

Rodenticide Resistance: Introduction and the RRAC

Dr. Stefan Endepols

Envu and RRAC

SKABRA

Trondheim, September 10th 2024



The Rodenticide Resistance Action Committee (RRAC) is a working group within the framework of CropLife International. Participating companies are:

BASF

Envu

LiphaTech S. A.

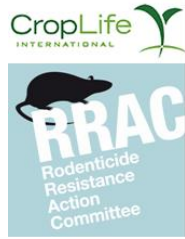
Pelgar

Rentokil Initial

Syngenta

ZAPI

Aktiva



The RRAC Resistance guide Co-Authors

Provided un-published data to resistance maps:

**Colin Prescott, Clare Jones & colleagues, D Rymer, K Baert, Tanja Blazic,
H-M Kohn, Freise & Runge, J Mooney, Y Motro, A Iacucci, T Montalvo,
RRAC, St Endepols, and others**

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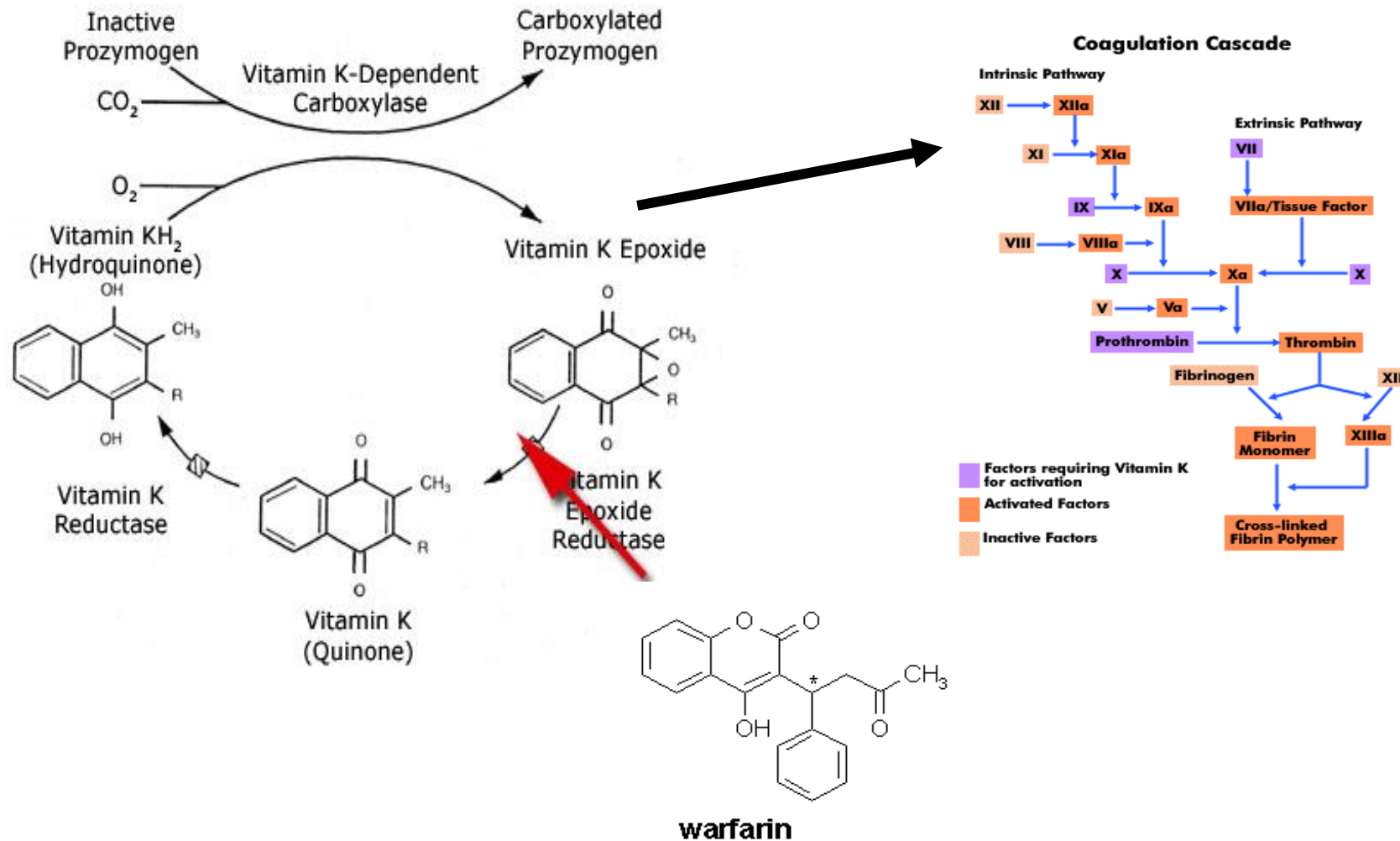
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www.rrac.info

