A SYMPOSIUM ON NET PRODUCTION OF TERRESTRIAL COMMUNITIES

Reviewed by

HOWARD T. ODUM

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REVIEWS

A Symposium on Net Production of Terrestrial Communities[1]

This is a well-edited group of advanced papers on net yields of plant communities presented with connecting discussions and editorial comment. Contributions of 15 authors are included and the symposium papers of F. Gessner and K. Walther are cross-cited as published elsewhere. Except for 2 papers by North American authors, contributions are in German. The organization is in 5 sections with literature citations combined at the end of each section.

Content

The *introductory section* includes the symposium program, participants, and definitions. The dedication to the late P. Boysen Jensen written by D. Müller recognizes conceptual roots and a school of study of organic budgets emerging in northern Europe.

In section two on *problems of calculating net production* is a concise tabular summary by D. Müller on the ratio of net to gross production as estimated by many authors (28% to 80%) and a paper with correlations of wood yield to CVP index by S. S. Paterson.[2] The CVP index is defined as the product of average temperature, annual precipitation, a number representing length of growing season, a number having evapotranspiration significance reciprocally derived from insolation, and a divisor containing the temperature span of coldest and warmest months. The section includes a discussion with questions concerning the logic of integrating factors as done in the CVP index. A table of conversions is provided and need is stated for standardized reporting of net production data in g/m^2, cal/m^2, or dz/hectare (100 kg/h).

Section 3 on *production determinations* includes first a contribution by L. C. Bliss comparing net yield of alpine tundra with those of arctic tundra, the latter being slightly more productive. Efficiences approached 1% over short periods. W. Tranquillini reports a discrepancy in measurements of net production by the harvest method when compared with those by infra-red carbon-dioxide method, the latter being considerably greater. Then follow three papers on potential yields of meadows in Greenland and the high mountains of Europe. D. M. de Vries used dry matter yield rates as a measure of dominance potential in pure and mixed species plots with and without fertilizer added. Th. A. de Boer assayed yield potential in relation to plot moisture and season and found diminishing daily yield rates from early summer to fall. Krause found that different species combinations expressed maximum net production in fertilized plots as compared to unfertilized plots and conversely different plants were dominant when differences in autochtonous conditions varied total net productivity.

Aichinger proposes that four forest successional stages on 6 kinds of soil in Europe have corresponding stages in the meadows of Greenland, the net production figures for the latter increasing towards climax. Schlenker summarizes data for net production of wood of the same tree species in various temperature-precipitation regimes. Net production of oak was nearly twice as great in a beech region as in the oak region. In a paper added after the symposium J. R. Bray correlates area-based chlorophyll to rates of net production and finds that helicopter-determined photometric albedo roughly inverse to chlorophyll. Haber summarizes the indirect computation of community net production rates from the accumulations and respiration rates on the floor of the same community in the litter, logs, roots, soil, and animals.

In the fourth section on *net production data* is a 9 page table with information from many sources along with an invitation for other data to be submitted for future contributions. J. H. Becking next provides a table comparing annual yields of wood from European forests (about 500 $g/m^2/yr$) with higher yields from tree plantations in Java and South Africa (about 1200 $g/m^2/yr$). The yields are not so different when the shorter growing season of the temperate area is considered.

In the last section on *causal analyses* Knapp reports net production results of experiments with mixed stands in varying conditions of nitrogen, day length, germination temperature, and temperature range. Different ranges of optimum yield in each component species allowed substitutions in mixed stands and greater total yields. Kreeb correlated net production in arid regions to the water factor as measured by osmotic pressure and measures of water availability including convincing examples from several authors and several continents.

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This symposium volume brings into general impact the fruits of an emerging school of ecosystem study providing the philosophy of its approach, a view of the methods, a sampling of results, a representation of authors, some critical discussion, and a bibliographic entrance to the extensive publications scattered in European journals. The provincial flavor is also one of the volume's short-comings as data and concepts are not fully integrated with other scientific groups dealing with net production. Particularly absent are citations of the many pertinent contributions from Japan. Also absent are references to the extensive aquatic studies on net production. For example, back computation of net production from respiration zones, fertilization for determinations of potential production, and correlations of chlorophyll and production have a voluminous history in limnology.

Difficulties and Definitions

Although this symposium has definition sections which imply some unity of concept it is clear that the authors are measuring and discussing quite different fluxes under the same name. Consider the circuit diagram in Fig. 1 in which are represented the flows of energy from the sun through some of the junctions and storage categories of terrestrial ecosystem. Some authors define net production as the flow of energy beyond leaves (sum of X and Y), sometimes called *net plant production*. Other authors define net production as the storage rates that exceed *concurrent* losses. This is sometimes called *net community production*. In Fig. 1 this definition includes the sum of fluxes c through k. In a steady state c-k is zero but x and y large. In a strongly pulsing seasonal system with small rates of respiration the xy and c-k definitions may be similar. The flows c-k can be negative or posi-

[1] Lieth, Helmut, editor. 1962. Die Stoffproduktion der Pflanzendecke: Vorträge and Diskussionsergebnisse des internationalen ökologischen Symposiums in Stuttgart-Hohenheim vom 4.-7. Mai 1960. Gustav Fischer, Stuttgart, 156 pp., 42 figs., 39 tables, paperbound.

[2] The approach is further developed in: Paterson, Sten Sture. 1961. Introduction to phyochorology of Norden. Meddel. Statens Skogsforskningsinst. 50(5): 1-145. 10:—kr.

