



Detecting NGT Products: The Role of the GenEdit Database

Frédéric DEBODE, Vanessa GELHAY, Geena CARTICK, Ana GRANADOS CHAPATTE, Emily CLARK, Julie HULIN



Funded by
the European Union

Walloon Agricultural Research Centre



What are NGTs ?

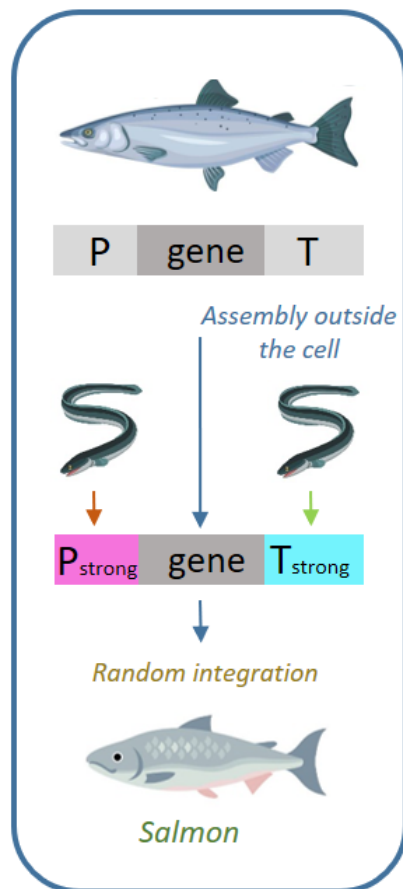
Established Genomic Techniques (EGTs) - genomic techniques developed before 2001, when the existing GMO legislation ([Directive 2001/18/EC](#)) was adopted.

E.g., mutagenesis, transgenesis (the most used, “conventional” GMOs)

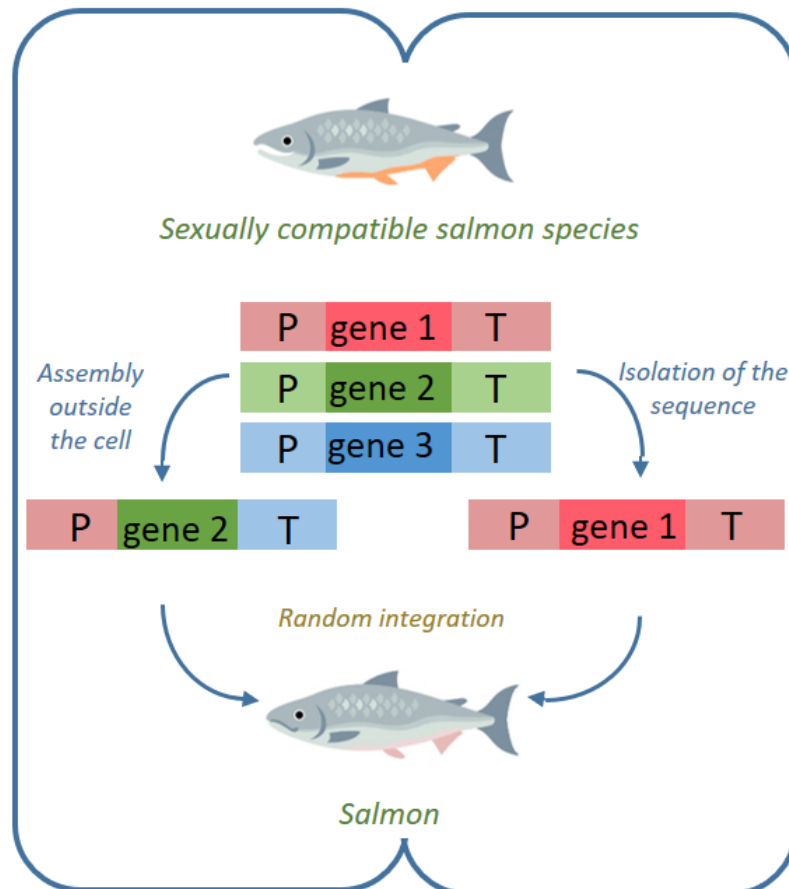
New Genomic Techniques (NGTs) - an umbrella term used to describe a variety of techniques that can alter the genetic material of an organism and that have emerged or have been developed since 2001, when the existing GMO legislation was adopted.

NEW GENOMIC TECHNIQUES (NGT)

