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FOIA MARKER

**This is not a textual record. This is used as an
administrative marker by the George Bush Presidential
Library Staff.**

Record Group/Collection: George H.W. Bush Presidential Records
Collection/Office of Origin: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: Correspondence Files

OA/ID Number: 62019
Folder ID Number: 62019-007

Folder Title:
Executive Office of the President: White House Correspondence [1 of 2] [1991]

Stack:

Row:

Section:

Shelf:

Position:

0

0

0

0

"Document Control"

TYPE: WHITE HOUSE CORRESPONDENCE DOCUMENT NUMBER: 9200247
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: GREEN, Shirley M.: SPECIAL ASSISTANT TO THE PRESIDENT

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 12/23/91

SUBJECT: SHE IS FORWARDING A COPY OF A LETTER FROM DR. C.P.
THOMAS REGARDING A PROCESS HE SUGGESTS WILL
ELIMINATE MANY PROBLEMS.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED:

ACTION STAFF
REQUIRED: REVIEW FOR DAB ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 01/30/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley
NATIONAL SECURITY

WHITE HOUSE TRACKING #: CONTACT PERSON:
REMARKS: PHONE: EXT:

OSTP RECEIVED: 01/27/92 DEPT RECEIVED:
FILE: P-EOP-WH CORRESPONDENCE
CENTRAL FILES:



0247d

DRAFT OF SMG LETTER

INITIALS: SMG / bb / *DT*

DOCUMENT TITLE: /slr/smg/thomas.c.bb

DRAFT DATE/LETTER DATE: Jan 17 1992/

CORRESPONDENCE #: 595302

CLEAR WITH:

WHCC: 92 JAN 27 AID: 57

CC:

CORRESPONDENCE ADDRESSED TO:

Dr. C. P. Thomas
Suite 192
800-AG8 Grand Avenue
Carlsbad, California 92008

ENCLOSURES AND SPECIAL INSTRUCTIONS:

cc: Office of Science and Technology Policy, OEOB, with incoming

Dear Dr. Thomas:

On behalf of President Bush, a belated thank you for your letter.

I have taken the liberty of forwarding your message to the President's science and technology advisers for their review. You can be sure that your interest in sharing your ideas with the President is very ~~much~~ appreciated.

With the President's best wishes, and my own,

Sincerely,

Shirley M. Green
Special Assistant to the President
for Presidential Messages
and Correspondence

Dr. C. P. Thomas
Suite 192
800-AG8 Grand Avenue
Carlsbad, California 92008

THE WHITE HOUSE

WASHINGTON

January 21, 1992

Dear Dr. Thomas:

On behalf of President Bush, a belated thank you for your letter.

I have taken the liberty of forwarding your message to the President's science and technology advisers for their review. You can be sure that your interest in sharing your ideas with the President is appreciated.

With the President's best wishes, and my own,

Sincerely,

A handwritten signature in cursive script that reads "Shirley M. Green".

Shirley M. Green
Special Assistant to the President
for Presidential Messages
and Correspondence

Dr. C. P. Thomas
Suite 192
800-AG8 Grand Avenue
Carlsbad, California 92008

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01. Letter	To: President Bush From: C.P. Thomas Re: Suggestions for eliminating problems [personal information redacted] (3 pp.)	12/11/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: Correspondence Files
WHORM Cat.:
File Location: Executive Office of the President: White House Correspondence [1 of 2] [1991]

Date Closed:	2/24/2010	OA/ID Number:	62019-007
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
Re-review Case #:		Appeal Disposition:	
P-2/P-5 Review Case #:		Disposition Date:	
AR Case #:		MR Case #:	
AR Disposition:		MR Disposition:	
AR Disposition Date:		MR Disposition Date:	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
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(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

"Document Control"

TYPE: WHITE HOUSE CORRESPONDENCE DOCUMENT NUMBER: 9200247
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: GREEN, Shirley M.: SPECIAL ASSISTANT TO THE PRESIDENT

TO: DR. D.A. BROMLEY

JAN 28 1992

DATE OF
CORRESPONDENCE: 12/23/91

SUBJECT: SHE IS FORWARDING A COPY OF A LETTER FROM DR. C.P.
THOMAS REGARDING A PROCESS HE SUGGESTS WILL
ELIMINATE MANY PROBLEMS.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED:

ACTION
REQUIRED: REVIEW FOR DAB STAFF
ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 01/30/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley
NATIONAL SECURITY

WHITE HOUSE TRACKING #: CONTACT PERSON:
REMARKS: PHONE: EXT:

OSTP RECEIVED: 01/27/92 DEPT RECEIVED:
FILE: P-EOP-WH CORRESPONDENCE
CENTRAL FILES:

*DAB
LISA called & corrected
the use of "science advisers"
If this does not require
a response, we can
tell Shirley Green
that decision.
1/29*

02479

DRAFT OF SMG LETTER

INITIALS: SMG / bb / *DT* *CS* *8* DOCUMENT TITLE: /slr/smg/thomas.c.bb

DRAFT DATE/LETTER DATE: Jan 17 1992/

CORRESPONDENCE #: 595302

CLEAR WITH:

WHCC: 92 JAN 27 AIO: 57

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CORRESPONDENCE ADDRESSED TO:

Dr. C. P. Thomas
Suite 192
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Carlsbad, California 92008

ENCLOSURES AND SPECIAL INSTRUCTIONS:

cc: Office of Science and Technol-
ogy Policy, OEOB, with incoming
MAIL ROOM

Dear Dr. Thomas:

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With the President's best wishes, and my own,

Sincerely,

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Special Assistant to the President
for Presidential Messages
and Correspondence

Dr. C. P. Thomas
Suite 192
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THE WHITE HOUSE

WASHINGTON

January 21, 1992

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I have taken the liberty of forwarding your message to the President's science and technology advisers for their review. You can be sure that your interest in sharing your ideas with the President is appreciated.

With the President's best wishes, and my own,

Sincerely,



Shirley M. Green

Shirley M. Green
Special Assistant to the President
for Presidential Messages
and Correspondence

Dr. C. P. Thomas
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800-AG8 Grand Avenue
Carlsbad, California 92008

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
02. Letter	To: President Bush From: C.P. Thomas Re: Suggestions for eliminating problems [personal information redacted] (3 pp.)	12/11/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: Correspondence Files
WHORM Cat.:
File Location: Executive Office of the President: White House Correspondence [1 of 2] [1991]

Date Closed:	2/24/2010	OA/ID Number:	62019-007
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
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AR Disposition:		MR Disposition:	
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PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

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 (b)(8) Release would disclose information concerning the regulation of
 financial institutions [(b)(8) of the FOIA]
 (b)(9) Release would disclose geological or geophysical information

1/28/92

Allan

The man asks
for nothing, and
reveals no details of the
his nature of his
discovery. The most we
could do is to write
a polite "we wish you
well in your work"
letter. Is a response
needed?

Needs no response Karl
DATE

Mary-

2/4

Attached is a chronology
of notes about this
one! Perhaps you could
close it out with the
remarks on these
notes?

Thanks!!

Lisa

Document Originally
Attached to
Following Page

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

1-30-92

Dave - (Tiffany - Director of Special Letter Response)

As the attached notes indicate, Dr. Bromley didn't think that a response was necessary for this man. However, if it is important for him to ~~be~~ send a gratuitous note, I'll draft a reply.

Let me know.

Lina, No reply,
back to you Thanks,
for your records Lisa

Dan

7347
46-6272

WHITE HOUSE STAFFING MEMORANDUM

DATE: 10/29/91 ACTION/CONCURRENCE/COMMENT DUE BY: ----
 PRESIDENTIAL REMARKS: ENVIRONMENT AND CONSERVATION CHALLENGE AWARDS
 THE ROSE GARDEN
 SUBJECT: THURSDAY, OCTOBER 31, 1991

	ACTION	FYI		ACTION	FYI
VICE PRESIDENT	☐	☒	HORNER	☐	☐
SUNUNU	☐	☐	MCCLURE	☐	☒
SCOWCROFT	☐	☐	PETERSMEYER	☐	☐
DARMAN	☐	☒	PORTER	☐	☒
BRADY	☐	☒	ROGICH	☐	☒
BROMLEY	☐	☒	SMITH	☐	☒
CARD	☐	☒	McBRIDE	☐	☒
DEMAREST	☐	☒	SNOW	☐	☒
FITZWATER	☐	☒	DELAND	☐	☒
GRAY	☐	☒	FIRESTONE	☐	☒
HOLIDAY	☐	☒		☐	☐

REMARKS:

The attached has been forwarded to the President.

RESPONSE:

Concur
Phillip D. Brady

PHILLIP D. BRADY
 Assistant to the President
 and Staff Secretary
 Ext. 2702

THE WHITE HOUSE
WASHINGTON

01 OCT 29 P4:58

October 29, 1991

MEMORANDUM FOR THE PRESIDENT

THROUGH: DAVID DEMAREST
TONY SNOW *TS*

FROM: MARY KATE GRANT *MLG*

SUBJECT: ENVIRONMENT AND CONSERVATION CHALLENGE AWARDS

I. Summary

On Thursday, October 31 at 11:25 a.m., you will present the Environment and Conservation Challenge Awards in the Rose Garden. Your remarks are 5-7 minutes in length, and will be on cards.

II. Information

Following the presentation of the awards, you will sign an Executive Order on recycling.

Grant / Aarhus
A:CEQAWARD Draft three
October 29, 1991

**BRIEF REMARKS: PRESIDENT'S ENVIRONMENT AND CONSERVATION
CHALLENGE AWARDS
THE ROSE GARDEN
THURSDAY, OCTOBER 31, 1991**

Welcome to the White House, and happy Halloween to all.

((I know there's been a lot of debate and discussion on one of the great existential questions of our time, and so today I'd to make an announcement: I cannot confirm or deny my belief in **The Great Pumpkin.**))

It's a pleasure to have our Presidential Challenge award winners here on such a beautiful late October day in the Rose Garden. I'd especially like to thank the Awards Partners, who made this first-time awards ceremony possible -- Gil Grosvenor [GROVE-ner] of the National Geographic Society; Frank Bennack of the Hearst Corporation; Drew Lewis of the Business Roundtable [represented by Edward Allison today]; and Russell Train of the World Wildlife Fund. Let me also add a note of thanks to the Awards Selection Committee and the Technical Advisors.

Last month, I had the chance to visit the Grand Canyon, a magnificent, almost miraculous sight, the scale of which staggers the senses.

That day in September, I spoke of the **power of innovation** and the **strength of cooperation** as the foundation for a new generation of environmental action. Today, we are honoring nine medalists and 23 citation winners who embody that new generation

of "environmental entrepreneurs." As President, I've had the distinction of honoring Americans for their achievements in the arts, humanities, and sciences. **The time has come for this country to honor achievement in the understanding and conservation of our environment.**

We have with us today people who have **formed partnerships to protect natural wildlife** -- from the Great Lakes in the North to the Playa Lakes in the Great Southwest, and from the Sacramento River to the Barrier Islands off the Atlantic seaboard.

We are also recognizing companies that have **integrated environmental values into virtually every business decision** -- whether they are involved in fast food, financial services, newspapers, utilities, household products or furniture.

We honor other winners because they have **pioneered new technologies** that save both money and the environment -- with creative solutions to challenges like agricultural pollution and ozone depletion, and state-of-the-art techniques for recycling paper, metal and plastics.

And finally, we recognize groups who have **inspired a new respect for the environment** in millions of Americans: newspaper and magazine groups, book publishers, teaching institutions, media advisors to TV and film industries -- even the Girl Scouts.

These outstanding Americans have given us cleaner technologies and products, better ways to manage natural areas, and a greater capacity for environmental problem-solving. They

are working to improve the quality of life for all Americans, through a safe and healthy environment.

Earlier in this century, a man I deeply admire also visited the Grand Canyon -- and likewise shared his thoughts with the crowd assembled. Looking out over what he called a vista of "great loneliness and beauty," President Theodore Roosevelt said: "The ages have been at work on it, and man can only mar it ... We have gotten past the stage, my fellow citizens, when we are to be pardoned if we treat any part of our country as something to be skinned for two or three years for the use of the present generation, whether it is the forest, the water, the scenery. **Whatever it is, handle it so that your children's children will get the benefit of it.**"

Each of you understands President Roosevelt's challenge. Each one of you has acted on it -- taken it upon yourselves to ensure that future generations will inherit a safe and healthy environment. For that, you have my admiration and my congratulations. Keep up the good fight, and now let's hand out these well-earned awards.

[PASS OUT MEDALS]

[RETURN TO PODIUM]

While I have you all here, I have a special announcement to make. ((We talk a lot about recycling -- well, today we're going to save a few trees by giving two speeches at the same time -- and we're piloting a new program in recycling **audiences**, too.))

Seriously, today we are taking a major step in placing the Federal government in its proper role of "leadership by example" by increasing all Federal recycling and use of recycled materials. By signing Executive Order # ----, we will establish a Federal Recycling Coordinator and individual recycling coordinators at each Federal agency. We are directing that where possible, products made from recycled materials are procured for government use. Simply put, we are requiring all Federal agencies to strengthen their recycling efforts.

With that said, I am pleased to sign this Executive Order.
[SIGN ORDER AND DEPART]

#

"Document Control"

TYPE: WHITE HOUSE CORRESPONDENCE DOCUMENT NUMBER: 9124798
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: TITUS, Peter

TO: PRESIDENT BUSH

DATE OF
CORRESPONDENCE: 09/28/91

SUBJECT: RE: HIS CONCERN OVER NUCLEAR/CHEMICAL WASTE AND THE
ADMINISTRATION'S POSITION ON THIS MATTER.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED:

ACTION STAFF
REQUIRED: DIRECT REPLY ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 12/02/91 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT: 1/3/95

COPIES TO:

WHITE HOUSE TRACKING #: CONTACT PERSON:
REMARKS: PHONE: EXT:

Dr. C. H. regarded.

OSTP RECEIVED: 11/18/91 DEPT RECEIVED:
FILE: EOP-WHITE HOUSE CORRESPONDENCE

CENTRAL FILES:



DRAFT OF SMG LETTER

4748

RECEIVED

INITIALS: SMG / jw / *print*

DOCUMENT TITLE: /draft/smg/titus.pat

DRAFT DATE/LETTER DATE: Nov 05 1991/

NOV - 7 1991 91 NOV 18 10:57
CORRESPONDENCE #: 539902

CLEAR WITH:

WHCC:

CC:

CORRESPONDENCE ADDRESSED TO:

Mr. Peter Titus
1609 Dudley Place
Santa Rosa, California 95401

ENCLOSURES AND SPECIAL INSTRUCTIONS:

CC: OSTP (0E0B358) IN +
OUT FOR ADDITIONAL
DIRECT REPLY.

Dear Mr. Titus:

On behalf of President Bush, thank you for your letter expressing your concerns about the accumulation of nuclear and chemical waste and about wetlands policy. The President appreciates hearing your views on these important issues.

On August 9, 1991, the President announced a comprehensive plan for improving the protection of the nation's wetlands. His goal is to make progress toward no net loss of wetlands, and the Administration's plan is based on three significant steps: First, the Administration will strengthen existing wetlands acquisition programs and wetlands restoration and creation efforts. It will also expand monitoring programs on wetlands trends and will enhance research efforts to better understand the function and value of wetlands. Public outreach and education programs will be targeted to increase general understanding of the importance of wetlands and the laws that protect them.

Second, the Administration will seek public comment on proposed revisions to the existing Federal Manual for Identifying and Delineating Wetlands. These revisions will help simplify the Manual and clarify its use to ensure that it is an effective and workable document. In particular, the public's comments on the proposed changes will be weighed carefully before final decisions are made. Third, the Administration will take steps to improve and streamline the current regulatory system.

President Bush believes this plan strikes an appropriate balance between environmental protection and economic growth. It recognizes the need to conserve wetlands systems and to take advantage of opportunities to restore wetlands. It will employ a new market-oriented mitigation banking system in order to involve the private sector in wetlands restoration and creation. Finally, it will encourage States to assume a greater role in wetlands management, thus allowing for greater sensitivity to local and regional resource needs.

Regarding your other concerns, I have taken the liberty of forwarding your letter to the office of the Assistant to the President for Science and Technology Policy. Officials there are in the best position to respond to your concerns, and you may be assured that your views will be noted.

With the President's best wishes,

Sincerely,

Shirley M. Green
Special Assistant to the President
for Presidential Messages
and Correspondence

Mr. Peter Titus
1609 Dudley Place
Santa Rosa, California 95401

539902

OCT 22 1991
JW

Peter Titus
1609 Dudley Place
Santa Rosa, CA 95401

September 28, 1991

President George Bush
1600 Pennsylvania Ave. NW
Washington, DC 20500

Dear President Bush:

SLR
There has been a disturbing trend to define domestic problems away, instead of dealing with them, among certain officials within your administration.

For example, growing public concern about the accumulation of nuclear waste has been met by redefining upward, with inadequate scientific justification, the point beyond which they are of "regulatory concern." Similar sleight-of-hand efforts are being made with regard to chemical toxicity. Please direct your staff to respect impartial scientific evaluation of these hazards so that their errors might be on the side of caution.

A third example may be found in the way that attempts are being made to redefine some 30 million acres of "wetlands" out of existence. This would be to the detriment of important marine nurseries and natural pollution reduction. If those lands are developed for waterfront housing, the public will have to pay heavily in terms of environmental loss.

Please act promptly and decisively to remedy this situation.

Thank you.

Most sincerely yours,



Peter Titus

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

January 3, 1992

Dear Mr. Titus:

I am writing in response to your letter to President Bush, in which you urge caution in evaluating the hazards of low level nuclear waste.

The head of the Nuclear Regulatory Commission, Ivan Selin, shares your concern. Dr. Selin informed me some time ago that he intended to review carefully a prior decision to relax the regulation of such wastes.

Sincerely,

A handwritten signature in dark ink, appearing to read "Karl A. Erb". The signature is fluid and cursive, with the first name "Karl" being the most prominent.

Karl A. Erb
Acting Associate Director
for Physical Sciences and Engineering

Mr. Peter Titus
1609 Dudley Place
Santa Rosa, CA 95401

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9123582
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

FROM: MCINTOSH, David: OFFICE OF THE VICE PRESIDENT

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 08/20/91

SUBJECT: RE: EPA EFFORTS TO PRIORITIZE WETLANDS.

DIRECTORATE STAFF
ASSIGNED: ASSIGNED:

ACTION STAFF
REQUIRED: ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley
ENVIRONMENT
Vickie Sutton
Ken Yale

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:
REMARKS:

OSTP RECEIVED: 08/23/91 FILE: P-EOP-WHITE HOUSE*P-ENVIRONMEN
DEPT RECEIVED:

3582



RECEIVED

OFFICE OF THE VICE PRESIDENT
WASHINGTON

OFFICE OF THE
DIRECTOR

MEMORANDUM TO ALLAN BROMLEY

FROM: David McIntosh *DM*

DATE: August 20, 1991

SUBJECT: EPA Efforts to Prioritize Wetlands

Attached is an interesting article that appeared in INSIDE EPA, which indicates that the Office of Research and Development and the Water Office are working together to formulate a study that will enable them to use a "risk based" method for deciding which wetlands are environmentally valuable. I thought this might be of interest to you in pursuing your review of the scientific literature associated with wetlands.

cc Allan Hubbard

everything they send in" for liability purposes. Because of this, some staff might argue that there are too many notices that product managers are hard-pressed to sort through them all, this source says. But when a developmental toxicological study is submitted suggesting a pesticide is "a frank teratogen," there is no excuse for not immediately flagging it, this source says. "They should have reviewed it right away."

EPA sources report they have worked up preliminary assessments for occupational exposure. One staffer reports these early assessments show that any pregnant woman would probably abort a fetus after inhalation exposure to metam sodium. Nevertheless, an agency source says it is not likely regulatory action will be taken prior to this winter, "when we get [new] data from the registrants." Another EPA source emphasizes that the assessment will have to be completed before deciding what action to take.

ILLINOIS ENVIRONMENT CHIEF EYED AS CANDIDATE FOR TOP OPPE SLOT

Illinois EPA director Mary Gade is a candidate to fill the top job in the federal EPA's Office of Policy, Planning & Evaluation, according to sources inside and outside of the agency. Gade, formerly the deputy assistant administrator for the Office of Solid Waste & Emergency Response, left the agency in February to become director of the state program (*Inside EPA*, Feb 1, p10).

Several sources confirm that Gade was in Washington recently, and that she is rumored to be a candidate for the OPPE job, but sources are split on how serious her candidacy is. One industry source says she is supported by the White House for the post, and EPA administrator William Reilly may be asked to take on Gade in exchange for his request that Raymond Ludwiszewski be nominated to the agency's General Counsel post. Ludwiszewski has been tapped to become acting General Counsel when that post is vacated by E. Donald Elliott later this month. Another industry source says such "trades" are not unusual, but that it is unclear why the White House would either strongly support Gade or need cajoling to accept Ludwiszewski. This source says Gade was interviewed for the OPPE job, but she may have accepted the interview only out of "courtesy" towards the Administration.

According to EPA and industry sources, Gade's primary liabilities are the fact that she is not an economist and she has only been in her Illinois post for a few months. The Administration is widely believed to be looking for an economist to fill the OPPE slot, and agency sources say it may be difficult for Gade to leave Illinois EPA so soon after taking the job. On the other hand, several sources say she is well respected within the agency and presents a good opportunity for the Administration to forward its goal of increasing the ranks of women in senior staff positions. Gade could not be reached for comment on her candidacy or aspirations.

In contrast to environmentalists' outrage

EPA SOURCES SAY BUSH WETLANDS PLAN IS REASONABLE GIVEN POLITICAL CLIMATE

EPA sources say Bush Administration wetlands policy proposals announced last week are reasonable in light of the intense political controversy surrounding the wetlands issue, in contrast to outraged environmentalists' contention that the policies will destroy millions of acres of valuable wetlands. While EPA lost an intense fight to allow drier lands to qualify as wetlands under a revised federal wetlands identification manual, agency sources maintain that certain small victories were achieved in the final Administration package. Also, given the intense political pressure in Congress for overturning the current wetlands protection program entirely, the Administration's proposals reflect a compromise with gains and losses for both sides, say both agency and Administration sources.

"This could have been a lot worse," says an agency source, noting that the Administration "took a reading on the Hill" and felt it had to allay a number of heated concerns raised by industry sectors and private citizens. For instance, the President's Aug. 9 announcement from Kennebunkport, ME calls for "streamlining wetlands regulations and adding flexibility" through a number of reforms aimed at quicker wetlands permit processing and better coordination among agencies. Permits will be deemed approved within six months unless an agency extends that deadline for "good cause" as determined by the Army Corps of Engineers. The use of general permits, which enable certain activities that affect wetlands to be conducted with minimal notification, will be expanded. An interagency technical committee will categorize wetlands according to their function, value and scarcity, completing its work within 18 months. The technical committee will also flesh out details of a "market-oriented mitigation banking system" that will enable developers to offset wetlands impacts through the use of "mitigation credits." Such concessions to address the furor among private property owners and developers "is a reasonable outcome" of the Administration's struggle to define its "no net loss" of wetlands policy, says another agency source, also commenting on the momentum for legislation to overturn the existing wetlands program.

continued on next page

To speed up permit processing

MANUAL FLAGS OPTION OF IGNORING SOME PLANTS IN IDENTIFYING WETLANDS

EPA and other agencies in a revised federal wetlands manual have underscored their desire for public comment on the critical issue of whether to ignore certain types of plants in identifying wetlands, thereby making permit review much quicker and easier.

The contentious issue centers on whether to ignore so-called "facultative neutral" vegetation, meaning plants that grow equally in wetland and non-wetland areas, when deciding whether an area is a wetland. Although ignoring such plants would greatly reduce the burden of identifying wetlands, it could also produce less accurate wetland assessments. A last-minute Administration compromise on the issue calls for a cumbersome process to be used in assessing plants at potential wetland sites. But a preamble to the federal wetlands manual asks the public to comment on an alternative that would set aside that compromise, as some White House officials had attempted to do before the revised manual was released to the public (*Inside EPA*, Aug. 9, p2).

Under the wetlands identification and delineation manual, three criteria must be met before a property is deemed a wetland subject to federal regulations. The area must possess the type of water, vegetation, and soil conditions associated with wetlands. To meet the water criteria, the manual requires an area to be inundated for 15 or more consecutive days, or saturated from surface or groundwater to the surface for 21 or more consecutive days during the growing season in most years. That proposal calls for far more wetness than under a 1989 version of the manual; that manual raised the ire of farmers and developers who charged that it brought many non-wetland areas under wetlands regulations. A recent EPA version of the manual would have sought public comment on a range of 10-20 or more days of wetness for an area to meet the criteria for wetlands water conditions (*Inside EPA*, July 12, p1).

In the manual slated at presstime for release this week, EPA and other agencies responsible for the manual say they are particularly interested in soliciting comments on an alternative for the wetlands vegetation criteria. The basic proposal calls for use of an "index" whereby all plants at a site would be counted and a complicated calculation would be performed to determine if most of the plants were typical of wetlands. Under the alternative, the "facultative neutral" plants would not have to be counted, nor would the complex calculation have to be performed.

Although the manual is considered a technical guidance document that does not require Administrative Procedure Act rulemaking procedures, EPA and the other agencies that signed the manual will be proposing portions of it for inclusion in federal regulations. That proposed regulatory language will be published at least 30 days prior to the end of the 60 day public comment period for the manual. An agency source says that if the agencies cannot agree on which language to propose for rulemaking, the comment period for the manual could be extended beyond 60 days.

An Administration source points out that the Council on Environmental Quality played a significant role in helping an isolated EPA keep its power to veto permits, which some in the Administration wanted to rescind. Similarly, CEQ and EPA succeeded in maintaining "sequencing" for high-value wetlands despite opposition to that proposal. Sequencing requires that a permit applicant first exhaust all non-wetland alternatives before developing a wetland. Some in the Administration pushed for a national wetlands mitigation banking system that, for instance, would have allowed destruction of a wetland in Maine to be offset using a wetland in California. Both CEQ and EPA succeeded in fending off that proposal, striking a compromise that will allow mitigation banking to occur within watersheds. That system will create a market for wetlands because developers could be required to buy high-value wetlands as part of their mitigation requirements, thereby creating a demand for property whose value is lowered when its use is restricted under wetlands rules, says an EPA source who regards the banking plan as a positive part of the overall proposals. "It's also significant that [CEQ chairman Michael] Deland was designated spokesman for this issue," says an Administration source, pointing out that as Region I administrator Deland had a reputation as a very tough advocate for wetlands protection. "There was some unhappiness with the way [special assistant to the President for policy development Teresa] Gorman was perceived and managed the whole process," the source says. Gorman headed the Domestic Policy Council's wetlands policy task force that hammered out the Administration's compromise initiative and was regarded by some as too outspoken in support of views espoused by developers.

EPA's view that the proposals are reasonable contrasts sharply with intense disappointment and frustration expressed by environmentalists. The Board of Directors of the National Wildlife Federation, in an Aug. 9 letter, implored President Bush to reconsider the initiatives. Commenting that the disconnect between the Administration's pledge to protect wetlands and its deeds has "reached a new low" plan, the Federation's Board castigates key elements of the proposal. "It features an arbitrary ranking scheme, scientifically-indefensible modifications to the wetland delineation manual, the environmental protection standards provided by the 'avoidance first' priority of current section 404 mitigation policy, far too much reliance on the unreliable techniques of wetlands

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mitigation banking, and unjustified expansion of the already seriously flawed general permit program," says the Aug. 9 letter. "The fact that they released this at 1:00 on Friday from Maine shows they're not proud of this action," says one environmentalist. Another environmentalist, also appalled by the Administration's initiative, says that the environmental community will draw attention to the huge economic costs of wetlands destruction. Commercial fishing has suffered major losses because wetland spawning grounds have been lost, floodwater controls have been undercut, and other costly wetlands destruction has occurred, at huge economic cost to society, the source says.

The Administration's attention to the issue improves the prospects for passing wetlands legislation, according to Rep. James Hayes (D-LA), chief sponsor of H.R. 1330, a wetlands bill with about 170 cosponsors that would fundamentally restructure federal wetlands policy. Hayes, in a telephone interview with *Inside EPA*, says that the fact that the full Cabinet wrestled over wetlands policy "elevates this to a level of greater attention" than before. Legislation is needed to give private landowners certainty, which Executive Orders or federal agency actions could not provide because they are easily changed, Hayes says. He adds that current wetlands problems arose because of a lack of legislation.

An industry source believes that legislation would be in everyone's interest. "All sides ought to want a fight within Congress" to address wetlands policy issues as opposed to having policies set through an internal Administration battle, the source says. Although many of the Administration's principles "reflect the goals of industry sectors in seeking a responsible program," it remains to be seen whether the revised wetlands manual actually limits regulations to "true, environmentally valuable wetlands," the source says.

To prioritize regulations

EPA WATER, RESEARCH OFFICES EYE RISK-BASED SYSTEM FOR DRINKING WATER REGS

EPA's Water Office is working with the agency's research program to examine developing a risk-based method for deciding which drinking water contaminants should be regulated first. The work dovetails with recommendations recently made by an EPA-industry workgroup -- formed to address future research needs -- which has found that the current law lacks a system for risk-based prioritizing that could lead to a misdirection of agency drinking water research activities.

The Safe Drinking Water Act (SDWA) requires EPA to develop "maximum contaminant levels" in drinking water for 25 substances every three years, from a list of 83 chemicals and microorganisms in the law. MCLs form the basis of federal drinking water standards and are used by EPA to monitor state drinking water programs. EPA's drinking water program has been sharply criticized in recent congressional hearings for failing to adequately implement the law, with critics charging the agency's enforcement effort is weak (*Inside EPA*, May 24, p11).

