Species drift and adaptability

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Content

Context – what are these concepts and how can they help us grow into the future?

Conclusion - the future depends on practice which in turn depends on knowledge, and working with those who have such knowledge and can help us get such knowledge

Example – understanding the life history traits of plant species of interest as part of our forward thinking and planning

Species drift – as genetic drift

Genetic drift (allelic drift or the Wright effect) is the change in the frequency of an existing gene variant (allele) in a population due to random chance.

Genetic drift may cause gene variants to disappear completely and thereby reduce genetic variation. It can also cause initially rare genes to become much more frequent and even fixed.

Describes random fluctuations in the frequencies of gene variants in populations, which can eventually cause a population of organisms to be genetically distinct from its original population and result in the formation of a new species.

At the structural level, genetic change appears at the organism level and is expressed at the population level. Phenotypic changes are the result of genetic change, and every change requires some sort of external force … climate change (direct and indirectly)

Species drift – more generally

- The way that species in geographical regions may change and how the occurrence of individual species change as they disperse/establish across the landscape?

- How do species move or disperse around the landscape, and establish individually and as communities of multiple species, in addition to humans deliberately moving them?

- Specifically, how will species respond to periods of drought, flood, changing water availability, changing seasons, changed temperature ranges, and greater variability and episodic events?

- Have retained the reference to genetic drift as the movement of species will be influenced by their genetic makeup, including mutations and adaptation to changed conditions – nature is not static at the gene level.

Adaptability

Variability in respect to, or under the influence of, external conditions; susceptibility of an organism to that variation whereby it becomes suited to or fitted for its conditions of environment; the capacity of an organism to be modified by circumstances.

Understanding how species respond to environmental changes is a major challenge in ecology & revegetation practice, and under climate change.

What is the adaptability or flexibility of an organism? Flexibility stems from phenotypic (observable characteristics) plasticity, the ability of an organism with a given genotype (genetic type) to change its phenotype (observable characteristics) in response to changes in its habitat, or to move to a different habitat. The degree of flexibility is inherited, and varies between individuals.

Adaptation space

The organization of interactions among species that occur together can influence their chances to adapt to novel conditions. Evidence that the ecological dynamics within a population can facilitate persistence of groups of species rather than entire communities.

Limited knowledge to identify groups of species that are able to adapt to new environments through a re-organization of their interactions. Knowing this could be valuable for 'growing into the future' or restoring degraded landscapes – knowing about the environmental conditions that are compatible with the groups persistence through the reorganization of interactions among species within the group.

The larger the adaptation space of a group, the more likely it is to adapt to a novel environment. The interactions in adjacent community outside of a group could provide structural constraints.

Based on Cenci et al 2018 https://doi.org/10.1016/j.jtbi.2017.10.016

What do we need to know to assess the adaptability of plant species

Much of what we would do locally would be based on observations of the phenotypic features of the species – especially plant form or life history traits

- **growth characteristics annual / perennial**
- **reproductive characteristics – seed / vegetative**
- **flowering, seeding & germination**

Responses to environmental conditions – ability to reproduce and spread

- **temperature, rainfall etc**
- **soil characteristics – nutrients, particle size, micro elements**
- **presence of other species**

AND genetic structure / hybridisation – nature at work

The climate emergency

Climate change? Try catastrophic climate breakdown

George Monbiot and The Guardian | 28th September 2013

Viewpoint

World Scientists' Warning of a Climate Emergency

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation and the graphical indicators presented below, we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

