



Rodenticide Resistance Action Committee

BCR resistance tests and field trials with bromadiolone for the control of rats (*Rattus norvegicus*) on farms in Westphalia, Germany, 2005 - 2008

Stefan Endepols, Bayer CropScience

Nicole Klemann, Consult

Alan P. Buckle, Univ. Reading

Steered by RRAC: BASF, Bayer CropScience, Liphatech, Rentokil, Sorex, Syngenta, (Pelgar)



Resistance in Westphalia

- **Practical Resistance to warfarin, coumatetralyl and bromadiolone proven in the 1980s in Muensterland (Bayer lab + field trials).**
- **Warfarin-resistance: widespread basic resistance, VKORC1: Y139C.**
- **Advanced resistance: bromadiolone, coumatetralyl, difenacoum, in spots.**
- **Incidence of resistance to couma + broma at 40% - 70% on respective farms.**
- **Resistance factor**

coumatetralyl:	60 - 80
bromadiolone:	10 - 15



Aim

- **Determine IR; Confirm the RF for broma on farms in known resistance foci in Muensterland.**
- **The relation of BCR resistance tests and control result should provide information on the usefulness of the INR-based BCR test method (RRAC 2003, Prescott et al. 2007) for the prediction of control success; Practical resistance?**



Methods: BCR-test

Number of tested rats:

Trial # 1: 12

Trial # 2: 16

Trial # 3: 15

Trial # 4: 15



Incidence of bromadiolone resistance:

Trial # 2, 3, 4: 2.5 x ED₅₀ of the CD-strain (1.17 mg/kg males, 1.65 mg/kg females).

Investigation of the degree of bromadiolone resistance on the farms

**Trial # 1+2 : 15 x ED₅₀ males, 10 x ED₅₀ females
(7.05 mg/kg males, 6.61 mg/kg females)**

**Trial # 3+4 : 10 x ED₅₀ males, 7 x ED₅₀ (females)
(4.70mg/kg males, 4.62mg/kg females)**



Methods: Field trials

Field trials structure (for protocol details: www.rrac.info):

- a) Implementation;**
- b) Pre-baiting census 5 days; 4 days break;**
- c) Baiting period 35 (42 in #1) days; 4 days break;**
- d) Post-baiting census 5 days.**

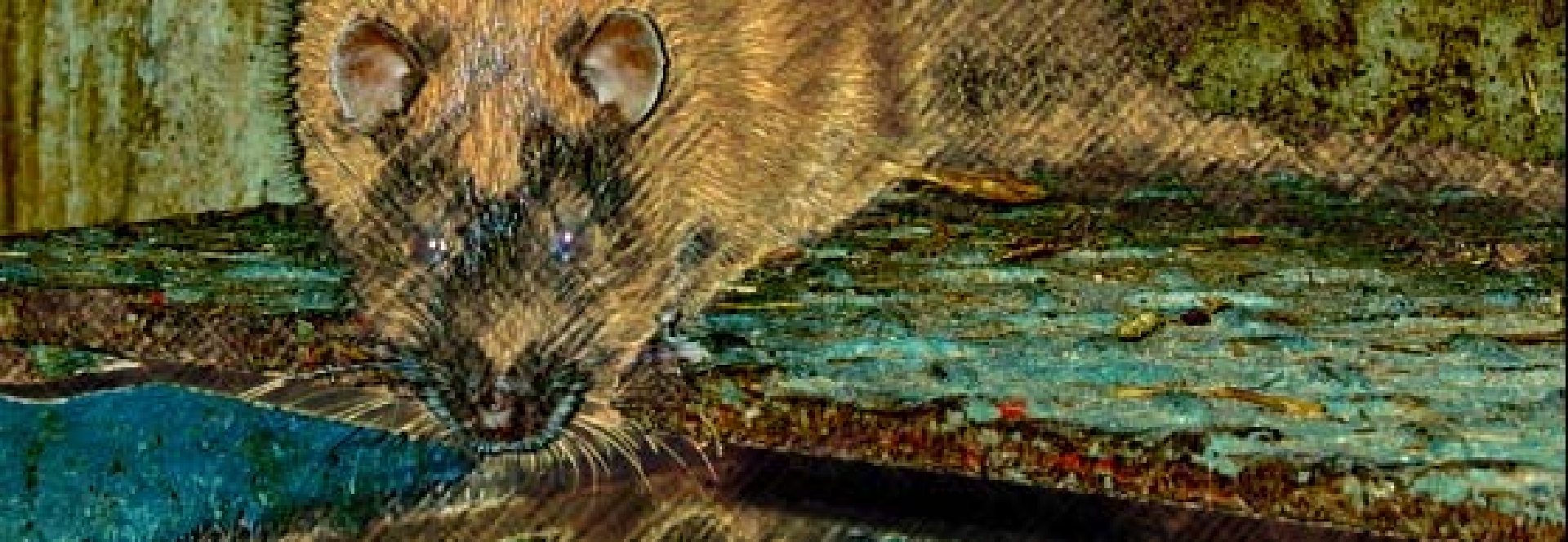
Census: 1) Consumption of rolled oats,
 2) Tracking plates with sand.

