Platform Meeting on Invasive Alien Species, November 29th, 2017

LIFE+ BIOAQUAE: eradication of introduced fish and recovery of high mountain lakes (Actions C.1 and C.2)

Parco Nazionale Gran Paradiso

BIOAQUAE

Biodiversity Improvement of Aquatic Alpine Ecosystems

Fish introductions in mountain lakes

REF: Ventura et al. 2017. In: Adv. Global Change Res., Vol. 62.

LIFE+ Project Bioaquae

BIOAQUAE

Biodiversity Improvement of Aquatic Alpine Ecosystems

1. Eradication of non-native fish species from some high altitude alpine lakes
2. Conservation actions for the marble trout populations (*Salmo marmoratus*)
3. Experimentation with phytodepuration techniques to improve the quality of high altitude aquatic environments

LIFE+ Project Bioaquae

LIFE+ Project Bioaquae

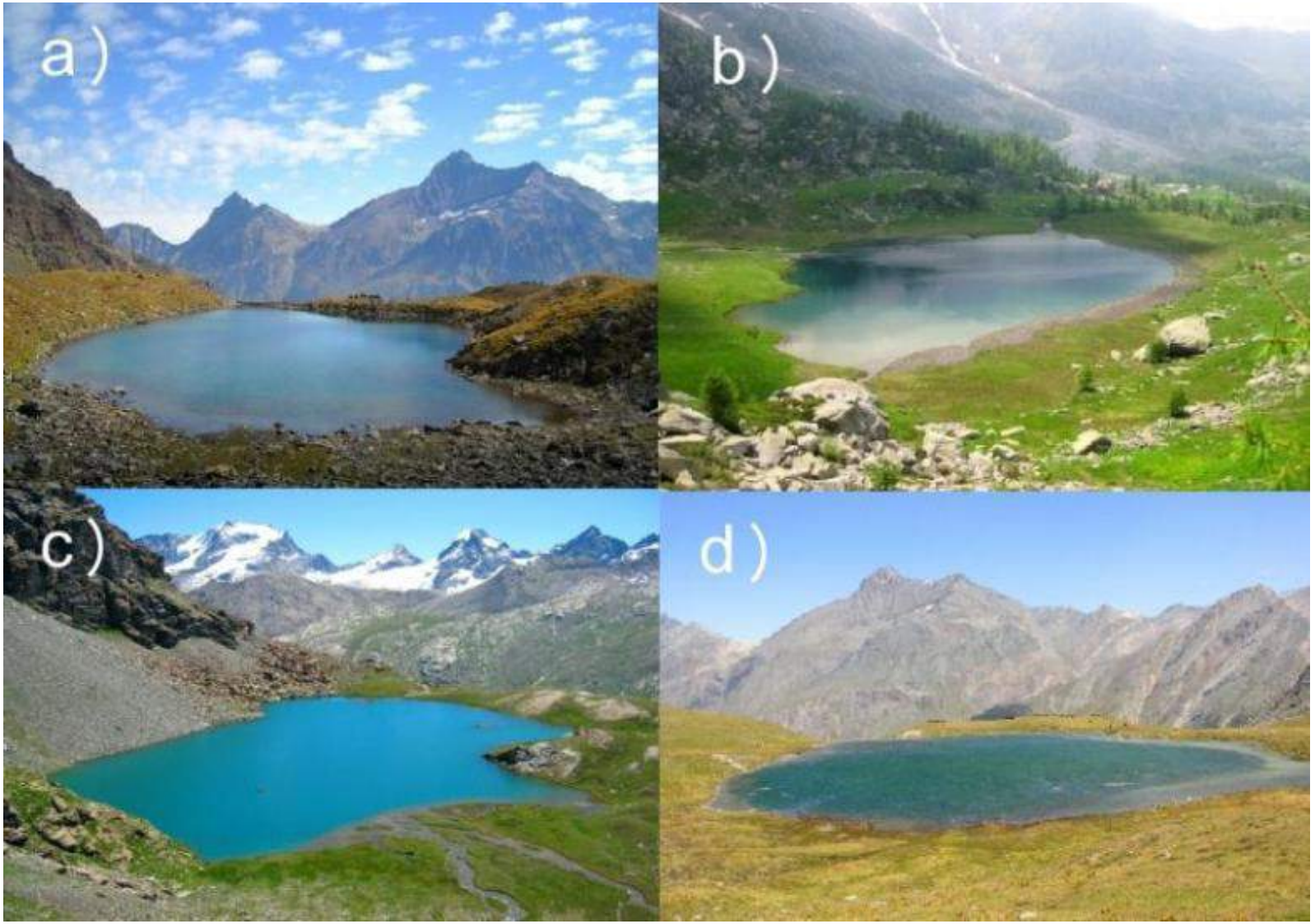
Table I. Main geographic, morphometric and chemical data of the Gran Paradiso National Park studied lakes. Geology – AG: catchment entirely composed by acidic gneiss; CS: catchment dominated by thick covering of calcareous schists. TP: total phosphorus; k: photosynthetic active radiation (PAR) attenuation coefficient; DJO: Lake Djouan; DRE: Lake Dres; LEY: Lake Leynir; NER: Lake Nero. Averaged variables are expressed as mean ± standard deviation (SD).

	DJO	DRE	LEY	NER
Latitude N	45°33′27”	45°24′45”	45°30′28”	45°33′06”
Longitude E	07°10′43”	07°13′25”	07°09′08”	07°10′07”
Altitude (m)	2515	2087	2747	2671
Maximum depth (m)	3.0	7.4	22.1	6.0
Area (ha)	1.3	2.6	4.5	1.7
Catchment area (ha)	31	292	157	87
Geology	CS	AG	CS	CS
Maximum surface temperature (°C) [a]	19.0	16.0	12.5	15.0
k [b]	0.35 ± 0.08	0.29 ± 0.07	0.18 ± 0.04	0.20 ± 0.02
pH [c]	8.7 ± 0.4	7.0 ± 0.5	8.0 ± 0.3	8.0 ± 0.3
Total phosphorus – TP [c] (µg L^{-1})	3.5 ± 1.3	4.3 ± 2.5	3.0 ± 0.9	2.3 ± 1.6

[a] measured between 2006 and 2015, 1–4 measurements per ice-free season; [b] averaged over 11–18 measures between 2010 and 2015; [c] averaged over 22–25 measures between 2008 and 2015.

Action: C.1 C.1 C.2 C.1

LIFE+ Project Bioaquae



Platform Meeting on Invasive Alien Species, November 29th, 2017

LIFE+ Project Bioaquae

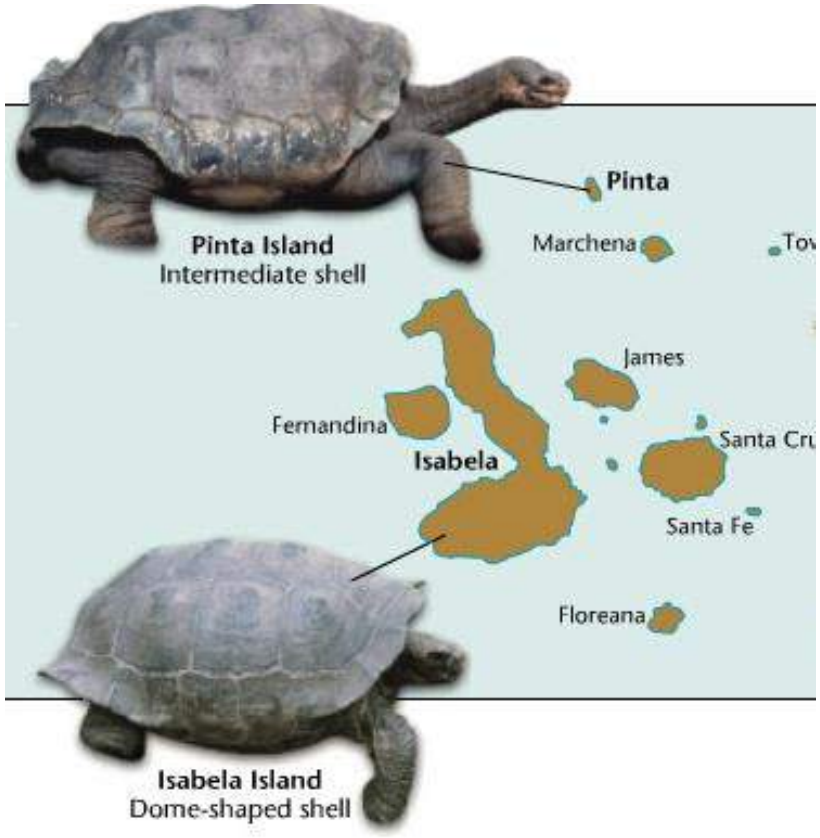
Foto A. Provenzale

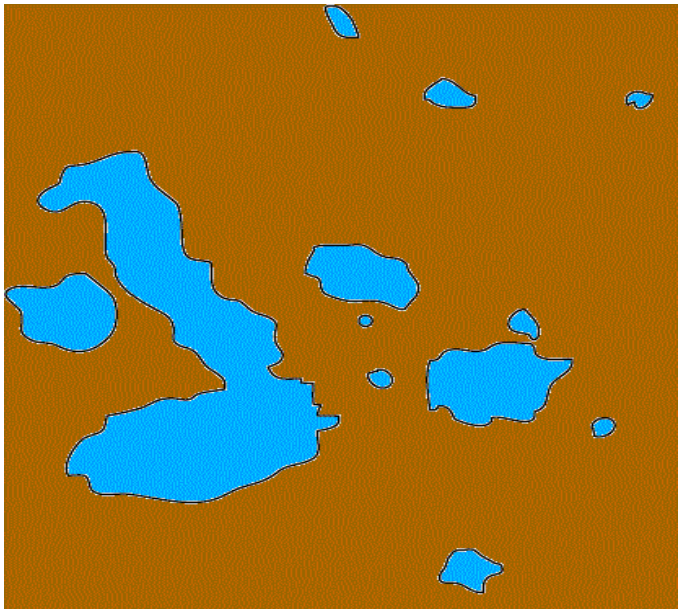
Platform Meeting on Invasive Alien Species, November 29th, 2017

