



Mosquito control and surveillance in wetlands in Sweden

Martina Schäfer



An introduction to the Nedre Dalälven region

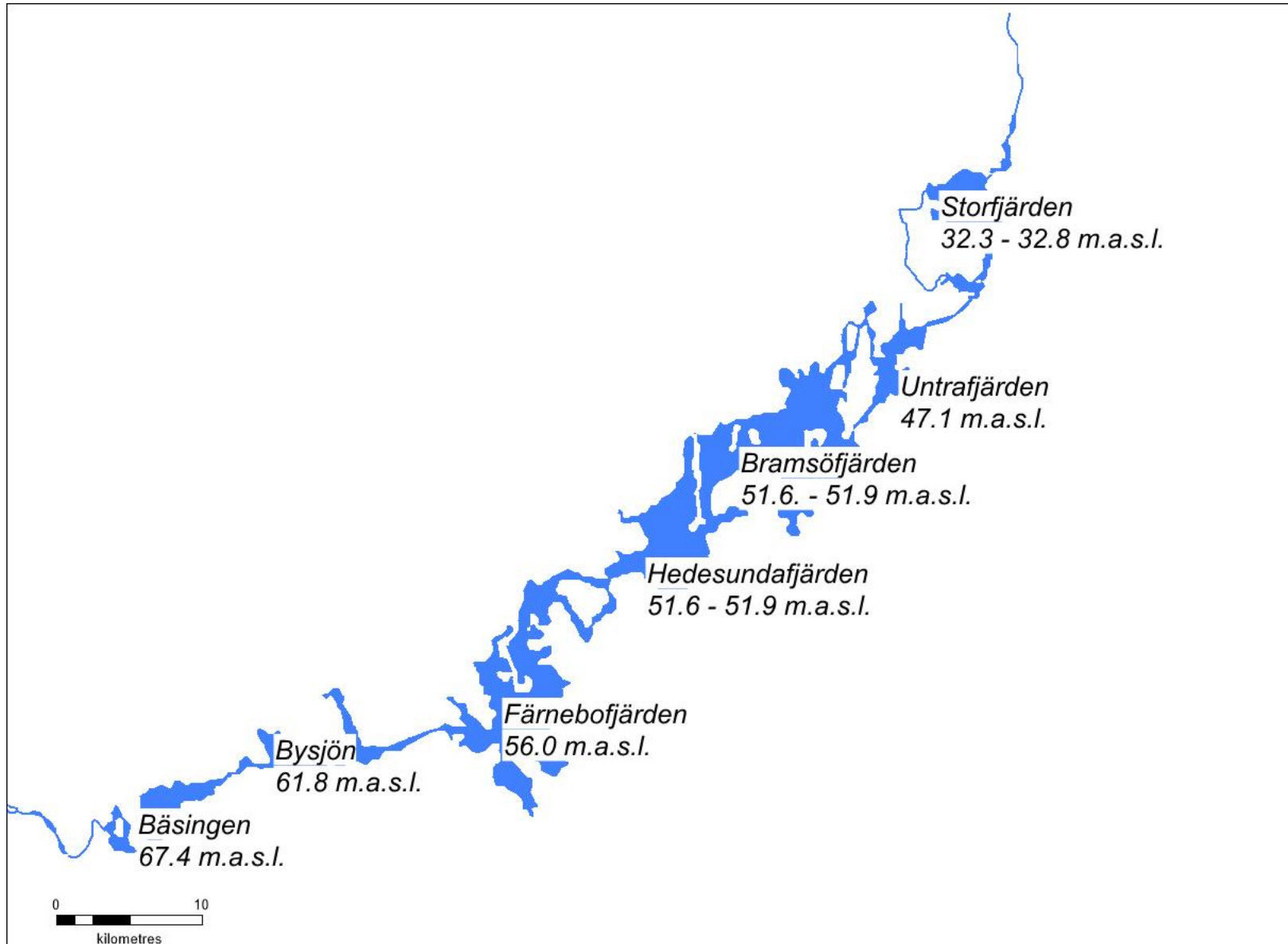




The floodplains of the River Dalälven



The floodplains of the River Dalälven



Water level fluctuations











The mosquitoes of the River Dalälven floodplains





The troublemaker
– *Aedes sticticus*

A brief history of mosquito control in Sweden



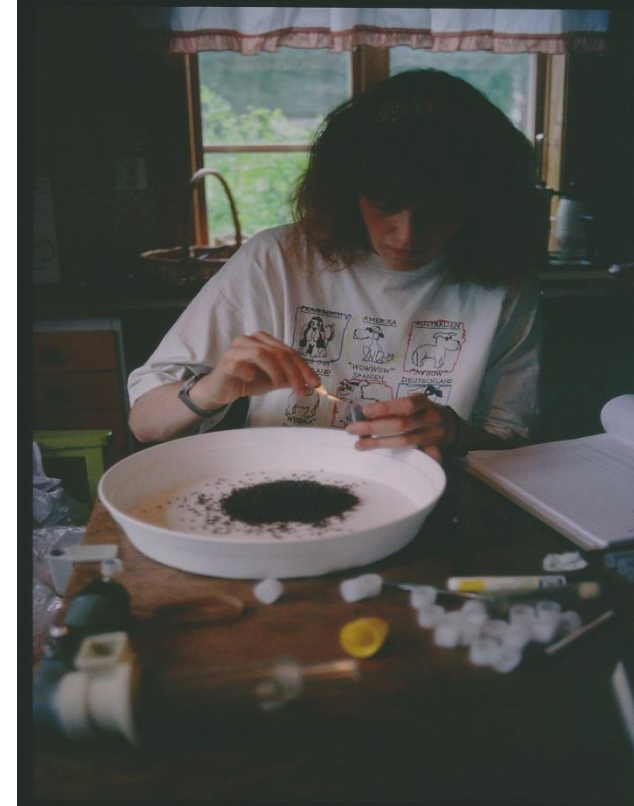
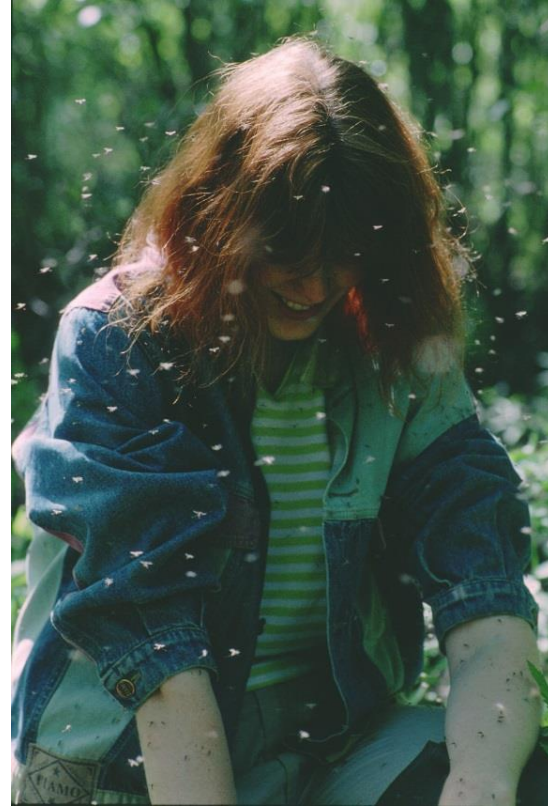
How it started...

Year 2000

- mosquito study for my PhD
- the worst mosquito year



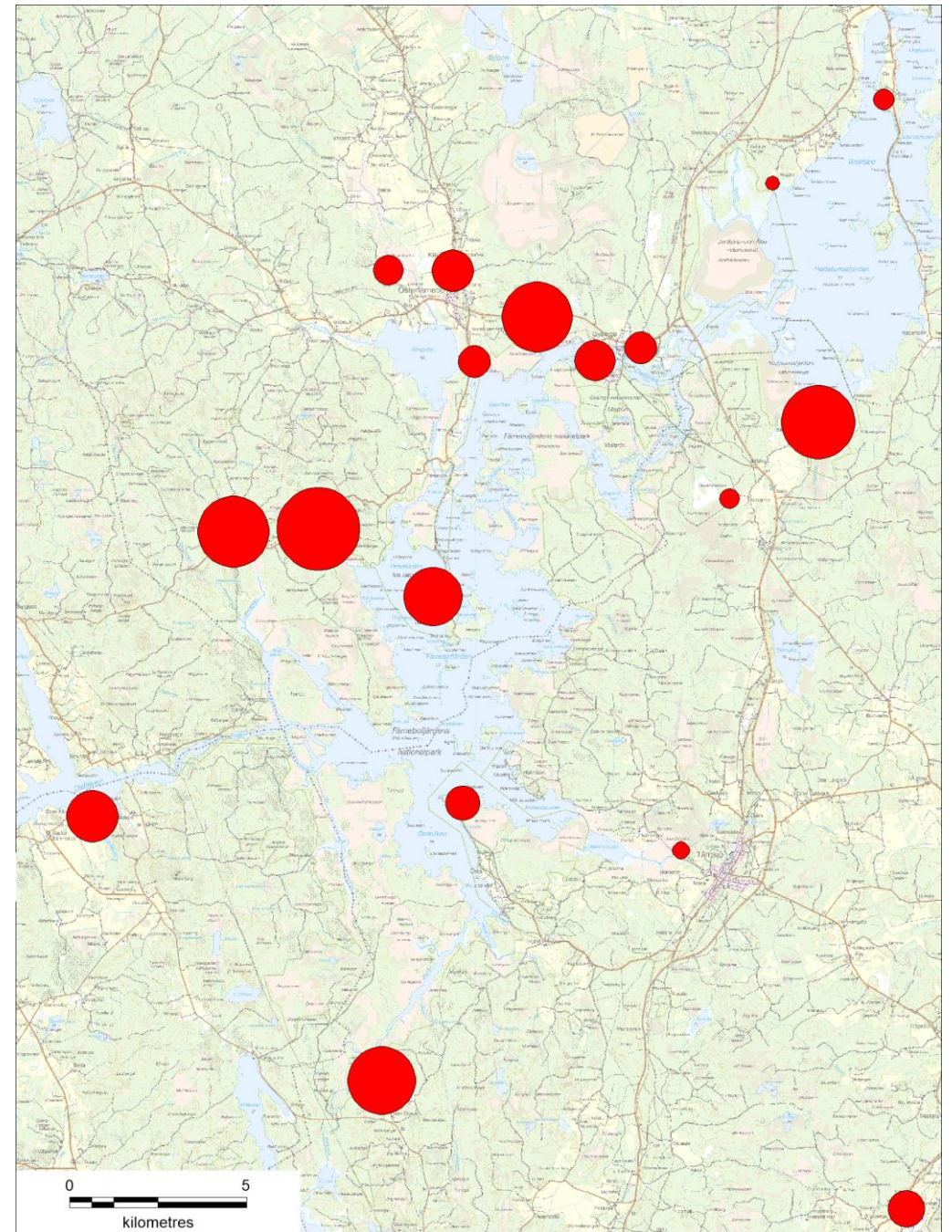
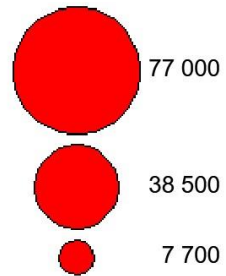
Kjell Larsson, Minister for the Environment, August 2000:
"You cannot have it like that"



Very high mosquito numbers in CDC-miniature light traps baited with CO₂



Max number of mosquitoes per trapnight



Floodwater mosquito control was badly needed!



