

Contents lists available at [ScienceDirect](#)

# Ecological Indicators

journal homepage: [www.elsevier.com/locate/ecolind](http://www.elsevier.com/locate/ecolind)

## Short Communication

# Development of an estuarine climate change monitoring program



Juliana Barrett<sup>a,\*</sup>, Julie M. Rose<sup>b</sup>, Jennifer Pagach<sup>c,1</sup>, Mark Parker<sup>c</sup>, Sarah Deonarine<sup>d</sup>

<sup>a</sup> Connecticut Sea Grant College Program/UConn Extension University of Connecticut, 1080 Shennecossett Road, Groton, CT 06340, USA

<sup>b</sup> NOAA Fisheries, Northeast Fisheries Science Center, Milford Laboratory, 212 Rogers Avenue, Milford, CT 06460, USA

<sup>c</sup> Connecticut Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, 79 Elm Street, Hartford, CT 06106, USA

<sup>d</sup> NYS Department of Environmental Conservation, Bureau of Marine Resources, 205 N. Belle Meade Road, East Setauket, NY 11733, USA

## ARTICLE INFO

### Article history:

Received 16 July 2014

Received in revised form 15 January 2015

Accepted 23 January 2015

### Keywords:

Sentinel  
Indicator  
Estuarine management

## ABSTRACT

Numerous coastal and estuarine management programs around the world are developing strategies for climate change and priorities for climate change adaptation. A multi-state work group collaborated with scientists, researchers, resource managers and non-governmental organizations to develop a monitoring program that would provide warning of climate change impacts to the Long Island Sound estuarine and coastal ecosystems. The goal of this program was to facilitate timely management decisions and adaptation responses to climate change impacts. A novel approach is described for strategic planning that combines available regional-scale predictions and climate drivers (top down) with local monitoring information (bottom up) to identify candidate sentinels of climate change. Using this approach, 37 candidate sentinels of climate change were identified as well as a suite of core abiotic parameters that are drivers of environmental change. A process for prioritizing sentinels was developed and identified six of high priority for inclusion in pilot-scale monitoring programs. A monitoring strategy and an online sentinel data clearinghouse were developed. The work and processes presented here are meant to serve as a guide to other coastal and estuarine management programs seeking to establish a targeted monitoring program for climate change and to provide a set of “lessons learned.”

© 2015 Elsevier Ltd. All rights reserved.

## 1. Introduction

Environmental monitoring is essential to support adaptation planning and management actions related to climate change (Lawler et al., 2010; West et al., 2009). A monitoring program ideally includes parameters broad enough to be relevant on a regional or national scale, in order to foster communication and coordination with other programs, and allow for the detection of trends on a larger geographic scale. At the same time, it is important

to include parameters that may be relevant only at a local scale but are critical for understanding changes within an individual ecosystem. Development of a comprehensive monitoring plan can therefore be quite challenging, particularly for small programs. In the United States, existing, federally funded monitoring programs (e.g. Long Term Ecological Research Network, National Park Service, National Estuarine Research Reserve Sites (NERRS), and National Ecological Observatory Network) may form the backbone for a more localized climate change monitoring program. National monitoring efforts, as summarized in the National Climate Assessment Indicators report (Janetos et al., 2012), have decades of data with the efforts of the National Oceanic and Atmospheric Administration (NOAA), US Environmental Protection Agency (EPA) and United States Geological Survey (USGS) focused on monitoring parameters that could also be related to climate change. Downscaling national data to spatial scales relevant to an ecosystem is not always possible. Regional and local programs thus also play a key role in climate change monitoring at this smaller scale such as the NERRS and National Estuary Program (NEP) networks in the United States.