EPA sources say the Water Office and the Office of Research & Development are looking at ways to develop an alternative, risk-based approach to the current system of developing MCLs under the SDWA. EPA sources say that while the agency promulgates standards on chemicals identified as posing a significant risk, the SDWA approach requiring promulgation of 25 new standards every three years fails to compare the expected occurrence of chemicals in drinking water with what is known about the associated hazards. "The exposure information is missing," one EPA source says, adding "we [EPA] need to know what's out there" before proceeding aggressively with establishing an MCL. A Water Office source says that by following the law, assessments are done on some chemicals which this source contends "don't even occur in drinking water." EPA needs a method for determining which substances should enter the assessment system first, one source says, adding that the current system is a "shopping list" approach, that places a high demand on research dollars without any way of knowing whether research is well-directed.

EPA convened a workshop July 14-19 in Breckenridge, CO with the American Water Works Assn. Research Foundation, an industry-backed water research group, to organize a Sept. 12 drinking water research conference to be held in Washington, D.C. The workshop abstract says the goal of the group is "to identify future societal, regulatory, and scientific issues in drinking water and health. These issues be used to develop a risk-based prioritized research agenda to meet public health and regulatory needs." The workgroup is comprised of independent scientists, drinking water facility managers and EPA.

EPA workgroup sources say the agency would like to present Congress with a rational assessing the risk posed by substances proposed for MCL development, but one agency source says Congress may not be receptive to the idea, given the recent hearings sharply criticizing management of the SDWA. Confirming this fear, a congressional source charges "current deadlines for establishing drinking water standards and says that now EPA is not significantly modify the program. This source questions whether EPA should develop a risk-based system, warning that there is "a real gap between what EPA is doing and how the public views the issue."

consideration.

Meanwhile, the benefits of the rule remain unclear. A July 17 briefing package on the rule notes that while it is "generally perceived as [a] 'good idea'," there is "no concrete, documented harm to be prevented" and it is "difficult to determine the degree of risk and extent to which the rule would reduce risk." An environmentalist argues that the toxic release inventory required under title III of the 1986 Superfund Amendments & Reauthorization Act provides evidence that billions of pounds of chemicals are being released annually, with potentially devastating effects to the environment. But an industry source says that much of the information EPA is likely to request is already available, and that the EHC rules are not likely to change the behavior of chemical handlers anyway. A congressional staffer argues that EPA itself has already collected significant environmental effects data under a variety of statutes, and should use this data to write handling requirements into permits, rather than simply requiring disclosure. The agency is planning to run a pilot reporting program with the several chemical manufacturers to see how the regulations would work and what changes should be made before finalizing the rule (see related story).

EPA RESEARCH OFFICE DEVELOPING PLAN TO IDENTIFY WETLANDS AT GREATEST RISK

Wetlands and other ecosystems at greatest risk from development and destruction may be identifiable under a new "risk-based framework for wetland protection" developed by EPA's Office of Research & Development, according to agency sources involved with the project. Sources say the new system could significantly contribute to EPA's efforts to implement President Bush's goal of "no net loss" of wetlands and to debates about classifying wetlands by function and value. But sources stress that research to test the risk-based framework must be completed before its usefulness can be accurately assessed.

EPA's proposal -- *Wetlands research: an integrated risk-based research strategy, FY 1992-1996 research plan* -- was crafted with input from regions and the Water Office, who were queried by ORD staff on the wetlands issues requiring the most research. ORD's plan basically seeks to define "ecological risk" and then to apply that definition to wetlands to test whether the definition "works," says an agency source, explaining that further changes will be made to the entire document before it is final. EPA's Science Advisory Board's wetlands research subcommittee reviewed the plan July 16-17 and was "impressed" by the document, says an SAB source, adding that it "is very relevant to the kinds of policy issues being debated" in Congress and at other levels of government. For instance, EPA administrator William Reilly has suggested that classifying wetlands by their functions and values would be a good idea. Through the ORD research plan, the "tools" to conduct such a classification will be greatly improved, the SAB source says. "The wetlands research program has developed a general risk-based framework that can be applied to environmental protection in general and wetlands in particular," according to ORD's document. An ORD source explains that the framework requires wetlands to be considered not in isolation but as part of a broader "landscape" without which the wetland might not possess its typical value and functions. "Wetlands assessment in the past only looked at site-specific, isolated wetlands," but both ORD and the Water Office have been "pushing for awareness that wetlands have to be considered in a landscape setting," the source says. Moreover, in defining the "value" of a wetland, policy makers must provide scientists with their decisions on what they value in a wetland, such as its water filtration or wetlands habitat functions. Scientists would then tell policy makers whether those functions were at risk of being lost. In assessing risks to wetlands, a number of factors would be considered, such as whether or not a wetland could be easily replaced, the source explains.

"We've purposely tried to keep this framework generic and not limit it to wetlands," says an ORD source. This source says the framework could easily apply to estuaries and other water bodies as well. But in trying to test its workability, ORD will focus on wetlands as "the first test case." The source comments that the effort is aimed in part at creating a more sophisticated view of wetlands "values," which the ORD document says should not be regarded as "absolute." For example, if the value of a wetland is its ability to protect against flooding, but flooding is not a danger in a given area, then that "value" would not be served by preserving the wetland. ORD's risk-based framework would allow federal, state, and local governments to implement risk assessments based on their different wetlands value policies, the source says. A local area may want to preserve a certain wetland value not deemed critical by the federal government, and the framework would allow it to assess whether the wetland value is at risk.

The ORD proposal follows up on an SAB report released in September, 1990 that urges EPA to focus its priorities on environmental problems posing the greatest risk. Reilly has strongly embraced the SAB recommendations, and ORD's plan is one of numerous initiatives within both ORD and other agency offices to shift towards a risk-reduction system for setting priorities, agency sources say.

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DIRECTORATE STATUS

FROM: HUBBARD, ALLAN B.: OFFICE OF THE VICE PRESIDENT

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 08/14/91

SUBJECT: A MEMORANDUM APOLOGIZING FOR FAILURE TO INVITE YOU
TO THE WETLANDS MEETING ON JULY 29 AND MATERIALS
GATHERED DURING THE PROCESS.

DIRECTORATE STAFF
ASSIGNED: ASSIGNED:

ACTION STAFF
REQUIRED: ACTION:

SENDER'S DUE DATE: STAFF DUE DATE
OSTP DUE DATE: DATE COMPLETED/DEPT:
DATE COMPLETED:

COPIES TO: D. ALLAN BROMLEY
ENVIRONMENT
FCCSET

WHITE HOUSE TRACKING #: CONTACT PERSON:
REMARKS: PHONE: EXT:

OSTP RECEIVED: 08/16/91
DEPT RECEIVED:

FILE: P-EOP-VICE PRESIDENTIAL



OFFICE OF THE VICE PRESIDENT
WASHINGTON

August 14, 1991

MEMORANDUM FOR DR. BROMLEY

FROM: ALLAN B. HUBBARD

Again I apologize for our failure to invite you to the wetlands meeting on July 29. Your presence would have been enormously helpful.

Enclosed are the scientific materials we gathered during this process. As we discussed on the phone, the manual that is being promulgated is a proposal. EPA will be evaluating the public comments, which hopefully will generate additional scientific information on these issues. You could be enormously helpful in assisting us in reviewing the proposed final rule.

Thanks so much.

Enclosure

Please
note
some of the
pages are
out of
order

The Chairman of the National Technical Committee for Hydric Soils, Maurice Mausbach, was contacted by phone during the Administration's effort to learn more about wetland science. He stated,

It is not quite correct to imply that the number of days it takes to create a hydric soil is the number of days it takes to create a wetland. We [the Committee] never intended to imply a one-to-one relationship between hydric soils and wetlands. Hydric soils are generally related to wetlands, but not one-to-one.

The report entitled Hydric Soils of the United States was prepared in cooperation with the National Technical Committee for Hydric Soils. It is a U.S.D.A. Soils Conservation Service document, Miscellaneous Publication Number 1491.

WETLANDS COMMENTS: Experts

Robert Pierce - Qualifications: With the Corps of Engineers from October 1982 through December 1988. During that period, he had lead technical and policy responsibilities in a number of program areas including wetland jurisdictional determinations and wetland valuation. He has taught two courses on wetlands for the Corps. He holds a M.A. and Ph.D. in zoology from Miami University and a B.S. degree in biology from the University of Dayton.

Duration of Inundation/Saturation:

Certainly fish need water. Most amphibians need at least 30 days for egg incubation and larval development. Both dabbling and diving ducks need approximately 6 weeks of open, standing water for chicks to fledge. Except for mosquitoes, most aquatic insects require a year or more below water for larval development. Even the vireos and warblers often used as examples of the value of "winter wet woods" are most often found where open water is present. And where do we find rare and endangered wetland plant species? Where the surface is saturated during most of the year.

D.E. Pettry - Qualifications: Professor of Soil Science at Mississippi State University.

Duration of Inundation/Saturation

The definitive statement relating the presence of water for a week or more during the growing season typically creating anaerobic conditions in the soil is controversial and not supported by research for the diverse types of soils in the U.S. ... Research indicates soils can be saturated to or above the soil surface for months, yet the oxygen levels in the upper 0.5 may remain high enough for oxidizing levels to prevail.

... suggest the hydric soil definition be modified to read as follows: "A hydric soil is a soil that in its natural state is saturated, flooded, or ponded long enough during the active growing season to have predominant anaerobic conditions in the upper 6 inches."

later on, Dr. Pettry writes suggested changes to the Hydric Soil Criterion:

Soils that are frequently ponded for long duration (7 to 30 days, SCS Nat. Soils Handbook, pages 603-645) or very long duration (longer than one month, SCS National Soils Handbook, pages 603-642).

Hydrophytic Vegetation

The definition of hydrophytic vegetation appears incongruent. How can macrophytic plant life growing in water be at least periodically deficient in oxygen as a result of excessive water content? How can water have excessive water content?

Gary J. Pierce - Qualifications: B.S. in Botany from Univ. of Wisc., M.A. in Biology from Western Michigan Univ., Ph.D. in Botany from Univ. of Wyoming. Dr. Pierce is active in conducting wetland studies serving as principal investigator and project manager for various projects. He has conducted wetland delineation studies for the Army Corps of Engineers in Central Florida. He has conducted a number of additional wetland delineation projects in New York, Pennsylvania, and Massachusetts. For the last four years he has been an instructor in the Corps of Engineer's in-house training course titled Wetlands Development and Restoration (taught in N.C. and CA.).

Duration of Inundation/Saturation

The flooding criteria should be according to regions, and soil types. Areas with seven days of saturation are often wetland while areas with 14 days of saturation are often upland. A number is difficult to interpret because we can not observe an area for the requisite time period. The areas with seven to 14 days of saturation are often wetland but lack ecological functions unique to wetlands because they are only marginally wetlands. Fourteen days or longer is appropriate but is should be emphasized that reasoned well supported and described professional judgment is the most important way to determine marginal hydrology.

Hydrophytic Vegetation

FAC plants are found to dominate areas that are often wetland areas that are upland. These must be interpreted carefully, but the three criteria must still be met and wetlands will normally be evidenced by lesser components of the vegetation.

Criteria

The criteria should be emphasized to the extent that no agency should be allowed to supplant the methods section for an objective evaluation of the criteria.

Dana Sanders - Qualifications: Ph.D. from Iowa State University; wrote the 1987 Wetlands Manual.

Required Duration of Inundation/Saturation

There are ample data to conclude that 7 days will produce a soil environment that will, if it persists for a sufficient period, result in hydric soil characteristics and select for plant species adapted for life in saturated soils. However, once produced by soil saturation, the anaerobic/reducing environment must persist for some period beyond 7 days to effect hydric soils and hydrophytic vegetation. Moreover, such periods of soil saturation must occur frequently enough to offset any reversal trends toward nonhydric soils and nonhydrophytic vegetation. ...

(1) The absolute time required to produce wetland hydrology (and the associated hydric soils and hydrophytic vegetation) probably varies across the nation. Factors such as the amount and distribution of precipitation, temperature regimes, length of growing season, and soil characteristics (e.g., texture and structure) will have a major influence on the required duration of soil saturation to produce wetlands conditions.

... The absolute duration of soil saturation required to produce wetland conditions (beyond the seven days that will result in an anaerobic/reducing soil environment) is not known. The technical literature in this area is relatively barren. The few studies conducted that touch on this subject indicate that a 5% or less duration of inundation/soil saturation occurring every other year (on average) usually will not produce wetland conditions, at least in the forested wetlands of the southeast. A 5% duration level translates to an absolute duration level of about 14 days for the southeastern United States. ... The same studies suggest that a minimum of 12.5% inundation/saturation definitely produces wetland conditions ... in forested wetlands of the southeast. This translates into an absolute duration of about 34 days for the southeastern United States. Thus, the duration of required inundation/soil saturation in forested wetlands of the southeast falls between 14 and

34 days, and is probably (opinion) about 21 days (approximately an 8% duration level).

Hydrophytic Vegetation

... The use of FAC species in the 1989 manual was greatly over-extended. Throughout the manual, FAC species could be considered as indicative of wetland hydrology if indicators of hydric soils were also present. The degree of certainty in the above usage is no more than 50%. ... Used alone, FAC species provide no indication of wetness. Used with indicators of hydric soils, one could often reach an erroneous conclusion in areas where soils have indicators of hydric soils due to factors other than soil saturation or in instances where former wetlands no longer have wetland hydrology.

My conclusion is that it is appropriate and correct to consider FAC species as contributing to hydrophytic vegetation as long as independent verification of each of the three criteria is required. I continue to question the validity of considering the FAC species as contributing to hydrophytic vegetation, since by definition they occur less than 50% of the time in wetlands.

Bernie Goode - Qualifications: He was the primary author of the current definition of wetlands for the 404 program adopted first by the Corps in July of 1977 and shortly thereafter by EPA. He was the Chief of the Corps' regulatory program from 1981 until his retirement in 1989. He has observed wetland systems in virtually every state and U.S. territory. Since retiring in 1989, he has worked on almost 100 wetland cases in 28 states. He has delineated wetlands on several projects, and has testified in litigation proceedings many times on the meaning of various wetland terms.

Duration of Inundation/Saturation

It is a myth that there is some sort of science as to how much water makes a "wetland." ... Will one week of surface water in the growing season yield an "aquatic area"? Not in my experience. What about 2 weeks? Again, I say no. ... My experience, admittedly lacking in scientific purity, is that at least a month of continuous surface water during the growing season is required before the lack of oxygen starts causing a vegetative community to be more typically reflective of a truly aquatic system.

DPC

1. Require that the water table be at or above the ground surface for at least 30 days during the growing season (not 18 inches below the ground for seven days).

Hydrophytic Vegetation

Since facultative species by definition occur with equal frequency in wetlands and uplands, it would be just as valid to use Facs as an indicator of uplands as is the current method of using them as an indicator of wetlands. The fairest approach is to neutralize them and look at what is left. ... The prevalence indicator method used by SCS is equivalent to a Fac-neutral approach. Adopting the Fac-neutral approach will put some meaning into the vegetation parameter which has largely turned out to be an automatic positive indicator of wetlands.

DPC

2. Make the vegetation test mean something. Obligate hydrophytes and facultative wet plants should be diagnostic of wetland vegetation. Facultative plants should be treated as neutral ... Areas dominated by facultative plants should be called wetlands only if they occur in the presence of solid evidence of wetland hydrology and hydric soils.

3. Return the concept of "normal circumstances" that was dropped as Corps policy to accommodate SCS programs. If it's normal for an area not to have wetland vegetation (e.g., it's planted in row crops), it should not be a wetland. The words have not been removed from the Corps and EPA wetland definitions and should be accorded the pre-manual interpretation.

Steven E. Walls - Qualifications: Spent 13 years delineating wetlands with the Corps of Engineers; is now with EH&A).

Hydrology

Requiring saturation to the surface for 20-21 days is at least as defensible as is choosing a shorter period, such as 10-14 days. Based on my experience, areas that would satisfy a 14-day test but would not satisfy a 21-day test are not "truly aquatic areas," do not generally support "a prevalence of vegetation typically adapted to life in saturated soil conditions," and do

not in general perform different or unique functions which would justify treating them differently from a regulatory viewpoint. In short, choosing a 21-day saturation test is completely defensible from a scientific perspective.

Hydrophytic Vegetation

The presence or absence of hydrophytic vegetation should be determined by requiring that more than 50% of all plants in the area in question be facultative-wet or obligate wet species to deem the area a "wetland." This is what "a prevalence of vegetation typically adapted to life in saturated soil conditions" means to a scientist. ... Eliminating the facultative species and then asking whether a majority of the remaining species are "wet" or "dry" would not be a scientifically valid means of implementing the regulatory definition of a "wetland," since that would allow an area to be called a wetland even though it lacked a prevalence of vegetation adapted to life in saturated soils.

Criteria

... there is no scientific validity to establishing a "three-parameter approach" to identifying wetlands, and then allowing one to ignore certain of the parameters when it suits the subjective goals of the delineator. All three wetland indicators should be required at all times, unless the area has been disturbed.

Three-years of Hydrologic Records Problem

... one of the problems with current revised drafts of the Federal manual is that it contains many subjective "indicators" of wetlands, but provides no objective, practical means for proving that an area is not a wetland." The one attempt in this direction is use of three consecutive years worth of groundwater monitoring data in which both yearly and monthly rainfall is within 90% of average. The problem is that rainfall is so variable that, during the past 11 years for which I have data in the Norfolk, Virginia area, ... no year would have qualified for data collection purposes.

Donald D. Hook - Qualifications: Received BS and MS degrees from Utah State University and his Ph.D. from the University of Georgia. Worked for Southeastern Forest Experiment Station from 1963-1971 -- final position, principal plant physiologist. Currently a professor in the College of Forest and Recreation Resources at Clemson University. Has over **60 technical publication** and was senior editor on two books on wetlands.

Since 1988, Dr. Hook has been teaching foresters how to delineate wetlands. He has taught several short courses on the subject in South Carolina and the Eastern shore of Maryland.

Duration of Inundation/Saturation

The jurisdictional definition of wetland states that: wetlands are dominated by those species that are adapted to a life in a saturated soil environment. The term life to me means, all of the time or most of the time and not a tiny fraction of the time. Seven days out of a 200 day growing season, or 3.5% of the time, does not translate to life to me.

Hydrophytic Vegetation

The option to determine whether a site dominated by FAC species is a wetland would need to focus on strong evidence of hydric soils and substantial soil saturation to the surface or inundation. In such cases, the evidence would need to be very convincing and be readily documented. ... There would need to be water lines, but swell, water root development, evidence of ponding of water, and/or have hydrologic record that substantiated saturation or inundation for more than two weeks consecutively.

From what appears to be a USDA Forest Service survey 4/24/91

Question: In your concept of wetland, what is the minimum duration and frequency of inundation?

Answer: Duration 14 to 21 days

Answer: Frequency 1 or more times each year (normal)

Question: What is the minimum duration and frequency of soil saturation to qualify as wetland from your standpoint?

Answer: Duration Early season=30+ days; Late=14+ days

Answer: Frequency annually

William McKee, Jr. - Qualifications: Ph.D. from Virginia Polytechnic Institute (Agronomy major, plant physiology and soil chemistry minors). From 1966-1975, worked as expert at Southern Forest Experiment Station in Alexandria, Louisiana. From 1975 to present, works as Research Soil Scientist charged with the responsibility for the study of mineral cycling, fertilization prescriptions and long-term productivity of forest soils. In

1978, developed new approach to measurement of water table depths in hydric soils by measurement of rust formation on iron rods (results published in several papers). In 1987, served on committee to write Best Management Practices for Forested Wetlands.

from USDA Forest Service survey, dated 4/22/91

Duration of Inundation/Saturation

Question: In your concept of wetland, what is the minimum duration and frequency of inundation?

Answer: Duration 60 DAYS Answer: Frequency annually

Question: What is the minimum duration and frequency of soil saturation to qualify as a wetland from your standpoint?

Answer: Duration 60 DAYS Answer: Frequency annually

Further explanation of answer: From monitoring data the time required to reduce iron from ferric to ferrous in Atlantic Coastal Plain soils at 40 to 50 degrees F is between 30 and 60 days where at least one half of the iron is reduced.

ANALYSIS OF A "FAC-NEUTRAL" ASSESSMENT APPROACH TO WETLAND DELINEATION IN SELECTED WETLAND TYPES

Robert J. Pierce
Wetland Training Institute
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EXECUTIVE SUMMARY

A three-step FAC-NEUTRAL procedure is applied to five selected community types: The Dismal Swamp, the Florida Everglades, evergreen forested wetlands, forested wetlands of the Atlantic and Gulf Coast and red maple swamps. In each wetland type except evergreen forested, application of the FAC-NEUTRAL approach yielded results completely consistent with the hydrologic parameters described for the systems. Sufficient data were not available to assess application to evergreen forested wetlands.

Location of studies on evergreen forested wetlands will allow for an accurate analysis of the acceptability of the FAC-NEUTRAL approach to evergreen forested wetlands. The recognition that any area with adequate hydrology and plants is a wetland (regardless of indicator status) eliminates the conceptual problem in this type of wetland. Furthermore, since the frequency of occurrence of this type of wetland is rare, if the routine, FAC-NEUTRAL approach does not work for this system, it can be adequately addressed in the Problem Section of the revised Manual. I am unaware of any problems associated with delineating this type of system since the 1989 Manual became effective (in other words it is a nonissue).

In conclusion, the results of this study indicate that the FAC-NEUTRAL approach will not cause a reduction in acreage of true wetlands, and in many cases will facilitate the decision-making process. In all cases it results in an approach that is completely logical with the concept of a functioning wetland.

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Poolesville, MD 20837-0099

INTRODUCTION

Reed (1988) provides a "wetland fidelity rating system" based upon a range of percent occurrences in wetland versus nonwetland. That system provides for five indicator categories of plants as follows:

Obligate Wetland (OBL). Occur almost always (estimated probability 99%) under natural conditions in wetlands.

Facultative Wetland (FACW). Usually occur in wetlands (estimated probability 67-99%), but occasionally found in nonwetlands.

Facultative (FAC). Equally likely to occur in wetlands or nonwetlands (estimated probability 34-99%).

Facultative Upland (FACU). Usually occur in nonwetlands (estimated probability 67-99%) but occasionally found in wetlands (estimated probability 1-33%).

Obligate Upland (UPL). Occur in wetlands in another region, but occur almost always (estimated probability 99%) under natural conditions in nonwetlands in the region specified. If a species does not occur in wetlands in any region, it is not on the National List.

The fact that FAC species have an equal probability of occurring in wetlands and nonwetlands has prompted the idea that a FAC-NEUTRAL approach may more clearly define the hydrophytic component of wetlands. Recently, there has been an assertion that adoption of a FAC-NEUTRAL vegetation criterion in the revision to the 1989 Federal Manual for Identifying and Delineating Wetlands (Manual) (FICWD, 1989) would result in the loss of millions of acres of area from categorization as jurisdictional wetland. The FAC-NEUTRAL approach was first described in federal wetland delineation procedures in 1987 (USAEWES). The approach was described as follows:

When FAC species occur as dominants along with other dominants that are not FAC (either wetter or drier than FAC), the FAC species can be considered as neutral, and the vegetation decision can be based on the number of dominant species wetter than FAC as compared to the number of dominant species drier than FAC. When a tie occurs or all dominant species are FAC, the non-dominant species must be considered. The area has hydrophytic vegetation when more than 50 percent of all considered species are wetter than FAC. When either all considered species are FAC or the number of species wetter than FAC equals the number of species drier than FAC, the wetland determination will be based upon the soil and hydrology parameters.

The systems where the most concern exists for adoption of the FAC-Neutral approach are:

The Dismal Swamp;
The Everglades;
Evergreen forested swamps;
Forested wetlands of the Atlantic and Gulf Coasts; and
Red maple swamps.

The purpose of this study is to describe the effect of "neutralizing" FAC species when determining the presence of hydrophytic vegetation for wetland delineation purposes by comparing plant species composition to soils and/or hydrology gradients when data are available or when such data are not available to examine the species composition for the selected wetland types to determine if sufficient non-FAC species are present to enable a reasoned decision. This study by no means considers all of the literature appropriate to the topic. Rather it relies upon information that was readily available.

METHODS

Species composition lists from a number of sources were examined and assigned indicator ratings based upon the National List of Plants that Occur in Wetlands (Reed, 1988). Plants with a FAC (+ & - ignored) rating were discounted. The ratio of the total number of OBL and FACW species to the sum of the FACU and UPL species was determined for the balance of each list. When data were available the ratios were determined for the total number of species identified as well as for dominance measure (e.g., cover or basal area). In some cases hydrology and/or soil information were available in the studies. In such cases, these data were integrated into the interpretation of the results.

RESULTS AND DISCUSSION

Great Dismal Swamp

Virginia P. Carter's dissertation entitled *Relation of Hydrogeology, Soils and Vegetation on the Wetland-to-Upland Transition Zone of the Great Dismal, Virginia and North Carolina* (1988) was based on data collected during the period from August 1979 through September 1985. Her data collection concentrated on the transition zone, i.e., the zone where environmental conditions change from clearly wetland to clearly upland. As such the data provide the perfect test to determine whether the application of a FAC-NEUTRAL approach would substantially alter the boundary between wetland and upland.

Table 9 (Appendix A) from Dr. Carter's dissertation lists the 117 species that she identified in the transition zone and the Indicator Status of each as derived from Reed (1988). Thirty-three species or 28.2% of the total identified are rated FAC. Of the remaining 84 species, 51 (43.6% of the total) were OBL and/or FACW and 33 (28.2% of the total) were either FACU or UPL. Thus, based upon all of the species found within the transition zone, less than one-third could qualify an area as a nonwetland. After all of the FAC species have been "neutralized", fully 60 percent of the remaining species would qualify an area as a wetland. Based upon total species count, implementing the FAC-NEUTRAL option should not reduce the overall acreage of the wetlands in the Dismal Swamp appreciably.

Tables 14 through 17 (Appendix B) present data on the cover of each species on four transects running from clearly wetland on the eastern end to upland on the western end. The length of the transects ranged from 430 to 707 meters long. Of the species contributing more than 0.5 percent to the total cover, 66 to 72 percent were FAC. Of the remaining species contributing to the total cover on each transect, the cover contribution of the OBL and FACW plants exceeded the contribution of FACU and UPL species (Table A). Based upon total cover, implementing the FAC-NEUTRAL option should not reduce the overall acreage of the wetlands in the Dismal Swamp appreciably.

Dr. Carter identified 11 soil series (Appendix C) along the four transects in her study. Along with the description of each soil, she has included a brief listing of the dominant plant species associated with that soil in the Dismal Swamp transition zone. Table B provides a summary of each soil series, whether it exhibits hydric soil characteristics and the comparison of OBL and FACW species to FACU and UPL species. In all but four species (Wasda, Augusta, Perquimans and Cape Fear), there was a direct relationship between the occurrence of hydric soil characteristics and the ratio of OBL+FACW:FACU+UPL.

The soil series Wasda is a Histic Humaquept. It has a aquic suborder and a histic epipedon. Interestingly, the horizon located at 12 to 16 inches, while having a chroma of 2 is not mottled. Only below 16 inches does the soil show mottling. The histic epipedon, however suggests that the surface is wet. Applying the FAC-NEUTRAL option on this site would yield a conclusion based upon vegetation that the area was not a wetland. Unfortunately, no hydrology data are provided.

The soil series Augusta is an Aeric Ochraqults. While it does have an aquic suborder, the aeric subgroup indicates that this soil is located a little higher on the landscape than is typical of this Ultisols. The soil lacks hydric soil indicators in that the BA horizon (7 to 14 inches) has a chroma of 4 with mottles and the Btg1 horizon (14 to 28 inches) has a chroma of 2 without mottles. Based upon an application of the FAC-NEUTRAL option, the vegetation would be considered hydrophytic (2 FACW:1 FACU). No hydrology data are provided, however, the location is the western-most site on transect B.

The soil series Perquimans is a Typic Ochraqults. This soil has an aquic suborder and the horizon at 14 to 25 inches (Btg1) has hydric indicators (chroma of 2 with chroma 4 mottles). Application of the FAC-NEUTRAL option indicates that the vegetation is not hydrophytic (1 FACW:2 FACU). The author provides to Notes on this soil: 1) Free water at 30 inches (April 9, 1985) in the auger hole; and 2) Area obviously disturbed by logging activities in the past. The soil is judged to be borderline to an Aeric Ochraqult classification. My interpretation of these comments is that the soil has been drained and the hydric soil characteristics are relic.

Cape Fear soil series is a Typic Humaquept. While this soil has an aquic suborder, soil characteristics immediately below the A horizon do not satisfy the field indicators (i.e., the chroma was 2 but there were no mottles. Application of the FAC-NEUTRAL option yielded a very definitive hydrophytic plant community (2 OBL:0 FACU or UPL). The author notes at this site that there were 3 inches of water on the site. Based upon hydrology and the vegetation, this site would qualify as a wetland.

The Everglades

Niering (1985) describes the plant and animal community for the Everglades (Appendix D) and for cypress swamps (Appendix E). He lists 14 species of OBL, 3 FACW and 1 FAC as characterizing the Everglades and 18 OBL, 15 FACW and 3 FAC species as characteristic of cypress swamps. Both descriptions are strongly dominated by OBL species. While Niering's is a popular account and could be expected to characterize the most obvious of areas, other studies support the prevalence of OBL species as clearly dominant in Everglades' communities.