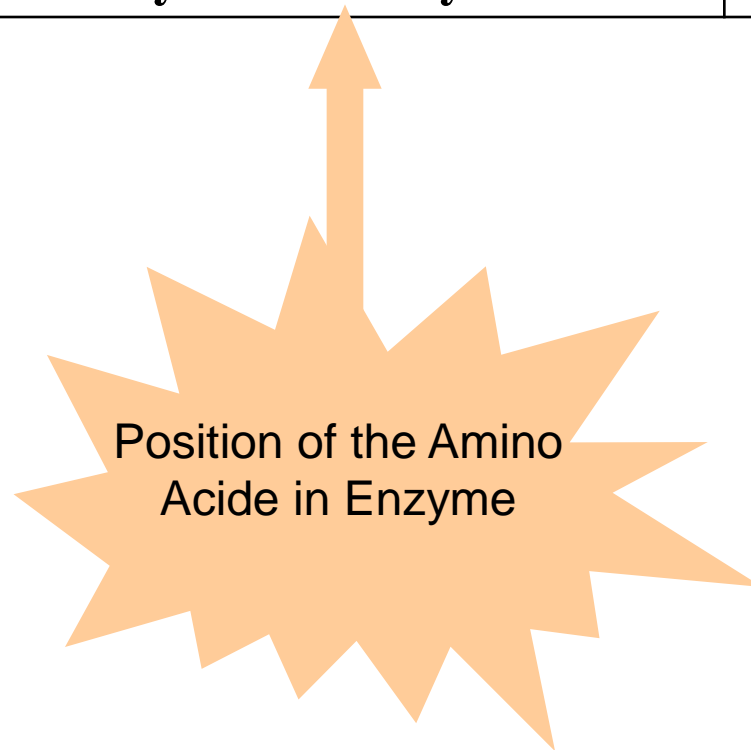
Principle of Anticoagulant Resistance and Resistant Strains

Anticoagulants inhibit the *Vkorc1* gene that drives the vitamin K cycle and blood coagulation



Marking the Genotypes of VKOR

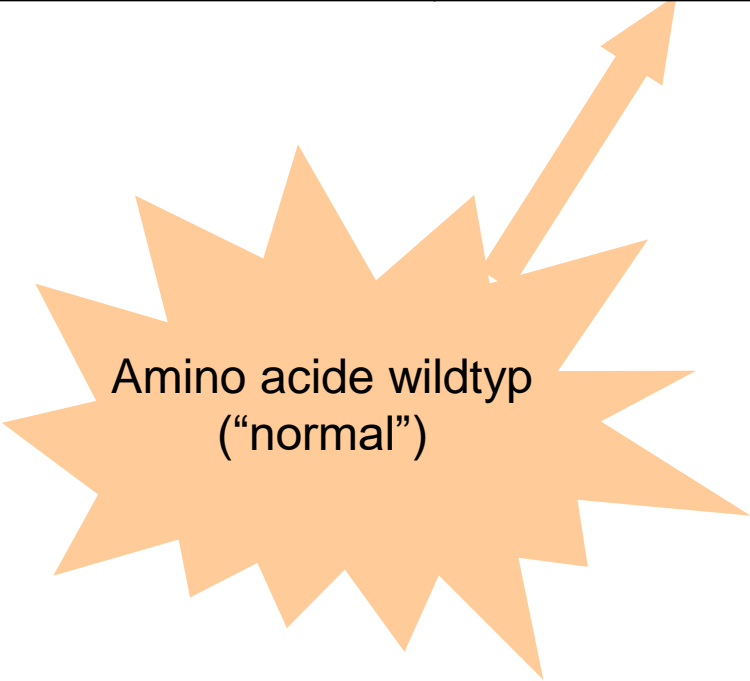
Resistance area	VKOR Polymorphism	
Westphalia, DK, NL, F, UK	Tyrosin 139 Cystein	Tyr139Cys, Y139C