LIFE+ Project Bioaquae

Foto A. Provenzale

Conservation value

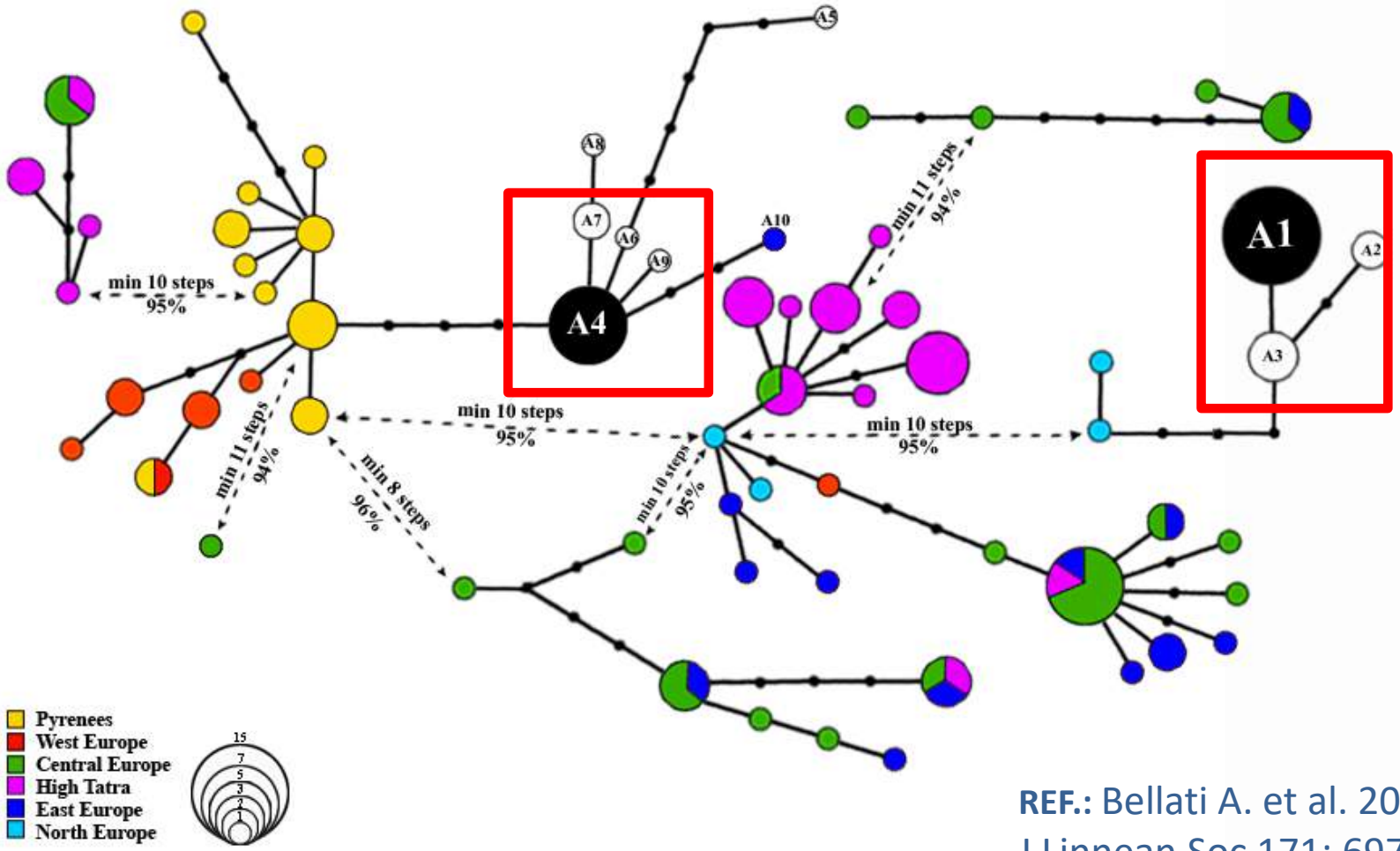




Conservation value

Conservation value

Unrooted haplotype networks showing disconnections at 97% parsimony threshold



REF.: Bellati A. et al. 2014. Zool J Linnean Soc 171: 697-715

Non invasive methods

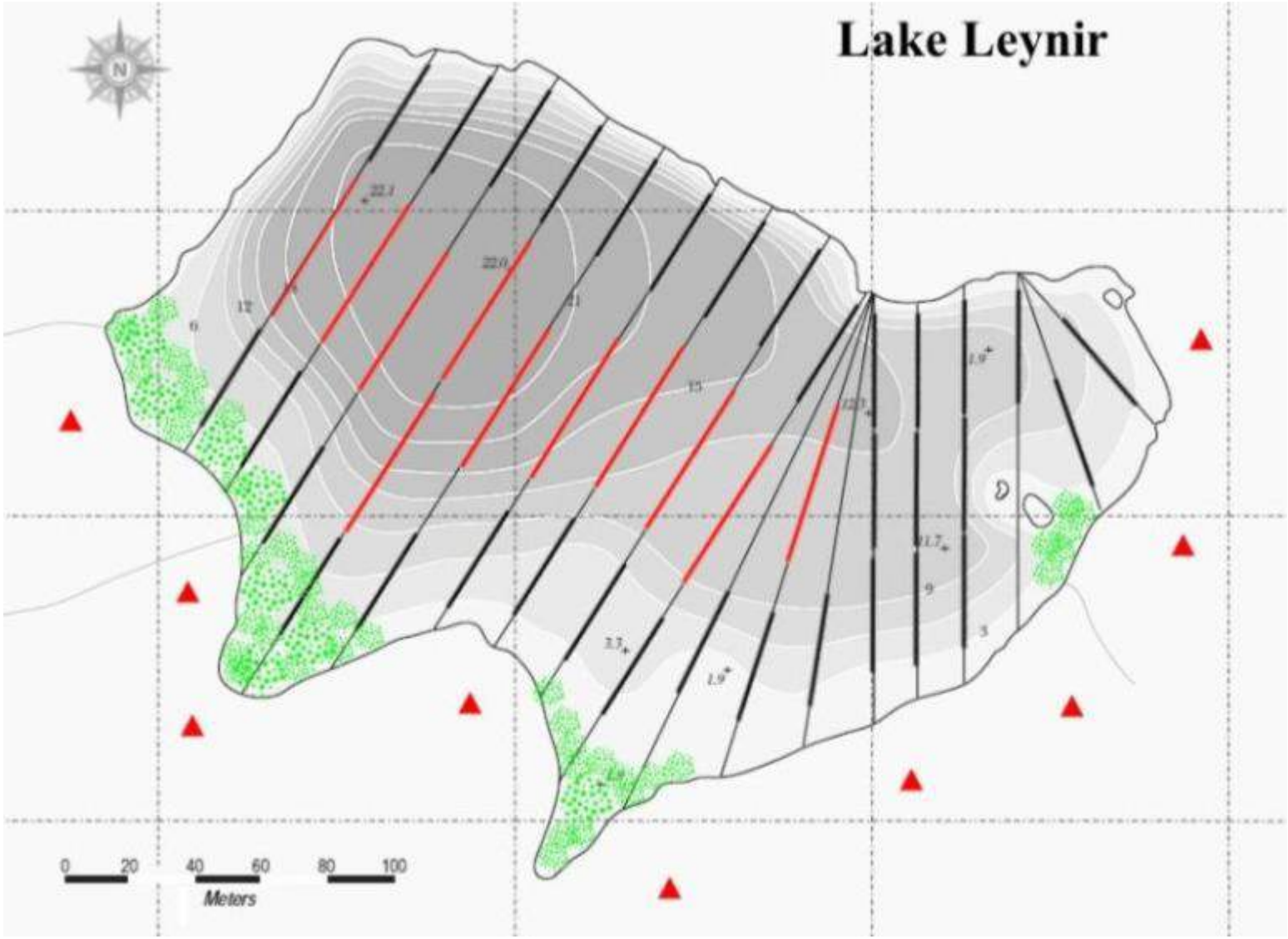
Eradication of Nonnative Fish by Gill Netting from a Small Mountain Lake in California

Roland A. Knapp[1]
Kathleen R. Matthews[2]

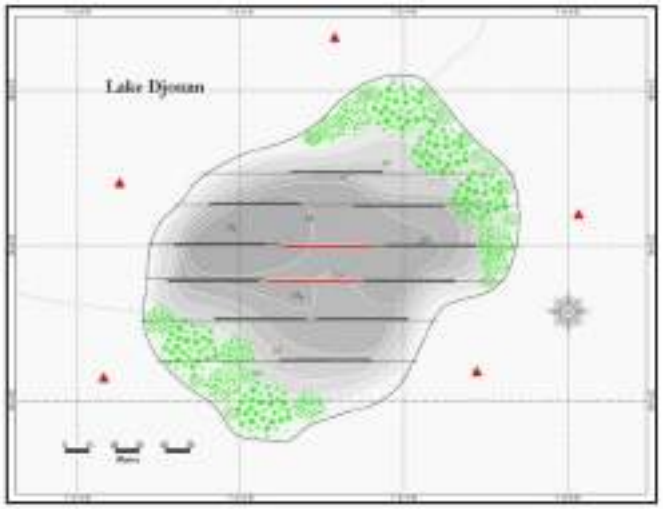
REF.: Knapp & Matthews 1998
Restoration Ecology 6:207