Wood and Tanner (1990) present data on the frequency of occurrence of plants in numerous 1.0 m quadrats at three randomly selected sites in four different Everglades management areas (Appendix F). The community types found in each area were classified as Tall Sawgrass, Medium Sawgrass and Wet Prairie. Wet Prairie had the deepest water of the three types. Each area was sampled 4 times: once each during the wet and dry periods in 1986 & 1987. The vast majority of plants at all locations were OBL (35). Only six were rated FACW and none drier. One additional genus was identified. Species in that genus are either FACW or OBL.

Dade County Florida, Department of Environmental Resource Management has conducted vegetation studies in the Bird Drive Everglades Basin. One of the plant community types that it identifies is called "Dense Melaleuca Stand." *Melaleuca quinquenervia* is an exotic nuisance species that is spreading through southern Florida. It has the capability of forming dense stands to the detriment of native species. However, even in the dense stands, there are numerous other species represented in the samples (Appendix G). Of the 27 species that were reported in association with *M. quinquenervia*, 11 were OBL, 10 were FACW, 5 were FAC and 2 were UPL.

While most of the associated species were listed as "uncommon", the two "common" species were both OBL.

Evergreen Forested Wetlands

In the short time allocated for this study, I have been unable to discover any published reports for this type of wetland other than the discussion of it in the Manual (FICWD, 1989). Niering (1985) discusses conifer swamps under his category of Northern Swamps and Floodplain Wetlands. However, he describes the more common OBL and FACW-dominated variety rather than the FACU type. I have spoken to enough knowledgeable wetland specialists to accept that FACU-dominated swamps do exist.

Michener, et al., (Personal communication; Appendix H) wrote a memo at my request describing their experience with hemlock swamps in northern New England. Their conclusion was that they are relatively rare and less frequent than the occurrence of other evergreens in wetlands. They provide data on an upland hemlock thicket growing adjacent to a small stream in Massachusetts. Applying the current vegetation criteria from the Manual (50% of the dominants are OBL, FACW, and/or FAC) yields a value of 50 % because of the presence of FAC species as dominants. This would throw the analysis into the "difficult to identify" category and require an analysis of soils and hydrology before a nonwetland decision could be made. The FAC-NEUTRAL approach demonstrates clearly that the vegetation is not hydrophytic (ratio = 0:2 based on dominants).

Forested Wetlands of the Atlantic and Gulf Coasts

Forested wetlands occur throughout the mid and south Atlantic provinces and the Gulf of Mexico states. They are often referred to as bottomland hardwood forests or the wetter ones as swamps when associated with a stream or river. Numerous studies and reports have been prepared on this community type, only a few of which will be discussed here.

All but 4 of the 29 species that Niering (1985) describes as characteristic of this community type are FACW or OBL (Appendix I). The 4 outliers are FAC plants. Niering's account of the ecology and value of this community type emphasizes its importance to the natural system. It is obvious, however, from both the plant species list that he provides and the overall presentation that he is describing the portion of the forest that is inundated regularly and for fairly long duration.

Tiner (1985) lists 744 species of vascular plants in Delaware's wetlands (Appendix J). The list includes species found in all wetland community types in the State. The breakdown of species by indicator status (Reed, 1988) is 371 OBL, 207 FACW, 93 FAC, 54 FACU and 19 UPL. After FAC plants are discounted, the comparative ratio is approximately 8:1.

In addition to the red maple forested wetland communities discussed later in this paper, Tiner gives examples of six types of temporarily flooded forested wetlands found in Delaware (Appendix K). The first two types (tulip tree and ash; American elm and red maple) as well as the loblolly pine community would be borderline hydrophytic with ratios of 5:5, 6:5 and 3:2, respectively. It is likely that many of these areas will not be saturated to the surface for any appre-

ciable time during the growing season. The other three community types described, however, clearly have a predominance of hydrophytic vegetation with ratios of 3:0, 4:0 and 7:0 and can be expected to have wetland hydrology on a regular basis.

In 1989, Rhodes, et al., collected data from Tudor Farms, Dorchester County, Md., for use in legal proceedings against the owner and project manager. Of the 16 sites at which data were collected, 13 were characterized as forested wetlands. Table C lists the ratios for the dominant species at each site after the FAC plants had been discounted. Note that the ratios at sites I, V, & VIIb were tied, and that the ratio at station VIIa would indicate a nonhydrophytic plant community. The protocol for utilizing the FAC-NEUTRAL procedure requires that when the dominants are tied, the ratio will be based upon all species present. When all species were considered the corresponding ratios were 3:4 and 6:13 at stations I and V, respectively. Non-dominant species were not recorded at station VIIb.

While Rhodes, et al., (1989) concluded that stations I, VIIa and VIIb were wetlands, Sanders (1989) who also sampled in those locations concluded that they were not wetlands, because they lacked wetland hydrology. Application of the FAC-Neutral protocol substantiates Sanders conclusions.

Teskey and Hinckley (1977) characterized three forest communities (i.e., southeastern mixed forest, Southern floodplain forest and Beech-sweetgum-magnolia-pine-oak forests) in the southeastern and Gulf regions (Appendix I). Each community was subdivided by generalized hydrologic regimes. The comparative ratio for each forest type and hydrologic regime are summarized in Table D. Discounting the FAC species and basing a hydrophytic vegetation decision on the remaining species yields results fully consistent with the hydrologic regimes established by the authors. Each community identified as being wet clearly had a ratio that indicated the dominance by hydrophytic vegetation.

During 1979 and 1980, Elder and Cairns (1982) sampled leaf litter fall from nets located in 16 study plots, representing five forest types in the Apalachicola River floodplain. The forest types were based upon general hydrologic regimes from "...levees and high ridges. Saturated only by high flooding..." to "...low, flat areas having poor drainage. Saturated almost continuously...." As a system, flooding generally lasted for 30 to 90 days each spring.

While 12 species contributed 90 percent of the leaf litter, litter from 43 species of trees, vines and other plants contributed to the total collection. Although the levee communities had less tree biomass, the diversity of trees and the quantity of litter produced per unit of ground surface were greater than in the swamp communities. Bell et al., (1978) similarly found highest litter fall in the upland, then the transition zone when compared to the flood plain in an Illinois stream system.

Based upon total species collected (Appendix M; Table 1), the ratio of OBL and FACW to FACU and UPL was 22:3. Wetter species outnumbered drier species 7 to 1. The three species drier than FAC apparently contributed only trace amounts and were not even listed as associated species in the five forest communities Appendix M; Table 2). Even on the highest forest type (A), the ratio of 7:0 after the FAC plants have been discounted clearly indicates a hydrophytic plant community.

Red Maple Swamps

Niering (1985) describes at length the composition and seasonal changes in the red maple swamps of the northern climes. While red maple itself is FAC, there normally exist in association with it, many other species of plants (Appendix N). Of the 52 species he lists as being found in northern swamps and floodplains, 17 are OBL, 30 are FACW and 5 are FAC. He does not list any FACU or UPL species that are common to this community type. The resultant ratio when the FAC plants are discounted is 47:0.

Tiner (1985) lists nine types of red maple forested wetland communities common to Delaware (Appendix O). These communities vary by tree dominance type and hydrologic regime. In addition to the dominants for each community type, he lists common associates and less common subordinate plants. Those communities with seasonal flooding are virtually free of FACU or UPL plants while those that are only temporarily flooded have a few FACU plants associated with them. The lowest ratio after the FAC plants have been discounted, however, is 5:2.

CONCLUSIONS

With the exception of the Evergreen Forested Wetlands type, the available literature supports the premise that adoption of a FAC-Neutral approach does not reduce the extent of areas recognized as wetlands. While evergreen forested systems dominated by a FACU species may produce a canopy that is so dense that it effectively eliminates all other species, I have been unable to assess this based upon a lack of data. If, however, subordinate species are present, the results from the analysis of the other four community types evaluated in this report, suggest that the associated species will be primarily FACW and/or OBL if hydrology is truly present.

I have analyzed data on total species composition of the entire transition zone, the contribution to total cover on four separate transects and the relationship between soils and vegetation on 11 different soils in the Dismal Swamp. In each case application of the FAC-NEUTRAL option resulted in most of the transition zone qualifying as wetland based upon vegetation. Thus, the assertion that adoption of the FAC-NEUTRAL option as the vegetation criterion would result in 200,000 acres of the Dismal Swamp no longer qualifying as wetland is without foundation. In fact the FAC-NEUTRAL option appears to correspond well with hydric soils and is consistent with a hydrology criterion which requires saturation to the surface for more than 14 consecutive days during the growing season.

Analysis of studies conducted in the Florida Everglades indicate that adoption of a FAC-NEUTRAL approach will not alter the conclusion that areas with sufficient hydrology have a hydrophytic vegetation component. Even areas dominated by dense stands of *M. quinquenervia* (FAC) in DADE County Florida, have numerous associated species which are predominantly OBL or FACW. The assertion that 500,000 acres of the Everglades will no longer qualify as wetland is without foundation.

Of the five systems examined, the least amount of written information was available for evergreen forested swamps. Those that have a sufficiently dense canopy to shade all other species are a problem. However, I believe that in many such systems there will be associated species that are FACW and/or OBL. These systems were accommodated in the Manual (1989) with

little difficulty and can so be addressed in subsequent revisions. Accepting the basic concept that a wetland can be identified as any area that has the appropriate amount of hydrology present and has plants growing in it diminishes the problem of justifying FACU-dominated evergreen swamps: they have hydrology and plants grow there. They simply do not fit snugly into the normal process.

The literature is replete with studies on forested wetlands of the Atlantic and Gulf coasts. All of them support perfectly the approach of "neutralizing" the FAC species. Teskey and Hinckley (1977) characterization of such communities in relation to hydrologic gradient supports the position that when hydrology is sufficient, an area will be vegetated by OBL and FACW species far in excess of the FACU and UPL species.

Similar results were derived from the analysis of red maple swamps. Tiner's (1985) description of nine such communities in Delaware all yielded a positive ratio supporting the position that associated species in a FAC-dominated wetland community will be primarily FACW and/or FAC.

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Table A. Number of species and percent of total transect cover in three indicator categories for four transects.

TRANSECT	<u>FAC SPECIES</u>		<u>OBL/FACW SPECIES</u>		<u>FACU/UPL SPECIES</u>	
	#	%	#	%	#	%
A	9	66.2	12	17.2	3	16.5
B	8	72.5	9	13.8	4	13.7
C	8	69.4	8	18.1	3	12.5
D	12	72.1	7	14.6	4	13.4

Table B. List of soil series, the presence of hydric soil indicators and the ratio of OBL/FACW:FACU/UPL plant species.

SOIL SERIES	HYDRIC SOIL INDICATORS	RATIO OBL/FACW:FACU/UPL
Ponzer	Yes	2:1
Wasda	Yes	1:3
Belhaven	Yes	2:1
Deloss	Yes	2:1
Augusta	No	2:1
Pettigrew	Yes	2:0
Roanoke	Yes	4:1
Tomotley	Yes	3:1
Perquimans	Yes*	1:2
Cape Fear	No	2:0
Altivista	No	1:4

* Notes on this soil suggest that soil conditions are relic.

Table C. Summary of data collected by Rhodes, et al., (1989) on Tudor Farms, Dorchester County, Md. Sample site, habitat type and ratio of OBL and FACW species to FACU and UPL species are presented.

SITE	HABITAT	RATIO	
		DOMINANTS	ALL SPECIES
I	Forest	1:1	3:4
II	Marsh	1:0	
III	Forest	3:0	
IVa	Forest	3:1	
IVb	Forest	2:1	
V	Forest	4:4	6:13
VIa	Forest	4:1	
VIb	Forest	4:1	
VIIa	Forest	2:3	
VIIb	Forest	2:2	No Data
VIIc	Forest	1:0	
VIII	Marsh	6:0	
IX	Marsh	6:0	
X	Forest	2:0	
XI	Forest	1:0	
XII	Forest	2:1	

Table D. Summary of FAC-NEUTRAL approach applied to three forested systems in the southern United States based upon the community structure information from Teskey and Hinckley (1977). Ratio is the total number of OBL and FACW species compared to the total number of FACU and UPL species.

SITE TYPE	DESCRIPTION	INDICATOR STATUS					RATIO
		OBL	FACW	FAC	UPL		
<u>Southern Mixed Forest:</u>							
	Dry	0	0	4	7	5	0:12
	Well Drained	0	4	6	6	5	4:11
Bottomlands	Seldom covered by water	0	6	6	5	0	6:5
Wet	Excessive moisture most of the year	1	5	5	1	0	6:1
<u>Southern Floodplain Forest:</u>							
	Well drained	3	5	5	4	0	8:4
Bottomlands		4	6	6	1	0	10:1
Wet	Excessive moisture most of the year	8	4	4	0	0	12:0
<u>Beech-Sweetgum-Magnolia-Pine-Oak Forest:</u>							
	Dry	0	2	3	1	5	2:6
	Moist	3	7	11	5	8	10:13
Bottomland	Seldom covered by water	4	12	11	5	1	16:6
Wet	Excessive moisture most of the year	10	7	6	0	0	17:0

APPENDIX A

117 Species

TABLE 9.--Species list for the transition zone of the Great Dismal Swamp showing code number, scientific name, common name, and FWS rank

	Scientific name	Common name	FWS rank
Trees			
1	<i>Ilex opaca</i> Aiton	American holly	FACU
2	<i>Magnolia virginiana</i>	sweet bay	FACW
3	<i>Persea borbonia</i> (L.) Sprengel.	red bay	FACW
4	<i>Pinus taeda</i> L.	loblolly pine	FAC
5	<i>Chamaecyparis thyoides</i> (L.) BSP.	Atl. white cedar	OBL
6	<i>Juniperus virginiana</i> L.	red cedar	FACU
101	<i>Acer rubrum</i> L.	red maple	FAC
102	<i>Carpinus caroliniana</i> Walter.	ironwood	FAC
103	<i>Diospyros virginiana</i> L.	persimmon	FAC
104	<i>Fagus grandifolia</i> Ehrhart.	beech	FACU
105	<i>Fraxinus caroliniana</i> Miller	water ash	OBL
106	<i>Liquidambar styraciflua</i> L.	sweetgum	FAC
107	<i>Liriodendron tulipifera</i> L.	yellow poplar	FAC
108	<i>Morus rubra</i> L.	red mulberry	FAC
109	<i>Nyssa sylvatica</i> Marshall	black gum	FAC
110	<i>Oxydendrum arboreum</i> (L.) DC.	sourwood	UPL
111	<i>Quercus alba</i> L.	white oak	FACU
112	<i>Quercus falcata</i> Michaux	southern red oak	FACU
113	<i>Quercus laurifolia</i> Michaux	laurel oak	FACW
114	<i>Quercus michauxii</i> Nuttall	swamp chestnut oak	FACW
115	<i>Quercus nigra</i> L.	water oak	FAC
116	<i>Quercus phellos</i> L.	willow oak	FACW
117	<i>Quercus velutina</i> Lam.	black oak	UPL
118	<i>Taxodium distichum</i> (L.) Richard	bald cypress	OBL
119	<i>Ulmus americana</i> L.	American elm	FACW
120	<i>Quercus stellata</i> Wang.	post oak	FACU
121	<i>Quercus marilandica</i> Muenchh.	black jack oak	UPL
122	<i>Carya sp.</i> Nuttall	hickory	
123	<i>Cornus florida</i> L.	dogwood	FACU
124	<i>Populus heterophylla</i> L.	swamp cottonwood	OBL
125	<i>Prunus serotina</i> Ehrhart	black cherry	FACU
126	<i>Asimina triloba</i> (L.) Dunal.	paw-paw	FAC
127	<i>Ailanthus altissimus</i> (Miller) Swingle.	tree of heaven	UPL
128	<i>Platanus occidentalis</i> L.	sycamore	FACW
129	<i>Sassafras albidum</i> (Nuttall) Nees.	sassafras	FACU
130	<i>Salix nigra</i> Marshall	black willow	OBL
Shrubs			
201	<i>Ilex glabra</i> (L.) Gray	inkberry	FACW
202	<i>Leucothoe axillaris</i> (Lam.) D. Don	leucothoe	FACW
203	<i>Lyonia lucida</i> (Lam.) K. Koch	fetter-bush	FACW
204	<i>Ilex coriacea</i> (Pursh) Chapman	sweet gallberry	FACW

FAC

10

OBL + FACW

16

FACU + APL

13

TABLE 9.--Species list for the transition zone of the Great Dismal Swamp showing code number, scientific name, common name, and FWS rank, continued

	Scientific name	Common name	FWS rank
Shrubs			
205	<i>Myrica cerifera</i> L.	wax myrtle	FAC
206	<i>Ligustrum sinense</i> Lour.	privet	UPL
301	<i>Amelanchier canadensis</i> (L.) Medicus.	shad-bush	FAC
302	<i>Clethra alnifolia</i> L.	sweet pepperbush	FACW
303	<i>Euonymus americanus</i> L.	strawberry bush	FAC
304	<i>Ilex verticillata</i> (L.) Gray	black alder	FACW
305	<i>Itea virginica</i> L.	Virginia willow	FACW
306	<i>Leucothoe racemosa</i> (L.) Gray	fetter-bush	FACW
307	<i>Rhododendron viscosum</i> (L.) Torrey	azalea	FACW
308	<i>Rubus hispidus</i> L.	dew berry	FACW
309	<i>Symplocos tinctoria</i> (L.) L'Her.	horse sugar	FAC
310	<i>Vaccinium corymbosum</i> L.	highbush blueberry	FACW
311	<i>Viburnum nudum</i> L.	viburnum	FACW
312	<i>Alnus serrulata</i> (Aiton) Lilld.	tag alder	FACW
313	<i>Aralia spinosa</i> L.	Hercules club	FAC
314	<i>Sambucus canadensis</i> L.	elderberry	FACW
315	<i>Lyonia ligustrina</i> (L.) DC.	male-berry	FACW
316	<i>Viburnum dentatum</i> L.	viburnum	FAC
317	<i>Rosa palustris</i> Marshall	swamp rose	OBL
318	<i>Sorbus arbutifolia</i> (L.) Heynhold.	chokeberry	UPL
319	<i>Gaylussacia</i> sp. HBK	huckleberry	
320	<i>Ilex decidua</i> Walter	possum haw	FACW
321	<i>Rubus</i> sp. L.	blackberry	
322	<i>Vaccinium tenellum</i> Aiton.		UPL
Vines			
601	<i>Anisostichus capreolata</i> (L.) Bureau	cross vine	UPL
602	<i>Lonicera japonica</i> Thunburg	honeysuckle	FAC
603	<i>Smilax laurifolia</i> L.	greenbrier	FACW
701	<i>Berchemia scandens</i> (Hill) K.Koch.	rattan vine	FACW
702	<i>Campsis radicans</i> (L.) Seemann	trumpet vine	FAC
703	<i>Decumaria barbara</i> L.	climbing hydrangea	FACW
704	<i>Dioscorea villosa</i> L.	wild yam	FAC
705	<i>Gelsemium sempervirens</i> (L.) Aiton f.	jessamine	FAC
706	<i>Parthenocissus quinquefolia</i> (L.) Planchon	Virginia creeper	FAC
707	<i>Rhus radicans</i> L.	poison ivy	FAC
708	<i>Smilax glauca</i> Walter	sawbrier	UPL
709	<i>Smilax rotundifolia</i> L.	greenbrier	FAC
710	<i>Smilax walteri</i> Pursh.	coral greenbrier	OBL
711	<i>Vitis rotundifolia</i> Michaux	muscadine grape	FAC
712	<i>Vitis aestivalis</i> Michaux	summer grape	FACU

FAC

14

OBL + FACW

17

FACU + UPL

6

TABLE 9.--Species list for the transition zone of the Great Dismal Swamp showing code number, scientific name, common name, and FWS rank, continued

	Scientific name	Common name	FWS rank
713	<i>Smilax hispida</i> Muhl.	greenbrier	FAC
714	<i>Ipomoea</i> sp. L.	morning glory	
715	<i>Clematis crispa</i> L.	leather flower	FACW
Herbaceous plants			
401	<i>Mitchella repens</i> L.	partridge berry	FACU
501	<i>Lobelia cardinalis</i> L.	cardinal flower	FACW
502	<i>Medeola virginiana</i> L.	indian cucumber	UPL
503	<i>Saururus cernuus</i> L.	lizard's tail	OBL
504	<i>Scutellaria integrifolia</i> L.	skullcap	FACW
505	<i>Hypericum</i> sp. L.	St. John's-wort	
506	<i>Arisaema triphyllum</i> L.	Jack-In-The-Pulpit	FACW
507	<i>Goodyera pubescens</i> (Willd.) R.Brown	rattlesnake orchid	UPL
508	<i>Phytolacca americana</i> L.	pokeweed	FACU
509	<i>Tipularia discolor</i> (Pursh) Nuttall	crane fly orchid	FACU
510	<i>Boehmeria cylindrica</i> (L.) Swartz	false nettle	FACW
511	<i>Polygonum punctatum</i> Ell.	smartweed	FACW
512	<i>Plantago</i> sp. L.	plaintain	
513	<i>Lycopus virginicus</i> L.		OBL
514	<i>Tovara virginiana</i> (L.) Raf.	jumpseed	FAC
515	<i>Galium</i> sp. L.	bedstraw	
516	<i>Commelina communis</i> L.	dayflower	FAC
517	<i>Geum canadense</i> Jacquin.	white avens	FAC
518	<i>Rumex conglomeratus</i> Murray.	dock	FAC
519	<i>Cuscuta</i> sp. L.	dodder	
520	<i>Solanum carolinense</i> L.	nightshade	UPL
521	<i>Impatiens capensis</i> Meerb.	jewel-weed	FACW
522	<i>Viola</i> sp. L.	violet	
523	<i>Perilla frutescens</i> (L.) Britton.	avens	FAC
524	<i>Verbesina occidentalis</i> (L.) Walter.		UPL
801	<i>Dennstaedtia punctilobula</i> (Michaux) Moore	hayscented fern	UPL
802	<i>Osmunda cinnamomea</i> L.	cinnamon fern	FACW
803	<i>Osmunda regalis</i> (Willd.) Gray	royal fern	OBL
804	<i>Thelypteris novaboracensis</i> (L.) Nieuwland	New York fern	FAC
805	<i>Woodwardia areolata</i> (L.) Moore	netted chain fern	OBL
806	<i>Woodwardia virginica</i> (L.) Smith	Virginia chain fern	OBL
807	<i>Athyrium asplenoides</i> (Michaux) A.A.Eaton	southern ladyfern	FAC
808	<i>Botrychium virginianum</i> (L.) Swartz	rattlesnake fern	FACU
809	<i>Asplenium platyneuron</i> (L.) Oakes	ebony spleenwort	FACU
810	<i>Thelypteris palustris</i> Schott	marsh fern	FACU
811	<i>Onoclea sensibilis</i> L.	sensitive fern	FACW
812	<i>Dryopteris celsa</i> (W.Palmer) Small	log fern	FAC
901	<i>Arundinaria gigantea</i> (Walter) Muhl.	switch cane	FACW
902	Cyperaceae family	sedge	

FAC

9

OBL + FACW

15

FACU + UPL

11

TABLE 9.--Species list for the transition zone of the Great Dismal Swamp showing code number, scientific name, common name, and FWS rank, continued

	Scientific name	Common name	FWS rank			
903	Poaceae family	grass				
904	Panicum dichotomum L.	panic grass	UPL			
905	Leersia sp. Swartz	rice cut grass				
906	Glyceria striata (Lam.) Hitchcock	manna grass	OBL			
907	Carex folliculata L.	sedge	UPL			
908	Carex swanii (Fernald) Mackenzie.	sedge	UPL			
909	Juncus sp. L.	rush				
910	Carex debilis Michaux	sedge	FACW			
911	Carex alata Torrey.	wingseed sedge	OBL			
				FAC	OBL+FACW	FACU+UPL
				0	3	3
	Total -			33	51	33
	%			28.2	43.6	28.2

APPENDIX B

TABLE 14.--Contribution of transect A species to cover on the transect. Cover is shown for each layer and all layers combined (total cover) by species. Percent cover is the percent of the total vegetative cover for the transect contributed by each species. Only species contributing >0.5 percent of the total transect cover are shown.

Species	Cover (m)			Total cover for all layers (m)	Percent of total transect cover
	Upper layer	Middle layer	Lower layer		
FAC Acer rubrum	1187.50	141.20	10.90	1339.60	17.91
FAC Nyssa sylvatica	1122.50	37.30	1.75	1161.55	15.53
FAC Clethra alnifolia		778.80	257.29	1036.09	13.85
FACU Ilex opaca	199.50	471.60	12.53	683.63	9.14 -
FACU Liriodendron tulipifera	433.00	53.80	1.80	488.60	6.53 -
FAC Liquidambar styraciflua	380.50	97.50	2.88	480.88	6.43
FACW Magnolia virginiana	356.50	58.00	2.94	417.44	5.58 +
OBL Fraxinus caroliniana	125.00	26.60	4.85	156.45	2.09 +
FAC Lonicera japonica	8.00	64.00	79.03	151.03	2.02
FAC Quercus nigra	132.50	10.70	0.57	143.77	1.92
FACW Leucothoe axillaris		6.20	118.03	124.23	1.66 +
FAC Smilax rotundifolia	15.00	90.50	6.95	112.45	1.50
FACW Smilax laurifolia	52.30	38.70	0.84	91.84	1.23 +
FACW Vaccinium corymbosum		83.40	5.57	88.97	1.19 +
FACW Lyonia lucida		45.40	40.16	85.56	1.14 +
FACW Quercus laurifolia	75.00	8.00		83.00	1.11 +
FACU Fagus grandifolia	53.00	11.00	0.18	64.18	0.86 -
FAC Pinus taeda	59.00			59.00	0.79
FAC Vitis rotundifolia	32.00	21.80	2.14	55.94	0.75
FACW Ilex glabra		37.80	15.68	53.48	0.72 +
OBL Taxodium distichum	53.00			53.00	0.71 +
FACW Persea borbonia	10.00	37.00	1.18	48.18	0.64 +
FACW Arundinaria gigantea		22.40	25.69	48.09	0.64 +
FACW Rhododendron viscosum		37.10	2.56	39.66	0.53 +

FAC

OBL + FACW

FACU + UPL

66.23

17.24

16.53

TABLE 15.--Contribution of transect B species to cover on the transect. Cover is shown for each layer and all layers combined (total cover) by species. Percent cover is the percent of the total vegetative cover for the transect contributed by each species. Only species contributing >0.5 percent of the total transect cover are shown.

Species	Cover (m)			Total cover for all layers (m)	Percent of total transect cover
	Upper layer	Middle layer	Lower layer		
FAC Acer rubrum	1680.50	273.50	22.18	1976.18	28.33
FAC Nyssa sylvatica	869.00	10.70	0.27	879.97	12.61
FAC Liquidambar styraciflua	799.00	46.40	4.73	850.13	12.19
FACU Ilex opaca	208.50	453.00	25.41	686.91	9.85 -
FAC Carpinus caroliniana	209.50	175.90	6.07	391.47	5.61
FAC Clethra alnifolia		155.60	161.66	317.26	4.55
FACW Quercus laurifolia	206.00	17.30	0.21	223.51	3.20 +
FACW Leucothoe axillaris		2.20	183.20	185.40	2.66 +
FACU Liriodendron tulipifera	152.00	4.20	0.84	157.04	2.25 -
DBL Woodwardia areolata			156.96	156.96	2.25 +
FAC Smilax rotundifolia	36.70	82.40	22.61	141.71	2.03
DBL Taxodium distichum	100.00			100.00	1.43 +
FAC Quercus nigra	90.50	7.60	0.88	98.98	1.42
FACW Quercus phellos	78.00	12.20	0.43	90.63	1.30 +
FACW Magnolia virginiana	63.50	23.60	2.86	89.96	1.29 +
FAC Vitis rotundifolia	49.50	24.00	5.85	79.35	1.14
FACU Fagus grandifolia	39.00	19.70	1.29	59.99	0.86 -
FACU Quercus alba	48.50	1.50	0.47	50.47	0.72 -
FACW Quercus michauxii	26.50	14.50		41.00	0.59 +
FACW Rubus hispidus			39.62	39.62	0.57 +
FACW Ulmus americana	27.50	7.20		34.70	0.50 +

FAC

DBL + FACW

FACU + UPL

72.53

13.79

13.68

TABLE 16.--Contribution of transect C species to cover on the transect. Cover is shown for each layer and all layers combined (total cover) by species. Percent cover is the percent of the total vegetative cover for the transect contributed by each species. Only species contributing >0.5 percent of the total transect cover are shown.

Species	Cover (m)			Total cover for all layers (m)	Percent of total transect cover
	Upper layer	Middle layer	Lower layer		
FAC Acer rubrum	1511.50	458.30	24.99	1994.79	24.70
FAC Liquidambar styraciflua	1171.70	66.40	12.37	1250.47	15.48
FACU Ilex opaca	251.00	554.00	49.60	854.60	10.58 -
FAC Nyssa sylvatica	647.50	21.90	0.91	670.31	8.30
FAC Clethra alnifolia		251.20	311.68	562.88	6.97
FACW Arundinaria gigantea		236.30	232.44	468.74	5.80 +
FACW Leucothoe axillaris		4.10	364.15	368.25	4.56 +
FACW Magnolia virginiana	224.00	81.90	9.63	315.53	3.91 +
FAC Quercus nigra	183.00	23.40	3.51	209.91	2.60
FAC Smilax rotundifolia	18.60	114.00	48.71	181.31	2.25
FAC Pinus taeda	142.00			142.00	1.76
FACW Vaccinium corymbosum		90.30	19.57	109.87	1.36 +
UPL Oxydendrum arboreum	64.50	24.60	1.87	90.97	1.13 -
FAC Lonicera japonica		21.00	47.79	68.79	0.85
UPL Quercus velutina	58.00	6.20	0.45	64.65	0.80 -
OBL Woodwardia areolata			64.05	64.05	0.79 +
FACW Smilax laurifolia	34.70	17.60	1.11	53.41	0.66 +
FACW Ilex glabra		17.80	25.65	43.45	0.54 +
FACW Quercus phellos	37.00	3.10	1.45	41.55	0.51 +

FAC

69.36

OBL + FACW

18.13

FACU + UPL

12.51

TABLE 17.--Contribution of transect D species to cover on the transect. Cover is shown for each layer and all layers combined (total cover) by species. Percent cover is the percent of the total vegetative cover for the transect contributed by each species. Only species contributing >0.5 percent of the total transect cover are shown.