Marking the Genotypes of VKOR

Resistance area	VKOR Polymorphism	
Westphalia, DK, NL, F, UK	Tyrosin 139 Cystein	Tyr139Cys, Y139C

Amino acide wildtyp
("normal")



Amino acide neu,
"Mutant"





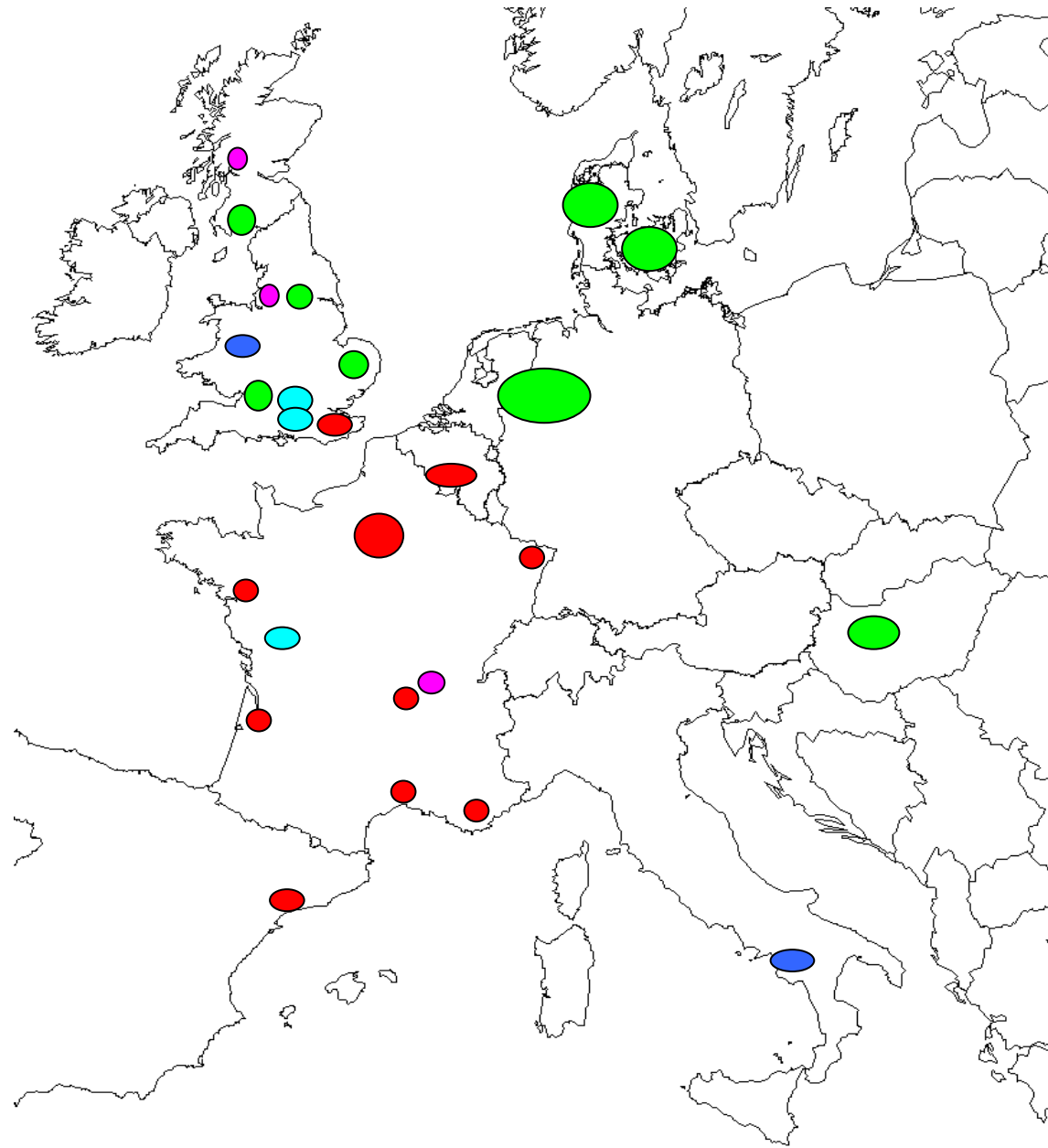
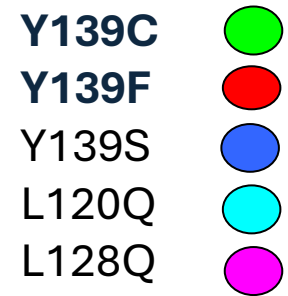
RRAC, study at JKI: Rat **Y139C**