Bait: 0.005% bromadiolone whole wheat bait (Contrax, Deadline)

Bait distribution: www.baytool.info (Endepols et al. 2003)



Results



Trial # 1



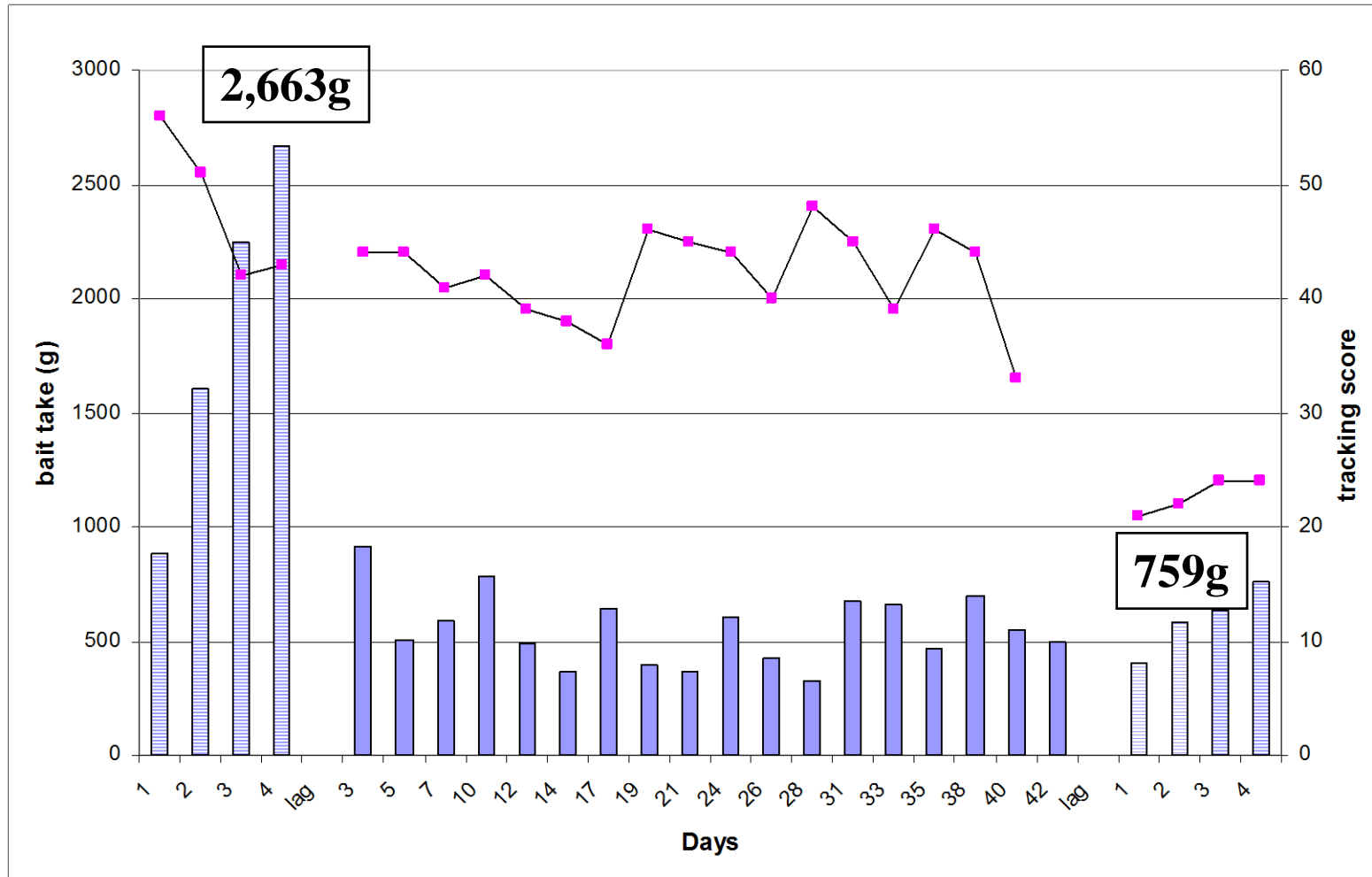
Results: Trial # 1

BCR test	Incidence of resistance	Degree of resistance 15 x ED ₅₀ ; 10 x ED ₅₀
	min 17% (34%)	2/12 (17%): INR ≤ 5.0 6/12 (50%): INR < 10.0

