

Regional Aquatic Invasive Species

Addressing the cultural, ecological, and economic issues associated with aquatic invasive species are challenging even in situations with only one jurisdiction. These issues become even more complex when the body of water involves multiple jurisdictions, as does Lake Champlain. Exotic species are defined as those that are introduced into a location primarily through human actions, either purposeful or accidental, and invasive species are exotics that cause demonstrable ecological or economic harm. The Lake is already subject to 49 different invasive species, which cause numerous problems ranging from causing declines in native species, impairing water quality, and restricting recreational opportunities. Once introduced it can be costly, if not impossible, to eliminate invasive species.

In addition to the current invasive species, Lake Champlain is threatened by a high risk of new invasions. Lake Champlain is geographically and culturally connected to other waterways, including the Hudson River (now home to 122 aquatic invasive species), the Great Lakes (184), and the St. Lawrence River (87); thus, the potential for future invasions is high. As a result, Lake conservation efforts need to focus on prevention.

Yet for prevention to be successful in Lake Champlain, efforts must be coordinated, culturally appropriate, and cost-effective.

The challenge we will attempt to meet in this project is five-fold:

1. Assess the approaches taken by the three jurisdictions (VT, NY, and QC) to prevent the introduction of exotic species into the Lake.
2. Identify the gaps and differences in these approaches in terms of preventing the introduction of exotic species.
3. Evaluate the possible consequences—economic, cultural, and ecological—of these gaps and differences with respect to protecting the Lake from future introductions.
4. For a subset of species, develop a suite of indicators for the economic, cultural, and ecological impacts of both (a) the introduction of species and (b) control measures to prevent their introduction that can be used over time to gauge the effects of invasive species on the Lake.
5. Make recommendations for how the approaches toward the prevention of introductions can be improved in order to be more coordinated across jurisdictions and adaptive over time.

During the course of our work on this project, we ourselves will remain adaptive and remain open to modifying this list of key goals as our research identifies unidentified barriers and new opportunities.

Description of community partner(s) and why this issue matters to them:

Our community partner for this project is the Lake Champlain Basin Program (LCBP). The LCBP “works in partnership with government agencies from New York, Vermont, and Quebec, private organizations, local communities, and individuals to coordinate and fund efforts which benefit the Lake Champlain Basin’s water quality, fisheries, wetlands, wildlife, recreation, and cultural resources”(www.lcbp.org). The LCBP is in the process of developing a structured decision making process for addressing phosphorous pollution in the lake, and is very interested in expanding this to include other aspects of lake health such as aquatic invasive species (AIS). Taking these efforts further would lead towards the desired goal of a full adaptive management framework for the Lake. A concerted effort to figure out what the important questions are for the management of AIS (i.e., not just what is academically interesting, but what is important to know in order to be effective managers) would be very beneficial to the LCBP and to its partners. Making headway on the foundations of an adaptive framework for AIS management, which would include identifying what the management and learning objectives are (or should be), how to measure those, and where the big gaps in knowledge are, would provide a solid base for the LCBP to build upon.

Baseline deliverable:

Presentation of your project results will take the form of a final written and oral presentation. The format for the written product will be informed by a combination of your thoughts on how to most effectively convey the gathered information and conversations with your community partners. All final work should consider the projects within the overarching course theme of transboundary issues in sustainability and your major in Environmental Studies at Middlebury College. Therefore, the final products should reflect an interdisciplinary approach to achieving the goals of your specific project.

Background information:

2012 State of the Lake report section on Biodiversity and Aquatic Invasive Species:

http://sol.lcbp.org/biodiversity_preserving-biodiversity-in-basin.html

(see drop down list of sub-sections in yellow Biodiversity & AIS side-bar)

David Lodge speaking about risk assessment and risk management of aquatic endangered species: <http://vimeo.com/33601767>

See Moodle site for notes on project development conversations with Meg Modley

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Regional Freshwater Connectivity

The maintenance of ecological connectivity within stream and riverine systems poses major challenges for society. Several stresses—including increased frequency and severity of storms, increased development of road networks, and decreased economic resources—combine to increase the threats to freshwater systems. Yet the complex nature of these systems and how they are managed requires that multiple agencies, organizations, and regulatory bodies (including local municipalities and state/provincial governments) be involved if long-term conservation measures that are effective both in terms of cost and conservation are to be implemented.