A. Transgenesis

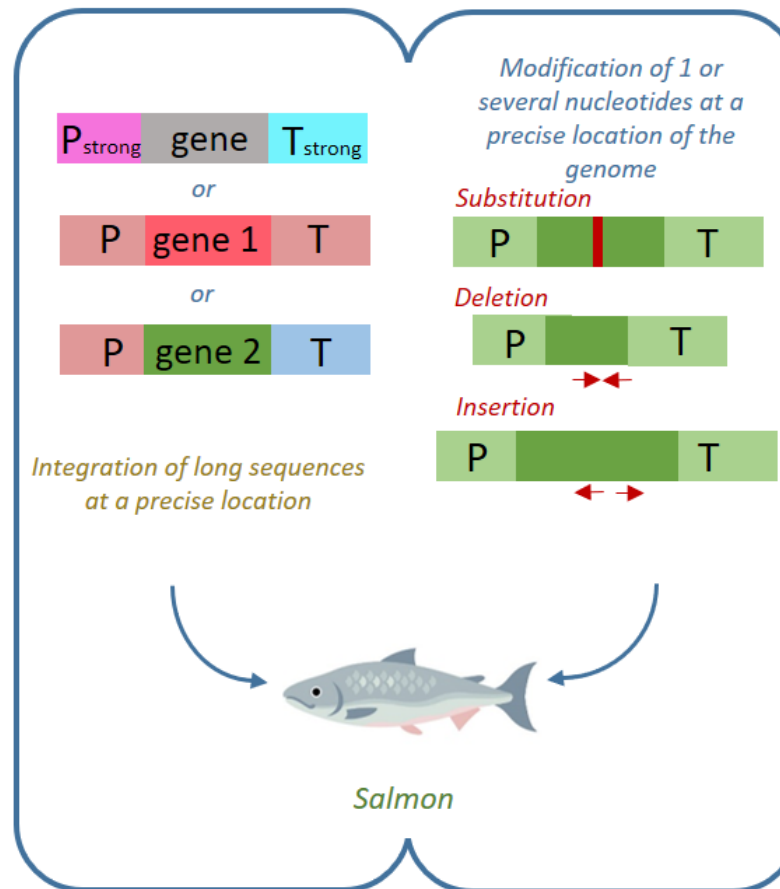


B. Intragenesis



C. Cisgenesis

D. Targeted genome editing



P: promotor of expression T: terminator of expression

- Only considering NGT plants for the moment
- Subdivision into 2 categories

NGT1

- Limited number of modifications (< than 20 nucleotides).
- Assimilated to conventional organisms
- Deletion OK

NGT2

- All other cases
- Same rules than for GMOs
- Modifications of the NTG1 type that result in a herbicide resistance gene are classified as NTG2

- NGTs not authorized in organic agriculture

Need to have detection methods for NGT products

- More difficult than for conventional GMOs because the genomic modifications can be minor
- Able to work on processed/mixed products
- Performance criteria of the methods
- Use of new technologies

- Off-target effects?
- Natural or human-induced modifications?

DETECTIVE, a four-year EU-funded research project (2024-2027)



DETECTION OF NGT PRODUCTS TO PROMOTE INNOVATION IN THE EUROPEAN UNION

It aims to **develop and validate innovative detection methods for plants and animals** obtained with new genomic techniques (NGTs), as well as in their derived products.

20 partners



(Coordinator: Dennis Eriksson)



Funded by
the European Union

19/10/2024

EAAP 2024 - 1st September 2024

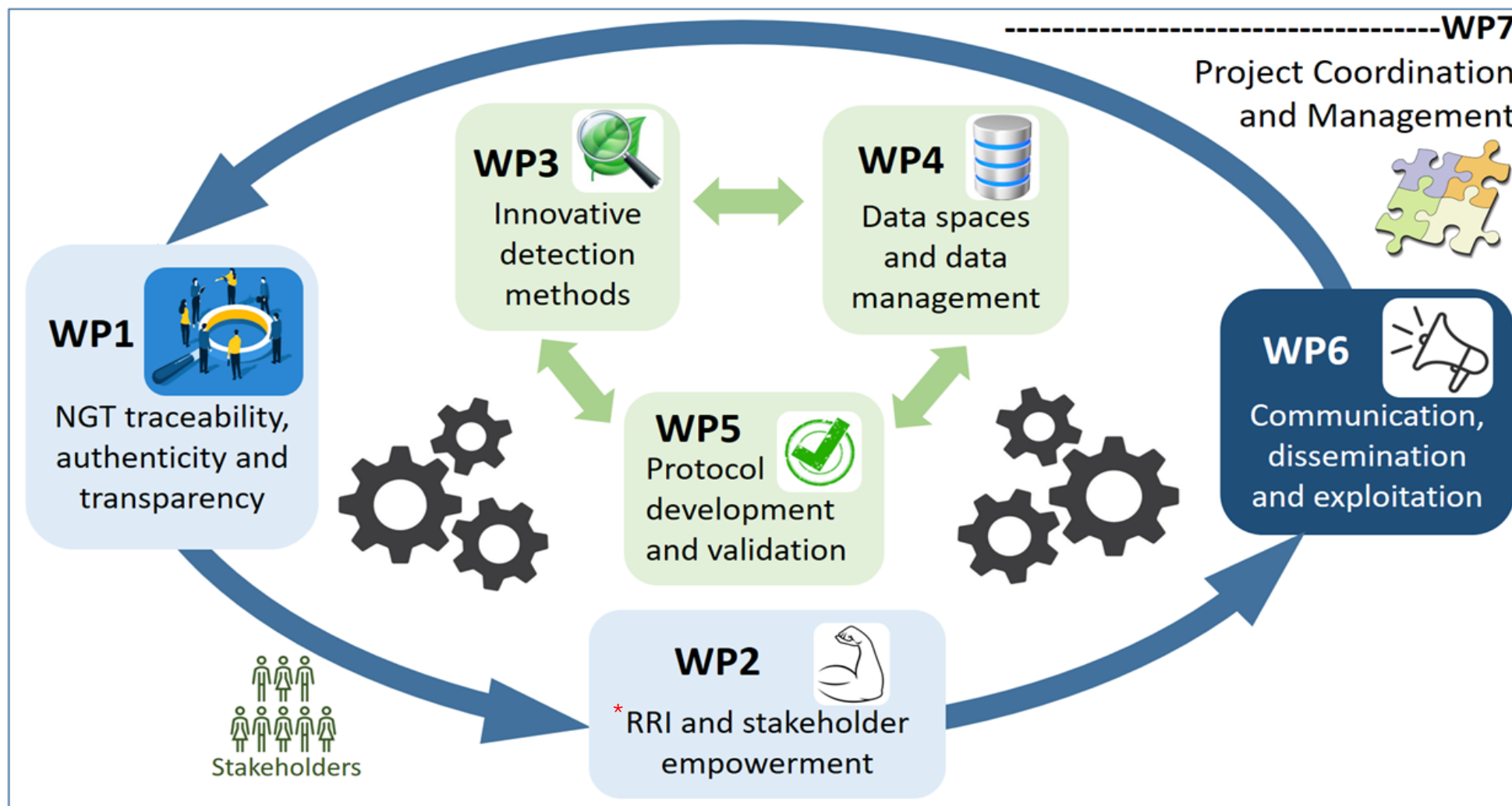
DETECTIVE – Expected results and impacts