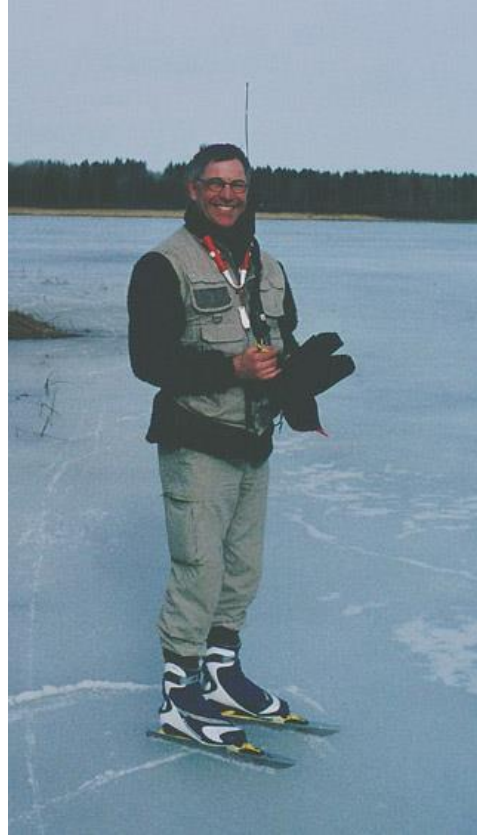
Our choice: VectoBac G corn cob granules applied by helicopter



First step – mapping of breeding sites



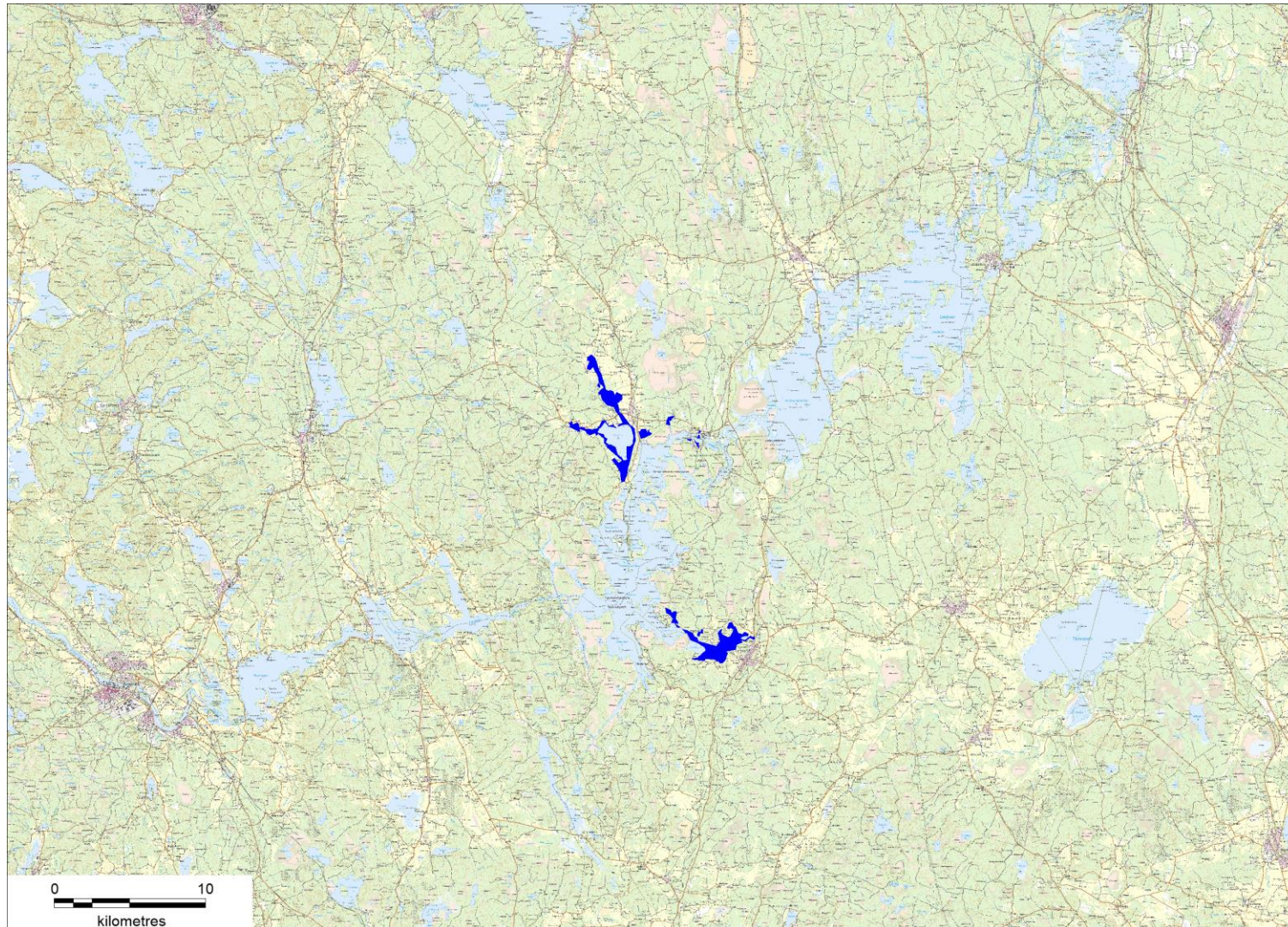
Autumn 2000- 2002: With a GPS in the field, very labour intensive



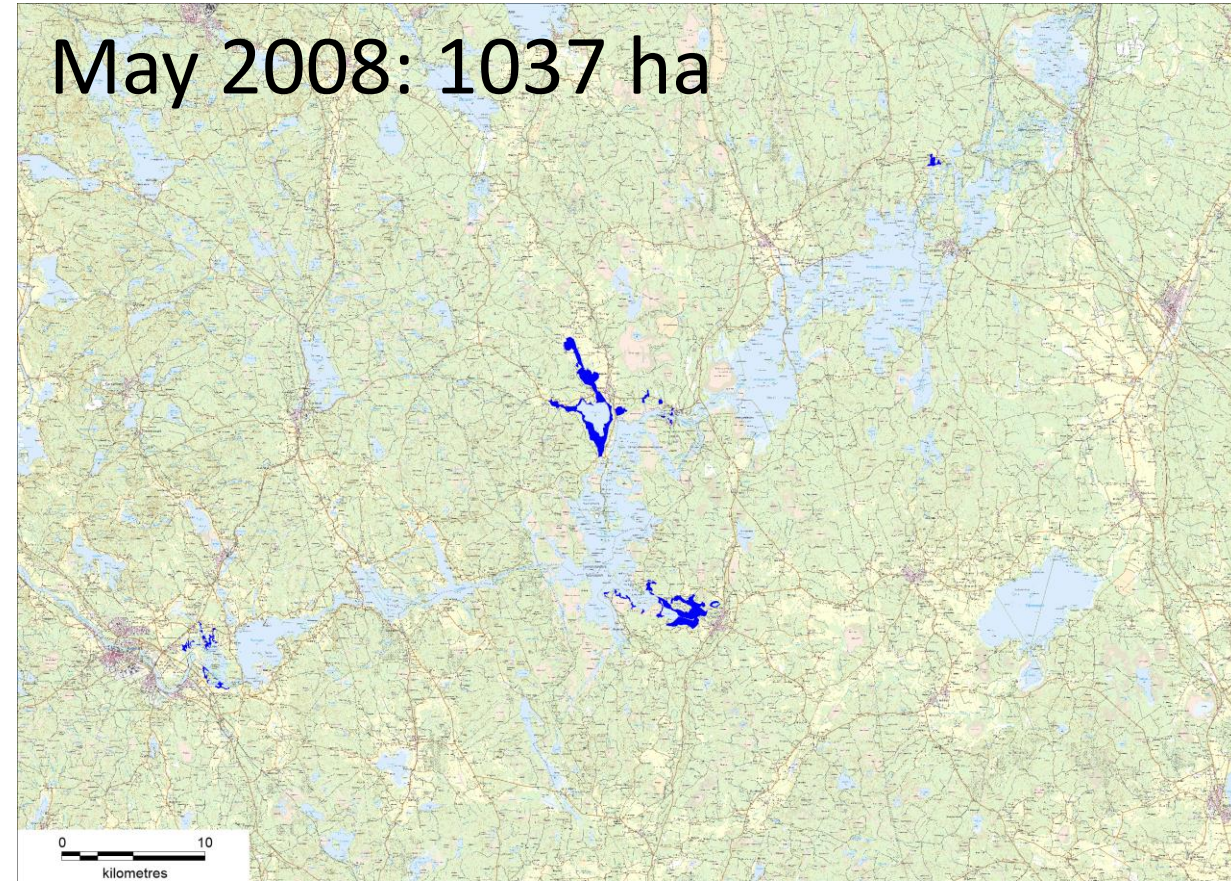
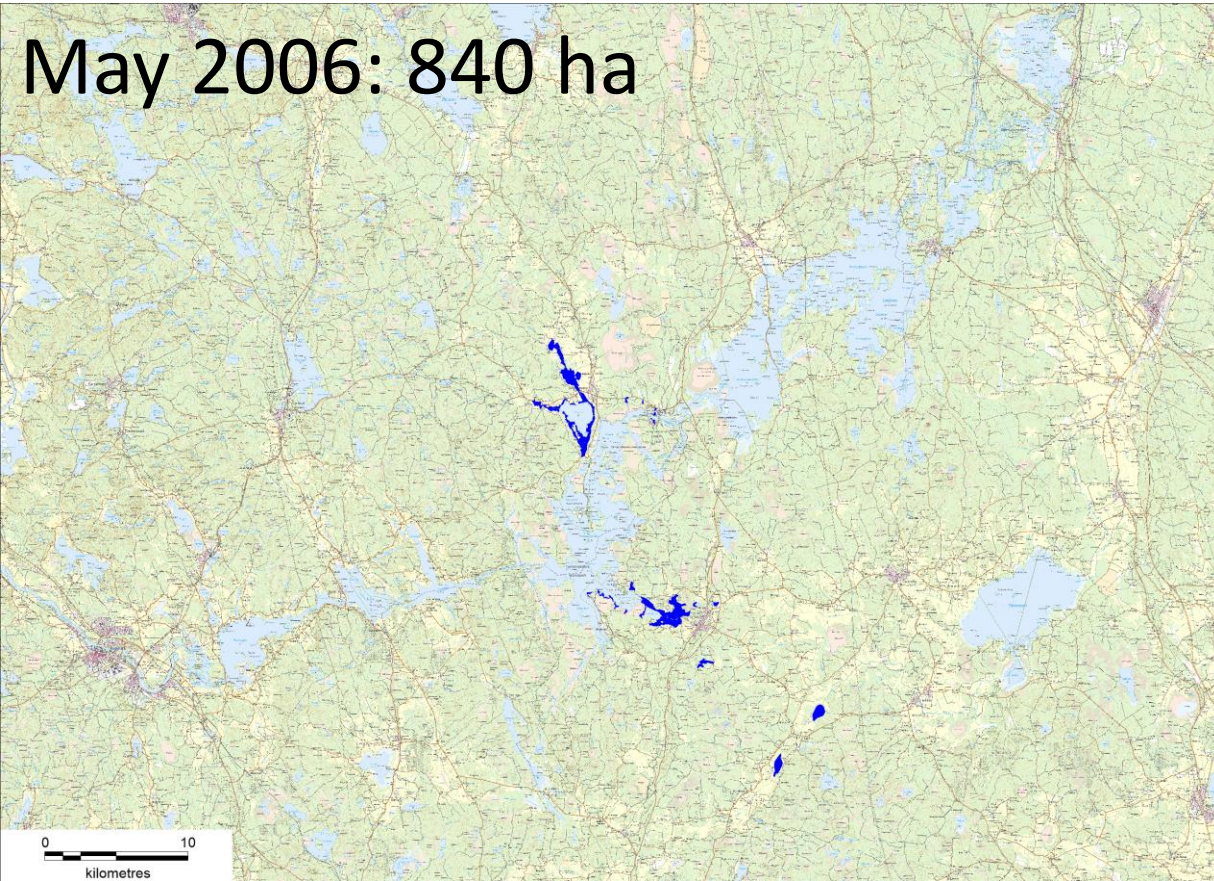
Spring 2003: Air-borne laserscanning for a digital elevation model (DEM)