This is well exemplified in the Lake Champlain/Richelieu River Basin, where multiple regulatory and governing bodies—including the International Joint Commission; the U.S. Army Corps of Engineers (ACE); the Federal Emergency Management Agency (FEMA); state/provincial transportation and environmental agencies of New York, Vermont, and Quebec; and numerous municipalities—all play a role in shaping how cultural infrastructure—particularly road networks—influences stream connectivity and affects their combined resiliency over time.

The Nature Conservancy (TNC), led by their Adirondack Chapter, has begun a project in the New York portion of the Champlain Basin to improve aquatic connectivity and build flood resilience in local communities in the context of climate change. This work has included:

- Identification of ecological priority stream crossings in a sub-watershed and on-the-ground assessment of these crossings;
- Outreach to town, county and state highway departments;
- An economic study of benefits and costs associated with improving stream crossings;
- Research to identify funding sources and opportunities to upgrade stream crossings; and
- Review of relevant federal, state and local regulations, standards and permitting processes.

This work is part of a larger pilot project aimed at improving connectivity in freshwater stream systems that focuses on the entire Champlain Basin. Toward that goal, The Nature Conservancy and Nature Conservancy Canada are extending their work to include both Vermont and Quebec.

Our challenge in this project will be four-fold:

1. Using the framework developed by TNC for the New York portion of the Champlain Basin, assess the broad range of scientific approaches, regulations, standards & best management practices (BMPs), permitting, and voluntary incentives used by Vermont and Quebec to improve flood resilience and decrease stream fragmentation by the roads network.
2. Identify the gaps and differences in these approaches.
3. Develop a “toolkit” of Best Practices—based on evaluation of how other jurisdictions have approached this issue—that could be applied in an integrated way throughout the Champlain Basin.

4. Based on the work conducted in Parts 1-3, make recommendations for how ecologically and economically sound management plans for road networks can be developed and made more coordinated across jurisdictions.

During the course of our work on this project, we ourselves will remain adaptive and remain open to modifying this list of key goals as our research identifies unidentified barriers and new opportunities.

Description of community partner(s) and why this issue matters to them:

Our community partner with this project is the Adirondack Chapter of The Nature Conservancy (TNC). TNC describes its mission as “conserving the lands and waters on which all life depends,” and its five core values as integrity; respect for people, communities, and cultures; commitment to diversity; a unified organizational focus; and tangible, lasting results.

The TNC chapters within the Northern Appalachian Whole System, including New York, Vermont, New Hampshire, and Maine, along with their colleagues at the Nature Conservancy Canada, or NCC have launched a multi-year, multi-themed project—referred to by TNC as their “Conservation Business Plan” —intended to promote a more regionally coordinated approach to conservation. One of the themes in this “business plan” focuses on stream connectivity, in particular on how current road networks affect stream flow and how resilient the combined stream-road system is to climate change.

This issue is important to TNC because (a) freshwater systems are a critical aspect of the ecological environment TNC seeks to conserve, and (b) road networks are critical aspects of the cultural environment that TNC’s mission embraces.

The Adirondack Chapter of TNC is taking the lead on this theme and using the Champlain Basin, which spans New York, Vermont, and Quebec, as a pilot project that may ultimately be extended to the entire region.

Baseline deliverables:

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Background information:

ES 401 report (Spring 2012): “After Irene”:

<http://www.middlebury.edu/academics/es/work/communityconnectedlearning/envs0401/archive>

ES 401 Final Presentation for the After Irene project:

<http://www.middlebury.edu/academics/es/work/communityconnectedlearning/envs0401>

Climate change report for Lake Champlain Basin:

http://www.nature.org/idc/groups/webcontent/@web/@vermont/documents/document/prd_002936.pdf

Lake Champlain Basin Program “flood resilience” workshops held in 2011: http://www.lcbp.org/flood_resilience.htm

Stream Continuity Partnership: www.streamcontinuity.org

See Moodle site for a first draft of the final report describing TNC’s culvert prioritization work in the Ausable watershed, a sub-watershed of Lake Champlain, to gain a sense of the science behind what TNC has been doing.

