

Phenology Lecture #2

Coordinated Phenological Research Networks: Nuts, Bolts, and Roles

Slide Notes

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Slide 1: coordinated phenological research networks

This lecture presents a broad introduction to ongoing coordinated phenological research. Academic scientists, government agencies, and citizens all around the world are conducting phenological research in an attempt to understand a variety of natural processes that affect human society (e.g., crop phenology) **and** how biological systems are responding to climate change.

This lecture assumes that students are familiar with the term phenology and have at least a basic understanding of global climate change.

Note to instructors: More phenology educational materials and activities are available online, including lesson plans for advanced undergraduate or graduate seminars; lesson plans for undergraduate laboratory activities; and phenological activities for use in informal educational settings. To learn more and to download materials, visit the Education section of the California Phenology Project website (www.usanpn.org/cpp/education) or the USA National Phenology Network (www.usanpn.org/education).

Slide 2: phenology: the science of the seasons

This slide briefly defines phenology and provides three examples of phenological events: spring wildflower blooms, the color changes of deciduous leaves in the fall, and bird migration.

Slide 3: phenology as an indicator of climate change

In its 2007 Assessment report, the IPCC recommended using phenological monitoring to track the environmental effects of climate change.

Slides 4-5: concrete benefits of monitoring phenology over time

This slide provides a reminder of some of the phenological processes that directly affect the human population. Because phenological processes affect our society in numerous ways, monitoring phenology over time has many direct benefits. Unfortunately, there are several factors that make it challenging for individuals or small groups to engage in large-scale, long term phenological monitoring. For example, it is difficult to collect data for extended periods of time, ensure that all researchers use standardized monitoring protocols, cover a large geographic area, and to archive large amounts of data.

Slide 6: introduction to coordinated phenological research networks

Phenological research networks are collaborative partnerships among researchers, government agencies, non-government agencies, educators, and citizen scientists. Coordinated phenological monitoring:

- Engages people with different but complementary areas of expertise
- Involves participants with many levels and types of expertise
- Uses standardized methods for large-scale data collection
- Results in larger data sets than a single researcher can readily obtain
- Provides centralized database management can facilitate data archival and analysis

Slide 7: outline

This lecture comprises four main sections.

1. A broad introduction to coordinated research networks
2. An overview of phenological research in the United States, including the National Phenology Network
3. A description of a statewide phenology network (the California Phenology Project)
4. A description of phenological research and outreach being executed at the regional level. Two examples will be presented: the Northeast Regional Phenology Network and the University of California, Santa Barbara Phenology Stewardship Program

Slide 8: coordinated phenology networks

National phenology networks have been established in many countries worldwide. This slide shows some examples of these networks. There are phenological networks in Canada, the UK, Sweden, Australia, and in several other countries. In the United States, phenological research is coordinated by the USA National Phenology Network (USA NPN).

Slide 9: overview of the USA NPN

The USA NPN was established to coordinate research and educational outreach activities aimed at understanding how plants, animals, and landscapes respond to environmental variation and climate change.

The USA NPN:

- Comprises a national biological science and monitoring program
- Provides a phenological data management system
- Enforces standard protocols for plants, animals, landscapes
- Engages government agencies, non-government agencies (NGOs), academia, and the public
- Partners with other monitoring networks
- Offers web-based tools & services
- Provides on-line education & training tools

Slide 10: the Clonal Lilac Project

The Clonal Lilac project is the longest-standing coordinated phenological research effort in the United States. Lilacs are easily to propagate clonally; plants can be split and the resulting parts can be grown independently of one another. This allows genetically identical individuals to be grown in different environments and compared. Lilacs are also non-invasive, so there is little need to worry about introducing an invasive species into a given region.

Slide 11: lilac phenophases

This slide depicts the different phenophases of the common lilac from breaking buds, to young leaves, open flowers, and up to full flowering.

