the sea, no doubt the result of airborne salts originating from sea spray. Fiber percent increases, and peats are generally drier (although rainfall tends to be higher) near the coast. Less snow cover near the coast is hypothesized as a principal causative agent. The plant species diagnostic of the coastal end of the environmental gradient are baked-apple berry (restricted to near the coast) and black crowberry (in abundance only near the coast), along with small cranberry (Vaccinium oxycoccos), round-leaved sundew (Drosera rotundifolia), and bog goldenrod. The greatest richness of species (number of species per unit area) occurs near the coast at medium-dry sites. The high richness comes

from herbs and mosses, not shrubs.

Thus, by niche analysis Johnson showed that the largest share of vegetation variance is related to mineral-ion concentration, especially as modified by atmospheric input owing to proximity to the sea, and to the amount of mineral soil ground water. The first environmental factor, and the first vegetation factor both display a coastal-inland gradient whose sharpest distinction occurs between extreme coastal sites with baked-apple berry and black crowberry, and more inland locations. This distinction is mapped easily based upon the distribution of the combination of these two species, and corresponds exactly with the landward limit of coastal raised peatlands. The second environmental factor, ombrotrophy-mesotrophy, showed no geographical correlation and is not further discussed here.

Other Peatland Types

Unlike the central inland and southern parts of Maine, forested peatland appears uncommon to rare in the Coastal Region, except for that which borders or is otherwise contiguous with open peatlands. In the latter case the open or semi-open area generally exceeds the forested area in acreage. Thicket peatlands appear to be equally uncommon. One reason for limited wooded peatland appears to be the absence of lakes (especially those with bays), and freshwater rivers with deadwaters. However, since this study made no attempt to locate wooded peatlands, some or many, including potentially significant ones, may have been overlooked.

Peatlands within the Coastal Region that are not forested, but differ considerably from the types described in this report, are not many, and do not seem to be of numerous types. At five sites, at least, there are streamside, shrub-rich peatlands. Peatlands at the junction of Bagley Brook and East Stream in Cutler and 0.8 mile northeast of Enoch Hill in Whiting (and possibly the peatlands at 1.1 miles west and west-northwest of Sandy River Beach in Jonesport) are shrub-rich, low plateaus whose raised peats have displaced or entrapped streams. The peatlands at Ackley Pond in Cutler, along Big Pond Stream on Petit Manan Point in Steuben, and north and northwest of Forbes Pond in Gouldsboro have less distinctive raised peats or consist solely of primary peats. Ackley Pond and Forbes Pond are being filled by peatlands at stream mouths. The large Forbes Pond peatland displays a classic geomorphology; the peatland, and perhaps the pond as well, merit evaluation as a potential Critical Area.

At and near the upper reaches of Schooner Brook in Cutler, and north of the Jonesport Heath in Jonesport, large complexes of shrub and thicket wetlands, graminoid, shrub, and wooded fens, wet meadows, and streams may contain various peatland types, and certainly are physiognomically very much different from any peatlands described in this report.

Shrub Slope Peatlands

During visits to central and southern Great Wass Island, an undescribed peatland type was discovered, one previously mentioned by Fernald and Weigand (1910). A subsequent investigation was undertaken to document substrate and peat topography, peat depth, composition, and degree of decomposition, vegetation composition, vigor, and community patterns, certain chemical and physical properties of the peat, and the composition of the litter. The analysis of the data is complete, and manuscript preparation is underway (Worley 1980b).

Still being assessed are the relationships of these peatlands with other heathlands, including those on mineral soils, and with blanket peatlands, whose deeper peats support a different vegetation. That these Shrub Slope peatlands occupy the terrain with the most exposed, rainy, foggy, cool temperate, maritime climate on the Maine Coast is of considerable signigicance.

The Shrub Slope peatlands on Great Wass Island are best expressed and most extensive in the southwestern portion of the island, but occur elsewhere on the island at least as far northward as just south of Folkingham Cove (Thompson 1979). This peatland type consists of several Ericaceous shrubs, especially sheep laurel (Kalmia angustifolia) and leather-leaf (Chamaedaphne calyculata), forming dense cover over peats 4-16+ in. in depth that lie over undulating bedrock with slopes at least as great as 13 degrees. In some locations there occur black crowberry (Empetrum nigrum) and/or Sphagnum spp. The peat is little to moderately decomposed, and has chemical properties reflective of an ombrotrophic setting adjacent to the sea. A few pools were found on the slopes. Trees, when present on the shrub slopes, are somewhat to much stunted, and usually less than several decades old. Tree death on the slopes is relatively common, and it appears (though not carefully documented) that the occasional trees are not colonizing the surface, for death and establishment are about equal. Charcoal, ash, and tree wood seem to be absent in the peat, the age of which is undetermined.

In the course of this study a few additional locations possibly having Shrub Slope peatlands were noted, all at the heads of islands or peninsulas that are very exposed to the sea (see later in this report).

THE COASTAL RAISED PEATLANDS

Prominence

Frequency

Peatlands occur throughout the Coastal Region, being especially numerous in the Cutler area, covering the highest proportion of the landscape at Great Wass Island, and being the largest and most extensive on the lower Jonesport peninsula.

The peatlands and associated wetlands of the Jonesport peninsula form an extensive system extending from the central portions of the peninsula through the Jonesport Heath to Kelley Point. The bulk of these peatlands lie in a NWN-SES line about 5 miles long, and are (at least in places) underlain by gravels and sands, possibly of pro-glacial outwash origin, with subsequent marine modification. Along this axis there appear to be significant ecological gradients. At the northern end are diverse wetlands including at least wet meadows, graminoid fens, and tall thickets; in the center are the exemplar Coastal Plateau Peatlands; to the south is the Kelley Point Peatland Complex, which includes fens, a Coastal Plateau Peatland, and some Shrub Slope peatland. The full significance of this gradient awaits discovery; it may be an expression of climatic variation, substrate character, hydrologic regime, or some combination of these. Clearly the maritime influence (especially fog, low cloud, mist, rainfall, sea breeze and precipitation ionic content) increases to the south and southeast.

On Great Wass Island peatlands occupy most depressions, especially in the southern part of the island. An exceptionally humid, cool, temperate climate prevails (Thompson 1979), as the extreme maritime setting of Great Wass Island as it projects well into the Bay of Fundy produces the highest Maine rainfalls, fog, mist, or cloud nearly every day, and moderated temperatures. Dry, sunny weather is rare; commonly sea fog protects the island, or at least its southern portions, while sunny skies and dry, high pressure prevails just landward. Consequently, not only do peatlands occupy depressions and form raised plateaus, but the farther south one goes on the island the greater the proportion of organic material in upland soils, with organic soils predominating on upland in the southern third of the island, and the more prominent becomes the Shrub Slope peatlands wherein shallow peat soils with an ericaceous shrub cover covers many bedrock slopes.

In the vicinity of Cutler peatlands are nowhere large, but they are notably numerous and express some variety in types. With increasing nearness to open tidewater, the peatlands have more prominent coastal morphologies and communities. Less than 15 miles from the sea, the coastal phenomena are nearly completely replaced by inland types. In addition to

the smaller coastal peatlands, there are occasional examples of other peatland types, such as Open Basin Lakeside, and Riverside Shore (c.f. Worley and Sullivan 1979).

Most of the terrain upon which there are coastal peatland phenomena is between 20 and 100 feet in elevation. The peatlands are most frequent at the most abundant elevation in a region; thus near Cutler and on the Schoodic Peninsula most peatlands are between 110 and 170 feet in elevation, whereas for the remainder of the Coastal Region 63% of the peatlands lie at elevations of 50 feet or less and 81% are at 70 feet or less elevation. Of the peatlands recommended for evaluation as potential Critical Areas similar elevations prevail, only West Quoddy Head Heath (110 feet) exceeds 70 feet elevation.

Size

Peatlands within the Coastal Region range in size from a fraction of an acre to several hundreds of acres. Only the Jonesport Heath (including the North Unit) exceeds 500 acres, totalling perhaps as many as 900-1000 peatland acres. No more than five other sites exceed 200 peatland acres, and not many others have more than 125 acres of peatland. Most raised peatlands are between 40 and 125 acres, and probably the most peatland acreage and peat volume in the Coastal Region occur in peatlands of this size. A great many peatlands less than 40 acres are found throughout the region; many are forested or shrubby, and it is not known what proportion are raised.

The ability of the topography to so evidently limit the occurrence and lateral spread of the ombrogenic peatlands indicates that the moisture excess (c.f. Damman 1979b) which permits the formation of the Coastal Plateau peatlands and other raised peatlands of the region is also a limiting factor to continued expansion. Although even less than 10 acres is sufficient to demonstrate a raised peatland morphology and coastal dwarf shrub communities, plateau development with central Scirpus lawns appears to require a minimum of about 60 acres, achieving its full characterization only at sites 130 acres or more in size.

With increasing size, the peatlands have more evident and more simple morphologies and community zonations. This is a direct result of the increased ability of the raised peatland ecosystem, which receives its nutrients and moisture only from the atmosphere (except for the laggs, of course), to ameliorate the local effects of topography, ground water, and climate.

Of the sites recommended for evaluation as potential Critical Areas, most are between 50 and 250 acres, the largest 420, the smallest 13*. The

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* Acreages given by Cameron (1975) for eight sites recommended by this report average 17% less than the acreages determined here for the non-forested portions of the peatlands (for three sites the difference exceeds 30%)

non-forested portions of these sites are somewhat smaller, occasionally (as at Big Heath) considerably less. Ten of the sites have quite distinctively raised plateaus. The plateaus of Corea Heath, the "large unit" of the Jonesport Heath, Larrabee Heath, Jonesport Heath North Unit, Great Cranberry Island Heath and Kelley Heath are between 170 and 103 acres, the South Trescott Heath, Kelley Point Peatland Complex, and West Jonesport Heath plateaus are between 79 and 59 acres, and the extant plateau of Carrying Place Cove Bog is about 22 acres in size.

Biota

Plant Communities

A plant community, as used here, is an assemblage of plants commonly found together. The community is recognizable by its constituent species and the relative abundance of the individual species. This section lists the different kinds of communities and the different communites reported for peatlands in the Coastal Region. The taxonomic relationships of some of the communities are also noted.

Quantitative site specific vegetation descriptions of a very limited number of coastal peatlands have been made by Osvald (1955, see also 1970), Damman (1977), Thompson (1979), and Worley (1980b). Osvald gives species lists and some cover-abundance values for a few stations at both Carrying Place Cove Bog and South Trescott Heath; Damman presents synthetic communities based upon cover-abundance values taken at a few stations at Jonesport Heath and possibly at a few other sites in Maine as well as some New Brunswick sites; Thompson lists percent cover values for plants at three locations in the Central Peatlands of Great Wass Island, and two locations in the Southwest Peatland of that island, as well as giving verbal community descriptions in conjunction with a vegetation map of southern Great Wass Island; and Worley in a description of the Shrub Slope peatlands of Great Wass Island includes cover values for plants at a few locations in the Southwest Peatland.

Very brief, non-quantitative vegetation notations are give by Bastin and Davis (1909) for South Trescott Heath, Fernald and Wiegand (1910) and Dachnowski-Stokes (1930) for Carrying Place Cove Bog, Dachnowski (1926) for West Jonesport Heath, and Rigg (1940) for Harrington Heath.

Seven peatlands in the study area were visited by Davis (Bastin and Davis 1909) in 1906, five being coastal raised peatlands. These are cited again in Burr (1917) and in Davis (1909). The terms "moss bog" and "heath" used by Davis do not distinguish different peatland types (Nichols 1919).

None of these studies is a detailed phytosociological work, and the stations are very few in number and mostly subjectively chosen. Consequently, Dominance and Sub-dominance Vegetation Types (Worley and Sullivan 1979) are quite incompletely enumerated. Furthermore, the amount of vegetation

variation perceived by one traversing a peatland clearly exceeds the vegetation listing, there being considerable variation within the broad community patterns presented here and by Damman (1977, 1979a,b, 1980).

Damman (1979a) contrasts the vegetation with its European counterparts (see later in this report), and describes (Damman 1977, 1979b, 1980) the eastern North American raised peatland vegetation pattern. The remainder of this section reviews Damman's work, then adds Dominance Types from other workers and from field work done in this study. This listing of Dominance Types is grossly incomplete, especially for less frequent communities, forest and tall shrub communities, lagg communities, and fen communities.

The principal communities of coastal raised peatlands can be grouped in five categories: Dwarf Forest (Low Forest), Dwarf Shrub (Low Shrub), Lawn, Mud Bottom, and Fen. Other categories remain to be described. The most abundant communities (Dominance Types and Sub-Dominance Types) recognized to date are:

Dwarf Forests
- Black spruce (*Picea mariana*) - (sub-dominance not reported)

Dwarf Shrub Heaths
- Sheep laurel (*Kalmia angustifolia*) - *Sphagnum fuscum*
- Sheep laurel - naked*
- Sheep laurel - lichen (*Cladonia silvatica*)
- Black crowberry (*Empetrum nigrum*) - *Sphagnum fuscum*
- Black crowberry - naked*
- Leather-leaf (*Chamaedaphne calyculata*) - naked
- Dwarf huckleberry (*Gaylussacia dumosa*) - *Sphagnum* spp.

Lawns
- *Scirpus cespitosus* - *Sphagnum fuscum*
- *Scirpus cespitosus* - *Sphagnum rubellum*

Mud Bottoms
- Bladderwort (*Utricularia cornuta*) - liverwort (*Cladopodiella fluitans*
- *Sphagnum cuspidatum* - naked

Fens
- Three-leaved false Solomon's seal (*Smilacina trifolia*) - *Sphagnum pulchrum*
- (other fens are listed below)

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*"Naked" means there are no understory plants.

Dwarf Forests: Dwarf forest communities have not been studied, their principal tree is black spruce, although tamarack (*Larix laricina*) may be admixed.

Dwarf Shrub Heaths: The prominent dwarf shrub heath vegetation units of ombrotrophic peatlands in the Coastal Region (Damman 1977, Table 1) of the class *Oxycocco - Sphagnetea*, the *Kalmia - Sphagnum fuscum* heath and the *Empetrum - Sphagnum fuscum* heath, belong to the *Kalmio - Sphagnetum* association (Damman 1977, 1980; Pollett and Bridgewater 1973). This association occurs throughout the raised peatland region of eastern North America to some distance north and west of the St. Lawrence River (Damman 1980, Figure 3). Sheep laurel (Figure 7) is the dominant shrub, and *Sphagnum fuscum* (Figure 8, a richly brown peat moss), *S. rubellum* (a bright red or reddish-

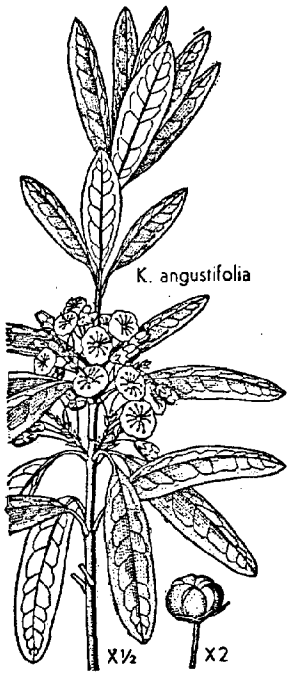

Figure 7. Sheep laurel, *Kalmia angustifolia*

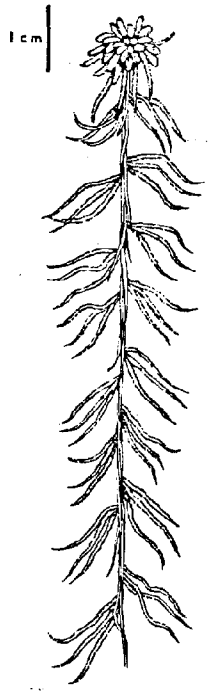

Figure 8. *Sphagnum fuscum* (*S. rubellum* looks much the same)

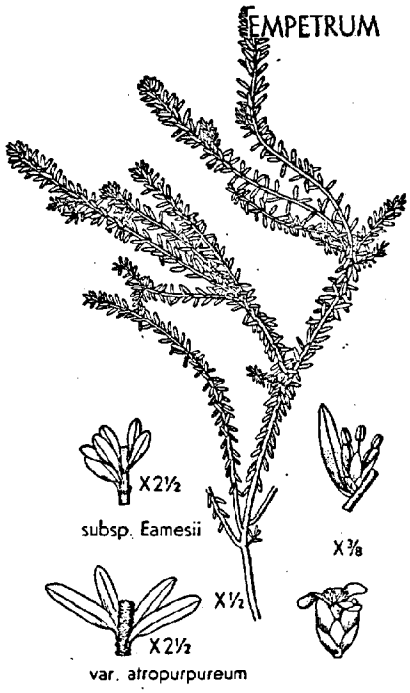

Figure 9. Black crowberry, *Empetrum nigrum*

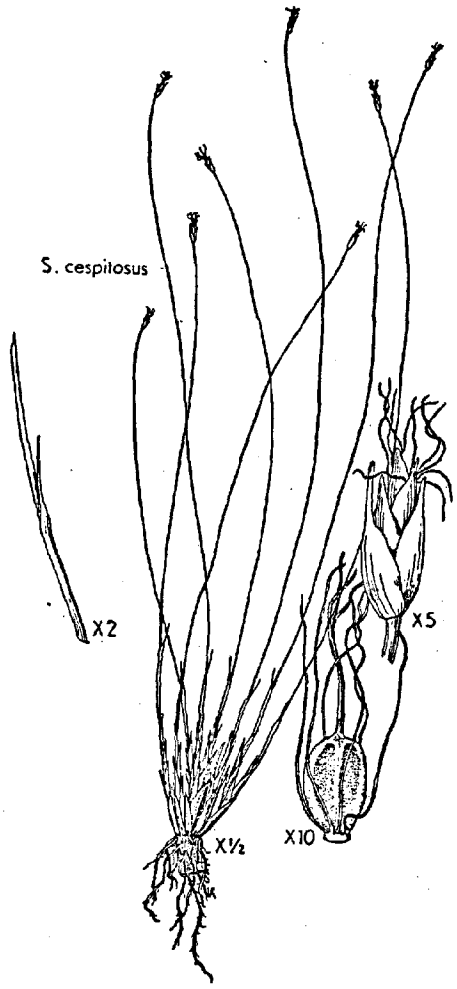

Figure 11. Scirpus cespitosus

imbricatum, scattered Scirpus cespitosus (Figure 11), occasional sweet gale (Myrica gale, Figure 12), common juniper (Juniperus communis, Figure 13), and other species of interest.

Osvald (1955, 1970) lists several "sociations" from coastal peatlands, a sociation being a group of plants commonly found together, occupying a few square feet or more, and generally equivalent to "community" as used here. The dwarf shrub sociations he lists are:

purple peat moss of similar size with S. fuscum) or S. nemoreum prevail beneath; Cladonia species (lichens) are often abundant, especially in burnt bogs poor in Sphagnum.

The Kalmia angustifolia - Sphagnum fuscum community, documented by Damman (1977, Table 1), is characterized by a 12-16 in. high dwarf shrub layer with various understories. In the Coastal Region the community contains additional species such as black crowberry (Figure 9), baked-apple berry (Figure 10), Sphagnum flavicomans, and Icmadophila ericetorum. Low black spruce, tamarack, or even jack pine (Pinus banksiana) trees and shrubs occur locally.

The Empetrum nigrum - Sphagnum fuscum community, documented by Damman 1977, Table 1), is easily recognized by the continuous, often "hollowless," Sphagnum fuscum carpet, the low height (4 in. or so) of the sparse dwarf shrubs, and the prominence of baked-apple berry and black crowberry. In extreme coastal settings it may include abundant Sphagnum

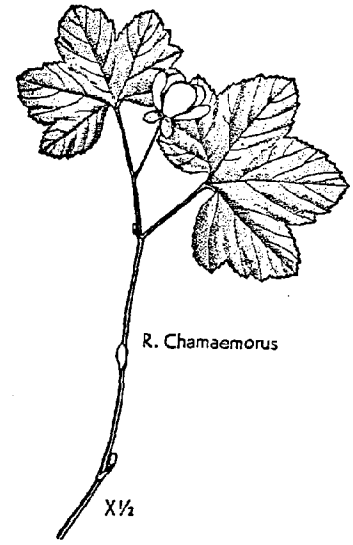

Figure 10. Baked-apple berry, Rubus chamaemorus

Kalmia angustifolia - Cladonia silvatica sociation
Naked Kalmia angustifolia sociation
Naked Chamaedaphne calyculata sociation
Empetrum nigrum - Sphagnum fuscum sociation
Naked Empetrum nigrum sociation

Fernald and Wiegand (1910) mention a community dominated by dwarf huckleberry (Figure 14) with an understory of Sphagnum spp., a community I have seen locally prominent at sites very near the sea. Dachnowski (1926) noted at West Jonesport Heath "a growth of low woody shrubs, mainly Chamaedaphne, Andromeda, Ledum, and Kalmia covers the surface but Empetrum nigrum and Rubus chamaemorus are also abundant." The presence of bog rosemary (Andromeda glaucophylla) may indicate recent burning prior to Dachnowski's visit.

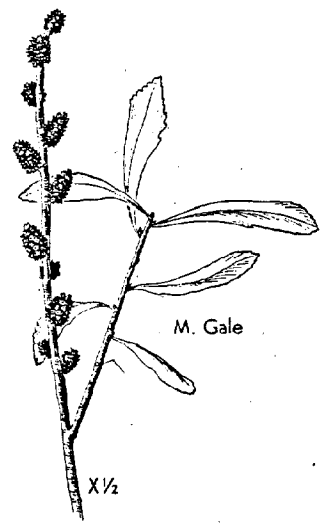

Figure 12. Sweet gale, Myrica gale

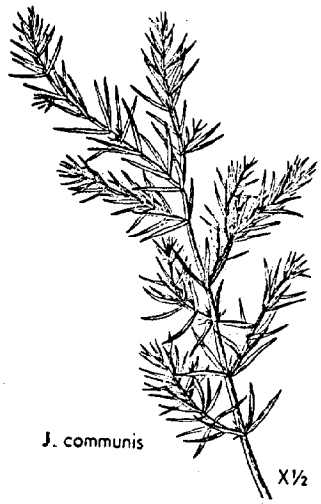

Figure 13. Common juniper, Juniperus communis

Osvald (1955, 1970), Damman (1977), and Thompson (1979) list many associated species in the dwarf shrub heaths, whose dominant shrubs at most sites are sheep laurel, Labrador tea (Ledum groenlandicum, Figure 15), leather-leaf (Chamaedaphne calyculata, Figure 16), and/or black crowberry. Considerable understory variation, varying shrub composition, height, and vigor, along with differences in hummock-hollow topography provide diverse peatland physiognomy and often are important in the formation of vegetation pattern on a peatland. These features are yet to be documented in detail.

Lawns: The prominent lawn vegetation unit in the Coastal Region (Damman 1977, Table 1) of the class Oxycocco - Sphagnetea, the Scirpus - Sphagnum fuscum lawn, belongs to the Scirpo - Sphagnetum tenelli (Damman 1977,

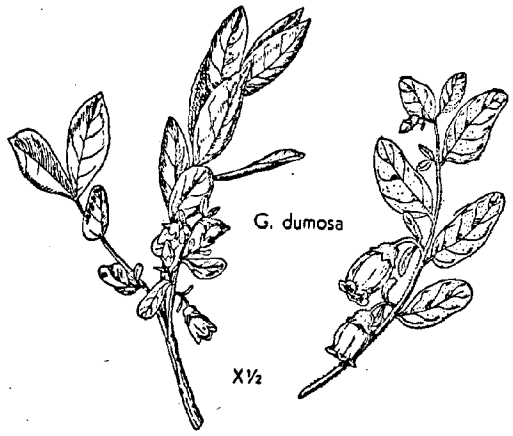

Figure 14. Dwarf huckleberry, Gaylussacia dumosa

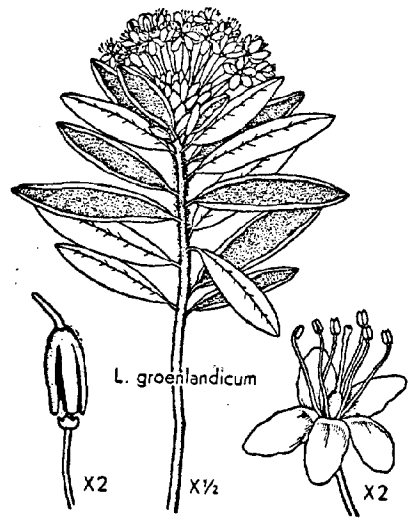

Figure 15. Labrador tea, Ledum groenlandicum

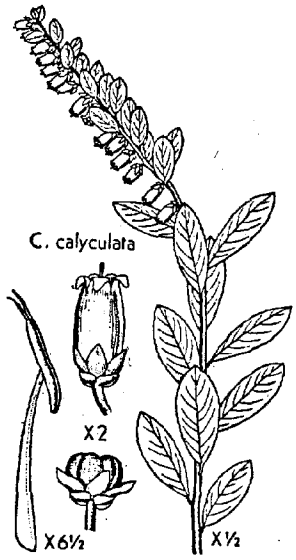

Figure 16. Leatherleaf, Chamaedaphne calyculata

1980; Wells 1976). Occurring in oceanic and sub-oceanic regions (Damman 1980, Figure 2), notably coastal eastern Maine, southwestern and northeastern coastal New Brunswick, most of Nova Scotia, and Newfoundland, this association is distinguished (Damman 1980) by Scirpus cespitosus, Sphagnum flavicomans, S. tenellum, Odontoschisma sphagni (a liverwort), and the lichen Cladonia terrae-novae; dwarf huckleberry and swamp-pink (Arethusa bulbosa) have their optimum in this association.

The Scirpus cespitosus - Sphagnum fuscum community, documented by Damman (1977, Table 1) has abundant Scirpus cespitosus above Sphagnum spp.

(variously S. rubellum, S. flavicomans, S. fuscum, and/or S. tenellum). Topographic differences are seldom greater than 4-6 in. in these wet bog flats and broad depressions.

Osvald (1955, 1970) recognizes the lawns as the Scirpus cespitosus - Sphagnum rubellum sociation. No other author describes them.

Scirpus cespitosus lawns are far more abundant in neighboring Canada, and their expression in Maine varies from site to site. It appears that there are two principal variations here: at several sites the Scirpus is less dense, the topography is more hummocky, and Sphagnum fuscum and baked-apple berry are more prominent, at other sites Scripus lawns occur marginally. The species composition of the marginal lawns is not known.

Mud Bottoms: From the class Rhynchosporetum albae Damman (1977, 1980) documents the coastal mud bottom vegetation unit Utricularia - Cladopodiella. Regional variation in mud bottom communities are not yet determined (Damman 1980), though the southern communities, as in Maine, are distinguished by the absence of Carex limosa and Scheuchzeria palustris.

Damman (1977) describes the mud bottoms:

> "This includes wet depressions with much bare peat and areas with a very loose Sphagnum carpet. In this region Sphagnum cuspidatum is the most important species in these carpets. The physiognomy varies greatly depending on whether Sphagnum spp. or Cladopodiella fluitans* are dominant, and whether Utricularia cornuta** is in flower. The vegetation of the mud bottoms of the ombrotrophic bogs of this region can probably best be included in two communities: the Rhynchospora alba - Sphagnum cuspidatum community*** and the Utricularia cornuta - Cladopodiella fluitans community. . . . The first occurs primarily along the margins of pools and in depressions with small water level changes or where the Sphagnum mat can move with the water table. The second community occupies the peaty depressions in the bog. Both cover negligible areas in the bogs of this region."

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* Figure 17.

** Figure 18.

*** This community is not listed by Damman as occurring in the Coastal Region, perhaps because of the limited development of ponds. I have seen it along pools and minor stream courses in a few marginal fens or laggs.

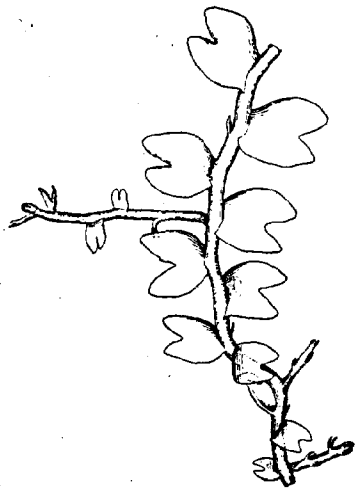

Figure 17. The mud bottom liverwort, Cladopodiella fluitans

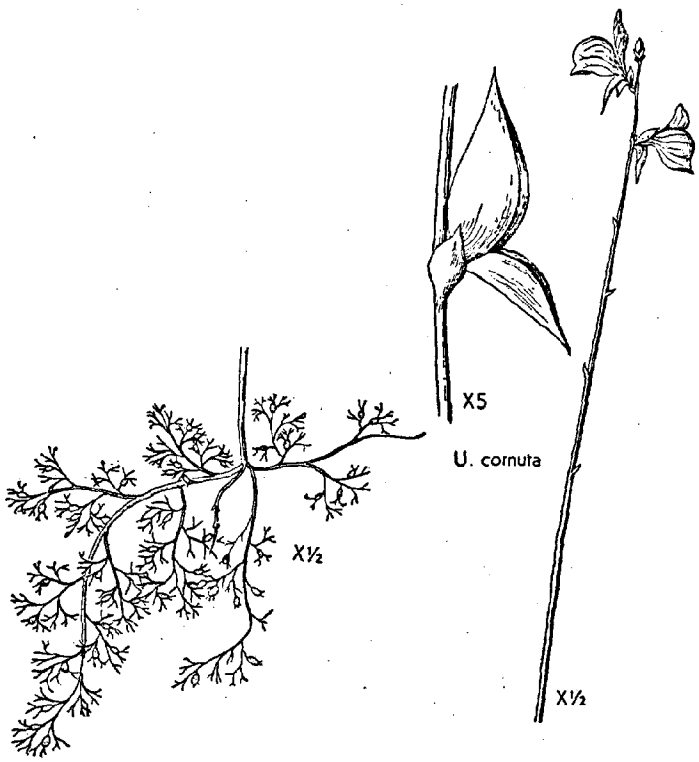

Figure 18. Bladderwort, Utricularia cornuta (the basal portion with leaves and bladders illustrated is from a related species U. vulgaris)

Nutrient-poor Fens: Also within the Oxycocco - Sphagnetea is the Smilacina - Sphagnum pulchrum extremely nutrient-poor fen (Damman 1977, Table 1) that occurs in the laggs of coastal raised peatlands. The Smilacina trifolia - Sphagnum pulchrum community denotes the parts of ombrogenic peatlands affected by minerotrophic ground water, thus Sphagnum papillosum, S. apiculatum, and S. flavicomans are also important. The brightly colored, green to yellow-green leaves of the three-leaved false Solomon's seal (Smilacina trifolia, Figure 19) clearly distinguish this community, and hence the influence of ground water.

Thompson (1979) records several fens at Great Wass Island:

a) Carex exilis (Figure 20) fen with common Scirpus cespitosus, Eriophorum angustifolium and Rhynchospora alba.

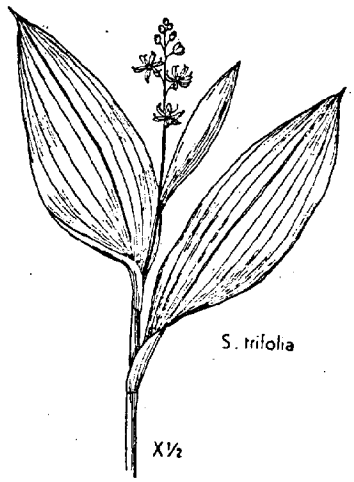

Figure 19. Three-leaved false Solomon's seal, Smilacina trifolia

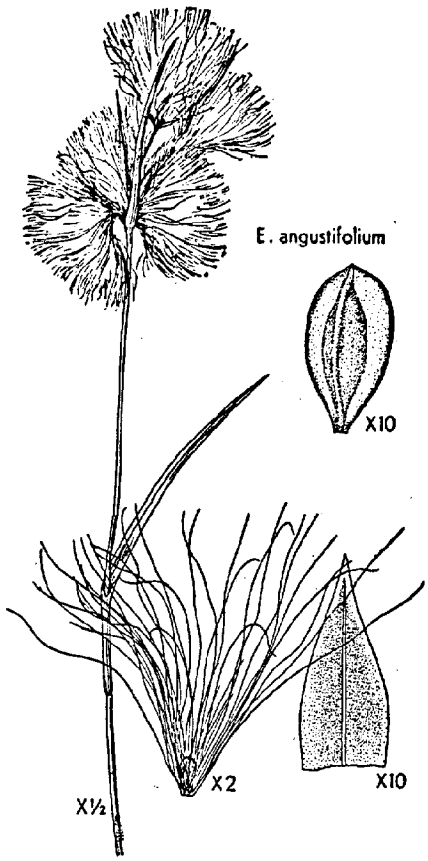

Figure 21. Cotton-grass, Eriophorum angustifolium

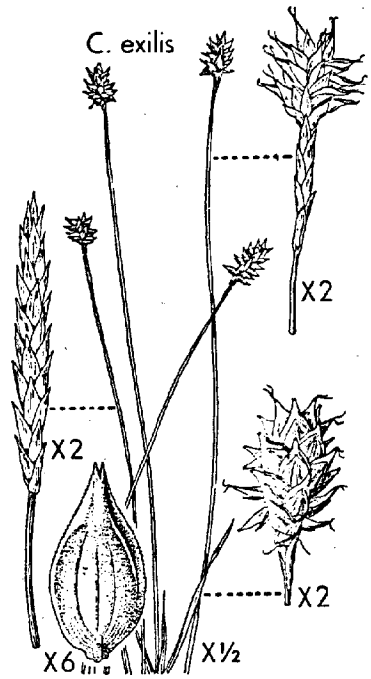

Figure 20. Carex exilis

b) Eriophorum angustifolium (Figure 21), E. virginicum, Scirpus cespitosus fen.

c) Rhynchospora alba (Figure 22) fen with common Eriophorum angustifolium, E. spissum, Carex pauciflora, and Eriophorum virginicum.

d) Carex trisperma, Eriophorum virginicum, E. angustifolium fen with Rhynchospora alba, Scirpus cespitosus and Smilacina trifolia.

e) As (d) except that shrubs (Myrica gale, Kalmia angustifolia, Pyrus floribunda and Chamaedaphne calyculata) are more abundant. Juncus gerardi is also present.

Figure 22. Beak-rush, Rhynchospora alba

f) Scirpus cespitosus, Carex exilis, Empetrum nigrum, Sphagnum spp. poor fen.

Other prominent fen communities, some on ombrogenic peats, include those dominated by leather-leaf, rhodora (Rhododendron canadense, Figure 23), sweet gale (Myrica gale), speckled alder (Alnus rugosa), black spruce, tamarack, northern white-cedar (Thuja occidentalis), and blue-joint grass (Calamagrostis canadensis, Figure 24). The species compositions of these communities are not known.