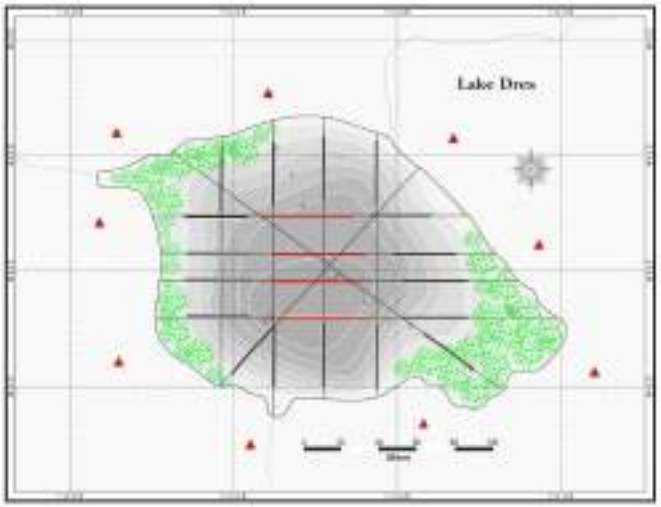
Methods

Methods - Gillnetting

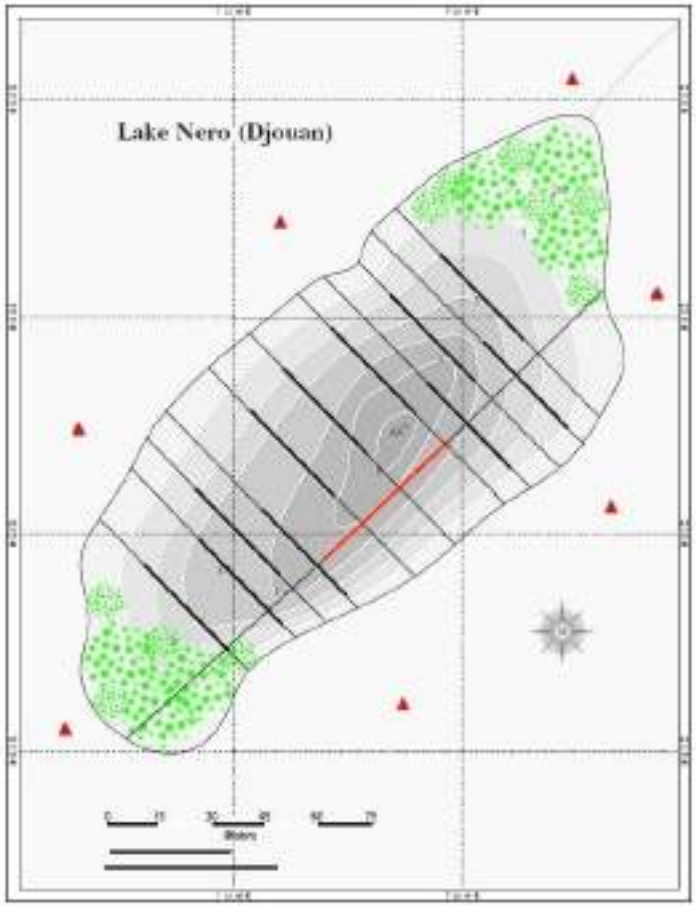


Methods - Gillnetting





RETE BRANCHIALE MULTIMAGLIA (36 X 1.8 m)
RETE BRANCHIALE MONOFILAMENTO (MAGLIA 30 mm, 50 X 5 m)
PANNELLO INFORMATIVO / SEGNALE PERICOLO BALNEAZIONE
AREA RIPRODUTTIVA PER TRAPPOLE A NASSA



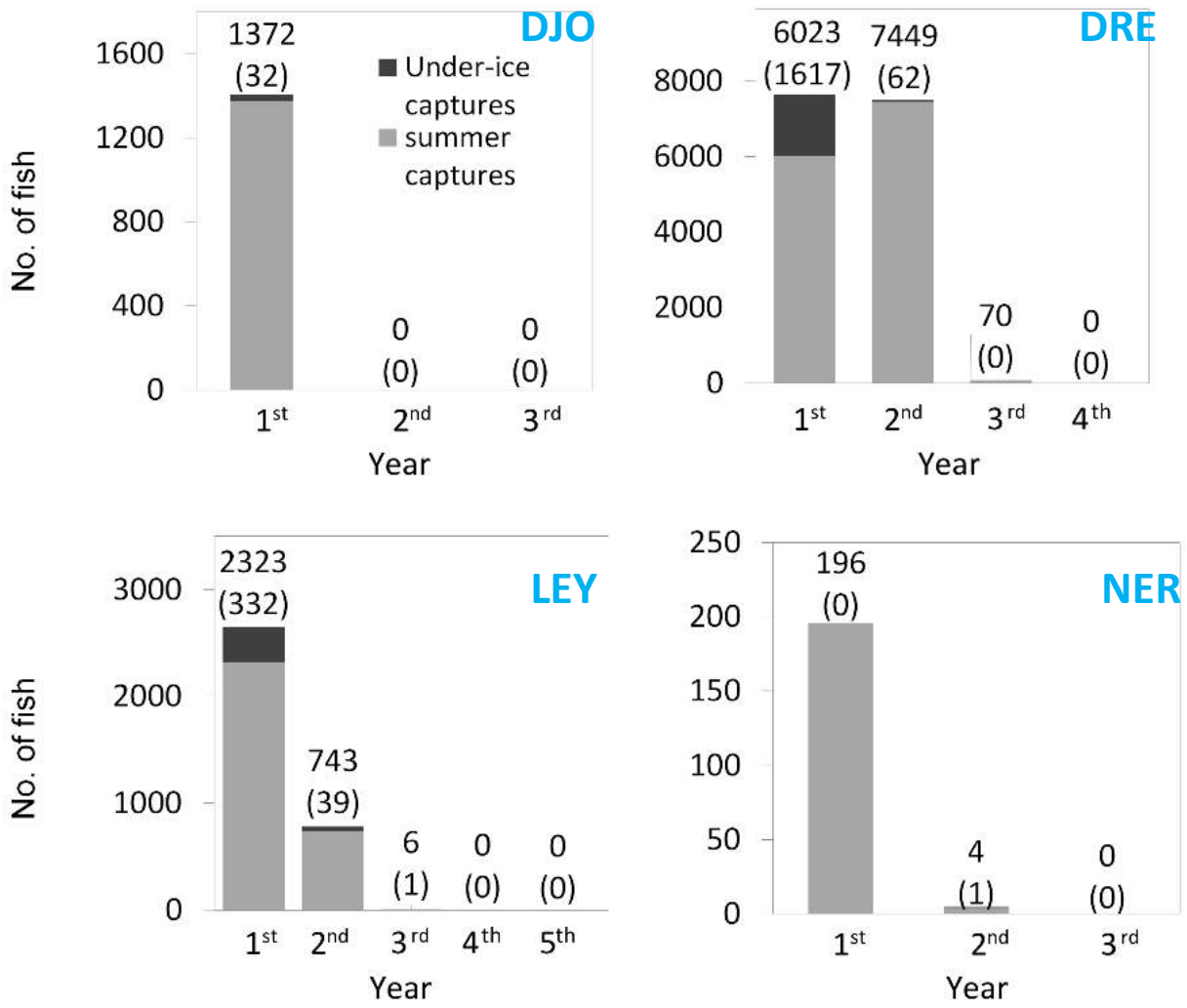
RETE BRANCHIALE MULTIMAGLIA (36 X 1.8 m)
RETE BRANCHIALE MONOFILAMENTO (MAGLIA 30 mm, 50 X 4 m)
PANNELLO INFORMATIVO / SEGNALE PERICOLO BALNEAZIONE
AREA RIPRODUTTIVA PER TRAPPOLE A NASSA

Eradication efforts

Lake	DJO	DRE	LEY	NER
Number of nets	14	30 (+7)	50	12
Total nets surface (m^2)	921	2620	8027	1148
Number of surveys of the gillnets	39	80	52	30
Number of electrofishing sessions	4	39	7	0