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The Regional Woodshed

Biomass, in the form of forest products, is a familiar and increasing source of energy in the northeastern US and in Québec. Middlebury College's biomass plant, which burns locally sourced wood chips, is one obvious, but by no means unique, example of an institution that seeks to source a major fraction of its energy from local biomass.

Using regional forests to produce energy is attractive because trees are abundant in this area, can be harvested sustainably and re-grown on the same land, and can be considered a renewable part of the region's energy portfolio that contributes to regional energy independence.

Currently, biomass meets about 6% of the electric load in Vermont, including biomass electric facilities, farm methane, and landfill methane. About 14% of the state heating needs are met with biomass fuels, including cordwood. Vermont currently hosts two wood-fired biomass electric facilities Burlington's McNeil Generating Station, (50 MW) and the Ryegate Plant (20 MW). Woody biomass is also used for combined heat and power (CHP) in some businesses, universities, and institutions around the state (2011 Vermont Comprehensive Energy Plan). New York has three power plants that have regularly produced electricity from woody biomass, two using biomass exclusively, and one that burns biomass, waste tires, or coal. Two other all-biomass plants have been proposed, and two power stations have experimented with co-firing biomass with coal. All of these plants have been approved to participate in the state's Renewable Portfolio Standard (New York Biomass Energy Alliance). In Quebec, forest biomass has not been used to produce energy—other than for heating—due to the high cost of logging and legal restrictions on public lands. However, replacing fossil fuels with wood-based fuels is a primary goal of the Ministry of Natural Resources.

However, there are many concerns about expanding the use of biomass. Wood products can be harvested and transported in energy and carbon intensive ways. They emit carbon and other pollutants when they burn and understanding the life cycle carbon implications of woody biomass use is a necessary step for accounting purposes. Unsustainable harvesting can fragment the landscape, negatively impact the forest carbon cycle, and compromise the ecological health of the Northern Forest, reducing its resilience to other stresses, including disease, climate change, and land-use changes.

Although it is known that wood products, including wood chips, cross the Vermont-Quebec border, not enough is known about the region's woodshed to compare the biomass industry and the effectiveness of conservation policies in the region's different parts. Borders in the region complicate forest conservation and regulating biomass production and use at the woodshed scale. For example, there are concerns that strengthening regulations on only one side of the United States-Canadian border could put that part of the woodshed at a competitive disadvantage.

There are five challenges for this project:

1. Develop and implement a framework to analyze the region's woodshed by mapping where biomass is being harvested, moved, and used.

2. Describe the current state of scientific understanding about the relationships among forest harvesting practices, carbon sequestration, and forest health.
3. Compare state and provincial policies intended to promote or regulate biomass production and use, identifying best practices as well as any gaps and differences.
4. Based on this comparison, evaluate the potential for regional coordination to improve management of the woodshed. If the analysis indicates better regional coordination is needed, make recommendations for improving woodshed policies.
5. Identify additional information that would help stakeholders coordinate regional management and address cultural concerns of biomass use of the woodshed.

During the course of our work on this project, we ourselves will remain adaptive and remain open to modifying this list of key goals as our research identifies unidentified barriers and new opportunities.

Baseline deliverable:

Presentation of your project results will take the form of a final written and oral presentation. The format for the written product will be informed by a combination of your thoughts on how to most effectively convey the gathered information and conversations with your community partners. All final work should consider the projects within the overarching course theme of transboundary issues in sustainability and your major in Environmental Studies at Middlebury College. Therefore, the final products should reflect an interdisciplinary approach to achieving the goals of your specific project.

Description of community partner(s) and why this issue matters to them:

Our community partners for this project are the Vermont Natural Resources Council (VNRC) Forests and Wildlife Program and the Vermont Department of Forests, Parks, and Recreation.

VNRC believes that keeping forests as forests is essential to Vermont's ecological, economic and social well-being. Maintaining healthy intact forests is a priority for VNRC, on both public and private land. Given that approximately 80% of Vermont's forests are privately owned, Vermont must develop policies to help landowners and communities promote the long-term stewardship of their forestland. Further, because some of the largest blocks of forestland are publically owned in the state, VNRC believes it is vitally important to encourage model management and conservation practices on state, federal, and municipally owned forests.

