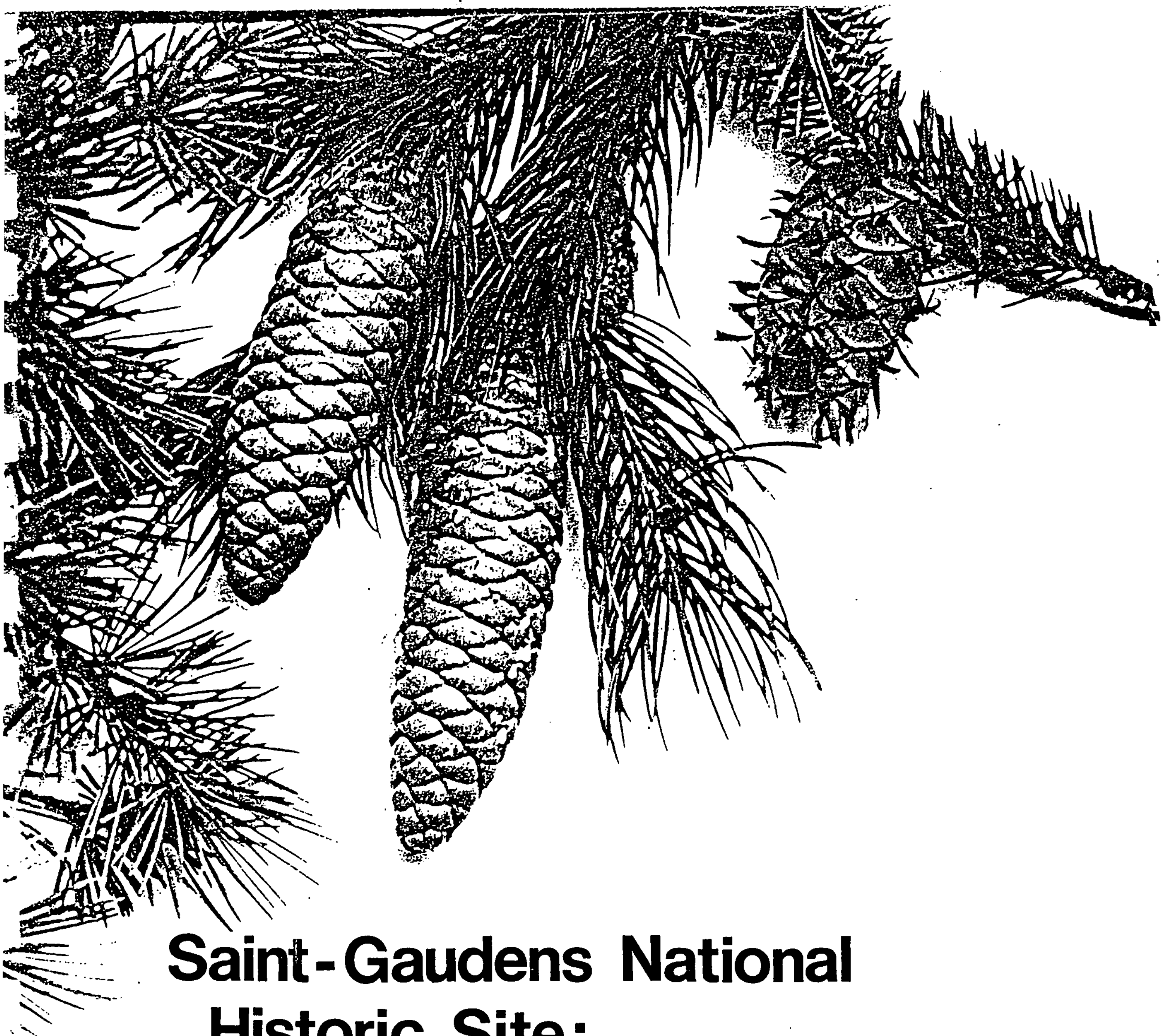

Saint-Gaudens National Historic Site:

A Natural Resource Inventory

By Christopher S. Cronan & Associates

1981

A NATURAL RESOURCE INVENTORY STUDY
AT
SAINT-GAUDENS NATIONAL HISTORIC SITE
CORNISH, NEW HAMPSHIRE

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INTRODUCTION

Saint-Gaudens National Historic Site is located in the rural town of Cornish New Hampshire, admidst the beautiful landscape of the upper Connecticut River Valley (Fig. 1). The Historic Site was formally established in 1964 by the National Park Service in order to preserve in public ownership the historically significant properties associated with the life and cultural achievements of Augustus Saint-Gaudens, a famed American sculptor. Saint-Gaudens lived and worked as an artist in the Cornish Colony from 1885 to 1907, and produced such outstanding statues as The Standing Lincoln, The Adams Memorial, and the Sherman Statue. Several decades after his death, the Saint-Gaudens estate was transferred to the National Park Service. At present, the Historic Site and adjacent natural areas include approximately 148 acres of open and forested land (Fig. 2).

In October, 1979, a natural resource inventory was initiated at the Historic Site and adjacent natural area to permit the development of an interpretive site description which would promote improved understanding, recreational use, and management of this historic core and natural subzones. The overall objective of this ecological study was to determine the content and extent of natural resources within the property boundaries. More specifically, the resource inventory was intended i) to provide the data required for the identification and preservation of resources in the ecological study area of Saint-Gaudens National Historic Site; ii) to identify ecological relationships among these resources; and iii) to indicate resource-related problems that could affect preservation and interpretation of the Saint-Gaudens National Historic Site. The results of this ecological resource inventory are presented in the report which follows. It should be noted that the report is organized into separate, independent chapters devoted to each major resource category. At the conclusion of the report, all of the chapters are reviewed in an executive summary, and management recommendations are offered for the entire Historic Site.

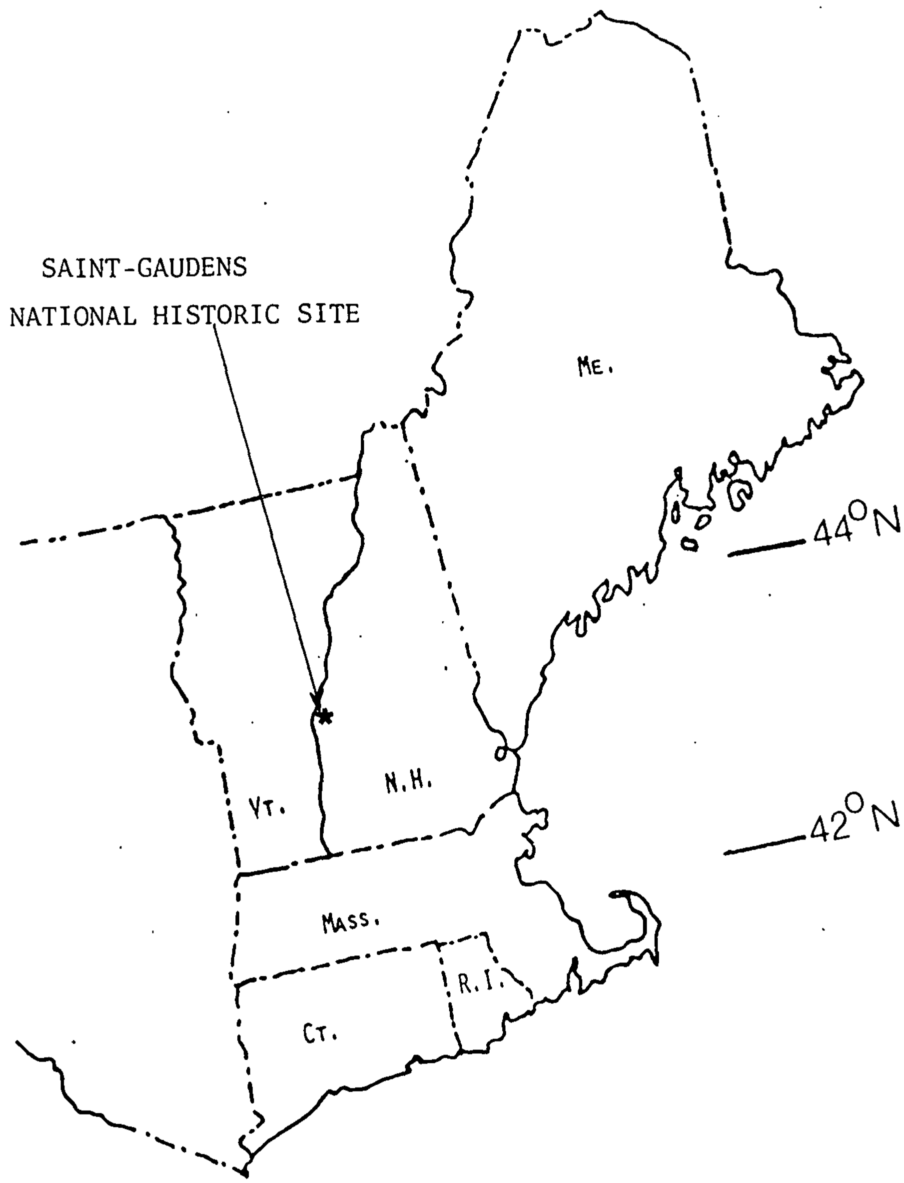

Fig. 1. Geographic location of Saint-Gaudens National Historic Site, Cornish, New Hampshire.

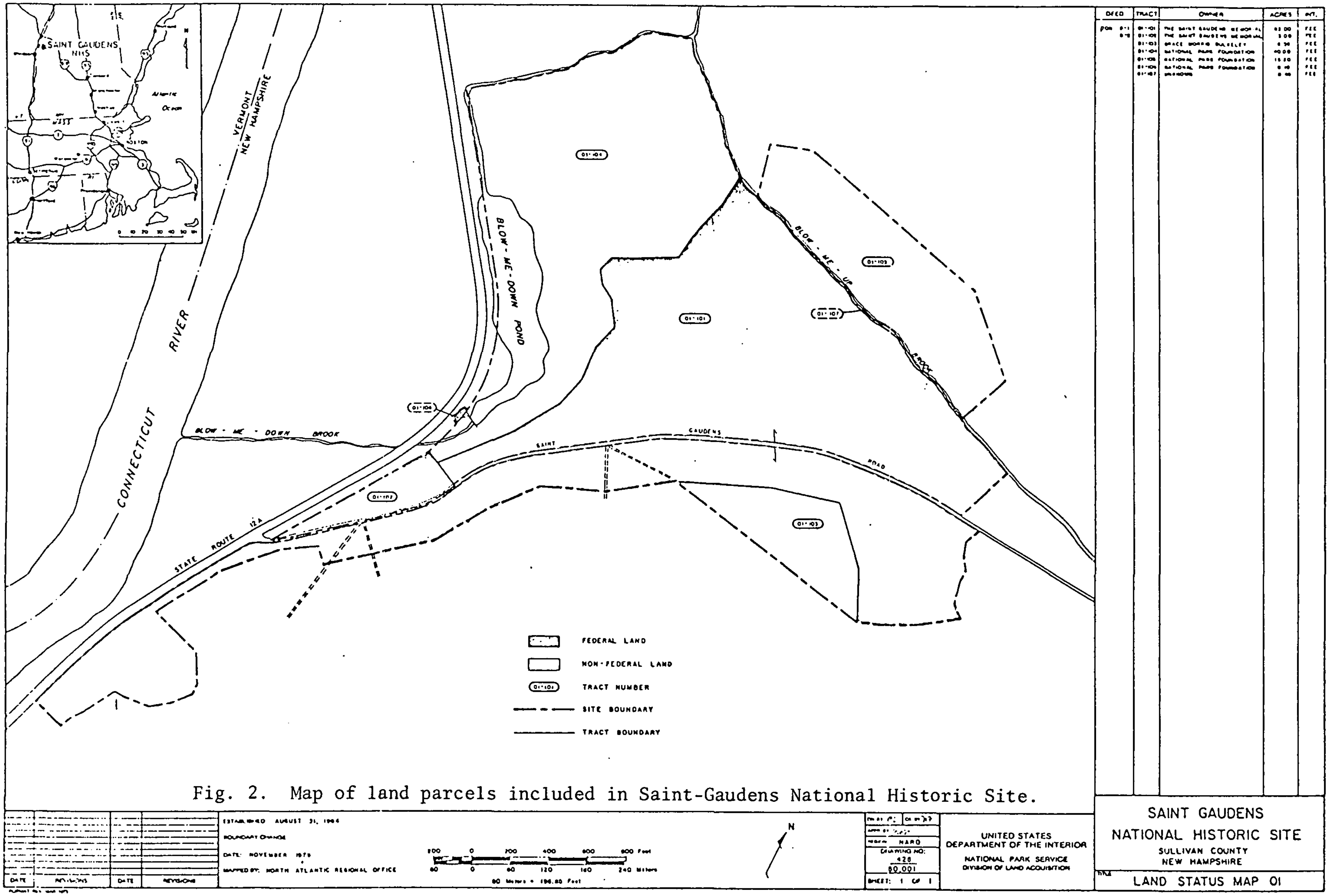

Fig. 2. Map of land parcels included in Saint-Gaudens National Historic Site.

VEGETATION RESOURCES AT SAINT-GAUDENS NATIONAL HISTORIC SITE

by

C. S. Cronan and M. R. DesMeules

1907 map fig. 14 ?

The landscape at Saint-Gaudens National Historic Site exhibits a refreshing mixture of vegetation contrasts and diverse topographic features. While the core of the Historic site contains a variety of managed and planted lawns and gardens, the natural area is characterized by a diverse pattern of forest and wetland vegetation that is distributed like a mosaic over the terraces, ravines, floodplains, and hillslopes of the site. Like much of the rest of New Hampshire, the natural vegetation is in a dynamic state of gradual successional change. Areas that were mown lawn or pastures during the period of Saint-Gaudens' life are now young successional forests. In other sections, vigorous wetland communities have encroached upon former areas of open water in Blow-Me-Down Pond. Elsewhere, former pine and hemlock mature forests have been transformed by logging activities to uneven-aged mixed successional forests. In the report which follows, an attempt is made to describe the vegetation resources at Saint-Gaudens N.H.S. in terms of existing vegetation patterns, successional trends, and special botanical resources.

Vegetation Patterns

Methods

The tree communities at Saint-Gaudens N.H.S. were sampled using a stratified random sampling design. First, aerial photos and ground reconnaissance were used to identify distinct vegetation cover types at the site. Then, 10 x 20 m quadrats were placed at random within each cover type to permit quantitative sampling of tree species densities and basal areas. In some instances,

classified photos?

the quadrats were placed individually, while in other cases, the quadrats were combined as segments of 10 m wide belt transects. The locations of these sampling quadrats and transects are shown on the topographic map in Fig. 1. In each quadrat, every tree greater than 2.5 cm in diameter was recorded by species, diameter at breast height (dbh), and condition (live or dead). Overall, data were obtained from 80 quadrats, for a total sampling area of 1.6 hectare (16,000 m^2). Back in the laboratory, the data were analyzed by computer techniques to determine the quantitative structure of the vegetation communities.

veg classif

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The density and tree diameter data were used to develop average density and basal area estimates, relative density and relative basal area measures, and importance values for each species. The importance values were used to rank the species according to dominance in each community (i.e. to determine which species were "most important" in each community in terms of size and individual abundance).

Shrub and herb communities were also characterized during the sampling program. For these wetland and understory vegetation components, line intercept methods were used to develop semi-quantitative percent cover estimates for the major species.

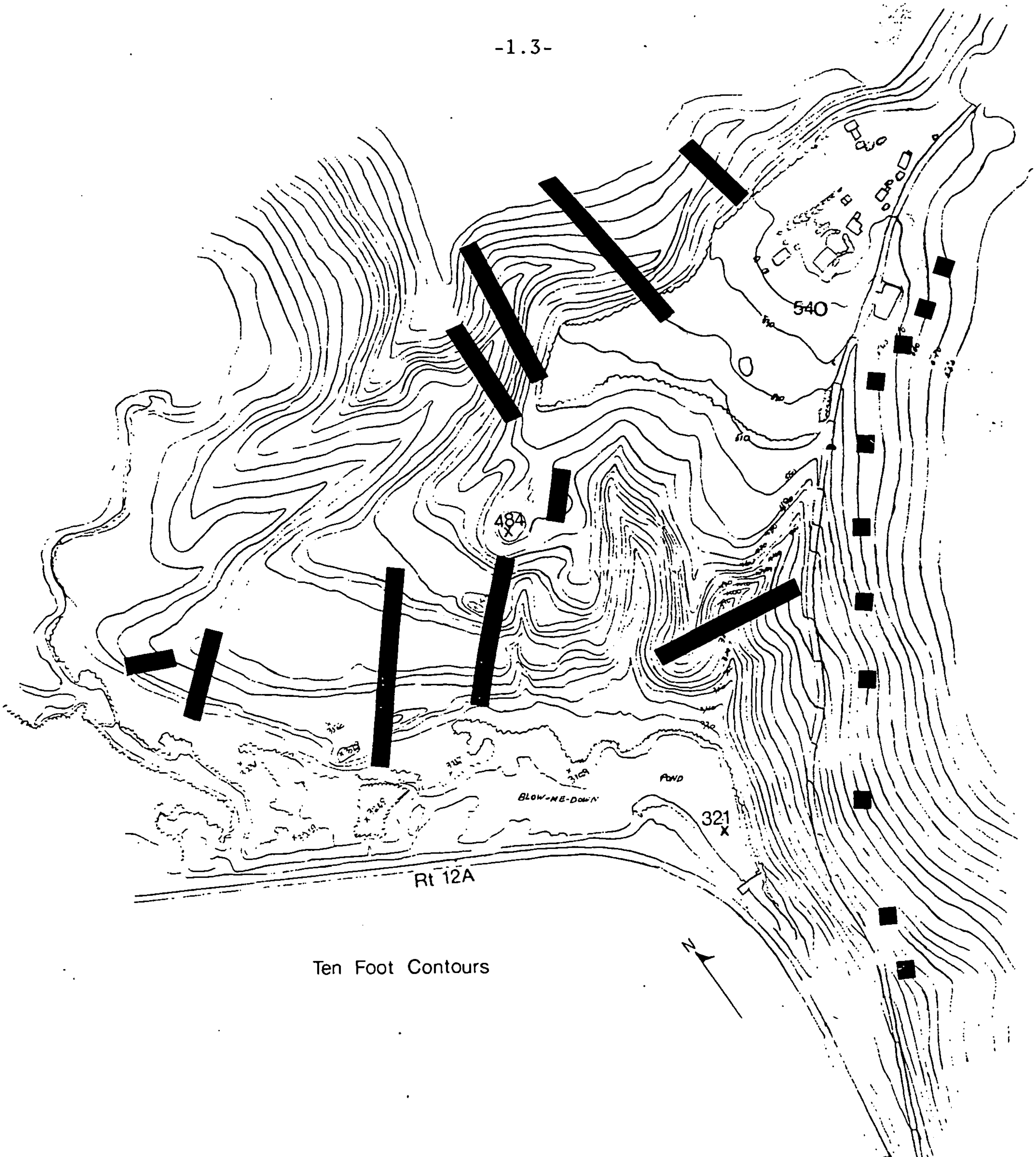


Fig.1. Sampling transects and quadrats used for the vegetation survey at Saint-Gaudens National Historic Site and natural area.

transects
quadrats

Results

The photograph in Fig. 2 presents an aerial overview of the vegetation at Saint-Gaudens National Historic Site, while the generalized pattern of vegetation cover types is shown in Fig. 3. As indicated, a large portion of the overall site is covered by mixed hardwood forest. There is also a prominent section of coniferous forest in the southeastern portion of the site. In addition, there are significant areas of early successional mixed-pine and mixed-hemlock forest, riparian or floodplain forest, and wetland marsh-shrub habitat. Overall, the major tree species found in the natural area include the following: Eastern Hemlock, White Pine, Red Maple, Sugar Maple, Red Oak, Black Birch, American Beech, and Paper Birch.

More detailed descriptions of the vegetation patterns are presented on the map in Fig. 4 and in the data sets shown in Table 1 and Appendix A. Each of the vegetation cover types may be described as follows.

South-Facing Hardwood Forest

The hillslope to the north of Blow-Me-Up Brook is covered by a vegetation type that we have termed the "South-Facing Hardwood Forest" (Fig. 4). Walking through this section of the natural area, one encounters a relatively open, medium-aged mixed hardwood stand that is dominated by three major tree species: eastern hemlock (*Tsuga canadensis*), american beech (*Fagus grandifolia*), and red maple (*Acer rubrum*). In all, there are roughly 17 tree species that occur in this portion of the natural area. Besides the co-dominant tree species, one also finds numerous examples of the following sub-dominant canopy species: sugar maple (*A. saccharum*), red oak (*Quercus rubra*), black birch (*Betula lenta*), white ash (*Fraxinus americana*), paper birch (*B. papyrifera*), and american basswood (*Tilia americana*). Other minor components of the canopy are shown in

Fig. 2. Color aerial photo of the vegetation pattern at Saint-Gaudens National Historic Site and natural area (29 November 1979).

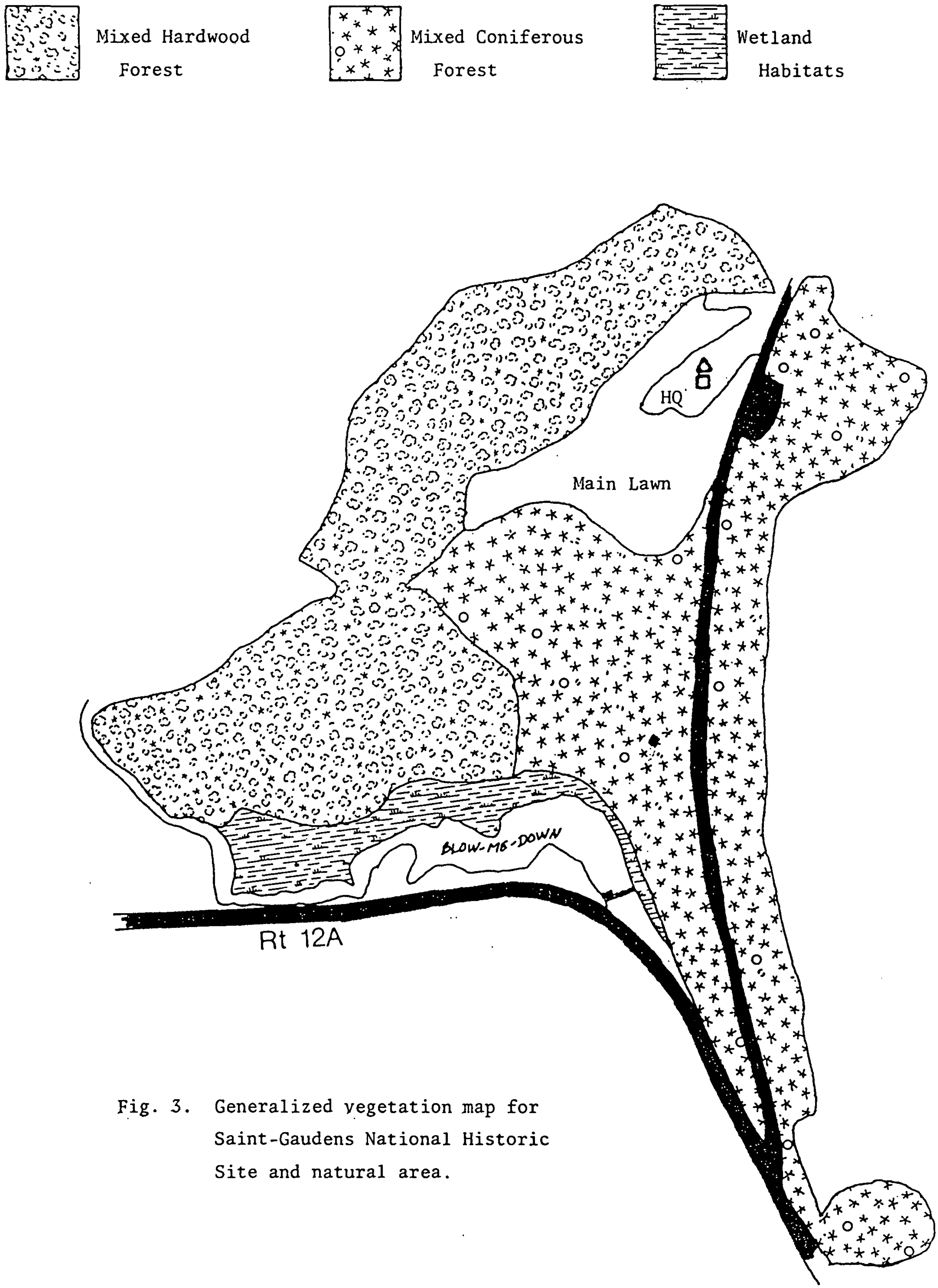


Fig. 3. Generalized vegetation map for Saint-Gaudens National Historic Site and natural area.

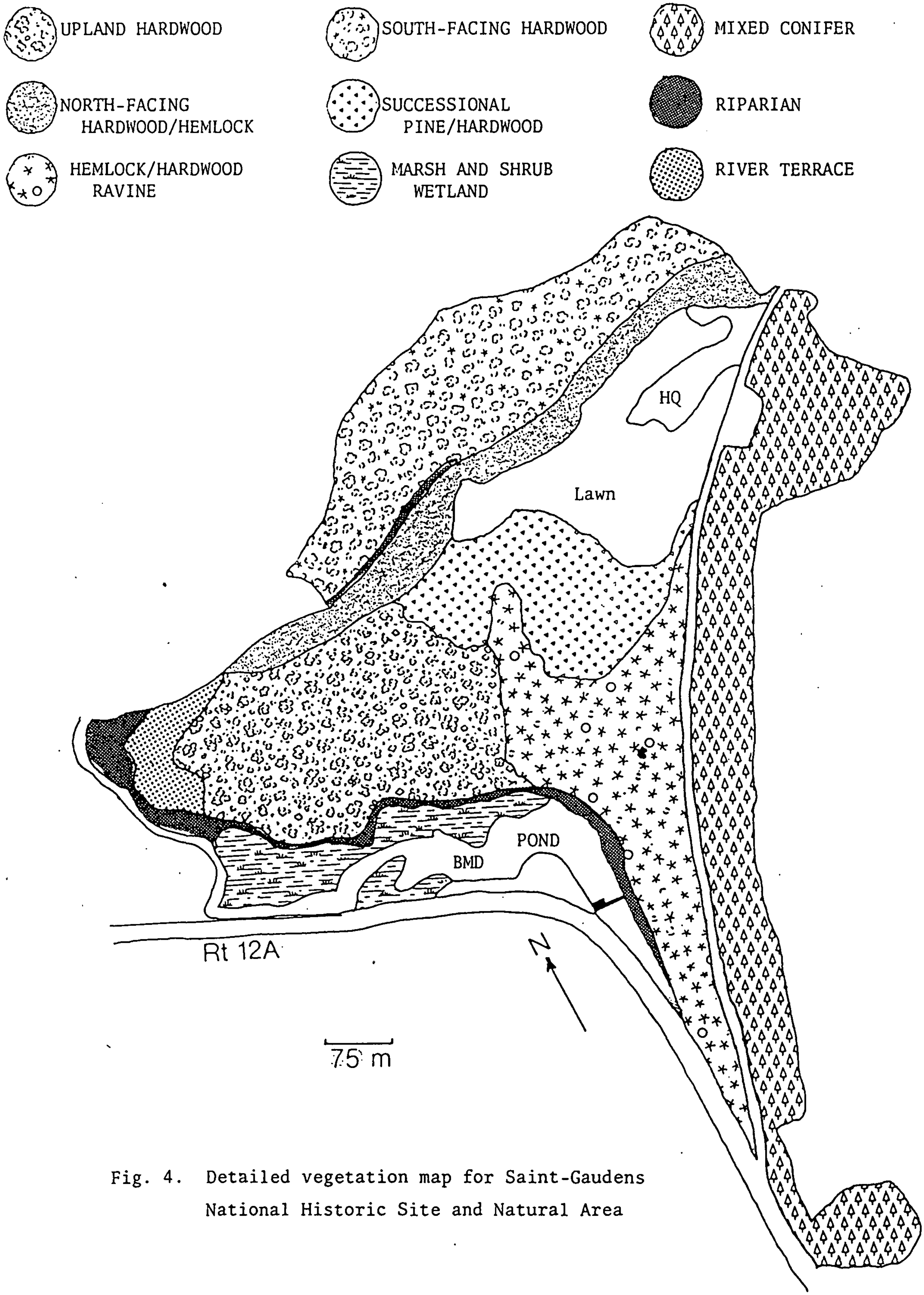


Fig. 4. Detailed vegetation map for Saint-Gaudens National Historic Site and Natural Area

TABLE 1. Species compositions and community structure for the forest cover types at Saint-Gaudens National Historic Site.

PARAMETER	VEGETATION COVER TYPES[4]							
	South-Facing Hardwoods	Upland Hardwoods	Hemlock/Hardwood Ravine Forest	North-Facing Hardwood/Hemlock	Mixed Coniferous	Pine-Hardwood Successional	River Terrace	Riparian
Relative Density[1]	Fg 21	Ar 40	Tc 50	Tc 30	Bl 22	Ps 70	Cc 48	Tc 21
	Tc 18	Ps 14	As 20	Bl 26	Ps 19	Bp 12	Hv 11	As 17
	As 15	Qr 9	Bl 7	Ps 7	Fa 14	Ar 8	Ar 9	Ta 11
	Ar 15	Fg 9		As 7	Tc 13	Pt 6	Qr 6	Fn 10
Relative Basal Area[2]	Tc 22	Ar 28	Tc 52	Tc 40	Ps 80	Ps 64	Ps 30	Tc 28
	Qr 16	Ps 26	Bl 11	Qr 15	Bp 5	Bp 15	Qr 15	Ta 24
	Ar 15	Qr 21	Ba 8	Bl 14	Tc 3	Ar 10	Bl 14	As 13
	Fg 11	Bp 10	Ar 8	Asp 6	Bl 3	Pt 7	Ar 11	Fn 6
Dominant Species[3]	Tc 40	Ar 68	Tc 102	Tc 70	Ps 99	Ps 134	Cc 56	Tc 49
(Ranked by Importance	Fg 32	Ps 40	As 26	Bl 39	Bl 26	Bp 27	Ps 32	Ta 35
Value)	Ar 30	Qr 30	Bl 18	Qr 17	Tc 16	Ar 18	Qr 21	As 30
	As 23	Bp 19		Asp 12	Fa 16	Pt 13	Ar 19	Fn 16
	Qr 21			Ps 12			Bl 16	Bl 12
Total Density, #/ha	1,986	1,471	1,142	3,050	1,931	4,201	1,291	1,450
Live	1,664	1,158	1,021	2,789	1,572	3,234	1,233	1,350
Dead	322	313	121	261	359	967	58	100
Live Basal Area, m^2/ha	28.6	33.2	41.0	34.8	45.6	24.9	20.8	25.9
Live Size Class Frequency								
$2.5 < x < 5$ cm dbh	350	139	293	1,056	509	533	458	263
$5 < x < 10$ cm dbh	439	211	243	906	514	1,583	417	400
$10 < x < 25$ cm dbh	719	629	250	656	305	1,100	258	500
$x > 25$ cm dbh	156	179	236	172	245	17	100	188

[1]Relative Density = (Species Density/Sum of all species densities) x 100.

[2]Relative Basal Area = (Species BA/Sum of all species BA) x 100.

[3]Importance Value = Relative Density + Relative Basal Area.

[4]The species abbreviations are as follows: Ar - red maple, As - sugar maple, Asp - mountain maple, Ba - yellow birch, Bl - black birch, Bp - paper birch, Cc - blue beech, Fa - white ash, Fg - American beech, Fn - black ash, Hv - witch hazel, Ps - white pine, Pt - trembling aspen, Qr - red oak, Ta - basswood, Tc - eastern hemlock.

Appendix A.

In addition to having its own particular mix of species, the south-facing hardwood forest is also distinguished by a number of ecological features. As a whole, the forest community averages 30-50 years in age, and exhibits stand density and biomass characteristics that are relatively typical for an intermediate age successional forest. The total tree density for the stand averages 1,986 stems per hectare, with live trees constituting approximately 84% of that total. The overall basal area of living trees in the forest community is approximately 28.6 m^2/ha. This measure serves as an index of standing biomass and indicates that the south-facing hardwood forest is intermediate in standing crop, as compared to the other stands shown in Table 1. The forest type also exhibits a distinctive distribution of size classes among the tree species. As shown in Table 1 and Fig. 5, most of the trees in this community are less than 25 cm in diameter, and the largest segment of the community falls into the 10-25 cm size class. In terms of dominant tree species, American beech is the most abundant tree in this cover type (averaging 344 stems/ha), while red oak shows the highest average stem diameter (18.2 cm). Finally, the greatest average basal area is contributed by the eastern hemlock component of the forest community.