Determination of effective doses in BCR test:

ED₅₀ Baseline (mg/kg) and Resistance Factor (RF).

	ED ₅₀ male	ED ₅₀ female	RF m	RF f	
Coumatetralyl	0.36	0.44	42.2	94.1	Endepols et al. 2007
Bromadiolone	0.47	0.62	17.0	15.5	Endepols et al. 2007
Difenacoum	0.65	0.79	1.6	2.9	JKI
Brodifacoum	0.22	0.23	1.2	1.8	JKI
Flocoumafen	0.29	0.34	0.8	1.0	JKI
Difethialone	0.43	0.49	0.5	0.8	JKI

Norway rat: Resistant Strains in Europe



SNPs confer practical resistance to AVKs of Brown Rat (*R. norvegicus*) and House Mouse (*M. musculus*)

AVKs Active Ingredients are

- Either active in practice and recommended to control these strains ■
- Or partially or totally inactive and not recommended for control of them ■

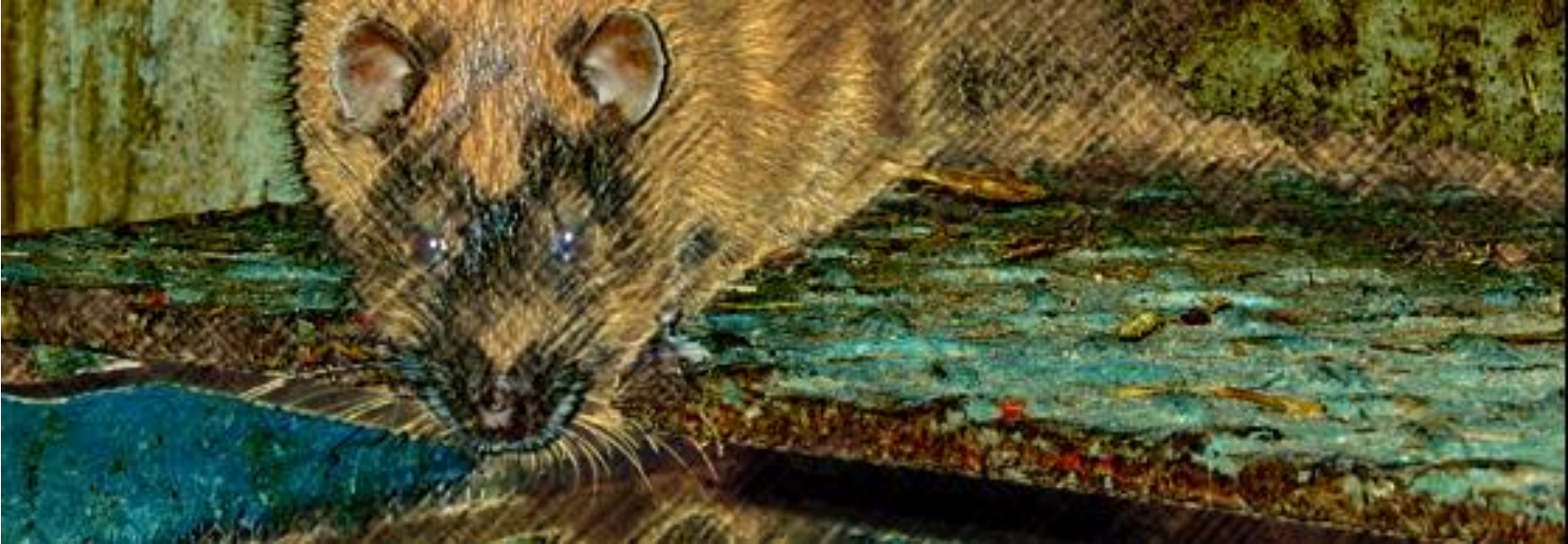
Brown Rats

VKOR SNPs	FGARS	Bromadiolone	Difenacoum	Brodifacoum	Flocoumafen	Difethialone	Different MoA: Cholecalciferol
L120Q							
L128Q							
Y139C							
Y139F							
Y139S							

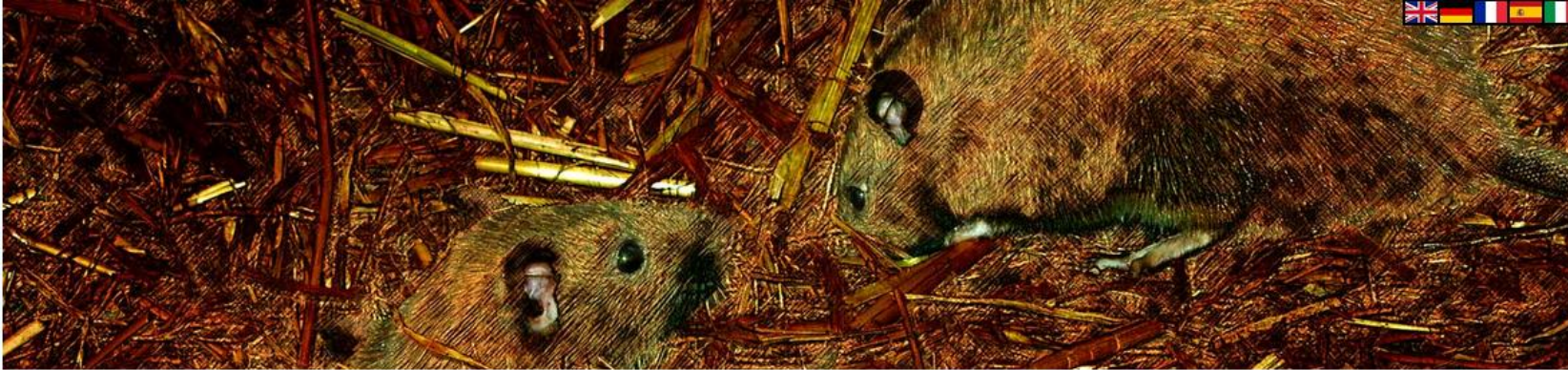
House Mice

VKOR SNPs	FGARS	Bromadiolone	Difenacoum	Brodifacoum	Flocoumafen	Difethialone	Different MoA: Cholecalciferol
L120Q	no data available						
L128S							
Y139C							
Y139S	no data available						
spretus introgression							

