MDRS final summary report – Crew 78

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Introduction

If interplanetary colonization is to be possible, humanity needs to learn as much as possible about how to rise to the challenges involved. One way to achieve this is, of course, through simulations.

Our crew, the 78th in the Mars Desert Research Station simulation, was intensively international, composed of 2 Canadians (Kathryn Denning, Vincent Beaudry), 2 Americans (Judah Epstein, Grier Wilt), one Belgian (Dirk Geeroms) and one Indian (Balwant Rai). None of us had met before, and joining together to overcome language barriers and explore cultural differences provided us with an intense intercultural experience, surely akin to those which will be a part of future space exploration.

As a group, we: developed our own knowledge of the challenges of space exploration; contributed to some ongoing MDRS research into extremophiles, environmental impact, and plant growth; furthered our individual projects in human physiology, long-distance teaching, and anthropology; acted as subjects for outside human factors researchers; and worked together to make life at the Hab go smoothly, including making some improvements to the Hab and to the EVA equipment.

The Group

Our crew was comprised of 6 individuals, with the following specialties: Vincent Beaudry was the commander, Judah Epstein the engineer and executive officer, Balwant Rai the scientist and health and security officer, Grier Wilt our biologist, Dirk Geeroms the teacher and astronomer, and Kathryn Denning our anthropologist and journalist. Although we all had our respective roles within this two weeks journey, we all enjoyed very much taking part in each others experiences and in the everyday tasks.

Crew 78 functioned effectively as a team under Vincent's supervision. We joined forces on everything from EVA field work to bucket brigades, household chores, and EVA challenges. We also enjoyed field trips together when out of simulation.

We did yoga and callisthenics together each morning, the former led by Kathryn and the latter led by Judah, which was good for our flexibility, strength, and for a few laughs. (We impressed ourselves and each other with our development just in this short rotation.) We made a point of eating together as a group, which provided nice space for discussions and a little relaxation together amid the flurry of work and reports. We also enjoyed a group EVA to play baseball in our spacesuits (spaceball?), which, in addition to providing some needed fun, gave us a better understanding of the limits of our spacesuit exercise possibilities.

We shared in presentations to students overseas, and shared in the composition of reports, frequently discussing English usage and collaborating to edit each other's work.

We also had the interesting experience of being observed for two days by a team of specialists/students in Human Computer Interaction, from NASA Ames and Carnegie Mellon University. They found that by observing our interactions as a simulated space team, they gleaned information that could help them in refining software used by real space science teams to plan and make mission-critical decisions.

Hab and EVA Equipment Maintenance and Repair

As our crew engineer, Judah tackled everything from routine engineering tasks to fixing radios, rigging a new water pumping system, building backpacks, and sharpening can openers. (He only failed at one repair of an essential system: he rendered a malfunctioning hairdryer permanently inoperable, with the excuse that it was "a girl device" and thus he could not fix it.)

Routine maintenance: HAB, engineering area, water, diesel generator, ATVs, grey water pumping

Backpacks: When Crew 78 arrived, there were 2 fully functional (and 2 more almost functional) spacesuit backpacks. After Judah's repairs, all 6 backpacks are fully functional. 2 backpack containers were completely remade. Worn-out batteries were replaced in 3 of the backpacks. A new air hose was made for one of the backpacks. Backpacks were cleaned up and the conditions improved (example: dust cleaned out of pack and air filters cleaned).

Radios: When we arrived, 3 of the radios configured to plug into the helmets were functional. After repairs, there are now 4 radios that match to plug into the helmets.

Spacesuit helmets: These were cleaned and maintained (improvements such as replacing duct tape with screws and bolts for sturdier construction)

Water pumping: When we arrived and for the first few days of our stay, the method for getting water from the outdoor tank to the indoor loft tank (and to the toilet) was a "water bucket brigade". As a team, we removed the need for this by rigging up a hose from the top of the HAB – running along the outside of the Hab – to the outside water tank on the trailer. The Little Giant water pump is working well for this, although it requires troubleshooting at times. Judah and Kathryn collaborated on documentation to explain this system, in case it is needed by a future crew.

