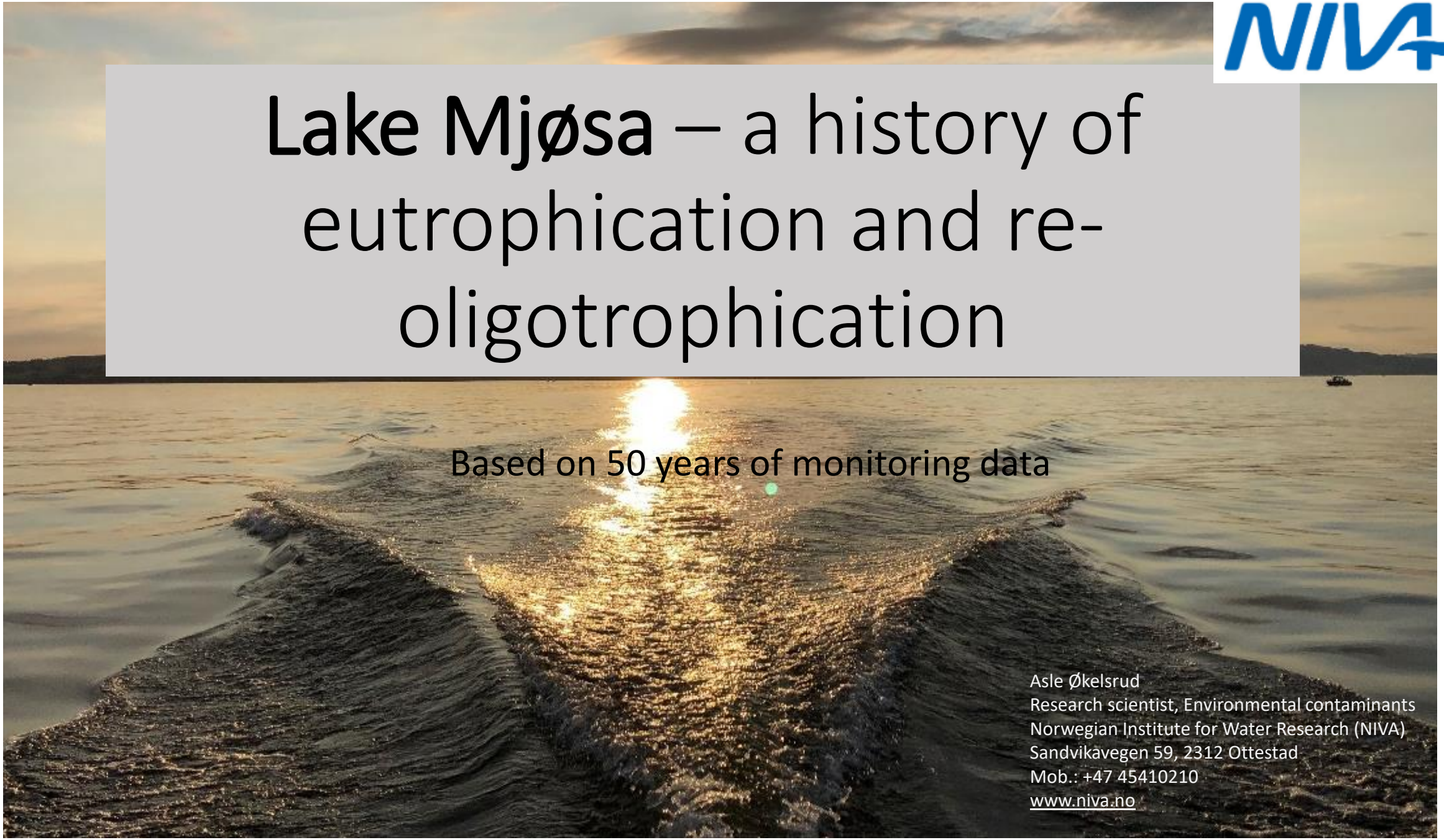

Lake Mjøsa – a history of eutrophication and re-oligotrophication

Based on 50 years of monitoring data

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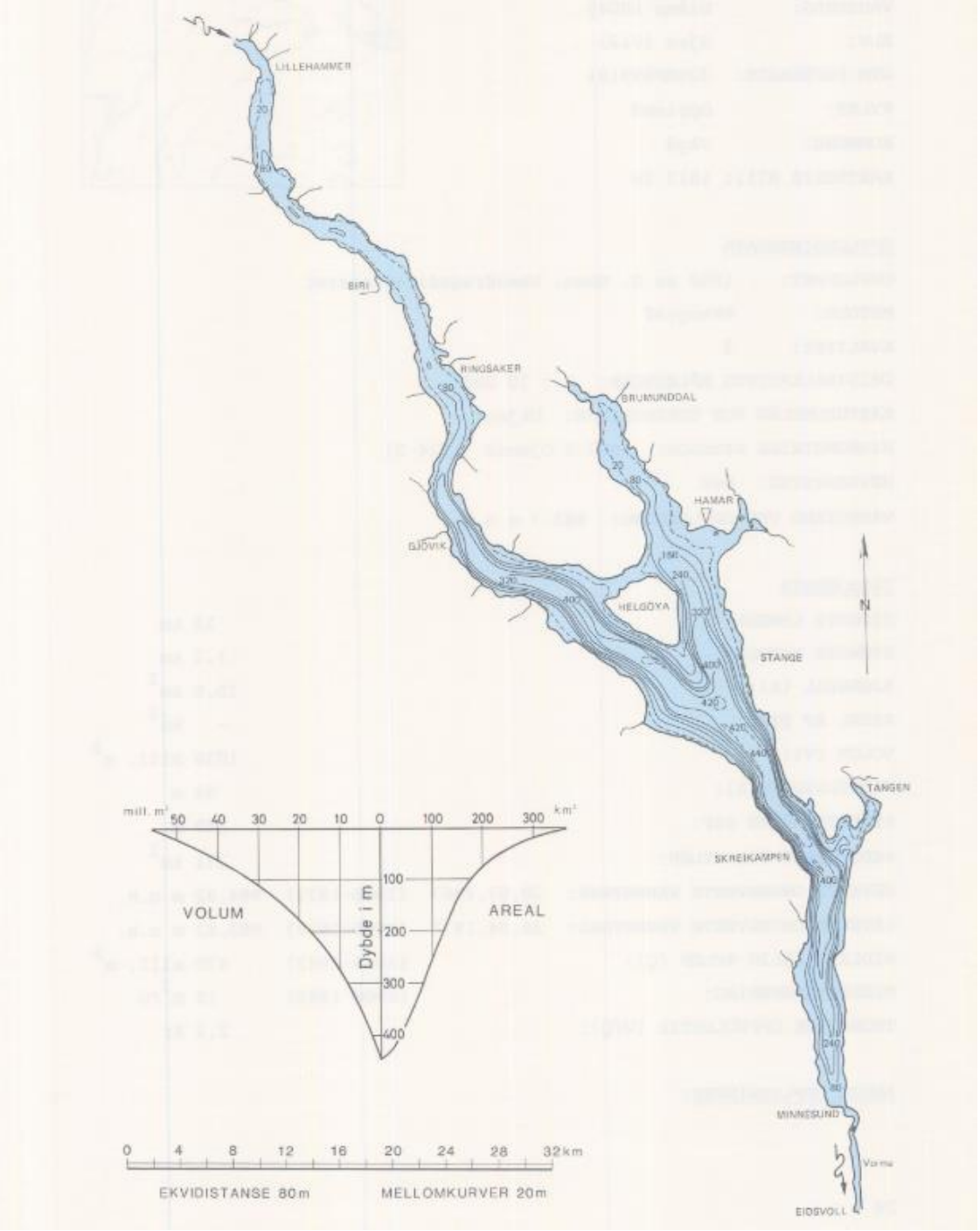
www.niva.no


Sverige
Norge
Bottenvika
Østersjøen
Nordsjøen
Danmark
Storbritannia
Irland
Nederland
Berlin
Polen
London
Warszaw
Tyskland
Belgia


LILLEHAMMER
BIRI
RINGSAKER
BRUMUNDDAL
HAMAR
GJØVIK
HELGØYA
STANGE
TANGEN
SKREIKAMPEN
MINNESUND
EIDSVOLL
N
mill. m³
50 40 30 20 10 0
100 200 300 km²
VOLUM
AREAL
Dybde i m
100
200
300
400
0 4 8 12 16 20 24 28 32 km
EKVIDISTANSE 80m
MELLOMKURVER 20m

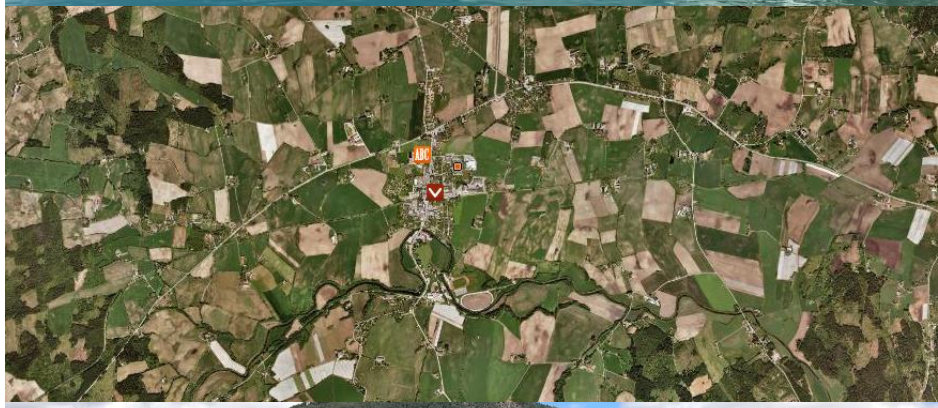
A lake with high local (and national) value