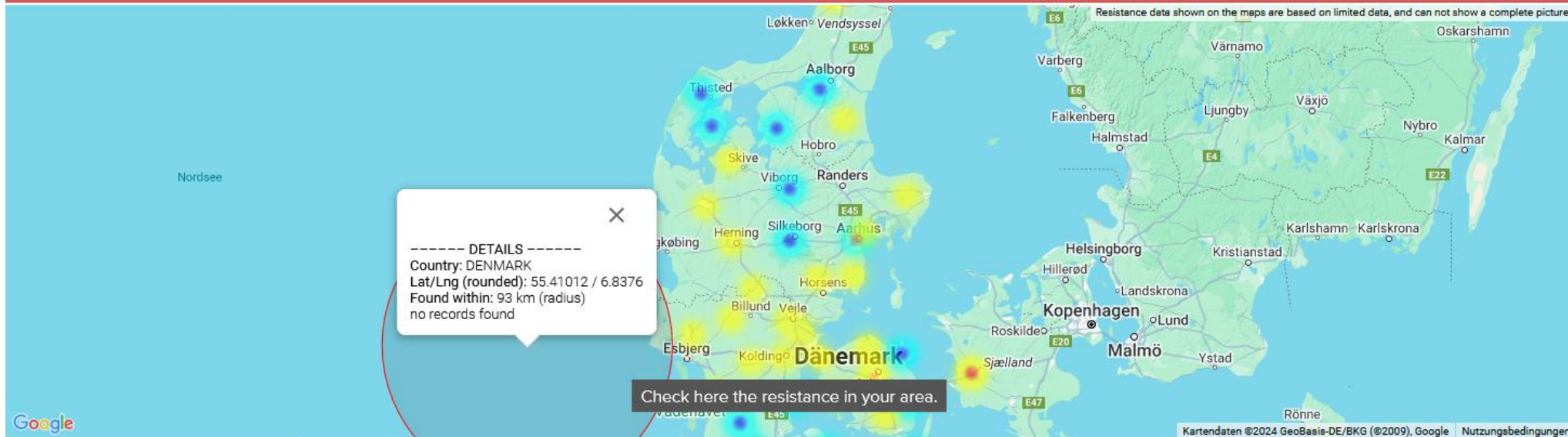
RRAC – www.rrac.info



Website Content



Now included in resistance maps: **4,550** Datapoints



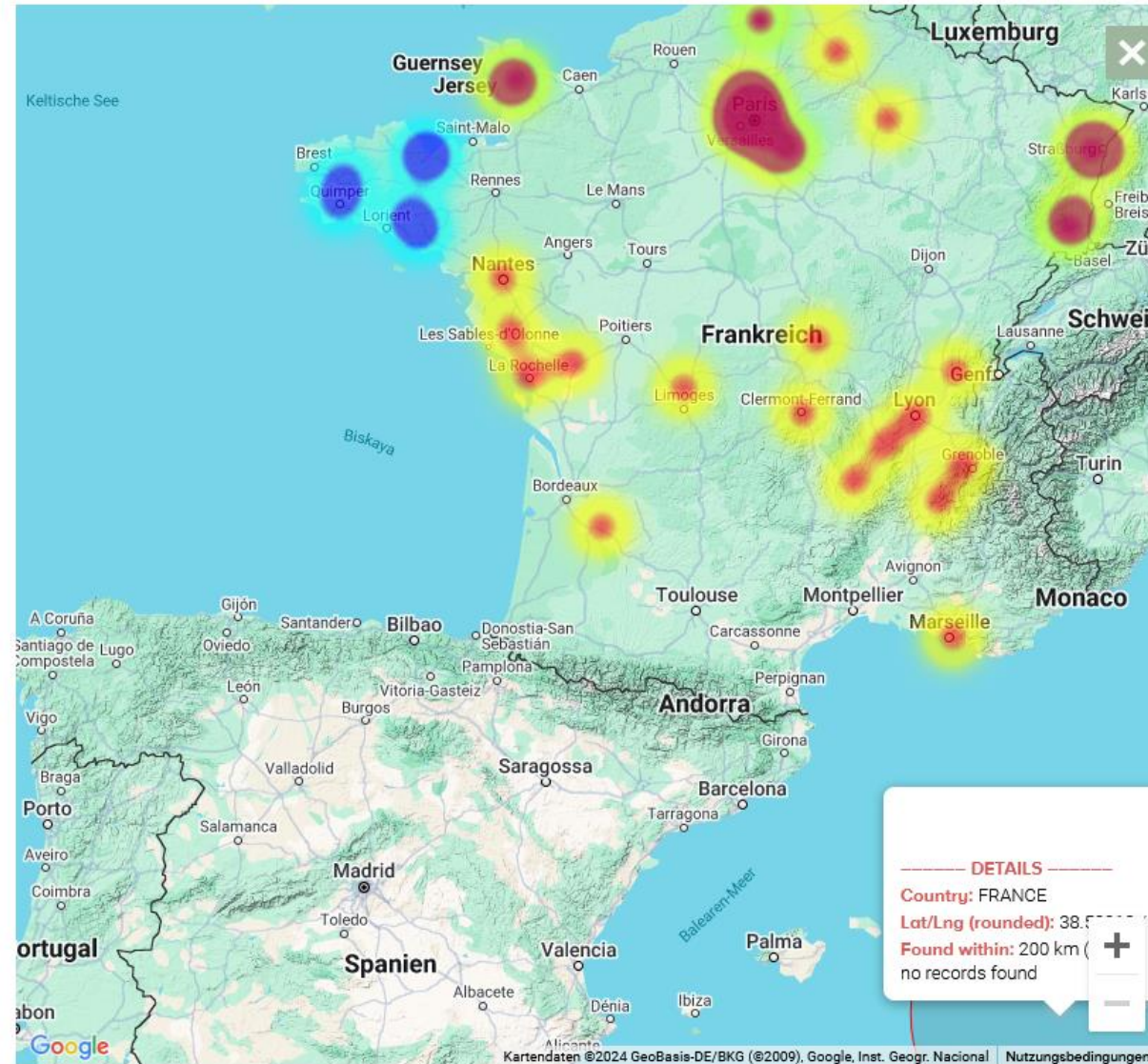
NEW

Hybrid-resistant mice strains

Proofs of the recently discovered hybrid-resistant mice strains are now visible on resistance maps of France, Germany, and the United Kingdom.

Aim and Authors
Introduction
Rodenticide Molecules <input type="checkbox"/>
Rodent control <input type="checkbox"/>
Alternatives to anticoagulants <input type="checkbox"/>
Resistance and Ecotoxicology
Further information <input type="checkbox"/>
Checklist pdf
Resistance maps
↳ Norway Rat
↳ House Mouse
↳ Africa
↳ America
↳ Asia
↳ Europe
↳ Austria
↳ Azores
↳ France
↳ Germany
↳ Greece
↳ Ireland
↳ Italy
↳ Netherlands
↳ Serbia
↳ Spain
↳ Switzerland
↳ United Kingdom

France



With the following buttons you enable ("on") or disable ("off") points on the map.

Type

- Resistance
- Susceptible

Strains

- L128S Y139C
- spretus
- spretus + L128S

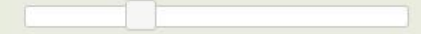
More functions

- Reset map position to France
- Disable surrounding info on map.
- Show map fullscreen.