Species	Cover (m)			Total cover for all layers (m)	Percent of total transect cover
	Upper layer	Middle layer	Lower layer		
FAC Acer rubrum.	589.50	632.50	57.53	1279.53	22.87
FAC Liquidambar styraciflua	529.50	213.60	16.90	760.00	13.58
FAC Nyssa sylvatica	547.50	27.10	7.66	582.26	10.41
FACU Ilex opaca	93.50	286.10	28.99	408.59	7.30 -
OBL Taxodium distichum	298.00	4.50		302.50	5.41 +
FAC Lonicera japonica	4.00	83.60	208.28	295.88	5.29
FACW Arundinaria gigantea		39.40	191.38	230.78	4.12 +
FACU Quercus alba	164.00	19.10	7.62	190.72	3.41 -
FAC Pinus taeda	184.00			184.00	3.29
FAC Quercus nigra	89.50	36.20	2.90	128.60	2.30
FACU Quercus stellata	114.00	2.40		116.40	2.08 -
FAC Smilax rotundifolia	6.50	70.50	25.59	102.59	1.83
FAC Rhus radicans	54.00	16.70	14.63	85.33	1.53
FACW Quercus phellos	78.00	1.60	2.44	82.04	1.47 +
FAC Campsis radicans	30.00	5.00	45.51	80.51	1.44
FAC Clethra alnifolia		13.40	61.84	75.24	1.34
OBL Saururus cernuus			64.79	64.79	1.16 +
OBL Populus heterophylla	60.00		0.10	60.10	1.07 +
FAC Vitis rotundifolia	9.50	16.20	23.30	49.00	0.88
FACW Ulmus americana	35.00	5.50	0.60	41.10	0.73 +
UPL Quercus velutina	15.00	19.20		34.20	0.61
OBL Woodwardia areolata			33.62	33.62	0.60 +
FACU Quercus falcata	29.00	4.00		33.00	0.59 -

FAC

72.06

OBL + FACW

14.56

FACU + UPL

13.38

APPENDIX C

PONZER SERIES

Classification: Loamy, mixed, dysic, thermic, Terric Medisaprist.

Soil Nos.: S82VA-3205-3-(1-5)

Location: Transect A - Site 1.

City of Suffolk, VA; 0.7 mile north of county road 674 on county road 642; 1200 feet east of county road 642.

Vegetation: White cedar, baldcypress, American holly, red maple, blackgum, sweet pepper bush.

Hydro

Remarks: 6 inches standing water on surface.

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

Oa1--0 to 4 inches; very dusky red (2.5YR 2.5/2) muck (sapric material); moderate medium granular structure; common fine roots. S82VA-3205-3-1.

Hydric soils

Oa2--4 to 24 inches; very dark brown (10YR 2/2) muck (sapric material); moderate medium granular structure; common fine roots. *S82VA-3205-3-2.

2C1--24 to 30 inches; very dark gray (10YR 3/1) mucky sandy loam; massive; common medium roots. S82VA-3205-3-3.

2C2--30 to 40 inches; dark grayish brown (10YR 4/2) sandy loam; massive; common medium roots. *S82VA-3205-3-4.

2C3--40 to 58 inches; dark gray (10YR 4/1) sandy clay loam; few fine gravels; pockets of sand in lower part. S82VA-3205-3-5.

* Sampled

white cedar	OBL	2:1
Baldcypress	OBL	
American Holly	FACU	
Red Maple	FAC	
Black gum	FAC	
Sweet pepper bush	FAC	

WASDA SERIES

Classification: Fine-loamy, mixed, thermic, Histic Humaquept.

Soil Nos.: S82VA-3205-4-(1-5)

Location: Transect A - Site 4.

City of Suffolk, VA; 0.7 mile north of county road 674 on county road 642; 1200 feet east of county road 642.

Vegetation: Willow oak, blackgum, sweetgum, water oak, red maple, American holly, American beech, blueberry, greenbrier, honeysuckle, yellow poplar, ivy.

Described by: W. G. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

Oal--0 to 3 inches; very dark grayish brown (10YR 3/2) muck (sapric material); moderate medium granular structure; common fine roots. S82VA-3205-4-1.

Oa2--3 to 12 inches; black (10YR 2/1) muck (sapric material); moderate medium granular structure; common fine and medium roots. *S82VA-3205-4-2.

2C1--12 to 16 inches; very dark grayish brown (2.5Y 3/2) mucky sandy clay loam; moderate medium subangular blocky structure; slightly sticky; common fine and medium roots. S82VA-3205-4-3.

2C2--16 to 38 inches; dark grayish brown (10YR 4/2) sandy clay loam; few medium distinct light yellowish brown (10YR 6/4) mottles; massive; slightly sticky; few fine roots. *S82VA-3205-4-4.

2C3--38 to 60 inches; light gray (10YR 7/2) sand to loamy sand; structureless, loose. S82VA-3205-4-5.

* Sampled

willow oak	BAC
blackgum	FAC
sweetgum	FAC
water oak	FAC
red maple	FAC
American holly	FACU
American beech	FACU
Blueberry	FACW
greenbrier	FAC
Honey suckle	FAC
yellow poplar	FACU
Ivy (poison)	FAC

1:3

?
Hystic asisodon
hydrae

chrom 2 w/
no mottles

non-hydrae?

BELHAVEN SERIES

Classification: Clayey, mixed, dysic, thermic, Terric Medisaprist.

Soil Nos.: S82VA-3205-2-(1-6)

Location: Transect B - Site 1.

City of Suffolk, VA; 0.3 mile south of county road 675 on county road 604; 1100 feet east of county road 604.

Vegetation: American holly, red maple, sweetgum, baldcypress, green ash, sweet pepper bush, ivy.

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

Oa1--0 to 10 inches; very dark brown (10YR 2/2) muck (sapric material); moderate medium granular structure; friable; many fine and medium roots. S82VA-3205-2-1.

hydric soil

Oa2--10 to 30 inches; black (10YR 2/1) muck (sapric material); strong coarse granular structure; many fine and medium roots. *S82VA-3205-2-2

Oa3--30 to 38 inches; dark reddish brown (5YR 3/2) muck (sapric material); <2% fiber rubbed; massive; many fine and medium roots. S82VA-3205-2-3.

2C1--38 to 42 inches; dark brown (7.5YR 3/2) mucky silt loam; massive; slightly sticky; many fine and medium roots. *S82VA-3205-2-4.

2C2--42 to 48 inches; very dark gray (5Y 3/1) silty clay loam; massive; very sticky; plastic; few fine and medium roots. S82VA-3205-2-5.

2C3--48 to 60 inches; very dark gray (5Y 3/1) silty clay; massive; very sticky, plastic. S82VA-3205-2-6.

* Sampled

American holly	FACU	
Red maple	FAC	
Sweet gum	FAC	
Baldcypress	OBL	
green ash	FACW	
Sweet pepper bush	FAC	
Ivy (poison)	FAC	

2:1

DELOSS SERIES

Classification: Fine-loamy, mixed, thermic Typic Ochraqult.

Soil Nos.: S82VA-3205-1-(1-6)

Location: Transect B - Site 3.

City of Suffolk, VA; 0.3 mile south of county road 675 on county road 604; 1100 feet east of county road 604.

Vegetation: baldcypress, red maple, sweetgum, American holly, chestnut oak, water oak

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

A1--0 to 4 inches; black (10YR 2/1) silt loam; moderate medium granular structure; friable; many fine and medium roots. S82VA-3205-1-2.

A2--4 to 10 inches; very dark brown (10YR 2/2) silt loam; moderate medium granular parting to blocky structure; friable; many medium roots. *S82VA-3205-1-2.

hydric soil
Btg1--10 to 17 inches; greenish gray (5GY 6/1) sandy clay loam; moderate medium subangular blocky structure; friable; few medium roots. S82VA-3205-1-3.

Btg2--17 to 32 inches; light gray (5Y 6/1) sandy clay loam; common fine prominent brownish yellow (10YR 6/8) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots. *S82VA-3205-1-4.

Btg3--32 to 60 inches; light gray (5Y 6/1) sandy clay loam; common fine prominent brownish yellow (10YR 6/8) and few fine prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; friable. S82VA-3205-1-5.

Cg--60 inches +; light gray (5Y 6/1) sandy loam; common medium prominent yellowish brown (10YR 5/6) mottles; structureless; loose. S82VA-3205-1-6.

*Sampled

Baldcypress	OBL	
red maple	FAC	1:2
sweetgum	FAC	2:1
American holly	FACU	
* swamp chestnut oak	UPT FACW	
water oak	FAC	

AUGUSTA SERIES

Classification: Fine-loamy, mixed, thermic Aeric Ochraqults.

Soil Nos.: S85VA-800-1-(1-6)

Location: Great Dismal Swamp National Wildlife Refuge;
Transect B - westernmost site

City of Suffolk, Virginia; 0.3 mile south of county road 675 on county road 604; 1,100 feet east of county road 604, 300 feet east of pond.

Vegetation: Loblolly pine, red maple, American holly, sweetgum, fetter-bush, Lyonia.

Described by: J. H. Ware, Vivian Owen, and Pat Gammon.
Description and sample by auger April 9, 1985.

Oi--2 inches to 0; loose pine needles and leaves.

Al--0 to 2 inches; very dark grayish brown (10YR 3/2) mucky loam; moderate medium granular structure; very friable; nonsticky, nonplastic; many fine and medium roots; clear smooth boundary.

*A2--2 to 7 inches; very dark gray (10YR 3/1) mucky fine sandy loam; moderate medium granular structure; very friable; nonsticky, nonplastic; many fine and medium roots; clear smooth boundary. (Sample No. S85VA-800-2)

Non hydric
BA--7 to 14 inches; light yellowish brown (2.5Y 6/4) fine sandy loam; common fine faint light brownish gray (2.5Y 6/2) mottles and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; slightly sticky, slightly plastic; common fine and medium roots; gradual smooth boundary.

Non mottles
*Btg1--14 to 28 inches; light brownish gray (2.5Y 6/2) sandy clay loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; few fine roots; gradual smooth boundary. (Sample No. S85VA-800-4)

Btg2--28 to 46 inches; gray (10YR 5/1) sandy clay loam; few medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; sticky, plastic; few fine roots; gradual smooth boundary.

Cg--46 to 60 inches; gray (10YR 5/1) fine sandy loam; massive, very friable; slightly sticky, slightly plastic.

* Sampled

Notes:

(1) Free water at 10 inches in auger hole.

Loblolly pine	FAC
Red maple	FAC
American holly	FACU
Sweetgum	FAC
Fetter bush	FACW
Lyonia	FACW

2:1

PETTIGREW SERIES

Classification: Fine, mixed, acid, thermic Histic Humaquept.

Soil Nos.: S82NC-073-3-(1-3)

Location: Transect C - Site 1.

Gates County North Carolina; 1 mile south of VA-NC state line on NC Hwy 32; 1.7 mile east of Corapeake.

Vegetation: blackgum, red maple, baldcypress, sweet pepper bush, switchcane.

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

Oa--0 to 10 inches; black (10YR 2/1) broken face and rubbed, muck (sapric material); moderate medium granular structure; very friable; non sticky; many fine and medium roots. *S82NC-073-3-1.

Bgl--10 to 18 inches; dark gray (5Y 4/1) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; sticky, plastic, common fine and medium roots. S82NC-073-3-2.

Cg--18 to 60 inches; dark greenish gray (5BG 4/1) clay; few fine prominent olive (5Y 5/6) and yellowish red (5YR 4/6) mottles; massive; sticky, plastic. *S82NC-073-3-3.

*Sampled

blackgum FAC 2:0
 redmaple FAC
 baldcypress OBL
 sweet pepper bush FAC
 switchcane FACW

ROANOKE SERIES

Classification: Clayey, mixed, thermic Typic Ochraquults.

Soil Nos.: S82NC-073-4-(1-6)

Location: Transect C - Site 2.

Gates County North Carolina; 1 mile south of VA-NC state line on NC Hwy 32; 1.7 mile east of Corapeake.

Vegetation: loblolly pine, American holly, blackgum, sourwood, redbay, swithcane, blueberry, sweet pepper bush, elm, water oak.

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

Al--0 to 4 inches; very dark gray (10YR 3/1) loam; weak fine granular structure; very friable; many fine roots. S82NC-073-4-1.

Btg1--4 to 7 inches; dark gray (5Y 4/1) silty clay loam; few fine faint olive (5Y 5/4) mottles; moderate fine subangular blocky structure; friable; many fine and medium roots. *S82NC-073-4-2.

Btg2--7 to 15 inches; gray (5Y 5/1) clay; common medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm, sticky, plastic; few fine and medium roots. *S82NC-073-4-3.

Btg3--15 to 36 inches; greenish gray (5BG 5/1) clay; many fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm, sticky, plastic; few medium roots. *S82NC-073-4-4.

Btg4--36 to 48 inches; greenish gray (5BG 5/1) clay; common fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm, sticky, plastic. S82NC-073-4-5.

Cg--48 to 60 inches; greenish gray (5BG 6/1) sandy clay loam; massive; slightly sticky, slightly plastic. S82NC-073-4-6.

* Sampled

Loblolly pine	FAC
American holly	FACU
Black gum	FAC
Sourwood	NI
Redbay	FACW
Swithcane	FACW
blueberry	FACW
Sweet pepper bush	FAC
elm	FACW
water oak	FAC

4:1

hydric soils

TOMOTLEY SERIES

Classification: Fine-loamy, mixed, thermic, Typic Ochraquult.

Soil Nos.: S82NC-073-5-(1-5)

Location: Transect C - Site 3.

Gates County North Carolina; 1 mile south of VA-NC state line on NC Hwy 32; 1.7 mile east of Corapeake.

Vegetation: red maple, sweetbay, redbay, sweetgum, water oak, ilex glabra, American holly.

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

A11--0 to 3 inches; very dark gray (10YR 3/1) mucky sandy loam; weak medium granular structure; friable; many fine and medium roots.
S82NC-073-5-1.

A12--3 to 10 inches; dark gray (10YR 4/1) fine sandy loam; moderate medium granular structure; friable; common fine and medium roots.
*S82NC-073-5-2.

hydric soils
Btgl--10 to 40 inches; gray (10YR 5/1) sandy clay loam; few medium faint light brownish gray (10YR 6/2) and dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; friable; few fine roots.
*S82NC-073-5-3.

C--40 to 60 inches; gray (5Y 5/1) loamy sand; structureless; loose.
S82NC-073-5-4.

*Sampled

red maple	FAC	
sweetbay	FACW	
redbay	FACW	3:1
sweetgum	FAC	
water oak	FAC	
ilex glabra	FACW	
American holly	FACW	

PERQUIMANS SERIES

Classification: Fine-silty, mixed, thermic Typic Ochraquults.

Soil Nos.: S85NC-073-1-(1-6)

Location: Great Dismal Swamp National Wildlife Refuge;
Maness transect - Site #1.

Gates County, North Carolina; 1 mile south of VA-NC, state line on NC Hwy. 32, 1.7 miles east of Corapeake, about 50 feet east of cultivated field.

Vegetation: red maple, sweetgum, water oak, American holly, yellow poplar, switchcane, honey suckle.

Described by: J. H. Ware, Vivian Owen, and Tom Padgett.
Description and sample by auger April 9, 1985.

A--0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam; weak very fine granular structure; very friable, nonsticky, nonplastic; many fine, medium and large roots; clear smooth boundary.

*E--5 to 14 inches; dark grayish brown (2.5Y 4/2) silt loam; weak fine subangular blocky structure; very friable, nonsticky, nonplastic; common medium and large roots; clear smooth boundary. (Sample No. S85NC-073-2)

Btg1--14 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4) mottles and oxidation stains around roots; very friable; slightly sticky, slightly plastic; few fine and medium roots; clear smooth boundary.

hydric soils
*Btg2--25 to 34 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; friable; slightly sticky, slightly plastic; few fine roots; clear smooth boundary. (Sample No. S85NC-073-4)

Btg3--34 to 45 inches; grayish brown (10YR 5/2) silty clay; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; sticky, plastic; few fine roots; clear smooth boundary.

Cg--45 to 60 inches; dark grayish brown (10YR 4/2) silty clay; few fine distinct yellowish brown (10YR 5/4) mottles; massive; very firm; very sticky, very plastic; few fine fibers and decaying roots.

*Sampled

Notes:

- *Note — (1) Free water at 30 inches in auger hole.
*Note — (2) Area obviously disturbed by logging activities in the past. The soil is judged to be borderline to an Aeric Ochraquult classification.

red maple FAC
sweetgum FAC
water oak FAC
American holly FACU
yellow poplar FACU
switchcane FACU
honey suckle FAC

1:2

CAPE FEAR SERIES

Classification: Clayey, mixed, acid, thermic, Typic Humaquept.

Soil Nos.: S82NC-073-1-(1-5)

Location: Transect D - Site 1.
Gates County North Carolina; 5 miles south of Corapeake on North Carolina Hwy 32; 1.0 mile east of paved road.

Vegetation: baldcypress, red maple, Tupelo

Remarks: Three inches of water on surface

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

All--0 to 7 inches; black (10YR 2/1) mucky silt loam; moderate coarse granular structure; slightly sticky; many fine roots; clear smooth boundary. *S82NC-073-1-1.

A12--7 to 12 inches; black (10YR 2/1) mucky silt loam; moderate medium granular structure; slightly sticky; many fine and medium roots; clear smooth boundary. S82NC-073-1-2.

Hydric soil?
not no - mottles
Btg1--12 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam; weak medium subangular blocky structure; slightly sticky; few fine roots; gradual smooth boundary. S82NC-073-1-3.

Btg2--18 to 48 inches; dark gray (5Y 4/1) silty clay; common medium faint dark gray (N 4/0) and few coarse distinct reddish brown (5YR 4/4) mottles; weak coarse blocky structure; sticky; few fine roots; gradual smooth boundary. *S82NC-073-1-4.

Cg--48 to 60 inches; mottled dark gray (N 4/0) olive (5Y 4/4) gray (5Y 6/1) reddish brown (5YR 4/4) sandy clay with thin lenses of sand; massive; sticky. *S82NC-073-1-5.

* Sampled

Baldcypress
red maple
Tupelo

OBL
FAC
OBL

2:0

ALTAVISTA SERIES

Classification: Fine-loamy, mixed, thermic, Aquic Hapludult.

Soil Nos.: S82NC-073-2-(1-6)

Location: Transect D - Site 3.

Gates County North Carolina; 5 miles south of Corapeake on North Carolina Hwy 32; 1.0 mile east of paved road.

Vegetation: White oak, sweetgum, loblolly pine, American holly, red maple, black cherry, smilax, switchcane, honeysuckle, Virginia creeper.

Described by: W. B. Parker, J. H. Ware, E. N. Hayhurst, and J. S. Quesenberry

A1--0 to 3 inches; very dark gray (10YR 3/1) loam; weak fine granular structure; very friable; many fine and medium roots; clear smooth boundary. *S82NC-073-2-1.

E--3 to 6 inches; mixed yellowish brown (10YR 5/4) and dark grayish brown (10YR 4/2) fine sandy loam; weak medium subangular blocky structure; friable; many fine and medium roots; clear smooth boundary. S82NC-073-2-2.

Bw--6 to 13 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; gradual wavy boundary. *S82NC-073-2-3.

Non hydric soil Bt1--13 to 22 inches; brownish yellow (10YR 6/6) sandy clay loam; few fine faint pale brown (10YR 6/3) and few fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; coatings on ped faces; few fine and medium roots. *S82NC-073-2-4.

Bt2--22 to 36 inches; yellowish brown (10YR 5/6) sandy clay loam; few fine distinct strong brown (7.5YR 5/6) and many coarse distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm. S82NC-073-2-5.

Bt3--36 to 60 inches; yellowish brown (10YR 5/6) sandy clay loam; few fine distinct strong brown (7.5YR 5/6) and many coarse distinct light brownish light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; lenses of sandy loam between 50 and 60 inches. *S82NC-073-2-6.

* Sampled

white oak	FACU
sweetgum	FAC
loblolly pine	FAC
American Holly	FACU
red maple	FAC
black cherry	FACU
smilax	FAC
switchcane	FACU
honeysuckle	FAC
Virginia creeper	FACU

1:4

APPENDIX D

WETLANDS

A Chanticleer Press Edition

By William A. Niering

Birds

John Bull, Field Associate, The American Museum of Natural History; John Farrand, Jr., Editor, *American Birds*, National Audubon Society; and Miklos D. F. Udvardy, Professor of Biological Sciences, California State University, Sacramento

Butterflies

Robert Michael Pyle, Consulting Lepidopterist, International Union for Conservation of Nature and Natural Resources

Fishes

James D. Williams, Research Associate, National Museum of Natural History

Insects and Spiders

Lorus Milne and Margery Milne, Lecturers, University of New Hampshire

Mammals

John O. Whitaker, Jr., Professor of Life Sciences, Indiana State University

Mushrooms

Peter Katsaros, Mycologist

Reptiles and Amphibians

John L. Behler, Curator of Herpetology, New York Zoological Society; and F. Wayne King, Director, Florida State Museum

Trees

Elbert L. Little, Jr., U.S. Forest Service

Wildflowers

William A. Niering, Professor of Botany, Connecticut College, New London; Nancy C. Olmstead, former Research Associate, Connecticut Arboretum; and Richard Spellenberg, Professor of Biology, New Mexico State University

Alfred A. Knopf, New York

Amphibians

Southern Cricket Frog 142
Two-toed Amphiuma 103

Reptiles

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Cottonmouth 177, 194
Florida Redbelly Turtle 158
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Mud Turtle 160
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Wildflowers, Ferns, and

Grasses
Arrowhead 247 **OBL** ?
Butterfly Orchid 265 ?
Common Butterwort 302 **NO**
Common Cattail 220 **OBL**
Delicate Ionopsis 232 ?
Fire Flags 303 **OBL**
Fragrant Water Lily 255 **OBL**
Grass Pink 269 **OBL**
Lizard's Tail 236 **OBL**
Rose Pogonia 268 **OBL**
Spider Lily 228 **OBL**
Swamp Lily 227 **OBL**
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Insects and Spiders

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Elsa Skimmer 370
Green Darter 366
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Saw-grass Skipper 420

Trees

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Carolina Ash 437 **OBL**
Coastal Plain Willow 455 **OBL**
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Southern Bayberry 461 **FAC**
Sweetbay 449 **FACW**

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Anhinga 518
Barred Owl 566
Bald Eagle 562
Black-crowned Night-Heron 529
Common Moorhen 536
Common Yellowthroat 584
Great Blue Heron 528
Great Egret 526
Green-backed Heron 534
Horned Grebe 485
King Rail 541
Lesser Scaup 503
Little Blue Heron 521, 525
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Mink 613
Raccoon 614
River Otter 612
Round-tailed Muskrat 608
White-tailed Deer 617

In the northern part of North America, several different types of forested wetlands can be found. Perhaps easiest to recognize are the widely represented Red Maple swamps, which are painted with brilliant splashes of red in the autumn. Conifer swamps, with their evergreen cover, are sometimes mistaken for bogs and thus require a closer look for identification. Some swamps support a mixture of evergreen and deciduous trees. The forested wetlands of the North resemble the surrounding upland forests, but they occur in the lowlands on poorly drained sites; they are frequently associated with streams and have standing water for part of the year.

The northern floodplain forests, like the bottomland hardwood swamps of the South, border the major rivers; they form meandering ribbons of forest and are composed primarily of a variety of hardwoods that find the silty alluvial soil a congenial place to grow. Northern floodplain forests, although blending with those to the south, occur along more rapidly flowing rivers, are frequently flooded for shorter periods of time, and are characterized by different species. Here, Black Willow, cottonwoods, and Silver Maple are among the common trees (in contrast with the Baldcypress, Water Tupelo, and aquatic oaks of the South).

Distribution

These northern wetlands are widely distributed throughout the East, extending as far south as the Appalachians and west to the Great Lakes states. In the Far West, beyond the grasslands, they reappear. Spruce-hir and Northern White-cedar swamps occur northward into the conifer forest region, where bogs are also common. Atlantic White-cedar swamps and bogs extend from Cape Cod southward along the coast. In the Far West, Western Hemlock, Red Alder, and other evergreens predominate in the wetlands. Floodplain forests occur where extensive floodplains have developed along such major rivers as the Connecticut, the Wabash, the Tippecanoe, and the upper Mississippi.

Ecology

Northern boreal swamps are dominated by Black and White spruces, Balsam Fir, Larch (or Tamarack), and Northern White-cedar. On richer sites, cedar may form swamps or bogs, assisted by periodic fires. The slightly more southern hardwood swamp forests are dominated by Red Maple or a variety of other deciduous trees, such as Black and White ashes, Black Gum, Yellow Birch, Pin Oak, Swamp White Oak, and American Elm. Still farther south, Sweet Gum is a significant species.

Like the forests of the surrounding uplands, which they resemble, the northern swamp forests typically have a tree canopy that dominates the community. Often the evergreen swamps are so shady that mosses form a carpet on the forest floor. If there is enough light, though, shrubs can grow beneath the canopy, along with ferns and wild flowers. Some of these forests are layered and thus provide many niches for different forms of animal life.

APPENDIX E

CYPRESS SWAMPS: PLANTS AND ANIMALS

Coastal/Gulf
Forested
Wetlands

Fishes

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Golden Shiner 70
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Red Salamander 120
River Frog 135
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Reptiles

American Alligator 172
Black Swamp Snake 181,
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Brown Water Snake 190
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Florida Red-bellied
Turtle 158
Glossy Grayfish Snake 184
Green Water Snake 185
Mud Snake 182
Razorback Musk Turtle 168
Slider 157, 163
Snapping Turtle 151
Southern Water Snake 191,
196
Timber Rattlesnake 193,
197, 198

Wildflowers, Ferns, and

Grasses

Arrowhead 247 **OBL**
Burtonbush 237 **OBL**
Butterfly Orchid 265
Cinnamon Fern 304 **FACW**
Crimson Pitcher Plant 280 **OBL**

Delicate Ionopsis 232 ?

Elderberry 242 **FACW**
Golden Club 222 **OBL**
Green Dragon 311 **FACW**
Hibiscus 275 **OBL**
Horned Bladderwort 218 **OBL**
Jack-in-the-pulpit 309, 327 **FACW**
Lizard's Tail 236 **OBL**
Pickerelweed 295 **OBL**
Red Iris 276 **OBL**
Royal Fern 306 **OBL**
Soft Rush 324 **FACW**
Spotted Touch-me-not 279 **FACW**
Swamp Honeysuckle 229 **FACW**
Swamp Rose 273 **OBL**
Sweet Pepperbush 235 **FACW**
Tall Meadow Rue 257 **FACW**
Titi 243 **FACW**
Trumpets 224 **OBL**
Water Hemlock 240 **OBL**
Water Hyacinth 296 **OBL**
Water Lettuce 308 **OBL**
Wild Pine 283 ?
Winterberry 244, 328 **FACW**
Wood Grass 322 **OBL**
Yaupon 329 **FAC**

Mushrooms

Wrinkled Thimble-cap 337

Insects and Spiders

American Horse Fly 378
Golden-silk Spider 383
Vinegar Fly 381

Butterflies and Moths

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408
Broken Dash 424
Creole Pearly Eye 410
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Skipper 411
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Trees

Baldcypress 433 **OBL**
Black Ash 435 **FACW**
Black Tupelo 443 **FAC**
Carolina Ash 437 **OBL**
Dahoon 448 **FACW**
Loblolly-bay 460 **FACW**
Possumhaw 469 **FACW**
Red Maple 479 **FAC**

Redbay 451 **FACW**
Sweetbay 449 **FACW**
Water-elm 464 **OBL**
Water Tupelo 462 **OBL**

Birds

American Swallow-tailed
Kite 559
Anhinga 518
Barred Owl 566
Black-crowned Night-
Heron 529
Great Blue Heron 528
Green-backed Heron 534
Limpkin 522
Little Blue Heron 521, 525
Pileated Woodpecker 569
Red-bellied
Woodpecker 570
Red-shouldered Hawk 564
Short-tailed Hawk 560
White-faced Ibis 523
Wood Duck 491
Wood Stork 524
Yellow-crowned Night-
Heron 530

Mammals

Black Bear 615
Bobcat 616
Cotton Mouse 597
Golden Mouse 598
Raccoon 614
White-tailed Deer 617

FAC

FACW

OBL

3

15

18

APPENDIX F

another forum are submitted to the journal, the authors must notify the editor. They must provide documentation regarding the nature of revisions that substantiate further publication or regarding review procedures, publication policies, intended use, and dispersal of the previous publication outlet. This will allow the editor to make a case-by-case review of each manuscript. If everything has been handled legitimately, this disclosure should not create problems in having the manuscript refereed and subsequently published in *Wetlands*. If authors do not disclose information regarding previous publication, their papers will be rejected.

