Title: Designing an Urban Green Infrastructure Network: Balancing Biodiversity and Stakeholder Needs

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Student Handouts

This document contains a sequence of student handouts that can be used to implement the case study in the classroom. The handouts are cross-referenced to the appropriate class periods described in the Classroom Management section of the associated teaching notes document (pp. 6-13). The case study as presented below will require approximately eight three-hour periods (or one month of a typical college laboratory science course). The amount of time required could be reduced by up to half by using hypothetical parks/natural areas and classroom materials that contain more of the key pieces of information the students need to complete the exercises (i.e., rather than requiring students to do their own research). This would eliminate the need for a field trip to visit illustrative sites and speak with park managers. The stakeholder assessment exercise could also be condensed and integrated into the multiple species assignment. Times will also be shorter in classes that have already covered key background concepts like biodiversity conservation, restoration ecology, urban ecology, and ecosystem services.

Note: Many of the handouts are specific to the geographic location that this case study was originally designed for (i.e., Jamaica Bay region of New York City). Instructors may choose to modify the case study to make use of a location close to their school or to create a hypothetical location to simplify and condense the case study.

Part II: Introduction to biodiversity and conservation biology in the urban context

During the second half of the class period, the students will work through the published case study, "Do Corridors Have Value in Conservation" by Andrea Bixler, Clark University (published in the National Center for Case Study Teaching in Science's (NCCSTS) collection of case studies). The handouts for this case study can be accessed at NCCSTS's website http://sciencecases.lib.buffalo.edu/cs/ by navigating to the pages for the case collection. Instructors will need to create an account in order to access the answer key for the Corridors case study.

Part III: Green Infrastructure Networks and Design for Ecological Function and Human Use; Preparation for Field Trip, and introduction to concept mapping

During this class period students will practice completing a concept (or system) map using a familiar system (i.e., campus or classroom). Also, the instructor will introduce some key concepts, information about specific sites and systems, and logistical information for the field trip. The field trip handout is not presented here, as this content will vary significantly among instructors and must be instructor-generated.

SYSTEM MAPPING HANDOUT

FIELD TRIP HANDOUT (not included in this document)

Part V: Introduction to Designing a Green Infrastructure Network

During this class period the students will be introduced to the first part of the group work associated with the case study. Groups will be asked to create a proposed green infrastructure network from a set

of potential sites with a defined budget. This network will be designed to protect a single species. Each group will work on a different species. First the groups will complete an information needs assessment exercise to structure their research and information gathering efforts. Students will develop a concept map that defines key aspects of the biology of their species that is relevant to a green infrastructure network. Groups will use their concept maps to present their proposed networks to the rest of the class.

SINGLE SPECIES GROUP HANDOUT

INFORMATION NEEDS ASSESSMENT HANDOUT

Part VI: Group Presentations of Single Species Proposed Networks

During this class period the single species groups will present their proposed green infrastructure networks. Their peers will be asked to provide feedback and critiques, using a structured instrument.

HANDOUTS FOR STUDENTS TO DOCUMENT FEEDBACK ON SINGLE SPECIES GROUP PRESENTATIONS

Part VII: Human Dimensions of Conservation and Stakeholder Analysis

During this class period groups will be asked to consider the human dimensions of green infrastructure network planning. Groups will complete a stakeholder assessment exercise and think about how they might revise their proposed networks to account for stakeholder interests and concerns.

STAKEHOLDER ASSESSMENT HANDOUT

Part VIII: Putting it All Together – Multiple Species Green Infrastructure Network Design

During these class periods students will be reassigned to multiple species groups. Each synthesis group will include at least one member from each of the single species groups. The synthesis groups will be charged with harmonizing the single species proposed networks into one proposed network that will best protect all of the species as well as account for stakeholder interests and concerns. Groups will develop concept maps that will be used in their final presentations.

MULTIPLE SPECES NETWORK HANDOUT

Part IX: Final Presentations

During this class period the synthesis groups will present their proposed networks in a structured poster session (i.e., gallery walk format). Students will provide peer feedback and comments using a structured instrument. Students will also complete a self and peer evaluation to report on their own contribution compared to the contributions of their groups members. Finally, groups will submit final papers, and students will submit individual reflection papers.

