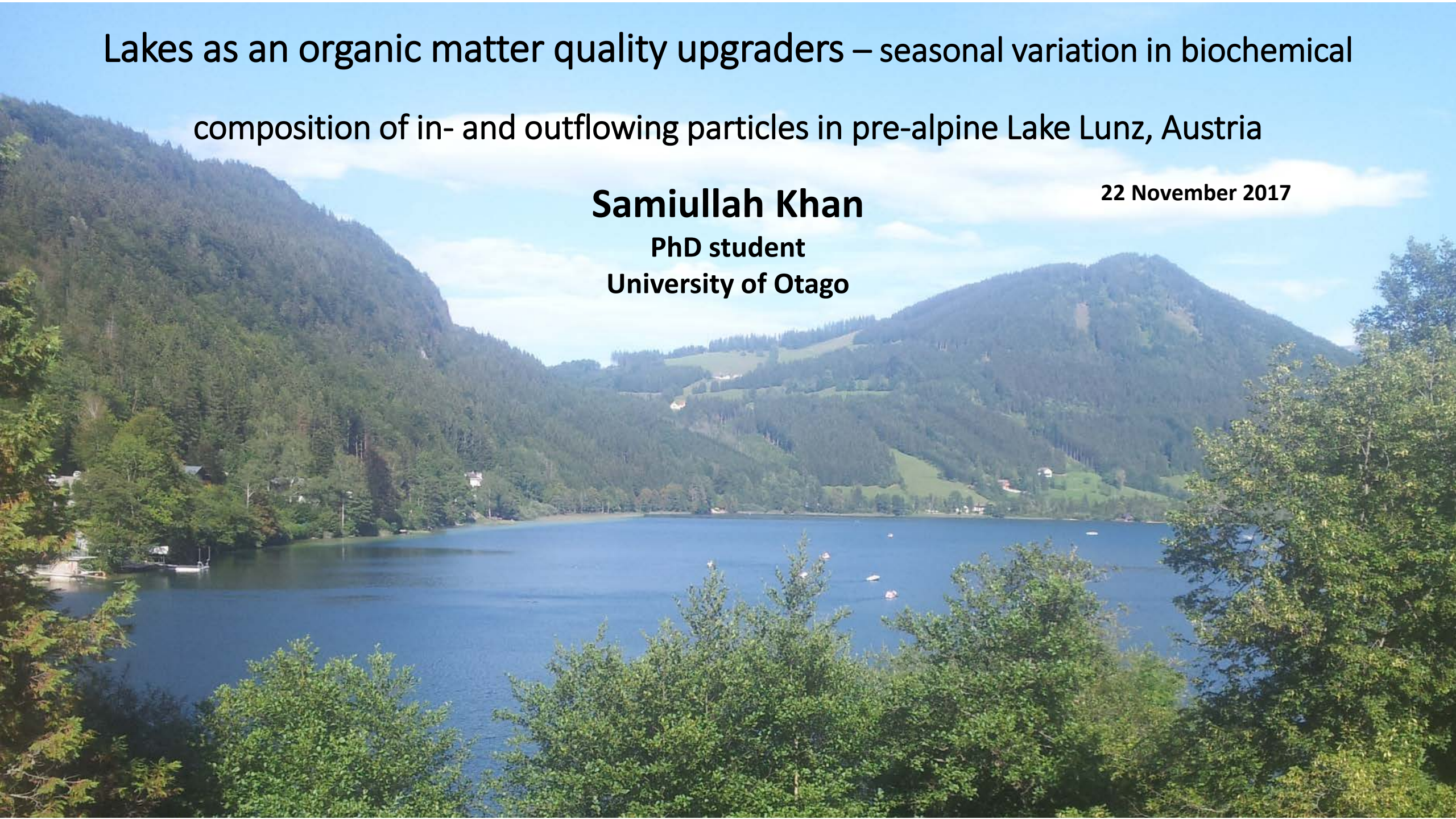
Lakes as an organic matter quality upgraders – seasonal variation in biochemical composition of in- and outflowing particles in pre-alpine Lake Lunz, Austria



Samiullah Khan
PhD student
University of Otago

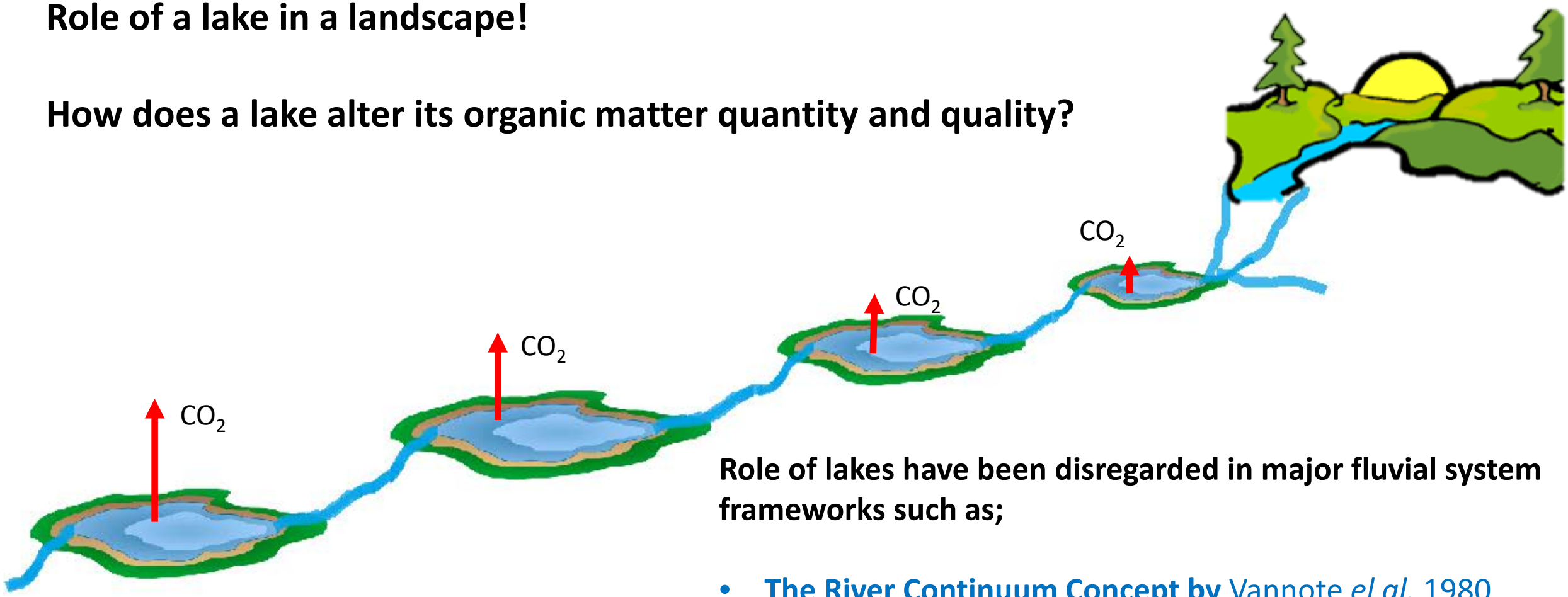
22 November 2017

Realm and concept of the research project

Lakes Chain Concept

Role of a lake in a landscape!

How does a lake alter its organic matter quantity and quality?



Role of lakes have been disregarded in major fluvial system frameworks such as;

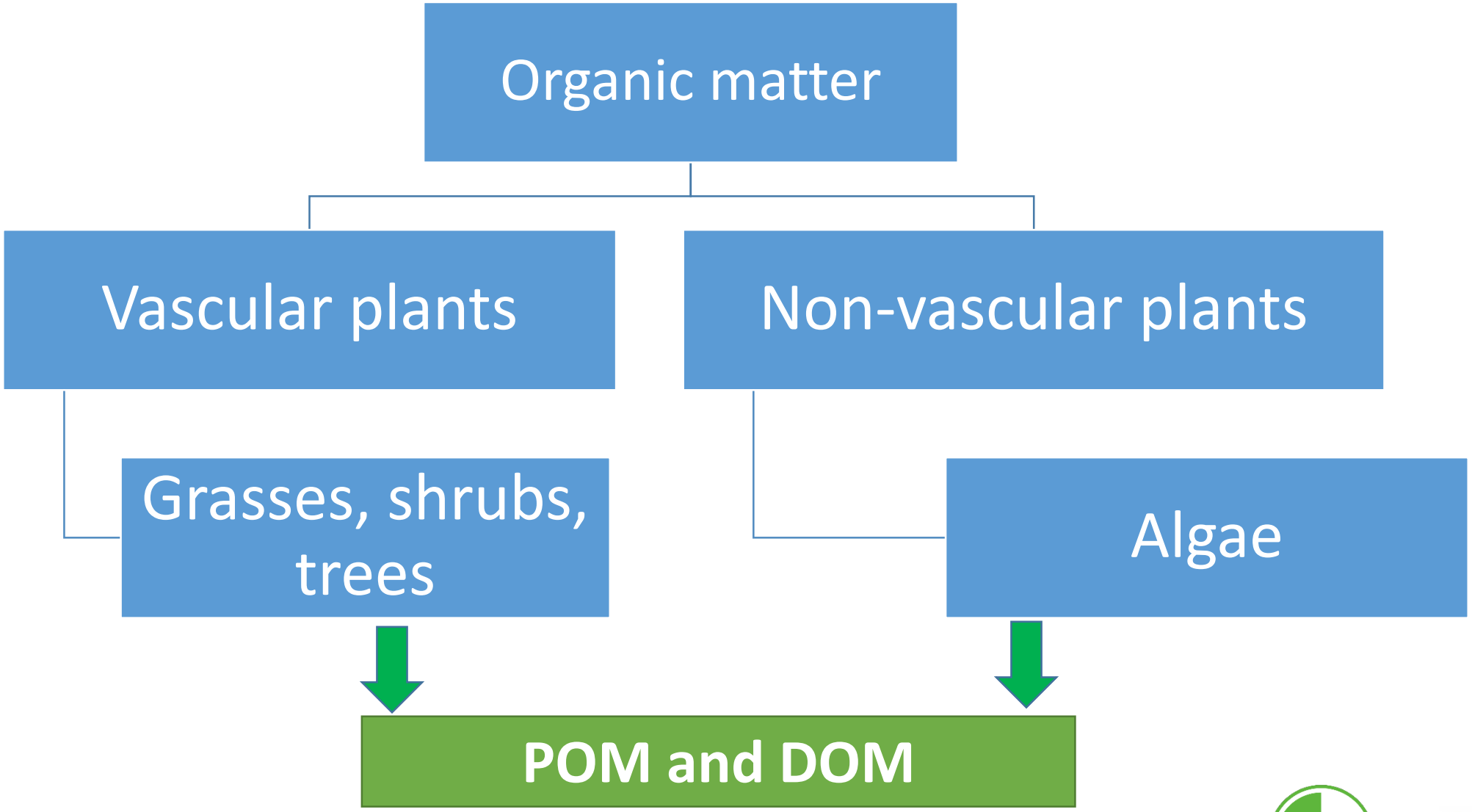
- **The River Continuum Concept by** Vannote *el al.* 1980
- **Serial Discontinuity Concept by** Ward and Stanford. 1979.

