

BIODIVERSITY IN



metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION



**GABRIEL SMITH
LESLEY MILLER
RAGHAV AGGARWAL**

What is Biodiversity?

Encompasses
all species on
Earth...



... and the
environments
in which they
live.

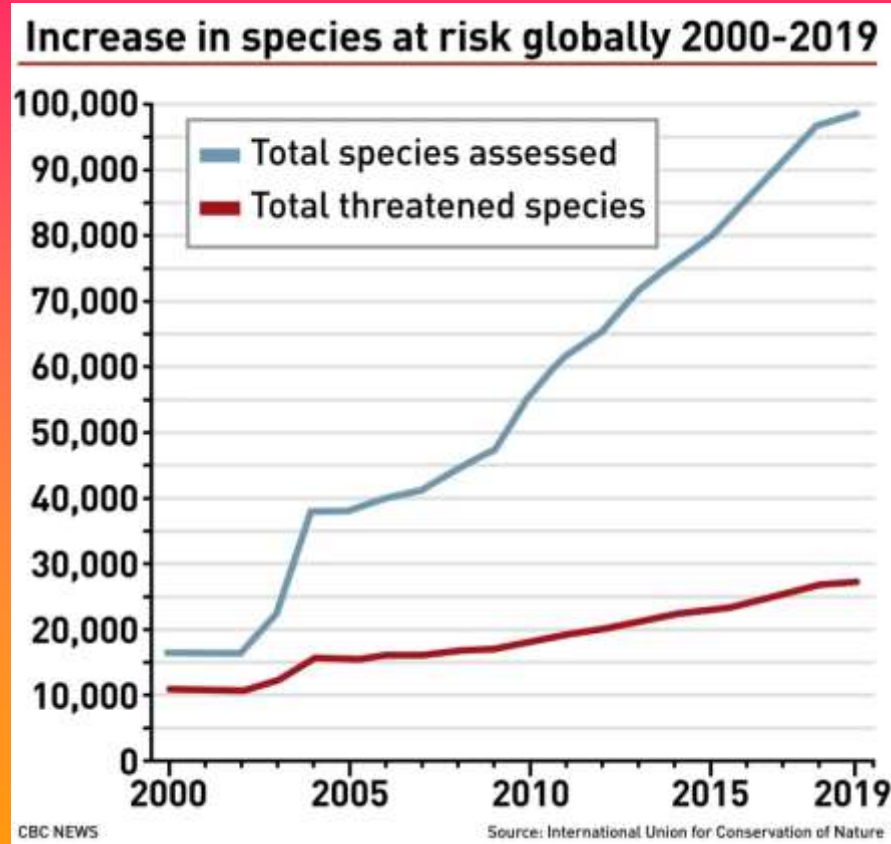
What is Biodiversity?

Our Life
Support
System....