Eradication: brook trout captures

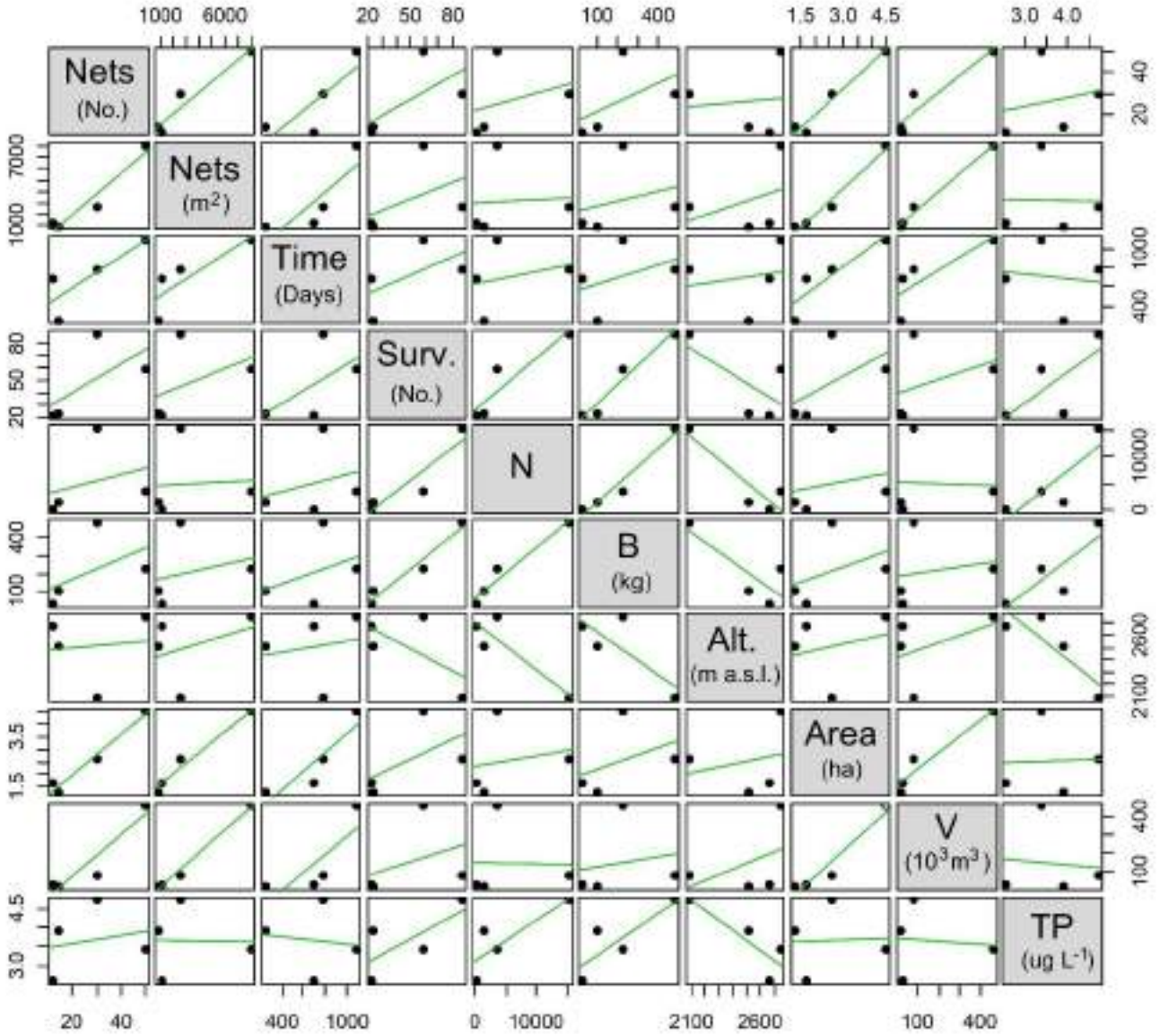
Fish extinction



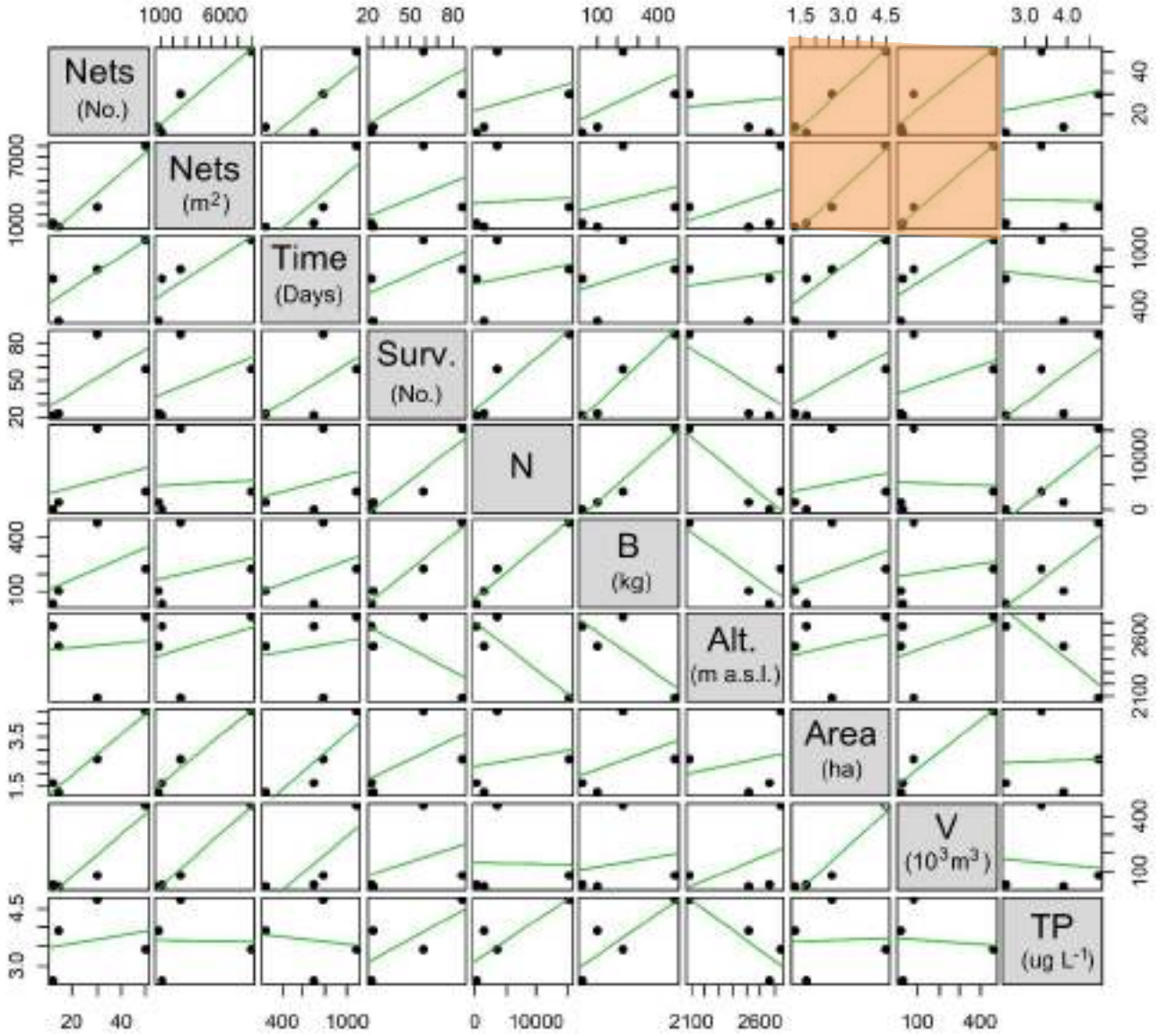
Eradication summary

Lake	DJO	DRE	LEY	NER
Date of settlement of the first nets	4 Jul 2013	24 Jun 2013	5 Ago 2013	11 Jul 2013
Date of removal of the last fish	14 Jun 2014	11 Aug 2015	5 Jul 2016	7 Jun 2015
Date of removal of the nets	17 June 2016	10 Jun 2017	8 Jul 2017	3 Jul 2016
Duration of the eradication process (days)	95-346	781	785-1095	438-696