HANDOUTS FOR STUDENTS TO DOCUMENT FEEDBACK ON MULTIPLE SPECIES GROUP PRESENTATIONS

SELF AND PEER EVALUATION HANDOUT

INDIVIDUAL REFLECTION PAPER HANDOUT

System Mapping Exercise

During today's class you will learn how to use a **system map** (also called a concept map or a mind map) as a tool to organize your thoughts and ideas about the structure and function of a system. You will be using system maps throughout the rest of the semester to organize and present your ideas to your peers, so this is your chance to learn about system maps and practice making an effective map for a system you know well before you use this technique to describe systems you will learn about over the next few weeks.

System maps are used to show the components of a system and the relationships between those components in a visual way. The system components are typically enclosed in circles or boxes, with the largest or most general components or concepts arranged at the top of the map and smaller or more specific components or sub-components arranged below. Connecting lines are used to show the relationships between system components, with words written on the line to describe the relationship between two components. These elements should be carefully constructed, so that each pair of linked components and the linking words or phrases between them all together forms a coherent thought or short sentence. Keep the wording as concise as possible. System maps are typically read from top to bottom, from more general to more specific concepts. Maps can be drawn on a piece of paper or you can use a free online program like Mental Modeler (http://www.mentalmodeler.org/) or XMind (http://www.xmind.net/) or similar (you can use search terms like "free online concept map program" or "free online mind map program" to look for a program you like) to draw your map. For more information about system (or concept) maps, check out this website: http://cmap.ihmc.us/docs/conceptmap.html

We worked through a sample system map together in class. Now it's your turn to practice with a system very familiar to you – your college campus. Split up into groups of 4 or 5. Your group's job is to show the key ***ecological and social components*** of the campus "urban ecosystem" and explain the ***relationships between those components***. **Your system map should answer the question "How does campus function as an urban ecosystem?"** The best way to start tackling this task is to go outside and observe the campus. Keep the focus question in mind, and you will begin to see the campus, which is so familiar to you, with new eyes. What are the ecological and social components that make it an ecosystem? Remember, these components may be physical (i.e., buildings, parking lots, forested areas, etc.) or conceptual (i.e., student organizations, student learning, etc.). How do these components interact to produce socio-ecological functions (i.e., biodiversity conservation, ecosystem services, student-faculty interactions, etc.)? Use a foam board and sticky notes or use one of the free online software programs to construct your map. Be prepared to present your map to the class and to compare your map to other groups'. Consult with your instructor for feedback and ideas as your group works through the process of constructing your map. Take note of the aspects of the task that come easily to you and those that are more challenging or problematic.?

Here are some questions we'll discuss as a group:

1. What are some interesting similarities and differences between the system maps of different groups? Focus on the components chosen, connectors drawn, linking words, and spatial arrangement of components on the page.

2. What were parts of the task that came easily to students? What was more challenging or problematic? Why? Are there patterns or trends among the students in your group, or was everyone different?
3. How well do you think the ecological and social components of campus function to conserve biodiversity of native species?

Are you stuck? Here's suggestion: start by listing some components, one column for ecological components (i.e., upland forested areas, grassy meadow areas, riparian forest, stream, etc.), and a second column for social components (i.e., classroom buildings, cafeteria, , educational activities, student organizations, etc.). Then try drawing lines between the components. Next begin to rearrange the components into groups (sometimes called domains) – more related components closer to each other on the page. Arrange the groups on the page in a way that represents the relationships or connections between the groups. Then you can start drawing links between components and finally fill in some connecting words. Remember, you should be able to read two adjacent components with the linking words between them all together as simple sentences.

Introduction to the Case Study and Single Species Network Assignment

Background and Context

In class we watched clips from the documentary, The Legend of Pale Male, about a red-tailed hawk who chose to reside in the heart of New York City. Not only was it unusual for a red-tailed hawk to actually nest in Manhattan, but Pale Male was particularly special because he and his mate decided to build their nest on the façade of an apartment building rather than in a tree in a park. Red-tails are well known for avoiding contact with humans, so for a pair to choose to live and raise chicks in full view of the comings and goings of the human population on the Upper East Side of Manhattan was truly a first. In addition, there were no previously documented cases of red-tails using built structures of the urban environment for nesting – anywhere.

