

NITRIFICATION POTENTIALS IN PRIMARY AND SECONDARY SUCCESSION¹

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Abstract. Potential nitrogen mineralization and nitrification were measured in soils from a primary successional sequence developed on sand dunes and from a secondary successional sequence on old fields. Potential nitrogen mineralization in soils from the primary were increased through the first five stages and then leveled off. Nitrogen mineralization was relatively constant in soils from the secondary sere, except that the highest rates were observed in the oldest site. Nitrification was very closely correlated with nitrogen mineralization in soils from both the primary and secondary seres. Only one site had both substantial nitrogen mineralization and low nitrification.

The results of this study do not support the hypothesis that nitrification is progressively inhibited in the course of ecological succession.

Key words: *dunes; Indiana; mineralization; New Jersey; nitrogen; nutrient cycling.*

INTRODUCTION

Rice and Pancholy (1972) proposed that nitrification, the microbial oxidation of ammonium to nitrite and nitrate, progressively decreases in the course of ecological succession. They suggested that the mechanism causing the decrease is allelochemical inhibition of nitrification, and that the decrease is selectively advantageous to mature ecosystems because it conserves both nitrogen and energy. Nitrogen could be conserved by the inhibition of nitrification because ammonium, a cation, is retained within the soils by cation exchange, whereas nitrate, an anion, is excluded from cation exchange sites and easily leached from most soils. They suggested that energy could be conserved because the inhibition of nitrification increases ammonium and decreases nitrate concentrations in soil, thus favoring use of ammonium as a plant nitrogen source. Plants can incorporate ammonium directly into amino acids whereas the assimilation of nitrate involves two reduction steps that can be energetically costly.

Several lines of evidence have been used in support of this hypothesis. Warren (1965) reported that soil nitrate concentrations and numbers of nitrifying bacteria decreased along a South African grassland sere, and concluded that nitrification rates changed similarly. Rice and Pancholy (1972, 1973) took a similar but more comprehensive approach by studying three different three-point seres, one grassland and two forest, in southern Oklahoma. They too found that soil nitrate concentrations and numbers of nitrifying bacteria tended to decrease with succession in each sere, and

that soil ammonium concentrations increased. Lodhi (1979) reported similar results in a mine spoil succession in North Dakota. Todd et al. (1975) studied numbers of nitrifiers and nitrate losses from several southern Appalachian watersheds and also concluded that nitrification decreased through succession. Vogt and Edmonds (1977) suggested that allelochemical inhibition of nitrification caused low nitrate and high ammonium concentrations in old low-site-quality Douglas-fir stands in western Washington. Monroe (1966) and Rice and Pancholy (1973, 1974) found that various organic compounds in soils and plant extracts were highly toxic to soil or solution cultures of nitrifiers and were found in generally increasing amounts in soils from progressively later stages of succession, although Neal (1969) found the opposite trend in a Canadian prairie sere. Rice (1974, 1979) has thoroughly reviewed much of this research.

Haines (1977), after examining the relative uptake of applied ammonium and nitrate in a Georgia old-field to forest sere, concluded that plants from the younger stages preferentially utilized nitrate while those from the older stages used ammonium. Franz and Haines (1977) examined levels of nitrate reductase in foliage in the same sere and reached the same conclusion.

We question both the evolutionary basis of this hypothesis and the evidence that has been used to support it. As stated, the evolutionary rationale (Rice and Pancholy 1972, Haines 1977) relies mainly on the ecosystem as a unit of selection. While the evolutionary argument could be reformulated in terms of more realistic models of selection, we are more concerned with the evidence that has been used to examine changes in nitrification through succession. Relying on nitrate or ammonium pool size and numbers of nitrifiers to indicate relative rates of nitrification implicitly assumes that (1) nutrient pool size reflects the rate of nutrient utilization, and (2) reported population sizes of nitrifying bacteria accurately reflect nitrifier activi-

¹ Manuscript received 19 July 1979; revised 15 May 1980; accepted 17 June 1980; final version received 28 July 1980.

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Nitrification Potentials In Primary And Secondary Succession

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Nitrification Potentials In Primary And Secondary Succession:

The Characterization and Control of Nitrification in Primary and Secondary Succession G. P. Robertson, 1980 Ecology of Arable Land — Perspectives and Challenges M. Clarholm, L. Bergström, 2012-12-06 Agriculture in the industrial world has gone through dramatic changes over the past decades. A common interest of the contributors is to increase the understanding of the turnover of carbon. Mechanization in combination with high inputs of organic and inorganic nutrients in terrestrial ecosystems, fertilizers and pesticides, has turned deficits of agricultural products into surplus. Over the same directions depending on their interests and experience, we have experienced increased environmental problems. Difficulties are identified in the quantification of problems in both the atmosphere and our water. Below ground production where death and resources which have been associated with the regrowth if incorporated into the calculations, changes in management practices can change production figures considerably. Concern about the potential pollution by compared to values derived from peak estimates of nitrogen fertilizers as well as the low utilization of the role of root derived carbon is investigated. Efficiency of applied nitrogen by plants has created relation to nutrient competition between roots and a need for a better understanding of nitrogen microorganisms, the cost of N₂ fixation and the cycling in the plant-soil-water system. To achieve decomposition of organic nitrogen, Mycorrhizae, this it is necessary to study process interactions, use root derived carbon and their roles in phosphorus and process regulation in an ecosystem context, phosphorus conservation and in supplying nutrients to plants. During the last decade many ecosystem studies the host are exemplified.