Where does this leave an author who has been asked to contribute a paper to a proceedings volume or to an edited book? If your requirements are that it be refereed and/or receive widespread circulation, make certain that such is the case. If your requirements will not be met and further publication will be precluded, think twice and choose the most suitable outlet the first time.

N.B. 100% of plant found
were DBL or FACW

GRAMINOID COMMUNITY COMPOSITION AND STRUCTURE WITHIN FOUR EVERGLADES MANAGEMENT AREAS

John M. Wood and George W. Tanner
Department of Wildlife and Range Sciences
University of Florida
Gainesville, Florida 32611

Abstract: Estimates of species density, percentage vegetative cover, biomass, and sawgrass (*Cladium jamaicense*) height were made in Tall Sawgrass, Medium Sawgrass, and Wet Prairie communities in the SE portion of Water Conservation Area 3A (3A), the SW portion of Water Conservation Area 3B (3B), the NW portion of Northeast Shark Slough (NSS), and the NE portion of Everglades National Park (ENP) during dry season and wet season sampling periods in 1986 and 1987. We summarized the history of water management and hydroperiod manipulation in the study area. Wet Prairie had the deepest water of the four plant communities studied, while 3A had deepest water and longest hydroperiod of the three areas. Generally, the greatest species density occurred in NSS, where water was shallowest. Individual sawgrass plants and their basal tussocks were taller in 3A than in the other three areas. Sawgrass fluctuated more between sampling periods than among management areas, which may make plants in 3A more susceptible to damage by airplanes and fire. Cover and biomass of sawgrass fluctuated more between sampling periods than among management areas, which rendered lower measurements in Tall Sawgrass in 3B non-significant. Species composition of Wet Prairies, particularly in 3A where *Rhynchospora* spp. were absent, and *Nymphaea odorata* was dominant, resembled aquatic sloughs. The low species density in the study area may be related to rapid fluctuations in water levels that could drown slow-growing plants, and to infrequent dry periods that preclude seed germination. Species richness was low, compared with other Everglades plant community studies. No annual emergent plants were encountered.

Key Words: sawgrass, wet prairie, hydroperiod, diversity, biomass, cover.

INTRODUCTION

The Everglades ecosystem lies at the southern end of a massive drainage system that originates in Orange and Osceola counties, Florida. Costanza (1977) estimated that it originally encompassed 1.9 million ha of continuous swampland, marshes, prairies, and sloughs; he estimated 1.2 million ha remain. In the past, Lake Okeechobee overflowed during periods of high water from its southern shore into the swamps and marshes of the northern Everglades. Marsh plants nourished

OBL 35 FACW 6 FAC 0 0.15 L/FACW

Table 2. Frequency of occurrence (%) of plants within (n) 1.0 m² quadrats sampled during four sampling periods (Dry 1986, Wet 1986, Dry 1987, and Wet 1987) at three randomly selected sites per management area. Missing data in Dry 1987 account for unequal sample sizes.

	TALL SAWGRASS				MEDIUM SAWGRASS				WET PRAIRIE			
	3A*	3B	NSS	ENP	3A	3B	NSS	ENP	3A	3B	NSS	ENP
Sample Size (n)	180	180	180	135	180	135	180	135	180	150	180	135
<i>Aeschynomene pratensis</i> (5) ^b	OBL 0	0	1	3	1	0	2	0	0	0	1	3
<i>Annona glabra</i> (4)	OBL 0	0	1	0	0	0	0	0	0	0	0	0
<i>Bacopa caroliniana</i> (5)	OBL 0	0	2	0	2	21	8	8	0	10	4	2
<i>Cephalanthus occidentalis</i> (4)	OBL 7	9	15	9	4	1	2	1	0	0	0	0
<i>Chara</i> spp. (6)	*OBL 0	0	0	0	0	6	0	3	2	12	13	12
<i>Cladium jamaicense</i> (1)	OBL 97	100	100	100	99	100	100	100	0	12	4	4
<i>Coelorachis rugosa</i> (2)	OBL 0	0	0	0	0	0	3	0	0	0	0	0
<i>Crinum americanum</i> (5)	OBL 13	4	13	0	20	6	38	9	5	0	11	0
<i>Cyperus haspan</i> (2)	OBL 0	0	1	3	0	0	0	0	0	0	0	0
<i>Eleocharis cellulosa</i> (3)	OBL 1	3	10	3	22	40	67	68	43	93	98	99
<i>E. elongata</i> (3)	OBL 0	0	0	0	5	0	0	0	35	0	0	0
<i>E. interstincta</i> (2)	OBL 0	0	0	0	11	0	2	0	0	0	0	0
<i>Eriocaulon</i> sp. (2)	OBL 0	0	0	0	0	0	0	3	0	0	0	0
<i>Fuirena breviseta</i> (2)	OBL 0	0	0	0	0	0	0	2	0	0	0	0
<i>Ipomoea sagittata</i> (5)	FACW 2	14	34	45	0	3	23	1	0	0	0	0
<i>Justicia ovata</i> var. <i>angusta</i> (5)	OBL 2	13	8	9	2	15	19	12	0	0	0	0
<i>Leersia hexandra</i> (2)	OBL 2	0	4	0	4	4	2	2	0	2	0	0
<i>Ludwigia peruviana</i> (5)	OBL 0	0	1	4	0	0	2	0	0	0	0	0
<i>L. repens</i> (5)	OBL 0	0	1	0	0	0	0	0	0	0	0	0
<i>Mikania scandens</i> (5)	FACW 2	0	0	6	0	0	0	0	0	0	0	0
<i>Nymphaea odorata</i> (3)	OBL 8	4	0	0	16	2	1	0	99	34	3	0
<i>Osmunda regalis</i> (5)	OBL 0	1	0	0	0	0	0	0	0	0	0	0
<i>Oxypolis filiformis</i> (5)	FACW 0	0	0	1	0	2	3	0	0	0	0	0
<i>Panicum hemitomon</i> (3)	OBL 3	2	0	0	10	15	22	12	9	43	58	9
<i>P. tenerum</i> (2)	FACW 0	0	0	0	0	0	5	0	0	0	0	0
<i>Paspalum geminatum</i> var. <i>paludivagum</i> (3)	OBL 0	0	0	1	5	1	2	2	18	23	21	9
<i>Peltandra virginica</i> (5)	OBL 12	5	3	2	5	3	3	1	1	2	0	0
periphyton- <i>Utricularia</i> (6)	OBL 22	25	2	1	55	71	57	71	97	92	91	86
<i>Pluchea rosea</i> (5)	FACW 0	0	23	10	0	0	10	0	0	0	1	0
<i>Polygonum hydropiperoides</i> (5)	OBL 34	0	0	12	2	0	0	0	0	2	1	0
<i>Pontederia cordata</i> var. <i>lanceolata</i> (5)	OBL 18	2	8	10	11	2	1	0	5	1	2	1
<i>Potamogeton illinoensis</i> (6)	OBL 0	0	0	0	1	0	0	0	3	16	8	0
<i>Pteris</i> sp. (5)	OBL - FACW 1	14	10	2	0	0	0	0	0	0	0	0
<i>Rhynchospora decurrens</i> (2)	OBL 0	0	0	0	0	0	2	0	0	0	0	0
<i>R. inundata</i> (2)	OBL 0	0	0	1	0	3	11	3	0	0	2	3
<i>R. tracyi</i> (3)	OBL 0	0	2	0	0	29	18	4	0	22	48	62
<i>Sagittaria graminea</i> (3)	OBL 1	0	1	2	1	6	6	1	3	40	50	41
<i>S. lancifolia</i> (5)	OBL 7	4	28	17	2	7	12	1	0	1	0	0
<i>Salix caroliniana</i> (4)	OBL 0	0	12	2	0	0	2	0	0	1	0	0
<i>Salvinia minima</i> (5)	OBL 0	0	0	2	0	0	0	0	0	0	0	0
<i>Spiranthes laciniata</i> (5)	FACW 0	0	0	0	0	1	1	0	0	2	0	0
<i>Typha</i> spp. (5)	OBL 1	0	14	12	0	1	1	0	2	0	0	0

*Management areas: 3A = Conservation Area 3-A; 3B = Conservation Area 3-B; NSS = Northeast Shark Slough; ENP = Everglades National Park.

^bNumbers in parentheses indicate to which component each species was assigned: (1) Sawgrass (2) Grasses and Sedges (3) Wet Prairie Emergents (4) Woody Plants (5) Herbaceous Plants (6) Submergents.

APPENDIX G

Florida Department of
Environmental
Resources
Management

Bird Drive Everglades Basin/
Pennsuco Wetlands Vegetation and
Cover Type Mapping Study

Post-It™ brand fax transmittal memo 7671		# of pages • 2
To BOB PIERCE	From K. FANNING	
Co. WETLAND TRAINING INST.	Co. DADE CO. DERM	
Dept.	Phone # (305) 375-3312	
Fax # (305) 972-8112	Fax #	



DERM Technical Report 89-5

Table 8. Plant Species Occurring in the Dense Melaleuca Stand Vegetation Community Type Within the Study Area.

Scientific Name	DERM Status	Common Name	Relative Abundance/ Federal Status/DER Status
<i>Andropogon glomeratus</i>	(2)	Beardgrass	Uncommon/FACW/U
<i>Baccharis halimifolia</i>		Saltbush	Uncommon/FAC/U
<i>Cephalanthus occidentalis</i>	(1)	Buttonbush	Uncommon/OBL/S
<i>Cladium jamaicense</i>	(1)	Sawgrass	* Common/OBL/S
<i>Cissus sicyoides</i>		Possum Grape	Uncommon/UPLAND/U
<i>Cyperus haspan</i>	(2)	Sheathed Cyperus	Uncommon/OBL/S
<i>Dichromena colorata</i>		White Top	Uncommon/FACW/T
<i>Eleocharis atropurpurea</i>	(1)	Purple Spikerush	Uncommon/OBL/S
<i>Erianthus giganteus</i>	(2)	Sugarcane Plumegrass	Uncommon/FACW/(S)
<i>Erigeron vernus</i>		Fleabane	Uncommon/OBL/U
<i>Eulophia alta</i>	(2)	Wild Coco	Uncommon/FACW/(T)
<i>Eupatorium leptophyllum</i>		Fennell	Uncommon/FAC+/U
<i>Ipomoea sagittata</i>	(2)	Glades Morning Glory	Uncommon/FACW/(T)
<i>Melaleuca quinquenervia</i>		Cajeput	→ Abundant/FAC/-
<i>Mikania scandens</i>		Climbing Hempvine	Uncommon/FACW+/S
<i>Myrica cerifera</i>	(2)	Wax Myrtle	Uncommon/FAC/(-)
<i>Osmunda regalis</i>	(2)	Royal Fern	Uncommon/OBL/S
<i>Passiflora suberosa</i>		Passionflower	Uncommon/UPLAND/U
<i>Peltandra virginica</i>	(1)	Arrow Arum	Uncommon/OBL/S
<i>Pluchea rosea</i>		Marsh Fleabane	Uncommon/FACW/T
<i>Proserpinaca palustris</i>	(1)	Swamp Mermaid	Uncommon/OBL/S
<i>Rhynchospora microcarpa</i>	(1)	Littleseed Beakrush	Uncommon/FACW/S
<i>Sagittaria lancifolia</i>	(1)	Giant Arrowhead	Uncommon/OBL/S
<i>Salix caroliniana</i>	(1)	Coastal Plain Willow	* Common/OBL/S
<i>Schinus terebinthifolius</i>		Brazilian Pepper	Uncommon/FAC/-
<i>Schizachyrium rhizomatum</i>	(2)	Narrow Beardgrass	Uncommon/FACW-/T
<i>Solidago stricta</i>		Willowleaf Goldenrod	Uncommon/OBL/(T)
<i>Thelypteris kunthii</i>		Shield Fern	Uncommon/FACW/T

OBL FACW FAC FACU uPL
 11 10 5 0 2

21:2

Two most common associated plants w/ Melaleuca
 are both OBL

APPENDIX H

Normandeau Associates, Inc.

25 Nashua Road
Bedford, NH 03102-5999
(603) 472-5191
(603) 472-7052 (Fax)

Dr. Robert Pierce
Wetland Training Institute
P. O. Box 1022
Poolesville, MD 20837-0099

NORMANDEAU ASSOCIATES

July 27, 1991

MEMO REGARDING: Dominance of Eastern hemlock in New England water resources.

We have polled other wetland scientists at Normandeau Associates, Inc. familiar with wetland delineation and evaluation throughout northern New England, about hemlock as a dominant plant in wetland resources. It is our summary strong opinion that hemlocks prefer rock ledge areas, and are shallow-rooted in predominantly upland locations and places bordering streams. The species occurs sporadically in wetlands, with a frequency of less than that of most other conifers (White and pitch pines, *Pinus strobus*, *P. rigida*). Hemlocks found within wetlands are never really prevalent, only occasional. Hemlocks found along wetland edges may obscure the proper line, especially where they grow in thickets of dense shade. Here the hemlock's FACU rating may cause delineation disputes, but other plant species are sufficiently prevalent to make the resource as easy to identify as any forested wetland areas in our vicinity.

Hemlock occurrences along rocky streams, especially over compact till or shallow-to-ledge soils, often occur as near monocultures, with little understory, due to the intense shading and shade tolerance of the species. Following a delineation manual explicitly might lead a novice to the wrong conclusion, but the hydrologic signs of the streamway are, in all cases we can recollect, evident from the topography and the non-dominant plant species, even though the soil investigation may be thwarted by the rockiness of the site.

More of a problem, is the 1989 Federal Manual's (and the New England CORPs) requirement that all layers be represented only by dominants on formal datasheets. No regard is given to weighting richly populated and sparsely populated layers. A single poison ivy vine in a plot (FAC) provides as much weight in making the vegetation decision as a dense canopy of upland oaks. In areas of 15 to 30% slope on rock hillsides, we occasionally find Witch hazel (*Hamamelis virginiana*), listed as a FAC- species, occurring sparsely in the Sapling, the Shrub and the Herb layers, as presently defined. This species occurs less than half the time within wetland edges, yet presently is considered to indicate the presence of wetlands! Finding it in three layers, with no weighting given for fact that the plant is only a sparse component of the overall plot, makes it outweigh the much more areally dominant oak and pine overstory, giving a false positive wetland delineation result.

Best regards, for Normandeau Associates, Inc.

Martin C. Michener
Martin C. Michener, Ph.D.
Senior Wetlands Specialist

Patrick W. Fairbairn
Patrick W. Fairbairn, Ph.D.
Senior Wetlands Ecologist

Sarah Allen
Sarah Allen, M.S.
Wetlands Ecologist

Bedford, NH
Hampton, NH
Yarmouth, ME

Middleboro, MA
Bloomfield, CT
Peekskill, NY
Lakewood, NJ

Aiken, SC
Greenville, SC
LeClaire, IA

New England Institute for Environmental Studies, Inc.
 Plant Community Indicator Database, Software Copyright(c) 1990; Ver. 9015.

Site location: Upland thicket, adjacent to small wetland, MA
 Data collected by: P. W. Fairbairn, on:
 Report from file: D:\BOTANY\RIDGE1.VCD on: 07-25-1991 at: 18:05:03

Scientific name	Common name	Abun-	NWI	Geo.
		dance	Categ.	Src
TREE LAYER				
<i>Tsuga canadensis</i>	Hemlock	60.0	FACU	N
<i>Acer saccharum</i>	Sugar maple	20.0	FACU-	N
<i>Betula lenta</i>	Sweet birch	15.0	FACU	N
<i>Castanea dentata</i>	American chestnut	1.0	UPL	N
SHRUB LAYER				
<i>Clethra alnifolia</i>	Sweet pepperbush	3.0	FAC+	N
HERB LAYER				
<i>Aralia nudicaulis</i>	Wild sarsaparilla	8.0	FACU	N
<i>Maianthemum canadense</i>	Canada mayflower	5.0	FAC-	N
<i>Osmunda claytoniana</i>	Interrupted fern	4.0	FAC	N
<i>Athyrium filix-femina</i>	Lady fern	4.0	FAC	N
<i>Smilax rotundifolia</i>	Greenbriar	0.1	FAC	N
<i>Trientalis borealis</i>	Starflower	0.1	FAC	N

TOTAL ABUNDANCES: 120.2

SUMMARY: WSI: 0.205
 Diversity Index H = 2.29, binary;
 (meaning 4.9 equiabundant species).

APPENDIX I

Coastal/Gulf Forested Wetlands

SOUTHERN BOTTOMLAND HARDWOOD SWAMPS: PLANTS AND ANIMALS

Fishes

Alligator Gar 78
Chain Pickerel 75
Golden Shiner 70
Green Sunfish 54
Least Killifish 101
Pirate Perch 57
Starhead Topminnow 65
Swamp Darter 61
Warmouth 47

Amphibians

Bird-voiced Treefrog 147
Bullfrog 136, 137
Dwarf Siren 108
Greater Siren 106
Green Frog 134
Lesser Siren 107
Mud Salamander 111, 116,
118, 119
Red Salamander 120
River Frog 135
Southern Cricket Frog 141,
142
Spring Peeper 150
Striped Chorus Frog 132
Two-lined Salamander 110,
121
Two-toed Amphiuma 103

Reptiles

American Alligator 172
Black Swamp Snake 181,
183
Brown Water Snake 190
Cottonmouth 175, 177,
194
Glossy Crayfish Snake 184
Green Water Snake 185
Mud Snake 182
Painted Turtle 159, 161,
162
Razorback Musk Turtle 168
Slider 157, 163
Southern Water Snake 191,
196
Timber Rattlesnake 193,
197, 198

Wildflowers, Ferns and

Grasses

Buttonbush 237 **OBL**
Titi 243 **FACW**
Yaupon 329 **FAC**

Mushrooms

Wrinkled Thimble-cap 337

Insects and Spiders

American Horse Fly 378
Golden-silk Spider 383
Vinegar Fly 381

Butterflies and Moths

Appalachian Brown 400,
408
Broken Dash 424
Creole Pearly Eye 410
Harvester 394
Lace-winged Roadside
Skipper 411
Palamedes Swallowtail 389

Trees

Atlantic White-cedar 429 **OBL**
Baldcypress 433 **OBL**
Black Ash 435 **FACW**
Black Tupelo 443 **FAC**
Black Willow 453 **FACW**
Buckwheat-tree 446 **OBL**
Carolina Ash 437 **OBL**
Dahoon 448 **FACW**
Honeylocust 434 **FAC**
Loblolly-bay 460 **FACW**
Northern White-cedar 428 **FACW**
Nutmeg Hickory 440 **FACW**
Overcup Oak 475 **OBL**
Poison Sumac 441 **OBL**
Possumhaw 469 **FACW**
Red Maple 479 **FAC**
Redbay 451 **FACW**
Silver Maple 478 **FACW**
Sugarberry 463 **FACW**
Swamp Chestnut Oak 473 **FACW**
Swamp-priver 456 **OBL**
Sweetbay 449 **FACW**
Water-elm 464 **OBL**
Water Hickory 439 **OBL**
Water Oak 474 **FAC**
Water Tupelo 462 **OBL**
Willow Oak 452 **FACW**

Birds

American Swallow-tailed
Kite 559
Anhinga 518
Bald Eagle 562
Barred Owl 566
Black-crowned Night-

Heron 529
Common Yellowthroat 584
Double-crested
Cormorant 520
Hooded Merganser 509
Little Blue Heron 521, 525
Louisiana Water Thrush 578
Osprey 563
Prothonotary Warbler 585
Red-bellied
Woodpecker 570
Red-shouldered Hawk 564
Red-winged Blackbird 580,
588
Swainson's Warbler 581
Swamp Sparrow 576
Wild Turkey 567
Wood Duck 491
Yellow-crowned Night-
Heron 530

Mammals

Beaver 611
Black Bear 615
Bobcat 616
Cotton Mouse 597
Golden Mouse 598
Mink 613
Moose 618
Muskrat 609
Raccoon 614
River Otter 612
Smoky Shrew 593
Southern Red-backed
Vole 601, 602
Star-nosed Mole 595
Swamp Rabbit 606
White-tailed Deer 617

0 FW F FU U
11 14 4 0 0

APPENDIX J

WETLANDS OF DELAWARE

by

Ralph W. Tiner, Jr.
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Habitat Resources
U.S. Fish and Wildlife Service
Region 5
Newton Corner, MA 02158

SEPTEMBER 1985

Project Officer
David L. Hardin
Department of Natural Resources and Environmental Control
Wetlands Section
State of Delaware
89 Kings Highway
Dover, DE 19903

Cooperative Publication

U.S. Fish and Wildlife Service
Region 5
Habitat Resources
One Gateway Center
Newton Corner, MA 02158

Delaware Department of Natural
Resources and Environmental
Control
Division of Environmental Control
89 Kings Highway
Dover, DE 19903

Scientific Name	Plant Common Name	Scientific Name	Plant Common Name
Umbelliferae		<i>Sabatia difformis</i> OBL	Marsh Pink
<i>Hydrocotyle americana</i> OBL	Water Pennywort	<i>Sabatia dodecandra</i> OBL	Marsh Pink
<i>Hydrocotyle ranunculoides</i> OBL	Floating Pennywort	<i>Sabatia stellaris</i> Facw	Marsh Pink
<i>Hydrocotyle umbellata</i> OBL	Water Pennywort	* <i>Gentiana autumnalis</i> Facw	Pine Barrens Gentian
<i>Hydrocotyle verticillata</i> OBL	Whorled Pennywort	<i>Gentiana catesbaei</i> OBL	Sampson's Snakeroot
<i>Conium maculatum</i> Facw	Poison Hemlock	<i>Gentiana saponaria</i> Facw	Soapwort Gentian
<i>Sium suave</i> OBL	Water Parsnip	<i>Gentianopsis crinita</i> OBL	Fringed Gentian
* <i>Cicuta bulbifera</i> OBL	Water Hemlock	<i>Bartonia paniculata</i> OBL	Twining Bartonia
<i>Cicuta maculata</i> OBL	Water Hemlock	<i>Bartonia virginica</i> Facw	Bartonia
<i>Lilaeopsis chinensis</i> OBL	Eastern Lilaeopsis	* <i>Nymphoides aquatica</i> OBL	Big Floating Heart
<i>Ptilimnium capillare</i> OBL	Mock Bishopweed	<i>Nymphoides cordata</i> OBL	Little Floating Heart
<i>Angelica atropurpurea</i> OBL	Angelica		
* <i>Oxypolis canbyi</i> OBL	Canby's Dropwort	Apocynaceae	
<i>Oxypolis rigidior</i> OBL	Stiff Cowbane	<i>Apocynum cannabinum</i> Facw	Indian Hemp Dogbane
<i>Eryngium aquaticum</i> OBL	Eryngium	<i>Apocynum sibiricum</i> Fac	Prairie Dogbane
Cornaceae		Asclepiadaceae	
<i>Cornus amomum</i> Facw	Silky Dogwood	<i>Asclepias incarnata</i> OBL	Swamp Milkweed
<i>Nyssa sylvatica</i> Facw	Black Gum	<i>Asclepias lanceolata</i> OBL	Milkweed
		<i>Asclepias rubra</i> OBL	Red Milkweed
Clethraceae		Convolvulaceae	
<i>Clethra alnifolia</i> Fac	Sweet Pepperbush	<i>Convolvulus sepium</i>	Hedge Bindweed
		<i>Cuscuta gronovii</i>	Swamp Dodder
Ericaceae		Boraginaceae	
<i>Rhododendron periclymenoides</i> Fac	Purple Azalea	<i>Myosotis laxa</i> OBL	Forget-me-not
<i>Rhododendron viscosum</i> OBL	Swamp Azalea	* <i>Myosotis scorpioides</i> OBL	True Forget-me-not
<i>Kalmia angustifolia</i> Fac	Sheep Laurel	<i>Mertensia virginica</i> Facw	Bluebells
<i>Leucothoe racemosa</i> Facw	Fetterbush	* <i>Heliotropium curassavicum</i> OBL	Seaside Heliotrope
<i>Lyonia ligustrina</i> Facw	Maleberry		
<i>Chamaedaphne calyculata</i> OBL	Leatherleaf		
<i>Gaylussacia baccata</i> Facw	Black Huckleberry	Verbenaceae	
<i>Gaylussacia dumosa</i> Fac	Dwarf Huckleberry	<i>Verbena hastata</i> Facw	Blue Vervain
<i>Gaylussacia frondosa</i> Fac	Dangleberry	<i>Phyla lanceolata</i> OBL	Frog Fruit
<i>Vaccinium corymbosum</i> Facw	Highbush Blueberry		
<i>Vaccinium macrocarpon</i> OBL	Big Cranberry	Labiatae	
<i>Vaccinium stramineum</i> Facw	Deerberry	<i>Teucrium canadense</i> Facw	Germander
		<i>Scutellaria galericulata</i> OBL	Common Skullcap
Primulaceae		<i>Scutellaria integrifolia</i> Facw	Hyssop Skullcap
* <i>Hottonia inflata</i> OBL	Featherfoil	<i>Scutellaria lateriflora</i> Facw	Mad-dog Skullcap
<i>Lysimachia ciliata</i> Facw	Fringed Loosestrife	<i>Prunella vulgaris</i> Facw	Self-heal
<i>Lysimachia hybrida</i> OBL	Loosestrife	<i>Stachys hispida</i> OBL	
<i>Lysimachia terrestris</i> OBL	Swamp Candles	<i>Stachys hyssopifolia</i> Facw	Hyssop Hedge-nettle
* <i>Samolus parviflorus</i> OBL	Water Pimpernel	* <i>Stachys palustris</i> OBL	Woundwort
* <i>Trientalis borealis</i> Fac	Starflower	<i>Stachys tenuifolia</i> Facw	Hedge Nettle
<i>Anagallis arvensis</i> OBL	Poor Man's Weather-glass	<i>Pycnanthemum muticum</i> Facw	Mountain Mint
		<i>Pycnanthemum verticillatum</i> Fac	
Plumbaginaceae		<i>Lycopus americanus</i> OBL	Water Horehound
<i>Limonium carolinianum</i> OBL	Sea Lavender	<i>Lycopus amplexans</i> OBL	Water Horehound
* <i>Limonium nashii</i> OBL	Sea Lavender	<i>Lycopus europaeus</i> OBL	European Bugleweed
		<i>Lycopus uniflorus</i> OBL	One-flower Bugleweed
Ebenaceae		<i>Lycopus virginicus</i> OBL	Bugleweed
<i>Diospyros virginiana</i> Fac	Persimmon	<i>Mentha aquatica</i> OBL	Water Mint
		<i>Mentha arvensis</i> Facw	Wild Mint
Styracaceae		<i>Mentha gentilis</i>	
<i>Symplocos tinctoria</i> Fac	Sweet Leaf	<i>Mentha spicata</i> Facw	Spearmint
Oleaceae		Solanaceae	
<i>Fraxinus americana</i> Facw	White Ash	<i>Solanum dulcamara</i> Fac	Bittersweet Nightshade
<i>Fraxinus pennsylvanica</i> Facw	Green Ash	<i>Solanum nigrum</i> Facw	Common Nightshade
<i>Fraxinus nigra</i> Facw	Black Ash		
Gentianaceae		Scrophulariaceae	
<i>Sabatia angularis</i> Fac	Square-stemmed Centaury	* <i>Scrophularia lanceolata</i> Facw	Figwort
<i>Sabatia campanulata</i> Facw	Marsh Pink	<i>Gratiola aurea</i> OBL	Hedge Hyssop

0 FW F FU U
46 24 12 7 1

Scientific Name

Plant Common Name

References

Mikania scandens FALW	Climbing Hempweed
Liatris graminifolia UPL	Blazing Star
Vernonia noveboracensis FALW	New York Ironweed
Cirsium muticum OBL	Swamp Thistle
Gnaphalium obtusifolium UPL	Cudweed
Filaginella uliginosa FAL	Low Cudweed
Senecio aureus FALW	Golden Ragwort
Senecio tomentosus FALU	Woolly Ragwort
*Sonchus arvensis UPL	Sow Thistle
Hieracium gronovii UPL	Hawkweed

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0	FW	F	FU	U
1	2	1	1	4

APPENDIX K

Table 16. Examples of temporarily flooded forested wetland communities in Delaware.

Dominance Type	Common Associates	Less Common Vegetation	Ratio (OBL:FACW:FACU)
Tulip Tree and Ash	Ironwood, Spring Beauty, Japanese Honeysuckle, and Spicebush FAC FACU	May Apple, Poison Ivy, Violet, Jack-in-pulpit, Trout Lily, Wild Garlic, Skunk Cabbage, Silky Dogwood, Black Cherry, Brambles, Elderberry, Greenbriar, and Jewelweed	5:5
American Elm and Red Maple	Sycamore, Jewelweed, Stinging Nettle, and Spicebush	Bluebells, May Apple, Spring Beauty, Silver Maple, Elderberry, Ash, Brambles, Black Cherry, Hawthorn, Wild Garlic, Wild Onion, and Japanese Honeysuckle	6:5
Red Maple and Black Gum	Sweet Gum, Ground-cedar, and Highbush Blueberry	Willow Oak, Shadbush, Winterberry, Oaks, Peat Moss (in depressions), Scrub Pine, and Huckleberry	3:0
Red Maple	Black Gum, and Poison Ivy	Sweet Gum, Willow Oak, Haircap Moss, Pin Oak, Greenbriar, Highbush Blueberry, Soft Rush, and Sedge	4:0
Red Maple and Sweet Gum	Sweet Pepperbush, Greenbriar, and Black Gum	Swamp Azalea, Inkberry, Rose, Willow Oak, Brambles, Net-veined Chain Fern, Sedge, Sweet Bay, Highbush Blueberry, and American Holly	7:0
Loblolly Pine	Sweet Gum, Red Maple, Poison Ivy, and Highbush Blueberry	Inkberry, Sweet Bay, Virginia Creeper, Greenbriar, American Holly, Ironwood, Black Gum and Beech	3:2

County. Examples of temporarily flooded forested communities are presented in Tables 15 and 16.