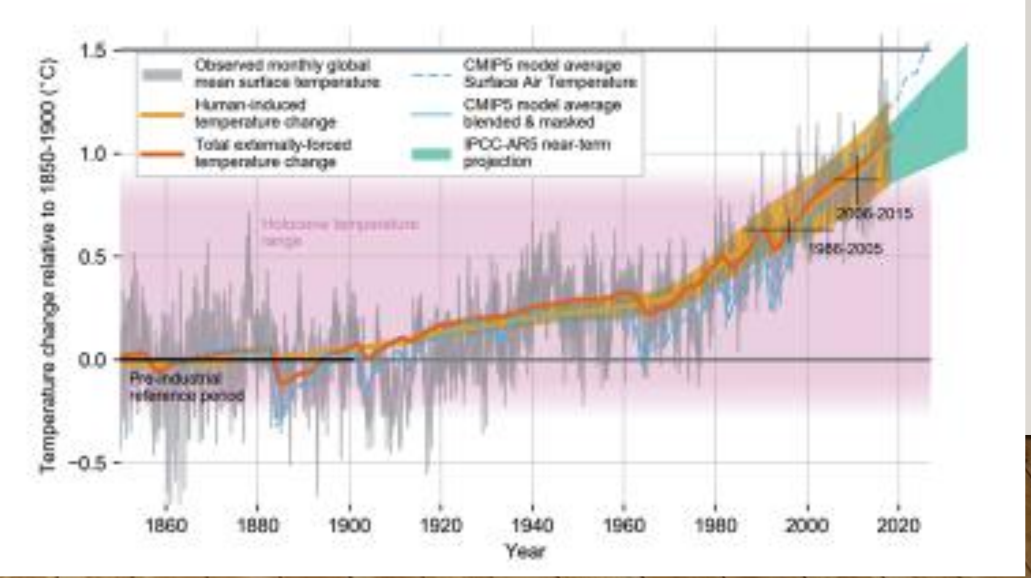
Exactly 40 years ago, scientists from 50 nations met at the First World Climate Conference (in Geneva 1979) and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017). Yet greenhouse gas (GHG) emissions are still rapidly rising, with increasingly damaging effects on the Earth's climate, as well as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically collected for at least the last 5 years, and updated at least annually.

The climate crisis is closely linked to excessive consumption of the wealthy lifestyle. The most affluent countries are mainly responsible for the historical GHG emissions and generally have the greatest per capita emissions (table S1). In the present article, we show general patterns, mostly at the global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working to implement the Paris climate agreement, the United Nations' Sustainable Development Goals, and the Aichi Biodiversity Targets.

Profoundly troubling signs from ... forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy has increased 373% per decade, but in 2018, it was still 28 times smaller than fossil fuel consumption (combined gas, coal, oil; figure 1h). As of 2018, approximately 14.0% of global GHG emissions were covered by carbon pricing (figure 1m), but the global emissions-weighted average price per tonne of carbon dioxide was only around US$15.25 (figure 1n). A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018 (figure 1o).

Especially disturbing are concurrent trends in the vital signs of climatic impacts (figure 2, supplemental file S2). Three abundant atmospheric

Evolution of global mean surface temperature (GMST) over the period of instrumental observations IPCC 2018



Hence how do we grow into a climate ready future when we have species drift (genetic and generally) and adaptability?

Assumption – our ecosystems are vulnerable to climate change, at different rates and extent. Can we make use of species drift and adaptability to ameliorate the impacts of critical and most vulnerable ecosystems, species or groups of species? We will and we will try to over ride nature and move things, as they move themselves.

Before doing so we need to assess the vulnerability of the ecosystems and their components (not everything will change at the same rate) and make decisions about what actions are needed, what species will change, and what species will adapt genetically (phenotypically) and move (migrate) or can be introduced?

We do have a lot of knowledge – scientific knowledge (how much and for what species?) and local knowledge (about our species, and species from elsewhere).

Lets look at local knowledge – likely an under recognised resource and also just as likely incredibly valuable if it can be shared and used to manage changes in our vegetation (and habitats); collate and share such information in effective ways – identify custodians and implement ways to recognise this and share and use … who is doing this? Land managers, scientific experts working with local experts in an equitable way … that's been said before … could be seen as a form of citizen science.

There is another part to this – many ecosystems have been modified or degraded and will change further under climate change. Growing into a sustainable future will also depend on how we restore these ecosystems, and in the process limit the impact of climate change … species drift and adaptability important for restoration.

To conclude – link the comments about plant life history traits to local knowledge

The 'traits' example is a formal way of assessing plant establishment and growth, and parallels what comprises local knowledge…. Think about (if you are not already ahead of me) what local plant experts are telling us, or could tell us …

They are telling us, based on knowledge and experience, how plants grow, and where in our region, and what is different between responses in different locations, under different conditions, and between seasons and years … Can we work with them to share it in an effective way? I'll leave the mechanisms for doing this to another day – today is about recognising that we have a valuable source of information, expertise, and a parallel effort to the complex research that could go into species drift and adaptability.

To grow into the future could we do better than feed off existing knowledge while we sow the seeds of further knowledge? Our local communities have a lot of knowledge … but not everything we will benefit from knowing …