Effect of wind farms on vultures: AMP case study

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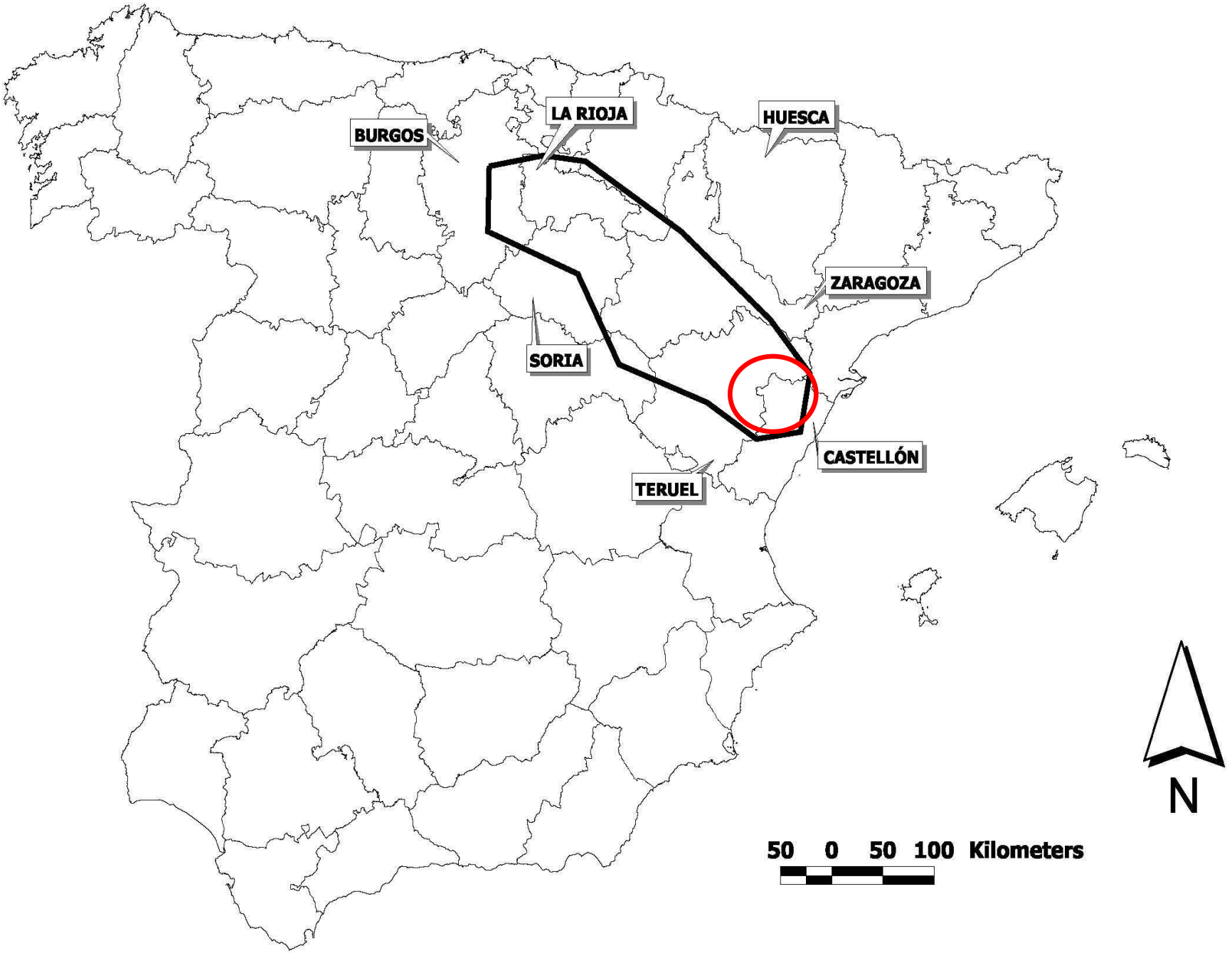
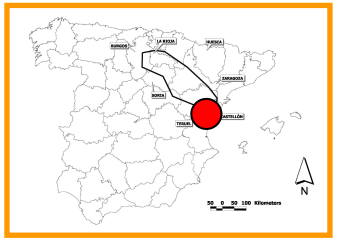
IDB


BURGOS
LA RIOJA
HUESCA
ZARAGOZA
SORIA
CASTELLÓN
TERUEL
N
50 0 50 100 Kilometers

Northern Valencia

- 10 windfarms :267 turbines.
- Environmental Impact Assessment (EIA) and EIS since 2004.
- Operating since September 2006.
- Measures against BSE resulted in changes both in food availability and space distribution (EIS uneffective).
- GV collisions increase: 393 birds killed from 2006 to December 2010.



Northern Valencia

- 33 turbines were shut down from May 2008-Sep. 2010 : Economic loss.

- Both Wind developer and Environmental Authorities accussed at the Court by affecting Birds Directive 2009/147/CE (79/409/CE).

Raptor species in the area

Species	Crossings	Nº Individuals
Circus cyaneus	4	7
Milvus migrans	32	41
Circaetus gallicus	67	75
Buteo buteo	36	38
Aquila chrysaetos	24	29
Gyps fulvus	3088	5485
Hieraetus pennatus	30	31
Accipiter gentilis	5	6
Accipiter nisus	21	21
Falco peregrinus	6	6
Falco tinunculus	100	118
Falco subbuteo	1	1

89,30% of crossings and 91.7% individuals belong to griffon vultures


955L
CAT

Correction measures

- **Avoiding griffons feeding at rubbish dump**

Goal: reduce mortality.

Measure: Closure of rubbish dump.

- **Provide vultures with food**

Goal: “Remove” vultures from rubbish dump

Measure: Build 2 vulture restaurants

Both applied simultaneously

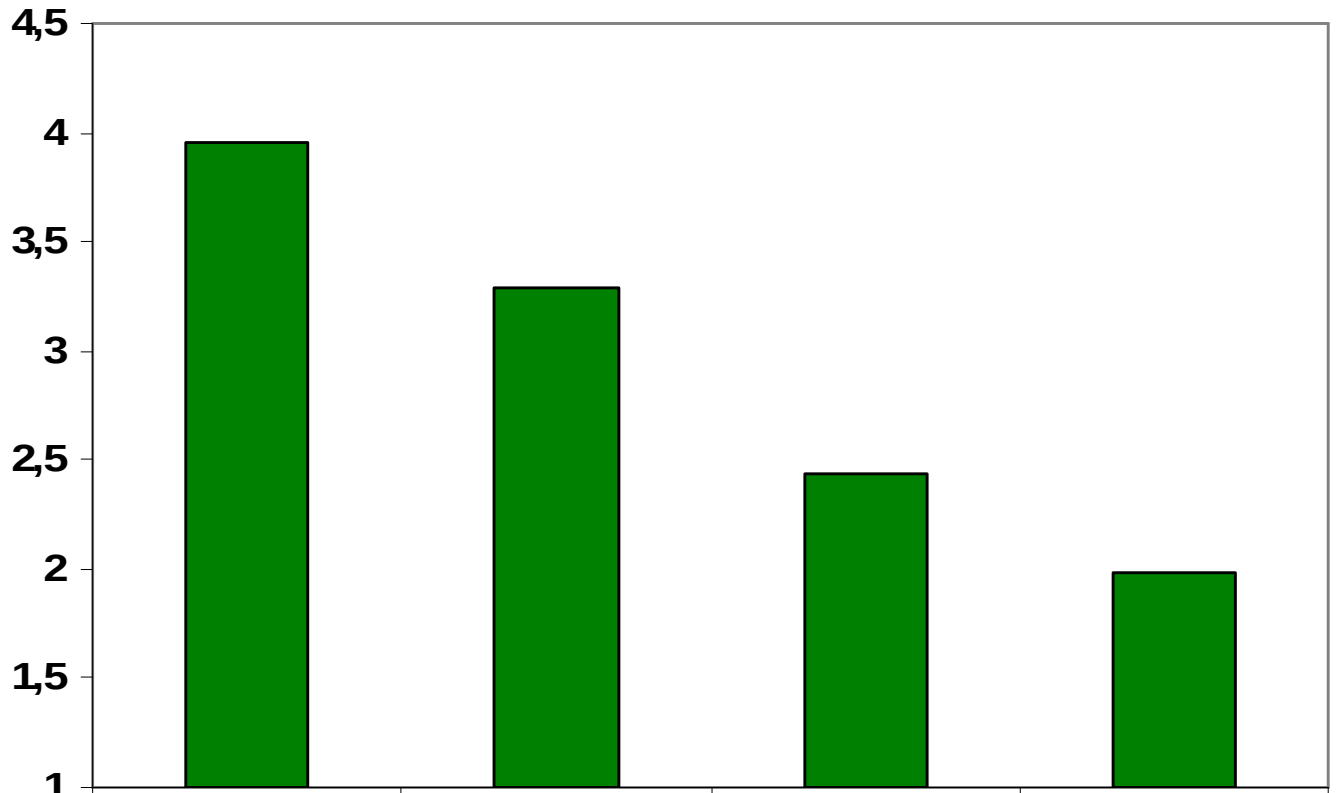
Rubbish dump use vs. closure

GLM

$p < 0{,}004$

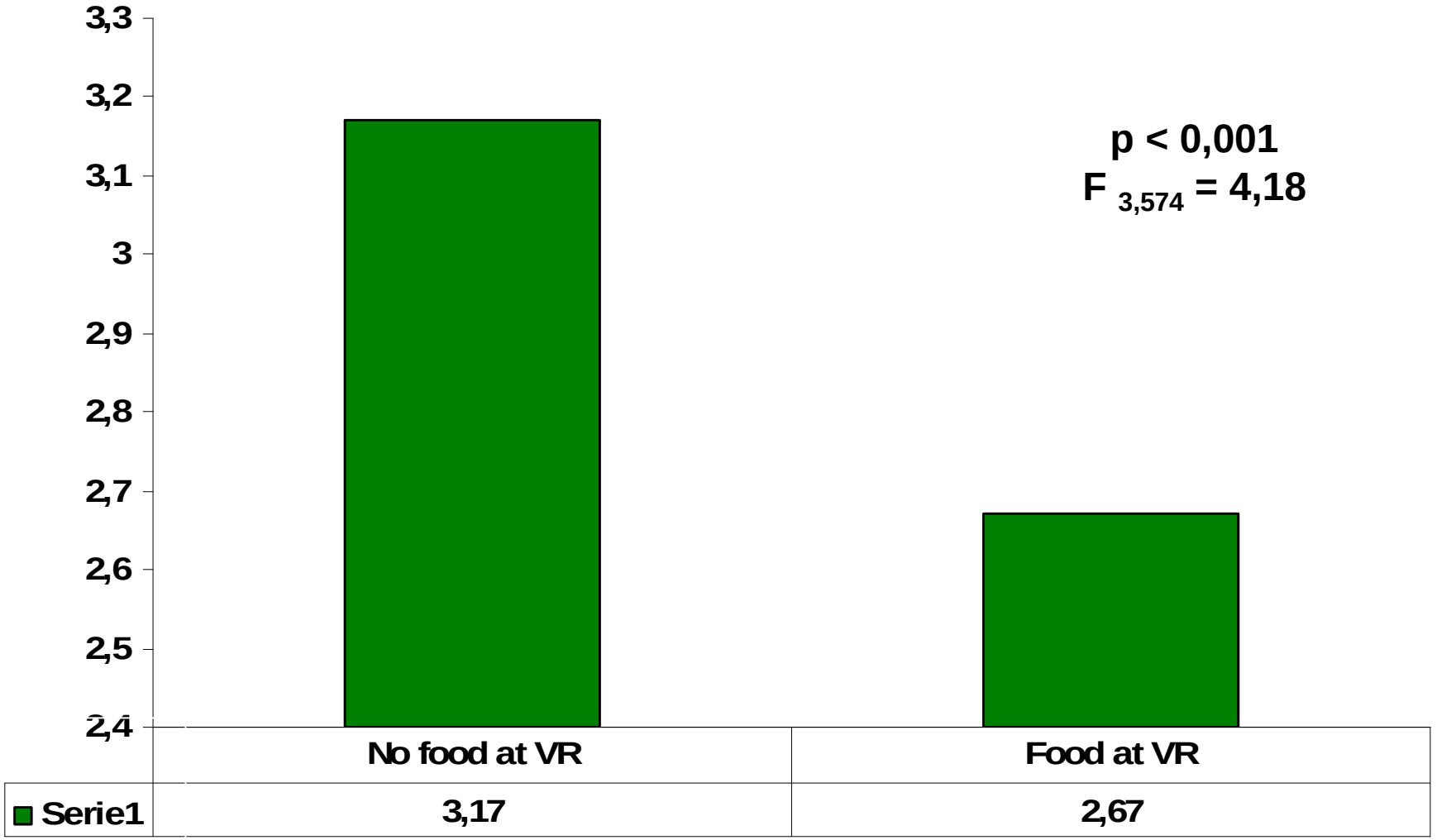
$R^2 \times 100 = 40{,}74\%$

$F_{3,574} = 3{,}17$

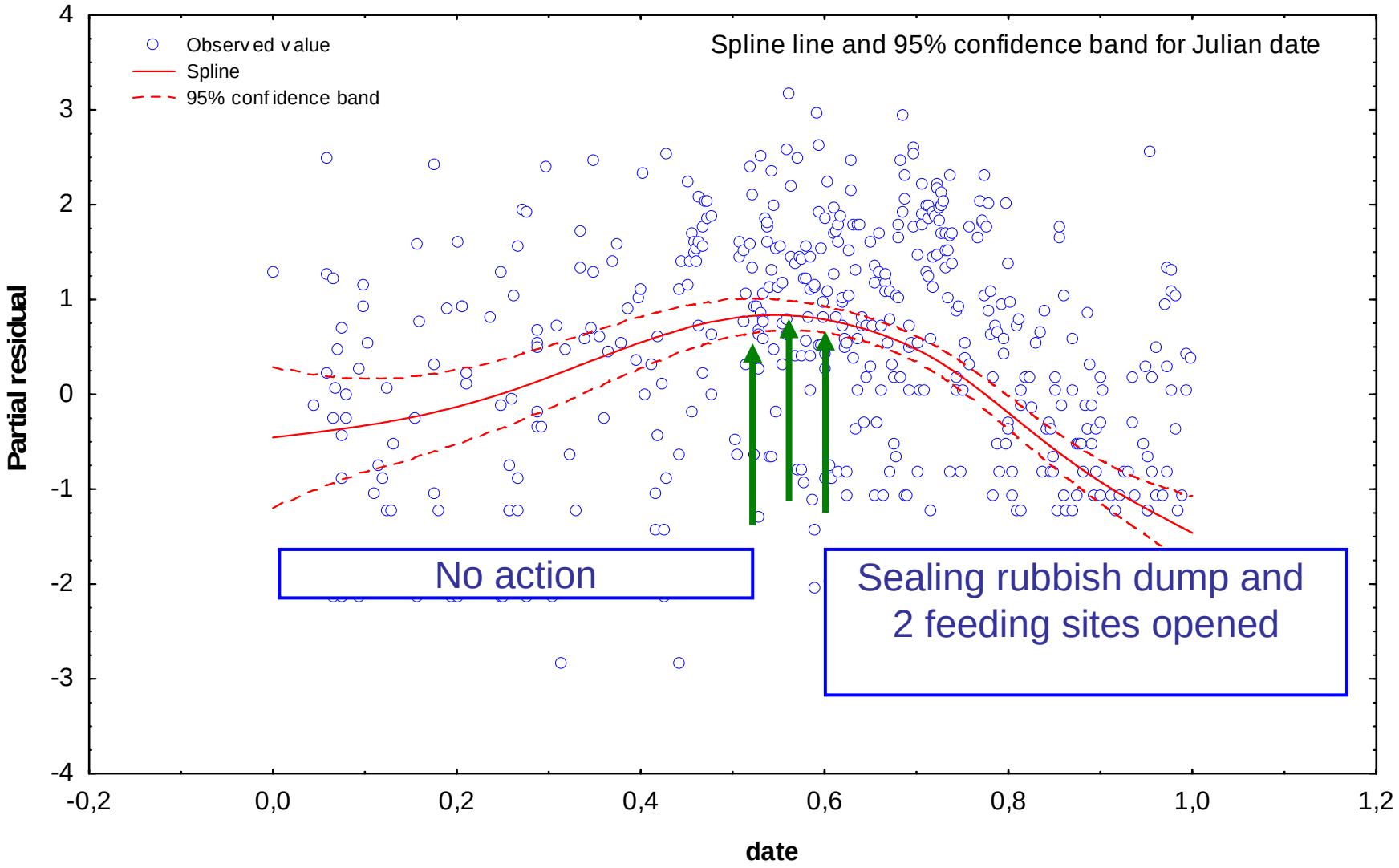


	No measures	Sealing rubbish dump	Sealing and 1st vulture restaurant	Sealing 2 vulture restaurants
Vultures at rubbish dump	3,96	3,29	2,44	1,98

Rubbish dump use vs. Food at vulture restaurants

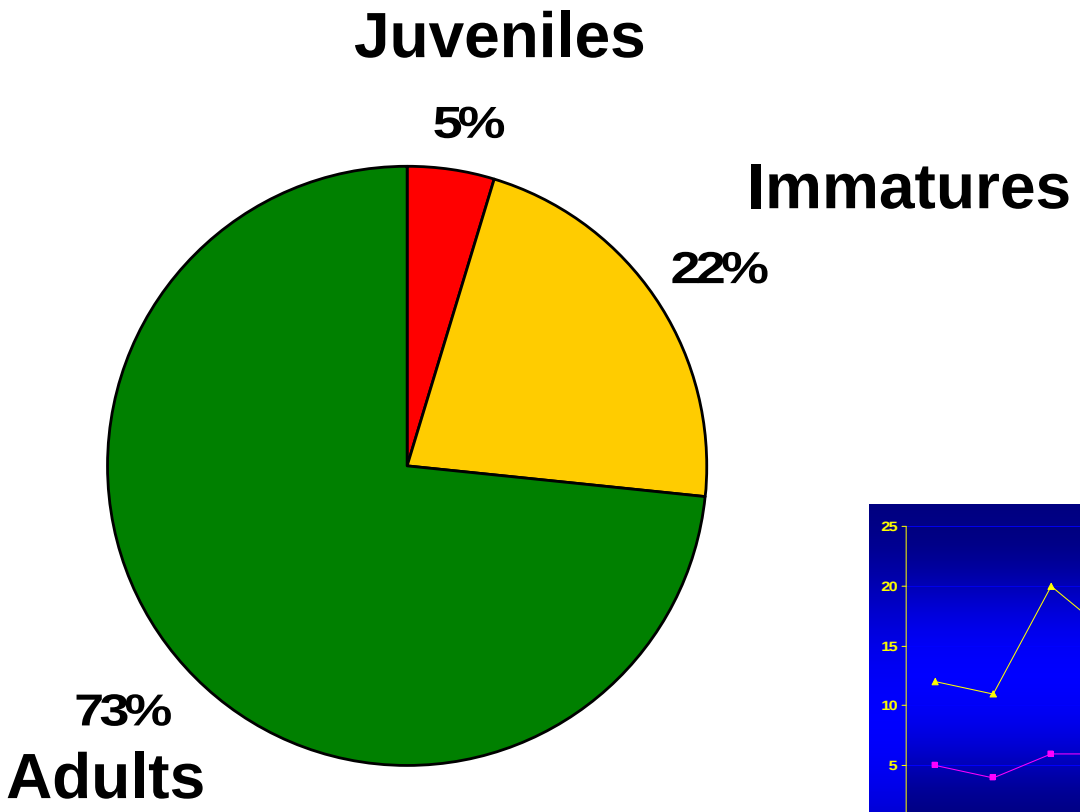


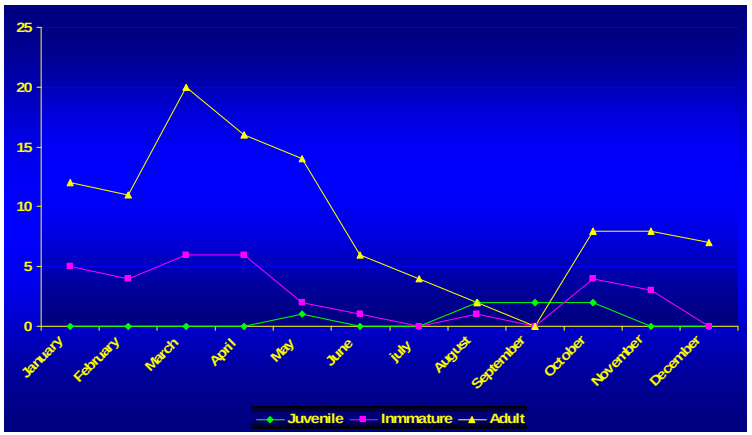
GAM Models


Observed value
Spline
95% confidence band
Spline line and 95% confidence band for Julian date
Partial residual
date
4
3
2
1
0
-1
-2
-3
-4
-0,2
0,0
0,2
0,4
0,6
0,8
1,0
1,2
No action
Sealing rubbish dump and
2 feeding sites opened

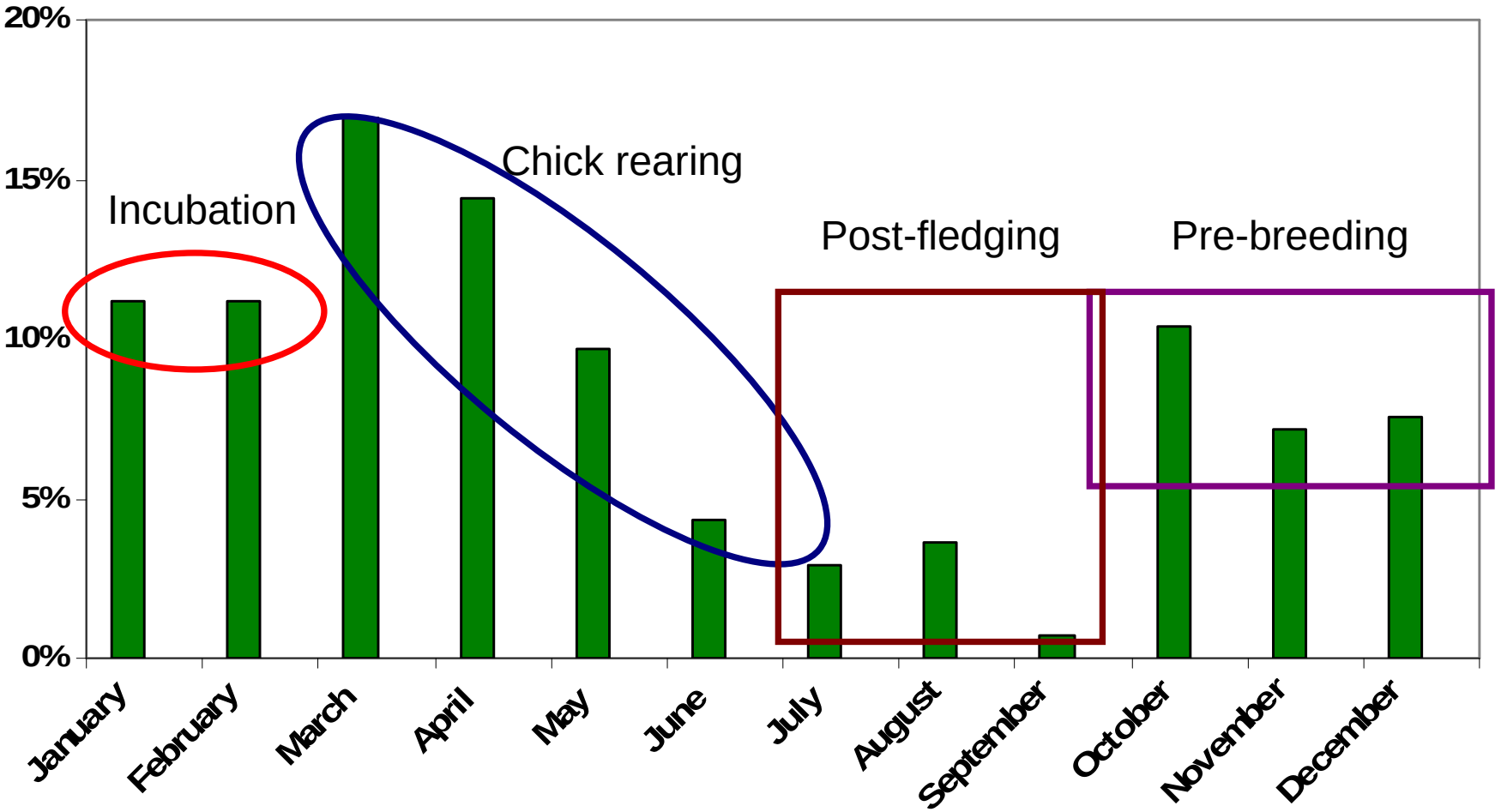
Overall mortality trend

Age of vultures collided

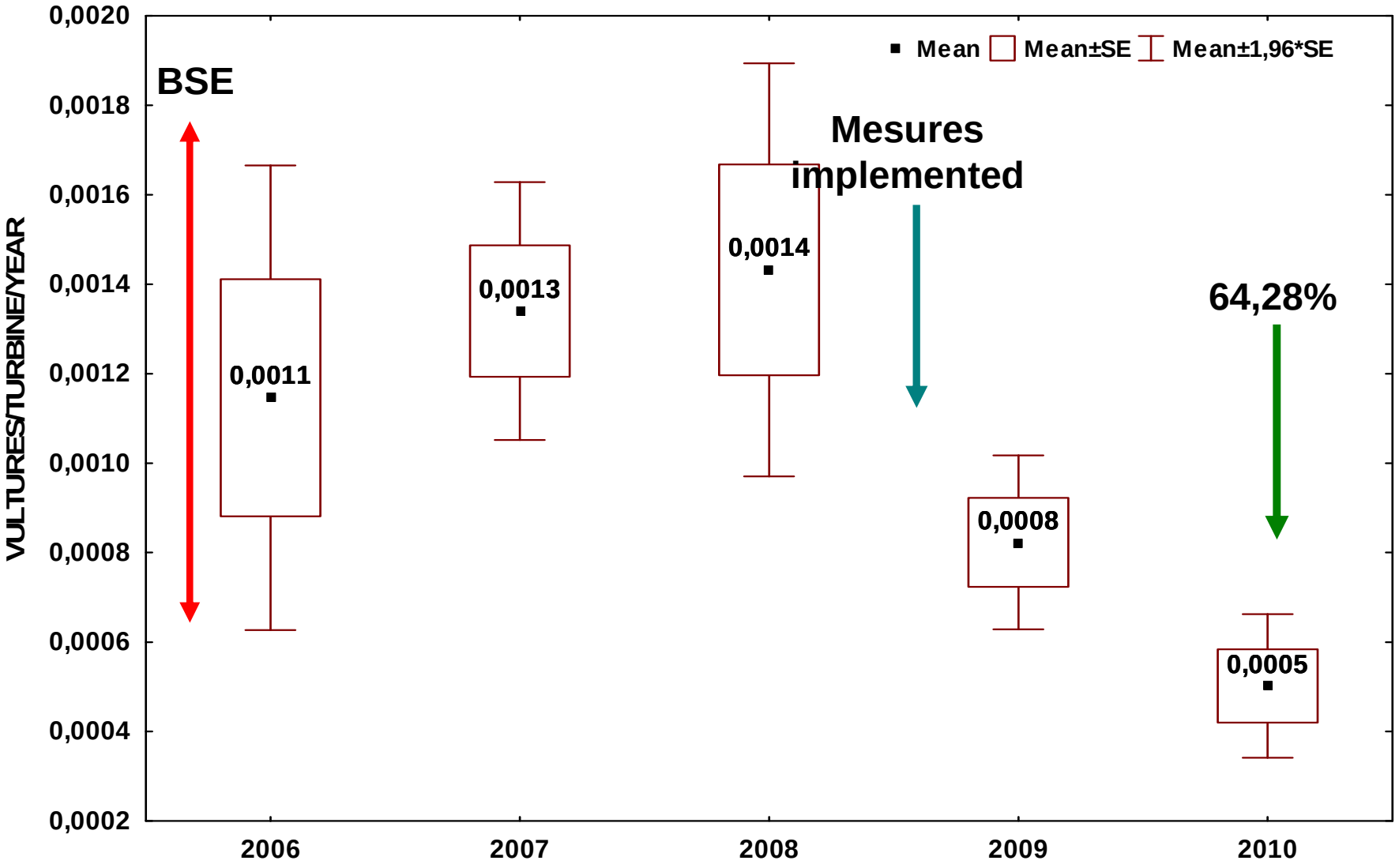




Percentage of mortality through the year

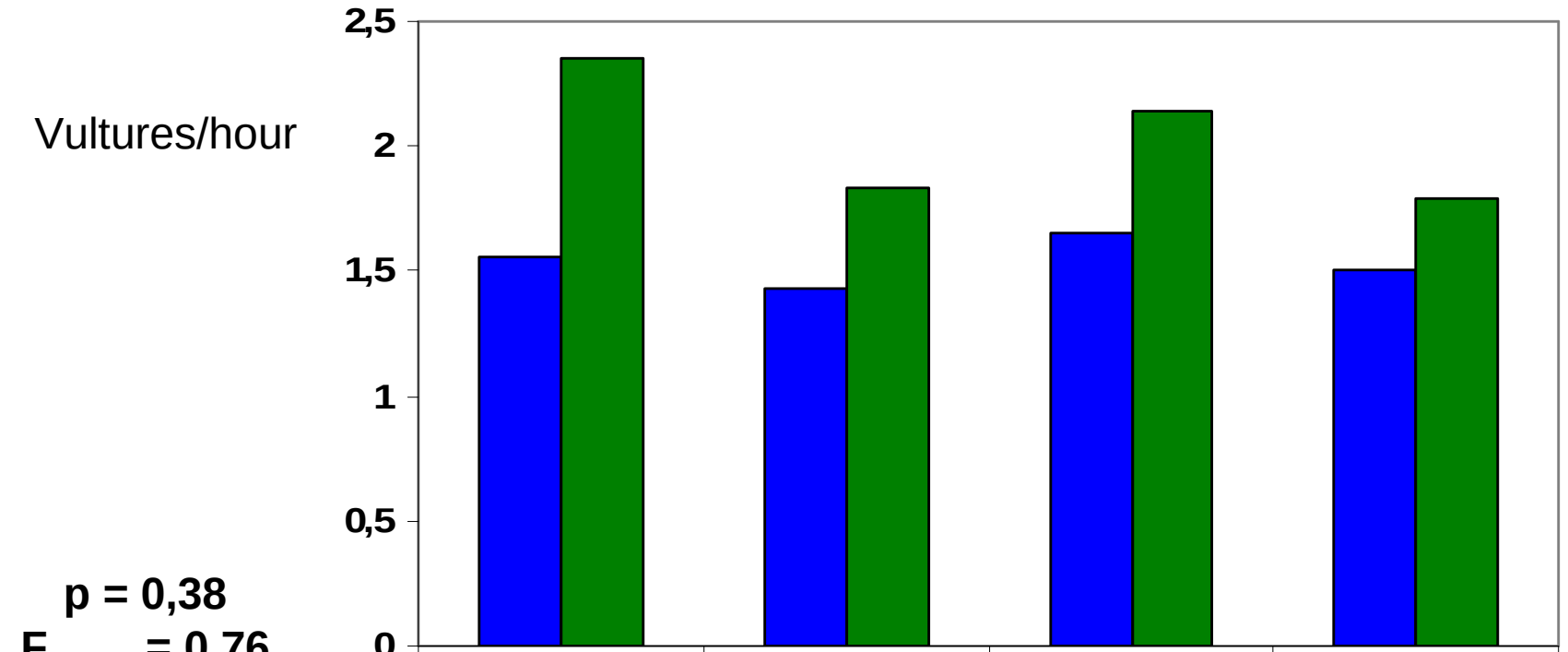


Mortality (vultures/turbine/day)



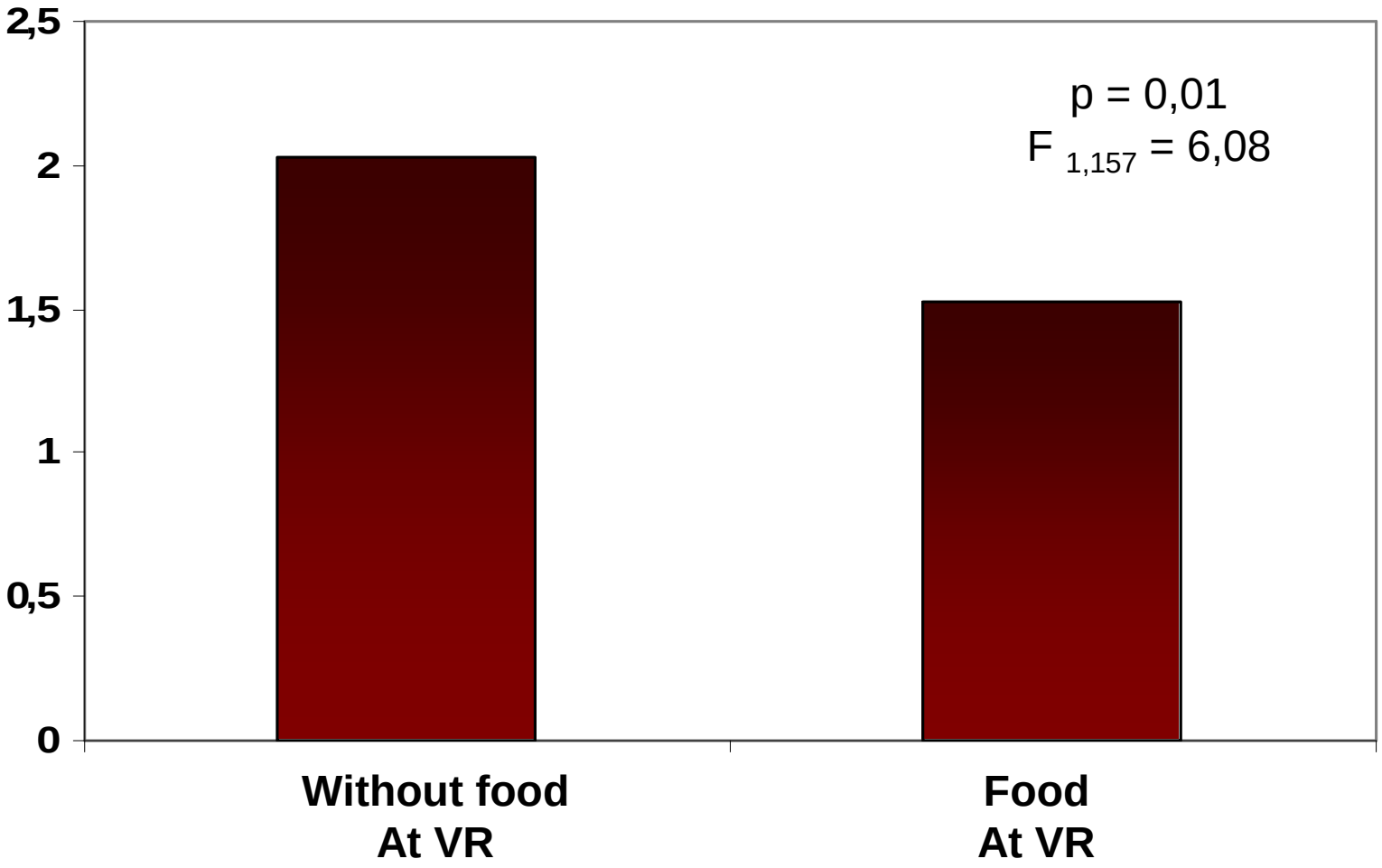
Other variables affected by measures adopted

Crossings throught turbine strings vs. The two correction measures



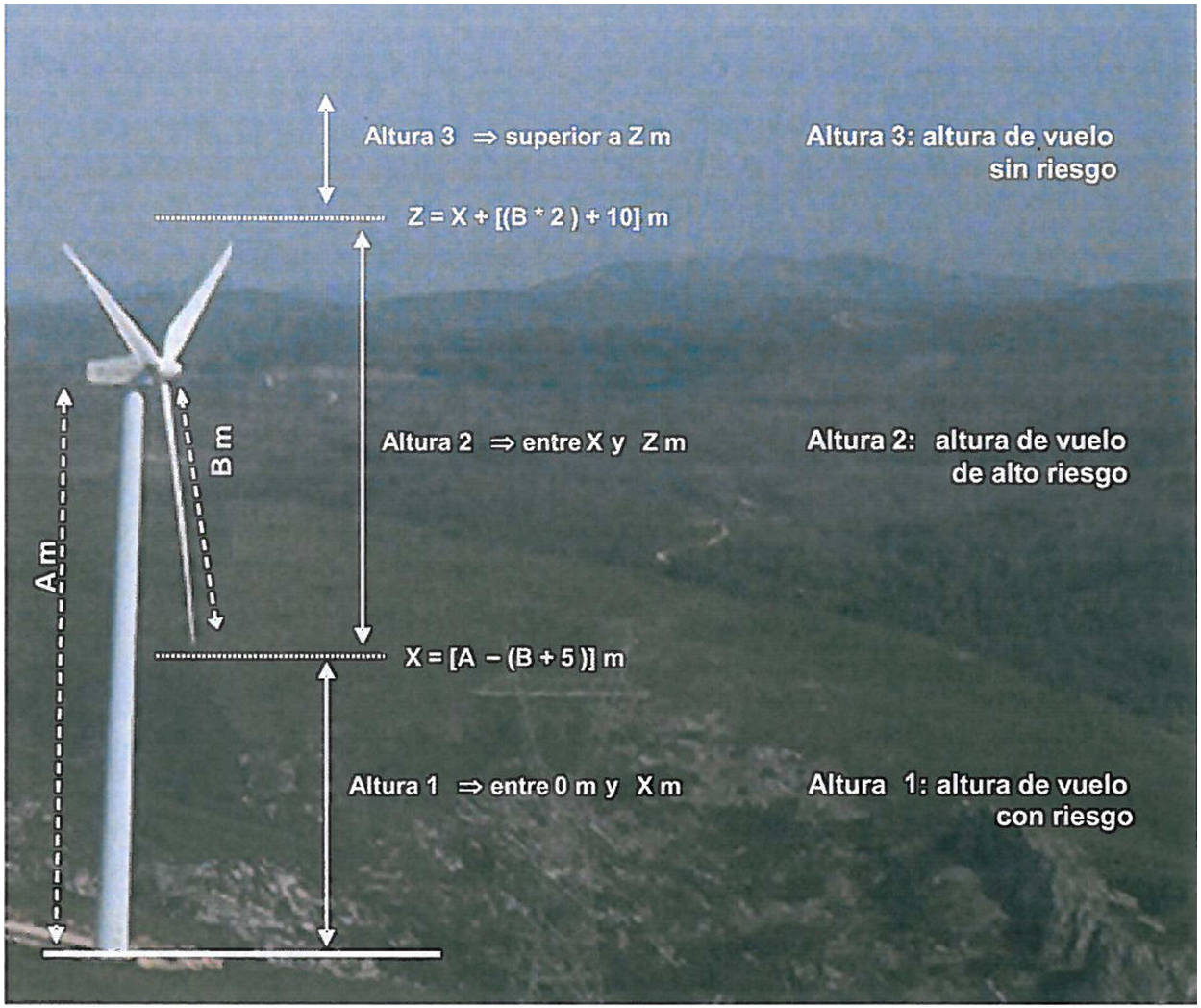
	No measures	Sealing rubbish dump	Sealing and 1st vulture restaurant	Sealing 2 vulture restaurants
Crossings /food VR	1,56	1,43	1,65	1,5
Crossings/NO food VR	2,35	1,83	2,14	1,79

Crossings through turbines vs. Food provided at v. restaurants



Understanding flight behaviour of griffons

Flight altitude vs. Daily mean temperature



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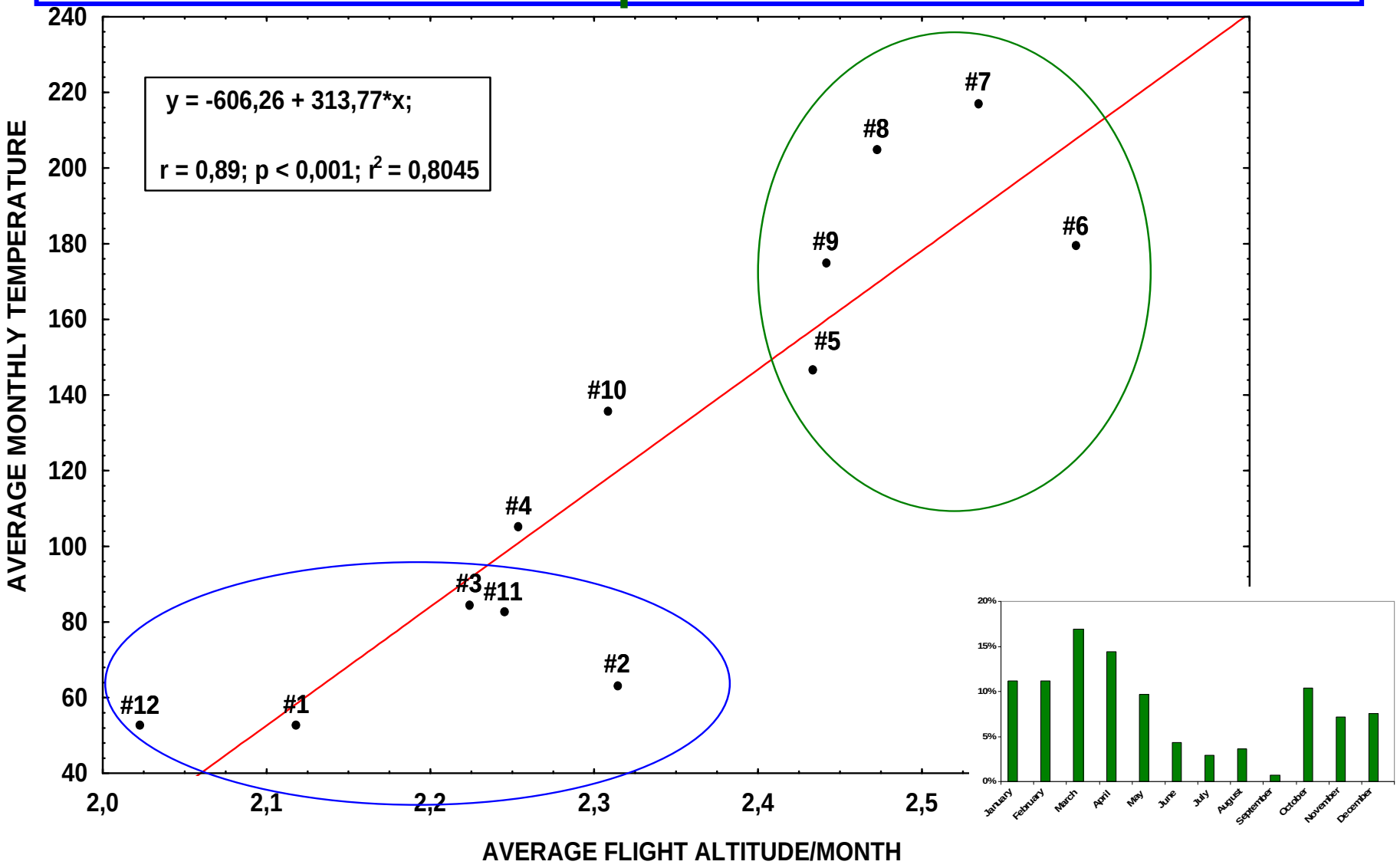


Flight vs. Wind conditions

- **GLM / variables nested on turbine string**

Slope

Tail / cross wind flying vulture components

Temperature

Tail / cross wind wind vectors

Turbine string: A1, A2, A3, F1

Date

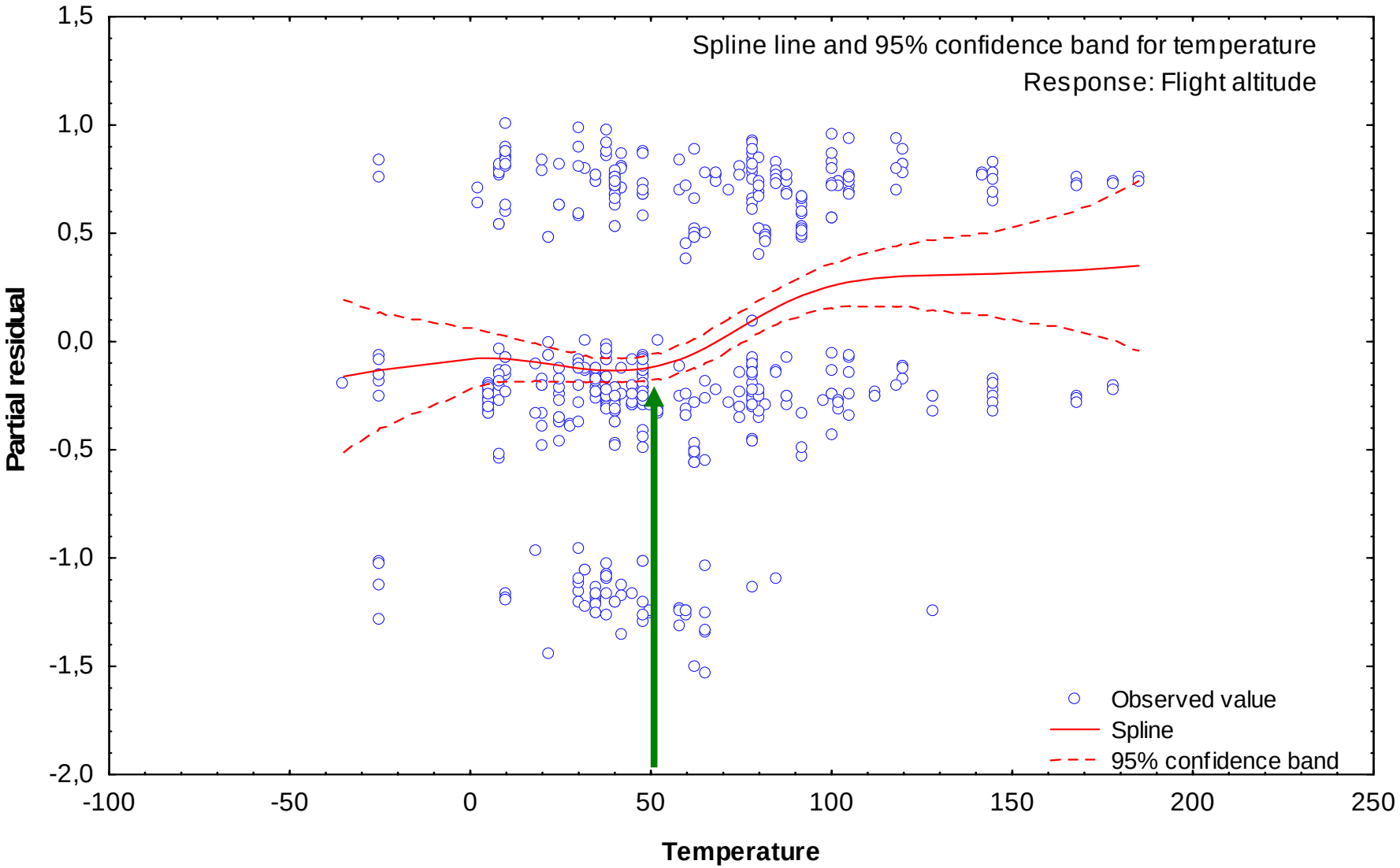
Flight altitude: Below, a the same level, above rotor swept area.

Flight altitude- GLM model

Hierarchically nested factor design

	SS	D.f.	MS	F	p
Turbine string * ***Slope***	4,6297	3	1,5432	3,99	0,0080
Turbine string * ***Temperature***	8,5487	3	2,8496	7,36	< 0,001
date	3,2062	1	3,2062	8,29	0,0042
date^2	2,3639	1	2,3639	6,11	0,0138

Flight altitude GAM-model



Complementary measures

- Monitoring of GV movements by means of Satellite Tracking Using GPS- PTT´s

- Population viability analysis (PVA) to measure the effect of mortality.

Thank you !

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