Two types of evergreen forested wetlands are found in Delaware: (1) loblolly pine wetlands, and (2) Atlantic white cedar swamps. The former type is more widespread and may occupy rather large areas, while the latter is relatively uncommon and limited to rather small stands in general. Loblolly pine wetlands occur in both seasonally flooded and temporarily flooded situations, whereas white cedar is usually associated with seasonally flooded areas and freshwater tidal wetlands.

Loblolly pine, although dominant, is often mixed in varying proportions with other trees, including red maple, sweet gum, Atlantic white cedar, sweet bay, and American holly (Plate III.d.). Less common associated trees are water oak (*Quercus nigra*), beech, ironwood, and black gum. The underlying shrub thicket is composed of several species, including highbush blueberry, inkberry, sweet pepperbush, swamp azalea, and wax myrtle. Occasionally elderberry and shadbush (*Amelanchier* spp.) are present. Greenbriars (*Smilax* spp.) and poison ivy may be common, especially at drier sites. Herbaceous plants scattered on the forest floor include skunk cabbage and ferns (e.g., cinnamon, marsh, net-veined chain, and royal) in seasonally flooded areas. Peat moss may be common in wetter depressions, while other mosses also occur.

Historically more abundant, Atlantic white cedar wetlands today are generally confined to rather small stands. Fleming (1978) describes several cedar areas. While white cedar dominates, other trees are intermixed such as sweet bay, loblolly pine, pond pine (*Pinus serotina*), black gum, and green ash. Associated shrubs may include smooth alder, inkberry, highbush blueberry, bayberry, evergreen bayberry (*Myrica heterophylla*), sweet pepperbush, maleberry, deerberry (*Vaccinium stramineum*), swamp rose, and poison ivy. Laurel greenbriar (*Smilax laurifolia*) and redberry greenbriar (*Smilax walteri*) may be present. Emergent groundcover often includes several ferns: royal, marsh, net-veined chain, and Virginia chain (*Woodwardia virginica*). Lizard's-tail may also be present. Fleming (1978) describes a mixed community of pond pine, water oak, and Atlantic white cedar, where Spanish oak (*Quercus falcata*), red maple, American holly, and sweet bay occur as associates.

Lacustrine Wetlands

The Lacustrine System is principally a deepwater habitat system of lakes, reservoirs and deep ponds. Consequently, as in the Riverine System, wetlands are generally limited to shallow waters and exposed shorelines. While algae are probably more abundant in these waters, the vascular macrophytes are more readily

APPENDIX L

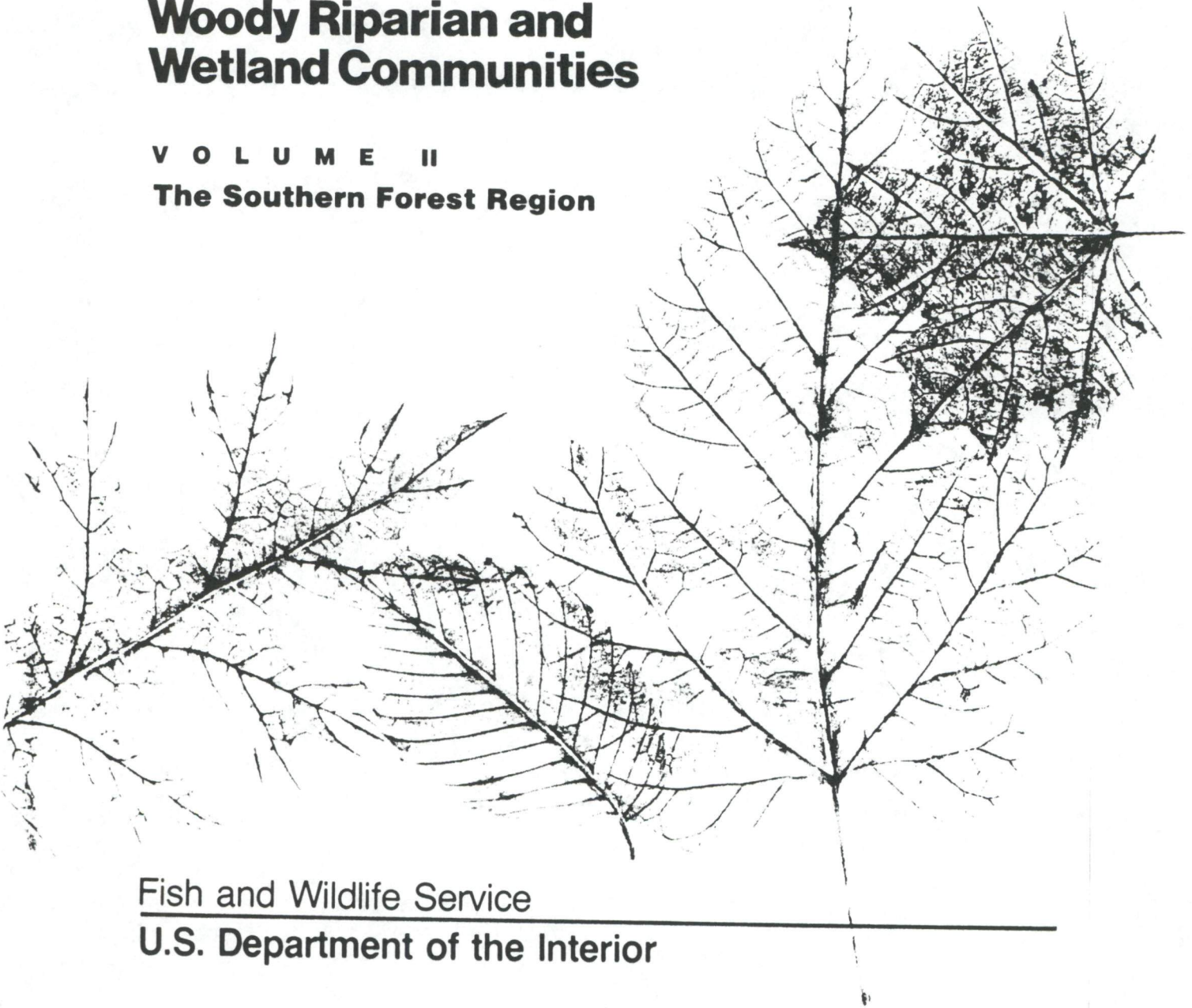
Biological Services Program

FWS/OBS-77/59
December 1977

**Impact of
Water Level Changes on
Woody Riparian and
Wetland Communities**

V O L U M E I I

The Southern Forest Region



Fish and Wildlife Service
U.S. Department of the Interior

Southern Mixed Forest

		ORL	FACW	FAC	FACU	UPL
		0	0	4	7	5
i.	Dry sites					
FAC	<i>Acer rubrum</i>					red maple
	<i>Carya</i> spp.					hickory spp.
FAC +	<i>Liquidambar styraciflua</i>					sweetgum
FAC	<i>Nyssa sylvatica</i>					blackgum
UPL	<i>Pinus echinata</i>					shortleaf pine
FACU +	<i>P. palustris</i>					longleaf pine
FACU -	<i>P. rigida</i>					pitch pine
FAC	<i>P. taeda</i>					loblolly pine
FACU	<i>Quercus alba</i>					white oak
UPL	<i>Q. coccinea</i>					scarlet oak
FACU -	<i>Q. falcata</i>					southern red oak
UPL	<i>Q. laevis</i>					turkey oak
UPL	<i>Q. marilandica</i>					blackjack oak
UPL	<i>Q. montana</i>					chestnut oak
FACU	<i>Q. stellata</i>					post oak
FACU	<i>Q. stellata</i> var. <i>margaretta</i>					slender post oak
FACU	<i>Tsuga canadensis</i>					eastern hemlock
ii.	Well drained sites	0	FW	F	FU	U
		0	4	6	6	5
FAC	<i>Acer rubrum</i>					red maple
FACW	<i>A. saccharinum</i>					silver maple
FACU -	<i>A. saccharum</i>					sugar maple
FAC	<i>Diospyros virginiana</i>					persimmon
FAC -	<i>Gleditsia tricanthos</i>					honeylocust
FACU	<i>Juglans nigra</i>					black walnut
FAC +	<i>Liquidambar styraciflua</i>					sweetgum
FAC	<i>Nyssa sylvatica</i>					blackgum
UPL	<i>Pinus echinata</i>					shortleaf pine
FACW	<i>P. glabra</i>					spruce pine
FAC	<i>P. taeda</i>					loblolly pine
FACW -	<i>Platanus occidentalis</i>					sycamore
FACU	<i>Prunus serotina</i>					black cherry
FACU -	<i>Quercus falcata</i>					southern red oak

0:12

4:11

UPL	<i>Q. coccinea</i>	scarlet oak
UPL	<i>Q. marilandica</i>	blackjack oak
FAC U	<i>Q. stellata</i> var. <i>margaretta</i>	delta post oak
UPL	<i>Q. velutina</i>	black oak
UPL	<i>Robinia pseudoacacia</i>	black locust
FAC U+	<i>Ulmus alata</i>	winged elm
FAC W	<i>U. americana</i>	American elm

iii. Bottomlands (seldom covered by standing water)

	<i>Carya leiodermis</i>	swamp hickory
FACW-	<i>C. myristicaeformis</i>	nutmeg hickory
FACU	<i>Fagus grandifolia</i>	American beech
FACU	<i>Fraxinus americana</i>	white ash
FACW	<i>F. pennsylvanica</i>	green ash
FAC+	<i>Liquidambar styraciflua</i>	sweetgum
FAC	<i>Liriodendron tulipifera</i>	yellow poplar
FAC+	<i>Magnolia grandiflora</i>	southern magnolia
FACW	<i>Pinus glabra</i>	spruce pine
FAC	<i>P. taeda</i>	loblolly pine
FACU-	<i>Quercus falcata</i>	southern red oak
FAC+	<i>Q. falcata</i>	
	var. <i>pagodaefolia</i>	cherrybark oak
FAC	<i>Q. nigra</i>	water oak
FACW-	<i>Q. phellos</i>	willow oak
	<i>Q. prinus</i>	swamp chestnut oak
FACW-	<i>Q. shumardii</i>	shumard oak
FACU	<i>Q. stellata</i>	post oak
	<i>Q. velutina</i>	black oak
FACU+	<i>Ulmus alata</i>	winged elm
FACW	<i>U. americana</i>	American elm

iv. Wet sites (excessive moisture most of the year)

FAC *Acer rubrum* red maple
FACH *Fraxinus americana* white ash
FACW *F. pennsylvanica* green ash



FAC+	<i>Liquidambar styraciflua</i>	sweetgum
FAC	<i>Liriodendron tulipifera</i>	yellow poplar
FACW+	<i>Magnolia virginiana</i>	sweetbay
FAC	<i>Nyssa sylvatica</i>	blackgum
OBL	<i>N. sylvatica</i> var. <i>biflora</i>	swamp tupelo
FACW	<i>Quercus laurifolia</i>	laurel oak
FAC	<i>Q. nigra</i>	water oak
FACW-	<i>Q. phellos</i>	willow oak
FACW	<i>Ulmus americana</i>	American elm

SOUTHERN FLOODPLAIN FOREST (2)

The forests of this ecoregion are predominantly bottomland forests found on the floodplain for the Mississippi River. Forests formed on river alluvial material can be subdivided into three sections: swamp forests, hardwood bottoms and ridge bottoms (Braun, 1972). All of these areas are often covered by standing water, at least during flood periods. The duration of standing water on these sites varies from throughout the year (except during drought years) in the swamp forests to only during flooded periods on ridge bottoms.

The climate is humid subtropical with warm summers and no dry season (Trewartha, 1943). The temperature ranges from greater than 22° C during the warmest month to between 18° C and -3° C in the coldest month (Bailey, 1976). Soils in this region are predominantly inceptisols with a few scattered bands of alfisols (Boul, 1973).

Bottomland Forest Succession

Establishment of tree species in this forest type follows patterns similar to adjoining ecoregions. Colonization begins with black willow, sandbar willow and cottonwood (Brown, 1931). This successional stage is followed by the overcup oak, water hickory type, which includes green ash and persimmon. A number of associations may follow this stage. One is the establishment of a hackberry, elm, ash association which includes water hickory and willow oak. Another possible association is the river swamp type with red maple, red gum, pin oak, willow oak and Nuttall oak associations. Flooding may also disrupt the successional patterns in upland tree species. In a flooded upland area all true upland species were killed by flooding. Species which were originally associated with the upland species but which survived flooding were persimmon, sweetgum, water tupelo, overcup oak and willow (Eggle and Moore, 1961).

Characteristic Species

The dominant and associated species as well as the site characteristics of the Southern Floodplain forest are listed (Soc. Am. For., 1954).

Dominant species of the region (Kuchler, 1964):

DBL	<i>Nyssa aquatica</i>	water tupelo
	<i>Quercus</i> spp.	oaks
	<i>Taxodium distichum</i>	baldecypress

Site characteristics of the dominant species:

- i. *Nyssa aquatica* - restricted to low, poorly drained flats, deep sloughs and swamps wet most of the year, also in very deep swamps and intermittently wet sites.
- ii. *Quercus* spp. - found in a range of sites from well drained to poorly drained.
- iii. *Taxodium distichum* - occurs on very low, poorly drained flats, deep sloughs and swamps wet most of the year. Found also in very moist but seldom wet areas.

Associated species:

	O	FW	F	Fu	u
i. Well drained sites	3	5	5	4	0
FAC	<i>Acer rubrum</i>				red maple
FACW	<i>Gordonia lasianthus</i>				loblolly bay
OBL	<i>Fraxinus caroliniana</i>				Carolina ash
FAC+	<i>Liquidambar styraciflua</i>				sweetgum
FACNT	<i>Magnolia virginiana</i>				sweetbay
OBL	<i>Nyssa aquatica</i>				water tupelo
FAC	<i>Nyssa sylvatica</i>				blackgum
FACut	<i>Pinus palustris</i>				longleaf pine
FACW+	<i>P. serotina</i>				pond pine
FAC	<i>P. taeda</i>				loblolly pine
FACW	<i>Quercus laurifolia</i>				laurel oak
	<i>Q. marilandica</i>				blackjack oak

8:4

FAC	<i>Q. nigra</i>						water oak	
FACU	<i>Q. stellata</i>						post oak	
FACU	<i>Q. stellata</i> var. <i>margaretta</i>						sand post oak	
FACU+	<i>Q. virginiana</i>						live oak	
OBL	<i>Taxodium distichum</i>						baldcypress	
	<i>T. distichum</i> var. <i>nutans</i>						pond cypress	
FACW	<i>Ulmus americana</i>						American elm	
ii.	Bottomlands	0 4	FW 6	F 6	FU 1	U 0		
FACW	<i>Acer negundo</i>						boxelder	
FAC	<i>Acer rubrum</i>						red maple	
FAC+	<i>Carya illinoensis</i>						pecan	10:1
FACW	<i>Celtis laevigata</i>						sugarberry	
FACU	<i>C. occidentalis</i>						hackberry	
FAC	<i>Diospyros virginiana</i>						persimmon	
FACW	<i>Fraxinus pennsylvanica</i>						green ash	
OBL	<i>Gleditsia aquatica</i>						water locust	
FAC-	<i>G. triacanthos</i>						honeylocust	
FAC+	<i>Liquidambar styraciflua</i>						sweetgum	
FACW-	<i>Platanus occidentalis</i>						American sycamore	
FAC+	<i>Populus deltoides</i>						eastern cottonwood	
FACW	<i>Quercus laurifolia</i>						laurel oak	
OBL	<i>Q. lyrata</i>						overcup oak	
OBL	<i>Q. nuttallii</i>						Nuttall oak	
FACW-	<i>Q. phellos</i>						willow oak	
OBL	<i>Salix nigra</i>						black willow	
	<i>Taxodium distichum</i>						baldcypress	
iii.	Wet sites (excessive moisture most of the year)	0 8	FW 4	F 4	FU 0	U 0		
FAC	<i>Acer rubrum</i>						red maple	
OBL	<i>Carya aquatica</i>						water hickory	12:0
FAC	<i>Diospyros virginiana</i>						persimmon	

OBL	<i>Fraxinus caroliniana</i>	Carolina ash
OBL	<i>F. profunda</i>	pumpkin ash
FAC†	<i>Liquidambar styraciflua</i>	sweetgum
FACW†	<i>Magnolia virginiana</i>	sweetbay
OBL	<i>Nyssa aquatica</i>	water tupelo
FAC?	<i>Nyssa sylvatica</i> var. <i>biflora</i>	swamp tupelo
FACW†	<i>Pinus serotina</i>	pond pine
OBL	<i>Populus heterophylla</i>	swamp cottonwood
FACW	<i>Quercus laurifolia</i>	laurel oak
OBL	<i>Q. lyrata</i>	overcup oak
OOL	<i>Q. nuttallii</i>	Nuttall oak
OOL	<i>Taxodium distichum</i>	baldcypress
FACW	<i>Ulmus americana</i>	American elm

BEECH-SWEETGUM-MAGNOLIA-PINE-OAK FOREST (3)

This ecoregion is confined to the Coastal Plain Province (Hunt, 1951) (Figure 1). The vegetation is a mixture of evergreen and deciduous communities including both conifers, broad leafed evergreens and deciduous hardwoods (Braun, 1972).

The climate is humid, subtropical, with warm summers and no dry season (Trewartha, 1943). The average temperature ranges from greater than 22° C in the warmest month to between 18 and -3° C in the coldest (Bailey, 1976).

The land area is geographically young with successively younger aged material toward the coast (Braun, 1972). The soils are predominantly ultisols with small sections of entisols, alfisols and inceptisols intermixed (Boul, 1973).

Bottomland Forest Succession

Bottomland succession begins with the colonization of bare areas by cottonwood and willow followed later by the presence of river birch, silver maple, boxelder, hackberry, green ash, pecan and sycamore which come to dominate. This forest is replaced as soil development continues by a mixed bottomland forest dominated primarily by sweetgum, red maple and swamp oak. These species may be associated with black willow, river birch, cottonwood, silver maple, boxelder, green ash, hackberry, pecan and sycamore. In the best drained sites, this forest is replaced by an even more mesophytic forest (Braun, 1972).

<u>Associated species:</u>		O	FW	F	FU	U	
		0	2	3	1	5	
i.	Dry Site						2:6
FAC	<i>Acer rubrum</i>						red maple
FACU-OBL	<i>Carya</i> spp.						hickories
FAC	<i>Diospyros virginiana</i>						persimmon
	<i>Ilex</i> spp.						holly
FAC+	<i>Magnolia grandiflora</i>						southern magnolia
FACW	<i>Persea borbonia</i>						red bay
UPL	<i>P. echinata</i>						shortleaf pine
UPL	<i>Quercus incana</i>						bluejack oak
UPL	<i>Q. laevis</i>						turkey oak
FACW	<i>Q. laurifolia</i>						laurel oak
UPL	<i>Q. marilandica</i>						blackjack oak
UPL	<i>Q. myrtifolia</i>						myrtle oak
FACU	<i>Q. stellata</i> var. <i>margaretta</i>						sand post oak
FACU+	<i>Q. virginiana</i> var. <i>maritima</i>						sand live oak

ii.	Moist Site	O	FW	F	FU	U	
		3	7	11	5	8	
FAC	<i>Acer rubrum</i>						red maple
FAC	<i>Carya cordiformis</i>						bitternut hickory
FAC+	<i>C. illinoensis</i>						pecan
FACN-	<i>C. laciniosa</i>						shellbark hickory
UPL	<i>C. tomentosa</i>						mockernut hickory
FAC-OBL	<i>Crataegus</i> spp.						hawthorn
FAC	<i>Diospyros virginiana</i>						persimmon
FACU	<i>Fraxinus americana</i>						white ash
OBL	<i>F. caroliniana</i>						Carolina ash
FACW	<i>F. pennsylvanica</i>						green ash
FAC-	<i>Gleditsia triacanthos</i>						honeylocust
FAC+	<i>Liquidambar styraciflua</i>						sweetgum
FAC	<i>Liriodendron tulipifera</i>						yellow poplar
FAC+	<i>Magnolia grandiflora</i>						southern magnolia
FACW+	<i>Magnolia virginiana</i>						sweetbay

OBL *Nyssa aquatica*
 FAC *Nyssa sylvatica*
 UPL *Pinus clausa*
 UPL *P. echinata*
 FACU+ *P. palustris*
 FACU- *P. rigida*
 FACW+ *P. serotina*
 FAC *P. taeda*
 UPL *P. virginiana*
 UPL *Quercus coccinea*
 FACU- *Q. falcata*
 FACW *Q. laurifolia*
 UPL *Q. marilandica*
 UPL *Q. myrtifolia*
 FAC *Q. nigra*
 FACW- *Q. phellos*
 FACU *Q. stellata*
 UPL *Q. velutina*
 OBL *Taxodium distichum*
 FACW *Ulmus americana*

water tupelo
 blackgum
 sand pine
 shortleaf pine
 longleaf pine
 patch pine
 pond pine
 loblolly pine
 Virginia pine
 scarlet oak
 southern red oak
 laurel oak
 blackjack oak
 myrtle oak
 water oak
 willow oak
 post oak
 black oak
 baldcypress
 American elm

iii. Bottomland Sites (seldom covered by standing water)

0	FW	F	FU	W
4	12	11	5	1

FACW *Acer negundo*
 FAC *A. rubrum*
 FACW *A. saccharinum*
 FAC *Carya cordiformis*
 FACW- *C. laciniata*
 FACU *C. ovata*
 UPL *C. tomentosa*
 FACW *Celtis laevigata*
 FACU *C. occidentalis*
 FAC *Diospyros virginiana*
 FACU *Fraxinus americana*
 FACW *F. pennsylvanica*

boxelder
 red maple
 silver maple
 bitternut hickory
 shellbark hickory
 shagbark hickory
 mockernut hickory
 sugarberry
 hackberry
 persimmon
 white ash
 green ash

16:6

FAC-	<i>Gleditsia tricanthos</i>	honeylocust
FAC+	<i>Liquidambar styraciflua</i>	sweetgum
FAC	<i>Nyssa sylvatica</i>	blackgum
FACW	<i>Pinus glabra</i>	spruce pine
OBL	<i>P. lyrata</i>	overcup oak
FAC	<i>P. taeda</i>	loblolly pine
FACW-	<i>Platanus occidentalis</i>	American sycamore
FAC+	<i>Populus deltoides</i>	eastern cottonwood
FACU-	<i>Quercus falcata</i>	southern red oak
FAC+	<i>Q. falcata</i> var. <i>pagodaefolia</i>	cherrybark oak
FACW	<i>Q. laurifolia</i>	laurel oak
FACW-	<i>Q. michauxii</i>	swamp chestnut oak
FAC	<i>Q. nigra</i>	water oak
OBL	<i>Q. nuttallii</i>	Nuttall oak
FACW-	<i>Q. phellos</i>	willow oak
FACW	<i>Q. shumardii</i>	Shumard oak
FACU	<i>Q. stellata</i>	post oak
FACW	<i>Q. stellata</i> var. <i>mississippiensis</i>	Delta post oak
OBL	<i>Salix nigra</i>	black willow
OBL	<i>Taxodium distichum</i>	baldecypress
FAC	<i>Ulmus crassifolia</i>	cedar elm

iv. Wet Sites (excessive moisture most of the year) 0 FW F Fu U
 10 7 6 0 0

FAC	<i>Acer rubrum</i>	red maple	
OBL	<i>Carya aquatica</i>	water hickory	
FAC	<i>Diospyros virginiana</i>	persimmon	17: 0
OBL	<i>Fraxinus caroliniana</i>	Carolina ash	
OBL	<i>F. profunda</i>	pumpkin ash	
OBL	<i>Gleditsia aquatica</i>	water locust	
FACW	<i>Gordonia lasianthus</i>	loblolly bay	
FAC+	<i>Liquidambar styraciflua</i>	sweetgum	
FACW+	<i>Magnolia virginiana</i>	sweetbay	
FAC	<i>Nyssa sylvatica</i>	blackgum	
OBL	<i>Nyssa sylvatica</i> var. <i>biflora</i>	swamp tupelo	

FACW	<i>Persea borbonia</i>	redbay
FACW	<i>Pinus elliottii</i>	slash pine
FACW+	<i>P. serotina</i>	pond pine
FAC	<i>P. taeda</i>	loblolly pine
FAC+	<i>Populus deltoides</i>	eastern cottonwood
OBL	<i>P. heterophylla</i>	swamp cottonwood
FACW	<i>Quercus laurifolia</i>	laurel oak
OBL	<i>Q. lyrata</i>	overcup oak
OBL	<i>Q. nuttallii</i>	Nuttall oak
OBL	<i>Salix nigra</i>	black willow
OBL	<i>Taxodium distichum</i>	baldecypress
	<i>T. distichum</i> var. <i>biflora</i>	pondecypress
FACW	<i>Ulmus americana</i>	American elm

BLUESTEM PRAIRIE (4)

This ecoregion is predominantly prairie, with forests usually restricted to river bottoms (Figure 1). The climate is humid continental with cool summers in the north and warm summers in the south (Trewartha, 1943). Rainfall is generally adequate with maximum rainfall occurring in the summer. Temperatures are variable, and droughts are frequent (Bailey, 1976). The soils are almost entirely mollisols (Buckman and Brady, 1969).

Bottomland Forest Succession

Floodplain forests of this region exist in narrow bands along rivers. The first bottoms are occupied by early colonizers, including willows and cottonwood and some shrubs including hazel, sumac and coralberry and various sedges, rushes and hydric grasses (Ware and Penfound, 1949; Weaver, 1960). Succession of tree species begins with the establishment of willow followed by cottonwood. Once established, cottonwood usually dominates the communities and this parallels a decline in willow populations (Wilson, 1970). Soil development leads to a succession of a variety of species including American elm, green ash, white ash, hackberry, black walnut, sugar maple, honeylocust, kentucky coffeetree and sycamore on more mature sites. More mesic forests of northern red oak, hickory, linden and bur oak form a transition zone between the grasslands, dominated by big bluestem, and the floodplain forests.

Swamp vegetation consists of various rushes, reeds and cattails. Transition zones between wet land vegetation and better drained soils are dominated by switchgrass and Canada wildrye. Big bluestem dominates the

Chapter B

PRODUCTION AND DECOMPOSITION OF FOREST LITTER FALL ON THE APALACHICOLA RIVER FLOOD PLAIN, FLORIDA

By JOHN F. ELDER and DUNCAN J. CAIRNS

U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 2196

Apalachicola River Quality Assessment

Gulf Forested Wetland

After weighing and ashing, the remainder of each sample was finely ground in a mill, producing 125- μ m particles and split into subsamples for nutrient analyses. Carbon and nitrogen concentrations were determined on a carbon-hydrogen-nitrogen analyzer. The analysis is a total combustion to gaseous forms of carbon and nitrogen, which are then separated in a chromatographic column and measured by thermal conductivity. Total phosphorus concentration was determined through digestion and acid molybdate analysis (Skougstad and others, 1979).

Extrapolation to the Entire Flood Plain

The 16 plots along the two intensive transects were selected to be as representative as possible of the forest types in the flood plain. Information on a much greater areal scale was needed in order to extrapolate the production and decomposition measurements to the entire system. Additional data were available by means of tree species identification at 223 points across eight "cruise transects" (fig. 5), two of which coincided closely with the intensive transects. Details of the method applied in the Apalachicola study are described by Leitman and others (1982). Each tree sampled was identified, and its diameter at breast height (DBH) was measured to permit computation of relative basal area (RBA) by species. Tree measurement followed procedures described by Avery (1967).

On the basis of cruise-transect results, distribution of tree species over the entire flood plain was determined by Leitman and others (1982). Leaf-production rates at the plots were used to generally characterize production at species and community levels. Extrapolation of the data to the entire flood plain to provide estimates of nutrient and detritus production for the basin-wide flood plain was thereby accomplished.

RESULTS

Litter Fall

Species and Communities

During the 1979-80 sampling period, leaves from 43 species of woody plants (table 1) were collected from the litter nets. A number of vines and other nontree forms contributed to litter fall, but understory species were excluded because they were below the level of the collection nets. Photographs of some of the most common leaf species from the collections of litter fall are shown in figure 9.