Allelopathy S.J. Rizvi, 2012-12-06 Science is essentially a descriptive and experimental device. It observes nature, constructs hypotheses, plans experiments and proposes theories. The theory is never contemplated as the final truth but remains ever subject to modifications, changes and rejections. The science of allelopathy in a similar way has emerged and exists on a similar footing. Our endeavour should be to keep it fresh and innovative with addition of newer information and concepts with the rejection of older ideas and antiquated techniques. During the past few decades encouraging results have been obtained in various aspects of allelopathic researches. However, in addition to continuing efforts in all these directions, constant attempts are to be made to describe the mechanics of allelopathic activity in molecular terms and to discover ways and means to exploit it for the welfare of mankind. We feel that multidisciplinary efforts are the only tool to achieve this goal. It is the hope of the editors that this book will serve as a document which identifies an integrated approach through which research both to understand and exploit allelopathy can be conducted. The present volume arose out of an attempt to bring together eminent scientists in allelopathy to describe their work of a highly diverse nature under one title.

Biogeochemistry W.H. Schlesinger, 1997-02-20 This book considers the effects of life on the Earth's chemistry on a global level. Research Articles, 2004 Aboriginal reconciliation, Addictions, Allergies, Archeology, Alternative fuel for cars, Atomic bomb, Australian animals, Australian cultural icons, Ballet, Beetles, Brand power, Climbing mountains, Computer animation

Computer dating Convicts in exile Captain Cook's voyages Dairy production Dangerous predators Dogs Dumbing down of society Ecological footprint Euthanasia Fast food Gambling Gay cowboy Genetic engineering Germs viruses epidemics Global warming Hijab Horses Insomnia cure Internet John Pilger Life savers Love Lunar and social eclipses Monster makers Nanotechnology National treasures Pirates Pope John Paul II Qantas 85th Anniversary Re cycling Science fiction Space travel Sharks Sheep farming Spam Sun Text messaging Tunnels Venomous creatures Water Whaling Wizardry Women at war Seven wonders of the world World War 2

Studying Successional Pathways in Forest Communities Julie A. Elliott, David M. Morris, Ontario. Ministry of Natural Resources, Jamie L. Kantor, Ontario Forest Research Institute, 1993 Annotated bibliography whose purpose is to aid in the development of research initiatives studying forest succession in Ontario by providing a central source of relevant material Although the focus was on northern forest ecosystems articles that had application to studying succession in these ecosystems were also included The bibliography is divided into succession theory natural succession role of fire impacts of harvesting relationship to nutrient cycling and modelling Articles are cross referenced by subject area Also included are a list of scientific and common names for plant species and a list of books conferences and proceedings associated with forest succession

Manual of Field Biology and Ecology Allen H. Benton, William Ernest Werner, 1983

The Dynamics of Carbon, Nitrogen and Soil Organic Matter in Populus Plantations William Richard Horwath, 1993

Ecology, 1995

Mineral Nitrogen in the Plant-soil System R. J. Haynes, 1986

Mineral Nitrogen in the Plant Soil System provides integrated accounts of the transformations and fate of mineral nitrogen in the plant soil system This book emphasizes the understanding of various processes and the factors that affect these processes It also focuses on the role of biological nitrogen fixation in nitrogen cycling in natural and agricultural systems The book is divided into seven major chapters and each chapter is further subdivided into various subtopics The first chapter introduces and outlines the origin distribution and cycling of nitrogen in natural and agricultural

Vegetation Development and Community Dynamics in a Dated Series of Abandoned Lead-zinc Mines in Southwestern Wisconsin Robin Wall Kimmerer, 1983

Concepts of Ecology Edward John Kormondy, Edward J. Kormondy, 1996 Designed for those studying ecology for the first time whether or not they've had a first year course in biology this text explores the significant concepts of modern ecology using a minimum of jargon and only basic simple mathematics

Australian Plant Communities Raymond Louis Specht, Alison Specht, 1999 For 100 million years the Gondwanan vegetation of Australia has survived and developed in the face of vast changes in climate and soils The pressure imposed on the vegetation by European settlers during the last 200 years is in clear contrast to the minimal impact of Aborigines Environmental managers and planners predicting the short and long term effects of environmental changes on ecosystems need to understand the basic principles of plant community physiology Australian Plant Communities The Dynamics of Structure Growth and Biodiversity is the first synthesis of the physiological processes that shape Australian vegetation at the level of the entire plant community

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Proceedings of the Royal Society of Edinburgh ,1990 Proceedings ,1991 **Ecosystem and Plant Community Consequences of Climate Warming in a High-altitude Meadow** Mary Rebecca Shaw,1997 **High Elevation Forest Soils in the Mt. Mitchell Area of Western North Carolina** Kathryn S. King,1987 **Mycorrhizal Infection of Pygmy Forest Pine (Pinus Contorta Spp Bolanderi) Under Various Nutrient Regimes** Allison Leslie Warner,1992

Patterns of Interspecific Competition in Even-aged Northern Hardwood Forests in the Great Lakes Region
James Mark Guldin,1982

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