- 1** Develop reliable detection methods to address the sustainable farming and food systems challenges
- 2** Validate detection methods for enforcement authorities as well as for developers and agro-food operators
- 3** Empower enforcement authorities, developers and agri-food operators for the authenticity and traceability of products obtained through NGTs
- 4** Enable informed consumer choices by enhancing transparency and traceability across the food chains
- 5** Foster innovation in the food chain systems linked to NGTs



DETECTIVE – WP structure and interdependencies



WP3. Development of detection methods



WP leader :  Wallonie
recherche
CRA-W

Task 3.1. Collection of samples

- **Types of mutations:** deletions, substitutions, of one or more than one nucleotide, etc.
- **Organisms:** it is essential to consider various categories of commercially important plants but also animals (such as beef, pork, poultry, and fish).
- **Gene/trait categories**
- **Complexity of the genome**
- **Status:** commercialisation, pre-commercialisation, research
- **Developers:** ability to bring products from development to commercialisation stage
- **Processing:** applicability to processed food
- **Origin:** countries
- **NGT category:** NGT1 and NGT2

→ **Important to have a collaboration with animal breeders**



Funded by
the European Union

19/10/2024

WP3. Development of detection methods

Task 3.2. Targeted approaches

- Methods that are present in control laboratories (qPCR, dPCR,...)
- Methods used in the medical field (adapted for food and feed?)
- Additional methods (sequencing,...)

Task 3.3. Multi-targets approaches

Methods able to detect several modifications in one single experiment.

Task 3.4. Untargeted approaches

Methods looking at different sequences (high-throughput sequencing approaches, machine learning, detection of mutations, off-target detection)

- Evaluation of the approaches
- Link with databases (WP4)
- Methods will be selected for validation (WP5)
- Methods used by the developers of the material can be evaluated under different performance criteria

