AbGradCon 2018

1
00:00:00,260 --> 00:00:11,869
[Music]

2
00:00:18,179 --> 00:00:15,150
my name is Larry McCarthy and I'm a PhD

3
00:00:21,870 --> 00:00:18,189
student in the Schmidt lab a few Baldr

4
00:00:24,390 --> 00:00:21,880
and our lab studies microbial diversity

5
00:00:28,109 --> 00:00:24,400
and communities at extreme high

6
00:00:30,750 --> 00:00:28,119
elevation and today I will talk to you

7
00:00:33,270 --> 00:00:30,760
about how some of these environments in

8
00:00:35,220 --> 00:00:33,280
particular the atacama volcanoes can be

9
00:00:37,710 --> 00:00:35,230
represented and can represent some of

10
00:00:39,690 --> 00:00:37,720
the best martian analogs here on earth

11
00:00:42,889 --> 00:00:39,700
and tell you about what we have found

12
00:00:45,380 --> 00:00:42,899
out of the life existing there through

13
00:00:48,060 --> 00:00:45,390

different approaches that go from

14
00:00:53,549 --> 00:00:48,070
microbial diversity community analysis

15
00:00:55,590 --> 00:00:53,559
to genomics so terrestrial analogs of

16
00:00:58,310 --> 00:00:55,600
the Martian surface of her insights on

17
00:01:01,560 --> 00:00:58,320
its available Abbot's ability potential

18
00:01:03,299 --> 00:01:01,570
and in the last decade extreme

19
00:01:05,580 --> 00:01:03,309
environments that were thought to be

20
00:01:07,800 --> 00:01:05,590
devoid of life have actually been shown

21
00:01:10,490 --> 00:01:07,810
to be populated by various levels of

22
00:01:13,140 --> 00:01:10,500
biodiversity supporting the notion that

23
00:01:16,649 --> 00:01:13,150
pretty much at least on earth the life

24
00:01:19,850 --> 00:01:16,659
always finds a way however we know that

25
00:01:21,770 --> 00:01:19,860
no analogue is a perfect lips or the

26
00:01:25,770 --> 00:01:21,780
representation of the Martian surface

27
00:01:28,710 --> 00:01:25,780
but we argue that high elevation cold

28
00:01:32,910 --> 00:01:28,720
desert soils are some of the best model

29
00:01:36,260 --> 00:01:32,920
systems for life on Mars surface so this

30
00:01:39,510 --> 00:01:36,270
type of Hilah vation cold deserts occur

31
00:01:41,580 --> 00:01:39,520
worldwide on mountain ranges between the

32
00:01:43,560 --> 00:01:41,590
upper boundary of land distribution and

33
00:01:45,390 --> 00:01:43,570
the lower limit of permanently

34
00:01:47,219 --> 00:01:45,400
ice-covered regions so that's

35
00:01:49,380 --> 00:01:47,229
represented in this picture where we

36
00:01:54,030 --> 00:01:49,390
have a relationship between latitude and

37
00:01:56,910 --> 00:01:54,040
elevation and they would occur in they

38
00:01:58,859 --> 00:01:56,920

would occur in this brown belt worldwide

39
00:02:01,620 --> 00:01:58,869
and some of the highest peaks are also

40
00:02:03,749 --> 00:02:01,630
shown as a reference so among these

41
00:02:05,999 --> 00:02:03,759
environments the most extreme are

42
00:02:07,800 --> 00:02:06,009
probably occur in the Dry Valleys and

43
00:02:11,000 --> 00:02:07,810
slope of the Andean volcanoes

44
00:02:13,830 --> 00:02:11,010
above 5000 meters of elevation so

45
00:02:16,589 --> 00:02:13,840
conditions that life has to face there

46
00:02:18,010 --> 00:02:16,599
is even more extreme that where we will

47
00:02:21,850 --> 00:02:18,020
find in the Attic

48
00:02:23,590 --> 00:02:21,860
desert so microbial life has to come to

49
00:02:26,220 --> 00:02:23,600
cope with a complex interplay of

50
00:02:29,260 --> 00:02:26,230
parameters that go from high UV flux

51
00:02:31,720 --> 00:02:29,270
extreme 3 or no freeze-thaw cycles low

52
00:02:34,270 --> 00:02:31,730
atmospheric pressure and pH and soils

53
00:02:38,380 --> 00:02:34,280
and an extremely low nutrient content

54
00:02:41,350 --> 00:02:38,390
and water activity so the highest of

55
00:02:43,810 --> 00:02:41,360
this volcanoes is volcano yakko which is

56
00:02:46,540 --> 00:02:43,820