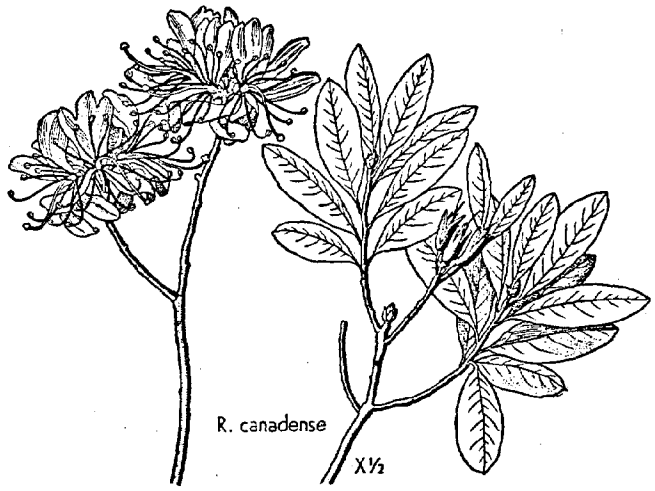

Figure 23. Rhodora, Rhododendron canadense

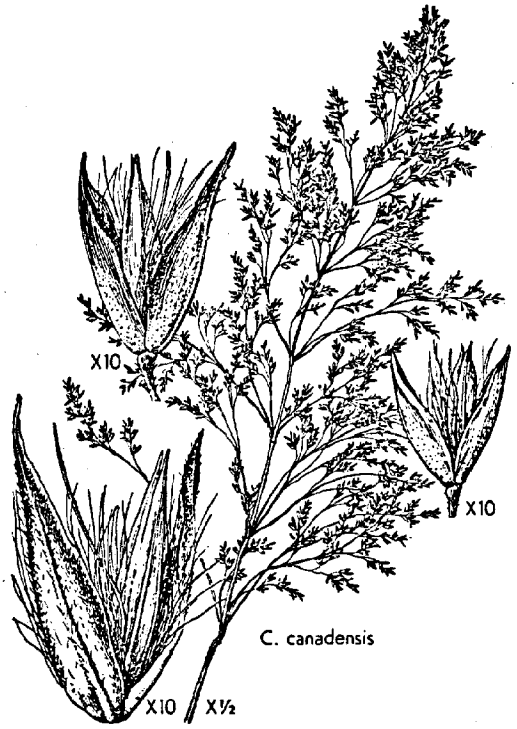

Figure 24. Blue-joint grass, Calamagrostis canadensis

Damman (1980, Table 1), with lists of species, shows the major floristic differences in eastern North America among dwarf shrub, lawn, and mud bottom communities of the raised portions of the ombrotrophic peatlands:

Species essentially restricted to dwarf shrub communities

Sphagnum fuscum	Gaylussacia baccata
Kalmia angustifolia	Rubus chamaemorus
Vaccinium angustifolium	Sphagnum imbricatum
Empetrum nigrum	Polytrichum strictum
Dicranum bergeri	Cladonia arbuscula
Cladonia alpestris	

Species essentially restricted to lawn communities

Scirpus cespitosus	Odontoschisma sphagni
Sphagnum rubellum	Gaylussacia dumosa
Carex oligosperma	Arethusa bulbosa
Cladonia terrae-novae	

Species essentially restricted to mud bottom communities

Utricularia cornuta	Cladopodiella fluitans
Drosera intermedia	Sphagnum cuspidatum

Species of both lawn and mud bottom communities

Eriophorum virginicum	Sphagnum tenellum
Rhynchospora alba	

Species of both dwarf shrub and lawn communities, with sporadic occurrence in mud bottom communities

Chamaedaphne calyculata	Vaccinium oxycoccos
Eriophorum spissum	Sphagnum rubellum
Cephalozia connivens	Kalmia polifolia
Drosera rotundifolia	Ledum groenlandicum
Sphagnum magellanicum	Microlepidozia setacea
Sarracenia purpurea	Andromeda glaucophylla
Aronia floribunda	Mylia anomala
Pohlia nutans	

Additional species are listed by Damman (1977), Thompson (1979), Worley (1980b), and Osvald (1955, 1970) for a total in excess of 100 species that are reported to grow on ombrogenic peatlands in the Coastal Region.

Rare or Restricted Flora

Unlike the coastal peatlands of British Columbia and Alaska, which have abundant rare, restricted, endemic and highly disjunct vascular and crytogamic species (Schofield 1969a; Worley 1972, 1974, 1980c; Streveler et al. 1974), the coastal peatlands of Maine are exceptionally barren of biogeographically interesting species, a phenomenon noted by Fernald and Wiegand (1910) who described the region as "the sterile coastal region of eastern Maine."

The most prominent such species are black crowberry (*Empetrum nigrum* sensu lato), baked-apple berry (*Rubus chamaemorus*), and *Scirpus cespitosus*. In Maine the first two are abundant along the eastern coast and locally abundant on some mountains. Black crowberry also grows on some hummocks of a few large inland raised peatlands. *Scirpus cespitosus* grows only very locally on ombrotrophic peats in the inland, whereas it is common and abundant throughout most of the state in various minerotrophic settings.

A moderate search of bryophyte literature, concentrating on the liverworts among which are many of the most interesting disjunctions of peatland plants (Worley 1972, 1980c), failed to produce any non-Sphagnaceous species of the coastal peatlands whose distributions were noteworthy. No such species were located at any of the sites, at least 15 minutes of each visitation being spent looking at bryophytes (mostly in the most ombrotrophic locations, and in and adjacent to ponds, wet depressions, and relatively wet areas).

Damman (1977) comments on four *Sphagnum* species that are far more abundant in the Coastal Region than inland: *S. flavicomans*, *S. tenellum*, *S.*

imbricatum, and S. pulchrum.

Among vascular plants Damman (1977) notes that three species, sweet gale (Myrica gale), bayberry (M. pensylvanica), and common juniper (Juniperus communis) are "restricted to mineral soils and minerotrophic bog borders" in Maine, but "in the immediate vicinity of the coast they can be found also on ombrotrophic peat." I agree except that I have never seen the common juniper on a "minerotrophic bog border." Records compiled in this study list common juniper at only seven peatlands, all in the most maritime parts of the study area, very near open ocean:

Big Heath, Acadia National Park
Great Cranberry Island Heath
Corea Heath
Central Peatlands, Great Wass Island
Southwest Peatland, Great Wass Island
Boot Cove Heath
Carrying Place Cove Bog

Five vascular plant species listed by Eastman (1978) as rare in Maine grow in peatlands of the Coastal Region. Baked-apple berry is discussed below, as is Empetrum atropurpureum. Only 28 citations are given for the entire state for swamp-pink (Arethusa bulbosa). There must be at least 2-3 times that many peatlands in the Coastal Region with this species. My visitations generally were after flowering times for this orchid, so no notations were kept. Orchids, incidentally, appeared to be locally abundant in all coastal raised peatlands.

Also listed by Eastman is Geocaulon lividum; 11 collections are noted, 9 from interior mountains, 1 from "peat bog, Roque Bluffs," and one from "heath at base of West Quoddy Head, Lubec" (the last two citations based upon Fernald and Wiegand (1910). Stern (1979) has found G. lividum to be not rare as formerly believed in the Mahoosuc Range of Maine and New Hampshire. Similarly, this species probably grows at many or most coastal raised peatlands. I am unfamiliar with the species, and did not seek it out. The fifth species listed by Eastman, Carex rariflora, is only known in Maine from "Bog, Petit Manan."

Lycopodium annotinum var. pungens was recorded by Fernald and Wiegand (1910) on ombrotrophic peats at Boot Cove Heath and on Great Wass Island; I found plants ascribable to this variety at the North Cutler Heaths.

Skunk cabbage (Symplocarpus foetidus) occurs in several counties of Maine (Hyland, pers. comm.), but is most common along the coast (Eastman, pers. comm.). Most frequently a plant of wet meadows, woods, and thickets, the plants become "sparse or absent" in the Sphagnous areas of peatlands (Hyland, pers. comm.) except on some islands at the eastern limit of its range, including Harbor Island in Muscongus Bay, Isle au Haut, Mount Desert Island, and Great Cranberry Isle (Eastman, pers. comm.), where plants grow among Sphagnum along with swamp-pink, snake-mouth (Pogonia ophioglossoides), and pitcher plant (Sarracenia purpurea). At least at Big Heath on Mount Desert Island, this habitat is ombrotrophic.

Jack pine (Pinus banksiana) is listed by Eastman (1978) from a number of sites scattered throughout the state, none peatlands. It is known in the Coastal Region in abundance on the Central Peatlands of Great Wass Island, sparsely scattered on other Great Wass Island peatlands, rarely on the margins of Corea Heath (Tyler, pers. comm.).

Baked-apple berry (Rubus chamaemorus), according to Eastman (1978) has been collected 15 times within the study area in 8-10 different peatlands that span the Coastal Region from "Bog in direction of West Quoddy Head near sea" to "Great Heath, Great Cranberry Island." A few montane sites are reported by Eastman (1978), Fawey (1976), Marchand (1977), and May and Davis (1978). Some 114 peatlands considered in this study very likely contain this species. At 38 of these sites visited all had the species, often in considerable abundance. The range of the species extends from the small peatland in the center of West Quoddy Head, to Big Heath at the southern tip of Mount Desert Island (where it flowers, but does not fruit). It rarely occurs inland of the Coastal Region. The robustness of baked-apple berry corresponds to shrub canopy (and perhaps jointly to nutrient availability), possibly reflecting insolation requirements. However, even the smallest plants in the most shrub-free, exposed sites may fruit abundantly.

This study made no attempt to distinguish species, subspecies, or varieties of Empetrum. Eastman (1978) accepts Empetrum atropurpureum Fern. & Wieg., noting its occurrence at 11 locations in the state, 5 being in the Coastal Region, including 2-3 peatland sites (Harrington Heath, a heath on Great Wass Island, and a citation for the Jonesport area without habitat indication). Damman (1977) considers Empetrum nigrum sensu lato, and states that it "occurs commonly throughout eastern North America, and is the only Empetrum in the bogs described here." All Empetrum plants encountered in this study are considered Empetrum nigrum sensu lato, following Damman (1977).

Curly grass fern (Schizaea pusilla), whose disjunct North America population (New Jersey Pine Barrens, Nova Scotia, Bruce County, Ontario) is well known but lacks suitable explanation, was sought with diligence but not found.

Aesthetic Flora

The diversity of habitats in peatlands, coupled with the vistas possible by their openness, provide many showy blossoms, spectacular and subtle foliage displays, dwarf forests and natural bonsai trees, and frequent occurrences of the intriguing carnivorous plants.

Foremost in beauty to many people are the intricate flowers of the several species of orchids that inhabit the peatlands. Most common are grass-pink (Calopogon pulchellus, Figure 25) and swamp-pink (Arethusa bulbosa, Figure 26), whose bright reddish-pink flowers in some years are in considerable abundance.

Colorful lilac-purple and golden displays of bog aster (Aster nemoralis) and bog goldenrod (Solidago uliginosa, Figure 27) vary seasonally. Baked-apple berry (Rubus chamaemorus) has a delicate white flower that when in abundance is especially attractive. Water lilies (Nuphar variegatum) are scarce in the Coastal Region, but flower with typical lushness. Wherever they occur, especially in laggs, marginal fens, and in mud bottom communities, bladderworts (Utricularia cornuta) often produce copious, brilliant

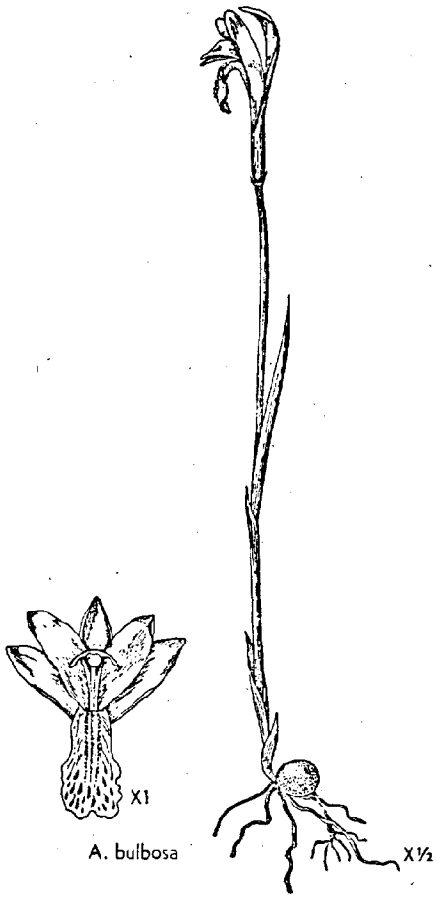

Figure 26. Swamp-pink, Arethusa bulbosa

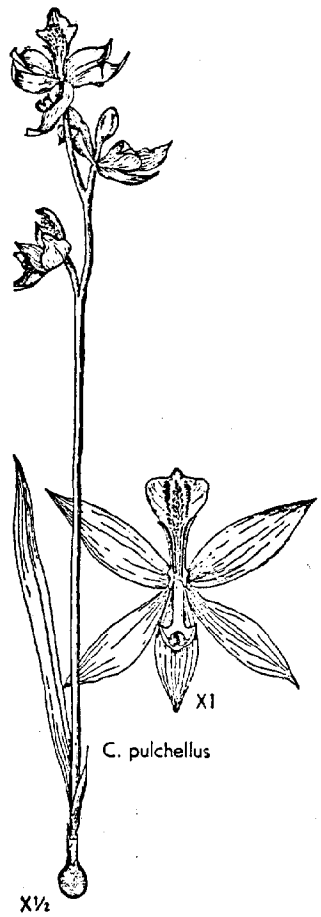

Figure 25. Grass-pink, Calopogon pulchellus

yellow flowers that stand as dwarf meadows of color above shallow water. The large, curiously shaped flowers of the ubiquitous and often abundant pitcher plant (Sarracenia purpurea, Figure 28) nod above the Sphagnum carpets, while the miniature sundews (Drosera intermedia, Figure 29, and D. rotundifolia, Figure 30) flowers must be sought at close inspection.

Most of the shrubs have colorful and fragrant blossoms, whose

Figure 27. Bog goldenrod, Solidago uliginosa

shapes range from the expanded petals of the laurels to the pendant bells of the blueberries. The red-pink laurel flowers (Kalmia angustifolia and K. polifolia) ofttimes color entire peatlands. Rhodora (Rhododendron canadense) blooms before its leaves flush in the spring, and in warm autumns there may be a second flowering. Black chokeberry (Pyrus melanocarpa) flowers appear as white stars amid green and brown leaves and mosses. Less showy at a distance, but with great grace and subtleness of design and color at closer inspection, are the flowers of the blueberries (Vaccinum angustifolium), huckleberries (Gaylussacia dumosa and G. baccata), cranberries (Vaccinium oxycoccos, Figure 31, and V. macrocarpon), black crowberry (Empetrum nigrum), and Labrador tea (Ledum groenlandicum).

The three genera of carnivorous plants have quite different and remarkable entrapment mechanisms. The specialized cone-shaped leaves of the pitcher plant have hairs along the inside that prevent certain insects from departing. Digestion takes place enzymatically in the water solution within the bottom of the leaf. Other insects and spiders use the leaf for protection, including a moth that drains the leaf and sews it shut to form a home for its larvae.

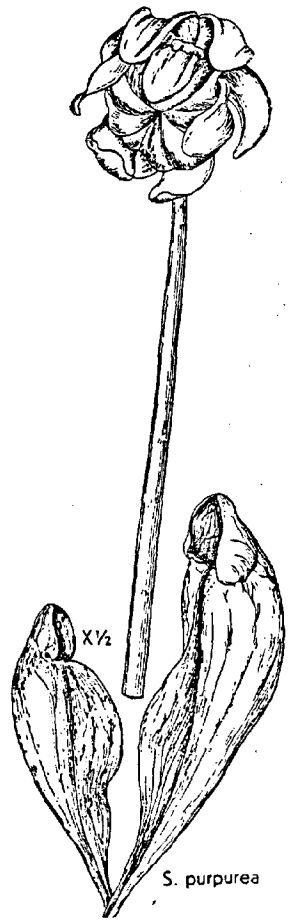

Figure 28. Pitcher plant, Sarracenia purpurea

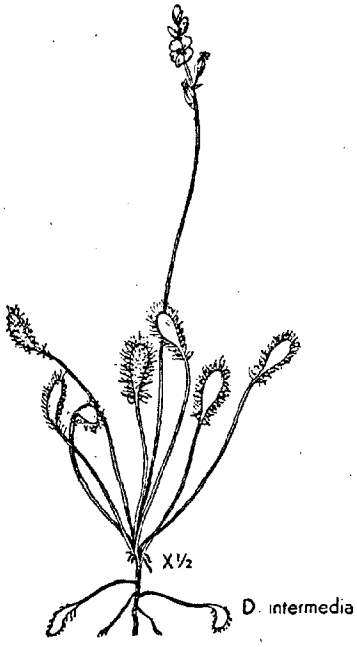

Figure 29. Intermediate-leaved sundew, Drosera intermedia

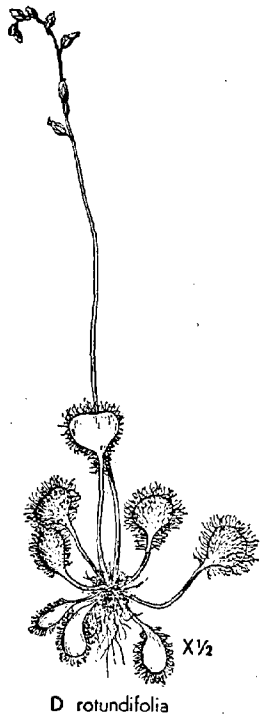

Figure 30. Round-leaved sundew, Drosera rotundifolia

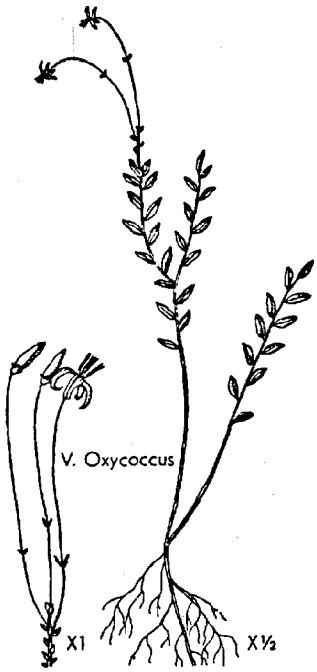

Figure 31. Small cranberry, Vaccinium oxycoccos

The sticky hairs that protrude from the leaves of the sundews not only can snare an insect, but adjacent hairs further constrain the captive, which is digested as it is held tighly to the surface of the leaf. Unlike these passive carnivores, the bladderworts (Utricularia spp.) actively trap their prey in minature buckets.

Summer foliage colors are most attractive close at hand, where the myriad of Sphagnum hues — greens, golds, yellows, reds, purples, and browns — provide backdrop for the green, greenish brown, and sometimes purplish green leaves of shrubs and herbs. Deep red pitcher plants may locally dominate the landscape, while small, reddish entrapment leaves of sundews, with their sticky droplets, glisten at ground's surface.

With the advent of autumn the dwarf shrubs trade greenness for reddish, purplish, and brownish shades. The most striking of all the autumnal foliage, the brilliant scarlets and reds of the huckleberries and blueberries rival any deciduous forest for sheer intensity and depth of coloration. More subtle, but rich in its purplish tint, rhodora highlights many peatland margins.

Many persons enjoy the flowers and fruits of bog sedges and grasses. The star-like cluster of fruits atop beak-rush (Rhynchospora alba) are especially notable. A bane to deer hunters, the arching stalks of blue-joint grass (Calamagrostis canadensis) in marginal fens are especially attractive to those who delight watching waves of wind sway the tall grasses.

The broad, open landscape of peatlands often is accentuated by dwarfed trees, primarily black spruce. At some sites a miniature forest has formed, most of which lies below the height of man. In extremes of nutrient deficiency and maritime climate, dwarfed and stunted trees form natural bonsai. Both dwarf forests and bonsai take on an aura of mysteriousness when enveloped in the frequent fog of their oceanic habitat.

Edible Plants

Peatlands produce several kinds of important and tasty small fruits. The Coastal Region is the only place in the eastern United States where baked-apple berry (Rubus chamaemorus) grows with sufficient abundance to harvest. Considered a delicacy by some (especially in Scandinavia), it is used as a table fruit, in desserts, in preserves, and in the production of cloud-berry (another of its common names) liqueur. Once picked locally with commonness, most baked-apple berries in the Coastal Region now go unpicked. Several local persons talked about how their parents used to pick pailfuls of the berries, but at present there are few actual pickers.

In the earlier parts of this century many of the peatlands were burned periodically to enhance blueberry (Vaccinium angustifolium) production. Commercial and personal blueberry fields on uplands have become so highly developed that most peatland blueberry burning in the Coastal Region has been abandoned, as has the picking of blueberries there.

The cranberries (Vaccinium oxycoccos and V. macrocarpon) were formerly sought much more commonly than now. With the availability of commercial cranberries few persons now put forth the effort required to harvest the scattered berries of the small cranberry (V. oxycoccos) from among the Sphagnum mat, or of the larger cranberry (V. macrocarpon) which is infrequently, but sometimes locally abundant in wetter places at peatland margins.

A few persons seek out black crowberry (Empetrum nigrum) for preserves or desserts. Locally large quantities can be hand picked on many of the most coastal peatlands.

The fragrant leaves of Labrador tea (Ledum groenlandicum) are har-

vested occasionally for local use, or to be commercially packaged for sale in herbal or health food markets.

Foraging classes from the University of Maine have learned edible plants of peatlands during study trips to Great Wass Island.

In former times, as recorded by colonists and later observers, local Indians used nearly every peatland plant for some purpose (Kovacs 1979). For example, Sphagnum served as diapers for babies, the berry crops for food, and the rarer plants for medicinal or spiritual needs. The early colonists used the berry crops for desserts and preserves, and tried nearly every other plant as a remedy for diarrhea and other internal disorders.

Fauna

Site visitations were too brief to assess fauna other than exceedingly casually, and no attempt was made to research faunal constituents.

Some coastal peatlands have numerous deer trails, including transportation trails crossing directly from one boundary to another, and reticulate graze and browse trails in shrublands (Worley 1980a). Deer herbivory appears minor, important only in dense thickets of shrubs 2-5 feet tall.

Other mammal use appears light. No mammals were seen during any of my visitations (all made during daylight); medium and small-sized mammal trails, runways, and dens were scarce, restricted to sparse mouse or vole runways. The small mammal sign approximated that seen in coastal peatlands in southeastern Alaska during years with population lows (Terry 1977).

Birds were not observed to be abundant constituents in summer, except for a resident population of gulls at West Jonesport Heath, and occasional gulls at sites adjacent to shorelines. Gull middens include the remains of clams, sea urchins, and other intertidal organisms. Plant growth (usually hummock tops) is locally enriched by the nitrogen and calcium-rich debris, but is occasionally killed by excessive guano.

At Carrying Place Cove Bog swallows (probably bank swallows) nest in the vertical, sea-cut peat cliff.

Other birds in the open peatlands were very low in density during any of my visits (June, July, and September). Often no birds were heard for long periods. Very occasionally a few smaller passerines (including sparrows) would flit about the dwarf shrub communities. No nests were noted in any open peatland; occasional nests were noted where woody vegetation exceeded 3 feet in height. Where trees were present, bird diversity and frequency increased rapidly with increasing canopy closure. Raptor use appeared limited; occasional hawks hunted in a few of the open peatlands, and at the North Cutler Heath a single hawk defended territory (possibly a nest-

ing site) in the open peatlands. Other than the gulls, no sign or sightings of shorebirds or waterfowl were discovered, except, as can be expected, at the shores of sea-cut sites and at the beaver pond of Larrabee Heath. Some use of the open peatlands by migrating species can be expected. Palm warblers and Lincoln sparrows are known at Big Heath, Mount Desert Island, the former is also known on Great Wass Island.

Invertebrates were not enumerated. Insectivorous plants had ample prey. Ant colonies occasionally inhabit higher hummocks with bog haircap moss (Polytrichum strictum), as they do in Alaska as well (Worley 1977). Spiders were seen in typical abundance. Biting insects are much less numerous than at inland wetlands.

Origin and Deposits

Sufficiently detailed surficial geological information was not available for sites to permit description of relationships between the surficial geomorphology and the ontogeny and maintenance of the peatlands.

Limited basal substrate data by Dachnowski (1929), Dachnowski-Stokes (1930), Osvald (1955, 1970), and Cameron (1975) suggest that the coastal peatlands may have initiated in marshes, shallow lakes, or even outwash flats with high water tables. Initiation likely required standing water or persistent surface water tables, but upon peatland establishment paludification of surrounding terrain became possible.

Of the sites in the Coastal Region sampled by Cameron (1975) the underlying mineral substrate is sand at 30% of the sites, and clay at 80% of the sites. The origins of the sands and clays were not determined.

In nearby New Brunswick coastal peatlands appear to have needed only very small, shallow ponds for their initiation (Korpijaakko and Radforth 1972), whereas the importance of initial water bodies becomes more important at more inland sites. Paludification of mineral terrain then quickly followed in coastal regions as Sphagnum growth in the coastal environment caused the building up and lateral expansion of the raised bogs (Figure 32).

The initiation of these peatlands began shortly after the retreat of the sea following the close of the Pleistocene. Kennedy (1963) determined that peatlands near Belfast and Bangor, also requiring ocean retreat for their beginnings, have basal peats 9648 and 9748 years old as determined by radiocarbon dating. St. Andrews Bog, only a few miles into New Brunswick from the Maine border, at an elevation of about 280 feet above present sea level, has basal peats 7230 years old (Korpijaakko and Radforth 1972).

Peat deposits in the Coastal Region do not occupy deep basins, and are not known to exceed 18 feet in thickness, which includes raised peats that extend above basin limits.

For 10 sites* sampled by Cameron (1975) in the Coastal Region there is no correlation between acreage and either maximum or average depth of peat. The maximum depths range from 8 to 18 feet (mean = 12) and the average depths of peat range from 5-9 feet (mean = 6.1 feet)**. There is a very weak correlation between maximum peat depth and the average peat depth, suggesting the maximum to be twice the average. This correlation may be an artifact of the sampling technique. For sites with "Sphagnum moss peat" the maximum thickness ranges from 8 to 18 feet, with a mean of 10.3 feet; these sites have maximum peat depths ranging from 8-18 feet as well, with a mean maximum peat depth of 12 feet. The tertiary peats account for an average of 81% of the maximum depths. Thus, one may generalize for the region then, that tertiary peatlands generally have raised their local landscapes and water table 10 feet or more.

Data allowing a determination of lateral expansion beyond the basin in which the peatland initiated are almost lacking. Illustrations by Damman (1977) and Osvald (1955) indicate such expansion in cross-sectional diagrams, but complete basins are not figured. Osvald (1955) shows the ability of the tertiary peats to laterally ascend upland (Figure 32, South Trescott Heath), in this case extending nearly 800 feet ENE of the initiating basin, to an elevation some 9.2 feet above the original water level of the pond.

Osvald's (1955) profiles of the South Trescott Heath and the Carrying Place Cove Bog show a developmental sequence of shallow pond or marsh (cf. Dachnowski 1929), then sedge-Sphagnum fen in the primary basin and producing secondary peats. Both sites were at least partly wooded thereafter, a "swampy wood" at South Trescott, and trees atop Sphagnum fuscum bog at Carrying Place Cove Bog. Since that time tertiary peats have elevated the growing surfaces as much as 15 feet.

Where peats are thickest at the 10 peatlands sampled by Cameron (1975), four have "Sphagnum Moss Peat" from the surface to the base, three have "Peat" from the surface to the base, and three have Sphagnum Moss Peat overlying Peat, the former usually more than half the profile. Commonly the maximum depth recorded is very nearly the depth of tertiary peats. Thus, the illustrations of Osvald (1955) may apply generally in the Coastal Region,

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* Not included are several of the largest sites, notably the Jonesport Heath which is excluded by the U.S.G.S. policy of not providing data on active mines or their reserves.

** Maximum depths of peat at South Trescott Heath are 15 feet (Osvald 1955, Cameron 1975). Based upon Osvald's work the average depth is 10.7 feet, Bastin and Davis (1909) reported 6 holes with an average depth of 10.1 feet, whereas Cameron (1975) gives an average depth of 5 feet.

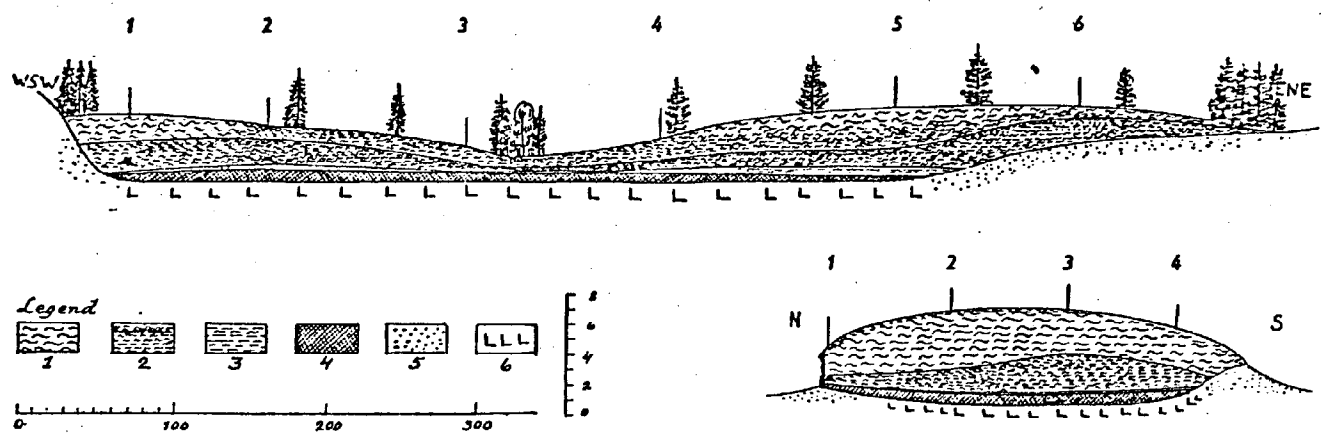

Fig. 1. Transect profiles through South Trescott Bog from the south-western margin to the north-eastern (above) and through Carrying Place Cove Bog (below to the right). In both profiles the points where the soundings were made are indicated by vertical lines. The points are numbered from the left-hand side.

Legend: 1 — *Sphagnum* peat, slightly decomposed; 2 — *Sphagnum* peat, well decomposed, and wood-*Sphagnum* peat with layers of charcoal and ash; 3 — sedge peat and *Sphagnum*-sedge peat; 4 — fine-detritus and coarse-detritus gyttja; 5 — sand; 6 — clay. Height to length scale 10 : 1.

Figure 32. Cross-sections of South Trescott Heath and Carrying Place Cove Bog. Reproduced from Osvald (1955).

the peatlands originating in shallow depressions without deep water. Presumably, the conversion from shallow water or wetland to peatland was relatively rapid, with tertiary peat deposition having begun shortly thereafter. Dating by radiocarbon, subfossils, or other means is necessary to determine the actual historical sequence.

Maximum depths of peat at Carrying Place Cove Bog range from 17 to 20.5 feet (Osvald 1955, Cameron 1975). Upper layers of the bog are Peat according to Cameron's classification and are little decomposed, having von Post* values of 1-4 (Osvald 1955). Lower layers are more decomposed with von Post values of 6-10 (Osvald 1955). At South Trescott Heath, the Sphagnum Moss Peat (Cameron 1975) in the upper seven feet has von Post values of 2-4 and 5-8 (Osvald 1955), whereas the lower Peats (Cameron 1975) are well decomposed, with von Post values of 6-10 (Osvald 1955). A few additional peat characteristics for these and a few other sites are provided by Cameron (1975) and Bastin and Davis (1909).

The vigorous plant growth of dwarf shrub heath communities (as evidenced by a lack of bare peat and abundant lichens, and by closely spaced, relatively tall shrubs and/or a nearly complete Sphagnum ground cover) on some of the sites with the deepest peats (e.g., Larrabee, West Jonesport, and South Trescott Heaths) as well as many of the less deep sites suggests active deposition of tertiary peats and a continuing increase in peatland height.

Undisturbed sites with clearly defined central areas with Scirpus lawn communities (notably the Jonesport Heath, Jonesport Heath North Unit, Kelley Point Peatland Complex, and Carrying Place Cove Bog) may be at an equilibrium (Osvald 1955, Damman 1977) with the losses of organic materials equal to biomass production, at least in the lawn regions — lateral expansion of the peatlands continues.

Pollen and other materials within the peat deposits have not been studied for peatlands of the Coastal Region; however, Korpijaakko and Radforth (1972, Figure 6) correlate pollen zones from southern Connecticut (M. B. Davis 1969), northeastern United States (Deevey and Flint 1957), St. Lawrence Lowlands (Potzger and Courtemance 1953, 1956; Terasmae 1960), Nova Scotia (Livingstone 1968), and southern Finland (Donner 1969) with their own work from New Brunswick. There is considerable agreement, with principal changes in pollen composition roughly 9900, 9400, 8500, 7700, 6800, 5000, and 2300 years ago. Presumably most of the pollen changes indicate ecological responses to climatic shifts. Thus, one would expect peatland character to have changed as well, although this is little documented in the Coastal Region (c.f. Osvald 1955, Dachnowski-Stokes 1930, and Korpijaakko and Radforth 1972).

The Potzger and Friesner (1948) palynological studies at six peatlands from northern Mount Desert Island to west of Rockport just outside of the Coastal Region yielded similar results.

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* See Glossary

Ecology

Hydrologic Effects

In eastern North American ombrotrophic peatlands, hydrology determines the relative abundance of the three major structural and floristic vegetation units (Figure 33) according to Damman (1980):

a) mud bottom and soft carpet communities in hollows
b) dwarf shrub heath dominated hummocks, and
c) lawn and solid carpet communities that occupy an intermediate position.

A fourth unit, forest communities on ombrotrophic peatlands, is not discussed by Damman.

The major hydrologic factors are (Damman 1977, 1980):

a) the prevailing water level during the growing season,
b) the summer low water level, and
c) the ice buildup and spring high water level of the frozen peatland.

Damman (1977, 1980) has determined that the upper levels of the mud bottom communities are about 1½ in. above prevailing summer water tables. Lawn communities have a lower limit below the summer high water levels and an upper limit at the maximum spring water level. The dwarf shrub communities are above the maximum spring water level, or ice level, and in inland regions where water tables are lower two levels of dwarf shrub communities can be distinguished. Since at more inland sites the minimum summer water levels are often two feet below the surface, ericaceous dwarf shrub communities predominate But in humid regions, such as the flat surface of coastal plateau peatlands, lawn and mud bottom communities predominate.

In addition to these effects of hydrology upon the ombrotrophic vegetation units, water plays a major role as the conveyor of nutrients; thus, major vegetation changes are attributable to the seasonal extent and height of mineral ground water and to its relative abundance of various nutrients (Damman 1979a, Moore and Bellamy 1975, DuRietz 1949). The resultant marginal communities, laggs, fens, and drainage ways are discussed elsewhere in this report.

Climatic Effects

Damman (1979b), in speaking of peatlands in general, and ombrotrophic peatlands in particular, notes that:

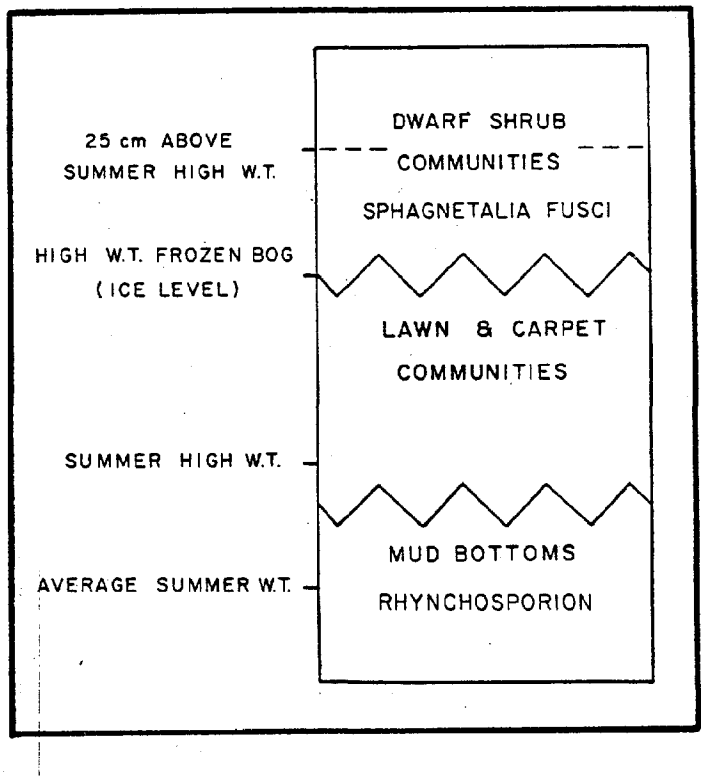

Figure 33. Relation between major physiognomic vegetation units of the ombrotrophic bog plain and water table positions. A relative water level scale is used because the actual difference between water level positions depends on climate. Illustration and caption from Damman (1980, Figure 1).

> "Peatland development is controlled by climate, nutrient supply, and topography (von Post and Granlund 1926). The importance of topography and nutrient supply decreases as a peatland develops, and therefore regional differences in peatland properties reflect to a large extent changes in climatic conditions."

The principal climatic agents (Thompson 1979, Johnson 1977, Damman 1977, 1979b) responsible for the topography and vegetation of the Coastal Region peatlands are the low evapotranspiration in conjunction with cool temperatures during the growing season, high fog frequency, high precipitation, intermittent winter snow cover, and the higher mineral content in precipitation near the sea.

Low evapotranspiration with an abundant atmospheric water source (Damman 1977 notes that there should not be "an average annual water deficiency based upon 10 cm storage") permits the formation of raised bogs. The lack of drought, the frequency of fog, and cool temperatures in the growing season (which restricts evapotranspiration, shortens the growing season, and slows growth) contribute to the persistent high water tables throughout the raised peatlands, and "as limiting factors, all of these would affect peat growth equally throughout the bog and thus could account for the flat bog surface" (Damman 1977).

The lack of dwarf shrub heath dominated communities in the central regions of the larger, least protected peatlands appears to be a result, at least in large part, of the intermittent and erratic snow cover. Most of the evergreen dwarf shrubs are subject to winter injury where there are cold winters with little or erratic snow cover. Thus, (Damman 1979a) the procumbent black crowberry (*Empetrum nigrum*) benefits from the reduced competition of ericaceous dwarf shrubs, and a dense, uniform moss carpet of *Sphagnum fuscum*, sometimes with *S. flavicomans* and *S. imbricatum* develops, or, in wetter or disturbed sites *Scirpus cespitosus* lawns, often with *S. fuscum* or *S. rubellum*, dominate.