Slides 12: the Clonal Lilac Project

- The first phenological monitoring effort in the U.S. Dr. Joe Caprio sent out clonal lilacs to thousands of citizens around the United States, who grew them in their gardens. Joe Caprio is pictured in this slide on the left, with Dr. Mark Schwartz, who has continued the Clonal Lilac project (in collaboration with other researchers and the USA NPN) since Dr. Caprio's retirement.
- 1950's – 1990's: ~3500 backyard scientists monitored cloned lilac plants in backyards and gardens
- Each year, the citizen scientists sent postcards reporting the date of first bloom to Dr. Joe Caprio at Montana State University. The postcards are also pictured in this slide.

Slide 13: the Clonal Lilac Project

The data collected by Dr. Caprio and the citizen scientists have been used to show the effects of elevation and latitude on the onset of spring and to assess climate change in the United States.

Slide 14: the Clonal Lilac Project

This slide shows how patterns of lilac phenology over several decades correspond to geographic regions in the United States. The blue dots represent long-term lilac monitoring sites. Note that there is a latitudinal cline in leaf emergence dates, as well as a cline that is determined by elevation (see the red lines). An excellent example of the latter can be found by looking at the areas around the Colorado Rocky Mountains.

This map integrates 30 years of data to elucidate an overall relationship between phenology and latitude, as well as phenology and elevation.

Potential questions to ask students: in which regions do leaves emerge the earliest? In which regions to leaves emerge the latest? What are the advantages of using lilac clones to monitor phenology over a large area and over many years?

Slide 15: the Clonal Lilac Project

The map on this slide depicts the same clinal information that was presented on the previous slide, but uses colors to indicate different dates of leaf emergence.

Slide 16: clonal lilacs in California

Other researchers looked at the onset of flowering at clonal lilacs in California. There were 26 observation sites located throughout the state, which were monitored for almost 40 years.

Slide 17: clonal lilacs in California

On average, lilacs are flowering 1.8 days earlier per decade in California. This observation implies that lilacs are responding to recent climate change in California. This research provides an excellent example of the large-scale studies that can be executed by coordinated phenological research networks.

Potential question to ask students: How feasible would it have been for one research lab to conduct this study?

Slide 18: the Nature's Notebook is a program coordinated by the USA NPN

The Nature's Notebook program is a nationwide phenological monitoring program. Citizen scientists use standardized protocols to monitor plants and animals in their regions. Their phenological observations can be uploaded to the Nature's Notebook data portal on the NPN website. These data are archived and maintained for ongoing and future research.

Slide 20: finding Nature's Notebook

This slide shows how to find Nature's Notebook online and how to learn more about participating in the program. At the Nature's Notebook website, participants can find plant and animal species to observe in their area, learn how to observe these species, register as citizen science observers, and download data sheets for data collection.

Slide 21: participating in the USA NPN

In addition to recording data for the Nature's Notebook program, citizens can also register their own data sets and rescue historical data from old postcards.

Slide 22: participation in Nature's Notebook

People are participating in the Nature's Notebook program nationwide. This map shows the location of citizen science observers nationwide. Each brown dot shows the location of a registered citizen scientist (as of August 2011)

Slide 23: participation in Nature's Notebook

This map shows the number of Nature's Notebook observers in each of the continental states in the U.S. The number in the center of each brown circle shows the number of observers in each state.

Slide 24: plant life forms incorporated in the Nature's Notebook program

The Nature's Notebook program has created standard protocols for monitoring many plant and animal species (as well as landscapes). The protocols are specific to different functional groups. For example, here is a list of the different plant life forms for which protocols have been established:

- Evergreens
- Cacti
- Conifers
- Deciduous
- Forbs
- Grasses
- Sedges

Slides 25-29: examples of Nature’s Notebook data sheets

Nature’s Notebook provides downloadable data sheets for every species that the USA NPN is currently monitoring. Each data sheet can be used to record data on multiple dates and also includes clear definitions of each phenophase that may be observed for a given species.

These slides show examples of data sheets (and corresponding phenophases) for two plant species: the California poppy and the black elderberry.

Slide 30: revisit the Outline

Phenological research is also being coordinated at the state level. The California Phenology Project is partnered with the USA NPN and currently focuses on developing intensive monitoring programs throughout California.

Slide 31: introduction to the California Phenology Project (CPP)

- California is a biologically diverse state, which spans a range of latitudes and elevations and contains numerous distinct habitats and vegetation types.
- The California Phenology Project seeks to take advantage of this environmental variation and addresses a variety of scientific questions related to phenology and climate change.

