



DNA Metabarcoding to quantify the ecological impact of climate-induced forest diebacks in the Pyrenees

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DNA Metabarcoding to quantify the ecological impact of climate induced forest diebacks in the Pyrenees

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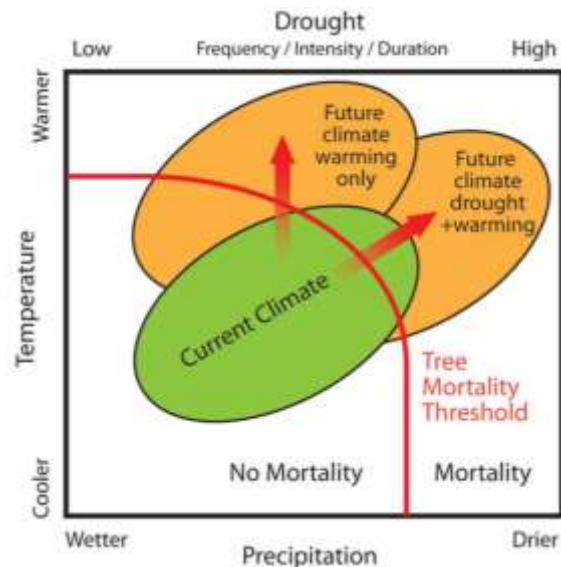
 CNRS

 IRBI

Global changes and forestry management

Global changes

"Climate change, insect infestations, drought..."



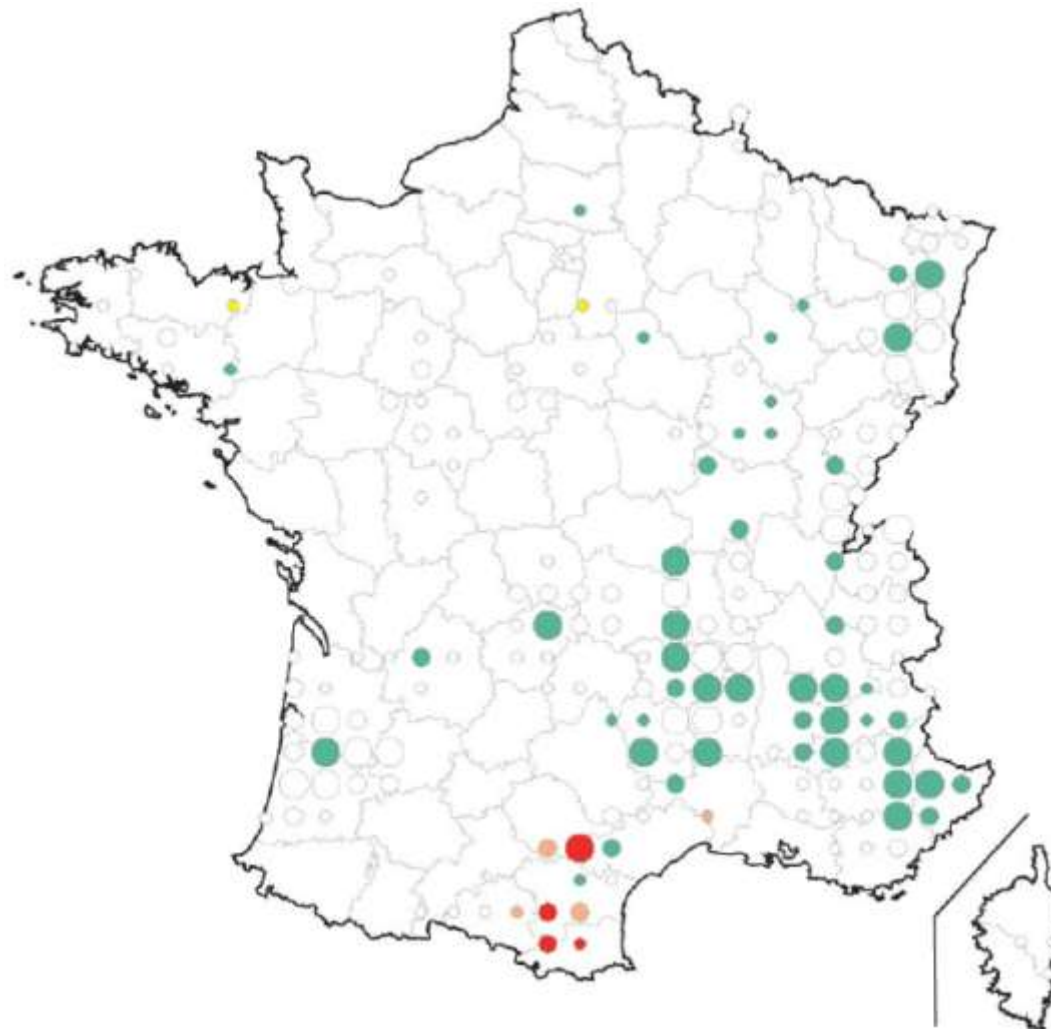
Allen et al., 2015

Salvage logging

"To harvest damaged trees in order to recover economic value otherwise lost."