The understory vegetation in this forest type is depicted with the bar graph in Fig. 6. As indicated, much of the understory is composed of seedlings from the dominant canopy trees (e.g. American beech, Eastern hemlock, Red maple, White ash, and Sugar maple). Other constituents include striped maple, witch hazel, and hobblebush.

Upland Hardwood Forest

Much of the landscape in the western upland section of the natural area is

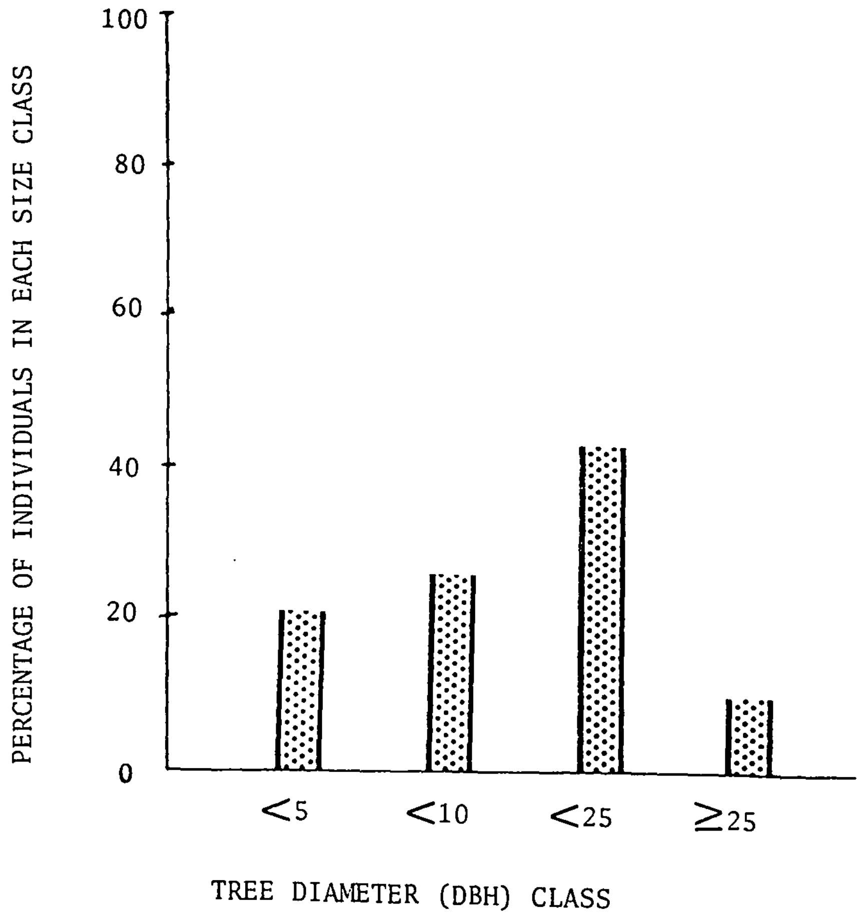


Fig. 5. Size class frequency distribution for all tree species in the South-facing Hardwood Forest.

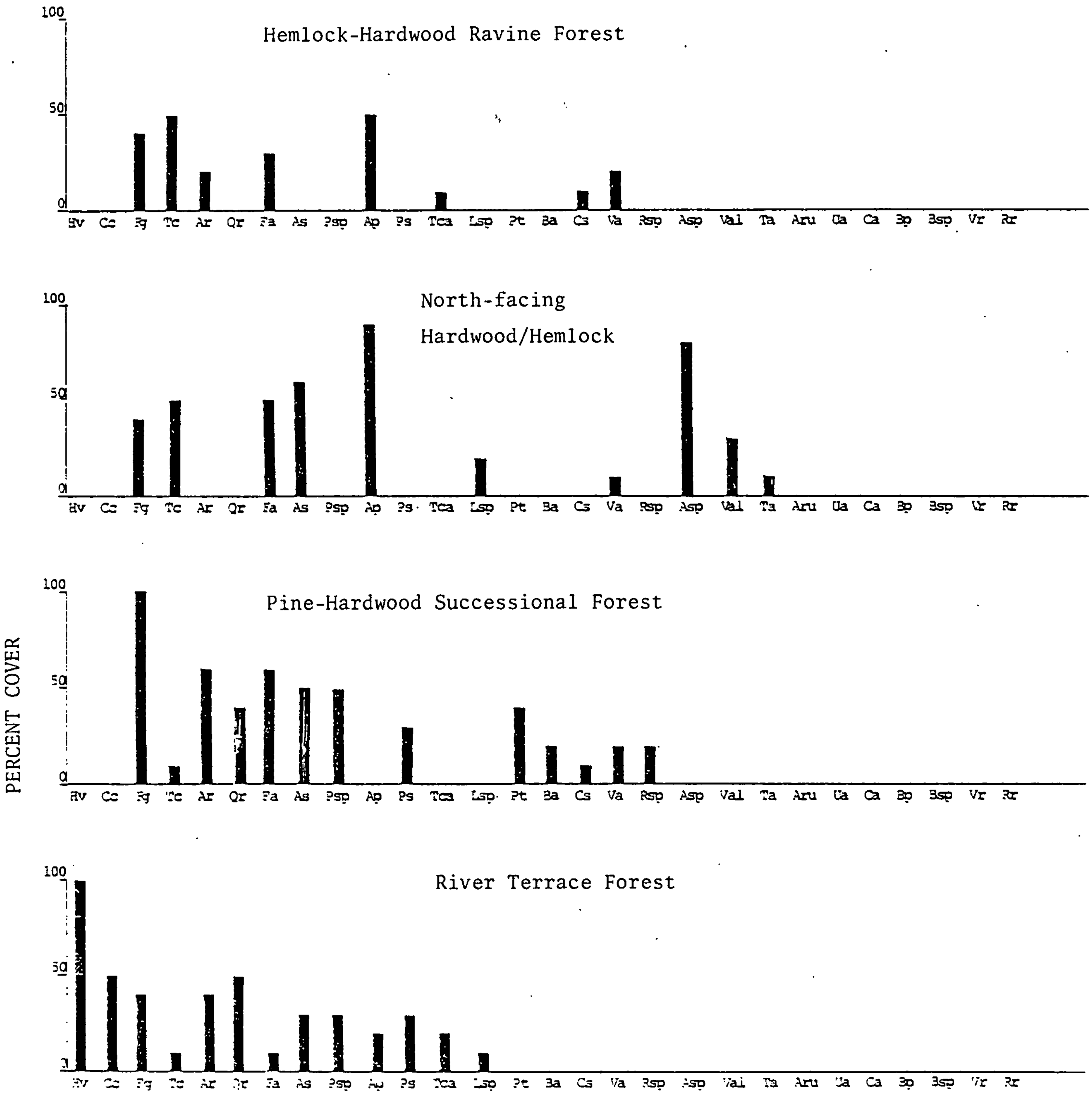


Fig. 6. Percent cover estimates for understory species in each forest cover type. Species codes are provided in part three of the figure.

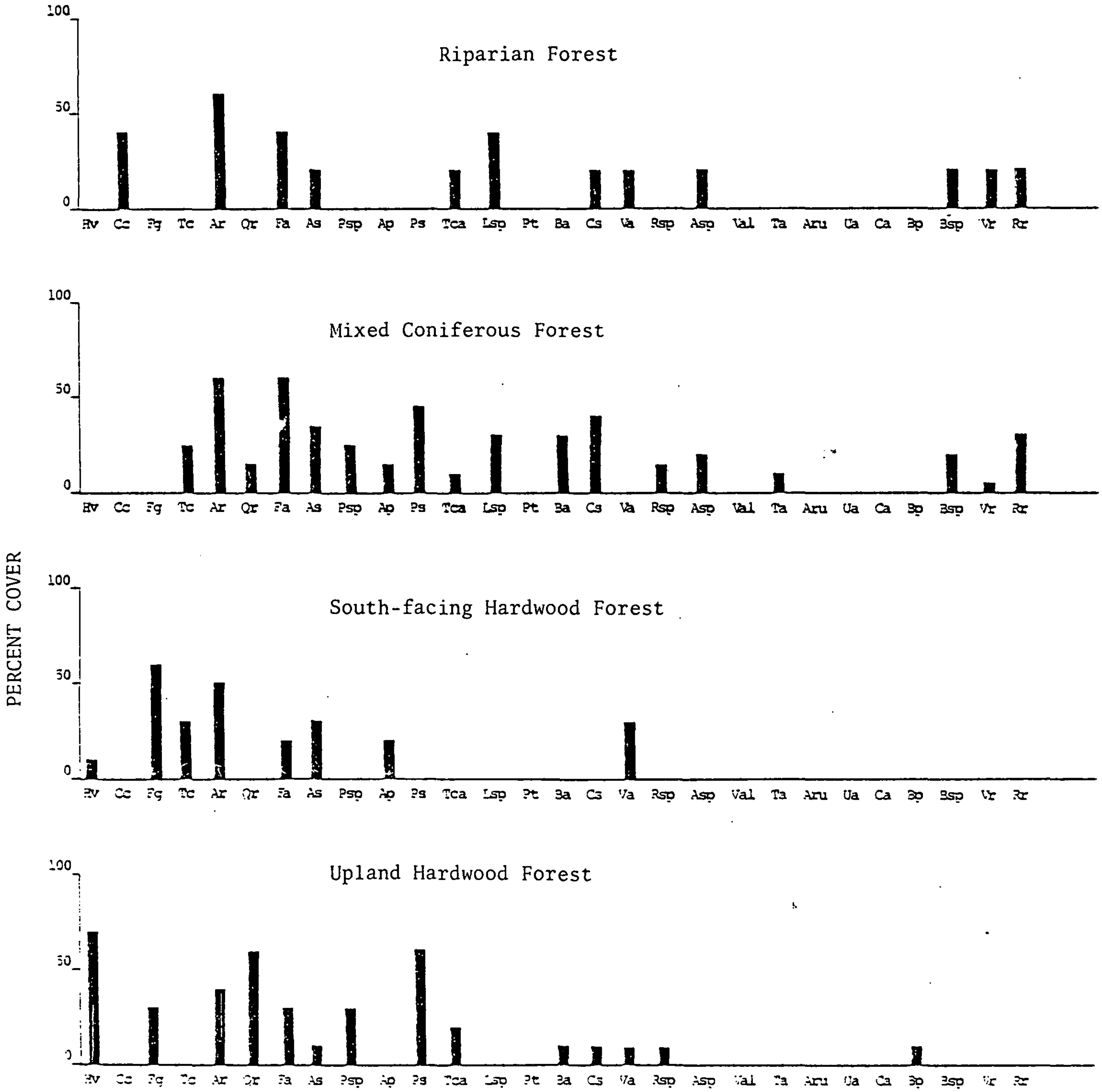


Fig. 6. continued.

SPECIES CODE FOR UNDERSTORY COMPOSITIONS

Hv	Hamamelis virginiana	Cc	Carya cordiformis
Fg	Fagus grandifolia	Tc	Tsuga canadensis
Ar	Acer rubrum	Qr	Quercus rubra
Fa	Fraxinus americana	As	Acer saccharum
Psp	Prunus species	Ap	Acer pensylvanicum
Ps	Pinus strobus	Tca	Taxus canadensis
Lsp	Lonicera species	Pt	Populus tremuloides
Ba	Betula alleghaniensis	Cs	Cornus stolonifera
Va	Vibernum acerifolium	Rsp	Rubus species
Asp	Acer spicatum	Val	Vibernum alnifolium
Ta	Tilia americana	Aru	Alnus rugosa
Ua	Ulmus americana	Ca	Cornus ammomum
Bp	Betula papyrifera	Bsp	Berberis species
Vr	Vibernum recognitum	Rr	Rhus radicans

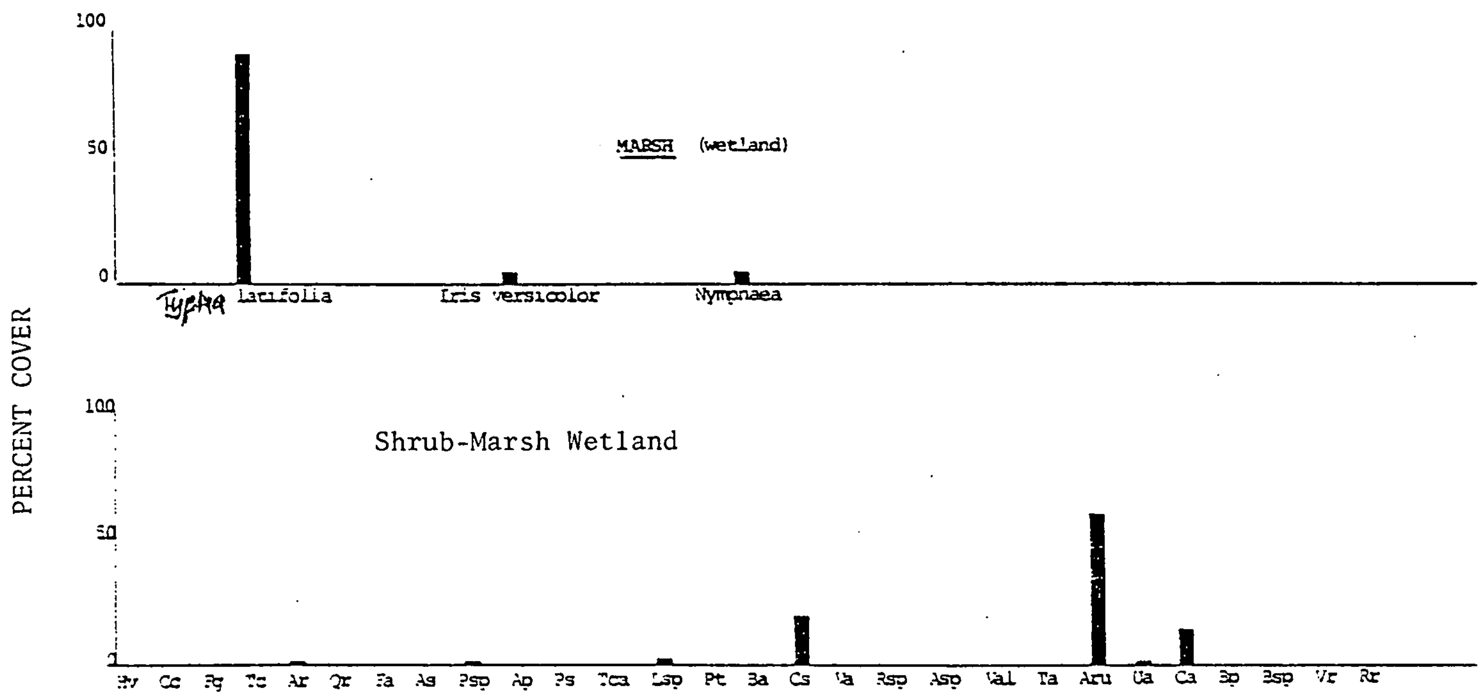


Fig. 6. continued.

covered by a vegetation cover type that we have termed the "Upland Hardwood Forest" (Fig. 4). This intermediate-age forest community is relatively open, contains a comparatively diverse assemblage of tree species (14^+ species), and is dominated by four major tree species: red maple (A. rubrum), white pine (Pinus strobus), red oak (Q. rubra), and paper birch (B. papyrifera). Other associated sub-dominant tree species include the following: eastern hemlock (T. canadensis), black birch (B. lenta), American beech (F. grandifolia), white ash (F. americana), and sugar maple (A. saccharum). In addition, there are a number of associated minor species as shown in Appendix A.

As indicated above, there is a subtle but distinctive shift in species dominance as one moves from the south-facing hardwoods of the Blow-Me-Up ravine to the upland hardwood community. However, there is relatively little change in community structure. In general, the two cover types have roughly comparable density and biomass characteristics (Table 1). The total tree density in the upland community is approximately 1,470 stems/ha, with living trees contributing about 77% of that total. In terms of standing biomass, the total live basal area for the upland hardwood forest is somewhat greater than the preceding forest type, averaging 33.2 m^2/ha. This larger basal area reflects an interesting contrast between the two communities — although the upland community has fewer trees per unit area, the trees tend to be larger (and probably somewhat older) than the trees in the south-facing hardwood forest. In spite of this general trend, the size class distribution of trees in the upland community is very similar to that observed in the south-facing forest. Again, the largest number of trees fall into the 10-25 cm diameter range (Table 1).

Among the individual tree species in the upland forest, red maple shows the highest density (460 stems/ha), while red oak exhibits the highest average stem diameter (21.6 cm). Overall, the largest average basal area is attributed to red maple (9.2 m^2/ha).

Beneath the upland hardwoods canopy, one finds a moderately diverse understory vegetation. As shown in Fig. 6, the understory of this forest is composed of some 14 species of tree seedlings and shrubs. The most prominent species are the following: witch hazel, American beech, red maple, red oak, white ash, cherry, and white pine.

Hemlock-Hardwood Ravine Forest

The steeply eroded ravine topography above the lower end of Blow-Me-Down Pond is covered by a vegetation type that has been termed the "Hemlock-Hardwood Ravine Forest" (Fig. 4). This older forest community is heavily dominated by relatively large eastern hemlock trees (*T. canadensis*). Among the sub-dominant and minor tree species in the community are twelve or more additional species, including: sugar maple (*A. saccharum*), black birch (*B. lenta*), red maple (*A. rubrum*), yellow birch (*B. alleghaniensis*), white pine (*P. strobus*), and red oak (*A. rubra*) (Table 1 and Appendix A).

The ravine forest exhibits a number of interesting structural features. In particular, it has the lowest tree density, but the second highest basal area for the entire natural area. This situation stems primarily from the fact that the ravine forest contains the greatest proportion of large trees (> 25 cm dbh) in the whole natural area. Overall, the total tree density for the community is 1,140 stems/ha, while live tree density is 1,020 stems/ha. Meanwhile, the total live basal area for the forest is approximately 41.0 m^2/ha. Looking at the size class distributions in Table 1, it is apparent that the ravine forest has the most even distribution of tree diameter classes of any of the forest types. The forest is evidently sufficiently mature and stable that it not only has large numbers of older age class individuals, but also equivalent numbers of regenerating individuals in each of the younger age classes. On individual terms, eastern hemlock is the species with the highest density (507 stems/ha) and the greatest basal area (21.3 m^2/ha) in this community. However, the largest average stem diameter is claimed by yellow birch (20.3 cm).

The understory vegetation in this forest type is depicted in Fig. 6. As shown, most of the understory community is dominated by seedlings of the following tree species; American beech, eastern hemlock, red maple, white ash, and striped maple.

North-Facing Mixed Hardood/Hemlock Forest

The "North-Facing Mixed Hardwood/Hemlock Forest" is perched on the steep slopes that form the south side of Blow-Me-Up ravine (Fig. 4). This mixed successional forest is in a dynamic period of recovery, following a number of past disturbances. Much of the young forest appears to date from a major disturbance around 1945-50. There is also evidence of a more recent selective logging of large hemlock trees. Although the present forest is predominantly hardwood, the single most important species is eastern hemlock (T. canadensis). Other important subdominant species are the following: black birch (B. lenta), red oak (Q. rubra), mountain maple (A. spicatum), white pine (P. strobus), and sugar maple (A. saccharum). These species and the other minor canopy components are presented in Appendix A.

Looking at the community structure data in Table 1, one can see that this mixed hardwood/hemlock forest exhibits the kind of high density (3,050 stems/ha) that one might expect in an early successional stand. Compared to the south-facing hardwoods across the stream valley, the mixed hardwood/hemlock forest contains about 2/3 more live trees per unit area (2,789 stems/ha compared to 1,664). As a result of the high tree density, the mixed hardwood/hemlock forest also exhibits a comparatively large live basal area (34.8 m^2/ha). In terms of tree size frequencies in the forest, most of the trees are less than 10 cm in diameter, and the largest proportion of trees are less than 5 cm in diameter. Finally, in individual terms, the eastern hemlock component shows the highest density (844 stems/ha), the largest average basal area (13.8 m^2/ha), and the highest average tree diameter (12.5 cm) for the forest type.

Beneath the mixed hardwood/hemlock canopy, the understory is a mixture of the following species: American beech, eastern hemlock, white ash, sugar maple, striped maple, mountain maple, and vibernum. The abundances of these seedlings and shrubs are shown in Fig. 6.

Mixed Coniferous Forest

Historically, white pine has been one of the very important vegetation components along the upper Connecticut River Valley. When the colonists first arrived in the Cornish area, they were greeted by towering forests of pine that were soon claimed as mastlands for the Royal British Navy. Photographs taken around the end of the nineteenth century indicate that the towering pines were also an important landscape feature at the historic site during Saint-Gaudens' active years. At that time, large white pine trees bordered Blow-Me-Down Pond, portions of the entrance road, and much of the boundary of the formal estate lawns. Now, some eighty years later, the white pines are still a very prominent component of the landscape at Saint-Gaudens National Historic Site, particularly along the terraces above Blow-Me-Down Pond and in the "Mixed Coniferous Forest" along the eastern and southeastern border of the entrance road (Fig. 4).

The Mixed Coniferous Forest is dominated by white pine (*P. strobus*), and includes a mixture of the following associated tree species: black birch (_B. lenta_), eastern hemlock (_T. canadensis_), white ash (_F. americana_), paper birch (_B. papyrifera_), red maple (_A. rubrum_), red oak (_Q. rubra_), and sugar maple (_A. saccharum_). Other minor tree species are indicated in Appendix A. As shown in Table 1, the mixed coniferous forest community has an intermediate range total density of 1,931 stems/ha, which includes a live tree component amounting to 1,572 stems/ha. Because of the combination of that moderate tree density and the substantial number of very large white pine individuals in the community, the mixed coniferous forest exhibits a tremendous overall live basal area (45.6 m^2/ha). In fact, it is the largest basal area of any community in the historic site and natural area. Looking further into the structure of this community, one finds that there is a very interesting size class distribution of individuals and species. As indicated in Table 1, most of the trees are less than 10 cm in diameter, yet the community also contains the largest number of trees in the largest size class (> 25 cm dbh). Overall, one can see from Fig. 7 that the hardwoods and hemlock dominate the smaller size classes, while white pines dominate the largest size class in the mixed coniferous community. It is interesting to note that tree ring data indicate that the hardwoods component of this community is 45-50 years old, whereas the white pine component ranges from 45-60 years of age (with some much older individuals).

In individual terms, the highest density in the community is attributed to black birch (350 stems/ha). Meanwhile, white pine shows the greatest average basal area (36.5 m^2/ha) and the highest average stem diameter (39.1 cm).

The mixed coniferous understory is relatively diverse as shown in Fig. 6. The major seedling and shrub species include the following: eastern hemlock, red maple, white ash, sugar maple, cherry, white pine, honeysuckle, yellow

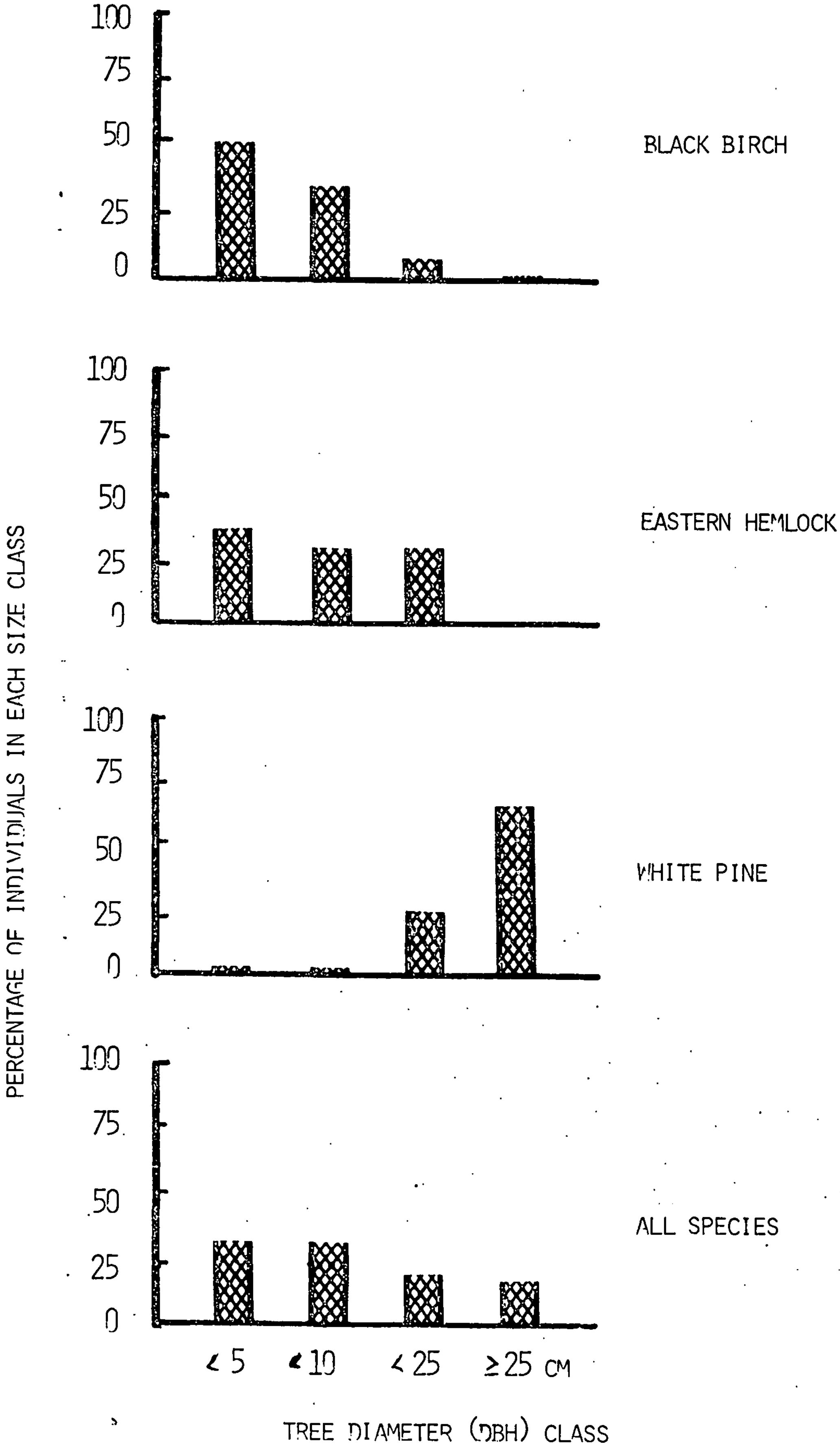


Fig. 7. Size distribution of tree species for the Mixed Coniferous Forest.

birch, red-osier dogwood, mountain maple, and poison ivy. Because of the presence of poison ivy in the community, hikers should use some caution in moving through this particular forest community.

Pine-Hardwood Successional Forest

Southwest of the main lawn at Saint-Gaudens, one encounters the dense regrowth of the "Pine-Hardwood Successional Forest" (Fig. 4). This young forest community averages 25-35 years in age, and has apparently developed from a cleared area that was formerly part of the estate golf course. The community is heavily dominated by white pine (*P. strobus*), but also contains appreciable numbers of paper birch (*B. papyrifera*), red maple (*A. rubrum*), trembling aspen (*Populus tremuloides*), and red oak (*Q. rubra*). Other minor species are described in Appendix A.

The structure of this community reflects the influence of two major early successional forces: (1) initial heavy stocking of the site by seed propagules derived from the numerous nearby seed sources; and (2) gradual self-thinning of the stand. At this stage of development, the stand exhibits the highest overall density (4,201 stems/ha), the highest live tree density (3,234 stems/ha), and the highest dead tree density (967 stems/ha) in the entire natural area. In spite of this tremendous density, the overall basal area for the stand is a relatively modest 24.9 m^2/ha. The size class distribution for this community is shown in Table 1, and indicates that most of the trees fall into the intermediate size range between 5-25 cm in diameter. The very few large trees are older white pines. Among the individual tree species in this community, white pine shows the highest density (2,267 stems/ha), red oak has the highest average diameter (14.6 cm) and white pine has the greatest average basal area (15.8 m^2/ha).

The understory (Fig. 6) beneath the dense pine-hardwood canopy is composed of seedlings of the following tree species; beech, red maple, red oak, white ash, sugar maple, cherry, white pine, trembling aspen, and a few other species. There is also a certain amount of hobblebush and raspberry.

River Terrace Forest

Near the junction of Blow-Me-Up and Blow-Me-Down Brooks, there is a distinctive transition forest situated between the river floodplain and the upland hardwood forest (Fig. 4). This forest community is referred to as the "River Terrace Forest" and is distinguished by the relative abundance of blue beech, witch-hazel, and bitternut hickory. As a whole, the forest community is dominated by blue beech (Carpinus caroliniana), white pine (P. strobus), red oak (Q. rubra), red maple (A. rubrum), and black birch (B. lenta). Other associated species are listed in Appendix A.

The river terrace forest has a comparatively low density (1,233 live stems/ha) and modest basal area (20.8 m^2/ha). Its size distribution is heavily dominated by smaller diameter trees. Among the individual tree species, blue beech is the most abundant in this community (592 stems/ha), while white pine has the largest basal area (6.2 m^2/ha) and the largest average diameter (18.4 cm).

The understory vegetation in this community contains large numbers of witch-hazel seedlings, along with seedlings of the following species: blue beech, American beech, red maple, red oak, sugar maple, cherry, and white pine (Fig. 6).

Riparian Forest

The forest community bordering the Blow-Me-Up and Blow-Me-Down Brooks has been termed the "Riparian Forest". This community is situated in the floodplain zone that is flooded periodically during times of high water. Although the riparian forest community composition changes from the upper section of BMU Brook to the junction of BMU and BMD Brooks, we have chosen to combine the data sets along these sections to produce one general riparian forest description. Based on these data, this community is dominated by eastern hemlock (*T. canadensis*), basswood (*Tilia americana*), and sugar maple (*A. saccharum*). Other important associated tree species include: black ash (*F. nigra*), black birch (*B. lenta*), blue beech (*C. caroliniana*), American elm (*Ulmus americana*), slippery elm (*U. rubra*), and sycamore (*Platanus occidentalis*) (Appendix A).

The tree density in this community amounts to 1,350 live stems/ha, while the basal area averages 25.9 m^2/ha (Table 1). The age structure is weighted heavily toward the 5-25 cm diameter class. Individually, eastern hemlock shows the highest density in this zone (288 stems/ha), as well as the largest average basal area (7.2 m^2/ha). However, basswood exhibits the largest average stem diameter in the community (16.4 cm).

Among the understory species shown in Fig. 6, the more prominent seedlings and shrubs include: blue beech, red maple, white ash, and honeysuckle. These populations and the other components of the riparian understory may at times be subjected to disturbance by ice scouring and flooding.

Wetlands

The final vegetation cover type indicated on the map in Fig. 4 is the "Wetland Community". As the visitor to the Blow-Me-Down Pond area will notice, there is a certain amount of heterogeneity to the wetland complex. However, in general, one can distinguish a marsh habitat and a more mature shrub-marsh habitat. The marsh habitat is dominated by cattail (*Typha* sp.), but also contains about 5% cover by iris and 5% cover by pond lily. The shrub-marsh habitat is dominated by 60% alder (*Alnus sp.*), but also contains 34% dogwood (*Cornus sp.*), 3% honeysuckle (*Lonicera sp.*), 1% elm (*Ulmus sp.*), 1% red maple (*A. rubrum*), and 1% cherry (*Prunus sp.*).

Botanical Resources

The flora of Saint-Gaudens National Historic Site and Natural Area is relatively diverse, and includes some 32 tree species and 100 or more species of herbaceous and shrubby plants. The tree species observed on the property are listed in Table 2. Herbaceous and shrub species are shown in Table 3, while Table 4 presents a list of the ferns and fern allies found on the property. Finally, in Table 5, a reference list is provided indicating the endangered plant species of New Hampshire. Herbarium specimens have been prepared for a number of the common species at Saint-Gaudens; these specimens will be kept on file at the superintendent's office.

One particularly interesting specimen tree in the historic core area is the tremendous honey locust (*Gleditsia triacanthos*) that stands at the southern entrance of the Aspet. This tree is estimated to be roughly one hundred years old.

