

■

SIGNS OF THE SEASONS:
A NEW ENGLAND PHENOLOGY PROGRAM
COASTAL FIELD GUIDE



The *Signs of the Seasons* Coastal Field Guide is adapted in part from *Nature's Notebook*, USA National Phenology Network.

The *Signs of the Seasons* Coastal Field Guide is adapted in part from *Nature's Notebook*, USA National Phenology Network.

Signs of the Seasons: Coastal Field Guide Information

INTRODUCTION

This coastal species field guide is focused on observing the rockweed species, *Ascophyllum nodosum*, in the intertidal zone of the Maine and New Hampshire coast. There are three procedures to consider in monitoring *Ascophyllum*. Each is focused on a different aspect of rockweed research. All data will be entered using the links in the Recording your Data section of the Resources for Coastal Observers page found on the Signs of the Seasons website (<http://umaine.edu/signs-of-the-seasons/coastal-observers/>).

Procedure A: Phenophase Observations

Participants will observe the phenophases of *Ascophyllum* by examining the presence and appearance of receptacles.

Procedure B: Water Quality Measurements

Two water quality parameters affecting the growth and phenophases of *Ascophyllum* are temperature and salinity. The water quality monitoring will be conducted each time the phenophase observations are made and also at the time of the age and growth assessment.

Procedure C: Age Assessment and Growth Rates

You may assist the research further by Assessing the Age and Growth Rates of the individuals you are observing in Procedure A. This should be accomplished once per year and typically in March/April, though it can be done at any time during the season.

Each of these Procedures is described in the instructions of this guide and training will be provided. Equipment, when available, will also be provided. **We greatly appreciate your time, interest and assistance in conducting this research.**

Before you go into the field:

- ✓ You will need to assess the tidal stage and plan accordingly. Tide charts may be found by selecting your region and location at *Maine Boats and Harbors* website where you can print monthly tide charts: <http://maineboats.us harbors.com/maine-tide-charts>
- ✓ Make certain you are prepared for the weather conditions, and that it is safe. Check the weather forecast for the time you will be in the field and wear appropriately safe shoes and clothing.
- ✓ Make sure you have the following field supplies and equipment: a transect line (soft tape measure), field hand lens, clipboard with field guide and data sheets, pencil, ruler, and water quality equipment (thermometer and refractometer).

Signs of the Seasons: A New England Phenology Program

Natural History of Rockweed

Appearance

Ascophyllum nodosum, sometimes called knotted wrack, is a member of a brown algal (seaweed) group called “rockweeds”. It forms single bladders in long, strap-like fronds, which hang downwards, draping sheltered intertidal rocks. A number of fronds grow from each holdfast (where the seaweed is attached to the rock).

Range

Along the northeast Atlantic coastline it ranges from NJ to Baffin Island, Canada. States where it is found: NJ, NY, CT, RI, MA, NH, ME.

Distribution

Found abundantly in the mid-intertidal zone on sheltered, hard substrate. A hardy organism, *Ascophyllum nodosum* can survive in varying environments and is tolerant of fluctuating temperature and salinity levels.

Role in the Environment

Rockweeds are conspicuous on North Atlantic rocky shores and provide habitat, shelter, and resources for a variety of marine biota.

Life Span

This species of rockweed is long-lived (a perennial plant): studies have documented that individuals can live for decades!

General Phenology and Life History

Each individual is either male or female. Reproduction appears to be correlated with temperature (Bacon & Vadas 1991)—the onset of reproduction generally occurs when water temperatures are 6°C (43°F), with peak reproduction at 10°C (50°F).

Similar to the way in which scientists use tree rings, the vesicles of *Ascophyllum nodosum* provide a record of its annual growth, showing which years had favorable or unfavorable conditions. Each spring, individuals create a new vesicle (airbladder) at the tip of each frond. Measuring the distance between vesicles provides a measurement of the growth rate from one growing season to the next.