Droughts induce silver fir (*Abies alba*) die-off in Pyrenees



Proportion of dominant trees with more than 25% of dead branches

- More than **35%**
- From **20** to **35%**
- From **10** to **20%**
- Less than **10%**
- No tree in that case

Number of living and dominant trees

- More than **100**
- From **50** to **100**
- From **25** to **50**

Studied areas



$N_{\text{total}} = 56 \text{ plots}$

2 valleys

Vallée d'Aure
Pays de Sault

~190km distance

3 dieback level conditions

- **Healthy** (20 plots)
- **Low dieback level** (12 plots)
- **High dieback level** (24 plots)

2 salvage logging conditions within high dieback level

- **Not harvested** (12 plots)
- **Harvested** (12 plots)

Characteristics of each plot



Micro Dendro-habitats



Larrieu et al., 2018

Canopy openness



1 Malaise trap in the center of **each plot**

Sampled **4 times** (each month) from **May** to **September**

$N_{\text{total}} = \mathbf{224 \text{ samples}}$

$n_{\text{ecological variables}} = \mathbf{84+}$

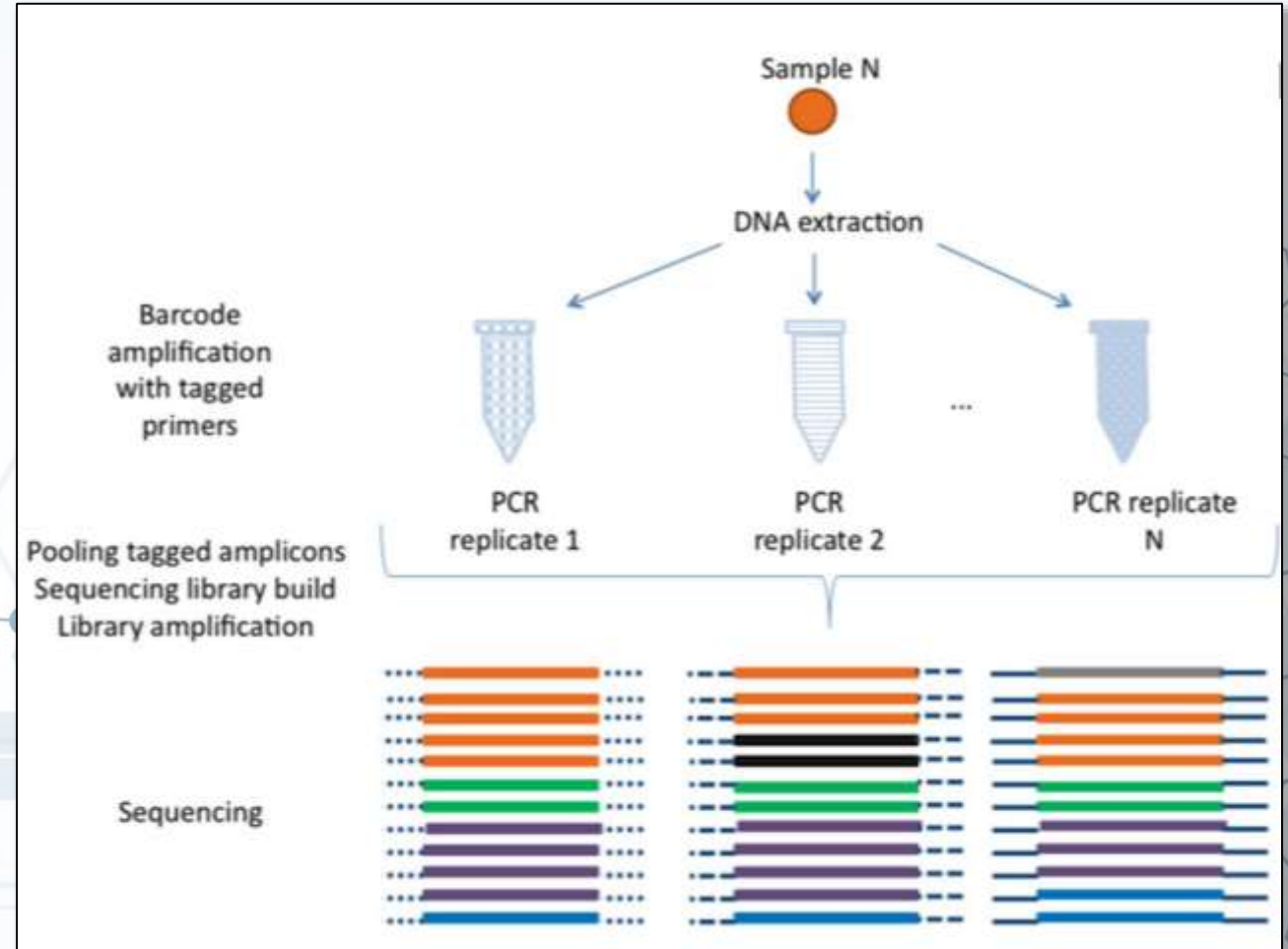
Sample preparation for metabarcoding



- Processed sample randomization
Bálint et al., 2018
- Filtration & Rincing
- Drying overnight
- Homogeneization
Elbrecht et al., 2017
- Grinding