It was not always possible to distinguish different species of a single genus when sorting partially decomposed leaves. Notable examples of this were tupelo and

22:3

Table 1. Common and scientific names of all species of woody plants whose leaves appeared in leaf-collection nets in 1979-80

	OBL 10	FW 12	F 14	FU 1	U 2
Common name	Form ¹	Scientific name			
Ash, Carolina	t	<i>Fraxinus caroliniana</i> Mill.			OBL
green	t	<i>Fraxinus pennsylvanica</i> Marsh.			FACW
pumpkin	t	<i>Fraxinus profunda</i> (Bush.) Bush.			OBL
Baldcypress	t	<i>Taxodium distichum</i> (L.) Rich.			OBL
Birch, river	t	<i>Betula nigra</i> L.			FACW
Boxelder		See maple.			
Chinaberry	t	<i>Melia azedarach</i> L.			
Coralbeads	v	<i>Cocculus carolinus</i> (L.) DC.			FAC
Cypress		See baldcypress.			
Dogwood,					
stiffcornel	t	<i>Cornus foemina</i> Mill.			FACW
Elm, American	t	<i>Ulmus americana</i> L.			FACW
slippery	t	<i>Ulmus rubra</i> Muhl.			FAC
winged	t	<i>Ulmus alata</i> Michx.			FACW
Grape	v	<i>Vitis</i> spp.			
Greenbrier	v	<i>Smilax</i> spp.			
Hickory, water	t	<i>Carya aquatica</i> (Michx. f.) Nutt.			OBL
Holly, American	t	<i>Ilex opaca</i> Aiton			FAC
Hornbeam,					
American	t	<i>Carpinus caroliniana</i> Walt.			FAC
Japanese climbing					
fern	f	<i>Lygodium japonicum</i> (Thunery) Swartz			FAC
Locust, honey	t	<i>Gleditsia triacanthos</i> L.			OBL
water	t	<i>Gleditsia aquatica</i> Marsh.			FAC
Maple, red	t	<i>Acer rubrum</i> L.			FACW
(Boxelder)	t	<i>Acer negundo</i> L.			WPL
Mistletoe	ps	<i>Phoradendron serotinum</i> (Raf.) M. C. Johnston			FAC
Mulberry, red	t	<i>Morus rubra</i> L.			FACW
Oak, diamond-leaf	t	<i>Quercus laurifolia</i> Michx.			OBL
overcup	t	<i>Quercus lyrata</i> Walt.			FACW
swamp-chestnut	t	<i>Quercus prinus</i> L.			FAC
water	t	<i>Quercus nigra</i> L.			
Peppervine	v	<i>Ampelopsis arborea</i> (L.) Koehne			FAC
Persimmon,					
common	t	<i>Diospyros virginiana</i> L.			OBL
Planer-tree	t	<i>Planera aquatica</i> Gmel.			FAC
Poison ivy	v	<i>Rhus radicans</i> L.			FACW
Possum-haw	t	<i>Ilex decidua</i> Walt.			WPL
Rattan vine	v	<i>Berchemia scandens</i> (Hill) K. Koch			
Resurrection fern	f	<i>Polypodium polypodioides</i> (L.) Walt			
Sourgum		See tupelo.			
Sugarberry	t	<i>Celtis laevigata</i> Willd.			FACW
Sweetgum	t	<i>Liquidambar styraciflua</i> L.			FAC

Table 1. Common and scientific names of all species of woody plants whose leaves appeared in leaf-collection nets in 1979-80—Continued

Common name	Form ¹	Scientific name	
Sycamore, American	t-----	<i>Platanus occidentalis</i> L.	FACW
Titi	t-----	<i>Cyrilla racemiflora</i> L.	FACW
Trumpet vine	v-----	<i>Campsis radicans</i> (L.) Seeman	FAC
Tupelo, Ogeechee	t-----	<i>Nyssa ogeche</i> Bartram ex Marsh	OBL
water	t-----	<i>Nyssa aquatica</i> L.	OBL
swamp	t-----	<i>Nyssa biflora</i> Walt.	OBL
Virgin's bower	v-----	<i>Clematis virginiana</i> L.	FAC

¹ t, tree; v, vine; ps, parasitic shrub; f, fern.

ash, two of the most abundant leaf-litter genera. All water tupelo and Ogeechee tupelo leaves were grouped together for weighing, as were all species of ash. Swamp tupelo was distinguishable from the other *Nyssa* species but only with considerable difficulty. Two other genera whose leaves were generally indistinguishable by species were grape and greenbrier.

The Apalachicola flood-plain forest has been categorized into five forest types (Leitman and others, 1982). The forest types differ in tree-species composition and hydrologic conditions (table 2). Each intensive-transect plot where leaves were collected represented only one forest type. All five forest types were represented by at least one plot.

Annual Litter Production

Litter-fall data are presented in most of the following discussions, tables, and illustrations as grams per square meter per unit time (year or day). These units were computed from means of all relevant data values. Individual species production, like total litter fall, was computed as the mean over all plots (or all plots representing a forest type), although no single species occurred at every plot. Hence, total production was divided by the total number of nets sampled to obtain a production rate on a square-meter basis. Daily litter production in any particular month was computed by dividing the production per square meter by the number of days in the sampling interval. Sampling intervals ranged from 25 to 38 days.

Although the leaf litter represented 43 different species of woody plants, it was largely composed of leaves from a few dominant species. Twelve species contributed more than 90 percent of the leaves collected (table 3). These twelve species were also the most abundant flood-plain tree species, with the exception of grape. Grape is the only vine in the group. As a vine, supported by trees, its stem size is small and its

foliage:DBH ratio is much greater than that of most tree species. It is very abundant in the flood plain, particularly in levee areas. In terms of density (numbers of plants per hectare, independent of basal area), grape was 10th among the species found in the cruise transects (Leitman and others, 1982). This ranking more closely corresponds to its leaf production. Swamp tupelo was the fourth most abundant species in the cruise transects but was not among the top 12 litter producers. Two factors are responsible for this: (1) difficulty in distinguishing swamp tupelo leaves from other tupelo leaves and (2) underrepresentation of swamp tupelo in the intensive-transect plots relative to its abundance on the flood plain. Only plot 1 had a substantial stand of swamp tupelo trees.

The important component of the litter fall that is not shown in table 3 is nonleaf material, such as twigs, stems, bark, berries, and nuts. Some leaf parts were also included in this material because all small leaf parts could not be totally separated from the conglomerate collected in the nets. Production of nonleaf material amounted to 330 (g/m²)/yr over the intensive transect plots, or nearly twice that of the most abundant leaf species and more than 40 percent of total litter fall. This material consisted of contributions from nearly every major tree species and a number of less common trees and other vegetation.

Table 3 also excludes a category of leaf material consisting of "miscellaneous and unidentified leaf material," principally leaf pieces from the major species. Because the material contained a diversity of leaf parts, it was considered to come from several species. It accounted for 10 (g/m²)/yr of the litter fall.

Table 3 shows that tree-species ranking with respect to leaf-litter production corresponds closely to tree abundance in cruise transects. It also shows similar agreement between leaf-litter production and tree abundance in the intensive transects. Whereas the first relation is an indicator of good representation of the entire flood plain, the second is a measure of sampling accuracy within the plots themselves. Vines were not included in basal area measurements in the intensive-transect plots; hence, no such data are available for grape. In the intensive transects, tree-abundance rank numbers 5 and 10 were occupied by swamp tupelo and red maple, respectively. Leaf productivity of these two species was slightly less than the 9.7 (g/m²)/yr of American hornbeam.

Leaf Fall per Stem Biomass

The data of table 3 suggest that leaf fall per stem biomass is greater among those species that are less abundant. This is confirmed by the relation shown in figure 10. Leaf-litter productivity data were transformed from productivity per unit ground surface to

OBL+FACW: FACU+UPL

Table 2. Forest types, their species composition, distinguishing characteristics, and occurrence in intensive-transect plots

Forest type	Plots ¹	Predominant species	Associated species	Plot characteristics	
7:0	A	4	Sweetgum <i>FAC</i>	Diamond-leaf oak <i>FACW</i>	Located on levees and high ridges. <i>N.B. - Dry</i>
		5	Sugarberry <i>FACW</i>	Green ash <i>FACW</i>	Saturated only by high flooding. <i>? upland</i>
			Water oak <i>FAC</i>	American elm <i>FACW</i>	High diversity of tree species.
			American hornbeam <i>FAC</i>	American sycamore <i>FACW</i>	
			Possum-haw <i>FACW</i>	Water hickory <i>OBL</i>	
7:0	B	3	Water hickory <i>OBL</i>	Sugarberry <i>FACW</i>	Located on high flats and low ridges. <i>Maybe upland</i>
		6	Green ash <i>FACW</i>	Red maple <i>FAC</i>	Saturated by low to moderate flooding. <u>High diversity</u> of tree species
		11	Overcup oak <i>OBL</i>	Water oak <i>FAC</i>	
		14	Diamond-leaf oak <i>FACW</i>	Possum-haw <i>FACW</i>	
			Sweetgum <i>FAC</i>	American hornbeam <i>FAC</i>	
13:0	C		American elm <i>FACW</i>		
		7	Water tupelo <i>OBL</i>	Overcup oak <i>OBL</i>	Located in low areas containing some ridges or hummocks that aid drainage. <i>wetland</i>
		15	Ogeechee tupelo <i>OBL</i>	Pumpkin ash <i>OBL</i>	Commonly saturated. High diversity of tree species.
		16	Baldcypress <i>OBL</i>	Red maple <i>FAC</i>	
		17	Swamp tupelo <i>OBL</i>	Water hickory <i>OBL</i>	
8:0		18	Carolina ash <i>OBL</i>	American elm <i>FACW</i>	
			Planer-tree <i>OBL</i>	Green ash <i>FACW</i>	
				Diamond-leaf oak <i>FACW</i>	
				Sweetbay <i>FACW</i>	
4:0	D	1	Water tupelo <i>OBL</i>		Located in low flat areas having poor drainage. Saturated almost continuously. <u>Low diversity</u> of tree species. <i>wetland</i>
			Swamp tupelo <i>OBL</i>		
			Ogeechee tupelo <i>OBL</i>		
			Baldcypress <i>OBL</i>		
			Carolina ash <i>OBL</i>		
			Pumpkin ash <i>OBL</i>		
			Planer-tree <i>OBL</i>		
			Sweetbay <i>FACW</i>		
	E	2	Water tupelo <i>OBL</i>		Located in low, flat areas having poor drainage. Saturated almost continuously. <u>Low diversity</u> of tree species. <i>wetland</i>
		12	Baldcypress <i>OBL</i>		
		13	Carolina ash <i>OBL</i>		
		19	Planer-tree <i>OBL</i>		

¹ Plot numbers appear in figures 6 and 7.

productivity per tree biomass unit (leaf fall in grams per square meter basal area). Because the biomass unit is basal area, computed from a trunk diameter, this index may also be termed leaf-litter productivity per stem biomass. Only the 11 most common species are plotted. Grape is excluded because of the lack of basal area data. All other species had such limited total basal areas that small differences in basal area would produce spurious fluctuations in the productivity calculation. Tupelo, which composed half of the tree biomass in the test plots, produced only a third of the leaf litter. It was least in leaf-litter productivity per unit basal area. The less abundant species were sometimes three to four times more productive than tupelo. A power curve was fitted to the data to suggest the type of relation that exists between tree abundance and leaf-fall productivity in this

system. A cause-effect relation should not be inferred from this association.

Forest-Type Differences

Forest-type differences in leaf production and tree abundance within plots are presented in table 4. At this breakout level, the data base becomes relatively small and sampling error factors become larger. Sugarberry, for example, may have been overrepresented in forest type A because one of the four collection nets representing that forest type in the study plots was located by random placement directly beneath a large sugarberry tree. The tree, in fact, was the only sugarberry in that plot (plot 4) but because of its size it accounted for 29 percent of the total basal area in the plot. Despite this

APPENDIX N

NORTHERN SWAMPS AND FLOODPLAIN
WETLANDS: PLANTS AND ANIMALS

Red Maple
Swamp

Amphibians

Green Frog 134
Pickerel Frog 144
Red Salamander 120
Spotted Salamander 126,
127
Spring Peeper 150
Striped Chorus Frog 132
Two-lined Salamander 110,
121
Wood Frogs 140, 149

Reptiles

Black Swamp Snake 181,
183
Brown Snake 189
Green Water Snake 185
Northern Water Snake 195
Timber Rattlesnake 193,
197, 198
Wood Turtle 166

Wildflowers, Ferns, and

Grasses
Blue Flag 297 OBL
Butterfly Orchid 265 NO
Burtonbush 237 OBL
Cardinal Flower 277 FACW
Cinnamon Fern 304 FACW
Elderberry 242 FACW
False Hellebore 320 FACW
Golden Ragwort 207 FACW
Great Hedge Nettle 284 NO
Great Laurel 230 FACW
Green Dragon 311 FACW
Hibiscus 275 NO
Highbush Blueberry 259, FACW
Jack-in-the-Pulpit 309, 327 FACW
Large Purple Fringed
Orchid 294
Lizard's Tail 236 OBL
Marsh Marigold 209 OBL
Marsh Skullcap 292 OBL
Nodding Bur Marigold 206 OBL
Red Iris 276 OBL
Royal Fern 306 OBL
Showy Lady's Slipper 264 FACW
Skunk Cabbage 312 OBL
Soft Rush 324 FACW
Spicebush 201 FACW
Spotted Joe-pye Weed 287 FACW
Spotted Touch-me-not 279 FACW
Swamp Buttercup 211 OBL

Tris versicolor
Enoplosa tempestas
Epilobium sp. subsp.

Stachys emersonii Region IX - FACW

Region IX - NO

Blitum sp.
grandiflora

Swamp Dewberry 252 FACW
Swamp Honeysuckle 229 OBL
Swamp Rose 273 OBL
Sweet Saxifrage 319 OBL
Sweet Pepperbush 235 FAC
Tall Meadow Rue 257 FACW
Tufted Loosestrife 200 OBL
Turk's Cap Lily 278 FACW
Water Hemlock 240 OBL
Winterberry 244, 328 FACW
Wool Grass 322 FACW
Yellow Skunk Cabbage 223 NO

Region IX OBL

Mushrooms

Blueberry Cup 341
Silky Parchment 342
Swamp Beacon 339
Wrinkled Thimble-cap 337

Insects and Spiders

American Horse Fly 378
Golden-silk Spider 383
Vinegar Fly 381

Butterflies and Moths

Appalachian Brown 400,
408
Broken Dash 424
Greole Pearly Eye 410
Great Gray Copper 403
Harvester 394
Lace-winged Roadside
Skipper 411
Palamedes Swallowtail 389
Sedge Skipper 422
Swamp Metalmark 398
White Peacock 404, 406

Note:
=

Region IX FACW

Region IX FACW

Swamp Dewberry 252 FACW
Swamp Honeysuckle 229 OBL
Swamp Rose 273 OBL
Sweet Saxifrage 319 OBL
Sweet Pepperbush 235 FAC
Tall Meadow Rue 257 FACW
Tufted Loosestrife 200 OBL
Turk's Cap Lily 278 FACW
Water Hemlock 240 OBL
Winterberry 244, 328 FACW
Wool Grass 322 FACW
Yellow Skunk Cabbage 223 NO

0 FW F FU W
17 30 5 0 0

Most of these plants can
be found in Red Maple
Swamps

Red Maple 479 FAC
Silver Maple 478 FACW
Swamp Cottonwood 470 FACW
Swamp White Oak 476 FACW
Western Redcedar 427 NO

Region IX FAC

Birds

Barred Owl 566
Barrow's Goldeneye 505
Black-crowned Night-
Heron 529
Black Duck 489
Common Yellowthroat 584
Double-crested
Cormorant 520
Little Blue Heron 521, 525
Prothonotary Warbler 585
Red-bellied
Woodpecker 570
Red-shouldered Hawk 564
Swamp Sparrow 576
Wild Turkey 567
Wood Duck 491
Yellow-crowned Night-
Heron 530

Mammals

Arctic Shrew 594
Black Bear 615
Bobcat 616
Moose 618
Raccoon 614
Smoky Shrew 593
Star-nosed Mole 595
White-tailed Deer 617

APPENDIX O

Appendix. Vascular Plants of Delaware's Wetlands.

$\frac{0}{371}$	$\frac{FW}{207}$	$\frac{F}{93}$	$\frac{FU}{54}$	$\frac{U}{19}$
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$$\begin{array}{r} 578 \\ 8 \end{array} : \begin{array}{r} 73 \\ 1 \end{array}$$
 $\Sigma = 744$

List of vascular plants occurring in Delaware's wetlands. Scientific names conform with the National List of Scientific Plant Names (U.S.D.A. Soil Conservation Service 1982). Although this list is comprehensive, it is not exhaustive, yet the majority of plants occurring in wetlands are listed. The list was compiled mainly from R.R. Tatnall's *Flora of Delaware and the Eastern Shore* and from observations during NWI field studies. An asterisk (*) denotes the state's most critically rare vascular plants associated with wetlands (DNREC Office of Nature Preserves, pers. comm.) and other rare plants according to Tatnall (1946). For additional information on rare and endangered vascular plants, see Tucker, *et al.* (1979).

Scientific Name	Plant Common Name	Scientific Name	Plant Common Name
Lycopodiaceae		Sparganiaceae	
<i>Lycopodium alopecuroides</i> <i>Facw</i>	Foxtail Clubmoss	<i>Sparganium americanum</i> <i>OBL</i>	Eastern Burreed
<i>Lycopodium clavatum</i> <i>Fac</i>	Running Clubmoss	<i>Sparganium eurycarpum</i> <i>OBL</i>	Giant Burreed
<i>Lycopodium inundatum</i> <i>OBL</i>	Clubmoss		
Selaginellaceae		Potamogetonaceae	
<i>Selaginella apoda</i> <i>Facw</i>	Spikemoss	<i>Potamogeton amplifolius</i> <i>OBL</i>	Pondweed
Isoetales		<i>Potamogeton crispus</i> <i>OBL</i>	Curly Pondweed
<i>Isoetes engelmannii</i> <i>OBL</i>	Quillwort	<i>Potamogeton diversifolius</i> <i>OBL</i>	Waterthread Pondweed
<i>Isoetes riparia</i> <i>OBL</i>	Quillwort	<i>Potamogeton epihydrus</i> <i>OBL</i>	Ribbonleaf Pondweed
Equisetaceae		<i>Potamogeton foliosus</i> <i>OBL</i>	Leafy Pondweed
<i>Equisetum fluviatile</i> <i>OBL</i>	Horsetail	<i>Potamogeton natans</i> <i>OBL</i>	Floatingleaf Pondweed
Ophloglossaceae		<i>Potamogeton nodosus</i> <i>OBL</i>	Longleaf Pondweed
<i>Botrychium dissectum</i> <i>Fac</i>	Oblique Grape Fern	<i>Potamogeton obtusifolius</i> <i>OBL</i>	Bluntleaf Pondweed
Osmundaceae		<i>Potamogeton pectinatus</i> <i>OBL</i>	Sago Pondweed
<i>Osmunda cinnamomea</i> <i>Facw</i>	Cinnamon Fern	<i>Potamogeton perfoliatus</i> <i>OBL</i>	Thorwort Pondweed
<i>Osmunda claytoniana</i> <i>Fac</i>	Interrupted Fern	<i>Potamogeton pulcher</i> <i>OBL</i>	Heartleaf Pondweed
<i>Osmunda regalis</i> <i>OBL</i>	Royal Fern	<i>Potamogeton pusillus</i> <i>OBL</i>	Baby Pondweed
Polypodiaceae		<i>Potamogeton richardsonii</i> <i>OBL</i>	Richardson Pondweed
<i>Pteridium aquilinum</i> <i>Facu</i>	Bracken Fern	<i>Potamogeton robbinsii</i> <i>OBL</i>	Robbins Pondweed
<i>Onoclea sensibilis</i> <i>Facw</i>	Sensitive Fern	* <i>Potamogeton spirillus</i> <i>OBL</i>	Snailseed Pondweed
<i>Woodwardia areolata</i> <i>Facw</i>	Net-veined Chain Fern	<i>Potamogeton strictifolius</i> <i>OBL</i>	Narrowleaf Pondweed
<i>Woodwardia virginica</i> <i>OBL</i>	Virginia Chain Fern	<i>Ruppia maritima</i> <i>OBL</i>	Widgeon Grass
<i>Athyrium filix-femina</i> <i>Fac</i>	Lady Fern	<i>Zannichellia palustris</i> <i>OBL</i>	Horned Pondweed
<i>Thelypteris thelypteroides</i> <i>Facw</i>	Marsh Fern	<i>Zostera marina</i> <i>OBL</i>	Eelgrass
* <i>Dryopteris bootii</i> <i>Facw</i>	Glandular Swamp Fern		
* <i>Dryopteris clintoniana</i> <i>Facw</i>	Broad Swamp Fern	Najadaceae	
<i>Dryopteris cristata</i> <i>Facw</i>	Crested Shield Fern	<i>Najas flexilis</i> <i>OBL</i>	Bushy Pondweed
<i>Dryopteris spinulosa</i> <i>Fac</i>	Spinulose Shield Fern	<i>Najas gracillima</i> <i>OBL</i>	Naiad
<i>Polystichum acrostichoides</i> <i>Facu</i>	Christmas Fern	<i>Najas guadalupensis</i> <i>OBL</i>	Naiad
<i>Cystopteris fragilis</i> <i>Facu</i>	Lowland Brittle Fern		
Pinaceae		Juncaginaceae	
<i>Pinus rigida</i> <i>Facu</i>	Pitch Pine	* <i>Triglochin maritima</i> <i>OBL</i>	Arrow Grass
<i>Pinus serotina</i> <i>OBL</i>	Pond Pine	* <i>Triglochin striata</i> <i>OBL</i>	Arrow Grass
<i>Pinus strobus</i> <i>Facu</i>	White Pine		
<i>Pinus taeda</i> <i>Fac</i>	Loblolly Pine	Alismataceae	
<i>Taxodium distichum</i> <i>OBL</i>	Bald Cypress	<i>Alisma plantago-aquatica</i> <i>OBL</i>	Common Waterplantain
<i>Chamaecyparis thyoides</i> <i>OBL</i>	Atlantic White Cedar	<i>Alisma subcordatum</i> <i>OBL</i>	Subcordate Waterplantain
<i>Juniperus virginiana</i> <i>Facu</i>	Red Cedar	<i>Sagittaria calycina</i> <i>OBL</i>	Hooded Arrowhead
		* <i>Sagittaria engelmanniana</i> <i>OBL</i>	Engelmann Arrowhead
		<i>Sagittaria graminea</i> <i>OBL</i>	Grassy Arrowhead
		* <i>Sagittaria isoetiformis</i> <i>NO</i>	Arrowhead
		<i>Sagittaria latifolia</i> <i>OBL</i>	Broadleaf Arrowhead
		<i>Sagittaria rigida</i> <i>OBL</i>	Bur Arrowhead
		* <i>Echinodorus parvulus</i> <i>OBL</i>	Burhead
Typhaceae		Hydrocharitaceae	
<i>Typha angustifolia</i> <i>OBL</i>	Narrow-leaved Cattail	<i>Egeria densa</i> <i>OBL</i>	Waterweed
<i>Typha latifolia</i> <i>OBL</i>	Broad-leaved Cattail		

$\frac{0}{46}$	$\frac{FW}{8}$	$\frac{F}{6}$	$\frac{FU}{5}$	$\frac{U}{0}$
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Scientific Name

Plant Common Name

Elodea canadensis OBL
Elodea nuttallii OBL
 **Limnobia spongia* OBL
Vallisneria americana OBL

Waterweed
 Waterweed
 Frog's Bit
 Wild Celery

Gramineae

Puccinellia fasciculata OBL
Puccinellia pallida OBL
 **Glyceria canadensis* OBL
Glyceria obtusa OBL
Glyceria septentrionalis OBL
Glyceria striata OBL
Poa trivialis FACW
Distichlis spicata FACW
Phragmites australis FACW
Elymus riparius FACW
Elymus virginicus FACW
Hordeum jubatum FAC
Hordeum pusillum FAC
 **Calamagrostis canadensis* FACW
Calamagrostis cinnoides OBL
Agrostis hyemalis FAC
 **Agrostis stolonifera* FACW
Cinna arundinacea FACW
 **Alopecurus carolinianus* FACW
 **Muhlenbergia torreyana* FACW
Aristida virgata FAC
Spartina alterniflora OBL
Spartina cynosuroides OBL
Spartina patens FACW
Spartina pectinata OBL
Trisetum pennsylvanicum OBL
Phalaris arundinacea FACW
Leersia oryzoides OBL
Leersia virginica FACW
Zizania aquatica OBL
Leptochloa fascicularis FACW
Paspalum dissectum OBL
Panicum agrostoides FACW
Panicum amarum FACW
Panicum hemitomon FACW
 **Panicum hirtii* OBL
Panicum longifolium OBL
Panicum virgatum FAC
Dichanthelium acuminatum FAC
 **Dichanthelium acuminatum*
 var. *wrightianum*
Dichanthelium dichotomum FAC
 **Dichanthelium scabriusculum* OBL
Dichanthelium scoparium FACW
Dichanthelium sphaerocarpon FACW
Echinochloa walteri FACW
Setaria geniculata FAC
Setaria magna FACW
Erianthus brevibarbis OBL
Erianthus giganteus FACW
Eulalia viminea FAC
Cenchrus tribuloides UPL
Amphicarpum purshii FACW
Andropogon virginicus FACW
 v. *abbreviatus*
 **Sacciolepis striata* OBL
 **Coelorachis rugosa* OBL
Tripsacum dactyloides FACW

Alkali Grass
 Pale Manna Grass
 Rattlesnake Manna Grass
 Blunt Manna Grass
 Eastern Manna Grass
 Fowl Manna Grass
 Meadow Grass
 Spike Grass
 Common Reed
 Wild Rye
 Wild Rye
 Squirrel-tail Grass
 Little Barley
 Bluejoint
 Hairyseed Reedgrass
 Bent Grass
 Bent Grass
 Wood Reedgrass
 Water Foxtail
 Torrey's Muhly
 Triple-awned Grass
 Smooth Cordgrass
 Big Cordgrass
 Salt Hay Grass
 Slough Grass
 Swamp Trisetum
 Reed Canary Grass
 Rice Cutgrass
 White Grass
 Wild Rice
 Bearded Sprangletop
 Mudbank Paspalum
 Panic Grass
 Beach Panic Grass
 Maiden Cane
 Hirst's Panic Grass
 Longleaf Panicum
 Switchgrass
 Pacific Panicum
 Wright's Panic Grass
 Forked Panicum
 Velvet Panicum
 Velvet Panicum
 Roundseed Panicum
 Walter's Millet
 Foxtail Grass
 Giant Foxtail Grass
 Plume Grass
 Plume Grass
 Sandspur
 Lowland Broomsedge
 American Cupscale
 Joint Grass
 Eastern Gama Grass

Scientific Name

Plant Common Name

Cyperaceae

Cyperus dentatus FACW
Cyperus diandrus FACW
 **Cyperus engelmannii* FACW
Cyperus erythrorhizos FACW
Cyperus esculentus FACW
Cyperus filicinus OBL
Cyperus odoratus FACW
Cyperus polystachyos FACW
Cyperus rivularis FACW
 **Cyperus rotundus* FAC
Cyperus strigosus FACW
Cyperus virens FACW
Dulichium arundinaceum OBL
Eleocharis acicularis OBL
Eleocharis engelmannii FACW
 **Eleocharis equisetoides* OBL
 **Eleocharis erythropoda* OBL
 **Eleocharis flavescens* OBL
 **Eleocharis halophila* OBL
 **Eleocharis intermedia* FACW
 **Eleocharis melanocarpa* FACW
Eleocharis microcarpa OBL
Eleocharis obtusa OBL
Eleocharis olivacea OBL
Eleocharis parvula OBL
Eleocharis quadrangulata OBL
Eleocharis robbinsii OBL
 **Eleocharis rostellata* OBL
Eleocharis smallii OBL
Eleocharis tenuis FACW
Eleocharis tortilis FACW
 **Eleocharis tricostrata* OBL
Eleocharis tuberculosa OBL
 **Psilocarya nitens* OBL
 **Psilocarya scirpoides* OBL
Fimbristylis autumnalis FACW
Fimbristylis caroliniana FACW
Fimbristylis castanea OBL
Fimbristylis perpallida NI
Scirpus acutus OBL
Scirpus americanus OBL
Scirpus atrovirens OBL
Scirpus cylindricus OBL
Scirpus cyperinus FACW
 **Scirpus etuberculatus* OBL
 **Scirpus expansus* OBL
Scirpus fluviatilis OBL
Scirpus polyphyllus OBL
Scirpus pungens FACW
Scirpus purshianus OBL
Scirpus robustus OBL
 **Scirpus smithii* OBL
Scirpus subterminalis OBL
Scirpus validus OBL
 **Eriophorum gracile* OBL
Eriophorum virginicum OBL
Fuirena pumila OBL
Fuirena squarrosa OBL
Rhynchospora alba OBL
Rhynchospora capitellata OBL
 **Rhynchospora cephalantha* OBL
 **Rhynchospora chalarocephala* OBL
 **Rhynchospora corniculata* OBL

Toothleaf Flatsedge
 Low Flatsedge
 Engelmann Flatsedge
 Redroot Cyperus
 Chufa
 Nuttall's Cyperus
 Fragrant Flatsedge
 Many-spiked Flatsedge
 Nutgrass
 Nutgrass
 Straw-colored Cyperus
 Green Flatsedge
 Three-way Sedge
 Slender Spikerush
 Engelmann's Spikerush
 Northern Jointed Spikerush
 Creeping Spikerush
 Yellow Spikerush
 Salt Marsh Spikerush
 Matted Spikerush
 Black-fruited Spikerush
 Torrey's Spikerush
 Blunt Spikerush
 Spikerush
 Dwarf Spikerush
 Squarestem Spikerush
 Trianglestem Spikerush
 Beaked Spikerush
 Small's Spikerush
 Slender Spikerush
 Twisted Spikerush
 Three-ribbed Spikerush
 Large Tubercled Spikerush
 Bald Rush
 Bald Rush
 Slender Fimbristylis
 Fimbristylis
 Salt Marsh Fimbristylis
 Fimbristylis
 Hardstem Bulrush
 Olney Three-square
 Green Bulrush
 Swamp Bulrush
 Woolgrass
 Swamp Bulrush
 Woodland Bulrush
 River Bulrush
 Leafy Bulrush
 Common Three-square
 Weak Bulrush
 Salt Marsh Bulrush
 Bluntscale Bulrush
 Water Bulrush
 Soft-stemmed Bulrush
 Cottongrass
 Virginia Cottongrass
 Umbrella-sedge
 Hairy Umbrella-sedge
 White Beakrush
 False Bog Rush
 Capitulate Beakrush
 Loose-headed Beakrush
 Horned Rush