When we think of urban wildlife, we immediately think of the small handful of animals, like rats, pigeons, starlings, squirrels, and cockroaches that have become extremely well adapted to urban environments. These organisms have figured out how to make a very good living on the food scraps of human civilizations and using aspects of the built environment to meet their needs for nesting, surviving extreme temperatures and weather events, and raising offspring. These animals have chosen urban environments as their preferred habitat. Although these are the most visible animals, there are many other species that have learned how to use urban environments to meet some or all of their requirements at various stages of their life histories. In suburban central New Jersey we are accustomed to seeing white-tailed deer, raccoons, skunks, opossum, various songbirds and raptors, and increasingly even shyer animals like black bears, foxes, and coyotes, foraging for resources in our lawns, gardens, garbage cans, garages, and even cars. Often these species may be less visible to us because they primarily use parks or fragments of remaining natural lands scattered throughout urban and suburban landscapes or are more active at night when we're not out to see them. Particularly in very developed

and fragmented landscapes like New York City and its nearby suburbs in northern and central New Jersey, animals may need to travel through built environments in order to complete aspects of their life histories. For example, migratory birds may need to travel through built environments in order to utilize preferred migratory stopover areas. Salamanders may need to cross busy roads in order to reach particular vernal ponds during the spring mating season. Large mammals like black bears, deer, and coyotes have large ranges that extend beyond the relatively small remaining fragments of natural areas into the surrounding built environment, and consequently have begun to use these areas to forage for resources and find mates. Don't forget – it's not just animal species that have to use these environments, it's also plants! Plants also have to establish and maintain populations in parks and fragments of natural areas and may need to disperse pollen and seeds across built environments in order to meet their life history requirements.

Some of these species are of particular interest because they are endangered, threatened or rare either at the federal, state, regional, or local level. Environmental professionals who are responsible for conserving rare species in the New York/New Jersey region have to think about how to protect these species when they move through and use urban built environments. What can managers do to ensure that species of concern have a way to move between remaining fragments of natural areas and to reach critical habitats like migration stopovers and mating grounds? Are there enough natural areas and parks in urban landscapes to support the habitat needs of these species? What is the quality of the natural areas that are remaining in developed landscapes – are they still able to meet all the biophysical and ecological requirements of these species of concern? One of the approaches that managers can take is to design and implement green infrastructure networks intended to provide for the needs and requirements of a range of species of concern. As we discussed during a recent class period, these green infrastructure networks typically consist of a set of sites of different sizes, shapes, and spatial arrangements called hubs, plus corridors that species can use to navigate among the hub sites.

Assigned Task

You, along with a few of your classmates, will take on the role of an environmental manager responsible for conserving and protecting one particular species of concern in the New York/New Jersey area. Each group of students will be assigned a unique species to research over the next week. Your group's charge will be to design a green infrastructure network to meet the habitat and life history requirements of your assigned species and present your ideas to your classmates. All the groups will focus on the Jamaica Bay watershed of New York City that we visited during our recent field trip. Refer back to your field trip handouts and posted reference materials for general information on the Jamaica Bay region, specific information about the sites we visited, and information about the ecosystem types we commonly see in Jamaica Bay.

All groups will be given the same master set of sites from which to choose five for your group's proposed network. These sites are city-owned properties and vacant lots that could be converted into a city park. Your group's job is to decide which sites to choose that will best conserve your species in the Jamaica Bay watershed. You should incorporate the following considerations in your decision making:

- Habitat and life history requirements of your assigned species. Which sites currently, or have the potential to, support ecosystem types that your species needs throughout its life history? Think

about the landscape setting of the site. For example, can the site support freshwater ecosystems or is there tidal influence?

- Quality of the existing habitat at each site. Does the site currently support a healthy, native ecosystem or does it contain an altered or novel urban ecosystem type or vegetation community? If the site has poor existing habitat quality, what is the landscape setting and context of the site (i.e., freshwater or saltwater, wetland or upland, etc.)? Could it be restored to support a more ecologically appropriate ecosystem type given its landscape setting?
- Spatial arrangement of your sites. How are your chosen sites arranged across space and in relation to existing parks and natural areas? How will populations of your species use the sites you're choosing? What are the sizes and shapes of the selected sites, and how do these match the needs of your species? Are there corridors they can use to move between the selected sites, or could such corridors be constructed?