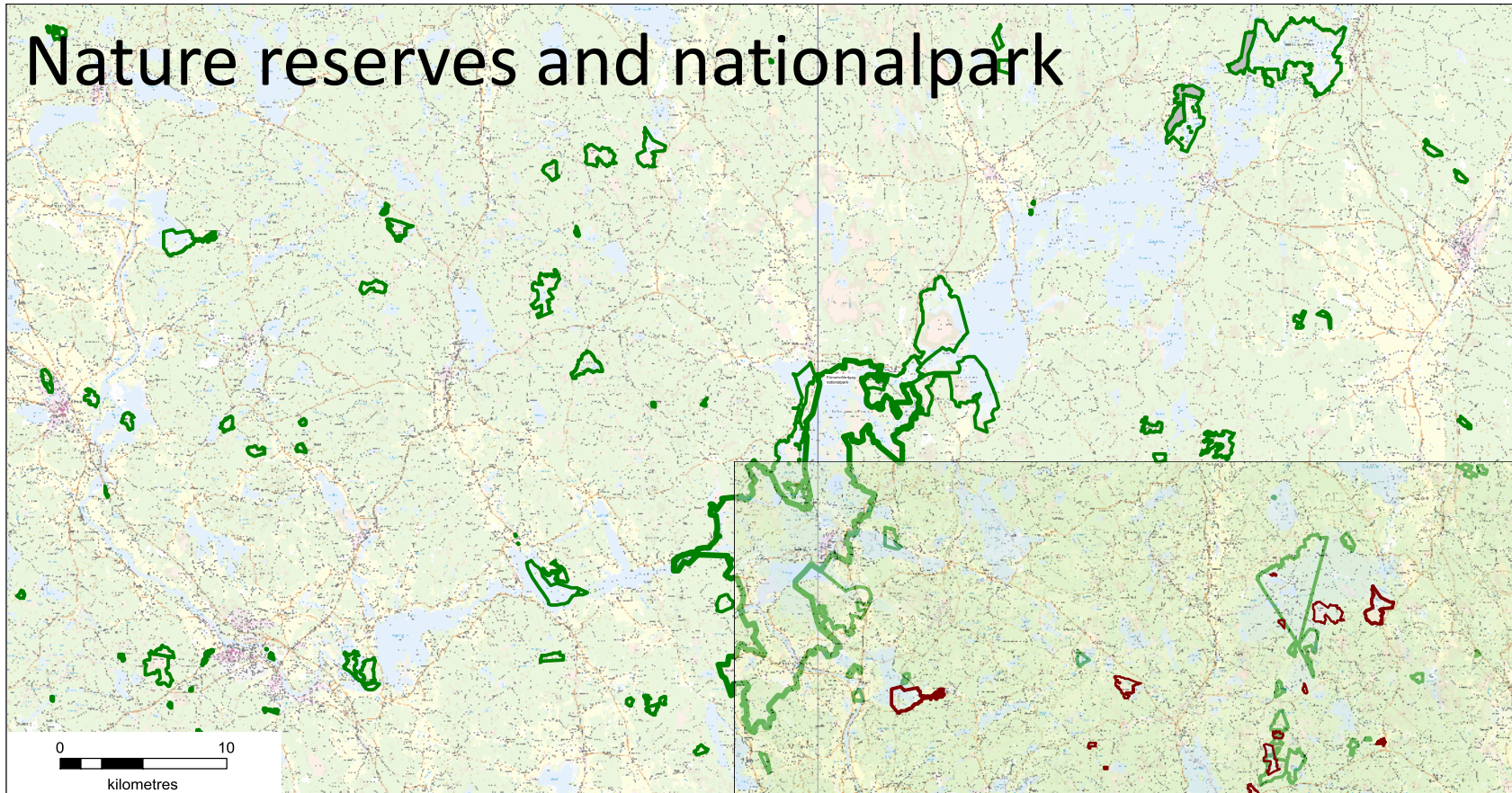
The first Bti-based mosquito control treatment in Sweden in 2002 – 443 ha in total



During the following years – about the same areas,
only minor increase

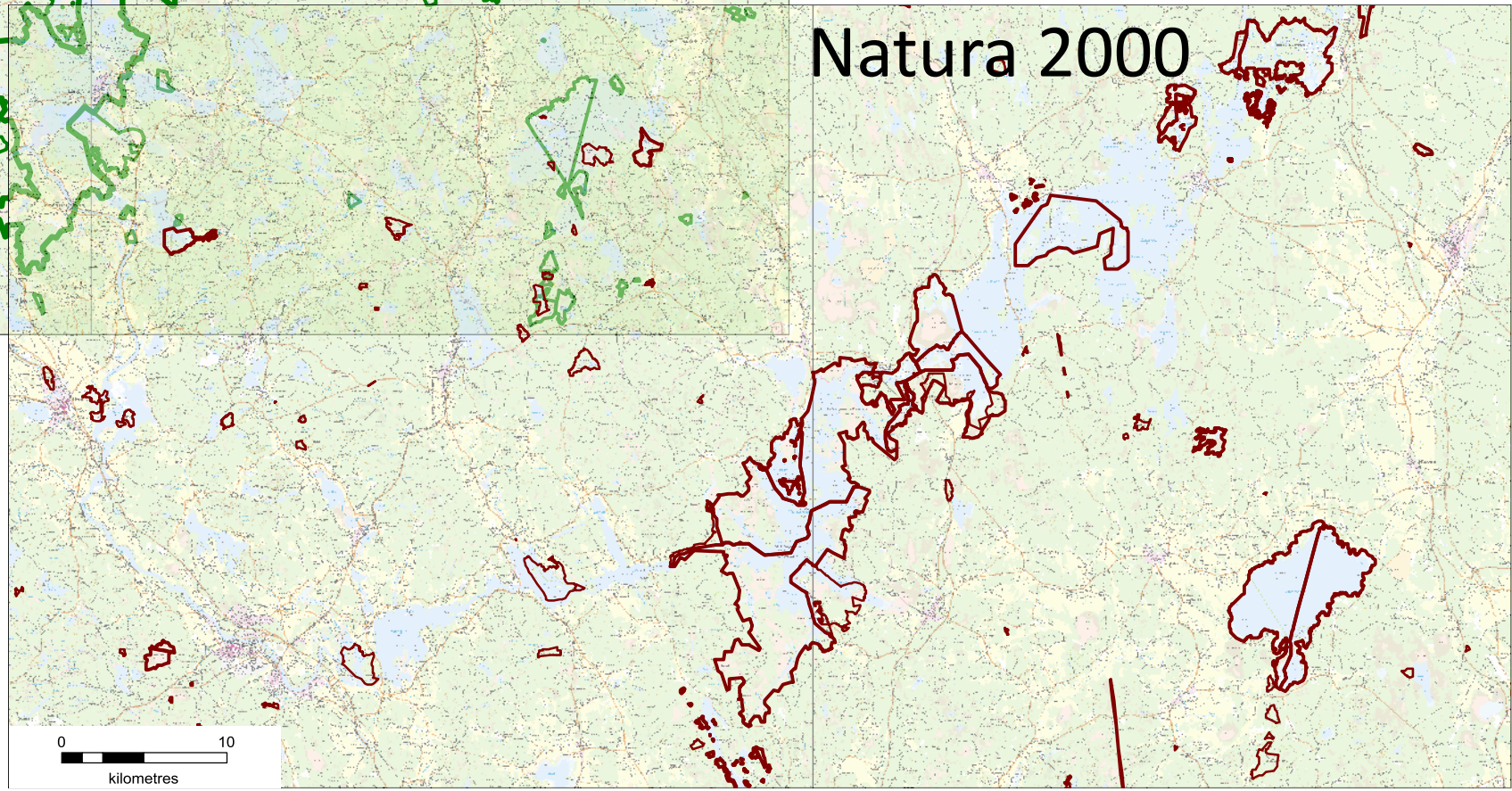


Nature reserves and national park



The problem -
a variety of
protected
areas

Natura 2000

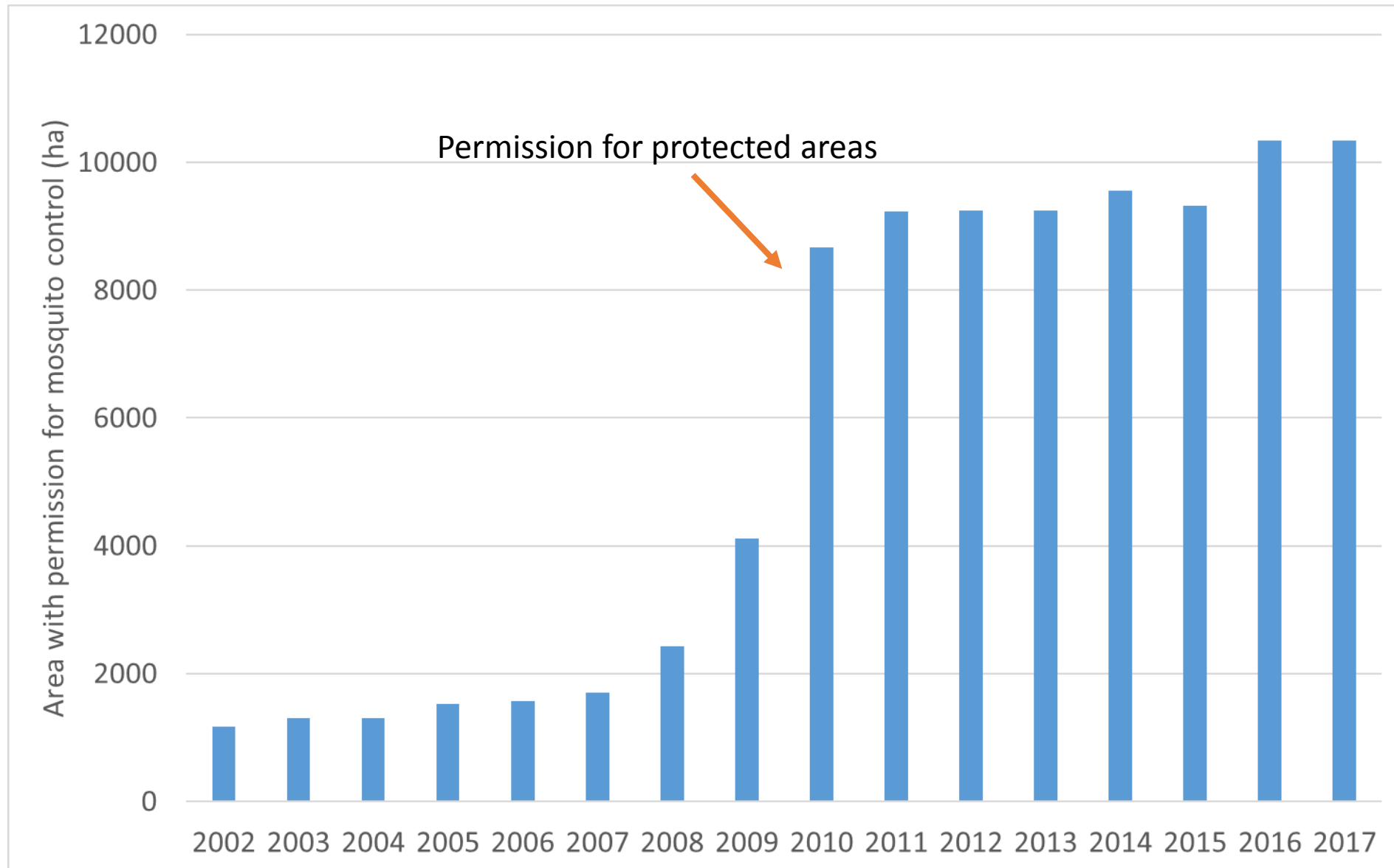


No permissions for protected areas - finally we went to court!