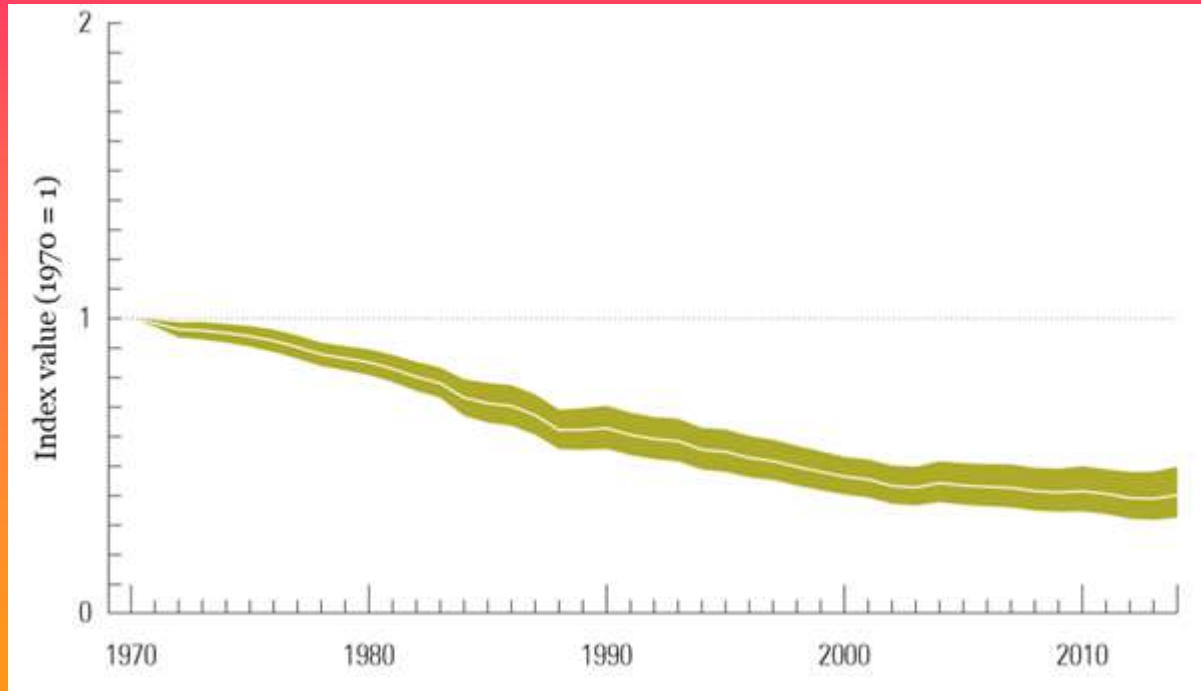


...and it's
greatly under
threat!

ENDANGERED SPECIES ON THE RISE



LPI (Living Planet Index) DECLINE IN VERTEBRATES



60% global decline since 1970

Threats to Biodiversity

**Unsustainable
Agriculture**

**Overexploitation
of Species**

**Habitat Loss
through
Development
Decisions**

The Problem



**Dispersed
data sources**

**Data quality
concerns**

Wrong scale

The Solution



Aggregate all quality data sources into one place!

AIMS

1. Discover and assess the types of biodiversity data that is available
2. Evaluate data quality
3. Explore what kinds of questions could be answered using that data
4. Establish a baseline inventory of species in Metro Vancouver and identify data gaps

OUR WORKFLOW IS SIMPLE

**COLLECT
DATA**



**PROCESS &
AGGREGATE**



**PREDICT &
VISUALIZE**





PRIMARY DATA DESCRIPTION



GBIF (Global Biodiversity Information Facility)

- Citizen Science
- Spatial & Temporal
- Taxonomy (Evolutionary Tree)
- Spans from 1700s to present



2,957,817 records

That's a lot of records



10,563 species

And a lot of species

235 sources

And a variety of sources

Subset of Data

	Year	Lat	Lon	Data Source
<i>Bombus impatiens</i>	2018	49.220991	-123.214155	iNaturalist
<i>Calidris bairdii</i>	2016	49.221082	-123.212838	UBC Herbarium
<i>Junco hyemalis</i>	1990	49.221091	-123.216278	eBird

***More columns in the actual data**

ENDANGERED LISTS

IUCN Red List

Database of endangered species at **international** level

SARA

Database of endangered species at **national** level

BC Red/ Blue Lists

Database of endangered species at **provincial** level

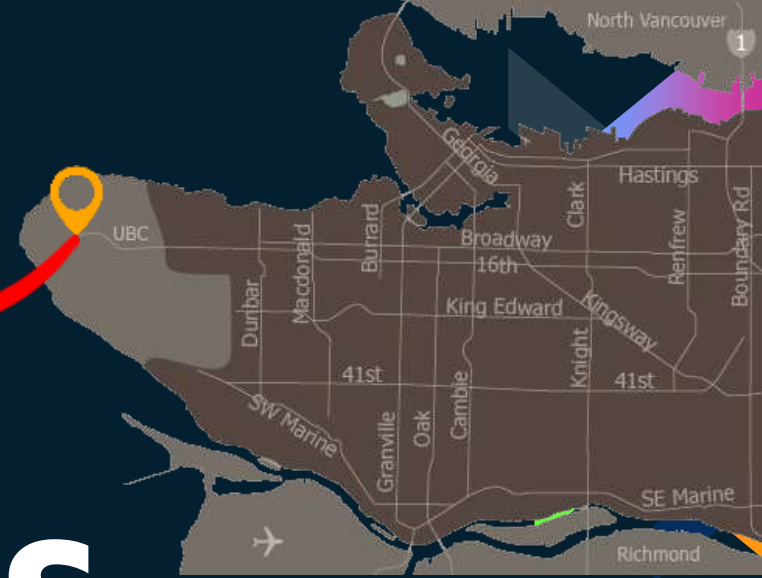
How many species on those lists?