Bacon, L.C. and R. L. Vadas (1991) A model for gamete release in *Ascophyllum nodosum* (Phaeophyta). *Journal of Phycology* 27 (2): 166-173

ROCKWEED PHENOLOGY PROTOCOL

PROCEDURE A.

Ascophyllum nodosum (Rockweed) Phenology Instructions

PLEASE BE CAREFUL! The intertidal zone is a slippery place. Your safety is our #1 concern. Please wear sturdy, closed-toed shoes, dress appropriately for the weather, and walk slowly on slick, uneven terrain. We highly recommend this monitoring be conducted in pairs for safety.

Please plan to evaluate the state of reproduction for *Ascophyllum* ideally one time per week (especially during the reproductive phases which start in very early spring) by observing the phenophases. If that is not feasible, make your observations twice a month. Pay particular attention to tide levels. In general, you will be able to access the shore one and a half hours before and after low tide. If your area is higher than high tide level, it may be accessible at all tide levels.

1. For each monitoring month, establish a representative transect (approximately 10 m) that runs parallel to the water line, and passes through a patch of *Ascophyllum nodosum* in the intertidal zone. The location for your site should be mid-intertidal in the stand of rockweed. Choose a site where you can return to the same area each time.
2. Haphazardly choose 10 individuals along the transect line. When handling individuals, take care. Although they are quite robust, they can be broken from their holdfast and will not reattach. It is difficult on some individuals to distinguish the primary shoot-in this case choose the longest frond close to the middle to check for phenophases. Avoid observing damaged fronds. There may be different phenophases occurring on one individual—in that case, establish the **majority phase** of the individual.
3. For each individual, evaluate the state of the receptacles (see photographs) to determine what phase it is in. Do this for all 10 individuals. You do not need to count the receptacles. The value for each phenophase would be how many plants are in that phase out of the 10 plants. (Essentially, how many plants out of the ten are in that particular phase at the time of your observation? Write that number (value) after Y or N or ?) After recording the phenophase on the **Phenophase Observations** (A) datasheet, enter your observations on-line at the SOS website on the SOS Coastal Observers (<https://extension.umaine.edu/signs-of-the-seasons/coastal-observers/>)

Note: This procedure should be conducted with water quality measurement for salinity and temperature (Procedure B).

Ascophyllum Phenophase Protocol adapted from GLOBE® 2005 Seaweed Reproductive Phenology Protocol, Earth System

Phenophase Definitions - Procedure A

Directions:

Record observations on a subset of 10 individual rockweeds at your site by determining how many observed individuals are in each phenophase. Do not make observations on rockweed individuals next to each other but every other one or haphazardly along the 10 meter transect line.

As you report on phenophase status (Y, N or ?) on the datasheets, refer to the definitions on this sheet to find out what you should look for, for each phenophase of this species. To report the intensity of the phenophase, choose the best answer to the question below the phenophase definition.

Leaves



New side branches

One or more new sides branches with smooth tips are visible on the plant. Side branches are considered "new" until they develop a receptacle, or until they reach a similar width and tough texture as the mature shoot on which they are growing. Do not include side branches with ragged tips, where a receptacle has recently detached. **How many individuals out of the ten observed have new side branches present? 1,2,3,.....10**

Flowers



Flat receptacles

Mostly flat, oval-shaped, olive-green receptacles are visible on the plant. **How many of the ten observed individuals are in this phase? 1,2,3,.....10**



Smooth inflated receptacles

Mostly inflated, smooth, olive-green receptacles are visible on the plant. **How many of the ten observed individuals are in this phase? 1,2,3,.....10**



Dotted inflated receptacles

Mostly yellow or orange receptacles studded with small, raised dots are visible on the plant. Do not include receptacles that are torn or ruptured. **How many of the ten observed individuals are in this phase? 1,2,3,.....10**



Torn receptacles

Mostly torn or ruptured, orange or dark brown receptacles are visible on the plant or plant has mostly ragged tips where receptacles have recently detached. **How many of the ten observed individuals are in this phase? 1,2,3,.....10**