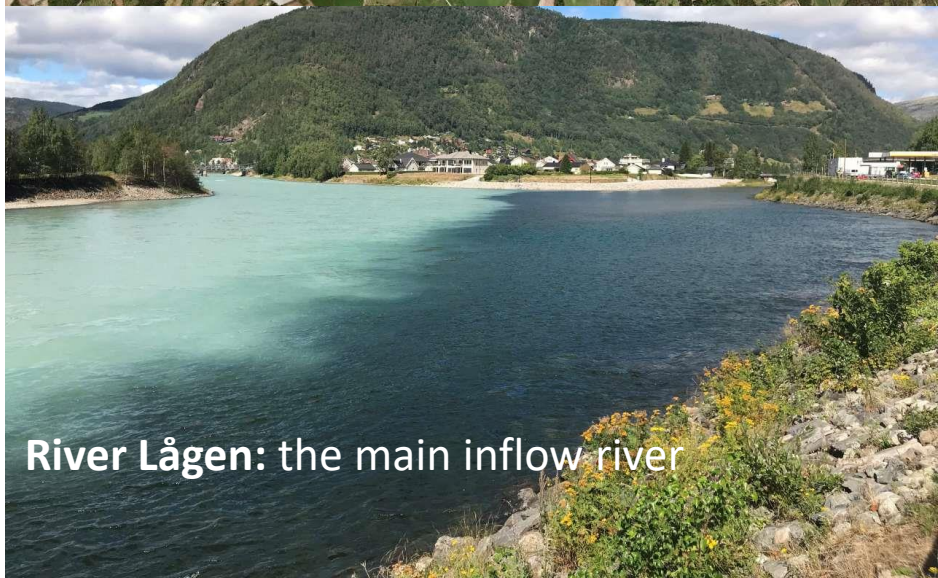
Photos: Atle Rustadbakken (top);
Asle Økelsrud (bottom)

The catchment

- **Area**: 16 420 km^2
  - 39 % high mountains
  - 37 % forest
  - 6 % agriculture
- **Main inflow river Lågen**:
  - Mean flow: 255 m^3/s
  - Clear, low nutrient, influenced by glacial runoff

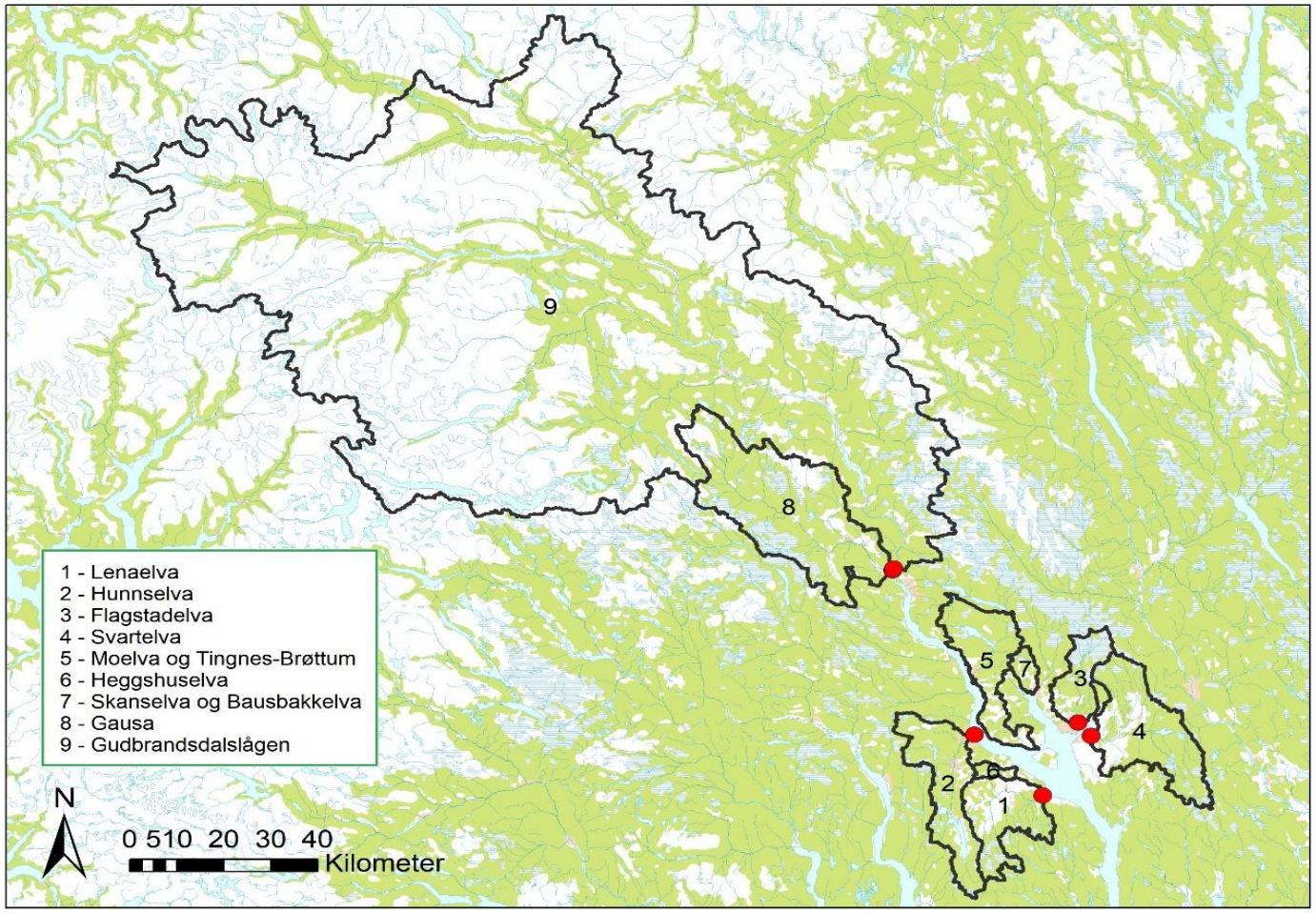
Lake Gjende: a high mountain lake in the upper catchment