The mission of the Department of Forest, Parks, and Recreation is to, "To practice and encourage high quality stewardship of Vermont's environment by monitoring and maintaining the health, integrity and diversity of important species, natural communities, and ecological processes; managing forests for sustainable use; providing and promoting opportunities for compatible outdoor recreation; and furnishing related information, education, and service."

The two primary issues of interest for these organizations that this project will help address are the concern that if different states and Quebec have different biomass procurement policies, that

harvesting will shift towards least strict jurisdiction, and the desire to optimize transboundary coordination to maintain *regional* forest and soil health.

Baseline deliverable:

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Background information:

Biomass Energy Working Group: <http://www.leg.state.vt.us/workgroups/BioMass/>

Biomass Energy Resource Center: <http://www.biomasscenter.org/>

New York Biomass Energy Alliance: <http://www.newyorkbiomass.org/>

Developing the use of Forest Biomass

(Direction du développement de l'industrie des produits forestiers)

<http://www.mrn.gouv.qc.ca/english/publications/forest/publications/biomass-action-plan.pdf>

ES 401 projects on biomass harvesting (Fall 2009 and Winter 2010):

<http://www.middlebury.edu/academics/es/work/communityconnectedlearning/envs0401/archive>

McNeil Plant Biomass Forest Mapping Project

<http://vtdigger.org/2013/02/08/lectronic-map-tracks-logging-for-biomass-energy-in-vermont/>

<http://www.energyjustice.net/map/mcneil>

Videos about biomass combustion and forestry:

<http://vimeo.com/30322084>

<http://vimeo.com/19574873>

<http://vimeo.com/40099331>

See Moodle site for additional resources

Primary contacts:

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Space and Place in Regional Conservation

Understanding people's relationship to their environmental space and what they value about the environment is important for defining and framing public conservation goals and thinking about how these goals might change over time in response to demographic shifts. For example, an environmental organization may face a growing conflict if its identity has historically focused on the conservation of biological diversity but younger people, those most likely to comprise the organization's future membership, instead value ecosystem services over biological diversity.

The need to understand how attitudes about nature vary across demographics is especially true in a transboundary context characterized by cultural and language differences, like the Northern Forest region of New England and southeastern Canada (an ecologically integrated region called the Northern Appalachian/Acadian ecoregion). Understanding how people construct the geographical scope of the area and value its environmental characteristics provides insight into the scale and focus for local involvement in regional conservation. Is there any shared regional identity among residents that can form the basis for regional environmental conservation or do people define their identity locally? Are their frames for environmental engagement that resonate more for some peoples and demographic sectors than others?

There are four challenges for this project:

1. Develop and implement survey strategies to map Vermont and Québec residents' relationships with and attitudes toward the environment based on regional issues and common activities through which many people in this region are active in their environment.
2. Evaluate the survey to determine the scale at which residents care about environmental conservation.
3. Evaluate demographic factors that could account for differences in survey results, such as whether people live in Vermont and Québec, whether they live in cities or rural areas, age, ethnicity and income.
4. Make recommendations for the scale and focus of conservation priorities based on the findings.

During the course of our work on this project, we ourselves will remain adaptive and remain open to modifying this list of key goals as our research identifies unidentified barriers and new opportunities.

Description of community partner(s) and why this issue matters to them:

Your community partners for this project are Nature Conservancy Canada and the Vermont Chapter of the Nature Conservancy. The Nature Conservancy Canada (NCC) is Canada's leading national land conservation organization. They are a private, non-profit organization that partners with individuals, corporations, other non-profits, and governments at all levels to protect the important natural areas that sustain Canada's plants and wildlife.

This project is of particular interest to NCC related to their Green Mountains Nature Reserve. Considering this as a potential case study area for your survey, how can the conceptualization, values, and attitudes of communities surrounding the Green Mountains Nature Reserve conservation project be replicated/used to “brand” other sub-landscapes of the Northern Appalachians (e.g. White Mountains)? If it can’t be replicated what are the key attributes on which NCC has to focus in order for regional communities to appropriate the evolving concept of landscape. At what scale do people refer/relate to a landscape or an ecological entity?