Moreover, the thin, sporadic snow cover allows frost to form deeply, and to persist in hummocks until late May, or even as late as early July in the northeasternmost portions of the Coastal Region. Thus, in spite of the milder winters than at inland sites (in terms of depth of snow and extremes of low temperatures) the centers of the large coastal peatlands have harsh growing conditions, both above and below the ground surface.

Climatic effects upon individual species vary. The coastal distribution of black crowberry and baked-apple berry (*Rubus chamaemorus*) seems related to cool summer temperatures; dwarf huckleberry (*Gaylussacia dumosa*) appears favored by longer vegetative season, and the distribution of *Scirpus cespitosus* and bog goldenrod (*Solidago uliginosa*) may reflect the availability of nutrients in the ocean derived precipitation.

Peatland Variation

Within the Coastal Region of Maine, only a very few sites completely fulfill the description presented by Damman (1977), which is based upon the Jonesport Heath. Since, as noted previously, within a given regional climatic zone the fullest expression of a peatland type occurs in the largest peatlands in the region, it is correct to choose the Jonesport Heath to typify the Coastal Plateau Peatland type, and then to discuss variation of the type as it is expressed by smaller peatlands as one reaches and leaves the borders of the climatic zone.

Variation due to decreasing peatland size within the climatic zone: The three northernmost plateaus of the Jonesport Heath, especially the "north unit" (about 128 acres) and the "largest unit" (about 156 acres), most fully display the characteristics of the Coastal Plateau Peatland type; the "largest unit" serves as Damman's typifying example. In the United States only Kelley Point Peatland Complex and Carrying Place Cove Bog also fulfill the typical Coastal Plateau Bog type in morphology, structure of the plant communities, and community zonation. The plateau of the Kelley Point Peatland Complex is about 70 acres, with the principal variation from the Jonesport Heath being in the decreased acreage of the communities. The plateau of Carrying Place Cove Bog (about 22 acres) was formerly considerably larger, perhaps many times as large (Osvald 1955, Dachnowski-Stokes 1930). The accentuated drainage caused by the marine erosion to the north may have altered the proportion of community types. The principal variation from the Jonesport Heath is that the *Scirpus* lawns occupy a considerably larger proportion of the existing plateau and are less obviously central (the center of the original plateau is not possible to determine because of the erosion from the north and the burying by beach deposits from the south.

The Corea Heath (170+ acres of plateau) and Kelley Heath (100+ acres of plateau) may have displayed typical Coastal Plateau Bog characteristics, but human disturbance has changed the vegetation pattern.

Smaller peatlands seem to follow three trends. At the North Cutler Heaths there is a large *Scirpus* lawn phenomenon centrally located, but the plateau morphology and the subsequent control of community location by morphology is not nearly as distinct as at the Jonesport Heath. In fact, it appears that the *Scirpus* lawn and *Empetrum nigrum* - *Sphagnum fuscum* communities are rather blended into a single community (or mosaic) occupying the entire central region of the largest open area of the site (30+ acres). This feature occurs less prominently at other sites, all equally near or nearer to the sea, such as Boot Cove Heath (20 acres or less) and part of the Southwest Heath of Great Wass Island (10-20 acres with this feature).

A second trend can be found at peatlands somewhat nearer to the sea than the Jonesport Heath, wherein *Scirpus*-dominated communities occur not centrally upon a plateau, but are along the upper margins of the peatland. This is best expressed at the westernmost of the three peatlands forming the "Central Peatlands" of Great Wass Island, and at Great Cranberry Island Heath.

The third trend with decreasing size is the progressive absence of the coastal communities. South Trescott Heath, especially the eastern plateau (about 50 acres), exhibits typical morphology, plant communities, and plant community zonation except there are no Scirpus lawns. West Jonesport Heath (about 60 acres) and Moose River Heath (30-40 acres) have no Scirpus lawns, and limited development of the Empetrum nigrum - Sphagnum fuscum community, which is restricted to near the upper elevations of these offset plateaus. Finally, at many of the smaller and smallest peatlands in the region (such as West Quoddy Head Heath, and the peatlands 0 5 miles east of Little Machias, on the west side of the road 0.8 miles north of Roque Bluffs, and between Youngs Point and Corea Harbor), there are no Scirpus lawns, and the Empetrum nigrum - Sphagnum fuscum development is scattered, sometimes more-or-less centrally located, but usually as individual hummocks rather than discrete zones.

Factors contributing to tree (mostly black spruce and tamarack, rarely jack pine) growth on the raised peatlands of the Coastal Region are essentially unknown, although Damman (1977) discusses nutrient availability, water relations, and fire as possible controlling factors. In general, the larger the coastal peatland, the fewer the trees, except at the margins. However, a few smaller sites are devoid of trees (an outstanding example is the wee peatland 0.3 mile north of Black Duck Cove on the east side of the road, Great Wass Island). With increasing distance from the peatland margin tree heights decrease rapidly (at some sites the central spruce are less than 3 feet tall), the proportion of spruce to tamarack increases rapidly (tamarack is commonly absent in the central areas), there is much more layering of spruce, tree densities decrease rapidly, and spruce become progressively more yellowed. Presumably growth rates decrease as well.

Investigations of sites such as Kelley Point Peatland Complex, which has a considerable variety of treed and treeless terrain, or at the several peatlands near Roque Bluffs (open peatland west side of road 0.8 mile north of Roque Bluffs, lightly treed Great Cove Heath, moderately treed peatland north of road 0.4 mile east of the mouth of Englishman River, and treed peatland south of road 0.2 mile north of Mack Cove) should provide significant insight.

Variation due to increased maritime effect: A feature of the most maritime sites, one quite apparent from the air, is the tendency for the peatland boundaries often to be indefinite (such as at the three peatlands west of Starboard Island Bar on the Point of Main, the peatlands north of Little Pond Head and The Pond on the southern tip of Great Wass Island, and the three small peatlands 0.5 mile southwest of Stanley Cove on Dyer Point).

At some sites with considerable maritime influence (such as the Southwest Peatland of Great Wass Island, Boot Cove Heath, the small peatland between Corea Harbor and Youngs Point, and Big Heath on Mount Desert Island), the Empetrum nigrum - Sphagnum fuscum community in places has an abundant and quite showy lichen component. This phenomenon resembles the Usnea (old man's beard) and Alectoria lichen draped white spruce (Picea glauca) forests also found adjacent to the sea, and reflects the considerable fog and mist of that habitat. Physiognomically similar Sphagnum fuscum - lichen commun-

ities also occur in the most maritime peatlands of southeastern Alaska. Many of these maritime peatlands also have scattered plants of Scirpus cespitosus in Sphagnum fuscum communities, a feature not known from less exposed sites.

Variation due to increasing inland effect: A considerable variety of changes occur in peatlands with increased distance from the coast. Changes in the Coastal Plateau Peatland type first can be recognized by the absence of Scirpus cespitosus in the central portions of the peatlands, then the diminished abundance of baked-apple berry (Rubus chamaemorus) and black crowberry (Empetrum nigrum). Sphagnum fuscum seldom forms the hollowless, continuous hummock topography sometimes prominent closer to the sea. Examples of inland raised peatlands nearby the Coastal Region are Runaway Pond Heath, the heath 0.5 mile southwest of Keniston Mountain, Whiting, and the peatland 0.3 mile north of Route 1 at the west edge of the Machias 7½' quadrangle (67°30' W Long.) in Whitneyville.

Damman (1977) identifies additional differences between Coastal Plateau Peatlands and nearby inland domed raised peatlands (such as Meddybemps Heath). There are no similar studies contrasting coastal and inland plateau peatlands, but the many smaller peatlands north of Cutler and in Addison would provide ample variation for study. Comparison of coastal peatlands with peatlands of central and northern Maine are lacking (Worley 1980a).

Variation due to increasing ground water input: Based upon casual observations by me, low elevation plateaus and peatlands that continuously or periodically receive runoff from adjacent uplands, stream flooding, or upwelling ground water seldom have Sphagnum fuscum, black crowberry, baked-apple berry, their communities, or elevated regions with Scirpus cespitosus. In some instances (such as the peatlands at the junction of Bagley Brook and East Stream in Cutler, 0.5 mile northeast of Enoch Hill in Whiting, and along Big Pond Stream on Petit Manan Point), the peatlands are low shrub dominated with sheep laurel (Kalmia angustifolia) and leather-leaf (Chamaedaphne calyculata) the most common shrubs, with rhodora (Rhododendron canadense) abundant to dominant in the more nutrient-rich sites. In other instances, for example the two eastern peatlands of the Central Peatlands of Great Wass Island, a variety of graminoid fen communities prevail (Thompson 1979).

Physiography and Morphology

"Offset" Plateaus and Plateau "Bays"

All of the plateau bogs of the Coastal Region have shapes which are limited, in part, by either confining upland, or slopes permitting too rapid drainage for peat deposition. Theoretically, given unlimiting, flat terrain, a plateau raised peatland will be circular in shape. Those which lie at watershed divides, or atop other ground water recharge sites, are the most likely to be circular; hydrologic modification comes about when the peatland occupies a location through which ground water (including surface water) is moving, or from which ground water is leaving preferentially in one or more directions. In these cases, the circular shape is modified, with the height of the peatland closer to the (ground water) upstream side of the peatland (Figure 34). By the same token, there is less peat accumulation and longer peatland slopes to the downstream side of the peatland. West Jonesport Heath clearly displays this "offset" plateau feature.

No peatlands in Maine have essentially flat and unconfining topography, such as occurs in northern Minnesota. Consequently, even those little affected by ground water flow have topographic constraints. For example, the shape of Carrying Place Cove Bog is now severely controlled by coastal geomorphic dynamics. The large plateaus of the Jonesport Heath (including the North Unit) are constrained by topography and stream flow.

Within the Coastal Region, only a few, large, more-or-less circular plateaus exist, including Corea Heath, Kelley Heath, South Trescott Heath (the eastern plateau), and the disturbed Harrington Heath near Harrington. Outside the Coastal Region there are occasional circular raised peatlands as well.

The obviously raised, circular plateaus have broad upper sufraces that appear very slightly convex (rather than flat or concave) and extend 1/2 to 3/4 or more of the way to the peatland margin. Near the margin slopes become more pronounced, being especially steep (so much so as to affect one's walking pace) near the peatland edge.

Along "downstream" margins of some plateaus, the peatland may be sharply highlighted by a semi-continuous row or zone of trees at the base of the steepest slope. Not uncommonly, beyond the row of trees there may be additional peatlands, at the elevation of the base of the plateau slope, often roughly semi-circular in shape, that form "bays" of open peatlands appended to the circular plateau (Figure 34). With typical communities these "bays" form a partially encircling fringe along the plateau. Excellent examples can be seen at Corea Heath, Kelley Heath, and Marst Heath. In places the plateaus appear to be actively expanding into the bays.

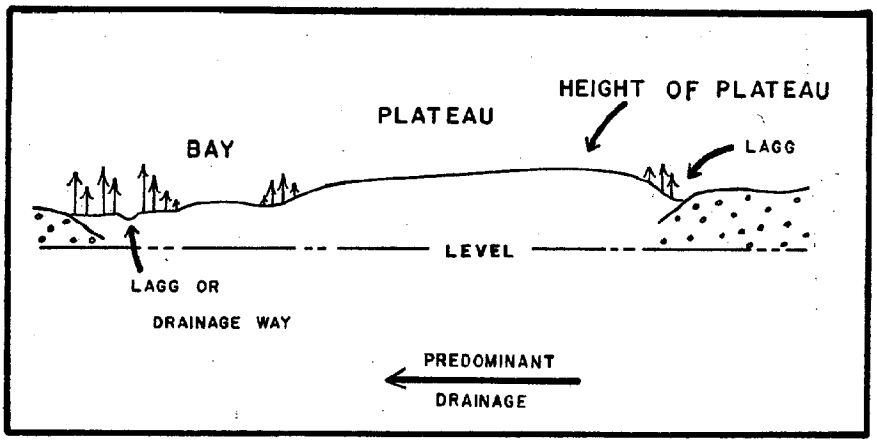

Figure 34. Idealized cross-section through a coastal raised peatland with "offset" height, bay, and prominent laggs. Considerable vertical accentuation is depicted to enhance the features.

Concentric Zonation and Pattern

Concentric zonation of major communities is one of the chief features of the Coastal Plateau Peatlands (Damman 1977), but concentric (or sub-concentric) patterning of communities and topography within the zones occurs at but three sites, Corea Heath, Kelley Heath, and Carrying Place Cove Bog. The center of concentricity is the highest elevation of the plateau; thus, both zonations and patternings are actually eccentric in most cases, for most plateaus are "offset" or imperfect circles at best. North Unit of the Jonesport Heath is an excellent example of strongly zoned communities, with the zonation parallel to the plateau margins and centered upon the height of the plateau, but with the actual shape of zones conforming to the arcuate shape of the plateau.

Concentric patterning of ridges and hollows frequently is striking at inland peatlands, and variation in the character of the patterning permits the definition of several peatland types (Worley 1980a). The concentric patterning at the three Coastal Region sites occurs on the upper plateau slopes or the upper shoulders, and is clearly related to downslope water movement. Vegetation differences highlight the ridges and hollows, whose long axes align with the peatland contours. At all three peatlands, Scirpus cespitosus communities prominently define the pattern, as they alternate with various dwarf shrub and mud bottom communities.

Because of the truncation of the Carrying Place Cove Bog plateau, its patterned area (which includes distinctive pond systems) is prominent only on the eastern and western upper shoulders. At both Corea Heath and Kelley Heath patterning appears primarily in the southern half of the plateaus (south is more-or-less "downstream" for both peatlands). At all three sites the highest elevation is highlighted by the patterning.

Throughout the Coastal Region plant community zonation and peatland topography vary significantly between peatland margins that abut upland, and those drained by streams or the sea. Larrabee Heath, the Jonesport Heath North Unit, and the plateau of the Kelley Point Peatland Complex provide excellent examples. Slopes tend to be longer and steeper to drained margins with broad community zonation, commonly a sequence of dwarf shrub heaths to rhodora (Rhododenron canadense) and/or sweet gale (Myrica gale) thickets to blue-joint grass (Calamagrostis canadensis) and sedge fens or meadows. Portions of laggs that carry little or no water are narrow, little lower than the raised peatland, and commonly grade from dwarf shrub heaths through narrow zones of taller shrubs, then to trees, then to the upland.

Laggs, Water Tracks, and Drainage Ways

The lagg, or margin of a peatland where directly affected by upland ground water or stream flow, characteristically has marked species zonation caused by the influx of less acid, more nutrient-rich water. Some laggs are no more than a few feet wide, and may be forested (as along the west margin of West Jonesport Heath), shrubby (for example, the south laggs of Carrying Place Cove Bog and Moose River Heaths), open with Sphagnum spp. and dwarf shrub heaths (minor portions of the western margin of the Kelley Point plateau, and a few locations where peatland abuts rock outcrops on Great Wass Island), or wet with mixed graminoids, broadleaf herbs and ferns (as at numerous sites).

The most distinctive laggs are sedge and grass fens. Scirpus cespitosus, beak-rush (Rhynchospora alba), cotton-grasses (Eriophorum spp.), and sedges (Carex spp.) dominate marginal laggs up to several tens of feet wide at many sites (for example, Kelley Point Peatland Complex, the Southwest Peatland of Great Wass Island, Head Harbor Island Heath, and Great Cranberry Island Heath). Commonly these laggs have mud bottom communities, wet depressions, and even miniature ponds. These wetter features may be somewhat patterned, as the "string of beads" pattern at Southwest Peatland, Great Wass Island.

Some of the largest treeless laggs (such as those at Jonesport Heath) have persistent, often meandering streams that are bordered by tall sedge and grass (especially blue-joint grass, Calamagrostis canadensis) communities.

Most smaller peatlands (for example, Great Cove Heath and Boot Cove Heath) have forested laggs of varying width, as do parts of larger peatlands (including Kelley Point Peatland Complex, Harrington Heath, Larrabee Heath and Kelley Heath). The richest parts of these laggs generally support quite vigorous tamarack (Larix laricina) growth, poor laggs have black spruce (Picea mariana). Understory vegetation varies significantly according to richness and wetness, from complete lichen (as at places on Great Wass Island and elsewhere) or bryophyte (as at West Jonesport and Boot Cove Heaths) cover, to fern, sedge, grass or mixed broadleaf. Some forested laggs have moats seasonally with standing water; duckweed (Lemna sp.) and several algal species bloom in late spring and summer.

The extent of ground water influence into ombrogenic peats can be traced by indicator plants such as three-leaved false Solomon's seal (Smilacina trifolia), by community composition such as those dominated by rhodora (Rhododendron canadense) or sweet gale (Myrica gale), or by plant vigor (rhodora is much shorter, black spruce are commonly dwarfed and yellowed, and tamarack often are short-lived on ombrotrophic peats).

Water tracks, the passage of minerotrophic water through an ombrogenic peatland, are uncommon and minor in the Coastal Region. Most prominent from the air, water tracks are recognizable by the presence of minerotrophic spe-

cies such as bog rosemary (Andromeda glaucophylla), rhodora, and various sedges. A few of the most open, smaller peatlands in Cutler and Addison have barely perceptible water tracks tailing away from upland outcrops in the peatland. Similar water tracks are common at many inland peatlands in Maine. Crossing South Trescott Heath and the middle of the Central Peatlands of Great Wass Island are minerotrophic features perhaps water tracks. Osvald (1955) describes the former, Thompson (1979) comments upon the latter.

Drainage ways lead from many ombrotrophic peatlands. When peatland themselves, they closely resemble the variety of laggs described above. The Kelley Point Peatland Complex has the greatest variety of lagg and drainage way types of any peatland in the Coastal Region.

Sloping Peats

Unlike most of southern Maine and the remainder of New England, where peatland surfaces are essentially level, sloping peatland is common in the Coastal Region. Raised peatlands have surfaces that slope away from central, high regions, usually becoming most steep at the margins. Some peatlands (such as the Southwest Peatland at Great Wass Island) slope from one margin to the other, and others follow sloping basins (e.g., West Quoddy Head Heath). Slopes can be especially pronounced toward truncations such as the sea cuts of West Jonesport and Carrying Place Cove Heaths. Noticeable slopes occur where more nutrient rich waters flow, as in water tracks, soaks, marginal fens and laggs, and drainage ways.

Tidewater Erosion of Peatland

Three peatlands recommended as potential Critical Areas have erosion of peat by tidewater. The exposures are significant in documenting post-Pleistocene land/sea relationships, the developmental sequence of raised peatlands, climatic change, biotic responses to climatic change, habitat requirements for rare and unusual species, the dynamics of the surface of peatland, and many similar phenomena.

The enhanced drainage of peatland adjacent to the erosion provides an exceptionally significant analogy with certain drainage practices employed in peat mining. Since the natural drainage has existed for many decades or more, some long-term effects can be determined at these sites.

Carrying Place Cove Bog has erosion exposing the entire cross section of a plateau and is by far the most important natural exposure. The vertical cliff of peat and underlying sediments have been reported by several researchers, notably Dachnowski-Stokes (1930) and Osvald (1955), but its immensely rich scientific potential is virtually untapped. It will be visited by a field trip of the Sixth International Peat Congress in August, 1980.

At Kelley Point Peatland Complex a small erosion face is maintained at a minor lagoon some distance from the plateau. The low height of the scarp and the generally level, adjacent peats limit the extent of enhanced drainage and vegetation changes.

West Jonesport Heath has a vertical erosion escarpment (with some slumping) one to three feet in height along the southern edge of the plateau. The entire southern end of the plateau slopes and drains to a tidal creek. The effectiveness of the enhanced drainage in establishing a sloping peatland topography is obvious. The peats may even extend beneath the intertidal or subtidal zones; possibly there exist relict peats south of the creek, peats once (or still) contiguous with the plateau.

Visible from Route 187 some 2½ miles northeast of Jonesport at Chandler Bay is a small, marine eroded peatland. Dachnowski-Stokes (1930) notes its natural exposure has a fine display of underlying mineral soil which includes "glei" and "Ortstein" features.

Exposed in a three feet high erosion scarp on the shore of Little Machias Bay just south of the North Cutler Heaths is a narrow band of peat between clay above and peaty clay below. At least 17 layers are readily discernable in the 15 inch thick peat, which is poorly decomposed and contains (based upon a very brief microscopic inspection) the remains of freshwater wetland vegetation.

Raised peatlands occur at northern latitudes of Atlantic and Pacific coastal North America, but I know of no West Coast peatlands being eroded by the sea (neither did Rigg in 1940). Hunter et al. (1975) provide photographs of marine erosion of peatlands in northeastern New Brunswick.

Disturbance

Human Use and Disturbance

With the exception of a very few sites (less than six percent), the Coastal Region peatlands appear to be in excellent health and essentially natural. Most peatlands with large-scale disturbance retain significant natural qualities, and in some cases are recommended for evaluation as potential Critical Areas.

Four sites are mined: the Jonesport Heath (extensive drainage, vegetation clearing, trenching, and vacuum mining; mining currently active and expanding), the nearby small heath that crosses Route 187 0.5 mile west of Natt Point (former drainage and trench mining), Harrington Heath (former drainage and clearing, limited peat removal), and Kelley Heath (surface vegetation harvested about 1963 for humus, very minor peat removal). At Jonesport Heath there was active agricultural peat mining as early as at least 1943 (Trefethen and Bradford 1944) and presumably before. Briquets were also produced briefly, presumably for burning. The mining of peat for bedding, locally common in southern Maine, was not done in the Coastal Region, to my knowledge. During the First World War, Nichols (1919) in-

spected the raised peatlands of Washington County to determine the quality of Sphagnum peat for surgical dressings. He found it acceptable, but none was ever mined for that purpose.

At least one peatland apparently has been totally destroyed, it being at the southern end of the peninsula now occupied by the transmission towers of the Cutler Navy Base. Military facilities have been built on Corea Heath, and adjacent to it and to Kelley Heath. One peatland (1.9 miles NW of North Cutler) was partially cleared of trees (by hand saw) some 20 years ago during the construction of the Cutler Navy Base. Unlike inland regions, in the Coastal Region peatlands are not used as landfills, although the Jonesport landfill borders West Jonesport Heath.

Roads cross or fringe several peatlands. The Carrying Place Cove Bog plateau is traversed by a road with three small culverts feeding shallow surface ditches. The peatland 0.5 mile west of Natt Point, northeast of Jonesport, is crossed by Route 187. A portion of the Kelley Point Peatland Complex is crossed by a gravel road with at least one culvert. Impeded drainage of peatland because of road or rail fill is minor in the Coastal Region in contrast with the prominent changes at some inland sites.

Vehicle tracks are occasional in the peatlands, seldom showing signs of repeated use. Snowmobile use is occasionally moderate, although little evidence appears to last into the summer, except in laggs where damage can be long-lasting.

Pedestrian traffic is generally light, though trails can be found in most of the peatlands. For the most part the human trails do not follow deer trail patterns, and are clearly distinguishable. The most serious disturbance of peatlands by human trails appears to be on Great Wass Island (Central Peatlands and Southwest Peatland) and at Big Heath on Mt. Desert Island.

Several peatlands have the remnants of barbed wire fences, unrepaired for several to many decades. The effects of grazing are not recognizable. Survey line cuts, old and new, cross some peatlands.

A few peatlands have limited but distinctive scars. A scar of undetermined origin partially crosses the West Jonesport Heath (perhaps it is the "road" reported by a local resident that used to cross the peatland). A short scar at the North Cutler Heaths was made during the construction of the Cutler Navy Base. The Navy decided to use the heath for an aircraft landing strip, and attempted to drive a large bulldozer onto the peatland to clear the site of trees. The bulldozer promptly mired itself up to its exhaust pipe. An episodic comedy of events, much to the delight of local residents, ensued as the Navy attempted to retrieve the heavy machine. With great effort it was finally dragged to firm ground (the airstrip idea was abandoned!).

Carrying Place Cove Bog and Big Heath on Mount Desert Island receive the only regular tourist visitations. Scientific and educational field trips have been held infrequently at many of the peatlands, mostly at those recommended here as potential Critical Areas. This use is increasing, especially following the publications of Cameron (1975) and Damman (1977), and the purchase of southern Great Wass Island by The Nature Conservancy. The release of this report will surely promote visitation of many sites. At present the most visited sites are Carrying Place Cove Bog, which must be crossed by everyone driving to the easternmost point of the United States, Big Heath, which is in Acadia National Park and well known, and the peatlands of Great Wass Island, which have periodically been used by classes of the University of Maine and are now well known through The Nature Conservancy.

In recent years berry picking in peatlands has dropped off considerably, as has the practice of burning the peatland vegetation to enhance blueberry production. Deer hunting is common at or adjacent to many of the peatlands. Some sites may still be burned to benefit deer hunting, primarily to provide succulent new growth and to remove the tall old growth (which obscures the hunter's vision) in blue-joint grass (Calamagrostis canadensis) meadows and fens that commonly fringe peatlands. I saw little evidence of these fires during my visits.

Fire history is mostly undocumented; Bastin and Davis (1909) reported fire at South Trescott Heath prior to 1906, Osvald (1955) reported fire at Carrying Place Cove Bog prior to 1927, the North Cutler Heaths were burned in recent decades (perhaps 20-30 years ago), Damman (1977) noted fire at Larrabee Heath in the early 1970's, and I have seen fire scars at West Jonesport Heath and several inland peatlands adjacent to the Coastal Region. Natural fires have also occurred at South Trescott Heath in times past as Osvald (1955) found charcoal and ash at several depths. Charcoal and ash were absent in my cores of the Shrub Slope peatlands of southern Great Wass Island (Worley 1980b).

Fires that move rapidly through treeless dwarf shrub heaths leave few long-lasting signs, and are difficult to recognize after only a very few years (e.g., I could find no fire sign at Larrabee Heath when I visited the site about 5 years after Damman's visit). Local residents differ in their recollections regarding the frequency of peatland fires; it does seem clear that in general the coastal peatlands have had fewer fires, whether natural or manmade, than inland peatlands, although probably the majority have been burnt at one time or another since colonial times.

Fragility and Recovery from Disturbance

For Coastal Region peatlands neither their susceptibility to, nor their recovery from, various kinds of disturbance has been studied. There are ample

recent situations of trails and treading, vehicular passage, tree cutting, vegetation removal, mining, draining, and fire to provide some idea of selected fragility characteristics, and short-term recovery modes and rates. The effects of activities in adjacent watersheds (such as logging, agriculture, quarrying, road construction and maintenance, and the building of dwellings, armed forces facilities, or other structures), acid rains, aerial application of pesticides, or natural climatic changes are unknown.

Casual observations at Kelley Heath, Harrington Heath and portions of mined heaths near Jonesport indicate that the physical removal of the living vegetation from undrained peats without severe channelization of the peatland surface is followed by a revegetation of the exposed peat within a few years. Peat loss by water erosion appears not great, but oxidative losses might be significant. The recovery vegetation, although composed of species generally present on coastal raised peatlands, is organized in new or modified communities for at least several decades following the scarification.

Near the coast, at undrained sites where the surface topography is little changed (Kelley Heath and Corea Heath), Scirpus cespitosus becomes the most abundant species, and lawn or mud bottom communities may occupy much of the terrain. At the more severely disturbed Jonesport Heath and the nearby peatland 0.5 mile west of Natt Point (crosses Route 187), black crowberry (Empetrum nigrum) and baked-apple berry (Rubus chamaemorus) are active colonizers. Further inland, such as the Harrington Heath, or where the peats have been and are drained, dwarf shrub and Sphagnum spp. communities prevail. On severely drained peats, as at parts of the Jonesport Heath and Harrington Heath, black spruce (Picea mariana), tamarack (Larix laricina), birch (Betula spp.), and occasionally speckled alder (Alnus rugosa) seed, germinate, and grow quickly.

Where deep drainage ditches have been placed, then abandoned for even decades, as at the Jonesport Heath and Denbo Heath (inland, near Deblois), active regrowth seems restricted to the top edges of the cut, and drainage persists. In these cases oxidative peat loss appears to be greater than peat accumulation (Worley 1980a).

Active peat erosion (other than that caused by tidewater) was only noted locally at the Jonesport Heath, and where there is heavy trail use, such as on Great Wass Island and at Big Heath in Acadia National Park. Trails formerly heavily used at Corea Heath, Harrington Heath and on Great Wass Island, and abandoned deer trails, such as at Larrabee Heath and Moose River Heath, appear to be fairly rapidly recolonized, especially by mud bottom and lawn species.

In all the aforementioned recovery situations, the accumulation of new peat appears to take much longer than the few years or decades since the disturbance.

Even less is known about the susceptibility to disturbance, than for recovery in the Coastal Region. Current mining technology is capable, of course, of removing an entire peatland, but lesser devastation is possible

(witness many sites in the British Isles and Fennoscandia). All-terrain vehicles with low pressure tires apparently do little damage, although their traces can be seen for at least a few years. The passage of people can noticeably accentuate hummock and hollow topography, and a few tens of persons using a trail per year is adequate to maintain a trail scar (for example, the trails on Great Wass Island, and the many short trails that enter peatlands along obvious access routes). Individual footprints in Sphagnum hummocks may last as long as two years (personal observation in northern Vermont and Alaska). Laggs, other wet areas, and the steeper marginal slopes of prominently raised peatlands are particularly vulnerable to channelization. Where the vegetation cover floats or is sometimes buoyant, once the root-rhizome mat is fractured, severe local damage can be caused by continued use (such as occurs amid the pond system at Acadia National Park's Big Heath).

The fires that have occurred this century in the peatlands may be important agents in determining the character of peatland vegetation, but the underlying peat seems seldom affected.

Thus, the coastal raised peatlands can be visibly altered by as small a disturbance factor as the passage of a single person. Disturbance from some phenomena, such as acid rain, has not been investigated. Exposed peats generally are quickly revegetated, but peat re-accumulation appears to require decades or centuries. Drained peatlands may not re-accumlate peat even if revegetated, and loss of some remaining peats is possible through oxidation and decomposition.

At sites to be protected as natural areas (c.f. Worley and Klein 1980), but at which visitation may be regular, heavy, or channeled, for protective measures elevated trail ways such as boardwalks (Killian 1979), observation towers, and similar devices, especially at laggs and other wetter places, should be considered. That most peatlands are relatively shallow and the peats are fairly firm would facilitate such constructions. Care must be taken to not obstruct natural water flow.

Recent Vegetation Changes

A meager amount of comparative vegetation description through recent decades is available for Carrying Place Cove Bog and the South Trescott Heath.

Davis (Bastin and Davis 1909) visited Carrying Place Cove Bog in 1906, noting it to be a "typical open moss heath." In 1909 Fernald and Wiegand (1910) noted that

> "the most conspicuous plant at the time of our visit was Gaylussacia dumosa . . . forming dense depressed shrubs only 1 or 2 decimeters high, closely embedded in the Sphagnum, and loaded

with beautiful white or pink-tinged bells."

Other noteworthy plants were Scirpus cespitosus, Carex pauciflora, Comandra livida, Rubus chamaemorus, Empetrum nigrum, Vaccinium pennsylvanicum var. angustifolium, and Aster radula var. strictus (their nomenclature).

Osvald visited 18 years later in 1927, took photographs (Osvald 1955), peat cores, and described the vegetation thusly:

> "At the time of my visit fires had ravaged parts of the bog, and on the dry parts there was but little natural vegetation left. It was evident, however, that the driest part of the bog had been occupied partly by the Kalmia angustifolia - Cladonia silvatica sociation with hummocks of Empetrum nigrum - Sphagnum fuscum sociation . . . and partly by a Chamaedaphne calyculata sociation without a bottom layer."

Near the ponds were Chamaedaphne calyculata and other shrub communities, with a "fairly great amount of Myrica gale and Juniperus communis v. depressa."

> "In other comparatively wet parts of the bog the Chamaedaphne sociations formed broad strips across the bog, alternating with wetter strips containing mainly Empetrum - Sphagnum fuscum sociation and some Trichophorum caespitosum subsp. austriacum*- Sphagnum rubellum sociation. . . . The Chamaedaphne strips could be distinguished from a long distance by the scattered low shrubs of Alnus rugosa."

Two years later in 1929 Dachnowski-Stokes (1930) recorded that the bulk of ground vegetation was Sphagnum cymbifolium, S. medium, S. fuscum, S. acutifolium, S. tenellum, and S. imbricatum in rounded hummocks. No mention was made of fire. He continued:

> "Decidedly less abundant are sedges and the heaths which usually characterize the drier portions of a high-moor. Rhynchospora alba, Eriophorum vaginatum, Scirpus caespitosus, and a goldenrod (Solidago sp.) have only a limited, scattered foothold. Heaths such as Andromeda polifolia, Rhododendron canadense, Cassandra (Chamaedaphne) calyculata, Ledum latifolium,

---

* Scirpus cespitosus

> L. groenlandicum, species of Kalmia and Vaccinium are scanty and greatly dwarfed. Drosera rotundifolia, Sarracenia purpurea, and several lichens (Cladonia rangiferina, C. uncialis) are common in hollows and moist places but not abundant."

Thus, from 1906 to 1929 there was a shift in prominence from Gaylussacia dumosa (dwarf huckleberry) to the patterned surface with Kalmia angustifolia (sheep laurel) and Cladonia silvatica (lichen) in drier places, and strips of Chamaedaphne calyculata (leather-leaf) alternating with Empetrum nigrum (black crowberry) - Sphagnum fuscum and Scirpus cespitosus - Sphagnum rubellum, to a Sphagnum dominated vegetation with scattered sedges and scanty, greatly dwarfed shrubs.

The contemporary vegetation is patterned and has prominent Scirpus lawns and Kalmia angustifolia heaths. Pattern is clearly a persistent feature. The vegetation obviously has the capacity to change rather rapidly, apparently from a disturbance shrub-dominated vegetation to a re-establishment of Sphagnum dominance, to the contemporary expression of the regional Coastal Plateau Peatland type.

Davis also visited South Trescott Heath in 1906 (Bastin and Davis 1909), which had been burned over locally to stimulate the growth of blueberries. Where burned, hair-cap moss (Polytrichum sp.) dominated over Sphagnum. Twenty-one years later Osvald (1955) found the peatland very similar to its present condition covered by dwarf shrub communities, notably the sheep laurel - lichen community (in some places rich with leather-leaf, Labrador tea, and rhodora) and black crowberry communities.

Regional Relationships

Eastern North American Peatland Variation

Peatland types, based upon morphology and vegetation, in North America east of longitude 185° W distinguish regional zones that conform with north-south and continental-maritime gradients as locally modified by topography. In the southern part of the continent peatlands are primary, with extensive coastal plain peatlands but only scarce and tiny, forested, filled-basin peatlands inland. The Everglades are the best known southern peatlands. In the northern reaches of the continent and the Arctic archipelago, permafrost peatland types prevail. Between these extremes of sub-tropical glade peatlands and regions of continuous permafrost, roughly at 44-46° N latitude, lies a most significant division, north of which there are ombrotrophic (raised) peatland types, south of which there are not.

Because Maine lies astride the southern limit of raised peatlands, because Maine has a long coastline, because Maine is large with long north-south dimensions, and because Maine has both low levels and uplands, Maine has a considerable diversity of peatland types and displays significant zonation. Moreover, as the most northern and eastern state in this part of the nation it contains the only examples in the United States of several peatland phenomena that occur in neighboring Canada.

Since Maine does contain the southern (and sometimes western or northern) limit of certain morphological and vegetational peatland phenomena, Maine peatlands provide important documentation of significant ecological climatic conditions. In particular, as climate changes, whether naturally (as happened during the recent Little Ice Age) or by human activity (as with acid rain), the southern limits of ombrotrophic peatlands become very sensitive indicators of the changes, with alterations of vegetation composition, growth and decomposition rates, hydrologic budgets and numerous other ecological features clearly documenting climatic variation.

In Maine, the continental-maritime (Figure 35) and south-north (Figure 36) gradients of peatland variation depicted by Damman (1979b) are evident; Worley (1980a) discusses additional variation along these gradients. In western and southern Maine peatlands are primary, unraised with flat, open or forested surfaces that developed at the elevation of the basin's water table. To the north and northeast peatlands (for example, Sweat Bog and Bangor Bog) become slightly raised, convex, and commonly with some trees in central regions. Then with increasing maritime influence (for example, the Great Heath, Denbo Heath, and Meddybemps Heath) the surface becomes more elevated, with clearly raised domes (often as multiple, coalesced domes) with central ponds and scarce central trees, whose convexity is apparently limited (Damman 1979b, 1977) by the summer low water table which is generally 16-24 in. below the ericaceous heath vegetation.