Hypothesis:

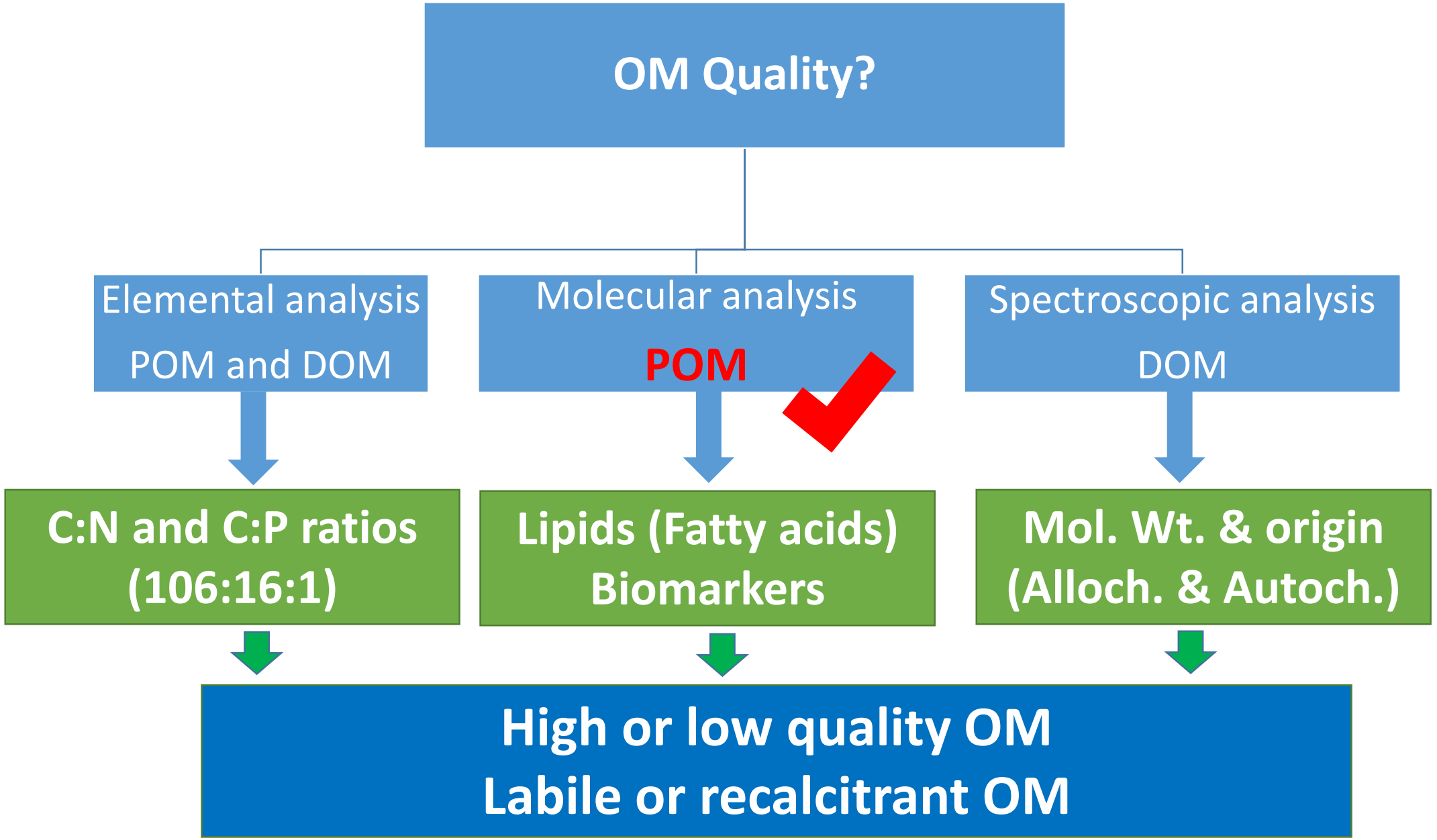
Inflowing POM is biochemically more recalcitrant than in-lake and outflowing POM.

Thus, it is hypothesized that the **pre-alpine Lake Lunz will biochemically upgrade POM mostly via algae production** that in turn will make it biochemically more labile.

Primary sources and biochemical quality of organic matter

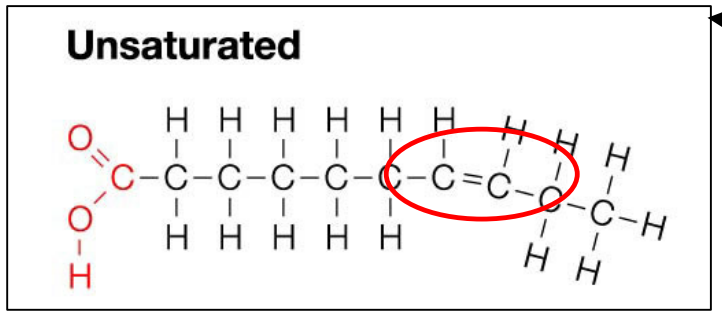


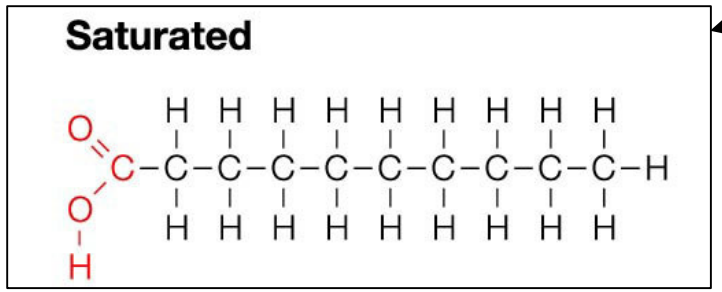
Primary sources and biochemical quality of organic matter (Contd…)



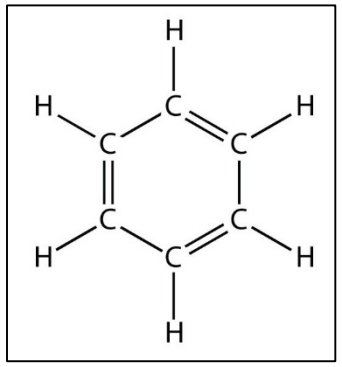
Primary sources and biochemical quality of organic matter (Contd…)

Fatty acids





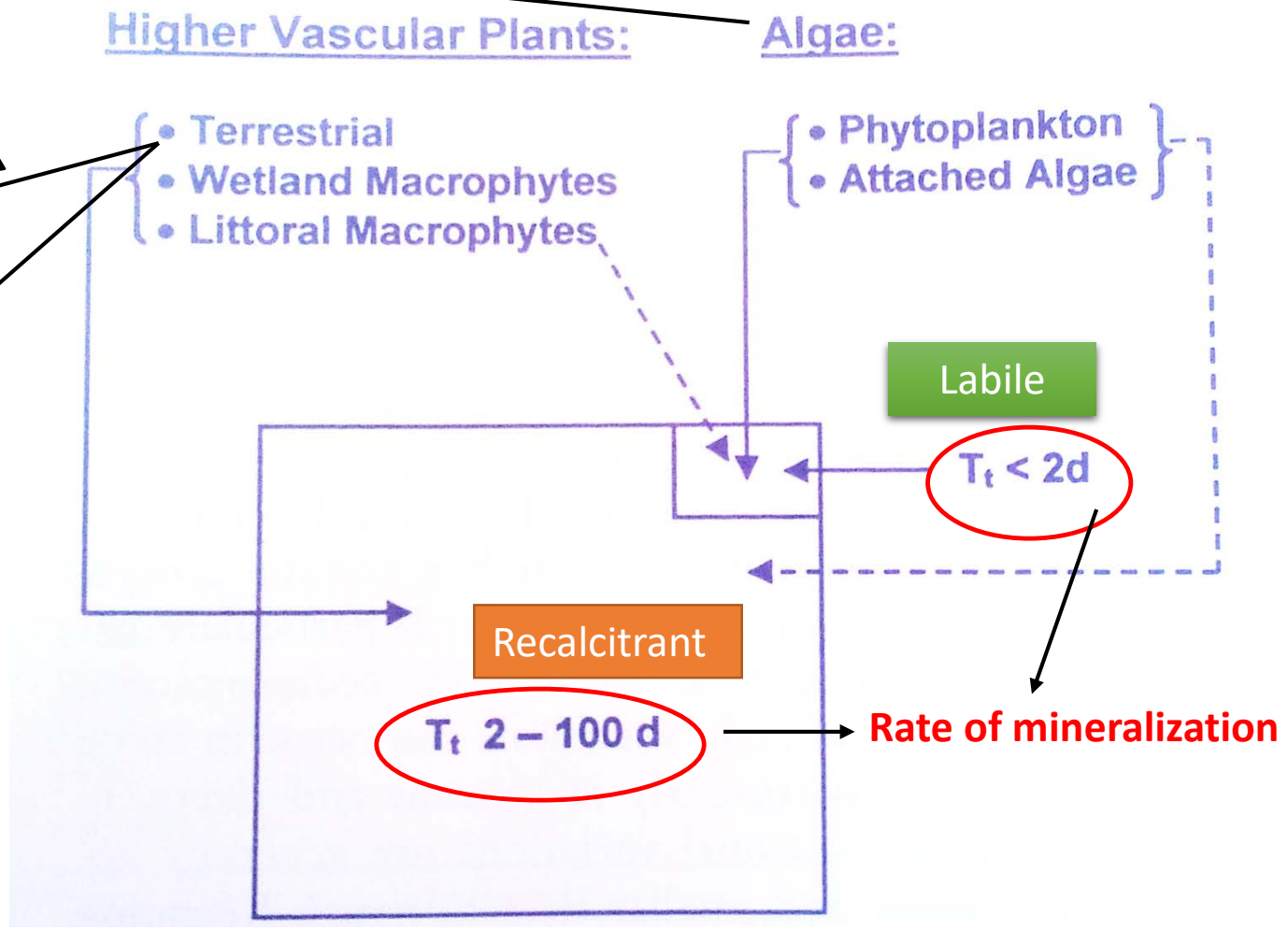
Lignin derivatives



(18-22 C) PUFA

(>20 C) SAFA

Stable compounds



Source: (Wetzel 2001)

Research Questions?

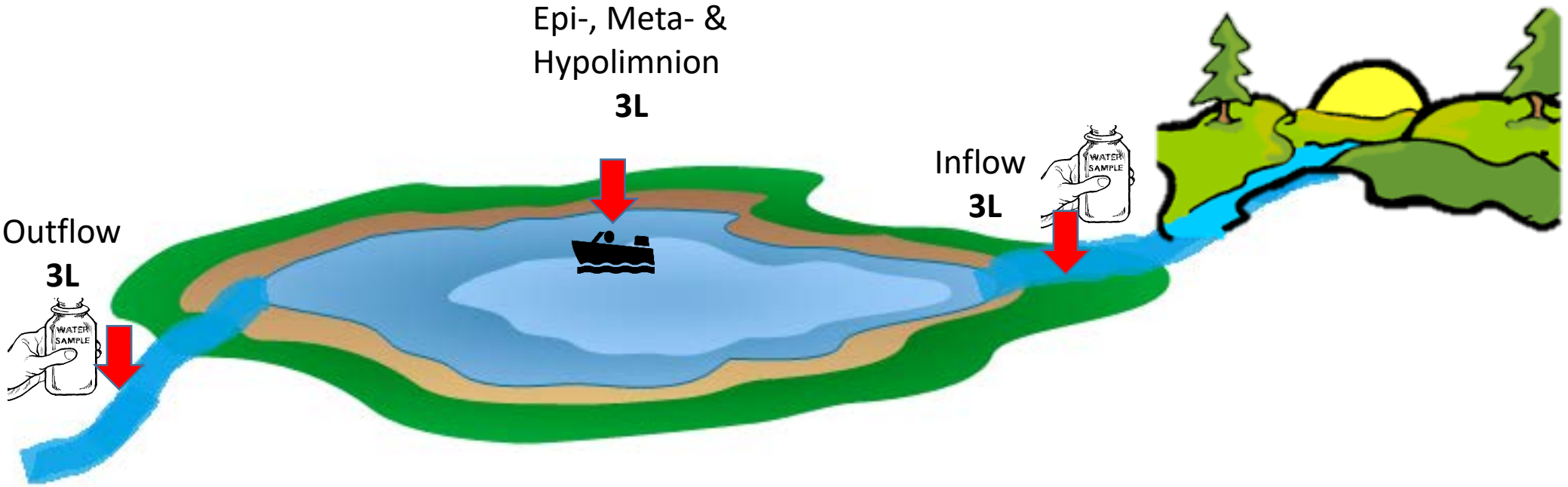
A. How does lake metabolism, independent of seasonality, affect the biochemical composition of inflowing particulate organic matter [POM] relative to outflowing POM in pre-alpine Lake Lunz?