also the highest archaeological site on

57
00:02:48,610 --> 00:02:46,550
earth so close to a summit some of the

58
00:02:50,560 --> 00:02:48,620
best the naturally preserved mummies

59
00:02:52,630 --> 00:02:50,570
have been found and they're really

60
00:02:54,130 --> 00:02:52,640
interesting on a microbiology

61
00:02:57,010 --> 00:02:54,140
perspective because they pretty much

62
00:02:59,340 --> 00:02:57,020
show no sign of decay after being very

63
00:03:03,240 --> 00:02:59,350

there for more than 500 years without

64
00:03:06,670 --> 00:03:03,250
preserving chemicals so this inspired

65
00:03:09,280 --> 00:03:06,680
our first expeditions to decide to

66
00:03:14,050 --> 00:03:09,290
address questions about the cold dry

67
00:03:16,810 --> 00:03:14,060
limits to life on Earth so a first

68
00:03:18,670 --> 00:03:16,820
analysis of the soils have shown that

69
00:03:21,700 --> 00:03:18,680
there's nearly undetectable levels of

70
00:03:23,770 --> 00:03:21,710
water organic carbon microbial biomass

71
00:03:25,900 --> 00:03:23,780
and the extracellular enzyme activity

72
00:03:28,540 --> 00:03:25,910
and it seems like only a very limited

73
00:03:31,330 --> 00:03:28,550
spectrum of bacterial and fungal images

74
00:03:33,430 --> 00:03:31,340
have been able to overcome the harshness

75
00:03:37,120 --> 00:03:33,440
of this environment and possibly

76
00:03:39,790 --> 00:03:37,130
functioning in the situ so when we look

77
00:03:42,220 --> 00:03:39,800
at the distribution of like the main

78
00:03:44,260 --> 00:03:42,230
phyla that we have in this environment

79
00:03:47,710 --> 00:03:44,270
we see that they're completely dominated

80
00:03:51,340 --> 00:03:47,720
by Laura flag sign up here and a tina

81
00:03:53,500 --> 00:03:51,350
bacteria so we are also below the dry

82
00:03:55,690 --> 00:03:53,510
limit of a photo on social fees there's

83
00:03:59,370 --> 00:03:55,700
no photo scripts I've ever been found at

84
00:04:02,380 --> 00:03:59,380
these elevations and they're probably

85
00:04:04,150 --> 00:04:02,390
the soils that have the lowest microbial

86
00:04:05,920 --> 00:04:04,160
diversity ever reported in the

87
00:04:07,810 --> 00:04:05,930
terrestrial system especially if we

88
00:04:12,040 --> 00:04:07,820

compare it to the Dry Valleys of

89
00:04:13,930 --> 00:04:12,050
Antarctica and Himalaya there are

90
00:04:16,659 --> 00:04:13,940
however some niches that are able to

91
00:04:19,060 --> 00:04:16,669
mitigate some of this environmental

92
00:04:21,729 --> 00:04:19,070
challenges for example fumaroles on

93
00:04:24,909 --> 00:04:21,739
volcanoes are able to provide water and

94
00:04:27,610 --> 00:04:24,919
warmth and the co2 through the gassing

95
00:04:31,540 --> 00:04:27,620
and we have seen that they support some

96
00:04:34,240 --> 00:04:31,550
way more complex communities especially

97
00:04:36,280 --> 00:04:34,250
like they form uh some a very peculiar

98
00:04:39,550 --> 00:04:36,290
math structure it's really close to the

99
00:04:41,770 --> 00:04:39,560
summit and it is evident from the

100
00:04:44,200 --> 00:04:41,780
rarefaction curves of our eukaryotic

101
00:04:47,440 --> 00:04:44,210
communities the fumarole supports a much

102
00:04:50,340 --> 00:04:47,450
more diverse community compared to the

103
00:04:53,590 --> 00:04:50,350
dry soils that are just surrounding them

104
00:04:53,950 --> 00:04:53,600
another Oasis is represented by the so

105
00:04:57,460 --> 00:04:53,960
called

106
00:04:59,560 --> 00:04:57,470
Nieves penitentes so these are ice

107
00:05:02,290 --> 00:04:59,570
structures that are pretty common uh

108
00:05:06,310 --> 00:05:02,300
along the high elevations of the Atacama

109
00:05:08,620 --> 00:05:06,320
and they periodically release meltwater

110
00:05:10,720 --> 00:05:08,630
around its soil so they're pretty much

111
00:05:12,760 --> 00:05:10,730
