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HUMAN CONTROL AND CLOSED ECOSYSTEM STABILITY

Abstract

Closed Ecological Life Support Systems (CELSS) rely on the natural circulation of water, atmosphere, and biomass to provide human inhabitants with consumable material in a closed system, such as a space habitat. This project is a conceptual approach for analyzing complex, long-duration CELSS reliability. The methodology is based on mathematical models of closed ecosystem dynamics. Preliminary considerations have led to the identification of critical variables including: 1. The average rate of material circulation in the system; 2. System uncertainty (fluctuations in the material circulation rates); 3. System buffer capacities (the mass of circulating materials); 4. Accuracy and limitations of human control within the system. The first conclusion is that the mass of circulating materials must exceed the baseline requirements of human inhabitants by a value proportional to anticipated material cycle fluctuations. The second conclusion is that the requirement for precise human control increases alongside the level of anticipated material cycle fluctuations.