	Species*
IUCN	79
SARA	66
BC Red-Blue	300

*Numbers in Metro Vancouver

SEI (Sensitive Ecosystems Inventory)

- Ecosystem classification for Vancouver
- Identifies different ecosystems (Mature forest, Wetlands etc.) across the region and indicates habitat quality



FEATURES





EXPLORATION & VISUALIZATION

1.SELECT CUSTOM REGION

Either draw out your own polygon or select from one of the layers provided



2.PLOT OCCURRENCES

Select or search any taxonomy level from the taxonomy tree to plot the observation data on the map

The screenshot displays a web application interface for plotting species occurrences. On the left, a map shows a residential area with streets like "Doncaster Way" and "West 2901 Avenue". A pop-up window identifies a species as "Anas platyrhynchos Mallard" with a Wikipedia link and an image. The map includes a legend for "Grayscale", "Streets", and "Municipalities". On the right, a "Plot species" panel shows a taxonomy tree with a search bar. The tree is expanded to "Aves" and lists various orders, with "Passeriformes" selected. A legend on the far right defines the color coding for taxonomy levels: organisms (orange), kingdom (purple), phylum (pink), class (light blue), order (dark blue), family (red), genus (green), and species (grey).

Plot species

Search

- organisms
- kingdom
- phylum
- class
- order
- family
- genus
- species

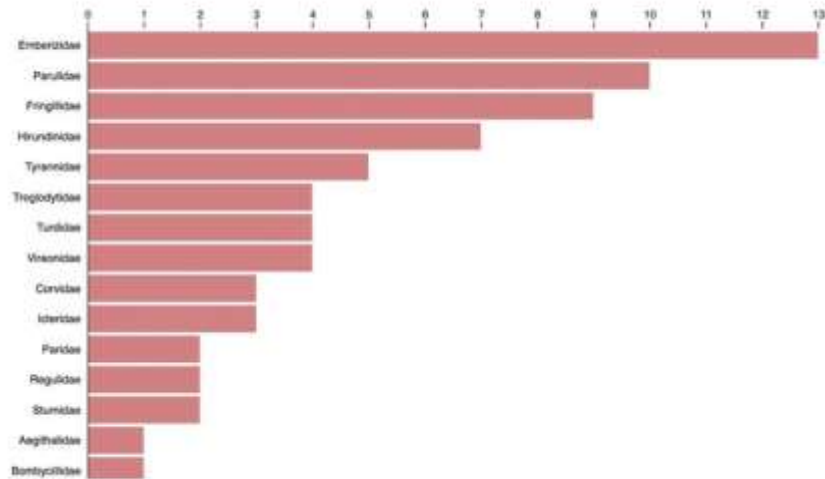
Organisms

- Animalia
- Chordata
- Aves
 - Passeriformes
 - Ansariformes
 - Charadriiformes
 - Accipitriformes
 - Apodiformes
 - Piciformes
 - Strigiformes
 - Columbiformes
 - Podicipediformes
 - Falconiformes
 - Gaviformes
 - Suliformes
 - Galliformes
 - Pelecaniformes
 - Caprimulgiformes
 - Coraciiformes
 - Gruiformes
- Mammalia
- Trechida