the only semi-permanent sources of water

112
00:05:15,250 --> 00:05:12,770
in this environment and again we've been

113
00:05:17,470 --> 00:05:15,260

able to see that they are able to

114
00:05:20,560 --> 00:05:17,480
support much richer communities and

115
00:05:23,290 --> 00:05:20,570
especially important is that we found

116
00:05:25,450 --> 00:05:23,300
photo tropes in the soils and the eye

117
00:05:27,780 --> 00:05:25,460
structures themselves compared to the

118
00:05:31,030 --> 00:05:27,790
dry soils where you would never find any

119
00:05:32,440 --> 00:05:31,040
photo troops so the photo just found our

120
00:05:34,810 --> 00:05:32,450
mainly the form of algae and

121
00:05:37,090 --> 00:05:34,820
interestingly no cyanobacteria have been

122
00:05:40,510 --> 00:05:37,100
retreated from here so it means that

123
00:05:44,170 --> 00:05:40,520
penitentes and the fumaroles are the

124
00:05:45,550 --> 00:05:44,180
only structures that allow the presence

125
00:05:47,340 --> 00:05:45,560
of photo troops in this type of

126
00:05:50,650 --> 00:05:47,350
environment

127
00:05:52,510 --> 00:05:50,660
another very harsh trait that has been

128
00:05:54,100 --> 00:05:52,520
completely under studied but it's very

129
00:05:57,070 --> 00:05:54,110
common in this high elevation

130
00:05:59,890 --> 00:05:57,080
environment is the extreme diurnal three

131
00:06:02,200 --> 00:05:59,900
cell cycle that occurs on the soils so

132
00:06:05,080 --> 00:06:02,210
as we can see temperatures can fluctuate

133
00:06:08,560 --> 00:06:05,090
starting from a - stand up to 30 degrees

134
00:06:10,810 --> 00:06:08,570
within a 24 hour cycle so daily

135
00:06:13,240 --> 00:06:10,820
temperature cycling across the freezing

136
00:06:16,600 --> 00:06:13,250
point is a key challenge for microbial

137
00:06:20,620 --> 00:06:16,610
growth and survival as it is known to

138
00:06:23,080 --> 00:06:20,630

cause multiple damages on a multiple

139
00:06:24,610 --> 00:06:23,090
level as it combines the stress of the

140
00:06:30,250 --> 00:06:24,620
cold with the reduction in water

141
00:06:32,080 --> 00:06:30,260
activity so the type of dry and cryo

142
00:06:34,870 --> 00:06:32,090
philic environments it was assumed -

143
00:06:37,240 --> 00:06:34,880
that the low biomass and diversity was

144
00:06:41,290 --> 00:06:37,250
mainly due to the lack of water however

145
00:06:42,910 --> 00:06:41,300
recent studies have challenged this by

146
00:06:44,310 --> 00:06:42,920
showing for example the nutrient

147
00:06:46,410 --> 00:06:44,320
additions in some

148
00:06:47,430 --> 00:06:46,420
periglacial soils in Peru and the

149
00:06:50,100 --> 00:06:47,440
Antarctic Dry Valleys

150
00:06:52,860 --> 00:06:50,110
have a much stronger effect than water

151
00:06:57,150 --> 00:06:52,870
additions on the community structures we

152
00:06:58,890 --> 00:06:57,160
know that microbial in that soils and

153
00:07:01,320 --> 00:06:58,900
you yaku have some of the lowest

154
00:07:04,080 --> 00:07:01,330
nutrients available so it is entirely

155
00:07:08,160 --> 00:07:04,090
possible at this point that microbial

156
00:07:09,720 --> 00:07:08,170
life happens in the soils only if when

157
00:07:11,250 --> 00:07:09,730
there is water availability also

158
00:07:14,460 --> 00:07:11,260
nutrients are available

159
00:07:16,680 --> 00:07:14,470
so given this premises I wondered how

160
00:07:20,940 --> 00:07:16,690
would these extra food communities

161
00:07:23,100 --> 00:07:20,950
respond if we partially elevated water

162
00:07:26,160 --> 00:07:23,110
and mutual limitations in this

163
00:07:29,760 --> 00:07:26,170

environment under the field the thermal

164
00:07:31,890 --> 00:07:29,770
fluctuation so we assumed that the

165
00:07:34,170 --> 00:07:31,900
communities law lay dormant for most of

166
00:07:36,750 --> 00:07:34,180