WP4. Data spaces and data management

Task 4.1: Building a federated data space structure

WP leader :  **ILVO**

Task 4.2: The GenEdit database



- Current situation
- Trends
- Define strategies

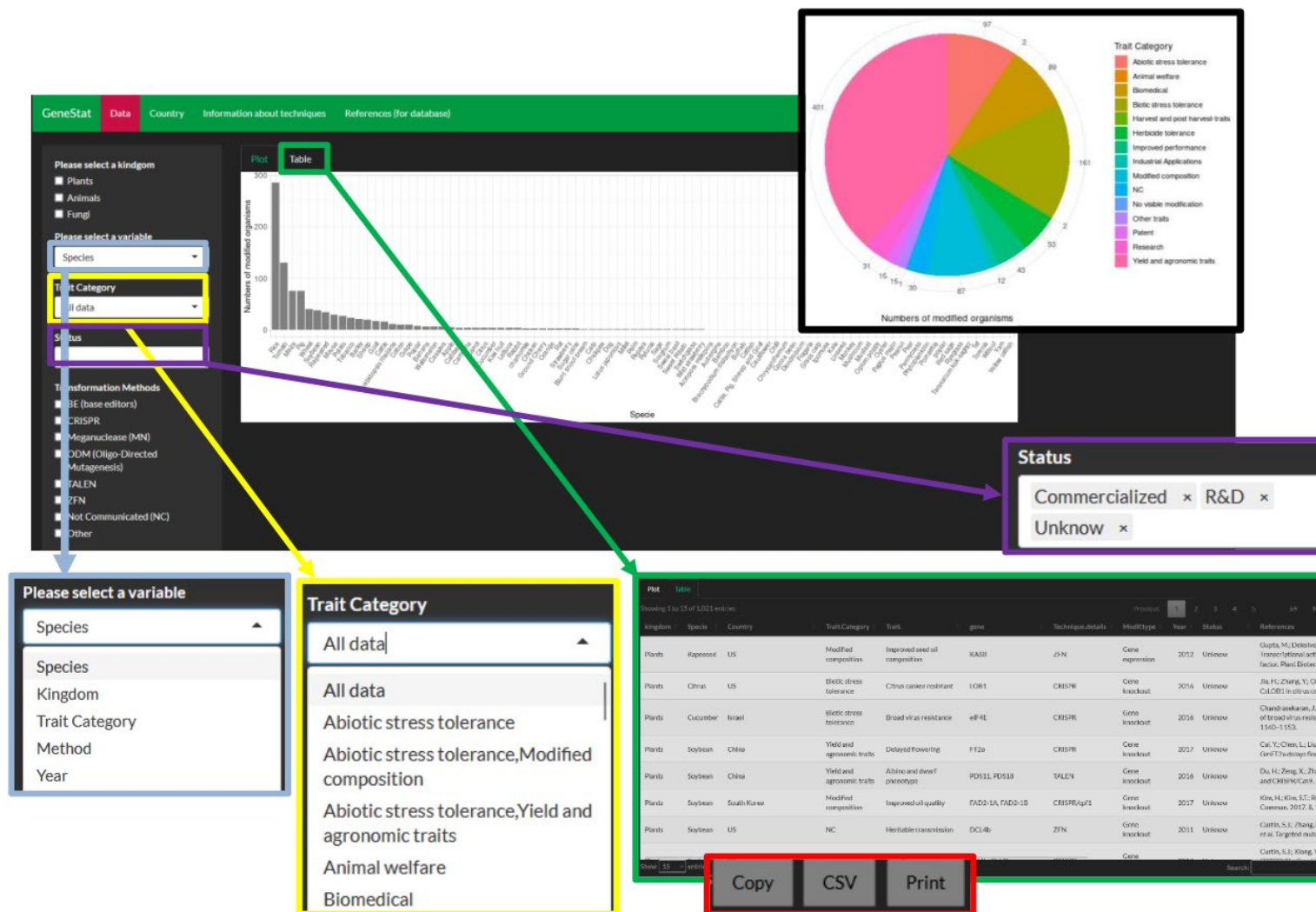
DATABASE 1 GenEdit database

- Species
- Countries
- Traits
- Genes involved
- Links to publications

Task 4.3: Building additional databases



1157 entries
840 plants
314 animals



Developer of the tool: Julie Hulin

The GenEdit database



Exclusively based on published information

Please select a kindgom

- ☐ Plants
- ☒ Animals
- ☐ Fungi

Please select a variable

Species

Trait Category

All data

Status

Commercialized x

R&D x

Unknown x

Transformation Methods

- ☐ BE (base editors)
- ☐ CRISPR
- ☐ Meganuclease (MN)
- ☐ ODM (Oligo-Directed Mutagenesis)
- ☐ TALEN
- ☐ ZFN

Showing 1 to 100 of 314 entries									
kingdom	Species	Country	Trait.Category	Trait.	gene	Technique.details	Modif.type	Year	Status
All	All	All	All	All	All	All	All	All	All
Animals	Goat	China	Meat production, Flesh quality	Meat and cashmere production	MSTN, FGF5			2015	Unknown
Animals	Cattle		Modified composition	Prevision :reduce b-lactoglobulin	BLG		Knock out	2011	Unknown
Animals	Goat	China	Modified composition	decreased BLG levels in milk	BLG		Knock out	2015	Unknown
Animals	Cattle	US	Animal welfare	Horn-free cattle	POLLED			2016	Unknown
Animals	Sheep	Uruguay,France	Meat production	improves meat production	MSTN		Knock out	2015	Unknown