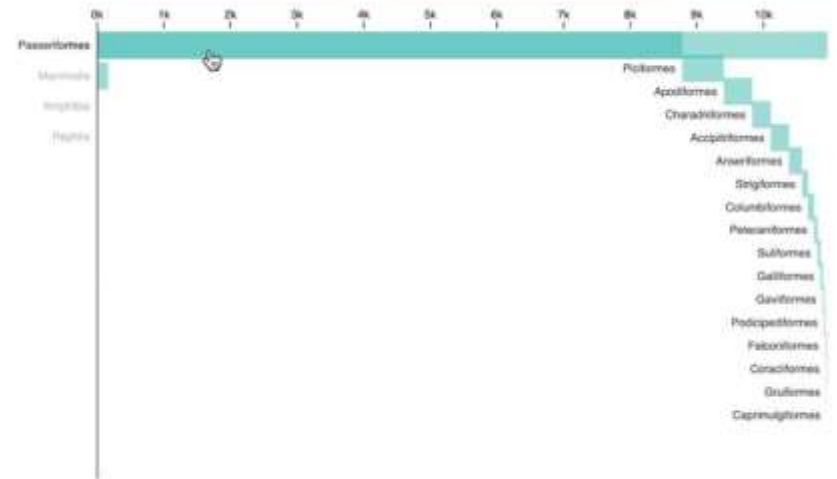
3.TAXONOMIC COUNT

Hierarchical histograms for unique species and total observations

Unique species distribution



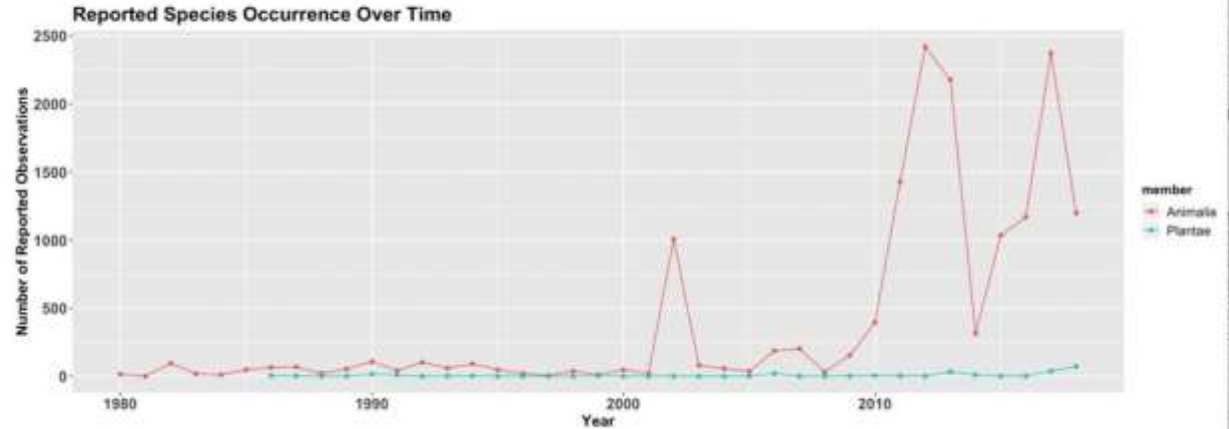
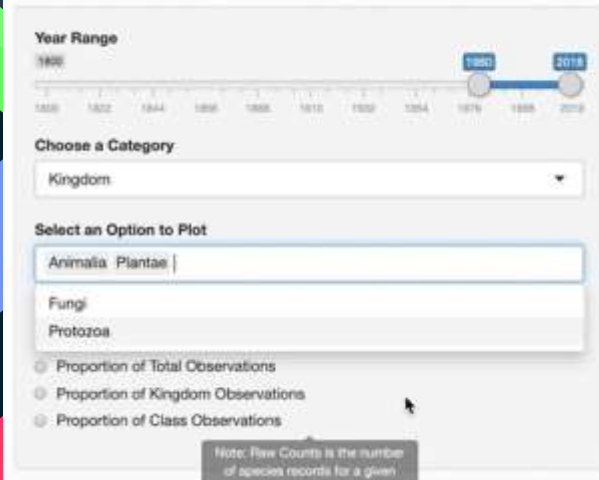
Species occurrence distribution



4.CHANGE OVER TIME

Interactive Time Series Plot

Species Occurrence Trends



PREDICTION

1.SEI PREDICTION

Predict Species that could occur in an SEI Polygon

Show: 10

Search:

rank	species	observed	prob
1	<i>Ptilidium californicum</i>	no	0.9998946808300432
2	<i>Myriophyllum pinnatum</i>	no	0.999890718753814
3	<i>Calypogeia muelleriana</i>	no	0.9998165686113583
4	<i>Larus heermanni</i>	no	0.9997646661938462
5	<i>Xylaria hypoxylon</i>	no	0.9996954425983913
6	<i>Marsupella sphacelata</i>	no	0.9994679507924029
7	<i>Lophocolea heterophylla</i>	no	0.9991923000698618
8	<i>Sphagnum magellanicum</i>	no	0.9991691579738173
9	<i>Porella cordaeana</i>	no	0.9987911190520429
10	<i>Setophaga ruticilla</i>	no	0.9986399945831678