Vegetation History and Plant Geography

Succession

The vegetation at Saint-Gaudens National Historic Site is the product of a number of historical events and successional forces, including logging, grazing, mass wasting along the steep ravines, disturbance by beaver, and secondary succession. Over the last century, these factors have interacted in different ways to shape the character of the plant communities at the Historic Site. In some cases, this has transformed the vegetation patterns from what they were during the lifetime of Augustus Saint-Gaudens; in other cases, the forest cover has either remained very much as it was or has recovered to a state resembling the historic past.

Parts of the Historic Site and natural area have undergone the gradual

Table 2. Master listing of tree species found on the properties of the Saint-Gaudens National Historic Site. Each species is listed by family name, genus, species, and common name.

Family	Species	Common Name
ACERACEAE - MAPLES	Acer pensylvanicum	STRIPED MAPLE
	Acer rubrum	RED MAPLE
	Acer saccharum	SUGAR MAPLE
	Acer spicatum	MOUNTAIN MAPLE
BETULACEAE - BIRCH FAMILY	Alnus serrulata	SWAMP ALDER
	Betula alleghaniensis	YELLOW BIRCH
	Betula lenta	BLACK BIRCH
	Betula papyrifera	WHITE BIRCH
	Betula populifolia	GRAY BIRCH
	Carpinus caroliniana	AMERICAN HORNBEAM
	Ostrya virginiana	HOPHORNBEAM
FAGACEAE - BEECH FAMILY	Fagus grandifolia	AMERICAN BEECH
	Quercus alba	WHITE OAK
	Quercus rubra	RED OAK
HAMAMELIDACEAE - WITCH-HAZEL FAMILY	Hamamelis virginiana	WITCH HAZEL
JUGLANDACEAE - WALNUT FAMILY	Carya cordiformis	BITTERNUT HICKORY
	Juglans cinerea	BUTTERNUT
LEGUMINOSAE - LEGUMES	Gleditsia triacanthose	HONEY LOCUST
OLEACEA - OLIVE FAMILY	Fraxinus americana	WHITE ASH
	Fraxinus nigra	BLACK ASH
PINACEA - PINE FAMILY	Pinus strobus	WHITE PINE
	Tsuga canadensis	EASTERN HEMLOCK
PLATANACEAE - SYCAMORE FAMILY	Platanus occidentalis	AMERICAN SYCAMORE
ROSACEAE - ROSE FAMILY	Prunus serotina	BLACK CHERRY
	Prunus pensylvanica	PIN CHERRY
	Prunus virginiana	CHOKE CHERRY
SALICACEAE - WILLOW FAMILY	Populus tremuloides	QUAKING ASPEN
	Populus grandidentata	BIGTOOTH ASPEN
	Populus nigra var. italica	LOMBARDY POPLAR
TILIACEAE - LINDEN FAMILY	Tilia americana	AMERICAN BASSWOOD
ULMACEAE - ELM FAMILY	Ulmus americana	AMERICAN ELM
	Ulmus rubra	SLIPPERY ELM

Table 3. Master listing of herbs and shrubs found on the properties of Saint-Gaudens National Historic Site, Cornish, New Hampshire. Each species is listed by family name, genus, species, common name, and habitat code indicating where it is most commonly found.

Family	Species	Common Name	Habitat
ANACARDIACEAE	Rhus typhina	STAGHORN SUMAC	(A,E)
	Rhus radicans	POISON IVY	
ARACEAE	Arisaema atrorubens	JACK-IN-THE-PULPIT	
ARALACEAE	Aralia nudicaulis	SARSAPARILLA	(B,C)
ARISTOLOCHIACEAE	Asarum canadense	WILD GINGER	(B,C)
ASCLEPIADACEAE	Asclepias syrica	COMMON MILKWEED	(A,F)
	Cynanchum nigrum	BLACK SWALLOWWORT	(A,E,F)
BERBERIDACEAE	Berberis sp.	BARBERRY	(B,C,F)
CAPRIFOLIACEAE	Lonicera morrowi	MORROW'S HONEYSUCKLE	
	Viburnum acerafolium	MAPLELEAF VIBURNUM	(B,C)
	Viburnum alnifolium	HOBBLEBUSH	(B,C)
	Viburnum trilobum	HIGH BUSH CRANBERRY	(D,E)
CHENOPODIACEAE	Chenopodium album	LAMB'S QUARTERS	(A,F)
COMPOSITAE	Antennaria solitaria	FIELD PUSSYTOES	(A,F)
	Arctium lappa	GREAT BURDOCK	(A,D,E,F)
	Arctium minus	COMMON BURDOCK	(A,D,E,F)
	Plantago major	PLANTAIN	(A,F)
	Prenanthes alba	WHITE LETTUS	(A,B,E,F)
	Solidago flexicaulis	ZIGZAG GOLDENROD	(A,D,E,F)
	Taxacum officinale	COMMON DANDELION	(A,F)
	Aster acuminatus	SHARP-LEAF WOOD ASTER	(B,F)
CORNACEAE	Cornus stolonifera	RED-OSIER DOGWOOD	(D,E)
	Cornus amomum	SILKY DOGWOOD	

-1.26-

Table 3 CONTINUED

Family	Species	Common Name	Habitat
CRUCIFERAE	Dentaria diphylla	TOOTHWORT	(B,E)
CUCURBITACEAE	Echinocystis lobata	WILD CUCUMBER	(A,D,E)
ERICACEAE	Epigaea repens	TRAILING ARBUTUS	(B,C)
	Gaultheria procumbens	WINTERGREEN	(B,C)
LILIACEAE	Clintonia borealis	CLINTONIA	(A,C,E)
	Erythronium americanum	TROUT LILY	(B,C,E)
	Medeola virginiana	INDIAN CUCUMBER	(B,C)
	Mianthemum canadense	WILD LILY-OF-THE-VALLEY	(B,C)
	Polygonatum biflorum	SOLOMON'S SEAL	(B,C,E)
	Smilacina racemosa	FALSE SOLOMON'SEAL	(B,C,E)
	Streptopus amplexifolius	TWISTED STALK	(B,C)
	Trillium erectum	RED TRILLIUM	(B,C)
	Uvularia perfoliata	PERFOLIATE BELLWORT	(B,C,E)
	Uvularia sessilifolia	WILD OATS	(B,C)
	Veratrum viride	FALSE HELLBORE	(B,C,D,E)
ORCHIDACEAE	Corallorhiza maculata	SPOTTED CORALROOT	(B,C)
	Cypripedium acaule	PINK LADY'S SLIPPER	(B,C)
	Epipactus hellborine	HELLEBORINE	(B,C)
OROBANCHACEAE	Epifagus virginiana	BEECH DROPS	(B)
PAPAVERACEAE	Sanguinaria canadensis	BLOOD ROOT	(A,B,C,E)
POLYGONACEAE	Polygonum Sp	SMARTWEED	(A,D,E)
	Rumex acetosella	SHEEP SORREL	(A,F)
PRIMULACEAE	Trientalis borealis	STAR FLOWER	(B,C)

Table 3 CONTINUED

Family	Species	Common Name	Habitat
PYROLACEAE	Chimaphila maculata	PIPSISSEWA	(B,C)
	Chimaphila umbellata	SPOTTED WINTERGREEN	(B,C)
	Monotropa hypopithys	PINESAP	(B,C)
	Monotropa uniflora	INDIAN PIPE	(B,C)
	Pyrola eliptica	SHINLEAF	(B,C)
RANUNCULACEAE	Actaea pachypoda	WHITE BANEBERRY	(A,B,C,E)
	Anemone quinquefolia	WOOD ANEMONE	(B,C)
	Coptis groenlandica	GOLDTHREAD	(B,C)
	Hepatica americana	ROUND LOBED HEPATICA	(B,C)
	Ranunculus abortiva	KIDNEYLEAF BUTTERCUP	(A,F)
ROSACEAE	Fragaria virginiana	COMMON STRAWBERRY	(A,F)
	Potentilla canadensis	ROUGH-FRUITED CINQUEFOIL	(A,F)
	Rubus Sp.	RASPBERRY	(A,B,F)
RUBIACEAE	Gallium Sp	BEDSTRAWS	(A,B,C,D,E,F)
	Houstonia caerulea	BLUETS	(A,F,G)
	Mitchella repens	PARTRIDGE BERRY	(B,C,E)
SAXIFRAGACEAE	Tiarella cordifolia	FOAM FLOWER	(B,C,E)
SCROPHULARIACEAE	Veronica officinalis	COMMON SPEEDWELL	(A,F)
THYPHACEAE[1]	Typha latifolia	COMMON CATTAIL	(D)
UMBELLIFERAE	Daucus carota	QUEEN ANNE'S LACE	(A,F)
	Zizia aurea	GOLDEN ALEXANDERS	(A,F)
VIOLACEAE	Viola blanda	SWEET WHITE VIOLET	(A,B,F)

Table 3 CONTINUED

"VEGETATION CODES"

A Roadside - Immediate shoulders.
B Hardwood Stand - Dominated by deciduous species, Yellow Birch, Sugar Maple, American Beech, Red Maple, White Ash.
C Conifer Stand - Dominated by coniferous species, White Pine, Eastern Hemlock.
D Wetland - Treeless, shrub growth on sediment build-up, Speckled Alder, Honeysuckle, Cat-tails.
E Riparian - River bank/flood plain, American Elm, American Sycamore, Butternut, White Ash.
F Field - Open, mowed grassland.
G Garden - Garden areas surrounding the main house.

Table 4. Master listing of ferns and fern allies found on the properties of Saint-Gaudens National Historic Site, Cornish, New Hampshire. Each species is listed by family name, genus, species, common name, and habitat code indicating where it is most commonly found.

Family	Species	Common Name	Habitat
EQUISETACEAE - HORSETAIL FAMILY	Equisetum hiemale	SCOURING-RUSH	(B,D,E)
	Equisetum scirpoides	DWARF SCOURING-RUSH	(R,C,D,E)
LYCOPODIACEAE - CLUB-MOSS FAMILY	Lycopodium annotinum	BRISTLY CLUBMOSS	(B,C,E)
	Lycopodium clavatum	STAGHORN CLUBMOSS	(B,C)
	Lycopodium complanatum	RUNNING PINE	(B,C,E)
	Lycopodium obscurum	GROUND-PINE	(B,C,E)
OPHIOGLOSSACEAE - ADDER'S TONGUE FAMILY	Botrychium dissectum	CUT-LEAVED FERN	(A,B,C,D,E,F)
	Botrychium virginianum	RATTLESNAKE-FERN	(B,C,D,E,)
OSMUNDACEAE - FLOWERING FERN FAMILY	Osmunda cinnamomeae	CINNAMON FERN	(B,C,D,E)
	Osmunda claytonia	INTERRUPTED FERN	(A,B,C,D,E)
	Osmunda regalis	ROYAL FERN	(B,E)
POLYPODIACEAE - FERN FAMILY	Adiantum pedatum	MAIDENHAIR-FERN	(B,C,E)
	Athyrium filix-femina	LADY FERN	(B,C,F)
	Dryopteris marginalis	MARGINAL SHIELD-FERN	(B,C,D,E)
	Dryopteris spinulosa	SPINULOSE WOOD-FERN	(B,C,D,E)
	Dennstaedtia punctilobula	HAY-SCENTED FERN	(B,C,F)
	Gymnocarpium dryopteris	OAK FERN	(B,C,E)
	Matteuccia struthiopteris	OSTRICH FERN	(C,E)
	Onoclea sensibilis	SENSITIVE FERN	(B,C,D,E,F)
	Polypodium vulgare	COMMON POLYPODY	(B,C)
	Polystichum acrostichoides	CHRISTMAS FERN	(B,C,D,E,F)
	Pteridium aquilinum	PASTURE-BRAKE	(B,C,F)
	Thelypteris noveborancensis	NEW YORK FERN	(B,C,D,E)
	Thelypteris phegopteris	NORTHERN BEECH FERN	(B,C,E)

Nomenclature is from The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada by Henry A. Gleason, Hafner Press, NY, 1952.

Table 4 CONTINUED

"VEGETATION TYPE CODES"

A Roadside - Immediate shoulders
B Hardwood Stand - Dominated by deciduous species, Yellow Birch, Sugar Maple, American Beech, Red Maple, White Ash.
C Conifer Stand - Dominated by coniferous species, White Pine, Eastern Hemlock.
D Wetland - Treeless, shrub growth on sediment build-up, Speckled Alder, Honeysuckle, Cat-tails.
E Riparian - River bank/flood plain, American Elm, American Sycamore, Butternut, White Ash.
F Field - Open, mowed grassland.
G Garden - Garden areas surrounding the main house.

Table 5. A list of the "Endangered Plant Species of New Hampshire."

Family	Species	Common Name
CURLY-GRASS FAMILY - SCHIZAEACEAE	Lygodium palmatum[1]	CLIMBING FERN
FERN FAMILY - POLYPODIACEAE	Athyrium pycnocarpon[1]	NARROW-LEAVED SPLEENWORT
PINE FAMILY - PINACEAE	Pinus divaricata[1]	JACK-PINE
SEDGE FAMILY - CYPERACEAE	Carex capitata[1]	SEDGE
ARUM FAMILY - ARACEAE	Arisaema dracontium[1]	GREEN DRAGON
LILY FAMILY - LILIACEAE	Uvularia perfoliata[1]	BELLWORT
	Lilium superbum[1]	TURK'S-CAP-LILY
ORCHIS FAMILY - ORCHIDACEAE	Cypripedium arietinum[1,2]	RAM'S-HEAD LADY'S-SLIPPER
	Cypripedium calceolus var. pubescens[1]	YELLOW LADY'S-SLIPPER
	Cypripedium reginae[1]	SHOWY LADY'S-SLIPPER
	Orchis spectabilis[1]	SHOWY ORCHIS
	Habernaria orbiculata[1]	ROUND-LEAVED ORCHIS
	Habernaria hookeri[1]	HOOKER'S ORCHIS
	Habernaria macrophylla[1]	LARGE ROUND-LEAVED ORCHIS
	Habernaria blephariglottis[1]	WHITE FRINGED ORCHIS
	Habernaria psycodes[1]	PURPLE FRINGED ORCHIS
	Habernaria fimbriata[1]	LARGER PURPLE FRINGED ORCHIS
	Isotria verticillata[1]	WHORLED POGONIA
	Isotria medeoloides[2]	SMALL WHORLED POGONIA
	Arethusa bulbosa[1]	BOG-PINK
	Calypso bulbosa[1]	CALYPSO
	Listera auriculata[2]	AURICLED TWAYBLADE
	Platanthera flava[2]	PLATANTHERA
WILLOW FAMILY - SALICACEAE	Salix herbacea[1]	SWARF WILLOW
	Salix Uva-ursi[1]	BEARBERRY-WILLOW
BIRCH FAMILY - BETULACEAE	Betula Nigra[1]	RIVER OR RED BIRCH
BUCKWHEAT FAMILY - POLYGONACEAE	Oxyria digyna[1]	MOUNTAIN-SORREL
	Polygonum viviparum[1]	ALPINE BISTORT
PINK FAMILY - CARYOPHYLLACEAE	Silene acaulis[1]	MOSS-CAMPION
	Paronychia argyrocoma var. albimontana[2]	SILVERING
CROWFOOT FAMILY - RANUNCULACEAE	Ranunculus fascicularis[1]	EARLY BUTTERCUP

Table 5 CONTINUED

Family	Species	Common Name
POPPY FAMILY - PAPAVERACEAE	Dicentra canadensis[1]	SQUIRREL-CORN
MUSTARD FAMILY - CRUCIFERAE	Draba lanceolata[1]	ASHY WHITLOW-GRASS
	Dentaria maxima[1]	LARGE TOOTHWORT
	Dentaria laciniata[1]	CUT-LEAVED TOOTHWORT
	Cardamine bulbosa[1]	SPRING-CRESS
	Cardamine bellidifolia[1]	ALPINE OR DWARF CRESS
	Arabis canadensis[1]	SICKLEPOD
SAXIFRAGE FAMILY - SAXIFRAGACEAE	Saxifraga rivularis[1]	ALPINE-BROOK-SAXIFRAGE
	Saxifraga cernua[1]	MODDING SAXIFRAGE
	Saxifraga aizoon[1]	LIVELONG SAXIFRAGE
	Parnassia glauca[1]	GRASS OF PARNASSUS
ROSE FAMILY - ROSACEAE	Sibbaldia procumbens[1]	SIBBALDIA
	Potentilla robbinsiana[1,2]	ROBBIN'S CINQUEFOIL
	Geum Peckii[1,2]	MOUNTAIN AVENS
	Rubus cuneifolius[1]	TRAILING BLACKBERRY
PULSE FAMILY - LEGUMINOSAE	Astragalus jesupi[1]	JESUP'S MILK-VETCH
	Astragalus alpinus[1]	NORTHERN MILK-VETCH
	Desmodium rotundifolum[1]	PROSTRATE TICK-TREFOIL
	Desmoidum marilandicum[1]	MARYLAND TICK-TREFOIL
	Desmodium rigidum[1]	STIFF TICK-TREFOIL
	Desmodium cuspidatum[1]	TICK-TREFOIL
	Lespedeza procumbens[1]	TRAILING BUSH-CLOVER
	Lespedeza virginica[1]	SLENDER BUSH-COVER
ST. JOHN'S WORT FAMILY - HYPERICACEAE	Hypericum pyramidatum[1]	GREAT ST. JOHN'S -WORT
ROCKROSE FAMILY - CISTACEAE	Hudsonia ericoides[1]	GOLDEN HEATHER
VIOLET FAMILY - VIOLACEAE	Viola palmata[1]	PALMATE VIOLET
EVENING PRIMROSE FAMILY - ONAGRACEAE	Epilobium alpinum[1]	ALPINE WILLOW-HERB
WATER-MILFOIL FAMILY - HALORAGACEAE	Proserpinaca pectinata[1]	COMB MERMAID-WEED
GINSENG FAMILY - ARALIACEAE	Panax quinquefolius[1]	GINSENG
PARSLEY FAMILY - UMBELLIFERAE	Lilaeopsis chinensis[1]	LILAEOPSIS
WINTERGREEN FAMILY - PYROLACEAE	Chimaphila maculata[1]	SPOTTED WINTERGREEN
	Pterospora andromedae[1]	PINE-DROPS

Table 5 CONTINUED

Family	Species	Common Name
HEATH FAMILY - ERICACEAE	Rhododendrom viscosum[1]	SWAMP-HONEYSUCKLE
	Cassiope hypnoides[1]	MOSS-PLANT
	Arctostaphylos alpina[1]	ALPINE BEARBERRY
GENTIAN FAMILY - GENTIANACEAE	Gentiana crinita[1]	FRINGED GENTIAN
MILKWEED FAMILY - ASCLEPIADACEAE	Asclepias quadriofolia[1]	FOUR-LEAVED MILKWEED
BORAGE FAMILY - BORAGINACEAE	Hackelia americana[1]	STICK-SEED
MINT FAMILY - LABIATAE	Pycnanthemum torrei[1]	TORREY'S MOUNTAIN-MINT
FIGWORT FAMILY - SCROPHULARIACEAE	Limosella aquatica[1]	MUDWORT
	Veronica alpina var. unalaschensis[1]	ALPINE SPEEDWELL
	Gerardia virginica[1]	DOWNY FOXGLOVE
	Castilleja coccineae[1]	PAINTED-CUP
	Euphrasia oaksii	
	Euphrasia williamsii[1]	EYEBRIGHT
BLADDERWORT FAMILY - LENTIBULARIACEAE	Pinguicula vulgaris[1]	BUTTERWORT
HONEYSUCKLE FAMILY - CAPRIFOLIACEAE	Triosteum aurantiacum[1]	HORSE-GENTIAN
	Viburnum rafinesquianum[1]	DOWNY ARROW-WOOD
COMPOSITE FAMILY - COMPOSITAE	Schlerolepis uniflora[1]	SCLEROLEPIS
	Solidago Tenuifolia[1]	SLENDER-LEAVED GOLDENROD
	Aster ptarmicoides[1]	ASTER
	Aster tenuifolius[1]	LARGE SALTMARS ASTER
	Gnaphalium supinum[1]	ALPINE CUDWEED
	Iva frutescens var. oraria[1]	HIGHWATER-SHRUB

[1]Endangered and Threatened Plants of The United States, Smithsonian Institution - World Wildlife Fund

[2]Hodgdon, A.R. 1973. Endangered Plants of New Hampshire. Society for the Protection of New Hampshire Forests, Forest Notes 114:2-6.

process of old field succession, a phenomenon that has occurred widely in New England since the mid-nineteenth century. This process was underway around the Historic Site when Saint-Gaudens purchased the property, and the phenomenon continued into the twentieth century. When Saint-Gaudens originally purchased his property, the house and property appeared as shown in Fig. 8. At that time, the main house was surrounded by cleared pastures and various clumps of woodland. Later photographs taken around the turn of the century tell us something about the landscape features that were familiar to Saint-Gaudens and his family. For instance, much of the hillslope to the south of the entrance road was cleared grazing land during Saint-Gaudens' lifetime (Fig. 9 and 10). However, that land was eventually abandoned around 1920, and a mixed coniferous forest developed over the hillslope. Judging from the present forest age structure, white pine seedlings were the first tree species to exploit the open land. Some years later, birch, hemlock, ash, and other northern hardwood species colonized the site.

A somewhat similar type of old field succession occurred at the lower portion of the main lawn of the Saint-Gaudens estate. During the latter period of Saint-Gaudens' years in Cornish, the lower section of the lawn was kept groomed as a private golf course. At that time, Augustus Saint-Gaudens and his friends enjoyed the view shown in Fig. 11. Later on in the 20th century (1940-50), the lower golf course was abandoned, and secondary succession began. Now, some years later, that area supports a dense pine-hardwood successional forest.

Another section of the natural area that has gradually changed since the time of Saint-Gaudens is the Blow-Me-Down Pond area. As shown by the photograph taken around 1905 (Fig. 12), Saint-Gaudens was able to stand at the dam and to look upstream over a broad expanse of open water. By contrast, the photograph

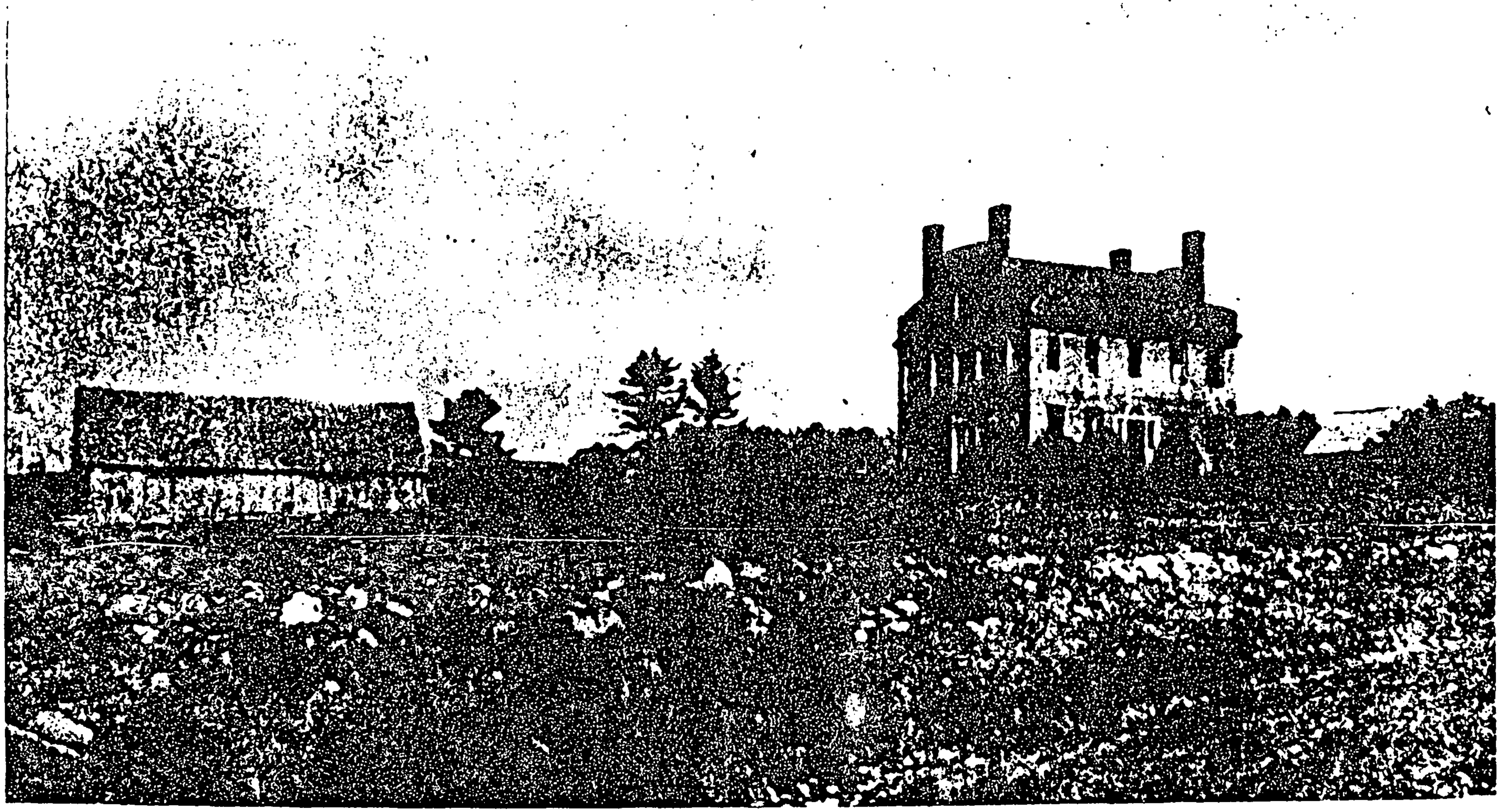


Fig. 8. An early photograph of Huggin's Folly, the house that was to become the core of the Augustus Saint-Gaudens estate.

Cornish Valley, Cornish, N. H.

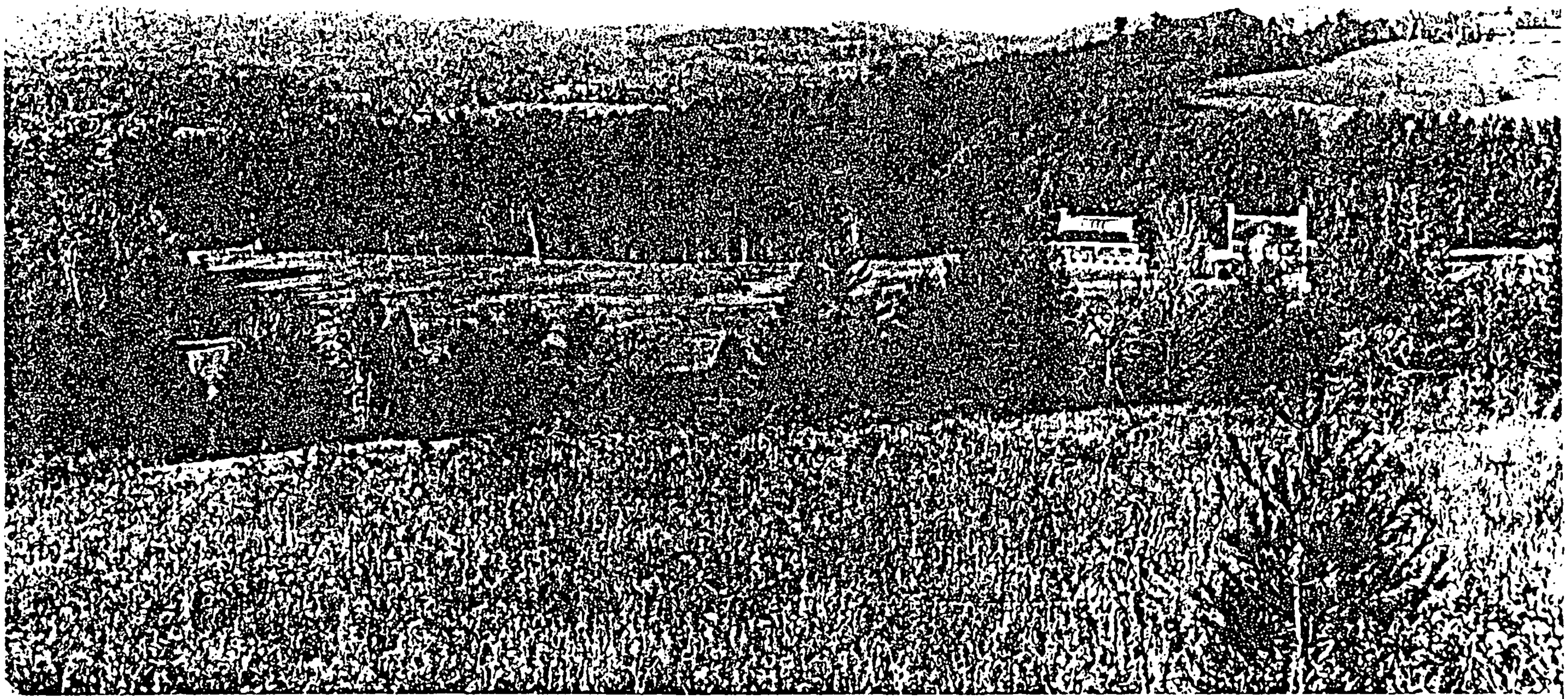


Fig. 9. A photo taken from the hillslope to the south of the Saint-Gaudens estate (ca. early 20th century).

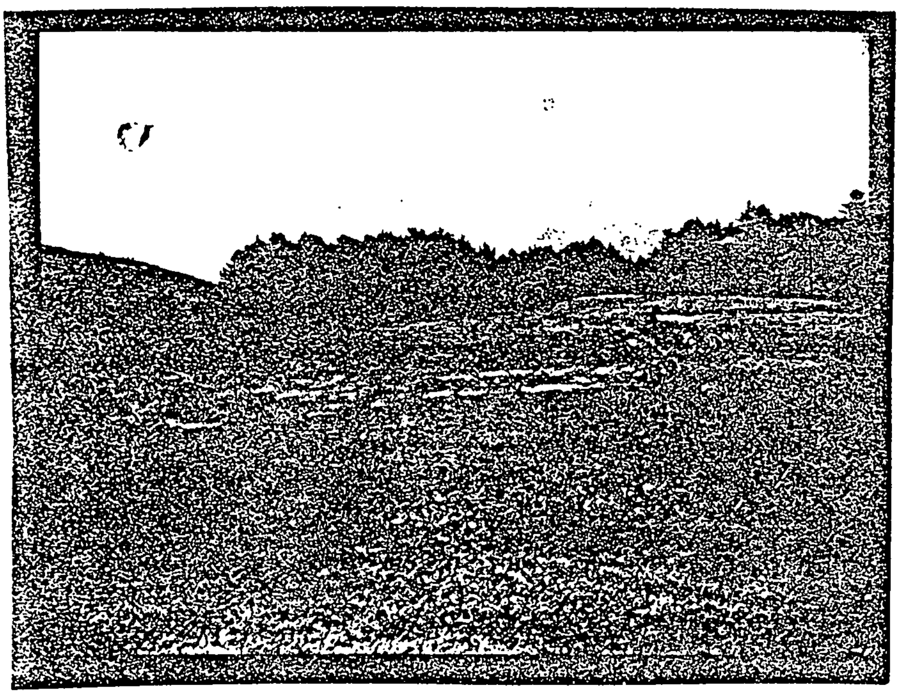


Fig. 10. A view of the cleared hillslope to the south of the Aspet (ca. late 1800's).

