

# Preparing for MARS

Analogue astronaut **Niamh Shaw** explores the Earth-based missions helping humanity prepare for our journey to Mars



**ABOUT THE WRITER**  
Dr Niamh Shaw is an engineer, scientist and analogue astronaut who has participated in Mars missions in Utah, US and Negev, Israel

**M**ars is hot right now. SpaceX recently launched a Tesla car towards the Red Planet courtesy of its Falcon Heavy rocket; the Curiosity rover has been sending us revealing images of its arid surface for over six years; and finally setting human feet there now seems a tantalisingly close prospect.

But are we really as ready to colonise the Red Planet as some would have us believe? We might be able to deploy rovers to Mars, but humans are a whole other matter. How do we prepare astronauts

for living in isolation for sustained periods of time with limited water, food and power? As interest in manned Martian missions mounts, many countries are looking to analogue missions on Earth as way of providing answers.

Since 2001, Earth-based test facilities have been simulating conditions on Mars at desert, volcanic, polar and underwater aquatic environments in Hawaii, Chile, Canada, Spain, Florida, the Arctic and the Antarctic. Each of these analogues focuses on specific aspects of extreme environments: psychosocial and scientific studies of crews and ▶





► Romain Charles (bottom row, far left) with the other members of the Mars-500 crew, which spent a year in isolation

► procedures, or prototyping specialised equipment such as rovers or spacesuit designs.

Mars-500 was a psychosocial isolation experiment conducted by Russia, ESA and China between 2007-2011, in which six male crew members were confined in a windowless habitat in Moscow for 520 days. "When that door closed, I decided that there was no world beyond this habitat; that's how I got through it," says Mars-500 crew member Romain Charles. "I would say three things were tough: food had a big effect on our morale; the daily repetition of the same experiments was difficult at times; and staying connected with family was paramount."

The major scientific findings of the mission were presented at the Mars-500 symposium in 2012. It found that 100 days was sufficient time to gather data in confinement studies. Charles is proud of his achievement and rightfully so. He now works for ESA as crew support at the Astronaut Centre in Cologne.

**"When that door was closed I decided there was no world beyond this habitat; that's how I got through it"** Romain Charles, Mars-500

### Red ringers for Mars

Founded in 2001, the Mars Desert Research Station (MDRS) in the Utah high desert in the US is equipped with a permanent habitat, science dome and observatory. The area was selected for its close resemblance to Martian terrain, and the facility has hosted 194 crews who experience realistic EVAs (Extra Vehicular Activities) or 'spacewalks' in spacesuits under simulated conditions. Beyond the scientific studies at MDRS, the station is also a useful platform for human operations training.

Dr Michaela Musilova, chair of the Slovak Organisation for Space Activities, participated in

two missions at MDRS in 2014. "MDRS is one of the few places on this planet where I can get first-hand experience of more realistic collection procedures," she says of the experience, adding, "I have a better appreciation of the limitations of astrobiological field sampling while wearing a spacesuit and within a tight EVA schedule."

For similar reasons Dr Jonathan Clarke, astrogeologist and president of Mars Society Australia, has also made repeated trips to MDRS. "Crew selection is everything," he says. "I've been

▼ Rick Blake, MDRS crew 173's GreenHab officer, returns to mission's base in the high desert of Utah



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## DIARY OF AN ANALOGUE ASTRONAUT

During her Mars analogue in the Utah desert, Niamh's daily reports to mission control revealed the struggle of being cut off from the outside world. Below is an extract from one of her reports



**MISSION REPORT BY CREW 173 JOURNALIST SOL 6**

Our lives back on Earth seem a lifetime away now. Roy went looking for something in his living quarters last night and came across some US currency and brought it out to show us.

**Money.**

It's so strange now, when you look at money on Mars. Only seven days ago back on Earth, we couldn't do anything without it. Breakfast – \$10. Batteries – \$4. Coffee – \$3. Now we can do nothing with it. Except, perhaps, use it to rub the mud off our boots as we re-enter the airlock post Extra Vehicular Activities.

That's the interesting thing about being here on Mars. When you strip your daily routine back to simply surviving the elements and completing daily tasks, life gets a whole lot easier. You can't help but reflect on life back on Earth. And all the stuff. The hoards of books that I probably haven't opened in years; the wardrobe of clothes, shoes and odds and sods; bed linen, carpets, cushions, bicycles, cafes, buses, trains. All useless here.

High value products on Mars: thermals, boots, camera, internet, heat, the solar generator, water, a functioning toilet, food, chocolate and coffee. Lots of coffee. Tinfoil to cover our plates at mealtimes and cut down on washing up. Movie night, sunrise, sunsets, laughter, sharing stories, the crew: these are our currency now.



Crew 173 outside the MDRS habitat. Niamh Shaw (bottom row, left) flies the flag for Ireland



Niamh Shaw on an EVA with the MDRS habitat, on the San Rafael Swell, Utah, in the background

on many SIMs over the years, some lasting up to three months and each one is different."

I couldn't agree more. I participated in an MDRS mission in early 2017 as crew journalist and artist for Crew 173, experiencing first-hand the claustrophobia of living in a confined space. The impact of every interaction with your crew is magnified, whether positive or negative. Thankfully I was blessed with a super crew.

