If we are to find life beyond Earth, we need to be explorers, not hunters

July 22 2015, by Duncan Forgan

What secrets will space reveal? Credit: AstroStar

The news that the search for extraterrestrial intelligence is to receive increased funding and data through the $100m (£64m) Breakthrough Listen project is welcome news for astrobiologists like myself. Launched by Stephen Hawking, it particularly helps to allay growing concerns in the field about having too narrow a focus in our search for life in the universe.

Last week I attended the Pathways Towards Habitable Planets conference in Switzerland, where leading scientists in the search for habitable planets shared their results and ideas for the future. What was especially interesting was the relatively strong consensus on the problems with our definition of the habitable zone – the area around a star which is neither too hot nor too cold for orbiting planets to support liquid water on the surface. Even its name is misleading, as we'll see in a moment. If we aren't careful, obsessing about this zone could prevent us from reaching our ultimate goal of finding extraterrestrial life.

For as long as we have considered planets orbiting other stars, we have speculated over their propensity to host living organisms in the way that the Earth does. The habitable zone concept has helped astronomers to define where, in all those quintillions of acres of galactic real estate, we should search for planets that might be inhabited.

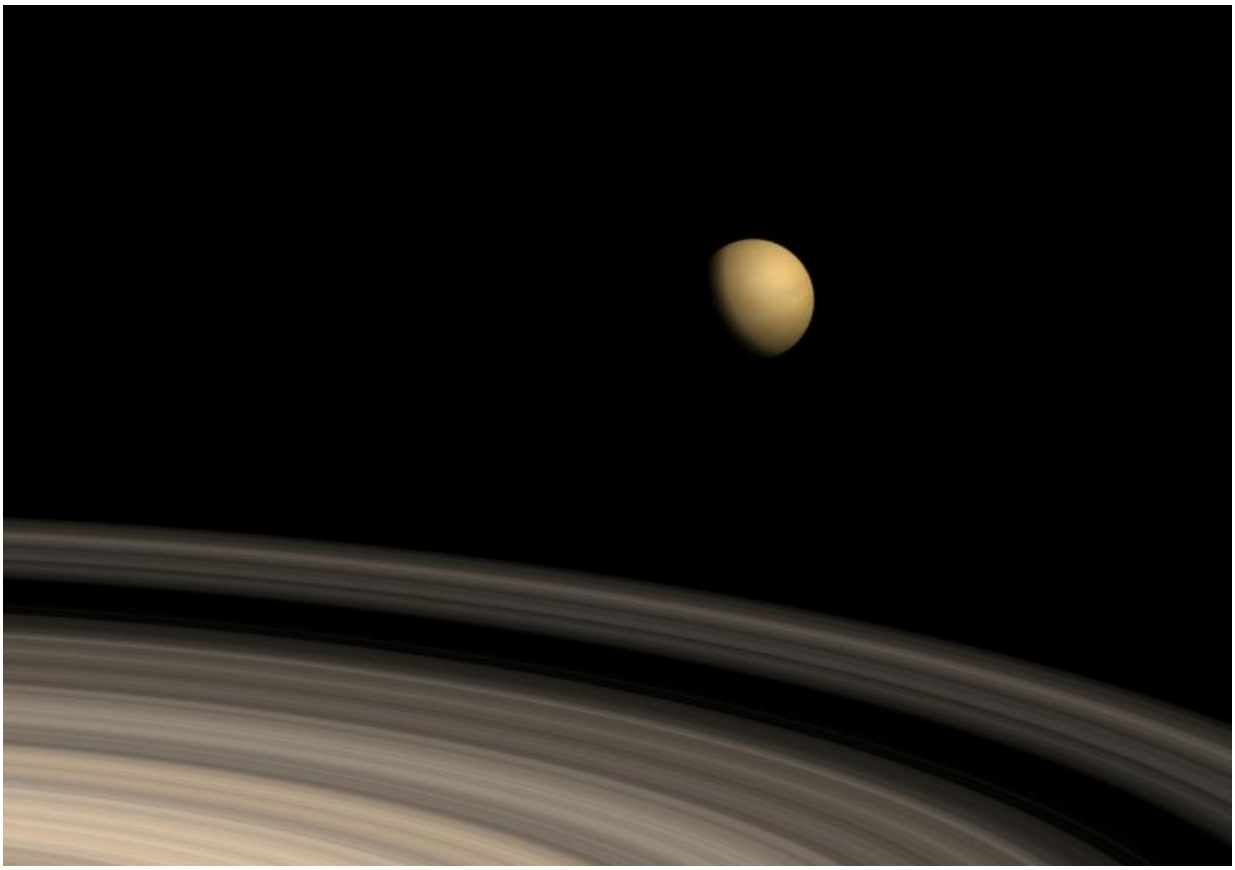
It may seem sensible to look for extraterrestrial life in regions where any Earth-like planet would have liquid water on the surface. Liquid water is an essential solvent for the chemical reactions that Earth biology relies on. If we find planets with liquid water, they satisfy a key criterion for being conducive to life as we know it.