With the increased water surplus in the Coastal Region, especially during the summer growing season, the convex raised peatlands are replaced by the plateau bogs with flattened centers and well-developed marginal slopes. Unlike the large inland and southern sites, the larger plateaus of the Coastal Region lack dwarf shrub communities and trees centrally, there being Scirpus cespitosus lawns instead.

Additional increases in moisture surplus lead to sloping and undulating peatlands that generally follow the topography of the underlying substrate. In southern Newfoundland occur well-developed Blanket Bogs (Damman 1979b). On the southern tip of Great Wass Island modified Plateau, gentle Slope and Shrub Slope peatlands provide a peat-dominated landscape.

Damman (1980, Figure 4) displays the floristic changes in the dwarf shrub, lawn, and mud bottom communities in ombrotrophic bogs along a west-east (continental-maritime) gradient through the southern part of the raised bog zone (southern Quebec and interior Maine/Maine/Bay of Fundy-Maine and New Brunswick/Nova Scotia/Newfoundland) as affected by the ecological and geographical conditions. This figure clearly demonstrates that the Coastal

Fig. 2. Changes in peatland development along a gradient from a continental to a maritime climate in the southern part of the eastern North American raised bog zone.

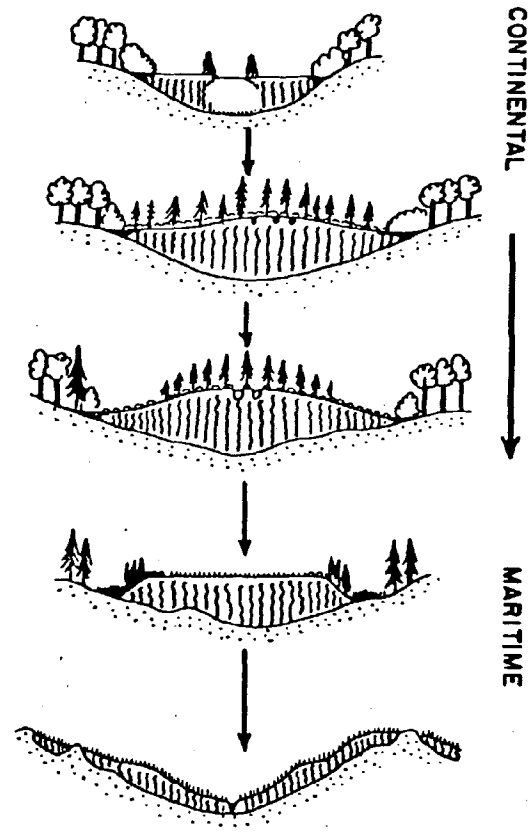

Table 1. Climatic and associated changes along a west-east transect in eastern North America. Thickness of the arrows indicates relative importance of the change.

	CONTINENTAL		MARITIME
Precipitation	lower	→	higher (+ fog)
Summer Temperatures	higher	←	lower
Potential Evapotranspiration	higher	←	lower
Effective Vegetative Season[1]	shorter	→	longer
Winter Snow Cover	permanent		erratic
		→	
	higher moisture surplus more active *Sphagnum* growth		

[1] Period of active growth of ombrotrophic hummock *Sphagna*, i.e. actual vegetative season minus periods that bog surface dries out.

Figure 35. Variation in peatlands in eastern North America along a continental-maritime gradient. Reproduced from Damman (1979b, Table 1, Figure 2).

Fig. 3. Changes in peatland development along a latitudinal gradient outside the immediate coastal zone of eastern North America

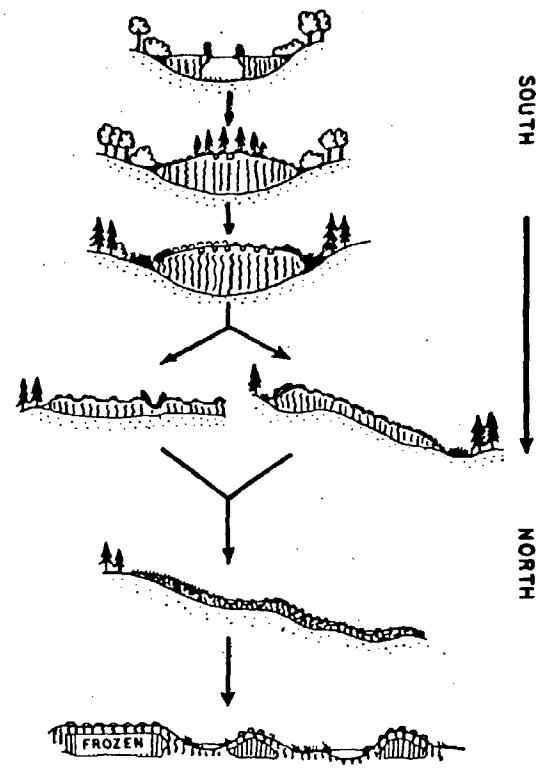

Table 2. Climatic and associated changes along a latitudinal gradient in eastern North America. Thickness of arrows indicates relative importance.

	SOUTH		NORTH
Summer Temperature	high	←	low
Potential Evapotranspiration	high	←	low
Effective Vegetative Season	(short) →	long ←	short
Snow Accumulation	negligible	→	important

higher moisture surplus
less active Sphagnum growth
spring runoff increases
summer precipitation less important

Figure 36. Variation in peatlands in eastern North America along a south-north gradient. Reproduced from Damman (1979b, Table 2, Figure 3).

Region peatlands have their most evident relationship with neighboring New Brunswick (the Bay of Fundy coast), coastal Nova Scotia, and coastal Newfoundland.

The climatic and associated changes important to peatland character along the latitudinal gradient are also given by Damman (1979b, Table 2, reproduced as Figure 36 of this report). Chief among these changes as they affect Maine's Coastal Region are the lower temperatures and lower potential evapotranspiration that help to provide a higher moisture surplus and shorter growing season. The increased snow accumulation with northerliness along this gradient is mitigated in the Coastal Region by milder winter temperatures.

Damman (1980, Figure 5) displays the floristic changes in the dwarf shrub, lawn, and mud bottom communities in ombrotrophic and oligotrophic basin peatlands along a north-south gradient outside the immediate coastal region in eastern North America (southern New England/inland Maine and southern Quebec/New Brunswick/central Newfoundland/James Bay, Quebec) as affected by the ecological and geographical conditions. South of the raised peatland limit even the most nutrient-poor peatlands are influenced by oligotrophic rather than ombrotrophic water sometime during the year, thus the predominance of some slightly more nutrient demanding species such as Vaccinium corymbosum, Woodwardia virginica, Chamaecyparis thyoides, and Myrica gale, along with the considerable vigor, abundance, and prominence of leather-leaf (Chamaedaphne calyculata).

The major floristic changes in the wind-exposed dwarf shrub vegetation of the ombrotrophic parts of coastal bogs along the east coast of North America are (Damman 1980, Table 2): in the Coastal Region of Maine and southwestern New Brunswick Sphagnum fuscum is the dominant peat former; in northern New Brunswick Cornicularia aculeata becomes prominent; in Newfoundland lichens become important dominants; and in northern Newfoundland Rhacomitrium lanuginosum (a moss) becomes the dominant peat former.

Vegetation is more diverse in the Coastal Region (Damman 1980) than inland, with differences most pronounced, as would be expected, in the wetter habitats. The prominent hummock species on the coast but not inland include common juniper (Juniperus communis), Sphagnum imbricatum, baked-apple berry (Rubus chamaemorus) and black crowberry (Empetrum nigrum).

A small portion of extreme coastal North America, including eastern Maine (the Coastal Region), most of Nova Scotia, and Newfoundland (Damman 1977, 1979a, Figure 1), contains ombrotrophic peatlands which have species that are restricted to minerotrophic habitats in other parts of eastern North America. This phenomenon is the direct result of the increased ionic content in precepitation and fallout near the sea enriching the ombrotrophic peat surface (Johnson 1977, Damman 1979a).

Amphi-Atlantic Vegetation Comparisons

The floristic composition and physiognomy of peatland vegetation is "remarkably similar throughout the Northern Hemisphere" (Damman 1979a). Tüxen et al. (1972) proposed that the vegetation class Oxycocco - Sphagnetea include the plant communities of not only European peatlands, but also those of Asia and North America; the Oxycocco - Sphagnetea to consist of plant communities with ombrotrophic and oligotrophic, primarily organic soils (with the exception of the mud bottom and Sphagnum-covered hollow vegetation which is included in the Scheuchzerietea).

Damman (1979a) compared the ecological position of the orders Sphagnetalia fusci and Eriophoro - Sphagnetalia papillosi of the Oxycocco - Sphagnetea as recognized in Europe with eastern North American phenomena to evaluate their applicability here. He concluded that "the variation in the peat bog vegetation is controlled by the same environmental factors on both sides of the Atlantic but there are important differences":

a) there are some floristic differences (c.f. Table 1 of Damman 1979a, which tabulates the differential species groups for the primary subdivision of the Oxycocco - Sphagnetea: dwarf shrub communities, lawn communities, and oligotrophic fens);

b) Sphagnum fuscum is an important hummock former in eastern North American coastal areas, even in the southern part of the raised bog zone (i.e., coastal Maine, Damman 1977);

c) there is less atmospherically derived nutrient enrichment in coastal peatlands in eastern North America than in Europe (due to the more frequent continental weather in eastern North America) as evidenced by the absence of Sphagnum papillosum and S. subnitens in coastal regions, such as eastern Maine; and

d) in eastern North America lawn communities are distinct from both the hummock communities and the mud bottom communities (Damman 1977) in all areas (except southern inland peatlands).

The mild, oceanic climate of western Europe contrasts markedly with the hot summers and cold winters of eastern North America that are produced by the temporal interfingering of continental and sub-tropical weather systems. In Europe the coastal regions with raised peatlands have a persistent and pronounced atmospheric nutrient enrichment along with a mild winter climate, whereas in eastern North America a lesser enrichment is coupled with severe and snow-rich winters (Damman 1979a). In coastal Maine these differences are compounded by the sporadic snowfall and periods of well below freezing temperatures with little or no snow cover (Damman 1977).

Consequently, Damman (1979a) concludes that the floristic criteria used to distinguish in Europe the northern and continental peatlands from the oceanic ones "cannot be applied to North America without seriously distorting the ecological context" of the Sphagnetalia fusci and the Eriophoro - Sphagnetalia papillosi. For possible classifications of the North American communities see Damman 1977 and 1979a.

Coastal North American Comparisons

The raised peatlands of eastern and western coastal North America are little compared, either in terms of vegetation or morphology. Gross similarities exist (Osvald 1928, Dachnowski-Stokes 1933, Rigg 1940) but there are apparently significant differences (Worley 1980c). For example, only 28 of 210 peatland species recorded for peatlands of the Maine and southeastern Alaskan coasts grow in both locations (Worley 1980c).

Worley (1980c) concludes that because the Maine Coastal Region receives the severity of continental weather and lacks a persistent atmospheric nutrient enrichment from the sea it contrasts in morphology and vegetation compostion with the peatlands of southeastern Alaska (whose hyperoceanic flora of liverworts and mosses is shared in northwestern Europe, Japan, and the Himalayas, but not eastern North America).

Greater similarity between the two North American coasts may exist if one compares the Maine coastal raised peatlands with those of southern British Columbia and adjacent Washington. Rigg (1940) describes plateau-form peatlands near the mouth of the Fraser River and in western Washington.

Some prominent species of ombrogenic peatlands shared between the two coasts (Rigg 1940, Worley 1980c) are Scirpus cespitosus, Eriophorum angustifolium (a cotton-grass), beak-rush (Rhynchospora alba), round-leaved sundew (Drosera rotundifolia), baked-apple berry (Rubus chamaemorus), black crowberry (Empetrum nigrum), Labrador tea (Ledum groenlandicum), bog laurel (Kalmia polifolia), small cranberry (Vaccinium oxycoccos), Sphagnum fuscum, Sphagnum papillosum, Sphagnum rubellum, Sphagnum tenellum, bog hair-cap moss (Polytrichum strictum), Pleurozium schreberi (a moss), and Cladopodiella fluitans (a liverwort).

SELECTION OF COASTAL PEATLANDS RECOMMENDED FOR EVALUATION BY THE CRITICAL AREAS PROGRAM

METHODS FOR THE RANKING AND SELECTION OF SITES FOR RECOMMENDATION

In the Introduction is given the general methodology for the collection of data from the field and the literature. This section details the analytical methodology used to classify the peatlands of the study area and to select those sites to be recommended as possible Critical Areas.

Significancy of Natural Features and Ranking of Sites

From the distinguishing characteristics of the coastal raised peatlands described earlier in this report were selected 20 features (Figure 37) felt to represent best the natural significance of these peatlands. In addition to these "Coastal Features," 20 "Additional Features" (Figure 37) of significance for peatlands in general were chosen.

Evaluation Criteria Score Sheets (Figure 37) were then filled out for each site that contained some of the Coastal Features, according to a 3-point scale for the distinctiveness of the feature (i.e., how clear and exemplar the feature is) and for the extent of potentially available terrain occupied by the feature (e.g., is Rubus chamaemorous found over an entire plateau, or just in one small location).

For unvisited but overflown sites the score sheet proved adequate, but I feel that it is inappropriate to recommend a site as a possible Critical Area without a visit on the ground, and thus no unvisited site is here recommended for evaluation, though several are recommended for visits.

After the completion of scoring two values were computed on a Summary Table (Figure 38) for each site allowing a ranking of the sites based upon significant natural features. The Significancy Indexes are the highest for sites with many well-developed significant natural features.

The sites were then ranked by decreasing Coastal Features Significancy Index, and by decreasing All Features Significancy Index. The former ranking is used in this report to determine which sites should be recommended for evaluation as possible Critical Areas, and compares the sites based upon those peatland features diagnostic of Coastal Peatlands. The latter ranking permits a partial, weighted comparison with Inland peatlands. Index values have only comparative meaning and are not included in this report.

The sites also were given a number from 1 to 4 based on the estimated interest of the general public based upon the natural qualities of the site, and similarly, upon the visibility of the peatland. These values were not used in the ranking of the sites.

Figure 37.

EVALUATION CRITERIA SCORE SHEET - Coastal Raised Peatlands

Site _____

Data source _____

Completeness of data _____

_____

		Distinctiveness of Feature*	Occupation of potentially available terrain*	Comments
COASTAL FEATURES	Raised			
	Flat-topped (or whale backed)			
	Obvious bog slope			
	Trees only on slope			
	Dwarf shrub community only on slope or edge of plateau			
	Scirpus lawn community covers plateau surface			
	Scirpus-S. fuscum community present			
	Empetrum-S. fuscum community present			
	Rubus chamaemorus extremely abundant			
	Empetrum nigrum extremely abundant			
	Scirpus cespitosus extremely abundant			
	Juniperus communis present on ombrotrophic peat			
	Myrica gale present on ombrotrophic peat			
	Solidago uliginosa extremely abundant			

Figure 37 (continued)

COASTAL FEATURES	Sea cut peat face			
	Sea enhanced marginal slope			
	Mineral soil water limit clearly visible in vegetation and topography (emphasis on topograhy)			
	Ponds rare			
	Mud bottom communities rare, anywhere on plateau			
	Distinctive ponds on marginal slopes			
ADDITIONAL FEATURES	Sharply defined open peatland/ upland boundary			
	Stream enhanced marginal slope			
	Pronounced stream diversion			
	Pronounced lagg with moat			
	Water track present			
	Soak present			
	Strongly patterned peatland surface			
	Complex of peatland types			
	Orchids abundant			
	Rare species present (give name, citation)			
	Species disjunction and/or range limit (give name, citation)			

Figure 37. (continued)

ADDITIONAL FEATURES	Association with geomorphic, geologic, hydrologic, biologic, or archeologic sites or items of importance			
	Peatland with known historical significance			
	Size of peatland system**			
	Size of raised peatland**			
	Size of principal or notable peatland type**			
	Rare type of peatland system in Maine			
	Rare type of peatland system in USA			
	Rare type of peatland system in North America			
	Rare type of peatland system in World			

*Scoring:

Distinctiveness of feature

Exceptionally evident and clearly distinctive	3
Evident and easily discernible	2
Barely discernible	1
Absent	0
Not sampled	-

Occupation of Potentially Available Terrain

Feature occupies 67-100% of potentially available terrain	3
Feature occupies 34-66% of potentially available terrain	2
Feature present but occupies less than 34% of potentially available terrain	1
Feature absent	0
Feature not sampled	-

**For Distinctiveness of feature:

500 or more acres	3
100 to 499 acres	2
less than 100 acres	1

Leave "Occupation of potentially available terrain" column blank.

Figure 38

SUMMARY TABLE
of Significancy Criteria Scoring for Coastal Raised Peatlands

	(i) Numbers of features present vs. Total features possible*	(ii) Distinctiveness points scored vs. Total points possible*	(iii) Terrain Occupation points scored vs. Total points possible*	Significancy Index $\frac{(2i + ii + iii)}{4} \times 100$
(a) Coastal Features				**
(b) Additional Features				
All Features (a&b)				***

* This value varies from site to site, as it only includes features for which data were collected.
** This value is used to rank the sites according to "Coastal Plateau Features."
*** This value is used to rank the sites according to "All Features."

Notes on the Significance of Features at Disturbed Sites

Peatland significance may be considered for (a) unaltered peatland (as discussed in the preceding section and elsewhere in this report), (b) the remnants of altered peatland, and (c) the present and potential successional stages of altered peatland. Clearly, the few disturbed peatlands in the study area have many features of significance, features scored in the determination.

The Remnants of Altered Peatland. In the Coastal Region major peatland alteration occurs at only a few sites and includes peat mining, the removal of surface vegetation, and the construction of roads, buildings, and other structures. Even at the most severely altered site, the Jonesport Heath, the mining practices have not obliterated the entire peatland. The proportion of peat volume removed by mining or ditching for drains is far less than the proportion of surface area disrupted. In most areas of former trench mining not all trenches reach the underlying mineral substrate, and between the trenches are intact peats used for transportation and drying. In the areas vacuum mined, the materials are removed relatively evenly. Since the vacuum mining has been in operation for only a few years, the bulk of the peat is still present. Furthermore, most mining does not extend to the very margins of the peatlands, but leaves areas of relatively undisturbed peatland along the periphery of the sites. Thus, even at the mined sites not only is a large proportion of the peat still present, it is intact stratigraphically. At Kelley Heath there was only surficial disruption; thus the peat deposit remains essentially undisturbed and natural.

The reclamation of trenched areas, by the mechanical smoothing of the surface to permit future vacuum mining, is underway at the Jonesport Heath. This reclamation destroys most of the residual stratigraphy.

Since the most heavily disturbed sites are the largest in the Coastal Region, and since the largest peatlands in a region are the most responsive to the regional climate and its changes, their peats contain an important record of climatic and biotic activity. This is especially so at the Jonesport Heath, whose multiple, contiguous plateaus are the only coastal circumstance approaching the very large coalesced peatlands (such as The Great Heath and Meddybemps Heath) that lie inland on the periphery of the Coastal Region. Consequently, the Jonesport Heath may provide information helping to determine what permits the existence of the largest of Maine peatlands.

The hydrologic function (whose importance to adjacent ecosystems and ground water regimes is unknown at this point) of the disturbed peatlands in the Coastal Region seem not fundamentally changed. Even at the Jonesport Heath the restoration of lost function may be possible by the careful blocking and filling of drains.

Successional Stages of Altered Peatland. It has not been determined if the coastal raised peatlands, individually or as a group, are at an ecological steady state, or whether some form of natural succession is in progress. Observing succession following certain forms of disturbance may help answer that question. Furthermore, since clearly the character of succession will vary greatly among the different physio-climatic regions

of Maine, and according to the kind of disturbance, disturbed peatlands in the Coastal Region provide an excellent basis for the determination of the types of succession that may occur. Such information is necessary for any management, from consumptive use to complete preservation.

For the purposes of the Critical Areas Program, it would be preferable that some disturbed sites were unaltered by the activities of man. However, although mining or other disturbances have subdued the natural significance of several peatlands, they have not denied that significance. In fact, with respect to succession, disturbance has even added a component of significance.

Site Classification

Each peatland considered in the study area was classified (c.f. Table 4, at end of Results Section) according to its coastal or inland character, and its suitability for evaluation as a potential Critical Area. Since not every site was visited on the ground, some qualified classifications were necessitated.

Coastal raised bogs are classified as R if recommended for evaluation as a potential Critical Area, Rv if likely suitable for recommendation but more data needed, X if clearly not suitable as a Critical Area, C if acceptably natural but with insufficient characteristics now known to recommend for evaluation, and Cv if likely a Coastal raised bog but more data needed to confirm coastal character and insufficient characteristics now known to recommend for evaluation.

Peatlands are classified as I if clearly outside of the coastal region, Iv if likely an inland type, acceptably natural, but with insufficient characteristics now known to recommend for evaluation, and Ic if not a coastal raised bog but in the coastal region and related to inland types.

Possible Shrub Slope peatlands are classified as S.

The exact inland boundary of the Coastal Region is imperfectly determined because of the inaccessibility of many of the peatlands. The overflight demonstrated that even if species such as black crowberry (*Empetrum nigrum*) and baked-apple berry (*Rubus chamaemorous*) occur farther from the coast than is indicated by this classification of the sites, prominent *Sphagnum fuscum* communities with them, and central *Scirpus cespitosus* lawns do not.

RESULTS

Summary of the Classification of the Peatlands in the Study Area

In this study in excess of 229 peatlands (Table 4, this table appears at the end of the Results section) were considered, with study intensity ranging from well-referenced sites which received several visitations, overflight and aerial photo interpretation and mapping, to sites only noted on topographic quadrangles, overflown, or identified on aerial photos. More than 159 (69%) peatlands were overflown. On-the-ground visits were made to 59 (26%) individual peatlands.

Of the sites, 21 (10%) are recommended for evaluation as possible Critical Areas (which, after mergers actually total 18 recommendations). For an additional 18 (8%) unvisited sites, it is recommended that on-the-ground visits be made, as the sites are likely to have sufficient qualities as possible Critical Areas. Thirteen (6%) sites (including more than 22 locations) are recommended for study as possible Shrub Slope peatlands, although the actual number of sites actually having Shrub Slope peatlands may be considerably less.

Only 14 (6%) sites were found totally unsuitable for evaluation as potential Critical Areas. That 94% of the peatlands have natural features and/or integrity sufficient that Critical Area status could be possible is noteworthy. This percentage of naturalness far exceeds that for any European country, a continent where peatland use has had a long history. At least 113 (49%) sites have acceptable natural conditions, but lack, or likely lack, sufficient features to recommend for evaluation as potential Critical Areas; 55 are classified as Cv, 13 as C, and 45 as Iv. More than 62 (27%) sites were found to be principally Inland in character, 10 occurring well within the Coastal Region.

The coastline of the study area consists of a series of peninsulas and islands projecting into the sea, alternating with sounds, bays, and elongated river mouths with long estuaries. The boundary between Inland and Coastal peatlands lies somewhat slightly seaward of the generalized landward extent of tidal effect (Figure 1). This boundary appears to be nearer the sea to the southwest end of the study area, and farther inland near the New Brunswick border, although additional documentation in these areas is necessary to produce a definitive boundary line.

It is inappropriate for this report to suggest that any of the Inland peatlands might qualify as a Critical Area, for the full complement of peatlands of that type would need to be considered as a group.

Most of the Inland peatlands seen in the landward portion of the study area are slightly to noticeably raised plateaus, uniformly vegetated with

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*All percentages are based upon 229 peatlands. The percentages total slightly more than 100% for the categories since some sites received more than a single classification.

vigorous dwarf shrub communities, with trees restricted to or near the margins, with no or mottled surface pattern (as viewed at a scale of about 1:12,000), and without pools or pool systems. A much smaller number are similar except that they have varying amounts of open canopy (savannah) tree cover. These peatlands may be adjacent to rivers, large streams, or lakes, or in basins in upland related to ponds or water courses. At the inland edge of the study area are a few, domed, large raised peatlands with pond systems in their upper elevations.

Sites Recommended for Evaluation as Possible Critical Areas

Eighteen sites (Tables 2, 3) are recommended for evaluation as possible Critical Areas. One site has an "undecided" status. An additional eighteen sites are likely suitable for evaluation; these are discussed following this section. The sites span the length of the study area (Figure 39), though only three lie west of Addison. The greatest concentrations are in Jonesport and Beals (6 sites), and over half (10) are fairly evenly distributed from Roque Bluffs to Lubec.

Of these peatlands (the eighteen recommended plus the one undecided peatland):

a) As measured to their centers all but four are within 0.5 mile of tidewater. Only three centers exceed one mile from tidewater: Kelley Point Peatland Complex, 1.1 mile; Jonesport Heath North Unit, 1.3 miles; and Jonesport Heath (the largest plateau) 1.8 miles.

b) More than half of the peatlands are less than one mile from the generalized coastline of Eastern Maine as drawn from peninsula tip to peninsula tip; only three are beyond 3.3 miles from that line, Great Cove and Larrabee Heaths are 4.4 miles, and Kelley Heath is 5.1 miles distant.

c) Only West Quoddy Head Heath at 110 feet elevation exceeds 70 feet above sea level.

d) Site acreages (approximate) range from 720 (Jonesport Heath) to 13 (West Quoddy Head Heath) with a median of 110.

e) Acreages (approximate) of the non-forested peatland portions of the sites range from 640 (Jonesport Heath) to 7 (West Quoddy Head Heath) with a median of 75.

f) Acreages (approximate) of individual peatland units with distinctive plateau morphology (at sites 2, 3, 4, 7, 8, 9, 11, 12, 16, and 18) range from 170 (Corea Heath) to 22 (Carrying Place Cove Bog) with a median of 116.

g) The peatlands farthest from tidewater or the generalized coastline are among the largest peatlands, indicating that with increasing distance from the sea a larger open peatland expanse is required for the display of coastal phenomena.

Table 2. Location and size of Coastal Raised Peatlands recommended for evaluation as possible Critical Areas and including a significant peatland in an undecided category listed from west to east. Following the site name and township are a brief location, the U.S.G.S. quadrangle upon which the site appears, and the approximate site acreage. For some sites acreages of open or plateau portions of the site are less than acreages given in this table; see site descriptions in the text for those figures.

1. BIG HEATH, MT. DESERT ISLAND, Southwest Harbor
   0.8 mile NW of Bennet Cove, Mt. Desert Island. Swans Island 15' Quad. 423 ac.

2. GREAT CRANBERRY ISLE HEATH, Cranberry Isles
   SW quarter of Great Cranberry Isle. Swans Island 15' Quad. 217 ac.

3. COREA HEATH, Gouldsboro
   0.5 mile NW of Corea. Petit Manan 7½' Quad. 253 ac.

4. WEST JONESPORT HEATH, Jonesport
   Between heads of Hay Creek and Snare Creek. Addison 7½' and Jonesport 7½' Quad. 78 ac.

5. CENTRAL PEATLANDS, GREAT WASS ISLAND, Beals
   0.5 mile E of Norton Point, 0.6 mile NE of Three Falls Harbor, and 0.3 mile NW of Cape Cove. Great Wass Island 7½' Quad. 110 ac.

6. SOUTHWEST PEATLAND, GREAT WASS ISLAND, Beals
   0.3 mile N of The Pond. Great Wass Island 7½' Quad. 67 ac.

7. JONESPORT HEATH, Jonesport (Undecided)
   The whole interconnected and lobed complex of peatlands south of E-W stream 2.0 miles directly W of Bar Island; the complex extends to 0.3 mile N of the head of Sawyer Cove. Jonesport 7½' Quad. 720 ac.

8. NORTH UNIT, JONESPORT HEATH, Jonesport
   1.5 miles E of Indian River community (c.f. Addison 7½' Quad.). Jonesport 7½' Quad. 239 ac.

9. KELLEY POINT PEATLAND COMPLEX, Jonesport
   Complex of peatlands between Rhine Point, Kelley Point, and Sawyer Cove; includes large unit, small unit between road and Kelley Point, and unit W of road, 0.4 mile W of Loon Point. Jonesport 7½' Quad. 254 ac.

10. GREAT COVE HEATH, Roque Bluffs
    0.8 mile NE of Great Cove, N of road. Machias 7½' Quad. 98 ac.

11. LARRABEE HEATH, Machiasport
    0.7 mile SW of Larrabee. Machias 7½' Quad. 235 ac.

Table 2 (cont.)

12. KELLEY HEATH, Cutler
    0.4 mile S of Huntley Creek, by small U.S. Navy transmission station. Machias Bay 7½' Quad. 170 ac.

13. HEATH, 1.9 MILES WEST OF NORTH CUTLER, Cutler
    1.9 miles W of North Cutler. Machias Bay 7½' Quad. 30 ac.

14. NORTH CUTLER HEATHS, Cutler
    0.4, 0.7, and 1.1 miles W of North Cutler. Machias Bay 7½' Quad. 113 ac.

15. MOOSE RIVER HEATH, Trescott
    0.3 mile S of Moose River, 0.3 mile W of shore. Cutler 15' Quad. 61 ac.

16. SOUTH TRESCOTT HEATH, Trescott
    0.8 mile W of Baileys Mistake. West Lubec 7½' Quad. 106 ac.

17. BOOT COVE HEATH, Lubec
    0.4 mile W of Boot Cove. West Lubec 7½' Quad. 49 ac.

18. CARRYING PLACE COVE BOG, Lubec
    West Quoddy Head neck, N of Carrying Place Cove. Lubec 7½' Quad. 43 ac.

19. WEST QUODDY HEAD HEATH, Lubec
    0.6 mile SW of West Quoddy Head lighthouse. Lubec 7½' Quad. 13 ac.

Table 3. Significancy Ranking of Recommended and Undecided Sites

Coastal Features	Site	All Features	General Public Interest	Visi-bility
1*	Carrying Place Cove Bog**	3	1	1
2*	Kelley Point Peatland Complex**	1	2	2
3*	Jonesport Heath ***	2	1	3
4*	North Unit, Jonesport Heath	5	2	3
5*	Corea Heath	6	2	2
6*	North Cutler Heaths	12	4	2
7*	Kelley Heath, Cutler	10	3	2
8*	Great Cranberry Isle Heath	9	3	3
9*	Central Peatlands, Great Wass Island	7	2	3
10*	Southwest Heath, Great Wass Island	8	2	3
11*	Big Heath, Mt. Desert Island	4	1	3
12	West Jonesport Heath**	15	2	1
13*	Heath, 1.9 miles W of North Cutler	18	4	4
14*	Boot Cove Heath	14	4	3
15	Larrabee Heath	11	3	2
16	South Trescott Heath	13	3	3
17	Moose River Heath	16	3	2
18	Great Cove Heath, Roque Bluffs	17	3	2
19	West Quoddy Head Heath	19	4	4

* *Scirpus cespitosus* present on plateau, often as *Scirpus* lawn communities.

** Sites with peat erosion by tidewater.

*** Undecided Status Regarding Critical Area Designation.

Table 3 (cont.)

General Public Interest:

Includes interest by resident and non-resident lay public in scenic qualities (vista, reminiscent of Arctic, mysterious or eerie, colorful, lies near shore or in enclosed valley, etc.), berry production, size, history (natural or human), and similar features; does not include economic interests such as mining, horticulture, silviculture, water retention, landfill, or development.

Public interest currently exhibited; much interest expected when public becomes informed	1
Occasional public interest currently exhibited; greater interest expected when public becomes informed	2
Public interest currently minor or rare, moderate interest, or more, expected when public becomes informed	3
Essentially no public interest; would take considerable education or interpretation to maintain public interest . . .	4

Visibility:

Seen from above, easy access	1
Seen from above, moderate to difficult access; or seen from marginal vista, easy access	2
Seen from marginal vista, moderate to difficult access	3
Seen from within site, vistas limited, moderate to difficult access	4

INDEX OF USGS QUADRANGLES

126 Gardner Lake
127A Pembroke
127B Eastport
127C Whiting
127D West Lubec
127E Lubec
140 Tunk Lake
141 Cherryfield
141A Cherryfield
141B Harrington
142A Columbia Falls
142B Whitneyville
142C Addison
142D Jonesport
143A Machias
143B Machias Bay
143C Roque Bluffs
143D Cross Island
144A Cutler
144B Moose River
155 Blue Hill
156 Mount Desert
157 Bar Harbor
158A Petit Manan
158B Bois Bubert
159A Drisko Island
159B Great Wass Island
170 Deer Isle
171 Swans Island

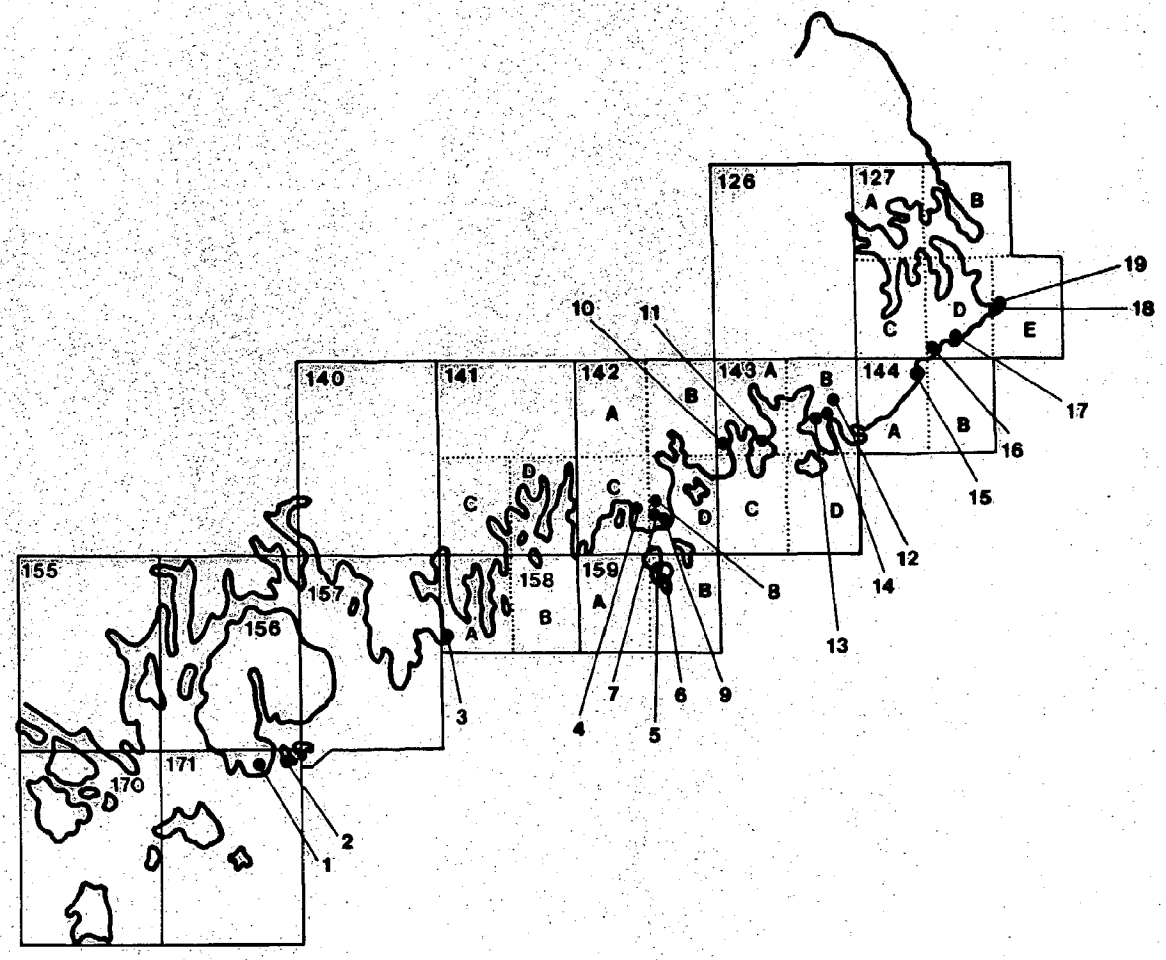

Figure 39. Location of recommended and undecided coastal raised peatlands.

When ranked in order of the Coastal Features Significancy Index (Table 3) the first 14 peatlands have Scirpus cespitosus on the raised peats and/or have peat erosion by tidewater, the top two have both features. The differences in the ranking based upon "All Features" is mostly attributable to the presence or absence of biogeographically significant species and communities. Note that sites with high General Public Interest or Visibility occur variously within the ranking.

The reasons for recommendation, location, and general description of the nineteen sites follow, in order from west to east. Names have been assigned each site, using existing names when known. The acreages (approximate at best) were calculated by dot-grid method from U.S.G.S. maps, the boundaries drawn from map data, air photo interpretation, field checks, and the overflight. Additional comments regarding condition and use, as well as more detailed descriptions of site boundaries, are available from the Critical Areas Program.