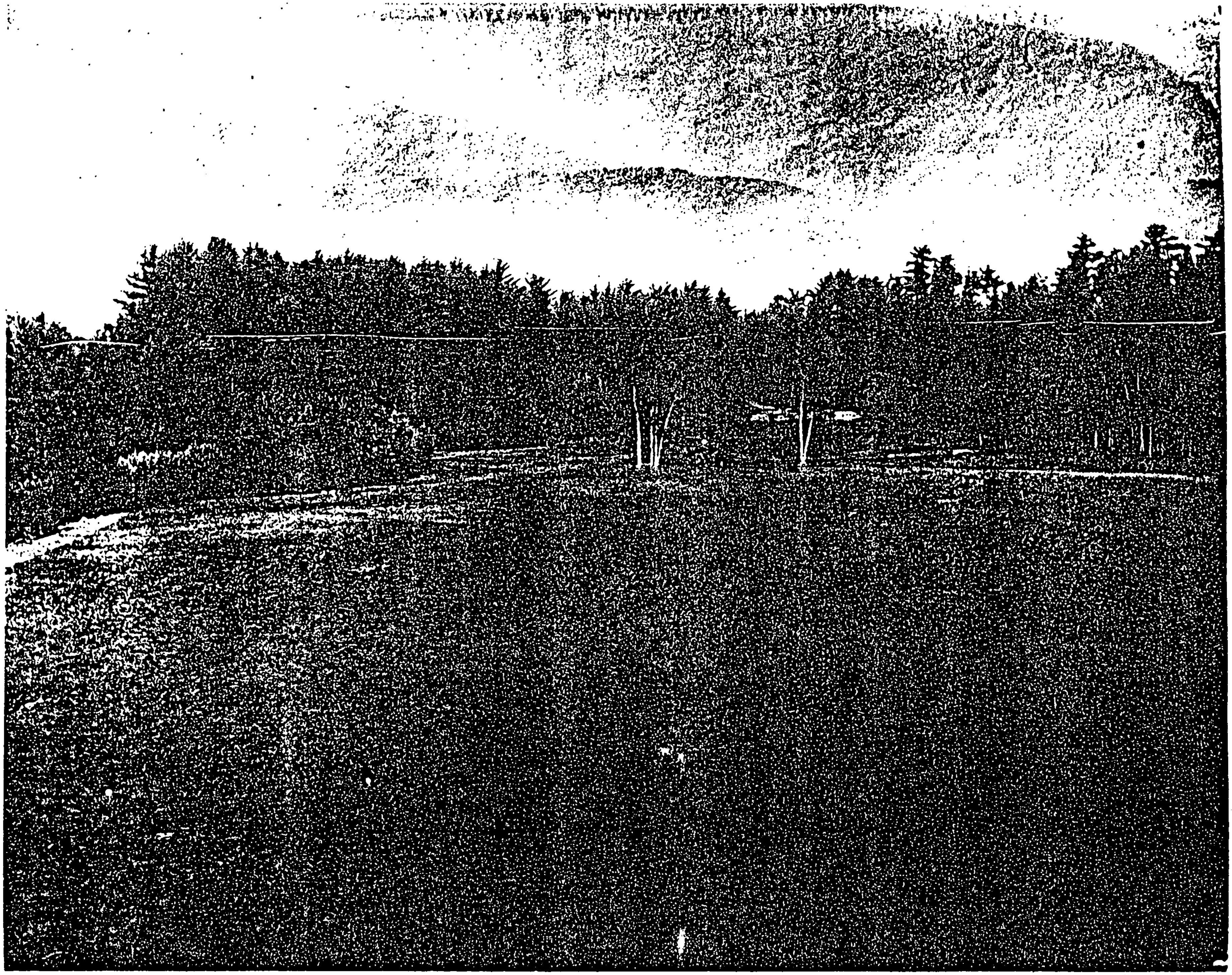


Fig. 11. The golf course at the Saint-Gaudens estate.

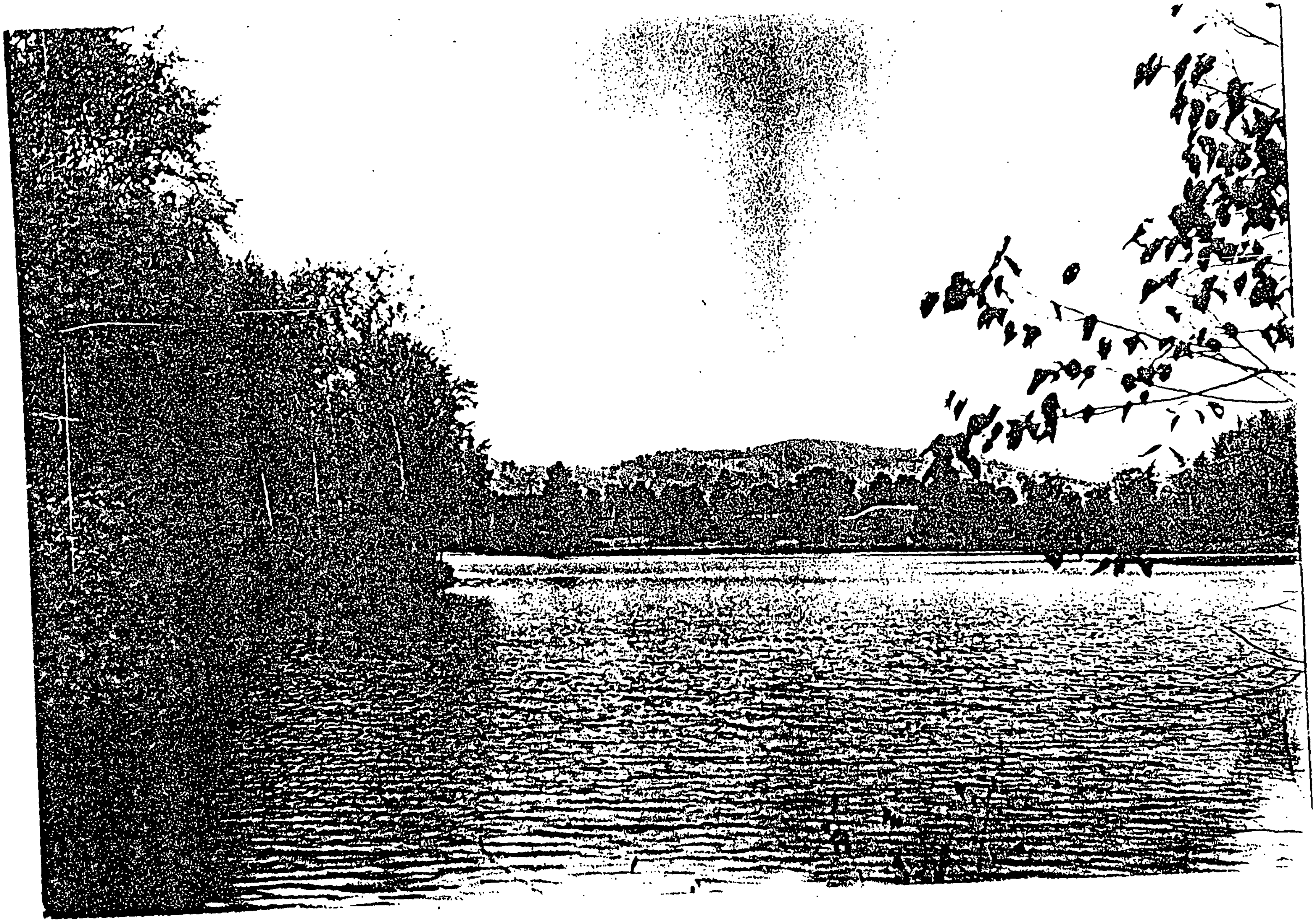


Fig. 12. View of Blow-Me-Down Pond from the turn of the century.

taken in 1980 (Fig. 13) shows that wetland communities have encroached significantly during the last several decades upon the original open water of Blow-Me-Down Pond. Gradually, through the processes of sediment accretion and plant invasion, portions of the pond have given way to marsh and marsh-shrub habitats that have contributed an important new diversity to the area around the pond. At the same time, beaver activity has increased around the upper end of the pond, and has exerted its influence on the composition of the nearby plant communities.

Other changes have occurred along the Blow-Me-Up Brook ravine — some as the result of natural processes and others in response to logging. Records indicate that Saint Gaudens and his friends enjoyed taking swims in a dammed section of BMU Brook below the temple. At that time, Saint-Gaudens probably became accustomed to walking through a relatively mature hemlock-pine-hardwood forest on his way to swim. Now, many decades later, the south slope of the ravine is covered by dense successional regrowth. Logging activities in the last several decades have removed many of the mature hemlock and associated species from the forest. In addition, earthslides along some of the steeper sections of the ravine have also eliminated some of the previous forest cover.

In summary, the Historic Site and natural area have undergone a series of changes since the time of Augustus Saint-Gaudens. Much of the change traces back to logging activities conducted in 1920-25, 1940-50, and 1964-65. Other changes are related to the growth of successional forests on abandoned fields. In spite of this, much of the essential character of the landscape has remained very similar to the way it appeared around the turn of the century. The tall white pines that rimmed the perimeter of the lawn during Saint-Gaudens' life still lend their distinctive character to the lovely historic area. Off in the

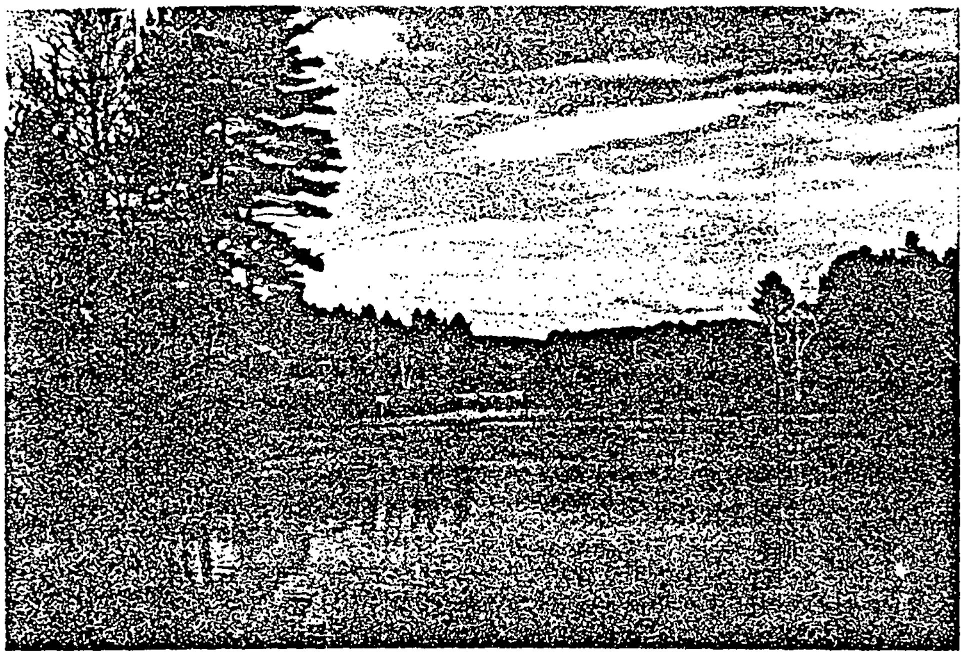


Fig. 13. View of Blow-Me-Down Pond in 1980.

distance, the sillouette of Mt. Ascutney continues to provide inspiration to visitors.

Exotic Plant Species

Among the botanical resources at Saint-Gaudens National Historic Site are a great number of native and exotic species that have been planted in the gardens surrounding the "Aspet". Many of these plantings probably date back to the time of Saint-Gaudens' residence on the property. During that period, the estate included flower gardens, a vegetable garden, and an orchard. The list of planted species that may now be found on the grounds is shown in Table 6.

Noxious Plant Species

As one component of the natural resource inventory, an attempt was made to identify the potentially noxious plant species on the property. These plants are as follows:

1) Poison ivy (*Rhus radicans*). This three-leaved woody vine occurs in various woodland and forest border habitats on the property. All parts of this plant are poisonous and may cause skin rash.

2) Indian poke (*Veratrum viride*). This plant may occur in moist areas around the property. Its clasping broad leaves with parallel vein markings are conspicous. The alkaloids present in the roots and leaves of this plant may cause poisoning if ingested.

3) European bittersweet (*Solanum dulcamara*). This woody climbing or reclining herb may potentially occur along fence walls. During the summer and early fall, the plant fruits become attractive berries that are bright red to scarlet. The leaves and unripe fruits of this plant contain alkaloid-related compounds that may cause poisoning, if taken internally.

4) Baneberry (*Actaea rubra*). This perennial herb may occur in the woodlands of the natural area. The roots, sap, and red berries of this plant may cause internal poisoning.

Other information on potentially poisonous plants may be obtained from the U.S. Dept. of Health publication entitled "Common Poisonous Plants of New England."

Table 6. Master listing of native and exotic species planted in and around the gardens and grounds of the Saint-Gaudens National Historic Site, Cornish, N.H. Each species is listed by family name, genus, species, and common name. Compiled by Lynne Hoxie of Dartmouth College.

Family	Species	Common Name
AMARYLLIDACEAE	Narcissus hybrids	Narcissus
APOCYNACEAE	Vinca minor	Myrtle
BETULACEAE	Betula populifolia	Gray Birch
COMPOSITAE	Tagetes hybrid	Marigold
CRASSULACEAE	Sedum sp	SEDUM
GERANIACEAE	Pelargonium hortorum (derivation)	Geranium
IRIDACEAE	Iris germanica	Bearded Iris
	Iris siberica	Siberian Iris
LABIATAE	Glechoma hederaceae	Gill-Over-The-Ground
	Thymus serphyllum	Thyme
LEGUMINOSAE	Gleditsie triacanthos	Black Locust
	Lupinus hybrid (Russell)	Russell Lupine
LILIACEAE	Hemerocallis fulva	Day Lily
	Hosta spp	Plantain Lily
	Muscari botryoides	Grape Hyacinth
	Scilla Sp	Squill
	Tulipa hybrids	Tulip
MALVACEAE	Althaea rosea	Hollyhock
OLEACEAE	Syringa vulgaris	Lilac
PAPAVERACEAE	Chelidonium majus	Celandine
	Dicentra spectabilis	Bleeding Heart
	Papaver orientale	
POLEYMONIACEAE	Polemonium reptans	Greek Valerian
RANUNCULACEAE	Aquilegia hybris	Columbine
	Paeonia lactiflora	Peony
	Trollius europaeus	Globe Flower

Table 6. Continued

Family	Species	Common Name
ROSACEAE	Pyrus malus	Apple
	Rosa hybrid	Rose
SALICACEAE	Populus nigra	Lombardy Poplar
SAXIFRAGACEAE	Astilbee sp	Astilbee
SOLANACEAE	Petunia hybrida	Petunia
VIOLACEAE	Viola papilionaceae	Common Blue Violet
	Viola tricolor	Pansy
VITACEAE	Vitis sp	Grape

References Used: Wyman, Donald (1971) Wymans Gardening Encyclopedia. Macmillan Co. (New York)
Claire, S.H. (1978) Green Immigrants, Harcourt Brace Jovanovich. (New York)
Anderson E. (1971) Plants, Man & Life, Univ. Calif. Press. (London)

Notes on Selected Species:

APOCYNACEAE — *Vinca minor* — *Myrtle*

Introduced from Europe but firmly established in America where it was grown by early settlers.

LABIATAE — *Thymus serphyllum* — *Thyme*

Known to grow wild in Italy, Southern France and is besides cultivated throughout middle Europe. Also in Greece and Greek Islands and in Siberia. It was carried to Northeast America by European colonists where it continues under cultivation and in the wild. It has long been used as a seasoning herb and its essential oil is administered to remove flatulence.

LEGUMINOSAE — *Gleditsia triacanthos* — *Black Locust*

An American native from Ontario to George to Texas. Its wood weigh s 42 pounds per cubic foot, is durable, yellow brown, with darker streaks. Pollination by insects. Wood is used for fence rails, wheel hubs. The fruits are eaten by cattle, deer, hares, cottontails, squirrels, starling, and quail. The sweet pulp makes a good relish.

Table 6. Continued

LILIACEAE	*Hemerocallis fulva*	*Day Lily*

Found from France to Japan. These lilies mark last evidence of many an early homestead and their presence in quantity usually means that nearby is the foundation of an old home.

	Tulipa hybrid	

Native of Russia and Asia. Developed for garden purposes extensively in Holland and Denmark and imported into America for a long time. Possibly first grown in Austria in 1554, in England in 1577.

MALVACEAE	*Althaea rosea*	*Hollyhock*

Native of China. Carried to Europe by the crusaders; to America by the pilgrims; now commonly established throughout the U.S. and through much of the temperate world.

PAPAVERACEAE	*Dicentra spectabilis*	*Bleeding Heart*

Native of Japan where it was discovered in the middle of the nineteenth century by Robert Fortune and introduced into English gardens about 1847. Related to our native Squirrel Corn and Dutch-Man's-Breeches. A popular plant in old fashioned flower gardens. Children delight in pulling the flower apart and giving parts names based on their shape such as rabbits for the red outer petals, a harp, a pair of glasses, and a bottle-the pistil.

	Papaver orientale	*Oriental Poppy*

A native of the Mediterranean region east to Persia. Widely grown in gardens.

Disturbance Factors

Part of the process of understanding the natural resources of an area involves learning about the natural disturbance factors which have historically influenced the patterns of these resources. One of the potentially important forces in northeastern forests is storm damage and associated windthrow. Although this natural disturbance factor is prominent in many areas of New Hamsphire, there is relatively little evidence at Saint-Gaudens N.H.S. to indicate that much storm damage has occurred in the recent past. Part of the explanation for this may be that the well-drained loamy soils permit comparatively deep rooting by the trees. Likewise, there is little evidence to indicate that fire has been an important factor shaping the forest composition. Apparently, the growing conditions in these forests are sufficiently cool and moist that fire has not been common.

We know relatively little about the specific occurrence of insect or disease outbreaks in the historic site or natural area. In general, one might assume that gypsy moth outbreaks would occasionally attack the oak component of the natural area forests. In addition, the elm component of the natural vegetation might be expected to suffer attacks from Dutch Elm Disease. Finally, the beech populations would be expected to suffer a certain amount of damage from beech scale disease.

Another known natural disturbance process in the natural area is the phenomenon of mass wasting and earthslide activity. In the steeper ravines, the lacustrine silt and clay deposits occasionally slump downslope, causing destruction to the immediate plant community. These fresh earthslides then undergo a gradual successional recovery that may take decades.

Historic Features of the Site

Visitors to the present-day Saint-Gaudens National Historic Site and natural area are surrounded by an interesting historic past. Part of this past is portrayed in the map from 1907 shown in Fig. 14. From this drawing, one can visualize the tree line and open area limits, the recreational features, the trail systems, and the general layout of Augustus Saint-Gaudens' estate. Other photographic views of the site are presented in Fig. 15 and 16.

Fig. 15. Saint-Gaudens' swimming pool dam along Blow-Me-Up Brook, below the Temple.

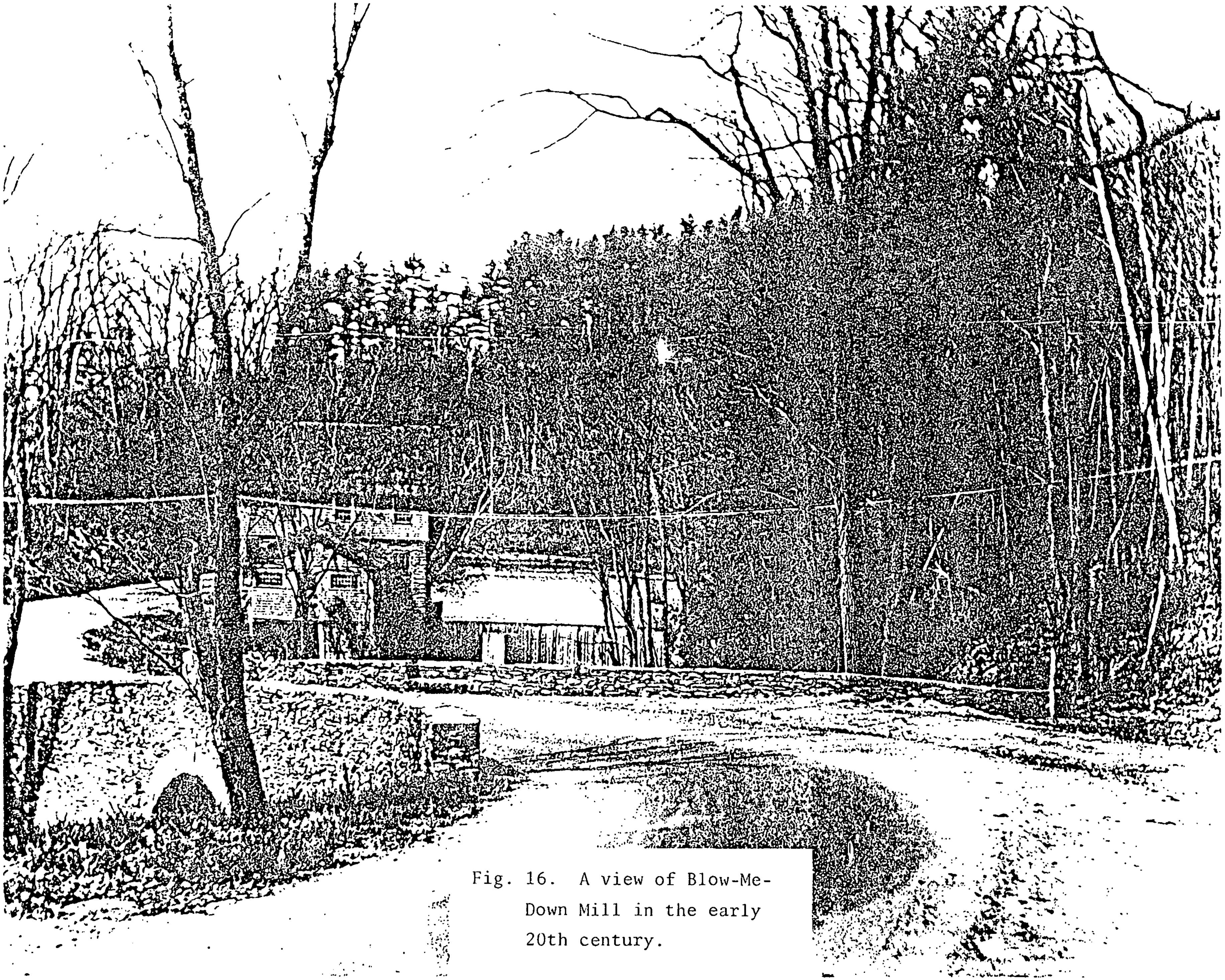


Fig. 16. A view of Blow-Me-Down Mill in the early 20th century.

POND AND STREAM RESOURCES

by

C. S. Cronan and J. R. Litton

The aquatic and wetland resources are a very important and valuable component of the landscape of the Saint-Gaudens National Historic Site and adjacent natural area. As shown on the map in Fig. 1, approximately half of the entire site is bordered by stream and pond habitats. Along the northern edge of the property, Blow-Me-Up Brook tumbles through riffles and pools, drops through sections of sharply incised ravines, and meanders through a dense floodplain forest on the way toward its confluence with the larger Blow-Me-Down Brook. From the northwestern corner of the property, Blow-Me-Down Brook winds and braids its way through the thickly vegetated alluvial plain along the western boundary of the property. Then, the brook meanders southeastward through a marsh-shrub habitat, and finally opens up into Blow-Me-Down Pond, a 2-hectare body of water located between Route 12-A and the southwestern section of the property. Finally, Blow-Me-Down Brook rushes over the old stone mill pond dam on the Historic site property and flows out to merge with the broad reaches of the Connecticut River.

Pond History

Historical records indicate that there has been considerable recreational and commercial activity along the sections of Blow-Me-Up and Blow-Me-Down Brooks included in the Saint-Gaudens National Historic Site and natural area. For example, Augustus Saint-Gaudens and his guests used to enjoy swimming in an impounded stretch of Blow-Me-Up Brook located below the Temple. During the winters, many members of the Cornish art colony enjoyed skating on the frozen Blow-Me-Down Pond. Some of the other historical

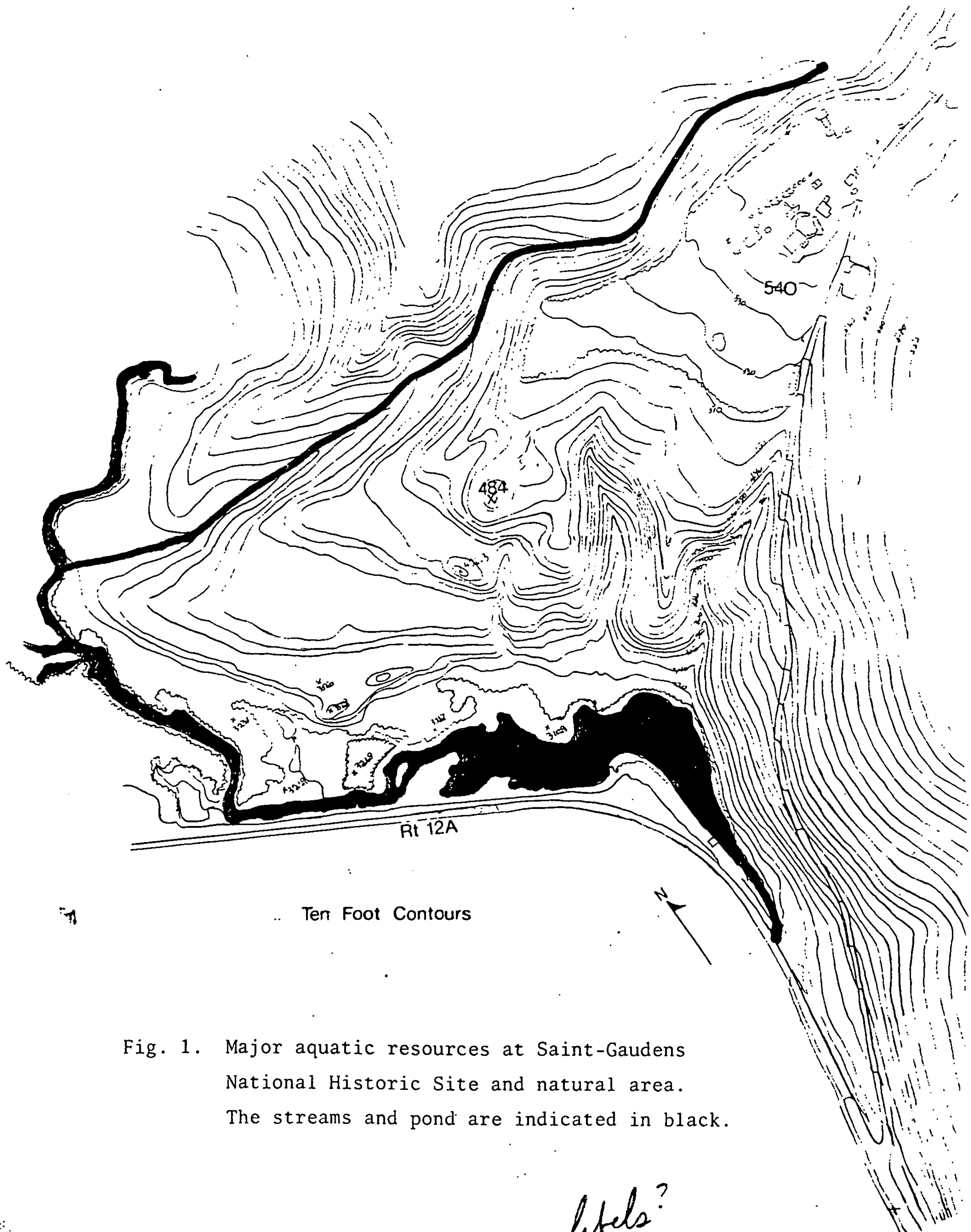


Fig. 1. Major aquatic resources at Saint-Gaudens National Historic Site and natural area. The streams and pond are indicated in black.

labels?

accounts associated with the streams and pond are shown below.

Year	Activity
1830's	Water Mercer, a Scotsman, built a carding and fulling mill to process wool from sheep that grazed in neighboring meadows. Remains of this mill are still visible on Blow-Me-Up Brook.
1887	Charles Beaman signed an agreement with the selectmen of Cornish to build a stone bridge over Blow-Me-Down Brook.
1890	The dam was constructed across Blow-Me-Down Brook.
1891	The Blow-Me-Down grist mill was built (Designed by the N.Y. architectural firm of McKim, Mead, and White).
1900	Blow-Me-Down Pond supplied ice for ice houses, to be used in summer.
1918	The grist mill was closed.
1938	A major hurricane devastated New England and washed out the dam. This flood event probably scoured a great deal of sediment out of the Blow-Me-Down Pond basin.
1939-40	The dam was reconstructed by the Town of Cornish.

Additional historical perspective on the pond is provided by the series of maps shown in Fig. 2a-c. In the first map from 1805, one can see the section of Blow-Me-Down Brook as it existed prior to the construction of the dam that created Blow-Me-Down Pond. In the next map from 1910, one can note the recently created Blow-Me-Down Pond to the south of the Saint-Gaudens estate. Finally, in Fig. 2c, one can observe how the pond-wetland complex appeared in 1980.

Pond and Wetland Mapping

Methods

Maps for water depth and sediment thickness were developed for Blow-Me-Down Pond during January 1980. For this project, 15 transect lines were laid out

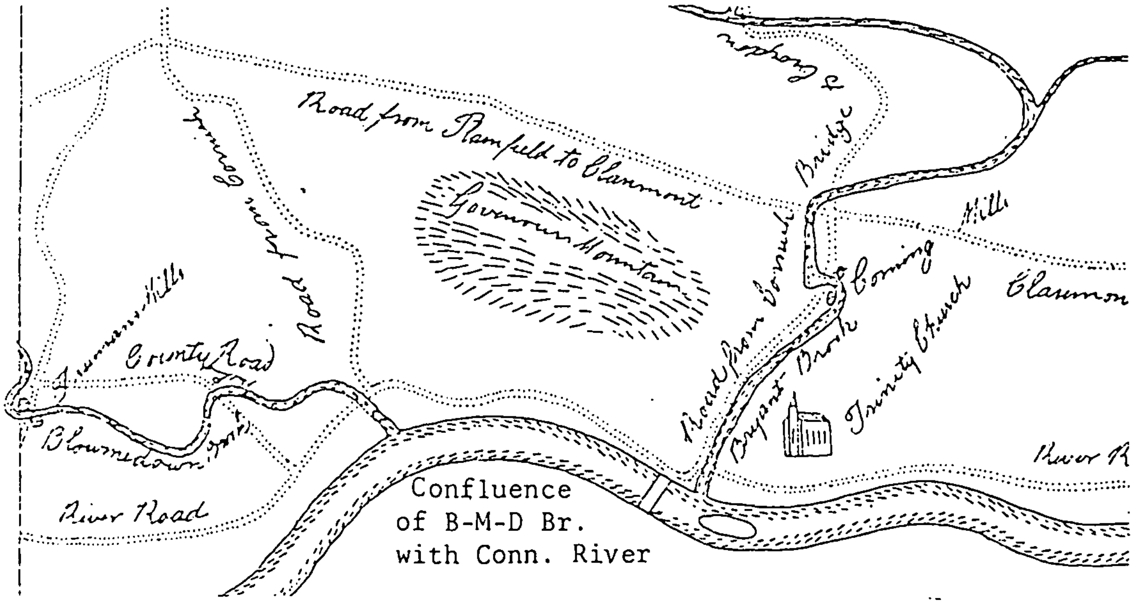


Fig. 2a. A map from 1805 showing the Blow-Me-Down Brook area that is now included in the Saint-Gaudens National Historic Site.

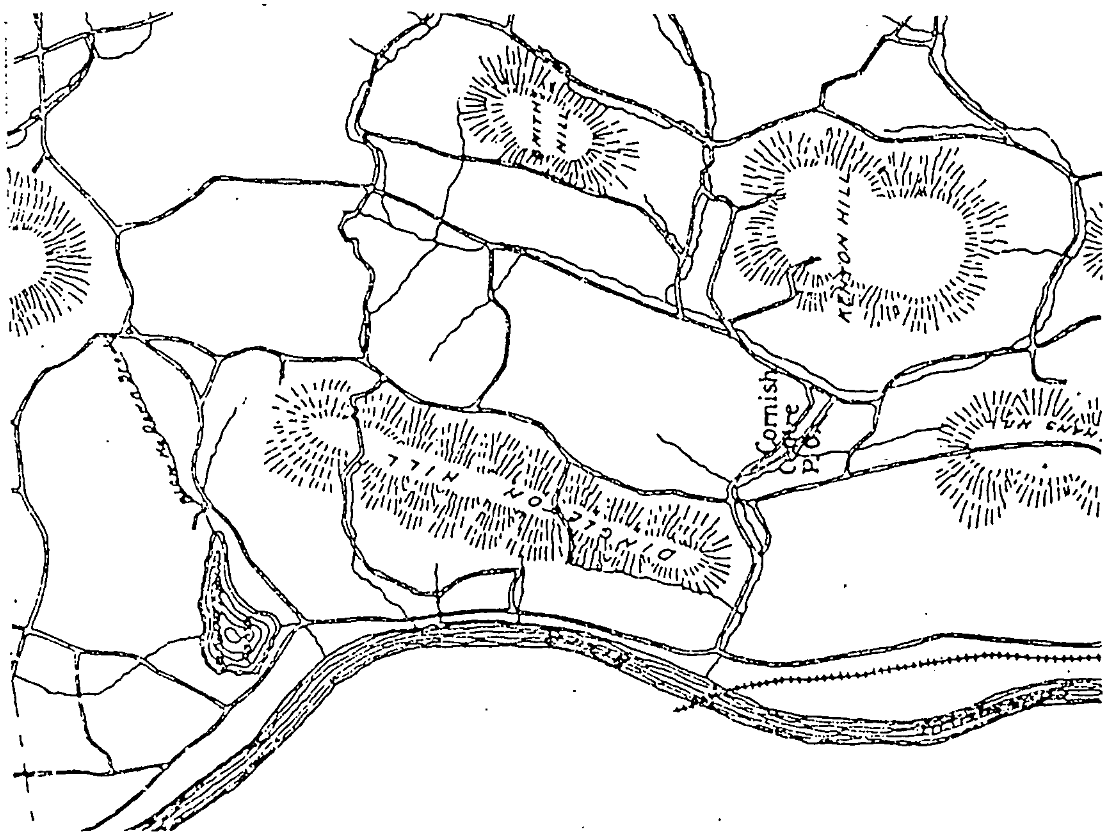


Fig. 2b. A map from 1910 showing the same area of Blow-Me-Down Brook,along with Blow-Me-Down Pond.