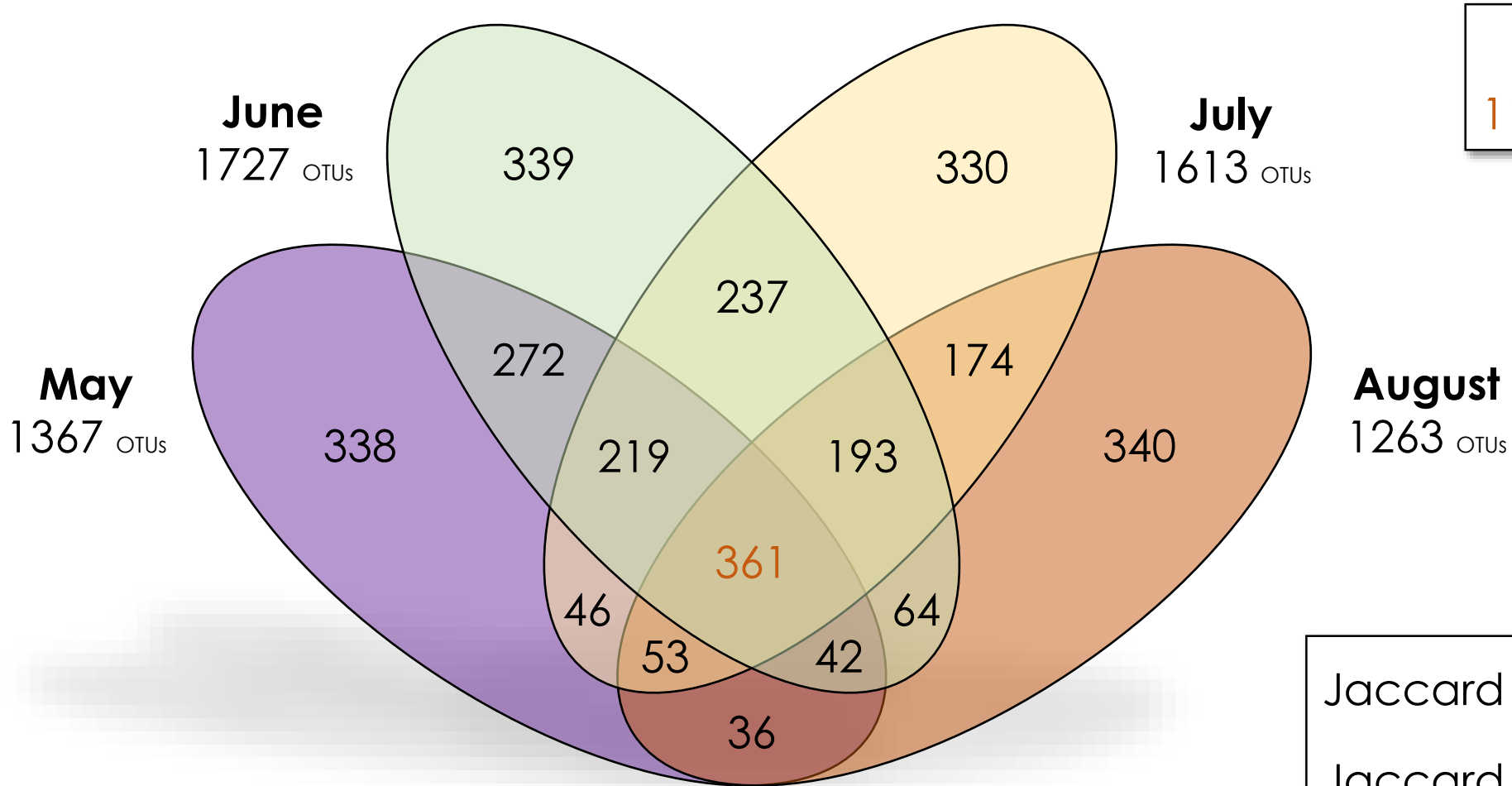
Metabarcoding pipeline

- ❖ **COI** marker (313bp)
Leray et al., 2013
Geller et al., 2013
- ❖ PCR triplicates
- ❖ Illumina MiSeq V3 paired-end
- ❖ OTU clustering **97%** (sumacrust)
- ❖ **3 PCRs & 3 reads** minimum
- ❖ Taxonomic assignement using **BOLD**