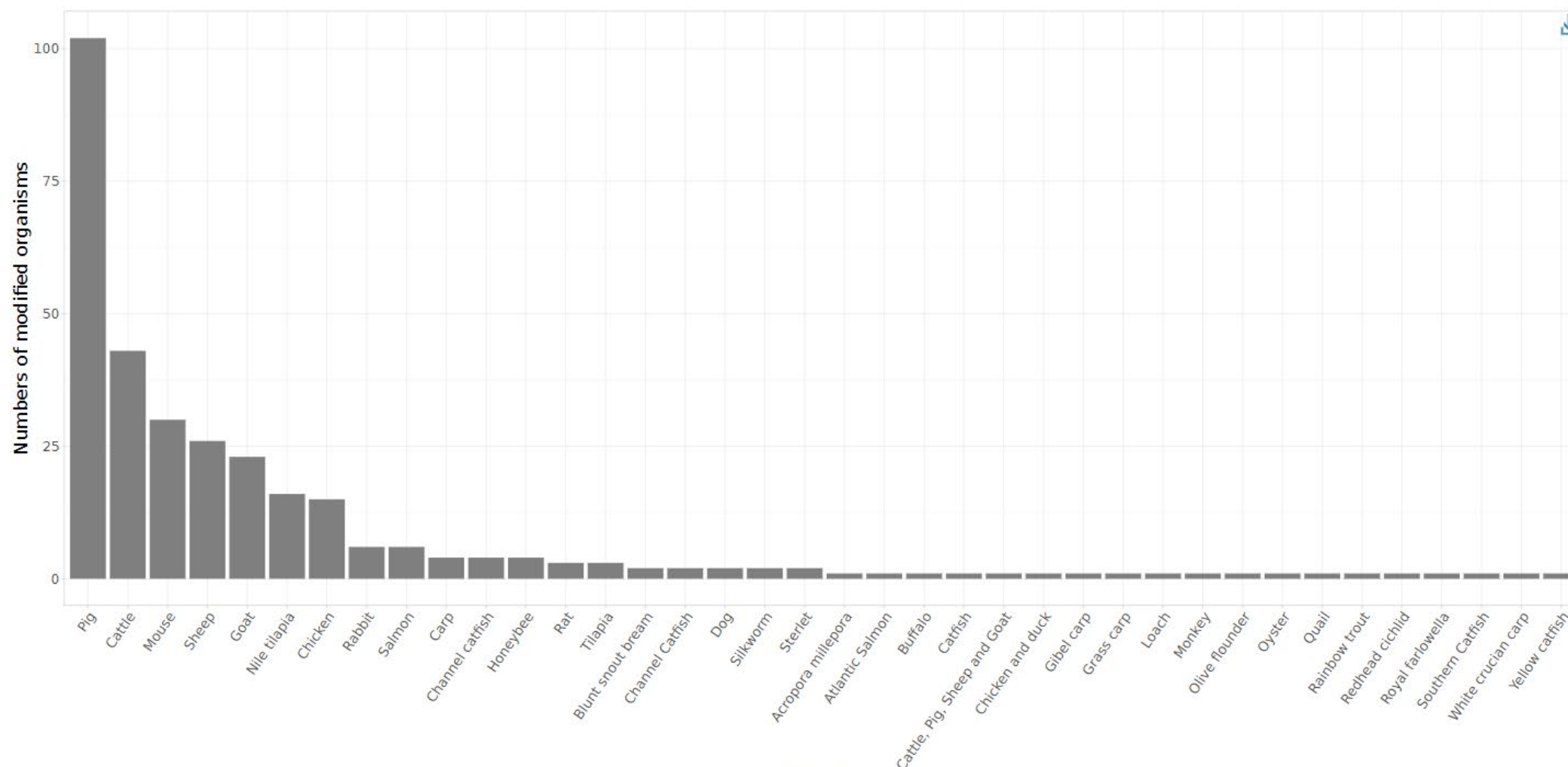
Funded by
the European Union

19/10/2024

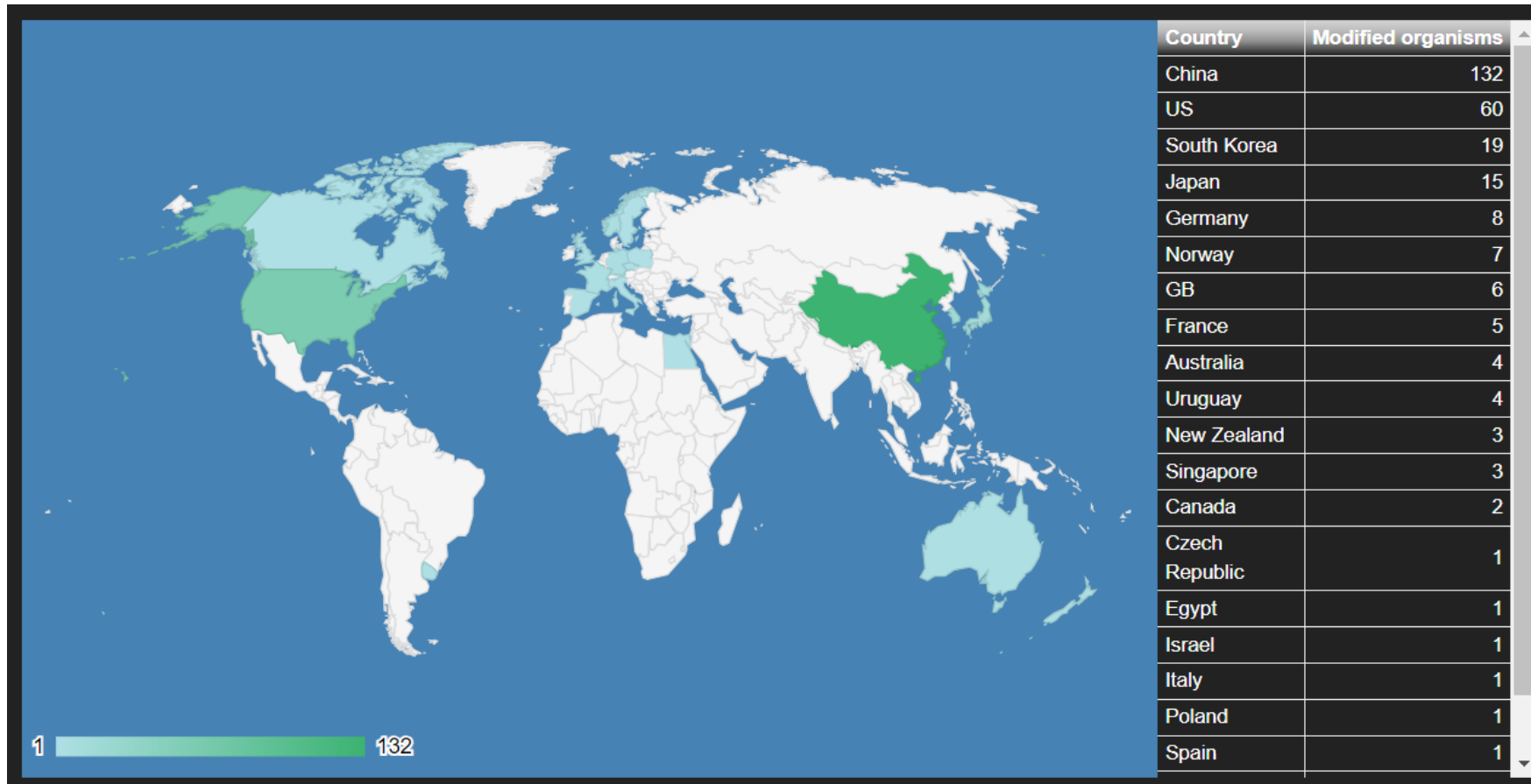
EAAP 2024 - 1st September 2024

13

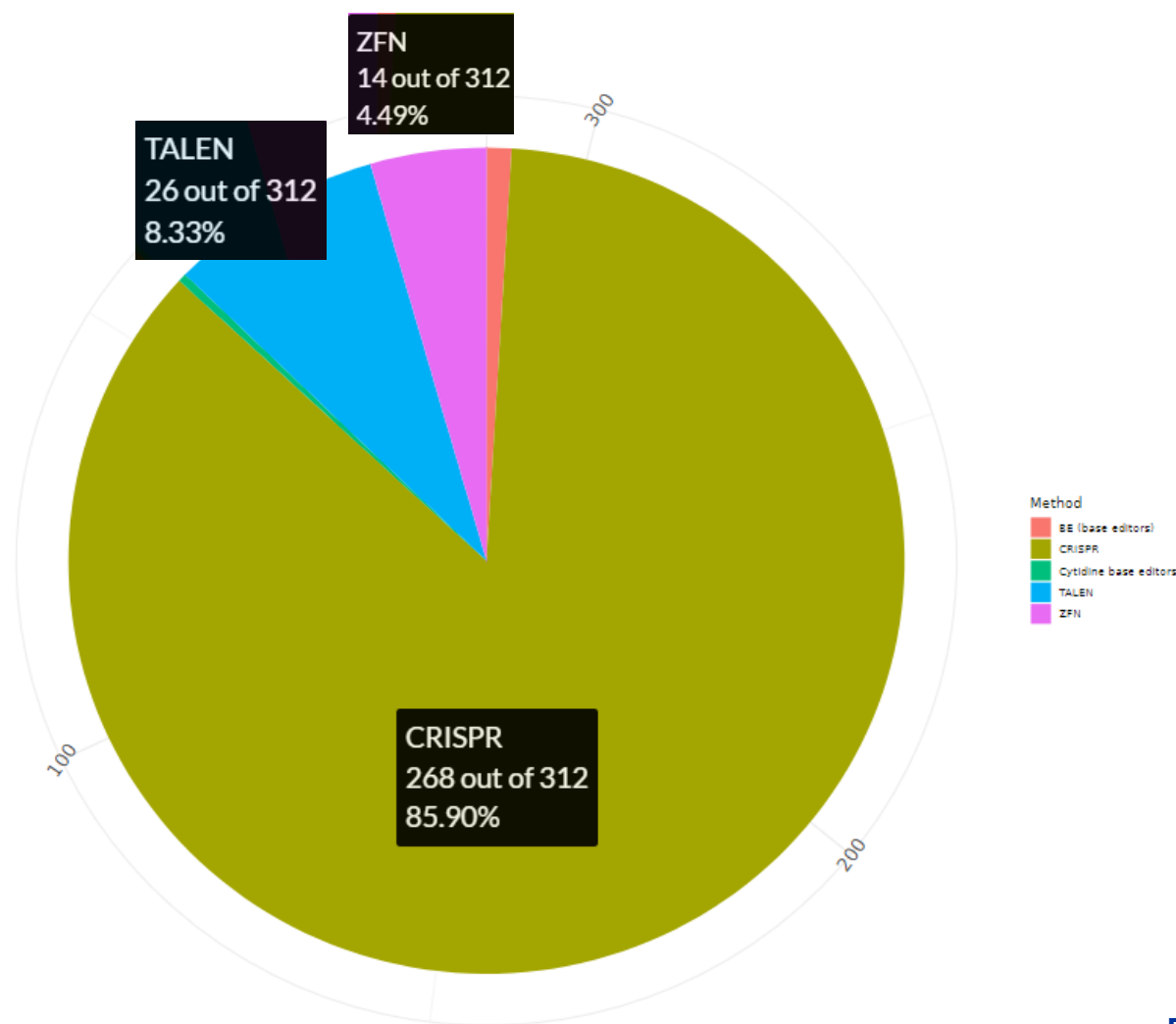