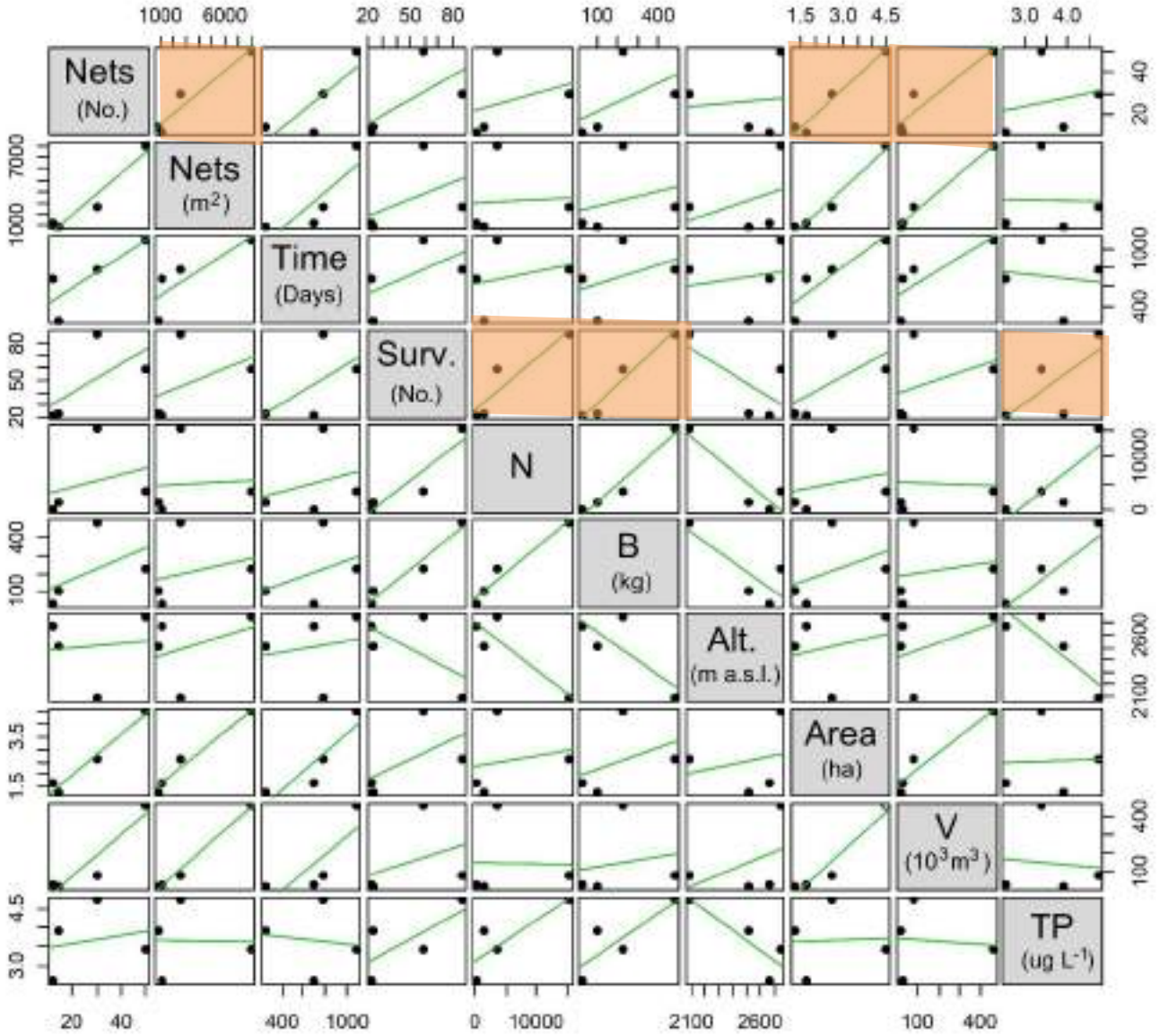
Applicability



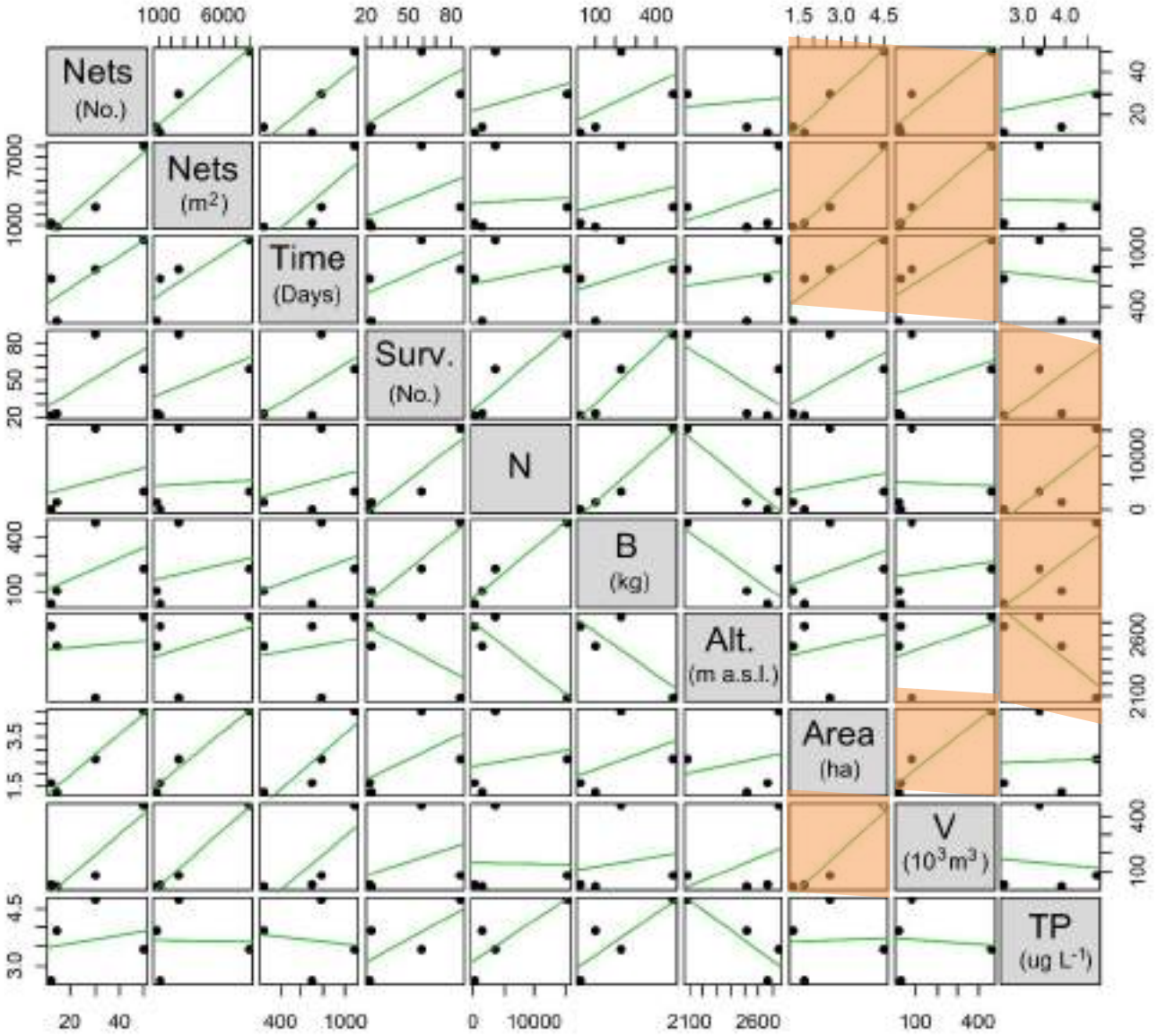
Applicability: equipment constrains



Applicability: time/personnel constrains



Applicability: environmental constrains



Ecological consequences

Direct impact

REF: Tiberti et al. 2014. Hydrobiologia 724:1-19.