Zepeda-Mendoza et al., 2016

High general temporal turnover



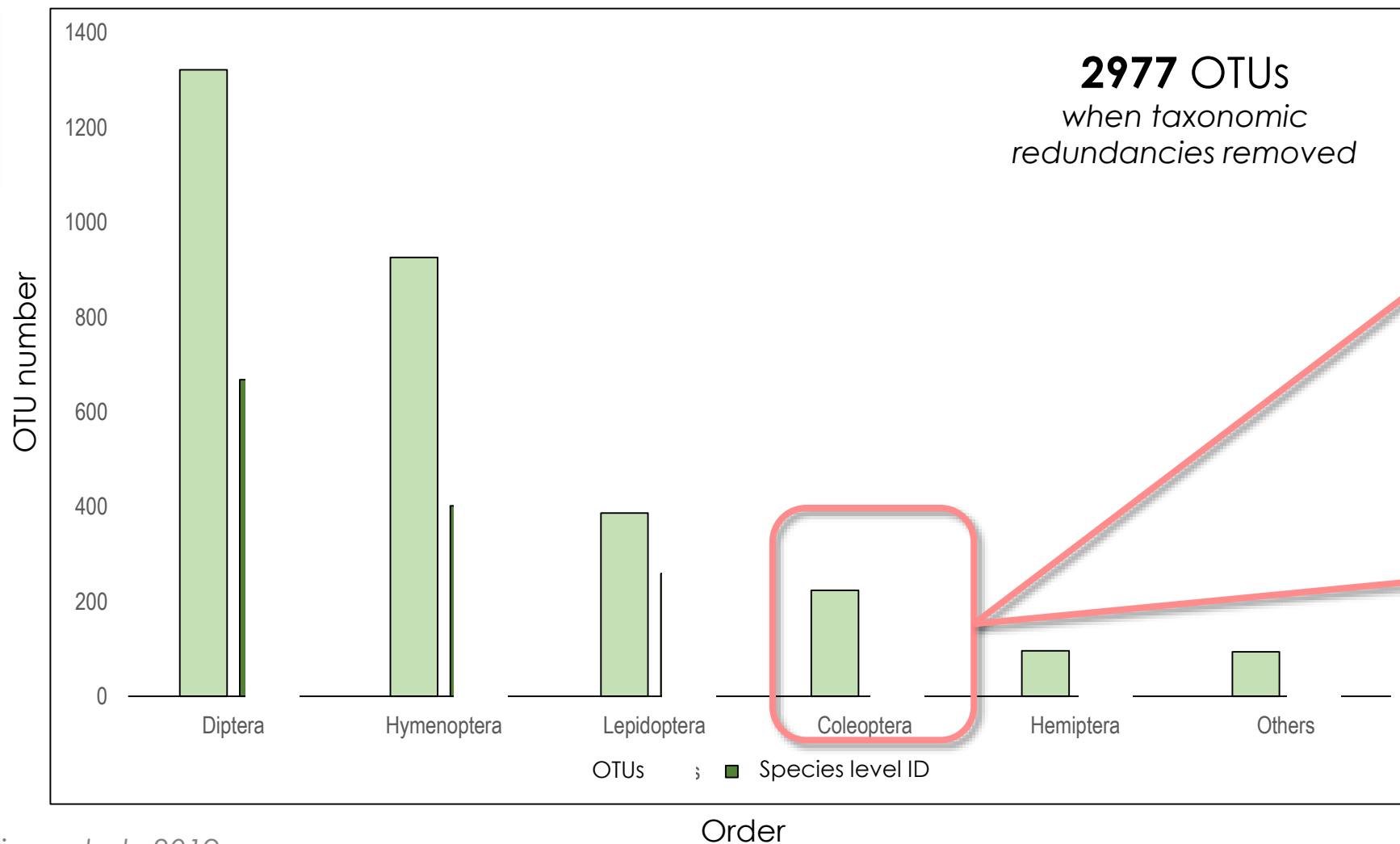
3041 OTUs