Signs of the Seasons Coastal Observation

Name of Observer: _____ Species: Rockweed (*Ascophyllum nodosum*)

Site Name/Location: _____ State (circle): ME NH

Date					
Time of Observation					
	AM or PM	AM or PM	AM or PM	AM or PM	AM or PM
Tidal Stage	Low Mid High	Low Mid High	Low Mid High	Low Mid High	Low Mid High
Procedure A – Phenophase Observations					
<i>Do you see growth...</i>					
new side branches	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____
<i>Do you see receptacles...</i>					
flat receptacles	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____
smooth inflated receptacles	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____
dotted inflated receptacles	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____
torn receptacles	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____	Y N ? #_____
Procedure B – Water Quality Data					
Temperature (°C)					
Salinity (ppt)					

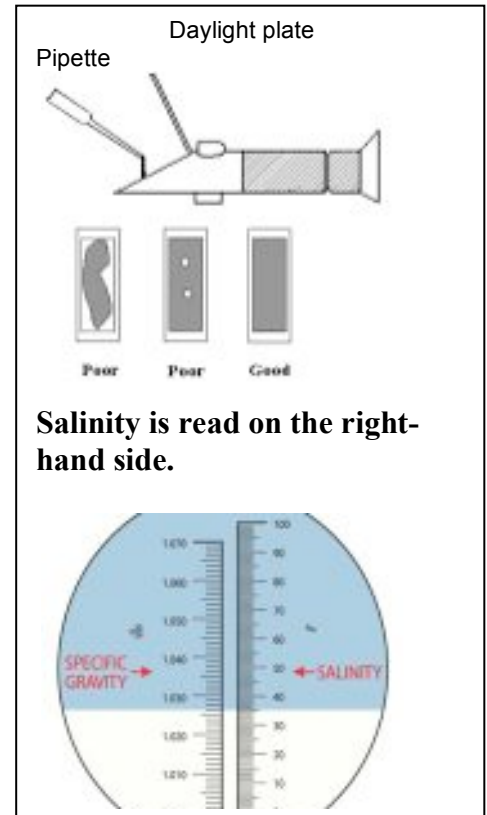
Comments:

PROCEDURE B.

Water Quality Instructions

Instrument Preparation for Field Work: The refractometer should be calibrated each time observations are made, preferably before traveling to the site. First, open the lid and place several drops of distilled water on the daylight plate. Keeping the refractometer in a horizontal position, gently close the lid and be sure the sample is evenly distributed with no bubbles across the daylight plate. Look through the eyepiece and, if it appears blurry, turn the black ring to put the scale into focus. Loosen the calibration ring with the screwdriver and turn the ring until the boundary line between the white and blue regions crosses the right-hand scale at 0 (0/00). When this is complete, tighten the screw in the calibration ring. Use a Kim wipe to remove the distilled water. The refractometer is now ready for field use.

1. Wade or reach into the water at the closest point to the rockweed transect that you are observing. Do not disturb the bottom. **Take the temperature reading, and pipette the salinity sample at the exact same location ideally 5 to 7 inches below the surface of the water; note that often this can only be a few inches due to the tidal stage and safety.** Submerge the thermometer probe until a steady reading is displayed. Submerge the pipette, rinse once and fill.
2. In a stable spot (away from the water), record the water temperature on field data sheet and measure salinity using the hand-held refractometer.
3. Place two drops of sample water from the pipette onto the daylight plate. Gently close the lid over the daylight plate. If necessary, point the refractometer towards or away from the sun to brighten or darken the field of view. You can also adjust for your eyesight by twisting the black ring near the eyepiece to focus the field of view. Read the salinity value on the right hand side. The value is where the boundary line of the blue and white fields cross the scale. Record the value on the field data sheet.
4. Rinse the daylight plate with distilled water and wipe clean with a Kim wipe. (If the daylight plate is smeared with oil or similar liquids, it will repel the sample and alter the measurement.)
5. Write your data for water quality parameters in the **Water Quality (B)** data section of the datasheet and enter on the SOS website in the SOS Coastal Observers page.