1 BIG HEATH, MOUNT DESERT ISLAND, Southwest Harbor

Reasons for Recommendation:

Big Heath is recommended because it is the southwesternmost coastal raised peatland in Atlantic North America, with an excellent display of coastal vegetation. In completely natural condition it lies at an ecologically important transition between climatic zones, and is at the limit of distribution of certain species and communities. Its pond system is unique in Atlantic coastal United States. The significance of Big Heath, among 115 coastal raised peatlands in Maine, ranks 11th for Coastal Peatland Features and 4th for All Peatland Features.

Significant Features:

- southwestern limit of the known coastal and lowland distribution of baked-apple berry (Rubus chamaemorus, which does not flower here), black crowberry (Empetrum nigrum), the Empetrum nigrum - Sphagnum fuscum community, the Scirpus cespitosus - Sphagnum fuscum community, and the Scirpus cespitosus lawn physiognomy
- southwestern limit of obviously raised peatlands
- southernmost peatland in eastern United States with a well-developed surface pond system
- variety of pond, pond margin and wet depression communities
- one of only two ombrotrophic peatlands in Maine known to me to have skunk cabbage (Symplocarpus foetidus)
- only circumstance of water lilies in ponds of raised peatlands of the Coastal Region
- area of lichen - Sphagnum fuscum - Empetrum nigrum maritime community
- common juniper (Juniperus communis) present on ombrotrophic peats (possibly southern limit in peatlands)
- breeding site for the uncommon Lincoln Sparrow (Melospiza lincolnii), also frequented by the Palm Warbler (Dendroica palmarum)

Location and Size:

Located at the southern end of Mount Desert Island in Acadia National Park, Big Heath lies north of Route 102A less than a mile southwest of the Seawall Pond campground and picnic area. Open peatland accounts for about 150 of the more than 420 acres of the site.

Ecology:

A most significant biogeographical site along the Atlantic Coast of North America, and diagnostic of biologically important climatic limits, Big Heath can be expected to have additional species and communities other than those listed above that are at distribution limits.

Big Heath is a relatively small raised peatland whose basic plateau configuration partially is masked by low and tall tree cover, by limited lateral dimensions which reduce the height of raised peats, and sometimes by bisecting or marginal drainages or small streams which further reduce the raised area. The peatland is much forested along its margins and in most of its northern area, and has a number of tree islands in the largest open area, the southern portion.

Most of the significant features are located in the open area, through which passes the very important drainage. Emanating from the northern portion of the peatland, a broad wet area arcs southwestward, becoming wider and wetter nearer the southern edge of the peatland. A variety of communities favoring wet depressions and soaks occur, including several Sphagnum dominated communities, mud bottom communities, and Scirpus cespitosus communities that have or approach lawn physiognomy. With increasing frequency and size to the south are a series of depressions and ponds, slightly patterned (a quite crude ladder formation). Wetter than any others I have experienced in Maine, the fringes of these surficial ponds are, in places, quaking (buoyant or floating). In some of the ponds grow water lilies. Skunk cabbage grows here and there in wet peat depressions (also in the nearby lagg, the peatland margin).

To the sides of the wet area are raised peats with dwarf shrub communities, the Empetrum nigrum - Sphagnum fuscum community, and clusters of black spruce of various sizes. Black crowberry occurs throughout most of the open peatland, but baked-apple berry grows rather locally, and is not known to flower or fruit here. In places the Sphagnum fuscum approaches the "hollowless plain" character; elsewhere there are typical hummocks and hollows. In some areas lichens form a prominent, rich understory for dwarf shrubs, often in conjunction with Sphagnum fuscum and/or black crowberry. The lichen - black crowberry hummocks are especially showy, and reveal the extreme maritime location of this peatland. As with other extreme maritime sites, there is common juniper (Juniperus communis) in the open peatland.

Consequently, this site contains many of the elements of the Coastal Plateau Bog peatland type, but not simply zoned as at Jonesport Heath, the type example.

Condition and Use:

The National Park Service has not "improved" this site; there are no signs, parking pull-outs, or trails. Disruption is no greater, in general, than that at most other unmined sites covered by this report, except that there has been moderate to heavy trampling in the vicinity of the ponds.

There is potential for considerable disruption of the most significant features of this site. This site has far more tourists, and possibly more permanent residents, nearby than any other site recommended by this report.

Of especial fragility are: the narrow drainage ways; the drainage patterns between and among the wet depressions; the plant communities in those areas, other wet areas, and in the ponds; the peat margins of the ponds, especially when soggy or floating; the very edges of the ponds, which may be overhanging, vertical, or sloping in shape, as well as receding through decay, advancing through growth or stationary; the pond and depression bottoms, which are peats unprotected by vegetation and root mats, and which, if undisturbed, may undergo accelerated decay; and the *Sphagnum fuscum* - *Empetrum nigrum* terrain and areas with extensive lichen development, with hummock-hollow and/or "hollowless plain" form.

2 GREAT CRANBERRY ISLE HEATH, Cranberry Isles

Reasons for Recommendation:

Great Cranberry Isle Heath is recommended because it is the southwesternmost peatland in Atlantic North America that clearly displays the coastal plateau morphology and characteristic coastal plant community zonation. In completely natural condition the peatland provides habitat for species and communities at or near the limit of their distribution. The significance of Great Cranberry Isle Heath, among 115 coastal raised peatlands in Maine, ranks 8th for Coastal Peatland Features and 9th for All Peatland Features.

Significant Features:

- "offset" plateau, with height on upstream side of peatland
- *Empetrum nigrum* - *Sphagnum fuscum* community well developed, with abundant baked-apple berry (*Rubus chamaemorus*)
- *Scirpus cespitosus* lawns on upstream flank of peatland
- *Sphagnum fuscum* - lichen community locally prominent
- easternmost location in United States with skunk cabbage (*Symplocarpus foetidus*) on ombrotrophic peats, one of only two Maine raised peatlands with the species
- frequent, locally abundant common juniper (*Juniperus communis*) on plateau
- two kinds of scattered spruce islands; no other Coastal Plateau peatland visited has a similar region of islands of so uniformly stunted spruce
- cranberries at this peatland and at a smaller peatland on a nearby island presumably have provided the names for two islands, a harbor, a post office, and a township

Location and Size:

This moderately large coastal raised peatland occupies about half of the southwestern corner of Great Cranberry Isle. The site contains about 215 acres, at least 150 of which are open peatland.

Ecology:

Although the nearby "Big Heath" on Mt. Desert Island is slightly more southerly and westerly, its raised peatlands lack the clear plateau form and the characteristic Coastal Plateau Bog community zonation of Great Cranberry Isle Heath. This peatland slopes to the west from its upper, eastern reaches, which have areas with considerable *Scirpus cespitosus*. Baked-apple berry (*Rubus chamaemorus*) is abundant in the *Empetrum nigrum* - *Sphagnum fuscum* community, widespread in the center of the peatland. It is not known to me if the *Rubus* fruits (as it does eastward of this site) or if it is sterile (as it is at nearby Big Heath to the west). Common juniper (*Juniperus communis*) is frequent and locally abundant in the central *Sphagnum fuscum* communities.

Black spruce (*Picea mariana*) forms two kinds of islands rather evenly scattered, and possibly patterned, in the continuous, but exceptionally variable plateau communities (including *Sphagnum fuscum* - lichen, *S. fuscum* plains, and hummocky *S. fuscum* communities). Most commonly the spruce, everywhere yellowed due to the extreme nutrient deficiency, form sub-circular to elongate, low islands less than 3 feet in height, a few to several feet in horizontal extent. A very few islands have trees to 6-8 feet tall, with a typical encircling ring of layered progeny. In the Coastal Region spruce are absent on larger plateaus, and when present on smaller plateaus grade in height rather evenly from tall, marginal trees to shorter, more stunted individuals in central parts of the peatlands. Peatlands with areas of uniformly stunted spruce seem generally restricted to inland locations. Consequently, the presence of spruce islands amid the well-developed coastal communities may reflect that this peatland, like the neighboring Big Heath, is at the transition between major biogeographical (both floristic and ecological) zones of the New England coast.

An unvisited narrow arm of the peatland descends westwardly toward the sea. It may be a fen drainage for the peatland, and possibly contains features of significance.

Vaccinium oxycoccus (small cranberry) is widespread in the *Sphagnum fuscum* communities, especially where shrub growth is subdued. In favorable seasons abundant cranberries would have attracted pickers in colonial times. Presumably, the abundance of cranberries in this peatland, and a smaller one on an adjacent island, gave rise to the names of the islands Great Cranberry and Little Cranberry, the intervening harbor Cranberry Harbor, the Cranberry Isles post office, and the Cranberry Isles township.

Condition and Use:

This peatland appears little visited and in excellent natural condition.

3 COREA HEATH, Gouldsboro

Reasons for Recommendation:

Corea Heath is recommended because it is a clearly raised, essentially treeless, coastal peatland with its distinctively coastal vegetation prominently patterned in concentric arcs--a rare phenomenon in the coastal region. Furthermore, much of the peatland, whose circular shape and adjacent "bays" of peatland at lower elevations are noteworthy, contains abundant *Scirpus cespitosus*, often as lawns; only one other peatland has such prominent *Scirpus*. The significance of Corea Heath, among 115 coastal raised peatlands in Maine, ranks 5th for Coastal Peatland Features and 6th for All Peatland Features.

Significant Features:

- clearly raised, essentially treeless peatland with steeper marginal slopes
- one of only three coastal raised peatlands with concentric patterning, most clearly defined, and second most extensive patterning of any peatland in the Coastal Region
- one of only three coastal raised peatlands with abundant *Scirpus cespitosus* on most of raised portion of peatland
- one of only three coastal raised peatlands of essentially circular form
- one of the larger peatlands in the Coastal Region
- adjacent peatland "bays" on downslope (southern) margins of the plateau
- multiple drainages with locally prominent marginal fens with various vegetation types
- a few jack pines (*Pinus banksiana*) at the peatland margins; the only Maine peatland other than those on Great Wass Island known to have the species
- common juniper (*Juniperus communis*) a common constituent
- portions of the plateau have abundant lichens in the *Sphagnum fuscum* communities
- readily visible and highly accessible

Location and Size:

This site is the largest peatland near Corea; it abuts the village and lies south and west of the main road to that community. Access is easy from all sides. The site is about 250 acres, of which over 210 are open with about 170 plateau.

Ecology:

In spite of former disruptions, which appear to be only surficial, and fortunately do not include drainages, this peatland has numerous prominent natural features of significance.

A large proportion of this peatland, especially throughout the southern half, is characterized by ridge and depression relief, being more clearly defined than at any other peatland in the Coastal Region. The hollows contain a variety of mud bottom, *Scirpus cespitosus*, dwarf shrub, and lichen

dominated communities; some retain surface water for long periods and approach pond structure. The ridges similarly are variously composed, and include Sphagnum fuscum, black crowberry (Empetrum nigrum), dwarf shrub, lichen, and highly stunted (less than 2-3 feet tall) spruce (Picea mariana) dominated communities.

Only three other raised peatlands in Maine have such high proportions of their surfaces with Scirpus cespitosus or Scirpus lawn communities. Kelley Heath and Carrying Place Cove Bog are the most similar, presumably due to the disturbance history of the sites; the portions of North Cutler Heath with extensive Scirpus is quite different, no doubt due to the lack of disturbance. At Corea Heath Scirpus cespitosus is most prominent in broad hollows on the lower slopes and margins of the plateau, but it also grows as scattered individuals throughout the peatland.

The graminoid dominated vegetation of the two prominent drainage ways, one to the north and one to the southwest, is frequently rich in broadleaf herbs. The marginal laggs are mostly open, but have forested fen in places.

Condition and Use:

A U.S. Navy electronics facility with a large, circular, concrete antenna pad abuts the west side of the peatland. A very minor area of peatland was destroyed by the construction, and the lateral effect of the facility into the peatland seems nil. From the east, an abandoned access road built upon fill atop the plateau peats leads about ¼ of the way across the heath to an apparently abandoned small frame building. Associated boardwalks and fence posts are in considerable disrepair and are being overgrown by Sphagnum and other plants. These disturbances have only minor local effect upon the peatland. If the peatland surface was laid bare some time ago (as at Kelley Heath), the only evidence apparent is the extensive Scirpus cespitosus. The exact character and dates of the disturbances were not determined. Since drainage patterns appear unaltered, and since the peat deposit seems intact, the site offers significant opportunity to investigate regenerative rates and patterns in the Coastal Region. Of particular interest are growth rates in the vicinity of vehicle tracks, fence posts and boardwalks.

Although access is easy from several locations along roads and from the contiguous Navy base, present use appears minimal.

4 WEST JONESPORT HEATH, Jonesport

Reasons for Recommendation:

West Jonesport Heath is recommended because it is a highly visible, prominently raised, essentially natural coastal plateau peatland with characteristic coastal vegetation zonation. The only coastal raised peatland in the United States with open peatland communities contiguous with tidal marsh, it is only one of two coastal peatland plateaus in the United States with tidewater erosion. The significance of West Jonesport Heath, among 115 coastal raised peatlands in Maine, ranks 12th for Coastal Peatland Features and 15th for All Peatland Features.

Significant Features:

- oblong plateau with a clearly offset upper region
- vegetation zonation characteristic on surface and slopes of plateau, the only Coastal Plateau peatland in the United States with open peatland communities abutting tidal marsh
- exceptionally simple in morphology and vegetation
- *Sphagnum fuscum* plains with baked-apple berry (*Rubus chamaemorus*) and black crowberry (*Empetrum nigrum*) prominent at plateau height
- minor depressions and semi-permanent ponds mark the steeper marginal slopes
- peatland may extend beneath or beyond the tidal creek
- persistent gull activity on peatland height with moderate midden

Location and Size:

Totally visible from Route 187 about 1 mile north of West Jonesport, this peatland lies west of the roadway between the heads of Hay Creek and Snare Creek. The site contains about 78 acres, some 60 of which are open plateau.

Ecology:

Highest in the northern third of the plateau, and higher in the west than in the east, the site clearly displays the "offset dome" phenomenon, wherein the maximum elevation of the peatland is not central, but lies closest to the upstream end of the site (i.e., the northern and western upland boundaries are higher than the southern and eastern boundaries).

The long slope of the peatland to the south and southeast end in saltwater marshes, with areas of direct tidal erosion of the peat forming vertical and slump erosion escarpments up to three feet or more in height. One of the most significant features of this tidewater erosion is the potential for accurate determination of land/sea relationships on a coast where relative sea level has been rising. The site becomes especially significant if, as is certainly possible, the peats extend beneath the intertidal, or if there are relict peats south of the Hay Creek once (or perhaps still) contiguous with the plateau. The effectiveness of the enhanced drainage of the peatland caused by the Hay Creek in establishing a sloping topography is seen graphically from the road or air. One small surface pond lies at the northernmost end, and a few ponds or depressions mark the steeper slopes or the break in the slope along the southeastern quarter where tidewater drainage is evident.

Few in number, the vegetation types have characteristic Coastal Plateau Bog zonation. The height of the plateau has well-developed *Sphagnum fuscum* plains and hummocks, with locally abundant black crowberry (*Empetrum nigrum*), baked-apple berry (*Rubus chamaemorus*), and bog goldenrod (*Solidago uliginosa*); *Scirpus cespitosus* appears absent. At slightly lower elevations, and covering the bulk of the peatland, are dwarf shrub communities, with sheep laurel (*Kalmia angustifolia*) and leatherleaf (*Chamaedaphne calyculata*) prominent. The southern and most of the eastern margins are bordered with more vigorous dwarf shrub communities, commonly with sweet gale (*Myrica gale*) and rhodora (*Rhododendron canadense*). Along the western margin grow coniferous trees in a very narrow zone.

A colony of large gulls rests and feeds on the upper elevations of the peatland. Their rather abundant midden consists primarily of crab shells and bread wrappers. Some gull occupied hummocks are totally dead due to guano, others have an adventive grass, and a few contain small mammal dens. Deer trails parallel the peatland margins, and raccoon scats with baked-apple berry (Rubus chamaemorus) remains are locally and seasonally abundant.

The significancy ranking of this site would be considerably higher were Scirpus cespitosus present, especially in a lawn community. Also, since the site is exceptionally simple in morphology and vegetation, it did not score as high as more diverse sites. It should be recognized that its simplicity imparts noteworthy significance as well.

Condition and Use:

Except for the items listed below, this peatland is in excellent natural condition. Fire scars are evident in the southwestern quarter. However, in the upper plateau there appears to be a former growth surface 8-16 inches down, upon which present hummocks have formed.

The site seems to receive almost no direct human use, an especially noteworthy fact due to its visibility and accessibility. An old drainage(?) ditch scar partly crosses part of the plateau beginning at the east margin about 1/3 of the way from the south end.

The Jonesport landfill lies immediately adjacent to the northwestern edge of the plateau, on slightly higher ground than the peatland and only a few yards from it. Transgressions of runoff containing the numerous solutes from refuse, air blown materials, fumes, noise, and fire can and do invade the peatland.

5 CENTRAL PEATLANDS, GREAT WASS ISLAND, Beals

Reasons for Recommendation:

The Central Peatlands of Great Wass Island are recommended because they are an outstanding example of the variation in peatland types along an ombrotrophic (nutrients scarce, from precipitation) to minerotrophic (nutrients abundant, from surface and ground water) gradient. In completely natural condition the peatlands have exemplar coastal vegetation features including the only peatland in the northeastern United States to have jack pine (Pinus banksiana) as a prominent feature. The significance of these peatlands, among 115 coastal raised peatlands in Maine, ranks 9th for Coasal Peatland Features and 7th for All Peatland Features.

Significant Features:

- three peatlands, hydrologically connected; the western has a Coastal Plateau Bog, the eastern is a graminoid fen, the middle is transitional
- complex hydrology, including marginal fens by raised peatland, and noteworthy water track drainage in middle peatland

- diversity of fen communities
- characteristic Empetrum nigrum - Sphagnum fuscum communities with some "hollowless" plain development
- large areas with Scirpus cespitosus communities adjacent to plateau
- peatland merges with upland organic soils in places
- jack pine (Pinus banksiana) habit and habitat very similar with shore pine (Pinus contorta) habit and habitat on maritime peatlands along the Gulf of Alaska

Location and Size:

This site, owned by The Nature Conservancy, includes three open peatlands in central Great Wass Island (Table 4): "0.5 mile E of Norton Point," "0.6 mile NE of Three Falls Harbor," and "0.3 mile NW of Cape Cove." It includes roughly 110 acres, of which about 75 are open peatland.

Ecology:

The three open peatlands and their connecting isthmuses demonstrate a complex hydrology that extends beyond the peatland margins, at some places into ecosystems with shallow peat or organic soils. The two western of the three peatlands warrant recommendation in their own right, the third may as well, but it has not been compared with other, similar sites. In addition to the importance of the individual peatlands, the site gains considerable significance because of the hydrological continuity of the peatlands.

The three peatlands lie in a line roughly from northwest to southeast, with water flow, at least during rainy periods, between the peatlands in that direction. The middle and eastern peatlands receive runoff from upland sources as well. The communities are most ombrotrophic in the western unit, and most minerotrophic in the eastern unit.

The western peatland, obviously raised, in its open regions is generally similar to several of the smaller Coastal Region peatlands visited in this study. In the upper portion of the raised bog the Empetrum nigrum - Sphagnum fuscum community is characteristically developed, with some areas of "hollowless" plain. Baked-apple berry (Rubus chamaemorus) is abundant, and fruits freely. Bog goldenrod (Solidago uliginosa) occurs throughout, locally with abundance. At least one large area of a Scirpus cespitosus community, lawn-like, occurs in a slightly lower region on the northeast side of the central raised area.

Of outstanding significance is the presence of low jack pine (Pinus banksiana) individuals scattered through the peatland. I consider them be to superimposed upon peatland types found elsewhere in the study area, but this view may be modified or rejected as the site becomes better known. The jack pine habitat, frequency, and locations within the peatlands is amazingly reminiscent of its sibling species, shore pine (Pinus contorta), in the maritime, tertiary peatlands of Alaska and British Columbia along the Gulf of Alaska. No other peatland in this study is known to have jack pine throughout its open region, although some other peatlands of Great Wass Island, and the Corea Heath, have isolated individuals. The marginal communities, ecotones, and hydrologies of this peatland appear to be somewhat complex, with the peatland boundaries not always sharply defined.

The outstanding feature of the middle peatland is a broad water track of minerotrophic communities that arcs from the northwestern margin southward across the ombrotrophic, dwarf shrub peatland. The eastern peatland is a very wet, minerotrophic, graminoid fen with prominent Carex exilis and that often has standing water.

Condition and Use:

The peatlands receive a fair amount of foot traffic, from both individuals and organized groups, for a site that is rather remote. This traffic has created a major trail scar through each of the peatlands in places enhancing water flow. Otherwise the site is in excellent natural condition.

6 SOUTHWEST PEATLAND, GREAT WASS ISLAND, Beals

Reasons for Recommendation:

The Southwest Peatland of Great Wass Island is recommended because it has the most extreme maritime climate of any of the coastal peatlands, it displays a large variety of coastal peatland morphologies, communities and hydrologic settings, all with modifications by the extreme climate, it is contiguous with the best development of Shrub Slope peatlands in the eastern United States, it has an exceptionally abrupt fen-raised bog ecotone, and it merges with various organic soils on adjacent uplands. The significance of this site, among 115 coastal raised peatlands in Maine, ranks 10th for Coastal Peatland Features and 8th for All Peatland Features.

Significant Features:

- contiguous Shrub Slope peatlands, the best development of such a phenomenon at low elevations in eastern United States
- modified (by extreme maritime climate) Coastal Plateau topography with notable variety of communities
- well-developed Sphagnum fuscum communities, with "hollowless" plains lichen dominated areas, and dwarf black spruce "forests"
- abundant black crowberry (Empetrum nigrum) and baked-apple berry (Rubus chamaemorus) that fruit copiously
- common juniper (Juniperus communis) locally abundant in Sphagnum fuscum communities
- scattered Scirpus cespitosus and jack pine on plateau
- variety of typical and modified (by extreme maritime climate) Coastal Zone peatland communities
- variety of fen communities bordering plateau
- an exceptionally abrupt ecotone between fen and plateau (along the eastern boundary)
- "string of beads" patterned depressions and miniature ponds in marginal fen
- northern white cedar (Thuja occidentalis) stand at margin
- organic soils dominate adjacent uplands
- complex topography and drainage patterns
- diversity of peat types

Location and Size:

This peatland lies north of The Pond and southeast of Three Falls Point in the southwestern part of Great Wass Island. It contains about 67 acres.

Ecology:

Because of those adjacent, well-developed Shrub Slope peatlands and the other extreme maritime features this site may be one of the most noteworthy individual peatlands in the eastern United States.

The principal peat mass in this site has a surface topography that approximates a plateau, but one quite modified. In general, the peatland appears to slope from the south and southwest to the north and east. Along the western and southern margins the Shrub Slope peats merge, in places, with this site's peats. The line of merger is discernible from a distance, but by no means discrete. The central portion of the peatland is a clearly raised plateau bog, whose plateau may indeed slope throughout. There is an excellent example of rolling, unpatterned, coalesced hummocks and "hollowless" terrain of *Sphagnum fuscum* with miniature black crowberry (*Empetrum nigrum*), abundant baked-apple berry (*Rubus chamaemorus*), and very stunted and scarce dwarf shrubs. *Scirpus cespitosus* occurs here and there, but never forms large lawns on the plateau. In the higher, southern portion is a relatively large area with considerable lichens amid hummocky *Sphagnum fuscum*. Characteristically stunted jack pine (*Pinus banksiana*) grow very sparsely on the plateau.

One of the most striking features of this site is the diversely speciated, graminoid fen bordering the northern and eastern margins of the plateau. In the narrowest parts the fen contains patterned depressions with mud bottom communities and some minor ponds. Brief channel segments are sometimes present forming "bead" pattern with the ponds and depressions. At one point along the eastern margin, where the fen is narrowly squeezed between the plateau and bedrock exposure, there has formed an exceptionally striking plateau-fen interface. The plateau rises abruptly 1-3.5 feet above the fen peats with absolutely no intergradation of the communities. With no ecotone apparent, there can be no finer example of ecosystem differentiation in nature.

In the adjacent lowland, drainage areas with peat or sub-peat substrates, there are patches of treed fens. Noteworthy because of the diversity it adds to the site, and because it is an uncommon community of coastal peatlands, is the northern white cedar (*Thuja occidentalis*) fen or swamp in the southeastern corner of the site.

Condition and Use:

The site appears to be in excellent natural condition except for the remnants of a long abandoned telephone line and a couple of pathways used relatively frequently by naturalists, scientists, hunters, and others visiting the southwestern portion of the island.

7 JONESPORT HEATH, Jonesport

Reasons for Undecided Status:

The Jonesport Heath is significant because it contains the finest example of, and is the defining (Damman 1977) site for, the Coastal Plateau Bog peatland type. It is the only set of separate but contiguous coastal plateaus, has the most extensive *Scirpus cespitosus* central lawns, and totals the greatest acreage of any coastal raised peatland in the United States. The magnitude of the site provides excellent opportunity for the documentation of past and present climates. With the variety of kinds and degrees of mining disturbance on the multiple plateaus, the Jonesport Heath provides the premier situation for succession and recovery studies in the coastal raised bog region. The significance of the Jonesport Heath, among 115 coastal raised peatlands in Maine, ranks 3rd for Coastal Peatland Features and 2nd for All Peatland Features.

Significant Features:

- exceptionally well-developed plateau morphology
- contiguous but not coalesced plateaus
- excellent development and zonation of Coastal Plateau Bog communities
- largest *Scirpus cespitosus* central lawns in the United States
- one of only three sites clearly displaying shallow, radial channels
- small area of ponds and wet depressions between plateaus
- excellent example of streams, one moderate in size, offset by plateau development; the community zonation is characteristic and readily evident
- variety of non-plateau peatland types along margins of plateaus, possibly some adjacent upland with organic soils
- magnitude of site provides significant documentation of climate, now and in the past

Location and Size:

North and east of Jonesport, this site includes the whole interconnected and lobed complex of peatlands south of an east-west stream that is directly west of Bar Island at 44°33'59" N latitude, and extends southward to 0.3 mile north of the head of Sawyer Cove. The site consists of some 720 acres, about 640 being open and/or cleared.

A contiguous peatland of significance (North Unit, Jonesport Heath) lies just north of the stream.

Ecology, Condition and Use:

This highly lobate, multiple plateau, northwest-southeast trending peatland complex lies in gently undulating terrain of low relief. It is the most extensive complex of peatlands within the Coastal Region, consisting of several contiguous plateaus with little of the extensive coalescence that exists at some more inland sites. Nowhere in the Maine Coastal Region are there multiple, adjacent plateaus as at this site.

The northern third of the complex is composed of one large, elongated plateau, to its immediate east a smaller, lobed plateau, and to the northwest a much smaller plateau. As of September 1978 the northern 60% of the largest plateau, and all of the other two plateaus, the intervening streams, and streams and peatlands to the north of this site were unaltered by man.

Mining began in the southern plateaus of the site during or before the Second World War. That mining included drainage, with trench mining and briquet production. The peat may have been harvested in forms other than the briquets, as well. During the past decade, vacuum mining has been reactivated, spreading far northward and including 40% of the largest plateau. The peat is bagged for horticultural purposes.

The largest plateau forms the basis for most of the characterization of the Coastal Plateau Bog type given by Damman (1977). Considering the area untouched as of September 1978, no other site in this study more clearly displays the characteristic morphological and biological features of the Coastal Plateau Bog peatland type. An oblong plateau, the peatland rises rather sharply some nine feet above its margins to an extensive plateau (see cross-sectional diagrams in Damman 1977, Figures 2 and 4). Trees are exceptionally sparse, and occur exclusively on the marginal slopes. Absent from the central plateau, dwarf shrub communities occupy the edges of the upper surface and the marginal slopes. Fringing the Scirpus cespitosus - Sphagnum fuscum lawns are expanses (perhaps the largest anywhere in the United States) of the Empetrum nigrum - Sphagnum fuscum community, with much baked-apple berry (Rubus chamaemorus). As the marginal slope steepens, the Kalmia angustifolia - Sphagnum fuscum community (and closely related variations) predominates until minerotrophic conditions are encountered at the margins. Where there is no free flowing water there commonly is the Smilacina trifolia - Sphagnum pulchrum community, and where streams abut the plateau there are rhodora (Rhododendron canadense) and/or sweet gale (Myrica gale) shrub communities.

A small group of distinctive ponds occurs midway along the eastern margin where a small stream from the southeast meets the peatland and accelerates drainage, thus oversteepening the slope and allowing pond formation. Minor ponds and mud bottom hollows can be expected sporadically on the margins of the plateau. This plateau has clearly directed the flow of small streams along its eastern and western boundaries and the larger stream forming the northern boundary.

Within the dwarf shrub communities variations in plant composition demark widely spaced, broad (perhaps 20-60 feet wide) radial "channels" (probably so shallow as to be easily overlooked by an on-the-ground visitor) leading from the Scirpus lawns to the middle lower slopes of the peatland. Several regularly spaced "channels" radiate from the northern half of the plateau height. Only two other sites in this study have so clearly developed channels.

Also unaltered are the two peatlands flanking this large plateau. Both share some of the significant features of the large plateau. The western unit appears typical of the many small coastal plateau bogs lacking Scirpus lawns that occur commonly in this part of the Coastal Region. The eastern of the three plateaus approximates the principal plateau, but is somewhat

smaller, there being an upland lobe that gives it the shape of a lopsided letter C, and the Scirpus lawns are smaller, diffuse, and not distinctive. This peatland shares a common margin with the principal plateau for about ½ mile.

It is reasonable to presume that this peatland complex has been a peatland for 7000 or more years, increasing in thickness and perhaps breadth at variable rates, according to climate and the hydrological limits of the morphological development, since that time. The proportion of peat volume removed by mining or ditching to date is far less than the proportion of surface area disrupted. Furthermore, most mining does not extend to the very margins of the peatlands, but leaves pockets of relatively undisturbed peatland along most of the periphery of the complex.

In most areas of former trench mining, few of the trenches reach the underlying mineral substrate, and between the trenches were left in place intact peats, for transportation and briquet drying. Thus, not only is a large proportion of the peat still present, it is intact stratigraphically. In areas currently being vacuum mined, the materials are removed relatively evenly from the peatland surface. Since the vacuum mining has been in operation for only a few years, for most of the mined area the bulk of the deposit is still present. The reclamation of trenched areas, smoothing the surface to permit future vacuum mining, is underway. This reclamation destroys much or all of the residual stratigraphy.

Consequently, since this peatland is a three-dimensional portion of the landscape, with a past that is recorded in the deposition of materials over thousands of years, the presence of the bulk of those materials, essentially unchanged, means that perhaps as much as 80% or more of the peatland remains intact and essentially undisturbed.

The removal of water by drainage has its major effects in the drainways and in the uppermost portion of the peatland--the living vegetation and the top few inches of the sediments. The most important impact is the increase in the region of aerobic activity, principally decay, and the subsequent alteration in community composition. The drainage at this site appears to be designed to effect a local draw-down of several inches or more, with the necessity of additional ditching once all peats are mined that the first draw-down permitted. Consequently, one may conclude that the hydrologic functions of this peatland complex, although somewhat altered, are not fundamentally changed, and that restoration to near natural condition is possible by the careful blocking and filling of drains. These hydrologic functions include the role of Jonesport Heath in the ground water regime in the Jonesport area.

Since this site contains the largest, most clearly developed, and only multiple plateau system in the Coastal Plateau Bog zone, its peats contain important records of climatic and biotic activity. Thus, this site contains many clues of importance to the post-Pleistocene biologist, anthropologist, climatologist, hydrologist, as well as ecologist, clues perhaps unavailable or less clear at other coastal peatland sites.

Coalesced raised peatlands wherein original basins and simple morphology are masked by the coalescence appear to be confined in the eastern United

States to Maine. In order to understand peatlands such as Meddybemps Heath or The Great Heath one need also investigate features nearby that approach the phenomenon but do not achieve it. All of the coalesced peatlands in Maine are inland, some of the largest are on the periphery of the coastal zone. It is therefore of considerable importance that coalesced peatlands are absent from the Coastal Zone, and the only circumstance approaching coalescence are the multiple, contiguous plateaus of the Jonesport Heath.

Succession patterns of natural ecosystems on altered, especially mined, peatlands in North America, especially those of the United States, are essentially unknown. No successional features on disturbed peatlands in Maine have been detailed. It is clear that succession on such peatlands will vary greatly according to the region of the state in which the site occurs, as well as local hydro-geomorphological conditions. Thus, succession must be studied within each peatland region. Since this site has the most distinctive expression of the Coastal Plateau Bog, has multiple plateaus, and has a variety of types and degrees of disturbance, it provides the premier situation for succession studies in the region.

The Jonesport Heath is placed in an undecided category because additional field work is required to identify those portions of this system that remain in a natural state, and also because some of this area is currently a commercial peat operation.

8 NORTH UNIT, JONESPORT HEATH, Jonesport

Reasons for Recommendation:

The North Unit of the Jonesport Heath is recommended because it is the most outstanding undisturbed Coastal Plateau Bog in the United States. It exhibits fully the plateau morphology and community zonation with extensive development of all plateau communities; the undisturbed central *Scirpus cespitosus* lawns are the largest such in the United States. The plateau confined marginal streams, and the treeless marginal wetlands are exceptional. The significance of the North Unit of the Jonesport Heath, among 115 coastal raised peatlands in Maine, ranks 4th for Coastal Peatland Features and 5th for All Peatland Features.

Significant Features:

- largest intact Coastal Plateau Bog in the United States
- largest undisturbed central *Scirpus* lawns in the United States
- large zone of *Sphagnum fuscum* - *Empetrum nigrum* community
- one of only three sites with well-developed shallow radiating channels on upper plateau sites
- distinctive marginal slopes and obvious rise to plateau
- broad zonation of lower slope communities; sweet gale (*Myrica gale*) dominance below dwarf shrub heaths, then rhodora (*Rhododendron canadense*) community at base of slope
- variety of especially well-developed, treeless marginal wetlands

Location and Size:

North of Jonesport, this plateau peatland unit lies north of an east-west stream that is directly west of Bar Island at 44°33'59" N latitude. It is 1.5 miles east of Indian River community. The site contains about 240 acres, of which the plateau is about 130.

Ecologically, it appears unwise to separate this site from the Jonesport Heath site, but such distinction is mandated because of the present mining activities. There is no question that the two sites are part of a single hydrologic system of considerable complexity. If the waterflow in the stream that passes between the sites remains essentially unaltered, the integrity of this site should not be violated.

Ecology:

The raised plateau bog portion of this site more closely resembles the highly significant principal plateau of the Jonesport Heath site than does any other peatland in the United States. It differs in being slightly smaller, having a somewhat arcuate long axis, having a somewhat smaller proportion of the peatland occupied by Scirpus lawns, having slightly less steep marginal slopes, and in having more extensive marginal fens.

No other undisturbed Coastal Plateau Bog in the United States so clearly exhibits the characteristic morphological and biological features of this peatland type. Because of the large size of the site, which permits a full and exemplary development of the communities, and their zonation in accordance to the plateau morphology, and because the plateau is complete, without alteration or truncation, it is the most significant of all the Coastal Plateau Raised Bogs in the United States as the fullest and most complete expression of the type. It is the paradigm against which other peatlands can be interpreted, since the preferred type site is being mined.

In addition to the plateau features, this site contains a notable diversity of marginal phenomena. To the south and west is a stream of moderate size that is the principal drainage stream of the central part of the Jonesport peninsula. Having come from large wetlands to the east, this stream drains the northern slopes of the Jonesport Heath and the southeastern slopes of this site's plateau. These raised peatlands form a confined passage for the meandering stream, which possibly flows atop peat at that point. The stream continues westward, with flanking wetlands, then turns northward where it flows adjacent to the base of the North Unit plateau until joined by the smaller, northern marginal stream. This northern stream is not large and lies entrapped between the raised peatland and treeless wetland.

Where streams are entrapped against raised peatland, there are typical streamside zonation of communities, including graminoid fen margins, with Myrica gale and Rhododendron canadense communities at the base of the plateau slopes. Broad areas of treeless wetland of undetermined composition lie north of the plateau and in the southwestern corner of the site, in the bend of the large stream as it turns from westward to northward. To the east, part of the plateau abuts upland with discrete but narrow lagg; no well-developed moat appears to be present.

Condition and Use:

Surrounded for the most part by wetlands that likely are difficult of passage for most of the year, and centrally located in the Jonesport peninsula a mile or more from roads, the site must be rarely visited. As of September 1978, this peatland was in excellent, undisturbed natural condition.

9 KELLEY POINT PEATLAND COMPLEX, Jonesport

Reasons for Recommendation:

The Kelley Point Peatland Complex is recommended because it is an excellent, complete, undisturbed Coastal Plateau Bog, one of only two such in the United States. The exceptional diversity of peatland types make it the most significant undisturbed site in the coastal region. It is one of only three recommended sites with tidewater erosion of peats. The significance of the Kelley Point Peatland Complex, among 115 coastal raised peatlands in Maine, ranks 2nd for Coastal Peatland Features and 1st for All Peatland Features.