11.9% shared by all

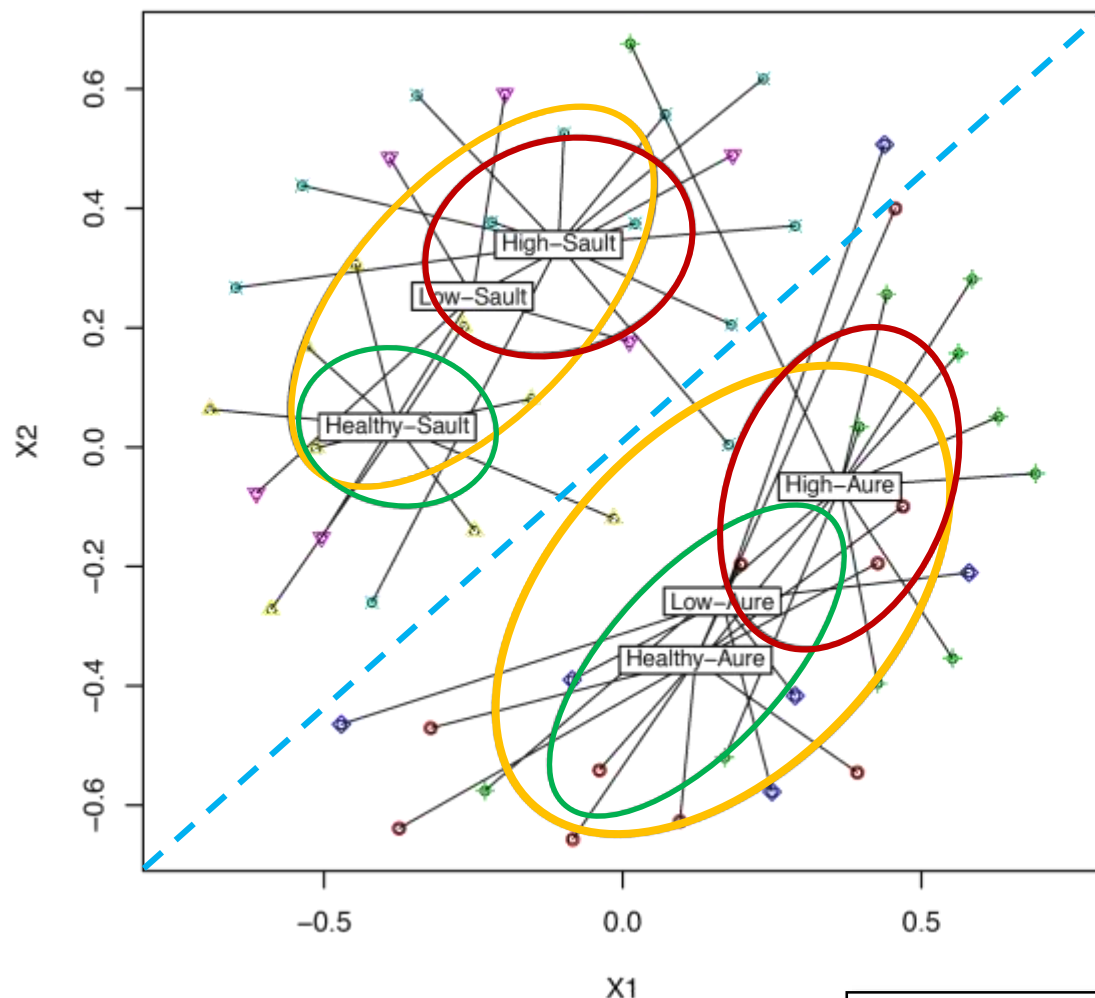
Jaccard Index : $J_{\text{May} / \text{August}} = 0.23$