GE animals – Current situation



WP4: GE animals – countries (research papers)



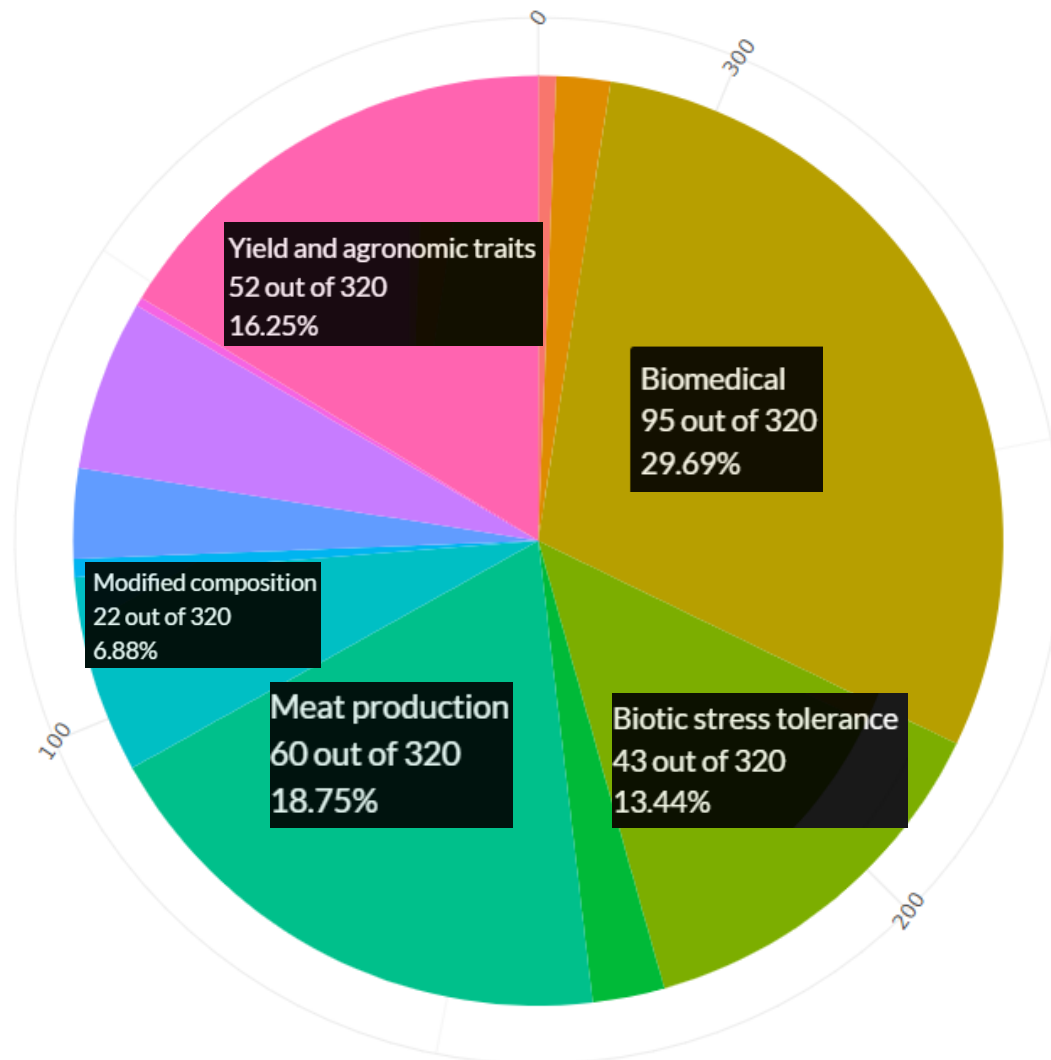
GE animals – Methods used for modifications



