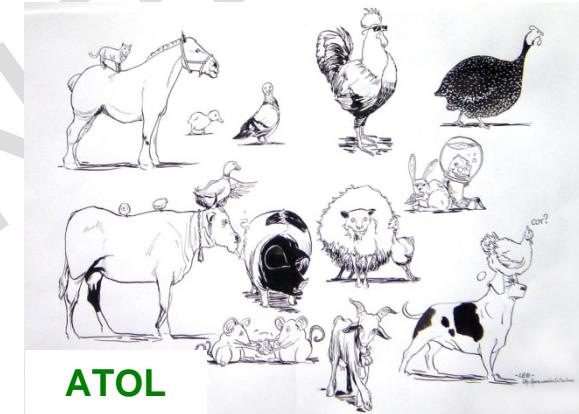


ATOL : a new ontology for livestock



C. Hurtaud, M.C. Meunier-Salaün,
J. Bugeon, A. Fatet, M. Reichstadt, A. Valancogne, J. Vernet, I. Hue, P.Y. Le Bail
O. Dameron,
J. Reecy, C. Park

INRA PHASE department
INSERM Rennes
Iowa State University

ATOL: why? Because of an increasing complexity



- A more and more complicated knowledge
- Increasing amount of information
- Diversification of community of users
- A need of a more efficient management c.
evolution of our production systems \Rightarrow

PREDICTION OF PHENOTYPE

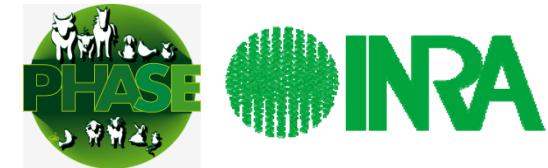
Change of paradigm

From an analytic
approach to an
integrated and systemic
approach

Necessary to have a shared language

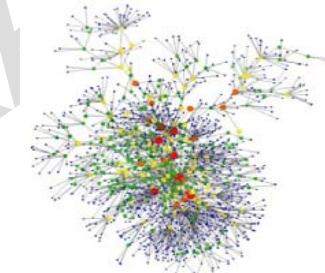
a language usable by software and in the same time offering possibility of data basis
management, semantic analysis or modeling approach using concept and
relationships between measurements

ATOL : an ontology



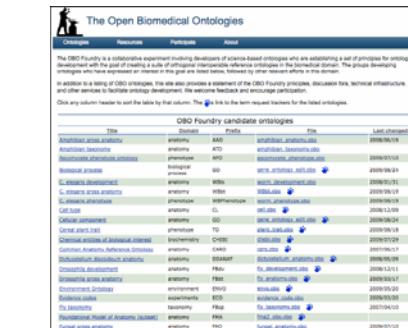
Ontology ?

1) Ontology = formal representation of concepts and of relationships between these concepts within a subject or a specific area.



2) Characteristics :

- It describes a field of interest with concepts and relationships
 - The concepts and the relationships are **clearly defined**
 - The meaning of an item is used in **an unequivocal way.**
 - The concepts are organized in **a structural way** (often a hierarchy)
 - The items have to **be easily used by computer** (for bibliographic request research).



ATOL: the context



Context of the establishment of ATOL

- 1) Numerous ontologies in biology (such as PATO-Phenotypic Quality Ontology, ChEBI, Digital Morphology, Zebrafish Anatomical Ontology, Disease Ontology, Infectious Disease Ontology, Mouse Pathology, Gene Ontology, Mouse Genome Informatics...)
- 2) Those focused on phenotypage (Human Trait Ontology, Mammalian Phenotype Ontology...) mainly concern the human or animal models used to study human diseases.



→ Building of an ontology of normalized traits for farm animals « **ATOL** » (**Animal Trait Ontology for Livestock**), by **INRA** (department **PHASE**) and **Iowa State University**.