You will have to work within New York City's budgetary constraints to conserve your species. You may be tempted to choose ALL of the sites, but unfortunately the city will not have enough money to make all of these sites into parks and conduct the restoration activities necessary to make the sites suitable for your species. Your supervisors have given you only $8.2 million to spend in creating this network. These costs are to be used entirely for establishing your green infrastructure network; other funds will be dedicated to maintaining the network in the future. You should plan to spend the entire budget, as any unspent funds will be recovered by the city and reallocated to other projects.

$8.2 million sounds like a lot of money, but keep in mind the following estimated costs:

- Restoration of salt marsh ecosystem = $50,000 per acre
- Restoration of upland oak-hickory forest = $20,000 per acre
- Restoration of open meadow = $15,000 per acre
- Restoration of dune ecosystem = $75,000 per acre
- Restoration of freshwater wetland ecosystem = $50,000 per acre
- Construction of recreation amenities (i.e., ball fields, splash parks,etc.) = $40,000 per acre
- Construction of passive recreation amenities (i.e., walking trails, interpretive signs, etc.) = $20,000 per acre
- Construction of green stormwater structures (i.e., bioswales, rain gardens, green roofs, etc.) = $50 per square foot

The above costs include labor, materials, and equipment needed for restoration/installation. However, you may decide to hire technical consultants to assist in the design of the restoration/construction projects; this kind of expertise can cost around $500 per day per individual. You may also want to budget for specific structures needed for your species; it is your group's responsibility to research species-related costs that are not included in the list above. Finally, you may want to devote some of your funds toward constructing educational facilities like nature centers or community centers to help convince local residents to support your proposal. Again, your group will need to provide budget estimates for these activities. Choose a combination of sites and restoration/construction activities that will optimize the conservation of your species within your given budget limits. Remember, you may not need to restore every acre of each site you select. Use your judgment in analyzing the aerial photos to determine how much restoration is required to provide usable habitat for your species. You may have to make some hard decisions!

Required Products

Each group will have approximately one week to decide which sites to include in their proposed network and to prepare a presentation of their work to the rest of the class. The instructor will make class time available for students to work in their groups and to consult with the instructor. To complete the assignment, each group is required to produce the following materials:

- **Information needs assessment** (see separate handout for format and detailed instructions). This assessment will help the groups identify what kinds of information they will need to gather in order to complete the assignment. Groups will be encouraged to use this assessment to divide up research tasks among group members.
- **System map for their assigned species** in the Jamaica Bay watershed. Each group will construct a system map that includes the following elements:
    - habitat and life history requirements of their species,
    - current conservation status (i.e., distribution and abundance) and threats to the conservation of the species, and
    - how the species uses (or can use) urban environments like the Jamaica Bay watershed.
- **Presentation to the class**. Each group will use Powerpoint or Prezi (or similar presentation program or platform) to present their proposed network to the other groups. Presentations should be 15-20 minutes in length, not including time for questions from the audience. Remember to make your presentations visually appealing and to avoid using too much text on your slides. Presenters should avoid reading off their slides but instead should use the text on the slides as a jumping off point for a more in-depth discussion. Groups are encouraged to have more than one person present. It's not necessary to have every group member speak, but all group members are encouraged to help answer questions after the presentation. Groups may prepare handouts for their classmates if they feel it is necessary or adds to the presentation; this is not required. Presentations should include the following elements:
    - the species concept maps and any additional information needed to provide context about the species (i.e., why it is rare/threatened/endangered, historical context, etc.),
    - elements of (or the entire) information needs assessment as an illustration of the methods the group used to gather relevant information about their species, and
    - description of the proposed green infrastructure network, including 1) visualization of the spatial arrangement of the selected sites and how your species may be able to move among sites where appropriate, 2) explanation of how/why the sites were selected, 3) challenges encountered in finding necessary information, selecting sites, and staying within the given budget, and 4) prediction for how well the network will function to protect the species in the Jamaica Bay watershed.

Resources

A number of information resources will be made available to you through our online course management system. These resources include:

- New York City Department of Environmental Protection. 2014. Jamaica Bay Ecological Atlas map.
- E. Kiviat and E.A. Johnson. 2013. Biodiversity Assessment Handbook for New York City. American Museum of Natural History and Hudsonia, Ltd.
- plaNYC Progress Report: Sustainability and Resiliency 2014. City of New York.