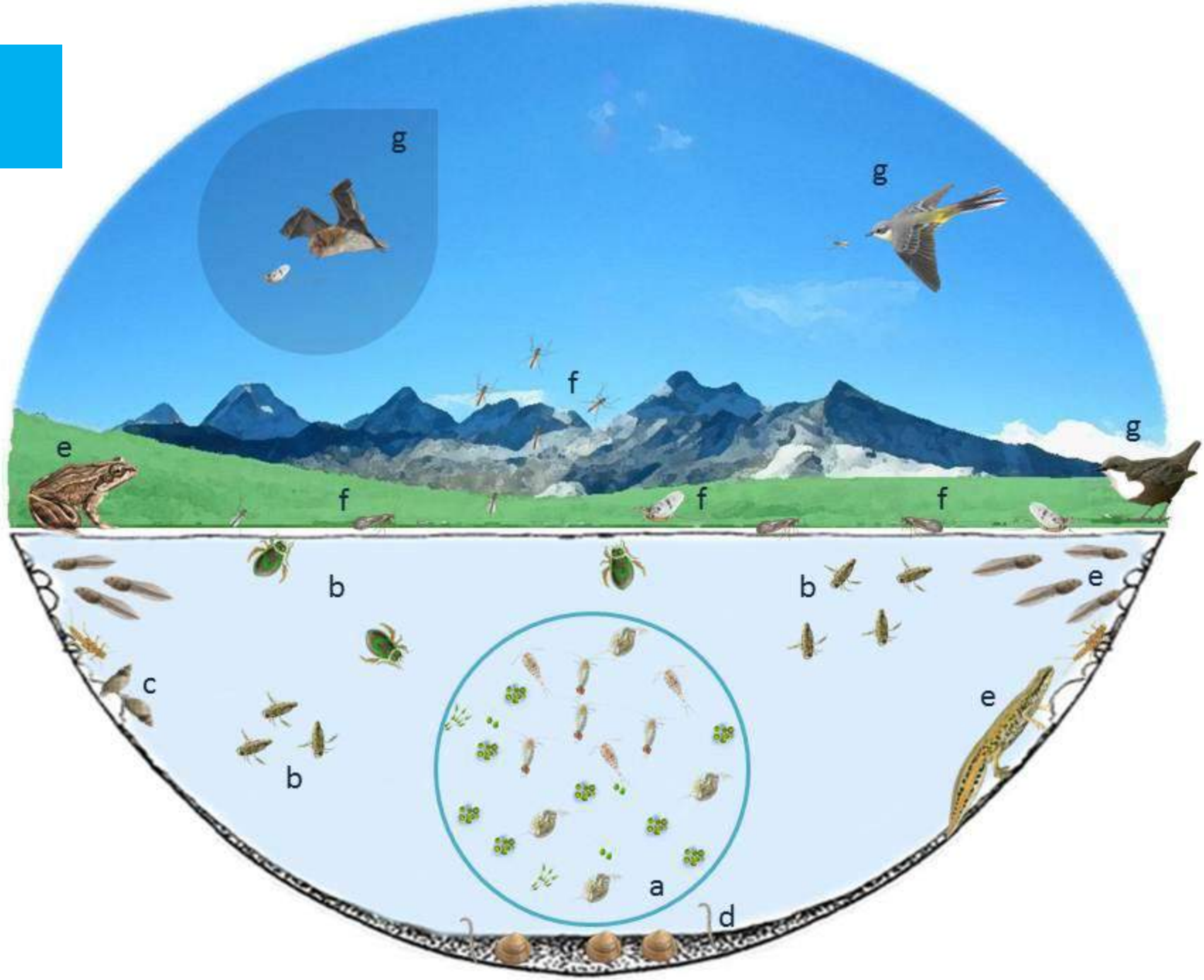
Ecological consequences

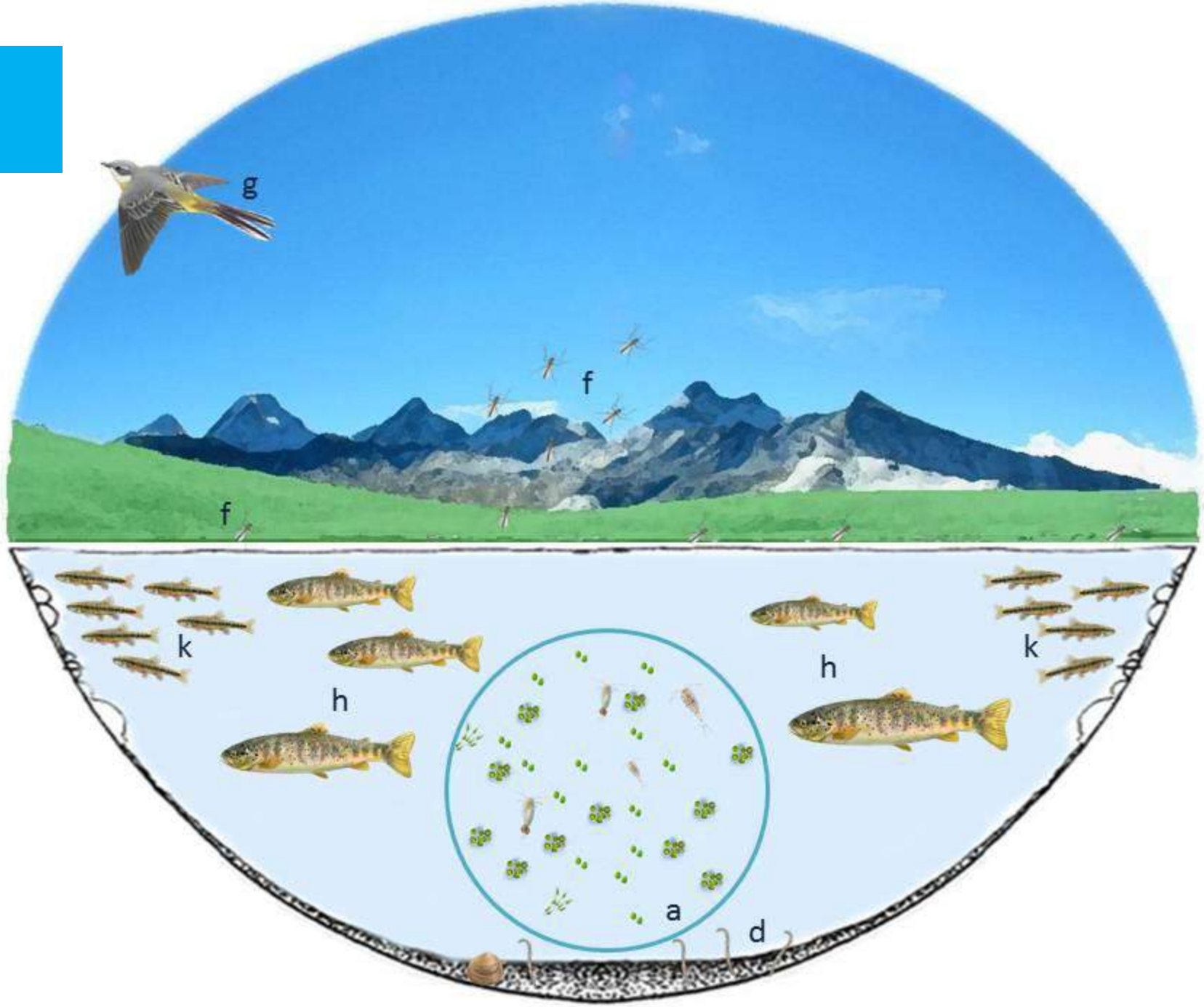
Direct impact

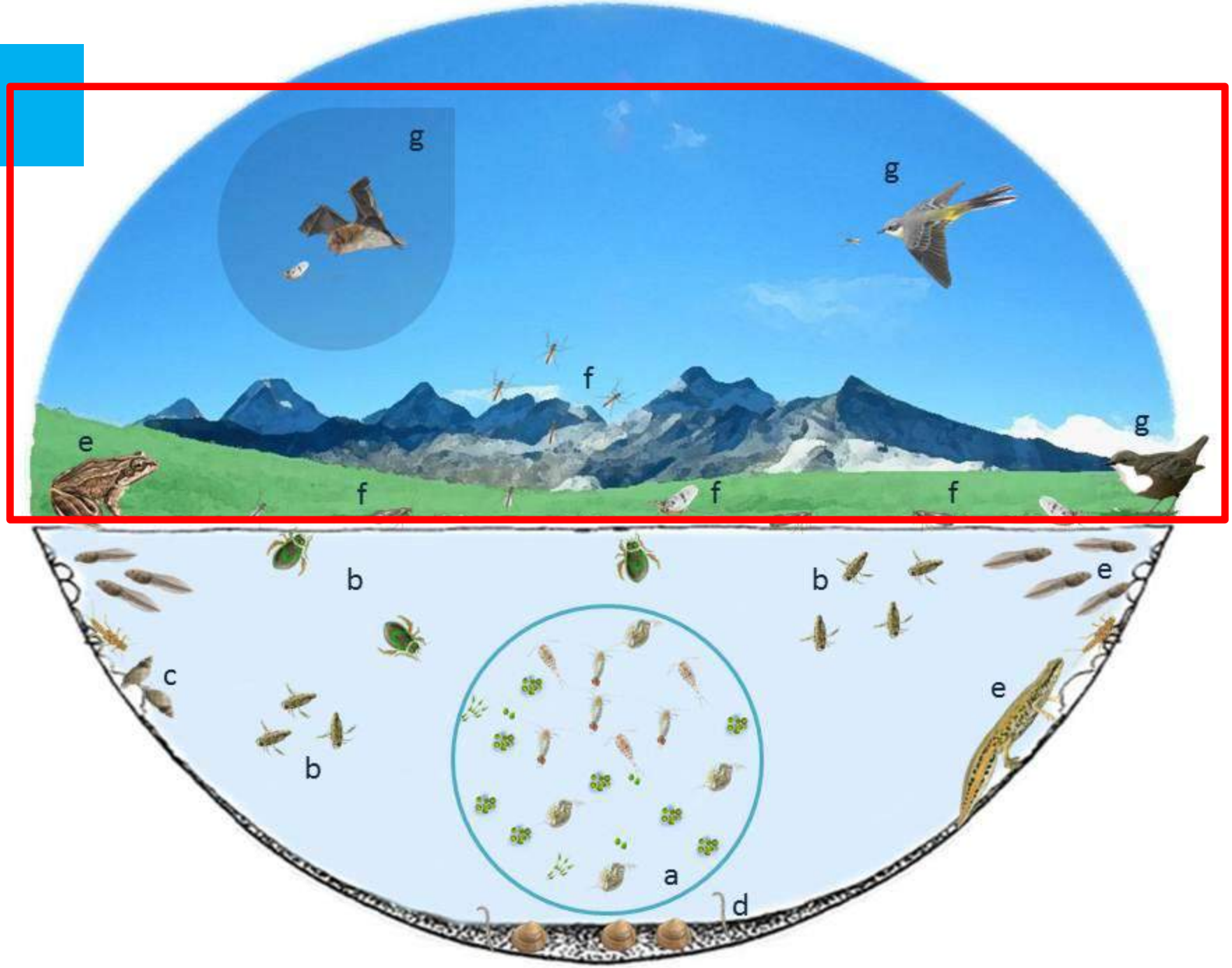
REF: Tiberti and von Hardenberg, 2012. Amphibia-reptilia 33: 303-307