Reparation of dome of Musk Observatory was also undertaken. It is moving much more smoothly now.

Items still pending for future crews:
-Repair or order at least 2 new double prong radios (currently using GENEX Gmrs Model #MK2000)
-Sew and patch holes in the spacesuit clothing
-Helmet #1 still has a loose connection for the microphone. Helmet #1 can successfully receive transmissions, but it has problems transmitting. Sometimes it works correctly, sometimes not transmit at all, and sometimes it continuously transmits static and thus causes disruption for everyone's communication. Judah took this microphone apart and remade the connections, but despite this, it still has problems. A good solution would be to order a new microphone part.

Upstairs, Indoors: Judah and Kathryn joked that he was the "outside engineer" and she was the "domestic engineer". Kathryn undertook many of the upstairs home-making responsibilities, ranging from a thorough clean-out and tidying of the kitchen cupboards, to shopping for supplies, menu planning and cooking, compilation of a 'kitchen advice file', and some tidying and minor reorganization of the upper level of the Hab and the loft (putting things into appropriate storage containers and labelling them so things can be found more easily in future).

Group Scientific Projects: Crew 78, and Ongoing MDRS studies

Kathryn Denning acted as local coordinator for our participation in the Food Study run by Kim Binsted. This mostly involved looking for misplaced equipment (with varying degrees of success), instructing crew members on the protocols, and nagging people to fill in their reports.

Grier Wilt took on a major role in overseeing the MDRS science projects for Crew 78, including primary responsibility for coordinating our group's participation in the ongoing RSL study, and the Hab area environmental contamination study. She also assumed responsibility for Greenhab projects.

Green HAB

A study of plant growth in various soils available to MDRS crews was conducted to see which yielded the best results in the Greenhab environment. One notable soil used is in the form of expanding soil wafers (small soil disks) which are very small and light but expand significantly upon watering. Their small size could be useful for long duration space missions.

Cinnamon Basil

In August 2007, STS 118 shuttle astronauts took a set of cinnamon basil seeds into space to expose them to the microgravity and radiation conditions experienced during a typical space mission. Crew 78 was fortunate enough to receive a portion of these seeds to do a study comparing the growth of the space-exposed seeds to earth-based cinnamon basil seeds.

Unfortunately, the space-exposed seeds received were crushed (possibly during shipment) and while planted, are not expected to grow. More seeds were sent, however crew 78 has yet to receive them.

RSL Study

As part of this ongoing study, crew 78 revisited two locations and selected two new locations based on their likelihood to contain extremophiles. At each of these locations, soil samples were collected and stored at room temperature until the end of our rotation when they will be shipped to RSL along with a report containing photographs of the sites and those sites' GPS coordinates.

Environmental Contamination

The environmental contamination study is a multiple season project which will analyze the impact MDRS has had on the surrounding environment over the past 8 years. In order to make an initial evaluation of

this impact, three parameters will be evaluated: physical properties of the soil, chemical properties and any biological contamination.

The physical properties of the soil will be analyzed by the use of a penetrometer to determine how compact the soil is. The chemical properties will be determined by a pH analysis and the biological contamination by *E Coli* levels. These analyses will be taken at sites which are located in intervals of 8 m outward from the HAB in the east and west directions in the form of survey lines.

Crew 78 created the survey lines and marked the site locations for this study. At each of the 20 sites along the survey line, crew members did three *E Coli* analyses to account for the biological contamination portion of the study. Unfortunately the penetrometer and pH kit, which were to be used to evaluate the physical and chemical properties, did not arrive in time for our crew to complete these analyses.

Future work for subsequent crews will include creating the control line (parallel to the survey line and south of the HAB) and completing the chemical and physical analyses at each site.

Individual Scientific Projects with Group Participation

Two crew members were running their own studies, both of which required some participation from other crew members.

Balwant Rai: Human physiology under simulated microgravity conditions

Balwant's studies of human physiology lent an air of veracity to our Mars simulation, since of course crews on a mission to Mars would be subject to regular examination of their physical and mental states. Balwant's research particularly focused upon simulated microgravity.