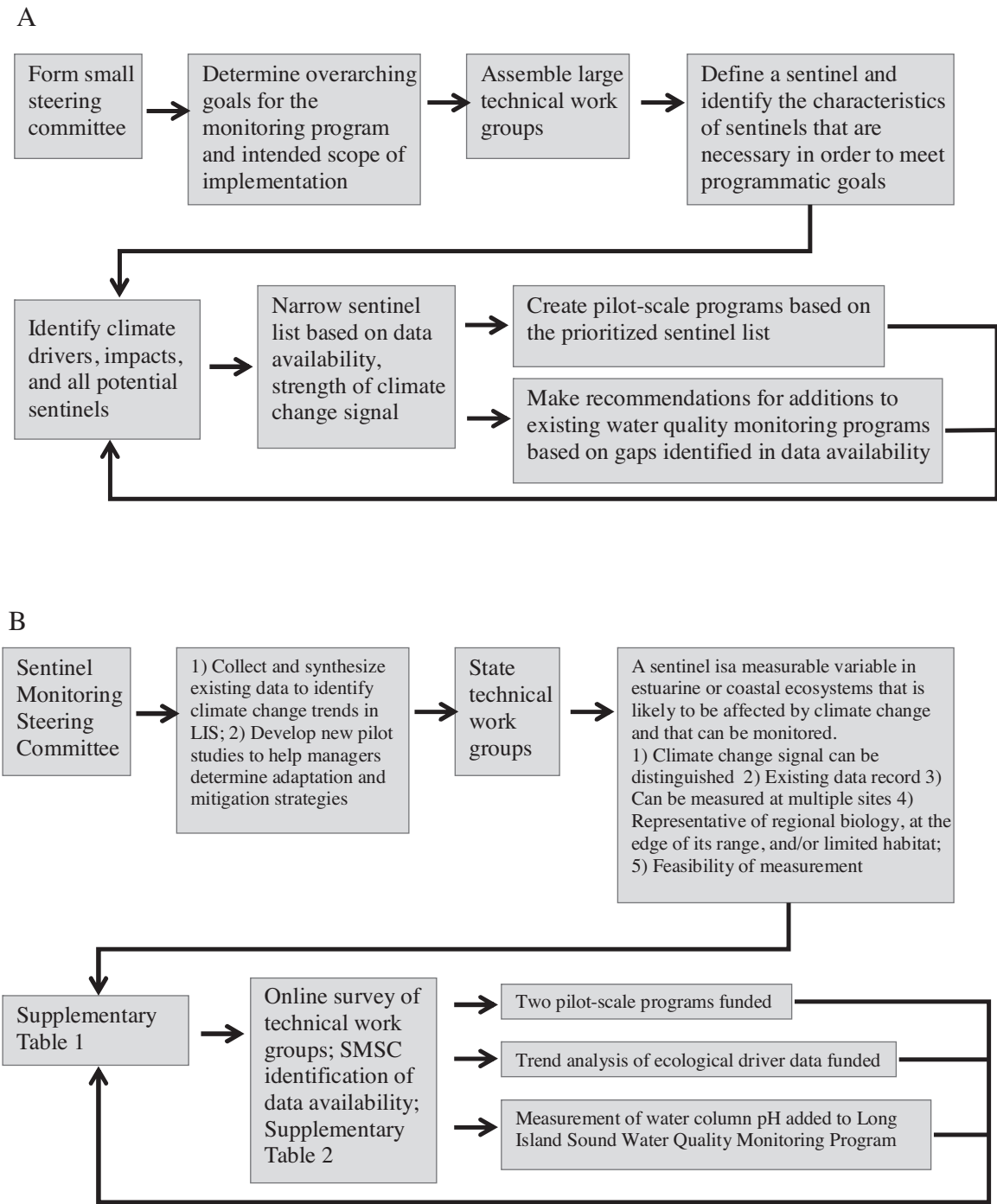
Long Island Sound (LIS) is one of 28 National Estuary Programs in the United States, a program established by Section 320 of the Clean Water Act and overseen by the EPA. Recognizing that continuing management as it has always been done will lead to significant

**Abbreviations:** LISS, Long Island Sound Study; LIS, Long Island Sound; SMCCP, Sentinel Monitoring for Climate Change in Long Island Sound Program; SMSC, Sentinel Monitoring Steering Committee; NERRS, National Estuarine Research Reserve System; NEP, National Estuary Program; NOAA, National Oceanic and Atmospheric Administration; EPA, United States Environmental Protection Agency; CRE, Climate Ready Estuaries; USGS, United States Geological Survey; NY, New York; CT, Connecticut; RFP, request for proposals.

\* Corresponding author. Tel.: +1 860 405 9160.

E-mail addresses: [juliana.barrett@uconn.edu](mailto:juliana.barrett@uconn.edu) (J. Barrett), [julie.rose@noaa.gov](mailto:julie.rose@noaa.gov), [jpagach@conncoll.edu](mailto:jpagach@conncoll.edu) (J.M. Rose), [jennifer.pagach@ct.gov](mailto:jennifer.pagach@ct.gov) (J. Pagach), [mark.parker@ct.gov](mailto:mark.parker@ct.gov) (M. Parker), [Sarah.Deonarine@dec.ny.gov](mailto:Sarah.Deonarine@dec.ny.gov) (S. Deonarine).

<sup>1</sup> Present address: The Goodwin-Niering Center for the Environment, Connecticut College, 270 Mohegan Avenue, New London, CT 06320, USA.



**Fig. 1.** (A) Schematic outline of the general process for creating an estuarine monitoring program for climate change; and (B) schematic outline of the specific process used by the LISS. Boxes in (B) directly correspond to the process outlined in (A) and also include references to Supplementary Tables 1 and 2.

losses of natural resources and processes (Charlotte Harbor NEP, 2010), the EPA and NEP established the Climate Ready Estuaries (CRE) partnership in 2008 to assist local estuary programs and resource managers in identifying and improving resilience to climate change impacts (USEPA, 2009). Many of the NEP projects selected for CRE funding or technical assistance focused on performing vulnerability assessments to assist in adaptation planning based on current climate change projections (USEPA, 2013). Many programs utilized local and regional expertise and insight to assist in the assessment process, such as Charlotte Harbor (CHNEP, 2010), Delaware Estuary (Kreeger et al., 2010), and Massachusetts Bays (USEPA, 2013).

LIS is a large urban estuary in the Northeastern United States with several major riverine inputs and two connections to the Atlantic Ocean. The Long Island Sound Study (LISS) was formed in 1985 by the EPA, the States of New York (NY) and Connecticut (CT), and other partners to restore and improve the environmental health of the LIS ecosystem. In 1994, a Comprehensive Conservation and Management Plan was completed which identified seven priority issues facing the Sound (<http://www.longislandsoundstudy.net>), none of them dealing with or considering climate change. Historically, conservation management plans for natural systems have been based on the presumption of a stable climate, and LIS is no exception (Adger

Download English Version:

<https://daneshyari.com/en/article/6294435>

Download Persian Version:

<https://daneshyari.com/article/6294435>

[Daneshyari.com](https://daneshyari.com)