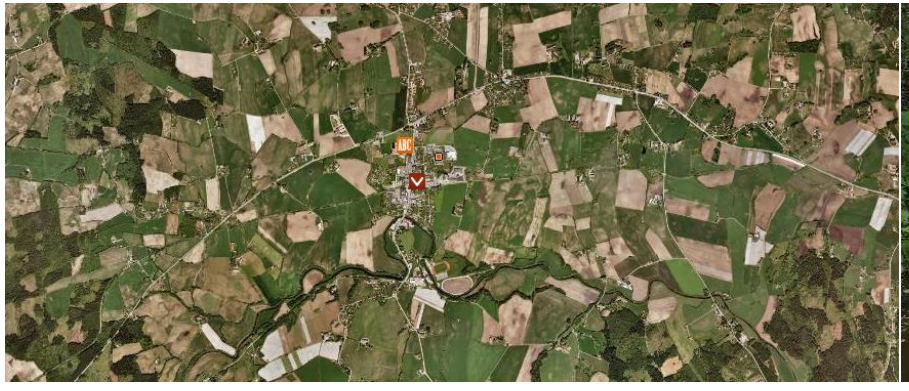




River Lågen: the main inflow river

The catchment

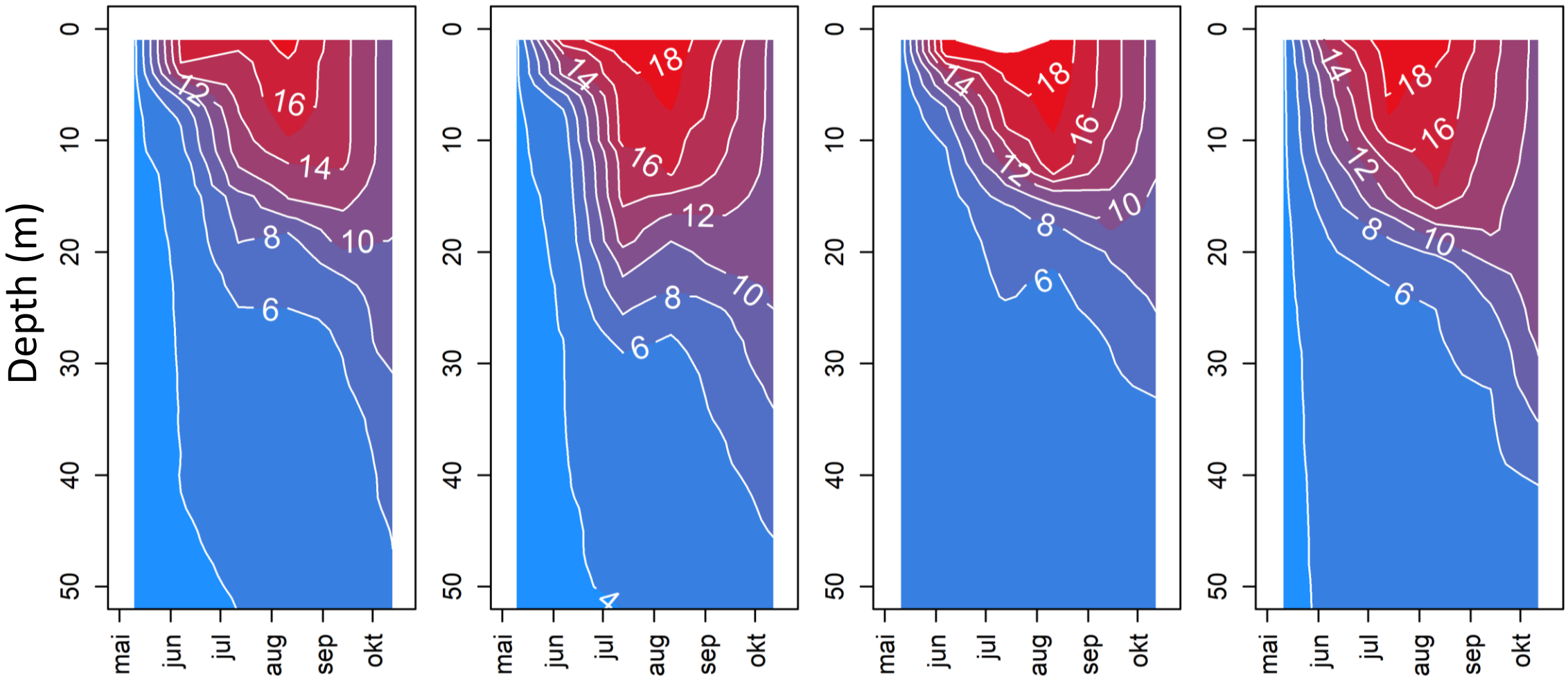




Almost 50 years of lake monitoring

Almost 50 years of lake monitoring

Surface temperature in 2021 at four stations



Monitoring in inflow rivers

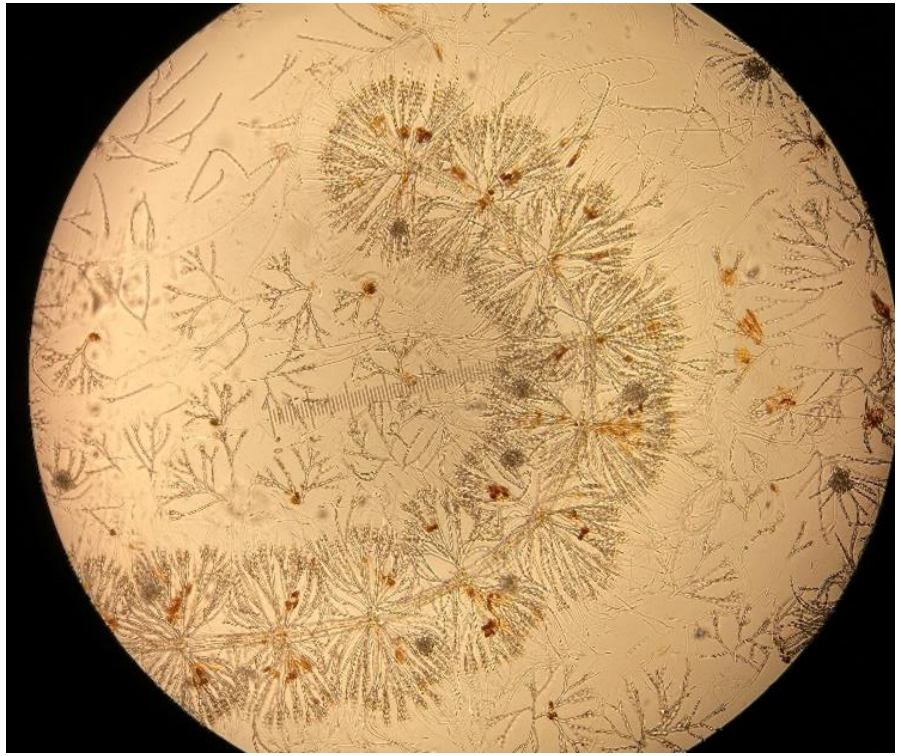
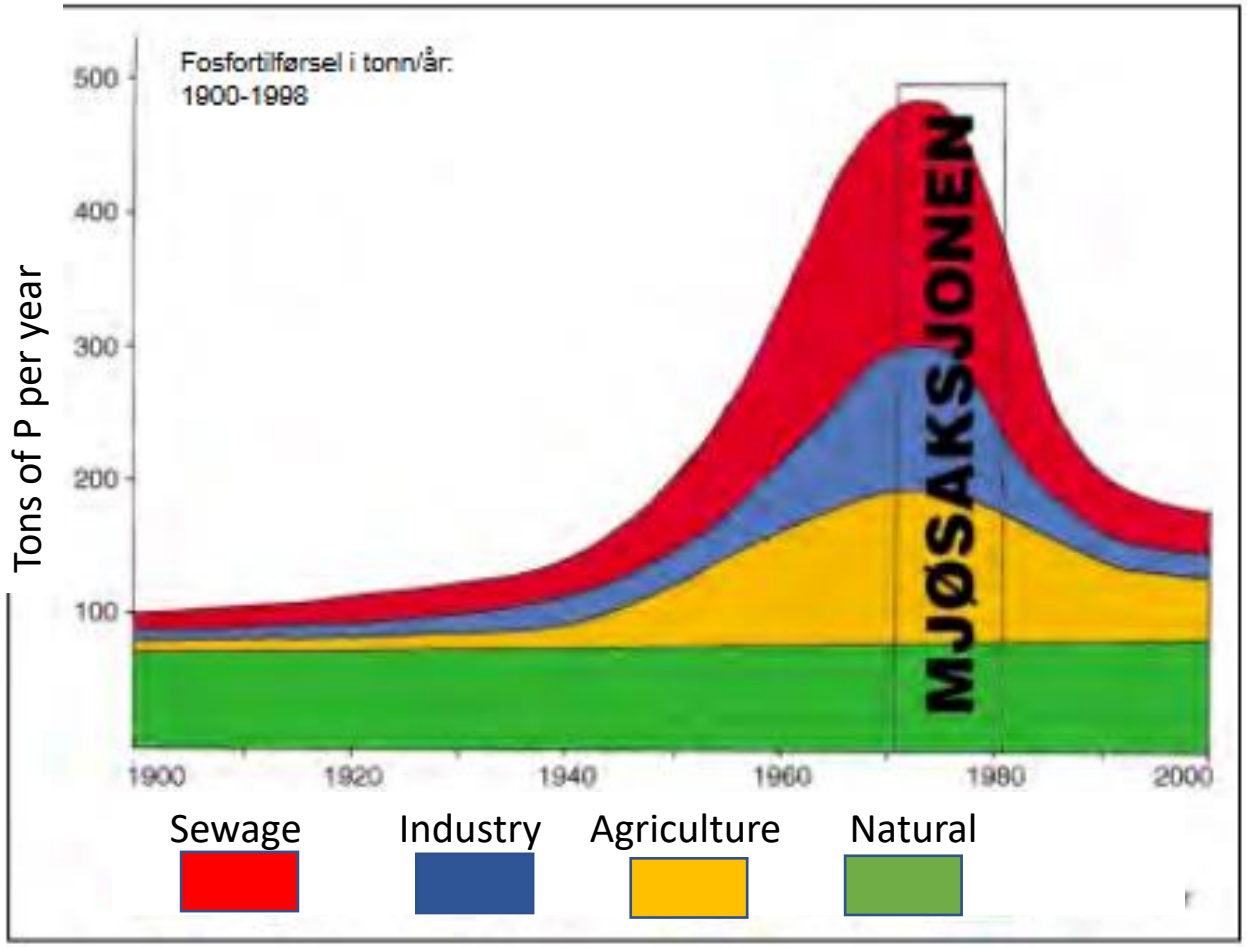


Photo: Randi Haugen

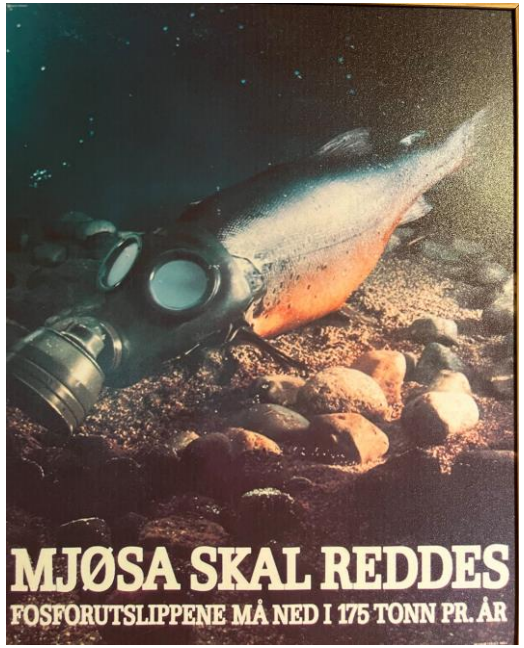
… The monitoring has given us 50 years of **good ecological time series**, documenting a history of **eutrophication**, re-**oligotrophication** and **climate effects**

A history of eutrophication and re-oligotrophication

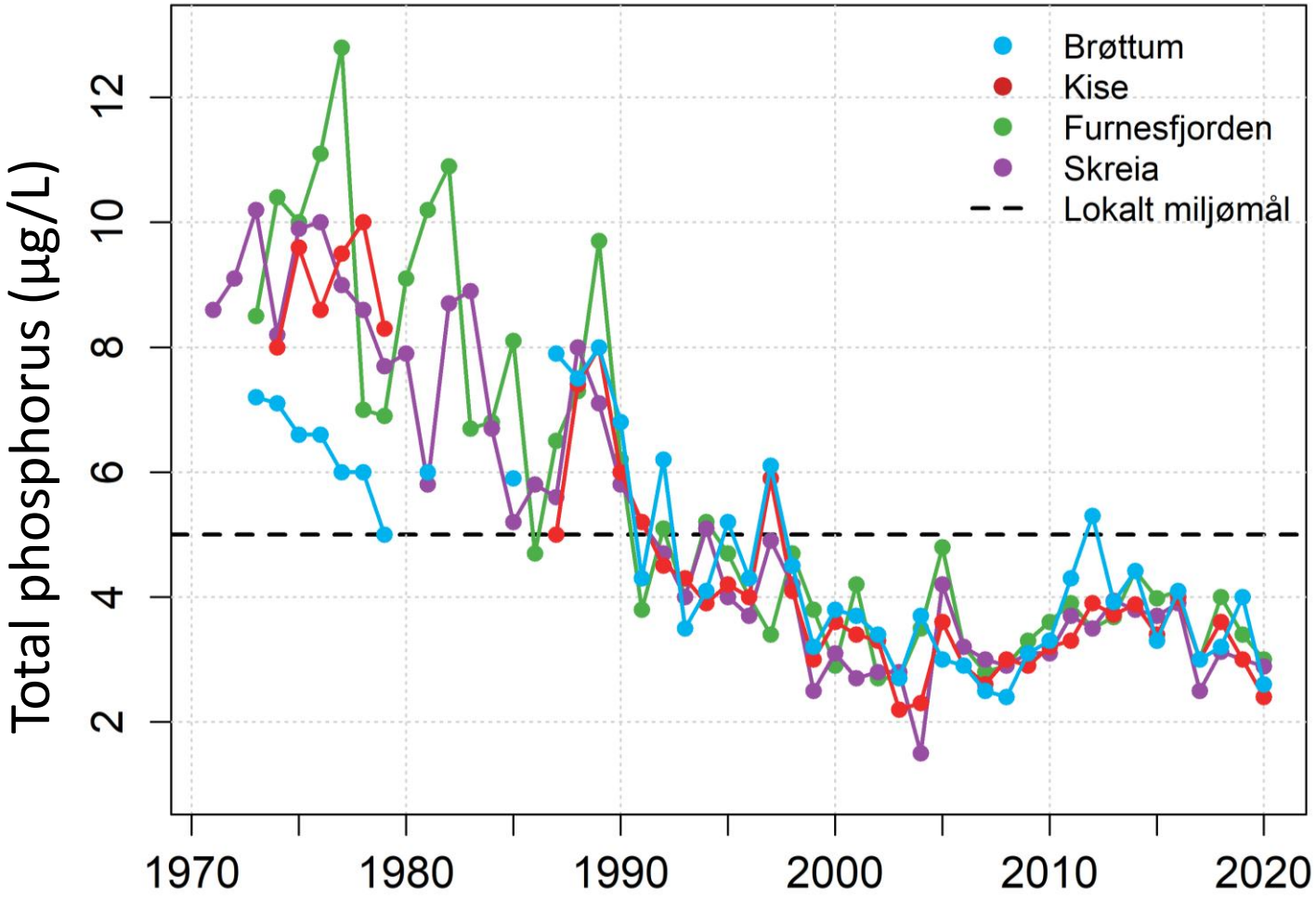


Tiltak etter Mjøsaksjonen har ytterligere redusert fosfortilførslene til Mjøsa. I dag beregnes de å ligge på ca. 180 tonn pr. år. Dette er 5 tonn over den målsetting som er satt for fosfortilførsel til innsjøen.