- **Provided the multiples tested fit well with the RF as determined earlier in this population, an IR is supposed at 34%.**



Results: Trial # 1



Bait take (histogram) and tracking score (line). Hatched bars - census bait takes; solid bars - rodenticide bait takes.



Results: Trial # 1

BCR test	Incidence of resistance	Degree of resistance
		15 x ED ₅₀ ; 10 x ED ₅₀
	34% (min 17%)	2/12 (17%): INR ≤ 5.0
		6/12 (50%): INR < 10.0

Field trial

Bait consumption:	10 kg
% survivors	29 %

- **Provided these multiples fit well with the RF as determined earlier in this population, the IR is supposed at 34% (17 – 50%) – good fit with trial success rate.**



Trial # 2



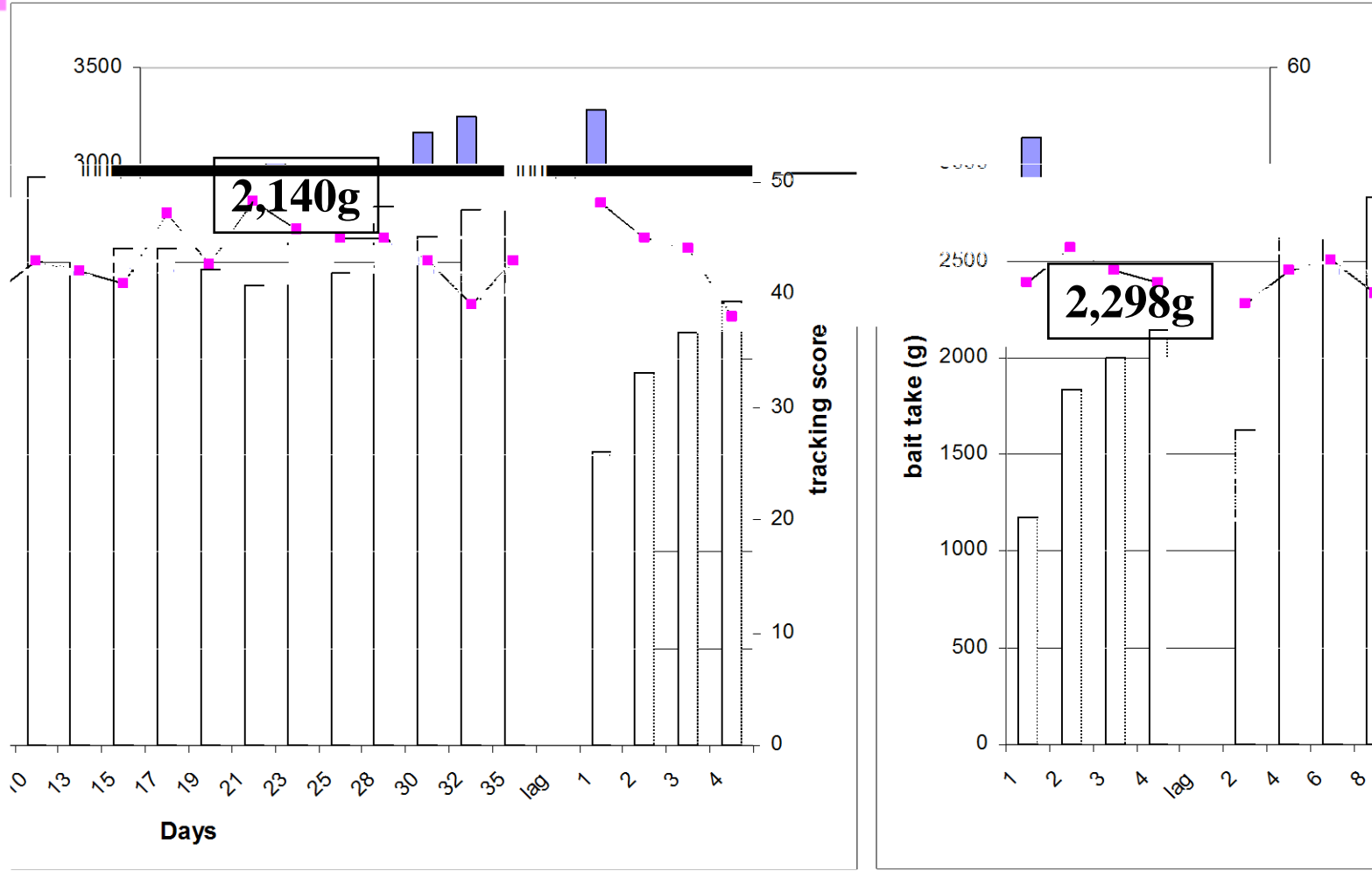