the time and only come to life pretty

167
00:07:39,900 --> 00:07:36,760
much when there are pulses of water and

168
00:07:41,850 --> 00:07:39,910
the nutrients through snowfall events

169
00:07:43,920 --> 00:07:41,860
which are pretty infrequent in this

170
00:07:46,620 --> 00:07:43,930
environment and I only ended positions

171
00:07:48,570 --> 00:07:46,630
of organic matter from the atmosphere so

172
00:07:50,790 --> 00:07:48,580
the potential for this communities under

173
00:07:53,550 --> 00:07:50,800
occasional favorable conditions remains

174
00:07:56,790 --> 00:07:53,560
completely unknown to date so what I

175
00:07:59,250 --> 00:07:56,800
decided to do was to apply experimental

176
00:08:02,280 --> 00:07:59,260
water nutrient amendments in the street

177
00:08:05,490 --> 00:08:02,290
events to soil to soil micro systems

178
00:08:08,010 --> 00:08:05,500
micro cars and subject them to the

179
00:08:12,780 --> 00:08:08,020
freeze-thaw cycles that we see in the

180
00:08:15,570 --> 00:08:12,790
field so to do that I place the some

181
00:08:18,360 --> 00:08:15,580
soils that we collected above 6000

182
00:08:20,340 --> 00:08:18,370
meters on Union yahko in a temperature

183
00:08:22,620 --> 00:08:20,350
control chamber that is able to mimic

184
00:08:25,140 --> 00:08:22,630
that fluctuation in temperature that we

185
00:08:28,500 --> 00:08:25,150
see also in the field and we had a two

186
00:08:32,459 --> 00:08:28,510
type of treatment so we had microcosm

187
00:08:36,060 --> 00:08:32,469
that were exposed to water additions to

188
00:08:39,330 --> 00:08:36,070

simulate the snowfall events and then

189
00:08:41,760 --> 00:08:39,340
three stop blast water and nutrients to

190
00:08:43,140 --> 00:08:41,770
simulate also occasional aisle in

191
00:08:47,340 --> 00:08:43,150
depositions in this soil

192
00:08:52,100 --> 00:08:47,350
I also parsed out to be cumulative

193
00:08:54,870 --> 00:08:52,110
effect of multiple watering events by

194
00:08:58,020 --> 00:08:54,880
simulating three discrete snowfall

195
00:09:00,690 --> 00:08:58,030
events we also allow

196
00:09:02,310 --> 00:09:00,700
the soils to dry up to 90% before

197
00:09:06,290 --> 00:09:02,320
applying a new water addition so that

198
00:09:08,760 --> 00:09:06,300
they would simulate pretty much the the

199
00:09:12,830 --> 00:09:08,770
moisture conditions that are normally

200
00:09:15,930 --> 00:09:12,840
found in in this environment so after

201
00:09:19,110 --> 00:09:15,940
extracting our DNA doing the sequencing

202
00:09:22,800 --> 00:09:19,120
of the main 16s and 18s of the community

203
00:09:25,350 --> 00:09:22,810
analyzing them what we saw is that the

204
00:09:27,330 --> 00:09:25,360
community was significantly changing so

205
00:09:29,340 --> 00:09:27,340
in here we have a pickup PCoIP lot of

206
00:09:33,860 --> 00:09:29,350
the bacterial community and we see how

207
00:09:36,690 --> 00:09:33,870
the community significantly changes when

208
00:09:39,420 --> 00:09:36,700
treatments are applied both if it's just

209
00:09:41,750 --> 00:09:39,430
the water addition or water plus

210
00:09:46,230 --> 00:09:41,760
nutrient additions and the community

211
00:09:50,970 --> 00:09:46,240
increases each time more with every

212
00:09:54,930 --> 00:09:50,980
addition so which organ is are actually

213
00:09:57,690 --> 00:09:54,940

allowing of this shift so we looked a

214
00:10:00,150 --> 00:09:57,700
little bit and first of all we saw that

215
00:10:02,660 --> 00:10:00,160
the there is a response to water input

216
00:10:05,579 --> 00:10:02,670
even when nutrient limitations are not

217
00:10:07,530 --> 00:10:05,589
alleviated so this may mean that water

218
00:10:10,110 --> 00:10:07,540
availability allows this try adapted

219
00:10:14,370 --> 00:10:10,120
communities to at least respond to the

220
00:10:16,500 --> 00:10:14,380
very low nutrients that are available we