Jaccard Index : $J_{\text{June} / \text{July}} = 0.43$

Incomplete reference libraries & taxonomic assignment



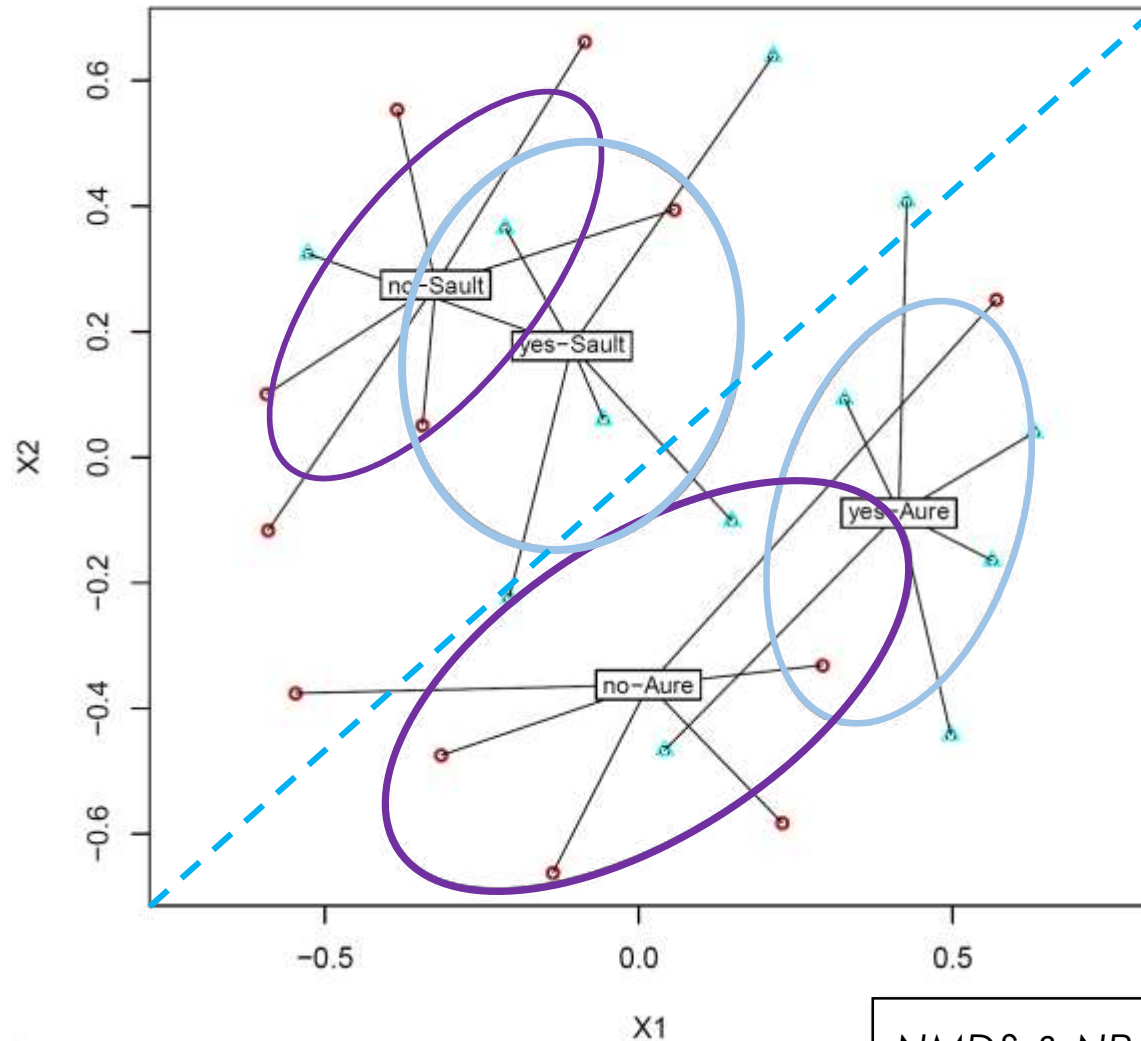
Insect composition varies with dieback level



- Strong **difference** in insect composition **between both valleys**
- **Highly significant difference (***)** between **healthy** & **high level of dieback**
- **Low level of dieback** shows **no difference** in insect composition



