ITEX SPECIES POOL PROTOCOL 2018

KEY QUESTION

What is the local vascular plant species pool at your ITEX site?

SUMMARY

1) **Local species pool**

One of the important findings of Anne's trait biogeography manuscript (and future manuscripts) is that species turnover rather than shifts in abundance primarily drives the patterns of trait change over time. However, we don't know where this turnover is coming from, and thus we would like to know more about the local species pool.

2) **Environmental heterogeneity**

We would also like to be able to estimate fine-scale environmental heterogeneity at the plot level in order to understand how local heterogeneity influences community change over time. Thus, we would like to have GPS coordinates for EACH PLOT in order to extract this information from ArcticDEM, etc.

3) **Rate of species accumulation**

The rate at which new species are found across a landscape likely depends on environmental heterogeneity. Building on our knowledge of 1) the local species pool, and 2) the precise locations of each ITEX plot, if we have the distance at which each new species is found (measured from the center of the site), we can quantify the species-area curves for each ITEX site and test among-site variation in the rates of species accumulation.

Please see below a very short and a longer version of the protocol. The long version requires a little more time (not much more), but gives us more information for relevant analyses (e.g. species-area curves and trait variation).

If you are interested in participating, we would rather have you contribute the short and fast version than not at all.

SHORT PROTOCOL

Why?

1) We know which species are in the ITEX plots, but we don't know which species and how many species grow around the plots and which species could possibly invade into the plots in the near future.

2) We would like to be able to estimate fine-scale environmental heterogeneity at the plot level in order to understand how local heterogeneity influences community change over time. Thus, we would like to have GPS coordinates for EACH PLOT in order to extract this information from ArcticDEM, etc.

The plant record should take less than a day.

How?

Local species pool:

Note all the vascular plant species in the area at and around your ITEX site in the attached excel sheet.

We would ideally like **a minimum area with radius of 100 m** around the center of your site (if accessible). Mark the approximate boundaries of the area you survey with a GPS or on a map or aerial photo.

Separately, please use your expert knowledge and note any "new" species that have arrived at the site since you started working there, or, alternately, any species that used to occur and now don't (need to be added to the survey, of course).

Fine scale environmental heterogeneity:

Note GPS coordinates (preferably with a differential GPS) of all plots in the data sheet in the attached excel file.

Equipment:
GPS, preferably differential GPS
Markers/tape to mark survey area

SLIGHTLY LONGER PROTOCOL

Why?

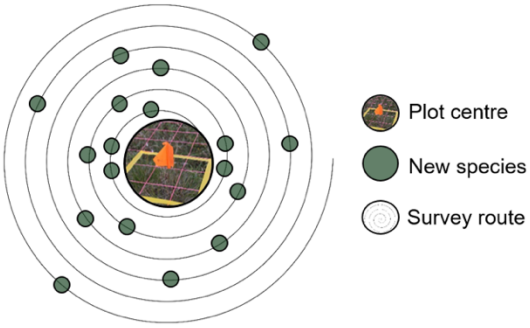
In addition to the above-mentioned points, this protocol will allow us to analyze species-area curves (a challenge in the ITEX data because of different plot sizes and methods), frequencies and traits of plants in the area.

How?

Local species pool:

- Go to center of the site (sort of in the center of all the plots and OTCs), mark with a nail or peg or something, record GPS coordinates.
- The complete region size will be a circle with a max. 250 m radius (but at least 100 m) around your center. It might help to lay out ropes with markings in a cross so that you can roughly know how far you record a plant from the center. Or you put up little flags e.g. every 25 m.
- Put a small frame (25 x 25 cm) around the center.
- Write down all vascular plant species in that plot.
- Put a larger frame around the center (1 m^2). Add all additional species to the list.
- The next plot size is 5 m^2. Mark a circle with an approximate radius of 1.25 m. Add all new species to the list.
- Once you have all species in the central 5 m^2, go in larger and larger circles around the center, and write down **all new species** (i.e., those not found in the 5 m2 plot) **and their approximate distance from the center.**

Getting the distances from the center is quick and easy if you mark the center point on a GPS and select "Go to point" (or the equivalent on your GPS). Then, as you are walking in circles with a GPS, you can see how far you are from your "destination (the center point)".



At the end you should have listed all species in the large circle and their approximate distances from the center.