221
00:10:18,960 --> 00:10:16,510
saw that one of the main orders that

222
00:10:22,020 --> 00:10:18,970
responded to multiple wiring events were

223
00:10:25,050 --> 00:10:22,030
was the Burkholder reality so this order

224
00:10:27,510 --> 00:10:25,060
is very widespread in cryo philocan

225
00:10:29,040 --> 00:10:27,520
oligotrophic environment so it may be

226
00:10:35,030 --> 00:10:29,050
able to function in situ and take

227
00:10:38,790 --> 00:10:35,040
advantage of this water and water in

228
00:10:41,400 --> 00:10:38,800
impulses we saw an increase in the

229
00:10:43,470 --> 00:10:41,410
action of mice italics especially when

230
00:10:45,960 --> 00:10:43,480
you're providing them with nutrients and

231
00:10:47,760 --> 00:10:45,970
with the first water addition there was

232
00:10:49,890 --> 00:10:47,770
an increase in chloro sort of bacteria

233
00:10:51,840 --> 00:10:49,900
so this group is interesting because it

234
00:10:53,640 --> 00:10:51,850
has a potential to do photosynthesis

235
00:10:59,130 --> 00:10:53,650
even if it's not demonstrated in our

236
00:11:00,690 --> 00:10:59,140
soil and we saw pretty much like a

237
00:11:03,420 --> 00:11:00,700
decrease in diversity

238
00:11:06,360 --> 00:11:03,430

after the third event for both type of

239
00:11:08,400 --> 00:11:06,370
treatments so this indicates probably

240
00:11:11,410 --> 00:11:08,410
that only a very minor part of the

241
00:11:13,180 --> 00:11:11,420
community would be active when

242
00:11:15,370 --> 00:11:13,190
conditions allow for that and the rest

243
00:11:18,490 --> 00:11:15,380
of the taxonomy that we see in this

244
00:11:20,290 --> 00:11:18,500
soils is probably due to just like IO in

245
00:11:23,410 --> 00:11:20,300
the position that they are dormant in

246
00:11:25,420 --> 00:11:23,420
the soil a similar pattern is shown for

247
00:11:28,510 --> 00:11:25,430
the eukaryotic community again we see

248
00:11:31,900 --> 00:11:28,520
that multiple simulated snowfall events

249
00:11:34,900 --> 00:11:31,910
and nutrient additions make the

250
00:11:38,320 --> 00:11:34,910
community change and this is especially

251
00:11:41,230 --> 00:11:38,330
more evidence for just like water

252
00:11:43,570 --> 00:11:41,240
additions and interestingly we see that

253
00:11:46,240 --> 00:11:43,580
freethought alone has an impact on the

254
00:11:49,330 --> 00:11:46,250
community as we see here our starting

255
00:11:53,410 --> 00:11:49,340
point cluster separately from our

256
00:11:55,240 --> 00:11:53,420
freeze-thaw alone treatment so it may be

257
00:11:57,100 --> 00:11:55,250
that some of this organizers are

258
00:12:01,000 --> 00:11:57,110
actually responding just to the

259
00:12:03,580 --> 00:12:01,010
FreeStore alone which microorganism

260
00:12:07,270 --> 00:12:03,590
again like a responding to this so the

261
00:12:11,470 --> 00:12:07,280
first and most interesting to us is the

262
00:12:14,140 --> 00:12:11,480
Cryptococcus so this is very relevant in

263
00:12:17,110 --> 00:12:14,150

our soil so it's one of the most

264
00:12:19,960 --> 00:12:17,120
commonly we found and we saw that it

265
00:12:22,840 --> 00:12:19,970
increases dramatically once you give the

266
00:12:25,240 --> 00:12:22,850
first water and water plus nutrient

267
00:12:27,430 --> 00:12:25,250
addition so it's possible that takes

268
00:12:31,270 --> 00:12:27,440
advantage like very fast of this water

269
00:12:33,550 --> 00:12:31,280
and nutrient impulses we see an increase

270
00:12:35,860 --> 00:12:33,560
in the thea mindsets these are other

271
00:12:38,470 --> 00:12:35,870
type of funds like they may not be as

272
00:12:40,090 --> 00:12:38,480
fast of responders but they are known to

273
00:12:42,250 --> 00:12:40,100
be well suited to low nutrient

274
00:12:45,760 --> 00:12:42,260
environments and then the most dramatic

275