Fig. 2c. A contemporary view of Blow-Me-Down Pond, taken in 1979.

over the frozen pond surface; the lines were placed at known distances from each other and from known benchmarks, and were oriented at specific compass angles. At 1-5 m intervals along each transect line, a hole was chopped through the ice and a measuring staff was used to measure the depth to the sediment surface and to the firm pond bottom. Overall, approximately 142 holes were included in the survey. Back at the laboratory, the data were analyzed and compiled to produce one-foot contour maps of pond water depth and sediment depths.

Results

The mapping efforts yielded an interesting set of baseline data for Blow-Me-Down Pond. As shown in Fig. 3, water depths ranged up to 7-8 feet near the dam, and averaged 3.8 feet for the pond as a whole. Similarly, the soft bottom sediments averaged 3.6 feet in thickness, but were as thick as 6-7 feet in some areas (Fig. 4). It should perhaps be noted that the average water depths measured in winter might be considerably different from the high and low water periods encountered during storm events or extended periods of dryness.

not clearly presented or properly drawn.

Overall, the water depth and sediment thickness maps reflect the dynamic and diverse character of the Blow-Me-Down Pond - Wetland complex. The distribution patterns of water and sediment are very much a product of the dynamic processes of erosion and accretion. These processes, themselves, are controlled by hydrologic changes in stream discharge, by land-use patterns, and by changes in vegetation distribution. During periods of normal run-off, much of the sediment load carried by Blow-Me-Up and Blow-Me-Down Brooks may be deposited in the quiet water sections of marsh at the northwest end of the pond and along the pond shoreline. This pattern of accretion may develop into a cycle wherein the sediment deposits provide new substrate for rooted aquatic

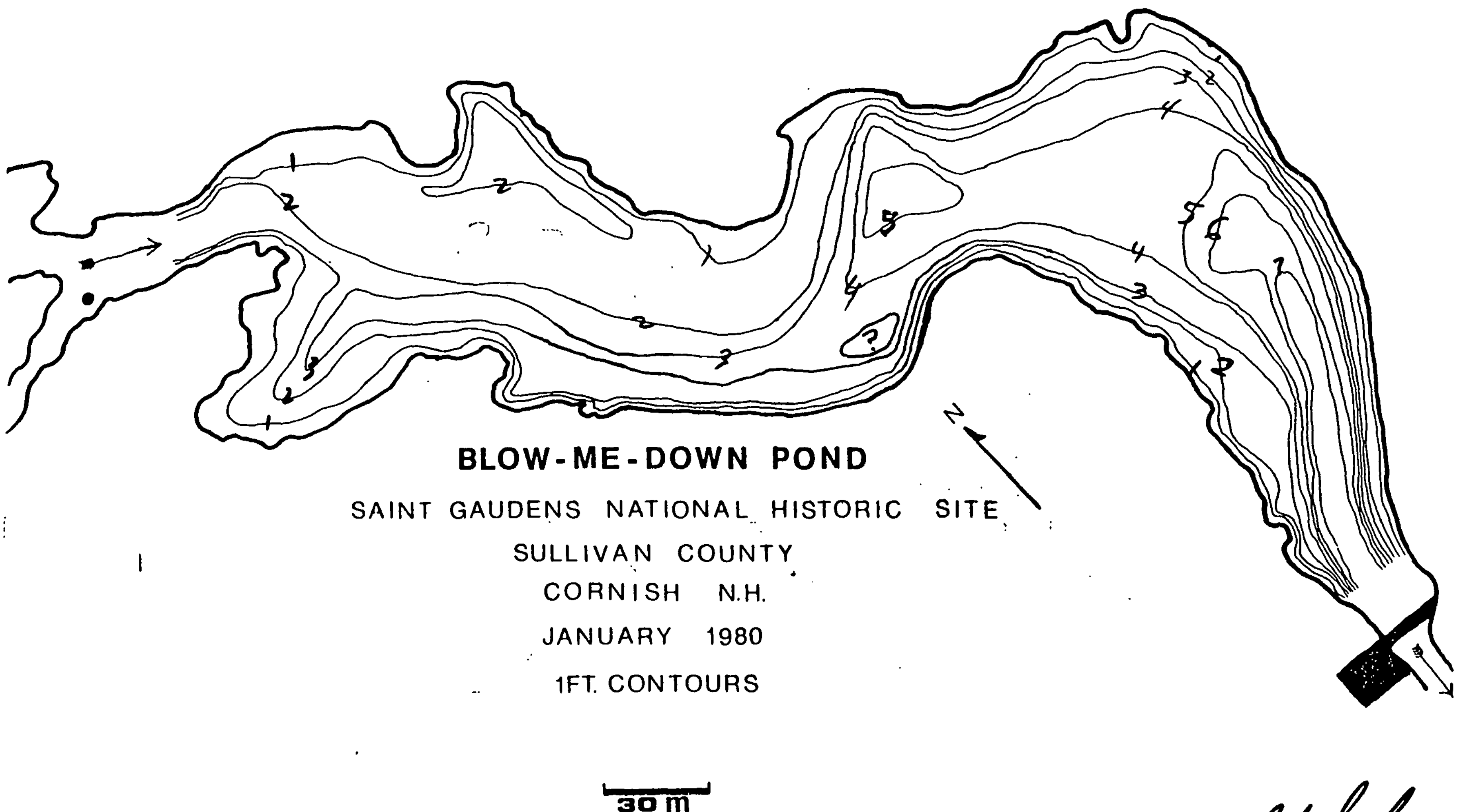


Fig. 3. Water depths at Blow-Me-Down Pond, Cornish, N.H.

Not labeled.

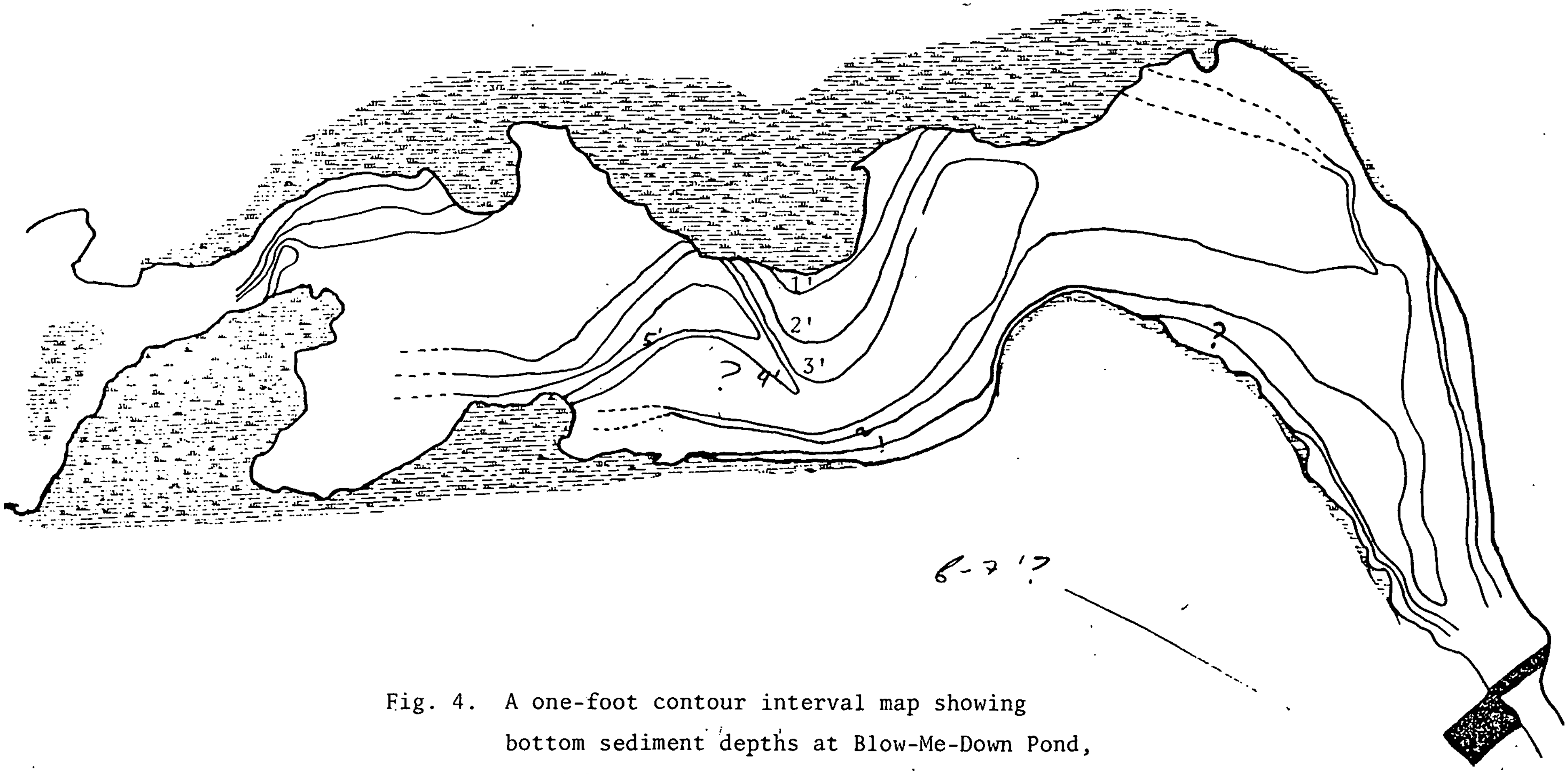


Fig. 4. A one-foot contour interval map showing bottom sediment depths at Blow-Me-Down Pond, Cornish, N.H. Wetland areas are also indicated.

plants which may then act as sediment traps, thereby promoting further sedimentation and expansion of the marsh habitat. Over time, the sediment accumulation may be increased even further by the annual contribution of dead organic matter from the plant community. However, during storm flow periods, the dramatic increase in stream velocity and discharge may initiate a cycle of erosion that results in an altogether new redistribution of sediments. The most recent and dramatic example of that type of erosion occurred during the 1938 hurricane, when the stone dam was washed out, along with tremendous amounts of sediment from Blow-Me-Down Pond.

Pond and Stream Chemistry

Methods

Water quality samples were collected using standard limnological methods from six sampling stations in Blow-Me-Up Brook, Blow-Me-Down Brook, and Blow-Me-Down Pond (Fig. 5, Table 1). These collections were made at four times during the year: February 11, 1980 (mid-winter), April 3, 1980 (spring high-flow), June 12, 1980 (summer low-flow), and August 4, 1980 (a supplementary summer low-flow collection). Following each collection, the water samples were analyzed for the following chemical parameters: pH, total suspended solids, specific conductivity, sodium, chloride, nitrate, total phosphorus, light extinction coefficient, chlorophyll *a*, dissolved oxygen, total and fecal coliform, and fecal streptococci. These analyses were performed using the standard methods listed in Table 2. The bacterial assays were performed by the State of New Hampshire Water Pollution Control Laboratory.

Results

The results of the water quality sampling program at Saint-Gaudens National Historic Site are presented according to collection date and sampling station in Table 3, and by chemical parameter in Appendix A. These data pro-

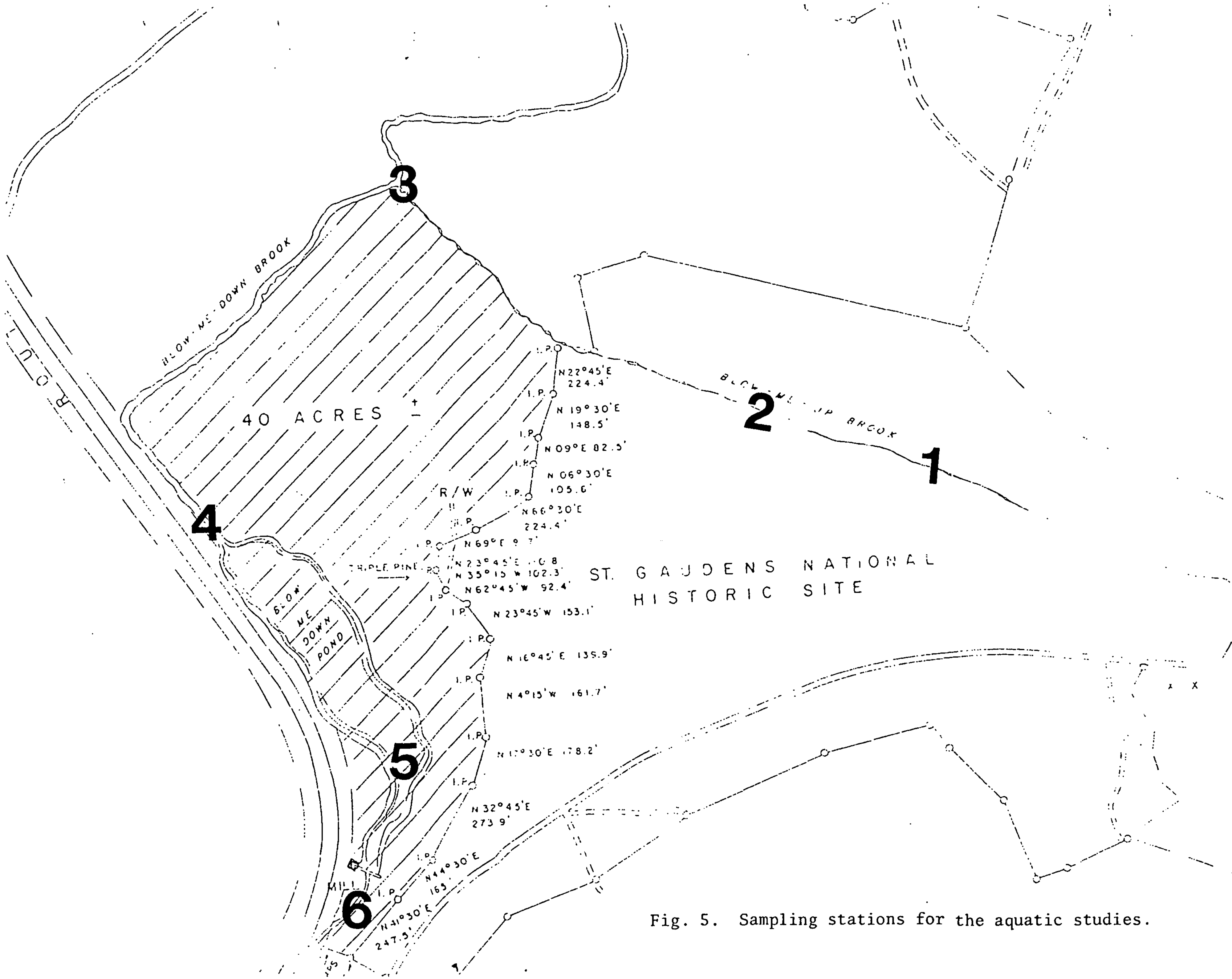


Fig. 5. Sampling stations for the aquatic studies.

Table 1. Sampling stations used for biological and chemical sampling.

SITE NUMBER	LOCATION/DESCRIPTION
1	Blow-Me-Up Brook -- where it enters ravine
2	BMU Brook -- 500 ft. from ravine entrance
3	Blow-Me-Down Brook -- confluence with BMU Brook
4	BMD Brook -- portion of brook along Rt. 12A right-of-way
5	BMD Pond -- mid-pond at 1 m depth
6	BMD Brook -- downstream from mill dam

Table 2. Methods used for water analysis at Saint-Gaudens N.H.S.

ANALYSIS	METHOD
pH	Potentiometric with Fisher Accumet, dual electrode
Conductivity	Barnstead Conductivity Meter
Na^+	Atomic Absorption Spectroscopy
Cl^-	Specific Ion Electrode
NO_3^-	Technicon Autoanalyzer (Cadmium reduction)
Total P	Inductively Coupled Plasma Spectrograph
TSS	Total non-filterable residue retained on a standard glass fiber filter and dried at 105°C
LEC	Whitney Underwater Daylight Meter
Chl. a	Fluorometric determination according to APHA 1975
Temp. & O_2	Yellow Springs Instruments temperature/dissolved O_2 probe
Bacteria	Performed by the N.H. Water Supply and Pollution Control Commission Laboratory using standard methods (APHA 1975)
Phytoplankton	Sedgewick-Rafter Cell Counting Chamber (Weber 1973)

TABLE 3. Water quality parameters for the six sampling stations in Blow-Me-Up Brook, Blow-Me-Down Brook, and Blow-Me-Down Pond.

Station	pH	Conductivity ($umho/cm^2$)	Na^+ ppm	Cl^- ppm	NO_3^- ppm	Total P ppm	TSS* ppm	LEC#	Chlorophyll a mg/m^3	Temp. °C	Dissolved oxygen (mg/l)	Total (Coliform) per 100 ml	Fecal (Coliform) per 100 ml	Fecal Streptococci per 100 ml
<u>11 FEB. 1980</u>														
1	7.74	163	2.4	9.8	1.7	.150	1.1	0.23	0.17	0.5	13.4	2	< 1	< 1
2	7.78	163	2.4	10.8	1.7	.132	1.0	0.26	0.17	0.5	17.5	3	< 1	1
3	7.74	169	8.4	9.2	2.2	.156	<1.0	0.27	0.21	0.5	14.4	41	22	< 1
4	7.80	144	8.9	-	1.9	.134	9.2	0.40	0.41	0.5	12.2	40	1	1
5	7.67	169	8.4	29.4	2.2	.149	3.0	0.30	1.34	0.5	14.4	3	< 1	50
6	7.64	173	8.6	29.7	2.2	.149	4.1	0.30	0.49	0.5	12.2	1	1	< 1
<u>3 APR. 1980</u>														
1	7.92	110	1.6	13.2	1.2	.153	<1.0	0.24	0.08	0.5	13.2	20	<10	50
2	7.80	110	1.6	11.9	1.2	.137	1.1	0.22	0.25	0.5	14.0	40	<10	50
3	7.75	93	3.2	18.0	1.6	.098	1.1	0.26	0.23	1.0	14.2	60	<10	60
4	7.62	88	3.6	23.3	1.6	-	7.0	0.39	0.26	2.5	12.8	70	<10	<10
5‡	7.65	89,89	3.7,3.6	20.9	1.6,1.6	.146	1.0	0.29	1.45	3.5	11.8	20	<10	20
6	7.65	89	3.6	20.2	1.6	.119	2.3	0.28	0.24	1.5	13.2	110	<10	20

TABLE 3. (CONTINUED)

Station	pH	Conductivity (umho/cm^2)	Na^+ ppm	Cl^- ppm	NO_3^- ppm	Total P ppm	TSS* ppm	LEC#	Chlorophyll a mg/m^3	Temp. ^oC	Dissolved oxygen (mg/l)	Total (Coliform) per 100 ml	Fecal (Coliform) per 100 ml	Fecal Streptococci per 100 ml
12 JUNE 1980														
1	8.16	130	2.2	11.1	0.6	.168	3.1	0.21	1.31	8.0	10.6	380	20	30
2	8.16	138	2.2	4.7	0.6	.120	1.0	0.24	2.10	8.0	9.9	290	20	80
3	8.08	97	5.5	20.2	0.6	.158	2.3	0.24	1.39	10.0	10.1	240	30	30
4	8.00	119	6.0	22.5	0.8	.137	17.0	0.39	1.56	11.5	9.0	740	20	170
5	8.04	106	6.2	22.0	0.7	.129	1.8	0.33	1.75	11.5	6.6	312	60	380
6	8.05	80	6.1	22.0	0.6	<.085	2.0	0.30	0.41	11.2	9.5	72	40	140
4 AUG. 1980														
1	8.35	213	3.2	10.3	0.8	.164	-	-	-	-	-	-	-	-
2	8.35	221	3.1	10.3	0.7	.102	-	-	-	-	-	-	-	-
3	8.10	152	7.3	25.8	1.1	.121	-	-	-	-	-	-	-	-
4	8.04	150	7.2	-	1.1	-	-	-	-	-	-	-	-	-
5	8.07	149	7.0	25.8	1.1	<.085	-	-	-	-	-	-	-	-
6	8.08	136	6.9	25.5	1.3	.104	-							

* TSS denotes Total Suspended Solids in mg/l
\# LEC denotes Light Extinction Coefficient at 1 meter depth
‡ The dual numbers represent values obtained for duplicate samples (i.e. they demonstrate reproducibility)
Note: The pH values are air-equilibrated measurements.

vide a basis for evaluating the water resources at the Historic site in terms of the suitability of the water for drinking, swimming, and the maintenance of fish and other aquatic organisms. Based upon the data, the following observations can be made concerning water quality in BMU Brook, BMD Brook, and BMD Pond.

First, the streams and pond exhibit very stable pH's over the course of the year, and are apparently well-buffered in the pH range between 7-8. At this time, there is very little likelihood that these waters would be subject to acidification by acid precipitation. The conductivity data are interesting in that they suggest that there may be a decrease in total dissolved substances between the smaller BMU Brook and the larger BMD Brook - BMD Pond systems. This pattern may imply that the increased biological productivity not sure in the BMD pond-wetland complex exerts a significant effect on stream water chemistry through net ion uptake. The data for Na^+ and Cl^- are perhaps most dramatic. As shown in Table 3, the concentrations of both ions are much lower in BMU Brook than in BMD Brook or BMD Pond. Furthermore, the concentrations of Cl^- are generally so high in the BMD Brook system that one would presume that Cl^- rather than HCO_3^-, is the dominant anion in solution. Based on this information, it would appear that there is a significant and probably unnatural source of chloride salts in the BMD Brook system. In all probability, this extreme leaching of chloride salts is the result of road salt run-off from the nearby Route 12A pavement. One curious point, here, is that sodium exhibits an apparent dilution during snow-melt, while chloride does not. This may indicate that other salts besides NaCl are used in the highway de-icing program; alternatively, it may be a reflection of the different mobilities of Na^+ and Cl^-. Looking at the nitrate data, one can see that nitrate concentrations were generally low in the streams and pond. Although the nitrate data were relatively consistent, there was some indication that concentrations were somewhat lower in summer, presumably as a result of nitrogen accumulation by organisms in the aquatic ecosystems. Finally, the total phosphorus data were interesting in that phosphorus concentrations were consistently high for nearly all sampling stations and sampling dates. In fact, the average total phosphorus concentration was approximately ten times higher than the recommended 0.015 ppm limit for Class B anc C waters in New Hampshire (N.H. Water Supply and Pollution Control Commission 1977). With total phosphorus concentrations averaging around 150 μg/l (0.150 ppm), it would appear that both streams are subject to excessive phosphorus loading from agricultural or septic system run-off. Based on this water quality parameter, the two streams would have to be categorized as potentially eutrophic water bodies.

Table 3 also presents several important physical and biological parameters for the streams and pond. As indicated, total suspended solids concentrations were low throughout the year in the pond proper. The feeder streams exhibited relatively low levels of suspended solids until the point at which Blow-Me-Down Brook reaches the Route 12A right-of-way. At that point, the suspended load in the stream increased markedly, probably as a result of stream bank erosion and highway surface runoff. After this increase, the suspended solids entering the pond decreased rapidly, indicating that most of the suspended load settles in the pond basin. This settling may contribute heavily to the flocculent deposits noted in the sediments of the pond (see Fig. 4). Independent measures of turbidity, measured on each sample using a Bausch and Lomb Spectronic 20, indicated that the stream and lake water samples never exceeded 2.0 Jackson units, well below the 5.0 unit limit for Class A New Hampshire waters.

As shown by the light extinction coefficient data (Table 3), there was relatively little variation in transparency throughout the year or between sampling stations. Furthermore, because BMD Pond was not thermally stratified, the light penetration did not vary from top to bottom of the water column. This would be expected in a non-stratified lake, because any particulate matter in the water would be evenly distributed from the bottom by water turbulence currents. The highest light extinction coefficient values were noted in Site 4 (BMD Brook along Route 12A) and correspond to the increased total suspended solids in the water column. In general, the light extinction coefficients indicate that BMD Brook and Pond have a transparency that is comparable to some of the cleanest lakes in neighboring Grafton County, N.H. For example, Group II lakes (Mirror, Squam, Tarleton, Tewksbury, and Crystal) have light extinction coefficients ranging from 0.34 to 0.40 for a three-meter interval of the water column (Kilham and Likens 1968). On a world-wide scale, Likens (1975) gives the following ranges for light extinction coefficients in lakes of different trophic states: ultra oligotrophic (0.03 - 0.8), oligotrophic (0.05 - 1.0), mesotrophic (0.1 - 2.0), and eutrophic (0.5 - 4.0). Values for the BMU-BMD system are located at the oligotrophic end of this spectrum.

The results of chlorophyll a analyses are also given in Table 3. Annual mean values ranged from 0.08 to 1.75 mg/m^3. These values can be used as an indicator of algal biomass (standing crop). Assuming that chlorophyll a constitutes about 1.5% of the dry weight organic matter of the algae, the algal biomass in the water column can be estimated by multiplying the chlorphyll a content by a factor of 67. Likens (1975) described the following chlorophyll a values for different lake trophic states: ultraoligotrophic (0.01 - 0.5), oligotrophic (0.3 - 3.0), mesotrophic (2.0 - 15.0), and eutrophic (10 - 500 mg/m^3). Clearly, the values obtained in the Blow-Me-Up/Blow-Me-Down aquatic system are low and indicative of an oligotrophic system. Curiously, this information presents somewhat of a conflict in comparison with the total phosphorus evidence, which implied that the system was a potentially eutrophic water body. At this time, we must assume that there is some deficiency or toxicity factor which limits algal primary production, in spite of abundant phosphorus concentrations.

comment w/ EP data

Table 3 also includes temperature and dissolved oxygen data collected for the BMU-BMD aquatic ecosystem. The data are not unusual for an oligotrophic aquatic system. Because the pond is so shallow and lacks thermal stratification, temperatures rise and fall with respective ambient levels. Slight increases in temperature are noted in the more open, exposed parts of the system, reflecting the greater solar radiation exposure. Oxygen concentrations show some decrease along the BMD stream and pond due to the increased biological oxygen demand of suspended organic matter. Yet, regardless of the decreases in dissolved oxygen, the total dissolved oxygen concentrations never fell below the 6.0 mg/l level recommended for Class A waters. In short, the levels of dissolved oxygen noted in the brook and pond systems are sufficient for the maintenance of cold water fisheries. Furthermore, there is no evidence that the pond becomes anoxic in winter, despite a thick ice cover. Apparently, on-going water movement through the pond, coupled with a presumably low biological oxygen demand, account for the maintenance of highly aerobic conditions throughout the year in the pond basin.

Finally, Table 3 also presents the bacterial counts (per 100 ml water) noted in the BMU-BMD aquatic system. The levels of coliform bacteria and fecal streptococci are probably a cause for concern with respect to the water quality of this system. All of the summer coliform values exceeded the established limits for Class A and B waters (less than 50 and less than 240 coliform per 100 ml water, respectively). Based on these data, the Blow-Me-

Down system would be designated a Class C water. This confirms an earlier spot check (August, 1977) by the N.H. Water Supply and Pollution Control Commission. Their study indicated the following ranges of bacteria at 10 sites on the two brooks: Total coliform (360-800); Fecal coliform (10-80); and Fecal Streptococci (50-580) -- with all counts reported as bacteria/100 ml water. At this time, it is difficult to state the specific sources for these high bacterial counts. A more thorough investigation of upstream bacterial populations will be required to isolate the source(s) of fecal bacteria noted in the brooks and pond. Such a study may show that both the total phosphorus and bacterial enrichments arise from feedlot or septic system run-off.

impt

Pond and Wetland Biomass

Methods

Pond and wetland habitats were sampled for species compositions and abundances. Phytoplankton were quantitatively analyzed using a Sedgwick-Rafter cell counting chamber as outlined by Weber (1973). The phytoplankton analyses were based on two liter water samples that had been collected and concentrated (if necessary) using a number 25 mesh net. Zooplankton were analyzed quantitatively by filtering two liter samples of water through a screened cone (Likens and Gilbert 1970), and then counting in a standard counting chamber (Weber 1973). Benthic macroinvertebrates were collected by dip net and seine, and were then preserved for identification. Fish were collected over the course of several days at spring high flow using a hoop net, gill net, and electrofishing gear (Weber 1973) in both brook and pond habitats (See Fig. 6). Finally, wetland macrophytes were sampled using line intercept and percent cover estimates.

Results

The phytoplankton species and genera encountered in samples from the BMU-BMD brook and pond system are presented in Table 4. As indicated, no single group of algae dominated the phytoplankton of the pond and its feeder streams. The largest number of species belonged to the Chlorophyta (19 species), and the vast majority of these were desmids. The other major components of the total phytoplankton flora were as follows: Cyanophyta (5 species), Chrysophyta (7 species), Bacillariophyta (11 species), and Dinophyta (6 species).

The phytoplankton flora of the BMU-BMD aquatic system was characterized by a number of species that were present during the entire year. Most of the chlorophytes, chrysophytes, and bacillarophytes could be found in each

Fig. 6. Sampling fish in Blow-Me-Up Brook using electrofishing equipment.

TABLE 4. Phytoplankton species in the pond and streams at Saint-Gaudens N.H.S. Quantitative data are reported for Blow-Me-Down Pond (as 1 X 10^5 cells/liter). Qualitative occurrence in stream samples is denoted by an asterisk. (-) = not detected.

TAXA	SAMPLING DATES 2/12/80	4/3/80	6/11/80
CYANOPHYTA			
Anabaena flos-aquae	.40	.37	.44
Aphanothece Clathrata	.03	.06	.09
Gloethece linearis	.15	.14	.16
Gomphosphaeria aponina	.01*	.11*	.10*
Merismopedia punctata	.07*	.06*	.06*
CHLOROPHYTA			
Botryococcus braunii	--	.04*	.05*
Crucigenia rectangularis	--	--	.03
Closterium sp	.06	.07	.03
Coelastrum sp	1.14	1.06	1.14
Cosmarium sp	.22*	.27*	.36*
Desmidium swartzii	.08	.17	.12
Dictyosphaerium pulchellum	.02*	.02*	.02*
Euastrum didelta	.33	.28	.06*
Euastrum pulchellum	.06*	--	--
Gloeocystis gigas	--	--	.07
Nephrocytium limneticum	-- *	.09*	1.67*
Oocystis borgei	--	.07	.51
Pediastrium sp	--	.09	.09
Quadrigula sp	.03	.07	.11
Scenedesmus sp	-- *	.88*	.17*
Sphaerocystis schroeteri	-- *	.72*	.66*
Staurastrum sp	.14	.18	.16
Staurodesmus sp	.16*	.19*	.05*
Xanthidium antilopaeum	-- *	.07*	.03*
EUGLENOPHYTA			
Colacium sp	.07*	.05*	.07*
Euglena sp	.03	.09	.06
XANTHOPHYTA			
Gloeobotrys limneticus	.03*	.03*	.15*
Ophiocytim capitatum	-- *	-- *	.05*

TABLE 4. (Continued)

TAXA	SAMPLING DATES 2/12/80	4/3/80	6/11/80
CHRYSOPHYTA			
Chrysophaerella longispina	.04	.01	.23
Diceras phaseolus	.01	.01	.03
Dinobryon spp	.07*	.08*	1.34*
Epipyxis tabellariea	--	--	.08
Mallomonas spp	.04	.04	.04
Synura uvella	.05*	.06*	.05*
Urogelnopsis americana	.03	.06*	.01*
BACILLARIOPHYTA			
Asterionella formosa	.20*	.46*	.05
Cyclotella bodanica	.03*	.06*	.06*
Cyclotella comta	--	--	.05
Cyclotella glomerata	-- *	.07*	.08*
Fragilaria capucina	.01	.78	.54
Fragilaria crotonensis	.02	.05	.03
Melosira distans	.08	.09	.05
Melosira islandia	.06*	.09*	.04*
Rhizosolenia sp	.08*	.08*	.09
Tabellaria tenestrata	.15*	.09*	.05*
Tabellaria flocculosa	.08*	.08*	.04*
DINOPHYTA			
Ceratium sp	.01	.01	--
Gonyaulax sp	.07	.01	--
Gymnodinium fuscum	.03	.03	--
Peridinium inconspicuum	.01	--	--
Peridinium limbatum	.01	.01	.03
Peridinium wisconsinense	--	.02	--
CRYTOPHYTA			
Cryptomonas erosa	.07	.04	.02
Cryptomonas marssonii	.21	.26	.02
Rhodomonas lacustris	.07*	.04*	.02

collection. The ephemeral species were chiefly the chroococales, chlorophytes (exclusive of desmids), the dinophytes. It should be noted that the phytoplankton observed in this system correspond closely to the flora described by Gruendling and Mathieson (1969) for a known oligotrophic N.H. lake (New Found Lake). In general, the diversity of the flora, lack of clear dominants, relatively low chlorophyll a concentrations, and absence of noticeable "algal blooms" suggest that the Blow-Me-Up/Blow-Me-Down aquatic system is indeed oligotrophic.