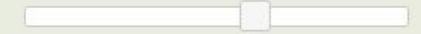
Time range: 2016 - 2017



Heatmap intensity: 0.6



Heatmap opacity: 0.6



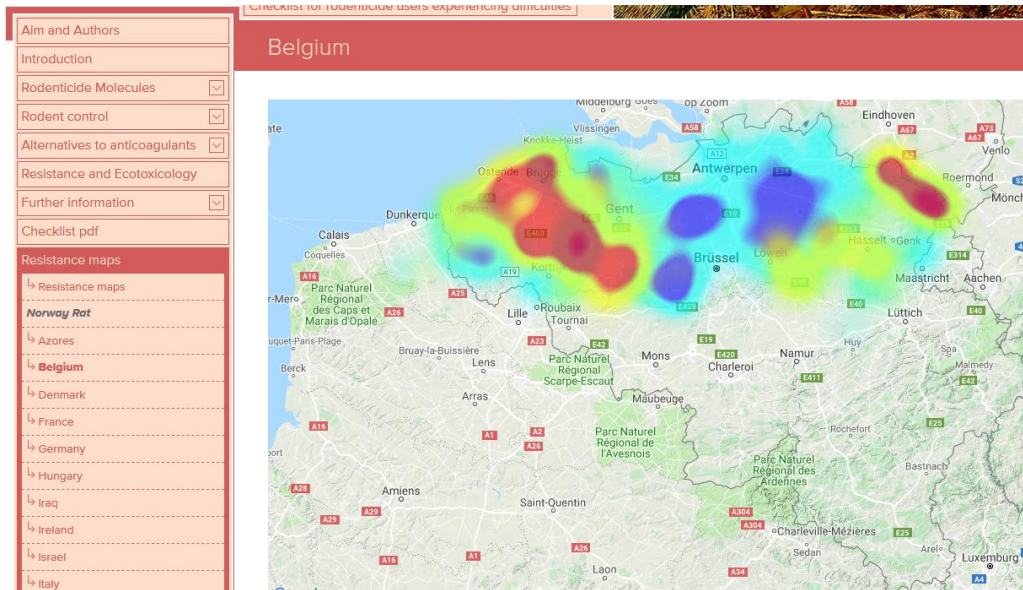
DETAILS

Country: FRANCE
 Lat/Lng (rounded): 38.5°N, 7.5°E
 Found within: 200 km (no records found)

Resistance Susceptible

Leave "RRAC guidelines", go back to "RRAC home".

RRAC – www.rrac.info



Need for samples from white areas:
Contact me for details.



RRAC Anticoagulant Resistance Mapping Project

SAMPLE COLLECTION PROTOCOL

With this initiative, the RRAC aims to further complete the picture on the distribution of anticoagulant resistance in Norway rats and in house mouse. We ask persons, companies and institutions to support this project by sending in samples to the University of Reading, our research partner for genetic analysis. The RRAC funds a certain number of analysis per year, in particular samples coming from areas with no data on resistance and susceptibility, respectively. This research is not aimed for quick operational support, however, as soon as data are generated, these will be visualised on resistance maps on our website www.rrac.info. Prior to collecting and sending samples, the site can also be visited to check if data on resistance already exist for the sample point of concern.

How to collect tails

- Please collect 1-3 tails per site.
- Collect tails from dead bodies or preferably trapped rodents (fresh, clean and intact bodies are needed for tests to work. If you suspect bodies are more than 3 days old and are not of good quality, do not use it)

How to process tails

- A tail tip (3-5 cm) is required to provide DNA from each rodent. Each tail tip must be removed using a clean blade or sturdy scissors and stored in a sealable plastic bag (e.g. Zip-Lok). Please put each tail in a separate bag.

How to store and send tails

- Once the tail sample has been collected and placed in a bag, it should either be frozen (within 12 hrs. of collection) or sent to the University of Reading for DNA testing.
- An exact location must be provided with a sample (GPS co-ordinates OR a post code OR Zip code), see form attached, or it cannot be processed.
- The samples must be labelled correctly and packed in a way that samples cannot be touched by un-authorized people

PLEASE NOTE: the quicker a fresh tail can be posted off OR stored in a freezer, the better the chances of successful results. To preserve samples, we recommend adding salt (NaCl) into the collection bags, in excess.

RRAC website

Thank you for attention!
www.rrac.info



Stefan.Endepols@envu.com



VKOR SNPs	FGARS	Bromadiolone	Difenacoum	Brodifacoum	Flocoumafen	Difethialone
L120Q	no data available					
L128S						
Y139C						
Y139S	no data available					
spretus introgression						