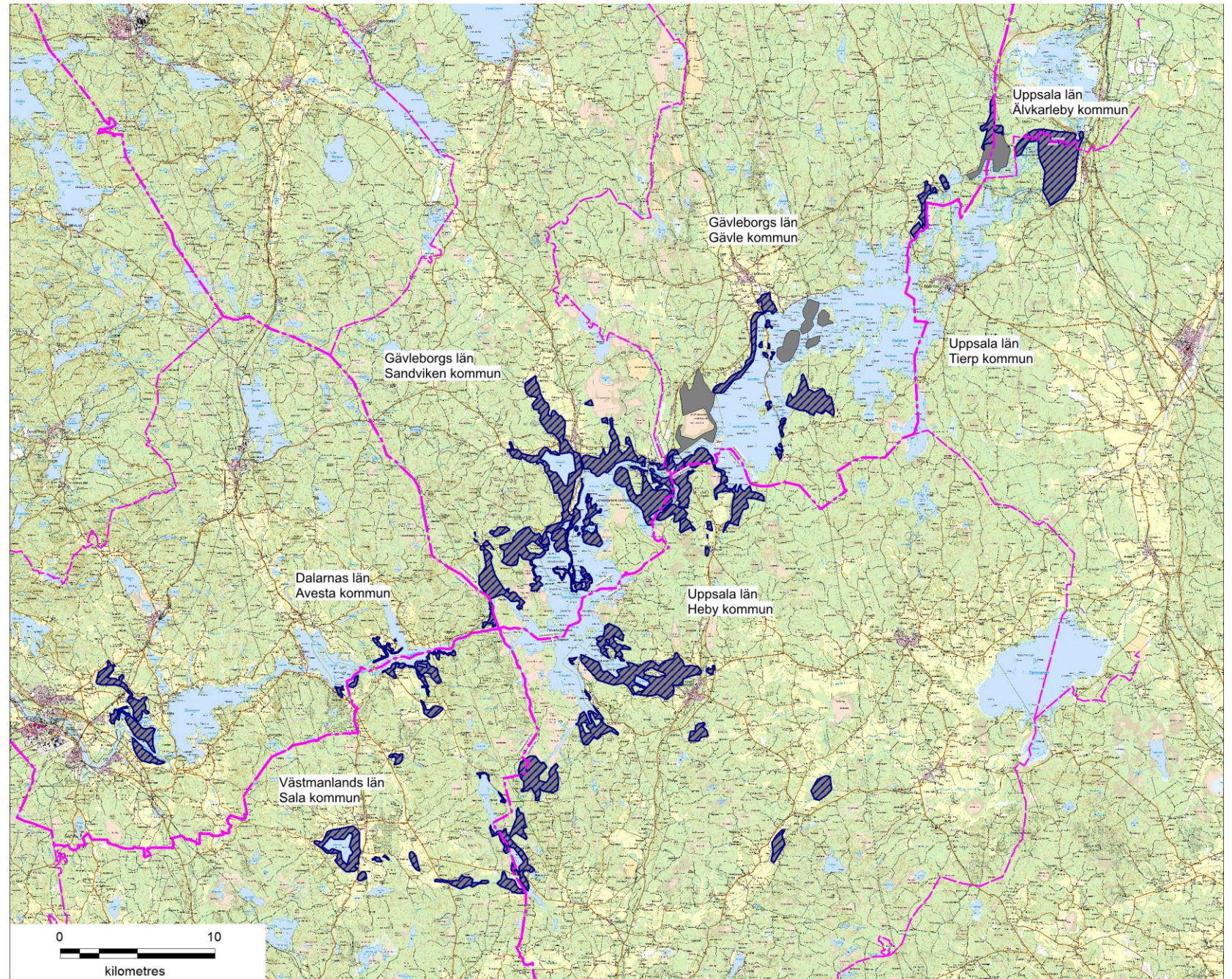
- In 2008, we raised a case against the administrative board of Gävleborg county at the Swedish environmental court and won.
- The administrative board reversed and the case was then handled by the superior environmental court. Once again we won
- Since July 2009, the permit includes protected areas

Gradual increase of mosquito control areas

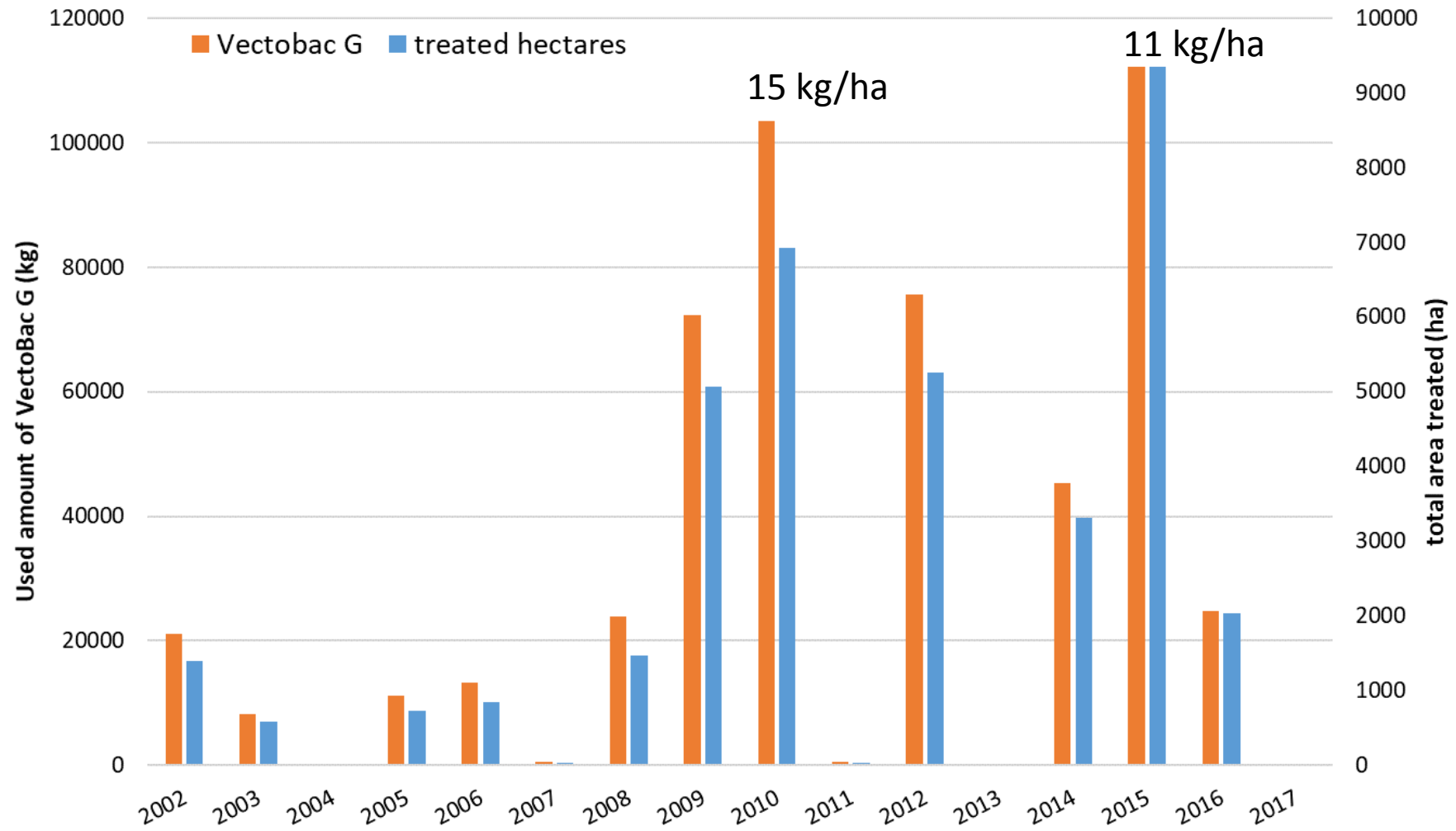


The actual situation

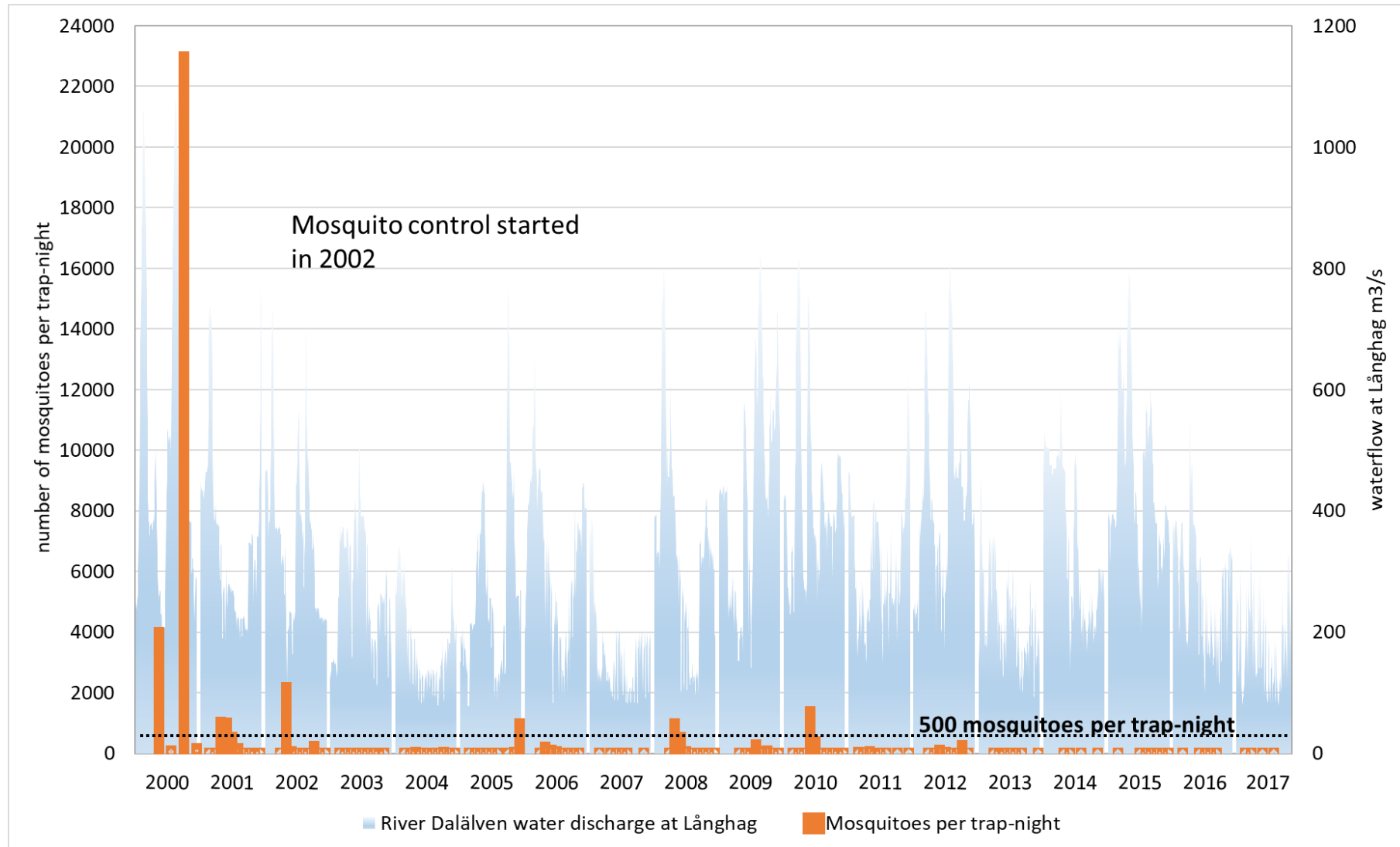
We have permissions for treatments in 10,346 ha