The results of the zooplankton counts are given in Table 5. Rotifers were by far the most numerous zooplankters in the pond system — especially the colonial Conochilus and the loricate Keratella and Kellicottia. In addition, copepod nauplii and calanoid and cyclopoid adults were also abundant. Among the subdominant species, the cladocerans were somewhat less numerous, but were apparently ever-present in the aquatic system. Complementing the zooplankton genera were the diverse taxa of benthic macroinvertebrates shown in Table 6. Overall, Blow-Me-Down Pond and its feeder streams exhibited the kind of zooplankton and macroinvertebrate diversity that one would expect in an oligotrophic aquatic ecosystem.

The results of the 1980 fish survey at Saint-Gaudens National Historic Site are presented in Table 7, along with comparative data from a 1939 survey of Blow-Me-Down Brook. It can be noted that all but two of the species observed in 1939 were also collected in 1980; in addition; two other species appeared in the 1980 census. Unfortunately, there is not enough information available to determine whether these differences represent a real change in fish community structure. At this point, we must assume that the differences between the two survey lists are a reflection of differences in collection techniques and/or efficiencies. Several of the fish caught in the 1980 survey are shown in Fig. 7.

TABLE 5. Zooplankton taxa observed in the pond and streams at Saint-Gaudens N.H.S. Quantitative data are only reported for Blow-Me-Down Pond (organisms/liter water). Qualitative occurrence in stream samples is denoted by an asterisk. (-) = not detected.

TAXA	DATES OF SAMPLING 2/12/80	4/3/80	6/11/80
Colonial Ciliates	13*	2.1*	12.6*
Crustacea			
Cladocera			
Diaphanosoma leuchtenbergianum	3.4	5.2	5.0
Holopedium gibberum	0.5	4.3	5.8
Daphnia longiremis	0.5	--	--
Daphnia dubia	1.0	1.0	1.5
Ceriodaphnia sp	0.5	3.5	4.5
Bosmina sp	4.0	5.0	1.0
Polyphemus pediculus	--	3.5	3.0
immature Cladocera	4.5	5.5	1.0
Copepoda			
Calanoida	12.5	15.0	11.0
Cyclopoida	4.5	5.0	5.0
nauplii	8.0*	8.5*	3.0
Ostracoda	--	0.5*	1.5*
Rotifera			
Kellicottia	3.5	5.0	8.0
Keratella	10.5	18.0	23.0
Lecane	1.5	--	--
Monostyla	3.5	3.0	3.0
Trichocerca	1.0	--	1.5
Ascomporpha	0.5	0.5	0.5
Filinia	1.5	1.0	0.5
Conochilus	14.5	17.0	26.0
Polyarthra	7.0	5.0	7.5
Nematoda	0.25	0.75	1.0
Hydracarina	0.5*	--*	--*
Insecta	0.5	0.5	--

TABLE 6. Benthic macroinvertebrates from the pond and streams at Saint-Gaudens N.H.S.

ORGANISM	NOTED IN POND	NOTED IN BROOKS
Turbellarai		
Phagocata	X	X
Nematoda	X	X
Oligochaeta		
Tubificidae		
Limnodrilus	X	X
Tubifex		X
Naididae		
Nais communis	X	X
Pristina breviseta	X	
Pristina schmiederi	X	
Stylaria proboscidea	X	X
Slavina appendiculata		X
Crustacea		
Amphipoda		
Hyalella azteca		X
Ostracoda	X	X
Hydracarina	X	X
Insecta		
Ephemeroptera		
Baetidae		
Ephemerella	X	X
Ephemeridae		
Hexagenia		X
Megaloptera		
Sialis	X	X
Trichoptera		X
Diptera		
Culicidae		
Chaoborus	X	
Chironomidae		
Tanypodinae		
Procladius	X	X
Clinotanypus	X	
Pentaneura	X	
other Pentaneurini	X	
Chironominae		
Chironomini		
Chironomus	X	X
Microtendipes	X	
Tanytarsini		
Tanytarsus	X	
Mollusca		
Pelecypoda		
Pisidium	X	X
Gastropoda		
Valvata	X	X
Gyraulus	X	

TABLE 7. Fish species list for Blow-Me-Down Brook and Pond. Data from the current study are compared with a 1939 study by the N.H. Department of Fish and Game.

Fish species (Common and Scientific Name)	Present 1939	Present 1980
Brook Trout (*Catostomus commersonnii*)	X	X
Eastern Common Sucker (*Catostomus commersonnii*)	X	X
Eastern Black-Nosed Dace (*Rhinichthys atratulus*)	X	X
Northern Creek Chub (*Semotilus atromaculatus*)	X	
Eastern Common Shiner (*Notrupis cornutus*)	X	X
Eastern Long-Nosed Dace (*Rhinichthys cataractae*)	X	X
Fallfish (*Leucosemus corporalis*)	X	X
Red-Breasted Sunfish (*Lepomis auritus*)	X	
Eastern Johnny Darter (*Etheostoma olmstedi*)		X
Common Shiner (*Notropis cornutus*)		X

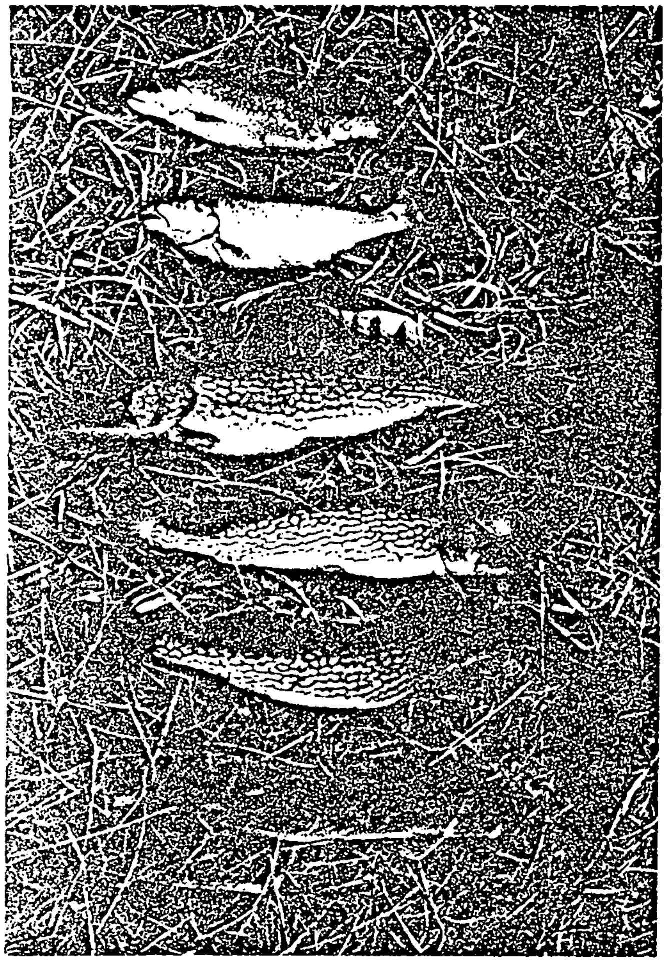


Fig. 7. Fish specimens collected from the Blow-Me-Down Brook system during the 1980 electrofishing survey.

One of the important factors that has helped to shape the fish community at Blow-Me-Down Brook over the last several decades is the fish stocking program of the N.H. Department of Fish and Game. As shown in Appendix B, Blow-Me-Down Brook has been stocked with several thousand brook trout per year for at least the last forty years. Yet, in spite of this stocking, there is little evidence of a sustained trout fishery in the brooks and pond at Saint-Gaudens N.H.S. Evidently, there has been a fairly close balance between the introduction of fish by the vigorous stocking program and the removal of fish by fishermen, natural mortality, and washout.

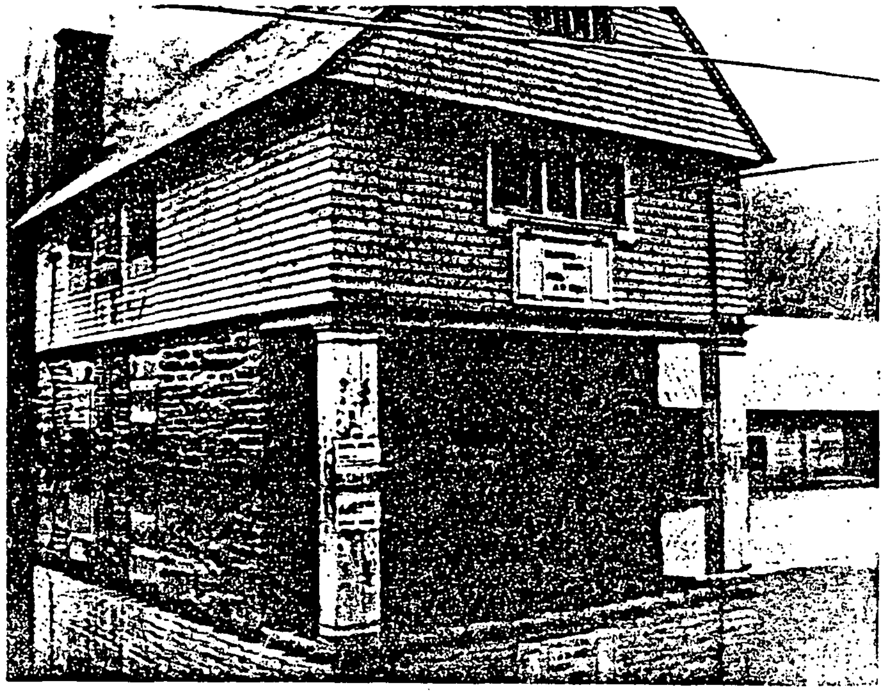
Line intercept techniques were used to develop percent cover estimates for the marsh and alder thicket wetland habitats. These results are presented in detail in the vegetation section. In general, the marsh community contained the following dominant and subdominant plants: cattails (90% cover), pond lily (5% cover), and Iris (5% cover). The alder thickets contained the following plants: speckled alder (60%), two species of Cornus (34% cover combined), honeysuckle (3% cover), elm saplings (1% cover), red maple saplings (1% cover), and pin cherry saplings (1% cover).

Overall, the characteristics of the Blow-Me-Down Brook and Pond system compare favorably with the limnological features described for several other important aquatic systems in New Hampshire. The data for these comparative lake systems are presented in Appendix C.

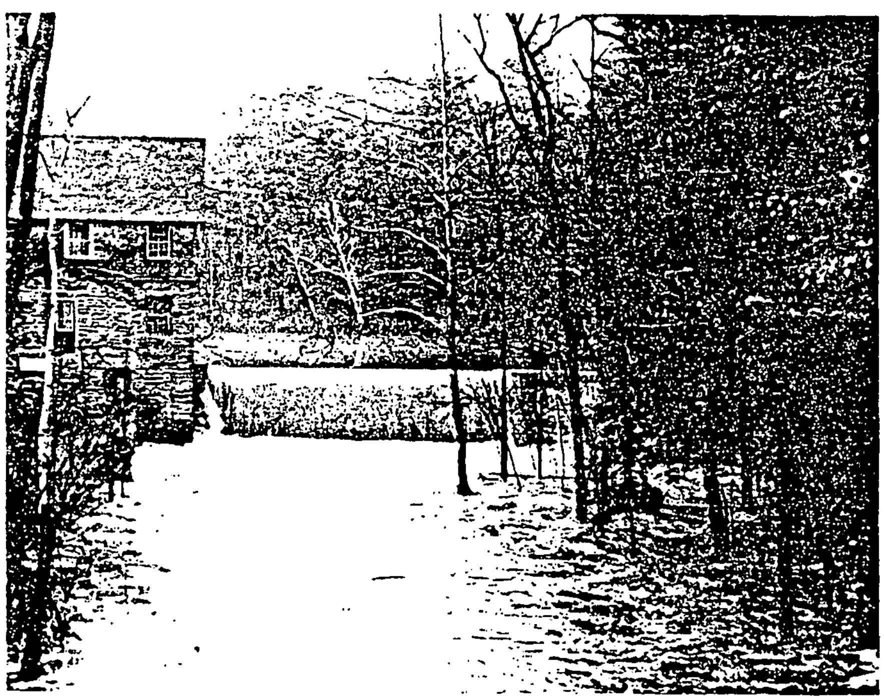
Stream Hydrology

The river and its floodplain are very much a dynamic system, both in space and over time. Moving down a river or stream channel, one may pass through turbulent riffle sections where swift currents and highly oxygenated water prevail, followed by calmer sections characterized by quiet, deep pools that harbor numerous fish species. Further on, one may move from steep straight channels plunging down hillsides to sections of stream that meander through gently sloping valley bottoms. Elsewhere, sections of cool, clear forested streams may gradually merge into warmer, silt-laden stream reaches that flow through plowed agricultural drainage areas. Likewise, there may be dramatic temporal contrasts in runoff patterns. As storm periods and droughts come and go, as weather patterns vary from year to year, and as seasons change, the river may experience an ever-changing pattern of response, ranging from periods of stream channel downcutting and erosion, to periods of flooding and over-bank deposition, to periods of extreme dryness characterized by limited base flow run-off.

These dynamic patterns of stream hydrology are very much a part of the natural cycle of events in the Blow-Me-Up and Blow-Me-Down Brook systems. For example, the Spring flood stage of run-off at Blow-Me-Down Brook is illustrated in the photos presented in Fig. 8 a+b. In contrast, Fig. 8c shows the summer low-flow conditions as they appeared around the turn of the century at the Blow-Me-Down mill. These and other kinds of hydrologic events occur naturally with differing degrees of probability in the Blow-Me-Down system. Over the short term, one can talk about the frequency with which the brooks achieve a bankful stage of discharge. This near-flood stage of discharge probably occurs somewhere between once per year to two out of every three years on the average at Blow-Me-Down Brook. Over a longer time scale, the brooks also experience larger flooding events, each with its own average recurrence interval and peak discharge. For example, the table below indicates the computed flood stages at Blow-Me-Down Pond for floods with recurrence intervals of 10, 100, and 500 years (Soil Conservation Service 1977).



The March 1936 flood on the Connecticut River backed water into Blow-Me-Down Mill. (Photo courtesy of Plainfield Library)



The April 1976 flood at Blow-Me-Down Mill shows the high water backing up from the Connecticut River to the base of the dam.

Fig. 8a. Flood conditions at Blow-Me-Down Pond.

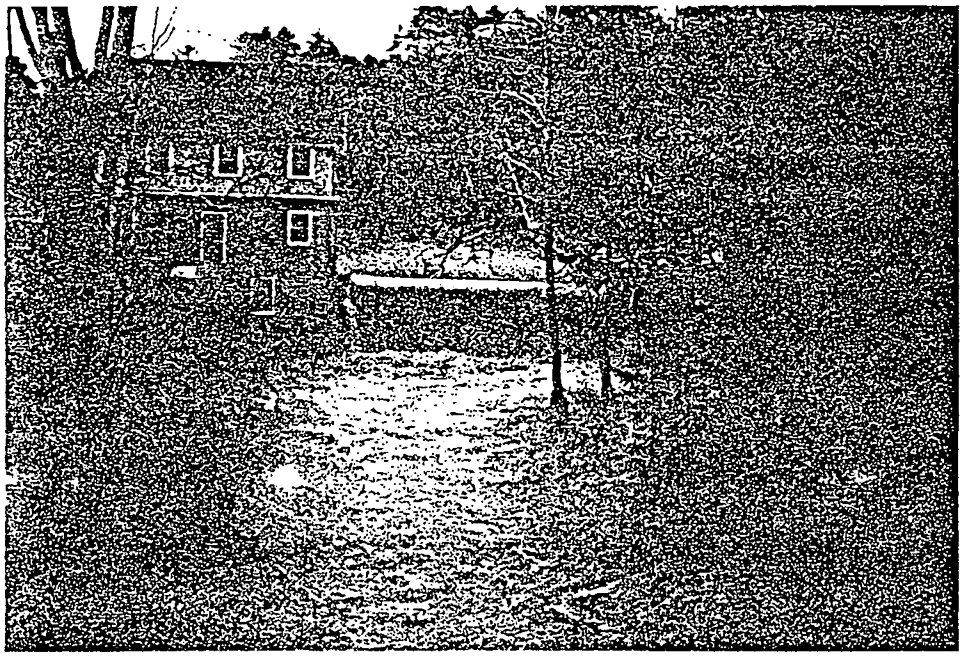


Fig. 8b. Spring flood in 1980 at Blow-Me-Down Brook.

Fig. 8c. Summer low-flow conditions at Blow-Me-Down Dam, around the turn of the century.

Flood	Discharge (cfs)	Elevation (ft. msl)
10-yr.	2,100	325.2
100-yr.	4,500	328.0
500-yr.	6,800	330.1

For reference, the photo in Fig. 9 also shows the flood levels of the 10 and 100-yr. floods in relation to the 323.3' concrete benchmark at the Blow-Me-Down mill.

It is at times of high water that the Blow-Me-Up and Blow-Me-Down Brooks may overflow their banks into the floodplain areas shown on the map in Fig. 10. These floodplain areas act as unstable depositional environments where sediments may accumulate or erode, depending upon the prevailing hydrologic conditions. Plant growth in these areas may be very lush, but may also be marked by dramatic disturbances caused by ice flows and extreme flooding events.

The history of Blow-Me-Up and Blow-Me-Down Brooks has been punctuated by a number of dramatic and sometimes devastating flood events. Some of these were recorded in the town records for Cornish and Plainfield and were described in the recent Flood Hazard Analysis for Cornish and Plainfield (Soil Conservation Service 1977). These accounts are as follows.

July 19, 1850:

> The flood of 1850 resulted from a succession of very heavy thunder showers occurring on the afternoon of July 19, 1850. These showers were almost continuous, lasting from 2:30 p.m. until nearly six o'clock. The rain poured in torrents most of this time. The effects were very marked and sudden. The brooks were swelled to unheard-of dimensions. Intervales and meadows were soon under water. Bridges were carried away. Acres of grass just ready for cutting were ruined. Some brooks were diverted from their original channel. The upper sawmill at the Flat, with its dam, gave way. The water with the timbers coming down, caused the lower dam also to give way, and the debris was all carried downstream and deposited on the meadows below. The damage to highways and bridges in Cornish by this freshet, amounted to nearly four hundred dollars.

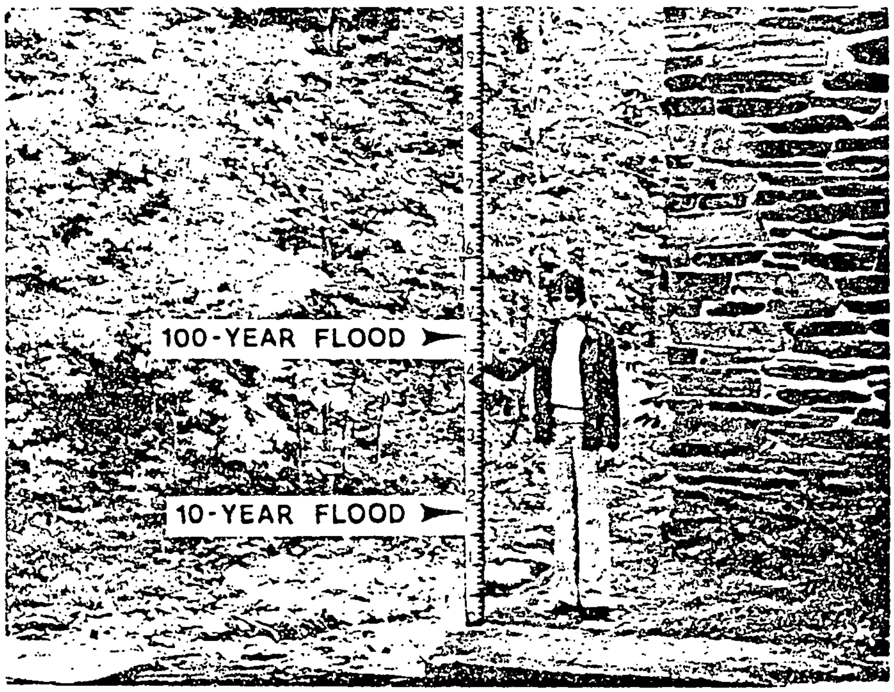


Fig. 9. Flood level reference marks at the concrete buttress above Blow-Me-Down dam.

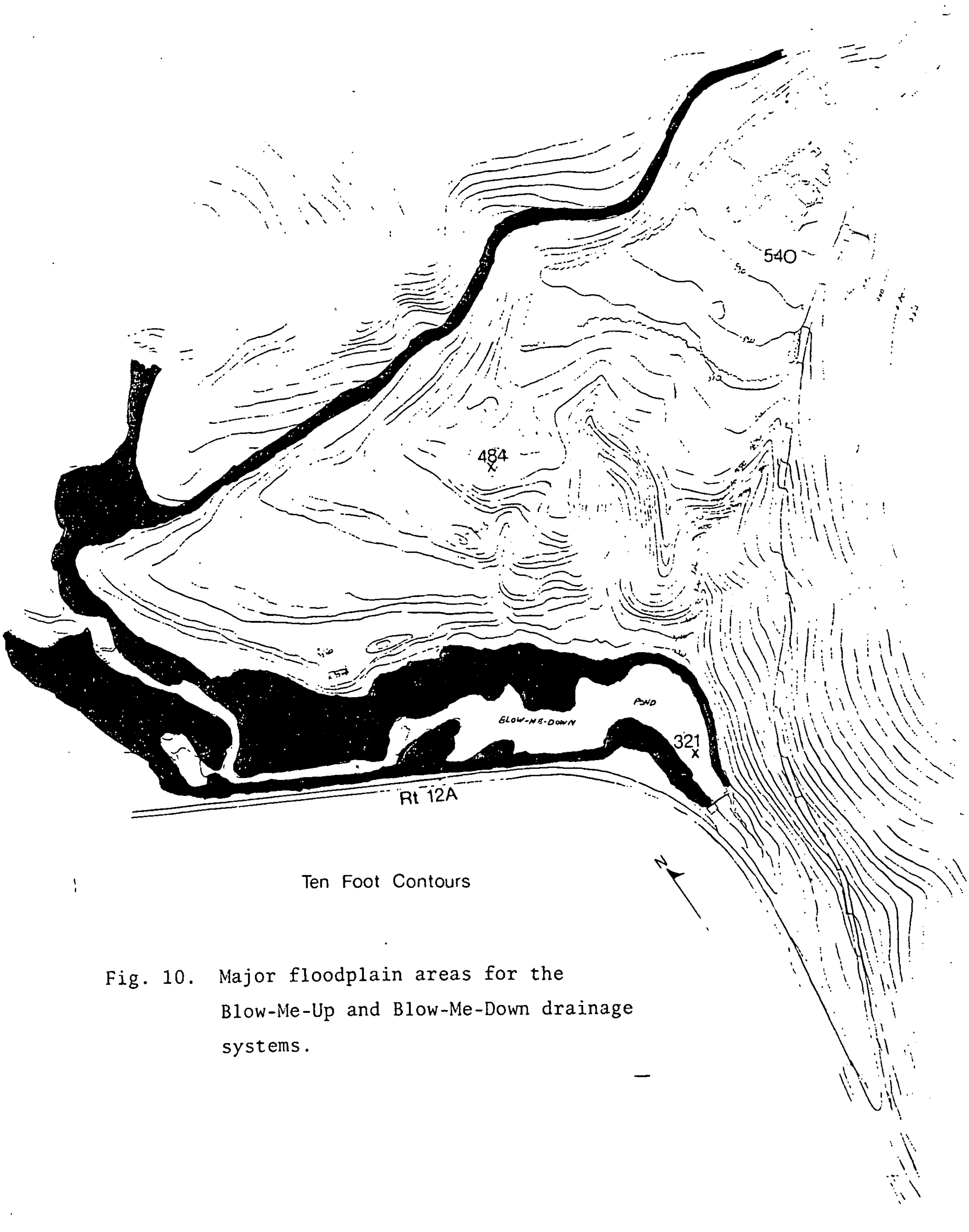


Fig. 10. Major floodplain areas for the Blow-Me-Up and Blow-Me-Down drainage systems.

March 3 and 4, 1866:

This was a veritable thaw and spring freshet. Water was high in all the brooks. Those pouring their waters into the Connecticut River caused the ice to break up. This dammed the water of the river at Cornish bridge. The latter could not stand the pressure, and gave way, and the bridge all went down stream. The other damage in Cornish was only trifling. A new bridge was erected the following season.

October 4, 1896:

A succession of heavy rains occurred on this day that caused the water to rise as high as was ever known by any persons of that time. This rain was more general throughout New England than was the flood of 1850. The damage was great and widespread. Brooks became small rivers and swept off many of the bridges crossing them. Roads were washed and many of them rendered impassable for a time. These conditions were similar in all of the surrounding Towns, but the damage was chiefly confined to highways and bridges.

November 2-3, 1927:

During the month of October, there was a continual heavy rainfall; the ground became so saturated that water stood on the surface; the brooks and rivers were bank-full. On November 2 and 3 there were cloudbursts that brought the water to the highest flood stage known for years. The Connecticut River flooded the main road in Cornish so that it was impossible to get to Windsor or Claremont by that rout for a few days. The damage in Town was confined mostly to washed out roads and some damage to bridges.

March 17, 1936:

Torrential rains coupled with spring run-off brought several days of serious flooding. The damage in Cornish was mostly confined to washed-out roads, culverts and bridges. The iron bridge over Mill Brook (at Chabot's) was washed away, and extensive damage to the Cornish Bridge closed it for repairs for three months.

August 13, 1955:

During the afternoon and evening, heavy rain drenched the east side of Town, with a cloudburst over Croydon Mountain bringing rain at the rate of one inch in an hour. Roads were impassable because of washing. The road leading from South Cornish up the mountain suffered the most damage; some parts of the road were washed three feet deep, and two sections were re-routed in an effort to avoid future damage.

June 3, 1956:

A heavy downpour caused serious damage to the western part of Town, largely confined to dangerous undermining of Route 12A and the railroad. In 1964 an early thaw in March caused high water along the Connecticut River as ice was flushed out of its tributaries. Ice piled up on the up-stream side of the Cornish Bridge and caused water to go over Route 12-A. Other ice jams caused water to go over the Cornish City curve on Route 12-A.

Storms occurring on June 30 and July 4, 1973 brought record flooding to the Connecticut River and its tributaries. Heavy rains at the end of June throughout the Connecticut River basin brought it to its crest at the Cornish Bridge about midnight on June 30. The already saturated ground on the steep slopes of the two towns was ripe for creating flash floods when torrential rains stuck on July 4, 1973. Over six inches of rain fell in a day over many areas within the towns with the result that Blow-Me-Down Brook sought out its old channel through the Village of Cornish Flat and continued onto farms downstream to wreak thousands of dollars of damage through erosion and lost crops. The flooding from the July 4, 1973 flood was wide-spread in Cornish and Plainfield with every little stream turning to its own flood plain. Mill Brook washed out portions of Town House Road in Cornish and Blow-Me-Down Brook kept portions of Route 120, Plainfield Road and Penniman Road under water for a period of time. Hell Hollow and Kenyond Road bridges were destroyed as a result of this flood and many small culverts were also washed out.

On April 1, 1976 water again rose to high levels when several inches of snow melted off in addition to heavy rains. The Connecticut River rose to levels close to those of the June 30, 1973 event and low-lying roads in Cornish and Plainfield were inundated by the tributary of the Connecticut River to levels representative of frequent minor floods.

THE FAUNA OF SAINT-GAUDENS N.H.S.

by P. Nothnagle and M. DesMeules

Mammal Fauna

Methods

Mammal species at the historic site and adjacent natural area were surveyed with a combination of observational and live trapping techniques. Observations of animals and animal tracks were accumulated throughout the course of the project, and were supplemented by informal interviews with Park Service personnel and local residents. In addition, live-trapping was conducted in several habitat types to assess the presence and abundance of those small mammals that could not be observed directly.

The trapping program was carried out between May 13-15 and August 19-20, 1980. Sherman live traps were set in groups of three and were spaced at 15 m intervals along trapping lines. Traps were set and baited with cracked corn in the late afternoon and were checked in the morning. Overall, the trapping program covered the following six different habitat types:

(1) Pine forest - south of the entrance road and adjacent to the public parking area.

(2) Mixed hardwoods regrowth - north of the entrance road and west of the main lawn.

(3) Mowed field - along the north side of the main lawn and adjacent to the visiting sculptor's studio.

(4) Riparian forest - along the east side of Blow-Me-Down Pond.

(5) Upland hardwoods forest - on the north side of Blow-Me-Up Brook

(6) Hardwood terrace site - on a post-glacial terrace to the east of Blow-Me-Down Pond.

Sites 1-3 were trapped in May, and sites 4-6 were surveyed in August.

Results

Small mammals typically have a seasonal pattern of abundance in which densities build to a peak in the late summer. This is just the sort of pattern that was observed at Saint-Gaudens N.H.S. The trapping efforts in May yielded relatively few captures (11 animals in 360 trap nights), and all of the captured animals were mice in the genus *Peromyscus*. Even among the captured individuals, there was some difficulty in making identifications to the species level, because of the presence of immature individuals. Among the adults, both *P. maniculatus* and *P. leucopus* were trapped in the pine area, while only *P. maniculatus* could be confirmed in the field and regrowth areas. A single *P. maniculatus* was captured in the field area, and this mouse presumably resided in the adjacent forested habitat.

Small mammal densities were considerably higher in August than in May. In August, *Peromyscus* species were again the most abundant animals, with 33 captures in 274 trap nights. Both *P. maniculatus* and *P. leucopus* were found in the Hardwood terrace and Riparian habitats, while only *P. maniculatus* was trapped in the upland hardwoods area. *Tamias striatus*, the Eastern Chipmunk, was captured intermittently in the Riparian and Hardwood terrace areas, although these diurnally active rodents were commonly observed in most areas of the Saint-Gaudens property. *Clethrionomys gapperi*, the Northern Redbacked Vole, was captured in low numbers (2 in 274 trap nights) in the hardwood terrace site, and *Napeozapus insignis*, the Woodland Jumping Mouse, was captured in the Riparian habitat (5 individuals in 274 trap nights).

Overall, the results obtained from the small mammal trapping and observational studies indicate that the historic and natural areas at Saint-Gaudens N.H.S. support a mammal fauna which is relatively typical for the region.

Although the trapping results seemed to imply some degree of habitat preference among the small mammals, most of the species probably exhibit considerable flexibility in utilizing the different habitat types encountered at the Saint-Gaudens site. A summary list is presented in Table 1 describing the names and ecological characteristics of those mammals that were confirmed as residents on the property of the Saint-Gaudens N.H.S.

Reptile and Amphibian Fauna

The reptiles and amphibians that have been observed at Saint-Gaudens N.H.S. are presented in Table 2. These species may be compared with the potential checklist of species for New Hamsphire shown in Table 3.

Insect and Spider Fauna

There is a diverse insect and spider fauna at the historic site and adjacent natural area. Some of the species that have been identified are shown in Table 4.

TABLE 1. Mammals that were sighted or live-trapped at Saint-Gaudens N.H.S. and natural area.