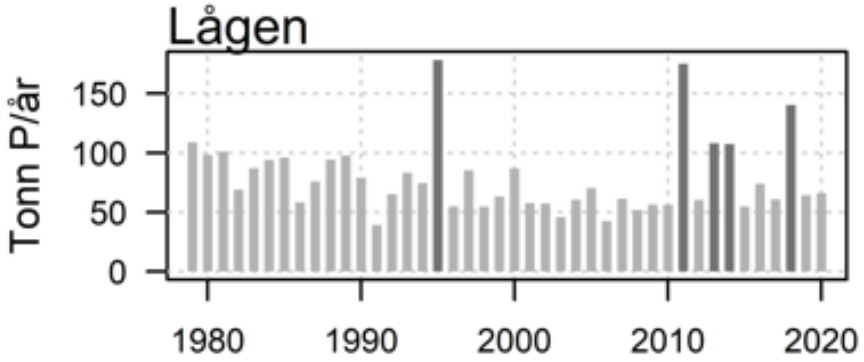
1973-1980: *Save lake Mjøsa*!

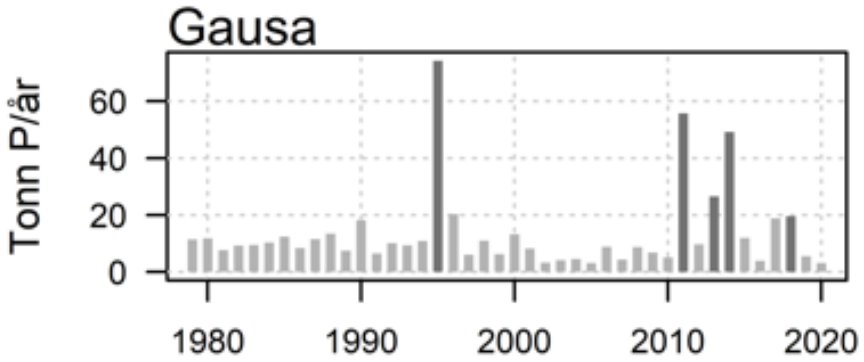


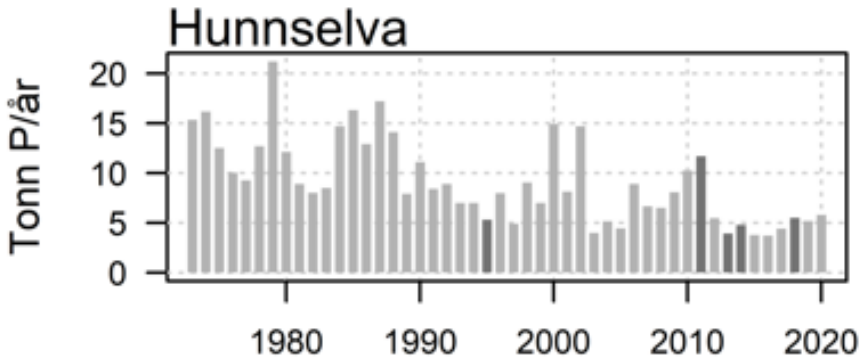
Phosphorus levels in Lake Mjøsa 1972-today