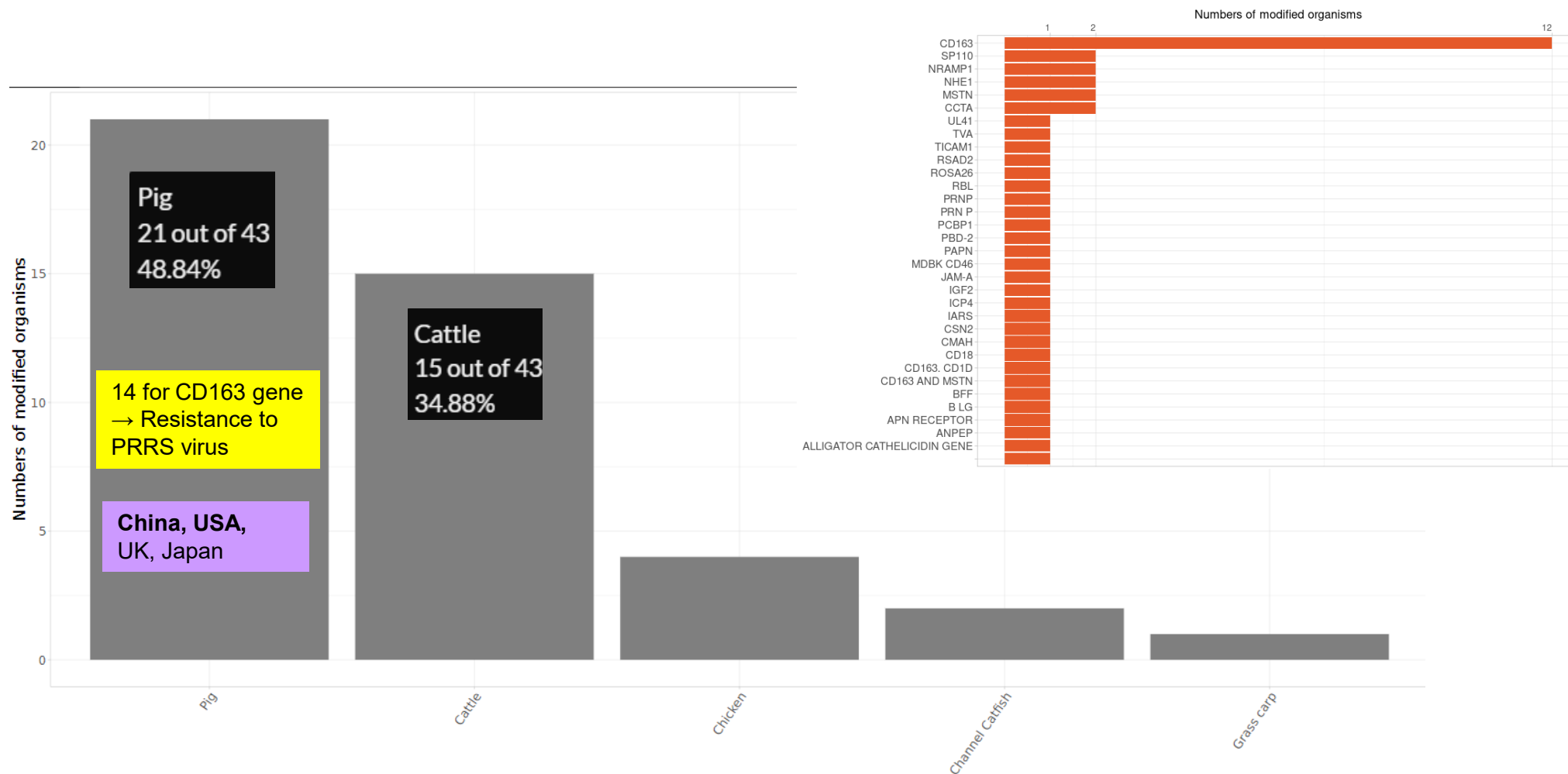
Why is the CRISPR-Cas technology presently the most used?

