NEON FSU Field and Lab Protocol for Ops CPER 2011: Plant Phenology Protocols

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TABLE OF CONTENTS

LIST OF TABLES

1 INTRODUCTION

1.1 Purpose

The primary purpose of this document is to provide a change controlled version of Observatory protocols and is the version used for external review by subject-matter experts. This document provides the content for training and field-based materials for NEON staff and contractors. Content changes (i.e. changes in particular tasks or safety practices) occur via this change-controlled document, not through field manuals or training materials.

This document is a detailed description of the field data collection, relevant pre- and post-field tasks, and safety issues as they relate to this procedure and protocol.

1.2 Scope

This document relates the tasks for a specific field sampling or laboratory processing activity and directly associated activities and safety practices. This document does not describe:

- general safety practices (i.e. how to drive a boat)
- site-specific safety practices (e.g. how to safely walk in a stream)
- general maintenance (i.e. fill the car with gas)

It does identify procedure-specific safety requirements such as safe handling of small mammals or safe use of required chemicals and reagents.

1.3 Acknowledgements

The NEON phenology measurements are based on the work by the National Phenological Network and are compatible with both NPN and Budburst measurements.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Reference Documents

(If you want to reference other procedural documents (e.g. associated Protocol document), drawings, etc. then include filenames in the following sections.)

RD[01]	NEON.DOC.000008 NEON Acronym List
RD[02}	EHS Safety Policy and Program Manual
RD]03…]	<primary science design docs explaining/justifying this protocol/these procedures>
RD[04]	NEON Sampling Design Document
RD[05]	Training Plan
	QA/PA Plan
	DOORS requirements
	ATBD
AD[01]	FSU Science Requirements
AD[02]	FSU Field Operations Plan
AD[03]	Data Products Level 1-3 Catalog
	NEON.DOC.000243 NEON Glossary of Terms

2.2 Acronyms

Insert table for definitions of acronyms used in this document.

NEON	National Ecological Observatory Network
FSU	The NEON Fundamental Science Unit at Headquarters
P&P	Procedure and Protocol

3 BACKGROUND AND OBJECTIVES

3.1 Background

This section describes the methods for collecting data on plant phenology. Three species have been selected for phenological measurements during the Field Operations Prototype 2011 *[TBR]*.

The NEON plant phenology measurements shall record the seasonal progression of critical biological processes and the timing of ecological events. The NEON phenology measurements shall track sensitive and easily observed indicators of biotic responses to climate variability by recording and monitoring the timing and duration of phenological events in plant communities. Phenology (a branch of science focused on relationships between climate and the seasonal timing of biological phenomena, such as bird migration and blooming dates) is one of the most sensitive and easily observed indicators of biotic response to climate variability. Phenology is affected by forces such as length of growing season, timing and duration of pest infestations and disease outbreaks, water fluxes, nutrient budgets, carbon sequestration, and food availability.

3.2 Science Requirements

This protocol fulfills the following Observatory science requirements:
List science requirements from DOORS that are met by this protocol.

3.3 Data Products

List Level 0 data products measured by protocol.

Table 1 A summary of field and related lab measurements and the associated NEON Data Products

Measurement	Data Product

4 PROTOCOL

The Plant Phenology measurements are performed weekly on marked individuals of three plant species. At each sampling time, the phenological stage for each individual is recorded *[TBR]*.

4.1.1 Plot Location

FSU is responsible for determining locations for sampling. Locations have been chosen such that each location is no closer than two or three times the width of one of the plants *[TBR]*.

4.1.2 Plot Establishment

Plots will be established by FSU prior to prototype field work *[TBR]*.

5 QUALITY ASSURANCE AND QUALITY CONTROL

The Quality Assurance and Quality Control plan is described in a Quality Control Plan document *[TBR]*.

6 DECISION TREE

Please see the decision tree document *[TBR]*.

Delay	Action	Adverse Outcome	Outcome for Data Product
3 days - 2 or more weeks	Note duration and cause of the delay. Contact appropriate scientific lead(s) on the FSU team for guidance. Cancel the impacted sampling bout and stop sampling until next scheduled sampling bout	true phenology of some species may be lost for this collection year if regular occurrence	affects Phenology measurements

7 SAFETY

There are no safety issues specific to this protocol.

Personnel working at a NEON site should be familiar with and practice safe field work as outlined in the EHS Safety Policy and Program Manual. Additional safety issues associated with this field procedure are outlined below. The Field Operations Manager and the Lead Field Technician have primary authority to stop work activities based on unsafe field conditions; however, all employees have the responsibility and right to stop their work in unsafe conditions.

8 PERSONNEL REQUIREMENTS

The sampling described here includes weekly sampling and should always be performed by two people in the field to increase sampling efficiency and uphold field safety standards. These two people can be hired at the technician level. *[TBR]*

9 TRAINING REQUIREMENTS

Training requirements for plant phenology are presented in the Training Plan document *[TBR]*.

10 FIELD STANDARD OPERATING PROCEDURE

10.1 Sampling Frequency and Timing

Each individual or plot should be visited weekly (e.g., every Monday) throughout the entire year. It is estimated that it will take two people four hours each sampling event to complete the measurements *[TBR]*.

10.2 Contingent decisions

Please see section 6.