Significant Features:

- distinctive *Scirpus cespitosus* lawn communities at plateau height
- large areas of *Sphagnum fuscum* - *Empetrum nigrum* "hollowless" plains
- abundant baked-apple berry (*Rubus chamaemorus*)
- obvious bog slopes
- peat erosion by tidewater
- exceptionally diverse marginal peatland types
- possible Shrub Slope peatlands
- some adjacent upland soils are organic
- large areas of non-plateau peatland types, including all degrees of cover, dominance by nearly every life form, and a wide range of ombrotrophic to minerotrophic conditions
- diverted marginal stream
- irregularly patterned pond and wet depression system in drainage fen
- possible beaver activity
- smaller areas of raised peats apart from principal plateau

Location and Size:

This complex peatland occupies over 250 acres between Rhine Point, Kelley Point and Sawyer Cove east of Jonesport. It is easily reached from Kelley Point Road.

Ecology:

The medium sized raised plateau is an excellent example of the type and is one of only four sites in the United States known to so completely exhibit the type characteristics, and one of only two complete and undisturbed, fully characteristic Coastal Plateau bogs in the United States (the other being the North Unit of Jonesport Heath). The peatland clearly rises from lower margins to a central height that is somewhat elongated from north to south. The highest elevation of the raised bog is a distinctive, though relatively small,

plateau of Scirpus lawns. In the northern third of the plateau, the lawns lie encircled by extensive areas of well-developed, dwarf shrub communities rich in Sphagnum fuscum, black crowberry (Empetrum nigrum), baked-apple berry (Rubus chamaemorus), and bog goldenrod (Solidago uliginosa). A prominent region of sweet gale (Myrica gale) fringes the east edge of the Scirpus lawns. The obvious bog slope varies in steepness depending upon direction from the plateau. Surface ponds are absent, and mud bottom communities nearly so, throughout the plateau and its shoulders.

Worthy of more careful inspection are what appear to be areas of Shrub Slope Peatlands, especially southeast of the plateau, as well as minor patches along the northwestern margin of the plateau.

Extending eastward from the height of the plateau are wooded, semi-wooded, thicket, and open peatlands which intermingle in a mosaic of peatland types. Occasional large boulders emerge amid or above the vegetation. In some more wet open patches orchids are abundant. This peatland area extends to tidewater where it is periodically eroded by storm waves as they crest the barrier beach and enter the lagoon. Sea-cut peatlands are known to exist at only three other locations in the study area (one is miniscule and occupied by a threatened home), and less than 5-7 locations in all of Maine. Only one other site, Carrying Place Cove Bog, has beach deposition upon terrestrially formed peats.

As waters descend from the plateau (which forms a multiple watershed divide), and sometimes are joined by upland waters, they pass through one of several drainage ways, including areas of Sphagnum - graminoid fens, thicket fens, tamarack fens, other wooded fens, and (beaver?) impounded waters. This diversity of drainage types is unparalleled at any site discussed in this report. If the impoundment is by beaver, this site is only one of three coastal peatlands with beaver damming, all of which appear to be the result of recent (last decade or two) activity. Of particular note are the surface ponds and wet depressions that are irregularly patterned ("ladder like" to "string of beads" formation) in the Sphagnum - graminoid - dwarf shrub fen drainage that leads southward from the plateau.

Condition and Use:

Visually attractive and accessible, this site is seldom visited. Berry picking was likely quite common in the past, but is now apparently only occasional. Throughout, this site appears to be in excellent natural condition.

10 GREAT COVE HEATH, Roque Bluffs

Reasons for Recommendation:

Great Cove Heath is recommended because it is an undisturbed, well-developed peatland that excellently displays features intermediate in character between those of extreme Coastal and Inland peatlands. It has unusually good visibility from an adjacent road. The significance of Great Cove Heath, among 115 coastal raised peatlands in Maine, ranks 18th for Coastal Peatland Features and 17th for All Peatland Features.

Significant Features:

- plateau height offset to upstream margin of peatland
- Empetrum nigrum - Sphagnum fuscum community with scattered baked-apple berry (Rubus chamaemorus) here and there at upper elevations of peatland
- Scirpus cespitosus absent except in marginal open fens
- diversity of peatland types, including open plateau, slightly wooded plateau, herbaceous fen drainageway, forested peatland, plus two separate, small, open peatlands

Location and Size:

Lying on the north side of the Jonesboro to Roque Bluffs road some 0.8 mile northeast of Great Cove, this peatland has easy access and excellent visibility. The site, most of which is treeless, is slightly less than 100 acres.

Ecology:

This medium sized plateau is typical and representative of many peatlands in the study area of similar size, that albeit are near tidewater, are not in the extreme maritime setting of heads of points or islands.

Raised, but not dramatically so, the southern half of the peatland is viewed easily from one's car when driving past. Typical with most raised peatlands, its highest elevation is "upstream," in this case appearing to be to the south and east of center. The principal open peatland has a fairly narrow spruce lagg bordering the upland along much of its periphery. Trees extend some distance into the peatland, rapidly becoming less dense and shorter, leaving a large, central, mostly treeless area dominated by dwarf shrub communities. Here and there, and more commonly at the higher elevations, is the Empetrum nigrum - Sphagnum fuscum community, with scattered baked-apple berry (Rubus chamaemorus) only occasionally abundant. No Scirpus cespitosus was seen on the plateau. No ponds or wet depressions appear to be present.

Some diversity of peatland types occurs in the northern and northeastern part of the site where there are at least two separate, small, open peatlands, one wetter drainage way with numerous herbaceous fen species, and wooded peatland and/or wetland.

South of the road the topography drops away, suggesting that the road lies astride a low ridge (of undetermined composition) that may have been a kind of "dam" creating a shallow basin in which the peatland initiated. The geomorphology of this feature should be compared with the "dam" at Moose River Heath.

This site clearly and typically represents the transition of peatland types for small and moderate size of peatlands, from: a) those in extreme maritime locations where Sphagnum fuscum forms undulating, essentially hollowless plains and/or dense hummock and hollow terrain (with Sphagnum fuscum even in the hollows) in which Empetrum nigrum is the exclusive or dominant shrub (most commonly very subdued in size), Rubus chamaemorus is copiously

abundant, and Scirpus cespitosus may grow as scattered plants; to b) those at Inland settings where Sphagnum fuscum very rarely or never approaches plain formation (being usually most common on the tops of, or on one side of, hummocks), where Empetrum nigrum is not present (or if present, as in a few larger, highly raised sites, it is of lesser prominence than other dwarf shrubs), and where Rubus chamaemorus is absent.

Therefore, the principal significance of this site resides in its being a typical example of the Coastal/Inland transition type, and in its public visibility (from the adjacent road).

Condition and Use:

Aside from occasional visitors, especially berry pickers and hunters, the site seems undisturbed. It appears in excellent natural condition.

11 LARRABEE HEATH, Machiasport

Larrabee Heath is recommended because it is an undisturbed, obviously raised plateau with steep marginal slopes that fills an elongated valley, confining stream flow to its margins; community zonation is simple and clearly developed. This is the only coastal plateau with prominent beaver activity adjacent. From above Larrabee Heath is especially appealing. Its characters are simply arrayed and easily perceived. The treeless plateau, enhanced by community zonation and the marginal streams, enclosed within a small valley, contrasts strikingly with the neighboring, forested upland. The significance of Larrabee Heath, among 115 coastal raised peatlands in Maine, ranks 15th for Coastal Peatland Features and 11th for All Peatland Features.

Significant Features:

- prominently raised peatland with steep marginal slope
- marginal slope communities distinctive and well developed
- Empetrum nigrum - Sphagnum fuscum community at height of plateau, but limited in extent
- baked-apple berry (Rubus chamaemorus) scattered, Scirpus cespitosus absent
- superb examples of meandering marginal streams with graminoid and wooded communities
- prominent beaver activity
- one of larger plateaus in Coastal Region

Location and Size:

This relatively large peatland (the site is about 235 acres, of which over 150 are open plateau) is partially visible to the southwest from the main road at Larrabee. Access is attained via woods roads.

Ecology:

One of the larger plateaus in this study, Larrabee Heath has distinctive lagg stream margins, evident community zonation, some coastal communities,

and significant beaver activity. If Scirpus lawns were present, this site would rank in the top eight sites.

Larrabee Heath fills an elongated valley with a wetland system dominated by a prominently raised plateau. Lateral expansion of the raised peatland has confined streams along the north and south margins adjacent to the uplands of the valley sides. These streams, which can be considered laggs, meander narrowly within graminoid fen vegetation. Except for the Jonesport Heath, no other site recommended in this report has such distinctive, "textbook quality" marginal stream displacement. With increasing water levels caused by the recent beaver dam below the confluence of the two streams, some areas of former marginal tamarack (Larix laricina) fen have been converted to graminoid fen due to the death of the trees. Confined marginal streams and/or beaver ponding are commonly associated with raised bogs in the Inland regions, but are rare in the Coastal Region.

The plateau topography, and the associated community zonation, is simply and clearly developed. As the streams become narrower with closer proximity to the plateau peats, leather-leaf (Chamaedaphne calyculata) abundance increases. The base of the plateau usually is clearly evident, marked by a distinctive peat rise and slope. Rhodora (Rhododendron canadense) and/or sweet gale (Myrica gale) shrubs become abundant, joined by Sphagnum spp. and ericaceous shrubs. At varying distances from the marginal streams (wider downstream, much closer upstream) this gentle slope abruptly rises 3-6 feet vertically as the principal slope of the plateau. Very minor seeps exude from this "escarpment" but a well-developed sequence of ponds and/or wet depressions does not ring the peatland (as occurs at the morphologically similar, Inland Plateau, "Runaway Pond Heath," a few miles to the north). Occasional ponds and wet depressions do occur along this juncture, notably along the northeastern end of the plateau.

On and above this slope are vigorous dwarf shrub heath communities, with increasing components of Sphagnum fuscum and black crowberry (Empetrum nigrum) with elevation. The plateau surface rather surprisingly has few areas dominated by the Empetrum nigrum - Sphagnum fuscum community, and Scirpus cespitosus appears absent. Baked-apple berry (Rubus chamaemorus), locally scattered in the Sphagnum fuscum communities, is nowhere abundant. Bog goldenrod (Solidago uliginosa) grows scattered over the plateau. The plateau is devoid of trees except for a tongue of coniferous forest upon undetermined substrate that extends from the south margin, and a region of low spruce trees near the northwestern periphery and scattered in the western end.

The beaver dam is optimally placed to produce the largest possible impoundment for the least dam size. It lies downstream of the junction of the marginal streams and creates a large pond in the crotch of the Y. The elevated water level extends at least along 25-35 percent of the northern margin. There is no reason to suspect the plateau to be affected by those higher water levels, except perhaps at its lowest margins, for the hydrology of the raised peat mass is essentially independent. No effects were noted on any of the raised portions of the site. If the beaver dams were removed, there should be no detrimental effect upon the plateau.

Beaver in association with Coastal Plateau Bogs is very rare, for seldom do the peatlands have sufficient flowing water or food sources for the beaver. No other site recommended in this report has beaver activity adjacent to a plateau, nor did I observe the remains of former dams, lodges, canals, or trails at any other peatland recommended here.

Condition and Use:

Seldom visited except by hunters, this peatland is in excellent natural condition. According to Damman (pers. comm. 1977), a fire crossed the surface in the early 1970's. No traces or scars of that fire were apparent in the contemporary vegetation.

12 KELLEY HEATH, Cutler

Reasons for Recommendation:

Kelley Heath is recommended because no other coastal raised peatland in Maine has so continuous a vista of *Scirpus cespitosus*, which is almost universal on the sub-circular plateau and uniquely in the well-developed, lower elevation, peatland "bays." It is one of only three coastal peatlands with concentric patterning of vegetation and topography, and the abruptly raised margins are among the most distinctive in the eastern United States. The significance of Kelley Heath, among 115 coastal raised peatlands in Maine, ranks 7th for Coastal Peatland Features and 10th for All Peatland Features.

Significant Features:

- distinctive plateau morphology with obvious marginal slopes
- *Scirpus cespitosus* abundant, with associated vegetation on an often patterned mosaic of "mud bottom," lichen dominated, *Sphagnum fuscum*, *S. rubellum*, and generally subdued, dwarf shrub communities likely accentuated by the former removal of the vegetation cover
- one of only three sites with so large a proportion of *Scirpus cespitosus*, one of only eight plateaus in the state with well-developed lawns
- one of only three Coastal Plateau Bogs in Maine with concentric patterning, the patterning is the most extensive and readily apparent from the air and on the ground
- excellent development of marginal, open peatland "bays"
- visible and accessible from U.S. Navy road

Location and Size:

This peatland is reached conveniently via the UHF transmission station access road opposite the main gate of the Cutler Navy Base on Route 191 just south of Huntley Creek. The mostly open site contains about 170 acres, of which about 103 are plateau.

Ecology:

According to the owner of the site, the surface of the open plateau expanse was "turned over with a bulldozer" and "blown into a trailer" for "humus" about "15 years ago" (i.e., about 1963). The surface of the peatland "grew back in a couple of years."

Very little volume of the peatland was removed, and the plateau retains a prominent plateau configuration, rising sharply 3-9 feet above marginal uplands and peatlands. Trees characteristically are restricted to the margins (as was apparently the case prior to the bulldozing), and there is no indication that the plateau is being colonized by trees. Presumably enhanced by the stripping of the vegetation Scirpus cespitosus is almost universal on the plateau, with a mosaic of associated vegetation, including Sphagnum fuscum communities, baked-apple berry (Rubus chamaemorus), black crowberry (Empetrum nigrum), and bog goldenrod (Solidago uliginosa). The boundary of disturbance is not evident, but the Scirpus extends well into areas with scattered trees clearly older than 15 years, as well as occupying central regions of the marginal, tree encircled, peatland "bays" that lie well below the plateau elevation at the base of the southern plateau slope. Thus, the Scirpus lawns are natural constitutuents of this peatland, as well as aggressive inhabitants of disturbed terrain 15 years after the removal of surface vegetation.

No other site in the Coastal Region is so prominently concentrically patterned. The patterning is formed by interfingerings, roughly crescentic to linear or rather oblong in shape, of Scirpus lawns and dwarf shrub communities. The latter tend to occupy low ridges, the former broad, shallow depressions (not always particularly deep or wet). Relief may vary from a few inches to three feet or so.

The patterning at this site is remarkable because it is recognizable over almost the entire plateau, it is so clearly concentric, it so clearly defines the central height of the plateau (which, typically, is offset to the hydrologically upper side of the peatland--in this case it is in the northern third of the plateau), and because it so completely masks any trace of the former disturbance.

The concentric patterning is superimposed upon the Coastal Plateau Bog concentric zonation of communities, central Scirpus lawns, with surrounding dwarf shrub communities extending to and down the plateau slope, with increasing tree frequency on the lower slopes and at their base. Bordering most of the sub-circular open plateau are forested peatland and wetlands, sometimes with open areas. To the west this region is quite narrow, to the south and east it is rather broad. Typical for sub-circular plateau heaths, but scarce in the Coastal Region, at the "downstream" side of the plateau there is a system of smaller "bay" peatlands extending from the southern base of the plateau, separated by an intervening row or grove of trees. It appears that the principal plateau is continuing to expand southward into the bays.

Condition and Use:

Currently, in spite of its proximity to the Navy facility, and being adjacent to a base road, this peatland appears lightly to rarely visited.

13 HEATH, 1.9 MILES WEST OF NORTH CUTLER, Cutler

Reasons for Recommendation:

The heath that lies 1.9 miles west of North Cutler is recommended because it is one of the smallest clearly raised plateaus with steep marginal slopes. There is an excellent development of Sphagnum fuscum communities, including "hollowless" plains. Sparsely scattered Scirpus cespitosus amid Sphagnum fuscum is known at only three other coastal peatlands. The significance of this peatland, among 115 coastal raised peatlands in Maine, ranks 13th for Coastal Peatland Features and 18th for All Peatland Features.

Significant Features:

- clearly raised plateau with steep marginal slopes
- "hollowless" plain of Sphagnum fuscum on part of plateau
- variety of peatland vegetation types characteristic of smaller peatlands in the Coastal Region
- area with dwarf forest of low black spruce (Picea mariana)

Location and Size:

About 1.9 miles west of North Cutler this site is clearly figured on the U.S.G.S. Machias Bay 7½' quadrangle, and can be reached by roads of the Cutler Navy Base. The site is less than 50 acres in extent, with about 25 open peatland areas.

Ecology:

The southern portion of this small peatland is prominently raised with exceptionally steep marginal slopes, thus almost the entire peatland (in the southern half at least) is plateau surface. This surface supports a vigorous Empetrum nigrum - Sphagnum fuscum community with copious baked-apple berry (Rubus chamaemorus). In places this community forms an undulating plain, sometimes "lumpy," but generally without distinctive hollows or depressions, a feature best expressed at peatlands very near the sea.

A wetter area partially separates the northern portion of the peatland, which is fairly densely treed with stunted and short black spruce, (Picea mariana), from the open, southern plateau. In it are a few wet depressions and minor ponds.

Condition and Use:

During construction of the Cutler Navy Base approximately 20 years ago, an ineffectual drainage ditch was dug in the extreme southwestern corner of the peatland, extending quite a distance from the bog. A boundary of the Navy Base crosses the southern portion of the peatland. South of the boundary most tree individuals were cut and removed during construction of the base. It is unclear what effect the removal of the generally sparse and small (or stunted) trees, along with the attempt to drain the peatland, has had on the Sphagnum fuscum communities, which are growing with obvious vigor. At present this peatland may be the least visited of any site recommended by this study.

14 NORTH CUTLER HEATHS, Cutler

The North Cutler Heaths are recommended because they have the highest proportion of open peatland with Scirpus cespitosus communities of any undisturbed raised peatland in the coastal region of the United States. The three, relatively small, contiguous peatlands display a gradient of typical coastal raised peatland vegetation, from open to wooded by low trees. The significance of the North Cutler Heaths, among 115 coastal raised peatlands in Maine, ranks 6th for Coastal Peatland Features and 12th for All Peatland Features.

Significant Features:

- exceptionally large proportion of the surface of the most open peatland occupied by Scirpus cespitosus communities
- widespread and abundant Coastal Region communities and species--including Scirpus cespitosus communities, Empetrum nigrum - Sphagnum fuscum communities, baked-apple berry (Rubus chamaemorus), and bog goldenrod (Solidago uliginosa)
- variety of typical, regional, peatland vegetation types
- visible and accessible from nearby road

Location and Size:

Readily accessible and visible from a town road, the site lies at the north base of the narrow ridge extending directly west from the road junction called North Cutler. Because of the shared geomorphic setting, the close proximity to each other, and the probable interrelatedness of their hydrologies, three peatlands ("0.4 mile W of North Cutler," "0.7 mile W of North Cutler," and "1.1 mile W of North Cutler," Table 4), which might even have contiguous peats, comprise this single site recommended for evaluation as a potential Critical Area. The site includes approximately 113 acres, about 63 of which are open.

Ecology:

The principal feature of significance of this site are the extensive Scirpus lawns, especially in the easternmost of the three open peatlands which most clearly conforms to the coastal plateau form. This unit has an exceptionally large proportion of its surface occupied by Scirpus communities, equalled in proportion by only three other sites in the Coastal region. This is the only undisturbed (whether by natural or human causes) peatland of the four sites.

In contrast with the characteristic community zonation for the Coastal Plateau Bog type, Sphagnum fuscum, Scirpus cespitosus, and black crowberry (Empetrum nigrum) are widespread and abundant over nearly the entire broad plateau surface. Baked-apple berry (Rubus chamaemorus) is not so common as at most sites visited in the Coastal region, and is most abundant away from the center of the plateau. Bog goldenrod (Solidago uliginosa) is locally abundant. Plants apparently ascribable to Lycopodium annotinum var. pungens were located in the open peatland of both the middle and eastern units. This variety has been reported otherwise on ombrotrophic peats only at Boot Cove Heath and on Great Wass Island.

Condition and Use:

Human intrusion appears negligible, although logging transgresses upon some boundaries. There is local berry picking, but otherwise the peatlands appear in excellent natural condition.

15 MOOSE RIVER HEATH, Trescott

Reasons for Recommendation:

Moose River Heath is recommended because of its openness and visibility, the well-developed, undisturbed, prominently zoned vegetation (especially the "hollowless" plains of *Sphagnum fuscum* and the abundant dwarf huckleberry, *Gaylussacia dumosa*), the proximity to the sea, and the confining dam-like margin which is likely a former beach. In one of the most scenic settings of any coastal peatlands, it has an excellent overlook from an adjacent rocky ridge. The significance of Moose River Heath, among 115 coastal raised peatlands in Maine, ranks 17th for Coastal Peatland Features and 16th for All Peatland Features.

Significant Features:

- clearly raised plateau
- well-developed "hollowless" plains of *Sphagnum fuscum*
- well-developed dwarf shrub communities
- locally abundant black crowberry (*Empetrum nigrum*), baked-apple berry (*Rubus chamaemorus*), bog goldenrod (*Solidago uliginosa*), and dwarf huckleberry (*Gaylussacia dumosa*)
- broad lagg with prominent rhodora (*Rhododendron canadense*) and dwarf huckleberry (*Gaylussacis dumosa*) along western margin
- very near the sea
- excellent visibility from atop neighboring rocky ridge

Location and Size:

This site is conveniently reached from the Cutler-Trescott road via the access road to a hunting club lodge just south of the mouth of Moose River. An excellent view of the entire peatland, some 60 acres in extent, can be had from the ridge separating it from the mouth of Moose River to the east.

Ecology:

This relatively small, completely open peatland lies very near the sea, removed sufficiently from the rocky shore to be well beyond splash or storm thrown debris. An exceptionally open peatland for its size, this plateau has no *Scirpus* lawns, and *Scirpus* was not noticed during the visit. *Sphagnum fuscum* communities are widespread, as is black crowberry (*Empetrum nigrum*). Baked-apple berry (*Rubus chamaemorus*) is locally abundant, and bog goldenrod (*Solidago uliginosa*) typically frequent but well dispersed. The *Emeptrum nigrum* - *Sphagnum fuscum* community forms sub-hollowless plains in places.

In autumn, brilliantly scarlet circular clones and exceptionally broad marginal zones of dwarf huckleberry (Gaylussacia dumosa) provide exuberant color, which contrasts with the purple-red of rhodora (Rhododendron canadense), also marginal, and the intense greens and browns of the black crowberry (Empetrum nigrum) hummocks. The northeastern lagg has a tree canopy, whereas moderately tall and thicket shrubs predominate in parts of the southwestern lagg. The extreme seaward edge of the peatland has a distinctive, narrow band of shrubs. Deer trails radiate from the northwestern tip into the peatland.

At present one can look directly at the sea when standing on the plateau, for the vegetation between the peatland and the shore contains mostly shrubs, grasses and herbs. At one time this area certainly was forested, presumably by a coniferous forest. Salt spray reaches the peatland during strong storms and winds, as well as abundant sea fog, providing a very maritime environment.

Along the seaward margin of the peatland is a low dam-like ridge of unconsolidated deposits parallel with the shore. Almost certainly a former beach deposit, this geomorphic feature may have provided the necessary shallow basin for the initiation of the peatland. This significant feature warrants investigation. Radiocarbon dating of the basal peats (and other inquiries) should provide important information about former land-sea relationships.

Condition and Use:

Apparently seldom visited the peatland appears in excellent natural condition. Use of the adjacent uplands appears common, possibly primarily because of the high scenic qualities of the coast. The smallness and accessibility of the peatland make it particularly vulnerable to human disturbance.

16 SOUTH TRESCOTT HEATH, Trescott

Reasons for Recommendation:

South Trescott Heath is recommended because it uniquely consists of a prominently raised circular plateau, an adjacent, incompletely circular plateau, and an intervening minor stream. Well-developed coastal communities form obvious vegetation zones, and the site has the best examples of radial, shallow drainage channels of any peatland in the eastern United States--a rare feature known only at two other Maine coastal raised bogs. The significance of South Trescott Heath, among 115 coastal raised peatlands in Maine, ranks 16th for Coastal Peatland Features and 13th for All Peatland Features.

Significant Features:

- most obviously raised of any of the smaller Coastal Plateau Bogs
- extensive Empetrum nigrum - Sphagnum fuscum community on treeless upper plateau, often as "hollowless" plains
- copious baked-apple berry (Rubus chamaemorus), and black crowberry (Empetrum nigrum)
- prominent community zonation throughout, especially with elevation, and along radial channels, the water track, and the plateau margins

- excellent development of radial channels on raised plateau
- distinctive, small water track crosses between the two raised units

Location and Size:

About 0.8 mile west of Baileys Mistake this peatland is easily reached from Route 191 south of South Trescott via the small road just northeast of The Pool. About 80 acres of the 106-acre site are open peatland.

Ecology:

This is a very distinctive site, and perhaps should be ranked even higher. As with Carrying Place Cove Bog, this peatland has added significance because of the documentation done by Osvald (1955, 1970) in 1927.

Of interest and significance is the shape of this peatland, being one complete, circular plateau, with a water track along its southwestern margin, and a second, incompletely circular plateau lying southwest of the water track. The two plateaus form a single, oblong peatland with origins in a shallow lake (Osvald, 1955).

The vegetation is typical of the peatlands of moderate size in the Coastal Region, and the descriptions of Osvald (1955) seem applicable still. The bulk of the plateaus are dominated by dwarf shrub heaths that give way to the Empetrum nigrum - Sphagnum fuscum community with copious baked-apple berry (Rubus chamaemorus) at higher elevations. No Scirpus cespitosus was noted by Osvald (1955) or observed during my visit.

The water track is distinctive on the ground and even more so from the air, and forms a prominent feature of significance, being a surficial drainage across a peatland of simple stucture (cf. the cross-section illustrated by Osvald, 1955, Figure 1). In autumn the pathway is colorfully marked by the purple-red rhodora (Rhododendron canadense). The water track drains surficial and possibly subsurface waters. From the center of the northeast plateau (really a shallow dome), radiate several linear depressions that channel surface water during heavy precipitation. Perceptibly, but not strikingly, marked by vegetation differences, a few of these channels, which are best seen from the air, lead to the water track. From the other dome a small region of rhodora dominated community lead from a few trees to the water track. It is likely a small soak.

Trees are nearly absent on the larger dome, which has the largest expanses of Empetrum nigrum - Sphagnum fuscum community, but are scattered on the smaller dome, which may be lower in elevation. A narrow, forested lagg surrounds most of the raised peatland.

Condition and Use:

Previously burned for enhancement of berry production, this peatland now seems little visited and essentially in completely natural condition.

17 BOOT COVE HEATH, Lubec

Reasons for Recommendation:

Boot Cove Heath is recommended because it displays notably both "hollowless" plain and accentuated hummock topographies with abundant coastal species in communities modified by an extreme maritime climate. It is one of the smallest sites with obviously raised peats. The significance of Boot Cove Heath, among 115 coastal raised peatlands in Maine, ranks 14th for Coastal Peatland Features and 14th for All Peatland Features.

Significant Features:

- excellent development of *Sphagnum fuscum* dominated communities, including "hollowless plains" and prominent hummocks
- locally abundant lichens in *Sphagnum fuscum* communities
- abundant baked-apple berry (*Rubus chamaemorus*) and black crowberry (*Empetrum nigrum*)
- scattered *Scirpus cespitosus*, but no lawns
- one of smallest sites with obviously raised peats

Location and Size:

A short woods road leads south from the South Trescott-Lubec road to this peatland that is about 0.4 mile west of Boot Cove. Less than 20 acres of this nearly 50-acre site are open.

Ecology:

This oblong peatland reveals its extreme maritime position by the very well-developed *Empetrum nigrum* - *Sphagnum fuscum* community, which occupies much of the plateau. In places there is very "lumpy" hummock-hollow terrain, elsewhere essentially hollowless *Sphagnum fuscum* plains prevail. Baked-apple berry (*Rubus chamaemorus*) is prolific throughout. Lichens commonly are prominent. Stunted spruce are here and there. *Scirpus cespitosus* grows throughout the site amid the *Sphagnum fuscum*, but does not form lawns.

The forested peatland margins merge with organic upland soils in places.

Condition and Use:

Apparently seldom visited this peatland is in essentially natural condition. Some logging activity abuts the peatland.

18 CARRYING PLACE COVE BOG, Lubec

Reasons for Recommendation:

Carrying Place Cove Bog is recommended as one of the most significant peatlands in the eastern United States because of its pronounced coastal plateau morphology and vegetation, the erosion by tidewater, the overriding

by an active beach, the documented persistence of the peatland features, and the visibility and accessibility of the site. The complete, natural cross-sectional exposure of raised peatland is unique in the eastern United States and of tremendous scientific importance; the isthmus geomorphic setting is unparalleled in the United States for a raised bog. The significance of Carrying Place Cove Bog, among 115 coastal raised peatlands in Maine, ranks 1st for Coastal Peatland Features and 3rd for All Peatland Features.

Significant Features:

- displays with exceptional clarity the morphological and biological characteristics of the Coastal Plateau Bog type; one of only four sites in the United States known to so completely exhibit the type characteristics
- outstanding examples of marginal slope morphology, with exceptionally well-developed surface ponds
- one of only three Coastal Plateau Bogs in Maine with concentric patterning
- coastal species and communities well represented
- *Scirpus cespitosus* lawns exceptional in the large proportion of the peatland covered
- described and photographed in 1927 (Osvald, 1955); appears in several publications; and frequently visited by scientists
- complete, natural cross-sectional exposure of raised peatland unique in eastern United States, and of tremendous scientific importance

Location and Size:

Carrying Place Cove Bog is located on the narrow isthmus between West Quoddy Head and the mainland. The site contains about 43 acres, some 22 of which are open plateau.

Ecology:

The peatland is clearly defined to the north by a sea cut, vertical erosion face that rises 10 or more feet above mud flats, and to the east and west by the prominent marginal slopes of the bog. To the south deposits of a scenic crescentic beach overlay the peat.

Carrying Place Cove Bog is in a geomorphological setting unparalleled in the United States. Having formed in a shallow depression (probably the central region of a tombollo) on the isthmus at an elevation beyond the reach of tide water, this peatland has been lowered as part of a "sinking" coastine phenomenon so that the sea directly affects the south and north faces of the peat deposit and its vegetation. The south margin is being overridden by a typical crescentic gravel beach. Most outstanding is the north face of the peatland which is a vertical erosion escarpment exposing a full cross-section of the peatland.

In this section one can see the entire peatland history, beginning with clays then shallow pond or marsh sediments, topped by the exposed roots of a swamp forest or thicket that was thence replaced by generations of hummocks and hollows that suffered occasional surface fires. I know of no

other natural exposure of peat, so graphic in its display of the history of the bog, so complete in its cross-section anywhere in the United States. The exposure is of tremendous importance for the scientific study of raised peatlands.

Carrying Place Cove Bog displays with exceptional clarity the morphological and biological characteristics of the Coastal Plateau Bog peatland types, and is one of only four sites in the United States known to so completely exhibit the type characteristics. An obvious raised bog, the peatland is noticeably a plateau with a flattened upper surface, sharply defined marginal slopes, and evident, narrow laggs. Outstanding examples of surface ponds occur on both the east and west shoulders of the peatland. Trees are absent from the peatland except at the laggs.

Dwarf shrub communities predominate on the slopes, and Scirpus lawn communities occupy much of the plateau surface. The Scirpus communities and the pond sytems, as they merge with the dwarf shrub communities, display concentric patterning that defines the surface elevational contours of the peatland.

Well represented are the coastal communities Scirpus cespitosus - Sphagnum fuscum and Empetrum nigrum - Sphagnum fuscum, as well as several important coastal species: baked-apple berry (Rubus chamaemorus), black crowberry (Empetrum nigrum), bog goldenrod (Solidago uliginosa), and common juniper (Juniperus communis). The Scirpus cespitosus lawns are exceptional in their extent. At least two additional, scarce species are reported from this peatland, Geocaulon lividum, a herbaceous root parasite, and Lycopodium annotinum var. pungens, a type of "club moss."

The narrow thicket of alder (Alnus crispa) where beach sands are being deposited upon peat is more than just a community simply formed as a blend of shore and peatland species (a feature noted by Osvald during his 1927 visit). The dwarf shrub communities (see Osvald 1955 for descriptions) are less vigorous in height than on most other coastal raised bogs due to the enhanced drainage caused by the exposure of the sea-cut face. More or less, the closer to the truncation the lower shrubs, the lesser the hummock and hollow relief, and the less prominent the Sphagna.

This peatland is not large compared with other sites recommended in this report; however, its original size was certainly larger as it extended at least ¼ mile further north, according to the recollections of local residents in the early part of this century (Bastin and Davis 1909), or more than a mile northward (Dachnowski-Stokes 1930).

Condition and Use:

The site is relatively undisturbed with the exception of West Quoddy Head Road across the isthmus to Quoddy Head State Park and the easternmost point of the United States. Occasional tourists stop along the road and walk over the bog. Increased treading of this sort could cause damage to the peatland. Hummock and hollow patterns and the pond system of the bog are likely the features most susceptible to visitor disturbance. In recent times the peatland seems to have remained in its natural state: the photos

taken by Osvald in 1927 could have been taken in 1979, there is such little difference. Of particular importance is his photo of some of the ponds. The ponds appear essentially the same now as in 1927. Osvald's vegetation description is applicable now, over 50 years after his visit.

The area has been used for scientific studies in the past, most notably by Osvald. Dachnowski-Stokes (1930) used the exposed north face for studies of vegetational history. Its accessibility makes it exceptionally desirable for research and education.

19 WEST QUODDY HEAD HEATH, Lubec

Reasons for Recommendation:

West Quoddy Head Heath is recommended because it has coastal raised peatland vegetation alongside "bead" patterned pondlets and wet depressions in a wet central drainage, and because it is the easternmost open peatland in the United States. The significance of West Quoddy Head Heath, among 115 coastal raised peatlands in Maine, ranks 19th for Coastal Plateau Features and 19th for All Peatland Features.

Significant Features:

- dwarf shrub communities and stunted spruce clumps the prominent vegetation in more open areas
- "bead" patterned pondlets and wet depressions in wet, central drainage
- considerable community and species diversity in small area
- not a plateau, but having infrequent *Sphagnum fuscum* hummocks with both black crowberry (*Empetrum nigrum*) and baked-apple berry (*Rubus chamaemorus*)

Location and Size:

About 0.6 mile southwest of West Quoddy Head lighthouse, this peatland can be reached by poorly marked ways through forest and scrub from north or south. The entire site is little more than 13 acres, of which about 7 are open.

Ecology:

Although the hydrology of the site was incompletely assessed during the visit, the site appears to be an oblong peatland that occupies a broad spot in the drainage of the scrub and forest of the upper elevations of West Quoddy Head. Most open near a wet, central waterway, the peatland has thicket, low tree and taller tree margins, with spruce the dominant woody plant.

In the more open areas there are infrequent *Sphagnum fuscum* hummocks with black crowberry (*Empetrum nigrum*) and baked-apple berry (*Rubus chamaemorus*). Dwarf shrub communities and stunted black spruce (*Picea mariana*) clumps are the prominent vegetation, which quickly gains height toward the

margins of the peatland. The central wet area approaches stream flow at places, and has a fine example of "bead" patterned pondlets and wet depressions. Graminoid species are common, and include Scirpus cespitosus, Rhynchospora alba, and cotton grasses (Eriophorum spp.).

Condition and Use:

Because of its small size, the wetness of the open area, and the nearness of the well-used public trail, the site, if access were made easier, could be severely altered through trampling. Occasional foot traffic already has accentuated some hummocks and channelized some wetter locations. Currently the peatland is little visited and in fine natural condition.

Sites Likely Suitable for Evaluation as Potential Critical Areas

Eighteen peatlands are "likely suitable for evaluation as a potential Critical Area as a Coastal Raised Bog or related phenomenon, but visit or other data needed to confirm status" (Table 4). None appear to have sufficient significancy to place them among the top five or so of the sites recommended, but probably are dispersed among the ranking of the other recommended sites.

Potentially the most important are three sites at the southwestern end of the study area. Peatlands at "SW corner of Little Cranberry Island"* and "0.8 mile E of Summer Harbor" may further define the southwestern limits of the Coastal Plateau Bog phenomenon, while the peatland "0.6 mile SW of Corea" appears to have beaver damming as well as an extreme maritime exposure. The morphology and vegetation of the Corea site are undetermined.