Ecological consequences

Direct impact

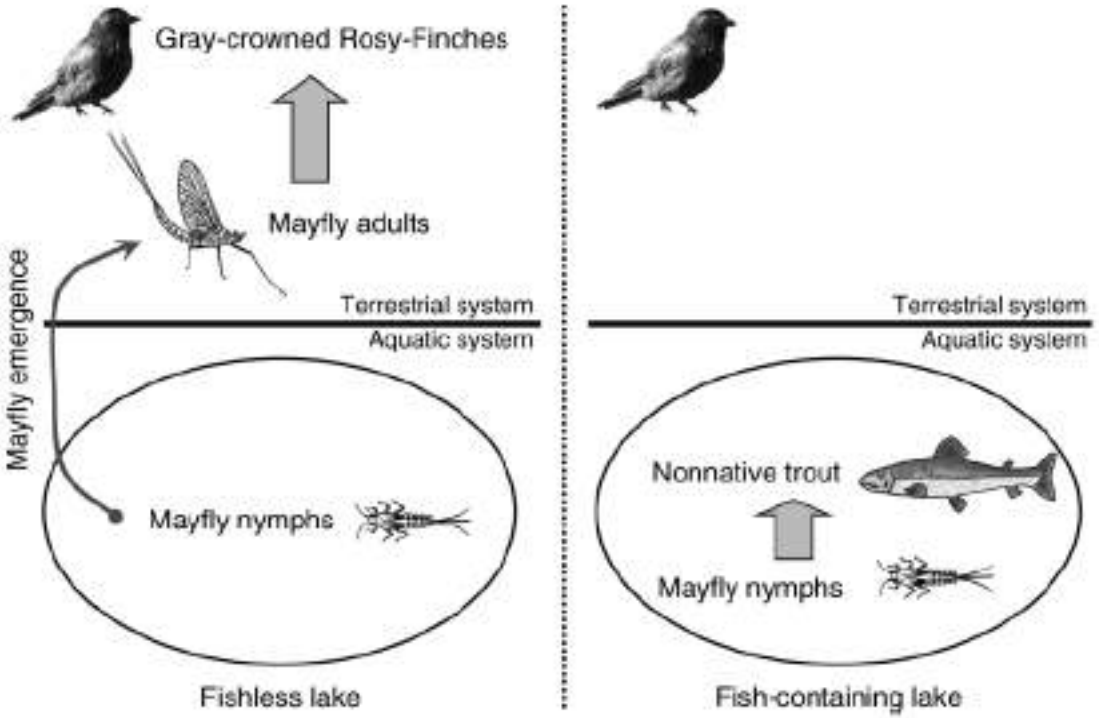

g
g
f
e
g
f
f
f
b
b
e
c
e
b
a
d


g
f
f
k
h
h
k
a
d


g
g
f
e
f
f
f
g
b
b
e
c
e
b
a
d

Ecological consequences

Lake-land reciprocal subsidies



REF: Enpanchin et al. 2010. Ecology 91: 2406-2415

Expected results

Ecological resilience

Amphibians

Zooplankton community

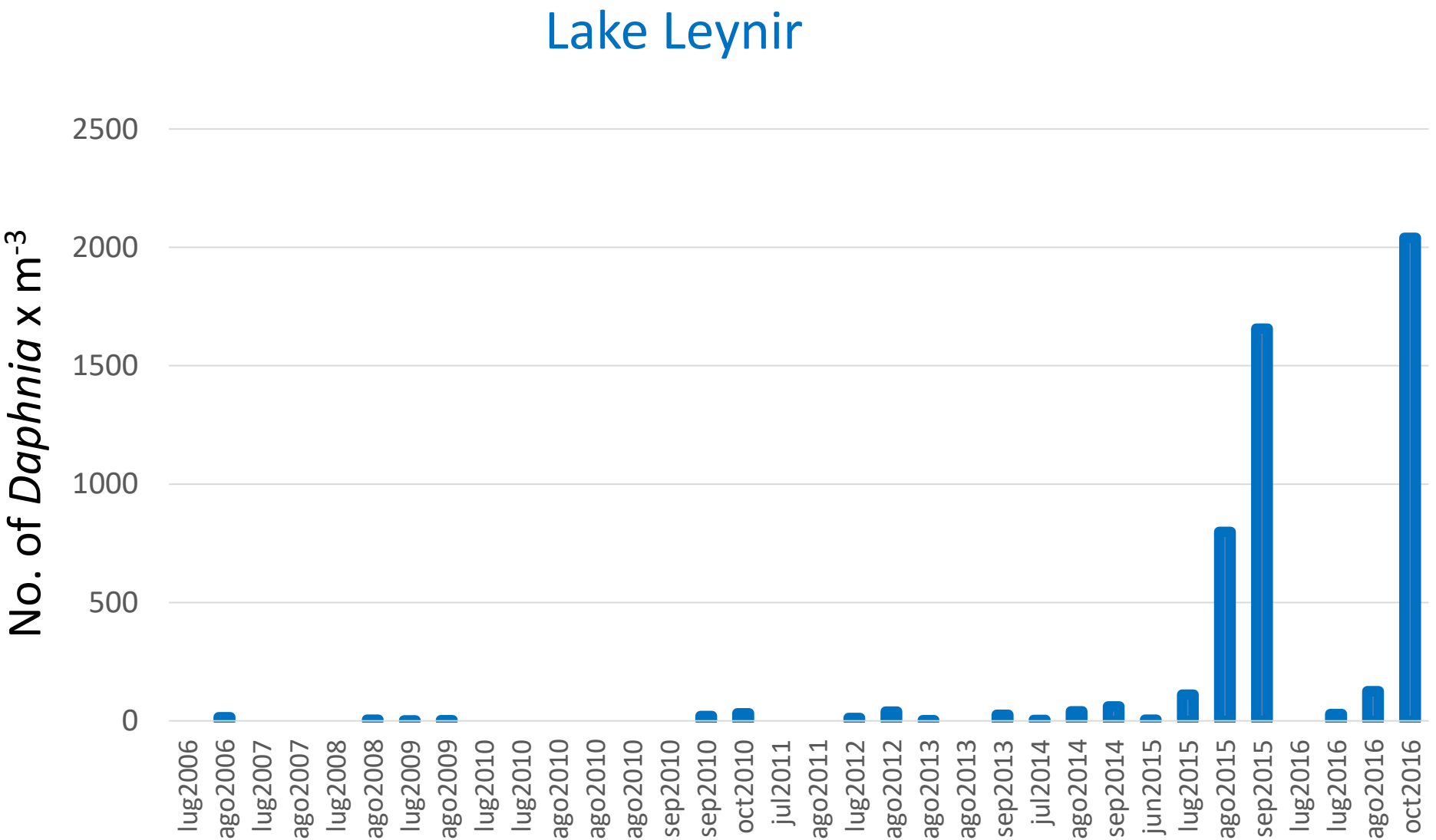
Aquatic insects

Trophic status

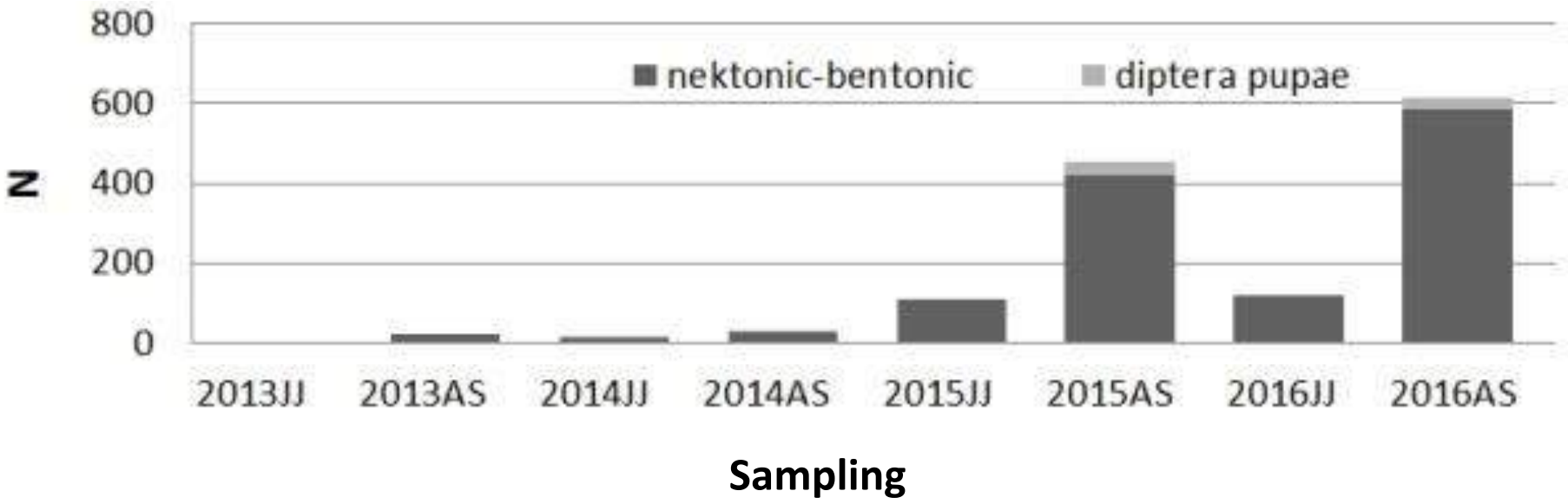
Ecological connection between terrestrial and aquatic habitats

Monitoring: Action D.1

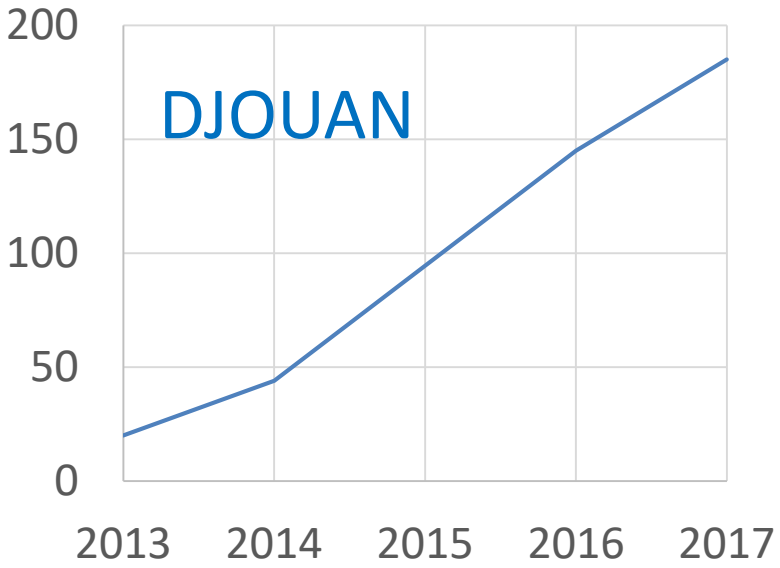
Resilience

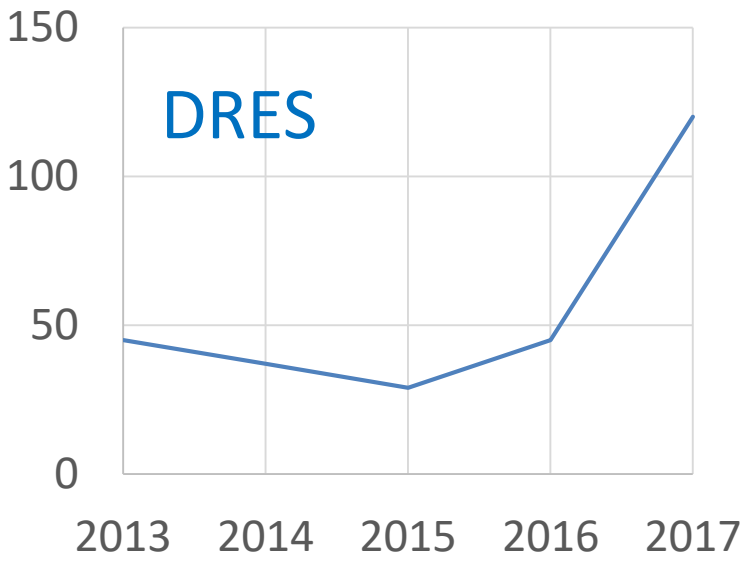

Lake Leynir
No. of Daphnia x m-3
2500
2000
1500
1000
500
0
lug2006
ago2006
lug2007
ago2007
lug2008
ago2008
lug2009
ago2009
lug2010
lug2010
ago2010
ago2010
ago2010
sep2010
sep2010
oct2010
jul2011
ago2011
lug2012
ago2012
ago2013
ago2013
sep2013
jul2014
ago2014
sep2014
jun2015
lug2015
ago2015
sep2015
lug2016
lug2016
ago2016
oct2016

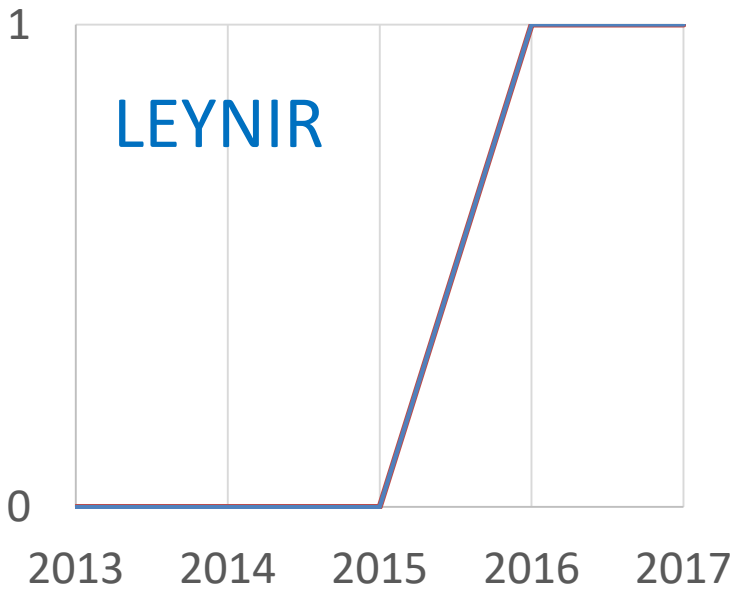
Resilience

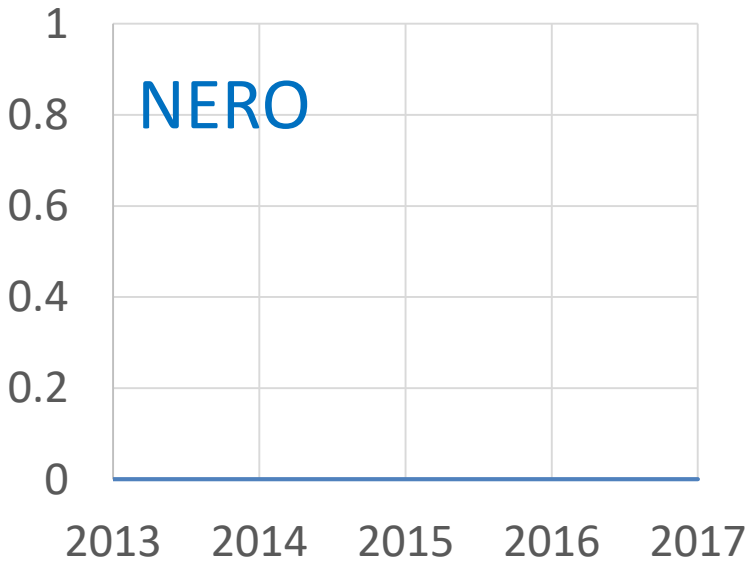

800
600
400
200
0
N
nektonic-bentonic
diptera pupae
2013JJ
2013AS
2014JJ
2014AS
2015JJ
2015AS
2016JJ
2016AS
Sampling