- Simplicity and ease of use
- Flexibility
- Efficiency
- Cost

GE animals – Main trait categories



GE animals – Biotic stress tolerance



14 for CD163 gene
→ Resistance to
PRRS virus

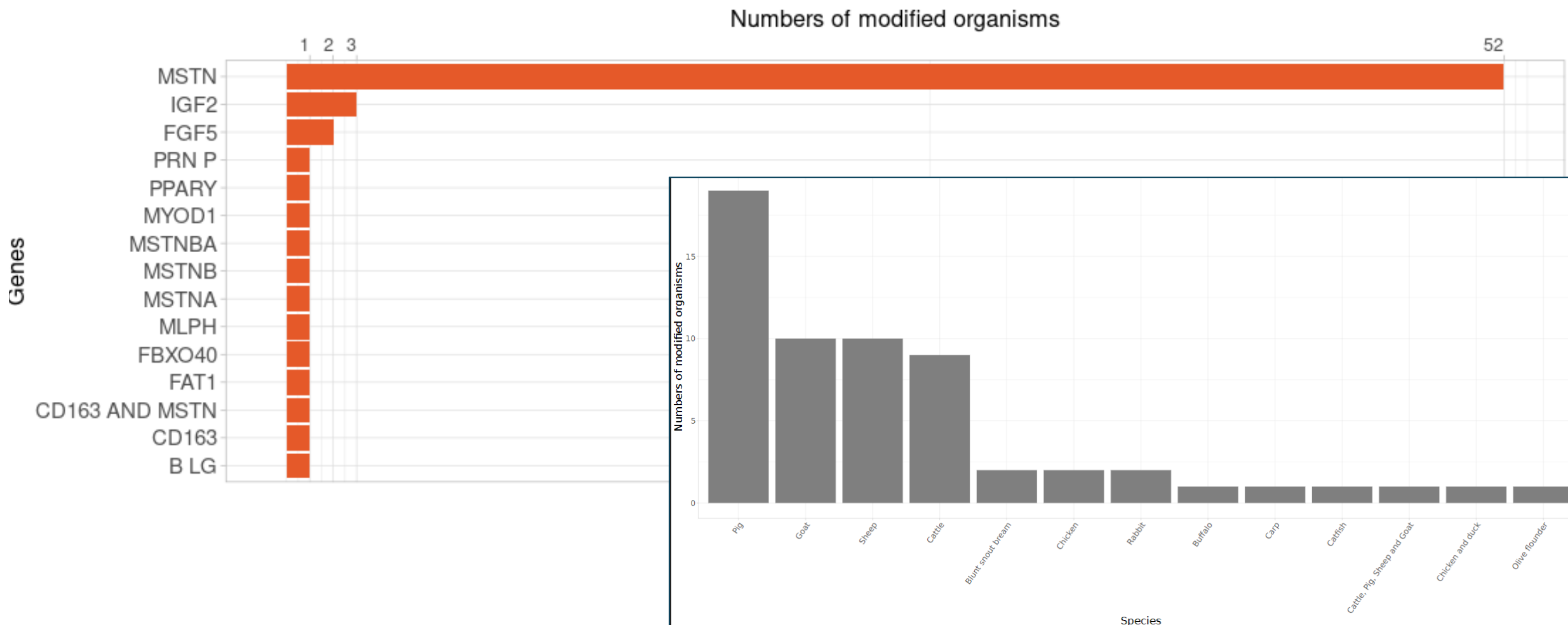
The virus needs a specific receptor (CD163) to make its own membrane fuse with the host cell membrane and release the viral genetic information into the cell

Modifications at the level of the receptor cysteine-rich domain 5 (SRCR5) region of the CD163 gene

Small or bigger modifications

Pig	CD163	TGCTGTGCAGGGAAGTACAGTGCAGCACTGTGGTTTCCCTCCTGGGGG
Pig	CD163	TGCTGTGCAGGGAAGTACAGTGCAGCACTGNNNNNNNNNNNNNNNTGGTTTCCCTCC
Pig	CD163	TGCTGTGCAGGGAAGTACAGTGCAGC--TGTGGTTTCCCTCCTGGGGG
Pig	CD163	TGCTGTGCAGGGAAGTACAGTGCAG--AACTACTGTGGTTTCCCTCCTGGGGG
Pig	CD163	TGCTGTGCAGGGAAGT-----CTGTGGTTTCCCTCCTGGGGG
		-(Δ124)-----CTGTGGTTTCCCTCCTGGGGG
Pig	CD163	-(Δ123)-----ACTGTGGTTTCCCTCCTGGGGG
Pig	CD163	TGCTGTGCAGGGAAGTACAGTGCAGCAACTGTGGTTTCCCTCCTGGGGG
Pig	CD163	-(Δ130)-----TCCTGGGGG
Pig	CD163	-(Δ132)-----CTGGGGG
Pig	CD163	GGTCGTGTTGAAGTACAAACATGG
Pig	CD163	GGTCGTGTTGAA--ACATGG
Pig	CD163	ACCCCGCCCTGAC--ATGTAGCCACAGCAGGG

GE animals – Meat production



The Role of the GenEdit Database

The GenEdit database

- Current situation
- Trends
- Define strategies

GenEdit database

- Species
- Countries
- Traits
- Genes involved
- Links to publications

Sequences of genes

- Variability in WT and mutated genes

- WT (for different species)
- WT (for different races)
- Edited genes

Sequences of natural variations

- Variability in naturally mutated genes

Define the strategies

Techniques of detection

WT sequence

or

Genome edited





www.detective-ngt.eu



Thank you for your attention !

A special thanks for
the contacts with
the animal sector to



Questions concerning this presentation: f.debode@cra.wallonie.be



**Funded by
the European Union**