Insect composition does not change with salvage logging

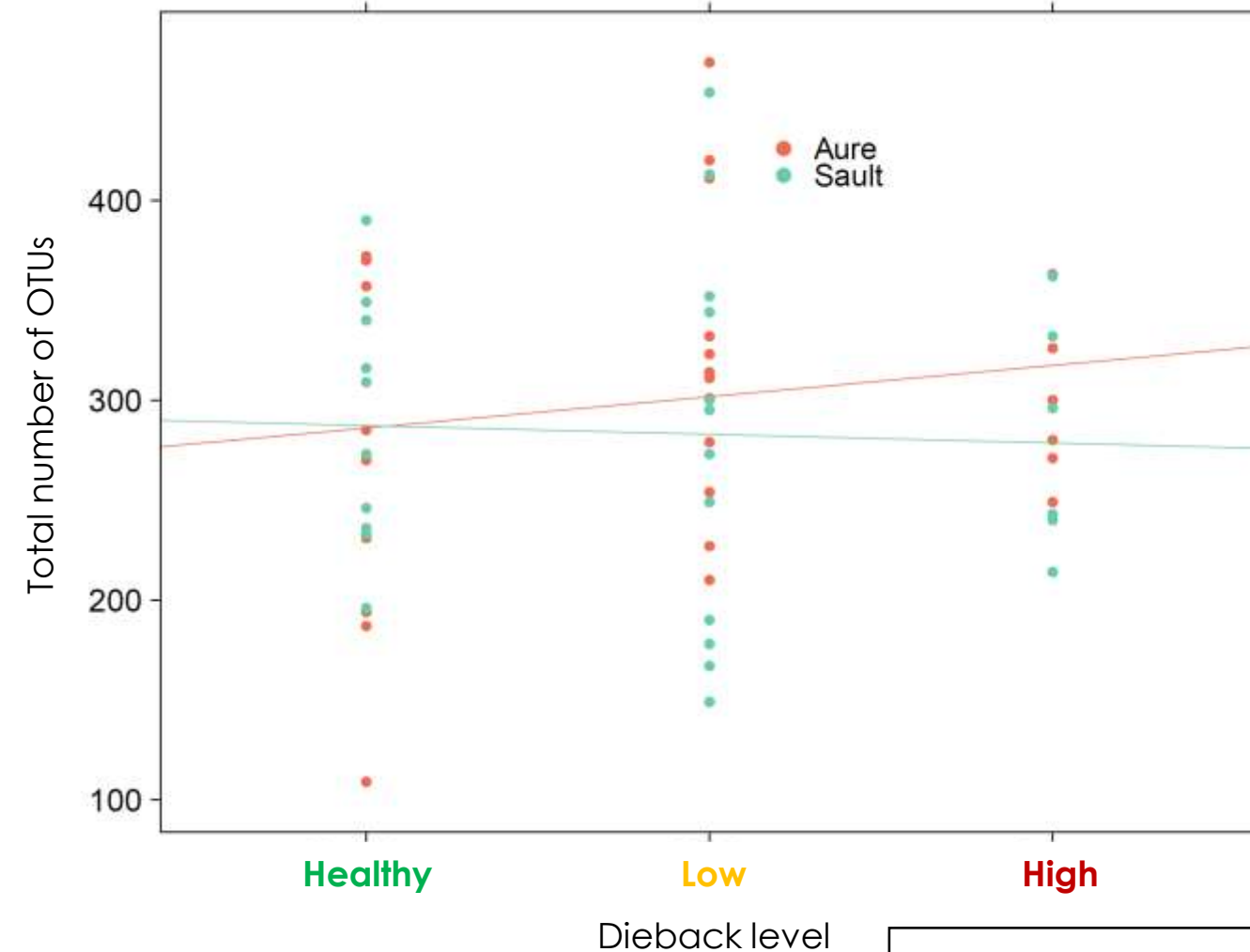


- Strong **regional effect**
- **No significant difference** between **not harvested** and **salvage logged**
- **No direct impact of salvage logging** on total insect composition **detected**



NMDS & NPmanova

Species richness does not vary with dieback level



- No valley difference
- No significant difference between **Healthy**, **Low** and **High** dieback levels in terms of species richness detected



Linear model & Type II Anova

Species associated with dieback levels

Potential candidates for bio-indication

Healthy

12 specific OTUs



CBG Photography Group - CC

Fannia abrupta

Native from Nearctic
Apparently introduced in China (2016)
No information about France

Low dieback level

21 specific OTUs



Pungeleria capreolaria

Feed on *Picea abies* and *Abies alba*
Fly from mid June to September

High dieback level

10 specific OTUs



Marko Mutanen - CC

Botanophila brunneilinea

Larval stage on *Centaurea* sp. plants

Leuchtman et al., 2015

Package R Indicspecies

OTUs found at least in 10 plots

To sum up before flying away!