Also near Corea are three peatlands ("0.2 mile W of Corea Cemetery; 0.7 mile W of Long Mill Cove; and 1.0 mile WNW of Newman Cove"), which like three sites on nearby Petit Manan Point ("0.7 mile NW of Chair Pond; 0.5 mile SW of Chair Pond; and along Big Pond stream, W of Wood Pond Cove and Wood Pond Point") are smaller peatlands, often complexes with associated streams, whose topography and vegetation were assessed only from the air. Although not large, clearly zoned Coastal Plateau bogs, these sites likely contain coastal peatland phenomena of significance.

Five sites ("southeastern end of Crowley Island; 0.3 mile N of Head Harbor; 0.8 mile NE of West Jonesport; 1.1 miles W and WNW of Sandy River Beach; and 0.1 mile N of shore, Little Pond Head") in the greater Jonesport area clearly require on-the-ground visitations as they lie between or adjacent to peatlands already recommended. Several of these sites may have well-developed coastal peatland features.

Four sites ("0.5 mile SE of Compass Rock; 1.5 miles E of 'Harmon Heath'; 0.2 mile E of 'Harmon Heath'; and 'Harmon Heath'") north and northeast of Culter likely are near the inland boundary of the Coastal Region. Relatively

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*Locations in quotations refer to Table 4.

small, these peatlands may have some coastal communities and species, but clearly lack central Scirpus lawns and prominent plateau morphology. Several similarly sized, and probably similarly vegetated, peatlands in Addison (including "1.1 miles W of Bryant Corners, E and N of hill; 0.9 and 1.8 miles W of Hall Hill; and 0.2, 1.0, and 1.5 miles E of road, E of Reef Point") may likewise be at or near the inland limit of Coastal Region characteristics.

Of all these sites only the peatland east of Summer Harbor (and possibly the Little Cranberry Island site) is suspected of having central a small area of central Scirpus lawn. The Little Cranberry Island site along with the peatlands "0.6 mile SW of Corea" and "0.1 mile N of shore, Little Pond Head, Great Wass Island" are noteworthy because they lie adjacent to the sea.

The Smaller Peatlands

Within the Coastal Region there are some 68 "smaller," open or sparsely treed, peatlands, with 15 to 75, or so, acres of raised peatland. The largest concentrations are in Cutler (19) and Addison (13), with about 6 in Roque Bluffs and 9 in Trescott/Lubec, but only 7 noted southwest of Addison.

Eighteen of these peatlands were visited; most were overflown. With one or two possible exceptions, all appear to be in an essentially unaltered natural state. Seven are recommended for evaluation as proposed Critical Areas. Fifty sites were not visited, most were overflown and many were photographed. Of these, eight may have sufficient features to recommend evaluation (see previous section). Visitation of these sites is encouraged.

The features of the remaining 53 peatlands appear to be represented in one or more of the sites recommended for evaluation by this study. Although each site has its own unique characteristics, and although the sites appear virtually undisturbed, they are sufficiently similar that, at this time, to recommend one would mean the recommendation of virtually all the 53. Considering their excellent natural condition, should additional features be discovered at some future time, some of the sites may be considered then for evaluation as potential Critical Areas.

Shrub Slope Peatlands

Sites known or suspected of having Shrub Slope peatlands commonly are contiguous with or very nearby raised peatlands, often with intergrading peats and hydrologies. None exceed a few acres in extent; many may prove to have mineral soils. The sites, of which only e, h, i, and j were visited in this study, include:

a) "Group of four peatlands N of Hamilton Cove," Lubec. With these small peatlands there may be a limited amount of Shrub Slope Peatland.

b) "Two peatlands, 0.4 and 1.0 miles W of Eastern Head," by Moose River, Trescott. These peatlands may include a limited amount of Shrub Slope Peatland.

c) "0.3 mile NE of Fairy Head," Cutler. This site, which has some open peatland, may include a limited amount of Shrub-Slope Peatland.

d) "Three peatlands W of Starboard Island Bar, on Point of Main," Machiasport. The overflight revealed a limited amount of possible Shrub Slope Peatland with the three small peatlands.

e) "Kelley Point Peatland Complex," Jonesport. What seems to be Shrub Slope Peatland occurs southeast of the plateau, descending westwardly into bog and patterned fen drainage. Minor patches occur along the northern part of the western margin of the plateau. These areas are included within the site being recommended for evaluation as a possible Critical Area.

f) "Jonesport Heath," Jonesport. Inspection of photographs taken at low elevations during the overflight reveal small portions of terrain along the periphery of the northern half of this site (and perhaps "Jonesport Heath, North Unit" as well) that might contain small amounts of Shrub Slope Peatland.

g) "0.1 mile N of shore, Little Pond Head," Great Wass Island. At the southeastern extremity of Great Wass Island this open peatland appears to merge with Shrub Slope Peatlands, both peatland types worthy of visitation and consideration as Critical Areas. Gaylussacia spp. are prominent shrubs. This site is especially noteworthy because of the extensive, barren, sea-washed rocks along its south margin. Flotsam is occasionally thrown on the margin of the peatland during very intensive storms. The site likely merits Critical Area status.

h) "0.3 mile NW of the Pond, " Great Wass Island. This is the "type" location of the Shrub Slope Peatlands, and includes much of the terrain between Three Falls Point, The Pond, and the heath north of The Pond. The Shrub Slope Peatlands are contiguous, in part, with the heath. The natural features of this site are exemplar and numerous; it will most certainly quality for Critical Area status.

i) "0.3 mile N of Black Duck Cove, W side of road," Great Wass Island. This site may be at or near the northern limit of Shrub Slope peatlands on Great Wass Island. Disruption by local road building provides some cross-sectional views of the peat.

j) Other Great Wass Island sites. Brief forays into other sections of central and southern Great Wass Island revealed other, usually small, instances of Shrub Slope Peatland.

k) "Tip of Petit Manan Point S and W of Big Pond," Steuben. The entire end of the Petit Manan peninsula is devoid of forest cover, with occasional bedrock outcrops exposed above a gently undulating cover of shrubs. A visit is crucial to confirm the presence of peat and Shrub Slope Peatland.

1) "0.5 mile SW of Stanley Cove, three small peatlands" and "0.3 mile S of Stanley Cove, on shore," Steuben. These two locations, near the tip of Dyer Point, might contain a limited amount of Shrub Slope Peatland.

Summary of the Natural Significance of the Coastal Raised Bogs

This summary of the natural significancy of the coastal raised bogs contains two sections. The first notes some of the natural phenomena of significance that these peatlands have by virtue of their being peatlands, in contrast with other kinds of landscape. This rather general listing is followed by the more specific natural significance of the coastal raised bogs, especially with respect to other North American peatlands.

Peatlands are significant natural features for at least these reasons:

a) in their development they very highly modify their local environment, more so than any other ecosystems

b) they store organic material and water

c) they act as nutrient sinks and reservoirs

d) they are monitors of climatic conditions

e) they contain a record for past millenia of climate, vegetation, fauna, etc.

f) they are habitats for species and communities

   i) that are uncommon or rare
   ii) that often occur in more northerly latitudes
   iii) that are pleasing to man (such as orchids, blueberries and other berries, carnivorous plants, dwarfed trees, species with showy autumn colors, etc.)

g) they are very distinct ecosystems that are important contributors to the diversity of the landscape

h) they offer natural open vistas in terrain otherwise naturally forested

i) they provide open landscape for various wildlife, notably deer, raptors, mice and voles

The coastal raised peatlands of Maine are significant peatlands because:

a) they include the only Coastal Plateau Bogs in the eastern United States

b) the Coastal Plateau Bogs are rare in North America, otherwise known only from limited coastal areas of New Brunswick, Nova Scotia and Newfoundland (and possibly along the North Pacific Coast)

c) the Coastal Plateau Bogs have a morphological counterpart in northern Europe with related vegetation that has differences in speciation, species composition, and ecological roles

d) they include outstanding examples of the Coastal Plateau Bog morphology (including allied features such as offset heights, bays, drainage ways, entrapped streams, radial channels, concentric patterning, etc.) and the coastal peatland communities

e) they are raised bogs; the only clearly raised bogs in the United States east of the northern Lake States are in Maine

f) they are at the southern limit of raised bogs in eastern North America, and include some of the southernmost raised peatlands in North America

g) they include the easternmost open peatland in the United States

h) as part of the continental to maritime variation of raised bogs in eastern North America, these are the most maritime in the United States, especially as they merge with the Shrub Slope Peatlands

i) they include an outstanding example of variation in peatland types along an ombrotrophic to minerotrophic gradient

j) they are the only raised peatlands in the eastern United States where minerotrophic species such as skunk cabbage (*Symplocarpus foetidus*) and common juniper (*Juniperus communis*) grow on ombrotrophic peats, a phenomenon otherwise restricted in North America to parts of New Brunswick, Nova Scotia, Newfoundland, British Columbia, Alaska, and possibly Washington.

k) they include the only peatlands in the eastern United States (perhaps anywhere in the United States) with jack pine (*Pinus banksiana*), whose subdued habit is similar to the habit of lodgepole pine (*Pinus contorta*) in coastal peatlands in Alaska

l) they have the southern limit of lowland habitat for baked-apple berry (*Rubus chamaemorus*) and black crowberry (*Empetrum nigrum*), important species of the Northern Hemisphere in higher latitude ecosystems

m) they have the southern limit of the *Empetrum nigrum* - *Sphagnum fuscum* and *Scirpus cespitosus* - *Sphagnum fuscum* communities

n) in lacking *Gaylussacia baccata* dwarf shrub heath community on hummock crests, they show their affinity with raised peatlands of adjacent extreme southwest New Brunswick and coastal Newfoundland

o) the prominence of Sphagnum fuscum in hummock, hollow (some), and lawn communities demonstrates their affinities with coastal peatlands of adjacent extreme southwest New Brunswick and the northeastern coast of that province

p) the Scirpus cespitosus lawns reveal their affinities with coastal and near-coastal peatlands of New Brunswick, Nova Scotia, Newfoundland and the Gulf of St. Lawrence region of Quebec

q) they apparently have the greatest diversity of species of raised peatlands in the eastern United States

r) they include a notable diversity of fen communities, especially in extreme maritime settings

s) they have the southernmost raised bog pond system in the eastern United States, probably in all of the United States

t) they include the southernmost variety of sloping peatland types at low elevations in the United States

u) because they are a special type of raised bog (hence depend upon the atmosphere for their moisture and nutrients) they clearly define a climatic zone of biologic importance, unique in the United States, though related to south coastal Alaska climates

v) they include the only ombrogenic peatlands in the United States being eroded by tidewater, a phenomenon rare in North America, otherwise only known from limited locations in extreme maritime Atlantic Canada

w) they have the only example in the United States known to me with a complete, natural cross-sectional exposure of a raised peatland

x) they have the only example in the eastern United States where open ombrotrophic peatland communities are contiguous with open tidal marsh communities

y) they have the only example in the eastern United States with a marine beach being deposited upon a raised peatland

z) they have the only example in the United States known to me where a raised bog forms an isthmus between mainland and an island

aa) they have sites with ground frost that persists locally well into the summer, probably the southernmost persistence of ice in lowland peatlands in the United States

bb) an exceptionally high proportion of the sites are in essentially natural condition

cc) there is some documentation, at least within this century, of the persistence of pond systems, vegetation pattern, and community composition, and of gross successional trends following fire and other disturbances

dd) they provide abundant opportunity for the study of succession in the Coastal Raised Bog Region, both natural succession and succession following disturbance

ee) they include a very small percentage of Maine's peatlands (less than two percent), and a far lesser percentage of the nation's peatlands; moreover, of the 135 or more coastal peatlands only 7 display the majority of Coastal Plateau Bog features, and only 2 sites, the Jonesport Heath (including the North Unit) and Kelley Point Heath, are fully characteristic of that bog type

ff) they include some of the more visible and accessible raised peatlands in the United States

gg) they, because of their cranberries, have provided local place names, including the name of a township

Table 4. Annotated inventory and classification of possible peatlands in the study area. The following notes refer to the last four columns (listed at beginning of table):

1. Identification number for recommended (R) sites.

2. Distances are generally to the center of the peatland; directions are approximate; names and locations from U.S.G.S. topographic maps

3. F - Low level overflight and photos
   A - Aerial photograph inspection (1:12,000-1:20,000, also 1:80,000)
   V - On the ground visit
   T - Topographic map (U.S.G.S. 7½' and/or 15')
   C - Included in Cameron 1975
   D - Included in Damman 1977 or Pers. Comm.
   J - Included in Johnson 1977
   O - Included in Osvald 1970 or 1955
   B - Included in Bastin and Davis 1909

4. R - Recommended for evaluation as a potential Critical Area

   R_u - Botanically and Ecologically Significant but undecided Status regarding Critical Area Designation

   R_v - Likely suitable for evaluation as a potential Critical Area as a Coastal Raised Bog or related phenomenon, but visit or other data needed to confirm status

   X - Not suitable for evaluation as a potential Critical Area (principal reason given in notes)

   S - To be considered in the peatland category Shrub Slope Peatlands

   C - Coastal Raised Bog or related phenomenon, acceptable natural conditions, but without sufficient characteristics now known to recommend for evaluation as a potential Critical Area

   C_v - Likely Coastal Raised Bog or related phenomenon, possibly an Inland peatland type, appears to be of acceptable natural condition, visit or other data needed to confirm peatland type, but apparently without sufficient characteristics to recommend for evaluation as a potential Critical Area

   I - Inland peatland type

   I_v - Likely an Inland peatland type, possibly a Coastal Raised Bog or related phenomenon, appears to be of acceptable natural condition, visit or other data needed to confirm peatland type; if Coastal Raised Bog or related phenomenon apparently without sufficient characteristics to recommend for evaluation as a potential Critical Area

   I_c - Not a Coastal Raised Bog or related phenomenon, but in the Coastal Raised Bog region; to be considered with peatland types also known from the Inland region (includes some marshes, fens, thickets, and swamps); includes sites with wide range of natural quality

Table 4 (continued)

Quadrangle	Township	No.[1]	Location or Name[2]	Data Source[3]	Status[4]
Eastport 7½'	Perry		0.5 mile N of Pattangal Cove	A,T	Iv
Pembroke 7½'	Pembroke		0.5 mile W of Long Cove N.B. Although unlikely, this site might contain coastal properties. The boundary between coastal and inland peatland types has not been precisely determined in this vicinity as yet.	A,T,C	Iv
"	"		1.0 mile N of Youngs Cove N.B. Should the nearby peatland at 0.5 mile W of Long Cove prove to have coastal properties, then this site should likewise be visited.	A,T,	Iv
"	"		0.5 mile E of Ayers Junction, north of and adjacent to railway	A,T,C	I
"	"		1 mile S of Pennamaquan Lake, 0.3 mile W of Pennamaquan River	A,T,C	I
"	"		Along Ohio Brook	A,,T	I
"	Edmunds		0.5 mile N of Dennysville Station	A,T,	I
Lubec 7½'	Lubec	19	0.6 mile SW of West Quoddy Head Lighthouse	F,A,V,T	R
"	"	18	West Quoddy Head Neck, N of Carrying Place Cove	F,A,V,C, D,O,J,B	R
West Lubec 7½'	Lubec		By road at Ridge Crossroads N.B. No features of significance noted.	F,A,V,T	X
"	"		Just S of Ellis Hill	F,A,T	Iv
"	"		0.5 mile E of Thayer Ledges	F,A,T	IV
"	"		1.2 miles E of Thayer Ledges	F,A,T	Iv
"	"		Group of 4 peatlands N of Hamilton Cove N.B. These peatlands, especially the larger two, may be quite similar to the peatland 0.4 mile W of Boot Cove, 2½ miles to the southwest along the coast. Like that site, these peatlands may have, or be associated with, Shrub Slope peatlands. *Scirpus* was not noted on the overflight.	F,A,T	Cv,S

Table 4 (continued)

West Lubec 7½'	Lubec	17	0.4 mile W of Boot Cove	F,A,V,T C	R
"	"		0.2 mile E of Rte. 191, 1.3 miles N of South Trescott	F,A,T	Cv
"	"		1 mile N of Baileys Mistake	F,A,T	Cv
"	"		1.7 miles N of Baileys Mistake	F,A,T	Cv
"	"		1.8 miles NNE of Baileys Mistake	F,A,T	Cv
"	Trescott	16	0.8 mile W of Baileys Mistake	F,A,V,T, C,O,J,B	R
"	"		Group of three peatlands 1 mile SE of No. 9 Hill N.B. The location of the boundary between coastal and inland peatland types has not been precisely determined in this vicinity	F,A,T	Iv
"	"		Along Finnegan Brook	F,A,T	Iv
"	"		0.9 mile S of Lily Lake	A,T	Iv
Cutler 15'	Trescott		Two peatlands, 0.4 and 1.0 miles W of Eastern Head N.B. This terrain was viewed only briefly on the overflight. There might be small patches of Shrub Slope peatland present.	F,A,T	Cv,S
"	"	15	0.3 mile S of Moose River, 0.3 mile W of shore	F,A,V,T J	R
Cutler 7½'	Cutler		0.5 mile E of Little Machias	F,A,V,T	C
"	"		0.2 mile NW of Great Head	F,A	C
"	"		0.5 mile NE of head of Little River inlet N.B. Possibly not a peatland	F,A,T	Cv
"	"		0.3 mile NW of Cutler Village	F,A,T	Cv
"	"		0.3 mile NE of Fairy Head N.B. This peatland possibly contains, or is associated with, Shrub Slope peatlands.	F,A,T	Cv,S

Table 4 (continued)

Cutler 7½'	Cutler	Three heaths at headwaters of Black Point Brook	F,A,T	Cv
"	"	Peatlands along upper reaches of Schooner Brook, south of road N.B. Wetlands in this area, and those 1.5 miles eastward in the Holmes Cove Brook drainage, appear to be mostly wet meadows, fens, and (non-bog) thickets.	F,A,V,T	Ic
"	"	By Bog Brook, east of road	F,A,T	Cv
"	"	Ackley Pond wetlands N.B. These pond and stream margin wetlands likely include peatlands, and should be considered with other similar peatlands in Coastal and Inland regions. Pond margin peatlands are very scarce in the Coastal region, the most similar being the much larger Forbes Pond system in Gouldsboro (which may be in the Inland, not the Coastal region).	F,A,T	Ic
"	"	At head of brook leading to Ackley Pond, N of Pond Ridge	F,A,T	Cv
"	"	"Harmon Heath," and peatland 0.2 mile E of "Harmon Heath" N.B. Harmon Heath is one of the largest of the "smaller" Coastal Raised Bogs, and is in the portion of the study area most dense with peatlands. This site is included in Damman's (1977) list of Coastal Plateau Bogs. It is virtually treeless, except for the lagg. There is but one pond, and it is at the margin of the peatland. Scirpus lawns were not visible from the air, but Scirpus might be present in a very minor graminoid wet area at one margin. From the air dwarf shrub communities and Sphagnum fuscum communities could not be differentiated easily, although the Sphagnum fuscum-Empetrum nigrum community seemed present, at least in small quantity, on much of the plateau. There are small patches of abundant lichens. The peatland boundary is distinct and sharply defined, and there is a single, not prominent, water track. This site apparently differs little from other of the "smaller" Coastal Raised Bogs, except perhaps in its combination of openness, size, extent of coastal communities, presence of a pond, and	F,A,T,D	Rv

Table 4 (continued)

		the presence of the water track. Low on the list when compared with peatlands being recommended, this peatland may have sufficient features to set it apart from the bulk of the "smaller" Coastal Raised Bogs. A visit is strongly encouraged.		
Cutler 7½'	Cutler	1.5 miles E of "Harmon Heath" N.B. This peatland is in the region of the study area most dense with peatlands. A few tens of acres, this lobed peatland contains 3 or 4 regions of differing vegetation types. A small stream divides the peatland, and some minor ponds are aligned on the peat adjacent to the stream. This site likely has features not found at the nearby Harmon Heath. The several features mentioned, and associated features yet to be confirmed, appear to be sufficient for this site to be evaluated as a potential Critical Area. An on-the-ground visitation is recommended.	F,A,T	Rv
"	"	0.5 mile SE of Compass Rock	F,A,T	Rv
"	"	Head of Bog Brook N.B. This site is forested, is presumably not raised, and is certainly more minerotrophic than the open peatland immediately to its west (which sites on a divide above the site at the head of Bog Brook).	F,A,T	Ic
"	"	"Warren Meadows" N.B. Peatlands, if any, in this region appear to be minerotrophic.	F,A,T	Ic
"	"	0.5 mile SE of Cocoa Mountain N.B. The boundary between coastal and inland peatland types has not been precisely determined in this vicinity	F,A,T	Iv
"	"	NE corner of town of Cutler	F,A,T	Iv
"	"	Junction of Bagley Brook and East Stream N.B. These shrub rich peatlands do not appear to have coastal communities. They have caused stream displacement and should be considered with other similar peatlands in Coastal and Inland regions.	F,A,T	Ic
"	"	"Little Harmon Heath," 0.8 mile N of "Harmon Heath"	F,A,T	Cv

Table 4 (continued)

Cutler 7½'	Cutler	0.4 mile SW of "Little Harmon Heath," W of road	F,A,T	Cv
"	"	W of junction of Eastern Marsh Brook and Spring Brook	F,A,T	Cv
"	"	W of Spring Brook	F,A,T	Cv
"	"	"Crotched Meadow" N.B. Peatlands, if any, in this region appear to be minerotrophic.	F,A,T	Cv
"	Whiting	Head of Lively Brook N.B. The boundary between coastal and inland peatland types has not been precisely determined in this vicinity.	A,T	Iv
"	"	Four small peatlands NE of peatland at head of Lively Brook	A,T,	Iv
Whiting 7½'	Edmunds	0.3 mile E of Hobart Meadow Mountain	A,T	I
"	"	0.5 mile NW of jct. of Crane Meadow Brook with Hobart Stream	A,T	I
"	"	Head of Crane Meadow Brook	A,T	I
"	Edmunds and Whiting	9 small peatlands, all within about 1.5 miles of Western Lake	A,T	I
"	"	1.2 miles SE of Whiting	A,T	Iv
"	"	Head of Reynolds Brook	A,T	Iv
"	"	0.5 mile SW of Keniston Mtn. N.B. No coastal species or communities were encountered during a walk through the central open area, which is relatively rich with woody plant growth. The central area is clearly raised above the water level of the Orange River. This peatland should be considered with other similar lake-bay peatlands in Coastal and Inland regions.	F,A,T,V, C	I
"	"	Head of Lively Brook	A,T	Iv
"	"	Group of three peatlands 0.7 mile SW of Reynolds Brook, just S of Route 1 N.B. This peatland appeared, upon	A,T,V	X

Table 4 (continued)

			brief visit, to be minerotrophic and somewhat disturbed, in part due to adjacent land use.		
Cross Island 7½'	--		NONE	T	--
Machias Bay 7½'	Whiting		"Hall(?) Heath," 1 mile SE of Indian Lake N.B. A knowledgeable, local resident called this peatland "Hall Heath." It could possibly have some coastal features but is likely within the Inland region.	A,T	Iv
"	"		0.8 mile NE of Enoch Hill N.B. This is a fine group of stream margin peatlands, with several raised portions. They do not appear to have any coastal species or communities, being shrub rich throughout the raised portions. They appear to be the finest example of their type within or adjacent to the Coastal region, and should be considered with other similar stream margin peatlands in Coastal and Inland regions.	F,A,T,C	Ic
"	"		0.4 mile E of lower Holmes Stream	F,A,T,V	C
"	Cutler		0.2 mile N of Huntley Creek	F,A,T	C
"	"	12	0.4 mile S of Huntley Creek, by small U.S. Navy transmission station	F,A,T,V, C	R
"	"		Four peatlands N of Western Marsh Brook, 0.2, 0.6, 0.9 miles	F,A,T	Cv
"	"	14	0.4 mile W of North Cutler	F,A,T,V, D	R
"	"	14	0.7 mile W of North Cutler	F,A,T,V, D	R
"	"	14	1.1 miles W of North Cutler N.B. This site may be hydrologically separate from the peatland to the east, but lies in the same geomorphic setting and should be included with those sites (see further discussion in the text)	F,A,T,V	R
"	"	13	1.9 miles W of North Cutler	F,A,T,V	R

Table 4 (continued)

Machias Bay 7½'	Cutler		1.5 miles NW of North Cutler N.B. This peatland is fairly treed.	F,A,T	C
"	"		0.5 mile NW of Holly Point N.B. This peatland was drained and otherwise disturbed during the construction of the Cutler Navy Base. A local resident claims it was totally destroyed.	A,T	X
Roque Bluffs 7½'	Jonesport		Halifax Island N.B. Based upon my experience on Nash Island, and upon reports from a Cutler resident, the wetland on this island is likely not a peatland, and is certainly highly altered.	A,T	X
"	Roque Bluffs		Flanking unnamed pond at Shoppee Point N.B. These wetlands were not visited, and their character is unknown to me.	F,A,T	Cv
"	"		0.8 mile N of Roque Bluffs, W side of road	F,A,T,V, C,B	C
"	"		0.4 mile E of mouth of Englishman River, N of road	F,A,T,V J,B	C
"	"		0.2 mile N of Mack Cove, S of road	F,A,T,V, C	C
"	Machiasport		Two peatlands W of mouth of Starboard Creek N.B. It is possible that these peatlands are part of the peatland system to their south, nearer the tip of the Point of Main.	F,A,T	Cv
"	"		Three peatlands W of Starboard Island Bar, on Point of Main N.B. From the air these peatlands seemed to be characteristic, small coastal bogs. However, they appeared to be associated with a limited amount of what might possibly be Shrub Slope peatland, and, thus, they should be considered under that category.	F,A,T	CvS
Machias 7½'	Machiasport	11	0.7 mile SW of Larrabee N.B. This peatland is commonly called "Larrabee Heath" in this report.	F,A,V,T, C,D	R

Table 4 (continued)

Machias 7½'	Roque Bluffs		0.7 mile E of Great Cove, W of road	F,A,V,T	C
"	"	10	0.8 mile NE of Great Cove, N of road	F,A,V,T, C,J,B	R
"	"		1.5 miles N of Great Cove	F,A,T	Cv
"	Whitneyville		0.3 mile N of Route 1 at W edge of quadrangle (67°30')	F,A,V,T C,J	I
"	East Machias		"Runaway Pond Heath," head of Meadow Brook	F,A,V,T C,D,J	I
Great Wass Island 7½'	Beals		0.3 mile N of Black Duck Cove, E side of road N.B. This peatland contains several coastal species, is treeless, and by virtue of its proximity to the road and clear occupation of a tiny basin, has notable local significance. I feel that it is too disturbed by the adjacent road, the utility poles, and nearby bulldozing to be considered of state significance. I know of no other site just like this one for smallness and accessibility to the coastal plants, but the species, communities and species compositions appear on other sites being recommended elsewhere in this report--usually as one of many features in a larger peatland system.	F,A,V	C
"	"		0.3 mile N of Black Duck Cove, W side of road	F,A,V	S
"	"	5	0.5 mile E of Norton Point	F,A,T,V C,J	R
"	"		0.6 mile SW of Mud Hole Point N.B. This site was not visited, and overflight photography consists of a single, distant photograph. It may be a large fen, similar to others on Great Wass Island, but of that I am uncertain. The forthcoming study planned by The Nature Conservancy (owner) should determine the general character of the site, permit its classification, and help to determine if the site should receive further evaluation by the Critical Areas Program. If this site is connected	F,A,T	C

			hydrologically with one or more of the peatlands to its south and west, then it would certainly prove to have significance, vis-a-vis that relationship with the other sites, whose importance is recognized elsewhere in this report.		
Great Wass Island 7½'	Beals	5	0.6 mile NE of Three Falls Harbor	F,A,T,V	R
"	"	5	0.3 mile NW of Cape Cove	F,A,V	R
"	"		0.5 mile N of Three Falls Harbor N.B. This site appears to contain features present at several Great Wass Island peatlands being recommended as Critical Areas, but with less distinctiveness. The study being undertaken by The Nature Conservancy (owner) may discover phenomena of significance. If this site is connected hydrologically with one or more of the peatlands to its north or south, then it would certainly prove to have significance, vis-a-vis that relationship with the other sites, whose importance is recognized elsewhere in this report.	F,A,T	C
"	"	6	0.3 mile N of The Pond	F,A,T,V	R
"	"		0.3 mile NW of The Pond	F,A,T,V	S
"	"		0.3 mile W of Popplestone Cove	F,A,T	Cv
"	"		0.1 mile N of shore, Little Pond Head	F,A,T	Rv,S
Jonesport 7½'	Jonesport		1.1 miles W and WNW of Sandy River Beach N.B. Aerial photos of this peatland were missing from the Maine Geological Survey files each of my visits. Our overflight only skirted its edge. It appears to be generally similar to the Jonesport Heath, but may not contain *Scirpus* lawns. The central streams appear to be fairly broad, perhaps indicating higher water levels than exist in the northern part of the Jonesport Heath complex. The peatland is divided into four or more units, each substantially	F,T	Rv

			smaller than any of the Jonesport Heath and Kelley Point Heath plateaus that contain Scirpus lawns. Thus, Scirpus lawns may be present, but are not expected; if present they are probably very limited in extent. Whether the chief natural values lie in the presence of Scirpus lawns, the bisecting stream character, and/or in as yet undiscovered features, this peatland very likely has sufficient features to warrant evaluation for potential Critical Area status. A low level overflight, and/ or on-the-ground visit are strongly recommended.		
Jonesport 7½'	Jonesport		E of Indian River, northerly of Jonesport Heath, large wetland complex N.B. This large wetland complex, apparently a variety of wet meadows, fens, and streams, was overflown, but its location was not determined precisely. Aerial photos of this region were missing from the Maine Geological Survey files each of my visits. The presence or extent of peatlands in the complex, which has numerous bedrock exposures, has not been determined.	F	I
"	"		1.3 miles W of Bar Island	T	Cv
"	"		1.1 miles NE of Indian River community (cf. Addison 7½' quadrangle) N.B. This wetland may be part of the complex discussed above ("E of Indian River, northerly of Jonesport Heath").	F,T	Iv
"	"	8	1.5 miles E of Indian River community (cf. Addison 7½' quadrangle) N.B. This is the northern unit of the Jonesport Heath complex, and is discussed elsewhere in the text.	F,T,D	R
"	"	7	The whole interconnected and lobed complex of peatlands south of E-W stream 2.0 miles directly W of Bar Island; the complex extends to 0.3 mile N of the head of Sawyer Cove	F,T,V,C, D,J	R_1,S
"	"		0.5 mile W of Natt Point, crosses Route 187 N.B. This is a characteristic Coastal Plateau Bog, small in size, and	F,T,V	X

Table 4 (continued)

			apparently without Scirpus lawns. It has been considerably disturbed by drainage ditches and trench mining. Portions of the peatland, between the trenches, and in areas not trenched, do support the Sphagnum fuscum-Empetrum nigrum-Rubus chamaemorus community. The apparently level, gravel (outwash?) substrate is evident in the bottom of parts of some of the trenches. Mining has not been active for at least 3 years, and perhaps as much as a decade.		
Jonesport 7½'	Jonesport		0.5 mile W of Little Pond Beach, W of Route 187 N.B. This site is part of the preceding site ("0.5 mile W of Natt Point, crosses Route 187").	F,T,V	C
"	"	9	Complex of peatlands between Rhine Point, Kelley Point, and Sawyer Cove; includes large unit, small unit between road and Kelley Point, and unit W of road, 0.4 mile W of Loon Point	F,T,V,D	R,S
"	"		0.8 mile NE of West Jonesport N.B. Inadvertently missed on the overflight, and not viewed on aerial photographs (which were missing from the files of the Maine Geological Survey on each of my visits), this peatland should be visited or overflown at low elevation, for it may share many of the characters of the peatlands nearby in all directions, most of which have been recommended for evaluation as potential Critical Areas.	T	Cv(Rv)
"	Beals		0.1 mile E of Beals Island--Great Wass Island Bridge N.B. This miniscule semi-open peatland is probably repeated in kind in numerous places on northern Great Wass Island. It does not contain sufficient features of significance to warrant Critical Area status.	F,A,V	X
"	"		0.3 mile SE of Beals Island--Great Wass Island Bridge N.B. This miniscule semi-open peatland is probably repeated in kind in numerous places on northern Great Wass Island. It does not contain sufficient features of significance to warrant Critical Area status.	F,A,V	X

Table 4 (continued)

Jonesport 7½'	Jonesport	0.3 mile N of Head Harbor Creek Cove, Head Harbor Island N.B. From the air this peatland appears to have many features considered significant at the sites on nearby Great Wass Island that have been recommended for evaluation as possible Critical Areas. An exceedingly distinctive marginal fen borders about three-fourths of the raised peatland. The entire west end of the peatland is forested, and the central open area has scattered tree individuals. Scirpus lawns do not appear to be present, but Scirpus may be found in the marginal fen. The marginal fen, so like those on southern Great Wass Island, seems to be the principal feature of significance, especially in conjunction with the plateau morphology and presence of the coastal communities. A visit is very strongly recommended.	F,A,T	Rv
Whitneyville 7½'	Whitneyville	Two tiny peatlands at N edge of quadrangle (44°45')	A,T	I
"	Centerville, Whitneyville Jonesborough	0.6 mile W of Whitneyville	F,A,T,V	I
"	Centerville	1.2 miles W of Whitneyville	F,A,T	I
"	Jonesborough	2.2 miles SW of Whitneyville, on township line	F,A,T	I
"	"	2.1 miles SW of Whitneyville, bordering railroad of N side	F,A,T	I
"	"	2.6 miles SW of Whitneyville, 0.2 mile S of railway	F,A,T	I
"	"	Small peatland 0.5 mile south of railway, between heights of land of 235 and 234 feet	F,A,T	I
"	"	2.2 miles N of Jonesboro, NE of Porcupine Ledges, 1.7 miles W of Route 1A	F,A,T	I
"	"	2 miles NNE of Jonesboro, 0.9 mile W of Route 1A	F,A,T	I
"	"	1.1 miles NE of Jonesboro, 0.6 mile W of Route 1A	F,A,T	I

Table 4 (continued)

Whitneyville 7½'	Jonesborough	0.4 mile E of Route 1A, 0.7 mile N of Route 1	F,A,T	I
"	"	0.7 mile E of Route 1A, 0.2 mile N of Route 1	F,A,T	I
"	"	0.6 mile E of Route 1A, 0.1 mile N of Route 1	F,A,T	I
"	"	0.9 mile E of Route 1A, 0.2 mile N of Route 1	F,A,T	I
"	"	1.8 miles E of jct. Route 1A and Route 1, 0.1 mile S of Route 1	F,A,T,V	I
"	"	0.3 mile SE of Gilman Hill	F,A,T	Iv
Drisko Island 7½'	Addison	Big Nash Island N.B. This island has supported a free ranging sheep flock (currently about 150 sheep) for many years. Plant growth is non-woody vigorous, and highly adventive. Native plant communities are totally replaced by grazing maintained communities. The wetland area figured on the quadrangle does not now show any obvious features indicating a peatland past.	A,T,V	X
Addison 7½'	Jonesport 4	Between heads of Hay Creek and Snare Creek	F,A,T,V, C,J	R
"	"	2 miles NNE of Indian River community, 0.2 mile E of Indian River N.B. The boundary between Coastal and inland peatland types has not been precisely determined in this vicinity.	F,A,T	Iv
"	Addison	1.2 miles NW of Bryant Cnrs., 0.2 mile E of Route 187 N.B. The site visited was predominantly forested, with Tamarack a prominent element.	F,A,T,V	I
"	"	1.1 miles W of Bryant Crns., E and N of Hill	F,A,T	Cv
"	"	0.9 mile NW of Bryant Cnrs.	F,A,T	Cv
"	"	0.9 mile W of Hall Hill	F,A,T	Cv

Table 4 (continued)

Addison 7½'	Addison	1.8 miles W of Hall Hill	F,A,T	Cv
"	"	0.2 mile E of road, E of Reef Point	F,A,T,C	Cv
"	"	1.0 mile E of road, E of Reef Point	F,A,T	Cv
"	"	1.5 miles E of road, E of Reef Point	F,A,T	Cv
"	"	0.2 mile E of road, ENE of Reef Point, near BM 105 ft.	F,A,T	Cv
"	"	0.2 mile E of road, E of Three Brooks Cove	F,A,T	Cv
"	"	0.7 mile E of road, E of Three Brooks Cove	F,A,T	Cv
"	"	0.6 mile S of Three Brooks Cove	A,T	Cv
"	"	0.5 mile N of the basin of Long Creek and Mill Creek	A,T	Cv
"	"	Southeastern end of Crowley Island N.B. By virtue of the geographical location of this site, which is very similar to the location of peatlands at West Jonesport and Jonesport that are being recommended for evaluation as potential Critical Areas, it may be that this site contains significant natural features. A visit is recommended.	A,T	Cv(Rv)
Columbia Falls 7½'	"	1.1 miles E of Route 187, 0.7 mile S of Route 1	A,T	Iv
"	Columbia Falls	In large delta, 2.6 miles NE of Columbia Falls; three wetlands N.B. These wetlands in obvious depressions in a former marine delta may be peatlands. Their character was undetermined in this study. Their presence in such a prominent geomorphological feature makes them especially worthy of note.	A,T	I

Table 4 (continued)

Columbia Falls 7½'	Columbia Falls	"Marst Heath" N.B. This large and somewhat complex peatland appears to have sufficient natural features to receive Critical Areas status. The site was not visited and hence the presence or absence of the coastal species and communities could not be confirmed. If they are present, the site would be the most inland of the Coastal Bog type. The overflight revealed the presence of graminoids in the central region, sometimes dense, sometimes diffuse. It could not be ascertained if Scirpus was a component. Other features of "Marst Heath" include: a clearly raised plateau surface; trees being restricted only to the lagg and very margin of the plateau; pools and mud bottoms are absent (or very small) on the plateau; there are some distinctive ponds at the margins or shoulders of the peatland; there is some stream displacement along one portion of the peatland margin; similar with other peatlands of like shape (essentially circular) and size (for example, "0.6 mile S of Harrington," "0.5 mile NW of Corea," and 0.4 mile S of Huntley Creek, Cutler") adjacent to the margin of the principal peat mass there are lobes, often more or less semi-circular in shape, of open peatland flanked by conifers that lie 2-9 feet below the elevation of the plateau, and the entire peatland appears in totally natural condition.	F,A,T,C	I
"	Centerville	0.4 mile S of Pecky Brook 1.1 miles SE of Centerville	F,A,T,C	I
"	"	0.3 mile N of Pecky Brook, 1.0 mile E of Centerville	F,A,T	I
"	"	"Big Heath," 0.8 mile E of Milton Mountain N.B. This peatland has been severely altered by past and present mining. The native plant communities are essentially absent, and the original surface topography has been erased; consequently, this peatland cannot be classified. It certainly lacks sufficient natural qualities to qualify as a Critical Area.	F,A,T,V J	X

Table 4 (continued)

Columbia Falls 7½'	Centerville	0.8 mile E of Chandler River, 0.2 mile N of Alder Brook	F,A,T	I
Bois Bubert 7½'	Milbridge	0.4 mile SW of Stover Cove	A,T	Cv
Harrington 7½'	"	0.5 mile W of Turner Hill	F,A,T	Iv
"	Harrington	0.6 mile S of Harrington	A,T,V,C, D	X
		N.B. The moderately large peatland was mined some time ago. The extent of mining is not clear, and it is nearly fully vegetated at present. The original surface character was not determined. Were the natural character less disturbed, the site might qualify for evaluation as a proposed Critical Area since it lies at or near the boundary of the Coastal and Inland peatlands, and since it is sufficiently large and exposed to have had a full expression of diagnostic peatland type. This is one of several peatlands in or near the Coastal region where peatland recovery after disturbance could be investigated.		
Petit Manan 7½'	Steuben	Tip of Petit Manan Point S and W of Big Pond	F,A	S
"	"	Along Big Pond Stream, W of Wood Pond Cove and Wood Pond Point	F,A,T	Rv
		N.B. These wetlands are well within the Coastal region, although no Coastal Raised Bog communities were ascertained on the overflight. Fens and vigorous dwarf shrub peatlands appear to dominate. It is possible that the hydrology of this system has had significant changes in the near and/or distant past, related in large part to the bar phenomenon at Big Pond. It is conceivable that the wetlands are, in part at least, youthful or relatively youthful. If so, they could be an extant example of an early phase in Coastal Raised Bog development. The natural conditions of the wetlands is excellent, and the site deserves consideration and visitation (perhaps within peatland categories including dwarf shrub, graminoid fen, and/or streamside). Critical Area status seems very likely.		