Showing 1 to 10 of 455 records

Pages: Previous **1** 2 3 ... 46 Next

SEI PREDICTION: Logistic Regression

Features included in the SEI

- Class/ Type
- Condition
- Context
- Size

Additional features

- Elevation
- Humidity
- Temperature
- Distance from fresh and salt water

Single equation for each species that predicts the probability of it being found in a given polygon

2.SDM (Species Distribution Modelling)

Predict the distribution of species spatially & identify biodiversity hotspots

Species Distribution Modelling

Depending on which species and algorithm you choose, calculating the predictive map may take up to several minutes.

Choose a Model Method

Single Species

Species Distribution Map

The map depicts an untested hypothesis for where species are more likely to be found based on known occurrence. Species are expected to be observed in areas with a higher probability score.

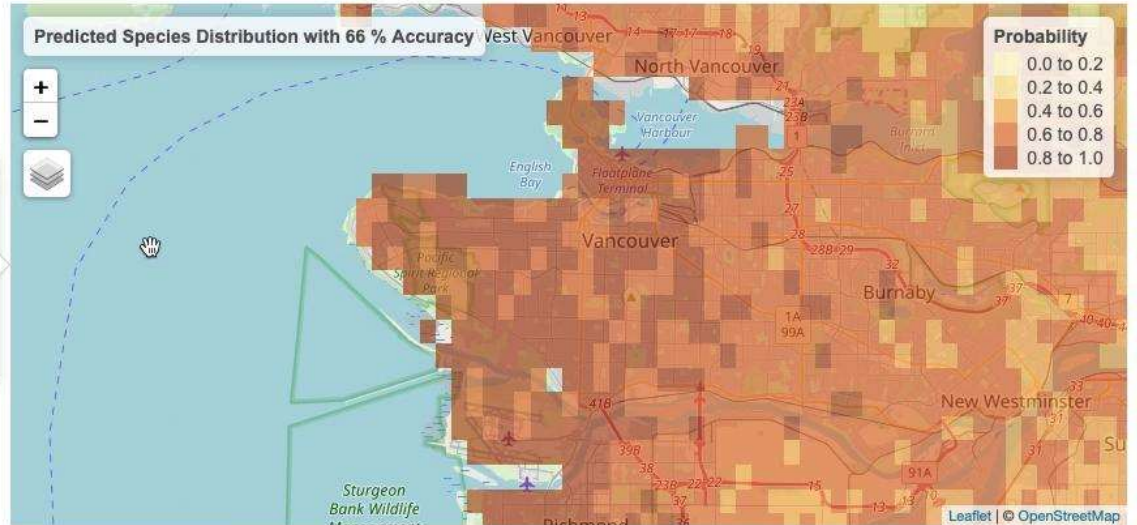
Choose an Algorithm

GLM

Choose a Species to

Selasphorus rufus

Plot Model



SDM PREDICTION: User Determined Algorithms

Features

- Elevation
- Humidity
- Temperature
- Precipitation

Heatmap of predicted probability density for a species or a collection of species

LIMITATIONS

Citizen Science

- Spatial bias
- Organism bias
- Temporal bias

Modelling Limitations

- Restriction on species that can be predicted
- Prediction bias

FULFILMENT OF AIMS

1. Discover and assess the types of biodiversity data that is available
2. Evaluate data quality
3. Explore what kinds of questions could be answered using that data
4. Establish a baseline inventory of species in Metro Vancouver and identify data gaps

FUTURE STEPS

Improve Modelling

- Additional environment variables (e.g. soil and air quality)
- Testing to remove redundant variables

Auto-update

- Refresh data and prediction metrics automatically after a set interval

RECOMMENDATIONS

Data Logging

- Use iNaturalist and eBird to log observations
- Include precise spatial and temporal info
- Migrate legacy records to GBIF

Target undersampled species and regions

- Use the app to identify

THANK YOU!



**CURRENTLY HOSTED
ON HEROKU**

<https://tinyurl.com/y3c3j5pm>