Water Quality Methods adapted from: Stancioff, Esperanza. *Clean Water: A Manual for Coastal Water Quality Monitoring*, published by Maine Sea Grant, 1992, revised 1996

PROCEDURE C.

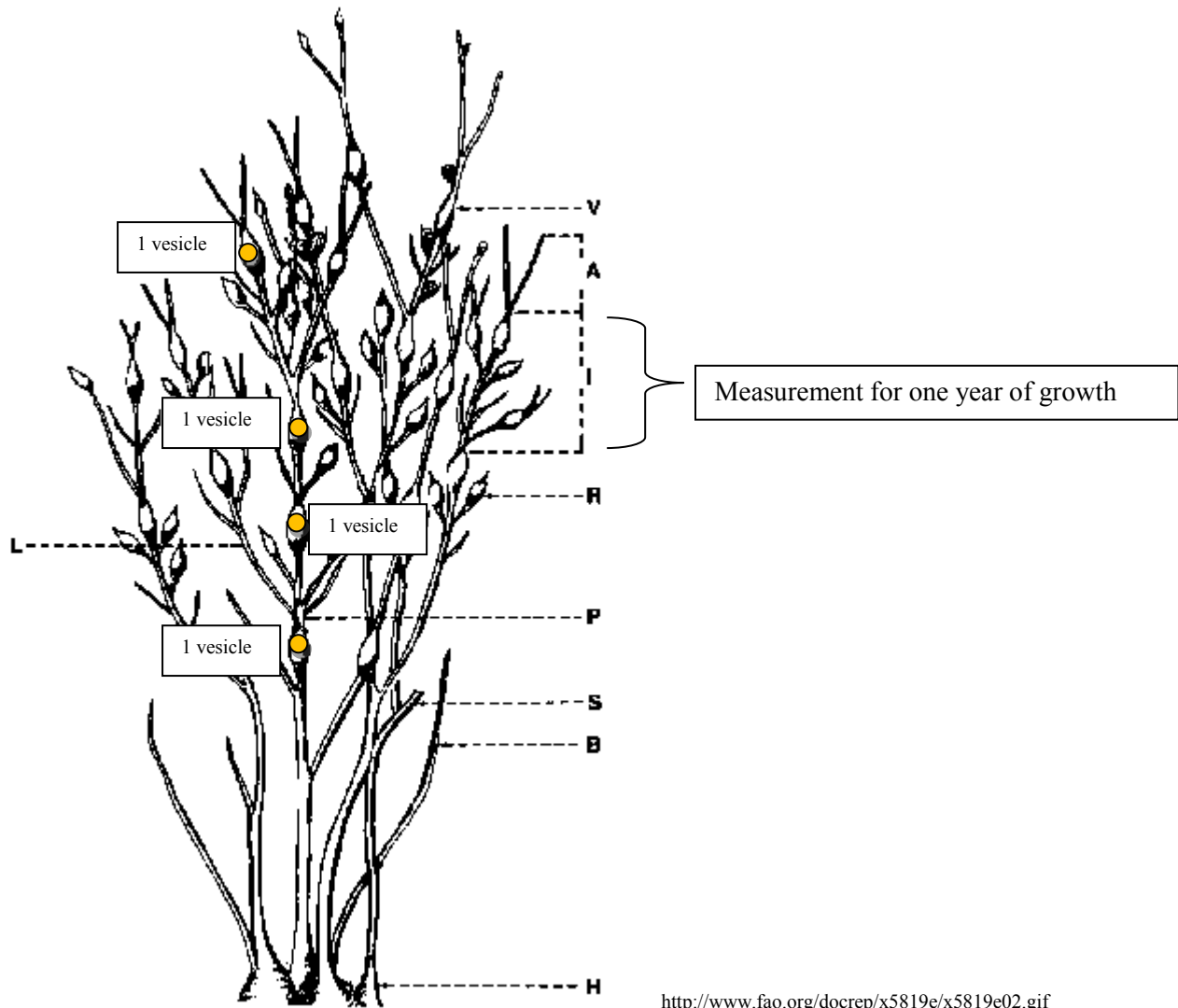
Assessing Age and Growth Rate for *Ascophyllum* Instructions

See accompanying image

Note: For both aging and growth rate, choose intact individuals and conduct this procedure once per year at any time during the season; though the preference is to conduct this in March/April.