Table 4 (continued)

Petit Manan 7½'	Steuben	0.5 mile SW of Chair Pond N.B. The possibility of this site having sufficient features to merit Critical Area status is only moderate. However, because of its proximity to other peatlands with the strong potential of having qualities worthy of Critical Area status, it should be visited along with the other peatlands of Petit Manan Point.	F,A,T	Cv(Rv)
"	"	0.7 mile NW of Chair Pond N.B. By virtue of its being close to and on the same stream as the larger wetlands to the south (the wetlands "Along Big Pond stream, W of Wood Pond Cove and Wood Pond Point"), this wetland should be investigated in conjunction with the more extensive system.	F,A,T	Rv
"	"	0.5 mile SW of Stanley Cove, three small peatlands	F,A,T	S
"	"	0.3 mile S of Stanley Cove, on shore	F,A,T	S
"	"	0.4 mile W of Eagle Hill	F,A,T	Iv
"	Gouldsboro	1.1 miles SW of Point Francis N.B. The boundary between Coastal and Inland peatland types has not been determined in this vicinity.	F,A,T	Cv
"	"	1.4 miles SW of Point Francis	F,A,T	Cv
"	"	1.0 mile WNW of Newman Cove N.B. This wetland complex of bog, fens, and (perhaps) non-peatlands may be hydrologically connected with the Corea Heath ("0.5 mile NW of Corea"). If so, it should definitely be investigated further. Even if the hydrological relationship does not exist, this system warrants study, perhaps in a followup study of Coastal Bog types, or with dwarf shrub and/or fen peatlands. This system appears to be larger than figured on the quadrangle, and appears hydrologically contiguous with wetlands figured separately to its north and southeast.	F,A,T	Rv
"	"	1.2 mile W of Newman Cove	F,A,T	Cv
"	"	0.7 mile W of Long Mill Cove N.B. This wetland area should be studied as part of the system to its	F,A,T	Rv

Table 4 (continued)

			northwest ("1.0 mile WNW of Newman Cove"), as it appears to be of like kind, and is probably hydrologically connected.		
Petit Manan 7½'	Gouldsboro		0.2 mile W of Corea Cemetery N.B. This peatland is part of the system "1.0 mile WNW of Newman Cove, although it is separated by a road, and should be studied with it.	F,A,T,V	Rv
"	"	3	0.5 mile NW of Corea	F,A,T,V	R
"	"		0.6 mile SW of Corea N.B. This peatland is immediately adjacent to the sea, although there appear to be no sea cut peats or sea enhanced marginal slopes. It consists of three somewhat connected peat masses that are denoted by water courses (in part) that extend from (to?) a lake of similar size. The lake appears to be dammed by beaver, and its history is unknown. No other peatland in the study area so close to the sea is adjacent to, and hydrologically part of, a lake. The only current instance of beaver ponding at a coastal peatland site is at the heath at "0.7 mile SW of Larrabee." The relationship to the pond, the proximity to the sea, and the presence of beaver are features enough to warrant visitation and probably recommendations for evaluation as a proposed Critical Area. Because of these features, one may expect unusual plant communities and/or species as well.	F,A,T	Rv
"	"		Between Youngs Point and Corea Harbor	F,A,T,V	C
Cherryfield 7½'	Milbridge		1.1 miles SSE of Milbridge	F,A,T	Iv
"	"		1.4 miles SW of Milbridge, N of Route 1 N.B. This small wetland contains insufficient features to warrant Critical Area status.	A,T,V	X
"	Steuben		1.8 miles NW of Milbridge	A,T	Iv
"	"		1.2 miles NE of East Stueben, N of Route 1 N.B. Because this peatland may be near the Coastal-Inland boundary (whose location has not been precisely determined	A,T	Iv

Table 4 (continued)

		in this region), and because of the prominent marginal and bisecting streams, it is worthy of inspection at some time.		
Cherryfield 7½'	Steuben	1.0 mile E of Steuben, S of Route 1 N.B. Because this peatland may be near the Coastal-Inland boundary (whose location has not been precisely determined in this region), and because of the prominent bisecting stream, it is worthy of inspection at some time.	A,T	Iv
"	"	Five small peatlands, 1.2, 1.3, 2.0, 2.0, and 2.2 miles NE of Steuben	A,T	Iv
"	"	0.9 miles NW of Steuben	A,T	Iv
"	"	1.4 miles S of Unionville N.B. Aerial photo interpretation suggests this to be dominated by Inland dwarf shrub communities. It certainly should be studied with its appropriate peatland type.	A,T,C	Iv
Cherryfield 15'	Cherryfield	2.9 miles NE of Cherryfield	A,T	I
"	T 18 MD, and Columbia	The "Great Heath," north of and along the Pleasant River N.B. This massive peatland is one of a few large peatlands that lie on a line roughly parallel to the coastline, only a few miles inland of the Coastal-Inland boundary. There is every likelihood that this peatland will be found to qualify completely for Critical Area status.	F,A,T,V C	I
"	T 18 MD, and Deblois	2.6 miles NW of Shoodic Lake	F,A,T	I
Bar Harbor 15'	Gouldsboro, and Winter Harbor	0.8 mile E of Summer Harbor N.B. Overflight revealed the possibility of the coastal communities, including some central Scirpus growth, at this peatland. A visit is needed to confirm these features. If Coastal features are present, this peatland would be worthy of recommendation for evaluation as a potential Critical Area, for it is near the southern limit for the Coastal Raised Bog type, it would be significantly "inland" for that type, and would document the boundary between the Coastal	F,A,T	Rv

Table 4 (continued)

			and Inland regions in an area lacking such documentation, and which is especially important in delineating the whole of the Coastal Region.		
Bar Harbor 15'	Winter Harbor		Three wetlands, 1.0, 1.3, and 1.8 miles NE of Winter Harbor N.B. The boundary between Coastal and Inland peatland types has not been determined precisely in this area.	F,A,T	Iv
"	Gouldsboro		N and NW of Forbes Pond N.B. These pond and stream margin wetlands are likely peatlands, and should be considered with other similar peatlands in Coastal and Inland regions. Forbes Pond is one of the very few ponds near the sea along the eastern Maine coast, and its extensive wetlands are similarly noteworthy. Comparison should be made with the "Ackley Pond wetlands" in Cutler, a smaller, but similar, phenomenon.	F,A,T	I
"	"		1.1 miles W of Jones Pond, SE of Route 186	F,A,T	Iv
"	"		"Dingle Meadow Heath," 1.5 miles NE of West Gouldsboro	F,A,T	I
"	T 7 SD		"Goose Pond Heath"	F,A,T	I
"	Cranberry Isles		SW corner of Little Cranberry Island N.B. Because this peatland potentially is very similar to, although smaller than, "The Heath" on Great Cranberry Island (a site highly recommended for evaluation as a potential Critical Area), it may prove to be a Coastal Bog with sufficient features for Critical Area status. Its proximity to the sea (perhaps it is sea cut or the marginal slope is sea enhanced), and the presence of surface ponds (as figured on the Bar Harbor 15' quadrangle) surely warrant verification. A visit is strongly recommended.	A,T	Rv
Tunk Lake 15'	--		A flight over several peatlands showed they are Inland peatland types.		I
Swans Island 15'	Southwest Harbor	1	"Big Heath," 0.8 mile NW of Bennet Cove	A,T,V,D	R

Table 4 (continued)

Swans Island 15'	Southwest Harbor		0.5 mile N of Bennet Cove, N of road N.B. This peatland contains vigorous leatherleaf shrub growth, and is likely a low shrub fen. It should be considered with similar peatlands in the Coastal and Inland regions.	A,T,V	Ic
"	Cranberry Isles	2	SW quarter of Great Cranberry Isle	A,T,V	R
Mount Desert 15'*					
"	Bar Harbor		"Fresh Meadow" N.B. A wetland complex with few trees, cattails and sedges in lower areas and adjacent to streams, and a raised peatland densely vegetated with Rhodora. The vigorous Rhodora, which cannot tolerate ombrotrophic conditions, may be able to grow on the raised peats partly because the surface was enriched during peat mining operations many years ago. Also, there are other instances where Rhodora is prominent on peatlands adjacent to stream systems in both the Coastal and Inland regions (cf. the peatlands "0.8 mile NE of Enoch Hill" in the township of Whiting). This site should be considered along with other similar peatlands in both regions. A large part of this wetland is owned by the Audubon Society.	F,A,T,V	I
"	"		"The Heath" N.B. This peatland, "Fresh Meadow" heath, and "Jones Marsh" should be visited and compared at some time. They are not expected to contain Coastal species or communities.	F,A,T,V	I
"	"		"Jones Marsh" N.B. A small open peatland with black spruce, this site was visited briefly very early in the study, and no coastal species or communities were noted.	F,A,T,V	I
"	"		"Sunken Heath"	A,T	Iv
"	"		"Long Heath"	A,T	Iv

*Includes only selected sites on Mount Desert Island.

GENERAL EVALUATION OF COASTAL RAISED PEATLANDS FOR INCLUSION ON THE REGISTER OF CRITICAL AREAS

1. Description of Coastal Raised Peatlands:

Coastal raised peatlands are slightly to much elevated peatlands found within a mile or so of tidewater along the coast of Maine from Mount Desert Island to West Quoddy Head. Ranging in size from less than 10 acres to more than 500 acres, they support a characteristic vegetation of the extreme oceanic coast. Many peatlands are clearly plateaus, treeless except at their margins, with dwarf shrub heaths in abundance, often with central lawns of a sedge, *Scirpus cespitosus*. Peat mosses, *Sphagnum* spp., are abundant throughout. Coastal peatland species, notably baked-apple berry (*Rubus chamaemorus*) and black crowberry (*Empetrum nigrum*) flourish. By morphology and vegetation these peatlands are most similar to coastal plateau peatlands in extreme southwestern New Brunswick, coastal Nova Scotia, and western Newfoundland.

2. Considerations In Registration:

A. Values and qualities represented by the area (specifically including any unique or exemplary qualities of the feature).

The coastal raised peatlands are a rare peatland type in North America, some of the species and communities are nowhere else in the eastern United States so abundant. These peatlands are habitat for showy and curious plants such as orchids and carnivorous species. Floral and foliage displays are most attractive; there are several species with prolific tasty fruits. Because they provide open vistas in a naturally forested landscape, and because they convey an aura of the Arctic, these prominently raised peatlands by the sea have considerable aesthetic appeal. Proximity to and erosion by the sea adds scenic and scientific significance.

B. Probable effects of uncontrolled use (specifically in relation to its intrinsic fragility).

The most devastating use is mining, which can obliterate any peatland. Partial mining may be somewhat less damaging if care is exercised; recovery times appear very long (decades to centuries), however. Human use, as pedestrians or by vehicles, quickly forms local channels which can disrupt drainage patterns and surface topography. Heavy visitation can destroy many significant features, including pond systems. Construction of roads, buildings, military facilities, etc., locally eliminates the peatlands and can alter drainages over a larger area. Since all nutrients the plants of the ombro-

trophic peatlands receive come from the air these peatlands are exceptionally susceptible to any aerial pollution. Use of the peatlands as landfills or dumps seriously alters water chemistry. Infrequent natural fires occur, but repeated burnings to enhance blueberries or deer hunting can alter natural communities for lengthy periods of time.

C. Present and probable future use (specifically present and future threats of destruction).

Interest in mining is very active, locally, at the state, national, and international levels. Complete removal of many of the larger peatlands is proposed. Aesthetic, educational, scientific, and management uses are increasing rapidly; several sites may soon be "over-visited." Rising populations will continue to bring dwellings and roads to the margins of the peatlands, increasing use, pollution, and fire. Berry picking may soon increase. Aerial pollutants from increased industrialization may have serious effects generally, as well as near refineries, power plants, etc.

D. Level of Significance.

The coastal raised peatlands recommended in this report are of local significance because of their openness, their berries and wildlife, and their economic potential as peat deposits. As the only peatlands of their type in the United States, they are of state and national significance. Because they include the southwesternmost coastal plateau peatlands, have marine erosion, are adjacent to Shrub Slope peatlands, and have an example of contiguous plateaus, they are of continental and global significance.

E. Probable effects of registration - positive and negative (specifically including the economic implications of inclusion of the area on the register).

The expected positive effect of registration will be to give official recognition to the most significant of the Coastal Raised Peatlands of Maine. Landowners will become informed of the importance of these peatlands and the means whereby their natural features can be protected. Registration will encourage monitoring of the peatlands and will encourage their conservation. Registration will draw attention throughout the United States that there are numerous kinds of peatlands, and that Maine has several types unique to it.

The expected negative effect of registration would be the conflicts raised with mining interests and the increased visitor use generated by the publicity caused by the registration process. The mining concerns will likely be on a site-by-site basis, for not all peatlands are equally economically attractive. Increased visitor use is more dilute, subtle, and potentially very damaging in the long run since the effects are less obvious than mining and spread out over many years.

F. Management Suggestions.

1. Guidelines for landowners outlining ways to minimize visitor damage should be prepared and circulated.

2. At heavily visited sites elevated boardwalks, overlooks, towers, or other vistas need to be built to reduce visitor damage.

3. Mining practices should include protection of unmined peatland adjacent to, within, or beneath the mine site, bonds for restoration of natural drainage and topography (as closely as possible) at the close of mining in order to speed recovery of the site, and selection of mining sites based upon natural as well as economic values.

4. Highly vulnerable features, such as the ponds of Big Heath in Acadia National Park, Mount Desert Island, and the peat cliff and ponds at Carrying Place Cove Bog need immediate protection.

5. Sources of water that feed the peatlands, and the major drainage ways from the peatlands, should be determined so that the hydrology of the peatlands can be protected from either disturbance in the watershed or alteration of the drainage.

3. Conclusions and Recommendations:

A. Conformance with definiton contained in the Act.

The Act defines a critical area as meaning: "areas containing or potentially containing plant and animal life or geological features worthy of preservation in their natural condition, or other natural features of significant scenic, scientific, or historical value."

The peatlands recommended for evaluation in this report are the result of an intensive survey of the peatlands of the Coastal Raised Peatlands of the Coastal Raised Peatland Region of Maine. Each of the peatlands has its own unique scenic and scientific attributes of state or wider significance which can be destroyed by uncontrolled or other use. The sites contain peat deposits, scenic vistas, and other qualities linked to the State's economy. The 19 recommended peatlands can thus be considered critical areas under the legislated definition.

B. Conformance with the Guidelines for the Registration of Critical Areas, adopted by the Critical Areas Advisory Board on September 11. 1975.

Section 1. Knowledge of the Area: This report, Coastal Raised Peatlands in Maine and Their Relevance to the Critical Areas Program of the State Planning Office was prepared for the Critical Areas Program in order to provide detailed documentation about the ecologic and scenic significance of coastal raised peatlands in Maine.

Section 2. Representation on the Register: Coastal Raised Peatlands are not included on the Register of Critical Areas at this time.

Section 3. Variety of Values: The recommended peatlands have a variety of values. They have geologic, geomorphic, and hydrologic significance as part of the earth's surface; they support rare plants and communities; they contain a unique ecology; they document past climates, biota, and land/sea relationships; they are important scenic and natural areas; they are of local importance for berry crops; and some sites are of historic significance in the deployment of military facilities and local mining.

Section 4. Scarcity: Each site recommended in this report is unique in at least one important respect. Most sites have several unique features of importance.

Section 5. Quality: The peatlands recommended in this report have been selected to be exceptional examples of the features which they contain. Fully 70% of the peatlands in the Coastal Region have been rejected from further consideration, and only 19 of the 53 other peatlands are recommended by this report for evaluation as potential Critical Areas.

Section 6. Persistence: These peatlands are 7000 to 9000+ years old, having begun their existence shortly after the emergence of the land from the sea at the close of the Pleistocene. The long term prospects for the continued existence of the peatlands is exceptionally promising if they remain unaltered by mankind.

Section 7. Geographic Distribution: Both the literature search and field work phases of this study were used to determine the extent of coastal raised peatlands in Maine. The sites recommended for evaluation come from throughout the coastal raised peatland region.

Section 8. Use: The coastal raised peatlands have exceptional potential for scientific, natural history, and educational use, and offer opportunity for passive recreation.

Section 9. Manageability: All peatlands recommended for registry can be managed easily to perpetuate their described features.

Section 10. Potential Economic Effects: Landowners favoring the maintenance of the peatlands in a natural state will find little or no economic effect because of registration. There may be economic implication for some landowners because of the potential for peat mining.

Section 11. Potential Effect of the Conservation of the Areas: Registration is expected to have a very positive effect on the conservation of Maine's coastal raised peatlands.

RECOMMENDATIONS

1. The exceptional coastal raised peatlands recommended in Table 2 should be evaluated for inclusion in the Register of Critical Areas.

2. The 18 coastal raised peatlands classified as "Rv" in Table 4 and discussed in the section, "Sites Likely Suitable for Evaluation as Potential Critical Areas" should be field checked and evaluated for inclusion in the Register of Critical Areas.

3. The Shrub Slope peatlands should be field checked and evaluated for inclusion in the Register of Critical Areas. Due to their limited number this could be accomplished without extensive resource allocation.

4. The various peatlands classified as "Ic" in Table 4 (peatlands not coastal raised peatlands, more like peatlands found elsewhere in Maine) should be studied according to their peatland type when that peatland type is the subject of Critical Areas Program enquiry.

5. The high use peatlands recommended for evaluation, notably Big Heath, the peatlands of Great Wass Island, and Carrying Place Cove Bog, should have management plans devised and implemented as quickly as possible to prevent further disturbance from uncontrolled use. Similar plans are recommended for highly visible and accessible sites such as Corea Heath, West Jonesport Heath, Kelley Point Peatland Complex, and Kelley Heath.

6. Additional field investigation should be undertaken to verify the significant natural portions of the Jonesport Heath.

7. Landowners of lands adjacent to peatlands, and their watersheds, recommended for evaluation should be encouraged to not significantly alter waters that affect the peatlands.

8. Research on the susceptibility to disturbances and the mode and rate of recovery from disturbances should be initiated as these topics are virtually unknown for the coastal raised peatlands. The results of these studies should lead to management practices.

GLOSSARY

This glossary provides brief descriptions of terms as used in this report; it does not attempt to enumerate additional uses of the terms as employed elsewhere.

amphi-Atlantic: both sides of the Atlantic

association: a taxonomic subdivision of Order in the Zürich-Montpellier vegetation classification system based upon physiognomy and floristic composition; e.g., the Kalmio-Sphagnetum fusci includes dwarf shrub heath vegetation with Kalmia angustifolia and Sphagnum fuscum as important constituents (c.f. Damman 1977).

basal: bottom; the bottommost peats of a peatland (basal peats), or the mineral materials immediately below those peats (basal substrate).

basin: a depression in the landscape

bay: an open peatland considerably smaller than, contiguous with, and having a lower surface elevation than a raised peatland

bog: commonly used, especially by general public, for all peatlands, most particularly those with Sphagnum and subdued, low, or absent woody cover; more specifically employed solely for ombrogenic peatlands (which includes nearly all peatlands with which this report is concerned)

class: the highest taxon of the Zürich-Montpellier vegetation classification system (based upon floristic affinities) used here; e.g., the Oxycocco-Sphagnetea includes all the plant communities of ombrotrophic and oligotrophic, primarily organic, soils with the exception of mud bottom and Sphagnum-covered hollow vegetation (c.f. Damman 1979a).

coastal: by the sea; usually infers near the sea with some effect by the sea; applied differently depending upon the geographic scale of interest

coastal region: that portion of eastern Maine and adjacent New Brunswick along the Gulf of Maine and Bay of Fundy that contains open plateau bogs with steep marginal slopes and central lawns, minerotrophic species on ombrotrophic peats, and communities with prominent Sphagnum fuscum, Empetrum nigrum, and Rubus chamaemorus; commonly used only in reference to Maine

community: an assemblage of plants recognized by species composition and relative abundance; typically the same community appears in different places (e.g., in numerous different peatlands); in the Zürich-Montpellier vegetation classification system the lowest taxon used here, for example the Scirpus-Sphagnum fuscum lawn community

concentric pattern: alternating topographic and/or vegetation features of a peatland that are more-or-less parallel and encircle, at least in part, the central region of the peatland

concentric zonation: the placement of the major plant communities of a peatland in bands (zones, rings, etc.) around the central region of the peatland generally parallel to the margin, regardless of the overall shape of the peatland (the term eccentric is reserved for zonation much more distorted than occurs in the study area)

domed peatland: a convex raised peatland that rises from all directions to a central high area

downstream: the portion of a peatland generally closest to a drainage way, commonly the lowest portion of the lagg; when overall a peatland slopes, then the lowest margins are the downstream side

drainage way: a narrowed area of wetland (frequently peatland) that leads away from a peatland unit, and through which water obviously drains from the peatland; commonly with minor stream channels and perceptible water flow

dwarf shrub: synonymous with low shrub

elevation: with reference to raised peatlands the height of the vegetated peat surface; when considering entire peatlands the average distance above sea level of the peatland surface

ericaceous: belonging to the plant family Ericaceae (the blueberries, huckleberries, cranberries, rhododendron, laurels, etc.); usually refers to shrub lands of low shrubs that mostly belong to the Ericaceae

evapotranspiration: the combination of water loss from an ecosystem to the atmosphere through evaporation and transpiration

extreme maritime: with reference to location—within a few hundred meters of the sea; with reference to climate—having much sea fog, frequent sea breezes, vigorous winds during coastal storms, direct salt spray at least during large storms, etc.

fen: peatland that receives mineral ground water input; vegetation varies greatly

graminoid: grasslike; graminoid vegetation is composed of narrow-leaved grasses, sedges, rushes, or similar plants

ground water: water in upper and lower layers of the landscape, including soil water and deeper waters

heath: a term used in portions of New England (Washington County, Maine through southern Maine to portions of adjacent New Hampshire) for peatlands, especially open peatlands; in much of the range of the use of the term it is restricted for raised peatlands, particularly those not more than a few miles from the coast; the term clearly stems from the British use of "heath" for terrain dominated by ericaceous, or related, shrubs. Heath also may mean an ericaceous low shrub dominated ecosystem, or only the shrubs of that ecosystem; or it may refer to the individual shrub species or the individual shrub plants.

height: the highest region of a raised peatland

histosol: U.S. Soil Conservation Service term for organic soil

hollow: a low area of vegetated or bare peat varying in size from less than four inches in depth to six feet or more, in breadth from eight inches or so to many feet, in morphology from conical, hemispherical or bowl-shaped to flat or curved-bottomed basins with shallow, steep or over-hung sides, in shape from circular to oblong or highly elongated, with simple, highly lobed or irregular margins; hollows may occur as discrete individuals, or be variously interconnected and anastomosed; the areas between hollows are commonly called hummocks; wet depressions, mud bottom sites, pools, and ponds are specialized hollows

hollowless plain: plains of Sphagnum essentially of hummock structure, but with considerable lateral development; the adjective "hollowless" is used to highlight the hummock structure and the absence of hollows and their vegetation

hummock: a rise of usually vegetated peat varying in size from less than four inches in height to six feet or more, in breadth from eight inches or so to many feet, in morphology from conical and hemispherical to butte or mesa, and in shape from circular to highly elongated, with margins smooth to highly irregular; hummocks may stand free as individuals, or be variously interconnected and anastomosed; the areas between hummocks are commonly called hollows

hydrology: with peatlands refers to all aspects of water that affect growth and development of a peatland; most particularly precipitation and ground, soil, and surface waters, their physical, chemical, geographical (i.e., location), and temporal character

inland: away from the coast; absolute distance from the coast depends upon geographic scale of interest; also specifically used here for peatlands without coastal morphology or communities

ladder-form: alignment of ponds, wet depressions or elongated hollows on a peatland surface resembling the rungs of a ladder; i.e., elongated features in parallel formation

lagg: the marginal area of a peatland that is evidently affected, both topographically and vegetationally, by mineral ground water; can vary

from a few feet to a few hundred feet in width, with or without open water, streams, and/or ponds, and with various vegetation; for nearly all peatlands, whether primary, secondary, or tertiary laggs are slightly to much lower than the adjacent peatland

lawn: low sedge (esp. Scirpus cespitosus) dominated communities of ombrogenic peatlands

low shrub: woody plant less than about 53 in (135 cm) tall, may be less than 4 in (10 cm) tall; intended for use with ericaceous and other shrubs of open peatlands, whose heights commonly are less than 31 in (80 cm)

margin: the edge or fringe of a peatland at which point topographic, vegetation, and/or hydrologic changes due to the proximity of adjacent upland or aquatic terrain becomes evident

maritime: of the sea; usually infers affected by the sea, as in maritime climate; applied differently depending upon the geographical scale of interest

marsh: used loosely for graminoid dominated wetlands

meadow: used loosely for open grassy areas

mine: a portion of a peatland that has had removal of peat by human activity, especially for agricultural, horticultural, bedding, fuel, or industrial purposes; also used to include facilities, roadways, etc., necessary for the peat removal

mineral ground water: synonymous with ground water; term simply highlights that the water contains more minerals than does precipitation

minerotrophic: a plant community, ecosystem, etc., that has or requires water with nutrients other than those supplied by precipitation and fallout

moat: sometimes used synonymously with lagg; sometimes refers to the portion of a lagg with standing or flowing water

morphology: in reference to peatlands the three-dimensional shape of the surface of the peatland, such as plateau, domed, flat, etc.

mud bottom: wet low areas of peatlands having exposed (muddy) peat amid scattered or loosely growing low plants

nutrient-poor: limited supply of plant nutrients; usually applied to hydologic situations when atmospherically supplied nutrients are supplemented by just enough ground water nutrients to cause a perceptible change in species composition

nutrient-rich: relatively abundant supply of plant nutrients

offset plateau, offset dome: condition when the highest elevation of a raised plateau or dome peatland is not central but nearer one margin of the peatland

oligotrophic: used in reference to primary peatlands in basins whose vegetation receives exceedingly nutrient-poor water, essentially all of which is provided by rainfall

ombrogenic: formed as part of an ombrotrophic peatland; often used to indicate that a slightly minerotrophic portion of a peatland is, in fact, of ombrotrophic origin

ombrotrophic: "food from the sky"; a plant, community, ecosystem, etc., that has or receives nutrients solely from precipitation and fallout

open: essentially treeless

order: the first taxonomic subdivision of Class in the Zürich-Montpellier vegetation classification system; e.g., the Sphagnetalia fusci includes hummock vegetation of ombrotrophic bogs and of the highest ridges in certain northern fens (see lengthy discussion on this order by Damman 1979a)

organic soil: according to the U.S. Soil Conservation Service organic soil materials have at least 12% (if no clay present) to 18% (if clay is 60% or more of universal fraction) organic carbon if soil is saturated for long periods, or with 20% or more regardless of saturation; an organic soil has (a) more than half of the upper 32 in. of soil materials organic, or (b) organic soil materials resting on rock or fragmented material with interstices filled with organic materials

paludification: to become wet or waterlogged; landscape formerly upland becomes peatland by upward and lateral growth of a tertiary peatland; i.e., through paludification

pattern: the regular alternation of peatland topographic and/or vegetation features at a scale perceivable as one walks through the peatland or flies over at low elevations

peat: partially decomposed organic matter usually found as natural shallow or deep deposits; encompasses "peat" and "muck" designations formerly used by U.S. Soil Conservation Service as well as wetland Histosols (organic soils) of their present classification scheme; includes all materials considered peat by U.S. Federal Trade Commission, U.S. Bureau of Mines, and American Society for Testing Materials; legal definitions of peat are based primarily on measurements of ash or organic carbon content

peat deposit: the peat of a peatland, whether primary, secondary, or tertiary

peatland: a three-dimensional portion of the landscape that is a wetland and has a peat substrate; includes the biota, the peat, and all surface and internal waters

plain: the "bog plain" is the region of a raised peatland that is most level; it lies central to the bog slope. "Sphagnum plains" are local regions of the peat surface where Sphagnum (primarily S. fuscum) forms an essentially level or slightly undulating firm carpet devoid of hummocks or hollows

plateau peatland: a morphologic form of raised peatland with fairly steep marginal slopes and relatively flat upper surfaces; most plateaus are actually slightly convex, but not clearly domed

pond: used here to refer to permanent, usually rather small (largest dimension from less than two feet to a few hundreds of feet) water bodies on the surfaces of peatlands; ponds may have no standing water during some droughts, but do not have continuous vascular plant and Sphagnum plant cover (as might ephemeral pools or wet depressions); occasionally used for any body of predominantly open, shallow water

pond system: a series, group, ensemble, etc., of ponds on the surface of a peatland that are interrelated by location, form, and hydrology

pool: usually used synonymously with pond; occasionally distinguished from pond by restricting the term for ephemeral or seasonal, small water bodies on the surfaces of peatlands

primary: peats or peatland formed or forming in a basin in such a way that the water level in the basin is not raised except perhaps locally in hummocks

raised peatland: peatlands where the accumulation of peat, and hence the growing surface, is elevated above the regional water table; commonly the peats are elevated above the adjacent mineral or aquatic landscape as well

ridge: an elongated rise of vegetated peat (hummock), varying in height from four inches to six feet, in length from a few feet to hundreds of feet, and in breadth from one to a few tens of feet; commonly the long axis of the ridge lies perpendicular to the slope of the bog

secondary: peats or peatland formed or forming above (and usually somewhat laterally beyond former limits) the former water level, but not beyond the confines of mineral topography; i.e., secondary peatlands are capable of elevating water tables, but not beyond topographic basins

shoulder: the portion of a raised peatland, especially a plateau peatland, where the bog plain changes to the bog slope; occasionally used for places where the bog slope abruptly becomes steeper

site: commonly used to mean a single peatland

slope: an area of peatland whose generalized surface (i.e., as if hummocks and hollows were smoothed out) is not level, but slopes; in many cases distinctive portions of the slope can be distinguished by steepness and vegetation

soak: a portion of an ombrogenic peatland considerably wetter than its surroundings, usually elongated with some perceptible water flowage

sociation: a group of plants commonly found together; essentially the same as community in the Zürich-Montpellier system

soil water: water in the upper layers of the landscape, especially the soil

string-of-beads: an alignment of pools or ponds on a peatland surface resembling a string of beads, usually several small or miniature, roundish ponds connected by a narrow channel in the middle of a marginal fen, lagg, or drainage way

tertiary: peats or peatland formed or forming above and/or laterally beyond former water levels without the aid of confining topography; tertiary peatlands are raised peatlands and receive their water and nutrients solely from the atmosphere (i.e., they are ombrotrophic), their internal and surface waters are commonly perched above (and sometimes separated from) the regional water table

thicket: used for shrublands five feet tall or more; i.e., shrublands through which passage is difficult

topography: the three-dimensional shape of the surface of the landscape, peatland, local portion of peatland, etc.

unit: an individual peatland; or, notably in the case of the Jonesport Heath, an individual plateau among two or more contiguous or slightly coalesced raised peatlands

upstream: the portion of a peatland generally farthest from a drainage way, commonly the highest portion of the lagg; when overall a peatland slopes, then the upper margins are its upstream side

vegetation unit: a physiognomic grouping of communities within an association in the Zürich-Montpellier vegetation classification system; e.g., the Dwarf Shrub Heaths, Lawns and Carpets, and Mud Bottoms of raised bogs

von Post: a 10-point system denoting the degree of peat decomposition; 1 is the least decomposed, 10 is the most decomposed

water track: an area of minerotrophic water that flows through an ombrogenic peatland, denoted by more minerotrophic species

wet depression: a lower area of open, vegetated peatland surface, commonly elongated, varying in depth from four inches to four feet and in breadth from 8 inches to many tens of feet; the long axis, if one, generally lies at right angles to the slope of the bog

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Action Plan

On January 16, 1981, the Critical Areas Advisory Board and the State Planning Office decided to implement the following actions:

1. The following peatlands will be evaluated for inclusion on the Register of Critical Areas.

   Carrying Place Cove Bog
   Kelley Point Peatland Complex
   North Unit, Jonesport Heath
   Corea Heath
   North Cutler Heaths
   Kelley Heath, Cutler
   Great Cranberry Isle Heath
   Central Peatlands, Great Wass Island
   Southwest Heath, Great Wass Island
   Big Heath, Mt. Desert Island
   West Jonesport Heath

2. The Critical Areas Program will contact the landowners of the following peatlands:

   Heath, 1.9 miles W of North Cutler
   Boot Cove Heath
   Larrabee Heath
   South Trescott Heath
   Moose River Heath
   Great Cove Heath, Roque Bluffs
   West Quoddy Head Heath

3. When funding resources allow, the program shall field check the 18 coastal raised peatlands classified as "Rv" in Table 4 shall be field checked and evaluated for inclusion in the Register of Critical Areas.

4. When funding resources allow, the program shall investigate the subject of shrub slope peatlands.

5. The peatlands classified as "Ic" in Table 4 shall be evaluated at a later date, when further peatland inventory work is undertaken by the Critical Areas Program.

6. The Critical Areas Program shall work closely with landowners of the peatlands which are registered to encourage wise management of the areas.

7. It if becomes apparent to the Critical Areas Program that waters entering a registered peatland are being significantly altered, the landowners of the watershed shall be advised of the impact of these alterations upon the critical area.

8. The Critical Areas Program shall encourage research by other agencies and individuals investigating the susceptibility of peatlands to various disturbances, and modes and rates of recovery from these.

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