I. ARTIODACTYLA (Deer, pig, sheep, etc.)

White-tailed Deer - Odocoileus virginianus

Habitat: Mixed woodlands, swamps, and open areas

Food: Browse materials such as twigs, leaves, grass, fungi, and herbs

Ecology notes: Deer can reach speeds of 30 mph, can jump 8 feet high, and can leap 30 feet horizontally. They yard up in the winter as herds, keeping the snow packed.

II. CARNIVORA (Flesh eaters)

Eastern Racoon - Procyon lotor

Habitat: Wooded areas near streams or lakes

Food: Insects, aquatic organisms, corn, vegetables, frogs, crayfish, birds' eggs, and a great variety of other available foods.

Ecology notes: Dens up in hollow trees, hollow logs, rock crevices, or ground burrows; does not hibernate; is a valuable fur bearer.

III. CHIROPTERA (Bats)

Common Brown Bat - Myotis lucifugus

Habitat: May forage over water, near clearings, or in buildings; may sleep or hibernate in caves, mine tunnels, hollow trees, or buildings.

Food: Feeds on insects caught on the wing using echo location.

TABLE 1 Continued

Ecology notes: Northern populations migrate south in the autumn; individuals may have a 20-year lifespan; bats are most active one hour after sunset and one hour before sunshine.

IV. RODENTA (Rodents or grawing mammals)

Beaver - Castor canadensis

Habitat: Streams and lakes with hardwood shores.

Food: Plant materials, with a major emphasis on the bark of aspen, popular, birch, willow, alder, and maple.

Ecology notes: Primarily nocturnal; constructs dams in headwater areas which affect water levels and create habitat for muskrat, waterfowl, and aquatic life.

Boreal Red-Backed Vole - Clethrionomys gapperi

Habitat: Cool, moist deciduous or coniferous forests.

Food: Primarily herbivorous, but some omnivory, as well.

Ecology notes: Active year-round; may be subject to substantial year-to-year population fluctuations.

Dear Mouse - Peromyscus maniculatus

Habitat: Varied habitat, including fields, woodlands, and dwellings.

Food: Plant and animal materials, including seeds, nuts, and insects.

Ecology notes: Lives approximately 5 years; occasionally uses abandoned bird nests for nesting; females display territorial behavior during breeding season.

TABLE 1 Continued

Eastern Chipmunk - *Tamias striatus*

Habitat: Cultivated lands, woodlands, hedge rows, rocky areas, brushy areas.

Food: Feeds on seeds, fruits, bulbs, nuts, insects, meat, eggs.

Ecology notes: Hibernator; diurnal, well-developed storage instinct; territorial; 3-8 year life-span.

Gray Squirrel - *Sciurus carolinensis*

Habitat: Hardwood forests with nut trees, river bottoms, with a particular preference for oak forests.

Food: Feeds on a variety of nuts, seeds, fungi, fruits, cambial tissue, and occasionally animal matter.

Ecology notes: Diurnal; food storage habits; keen sense of smell; nests in tree holes or builds tree top nests out of leaves and branches; lifespan of approximately 15 years.

Muskrat - *Ondatra zibethica*

Habitat: Waterways and marshes; edges of ponds, lakes, and streams; cattails, rushes.

Food: Primarily plant material shellfish like fresh-water mussels, and other small aquatic animals.

Ecology notes: Lives in burrows in bank or in houses made from marsh plants piled above the water line; valuable fur bearer.

New England Woodchuck - *Marmota monax*

Habitat: Open farming country - also in woods and thickets.

Food: Almost exclusively plants

Ecology notes: Primarily diurnal; burrows extensively

TABLE 1 Continued

Red Squirrel - _Tamiasciurus hudsonicus_

Habitat: Favors evergreen woods

Food: Plant and animal material, including seeds, fruits, eggs, fungi, and birds.

Ecology notes: May eat 200 birds in a season; nests in tree cavities or in branches; home range may be less than 200 m across; may live 10 years.

White-footed Mouse - _Peromyscus leucopus_

Habitat: Similar to _P. maniculatus_

Food: Similar to _P. maniculatus_

Jumping Mouse - _Napeozapus insignis_

Habitat: Cool deciduous forests and some mixed conifer areas.

Food: Both plant and animal materials are utilized; subterranean fungi may sometimes comprise a substantial portion of the diet.

Ecology notes: Hibernates from October to May; breeds throughout the snow-free season.

TABLE 2. Reptiles and amphibians sighted at Saint-Gaudens.

Snakes		
Eastern Hognose	-	*Heterodon platyrhinos*
Milk Snake	-	*Lampropeltis triangulum*
Common Garter Snake	-	*Thamnophis sirtalis*
Frogs and Toads		
Gray Treefrog	-	*Hyla chrysoscelis*
Pickerel Frog	-	*Rana palustris*
Wood Frog	-	*Rana sylvatica*
American Toad	-	*Bufo americanus*
Salamanders		
Red-spotted newt	-	*Notophthalmus viridescens*
Spotted Salamander	-	*Ambystoma maculatum*

TABLE 3. Potential checklist of reptiles and amphibians for New Hampshire.

Salamanders		
Mudpuppy	-	*Necturus maculosus*
Red-spotted Newt	-	*Notophthalmus viridescens*
Jefferson Salamander	-	*Ambystoma Jeffersonianum*
Spotted Salamander	-	*Ambystoma maculatum*
Northern Dusky Salamander	-	*Desmognathus fuscus*
Red-backed Salamander	-	*Plethodon cinereus*
Mountain Spring Salamander	-	*Gyrinophilus porphyriticus*
Four-toed Salamander	-	*Hemidactylium scutatum*
Northern Two-lined Salamander	-	*Eurycea bislineata*
Frogs and Toads		
American Toad	-	*Bufo americanus*
Fowler's Toad	-	*Bufo woodhousei*
Spring Peeper	-	*Hyla crucifer*
Gray Treefrog	-	*Hyla versicolor*
	-	*Hyla chrysoscelis*
Pickerel Frog	-	*Rana palustris*
Mink Frog	-	*Rana septentrionalis*
Northern Leopard Frog	-	*Rana pipiens*
Green Frog	-	*Rana clamitans*
Wood Frog	-	*Rana sylvatica*
Bull Frog	-	*Rana catesbeiana*
Turtles		
Snapping Turtle	-	*Chelydra serpentina*
Wood Turtle	-	*Clemmys insculpta*
Spotted Turtle	-	*Clemmys guttata*
Bog Turtle	-	*Clemmys muhlenbergi*
Eastern Box Turtle	-	*Terrapene carolina*
Map Turtle	-	*Graptemys geographica*
Eastern Painted Turtle	-	*Chrysemys picta*
Midland Painted	-	*Chrysemys marginata*
Stinkpot	-	*Sternotherus odoratus*

TABLE 3 CONTINUED

Snakes		
Timber Rattlesnake	-	Crotalus horridus
Northern Copperhead	-	Agkistrodon contortrix
Eastern Milk Snake	-	Lampropettis triangulum
Black Rate Snake	-	Elaphe obsoleta
Smooth Green Snake	-	Opheodrys vernalis
Northern Black Racer	-	Coluber constrictor
Northern Ring Neck	-	Diadophis punctatus
Eastern Ribbon Snake	-	Thamnophis sauritus
Northern Water Snake	-	Natrix sipedon
Northern Brown Snake	-	Storeria deKayi
Red-bellied Snake	-	Storeria occipitomaculata
Eastern Hognose	-	Heterodon platyrhinos
Eastern Garter Snake	-	Thamnophis sirtalis

Table 4. A few of the many insect species that may be found at Saint-Gaudens National Historic Site.

Common Name	Scientific Name
Eastern Tiger Swallowtail	Papilio glaucus
Red-spotted Purple	Limenitis astayanax
Red Admiral	Vanessa atalanta
Monarch	Danaus plexippus
Black Swallowtail	Papilio polyxenes
White Admiral	Limenitis arthemis
Wood Satyr	Euptychea cymela
Clouded Sulfur	Colias philodice
Bronze Copper	Lycanea thoe
Common Wood Nymph	Cercyonis pegala
Abbot's Sphinx Moth	Schecodina abottii
Hemlock Looper	Lambdina fiscellaria
Underwing Moth	Catecala spp.
Zebra Caterpillar	Ceramica picta
Japanese Beetle	Popillia japonica
Powder Post Beetle	
Stink Bug	Acrosterum spp.
Katydid	Pterophylla spp.
Bumblebee Flower Beetle	Euphoria inda
Black -and-Yellow Argiope	Argiope aurantis
Furrow Spider	Araneus cornutus

The Bird Community at Saint-Gaudens National Historic Site

by

Mark A. Davis and Marc R. DesMeules

Introduction

All birds require food, water, cover, and nesting sites. However, since the specific requirements vary considerably among species, the abundance and diversity of birds in an area is usually correlated with the productivity and diversity of the habitat. Thus, it is possible to infer much about a natural area simply from a list of the birds that live there. Moreover, changes in the composition of the bird community usually indicate changes in the environment. Therefore, periodic bird censuses can be used to detect changes in the quality and habitat diversity of an area. This study represents the first such census for the Saint-Gaudens National Historic Site.

Methods

The historic site and adjacent natural area were visited several times during each season of the year and all habitats were surveyed for birds. On most visits, the following circuit was covered on foot. From the site of the Blow-Me-Down dam, the observer walked north along route 12A to the edge of the park, then walked back to and across the dam to the main trail which borders the pond and marsh. Then, he walked along the trail until it intersected the Sycamore trail which ends short of the river terrace habitat. At this point, he left the trail and walked to the bank of the Blow-Me-Down brook. Then he returned to the Sycamore trail, then to the main trail and followed it up through the hardwoods and successional pines to the open lawns that surround the Park Headquarters. The observer followed the forest edge to the park buildings and then followed the entrance road back to route 12A and the Blow-Me-Down dam. It required from two to four hours to complete the circuit, depending upon the time of year and bird activity. On these walks, the observer carried a pair of binoculars, a spotting scope, and on occasion a tape recorder which was used to try to elicit calls from owls and rails.

As in most breeding censuses, a number of reliable indicators were used to infer nesting. These included singing, territory holding males, birds carrying nesting material, egg shells on the ground, and newly fledged birds. The regular presence of a species in its correct habitat throughout the breeding season also was assumed to mean the species was nesting. Naturally some birds might be incorrectly identified as nesting by this method, but these indicators are quite reliable, and the number of such misidentifications, if any, is certainly few.

In addition to his own observations, the senior author also obtained sighting records and other valuable information from Lawrence Taylor and Margaret Mayette, local residents and long time and accomplished birders. Jef Wallner, a member of Saint Gauden's summer staff 1979, and Mark DesMeules, of this project, also provided nesting records and sightings.

Results

Total Species

During this survey, 99 species were observed at Saint-Gaudens. At least 34 additional species have been recorded locally in comparable habitats. Thus in any year, the park almost certainly serves as the breeding grounds, migratory habitat, or wintering grounds for well over 100 species of birds.

The wide diversity of habitats in the park is responsible for the large number of birds that visit Saint-Gaudens. The New Hampshire Audubon Society lists 27 habitats throughout the state that are utilized by birds (Anonymous 1964). Eight of these are coastal or ocean habitats. Of the remaining 19 inland habitats, all but two are represented within the perimeter of the park. They are: coniferous woods, deciduous woods, semi-open bogs and swamps, shrubbery and thickets, wooded swamps, mixed woods, freshwater marshes, woodland undergrowth, brushland and thin woodland, weedy ponds, shade trees and orchards, buildings, semi-open country, freshwater in general, countryside in general, and open country in general. The two inland habitats not represented in Saint-Gaudens are lakes and fields.

Summer Residents (Breeding Birds)

The New Hampshire Audubon Society lists 68 species that are common summer residents in central New Hampshire (Anonymous 1964). In 1980, 54 of these species nested in Saint-Gaudens. In addition, four other species that are designated as uncommon and very local in occurrence also nested in the park, bringing the number of nesting species to at least 58 (See Appendix A). The four uncommon species are hooded merganser, traill's flycatcher, green heron, and Louisiana waterthrush. The latter species is very uncommon, even rare, in this part of the state.

Most of the summer breeders represent very stable and predictable populations comprising many nesting pairs. However, nine of the breeding species were represented by only one or two pairs, and their breeding status from year to year is less certain. These include green heron (1 pair), American bittern (1 pair), hooded merganser (1 pair), broad-winged hawk (1 pair), American woodcock (1 or 2 pair), barred owl (1 pair), pileated woodpecker (1 or 2 pair), Louisiana waterthrush (1 pair), ruby-throated hummingbird (1 or 2 pair).

On the basis of their habitat preferences, a few species were conspicously absent from the park. These included black duck, wood duck, long billed marsh wren, and Virginia rail, all of which commonly nest in cattail (*Typha* spp.) marshes similar to the Blow-Me-Down marsh. It is not unlikely that during some years, these species have nested in the marsh; this would place these species in the same category as the nine species just mentioned. Also absent from the park were four common field nesting species: eastern meadowlark, killdeer, bobolink, and savannah sparrow. Lack of appropriate habitat precludes these species.

The large number of breeding birds is also directly a function of the habitat diversity in the park. The 17 different habitats that are represented can be grouped into four categories: marsh and pond related habitats (i.e., wetlands), forest habitats, habitats associated with the marsh/forest ecotone, and those associated with the buildings, shade trees, and extensive open area surrounding the Park Headquarters. Table 5 shows that each of these habitat groups contributes significantly to the total number of breeding species. The importance of the wetlands is particularly striking. Without the marsh, and the marsh/forest ecotone, 16 species that currently nest at Saint-Gaudens would be absent. Moreover, all four uncommon species nest in the wetlands.

Winter Residents

Less than 20 species regularly overwinter on the park grounds. The lack of food forces all but the seed and bud eaters, bark probers, and predators to migrate further south. The overwintering species are: tree sparrow, gold finch, pine siskin, purple finch, evening grosbeak, cardinal, brown creeper, blue jay, dark-eyed junco, white-breasted nuthatch, red-breasted nuthatch, black-capped chickadee, crow, hairy woodpecker, downy woodpecker, pileated woodpecker, barred owl, and ruffed grouse. Other species which might be seen irregularly during the winter include common redpoll, red and white-winged crossbill, golden-crowned kinglet, boreal chickadee, and raven.

Except for the pileated woodpecker, barred owl, and ruffed grouse, all the regularly overwintering species are common and one could expect to see most of

Table 5. Habitat preferences for the 58 bird species nesting at Saint-Gaudens. Abbreviations are as follows: M=marsh, M/F=marsh-forest ecotone, F=forest, and H=area surrounding the Park Headquarters.

Habitat	Number of species that are restricted to the habitat for breeding	Number of species for which the habitat is sufficient for breeding
M	3	9
M or M/F	16	25
M/F	9	19
F or M/F	23	40
F	11	25
H	12	28

them on any day during the winter. The small seed eaters--chickadees, nuthatches, and brown creepers--travel in loose mixed foraging flocks. Two prime places to observe them are along the edge of the lawn in the mixed hemlock section of the forest, and in the white pines along the entrance road to the park. In October and November, these mixed flocks are often joined by ruby-crowned and golden-crowned kinglets.

Migratory Species

Sixty-four of the 131 species that have been seen at or near Saint-Gaudens neither breed nor winter in the park. Most of these are migrants that nest elsewhere, often further north, and winter further south. Saint-Gaudens serves as an important stopover for these birds, providing food, water, and cover. In fact, the greatest number of species that can be seen at one time at Saint-Gaudens occurs during the migratory period in May. During the middle of May, thrushes, warblers, blackbirds, flycatchers, hawks, sparrows, vireos, herons, and woodpeckers all utilize the park's habitats. On a good morning, one might see more than 50 species within the park.

Overall, the seasonal pattern of bird community dynamics may be described as shown in Table 6.

Discussion

seems I've heard that before

Birds require food, water, cover, and nest sites. The grounds of Saint-Gaudens provide all four abundantly. The marsh is the breeding habitat for millions of insects, the primary food for most young birds, and also for many adult birds, particularly warblers, flycatchers, and swallows. Catbirds and sparrows nest in the honeysuckle and other bushes that surround the pond. Redwings and the traill's flycatchers nest in the cattails and alders in the marsh. Tree swallows nest in the hollows of dead trees upstream from the beaver dam. Redstarts, chestnut-sided warblers, and the Louisiana waterthrush nest in the trees that border the pond. Chickadees, white-breasted nuthatches,

Table 6. Seasonal Summary of bird activity at Saint-Gaudens in Cornish, N.H.

Season	Level of Activity
Winter	15-20 species may be found. Lack of food forces most species to migrate. Winter residents consist of a few seed and bud eaters, bark probers, and predators.
Spring	100+ species may be found. Nesting species arrive and migrants pass through. This is the time of peak bird concentrations. Birds are also most visibly conspicuous at this time.
Summer	50-60 nesting species are present. Once nesting begins, less energy is devoted to defending territories, and the birds become less visible.
Fall	Overall, there are probably as many species as during the spring migration. However, the autumn migration is spread over a longer period, so that great population build-ups seldom occur.

downy, hairy, and pileated woodpeckers, along with wood thrushes, red eyed vireos, black-throated green warblers, the barred owl, broad winged hawk, and others nest in the woods. Robins, flickers, and phoebes nest in the trees and shrubbery around the park headquarters. Only the field species are not represented--bobolink, killdeer, meadowlark, and savannah, vesper, and grasshopper sparrows.

Certainly few areas of comparable size in central New Hampshire and Vermont can boast the diversity of habitats and birds exhibited at Saint-Gaudens. Depending on the priorities of the park, it might be worth the investment to initiate a simple ongoing habitat management program. From the point of view of the birds, it would certainly be worthwhile. The wetlands are probably the most fragile habitat, meaning the most likely to change. Already the surrounding vegetation is encroaching and the amount of open water declining. Trees as tall as 10 meters are growing in the marsh. This is a natural process of succession; however, if allowed to continue, the wetland habitat will definitely diminish in size. It will probably never disappear, owing to the dam, but even a significant decline in size would probably result in the disappearance of some of the wetland species.

Therefore, one potential management program would be the control of the encroaching vegetation, in order to assure both a sizeable cattail marsh and open water. This program would consist primarily of periodic cutting and pruning of the trees and shrubs that become established in the marsh. This does not include the shrubs and small trees that border the marsh. As pointed out earlier, the marsh/forest ecotone is itself a very important habitat. It, too, should be preserved. In places where the forest grows to the very edge of the marsh, it might be worthwhile to cut down a few of the large trees in order to enhance the number of alder, aspen, and birch trees, which are prominent members of the ecotone.

Why not
succes-
sion

Besides preserving the present habitats, there exists the opportunity of creating a field habitat, thereby increasing the number of habitats in the park. Currently, the Park Headquarters and galleries are surrounded by a mammoth lawn many acres in size. As far as the birds are concerned, the lawn is a very unsatisfactory habitat. Although such species as robins, flickers, starlings, and grackles feed on insects and earthworms that they find there, no bird nests on a mowed lawn for obvious reasons. Early in June, before the grass was cut, a savannah sparrow and a grasshopper sparrow were spotted in the tall grass. These are two field nesting species. However, once the grass was cut, the birds went elsewhere. If a large part of the lower end of the lawn were left uncut, the sparrows, as well as bobolinks, meadowlarks, and killdeer might very well stay and nest.

The creation of a field habitat at Saint-Gaudens is a particularly exciting possibility. This would be an entirely new ecological community. Moreover, this project would require virtually no management. If the lawn were cut just once a year, in the fall, the field nesting birds would have time to nest and raise their young. Cutting the field in the fall would prevent the encroachment of the forest into the open area. If desired, a slightly more ambitious field management program could be undertaken. In this case, the field would not be cut and a few small trees and shrubs would be allowed to grow up along the edges. This would represent a field/forest ecotone, another highly prized habitat by birds.

Birds certainly are not the focus of Saint-Gaudens. Nor are the beaver, the foxes, the mice, the wildflowers, nor the trees. Nevertheless, in addition to the galleries and sculpture of Saint-Gaudens, the resplendent natural setting, characterized by a remarkably diverse flora and fauna, might also be considered a treasure. For the public to appreciate any treasure, whether it be Saint-

Gauden's statues or a nesting Louisiana waterthrush, the treasure must be accessible. The establishment of posted nature trails, the publication of bird and plant checklists, and nature talks and walks are ways that would both enable and encourage people to explore the rest of the park. Naturally, any project like this must be carried out very cautiously. The large number of nesting species is in great part because the birds suffer little disturbance. For example, if a boardwalk were constructed through the marsh, it would be a good idea to close it off during the breeding season (end of May to middle of July). In larger marshes this would not be necessary, but in a small marsh, the disturbance might be too much for many birds like the American bittern and hooded merganser. The construction of a small observation tower at one end of the marsh is another way to permit access with a minimum of intrusion.

Summary

The Saint-Gaudens National Historic Site contains two treasures: the galleries and works of Saint-Gaudens, and the plants and animals that live in the park. Each year, Saint-Gaudens is visited by well over 100 species of birds. At least 50, and probably 60 or more species nest within the park. A sample bird checklist is shown in Appendix B. The large number of different habitats in the park is directly responsible for the abundant and diverse bird life. An effort should be made to preserve this habitat diversity and to augment it when possible.

APPENDIX A

This is a list of the 58 species that are believed to have nested at Saint-Gaudens in 1980. The general nesting habitat is indicated. M= habitats associated with the marsh and Blow-me-Down pond; F=habitats associated with the forest; M/F= habitats associated with the marsh/forest ecotone; H=habitats associated with the buildings, trees, and open areas around the park headquarters.

Species	Habitat	Species	Habitat
Green Heron	M	Cedar Waxwing	H
American Bittern	M	Starling	H
Hooded Merganser	M	Red-eyed Vireo	F & H
Broad-winged Hawk	F	Yellow Warbler	M & M/F
Ruffed Grouse	F	Black and White Warbler	F
American Woodcock	M/F	Black-throated Blue W.	F
Mourning Dove	M/F	Black-throated Green W.	F
Barred Owl	F	Blackburnian Warbler	F
Chimney Swift	H	Chestnut-sided Warbler	M/F
Flicker	H	Ovenbird	F
Pileated Woodpecker	F	Louisiana Waterthrush	M/F
Hairy Woodpecker	F & H	Yellowthroat	M & M/F
Downy Woodpecker	F & H	Canada Warbler	F
Eastern Kingbird	M & H	Redstart	M/F, F & H
Eastern Phoebe	H	House Sparrow	H
Traill's Flycatcher	M & M/F	Redwinged Blackbird	M
Wood Pewee	F & H	Common Grackle	M/F & H
Tree Swallow	M & H	Northern Oriole	F & H
Blue Jay	H	Brown-headed Cowbird	H
Common Crow	H	Scarlet Tanager	F
Black-capped Chickadee	F & H	Rose-breasted Grosbeak	F & H
White-breasted Nuthatch	F & H	Cardinal	H & M/F
Brown Creeper	F	Indigo Bunting	M/F
House Wren	H & M/F	Purple Finch	F & H
Catbird	M/F	American Goldfinch	H
Brown Thrasher	M/F	Rufous-sided Towhee	M/F
Robin	H	Chipping Sparrow	H
Wood Thrush	M/F & F	Song Sparrow	M/F
Veery	M/F & F	Ruby-throated Humming-bird	M/F, F & H

This is a list of the birds known to have visited Saint-Gaudens in 1980. The list includes those observed flying over the park. Thirty-four other species that have been seen locally in comparable habitats have been included and are indicated with an asterisk. While not observed in the park this year, these birds will almost certainly be added to the list within a few years, if future sightings are recorded. The best season for observing the different species is indicated. S=summer, W=winter, SF=spring or fall, P=permanent resident.

Pied-billed Grebe--S
Black-crowned Night Heron*--S
Mallard--FS
Hooded Merganser--S
Red tailed Hawk--S
Marsh Hawk--FS
Ruffed Grouse--P
Spotted Sandpiper*--S
Rock Dove--S
Black-billed Cuckoo*--S
Whip-poor-will*--S
Belted Kingfisher--S
Yellow-bellied woodpecker*--S
Black-backed Woodpecker*--W
Eastern Phoebe--S
Wood Pewee--S
Bank Swallow*--S
Cliff Swallow*--S
Common Crow--P
White-breasted Nuthatch--P
Tufted Titmouse*--S
Mockingbird*--S
Robin--S
Great Blue Heron--S
American Bittern--S
Black Duck--FS
Turkey Vulture--S
Red-shouldered Hawk*--S
Osprey--FS
Killdeer--S
Solitary Sandpiper*--FS
Mourning Dove--S
Great Horned Owl*--P
Common Nighthawk*--S
Yellow-shafted Flicker--S
Hairy Woodpecker--P
Eastern Kingbird--S
Traill's Flycatcher--S
Horned Lark*--FS
Rough-winged Swallow--S
Blue Jay--P
Black-capped Chickadee--P
Red-breasted Nuthatch--W
House Wren--S
Catbird--S
Wood Thrush--S
Green Heron--S
Canada Goose--FS
Wood Duck--FS
Sharp-shinned Hawk--FS
Broad-winged Hawk--S
Sparrow Hawk--FS
American Woodcock--FS
Herring Gull--FS
Yellow-billed Cuckoo*--S
Barred Owl--P
Ruby-throated Hummingbird--S
Pileated Woodpecker--P

Downy Woodpecker--P
Great Crested Flycatcher*--S
Least Flycatcher--S
Tree Swallow--S
Barn Swallow--S
Common Raven--W
Boreal Chickadee*--W
Brown Creeper--P
Winter Wren--FS
Brown Thrasher--S
Hermit Thrush--S
Swainson's Thrush--FS
Golden-crowned Kinglet--FS
Cedar Waxwing--S
Solitary Vireo--S
Black and White Warbler--S
Parula Warbler*--FS
Black-throated Blue W.--S
Blackburnian Warbler--S
Blackpoll Warbler*--FS
Louisiana Waterthrush--S
Canada Warbler--S
Redwinged Blackbird--S
Brown-headed Cowbird--S
Rose-breasted Grosbeak--S
Purple Finch--P
Pine Siskin--W
Savannah Sparrow--S
Dark-eyed Junco--W
Field Sparrow*--S
Fox Sparrow*--S
Snow Bunting*--W
Veery--S
Ruby-crowned Kinglet--FS
Northern Shrike*--FS
Red-eyed Vireo--S

Tennessee Warbler*--FS
Yellow Warbler--S
Myrtle Warbler--FS
Chestnut-sided Warbler--S
Pine Warbler--FS
Yellowthroat--S
American Redstart--S
Northern Oriole--S
Scarlet Tanager--S
Indigo Bunting--S
Pine Grosbeak*--W
American Goldfinch--P
Grasshopper Sparrow--S
Tree Sparrow--W
White-crowned Sparrow--FS
Swamp Sparrow*--S
Bluebird*--S
Water Pipet*--FS
Starling--S
Warbling Vireo*--S
Nashville Warbler--S
Magnolia Warbler*--FS
Black-throated Green W.--S
Bay-breasted Warbler--FS
Palm Warbler--FS
Wilson's Warbler*--FS
House Sparrow--S
Common Grackle--S
Cardinal--P
Evening Grosbeak--W
Common Redpoll*--W
Rufous-sided Towhee--S
Vesper Sparrow*--S
Chipping Sparrow--S
White-throated Sparrow--FS
Song Sparrow--S

GEOLOGY AND GEOMORPHOLOGY
by Rod Parnell

The geologic deposits of Saint-Gaudens National Historic Site are quite varied. They range from metamorphosed shallow water shales of the mid-Paleozoic age to river terrace deposits from the Holocene (see Table 1). The amount of exposed bedrock at Saint-Gaudens National Historic Site is very small and is limited to ravines and stream channels. However, the Mesozoic (ca. 150 million years ago) bedrock of Mt. Ascutney, across the Connecticut River in Vermont, looms over the area as a dominant feature in the landscape. A diagrammatic geologic cross-section of the region is shown in Fig. 1 .

The bedrock within the boundaries of Saint-Gaudens National Historic Site consists of a single unit--the Gile Mountain Formation, a Middle Ordovician or Lower Devonian dark gray slate or phyllite (Billings 1956). Although controversy still surrounds the exact age of the formation, it is clear that the original shale deposit was folded, faulted, and metamorphosed during the Acadian Orogeny (Lyons 1958). Dramatic evidence of the orogeny and its effects on the Gile Mountain formation occurs in one distinctive outcrop along Blow-Me-Up Brook. Approximately 60 m downstream from the old mill site is a bedrock flume formed by the brook. On the northeast face, one can observe a fold greater than 2 m in amplitude in the Gile Mountain Formation. According to Bird and Dewey (1970), the event responsible for this kind of deformation was a collision between two continental plates-- the proto-North American and proto-Eurasian plates. As the orogeny climaxed at approximately 380 million years B.P., the continental crust of the Eurasian plate encountered and plugged the subduction zone along the eastern edge of proto-North America. This hypothesis is advanced as an

Table 1. Geologic time scale (From Holmes 1965).