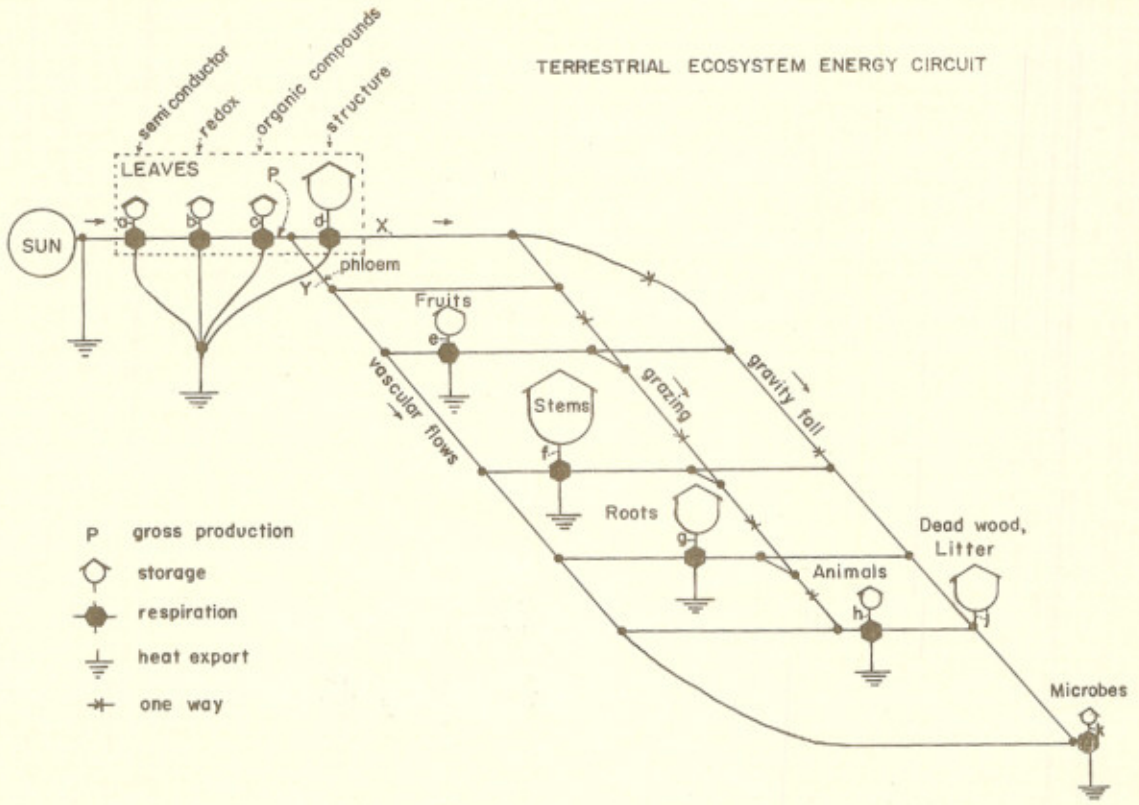

FIG. 1. Diagram for clarification of the definitions describing net production of energy in the ecosystem.

tive. The negative flows are just as important to understanding the main flows of the ecosystem as the positive flows, yet most of the authors without stating their reasons include only the positive flows. Yet by using long time intervals in measurements they often include both together.

Where harvest methods are used, the time interval used affects the rates estimated, since different combinations of transient gains are combined with transient drains as "concurrent." Thus a fixed procedure of harvesting may be objective but it does not provide any of the desired flows of the ecosystem in Fig. 1 until combined with other flux data in a circuit diagram. The papers also vary in including or excluding some of the storage flows such as roots, animals, or exports.

Some of the things attempted for net production may make sense only for gross production. That chlorophyll cannot be always correlated with net production is seen from the steady state case in which chlorophyll and gross photosynthesis are normal and net production zero. The CVP index prediction for net production rates in the moist tropics should be considered instead for gross photosynthesis, since in some tropical systems more respiration and losses are concurrent with the photosynthesis with less of the gross production going into net production of wood.

The use of net production measurements to study ecosystem flows is comparable to the study of traffic flows in a great city by counts of cars going into parking lots. One might first question the parking lot counts as being the main ultimate aim of a traffic study. One might also then question the usefulness of such data alone to compute main traffic flows in the streets. Then where some counts were done by subtracting car counts in lots at hour intervals, some others at day intervals, and still others at monthly intervals, one might question the validity of including them in the same table.

Because of the various different concepts of net production adopted through the method used, many of the data of this symposium are open to unwarranted comparisons especially as they might become tabulated with data from non-seasonal climaxes, steady states, and plankton systems with different kinds of storage capacitances. As C. C. Davis found in a recent review, verbal definitions are now too confused to convey consistent meaning in productivity work. Each author thus owes it to his reader to provide a circuit diagram to clarify the real meaning of his rate measurements and avoid using long harvest time periods in highly transient systems as though they were instantaneous rate measurements.

One might carry the parking lot analogy to its ultimate and seriously question the orientation of symposia on net production. Are the answers to predicting net production to be found by the direct study of net production or in the study of the main input output processes and their balances?

In spite of these severe conceptual limitations, this is a wonderful little book, for the separate papers are strong and within each one, usages are generally consistent. It is a must for the graduate seminar.

HOWARD T. ODUM
PUERTO RICO NUCLEAR CENTER