- US Fish and Wildlife Service. Significant habitats and habitat complexes of the New York Bight Watershed: Jamaica Bay and Breezy Point. http://nctc.fws.gov/resources/knowledge-resources/pubs5/web_link/text/jb_form.htm
- US Department of the Interior, National Park Service. 2014. Gateway National Recreation Area Final General Management Plan and Environmental Impact Statement. Selected chapters.
- New York City Department of Environmental Protection. 2007. Jamaica Bay Watershed Protection Plan. Selected chapters.
- New York City Department of Environmental Protection. 2012. Jamaica Bay Watershed Protection Plan 2012 Update.
- New York City Department of Environmental Protection. Paerdegat Basin Restoration fact sheet.
- Clean Earth, Inc. Case Study: Paerdegat Basin Restoration Project, Brooklyn, NY.
- New York City Department of Environmental Protection. Ecological Restoration of Pennsylvania and Fountain Landfills fact sheet.

Additional online resources you may find helpful include:

- NatureServe Explorer, a website that contains information about rare and endangered species in the United States and Canada; http://explorer.natureserve.org/
- US Department of Agriculture, Natural Resources Conservation Service plants database, website that contains information about plant species found in the United States; http://plants.usda.gov/java/
- Pinelands Preservation Alliance, Special Plants of New Jersey Fact Sheets; http://www.pinelandsalliance.org/ecology/plants/specialplantsnjfactsheets/

Site Profiles (see supplementary materials) and Species Assignments

Set of site profiles, each including:

- latitude-longitude information
- area of each site
- screen shot from Google Earth with drawn outlines of the site

Name of assigned species. The handouts will not provide information about the species; students will be expected to generate species descriptions. The following have been selected for the Jamaica Bay region:

- seabeach amaranth (*Amaranthus pumilus*)
- monarch butterfly (*Danaus plexippus*)
- spotted salamander (*Ambystoma maculatum*)
- osprey (*Pandion haliaetus*)
- eastern box turtle (*Terrapene carolina carolina*)

Information Needs Assessment

Your group has been assigned a species of conservation concern in the Jamaica Bay watershed. Your charge is to design a green infrastructure network that will protect your species in Jamaica Bay. The first step in tackling this assignment is to figure out what you need to know about your species, why it's rare or threatened in the NY/NJ region, and what characteristics potential parks would need to have to best protect your species. Once you know what you need to know, your group can begin to gather the information needed to complete the assignment.

In order to complete your information needs assessment, fill out the table below. For each provided category of information, fill in ***specific pieces of information you think you should know*** in order to design your green infrastructure network. For example, you will want to know the ecosystem type your species uses for nesting, size of the range, typical population density, etc. You don't need to provide the specific information in the table below (i.e., don't fill in the specific ecosystem type, actual size of the range, etc.). This table is just helping you think through what information you will need to look up in order to properly understand your species to be able to protect it. You can create more rows in the table if you need them. Review the resources already provided to you (see the list on the case study introduction handout and look through readings and materials posted on WebStudy) and determine which resources you think may be worth looking through to find the specific piece of information. If the resource has a table of contents, provide the chapter or page numbers you think would most likely contain the information. If you think it's unlikely that you'll find the information you're looking for in the resources already provided to you, specify this in the last column and indicate how you think you will look for this information (i.e., what google search terms will you use, what kind of resource will you look for – government report, endangered species database, campus library reference material, textbook, etc.).

Category of Information	Specific Piece of Information	Use of Provided Resources	Need for Additional Resources
Species habitat and life history requirements; general species characteristics			
Current status of species (i.e., rare, threatened, or endangered; # and location of existing populations			
Threats to species' ability to survive in NY/NJ			
Existing management recommendations to maintain species populations in NY/NJ			

region, particularly in urban landscapes			

Peer Evaluation of Group Presentations on Single Species Networks

Please rate each of the following required elements of the presentation on a 1 to 5 scale (where 1 is the lowest score and 5 the highest). You are encouraged to write specific comments in the space provided for each element. Why did you give the group the score you did? Provide some constructive criticism – what could they do to improve their presentation skills?

Species name _____

1. The group provided adequate information about their assigned species. This included information about habitat and life history requirements, current conservation status, threats to the conservation of the species, and how the species uses or can use urban environments like Jamaica Bay. The group used their concept map to explain some of this information.

   Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

2. The group presented the methodology they used to determine what they needed to know about the species in order to choose sites to conserve it. They explained how they gathered information about their species, what resources were the most helpful in finding the information they needed, and what information was difficult to find.

   Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

3. The group presented their proposed green infrastructure network, including a visualization showing the location and spatial arrangement of the sites they selected and discussion of potential for connectivity among sites. The group explained their justification for choosing these sites and the challenges they dealt with in selecting sites and staying within budget. They made a prediction as to how well they think the network will function to conserve their assigned species.

   Circle one 1 2 3 4 5

Comments_____
_____

_____
_____

4. The group's presentation was visually appealing.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

5. The presentation was easy to understand. The group tried to make the presentation interesting to the audience.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

Stakeholder Assessment Exercise

Up to this point your groups have been considering the needs of a unique species in the urban landscape of Jamaica Bay, New York. You have thought about the habitat and life history requirements of your species and how that maps onto potential new parks and natural areas in Jamaica Bay. You have proposed a network of new parks and restored natural areas in order to meet the needs of your species. You have done this within the budget limits given to you by your supervisors.

As environmental managers, are you now ready to present your proposed networks to the people who make decisions about New York City's parks system? Up to this point, you have been practicing traditional ecology, just in an urban context (so "ecology ***IN*** the city"). What has been missing from your analysis that the decision makers might be interested in? Who are the *people* of Jamaica Bay, and do you think they would be in favor of your plans to build and restore parks? Will the decision makers at various levels (i.e., local, state, federal) agree with your network design – does it fit in with their goals? It's time to start integrating people into your proposed networks and consider some of the social, cultural, economic, and political issues associated with these urban spaces in order to build some consensus for your proposed network. Once you start integrating the needs of different groups of people, or stakeholders, into your network design, you will be practicing "ecology ***OF*** the city." You will also experience the reality that environmental managers have to deal with every day – how can we best balance the needs of species and stakeholders in human-dominated landscapes?

Based on what you learned in lecture about stakeholder needs and interests, fill in the table below with information about known stakeholder interests (i.e., particularly stakeholder interests you were able to find mentioned in a publication or on a website) or potential stakeholder interests (i.e., stakeholder interests you imagine might exist but were not able to find mentioned in publications or websites) at

multiple scales in the overall Jamaica Bay watershed and in the particular neighborhoods surrounding your proposed green infrastructure network sites. Think about a broad group of stakeholders, including conservation organizations, business groups, developers, real estate firms, elected officials, government agencies, neighborhood associations, etc. (see illustrative list of stakeholder types in the McMahon and Benedict book on green infrastructure). You may contact park managers to informally interview them about known stakeholder interests (your instructor will assist you in contacting park managers). You can use the following resources available to you (see list below), or others that you find in your own research (for example: census information about demographics of neighborhoods surrounding individual sites; websites describing mission/agenda of non-profit and neighborhood organizations; etc.):

- plaNYC Progress Report: Sustainability and Resiliency 2014. City of New York.
- New York City Department of Environmental Protection. 2007. Jamaica Bay Watershed Protection Plan. Selected chapters.
- New York City Department of Environmental Protection. 2012. Jamaica Bay Watershed Protection Plan 2012 Update.
- US Department of the Interior, National Park Service. 2014. Gateway National Recreation Area Final General Management Plan and Environmental Impact Statement. Selected chapters.
- US Department of Agriculture – Forest Service. 2014. The Jamaica Bay Social Assessment: Understanding Park Users. Marine Park Profile.
- Benedict, M. A. and E. T. McMahon. Green Infrastructure: Linking Landscapes and Communities. New York: Island Press, 2012.
- E. A. Johnson and D. Smith, eds. 2006. *Legacy: Conserving New York State's Biodiversity*. The American Museum of Natural History, New York State Biodiversity Institute, New York State Department of Environmental Conservation, New York Natural Heritage Program, and The Nature Conservancy, Albany, NY.
- E. Gies. 2006. The Health Benefits of Parks: How Parks Help Keep Americans and Their Communities Fit and Healthy. San Franciso, Trust for Public Land.
- American Planning Association. How cities use parks for green infrastructure. City Parks Forum Briefing Papers 05.