Results: Trial # 2

BCR test	Incidence of resistance	Degree of resistance
		15 x ED₅₀ ; 10 x ED₅₀
	5/5 (100%)	1/11 (9%): INR ≤ 5.0

- **Incidence of resistance at 100%, but RF lower than suspected.**



Results: Trial # 2



Bait take (histogram) and tracking score (line). Hatched bars - census bait takes; solid bars - rodenticide bait takes.



Results: Trial # 2

BCR test	Incidence of resistance	Degree of resistance
		15 x ED ₅₀ ; 10 x ED ₅₀
	5/5 (100%)	1/11 (9%): INR ≤ 5.0

Field trial

Bait consumption: 43 kg
Survivors 107 %

- Incidence of resistance at 100%, but RF lower than suspected.



Trial # 3



Results: Trial # 3

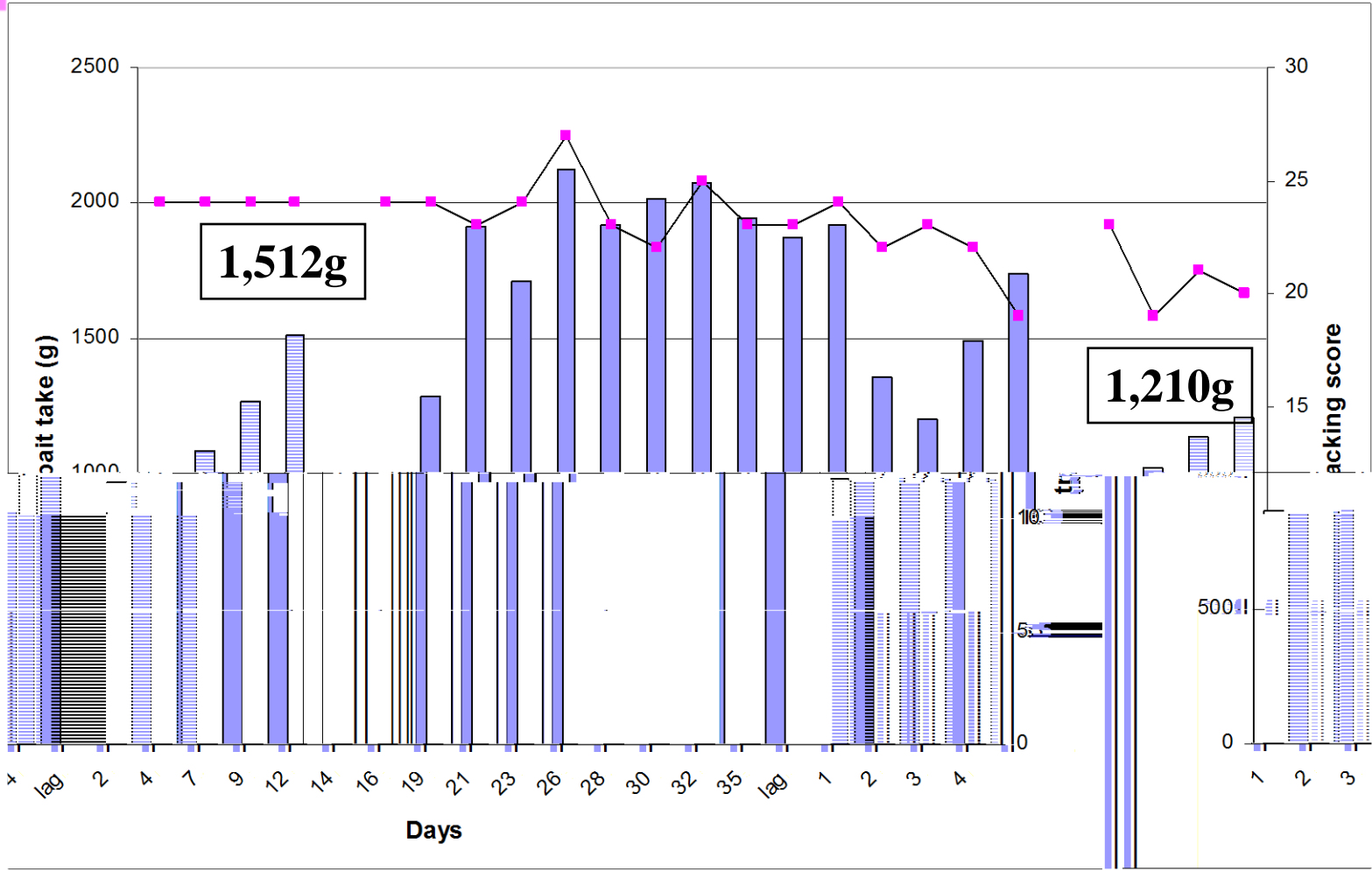
Multiples reduced according results trial # 2