Resilience


DJOUAN
200
150
100
50
0
2013
2014
2015
2016
2017


DRES
150
100
50
0
2013
2014
2015
2016
2017


LEYNIR
1
0
2013
2014
2015
2016
2017


NERO
1
0.8
0.6
0.4
0.2
0
2013
2014
2015
2016
2017

… and then eradications come

Fish eradication is **an advanced conservation action**

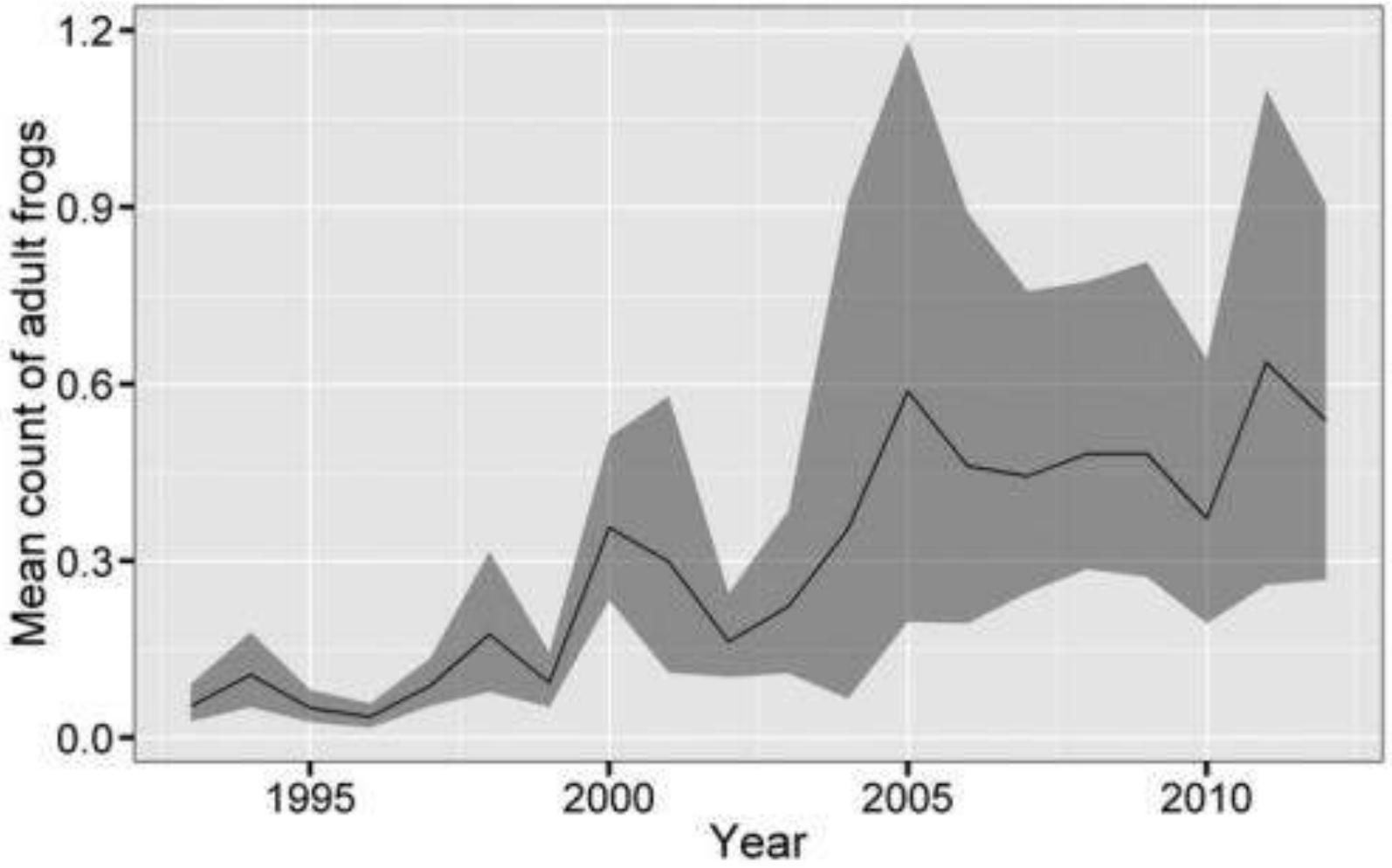
Formal protection, i.e. proibition:

- Fish stocking
- Fishing activities
- Use of live bait (such as minnows)

Effective protection (effective surveillance service)

Role of **protected areas**

Possible (and effective) solutions exist!



REF: *Knapp et al., 2016. PNAS:* 201600983

Fishing and stocking prohibition

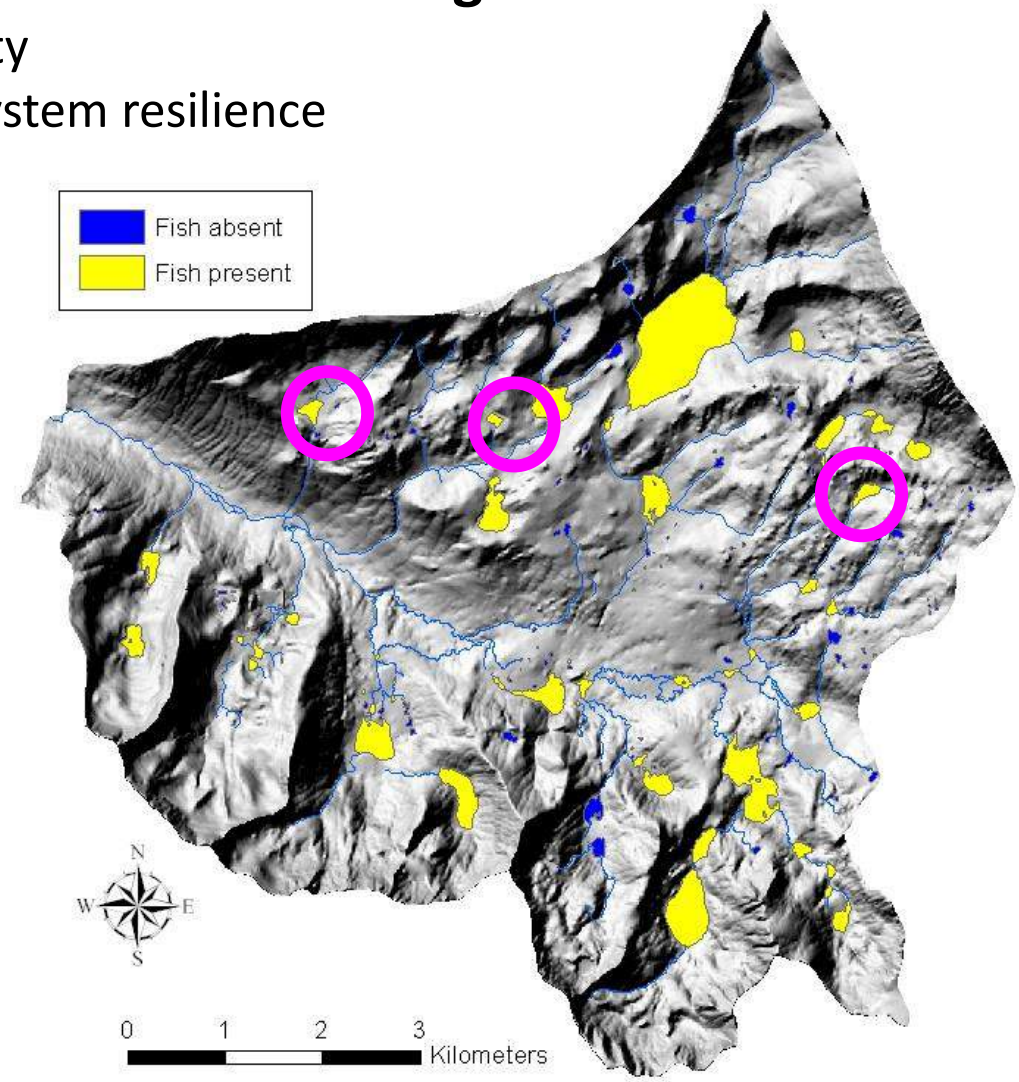
Without stocking the 10-40% of intorduced fish populations are doomed to extinction in a few generations

REF: Ventura et al. 2017. In: Adv. Global Change Res., Vol. 62.

A long way.... a question of scale

Is restoring individual lakes enough?

- Population viability
- Species and ecosystem resilience



A long way... how to define IAS?

Alien native species (!?)

A long way... education

Contacts: **www.bioaquae.eu**

LIFE+ BIOAQUAE

@bioaquae

GRAZIE!

R Tiberti
rocco.tiberti@gmail.com

www.bioaquae.eu

LIFE+ BIOAQUAE

@bioaquae

BIOAQUAE
Biodiversity Improvement of Aquatic Alpine Ecosystems