

Nitrogen Removal in Solar Aquatics Wastewater Treatment

by

Amy E. Armstrong

Submitted in partial fulfillment of the requirement for the Degree of Bachelor of
Arts from the Center for Environmental Studies at Brown University

December, 1992

Table of Contents

| | |
|--|----|
| Part I: Introduction | 1 |
| Part II: Background for Experiments | |
| Effects of Nutrient Pollution on Ecosystems | 3 |
| Regulation of Water Quality and Wastewater Treatment | |
| Water Quality | 4 |
| Wastewater Treatment | 6 |
| Conventional Treatment | 8 |
| Ecological Engineering for Wastewater Treatment | 10 |
| Solar Aquatics | 12 |
| The Nitrogen Cycle | 17 |
| Global Nitrogen Cycling | 18 |
| Bacterial Nitrogen Cycling | |
| Introduction | 20 |
| Ammonification | 20 |
| Nitrification | 22 |
| Denitrification | 24 |
| Bacterial Nitrogen Cycling Zonation in Natural Aquatic Ecosystems | 27 |
| Denitrification Rates | 28 |
| Techniques of Measuring Denitrification Rates | 30 |
| Nitrogen Removal in Wastewater Treatment | |
| Conventional Treatment | 33 |
| Ecological Treatment | 35 |
| Part III: Experiments | |
| Introduction | 39 |
| The Wright-Pierce Nitrogen Budget | 40 |
| Abstract/Summary of Experiments | 46 |
| Materials and Methods | |
| Background Water Sampling | 47 |
| Chamber Experiments | 49 |
| Results | 52 |
| Discussion of Background Water Sampling Results | 53 |
| Discussion of Denitrification Rate Experiments | |
| Evaluation of Technique | 60 |
| Rate Experiment Results | 61 |
| Correlation of Rates With Dissolved Material Concentration | 62 |
| How Do Our Experiments Fit With the Wright-Pierce Report to Describe System Denitrification? | 67 |
| Discussion of Experimental Error and of Result Significance | 70 |
| Summary of Experimental Conclusions | 75 |
| Implications of Results for System Design | 78 |
| Summary of Experimental Context | 80 |
| Recommendations for Future Experiments | 82 |
| Part IV: Conclusion | 88 |