### Creating new fields of research

A key objective of The Mars Society founder Robert Zubrin in establishing MDRS and its polar-based sister facility Flashline Mars Arctic Research Station (FMARS) was to create a legacy. "My goal has always been to eventually be made obsolete; that MRDS would provide a platform to open up a new field of research, new players too," he says. There appear ►



An analogue astronaut on an EVA for the AMADEE-18 mission in the Dohfar region of Oman



AMADEE-18 analogue astronauts test out their robotic rover



AMADEE-18 analogue astronauts Kartik Kumar and Stefan Dobrovlny

► to be indications of this very legacy emerging: the Austrian Space Forum (OeWF) established by former MDRS Crew 11 member Dr Gernot Groemer, is a key player in the steady growth of this citizen science organisation for space professionals. “Our missions are less about a personal experience of a confined simulated mission for the analogue astronaut,” he says. “We focus instead on using the analogue location to test equipment and run experiments under those conditions.”

Their latest mission, AMADEE-18, is part of a 10-year strategy focussing on procedures, workflows, spacesuit design and operational environments to provide a perfect requirement document for the first Mars mission. Dr Carmen Koehler, OeWF analogue astronaut since 2015, participated in the AMADEE-18 mission in the Dhofar region of Oman in February 2018. “15 of us were in isolation, and of those six were analogue astronauts, actually going outside the habitat,” she explains. “We had very long working hours, the workload was very high, but I loved it.” The research findings of all OeWF’s analogue missions are available on its website ([oewf.org](http://oewf.org)).

Israeli geologist Roy Naor is an alumnus of MDRS Crew 173. In 2016 he and astrobiologist Dr Reut Sorek-Abramovich and physicist Dr Hillel Rubinstein

created the Young Astronaut Academy Programme. “A key strategy of this programme was to provide an analogue facility for young students to learn science and technology subjects experientially,” says Naor. “When I returned from MDRS, we realised we could create our own analogue facility. We located a site in the Ramon crater [in Israel’s Negrev desert] and work began on designing the habitat.”

### Astronaut academy

And thus, D-MARS was born; a project conceived and imagined by an enthusiastic team of 100 young Israeli space professionals. “Everyone wanted to help us,” Abramovich says. “Companies provided state-of-the-art technologies in food delivery, power systems and other facilities for the habitat. We

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## ANALOGUE DIRECTORY

At-a-glance guide to analogue missions around the world

Facility	Established	Location:	No. of crews	Crew
<sup>1</sup> NEEMO NASA Extreme Environment Mission Operations	2001	Florida	22	4
<sup>2</sup> FMARS Flashline Mars Arctic Research Station	2001	Arctic	14	6-9
<sup>2</sup> MDRS Mars Desert Research Station	2001	Utah	194	6
Concordia Station	2005	Antarctica	14	10-15
<sup>3</sup> Mars-500	2007	Moscow	3	6
<sup>3</sup> AMASE Arctic Mars Analog Svalbard Expedition	2007	Svalbard	5	Up to 30
<sup>3</sup> ESA CAVES Cooperative Adventure for Valuing and Exercising human behaviour and performance Skills	2011	Sardinia	5	5-6
HI-SEAS Hawai’i Space Exploration Analog and Simulation	2013	Hawaii	6	6
NASA HERA Human Exploration Research Analog	2014	Houston	4	4
AMADEE-18	2018	Oman	1	15
DMARS Desert Mars Analog Ramon Station	2018	Israel	2	6

<sup>1</sup> Underwater environment <sup>2</sup> Run by The Mars Society <sup>3</sup> No longer active

completed our first mission in February 2018 and have already completed an additional two short missions for the Young Astronaut Academy. These young students will be better equipped to work in the space industry as a consequence.” They have a full schedule of short missions planned for 2019 and will partner with an OeWF AMADEE mission in 2020.

▼ NEEMO is an underwater NASA analogue based in a facility called Aquarius in Key Largo, Florida

The annual ‘Humans to Mars’ report launched at the Explore Mars summit in Washington DC in May this year provided a snapshot of current progress of



The D-Mars habitat in Israel’s Negev desert



D-Mars is an Israeli initiative aimed at nurturing young prospective astronauts

all global space activities. The report summarised key findings from the major space players and agencies, their progress and challenges, including contributions made by analogue missions to the bigger Martian agenda. There are many other space agency-led analogue missions happening across the globe: Concordia at the Antarctic; NEEMO (NASA Extreme Environment Mission Operations) in Key Largo, Florida; NASA HERA (Human Exploration Research Analog) in the Johnson Space Center in Houston and HI-SEAS (Hawai’i Space Exploration Analog and Simulation) in Hawaii, to name a few. Along with contributions from other analogues all over the world they are helping us find solutions to the future survival of astronauts travelling to the Red Planet. A small contribution to the bigger issue at hand, but a contribution nonetheless. We still have much to do, but rest assured, analogues are a key piece of the interplanetary puzzle. 🚀

**BBC iPlayer**

Watch an episode of *The Sky at Night* from 1969 in which Patrick Moore looks at images of Mars taken by the Mariner 6 probe (UK viewers only). [bbc.in/2ywBnWk](http://bbc.in/2ywBnWk)