10.3 Field Procedure

10.3.1 Equipment and Materials

- Datasheets
- Clipboard
- Pencil

[TBR]

10.3.2 Preparation

Datasheets should be prepared at least one day prior to field sampling. Familiarize yourself with the phenophase descriptions provided in the tables below each day of sampling *[TBR]*.

10.3.3 Sample Collection in the Field

This section is designed for the Field Operations Prototype at CPER 2011 *[TBR]*.

1. Locate the plot and individuals marked for plant phenology.
2. At each individual or plot record plant ID number and species. For each day that you make an observation, record the date and other appropriate information on your datasheet, and for each phenophase, record one of the following choices:
   - Yes (Y) – if you saw that the phenophase *is* occurring
   - No (N) – if you saw that the phenophase *is not* occurring
   - Uncertain (?) – if you were not certain whether the phenophase was occurring, or if you did not check for the phenophase

It is very important to record this information, even if nothing has changed on your plant since your last visit. Knowing when a plant is not in a given phenophase is just as important as knowing when it is.

10.3.3.1 Phenophases for each species

The species have been selected for the Field Operations Prototype at CPER 2011. These species will vary at each site and are likely to be revised after the science design reviews. *[TBR]*

10.3.3.1.1 Blue Grama (Bouteloua gracilis) & Cheatgrass (Bromus tectorum)

Special consideration for observing: If drought seems to be the cause of leaf withering for a plant, please make a comment about it for that observation.

Phenophase Title	Phenophase Definition
Initial growth	New growth of the plant is visible, either as new green shoots sprouting from nodes on existing stems, or new green shoots breaking through the soil surface. For each shoot, growth is considered "initial" until the first leaf has unfolded.
Leaves	One or more unfolded leaves are visible on the plant. A leaf is considered "unfolded" when it unrolls slightly from around the stem and begins to fall away at an angle.
All leaves withered	Of the leaves that developed this season, virtually all (95-100%) are dried and dead.
Flower heads	One or more flower heads (inflorescences) are visible on the plant. Flower heads emerge from inside the sheath of a grass stem and gradually grow taller. Do not include heads whose anthers have all dried and withered.
Open flowers	One or more open flowers are visible on the plant. A flower is considered "open" when anthers can be seen protruding from the spikelet. Do not include flowers with dried anthers that remain on the plant.
Grains	One or more grains are visible on the plant. Developing grains are soft or watery when squeezed, and eventually grow harder as they ripen.
Ripe grains	One or more ripe grains are visible on the plant. A ripe grain is hard when squeezed and is difficult to divide with a fingernail. Grains may also be considered ripe when they fall into your hand when the plant is handled.

10.3.3.1.2 Four-winged saltbrush (Atriplex canescens)

Phenophase Title	Phenophase Definition
Breaking leaf buds	One or more breaking leaf buds are visible on the plant. A leaf bud is considered "breaking" once a green leaf tip is visible at the end of the bud, but before the first leaf from the bud has unfolded to expose the petiole (leaf stalk) or leaf base.
Young leaves	One or more young unfolded leaves are visible on the plant. A leaf is considered “young” and “unfolded” once the petiole (leaf stalk) or leaf base is visible, but before the leaf has reached full size or turned the darker green color of mature leaves on the plant. The leaf may need to be bent backwards to see whether the petiole or leaf base is visible.
Flower buds	One or more flower buds or unopened flowers are visible on the plant. A flower is considered "unopened" up until the point when reproductive parts are visible between unfolded or open flower parts.
Open flowers	One or more open fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts are visible between unfolded or open flower parts. Do not include spent (wilted) flowers that remain on the plant.
Full flowering	For the whole plant, at least half (50%) of the flowers are open and still fresh.
Pollen release	One or more flowers on the plant release pollen when gently shaken or blown.
Full pollen release	For the whole plant, at least half (50%) of the inflorescences release pollen when gently shaken or blown.
Fruits	One or more fruits are visible on the plant. *A specific description of fruits for each species is provided*
Ripe fruits	One or more ripe fruits are visible on the plant. *A specific description of ripe fruits for each species is provided*
Recent fruit drop	Since your last visit to the plant, there is evidence that one or more mature fruits have dropped from the plant. Do not include obviously immature fruits that have dropped before ripening, such as in a heavy rain or wind. *This phenophase is only included for species where fruit ripeness is determined by drop (e.g. acorns)*

10.3.4 Data Handling (may not applicable for all Field SOPs)

At the end of each field day, enter data on field sheets into the appropriate excel file and save on the NEON server in the designated folder. *[TBR]*

11 DEFINITIONS

12 REFERENCES

Use Ecology style

APPENDIX A Field Data Sheets

In Operations, it is expected that data will be gathered on an electronic device. For the Field Operations Prototype at CPER 2011, physical data sheets will be provided during the training prior to the beginning of field work. Data sheets will include the following fields for each individual *[TBR]*:

-Date, Location, Name of collector, species, ID number

-For each phenophase listed in section 10.3.5, the collector will record Y, N or ?. An example of what these datasheets will look like is presented below.

ID number	Initial growth	Leaves	All leaves withered	Flower heads	Open flowers	Grains	Ripe grains
1	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
2	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
3	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
4	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
5	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
6	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
7	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
8	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?
…	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?	Y N ?

APPENDIX B Lab Data Sheets

APPENDIX C Considerations for implementation

APPENDIX D Procedure Checklist

13 TABLES

14 FIGURES

APPENDIX E