BCR test	Incidence of resistance	Degree of resistance
		10 x ED₅₀ ; 7 x ED₅₀
	3/3 (100%)	5/12 (42%): INR ≤ 5.0
	80 – 100%	

- Incidence of resistance at 80 - 100%, RF estimated at 7 - 10.



Results: Trial # 3



Bait take (histogram) and tracking score (line). Hatched bars - census bait takes; solid bars - rodenticide bait takes.



Results: Trial # 3

BCR test	Incidence of resistance	Degree of resistance
		10 x ED ₅₀ ; 7 x ED ₅₀
	3/3 (100%)	5/12 (42%): INR ≤ 5.0
	80 – 100%	

Field trial

Bait consumption: 26 kg

Survivors 80 %

- **Incidence of resistance at 80 - 100%, RF estimated at 7 - 10.**
- **Based on BCR data, Incidence at 84% derived (due to 50% response), good fit with field trial.**



Trial # 4



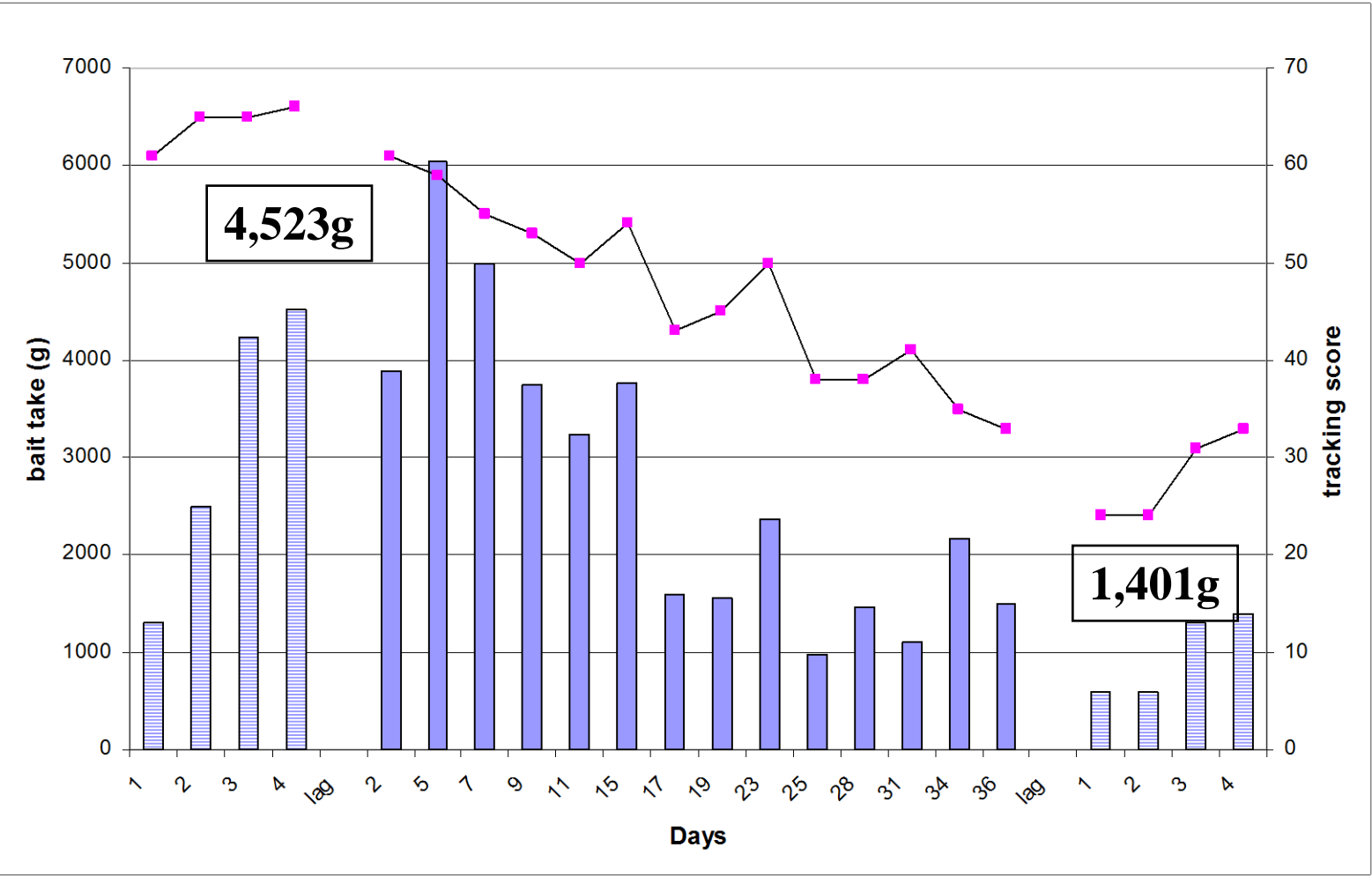
Results: Trial # 4

BCR test	Incidence of resistance	Degree of resistance
		10 x ED₅₀ ; 7 x ED₅₀
	4/7 (57%)	3/8 (38%): INR ≤ 5.0
	min. 37%	5/8 (63%): INR > 10

- **Incidence of resistance at 40 - 50%, RF estimated higher than 7 - 10.**



Results: Trial # 4