00:12:48,790 --> 00:12:45,770
shift happened when just water was added

276
00:12:50,920 --> 00:12:48,800
so we get one out of truck which is like

277
00:12:53,590 --> 00:12:50,930
an algae and new cloris RC know that

278
00:12:56,380 --> 00:12:53,600
starts becoming dominant and another

279
00:12:59,110 --> 00:12:56,390
group of fans I mostly do my seeds that

280
00:13:01,470 --> 00:12:59,120
again are well known that for being able

281
00:13:03,970 --> 00:13:01,480
like to withstand a lot of stresses and

282
00:13:06,010 --> 00:13:03,980
again like in the bacteria we see a

283
00:13:09,040 --> 00:13:06,020
significant decrease in alpha diversity

284
00:13:13,330 --> 00:13:09,050
with multiple water and nutrient

285
00:13:15,100 --> 00:13:13,340
additions so we saw that a Cryptococcus

286
00:13:16,720 --> 00:13:15,110
like becomes really dominant as soon as

287
00:13:19,750 --> 00:13:16,730
like he provided with a little bit of

288
00:13:22,150 --> 00:13:19,760

water and nutrients but interestingly it

289
00:13:25,030 --> 00:13:22,160
does so even when it's just exposed the

290
00:13:27,220 --> 00:13:25,040
tooth we saw dry condition so I'm

291
00:13:29,040 --> 00:13:27,230
maybe that it's partially active when

292
00:13:32,740 --> 00:13:29,050
there's an extremely low water content

293
00:13:34,840 --> 00:13:32,750
so we isolated this organist and

294
00:13:37,990 --> 00:13:34,850
cultured it and did a phylogenetic

295
00:13:39,639 --> 00:13:38,000
analysis and we saw that it's extremely

296
00:13:42,540 --> 00:13:39,649
closely related to another

297
00:13:44,590 --> 00:13:42,550
Cryptococcus from the Dry Valleys

298
00:13:46,590 --> 00:13:44,600
Cryptococcus trade money which is up

299
00:13:50,740 --> 00:13:46,600
there were tolerant and in the lytic

300
00:13:54,610 --> 00:13:50,750
type of Easton so cryptic Hachi have

301
00:13:56,710 --> 00:13:54,620
been found like many times in many

302
00:13:58,809 --> 00:13:56,720
glacial and extreme environments and

303
00:14:00,340 --> 00:13:58,819
given its ubiquity in the south of

304
00:14:03,490 --> 00:14:00,350
environments and the ability to

305
00:14:06,040 --> 00:14:03,500
withstand three spell cycles it may be

306
00:14:09,460 --> 00:14:06,050
an important functional component of

307
00:14:12,100 --> 00:14:09,470
this environment so what I did next was

308
00:14:14,199 --> 00:14:12,110
to try and figure out if the

309
00:14:16,180 --> 00:14:14,209
Cryptococcus was not just a surviving

310
00:14:18,490 --> 00:14:16,190
but if it was actively growing under

311
00:14:20,860 --> 00:14:18,500
this condition so what I did is that I

312
00:14:22,809 --> 00:14:20,870
set up called liquid cultures of it and

313
00:14:25,410 --> 00:14:22,819

I placed them in that same thermal

314
00:14:28,749 --> 00:14:25,420
chambers that allow fluctuations and

315
00:14:32,079 --> 00:14:28,759
incredibly it was able to grow despite

316
00:14:34,870 --> 00:14:32,089
freezing a solid every night so with a

317
00:14:36,189 --> 00:14:34,880
doubling time of about two days so this

318
00:14:37,990 --> 00:14:36,199
as far as we know is the first

319
00:14:40,449 --> 00:14:38,000
demonstration of growth of an organized

320
00:14:43,360 --> 00:14:40,459
during repeated extreme free cell cycles

321
00:14:45,400 --> 00:14:43,370
and it supports even more our original

322
00:14:48,069 --> 00:14:45,410
hypothesis that it has the capacity to

323
00:14:51,340 --> 00:14:48,079
grow during this free cell cycles in the

324
00:14:53,199 --> 00:14:51,350
environment mainly doing so when there

325
00:14:55,569 --> 00:14:53,209
is higher soil moisture which is

326
00:14:59,319 --> 00:14:55,579
provided by infrequent snowstorms in

327
00:15:01,269 --> 00:14:59,329
this environment the next question that

328
00:15:02,949 --> 00:15:01,279
we want to ask is which strategies does

329
00:15:04,809 --> 00:15:02,959