- ❖ Usefulness of **metabarcoding on Malaise** trap samples for **bio-monitoring**
- ❖ Strong **temporal** and **regional effects**
- ❖ **Need to complete reference libraries** for European **Diptera** and **Hymenoptera** in BOLD
- ❖ **Direct impact** of **high dieback level** on insect composition
- ❖ **No direct impact** of salvage logging
- ❖ Potential **bio-indicator candidates** for **dieback levels**



Thank you for your attention !



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ECOLE DOCTORALE **SSBCV**



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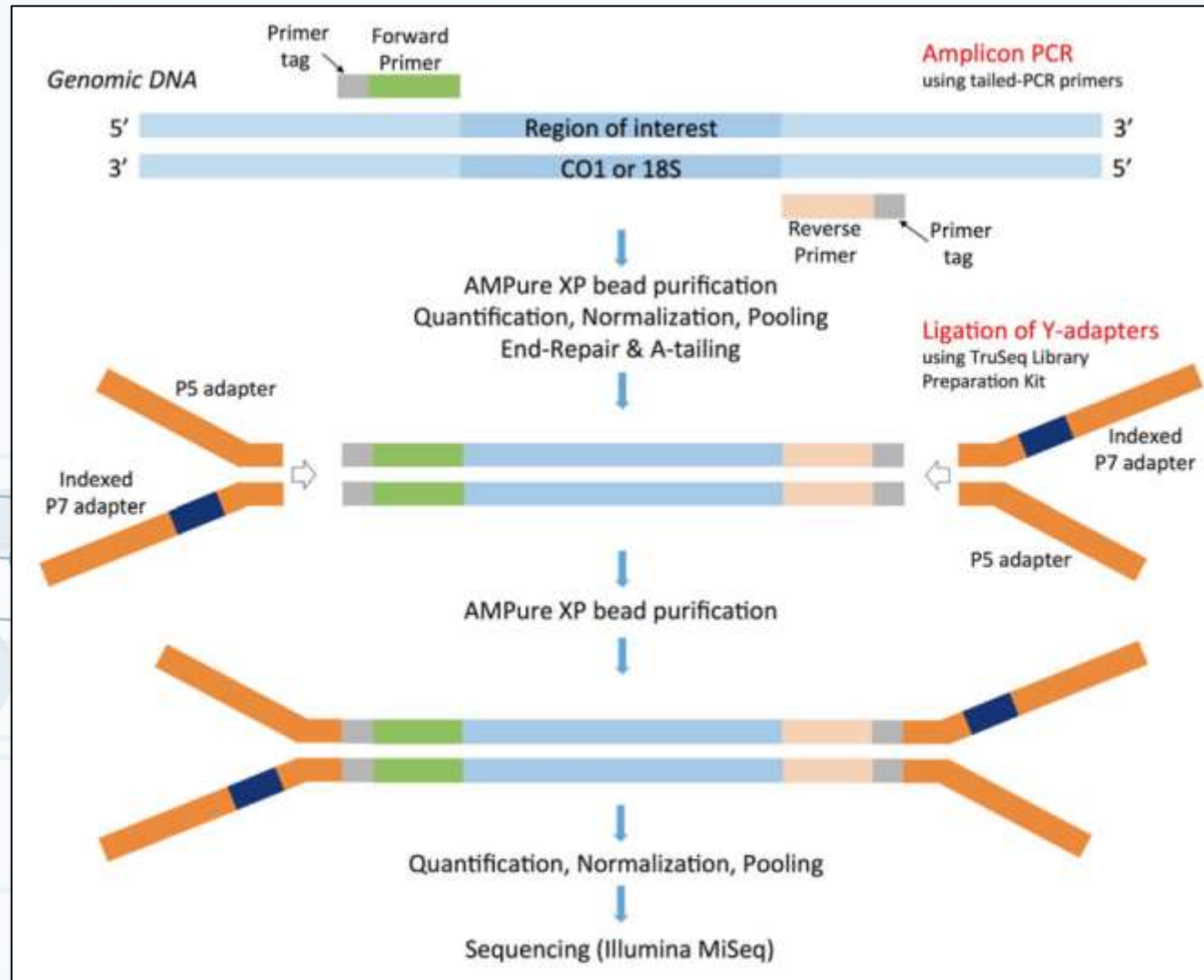
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Twin-tagging – Dual Indexing PCRs



Leray et al., 2016 (chap. 14)