From a larger transboundary perspective, NCC is also interested in how to develop a shared vision, based on regional and demographic factors, for the protection of the “Northern Forest” overlapping VT and QC, the results of which would benefit to the TNC/NCC partnership.

The Vermont Chapter of The Nature Conservancy has helped protect more than 183,000 acres of the Vermont’s most ecologically significant natural areas. Using the tools of science, they work to conserve Vermont’s biological diversity. The Nature Conservancy is a nonprofit organization that is distinct from federal and state agencies and is one of the largest land trusts in the nation with a primary objective of protecting the species and natural communities that comprise Vermont’s natural heritage.

In addition to benefiting from the above-mentioned shared vision with NCC for conservation based on regional and demographic factors, TNC is also quite interested in your findings to help guide their outreach, engagement, and marketing efforts stratified across differing demographic groups; to identify if peoples’ connection to a local scale or brand can be overcome to think about larger geographies, and to learn about what kind of conservation resonates with younger populations.

Baseline deliverable:

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Background information:

The Nature Conservancy: <http://www.nature.org/>

Nature Conservancy Canada: <http://www.natureconservancy.ca/en/>

2042 Today: Cultivating Conservation Leaders of the Future:
<http://www.landtrustalliance.org/about/saving-land/fall-2011/SL%20Fall11-2042%20Today.pdf>

Center for Whole Communities: <http://wholecommunities.org/>
(see details re. March conference entitled “Conservation in a New Nation”)

Primary contacts:

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Lake Champlain Water Quality Monitoring

The complexity of natural systems makes it challenging to monitor and assess their health relative to desired ecological conditions. This task becomes even more complicated in environments, such as Lake Champlain, which span jurisdictions with different regulatory objectives and monitoring strategies designed to achieve those goals. This project will seek to describe, compare, and evaluate the water quality monitoring strategies for the Lake Champlain region.

This project has four challenges:

1. Characterize the regulatory objectives and approaches (standards, parameters, and programs) to managing water quality in Lake Champlain by Vermont, New York, and Québec. Relate water quality management to broader sustainability goals.
2. Compare the water quality management strategies across jurisdictions, identifying any differences and gaps.
3. Evaluate from humanistic, policy and scientific perspectives whether the existing water quality monitoring strategies are capable of, or effective in, achieving the desired regulatory objectives and desired ecological conditions, as compared to an integrated regional approach.
4. If the analysis indicates better regional coordination is needed, make recommendations for improving regional water quality management in Lake Champlain.

During the course of our work on this project, we ourselves will remain adaptive and remain open to modifying this list of key goals as our research identifies unidentified barriers and new opportunities.

Description of community partner(s) and why this issue matters to them:

Your community partners for this project are the Lake Champlain Basin Program (LCBP) and the Lake Champlain Committee (LCC). The LCBP “works in partnership with government agencies from New York, Vermont, and Quebec, private organizations, local communities, and individuals to coordinate and fund efforts which benefit the Lake Champlain Basin's water quality, fisheries, wetlands, wildlife, recreation, and cultural resources.” The LCC is the only bi-state organization solely dedicated to protecting Lake Champlain’s health and accessibility. They use science-based advocacy, education, and collaborative action to protect and restore water quality, safeguard natural habitats and ensure recreational access. The LCBP is funded by EPA and the LCC is a member-based organization that engages in lobbying. These two entities are well coordinated with staff members serving on each other’s steering and technical advisory committees.

The LCBP and LCC are aware of the differing standards across jurisdictions and some of the root causes behind these differences (i.e. differing percentages of NY/QC/VT land in the Lake Champlain watershed and individual legislative bodies wanting their own unique stamp on

things). However, there has been no detailed consideration of whether these different standards are leading to different environmental outcomes or whether the outcomes would be the same regardless of whether the standards are unified or not. One identified benefit of the possibility of unified standards across jurisdictions is that everyone could have the same starting point for tracking and assessment. Currently, in addition to differing standards, there are also differences in levels of tracking, willingness to give and help access information, information is collected in different ways, and it is regulated by different agencies.