1. To obtain the **minimum** age of the plant, count all the vesicles (air bladders) on an intact primary shoot (if difficult to find primary shoot, select a shoot towards the middle of individual). *Ascophyllum nodosum* is dichotomous in branching, meaning the frond splits in a “Y”- follow one shoot all the way up. For example, in the line drawing of *A. nodosum*, the individual is at least 4 years old. Counting on the primary shoot, from the holdfast upwards, there are 4 vesicles (noted with yellow circles). Count and record the number of vesicles present, from the bottom to the top (oldest growth to the newest growth).
2. To measure **growth rate**, measure the distance between each internode section (from mid-vesicle to mid-vesicle; letter “I” in the line drawing). This measurement is the growth in one year. Measurements of all the intermodal sections for an individual will allow one to see differences in growth rates between years and compare to other individuals. Measure growth rate from the newest internode to the oldest internode-- so from the **top down**.
3. Write your data for water quality parameters and growth rate on the ***Ascophyllum* Age and Growth Rate** (C) datasheet, and enter online on the SOS website at the SOS Coastal Observers page.

Note: This procedure should be conducted with water quality measurement for salinity and temperature (Procedure B).



<http://www.fao.org/docrep/x5819e/x5819e02.gif>

A, apical tip; B, basal shoot; H, holdfast; I, internode; L/lateral shoot; P, primary shoot; R, receptacle; S, stump; V, vesicle.

Algal Morphology Terms for *Ascophyllum nodosum*

Stump – The region where growth occurs (the apical meristem) when the body of the plant (called the thallus) is cut so that the branch of the alga is initially missing).

Internode – The region of growth that is between two air bladders (vesicles).

Apical tip – The tips of the plant where growth occurs (they grow from the tips of the thallus).

Plant - An assemblage of fronds (branches) arising from a common holdfast.

Stand - A group of plants within a defined area.

Vesicles – Airbladders on the thallus. These are dilations of the shoot produced at intervals related to rate of annual shoot elongation.

Receptacles – Reproductive organ of the plant. Receptacles are produced along lateral (side) shoots

Shoot – A part of the thallus resulting from growth. Shoots are analogous to branches of a tree.

Primary shoot – The main branch (trunk) of the individual, originating from the holdfast

Lateral shoot – A side branch that comes off a primary shoot.

Intact shoot – A branch that has is able to grow from the tips of the branches out.

Signs of the Seasons Coastal Observation

Name of Observer: _____ Species: Rockweed (*Ascophyllum nodosum*)

Date: _____ Time of Observation: _____ (circle) AM or PM

Site Name/Location: _____ State (circle): ME NH

Tidal State (circle): Low Mid High

Procedure B – Water Quality Data

Temperature (°C):		Salinity (ppt):	
-------------------	--	-----------------	--

Procedure C – Age Assessment and Growth Rate *(to be completed once per season)*

Measure the annual growth (cm) between the nodes. Begin with the youngest airbladder near the tip and work your way backwards in history towards the holdfast.

Note: You will not be able to measure the growth for this season (2017-2018) because the plants are still growing.

Plant	1	2	3	4	5	6	7	8	9	10
<i>Stage of Reproduction</i>										
<i>Age</i>										
2017-2018										
2016-2017										
2015-2016										
2014-2015										
2013-2014										
2012-2013										

(Procedures B,C)

2011-2012										
2010-2011										
2009-2010										
2008-2009										
2007-2008										
2006-2007										
2005-2006										
2004-2005										
2003-2004										
2002-2003										
2001-2002										
2000-2001										
1999-2000										
1998-1999										

Comments: