Paper ID: 12465
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Life support Challenges for Human Space Exploration (10)
Life Support Technologies and Systems (1)

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THE ROAD LESS TRAVELLED: HUMANIZING LONG-TERM SPACE MISSIONS USING ADVANCED GREENHOUSE DESIGN AND MINIATURE FORESTS

Abstract

Co-authors Sandra Haeuplik-Meusburger (architect and habitability researcher Vienna), Carrie Paterson (artist-researcher, Los Angeles) consider the role of plants in long-term space missions historically since 1971 (Salyut 1) and propose technical design requirements for greenhouses and constructed environments given a range of plant-human relationships. Innovations in greenhouse design, anaerobic composting, and hydroponics will be considered alongside physical/health requirements and human psychology as well as the complex sensorial benefits of plants for humans. Functions discussed for plants include food supply, oxygen production, grey-water purification, relaxation, recreation, and emotional support.

Recent research reveals that greenhouses in space will require advanced technical systems of automatic watering, soil-less cultivation, artificial lighting, and computerized observation of plants. However, Häuplik-Meusburger and Paterson assert that human components of plant care cannot be forgotten nor their benefits underestimated. In a recent design-in-use study of astronauts' experiences in space habitats discussed in Architecture for Astronauts it was found that besides the basic advantages mentioned for life support there are clearly additional 'side effects' for habitability. Astronauts' experiences extend beyond the scientific to include a strong spiritual, poetic and existential component, though this has not been widely publicized by space programs and considered only minimally in space architecture.

The authors have composed several key theses about the plant-human relationship in space, including areas where synergy and symbiosis occur. The justification is taken from scientific research and astronauts' experiences as detailed in Architecture for Astronauts, as well as Paterson's investigation into the phenomenon of human "caretaking" of plants, especially in thousands of years-old tradition of penjing and the development of bonsai as art. These considerations will be introduced and discussed in the context of future missions as being "part and parcel" of the same necessity for including plants, greenhouses and environmental design to humanize the experience of space travel, prevent psychological crises, improve efficiency of life-support systems, promote health and well-being of astronauts, and create supportive environments for communities in space.