One outcome of this project that would be of particular interest to the LCBP, LCC, and other partners in the basin is a whitepaper on the standards, how they are different, the cultural and political underpinnings of how they were determined, and what the impact of these differences are. This would contribute to the LCBP and LCC's current work towards a structured decision making process for management objectives and will also serve as a useful base of information as these entities work towards the larger goal of an adaptive management framework.

Baseline deliverable:

Presentation of your project results will take the form of a final written and oral presentation. The format for the written product will be informed by a combination of your thoughts on how to most effectively convey the gathered information and conversations with your community partners. All final work should consider the projects within the overarching course theme of transboundary issues in sustainability and your major in Environmental Studies at Middlebury College. Therefore, the final products should reflect an interdisciplinary approach to achieving the goals of your specific project.

Background information:

Lake Champlain Basin Program: www.lcbp.org

Lake Champlain Committee: www.lakechamplaincommittee.org

LCBP State of the Lake report: <http://www.lcbp.org/lcstate.htm>

LCBP Links to Partners – see “LCBP Partners (Federal & State)” and “International Lake Links”
<http://www.lcbp.org/links.htm>

Managing Water: Governance Innovations to Enhance Coordination (May 2012 Resources for the Future Issues Brief by Lynn Scarlett):
<http://www.rff.org/RFF/Documents/RFF-IB-12-04.pdf>

Robin Gregory's (LCBP consultant) structured decision making work:
<http://www.decisionresearch.org/people/gregory/>

Primary Contacts:

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Lake Champlain Adaptive Water Quality Standards

Natural systems are dynamic and our knowledge about them is limited. As a result, there is strong interest in regulatory frameworks that allow for flexibility to respond to new information or changing objectives. However, there are few models for how to design such institutions to be flexible in practice. This project will seek to describe an adaptive regulatory framework for water quality in Lake Champlain. In order to begin to address this large issue, our initial focus will be on phosphorous standards, but we will look at these as entry point for adaptive water quality standards in general.

The project involves four challenges:

1. Identify the processes by which the current Lake Champlain water quality standards for phosphorous were developed and approved in Vermont, New York and Québec.
2. Describe the regulatory processes by which these standards can be changed in response to new information.
3. Identify and compare any impediments in each jurisdiction, from a humanistic, policy and scientific perspective, to changing the water quality standards.
4. Make recommendations for increasing regulatory flexibility for phosphorous management in Lake Champlain.

During the course of our work on this project, we ourselves will remain adaptive and remain open to modifying this list of key goals as our research identifies unidentified barriers and new opportunities.

Description of Community Partner(s) and why this issue matters to them:

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One key question for many organizations considering adaptive management frameworks is how nimble policy can be and how quickly they can respond to new research findings. Your work on developing an understanding of the impediments in each jurisdiction—from a humanistic, policy and scientific perspective—to changing the water quality standards will be a useful contribution

to the LCBP, LCC and other partners in the basin as they work towards a structured decision making process and adaptive management framework for Lake Champlain.

Baseline deliverable:

Presentation of your project results will take the form of a final written and oral presentation. The format for the written product will be informed by a combination of your thoughts on how to most effectively convey the gathered information and conversations with your community partners. All final work should consider the projects within the overarching course theme of transboundary issues in sustainability and your major in Environmental Studies at Middlebury College. Therefore, the final products should reflect an interdisciplinary approach to achieving the goals of your specific project.

Background information:

Lake Champlain Basin Program: www.lcbp.org

Lake Champlain Committee: www.lakechamplaincommittee.org

LCBP State of the Lake report: <http://www.lcbp.org/lcstate.htm>

LCBP Links to Partners – see “LCBP Partners (Federal & State)” and “International Lake Links”
<http://www.lcbp.org/links.htm>

Vermont Natural Resources Board / Water Resources Panel:
<http://www.nrb.state.vt.us/wrp/index.htm>

Williams, B.K. “Adaptive management of natural resources—framework and issues”. Journal of Environmental Management 92 (2011) pp. 1346-1353.
<http://www.webpages.uidaho.edu/fish510/PDF/Williams%202011%20adaptive%20mgt.pdf>

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