It is essential for space agencies to continue developing a full understanding of the effect of microgravity on the human body, because virtually every organ system functions differently in reduced gravity, and some of these changes are maladaptive. Astronauts travelling to Mars would have to live in the absence of gravity (or in partial, simulated gravity) for more than one year of travel, and would have to transition between weightlessness and planetary gravitational forces at the beginning, middle, and end of their mission.

To learn about the influence of simulated microgravity on different systems of the human body, Balwant used a standardized questionnaire and sensors. Five healthy MDRS crew members were studied before and after exposure to simulated microgravity, which was achieved using a -6° head-down-tilt (HDT) resting position, sustained for 20 minutes. The study data indicated that microgravity's effects on the human body may include effects on oral cavity (such as oxerostomia, facial pain, tooth pain, tooth numbness etc.), the cardiovascular systems (as a decreased heart rate and voltage), the respiratory system (with an increase in oxygen consumption and a decrease in respiratory rate), and the nervous systems (delay in central and peripheral nervous system reflexes, increased mental and cognitive fatigue, and increased negative mood). It is recommended therefore that research into factors such as these be continued, to ensure the success of future explorations such as missions to Mars.

Dirk Geeroms: Far-distance teaching, and astronomy

Dirk's intention for his time in Crew 78 was two-fold. On one hand there was his far-distance teaching project with the High School 'Stedelijke Humaniora', Dilsen, Belgium: he wanted to show that effective teaching would be possible even when he was not physically present in his classes. On the other hand there was his astronomy project. The latter includes several sub projects, like following recent supernovae (www.supernovae.net), measuring the varying magnitude of delta Cephei and RR Lyrae stars, taking pictures of Saturn and the craters of the Moon. There can be a nice link between teaching and astronomy because a colleague of Dirk's (Wim Cuppens, teaching in 'Sint-Augustinusinstituut', Bree, Belgium, who rents every school year a 29 inch telescope in South-Dakota), collects data of delta Cephei and RR Lyrae stars and let his students calculate the relative distance using this data.

One major challenge was that because of the time-difference of 8 hours in the first week and 7 hours (due to an earlier transition to daylight saving time in the US compared to the European continent) in the second week, Dirk's teaching project had to be done during night time. He discussed this issue during chat sessions with other crew members before our rotation started, and is thankful to his crew mates for their understanding about this schedule during the first week. The second week, Dirk was asked by mission control to change this set-up because real time teaching is in fact out of simulation because the distance between Mars and the Earth means that it takes a signal approximately 40 minutes to travel back and forth, rendering synchronous distance education impossible. This eased his schedule and made it possible for him to work in the Musk observatory. However, because of the 100% visibility of the moon during this week, it was possible only to take pictures of planets. This was done using the webcam available in the Musk and Dirk's own laptop instead of the Hab's laptop

In addition to regular classes, Dirk gave a series of special presentations to schools and organizations in Belgium and the USA. All crew members participated in these, particularly Vincent and Grier, and Kathryn also gave a guest lecture about Mars exploration, astrobiology, and SETI, to one of Dirk's classes.

Kathryn Denning: Anthropology of 'Mars'

As crew journalist, Kathryn wrote several journalist reports, commenting upon various aspects of Mars simulations. However, she was also thinking about ways of conducting anthropological study of Mars exploration, including Mars analogs like MDRS. Her anthropological work here was merely preliminary, in the sense that she was simply participating as a crew member, rather than conducting interviews etc. However, in the process, she gained a much improved understanding of Mars simulations and analog studies through her time at MDRS, and thanks her fellow crew members for sharing this experience with her.

Our MDRS Experience

Our time at MDRS has been educational and enriching. We are proud to have contributed in some way to the work of the MDRS and the Mars Society, and all feel that this was a significant exercise in our development as scientists, engineers, teachers, and human beings. We would thus like to thank the Mars Society and our Mission Support for bringing us one step closer in our dream of one day living on Mars…