Slide 32: CPP sites in 6 pilot national parks

The California Phenology Project is establishing phenology research areas in six pilot national park sites, located throughout the state:

- Redwood National Parks
- Lassen Volcanic National Park
- Golden Gate National Recreation Area
- Joshua Tree National Park
- Santa Monica Mountains National Recreation Area
- Sequoia and Kings Canyon National Parks

Slide 33: goals of CPP

- To establish a phenological monitoring network across California
- To monitor across a large geographic area and along key environmental gradients
- To address relevant scientific questions and resource management challenges

Slides 34: scientific questions addressed by the CPP

PHENOLOGICAL LITERACY

- Which taxa or functional groups are most sensitive to climate change?
- Are relationships between plant and animal mutualists being disrupted by climate change?
- Do communities or habitats differ in their phenological responses to climate change?
- What are the earliest indicators of spring?

These questions are being addressed over a wide latitudinal gradient. This research will inform scientific decision-making processes made by California natural resource managers considering different ways to manage natural areas as the climate changes.

Slide 35: the CPP's current activities

In 2011 & 2012, phenological researchers have been collaborating with and training botanists, ecologists, and education specialists at six pilot national parks in CA.

Park scientists are learning how to conduct phenological monitoring (using USA-NPN protocols and online tools) and considering ways to integrate phenological outreach activities into existing natural history educational programs aimed at park visitors.

Slide 36: revisit the outline

So far this presentation has discussed phenology networks operating at the state and national levels. But there are dozens of regional phenology networks that engage in a wide array of activities. Describing each of these networks goes well beyond the scope of this presentation. But we will learn about two regional phenology networks, both of which serve as excellent examples of regional phenological collaboration.

Slides 37: Northeast Regional Phenology Network

The Northeast Regional Phenology Network (www.nerpn.org) is based in the northeastern United States and eastern Canada. This network coordinates phenological monitoring of species that occur in the northeastern region of North America (e.g., the Appalachian dogwood and the eastern bluebird).

Slides 38: Northeast Regional Phenology Network

In addition to facilitating hand-on phenological monitoring with the USA NPN's Nature's Notebook Program, the Northeast Regional Phenology Network also collaborates with the Phenocam Network. The Phenocam Network engages in very widespread phenological remote sensing webcam monitoring and archives a vast amount of data. This slide shows a selection of images that were collected at Phenocam observation sites.

Slide 39: UCSB Phenology Stewardship Program

The UC Santa Barbara Phenology Stewardship Program is a regional network based at the University of California, Santa Barbara in southern California. This regional network engages in hand-on monitoring activities and educational outreach in the Santa Barbara community.

Slides 39 and 40: UCSB Phenology Stewardship Program: research

PHENOLOGICAL LITERACY

University students collect historical phenological data using the herbarium at UCSB's Cheadle Center for Biodiversity and Ecological Restoration. Students have the opportunity participate in phenological monitoring efforts at natural areas around the UCSB campus, such as the Coal Oil Point Natural Reserve.

Slide 41: UCSB Phenology Stewardship Program and PLUSS

To build on the efforts of the UCSB Phenology Stewardship Program, phenologists at UCSB recently obtained a grant from the USA NPN and the US Geological Survey. They formed a new program, focused on enhancing phenology literacy among people of all ages. This new program is called PLUSS (Phenology Literacy: Understanding Through Science and Stewardship). The PLUSS program engages in various activities, including building local phenology gardens, developing educational materials for university courses, phenology activities in the public schools, and after-school programs.

Slide 42: map

This map shows locations and names of organizations that have partnered with PLUSS and the UCSB Phenology Stewardship Program.

Slide 43: conclusion slide

In summary, efforts to observe and record seasonal biological changes in nature are currently underway all over the United States. Academic researchers, government agencies, educators, children, and nature enthusiasts are getting involved in phenological monitoring in various ways. Phenology networks operate at a variety of levels, so there are many opportunities for people with different interests (ranging from computer programming to educating small children) to join a growing community of citizen phenologists.