P-transport in flood years

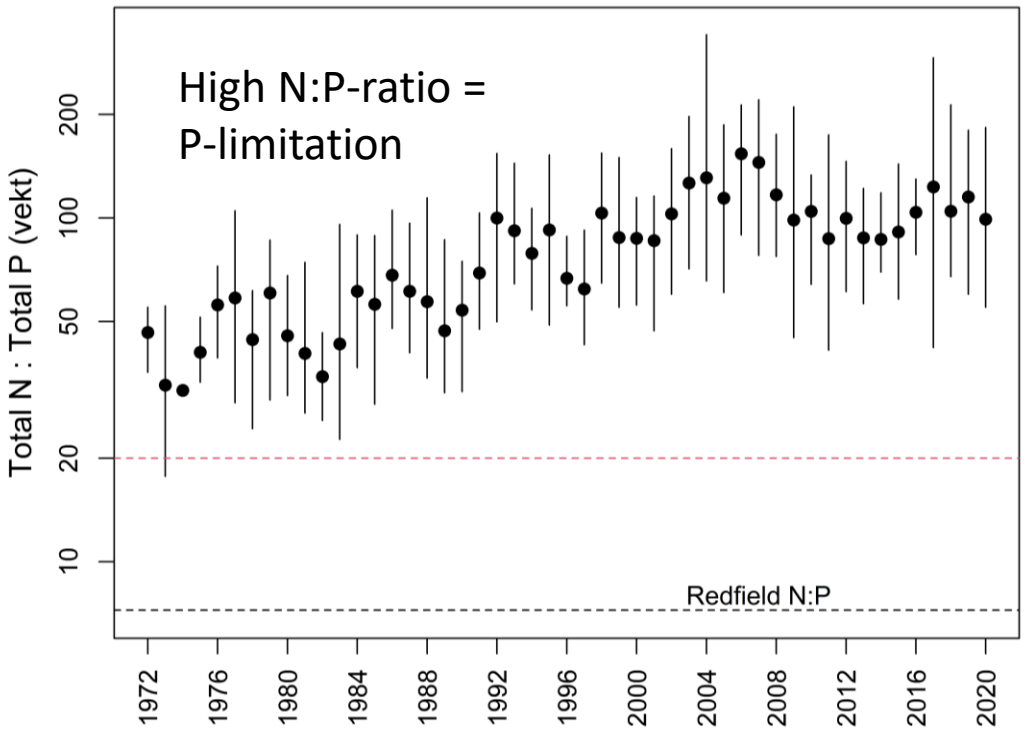


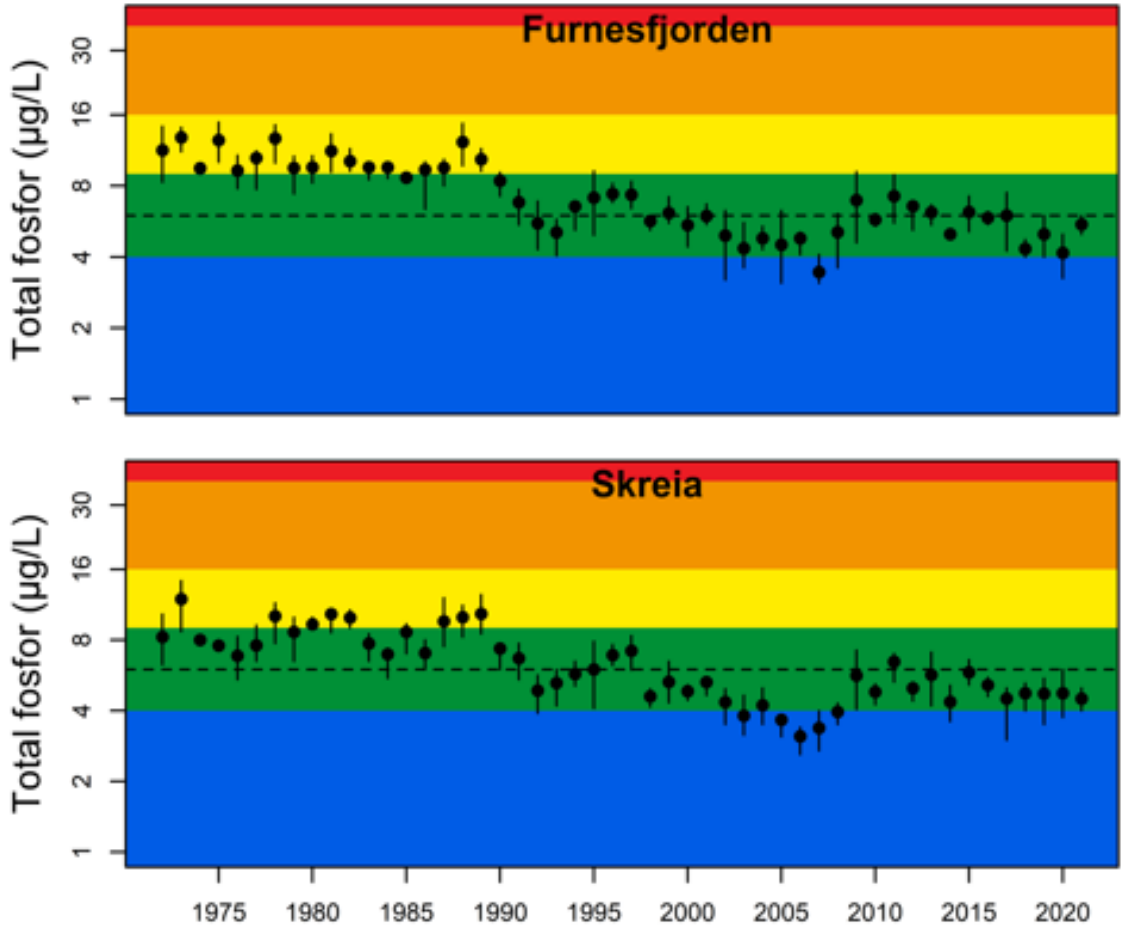




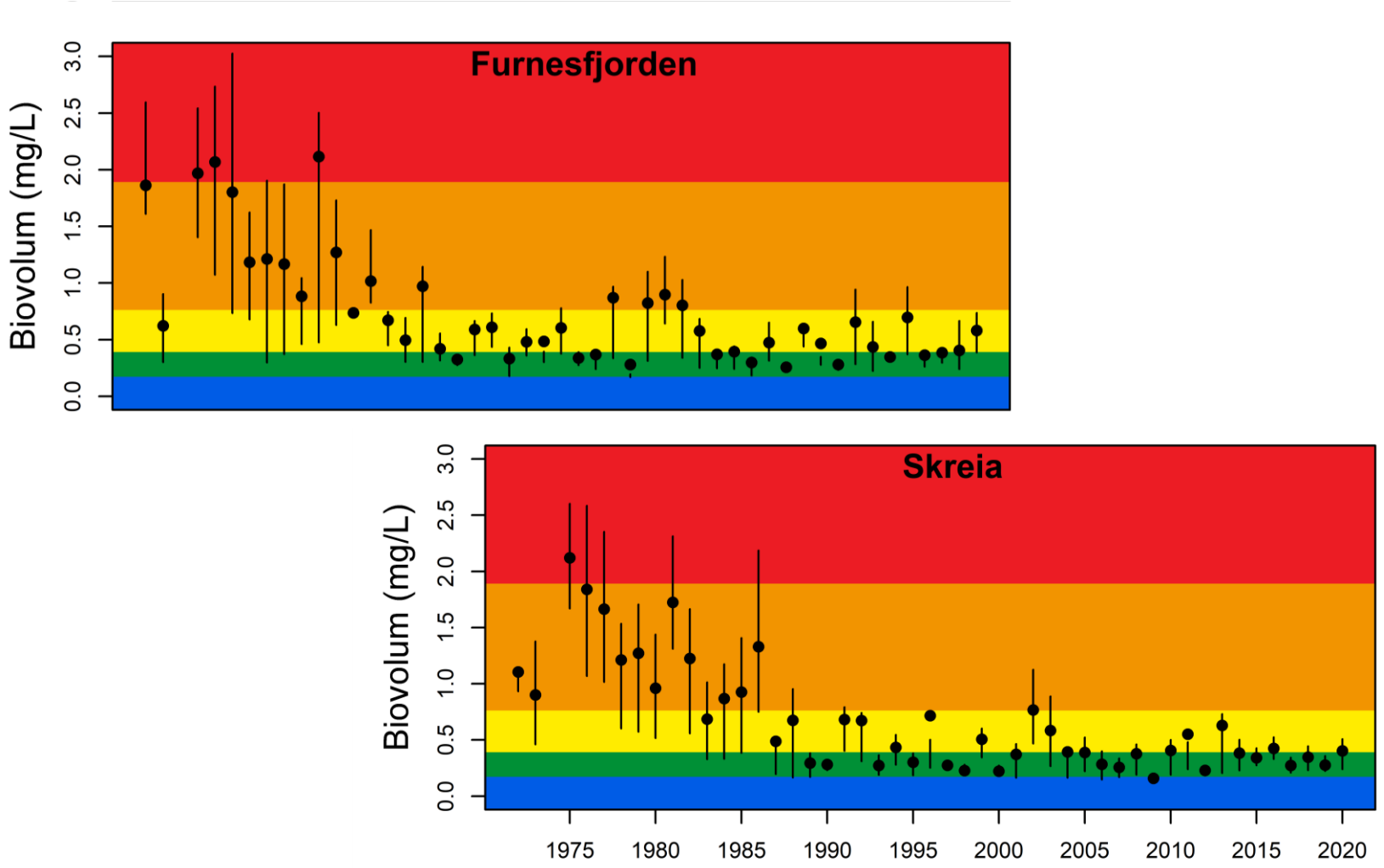
Phosphorus levels in Lake Mjøsa 1972-today

- Average concentration have also decreased significantly
- Recently, 4-6 µg P/L (good status)

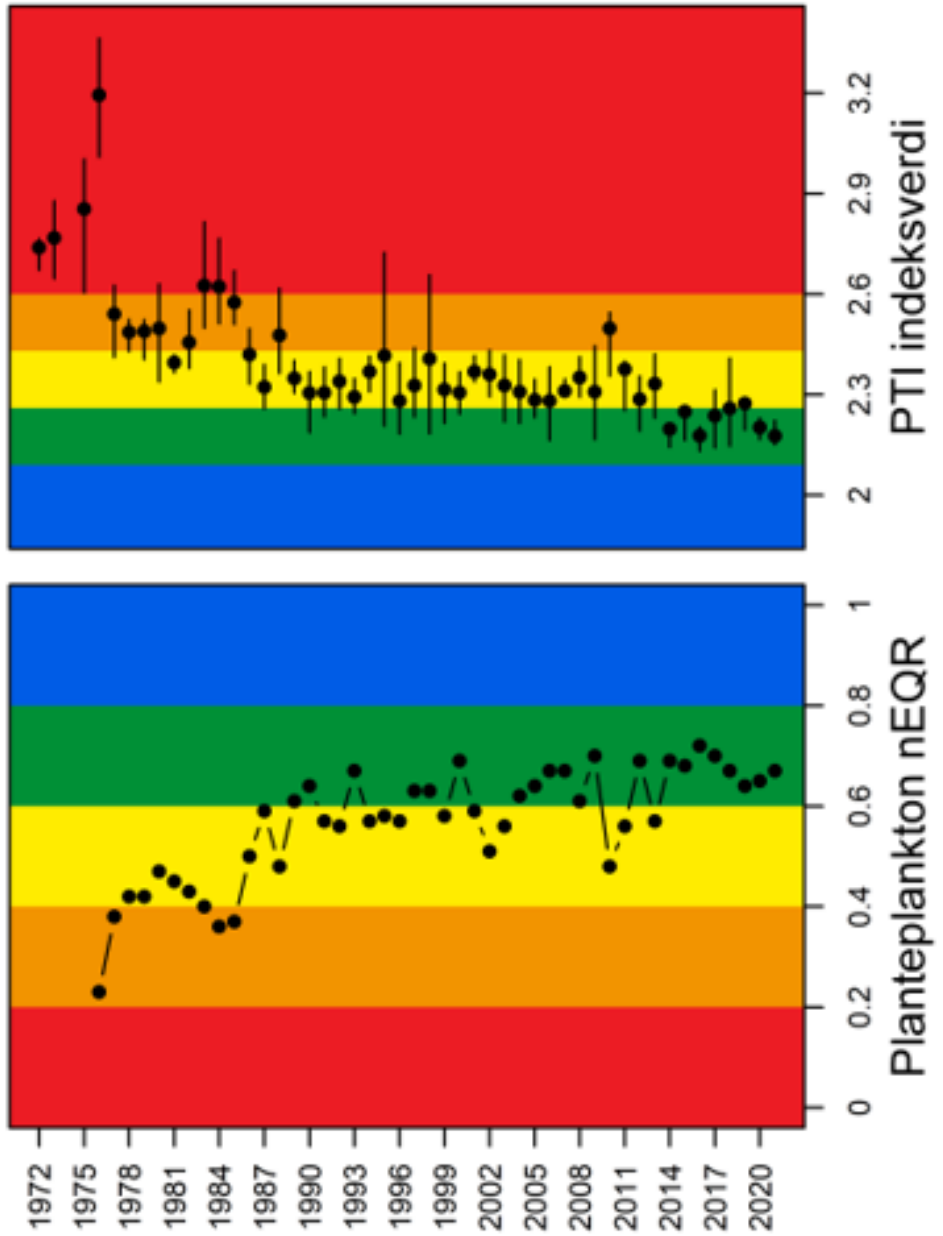




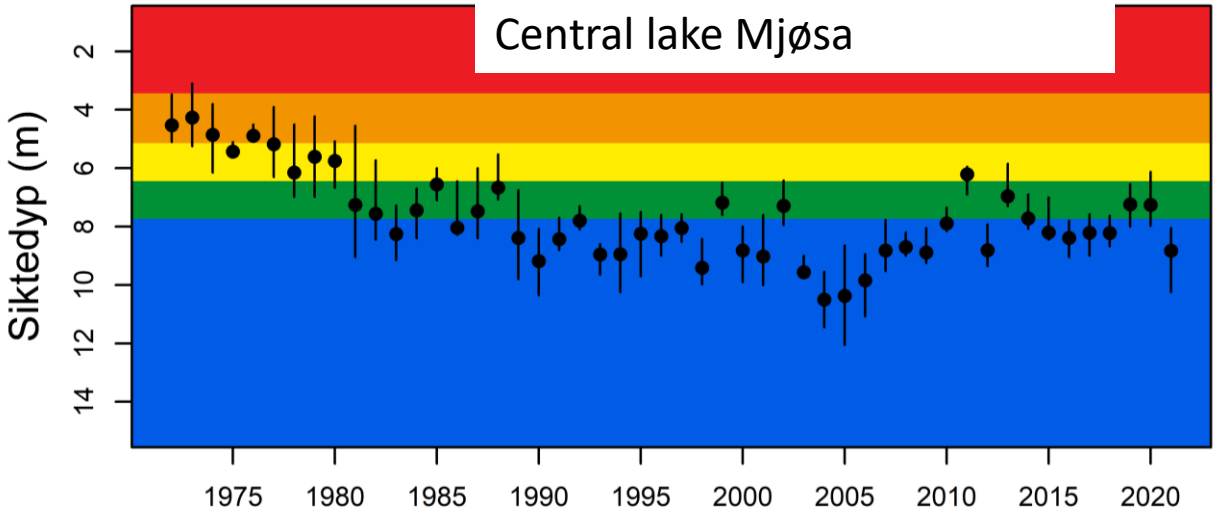
Algal biomass has decreased in line with P



