

The use of GIS in animal disease response

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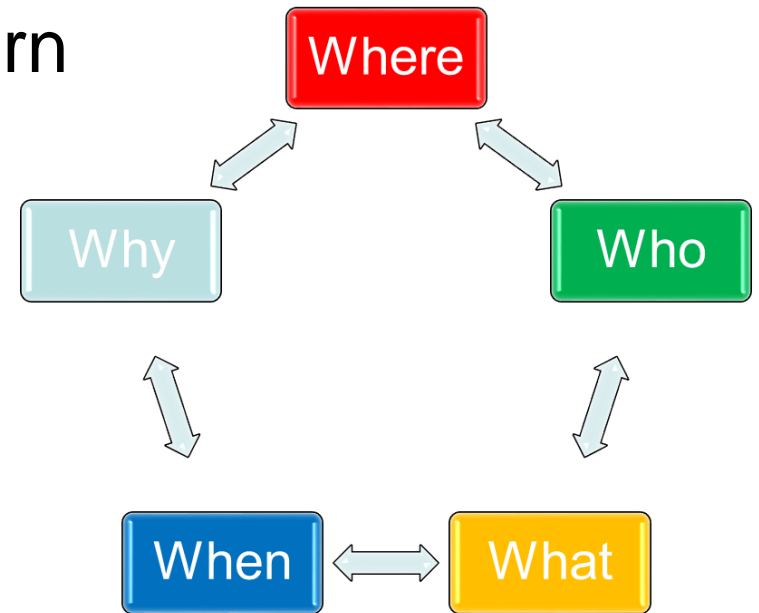
OIE Headquarters



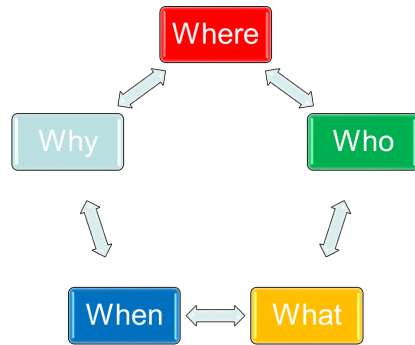
Disease events

The 5W's of epidemiology:

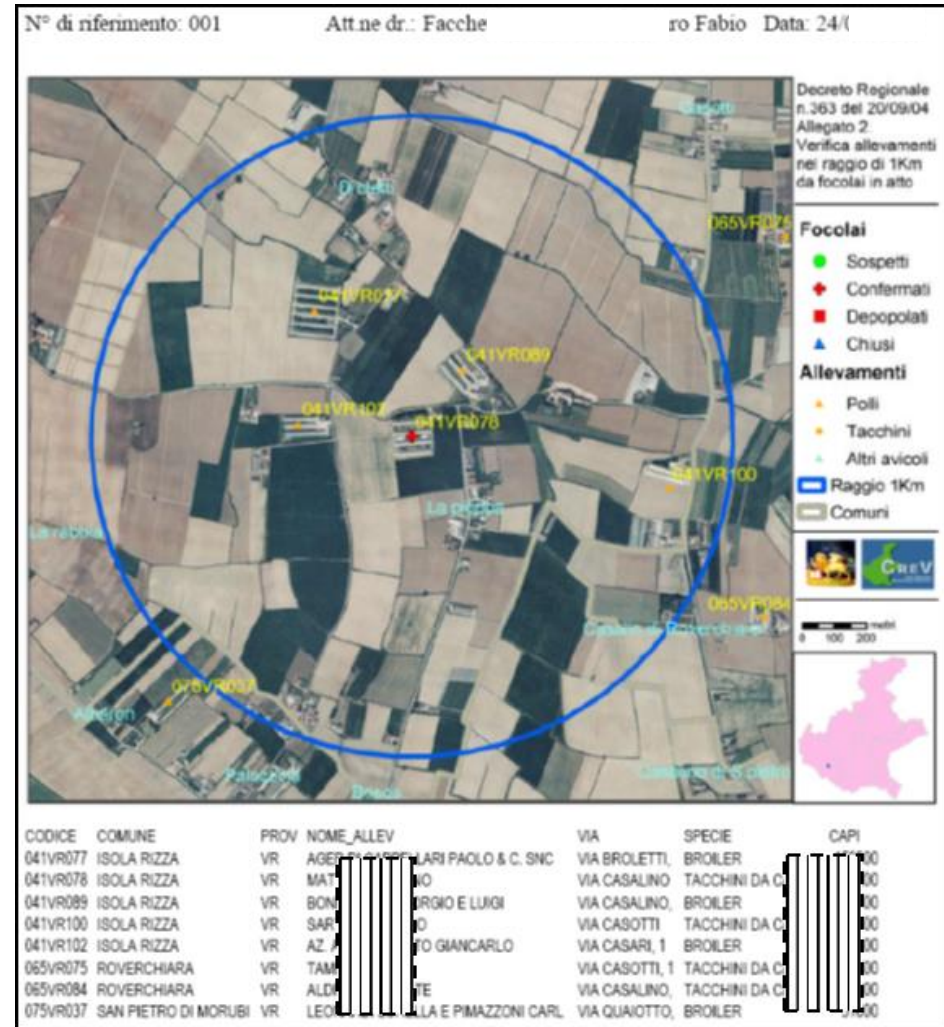
1. What = health issue of concern
2. Who = animals
- 3. Where = location**
4. When = time
5. Why/how = causes, risk factors, modes of transmission



Disease events

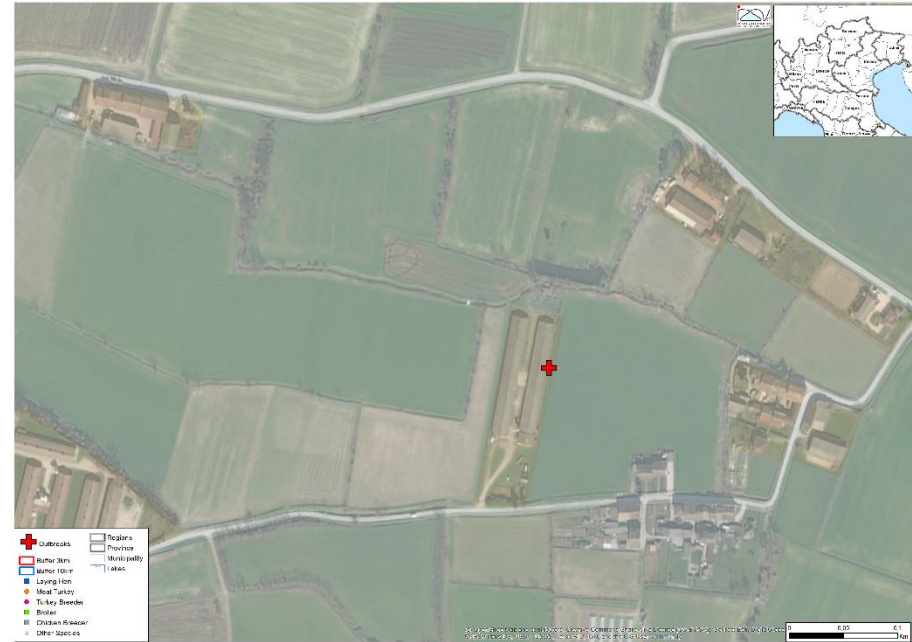


The spatial component of a disease outbreak has always been a basic element to **identify, describe..... characterize = control** a disease outbreak



Disease response

- To identify the location of an outbreak
- To organise disease control operations (protection and surveillance zones, stamping out, vaccination,..)
- To characterise the area at risk of infection (e.g. DPLA)
- To elaborate the first hypothesis on the origin of the disease (e.g. wet area for AI)



- *Farm code*
- *Address*
- *Animal species*
-

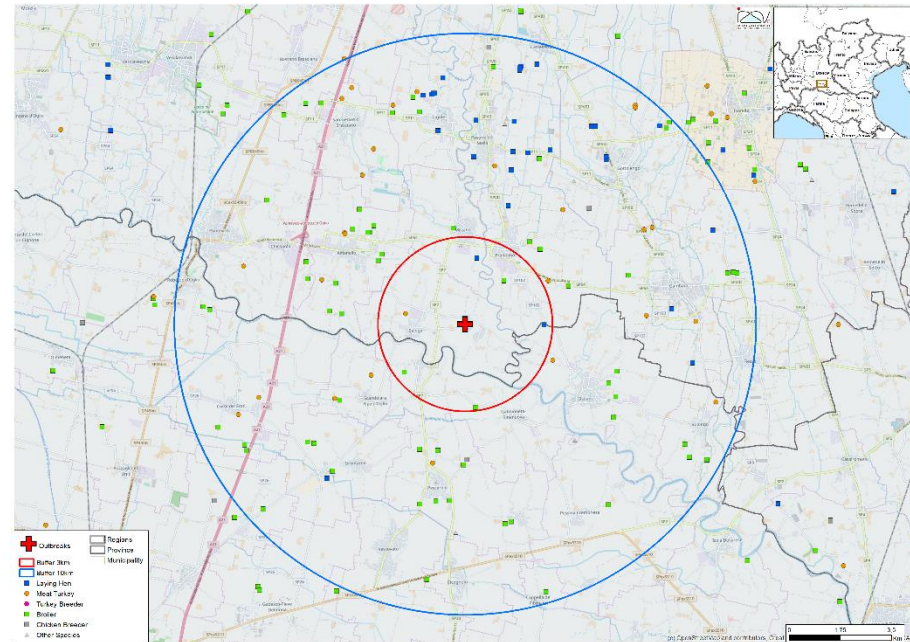
Source:

Farm register database

Ancillary maps (*image, street maps*)

Disease response

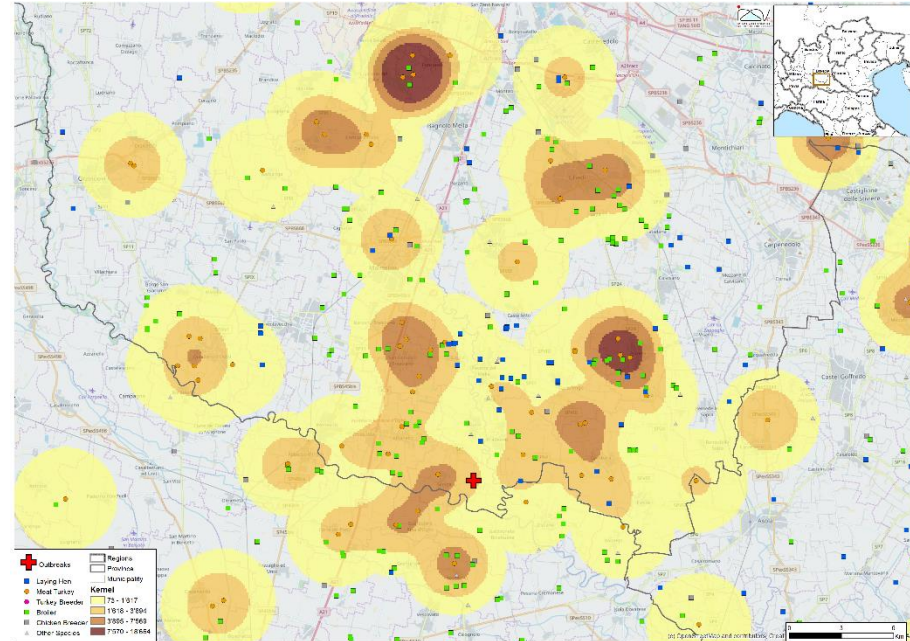
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- *Procedures*
- *GIS tools*

Disease response

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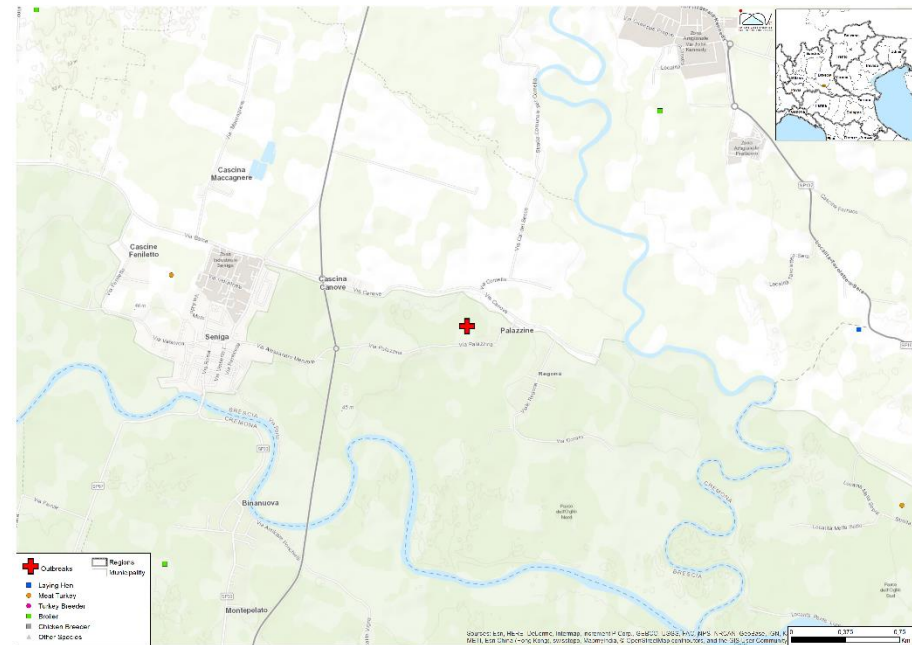


- *Procedures*
- *Exploratory Spatial Data Analysis*

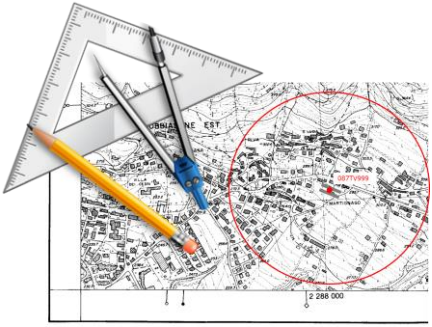
Disease response

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- *Ancillary data*
- *Satellite data*



Disease response – the role of GIS



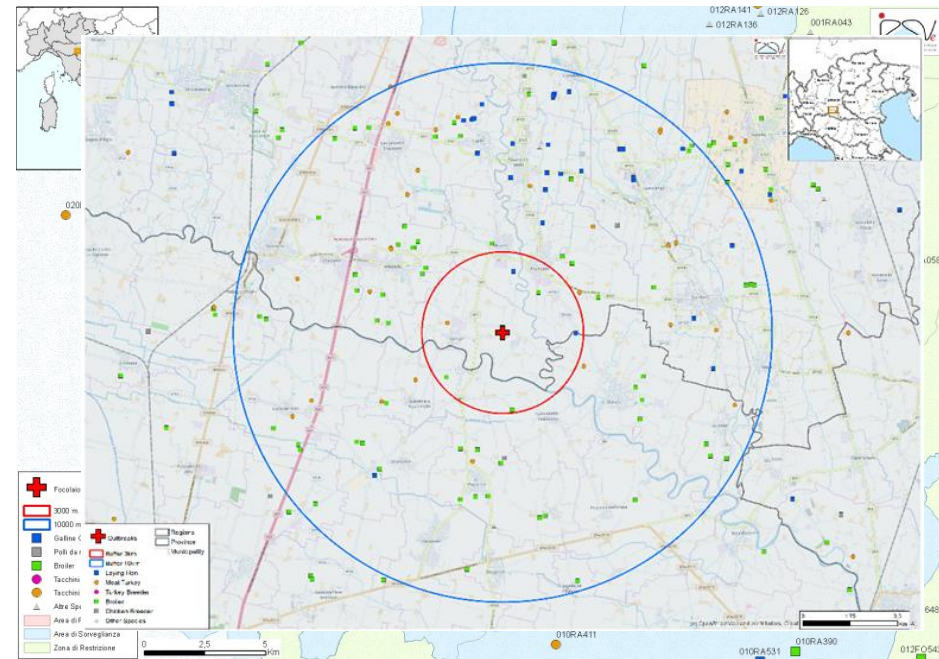
Historically the geographical component of an animal disease response was studied and managed using paper maps



Disease response – the role of GIS

Are procedures based on paper maps still of practical use?

YES = limited number of outbreaks

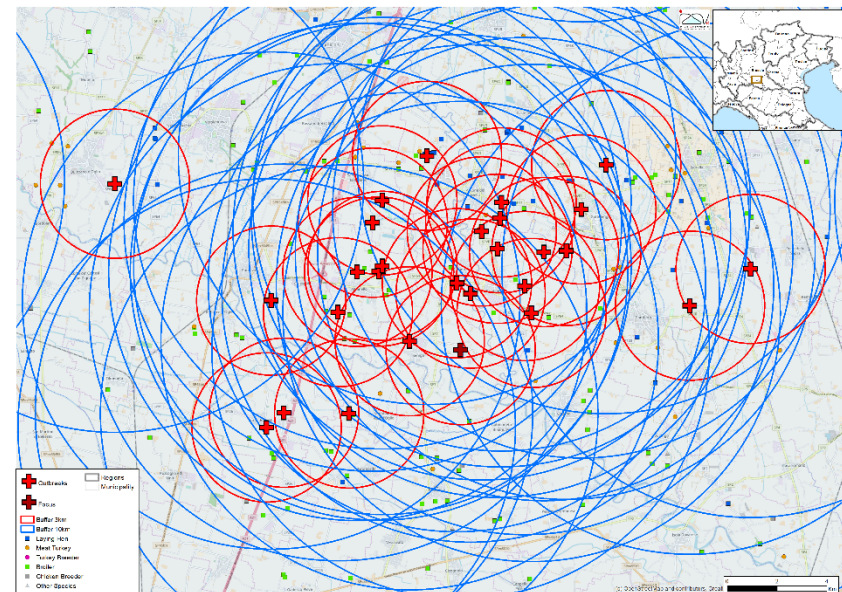


Disease response – the role of GIS

NO = many outbreaks

You **MUST** guarantee the enforcement of restrictions in areas at-risk for:

- disease control
- trade



Disease response – the role of GIS

Why an organisation should invest (money, time, commitment,) to build a GIS?

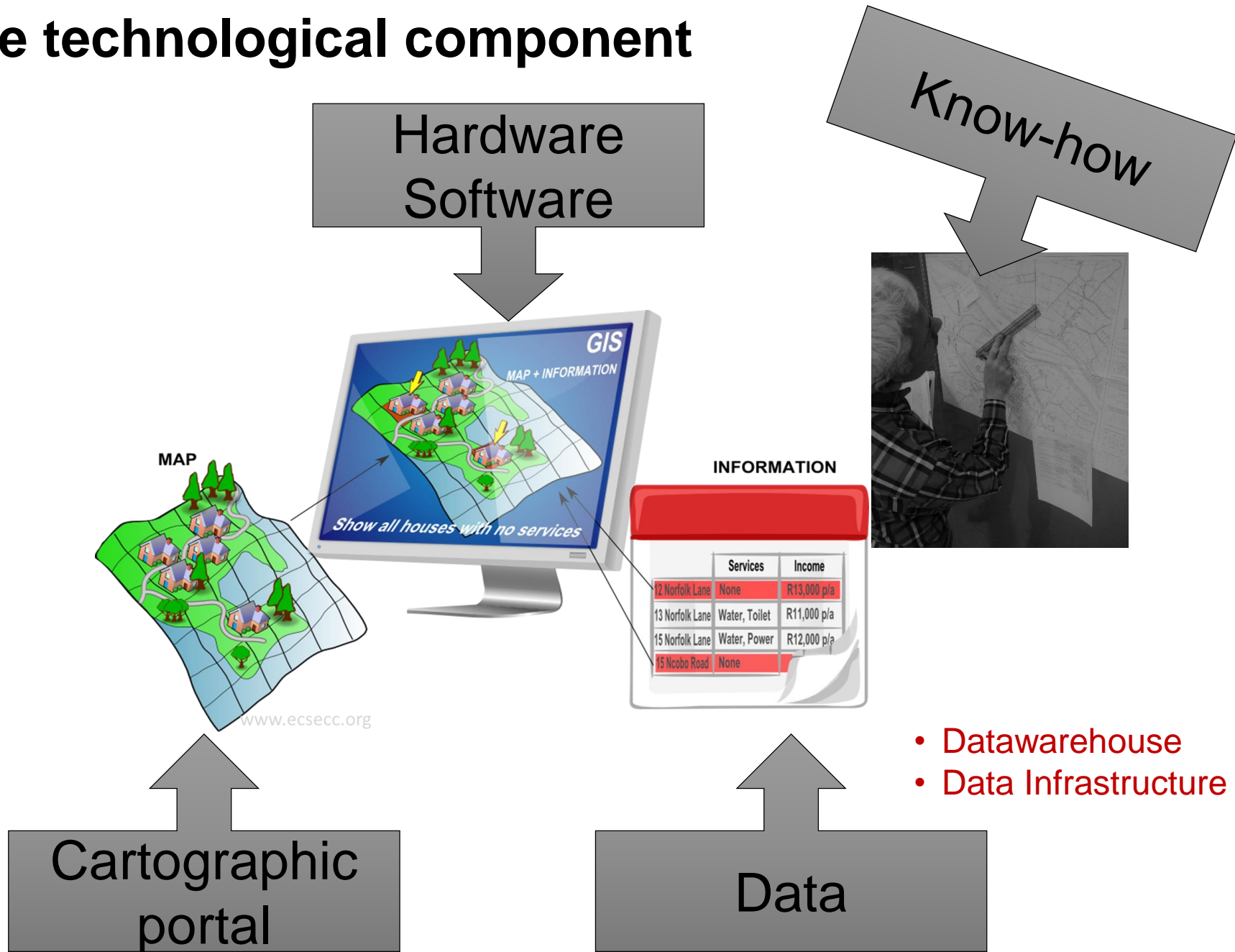
The infographic is titled "GIS RETURN ON INVESTMENT" and is divided into two rows of benefits. Each benefit is accompanied by a small image and a text box. The top row includes: "IMPROVE EFFICIENCY" (power lines), "INCREASE PRODUCTIVITY" (calculator), "SAVE TIME" (compass), "Take better decisions" (hand holding a pen), "Improve data accuracy" (calculator), and "SAVE LIVES" (ambulance). The bottom row includes: "IMPROVE INFORMATION PROCESSING" (hands on keyboard), "COMPLY WITH STATE AND FEDERAL MANDATES" (magnifying glass), "PROTECT YOUR COMMUNITY" (police officer), "IMPROVE COMMUNICATION, COORDINATION, AND COLLABORATION" (handshake), "PROVIDE DATA TO REGULATORS, DEVELOPERS, AND OTHER INTERESTED PARTIES" (stack of papers), and "Effective management of assets and resources" (hand holding a pen). The word "Source" is partially visible at the bottom right.

GIS RETURN ON INVESTMENT

- IMPROVE EFFICIENCY
- INCREASE PRODUCTIVITY
- SAVE TIME
- Take better decisions
- Improve data accuracy
- SAVE LIVES
- IMPROVE INFORMATION PROCESSING
- COMPLY WITH STATE AND FEDERAL MANDATES
- PROTECT YOUR COMMUNITY
- IMPROVE COMMUNICATION, COORDINATION, AND COLLABORATION
- PROVIDE DATA TO REGULATORS, DEVELOPERS, AND OTHER INTERESTED PARTIES
- Effective management of assets and resources

Source

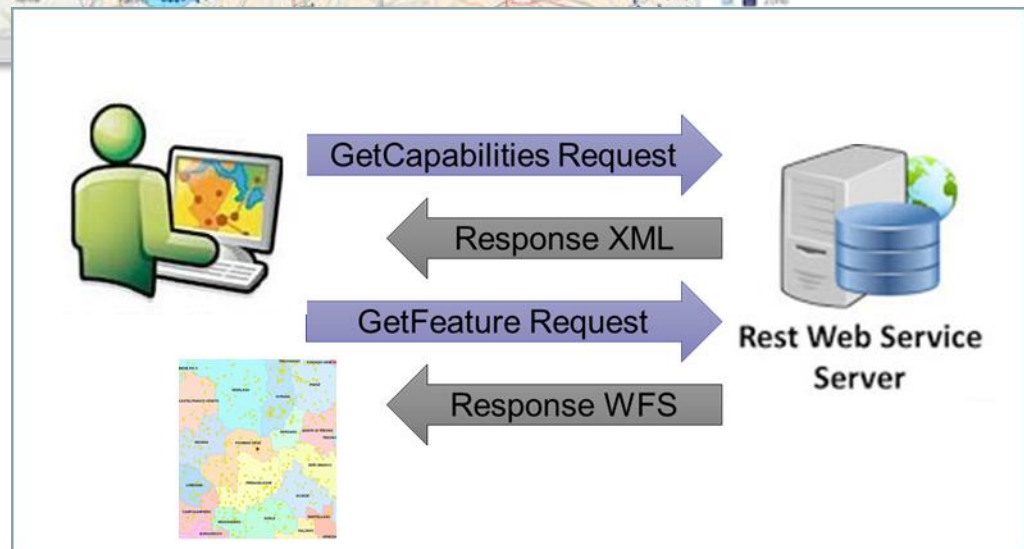
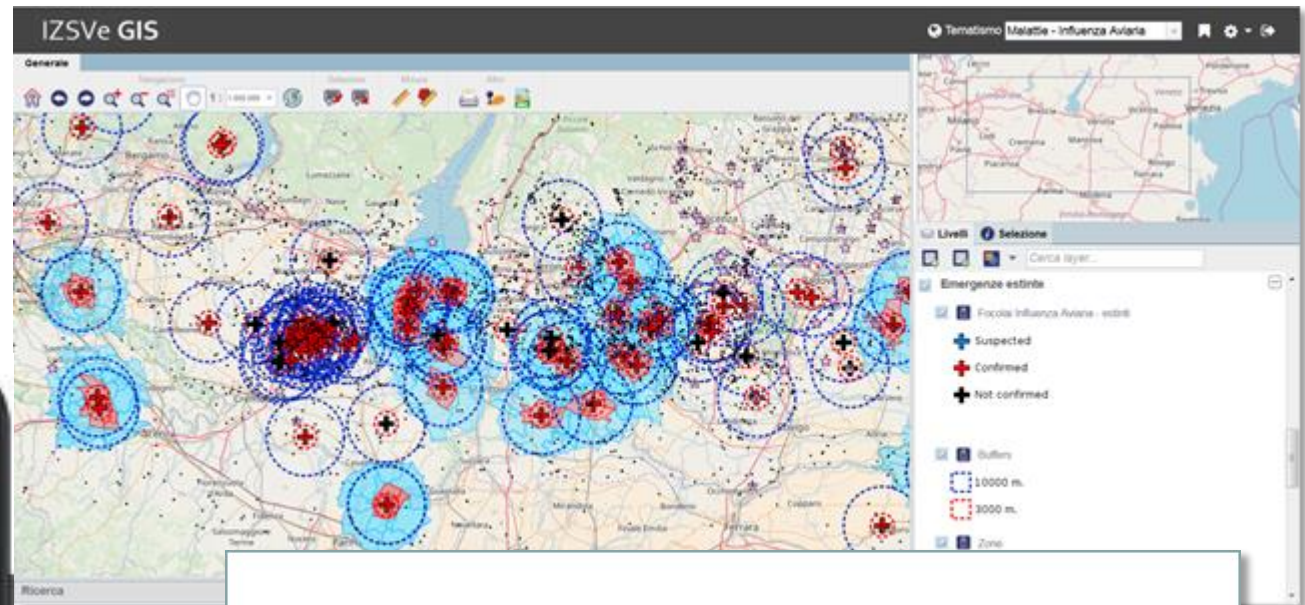
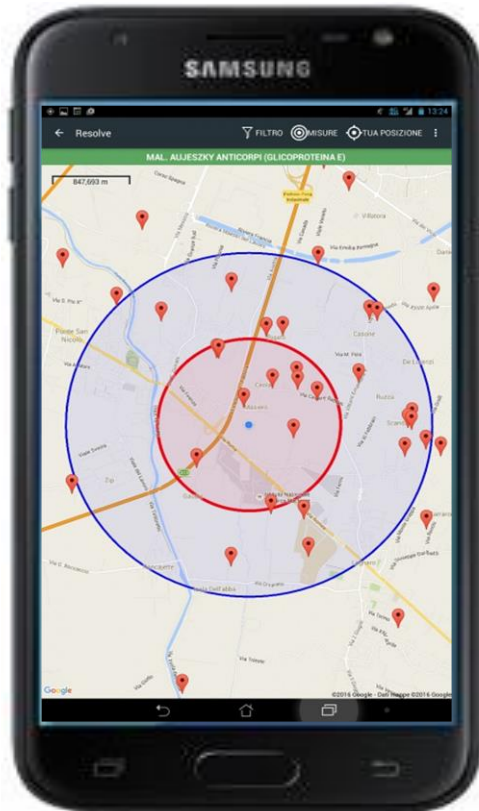
The technological component



The technological component

WebGIS

App



WebServices

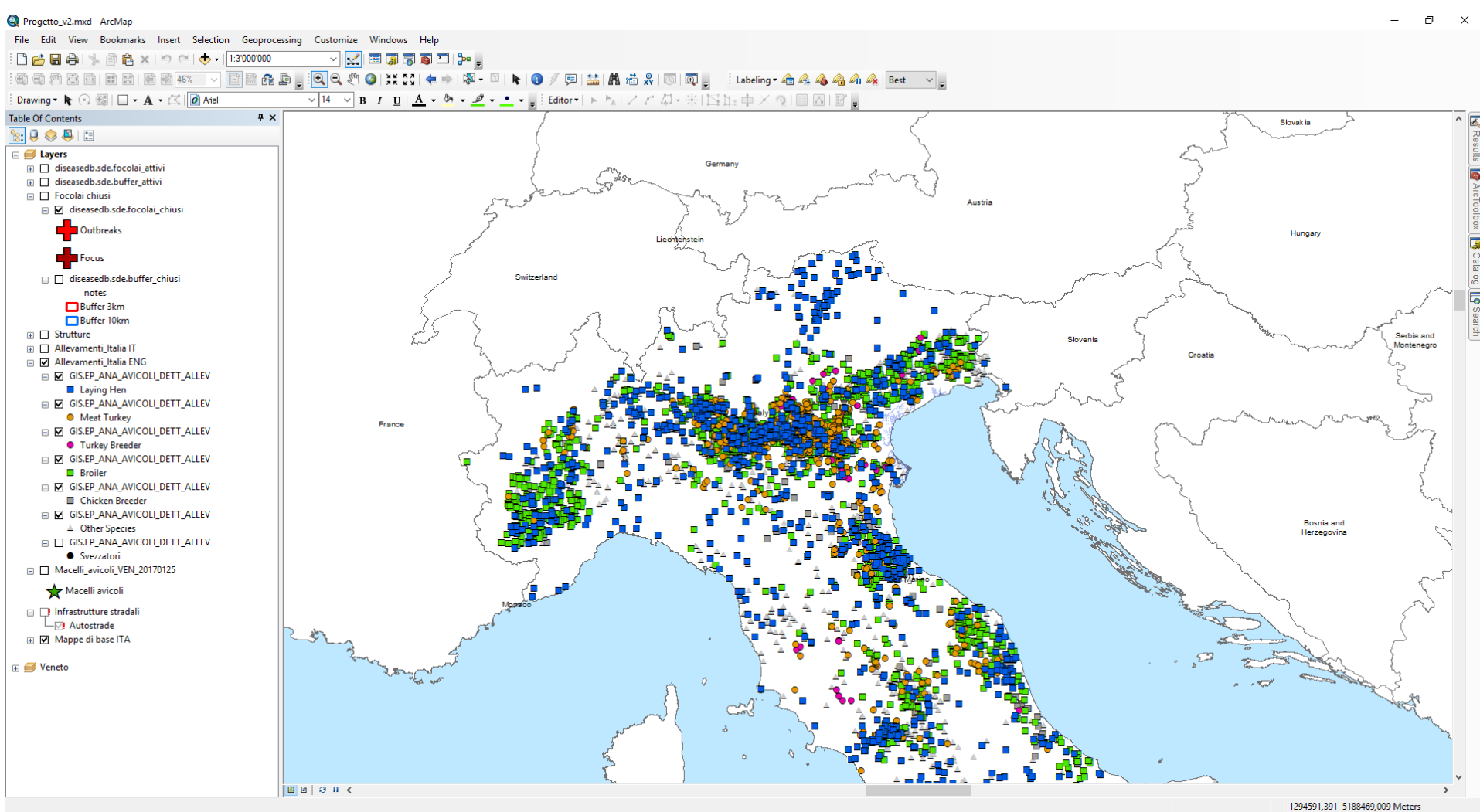
Disease events

HPAI



Applications – AI Management – Preparedness

Step 1 – peace time: set up data, procedures and methods



Applications – AI outbreak management

Step 2: location of AI affected poultry farm

The screenshot displays the ArcMap interface for a project named 'Progetto_v2.mxd'. The main map area shows a geographical view of Italy with various locations labeled, including Verona, Vicenza, and Padova. A 'Select By Attributes' dialog box is open, showing the following configuration:

- Layer: GIS_EP_ANA_AVICOLI_DETT_ALLEV_tac
- Method: Create a new selection
- Attributes: LUOCOD
- Expression: `SELECT * FROM GIS_EP_ANA_AVICOLI_DETT_ALLEV WHERE LUOCOD = '032VR086'`

The map shows several data points represented by colored squares and circles. A pink star is placed on a specific location in the Veneto region, likely indicating the location of an AI affected poultry farm. The 'Layers' panel on the left shows a list of layers, including 'diseasedb.sde.focolai_attivi', 'diseasedb.sde.buffer_attivi', 'Focolai chiusi', 'diseasedb.sde.focolai_chiusi', 'Outbreaks', 'Focus', 'diseasedb.sde.buffer_chiusi_notes', 'Buffer 3km', 'Buffer 10km', 'Strutture', 'Allevamenti_Italia IT', 'Allevamenti_Italia ENG', 'GIS_EP_ANA_AVICOLI_DETT_ALLEV', 'Laying Hen', 'Meat Turkey', 'GIS_EP_ANA_AVICOLI_DETT_ALLEV', 'Turkey Breeder', 'Broiler', 'Chicken Breeder', 'Other Species', 'GIS_EP_ANA_AVICOLI_DETT_ALLEV', 'Svezatori', 'Macelli_avicoli_VEN_20170125', 'Macelli avicoli', 'Infrastrutture stradali', 'Autostrade', 'Mappe di base ITA', 'Cartografia ISTAT', 'ITA', 'gis_os.sde.reg_ita', 'Regions', 'gis_os.sde.prov_ita', 'Province', 'gis_os.sde.Comuni', 'Municipality', 'comuni_italia_locale', 'Municipality', and 'FVG.Laquina FVG'.

Applications – AI outbreak management

Step 3: AI affected poultry farm (data check)

- Farm code
- Farm name
- Species and type of production
- Number of birds
- Restocking date
- Last AI inspection/test

The screenshot shows the ArcMap interface with a map of Italy. A yellow callout box lists the data fields to be checked for an AI-affected poultry farm. The Identify window is open, showing the following data for a selected feature:

Field	Value
LUOID	3137546
LUOCOD	032VR086
LUOIND	VIA CAVECCIA N. 3
LUOINSCAP	37060
LUOCODISTAT	023032
LUODESCOM	ERBÈ
LUOCODASL	9
LUOSIGLAPROV	VR
LUODESPRO	VERONA
LUOREG	050
LUODESREG	VENETO
PROP_ANADESCOM	
RES_ANADESCOM	TIZIANI SIMONE
RAS_ANADESCOM	SOC. AGR. LA PELLEGRINA S.P.A
AVIID	21945
AVITEMID_VALSTART	1
AVITEMID_VALEND	33237
AVIANAIID_RAS	4651
AVIANAIID_RES	85120
AVIANAIID_ESITIT	4651
AVIDATA_VALSTART	01/01/2010
AVIDATA_VALEND	31/12/2100
AVIELAB	72783
AVISYNGRO_PK	7102
RASCOD	K490347
RASINSCOD	V13583
RASANACODRAS	H03768
RASANACODRAL	H03768
RASDATAINIZ	31/12/2004
RASDATAFINE	31/12/2100
RASDATAACREA	02/04/2015 13:16:01

Applications – AI outbreak management

Step 3: outbreak eradication

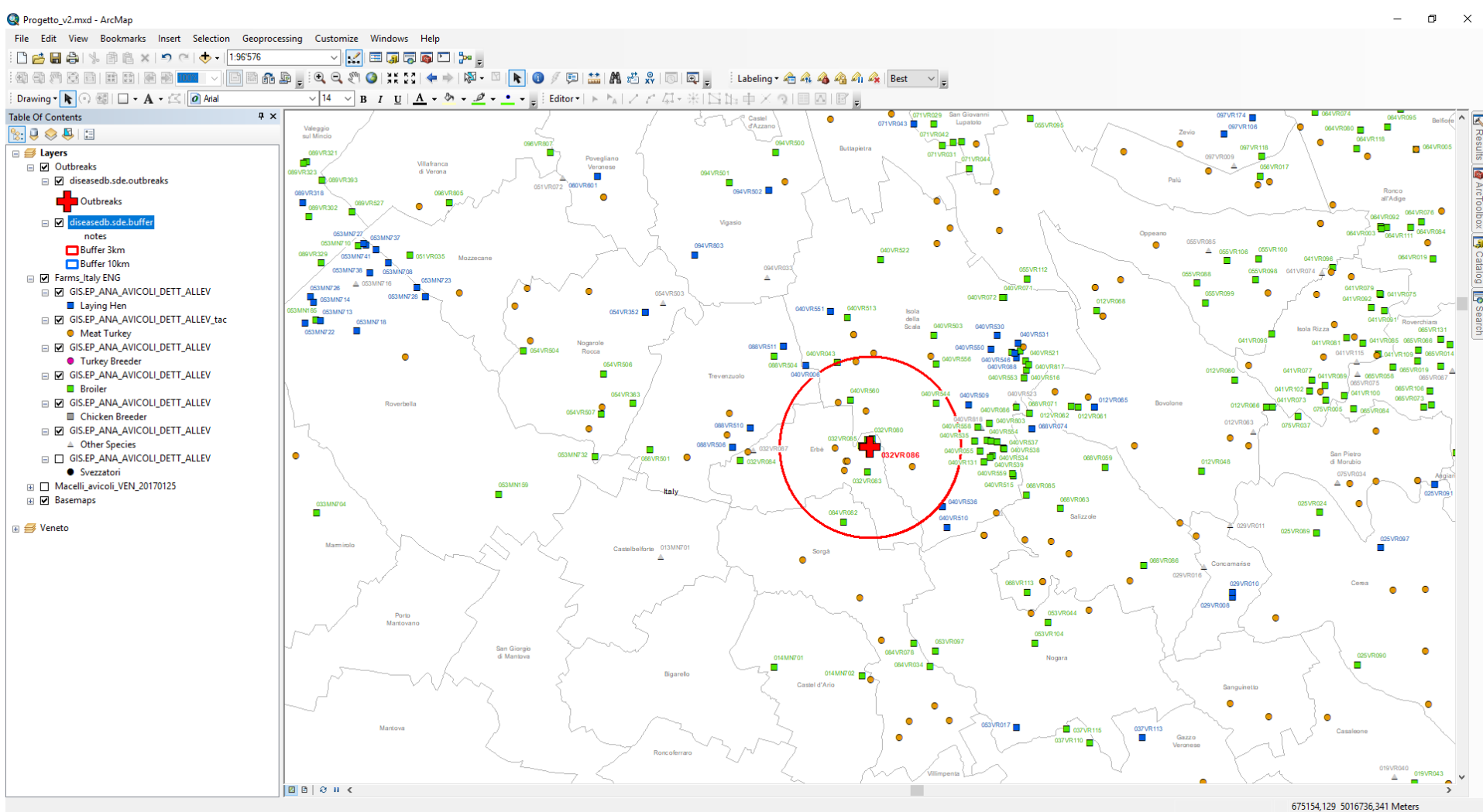
Field veterinarians

- Restrictions
- Stamping out measures
- Disposal of carcasses
- Cleansing and disinfection



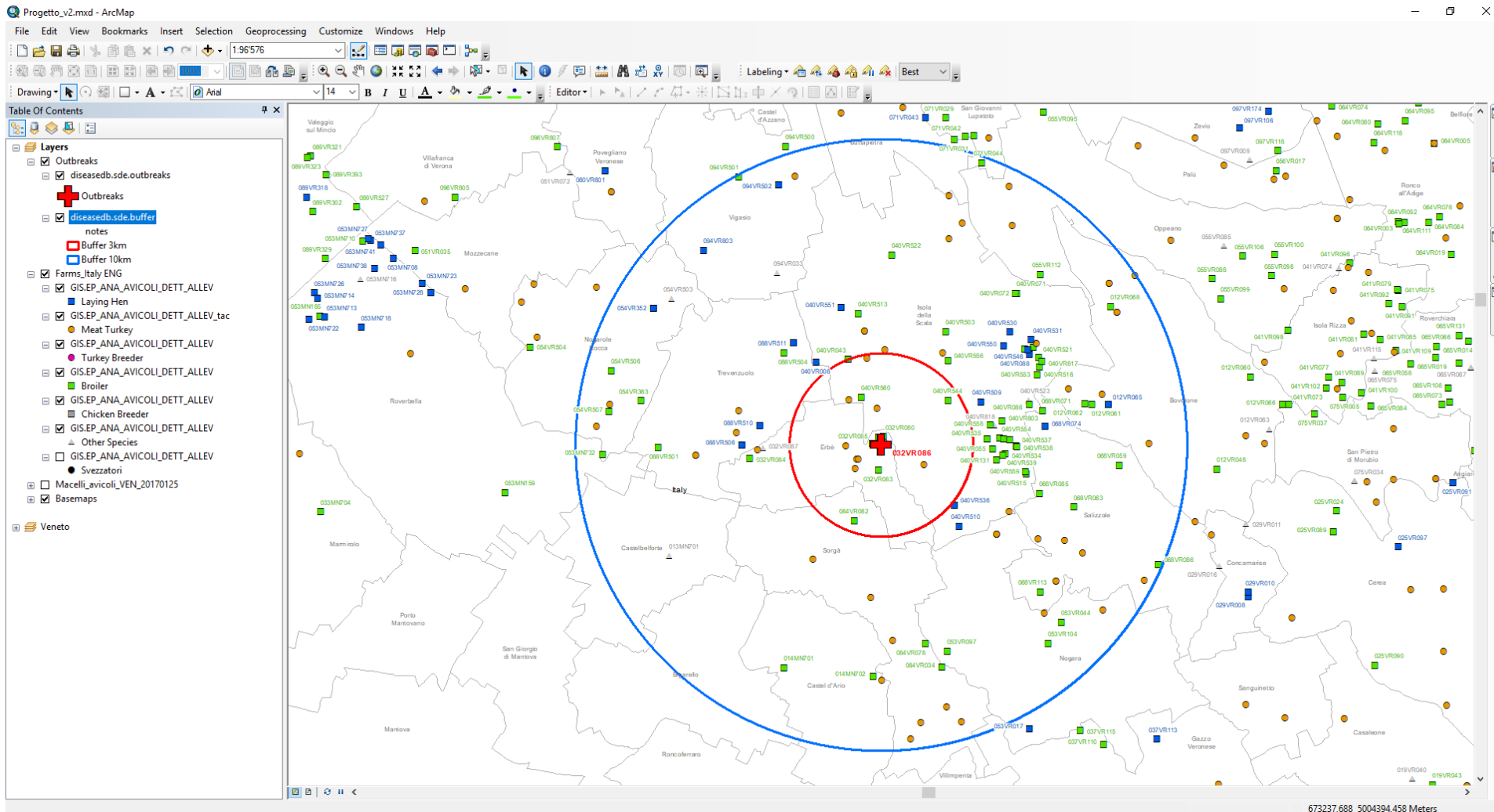
Applications – AI outbreak management

Step 4: protection zone



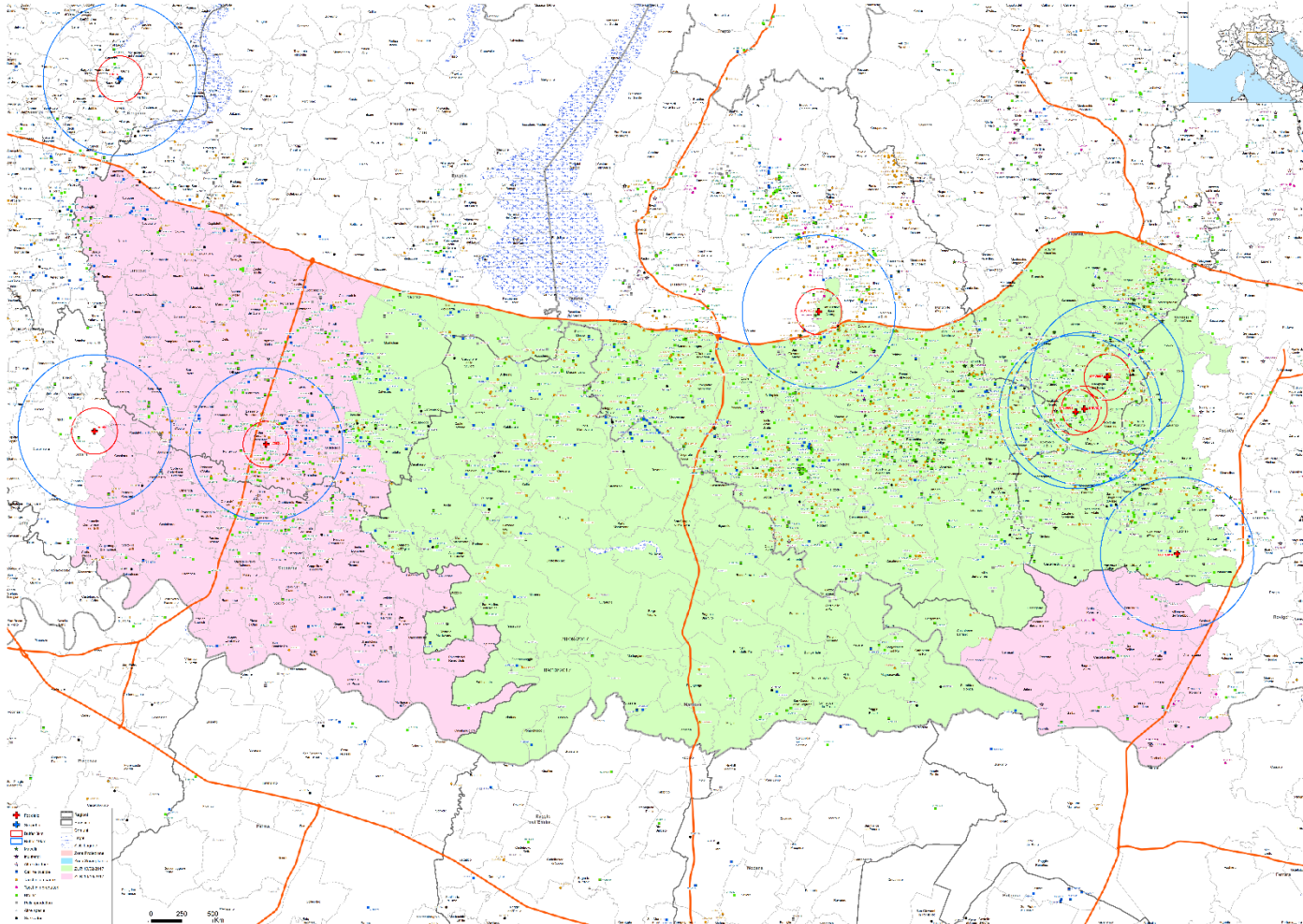
Applications – AI outbreak management

Step 5: surveillance zone



Applications – AI Management

Step 6: identification of further restricted zones



Applications – AI outbreak management

Step 7: list of poultry farms within the restricted areas

The screenshot displays the ArcMap interface for a project named 'Progetto_v2.mxd'. The main map area shows a geographical distribution of poultry farms, each represented by a colored dot and labeled with a unique ID (e.g., 032VR086, 040VR560, 040VR551). A red circle highlights a specific farm, and a larger blue circle encompasses a broader region. A 'Select By Location' dialog box is open in the foreground, showing the following configuration:

- Select By Location**
- Select features from one or more target layers based on their location in relation to the features in the source layer.
- Selection method: select features from
- Target layer(s):
 - Outbreaks
 - diseasdb.sde.outbreaks
 - diseasdb.sde.buffer
 - Farms_Italy ENG
 - GIS.EP_ANA_AVICOLI_DETT_ALLEV
 - GIS.EP_ANA_AVICOLI_DETT_ALLEV
 - GIS.EP_ANA_AVICOLI_DETT_ALLEV
 - GIS.EP_ANA_AVICOLI_DETT_ALLEV
 - GIS.EP_ANA_AVICOLI_DETT_ALLEV
 - GIS.EP_ANA_AVICOLI_DETT_ALLEV
 - Other Species
 - GIS.EP_ANA_AVICOLI_DETT_ALLEV
 - Svezatori
- Only show selectable layers in this list
- Source layer: diseasdb.sde.buffer (0 features selected)
- Use selected features
- Spatial selection method for target layer feature(s): are within the source layer feature
- Apply a search distance: 2000,000000 Meters
- Buttons: About select by location, OK, Apply, Close

Applications – AI outbreak management

Step 7: list of poultry farms within the areas – data export

The screenshot displays the ArcMap interface with a map showing various poultry farms. A blue buffer zone is visible around a specific farm. An Excel spreadsheet is overlaid on the map, showing a list of farms with their details. The spreadsheet has columns for DISTANZA, CODICE AZI, INDIRIZZO, COMUNE, PROVINCIA, REGIONE, SPECIE, TIPO, ORIENTAM, FASE, PROD, MODALITA, CAPACITA, P, RESPONSAB, REGIONE, SI, AVIHD, LUODESC, and LUODESPRC.

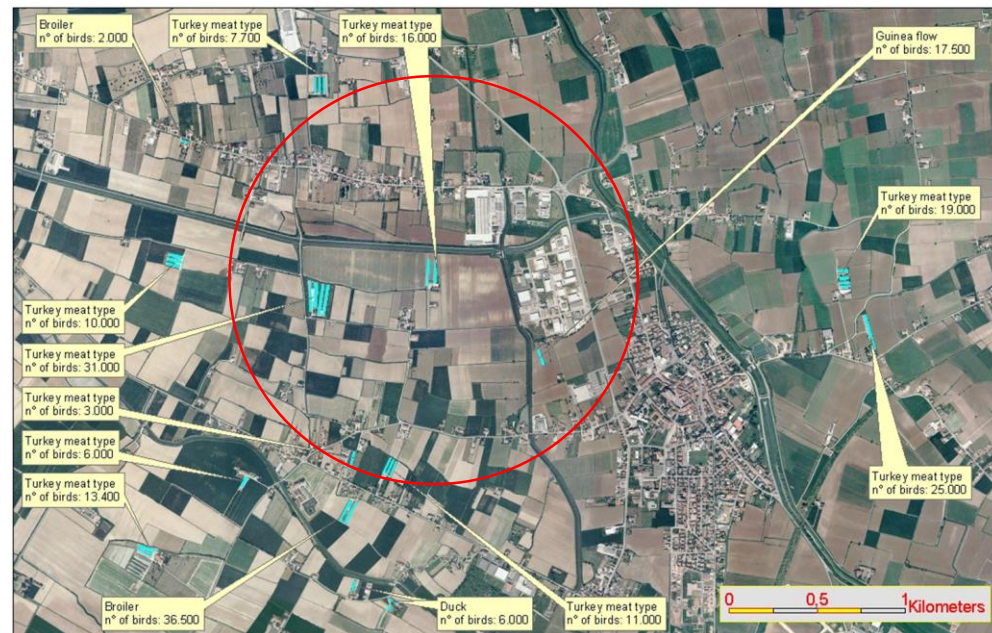
	A	B	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S			
1		DISTANZA	CODICE AZI	INDIRIZZO	COMUNE	PROVINCIA	REGIONE	SPECIE	TIPO	ORIENTAM	FASE	PROD	MODALITA	CAPACITA	P	RESPONSAB	REGIONE	SI	AVIHD	LUODESC	LUODESPRC
2	1	0,00	032VR086	VIA CAVECCIERBE	VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	7500,00	TIZIANI	SIMC	SOC. AGR. LF	21945,00	ERBE	VERONA		
3	2	117,97	032VR093	VIA CA' VECCERBE	VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	39000,00	TIZIANI	ENZC	SOCIETA' AG	65037,00	ERBE	VERONA		
4	3	137,34	032VR089	VIA CAVECCIERBE	VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	13600,00	CARPANESE	SOC. AGR. LF	21801,00	ERBE	VERONA			
5	4	265,32	032VR081	VIA CAVECCIERBE	VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	48000,00	TIZIANI	MAUS	SOCIETA' AG	65038,00	ERBE	VERONA		
6	5	278,75	032VR080	VIA CA' VECCERBE	VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	35000,00	TIZIANI	DAN	SOCIETA' AG	65069,00	ERBE	VERONA		
7	6	278,75	032VR080	VIA CA' VECCERBE	VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	17600,00	TIZIANI	FLAV	SOCIETA' AG	65070,00	ERBE	VERONA		
8	7	297,99	032VR085	VIA PARECCIERBE	VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	78000,00	TOSATO	RIN	SOCIETA' AG	17707,00	ERBE	VERONA		
9	8	297,99	032VR085	VIA PARECCIERBE	VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	98000,00	LADY	AVICO	SOCIETA' AG	25043,00	ERBE	VERONA		
10	9	816,29	032VR083	VIA FIORANEERBE	VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	38000,00	PATUZZI	MA	SOC. AGR. LF	64883,00	ERBE	VERONA		
11	10	875,69	032VR095	VIA CASTELLIERBE	VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	20000,00	AZIENDA	AG	SOC. AGR. LF	17569,00	ERBE	VERONA		
12	11	935,84	032VR090	VIA CASTELLIERBE	VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	15000,00	AZ. AGR.	PA	SOC. AGR. LF	17566,00	ERBE	VERONA		
13	12	1149,64	032VR091	VIA CASTELLIERBE	VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	26000,00	PATUZZI	GIC	SOC. AGR. LF	57094,00	ERBE	VERONA		
14	13	1155,97	032VR092	VIA CENTEN/ERBE	VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	10000,00	SOCIETA'	AG	SOC. AGR. G.	23112,00	ERBE	VERONA		
15	14	1217,13	040VR450	VIA PALAZZII	ISOLA DELLA VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	16000,00	PATUZZI	GA	SOCIETA' AG	58978,00	ISOLA DELLA VERONA			
16	15	1528,12	040VR511	VIA CAMAGFI	ISOLA DELLA VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	15000,00	CRISTOFOLI	MANG	MIFIC	18025,00	ISOLA DELLA VERONA			
17	16	1686,77	040VR560	VIA CROSONI	ISOLA DELLA VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	78800,00	GIOVANNON	SOC. AGR. LF	64882,00	ISOLA DELLA VERONA				
18	17	1810,71	040VR517	VIA CROSONI	ISOLA DELLA VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	18800,00	GIULIARI	NIC	SOC. AGR. LF	24043,00	ISOLA DELLA VERONA			
19	18	2620,29	084VR082	VIA CAMPAC	SORGA VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	39990,00	SOC. AGR.	CI	SOC. AGR. LF	23158,00	SORGA	VERONA		
20	19	2627,10	040VR544	VIA TOCCOLI	ISOLA DELLA VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	34000,00	TESCAROLI	PS	SOC. AGR. LF	64917,00	ISOLA DELLA VERONA			
21	20	2734,16	032VR100	VIA SAN CA	ERBE VR	VENETO	AVICOLI MIS	ALLEVAMEN	SVEZZAMEN	Indeterminat	NON INDICA	6197,00	FATTORIA	CC	FATTORIA	CC	64704,00	ERBE	VERONA		
22	21	2874,59	040VR805	VIA SCHIOPFI	ISOLA DELLA VR	VENETO	TACCHINI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	11200,00	CORTE	SCH	IK	SOC. AGR. LF	17574,00	ISOLA DELLA VERONA		
23	22	3017,84	040VR043	LOC. CANOVI	ISOLA DELLA VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	17000,00	AVICOLA	PI	AZ. AGR. CECC	59242,00	ISOLA DELLA VERONA			
24	23	3017,84	040VR043	LOC. CANOVI	ISOLA DELLA VR	VENETO	GALLUS GALI	ALLEVAMEN	POLLAME	D	Indeterminat	CONVENZIO	22000,00	PERBELLINI	RAZ.	AGR. CECC	58843,00	ISOLA DELLA VERONA			

Applications – AI outbreak management

Step 7: restriction zones

Epi-group

- Identification of poultry farms at risk of neighborhood spread
- Surveillance (inspection and testing,....)
- Planning eradication actions (buffer vaccination, pre-empty killing,..)



Applications – AI outbreak management

Step 7: restriction zones

Field veterinarians

- Surveillance
- Enforcement of restriction and eradication measures



Application – Eradication of sylvatic rabies

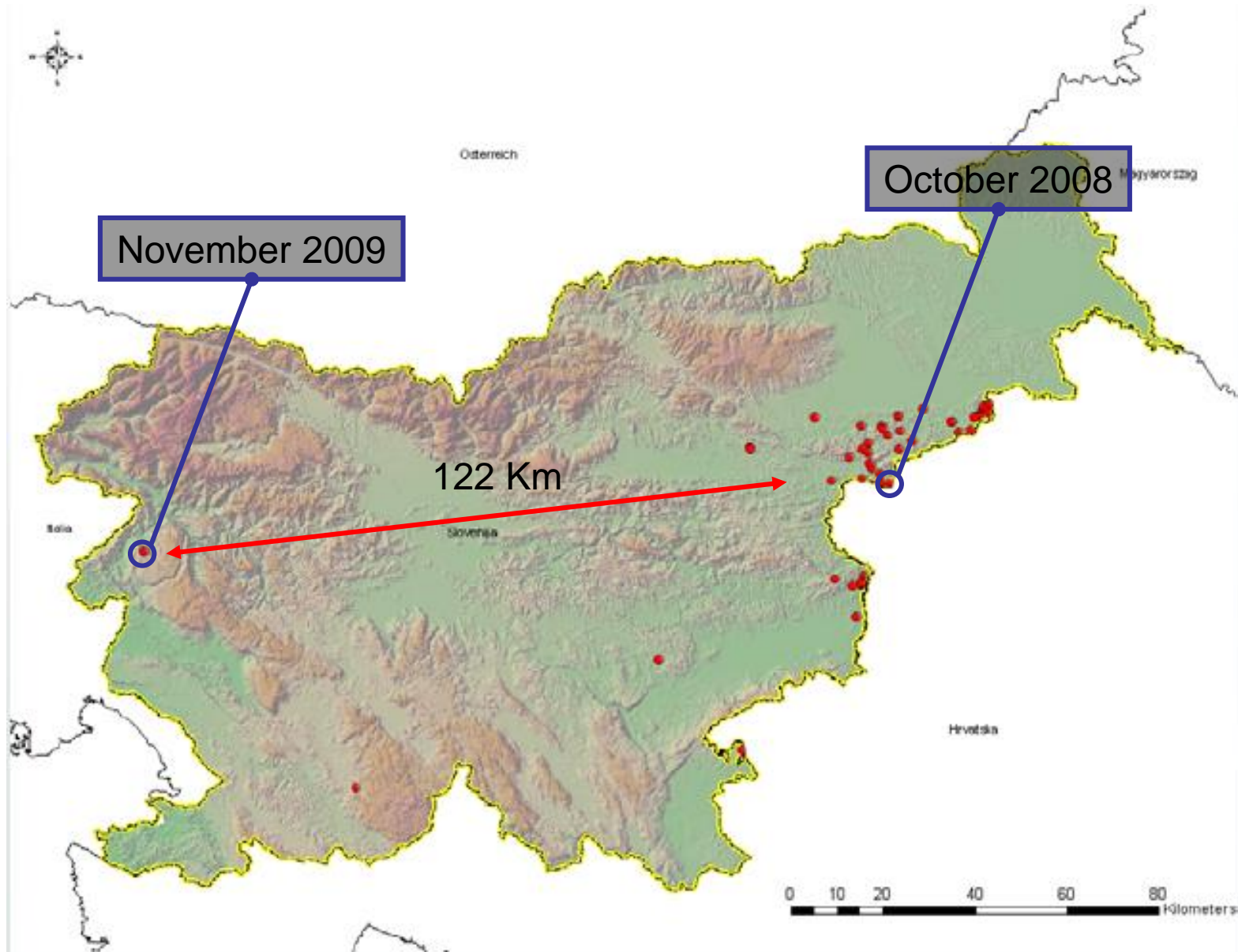
In Europe red foxes (*Vulpes vulpes*) are the reservoir of rabies

Sylvatic rabies has been eradicated from many EU countries by means of vaccination using live attenuated vaccines (oral rabie

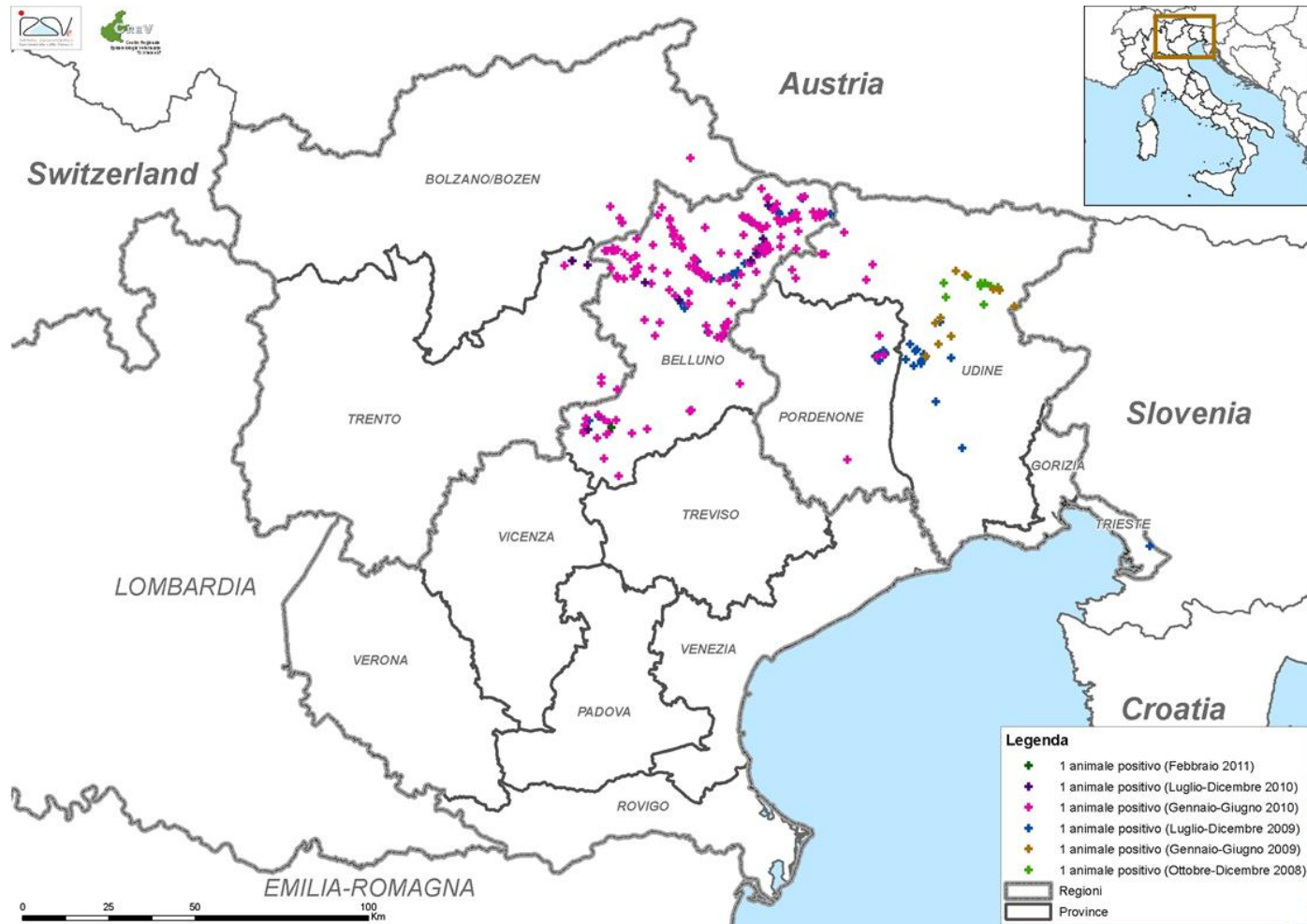
Italy had been rabies free since 1995



Application – Eradication of sylvatic rabies



Application – Eradication of sylvatic rabies



Application - Aerial distribution of vaccine baits



Bait storage



Baits belt packaging

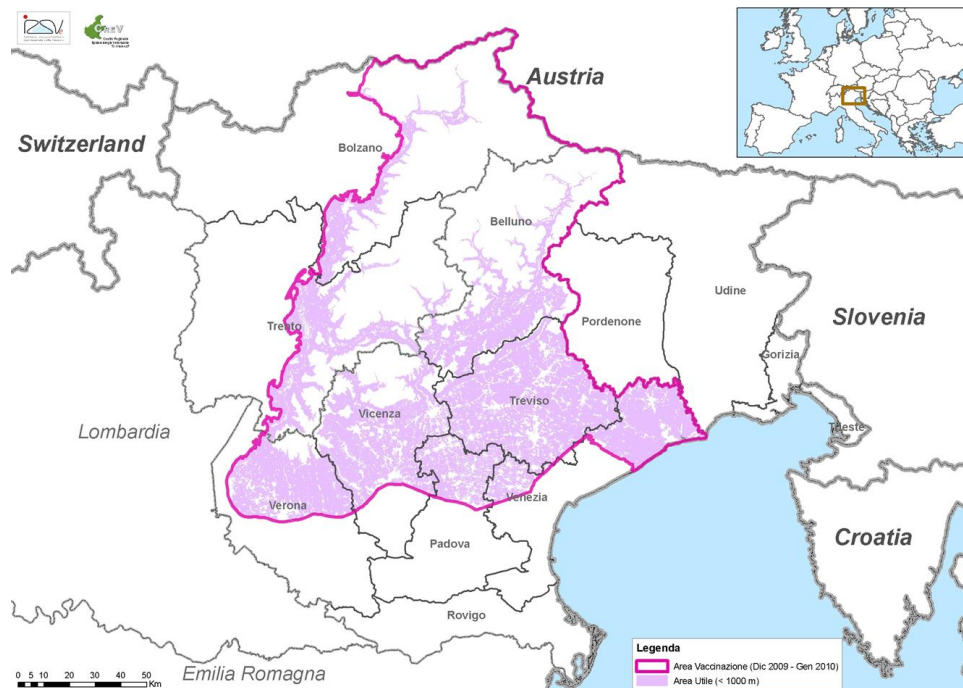


Application – Sylvatic rabies

GIS use in planning an ORV:

Precise definition of the vaccination area - **suitability**

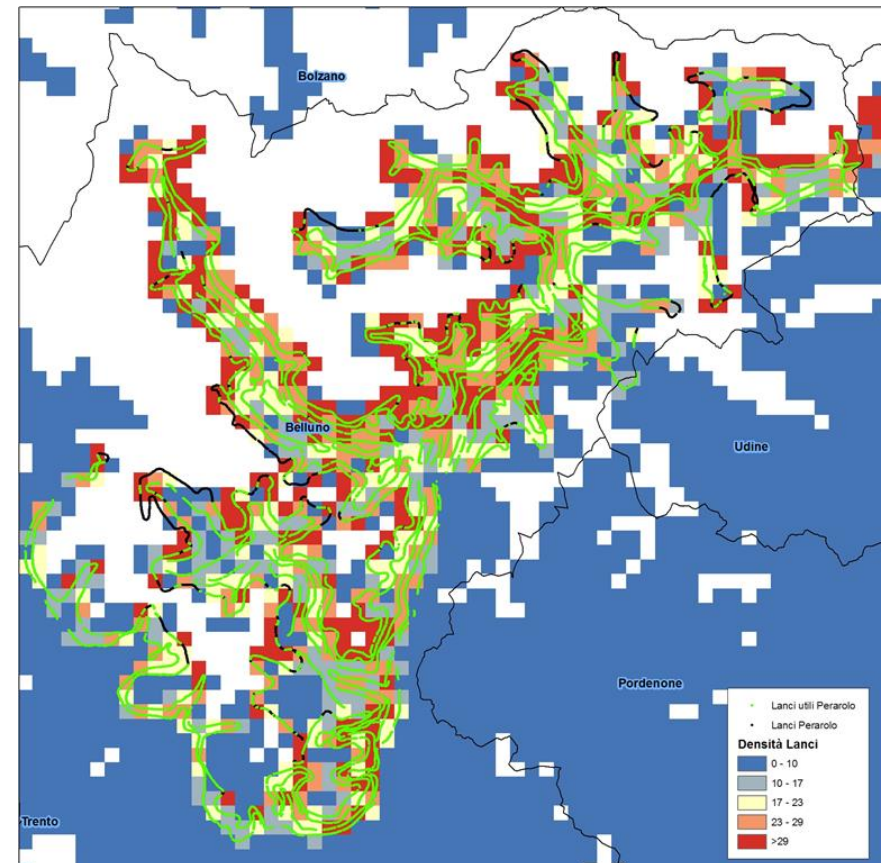
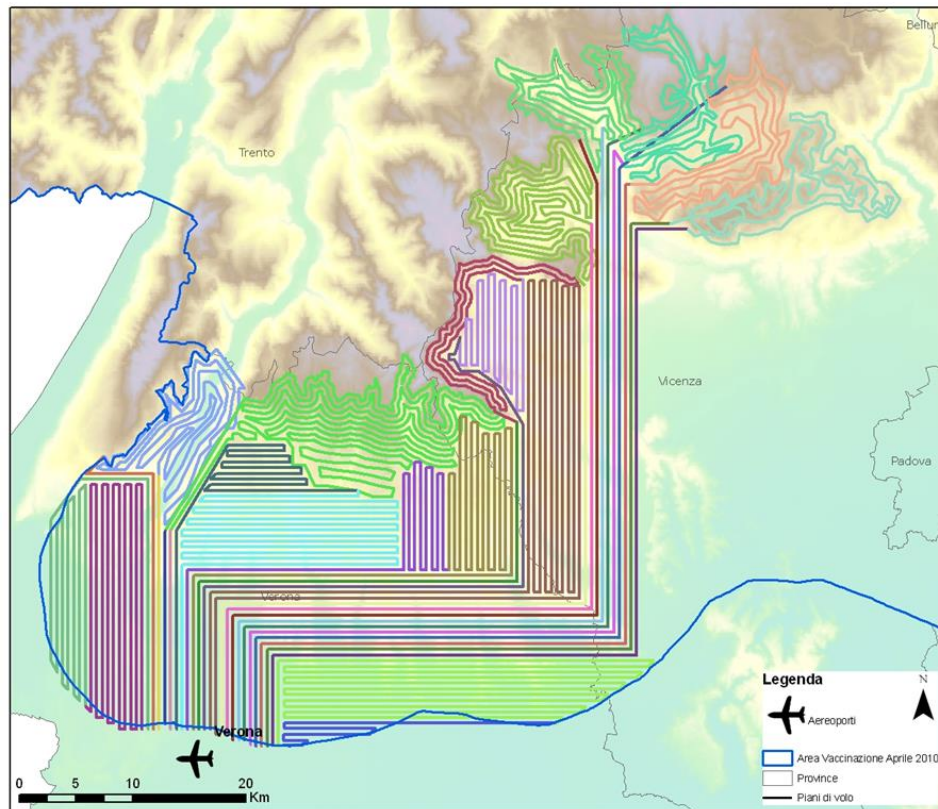
- Zones with low or high fox densities
- Zones where baits could not be dropped (cities, ...)
- Areas below the average freezing point (threshold = 0°C)



Application – Sylvatic rabies

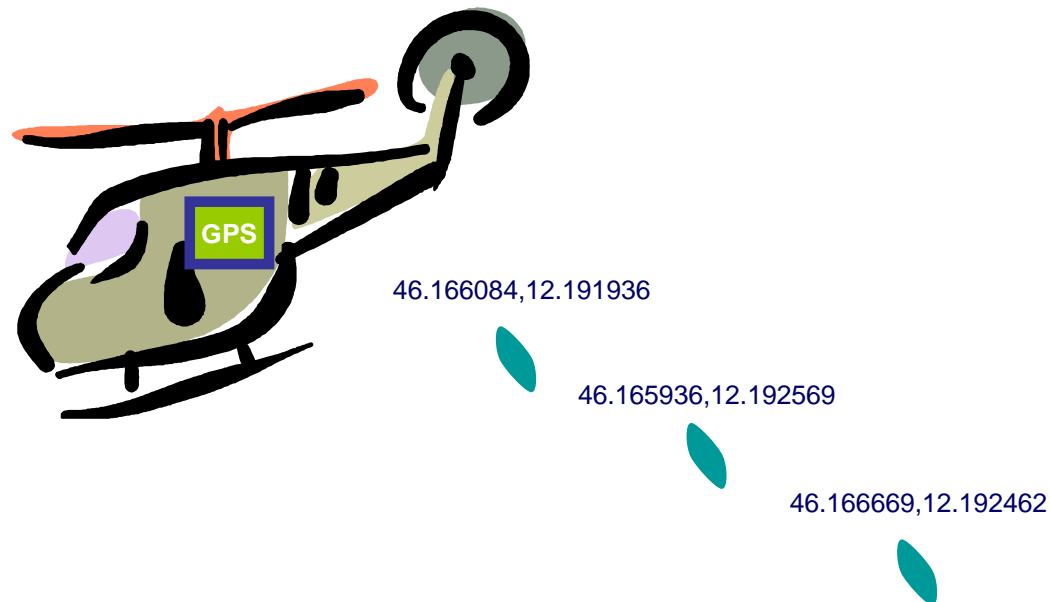
GIS use in planning an ORV:

Optimal flight paths for the helicopter



Application - Aerial distribution of vaccine baits

- **Aerial distribution** by helicopters, using a satellite-navigated and computer-supported automatic bait dropping system
- An electronic metronome connected to a GPS allowed the regular dropping of baits (density/km²) and recorded the coordinates where the baits were dropped



Application - Aerial distribution of vaccine baits



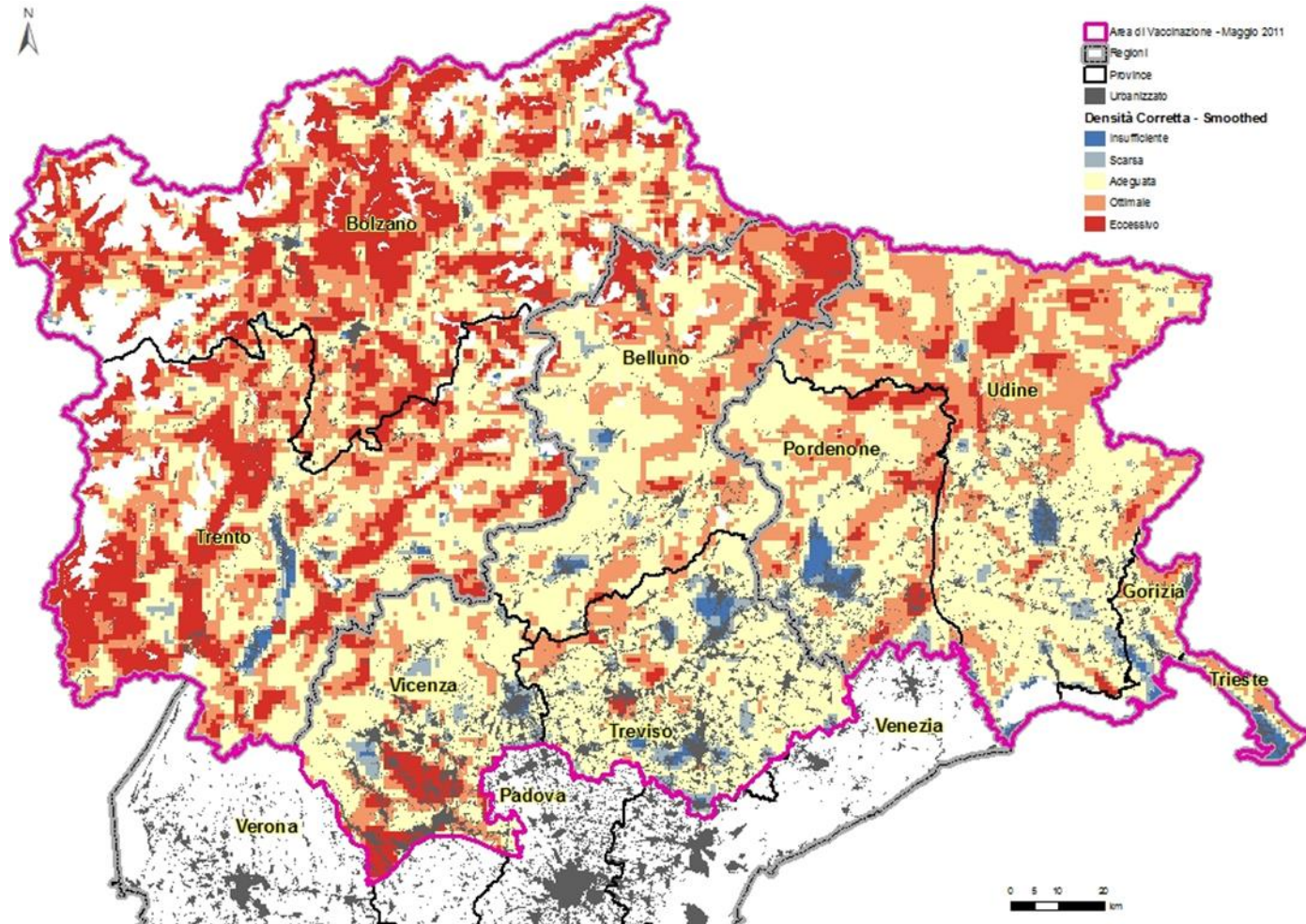
Satellite-navigated computer supported automatic system

- Constant and homogeneous release of baits
- Precise localization of each dropped bait (recorded on a file)
- Maps with the precise bait distribution

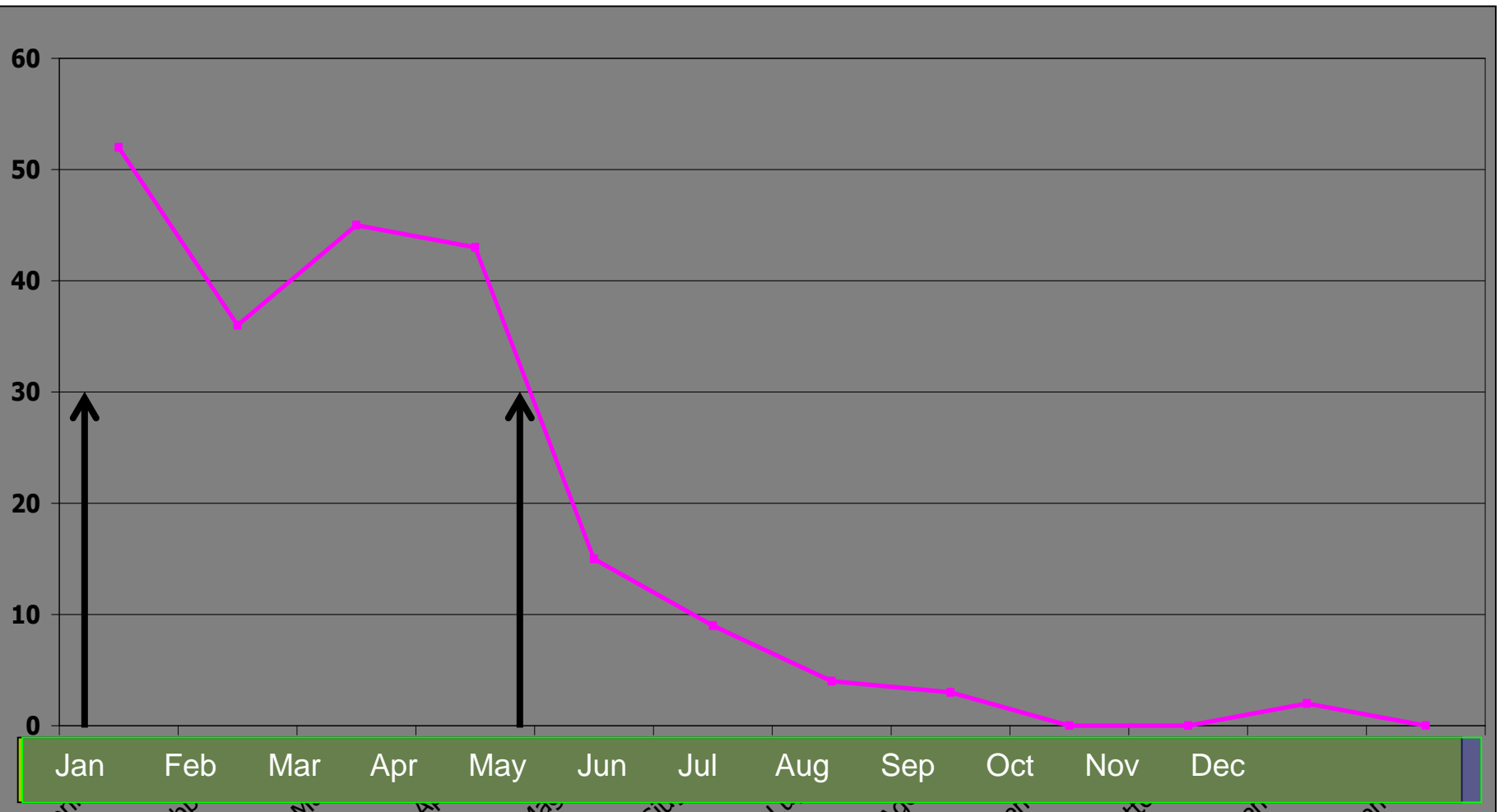
Application – Evaluation of vaccine bait distribution



Application – Evaluation of vaccine bait distribution



Monthly number of infected foxes – 2010



GIS - Conclusions

Historically the geographical component of an animal disease response was managed using paper maps

Currently the **technology** to implement a GIS is readily available (with limited investment)

Know-how for GIS use in the veterinary sector is well established in order to build a GIS infrastructure tailored to your needs and organization



online course

The Use of GIS in animal disease response

An empirical approach for the implementation of a GIS project to capture, manage and analyse spatial data related to disease events



www.izsvenezie.it