Yet being in the zone neither automatically means that a planet will have water, nor that it could support life. It needs to have a "healthy" atmospheric composition – usually assumed to mean similar to Earth's – and ideally a healthy magnetic field to shield it from high-energy particles belched forth by its parent star.

We might also demand that the planet's orbit and rotation is stable and that any planetary neighbours kindly leave it alone. We don't have enough data on the planets we have found to date to know if they meet all these criteria. Even if we did, we would most likely have to run a sophisticated computer simulation to model their climate before we

could determine what conditions were really like on the surface.

These difficulties with the definition of the habitable zone can lead to astronomers and astrobiologists coming a cropper when speaking to the press. When a press release announces the detection of "a planet in the habitable zone", the general public reads "a habitable planet". It's this confusion that prompted the discussion at the Pathways conference on whether we should change the zone's name to something else – perhaps the surface liquid water zone, or the temperate zone.



Could Titan’s methane lakes host life? Credit: manjik

Beyond this, there are other problems with the concept. Perhaps life doesn't require surface liquid water to survive at all. Some have speculated that the liquid hydrocarbons on Titan, Saturn's largest moon, could be a solvent for a very different form of life, for example.

Other moons in our solar system, such as Europa and Enceladus, meanwhile, appearto have subsurface liquid water even though they reside outside the traditional habitable zone. The tidal heating they receive from their host planets is enough to make habitable zones beyond the habitable zone, if that's not too confusing. The more we learn about other planets, the more the simplicity of the habitable zone's definition begins to look dangerous.

The need for focus

So why have astronomers persisted with the concept? The real reason is target selection. There are lots of stars in the Milky Way – and we now know of lots of planets surrounding them. Astronomers have limited resources, and not all astronomers want to search for biospheres.

Because we can only observe a few targets, we choose the ones that we think have a higher chance of yielding signs of life. Depending on how you detect them, most candidates are merely silhouettes on a star's surface or wobbles in a star's orbit. If we're lucky, some are both – or we have managed to discover some information about molecules in their atmospheres using transit spectroscopy, which is the study of the light the planet reflects from its parent star.

The next generation of exoplanet observations is designed to ensure we glean the maximum amount of information about as many planets as possible. This is in advance of the coming extremely large telescopes, which may be able to directly image any "Earth-like" planets nearby.

We should be exploring every kind of planet, not just hunting for ‘blue marbles’ like our own. Credit: Fisherss

Yet this isn't an excuse for going down the wrong path. It might be tempting to rush to the end of the search – hunting exclusively in the habitable zone – but we might be rushing to the wrong end. Consequently many scientists are saying we shouldn't be looking for things that look like life, but merely things that look anomalous and can't be explained by geochemical, non-biological processes.

The weird blooms of methane in Mars' atmosphere pointed towards life,

for instance. This turned out to be something of a false alarm, since they can also be explained without requiring organisms, as can many other potential signs of life on the planet. Frustrations aside, such anomalies are still worth exploring. The more we find, the more likely we are to find one caused by organisms.

I'm pleased to say that Breakthrough Listen is in the spirit of this approach. It will focus on sifting data from radio and infrared telescopes for signs of extraterrestrial intelligence. It will not restrict its focus to zones, particular conditions, or even planets at all, but scan more widely to look for signals that can't be explained by natural phenomena.

Every planet we find and learn about – even hellish worlds such as Venus, or gas giants such as Jupiter – is a piece of the puzzle of how planets form and evolve. They all help us learn how biospheres are born and how common or rare we really are. As we put our blue marble into ever clearer context, it's my fond hope it will help us appreciate and cherish our singular, complex, beautiful world all the more.

As Franck Selsis, a leading figure in finding and characterising potentially habitable worlds, said at the Pathways conference, "Perhaps the best strategy is to have no strategy – except to simply explore."

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