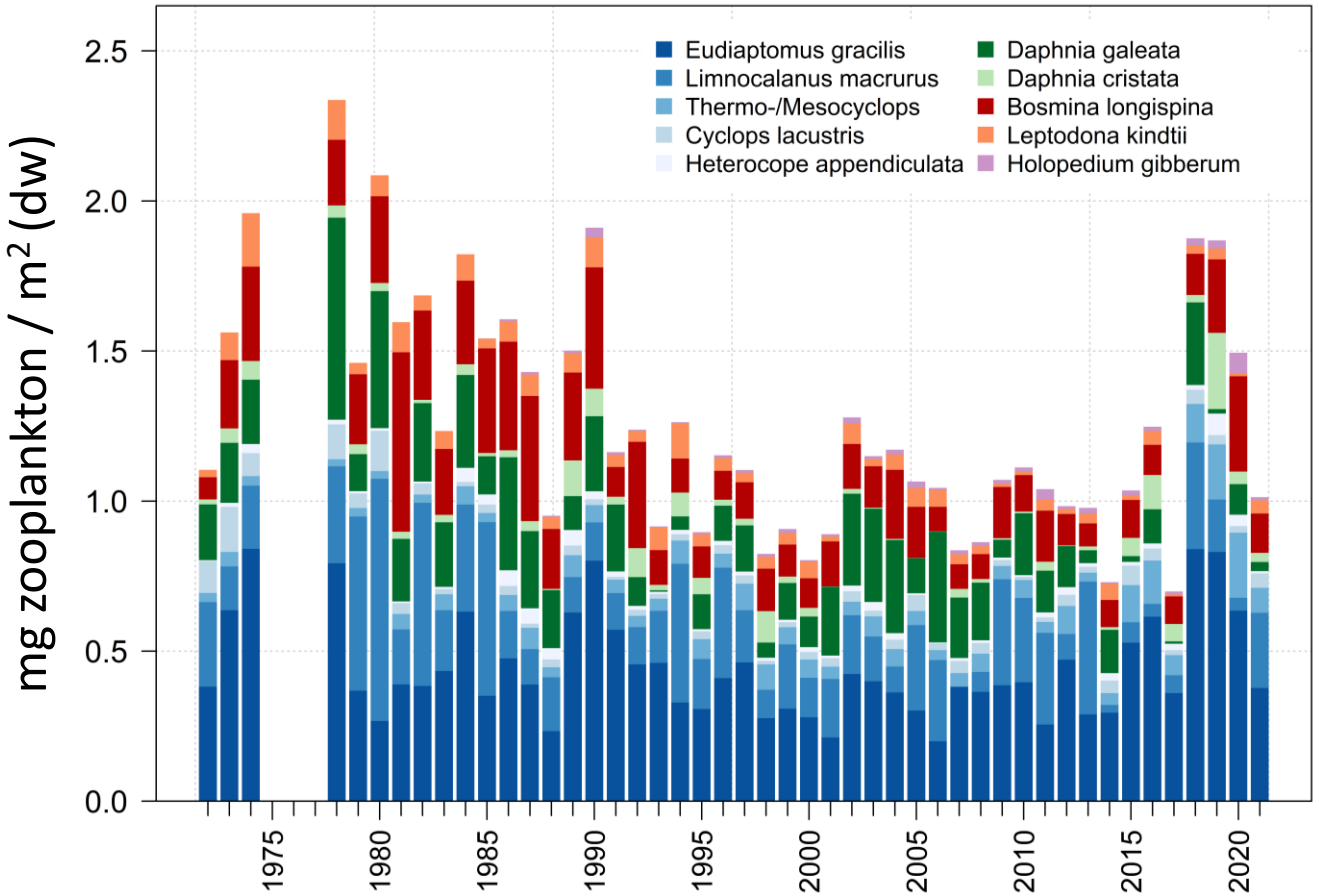
Species composition

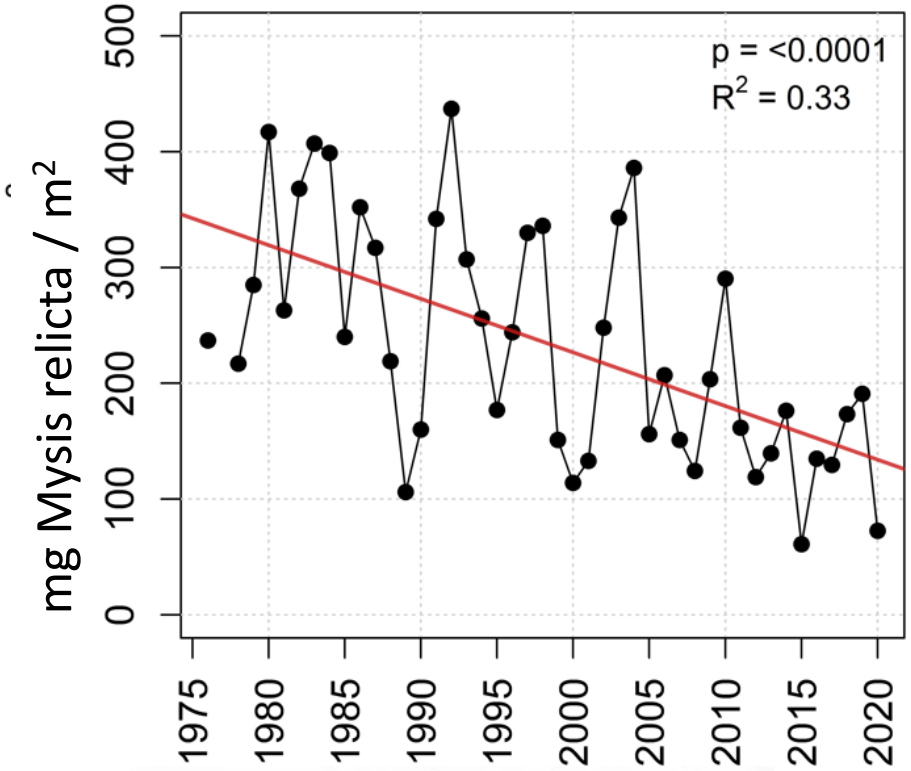


Water clarity has increased significantly



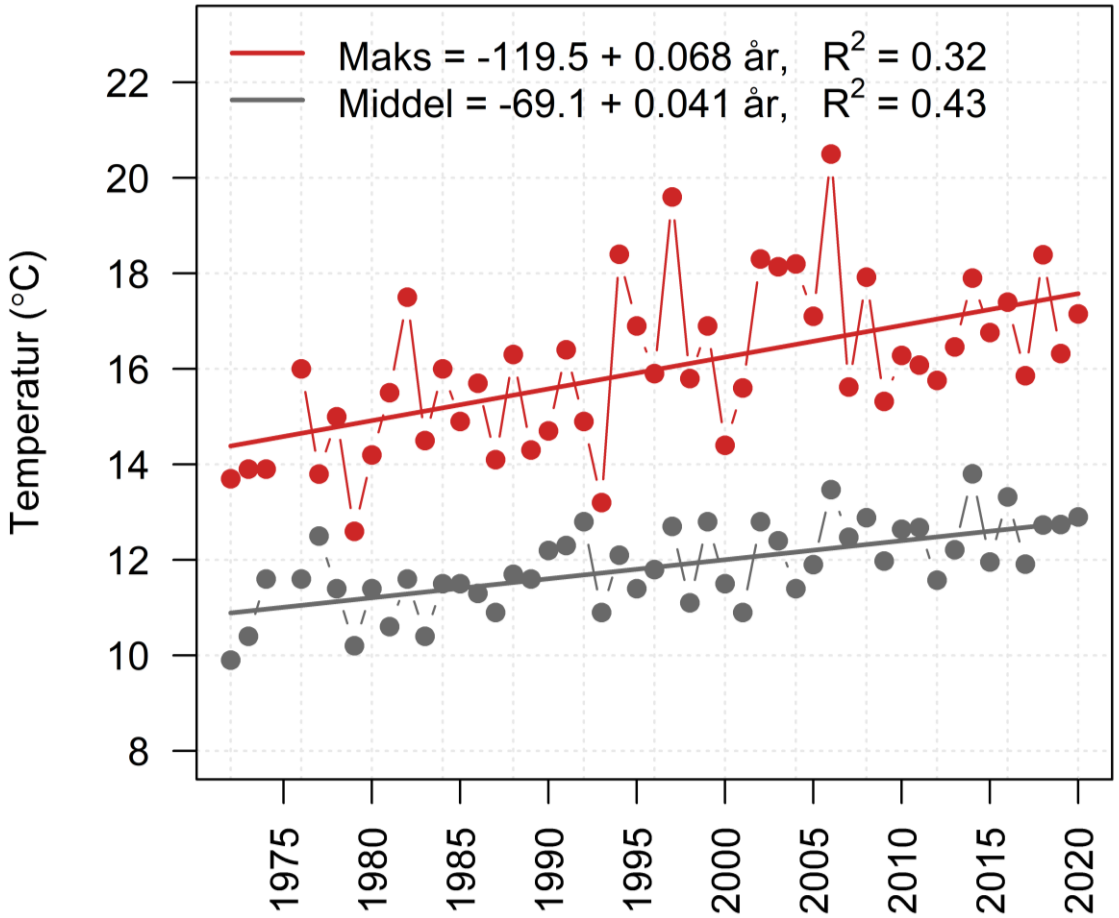
Zooplankton biomass reduced in line with algal biomass

