Int. J. of Sustainable Water and Environmental System
Volume 2, No. 1 (2011) 49-56

Monitoring and Classifying Trophic States of Selected Lakes in Yellowstone Park, USA

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Abstract

This paper discusses the monitoring and management of 40 lakes in Yellowstone National Park, USA, and presents the updated trophic state classifications for these lakes. The paper also documents that monitoring methods and perspectives used in this study meet current acceptable practices. For selected lakes in Yellowstone Park, phosphorus, nitrogen, chlorophyll-a, and other lake characteristics are studied to identify lake behavior and classify the annual average trophic state of the lakes over the past 12 years. The four main trophic states are oligotrophic, mesotrophic, eutrophic & hyper-eutrophic. The greater the trophic state, the greater the level of eutrophication that has taken place. Eutrophication is the natural aging process of a lake as it progresses from clear and pristine water to more shallow, turbid, and nutrient rich water where plant life and algae are more abundant. Human interaction tends to speed up eutrophication by introducing accelerated loadings of nitrogen and phosphorus into aquatic systems. As lakes advance in the eutrophication process, water quality generally decreases. Four models are used to classify the trophic state of the lakes; Carlson Trophic State Index, Burns Trophic Level Index, and the Vollenweider and Larsen-Mercier Models. Simple models are commonly used where steady-state conditions and lake homogeneity are assumed. There is concern that natural processes and human activity on and around the Yellowstone Lakes are causing the water quality to decline. Objectives of this study are to identify possible areas of concern and develop a baseline to which future evaluations can be compared.

Keywords: *trophic state, lake water quality, eutrophication, phosphorus, chlorophyll-a, Secchi depth, modelling.*

1. Introduction

Our program was formed for lake monitoring and management with the intent to document the methods, perspectives, and results of evaluating lakes in Yellowstone National Park. The key components of this program are goals, focuses of study, sampling parameters, sampling techniques, modeling, and human use implications and recommendations.

The major goal of this program is to determine if human activity is causing accelerated eutrophication in selected Yellowstone lakes. Other goals are monitoring of trends, documentation of current trophic conditions, and education of interested professionals as well as interested public.

Summer is the season of most tourism and is crucial in terms of public concern and impacts. Data and information on algae growth can help to explain variations in lake water nutrient levels and fertility and for studies of eutrophication.

There have been significant efforts made to monitor lakes in this the USA. In addition to local, state and federal agencies and universities, involvement from private organizations and citizens has increased over the past decades. The objectives of these organizations are educational, regulatory and planning.

The costs and benefits of the project are appropriate for this preliminary effort on important and highly visible lakes where concerns are justified and where problems may be unnoticed. This is certainly the case of the low to moderate eutrophication of lakes in Yellowstone National Park.

This paper discusses the updated classifications of the trophic state for lakes in Yellowstone National Park, USA. The paper also documents the study monitoring methods and perspectives as meeting current acceptable practice. For selected lakes in Yellowstone National Park, phosphorus, nitrogen, chlorophyll-a, and other lake characteristics were studied to identify lake behavior and to classify the annual average trophic state of the lakes. By studying short-term lake behavior, we learn how the trophic state of a lake can be averaged annually.

There is concern that natural processes and human activity on and around the lakes are causing the water quality to decline. We were unable to find any previous reports that defined the trophic state of the lakes. Our study objectives are to classify the current trophic state of the lakes, develop a preliminary

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DOI:10.5383/swes.02.01.007