B. What is the role of extreme weather events during multi-seasonal sampling, characterized by short and heavy storm events or long dry periods, on the biochemical composition of inflowing, in-lake and outflowing POM?

Study Area, Sampling / Experimental design……

Lake Lunz, pre-alpine oligotrophic Lake

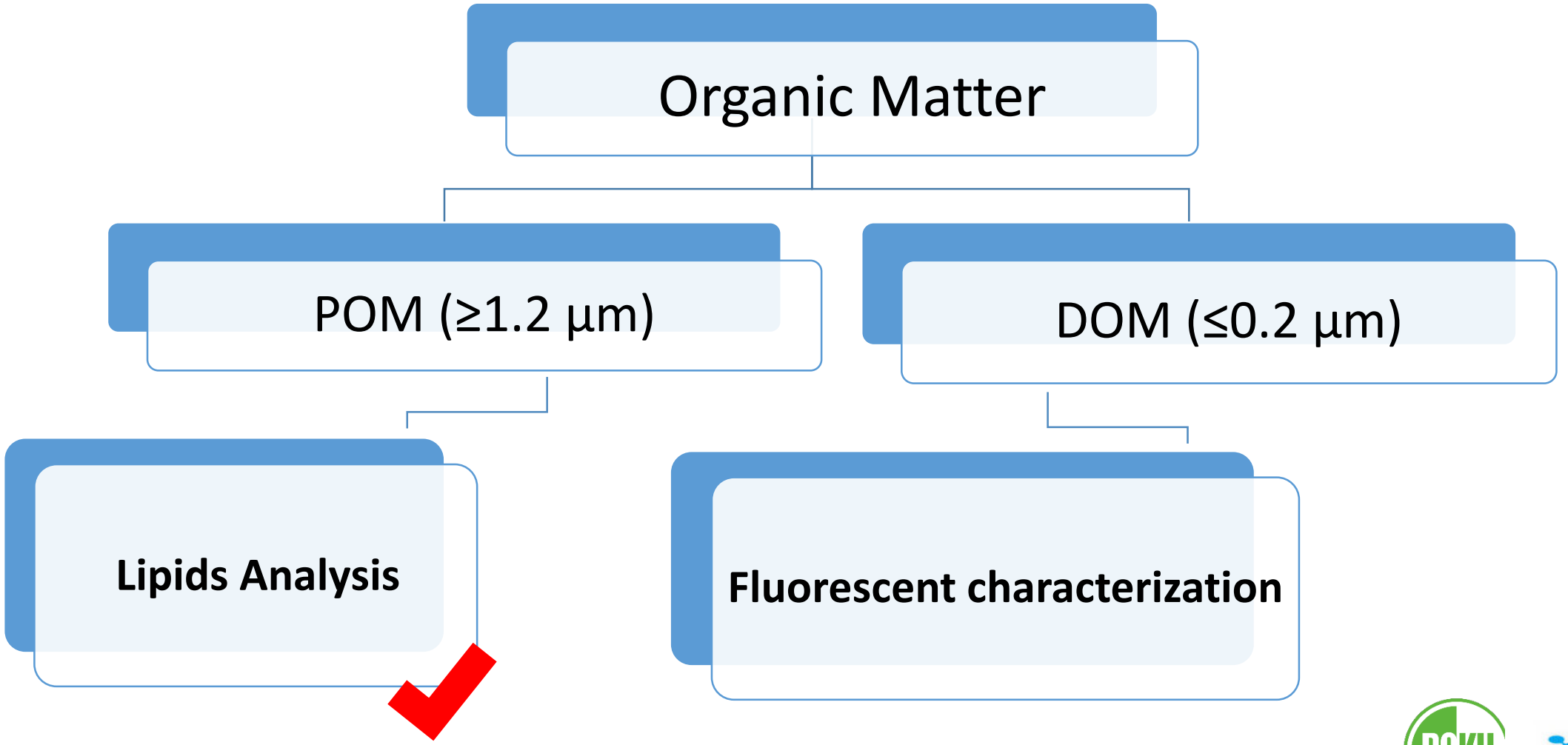
Seebach, pristine stream



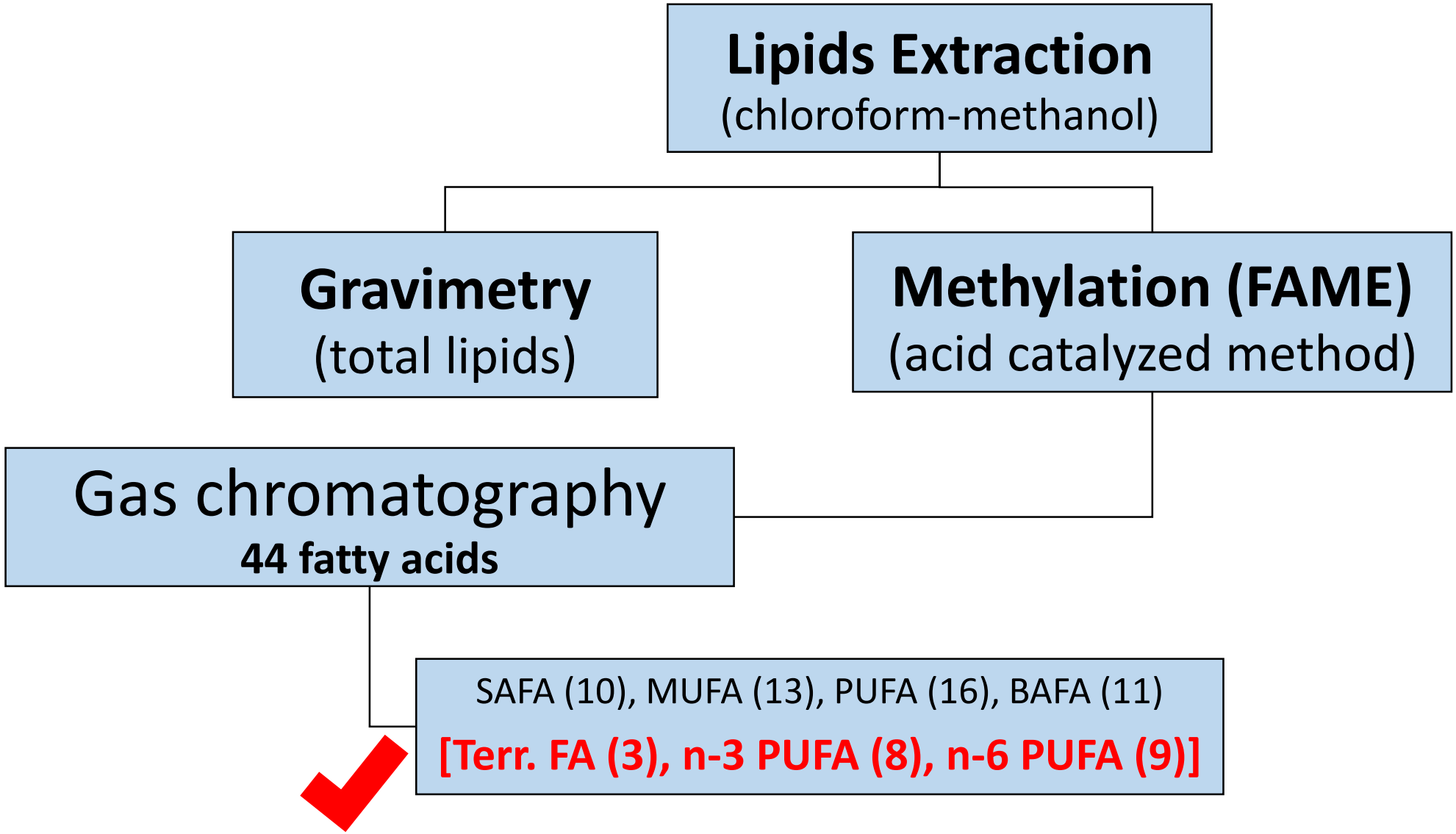
Monthly sampling during 2013-2015

Sources: Clip Arts from google-images

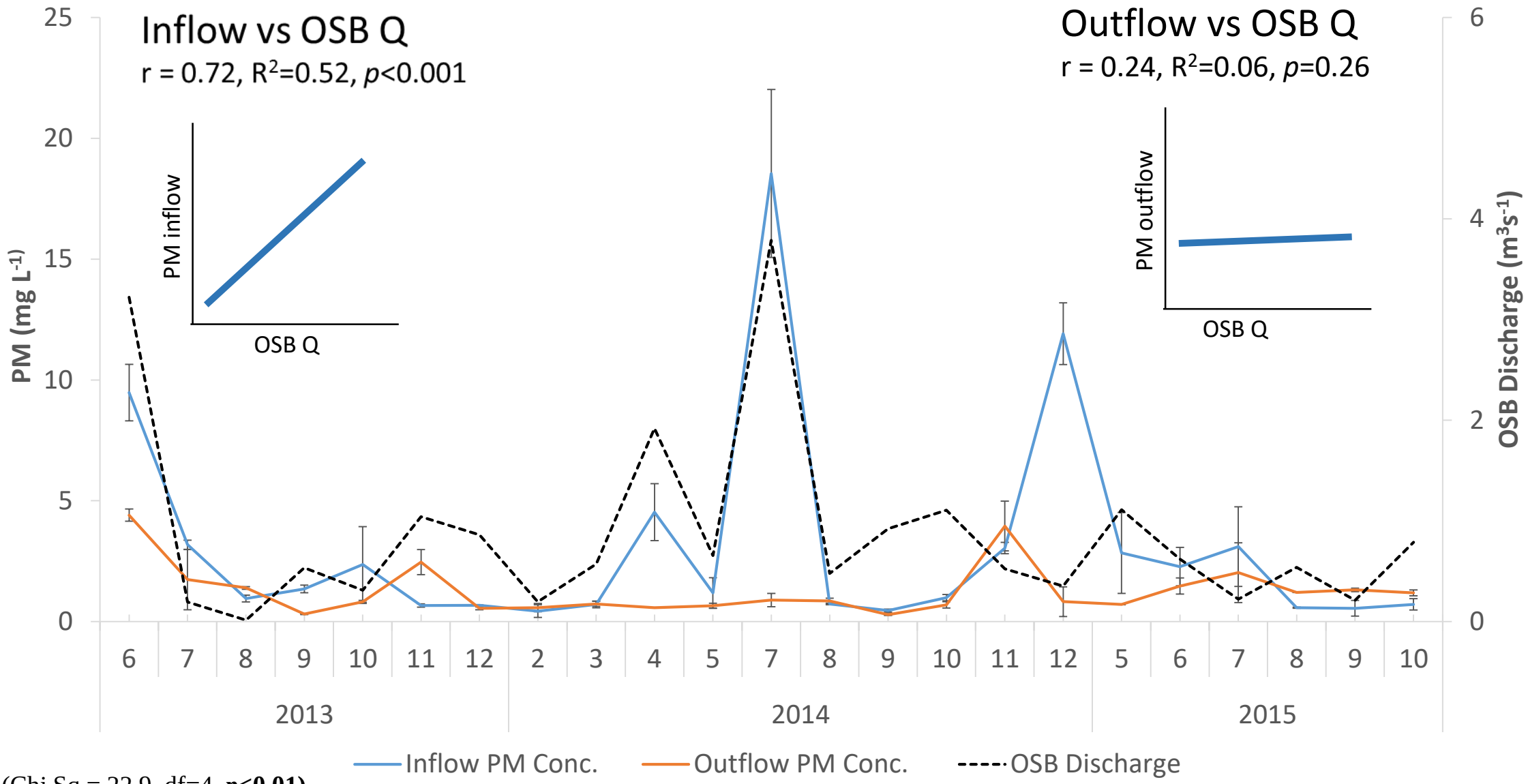
OM fractionation and biochemical categories



Lipids Analysis



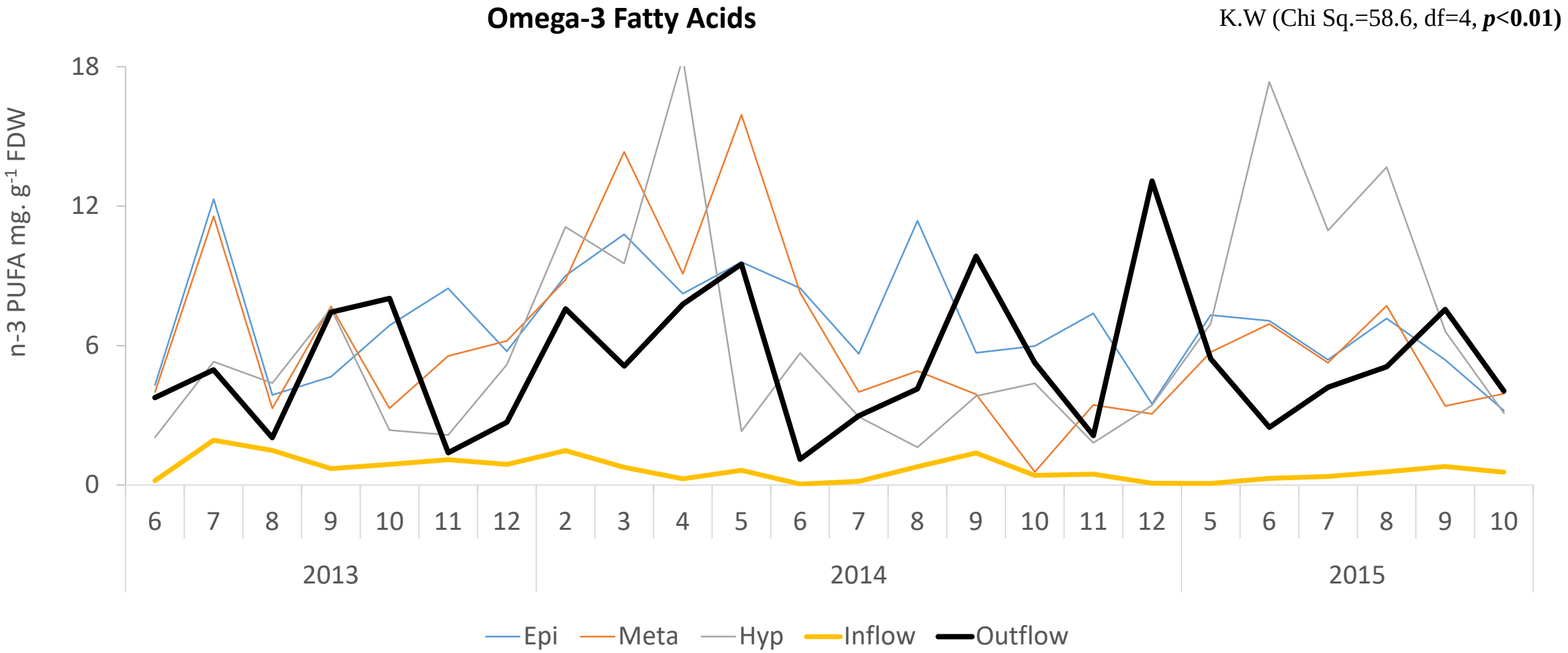
Particulate Matter inflow/outflow (conc.) vs lake inflow Q (2013-15)



K.W (Chi Sq.= 22.9, df=4, ***p*<0.01**)

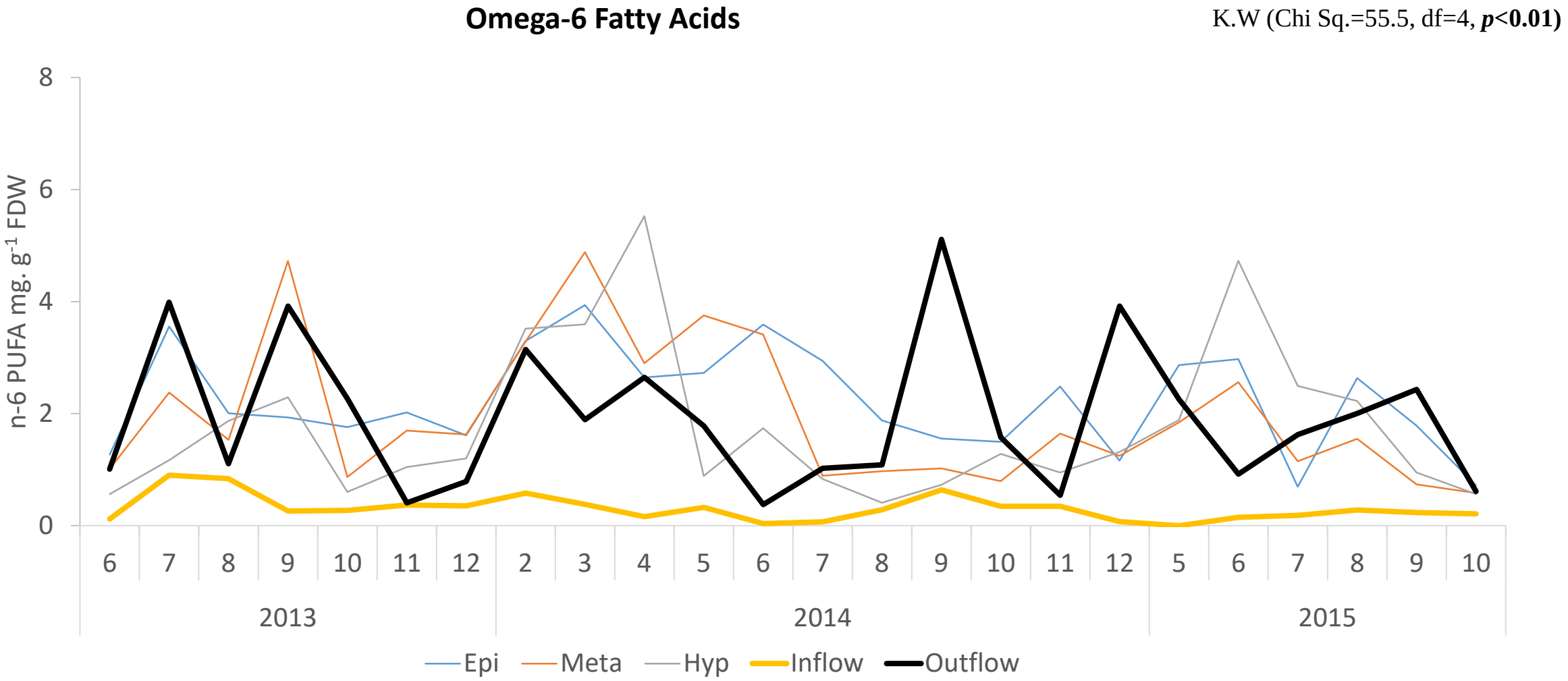
POM biochemical characteristics [Fatty acids]

Algal derived Fatty Acids [PUFAs) >> Omega-3 → Autochthonous production



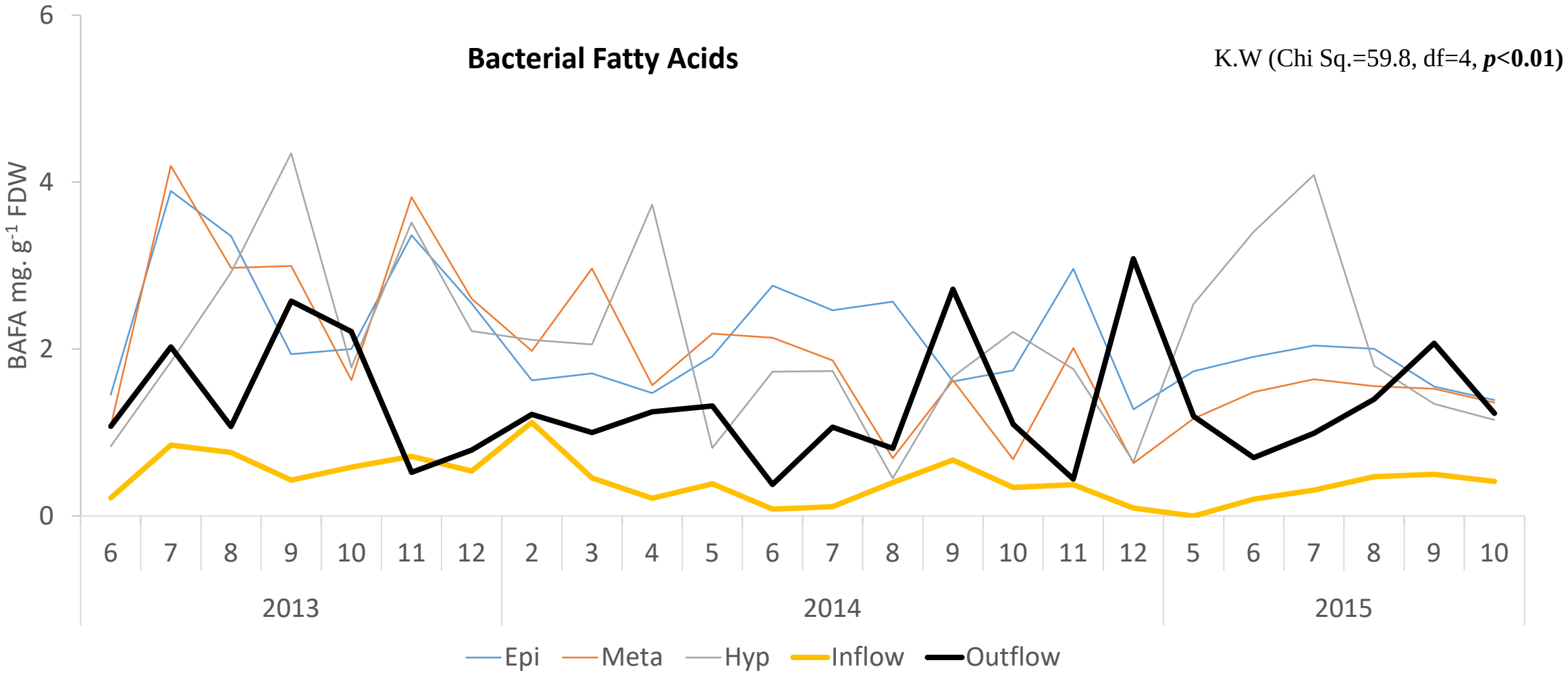
POM biochemical characteristics [Fatty acids]……

Algal derived Fatty Acids [PUFAs) >> Omega-6 FA → Autochthonous production



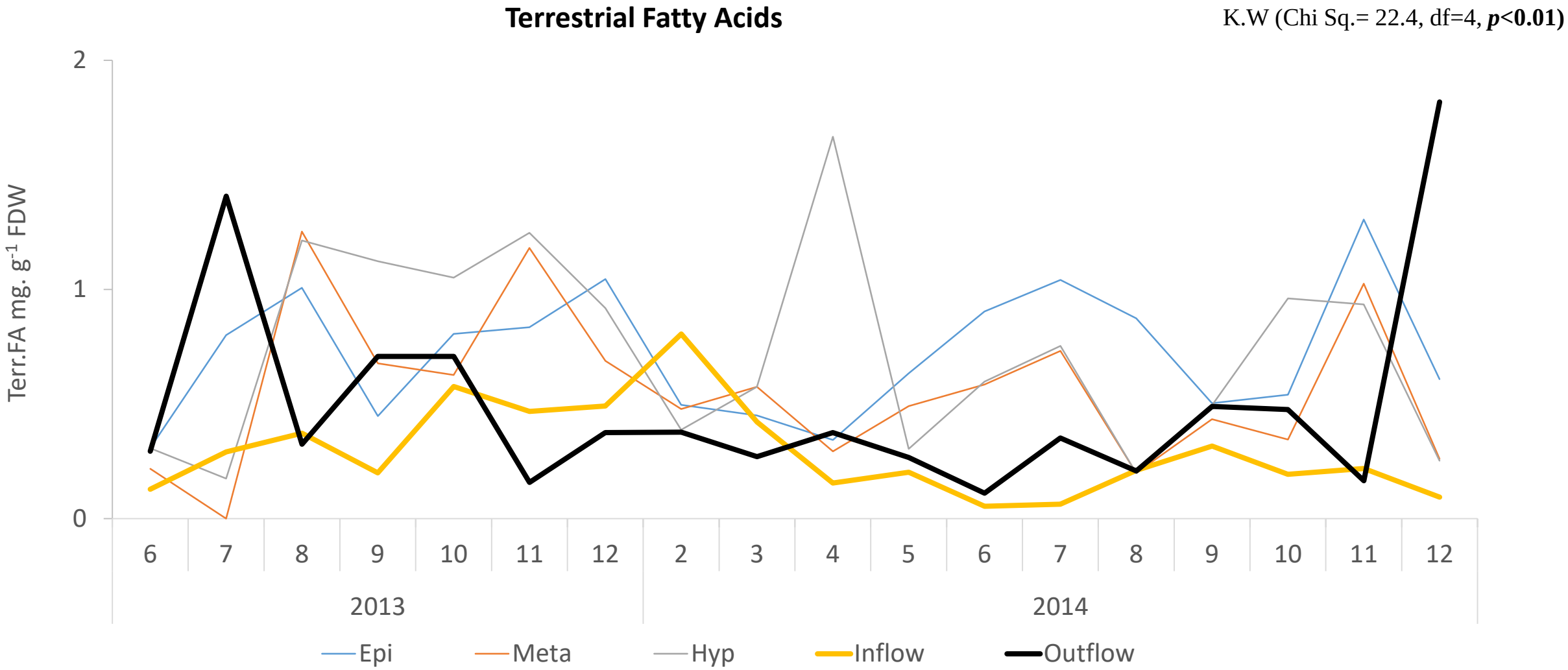
POM biochemical characteristics [Fatty acids].....

Bacterial FA → Bacterial response to OM supply



POM biochemical characteristics [Fatty acids] ……

Long chain saturated fatty acids (>20C) terr. FA → High vascular plants → allochthonous origin



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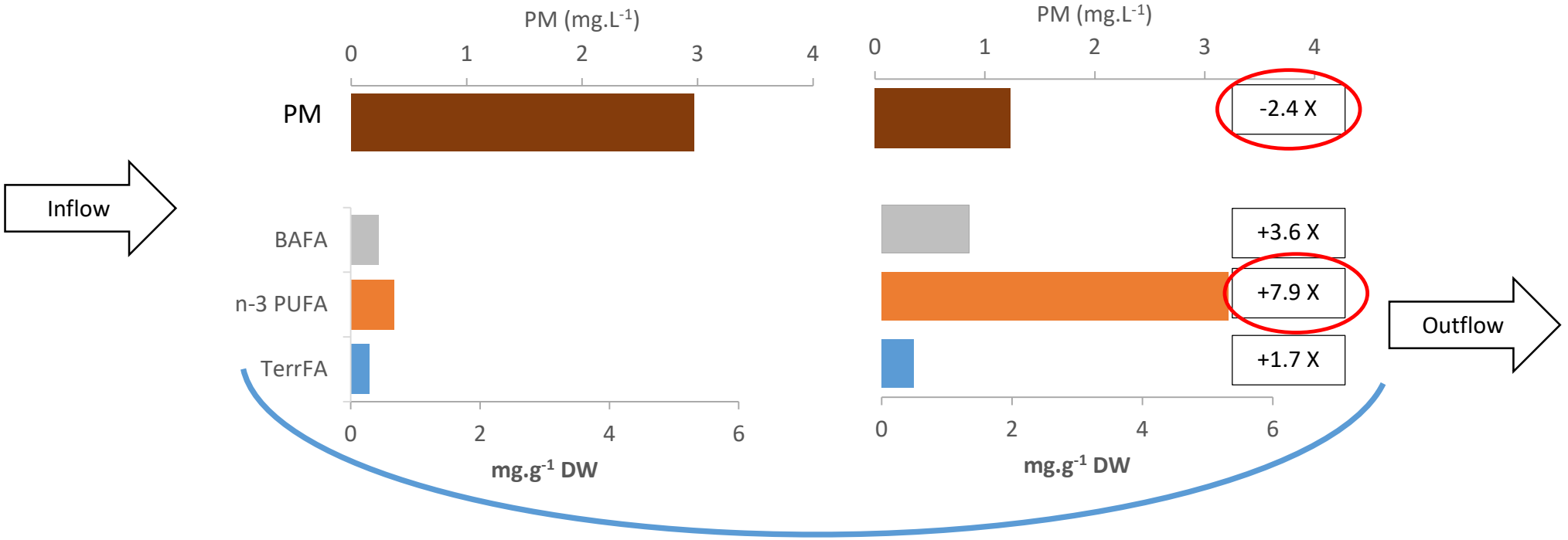
Conclusions/



Acknowledgments

I would like to thank Dr. Martin Kainz, Dr. Elisabet Ejarque, Katharina Winter, Stefanie Danner, Dr. Serena Rasconi and Gertraud Stenizcka for their field and lab support.

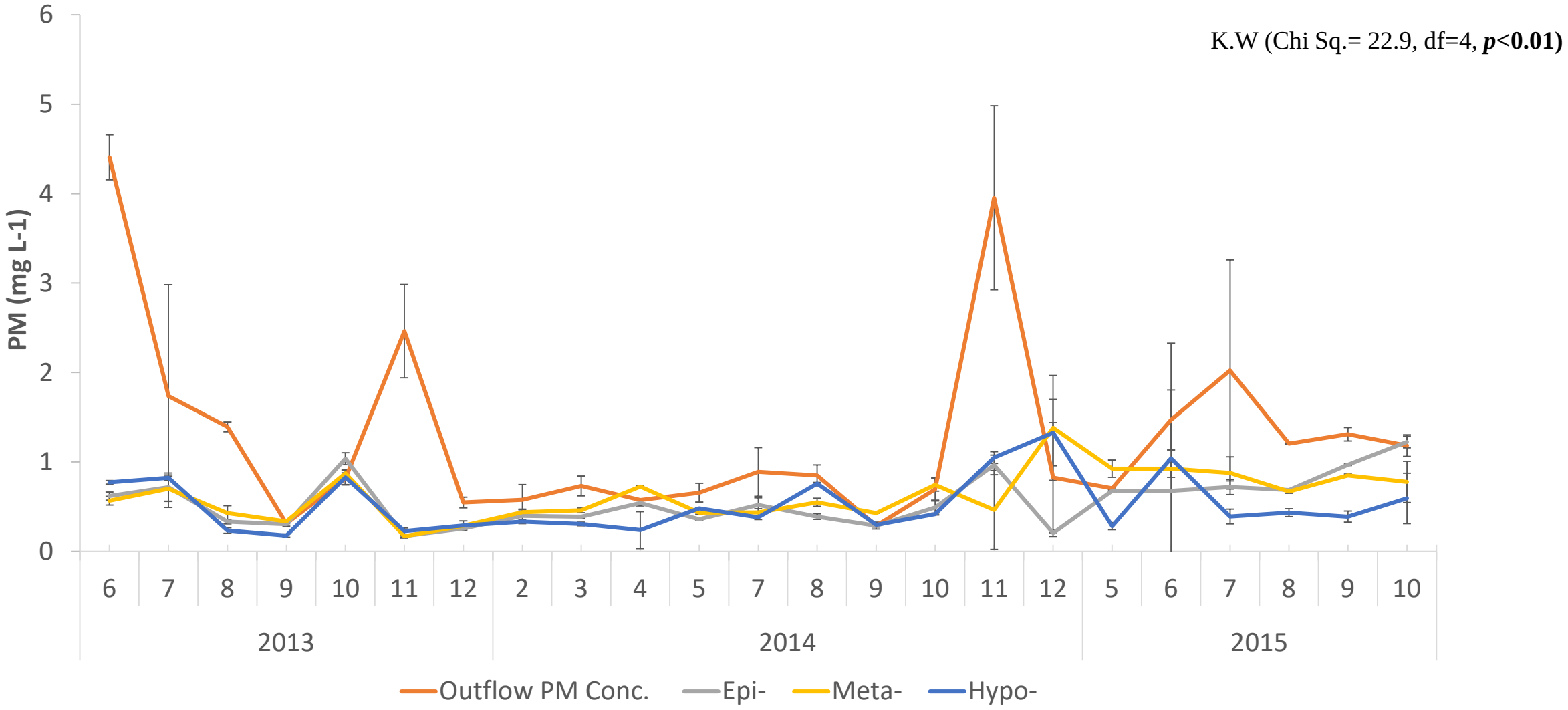
and

My financial supporters:

Annexures

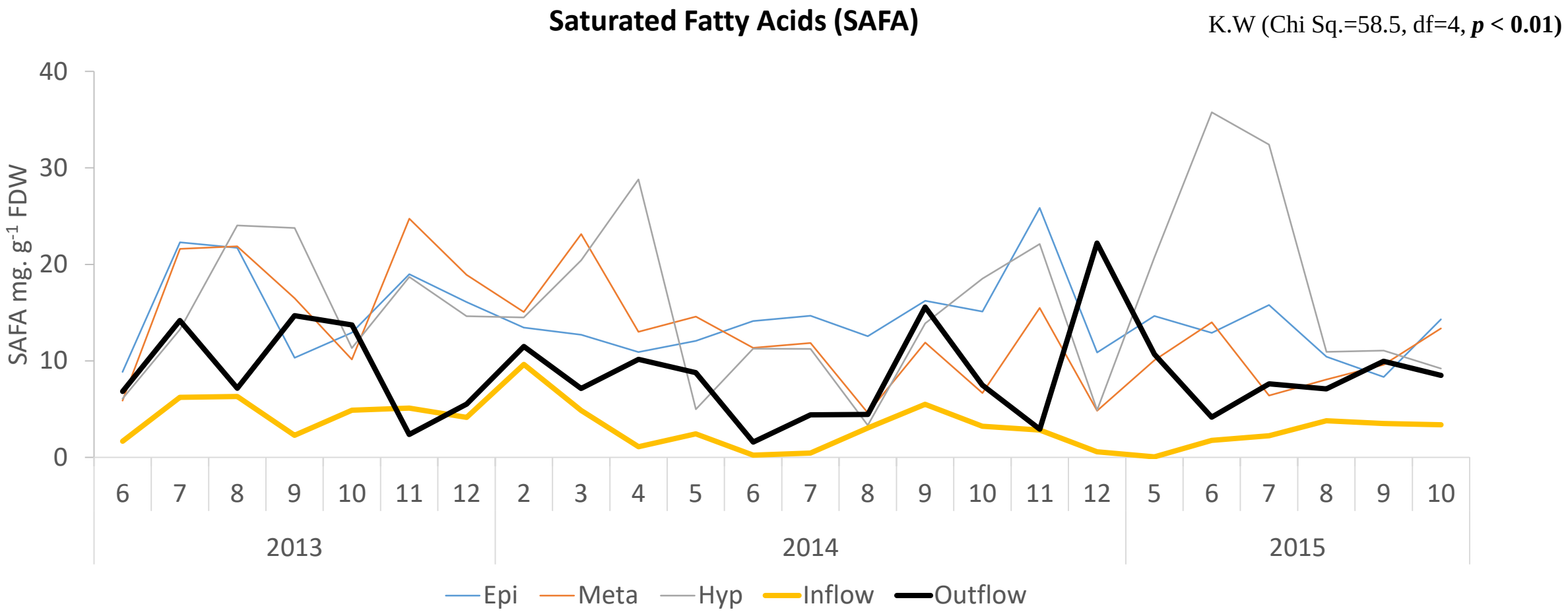
Particulate Matter Concentration (outflow) vs Lake

K.W (Chi Sq.= 22.9, df=4, ***p*<0.01)**

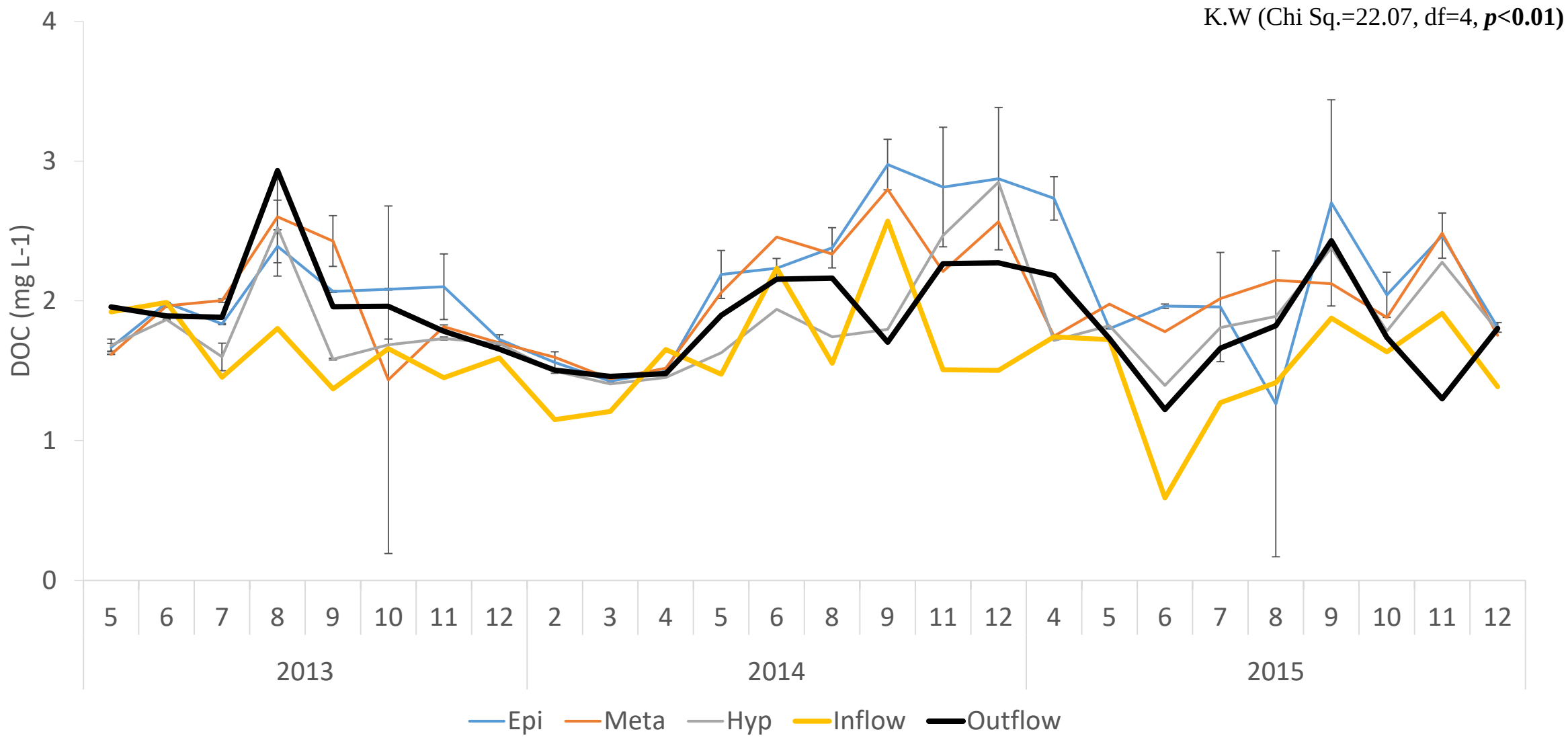


POM biochemical characteristics [Fatty acids]

Saturated Fatty Acids (SAFA) ⟶ (14-24 C Chain)



Dissolved Organic Matter inflow/outflow (conc.) vs Lake (2013-15)

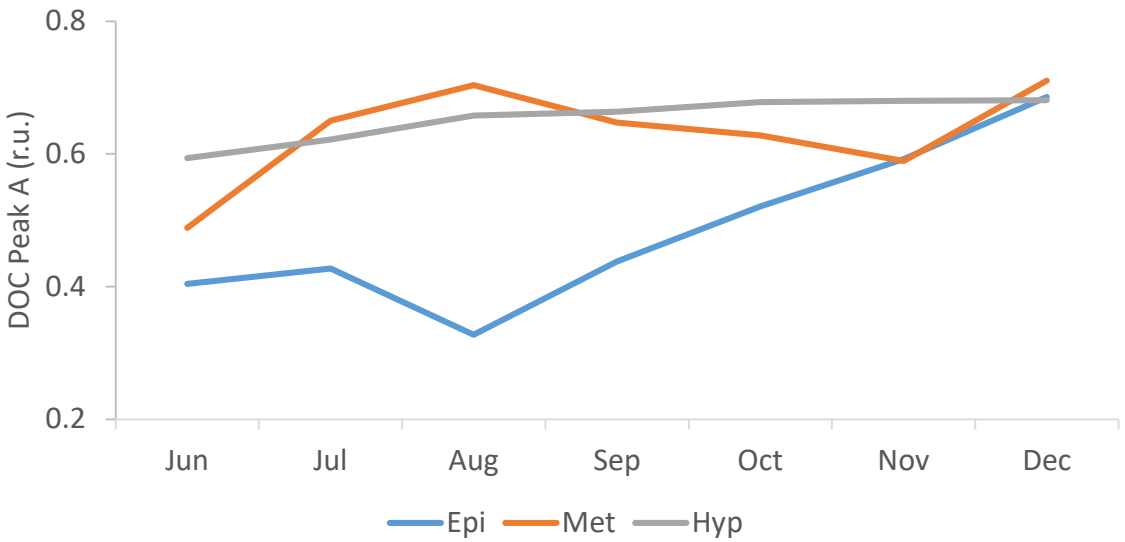


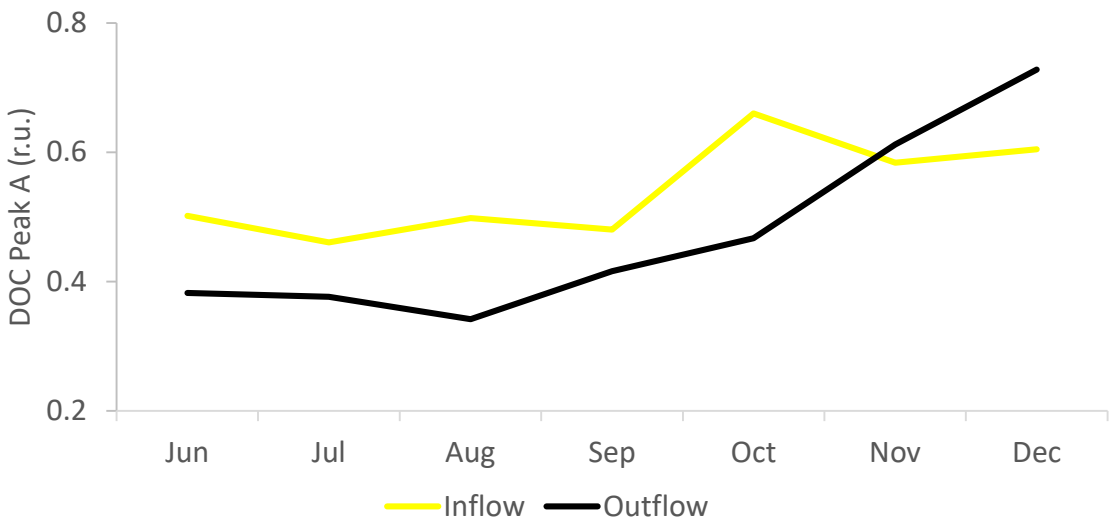
DOC fluorescent characteristics [signals]

Humic-like Substances (Peak A, C) → allochthonous origin DOM (Coble 1996, Marine Chemistry)

(Peak A)

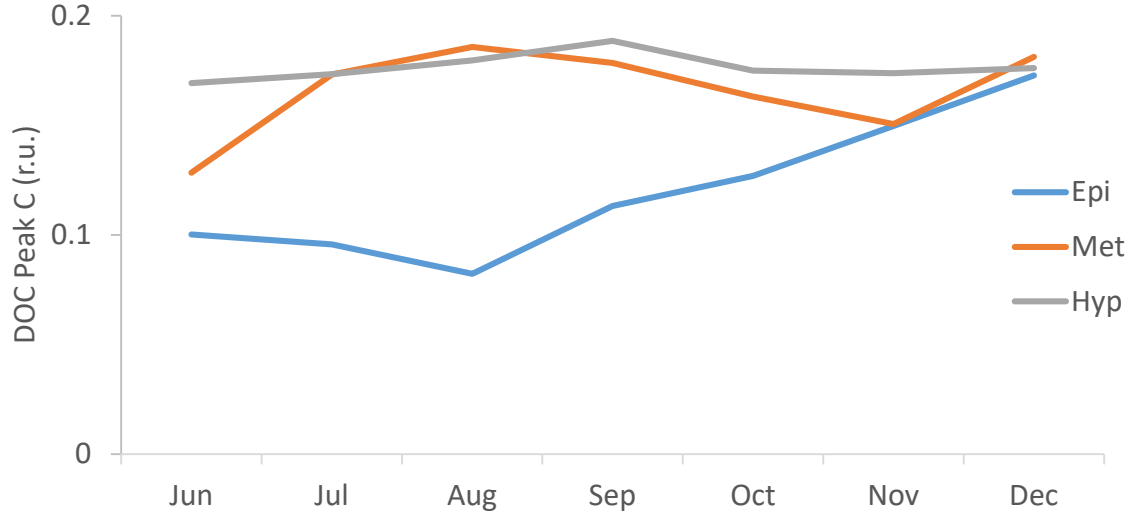
K.W (Chi Sq.=12.4, df=4, ***p*<0.01**)

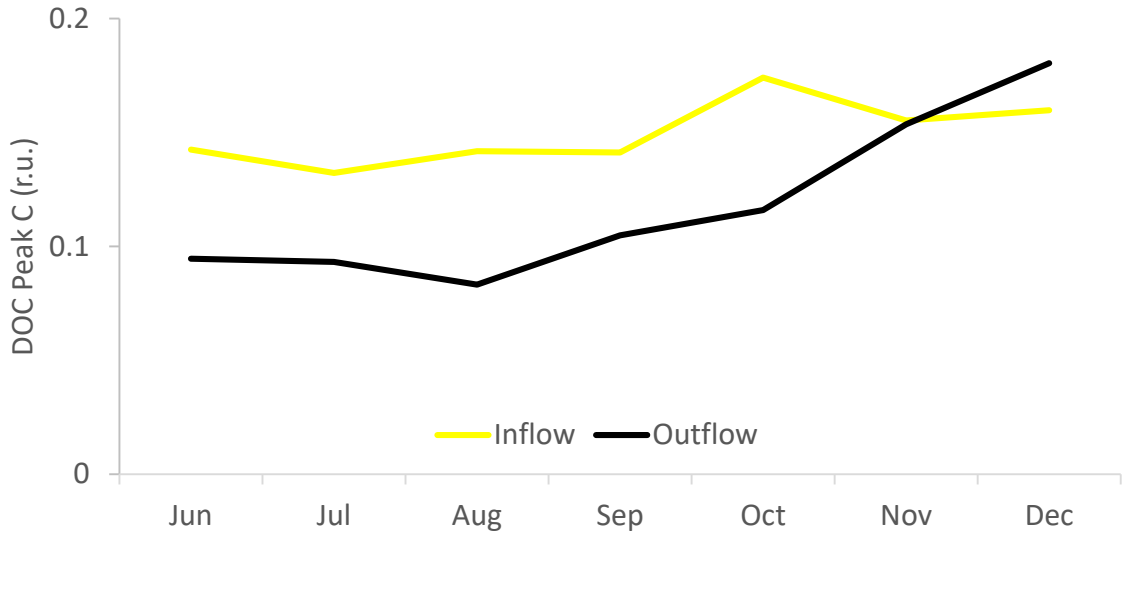




(Peak C)

K.W (Chi Sq.=17.25, df=4, ***p*<0.01**)

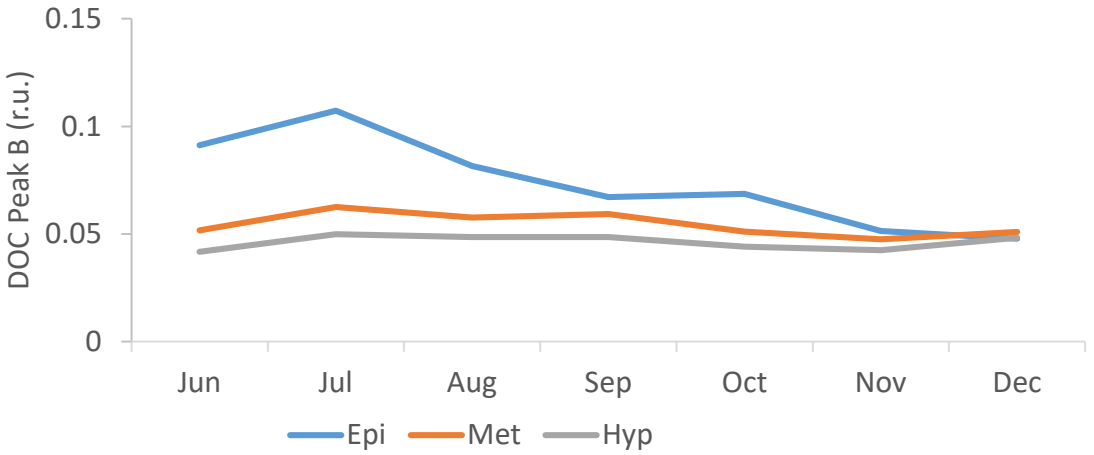


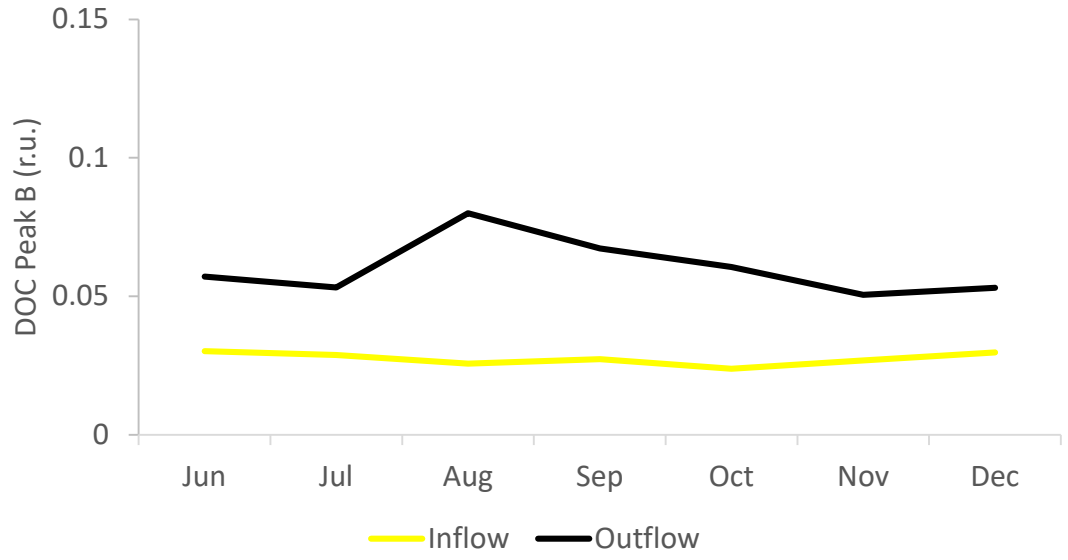


DOC fluorescent characteristics [signals…..]

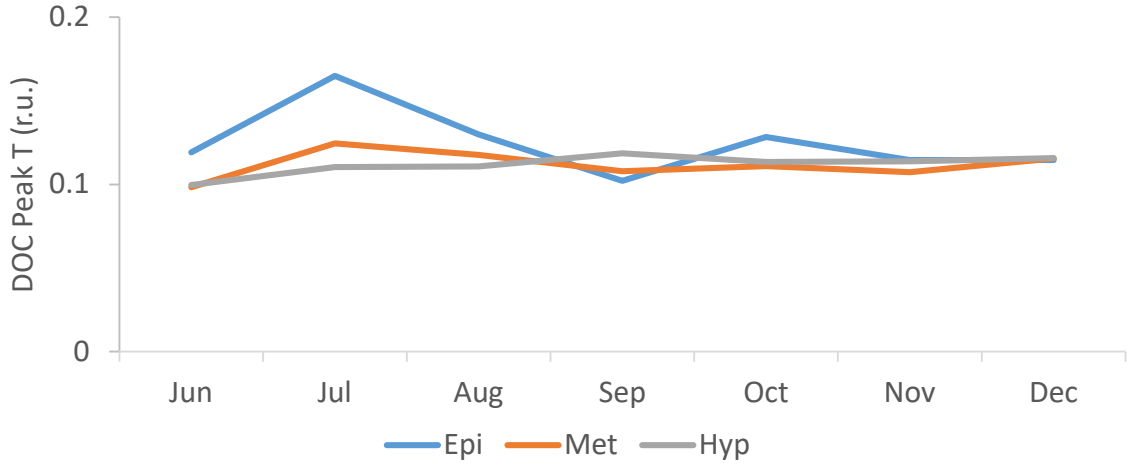
Protein-like Substances (Peak B, T) → Autochthonous origin DOM (Coble 1996, Marine Chemistry)

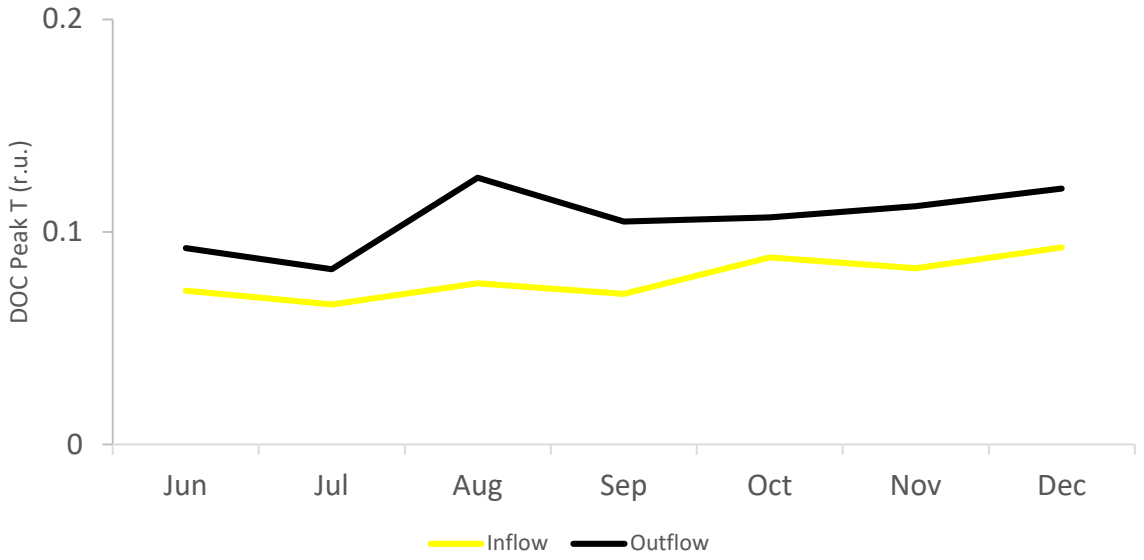
(Tyrosine-like Peak B) K.W (Chi Sq.=25.6, df=4, $p < 0.01$)





(Tryptophan-like Peak T) K.W (Chi Sq.=18.26, df=4, $p = 0.01$)

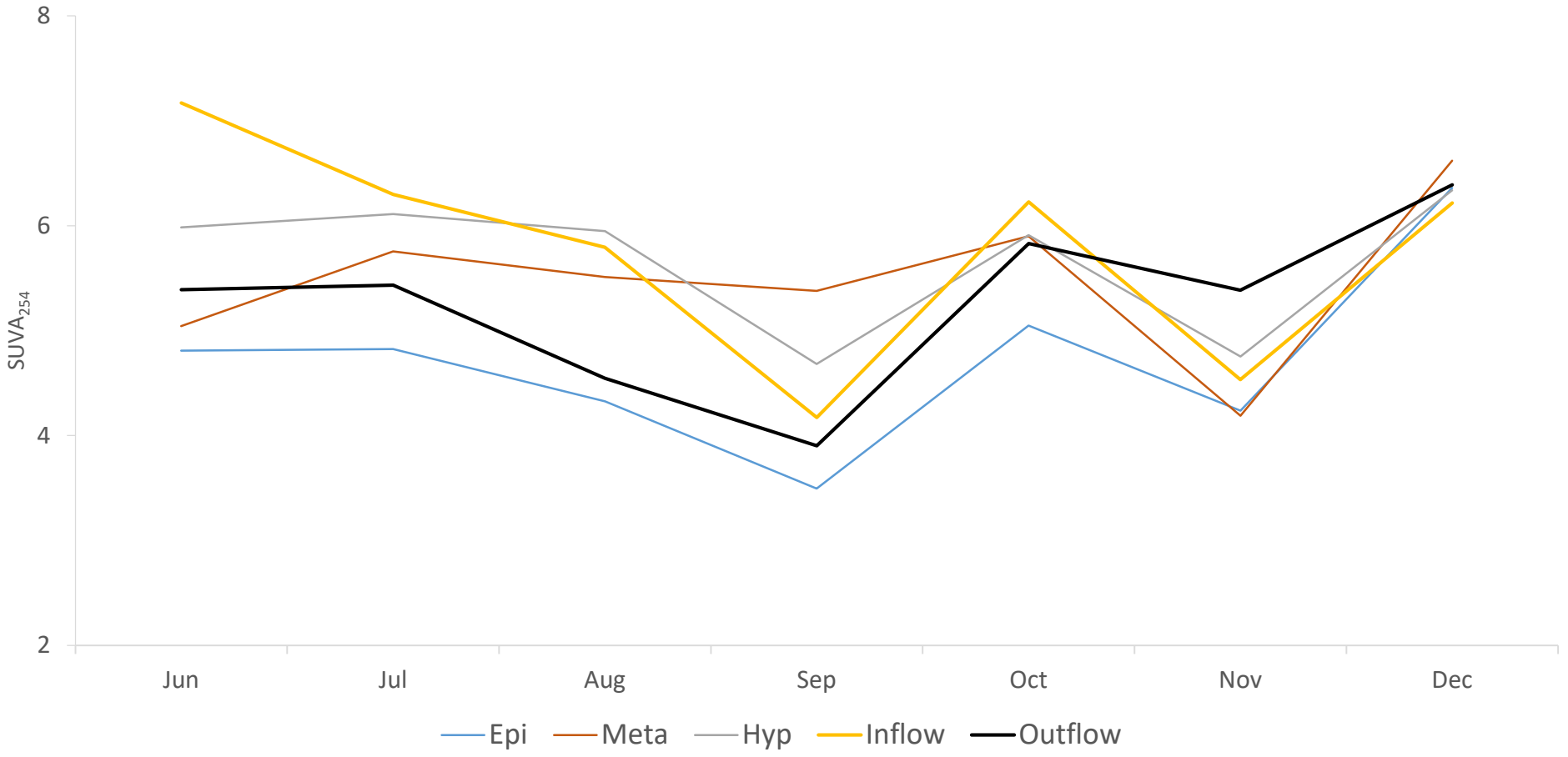




DOC fluorescent characteristics [Indices]

SUVA $_{254}$ → DOM Aromaticity (Weishaar *et al.*, 2003. Env. Sci. Technol.)

K.W (Chi Sq.=4.8, df=4, ***p*<0.31)**



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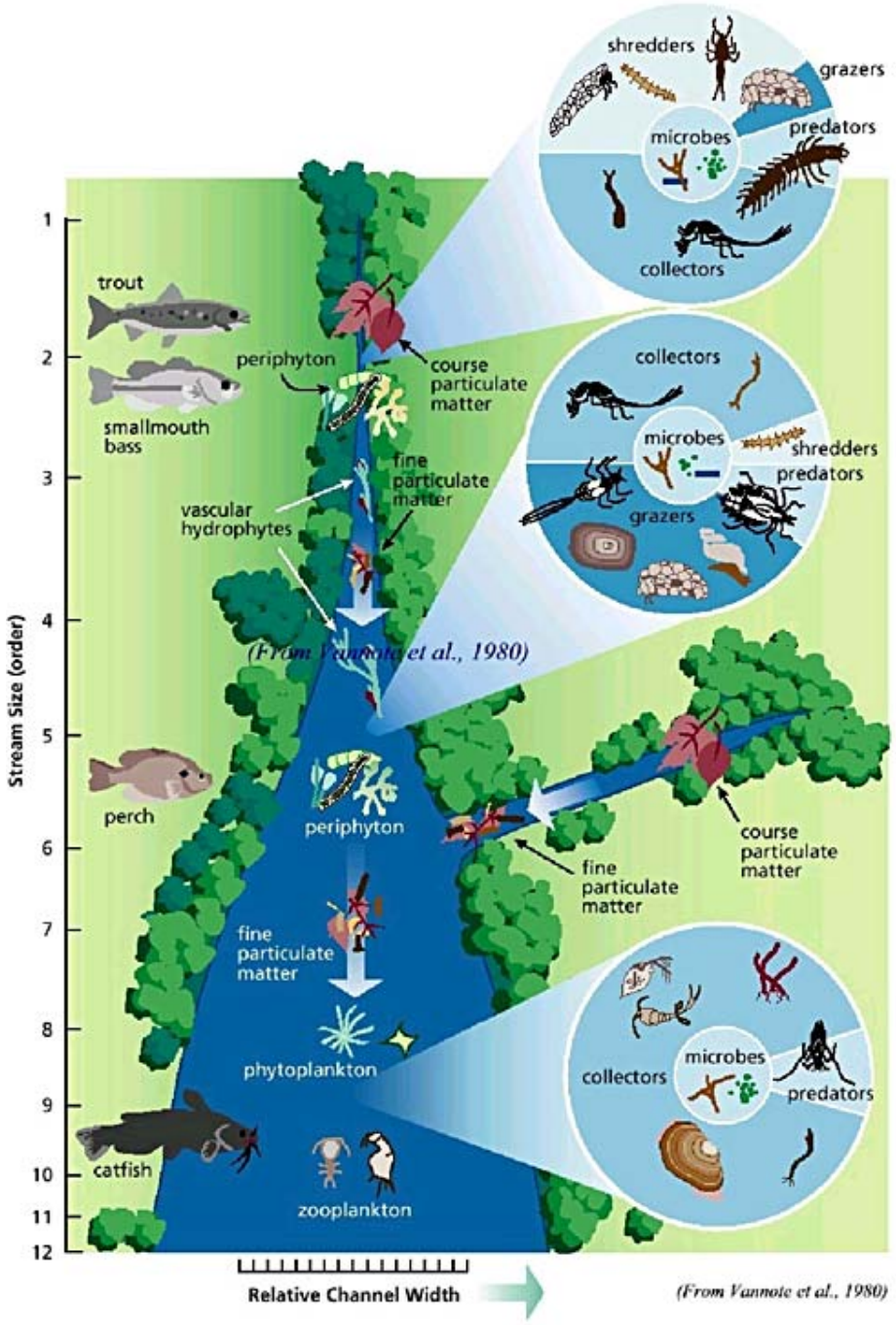
3. **Bacterial fatty acids in PM** at the inflow were significantly lower than in lake layers and at the outflow → lake supplies more energy-yielding substances to bacteria;
4. **Autochthonous DOM** at the inflow were significantly lower than in the lake and at the outflow → lake as supplier of labile DOM;
5. **Humic-like (allochthonous) DOM** at outflow were significantly lower than at the inflow → lake as trap and/or converter of allo DOM (respiration)

The River Continuum Concept (Vannote el al. 1980)

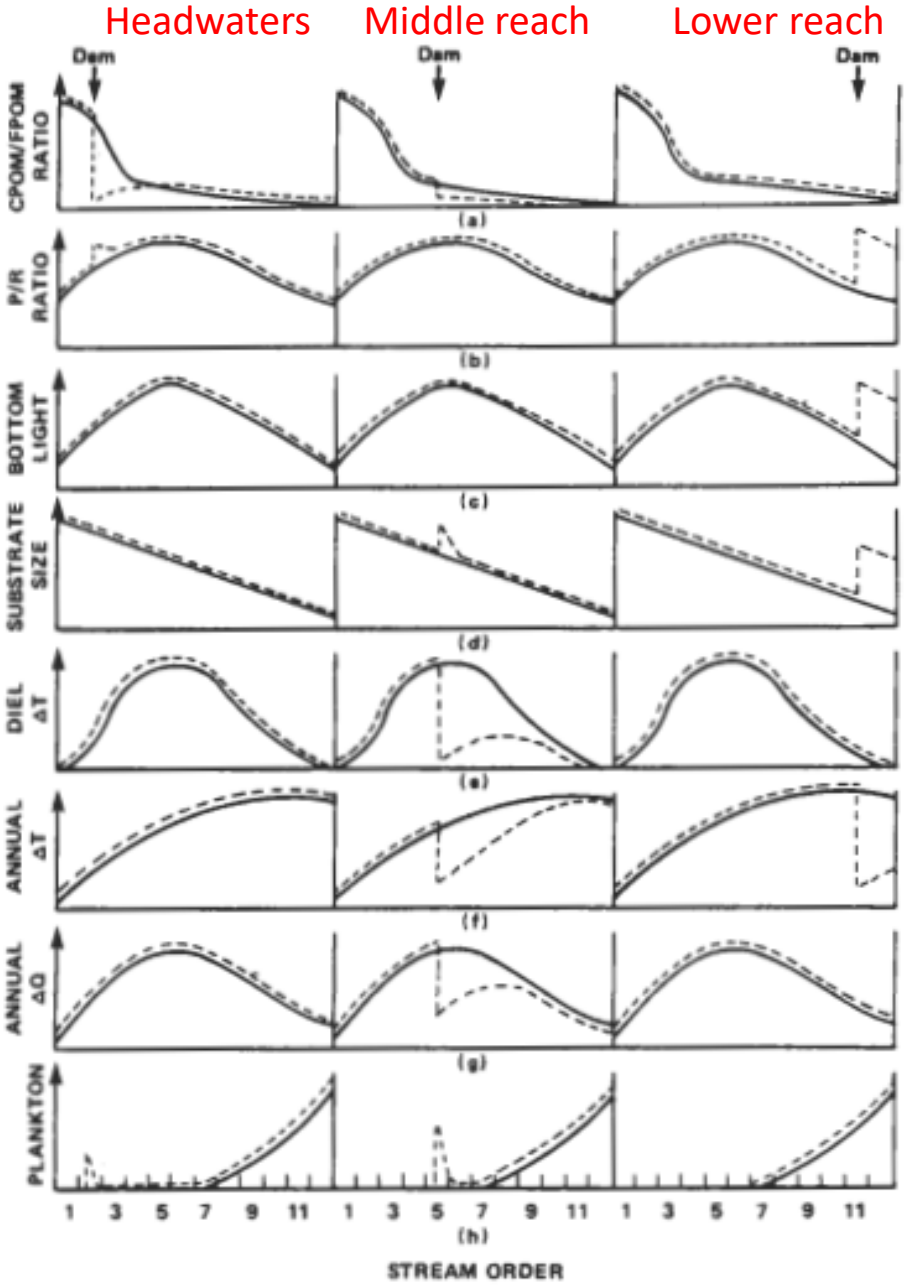


Role of Lakes have been ignored!

BOKU

wasser cluster lunz

Serial Discontinuity Concept by Ward and Stanford (1979)



Metalimnetic discharge

- thermal regime
- flow regime

Lakes have been ignored!