THE GEOLOGICAL TIME-SCALE *(as revised 1959)*

Eras	Periods and Systems	Derivation of Names	
CAINOZOIC *Kainos or Cenos* = recent *Zoe* = life (Recent life)	QUATERNARY*		
	Recent *or* Holocene	*Holos* = complete, whole	'cene' from *Kainos* = recent
	Glacial *or* Pleistocene	*Pleiston* = most	
	TERTIARY*		
	Pliocene	*Pleion* = more	
	Miocene	*Meion* = less (i.e. less than in Pliocene)	
	Oligocene	*Oligos* = few	
	Eocene	*Eos* = dawn	
	Paleocene	*Palaios* = old	
	The above comparative terms refer to the proportions of modern marine shells occurring as fossils		
MESOZOIC *Mesos* = middle (Medieval life)	CRETACEOUS	*Creta* = chalk	
	JURASSIC	*Jura* Mountains	
	TRIASSIC	*Threefold* division in Germany	
	(New Red Sandstone	= desert sandstones of the Triassic Period and part of the Permian)	
PALAEOZOIC *Palaios* = ancient (Ancient life)	UPPER PALAEOZOIC		
	PERMIAN	*Permia*, ancient kingdom between the Urals and the Volga	
	CARBONIFEROUS	*Coal* (carbon)-bearing	
	DEVONIAN	*Devon* (marine sediments)	
	(Old Red Sandstone	= land sediments of the Devonian Period)	
	LOWER PALAEOZOIC		
	SILURIAN	*Silures*, Celtic tribe of Welsh Borders	
	ORDOVICIAN	*Ordovices*, Celtic tribe of North Wales	
	CAMBRIAN	*Cambria*, Roman name for Wales	
PRECAMBRIAN ERAS: formerly described as	PROTEROZOIC	*Proteros* = earlier	
	ARCHAEOZOIC *or*	*Archaeos* = primaeval	
	EOZOIC	*Eos* = dawn	
	The term ARCHAEAN refers to the oldest known Precambrian crystalline rocks of a given region and has no other age significance		
UNDATED INTERVAL			
ORIGIN OF THE EARTH'S CRUST			
ORIGIN OF THE EARTH			

	Maximum known thicknesses (*Thousands of Feet*)	Duration of Period (*Millions of Years*)	Total from beginning (*Millions of Years*)	Distinctive Life
Recent / Pleistocene	6	2 or 3	2 or 3	Modern Man; Stone-Age Man
Pliocene	15	9 or 10	12	Great variety of Mammals; Elephants widespread
Miocene	21	13	25	Flowering plants in full development; Ancestral dogs and bears
Oligocene	26	15	40	Ancestral pigs and apes
Eocene	30	20	60	
Paleocene	12	10	70	Ancestral horses, cattle and elephants appear
Cretaceous	51	65	135	Extinction of Dinosaurs and Ammonites; Mammals and Flowering plants slowly appear
Jurassic	44	45	180	Dinosaurs and Ammonites abundant; Birds and Mammals appear
Triassic	30	45	225	Flying reptiles and Dinosaurs appear; First corals of modern types
Permian	19	45	270	Rise of Reptiles and Amphibians; Conifers and beetles appear
Carboniferous	46	80	350	Coal forests; First Reptiles and winged insects
Devonian	38	50	400	First Amphibians and Ammonites; Earliest trees and spiders; Rise of Fishes
Silurian	34	40	440	First spore-bearing land plants; Earliest known coral reefs
Ordovician	40	60	500	First fish-like Vertebrates; Trilobites and Graptolites abundant
Cambrian	40	100	600	Trilobites, Graptolites, Brachiopods, Molluscs, Crinoids, Radiolaria, Foraminifera; Abundant fossils first appear
Late Precambrian	(not defined) See Fig. 260			Scanty remains of primitive invertebrates sponges, worms, algae, bacteria
Earlier Precambrian	(not defined)			Rare algae and bacteria back to at least 3000 million years for oldest known traces of life

Undated interval between about 3,400 and 4,500 million years ago

Origin of the Continental Crust about 4,500 million years ago

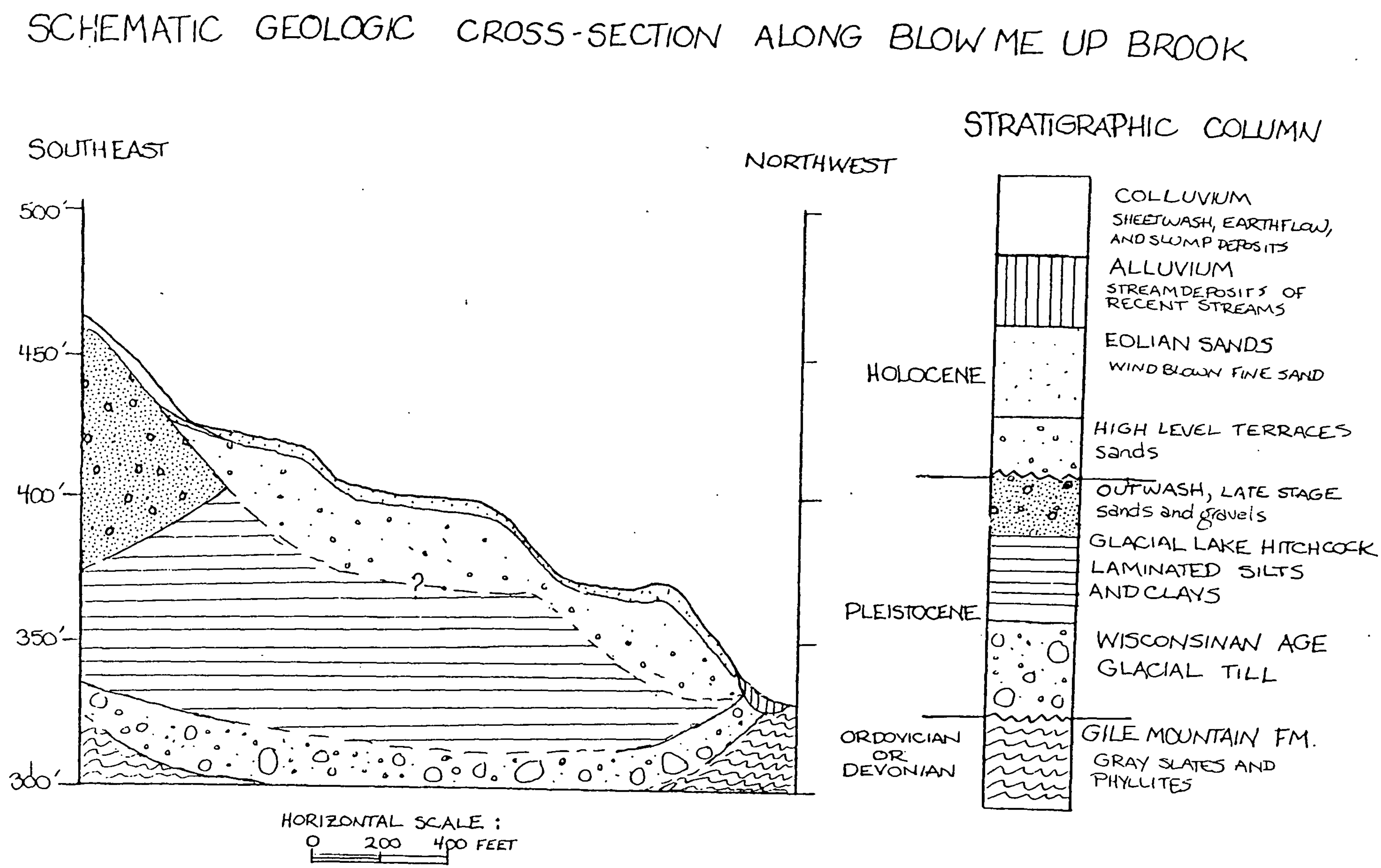


Fig. 1. Geologic cross-section along the Blow-Me-Up Brook ravine.

explanation for the formation of the Appalachian Mountain chain as well as for the types of small scale deformation observed in the bedrock of Saint-Gaudens. Thus, the folding observed along Blow-Me-Up Brook is a small-scale manifestation of the forces which created the Appalachians.

The only other bedrock geology influencing the landscape around Saint-Gaudens National Historic Site is that connected with Mt. Ascutney. The gabbros, diorites, syenites, and granites comprising Mt. Ascutney were intruded and crystallized in the mid- to late - Jurassic. The most reasonable dating on the Mt.Ascutney granites, done by fission track dating techniques, is 166 million years (Naeser 1967). These rocks are genetically related to those comprising the White Mountain batholith of New Hampshire. Both suites of rocks are part of the White Mountain Plutonic Volcanic Series (Chapman and Chapman 1940). The existence of several blocks of Moat Volcanics (extrusive rocks associated with the intrusive rocks) at Mt. Ascutney implies that active volcanism must have occurred in the Windsor, Vermont and Cornish, New Hampshire area during the Jurassic.

With the waning of volcanic activity in the Jurassic, the Connecticut Valley was dominated by erosional processes until the Pleistocene. Three significant deposits at Saint-Gaudens National Historic Site are related to the continental glaciation that occurred during the Pleistocene. The most recent glaciation, the Wisconsinan, began roughly 70,000 years ago (Flint 1956), and slowly advanced across New England. During a period of glacial stability approximately 25,000 years ago, the rate of advance of the ice sheet equaled the rate at which ice was melting (Schafer and Hartshorn 1965). As the glacier sat in one position, it developed a string of terminal moraines from Long Island to Cape Cod. About 18,000 years ago, the ice began to thin and to melt northward (Flint 1956). Beneath the advance and retreat of the glacier, a layer of till (unstratified, unsorted, unconsolidated boulders, stones, sand, silt, and clay) was plastered over much of New England. On up-glacier (north and west) slopes, substantial thicknesses of till were deposited in areas like the Saint-Gaudens National Historic Site.

During the retreat of the Wisconsinan glacier, the ice margin had reached a position near Middletown, Connecticut when the climate cooled temporarily. The ice sheet readvanced roughly 25 miles further south and deposited a huge mound of till and stratified drift (Schafer and Hartshorn 1965). About 13,500 years ago, the climate warmed slightly and the ice retreated again. The mound of glacial deposits left near Middletown acted like a dam, trapping meltwater from the retreating ice. Lake Hitchcock was formed as meltwater was trapped by the Middletown moraine to the south and the ice to the north (Schafer and Hartshorn 1965). The lake continued to grow as the ice retreated northward; at its maximum, the lake probably stretched from Middletown to north of Lyme, N.H. (Lougee and Lougee 1976). The maximum elevation of the lake waters in the Saint-Gaudens area was roughly 590 feet (Lougee and Lougee 1976).

Quiet water sedimentation occurring in the lake resulted in the accumulation of up to 160 feet of rhythmically stratified silts and clays (Goldthwait, 1916). These lacustrine deposits formed a smooth, flat mantle over the bottom of the Connecticut River valley. As quiet water sedimentation was occurring in proglacial Lake Hitchcock, deglaciation of the highlands was also occurring. Outwash was deposited in the form of plains, kame terraces and deltas. The large volume of recently exposed glacial till provided an easily erodible source of sediment. This late-stage outwash material built out into Lake Hitchcock. Evidence of this late-stage outwash flow into Lake Hitchcock is observed in the ravine southeast of Blow Me Up Brook. In two exposures, outwash sands are seen prograding southward over fine-grained lake sediments (see Figure 1). Locations of exposures of outwash and lacustrine deposits are shown on Figure 2 .

The Middletown dam, holding back the waters of Lake Hitchcock, was breached about 10,700 years ago, but it appears that the lake did not fully drain immediately (Flint, 1956). Instead, the lake probably dropped through a series of lower elevation smaller area lakes before draining. By this time, the ice had retreated well into Canada (Lougee and Lougee, 1976). Meanwhile, the Connecticut River reestablished itself in its preglacial drainage and began downcutting through the glaciofluvial and glaciolacustrine deposits.

As the waters of Lake Hitchcock receded, large volumes of recently deposited sediments were available for reworking. The eolian sands mantling portions of Saint-Gaudens National Historic Site are thus another type of surficial deposit present which formed as a result of the Laurentide Ice Sheet. In the early Holocene, wind sorting and reworking of the glacial, glaciofluvial, and glaciolacustrine deposits caused the deposition of a mantle of well-sorted fine sand over much of the Connecticut River Valley. Indeed, the present fertility of valley farm land beyond the reaches of the Connecticut River is due in part to this blanket of fine sand. Evidence that eolian activity is still present today may be found on Route 12A north of Saint-Gaudens National Historic Site where shifting, semi-stabilized sand dunes are visible from the road.

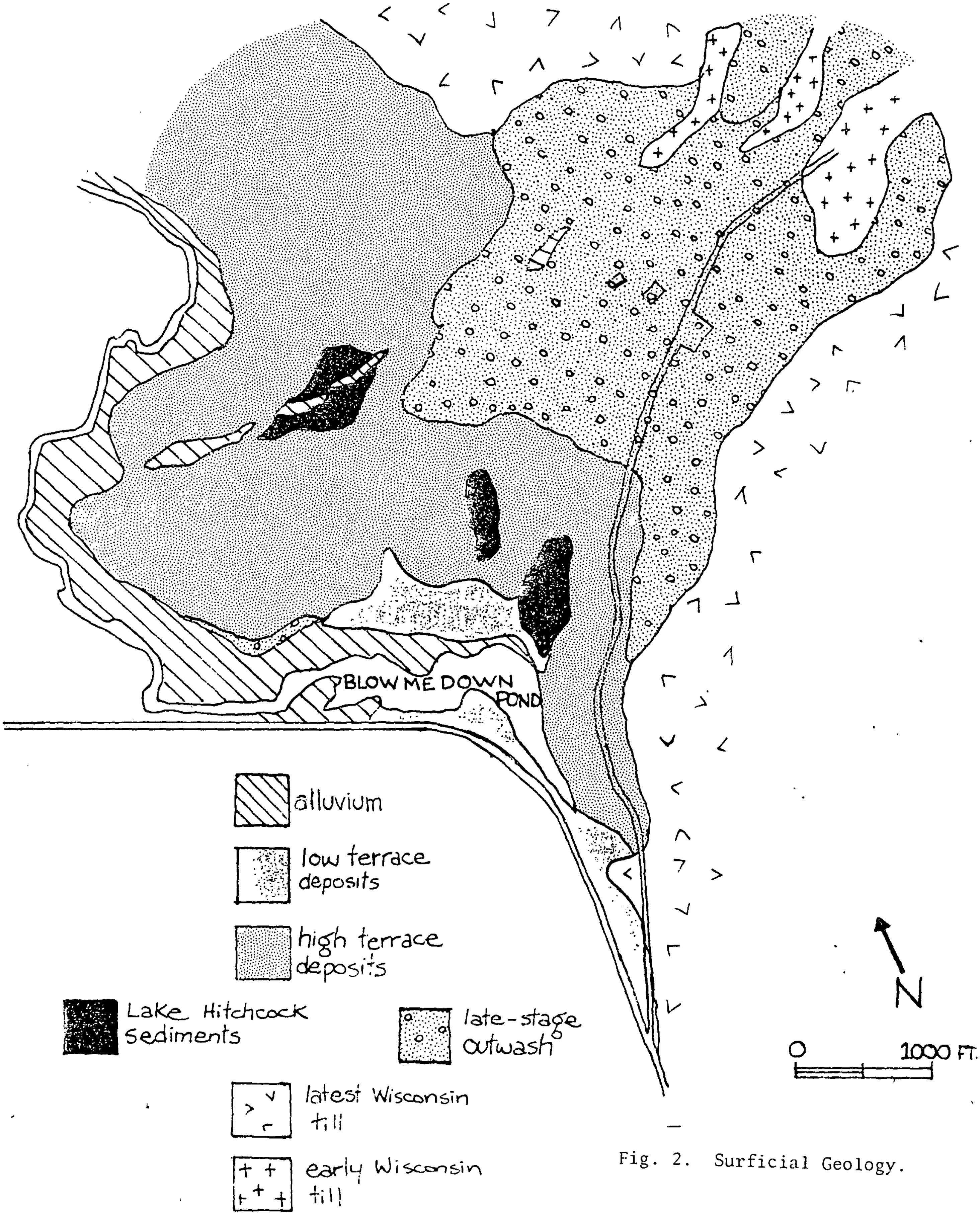


Fig. 2. Surficial Geology.

Substantial river terrace deposits at St. Gaudens testify to another significant Holocene process - erosion and deposition by the modern Connecticut River. Immediately east of Blow-Me-Down Pond, sands were deposited by the Connecticut River. These fine-grained sands were deposited over the foot of the coarser outwash deposits. As the river cut down through the valley fill deposits left by the lake, a series of fluvial terraces were cut into the fine-grained sands just deposited by the river. These sands comprise the higher elevation terraces shown on Figure 2 .

As the Connecticut approached its present location, the deposits in the historic site became more fine-grained because deposition was limited to overbank (floodplain) deposits. The lowest elevation terraces, comprised of the fine-grained overbank fine sands and silts are shown in Figure 2 .

The deep, steep-walled ravines comprising the present drainage system of the historic site are a by-product of the terrace, outwash, and lake deposits. These materials are relatively fine-grained, of loose consistence, and completely unconsolidated or compacted, and thus are easily transported. The present drainage system easily established itself, downcutting rapidly through the soft sediments and leaving oversteepened walls of sand and silt. At this point in time, Blow-Me-Up Brook has cut down to bedrock or consolidated glacial till, both much less erodible. Thus, the rate of further ravine cutting will be dramatically lower, and lateral (sidewall) erosion will predominate over downcutting.

Finally, another common geologic process - mass movement - has left its mark on the deposits of Saint-Gaudens National Historic Site. Two large Holocene slumps occur in the Lake Hitchcock clays exposed in the Blow-Me-Up Brook ravine. These mass movement features display the classic slump morphology and are prime examples of the instability of the Pleistocene lake bottom deposits which cover much of the upper Connecticut Valley.

SOILS AT SAINT-GAUDENS N.H.S.

By Rod Parnell

Because St. Gaudens N.H.S. is underlain by the most recent Pleistocene and Holocene deposits, soil-forming processes have had very little time to act. All the soils in the area are classified as Entisols or Inceptisols, the youngest soil classes in the 7th Approximation Soil Taxonomy system (USDA 1975). Because of the lack of time for pedogenic processes to act, there are only two fundamental factors determining soil type: drainage (topography) and parent material.

In the upland soils, incipient B-horizon-forming processes (humic and fine material translocation and oxidation) have been occurring. Sources of base cations are lacking, and insufficient time has passed to allow significant organic accumulation. Thus, the epipedons are all Ochric. Where soils are developed in thin till over bedrock, they are Lithic Dystrochrepts (see Figure 3). Soils on thicker till are Typic Dystrochrepts. Soils on the outwash material are influenced primarily by the droughtiness of the parent material--they are Typic Udipsamments. Soils developed in sandy terrace deposits are freely but not excessively drained and are, thus, Typic Dystrochrepts. However, soils on the very fine-grained lacustrine sediments are poorly drained and are classed as Aeric Haplaquents.

Soils in the lowest areas, in depressions and ravine bottoms, are influenced primarily by the degree of drainage. The most poorly drained soils, closest to the brooks and the pond, are Typic Haplaquents; farther away, and upslope from the surface water bodies are the drier Aeric Haplaquents. Finally, a moderately well drained soil has developed in recent overbank deposits and is now a Typic Udifluvent.

By combining geologic, physiographic, and pedologic criteria, it is possible to develop a Soil Series map (Figure 4). This map was adapted and

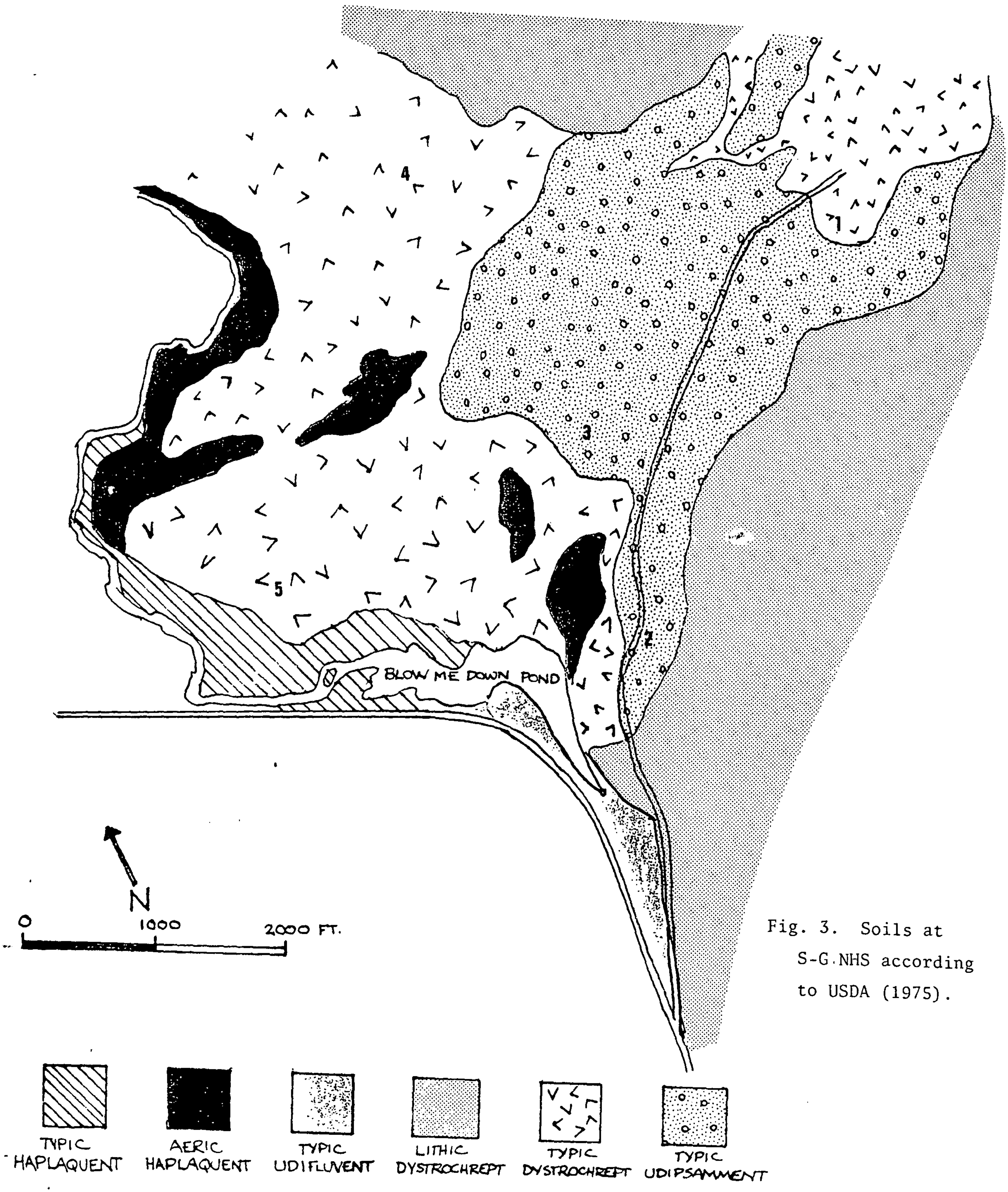


Fig. 3. Soils at S-G.NHS according to USDA (1975).

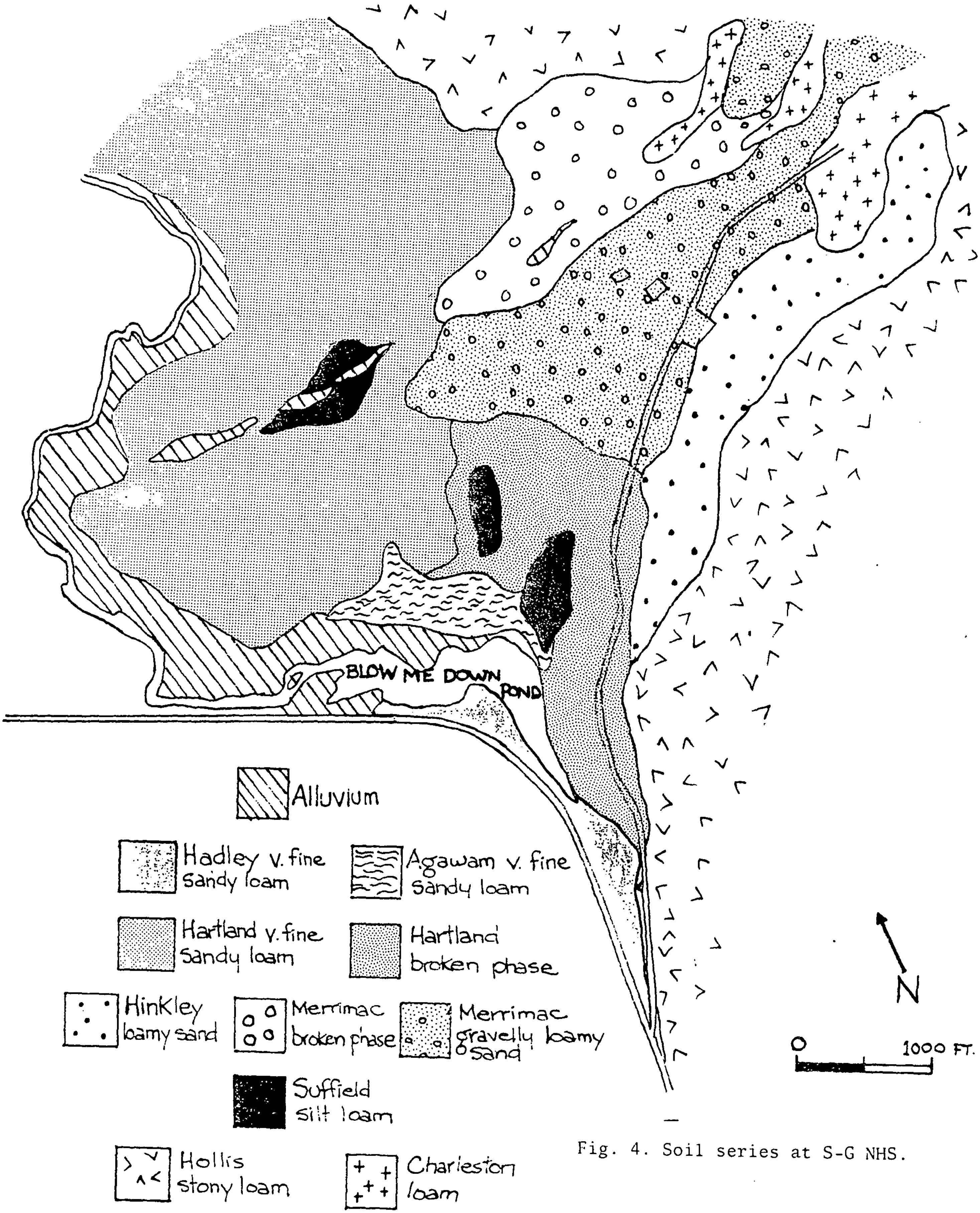


Fig. 4. Soil series at S-G NHS.

revised from a preliminary survey by Simmons et al. (1949). The nature (drainage, texture, erodibility, parent material, etc.) of each Series is given in Appendix A.

As may be seen by comparing Figure 4 with the vegetation units map (Section I, Fig. 4), Soil Series distributions show a strong correlation with vegetation units. Conifers are basically restricted to Hollis stony loam, a thin, loamy soil over bedrock. Hardwoods occur on the thicker, well-drained sandy loams of the Hartland series. Mature hardwoods occur along the gullies of the Hartland broken phase, an area of steep but thick soils. The field and field successional vegetation occurs on the droughty Merrimac series, which is too dry for hardwoods. The steep, shady slopes of the Merrimac outwash terraces (Merrimac broken phase) provide an acceptable environment for mixed/hemlock vegetation. Finally, riparian and wetland vegetation are restricted to the poorly to moderately well drained soils in alluvium, occurring in the lowest-lying topography.

EXECUTIVE SUMMARY

Vegetation Resources

The landscape at Saint-Gaudens National Historic Site exhibits a refreshing mixture of vegetation contrasts and diverse topographic features. A large portion of the overall site is covered by mixed hardwood forest containing the following major tree species: eastern hemlock, white pine, red maple, sugar maple, red oak, black birch, American beech, and paper birch. Based upon species composition, the forest cover at Saint-Gaudens can be divided into the following eight types of stands: south-facing hardwood forest, upland hardwood forest, hemlock-hardwood ravine forest, north-facing mixed hardwood/hemlock forest, mixed coniferous forest, pine-hardwood successional forest, river terrace forest, and riparian forest. These cover types are described in terms of species compositions, tree densities, tree basal areas, and understory composition.

The flora of Saint-Gaudens National Historic Site and Natural Area is relatively diverse, and includes some 32 tree species and 100 or more species of herbaceous and shrubby plants. In historical terms, the vegetation at Saint-Gaudens N.H.S. is the product of a number of events and successional forces, including logging, grazing, mass wasting along the steep ravines, disturbance by beaver, and secondary succession. These and other features of the vegetation resources are discussed in detail in this report

Pond and Stream Resources

The aquatic and wetland resources are a very important and valuable component of the landscape at the Saint-Gaudens National Historic Site and Natural Area. Throughout the last century, there has been considerable recreational and commercial activity along the sections of Blow-Me-Up and Blow-Me-Down Brooks included in the Historic Site. Today, Blow-Me-Down Pond is a relatively quiet

2-hectare pond that averages 3.8 ft. in depth, and exhibits many of the characteristic features of an oligotrophic aquatic system. The chemical, physical, and biological features are described in considerable detail, along with a brief account of stream hydrology at the Site.

Faunal Resources

Mammal species at the Historic Site and Natural Area were surveyed with a combination of observational and live trapping techniques. Results indicated that 13 or more mammals inhabit the overall site, including white-tailed deer, racoon, brown bat, beaver, voles, mice, chipmunk, squirrel, muskrat, and woodchuck. In addition, there are some nine or more species of reptiles and amphibians that occur at the site.

The bird species diversity at the Historic Site and Natural Area is remarkable for such a comparatively small site. In any given year, the Historic Site and Natural Area serve as the breeding grounds, migratory habitat, or wintering grounds for well over 100 species of birds. This great diversity of birds results primarily because of the wide diversity of habitats available within the Historic Site boundaries.

Geology and Soils

The soils at Saint-Gaudens N.H.S. are classified as Entisols or Inceptisols the youngest soil classes in the USDA soil taxonomy system. Soil types range from well-drained loamy soils on the uplands to poorly-drained silty soils in the floodplains. Geologically, the site is quite varied. Although the bedrock is primarily a dark gray slate or phyllite, the surficial geology contains a variety of glacial and post-glacial features, including lacustrine sediments from the Lake Hitchcock period, aeolian deposits, and glacial outwash deposits.

MANAGEMENT RECOMMENDATIONS
FOR
SAINT-GAUDENS NATIONAL HISTORIC SITE

Public Awareness Program

The natural resource inventory was conducted in part to provide a basis for improved public understanding of the natural environment associated with the Saint-Gaudens National Historic Site. Thus, the National Park Service may first want to publish the separate chapters of this report as condensed individual resource topic pamphlets, each with its own appropriate checklist of species or unique landscape features. As a second step toward increasing public awareness and enjoyment of the site, the Park Service could consider renovating the Blow-Me-Down Mill for use as a seasonal visitor center and museum. This would attract additional visitors to the Historic Site from Route 12A, would provide a meaningful use for the historic landmark building, and would provide an important satellite facility devoted to educating the public about the artistic and natural resources of the Saint-Gaudens National Historic Site. Finally, the Park Service is urged to incorporate highlights of the resource inventory results into a system of informative trailside signs. These signs could be placed along the nature walks and historic paths to describe the kinds of forest types in the vicinity, to note interesting landscape features, and to list the important animal and bird species common to the particular habitat.

Trail System

The following recommendations are offered concerning trail management:

(1) Try to avoid establishing trails that plunge directly down the steep, unstable slopes of the ravines.

(2) Try to preserve the fragile herb communities at the bottom of the ravine hemlock/hardwood forest by keeping trails away from the immediate vicinity.

(3) Try to take advantage of the diverse habitat types in planning the trail network.

Bird Communities

The following recommendations are made concerning the bird species at the Historic Site:

(1) The Park Service should weigh the option of permitting an experimental regrowth of meadow at the base of the formal lawn. This new bird habitat could be maintained with one annual cutting in the fall. Such an experiment would have to be evaluated with follow-up bird surveys. Although this management treatment would alter some of the character of the lawn as Saint-Gaudens new it, the meadow would restore an important habitat that formerly existed to the east of the entrance road at the turn of the century.

(2) In the wetland habitat, the Park Service could perform a selective pruning of shrubs and saplings in the marsh areas in order to stabilize this important habitat. This could be done every 3-5 yrs. Areas of shrub-marsh habitat could be left untreated.

(3) To improve visitor enjoyment of the pond-wetland complex, the Park Service could erect bird observation towers at one or two points around Blow-Me-Down Pond. Furthermore, it might be beneficial to establish sections of boardwalk through the wetlands to enable visitors to view more of the habitat. However, such boardwalks would probably have to be closed during breeding, and might require wintertime removal to minimize ice damage.

(4) There should be a plan for regular future bird surveys in order to assess the on-going habitat quality at Saint-Gaudens N.H.S.

Vegetation

Recommendations for vegetation management include the following:

(1) The Park Service could consider thinning the successional woodlands in order to achieve a particular mix of tree species.

(2) The Park Service is encouraged to maintain a reference photo collection in order to keep track of vegetation change at the site. This could include air photos and ground photos taken at five-year intervals.

(3) The Park Service may want to consider management alter-

natives for controlling tree disease and infestion by insects. For example, Dutch elm disease might require periodic tree removal and chemical/biological treatment of susceptible individuals. Beech scale disease might necessitate selective thinning in the hardwood stands. Finally, gypsy moth infestations might require a program to remove egg cases from trees or to control the larvae or adult moths. All of these alternatives could be explored with a local tree surgeon or with Dr. Alex Shigo, a pathologist with the U.S. Forest Service in Durham, N.H.

(4) Finally, the Park Service might consider tagging a number of the trees with name plates indicating genus, species, family, and common name.

Aquatic Systems

Based upon our aquatic studies, we offer the follow recommendations:

(1) The Park Service may want to discuss the road salt runoff problem with the highway department. It might be possible for the salting crews to shut off the salt dispensers when their trucks are covering the section of Route 12A that is immediately adjacent to Blow-Me-Down Brook and Pond.

(2) The stream studies indicated that there is a significant upstream source of phosphorus and bacteria. This should be examined further by either the local or state departments of health or by an independent consultant.

(3) Because of the dam impoundment, there is an almost inevitable siltation process occurring in Blow-Me-Down Pond. This process is gradually filling in the shores and bottom of the pond system. In order to maintain the pond-wetland complex as it is, the Park Service may have to consider dredging the pond in the autumn, every 5-10 years.

Future Research

(1) One of the first research priorities is to determine the upstream sources of phosphorus and enteric bacteria.

(2) As indicated, the Park Service is encouraged to keep track of vegetation changes with a reference photo collection.

(3) The pond ecosystem was curious in that it had ample light and phosphorus for a high productivity and yet other factors indicated that the system was oligotrophic. It would make an interesting study to determine the important factors controlling primary productivity and fish survival in the Blow-Me-Down system.

(4) The Saint-Gaudens Site could serve as a sampling station for monitoring rain quality, and air quality. In particular, it would be useful to monitor SO_x, NO_x, O_3, woodsmoke hydrocarbon pollutants.

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APPENDICES

COPIES OF THE FOLLOWING APPENDICES ARE ON FILE IN THE SUPERINTENDENT"S OFFICE AT SAINT-GAUDENS NATIONAL HISTORIC SITE, CORNISH NEW HAMPSHIRE:

SECTION 1 APPENDIX A: VEGETATION DATA

SECTION 2 APPENDIX A: CHEMICAL DATA

SECTION 2 APPENDIX B: FISH STOCKING RECORDS

SECTION 2 APPENDIX C: COMPARATIVE LAKE DATA FROM NEW HAMPSHIRE

SECTION 4 APPENDIX A: SOIL SERIES DESCRIPTIONS