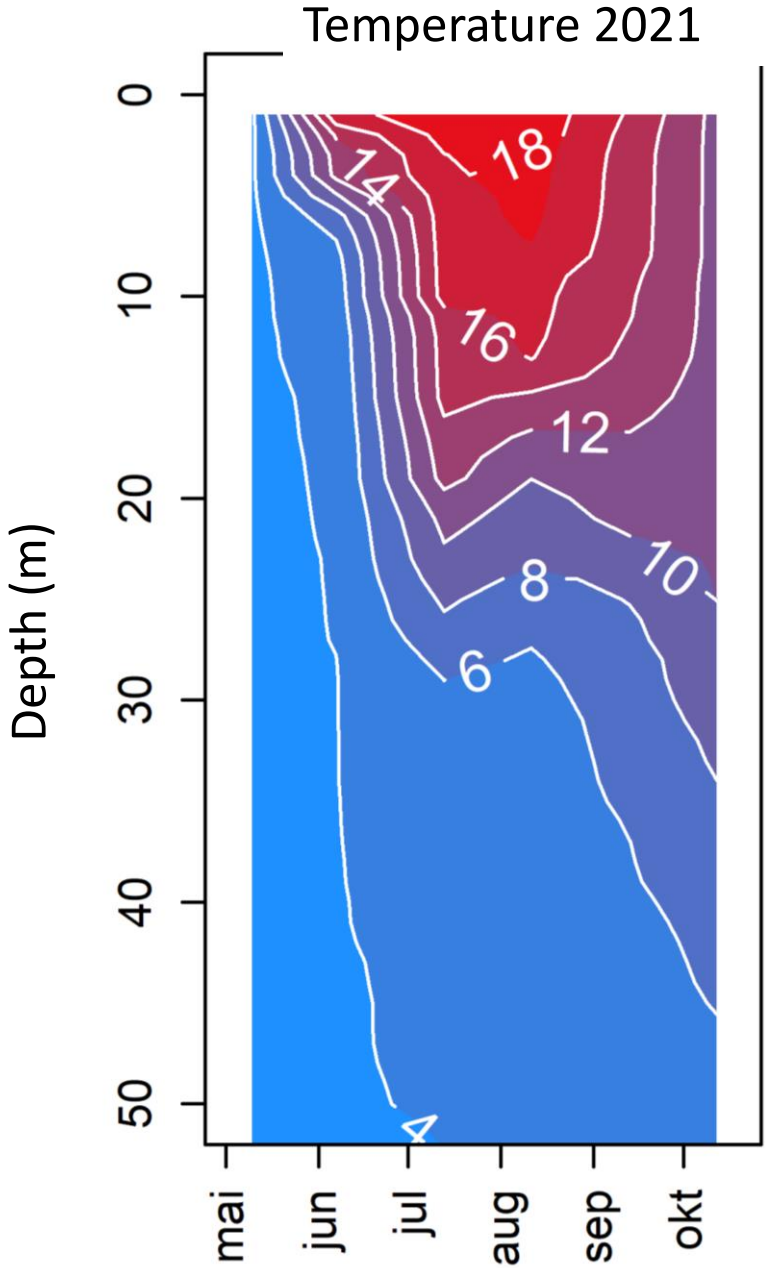




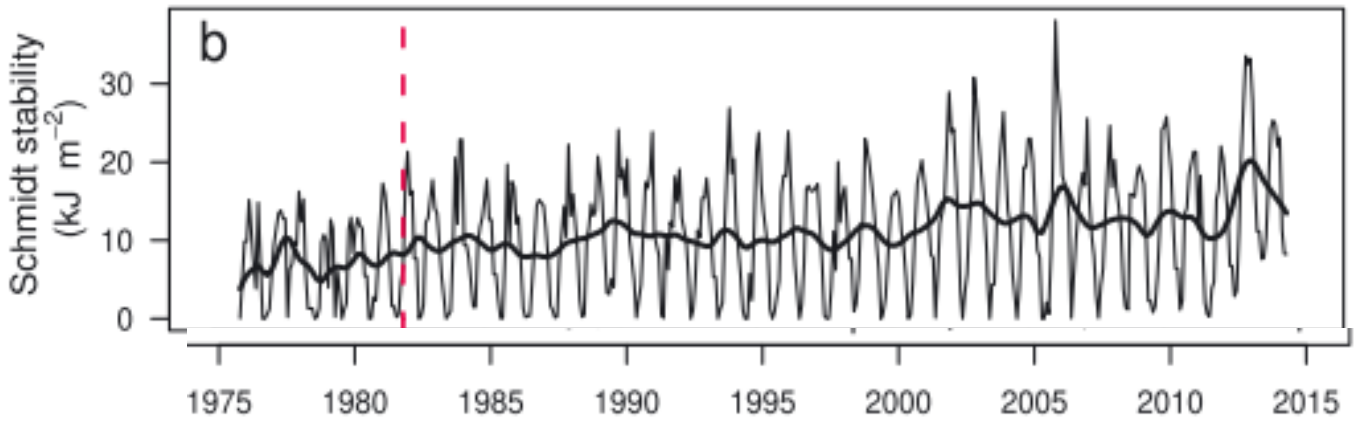
Coregonus albula & *Osmerus eperlanus*

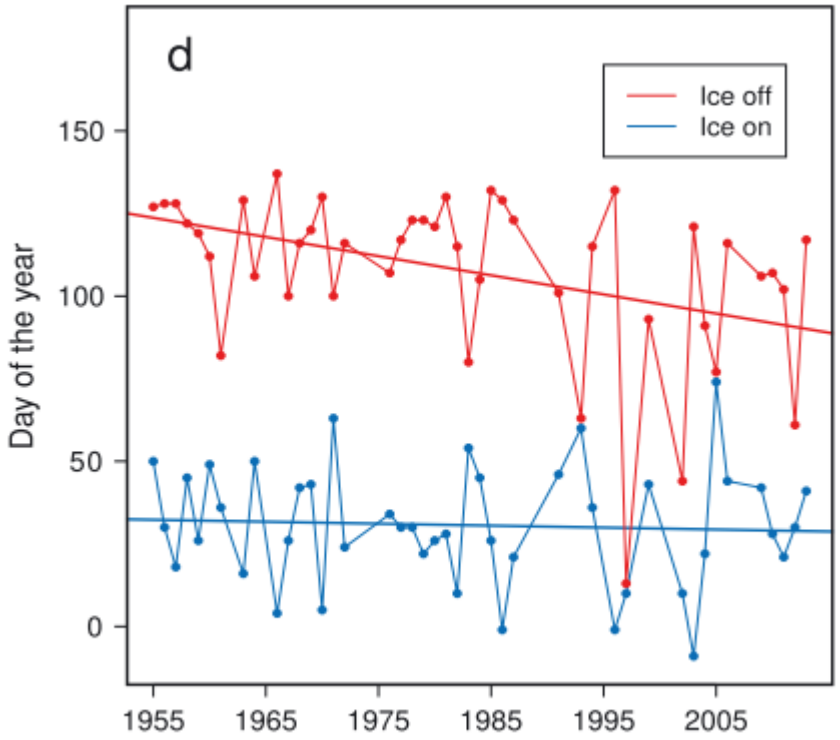
Lake surface warming 0,4˚C per decade

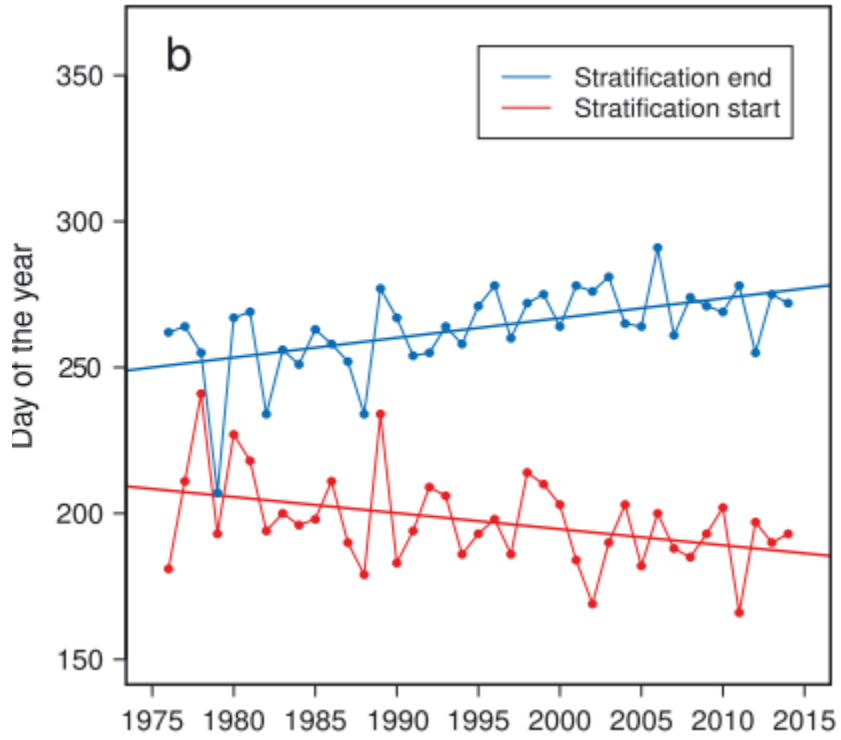




- Higher stratification stability

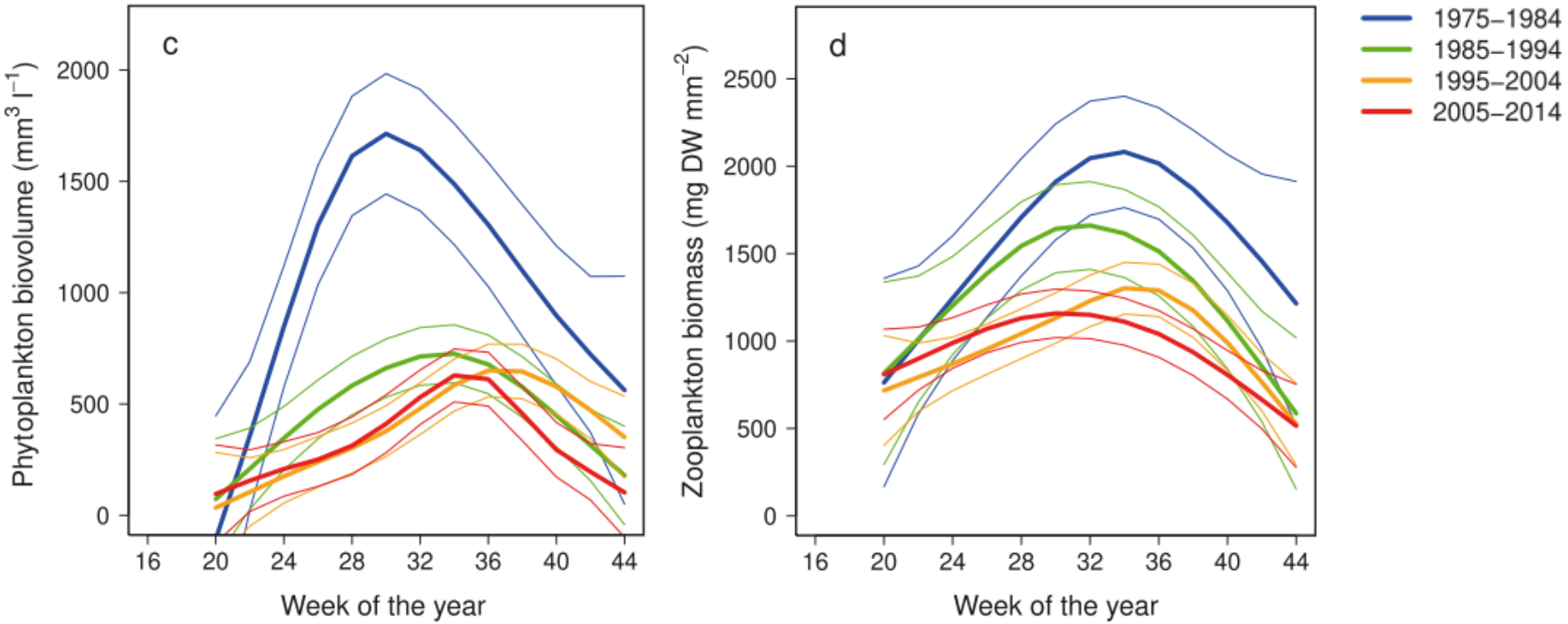






Changes in phenology

- Generally later peaks for phytoplankton (5/10 classes)
  - Why?
- Tendency for earlier peaks for zooplankton (not significant)



2019 and 2021: cyanobacterial blooms

2019 and 2021: cyanobacterial blooms

REVIEW

Freshwater Biology WILEY

Cyanobacterial blooms in oligotrophic lakes: Shifting the high-nutrient paradigm

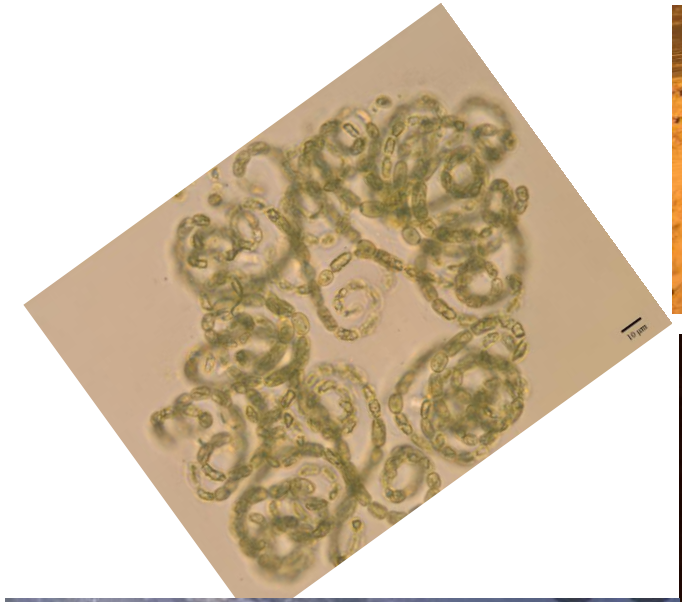
Kaitlin L. Reinl[1] | Justin D. Brookes[2] | Cayelan C. Carey[3] | Ted D. Harris[4] |

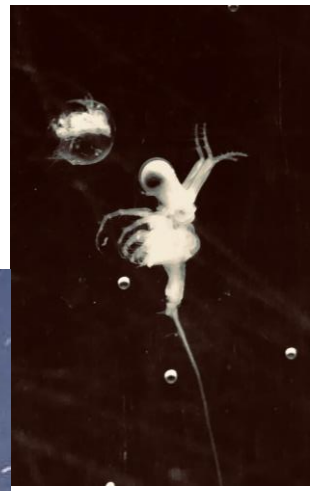
A first assessment of cyanobacterial blooms in oligotrophic Lake Superior

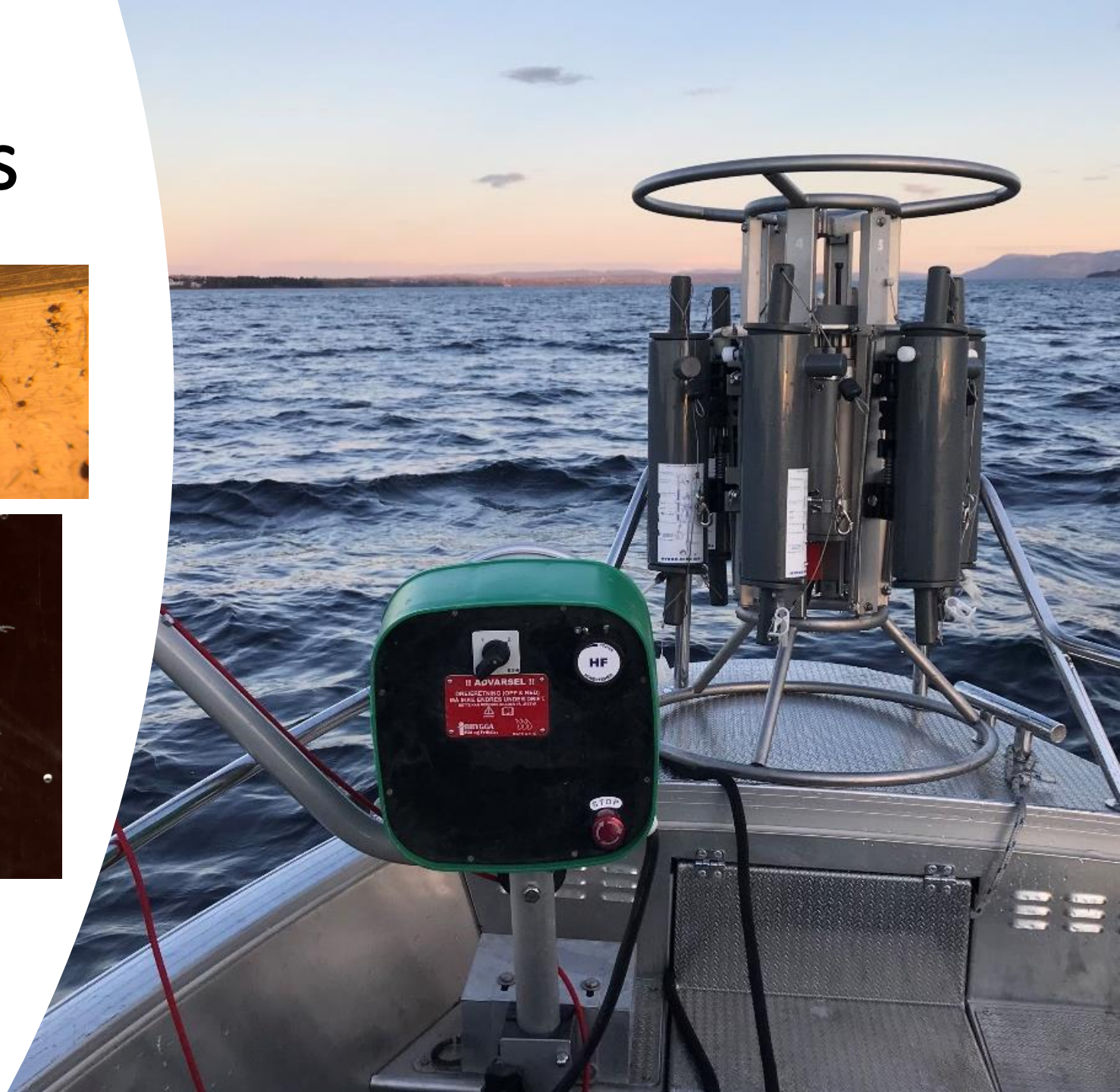
Robert W. Sterner,[1*] **Kaitlin L. Reinl**,[1] **Brenda Moraska Lafrancois**,[2] **Sandra Brovold**,[1] **Todd R. Miller**[3]
[1]Large Lakes Observatory, University of Minnesota Duluth, Duluth, Minnesota

Fig. 2. RapidEye Ortho Tile (5 m) image of the Lake Superior south shore from approximately Wisconsin Point to the Brule River (Fig. 1) from 09 August 2018 (Planet Team 2017), color-enhanced to emphasize bloom.

Future perspectives







Future perspectives:

Eutrofiering av Mjøsa -Kartlegging av årsaksforhold og kilder til fosfor i ni delnedbørfelt
Bechmann, Marianne (NIBIO); Thrane, Jan-Erik (NIVA); Kværnø, Sigrun (NIBIO); Turtumøygard, Stein (NIBIO)

Reducing phosphorous runoff from sources in catchments

Tabell 3.4. Tiltak for reduserte fosfortilførsler og estimerte effekter (Kværnø m.fl. 2019).

Kg fosfor per år	Lenaelva	Hunnselva	Flagstadelva	Svartelva	Moelva	Heggshuselva	Skanselva og Bausbakkelva	Gausa	Totalt
Opprydding i spredt avløp	900	1000	500	1600	1000	100	200	1200	**6500**
Kommunalt avløp – drift/overløp	Ikke estimert								-
Overvintring i stubb	230	140	80	50	280	20	10	-	**810**
Grasdekte vannveier	540	220	420	350	710	50	60	-	**2350**
Grasdekte kantsoner	110	70	50	70	80	20	20	-	**420**
Fangdammer	Ikke estimert								-
Reduksjon i jordas fosforstatus (effekt på løst fosfat ikke estimert)	>230	>180	>100	>170	>260	>50	>50	>250	**>1290**
Tiltak i potet og grønnsaker	Ikke estimert								-
Miljøvennlig spredning av husdyrgjødsel	Ikke estimert								-
Reduksjon i punktkilder	Ikke estimert								-
									>11 370

*Tiltakseffekter for jordbruksarealer er beregnet for 2016 med Agricat2-modellen[4]

Future perspectives: Restoration in the area

- **SABICAS: Nature based solutions** in river Gausa (flood plains, riparian zones):
- **Dam removal** in important trout river Tromsa
- **Trout population has been increasing:** Termination of stocking program for the «Hunder trout»

Norway blows up hydro dam to restore river health and fish stocks

Campaign by local angling club to free fishes' migratory routes is part of move across Europe to create free-flowing rivers

Campaigners say removing the seven-metre dam, in Fåvang, Norway, which has not been used in