Bait take (histogram) and tracking score (line). Hatched bars - census bait takes; solid bars - rodenticide bait takes.



Results: Trial # 4

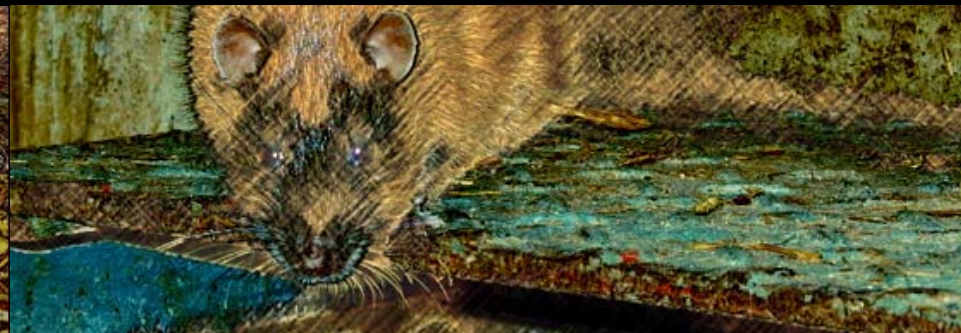
BCR test	Incidence of resistance	Degree of resistance
		10 x ED ₅₀ ; 7 x ED ₅₀
	4/7 (57%)	3/8 (38%): INR ≤ 5.0
	37 – 57%	5/8 (63%): INR > 10

Field trial

Bait consumption **38 kg**

Survivors **31 %**

- **Incidence of resistance at 40 - 50%, RF estimated higher than 7 - 10.**
- **Consider higher INRs to assess the incidence when multiples in the range of the resistance factor were administered.**
- **Good fit of BCR data.**



Trial Summary



Summary

#	IR (2.5 x ED ₅₀)	RF (x ED ₅₀)	Bait kg	Survivors	
1	(34%)	15 / 10	17%	10	29%
2	100%	15 / 10	9%	43	107%
(multiples too high)					
3	100%	10 / 7	42%	26	80%
4	37 - 57%	10 / 7	37%	38	31%
(multiples too low)					



After Trials



Y139C Genotypes Trial # 4

wildtype heterozygous homozygous

before trial:

5

10

0

#	IR (2.5 x ED ₅₀)	Bait kg	Survivors
4	37 - 57%	38	31%

6 months later:

5

4

13

Thanks for genotyping to Dagmar Funck (JKI Lab Pelz/Jacob)