Scale	Type of Stakeholder (i.e., local resident, city government, etc.)	Known Stakeholder Interest	Potential Stakeholder Interest
Local Neighborhood			
City			

State			
Federal			

Now that you have done some thinking about stakeholder needs and interests, consider whether these issues might have an impact on your proposed network. Answer the following questions:

1. Do you think you might have trouble building consensus for your proposed network among some of the stakeholders you listed above? Which stakeholders do you predict would be in favor of your plan, and which would oppose? Why? Explain.
2. How might you modify your proposed network to accommodate some of the stakeholder needs and interests listed in the table? Is there a way to address the needs and interests of the less supportive stakeholders and still increase habitat quantity and quality for your species of concern? Explain.
3. What ecosystem services does your group's proposed network provide that would be of interest to stakeholders at various levels?

Designing a Network to Conserve Multiple Species

Background and Context

Up to this point you and your group members have been focusing on the conservation of a single species. Although we did add the complexity of dealing with budgetary constraints and stakeholder issues, you did have it pretty easy. In the real world managers and environmental professionals often have to consider a number of species at the same time, and may be concerned about particular communities of species and the ecosystem types that support those groups of species. Sometimes these species of conservation interest have very different habitat and life history requirements. They may have very different needs in terms of habitat size and connectedness. The manager's job is to balance all of these varying needs, along with the needs of the human population within the usual political and economic constraints, to attempt to conserve as many species of interest as possible. No easy task.

Assigned Task

Now you get to try. We will rearrange the class groups so that each group has at least one member that worked on each of the five species. Using the same set of potential sites, the new groups will have to propose a new green infrastructure network that conserves all five species at once. We will adjust the

budget constraints to match your group's expanded scope. You will have class time to work in your groups, share your knowledge about your individual species, weigh the varying needs of each of the species, and ultimately determine which sites will do the best job within the given constraints.

These were the original considerations you incorporated into your decision making for your single species assignment:

- Habitat and life history requirements of your assigned species. Which sites currently, or have the potential to, support ecosystem types that your species needs throughout its life history?
- Quality of the existing habitat at each site. Does the site currently support a healthy, native ecosystem or does it contain an altered or novel urban ecosystem type or vegetation community? If the site has poor existing habitat quality, what is the landscape setting and context of the site? Could it be restored to support a more ecologically appropriate ecosystem type given its landscape setting?
- Spatial arrangement of your sites. How are your chosen sites arranged across space and in relation to existing parks and natural areas? How will populations of your species use the sites you're choosing? What are the sizes and shapes of the selected sites, and how do these match the needs of your species? Are there corridors they can use to move between the selected sites, or could such corridors be constructed?

Subsequently we asked you to integrate the needs and interests of various stakeholders into your decision making and designs.

Now we ask you to put all of these needs together into one synthesis network. Additional considerations you will want to discuss and address include (but are not limited to):

- The different ecosystem types required by the group of species
- Different shapes and sizes of park/natural areas needed by the group of species
- Different degrees and scales of connectedness and proximity of sites to support dispersal needs of the group of species
- How you can use the urban matrix to improve connectivity among your sites

Choose a combination of sites and restoration activities that will optimize the conservation of your species within your given budget limits. Just like last time, you may have to make some hard decisions!

Required Products

Each group will have approximately one week to decide which sites to include in their proposed network and to prepare a presentation of their work to the rest of the class. The instructor will make class time available for students to work in their groups and to consult with the instructor. Students can make use of all the resources provided during previous case study activities as well as materials they locate themselves. To complete the assignment, each group is required to produce the following materials:

- **Final group paper.** Groups will produce a final paper that presents their final proposed network. Papers should fully explain 1) the justification for the sites chosen for the network, 2) how your group used the budget (i.e., breakdown of costs), 3) how their group chose to balance the varying and sometimes opposing needs of different species and any other difficult choices they had to make, 4) the range of ecosystem services provided by their network, 5) how the network

addresses stakeholder interests, and 6) your group's prediction for how well the network will conserve all of the species.