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Scientific Name Plant Common Name

* <i>Rhynchospora fusca</i> OBL	Brown Beakrush
<i>Rhynchospora globularis</i> Facw	Pinehill Beakrush
* <i>Rhynchospora glomerata</i> OBL	Clustered Beakrush
<i>Rhynchospora gracilentia</i> OBL	Slender Beakrush
* <i>Rhynchospora inundata</i> OBL	Beakrush
* <i>Rhynchospora knieskernii</i> OBL	Knieskern's Beakrush
<i>Rhynchospora macrostachya</i> OBL	Horned Rush
* <i>Rhynchospora microcephala</i> Facw	Small-headed Beakrush
* <i>Rhynchospora oligantha</i> OBL	Few-flowered Beakrush
* <i>Rhynchospora pallida</i> OBL	Pale Beakrush
* <i>Rhynchospora torreyana</i> Facw	Torrey's Beakrush
<i>Cladium mariscoides</i> OBL	Twigrush
<i>Scleria minor</i> Facw	Slender Nutrush
<i>Scleria reticularis</i> OBL	Netted Razorsedge
<i>Scleria triglomerata</i> Facw	Whip-grass
<i>Scleria verticillata</i> OBL	Low Nutgrass
<i>Carex alata</i> ?	Wingseed Sedge
<i>Carex albolutescens</i> Facw	Sedge
<i>Carex atlantica</i> Facw	Eastern Sedge
* <i>Carex barrattii</i> OBL	Barratt's Sedge
* <i>Carex bromoides</i> Facw	Grassy Sedge
<i>Carex bullata</i> OBL	Bullsedge
<i>Carex bushii</i> Facw	Sedge
* <i>Carex buxbaumii</i> OBL	Buxbaum Sedge
<i>Carex canescens</i> OBL	Silvery Sedge
<i>Carex collinsii</i> OBL	Sedge
<i>Carex comosa</i> OBL	Longhair Sedge
<i>Carex crinita</i> OBL	Fringed Sedge
<i>Carex debilis</i> Facw	Sedge
* <i>Carex echinata</i> OBL	Prickly Sedge
* <i>Carex emoryi</i> OBL	Emory Sedge
<i>Carex exilis</i> OBL	Sedge
<i>Carex gigantea</i> OBL	Giant Sedge
<i>Carex granularis</i> Facw	Sedge
<i>Carex gynandra</i> X	Sedge
<i>Carex hormathodes</i> OBL	Sedge
<i>Carex howei</i> OBL	Howe Sedge
<i>Carex intumescens</i> Facw	Sedge
<i>Carex lacustris</i> OBL	River Sedge
<i>Carex laevivaginata</i> OBL	Wooly Sedge
<i>Carex lanuginosa</i> OBL	Wooly Sedge
<i>Carex leptalea</i> OBL	Bristle-stalked Sedge
* <i>Carex lupuliformis</i> Facw	Hoplike Sedge
<i>Carex lupulina</i> OBL	Hop Sedge
<i>Carex lurida</i> OBL	Lurid Sedge
* <i>Carex meadii</i> Facw	Mead Sedge
<i>Carex mitchelliana</i> ?	Sedge
* <i>Carex muhlenbergii</i> ?	Sedge
<i>Carex pennsylvanica</i> ?	Sedge
* <i>Carex polymorpha</i> Facw	Sedge
<i>Carex prasina</i> OBL	Sedge
<i>Carex rostrata</i> OBL	Beaked Sedge
* <i>Carex scabrata</i> OBL	Sedge
<i>Carex seorsa</i> Facw	Sedge
<i>Carex smalliana</i> ?	Sedge
<i>Carex squarrosa</i> Facw	Sedge
<i>Carex stipata</i> ?	Sawbeak Sedge
<i>Carex straminea</i> OBL	Sedge
<i>Carex stricta</i> OBL	Tussock Sedge
<i>Carex torta</i> Facw	Sedge
<i>Carex tribuloides</i> Facw	Bristebract Sedge
* <i>Carex trichocarpa</i> OBL	Slough Sedge
* <i>Carex trisperma</i> OBL	Threeseeded Sedge
<i>Carex typhina</i> Facw	Sedge

Scientific Name Plant Common Name

* <i>Carex venusta</i> OBL	Sedge
<i>Carex vesicaria</i> OBL	Inflated Sedge
* <i>Carex vestita</i> ?	Sedge
<i>Carex vulpinoidea</i> OBL	Fox Sedge
<i>Carex walteriana</i> OBL	Sedge
Araceae	
<i>Arisaema dracontium</i> Facw	Jack-in-the-pulpit
<i>Arisaema triphyllum</i> Facw	Jack-in-the-pulpit
<i>Peltandra virginica</i> OBL	Arrow Arum
<i>Symplocarpus foetidus</i> OBL	Skunk Cabbage
<i>Acorus calamus</i> OBL	Sweet Flag
<i>Orontium aquaticum</i> OBL	Golden Club
Lemnaceae	
<i>Spirodela polyrhiza</i> OBL	Big Duckweed
<i>Lemna minor</i> OBL	Duckweed
* <i>Lemna perpusilla</i> OBL	Duckweed
<i>Wolffia columbiana</i> OBL	Watermeal
* <i>Wolffiella floridana</i> OBL	Eastern Wolffia
Eriocaulaceae	
<i>Eriocaulon compressum</i> OBL	Pipewort
<i>Eriocaulon decangulare</i> OBL	Ten-angle Pipewort
* <i>Eriocaulon parkeri</i> OBL	Parker's Pipewort
<i>Eriocaulon septangulare</i> OBL	Pipewort
Xyridaceae	
<i>Xyris caroliniana</i> Facw	Carolina Yellow-eyed Grass
<i>Xyris difformis</i> OBL	Southern Yellow-eyed Grass
* <i>Xyris smalliana</i> OBL	Small's Yellow-eyed Grass
<i>Xyris torta</i> OBL	Twisted Yellow-eyed Grass
Commelinaceae	
<i>Commelina virginica</i> Facw	Dayflower
Pontederiaceae	
<i>Pontederia cordata</i> OBL	Pickersweed
<i>Zosterella dubia</i> OBL	Water Star-grass
<i>Heteranthera reniformis</i> OBL	Roundleaf Mud Plantain
Juncaceae	
<i>Juncus acuminatus</i> OBL	Tapertip Rush
<i>Juncus biflorus</i> Facw	Turnflower Rush
<i>Juncus bufonius</i> Facw	Toad Rush
<i>Juncus caesariensis</i> OBL	New Jersey Rush
<i>Juncus canadensis</i> OBL	Canada Rush
<i>Juncus coriaceus</i> Facw	Leathery Rush
<i>Juncus effusus</i> Facw	Soft Rush
* <i>Juncus elliotii</i> Facw	Bog Rush
<i>Juncus gerardii</i> Facw	Black Grass
<i>Juncus marginatus</i> Facw	Shore Rush
* <i>Juncus militaris</i> OBL	Bayonet Rush
* <i>Juncus nodosus</i> OBL	Knotted Rush
<i>Juncus pelocarpus</i> OBL	Bog Rush
<i>Juncus repens</i> OBL	Creeping Rush
<i>Juncus roemerianus</i> OBL	Black Noodlerush
<i>Juncus scirpoides</i> Facw	Needlepod Rush
Liliaceae	
* <i>Narthecium americanum</i> Facw	Bog Asphodel
* <i>Tolfieldia racemosa</i> OBL	False Asphodel
* <i>Helonias bullata</i> OBL	Swamp Pink
<i>Amianthium muscaetoxicum</i> Facw	Fly-poison

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Scientific Name	Plant Common Name	Scientific Name	Plant Common Name
<i>Zigadenus leimanthoides</i> OBL	Pine Barren Deathcamas	Betulaceae	
<i>Veratrum viride</i> Facw	False Hellebore	<i>Carpinus caroliniana</i> Fac	Ironwood
<i>Melanthium virginicum</i> Facw	Bunchflower	<i>Betula lenta</i> Facw	Sweet Birch
<i>Allium canadense</i> Facw	Wild Garlic	<i>Betula nigra</i> Facw	River Birch
<i>Allium vineale</i> Facw	Field Garlic	<i>Alnus maritima</i> OBL	Seaside Alder
<i>Lilium canadense</i> Fac	Turk's Cap Lily	<i>Alnus serrulata</i> OBL	Common Alder
<i>Erythronium umbilicatum</i> Fac	Trout Lily		
<i>Maianthemum canadense</i> Fac	Canada Mayflower	Fagaceae	
<i>Aletris farinosa</i> Fac	Colic Root	<i>Fagus grandifolia</i> Facw	Beech
* <i>Smilax hispida</i> Fac	Bristly Greenbriar	<i>Quercus bicolor</i> Facw	Swamp White Oak
<i>Smilax laurifolia</i> OBL	Bamboo-vine	<i>Quercus falcata</i> Facw	Southern Red Oak
<i>Smilax rotundifolia</i> Fac	Greenbriar	<i>Quercus lyrata</i> OBL	Overcup Oak
<i>Smilax walteri</i> OBL	Redberry Greenbriar	<i>Quercus michauxii</i> Facw	Basket Oak
		<i>Quercus nigra</i> Fac	Water Oak
Haemodoraceae		<i>Quercus palustris</i> Facw	Pin Oak
* <i>Lophiola americana</i> OBL	Gold-crest	<i>Quercus phellos</i> Fac	Willow Oak
<i>Lachnanthes caroliniana</i> OBL	Redroot	<i>Quercus rubra</i> Facw	Red Oak
Iridaceae		Ulmaceae	
<i>Iris prismatica</i> OBL	Slender Blue Flag	<i>Ulmus americana</i> Facw	American Elm
<i>Iris pseudacorus</i> OBL	Yellow Flag	<i>Ulmus rubra</i> Fac	Slippery Elm
<i>Iris versicolor</i> OBL	Blue Flag		
<i>Sisyrinchium atlanticum</i> Facw	Blue-eyed Grass	Urticaceae	
		<i>Urtica dioica</i> Facw	Stinging Nettle
Orchidaceae		<i>Laportea canadensis</i> Facw	Wood Nettle
<i>Platanthera blephariglotis</i> OBL	White Fringed Orchid	<i>Boehmeria cylindrica</i> Facw	False Nettle
* <i>Platanthera canbyi</i> ?	Orchid	<i>Pilea pumila</i> Facw	Clearweed
<i>Platanthera ciliaris</i> Facw	Yellow Fringed Orchid		
<i>Platanthera clavellata</i> Facw	Green Rein Orchid	Loranthaceae	
<i>Platanthera cristata</i> Facw	Crested Fringed Orchid	(<i>Phoradendron flavescens</i>)	Mistletoe
* <i>Platanthera flava</i> Facw	Tuberled Orchid		
* <i>Platanthera grandiflora</i> Facw	Large Purple Fringed Orchid	Santalaceae	
<i>Platanthera lacera</i> Facw	Ragged Fringed Orchid	<i>Comandra umbellata</i> Facw	Bastard Toad-flax
* <i>Platanthera nivea</i> Facw	Snowy Orchid		
* <i>Platanthera permoena</i> Facw	Fringeless Purple Orchid	Polygonaceae	
<i>Pogonia ophioglossoides</i> OBL	Rose Pogonia	<i>Rumex crispus</i> Facw	Sour Dock
* <i>Cleistes divaricata</i> Fac	Small Whorled Pogonia	<i>Rumex verticillatus</i> OBL	Swamp Dock
<i>Calopogon tuberosus</i> Facw	Grass Pink	<i>Polygonum amphibium</i> OBL	Water Smartweed
* <i>Arethusa bulbosa</i> OBL	Arethusa	<i>Polygonum arifolium</i> OBL	Halberd-leaved Tearthumb
<i>Spiranthes cernua</i> Facw	Nodding Ladies' Tresses	<i>Polygonum atlanticum</i> ?	
* <i>Spiranthes lucida</i> Facw	Wide-leaved Ladies' Tresses	<i>Polygonum hydropiper</i> OBL	Common Smartweed
<i>Spiranthes vernalis</i> Fac	Ladies' Tresses	<i>Polygonum hydropiperoides</i> OBL	Mild Waterpepper
		<i>Polygonum lapathifolium</i> Facw	Smartweed
Saururaceae		<i>Polygonum patulum</i> NI	
<i>Saururus cernuus</i> OBL	Lizard's-tail	<i>Polygonum pensylvanicum</i> Facw	Pennsylvania Smartweed
		<i>Polygonum persicaria</i> Facw	Lady's-thumb
Salicaceae		<i>Polygonum punctatum</i> OBL	Water Smartweed
<i>Populus deltoides</i> Fac	Cottonwood	<i>Polygonum ramosissimum</i> Fac	Bushy Knotweed
<i>Populus heterophylla</i> Facw	Swamp Cottonwood	<i>Polygonum sagittatum</i> OBL	Arrow-leaved Tearthumb
<i>Salix cordata</i> Facw	Heart-leaved	* <i>Polygonum setaceum</i> OBL	
<i>Salix exigua</i> OBL	Sand Bar Willow	<i>Polygonum virginianum</i> Fac	Virginia Smartweed
<i>Salix lucida</i> Facw	Shining Willow		
<i>Salix nigra</i> Facw	Black Willow	Chenopodiaceae	
<i>Salix sericea</i> OBL	Silky Willow	<i>Chenopodium ambrosioides</i> Facw	Mexican Tea
		<i>Atriplex arenaria</i> Fac	Seabeach Orach
Myricaceae		<i>Atriplex patula</i> Facw	Marsh Orach
<i>Myrica cerifera</i> Fac	Wax Myrtle	<i>Salicornia bigelovii</i> OBL	Bigelow's Glasswort
<i>Myrica heterophylla</i> Fac	Evergreen Bayberry	<i>Salicornia europaea</i> OBL	Common Glasswort
<i>Myrica pensylvanica</i> Fac	Northern Bayberry	<i>Salicornia virginica</i> OBL	Perennial Glasswort
		<i>Suaeda linearis</i> OBL	Sea-blite
Juglandaceae		* <i>Suaeda maritima</i> OBL	Sea-blite
<i>Carya cordiformis</i> Facw	Bitternut	<i>Salsola kali</i> Facw	Saltwort
<i>Carya ovata</i> Facw	Shagbark Hickory		

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Scientific Name Plant Common Name

Amaranthaceae

- Amaranthus cannabinus* OBL Water Hemp
**Amaranthus pumilus* Facw

Phytolaccaceae

- Phytolacca americana* Facu Pokeweed

Aizoaceae

- Sesuvium maritimum* Facw Sea Purslane

Portulacaceae

- Claytonia virginica* Facu Spring Beauty

Caryophyllaceae

- Myosoton aquaticum* Facw Chickweed
Stellaria longifolia Facw Chickweed
**Stellaria uliginosa* Chickweed
Honkenya peploides Facu Seabeach Sandwort
Spergularia marina OBL Sand Spurrey
Sagina decumbens Fac Trailing Pearlwort

Ceratophyllaceae

- Ceratophyllum demersum* OBL Coontail

Nymphaeaceae

- Brasenia schreberi* OBL Water Shield
Nuphar luteum OBL Spatterdock
Nymphaea odorata OBL White Water Lily
**Nymphaea tuberosa* OBL Water Lily
**Nelumbo lutea* OBL American Lotus

Magnoliaceae

- Magnolia virginiana* Facw Sweet Bay
Liriodendron tulipifera Facu Tulip Tree

Ranunculaceae

- Caltha palustris* OBL Marsh Marigold
Ranunculus ambigens OBL Water-plantain Spearwort
Ranunculus abortivus Facw Small-flowered Crowfoot
Ranunculus bulbosus OBL Bulbous Buttercup
Ranunculus cymbalaria OBL Seaside Crowfoot
**Ranunculus flabellaris* OBL Yellow Water Crowfoot
Ranunculus laxicaulis OBL Spearwort
**Ranunculus longirostris* OBL White Water Crowfoot
Ranunculus repens Fac Creeping Buttercup
Ranunculus sceleratus OBL Cursed Crowfoot
Ranunculus septentrionalis OBL Swamp Buttercup
Thalictrum pubescens Facw Tall Meadow Rue
Clematis virginiana Fac Virgin's Bower

Berberidaceae

- Podophyllum peltatum* Facu May Apple

Anonaceae

- Asimina triloba* Facu Pawpaw

Lauraceae

- *Persea borbonia* Facw Red Bay
Sassafras albidum Facu Sassafras
Lindera benzoin Facw Spicebush

Cruciferae

- Cakile edentula* Facu Sea Rocket
Cardamine bulbosa OBL Spring Cress

Scientific Name

Plant Common Name

- Cardamine pensylvanica* OBL Bitter Cress
Cardamine rotundifolia OBL Bitter Cress
Nasturtium officinale OBL Water Cress
Rorippa palustris OBL Water Cress
Barbarea vulgaris Facu Winter Cress

Capparidaceae

- Polanisia dodecandra* Facu

Sarraceniacae

- Sarracenia purpurea* OBL Pitcher Plant

Droseraceae

- *Drosera filiformis* OBL Dew-thread
Drosera intermedia OBL Spatulate-leaved Sundew
Drosera linearis OBL Slender-leaved Sundew
**Drosera rotundifolia* OBL Round-leaved Sundew

Crassulaceae

- Penthorum sedoides* OBL Ditch Stonecrop

Saxifragaceae

- Saxifraga pensylvanica* OBL Swamp Saxifrage
Chrysosplenium americanum OBL Golden Saxifrage
Itea virginica OBL Virginia Sweetspire

Hamamelidaceae

- Hamamelis virginiana* Fac Witch Hazel
Liquidambar styraciflua Fac Sweet Gum

Platanaceae

- Platanus occidentalis* Facw Sycamore

Rosaceae

- *Physocarpus opulifolius* Facw Nine-bark
**Spiraea alba* Facw Meadowsweet
Spiraea latifolia Fac Meadowsweet
Spiraea tomentosa Facw Steeplebush
Geum laciniatum Fac Avens
Crataegus viridis Facw Hawthorn
Rubus cuneifolius OBL Sand Blackberry
Rubus hispidus Facw Running Dewberry
Agrimonia parviflora Fac Agrimony
Sanguisorba canadensis Facw American Burnet
Rosa carolina OBL Carolina Rose
Rosa multiflora Facu Rose
Rosa palustris OBL Swamp Rose
Prunus pensylvanica Facu Pin Cherry
Prunus serotina Facu Black Cherry
Aronia arbutifolia Facw Red Chokeberry
Aronia melanocarpa Fac Black Chokeberry
Aronia prunifolia Facw Purple-fruited Chokeberry
Amelanchier arborea Fac Shadbush
Amelanchier canadensis Fac Canada Serviceberry

Leguminosae

- *Desmodium canadense* Fac Tick-trifol
Vicia caroliniana Fac Vetch
**Aeschynomene virginica* OBL Sensitive Joint Vetch
Strophostyles helveola Facu Beach Pea
Strophostyles umbellata Facu Wild Bean
Apios americana Facw American Potato Bean

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Scientific Name	Plant Common Name	Scientific Name	Plant Common Name
Geraniaceae		Hypericaceae	
<i>Geranium pusillum</i>	Cranesbill	<i>Hypericum adpressum</i> OBL	Shore St. John's-wort
Linaceae		<i>Hypericum boreale</i> OBL	Northern St. John's-wort
<i>Linum striatum</i> Facw	Flax	<i>Hypericum canadense</i> Facw	Canada St. John's-wort
Polygalaceae		<i>Hypericum densiflorum</i> Fac	Dense St. John's-wort
* <i>Polygala cymosa</i> OBL	Tall Pine Barren Milkwort	<i>Hypericum denticulatum</i> Facw	Coppery St. John's-wort
<i>Polygala cruciata</i> Facw	Cross-leaved Milkwort	* <i>Hypericum ellipticum</i> OBL	Pale St. John's-wort
<i>Polygala lutea</i> Facw	Yellow Milkwort	<i>Hypericum mutilum</i> Facw	Dwarf St. John's-wort
<i>Polygala mariana</i> Facw	Maryland Milkwort	* <i>Hypericum prolificum</i> Facw	Shrubby St. John's-wort
* <i>Polygala ramosa</i> Facw	Low Pine Barren Milkwort	<i>Hypericum punctatum</i> Fac	Spotted St. John's-wort
<i>Polygala sanguinea</i> Facw	Purple Milkwort	<i>Triadenum virginicum</i> OBL	Marsh St. John's-wort
Euphorbiaceae		<i>Triadenum walteri</i> OBL	Large Pink St. John's-wort
<i>Euphorbia polygonifolia</i> Facw	Beach Spurge	Elatinaceae	
* <i>Euphorbia purpurea</i> Fac	Wolf's Milk	<i>Elatine americana</i> OBL	Waterwort
Callitricheaceae		Violaceae	
<i>Callitriche deflexa</i> Facw	Water Starwort	<i>Viola blanda</i> Facw	Sweet White Violet
<i>Callitriche heterophylla</i> OBL	Larger Water Starwort	* <i>Viola brittoniana</i> Fac	Britton Violet
<i>Callitriche stagnalis</i> OBL	Green Water Starwort	<i>Viola conspersa</i> Facw	American Dog Violet
Limnanthaceae		<i>Viola cucullata</i> Facw	Marsh Blue Violet
<i>Floerka proserpinacoides</i> Fac	False Mermaid	<i>Viola emarginata</i>	Violet
Anacardiaceae		<i>Viola lanceolata</i> OBL	Lance-leaved Violet
<i>Rhus copallinum</i> NI	Dwarf Sumac	<i>Viola pallens</i> OBL	Northern Blue Violet
<i>Toxicodendron radicans</i> Fac	Poison Ivy	<i>Viola papilionacea</i> Fac	Common Blue Violet
<i>Toxicodendron vernix</i> OBL	Poison Sumac	<i>Viola primulifolia</i> Fac	Primrose-leaved Violet
Aquifoliaceae		* <i>Viola rotundifolia</i> Fac	Round-leaved Violet
<i>Ilex glabra</i> Facw	Inkberry	<i>Viola sagittata</i> Facw	Arrowleaf Violet
<i>Ilex laevigata</i> OBL	Smooth Winterberry	Lythraceae	
<i>Ilex opaca</i> Facw	American Holly	<i>Rotala ramosior</i> OBL	Toothcup
<i>Ilex verticillata</i> Facw	Winterberry	<i>Decodon verticillatus</i> OBL	Water Willow
Celastraceae		<i>Lythrum lineare</i> OBL	Loosestrife
<i>Euonymus americanus</i> Fac	Strawberry-bush	<i>Lythrum salicaria</i> Facw	Purple Loosestrife
Staphyleaceae		Melastomataceae	
<i>Staphylea trifolia</i> Fac	Bladdernut	* <i>Rhexia aristosa</i> OBL	Awned Meadow Beauty
Aceraceae		<i>Rhexia mariana</i> OBL	Meadow Beauty
<i>Acer negundo</i> Fac	Box Elder	<i>Rhexia virginica</i> OBL	Meadow Beauty
<i>Acer rubrum</i> Fac	Red Maple	Onagraceae	
<i>Acer saccharinum</i> Facw	Silver Maple	<i>Ludwigia alternifolia</i> Facw	Seed-box
Balsaminaceae		<i>Ludwigia hirtella</i> OBL	Spindle-root
<i>Impatiens capensis</i> Facw	Jewelweed	<i>Ludwigia linearis</i> OBL	Narrowleaf Seed-box
<i>Impatiens pallida</i> Facw	Pale Touch-me-not	<i>Ludwigia palustris</i> OBL	Water Purslane
Vitaceae		* <i>Ludwigia peploides</i> OBL	Perennial Water Primrose
<i>Vitis labrusca</i> HPL	Northern Fox Grape	<i>Ludwigia sphaerocarpa</i> OBL	Spherical-fruited Seed-box
<i>Vitis rotundifolia</i> FAC	Southern Fox Grape	<i>Epilobium angustifolium</i> Fac	Fireweed
<i>Parthenocissus quinquefolia</i> Facw	Virginia Creeper	<i>Epilobium coloratum</i> OBL	Purpleleaf Willowherb
Tiliaceae		<i>Oenothera fruticosa</i> Fac	Sundrops
<i>Tilia americana</i> Facw	Basswood	<i>Oenothera lacinata</i> Facw	Cut-leaved Evening Primrose
Malvaceae		Haloragidaceae	
<i>Kosteletzkya virginica</i> OBL	Seaside Mallow	<i>Myriophyllum brasiliensis</i> OBL	Brazilian Water Milfoil
<i>Hibiscus moscheutos</i> OBL	Rose Mallow	<i>Myriophyllum heterophyllum</i> OBL	Variableleaf Water Milfoil
		<i>Myriophyllum humile</i> OBL	Lowly Water Milfoil
		<i>Myriophyllum pinnatum</i> OBL	Eastern Water Milfoil
		* <i>Myriophyllum verticillatum</i> OBL	Needleleaf Water Milfoil
		<i>Proserpinaca palustris</i> OBL	Marsh Mermaidweed
		<i>Proserpinaca pectinata</i> OBL	Cutleaf Mermaidweed
		Araliaceae	
		<i>Aralia spinosa</i> Fac	Hercules Club

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APPENDIX M

azalea. Poison ivy, greenbriar, and Japanese honeysuckle (*Lonicera japonica*) usually become quite common in drier (temporarily flooded) red maple swamps. Common herbaceous plants of wetter swamps consist of skunk cabbage, royal fern, cinnamon fern, sensitive fern, net-veined chain fern, lizard's-tail, tussock sedge and other sedges, jewelweed, jack-in-the-pulpit, tall meadow rue, and others. Peat moss may be locally abundant in wetter depressions, while water willow may be common in wet open areas. Canada mayflower (*Maianthemum canadense*) and trout lily (*Erythronium umbilicatum*) may occur on hummocks. Examples of the variety of plant composition within red maple-dominated wetlands are presented in Table 15.

Temporarily flooded deciduous forested wetlands are the most abundant forested wetland type in Delaware. Many of them represent once wetter swamps that have now been partly drained by channelization projects.

Several tree species may dominate or share the forest canopy, including red maple, sweet gum, tulip tree, green ash, white ash (*Fraxinus americana*), black gum, oaks (e.g., pin, red, swamp white, and willow), loblolly pine, and American elm. In the Piedmont region, box elder (*Acer negundo*), sycamore (*Platanus occidentalis*), ironwood (*Carpinus caroliniana*), beech, silver maple (*Acer saccharinum*), bitternut (*Carya cordiformis*), spicebush, stinging nettle (*Urtica dioica*), spring beauty (*Claytonia virginica*), and may apple (*Podophyllum peltatum*) may be present and even locally abundant. In the Coastal Plain region, loblolly pine, American holly, sweet pepperbush, inkberry (*Ilex glabra*), elderberry, and highbush blueberry are more typical plants. Poison ivy, greenbriar, and Japanese honeysuckle are common in many temporarily flooded swamps, with partridgeberry (*Mitchella repens*) occurring in lesser amounts. Hercules club (*Aralia spinosa*) is occasionally present in these wetlands in Sussex

Table 15. Examples of red maple forested wetland communities in Delaware.

Ratio (OBL:FAW:FAU:UPL)	Dominance Type (Water Regime)	Common Associates	Less Common Plants
5:0	Red Maple (seasonally flooded/ saturated)	Black Gum, Sweet Gum, Basket Oak, Sedges, and Winterberry	American Elm, American Holly, Lizard's-tail, Greenbriar, Grape, Southern Arrowwood, Trumpet Creeper, and Beggar-ticks
3:0	Red Maple (seasonally flooded/ saturated)	Sweet Pepperbush and Mosses	Sweet Gum, Highbush Blueberry, Swamp Azalea, Southern Arrowwood, and Black Gum
5:0	Red Maple (seasonally flooded/ saturated)	Southern Arrowwood, Skunk Cabbage, Sensitive Fern, Net- veined Chain Fern, and Manna Grass	Sweet Bay
7:0	Red Maple (seasonally flooded)	Elderberry, Jack-in-the-pulpit, Jewelweed, Poison Ivy, and Grass	Marsh Blue Violet, Small-flowered Crowfoot, Skunk Cabbage, Silky Dogwood, Smartweed, Elm, and Greenbriar
8:0	Red Maple (seasonally flooded)	Silky Dogwood, Skunk Cabbage, Sensitive Fern, and Southern Arrowwood	Pin Oak, False Nettle, Soft Rush, Poison Ivy, Sedges, Grasses, Elderberry, Grape, Bitter Cress, and Sweet Gum
5:1	Red Maple (seasonally flooded)	Swamp Rose, St. John's-wort, Peat Moss, other Mosses, and Meadowsweet	Highbush Blueberry, Loblolly Pine (seedlings), and Dogbane
5:2	Red Maple, Sweet Gum and Loblolly Pine (temporarily flooded)	American Holly, Sweet Bay, Greenbriar, Highbush Blueberry, Poison Ivy, and Brambles	Choke Cherry, Inkberry, Sweet Pepperbush, Ironwood, Beech, Water Oak, and Clubmoss
4:0	Red Maple (temporarily flooded)	Black Gum and Poison Ivy	Sweet Gum, Willow Oak, Peat Moss, Soft Rush, Sedges, Greenbriar, Highbush Blueberry, and Pin Oak
5:1	Red Maple, Bitternut and Sweet Gum (temporarily flooded)	Sweet Pepperbush, Highbush Blueberry, and Greenbriar	Willow Oak, Swamp White Oak, Pin Oak, Southern Arrowwood, Grass and Sedges