they used to survive this multiple

330
00:15:06,819 --> 00:15:04,819
challenges in this life limiting

331
00:15:10,090 --> 00:15:06,829
environment and especially how does it

332
00:15:15,490 --> 00:15:10,100
cope with free-stall so our plan is to

333
00:15:18,819 --> 00:15:15,500
use a combined strategy of both genomics

334
00:15:20,500 --> 00:15:18,829
and transcriptomics to figure out which

335
00:15:22,840 --> 00:15:20,510
genes allow survival and metabolic

336
00:15:25,329 --> 00:15:22,850
activity in this organism and the to

337
00:15:27,879 --> 00:15:25,339
analyze its genome by seeing if it has

338
00:15:30,129 --> 00:15:27,889

significant deviations from its men's

339
00:15:32,530 --> 00:15:30,139
fellow counterpart so what we did was

340
00:15:36,639 --> 00:15:32,540
culturing it an optimal temperature that

341
00:15:39,080 --> 00:15:36,649
we found it to be 17 degrees and or we

342
00:15:41,750 --> 00:15:39,090
extracted total DNA

343
00:15:59,840 --> 00:15:41,760
sequence it and started its general

344
00:16:13,370 --> 00:15:59,850
assembly and on rotation I'm sorry okay

345
00:16:15,590 --> 00:16:13,380
I'm merely done okay yeah so very

346
00:16:20,000 --> 00:16:15,600
briefly like the jeans that we're gonna

347
00:16:23,180 --> 00:16:20,010
look for our metabolic gene so since we

348
00:16:25,220 --> 00:16:23,190
suspect this to be like versatile

349
00:16:27,230 --> 00:16:25,230
opportunity that is able to take

350
00:16:29,780 --> 00:16:27,240
advantage of whatever the atmosphere

351
00:16:36,520 --> 00:16:29,790
brings it on this high elevation we

352
00:16:39,080 --> 00:16:36,530
expected to have many degrading pathways

353
00:16:41,150 --> 00:16:39,090
we will look at genes associated with

354
00:16:42,920 --> 00:16:41,160
oxidant and the somatic stress we still

355
00:16:45,530 --> 00:16:42,930
don't know what kind of like stress

356
00:16:49,640 --> 00:16:45,540
signal is generated with with pre cell

357
00:16:51,680 --> 00:16:49,650
cycle cold adaptation genes genes

358
00:16:54,130 --> 00:16:51,690
necessary to complete meiosis to see if

359
00:16:57,560 --> 00:16:54,140
it's able to do with sexual reproduction

360
00:16:59,570 --> 00:16:57,570
and then G's that allow through with

361
00:17:02,710 --> 00:16:59,580
standfast temperature switches for

362
00:17:05,990 --> 00:17:02,720
example related to membrane fluidity and

363
00:17:07,730 --> 00:17:06,000

genes that allow it to live at water at

364
00:17:11,570 --> 00:17:07,740
a low water activity so we have to keep

365
00:17:15,170 --> 00:17:11,580
in mind that when there's low in this a

366
00:17:16,670 --> 00:17:15,180
freezing environment there is extremely

367
00:17:18,350 --> 00:17:16,680
low water activity so there are like

368
00:17:21,410 --> 00:17:18,360
very similar to hyper saline

369
00:17:25,120 --> 00:17:21,420
environments and the last step we'll do

370
00:17:27,980 --> 00:17:25,130
to do a transcriptomic analysis of

371
00:17:31,820 --> 00:17:27,990
specific time points within that thermal

372
00:17:34,040 --> 00:17:31,830
cycle so the idea is to grow it and

373
00:17:36,920 --> 00:17:34,050
sample at a different temperatures

374
00:17:40,030 --> 00:17:36,930
within the daily thermal cycle do a

375
00:17:42,320 --> 00:17:40,040
total RNA extraction and get its

376
00:17:44,360 --> 00:17:42,330
transcriptome sequence to find out which

377
00:17:46,910 --> 00:17:44,370
genes are up and down regulated under

378
00:17:49,250 --> 00:17:46,920
the free stress compared to optimal

379
00:17:52,549 --> 00:17:49,260
temperature and to see if it's active

380
00:17:54,710 --> 00:17:52,559
during the whole free soft cycle so

381
00:17:57,619 --> 00:17:54,720
all this work is relevant to the NASA

382
00:18:00,110 --> 00:17:57,629
Astrobiology roadmap because it aims to

383
00:18:01,970 --> 00:18:00,120
determine the physiological state of