Frequency estimate:

Do a coarse frequency estimate of all species (1 = 1 individual or cluster, 2 = 2-3 individuals, 3 = 4-10 individuals, 4 = 11-50 individuals, 5 = >50 individuals).

Photo records:

Take at least four photos of: 1) the central 25 x 25 cm, 2) the central 1 m2, 3) the entire area with the plots and OTCs and 4) the entire 250 m radius circle.

Some metadata:

Did you find different habitat types in the circle with very different species sets than in the plots (e.g. wetlands, snowbeds, ridges, shrublands)? How far away from your plots are habitats with potentially invading species in a warmer climate (e.g. shrub or even tree patches, or an area of warm microclimate)? Please add remarks.

Fine scale environmental heterogeneity:

Note GPS coordinates (preferably with a differential GPS) of all plots in the second data sheet in the attached excel file.

Plant height:

Please measure with a ruler the height of the first individual of all plant species you encounter. Should you encounter an unusually small or large individual, choose another one that is more representative of the population. Individuals should be healthy adult plants. Please note whether you record the height including reproductive structures or not (or, ideally, measure two heights per plant: first to the highest point of photosynthetic tissue and second to the highest point including reproductive structures).

This species pool protocol should take around a day – day and a half.

Equipment:

Nail or stick

Measuring tapes, some rope or thread, pinflags

Frame for small plot sizes (0.25 x 0.25 m, 1 m2). You can use the rope or tape for this.

Ruler

GPS, preferably differential GPS

After the record

Type in the data into the attached spreadsheet and send to us.

Processed measurements and data will be returned to collectors.

All data contributors will be co-authors on the resulting manuscript.

After publication of the manuscript, trait data (i.e., height measurements in this case) will be submitted to the TRY database (www.try-db.org) and made publically available.

MORE DETAILED VERSION FOR QIKIQTARUK

Background
The relationship between the regional species pool (all species present in a region) and local biodiversity trends, such as species turnover (the change in the species composition of a site over time) is a major research unknown for biology, particularly in the Arctic tundra, one of the biomes most sensitive to climate change. We will survey the regional species pool on Qikiqtaruk to test how environmental heterogeneity influences biodiversity trends at different landscape scales. I will combine plant identification with high-precision mapping using GNSS (Global Navigation Satellite System) technology to investigate:

1) The size, composition and spatial structure of the regional plant species pool (all present species, the potential source of future turnover)

2) The relationship between environmental heterogeneity (differences in physical geography and environmental factors, inferred from drone imagery) and species diversity

3) I will then quantify species-accumulation curves (the rate at which new species are found across a landscape).

Methods
In addition to recording the distance from the center of the site for the first individual of each new species, we will also use the GNSS to get a precise geographic location for those first individuals.

The procedure when encountering a new species then becomes:

- Identify species (take photo of the individual if we can't ID on the spot, make it obvious which individual the photo refers to!)
- Measure height - first to the highest point of photosynthetic tissue and second to the highest point including reproductive structures
- Record distance from site center
- Record the location of the individual using the GNSS
- Use SPP_HER01, SPP_HER02, etc for the name of the points. **NO SPACES IN POINT NAMES!** Using "01" is better than "1", because then the points get sorted as 01, 02, 03, not 1, 10, 2, 3 and it's easier to make sure you haven't skipped a number. **Be extra careful not to overwrite point names** – there are no warnings if you accidentally use the same name for a point twice.
- Every once in a while, use the map feature on the GNSS to make sure your points make sense – e.g., as we get further away from the site center, so should the points.

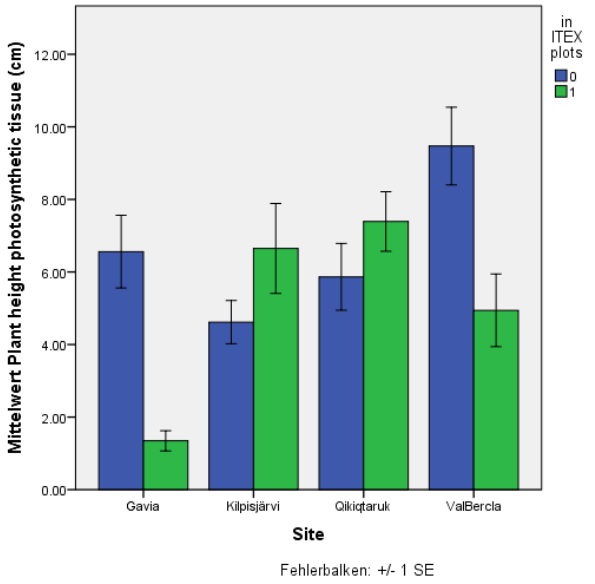
Drone component:

- Put out 13 drone markers at HER and 13 drone markers at KOM, GNSS them.
- Near to the time of doing the ground species pool protocol, collect drone imagery of both the HER and KOM site.
- Use existing points (i.e., keep the same shape of PS1 HER and PS1 KOM as from previous year) or fly a 50x50m grid where the center is the center of the site (the same center as what was considered the center for the ground species pool protocol?
- RGB and multispectral imagery at 20m and 50m height?
- Take photos and video (RGB) of both ITEX sites from the drone (starting from the center of the site, gradually going up and up) and then a photo of each plot (12 plots in total) – nadire photos from the drone hovering above the plots at the height at which the plot fills up the frame and then a few photos from higher up.

The protocol will be carried out for both the Herschel and Komakuk ITEX plots.

FINDINGS FROM 2017

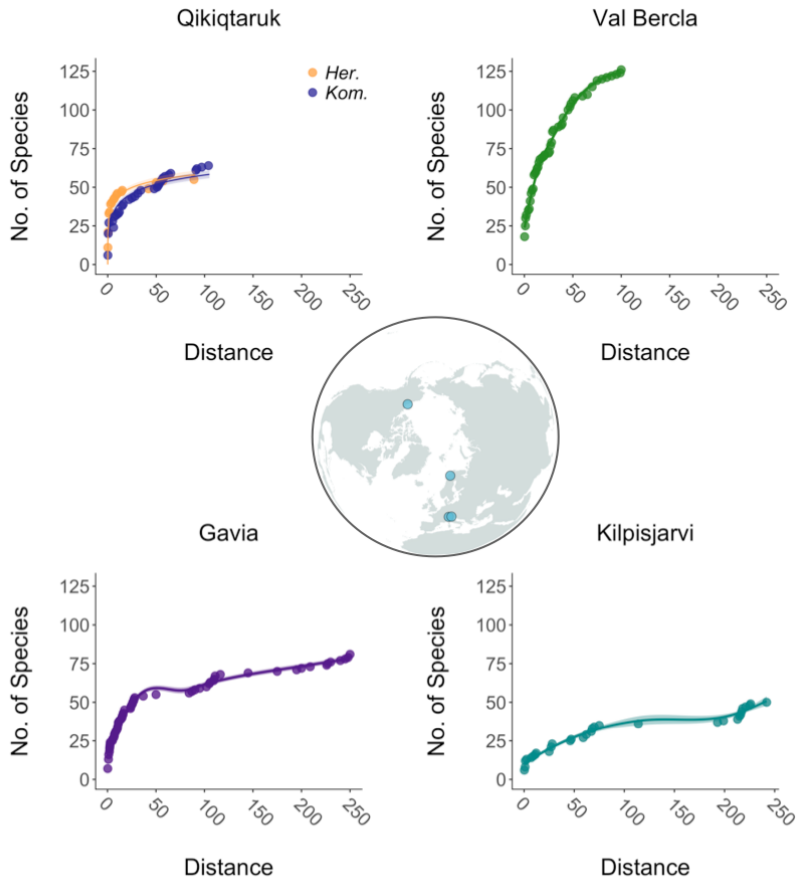
Mean plant height in and outside ITEX plots



Our sites differ tremendously with respect to the traits of the local species pool (Fig. 1)!

Fig. 1. Differences in mean plant height in (green) and outside (blue) ITEX plots vary across sites.

Species accumulation curves across ITEX sites



We hypothesise that the observed differences in the shapes of the species-accumulation curves (Fig. 2) are due to variation in env. heterogeneity.

Fig. 2. The rate at which species accumulate across the landscape differs among sites – it'd be interesting to find out why!

Curious to find out what the SAC curve looks like at your site, how plant height varies in and outside plots?

Join us for the 2018 season of the ITEX species pool protocol!