- **Presentation to the class**. Each group will create a poster presentation to present their results. Posters should contain a concept map to organize their thoughts and ideas and a visualization of their proposed network. Presenters should summarize the key points from their final papers during their presentation. Each of the six items mentioned above should be addressed in the presentation. Groups will present their posters to their peers via a "gallery walk" process. Groups will each have a station in the classroom to set up their poster. Each group will appoint one person to remain at their station to present the poster, and the remaining students will split up so that there's an audience of students at each poster. The appointed presenter will have 20 minutes to present their work and respond to questions from the audience; presenters should plan to speak for 15 minutes and take questions for five minutes. Then everyone will rotate clockwise to the next poster. The groups will assign a new presenter, who will have 20 minutes to present and respond to questions. Rotations will continue until the audience groups make a complete circle around the classroom.

In addition, each individual is required to complete the following products:

- **Feedback on presentations.** Students will be asked to provide feedback to their peers on their poster presentation (see separate handout).
- **Self and peer evaluation.** Because students are submitting final group papers, it is necessary to have an instrument to measure the individual contribute of group members. Students will evaluate their own contributions and those of their peers (see separate handout).
- **Individual reflection paper.** Students are required to submit short (1-2 page) individual reflection papers to demonstrate their grasp of the key concepts contained in the case study and reflect on their experience integrating balancing species and stakeholder needs in urban ecosystems. Students may want to comment on some of the differences among groups in terms of the decision making process and the final product.

Peer Evaluation of Group Presentations on Multiple Species Networks

Please rate each of the following required elements of the presentation on a 1 to 5 scale (where 1 is the lowest score and 5 the highest). You are encouraged to write specific comments in the space provided for each element. Why did you give the group the score you did? Provide some constructive criticism – what could they do to improve their presentation skills?

Name of presenter _____

1. The poster included a concept map to organize their thoughts and ideas about their proposed multiple species network.

   Circle one 1 2 3 4 5

Comments_____

_____

_____
_____

2. The poster included a visualization of the sites they chose and their spatial arrangement in the Jamaica Bay watershed.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

3. The presenter provided a justification for the sites they chose.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

4. The presenter explained the budget for the network.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____
_____

5. The presenter explained how the group balanced the varying and sometimes opposing needs of their species.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

6. The presenter explained the range of ecosystem services provided by the group's proposed network.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

7. The presenter described how the proposed network addresses a range of stakeholder interests.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____
_____

8. The presenter shared his/her group's prediction for how well they think their proposed network will conserve all five species.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

9. The poster was visually appealing, well organized, and well executed.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

10. The presenter did a good job responding to audience questions.

Circle one 1 2 3 4 5

Comments_____
_____
_____
_____

Self/Peer Evaluation Form

Rate yourself and your team members on the relative contributions that were made in preparing and submitting your group paper and presentation.

In rating yourself and your peers, use a one-to-five point scale, where:

5 = Best work possible, on task and self-motivated; a group player.

4 = Pretty good work, some reminders needed.

3 = OK work, would be better with more effort, focus, and/or initiative.

2 = Not so great. Off task a lot and/or not fully engaged in initiating and following through.

1 = Major distraction to the group and/or others had to pick up the slack.

Names (begin with your own)	**Participated in group discussions or meetings**	**Helped keep the group focused on the task**	**Contributed useful ideas**	**Quantity of work done**	**Quality of work done**	*Add a criterion of your own (define and give a score)*	*Add a second one (define and give a score)*	**Total scores**

Strength(s) of the group:

Weakness(s) of group:

Ways you resolved conflicts:

What could you have done better during this group project?

Additional Comments:

Individual Reflection Paper

You have been working in groups to propose green infrastructure networks to protect species in Jamaica Bay. All of your work so far has been produced in groups. Now is your chance to display your own personal understanding of the concepts and information you have been learning related to urban biodiversity conservation and green infrastructure.

Write a 2-3 page paper (single spaced, 11 point size in a normal font like Calibri, Times New Roman, or Arial) answering the questions below:

1. What ecological concepts did you have to understand in order to propose a green infrastructure network to protect one or more species in the Jamaica Bay watershed? Were you able to apply these concepts when you designed your network? If so, explain how. If not, explain why not.

2. What social and economic factors did you have to understand in order to propose your green infrastructure networks? How did you incorporate or address these factors in your network design?

3. In the end, which type of factor (ecological, social, or economic) had the greatest influence on your network design? Why (and/or how)? Did you find that ecological, social, and economic factors were opposing forces, or did they complement each other? Discuss both the single species and multiple species networks you worked on.

4. Comment on some of the differences among groups in terms of how they approached the assignment and the final proposed network.