384
00:18:03,619 --> 00:18:01,980
microbial cells that are found in

385
00:18:06,049 --> 00:18:03,629
extremely dry and temperature

386
00:18:08,779 --> 00:18:06,059
fluctuating environments to get more

387
00:18:10,549 --> 00:18:08,789
insight on the dynamics of survival of

388
00:18:13,220 --> 00:18:10,559

my keurig and its possibly on the

389
00:18:16,340 --> 00:18:13,230
surface of Mars and our work is the

390
00:18:19,430 --> 00:18:16,350
first to explore adaptations to external

391
00:18:21,470 --> 00:18:19,440
thermal fluctuation by analyzing the

392
00:18:22,999 --> 00:18:21,480
genome and transcriptome of what at this

393
00:18:27,080 --> 00:18:23,009
point can be called a poly external

394
00:18:31,460 --> 00:18:27,090
philic yeast so given its unique ability

395
00:18:33,799 --> 00:18:31,470
to withstand a lot of stressors it is a

396
00:18:35,690 --> 00:18:33,809
potential model organs of astrobiology

397
00:18:38,749 --> 00:18:35,700
and for stress resistance studies on

398
00:18:40,789 --> 00:18:38,759
eukaryotes so I want to thank the

399
00:18:43,310 --> 00:18:40,799
National Science Foundation's and the US

400
00:18:46,759 --> 00:18:43,320
Air Force which gave up the grants to be

401
00:18:48,820 --> 00:18:46,769
able to do this work and the Alpine and

402
00:18:51,710 --> 00:18:48,830
microbial Observatory which is my lab

403
00:18:53,629 --> 00:18:51,720
that has now become Arctic and Antarctic

404
00:18:55,700 --> 00:18:53,639
as well so if you're interested in

405
00:18:58,369 --> 00:18:55,710
looking at pretty pictures of all our

406
00:19:07,609 --> 00:18:58,379
sites and our work this is our website

407
00:19:08,149 --> 00:19:07,619
thank you thank you very much Laura we

408
00:19:16,309 --> 00:19:08,159
have time for

409
00:19:21,389 --> 00:19:19,589
right so I noticed in one of your slides

410
00:19:23,339 --> 00:19:21,399
you had something that you called plant

411
00:19:24,809 --> 00:19:23,349
material going down when you added water

412
00:19:27,239 --> 00:19:24,819
and nutrients and I was wondering if you

413
00:19:35,399 --> 00:19:27,249

could explain that a little bit oh sure

414
00:19:37,559 --> 00:19:35,409
so so when we look at this for example

415
00:19:41,989 --> 00:19:37,569
like we see that our untreated

416
00:19:46,019 --> 00:19:44,309
elevations have a lot of plant materials

417
00:19:48,779 --> 00:19:46,029
that we know it's not growing there but

418
00:19:50,399 --> 00:19:48,789
it's blown in so what we see is that

419
00:19:52,349 --> 00:19:50,409
there's a reduction of that plant

420
00:19:54,629 --> 00:19:52,359
material so we have two hypotheses about

421
00:19:56,249 --> 00:19:54,639
how that's happening so one is that

422
00:19:59,869 --> 00:19:56,259
Cryptococcus is actually taking

423
00:20:03,180 --> 00:19:59,879
advantage of that and like actually like

424
00:20:06,449 --> 00:20:03,190
degrading that plant material that is

425
00:20:08,639 --> 00:20:06,459
blown in we also saw that it has like a

426
00:20:11,459 --> 00:20:08,649
lot of genes that are able to degrade

427
00:20:14,009 --> 00:20:11,469
some plant compounds some plant derived

428
00:20:18,269 --> 00:20:14,019
compounds or the other option is that it

429
00:20:20,399 --> 00:20:18,279
will simply be degraded as a as a result

430
00:20:23,099 --> 00:20:20,409
of the free cell cycle itself because

431
00:20:25,680 --> 00:20:23,109
it's known to damage a lot of cells so

432
00:20:27,299 --> 00:20:25,690
it may be ethan alpha via the

433
00:20:29,219 --> 00:20:27,309
Cryptococcus or it may be just like

434
00:20:31,379 --> 00:20:29,229
degraded but in each case we suspect

435
00:20:33,149 --> 00:20:31,389
that it will you know make advantage of

436
00:20:36,869 --> 00:20:33,159
whatever new trend comes out of them

437
00:20:38,920 --> 00:20:36,879
okay thank you very much Lauren thank