Summary of 16 years of treatments



The situation after 16 years of mosquito control - example Österfärnebo



How we control floodwater mosquitoes



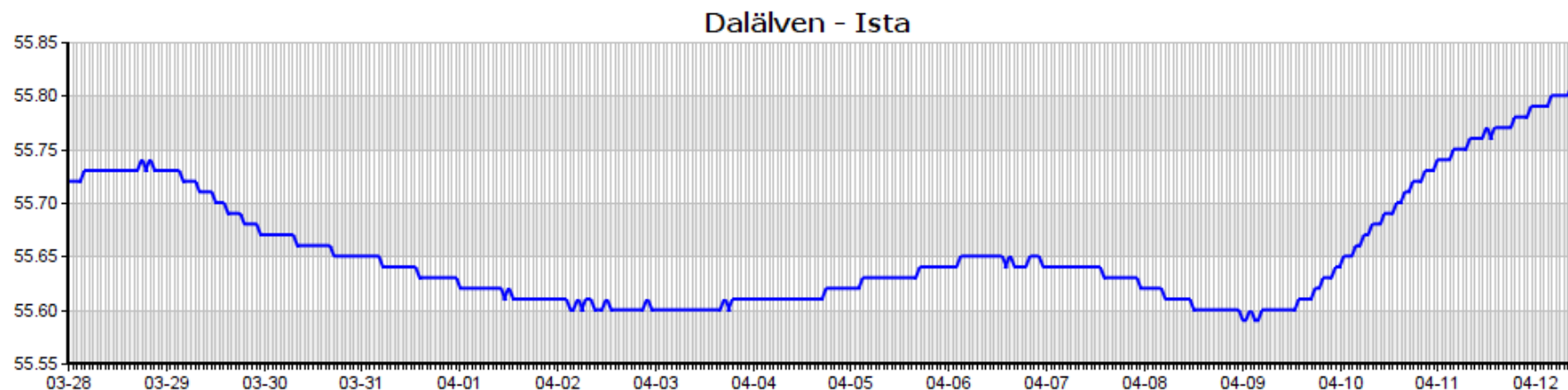
Monitoring the flood situation

From middle of April: Daily monitoring of the water flow of the River Dalälven and precipitation in the catchment area

Mockfjärd				75.90	74.01
Lima				19.10	23.40

Österdalälven	Just nu	Föreg. dygn	Föreg. vecka	Föreg. dygn (m ³ /s)	Real 08:00(m ³ /s)
Åsen				26.36	27.05

Dalälven	Just nu	Föreg. dygn	Föreg. vecka	Föreg. dygn (m ³ /s)	24h avg (m ³ /s)	Just nu (m ³ /s)
Venjan	92.38	92.38	92.39			
Dalstuga (Amungen)	226.10	226.12	226.12			
Tanger (Balungen)	196.78	196.77	196.72			
Långhag (Runn)	105.64	105.52	105.52	261.17	270.13	287.49
Utsjöhyttan	46.44	46.36	46.46			



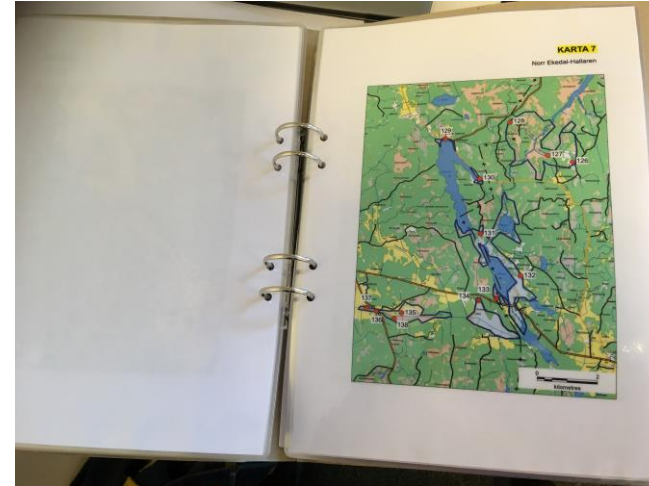
Monitoring of larvae

Requirements: More than 4 larvae /liter in large water bodies, more than 50 larvae/liter in small water bodies and ditches

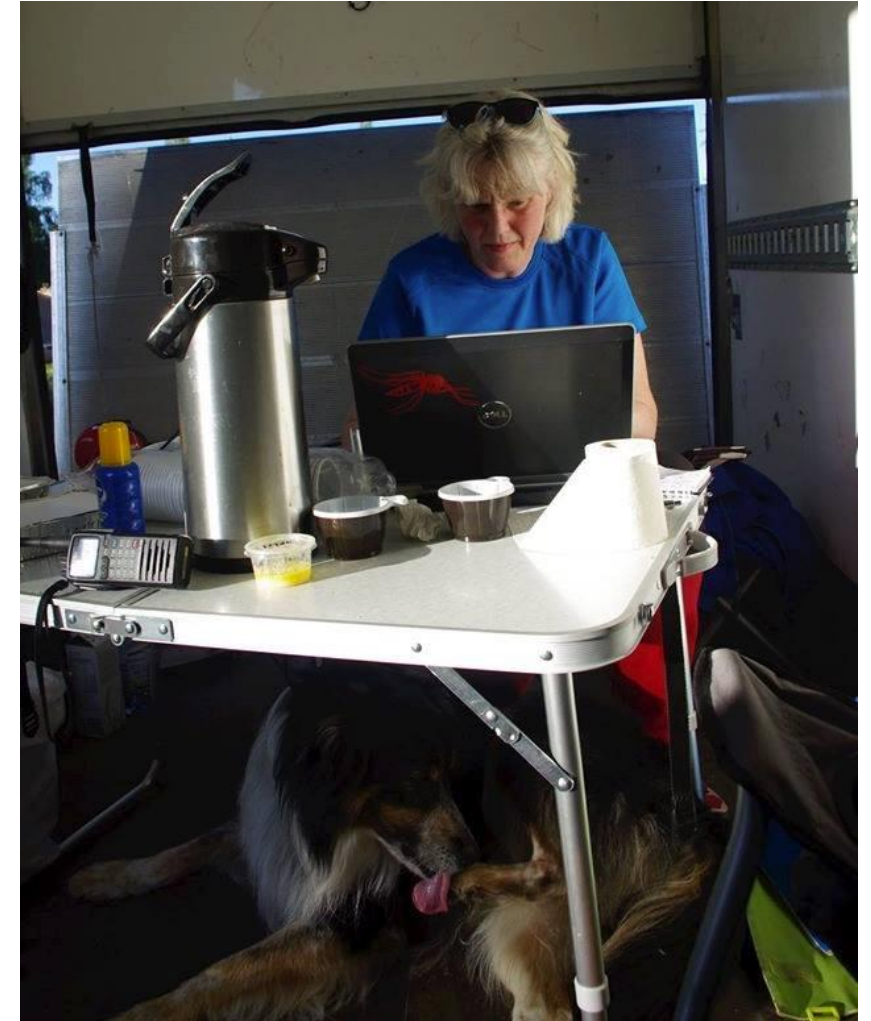
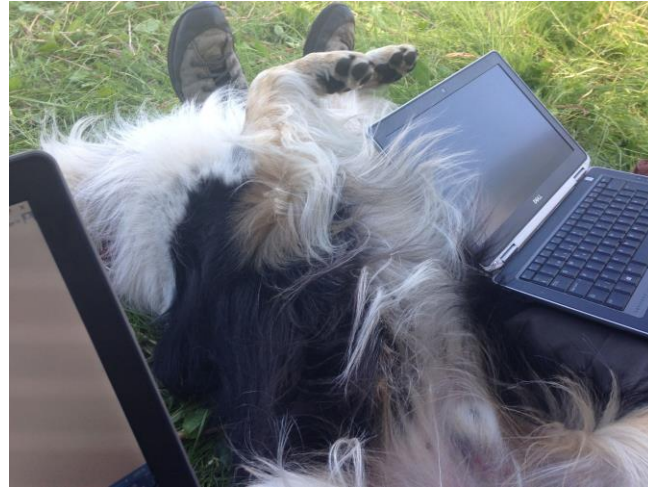
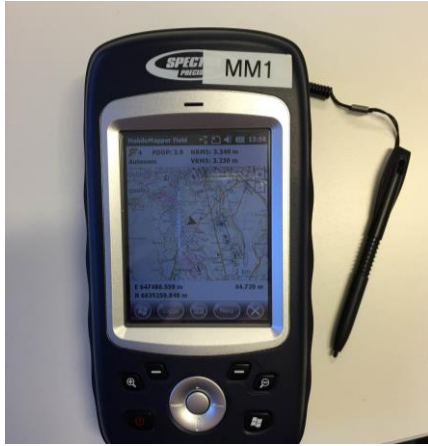


Monitoring of larvae

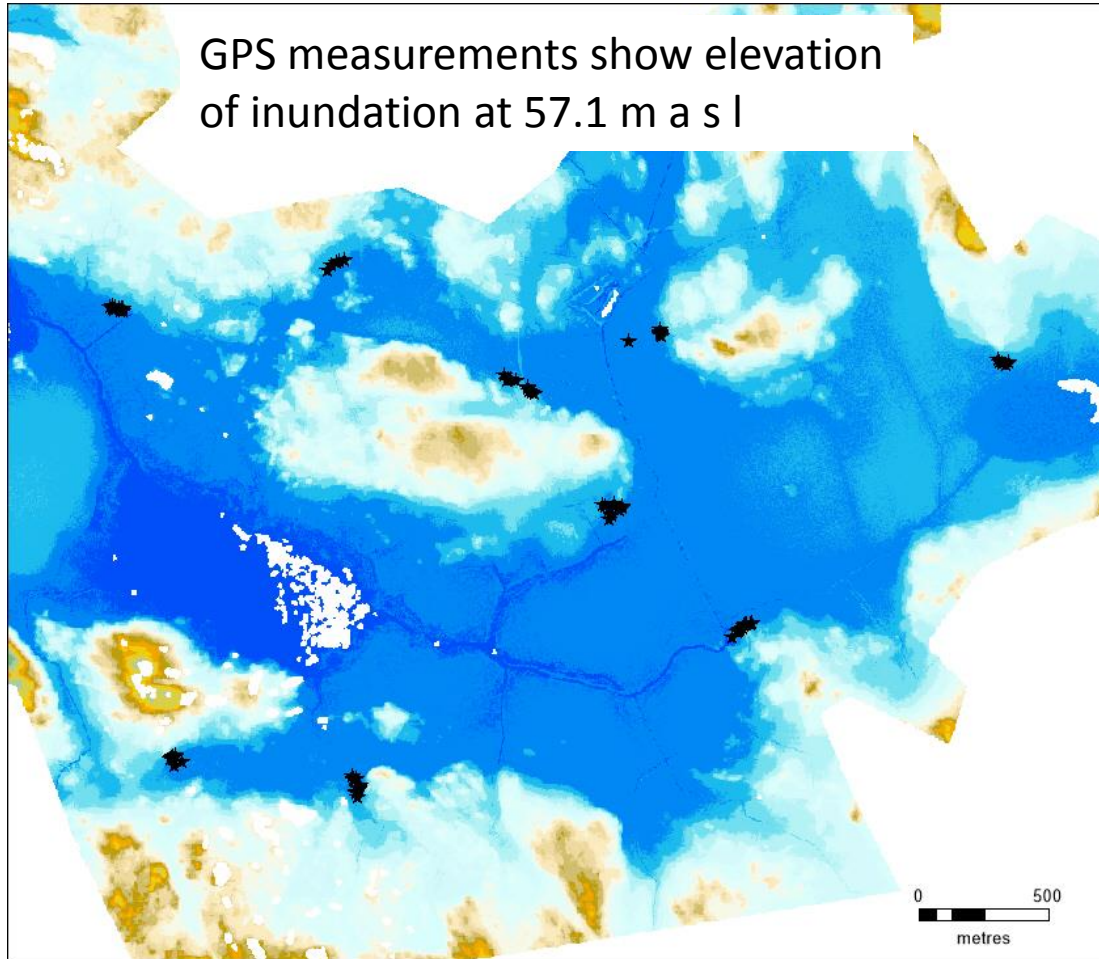
Teams of two persons each are sent to established sample sites with maps, a dipper and a GPS



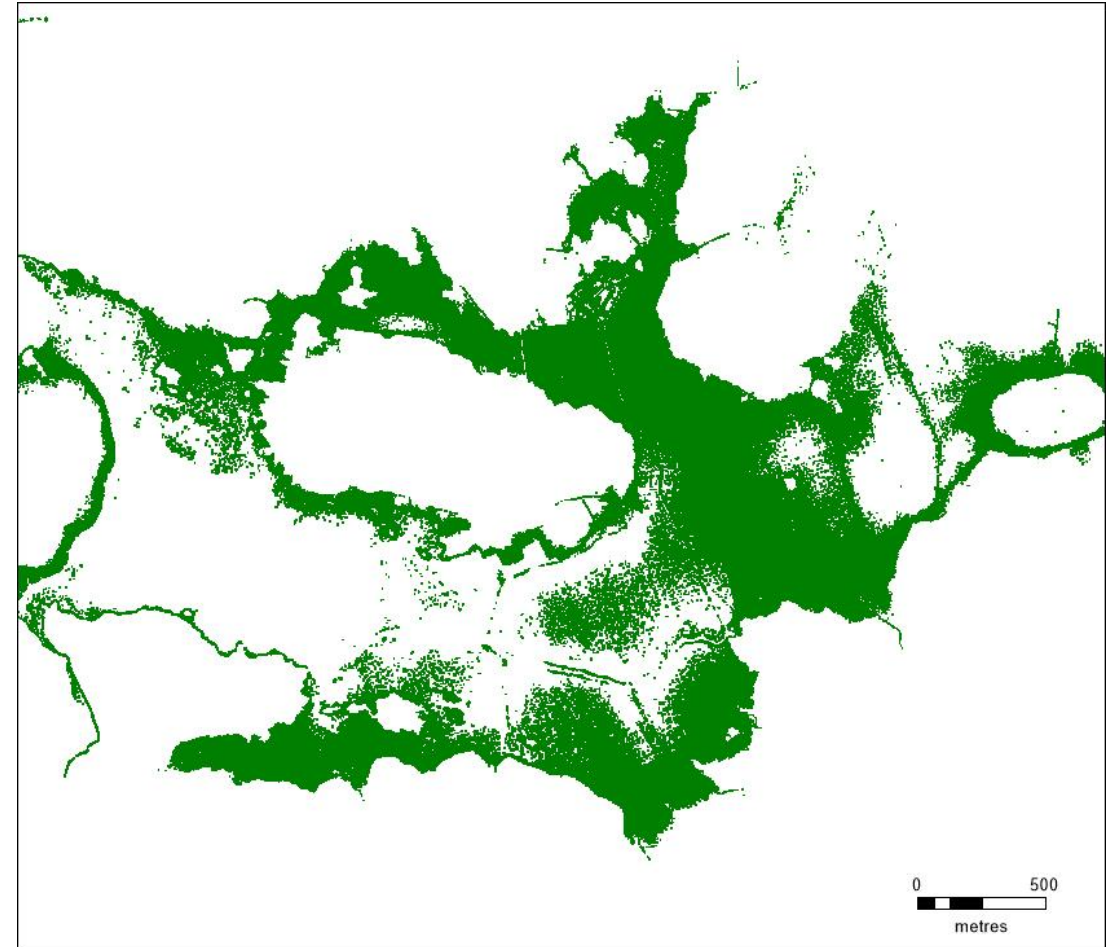
Preparing the areas for mosquito control – from GPS measurements to polygons for the helicopter



Preparing the areas for mosquito control – from GPS measurements to polygons for the helicopter

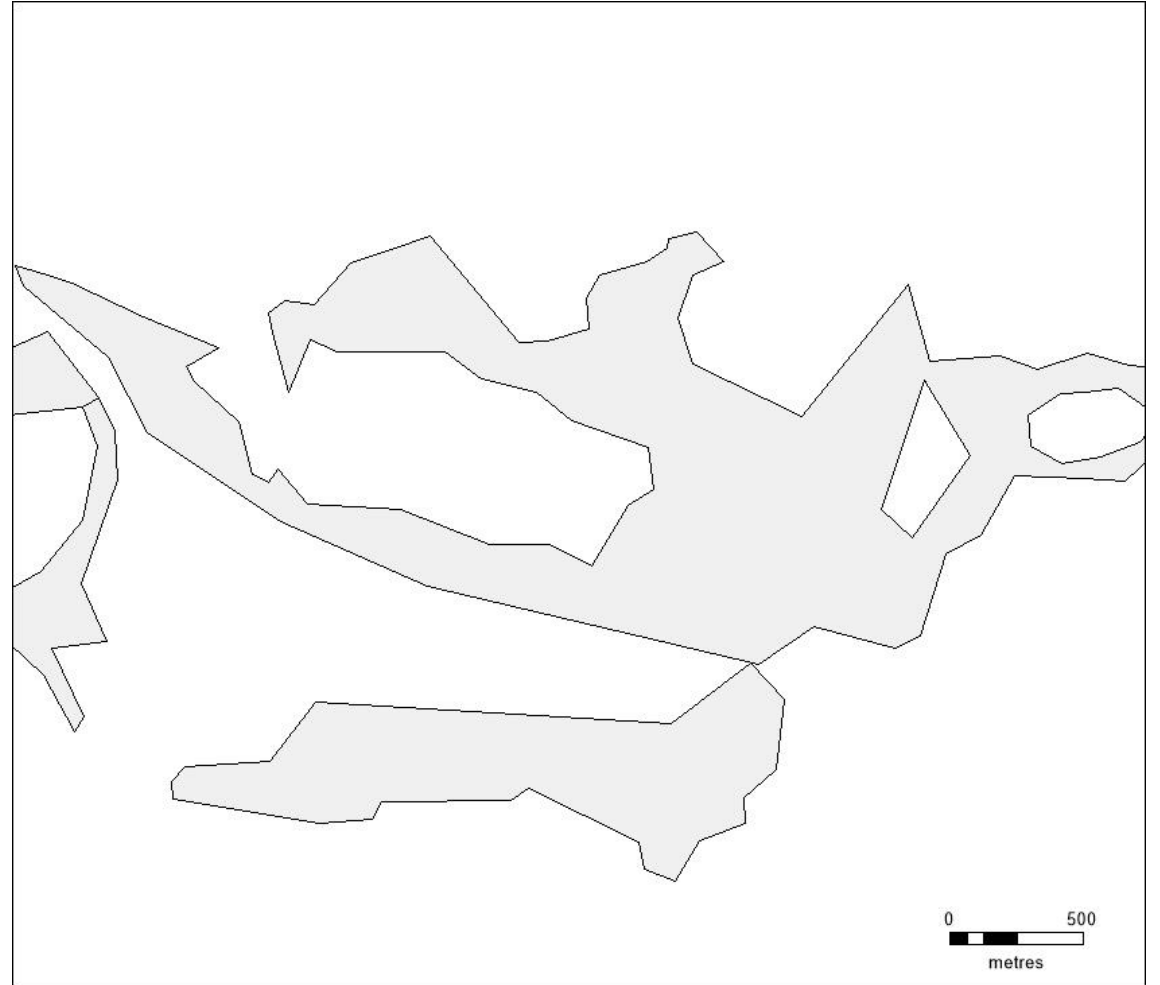
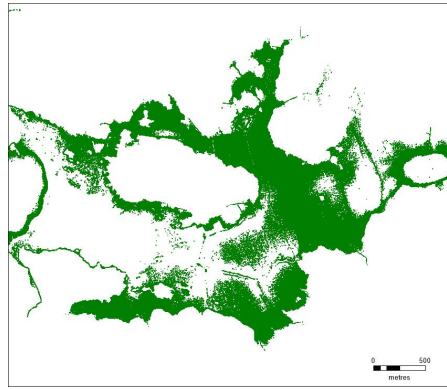
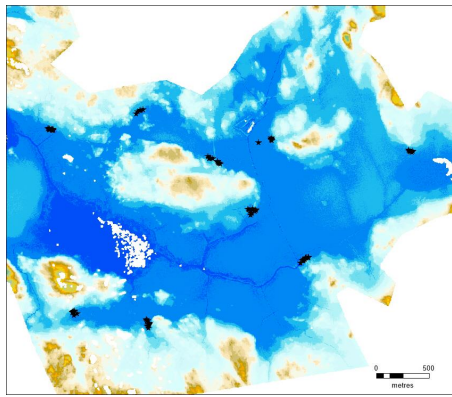


GPS measurements on digital elevation model (DEM)

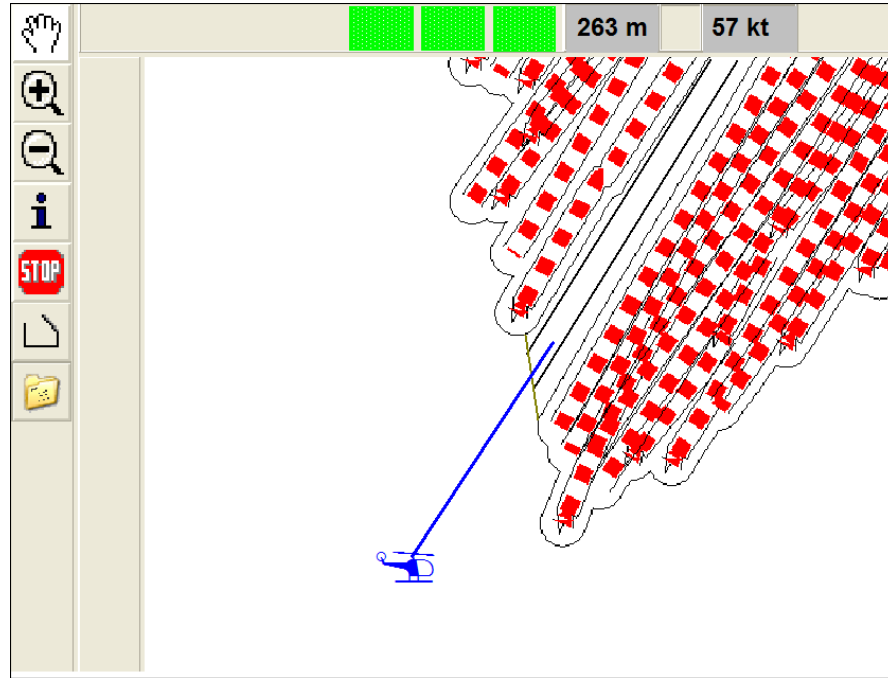


Query of the DEM: 57.1 to 56.5 - excluding parts with deep water and no larvae

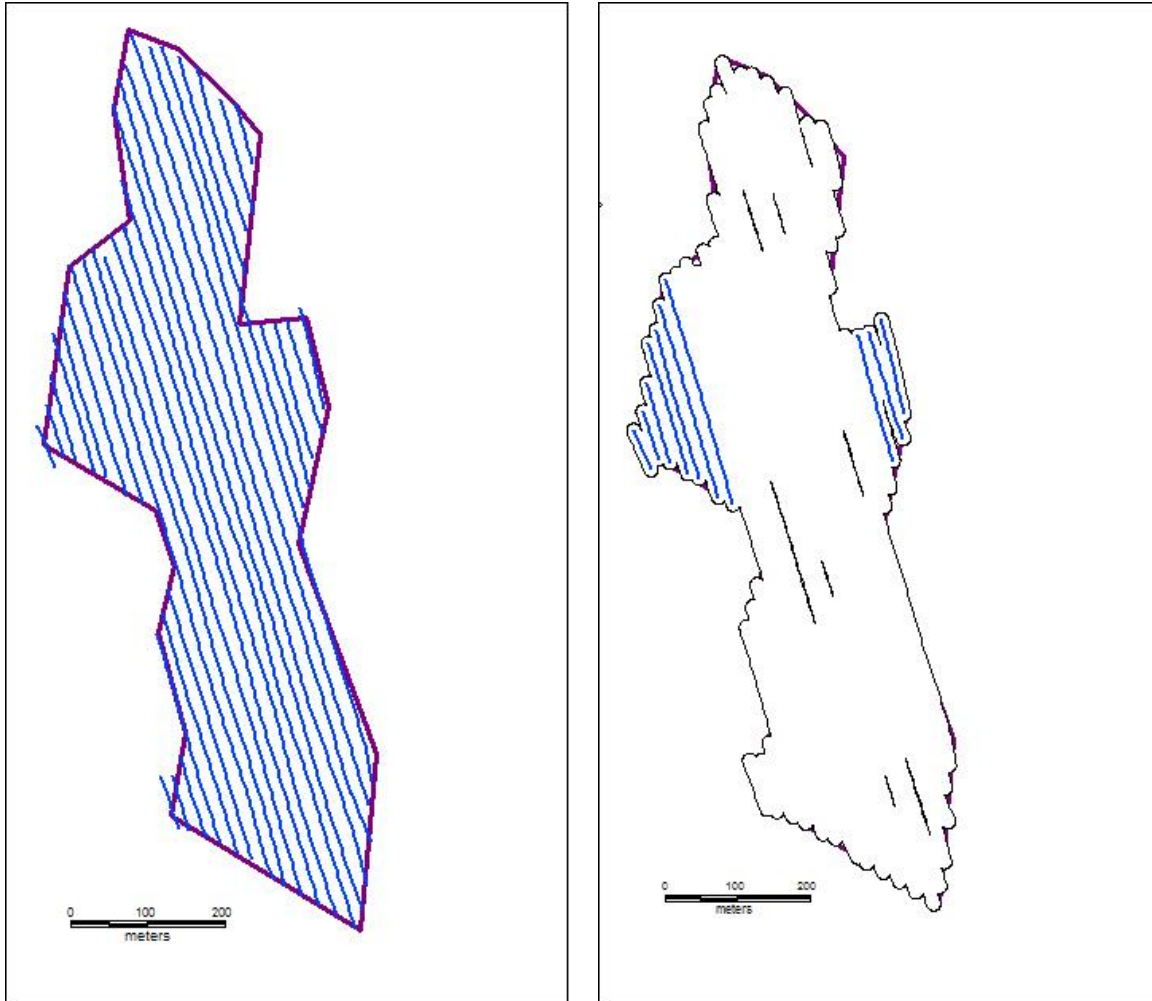
Preparing the areas for mosquito control – from GPS measurements to polygons for the helicopter



Preparing the areas for mosquito control – from GPS measurements to polygons for the helicopter



Quality control after treatment



Check of the digitized application
for eventual holes in coverage



Dipping for larvae 24 ha after treatments

The actual treatment



The actual treatment

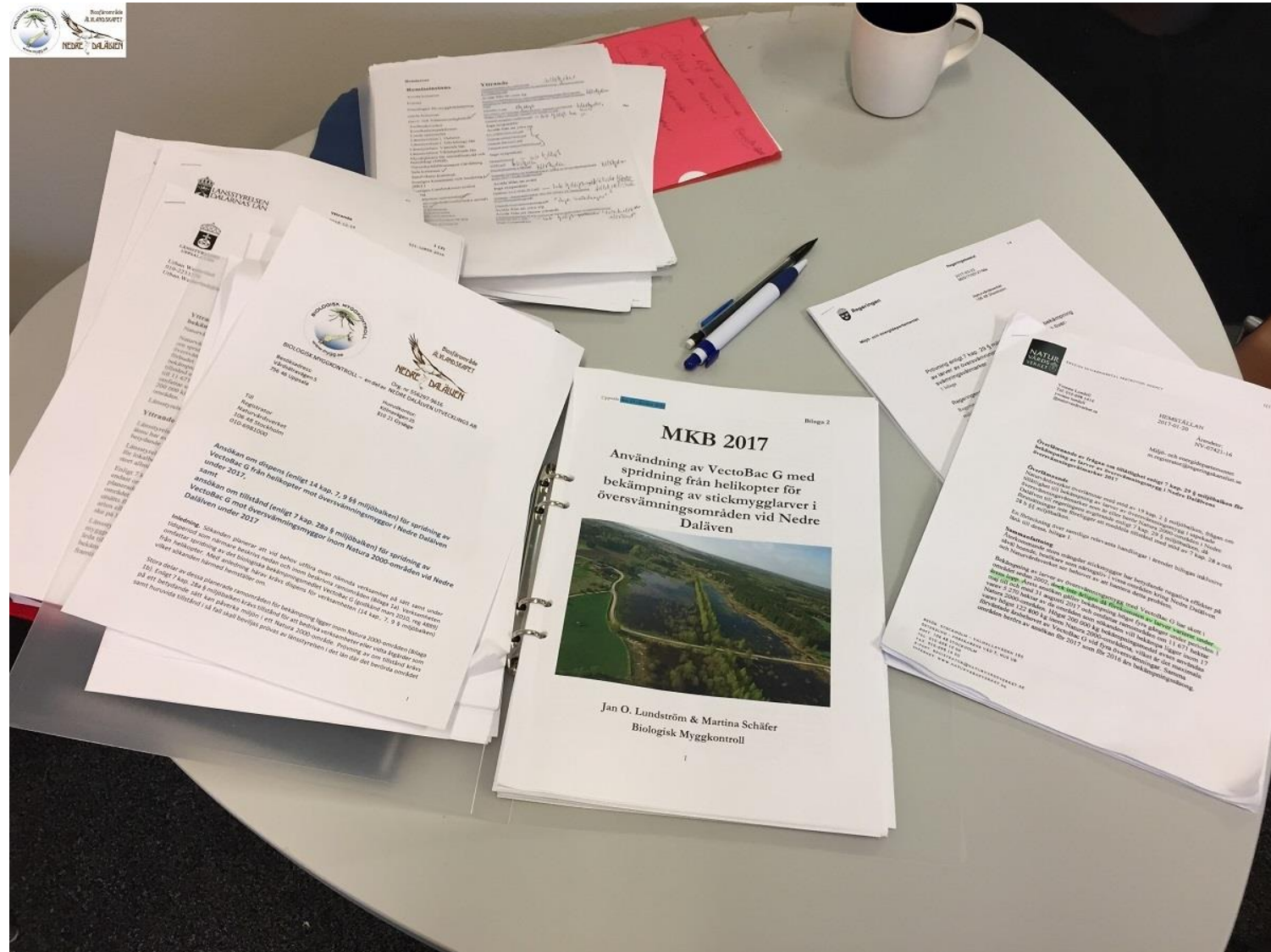
The time window for treatments during summer is approximately 5 days

We have the capacity to treat 1100 ha per day

Double crews and many hours of daylight



What we have to do to be allowed to control mosquitoes



Regulatory requirements for mosquito control

- Yearly application to the Swedish EPA for permit to use aircraft to apply control agent
- Yearly application to the Swedish EPA for permit to treat with Bti within Natura 2000 areas, including consultation with regulatory authorities, and an environmental impact assessment
- Yearly applications to each of the four county administrative boards for permits to use Bti for each nature reserve and the national park – but now for the first time permits for 3 years!
- All landowners must give written allowance to treat their land.

The major concerns of the environmental authorities

- Effects of Bti treatments on non-target organisms and the ecosystem

”We cannot exclude that there are absolutely no negative effects”

- Effects of helicopter flying over the areas, disturbing breeding birds

Bird survey to avoid disturbance by helicopter

Mandatory, focus on 5 bird species:

White-tailed eagle

Osprey

Whooper swan

Common crane

Black-throated diver



Bird survey to avoid disturbance by helicopter

- Every year, an ornithologist surveys the area (~14,000 ha) and reports coordinates for nests of these species.
- For White-tailed eagle, we have to ensure a buffer zone of 300 m around active nests and for osprey 200 m.
- Recently, also White-backed woodpecker has to be protected from disturbance...

Whooper swans don't really mind....



Surveillance of non-target organisms

- Mandatory programme from the very beginning
- The first programme of “follow-up studies” with 6 study areas (3 treated and 3 untreated areas with 4 traps each) ran from 2002 to 2007, resulting in several publications, e.g. :

Persson Vinnersten, T.Z., Lundström, J.O., Schäfer, M.L., Petersson, E. and Landin, J. 2010. **A six-year study of insect emergence from temporary flooded wetlands with and without BTI-based mosquito control.** Bulletin of Entomological Research 100: 715-725.

Lundström JO, Brodin Y, Schäfer ML, Persson Vinnersten TZ, Östman Ö. 2010. **High species richness of Chironomidae (Diptera) in temporary flooded wetlands associated with high species turn-over rates.** Bulletin of Entomological Research 100; 433-444.

Lundström JO, Schäfer ML, Petersson E, Persson Vinnersten TZ, Landin J, Brodin Y. 2010. **Production of wetland Chironomidae (Diptera) and the effects of using *Bacillus thuringiensis israelensis* for mosquito control.** Bulletin of Entomological Research 100: 117-125

Surveillance of non-target organisms

- Authorities remained critical and a new programme was launched in 2012, based on the former non-target programme and suggestions and discussions with Swedish Agricultural University
- The programme from 2012 to 2017 with 12 study areas (6 treated and 6 untreated areas and 10 traps each) focused on
 - Evaluation of the effect of Bti treatments on non-target organisms
 - Evaluation of the effect of Bti treatments on target organisms
 - Collection of environmental data (water depth, temperature, water chemistry)

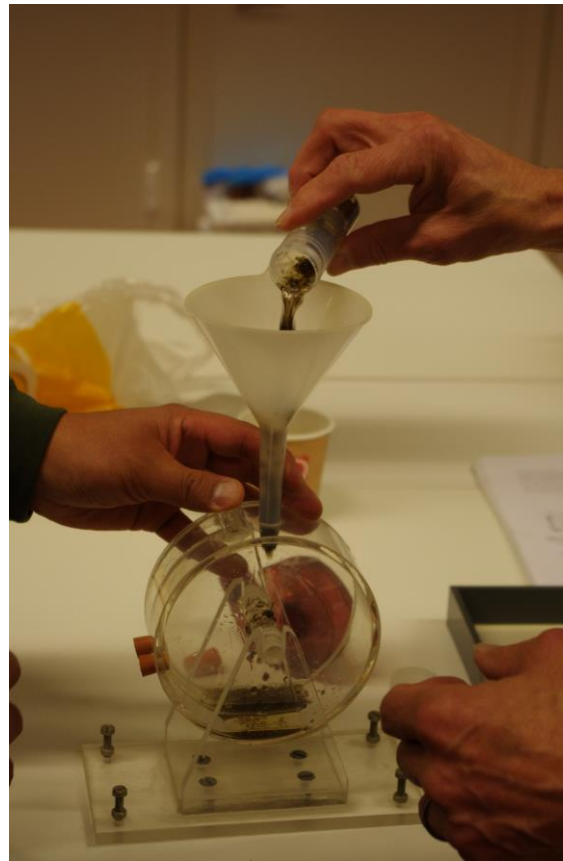
Emergence traps for non-target organisms



Emergence traps (non-target organisms)



Emptied every week from May to September



Subsampling in the lab,
fraction of 25% gets identified

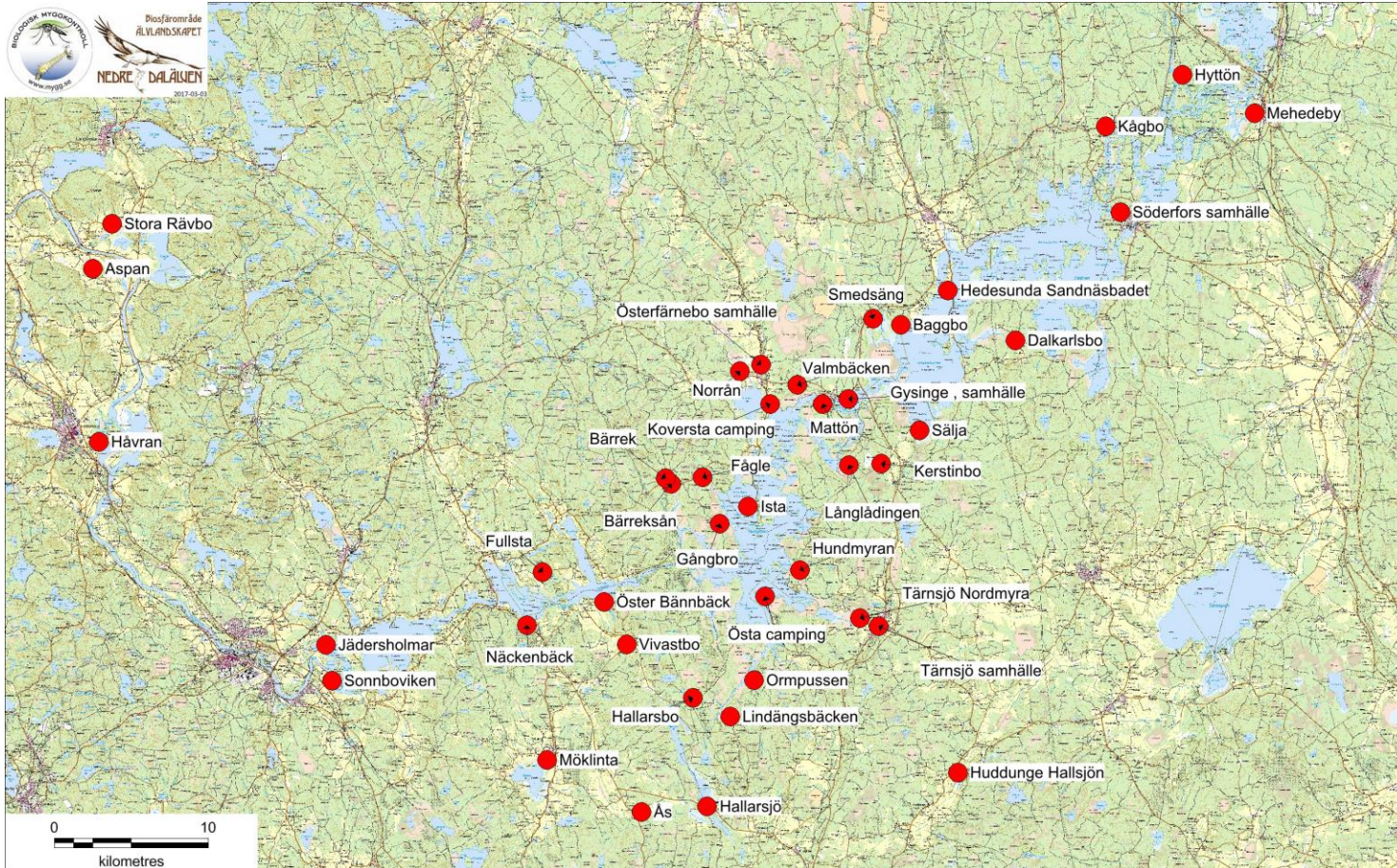


Surveillance of non-target organisms

Next programme period will be 2018 to 2023,
we will continue surveillance with focus on chironomids,
very important part of our mosquito control programme!



Surveillance of target organisms



42 sample sites, traps for one night every second week from May to September

Surveillance of target organisms



Mygggläget och myggprognos: x

Antal fångade 2017 v 37.pdf - Adobe Acrobat Reader DC

http://vattendata.se/... Vattenregleringsföret... Redigera Visa Fönster Hjälp

Antal fångade 201... x

1 / 1 114%

Tabell: Antal fångade stickmygg i 42 st CO₂-fällor 2017

Fångstplats	v. 19	v. 21	v. 23	v. 25	v. 27	v. 29	v. 31	v. 33	v. 35	v. 37
Hävrån	0	25	41	37	39	35	5	0	2	6
Aspan	0	0	16	72	143	247	101	8	13	0
Stora Rävbo	0	15	154	41	43	108	4	13	15	2
Sonnhoviken	0	11	189	157	76	85	37	0	7	0
Jädersholmar	0	28	168	139	380	160	34	17	0	0
Fullsta	0	3	15	175	69	20	2	1	0	1
Näckenbäck	0	4	28	25	5	17	1	2	2	1
Möklinta	0	1	34	175	73	41	13	11	4	5
Oster Bärnbäck	0	17	5	20	5	4	6	1	8	2
Vivastbo	0	16	5	16	13	2	3	4	1	0
Ås	0	2	72	123	20	17	16	4	3	1
Bärrek	0	0	2	6	4	2	1	0	3	1
Bärreksån	0	2	19	8	18	4	12	1	5	0
Hallarsbo	0	0	4	21	38	20	1	3	0	0
Hallarsjö	0	38	103	147	85	88	40	18	7	0
Fågle	0	2	115	52	46	16	27	19	14	3
Gångbro	0	0	6	19	41	5	7	1	1	0
Nationalpark, Lindängsbäcken	0	3	10	27	19	45	8	5	2	1
Nationalpark, Ormpussen	0	1	24	61	40	31	16	5	4	0
Ista	0	0	5	14	0	13	7	0	0	0
Osterfärnebo, Norrån nv	0	2	4	*	41	13	10	5	4	8
Osterfärnebo, samhälle	1	3	0	2	0	1	0	0	0	1
Osta camping	0	3	1	0	0	0	1	0	1	0
Koversta, camping	0	4	1	39	140	61	5	2	1	0
Hundmyran	0	4	64	164	42	12	3	7	2	0
Valmbäcken	1	5	44	77	134	253	42	27	1	4
Grsinge, samhälle	0	17	119	121	126	48	15	5	1	0
Mattön	0	1	0	5	4	21	0	0	0	1
Långlådingen	0	1	1	5	3	3	0	3	1	0
Tärnsjö, Nordmyra	0	0	8	72	37	59	23	8	3	1
Tärnsjö, samhälle	0	0	1	7	0	4	1	1	0	0
Smedsäng	0	1	325	361	155	104	14	3	5	0
Baggbo	0	4	1	86	350	390	91	3	4	0
Kerstunbo	0	4	1	12	12	13	4	3	0	0
Sälja	1	2	16	30	15	0	25	6	0	1
Huddunge, Hallsjön	0	0	13	36	32	47	0	2	16	14
Hedesunda, Sandnäsbadet	1	7	25	41	39	61	9	2	1	1
Dalkarlsbo	0	21	162	133	91	70	14	14	4	0
Kågbo	0	9	0	7	12	24	5	0	3	1
Söderfors, samhälle	0	2	14	106	52	98	15	0	1	-
Hyttön	0	1	2	14	32	18	4	2	8	2
Mehedeby	0	1	3	16	19	9	11	5	13	8

* Tekniskt fel

Results are published on our website at the end of the sampling week

Right now, we wait unpatiently for this year's
permit and regulation



Swedish EPA demands to decrease the amount of VectoBac G and increase the use of alternative methods



Swedish EPA demands to decrease the use of VectoBac G and increase the use of alternative methods

Water regulation - stable water level



Nature conservation requires more frequent floods with higher magnitude



Swedish EPA demands to decrease the use of VectoBac G and increase the use of alternative methods

Mowing and grazing



Swedish EPA demands to decrease the use of VectoBac G and increase the use of alternative methods

Our suggestion: **Sterile Insect Technique (SIT)**

- Currently mainly used/developed for *Aedes albopictus* and *Aedes aegypti*
- Not adapted to a floodwater mosquito species, needs to be tested in a pilot study
- So far the Swedish EPA shows no interest in supporting a test against *Aedes sticticus*, and we really tried...



Aldo Malavasi, IAEA Deputy Director General visited the Swedish government and informed about the potential of SIT



Jan O. Lundström



James Bond



Eric Blomgren



Pernilla Wahlqvist



Sandra Holmgren



We have a job opening for a Mosquito Control Technician, announcement will come soon. Are you interested or know someone who might be - contact us at Martina.Schafer@mygg.se