ATOL: the objectives

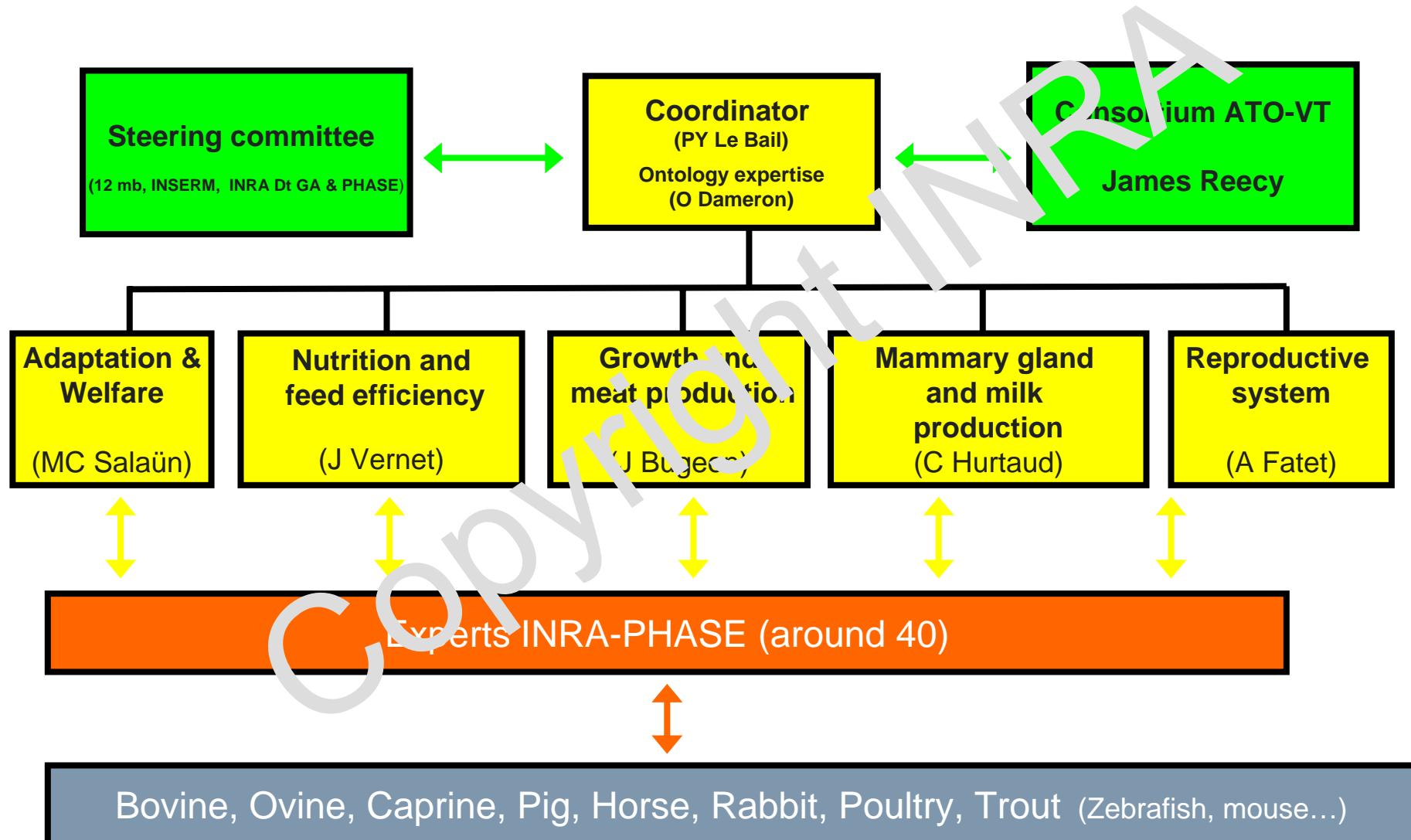


The objectives of ATOL

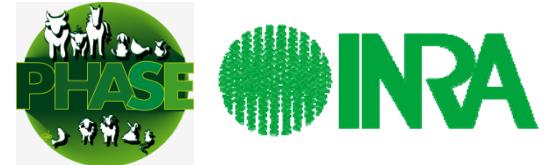
1. To have a **reference ontology** for phenotyping of farm animals shared by international scientific and teaching community.
 2. To have a **language usable by software** (data basis management, semantic analysis, modeling...)
 3. To have the traits as **generic** as possible
 4. To have the ontology as **efficient** as possible and close to technical measurements
 5. To have a structure applied to **production** targets



ATOL : Structure and network



Structure of the French ATOL network

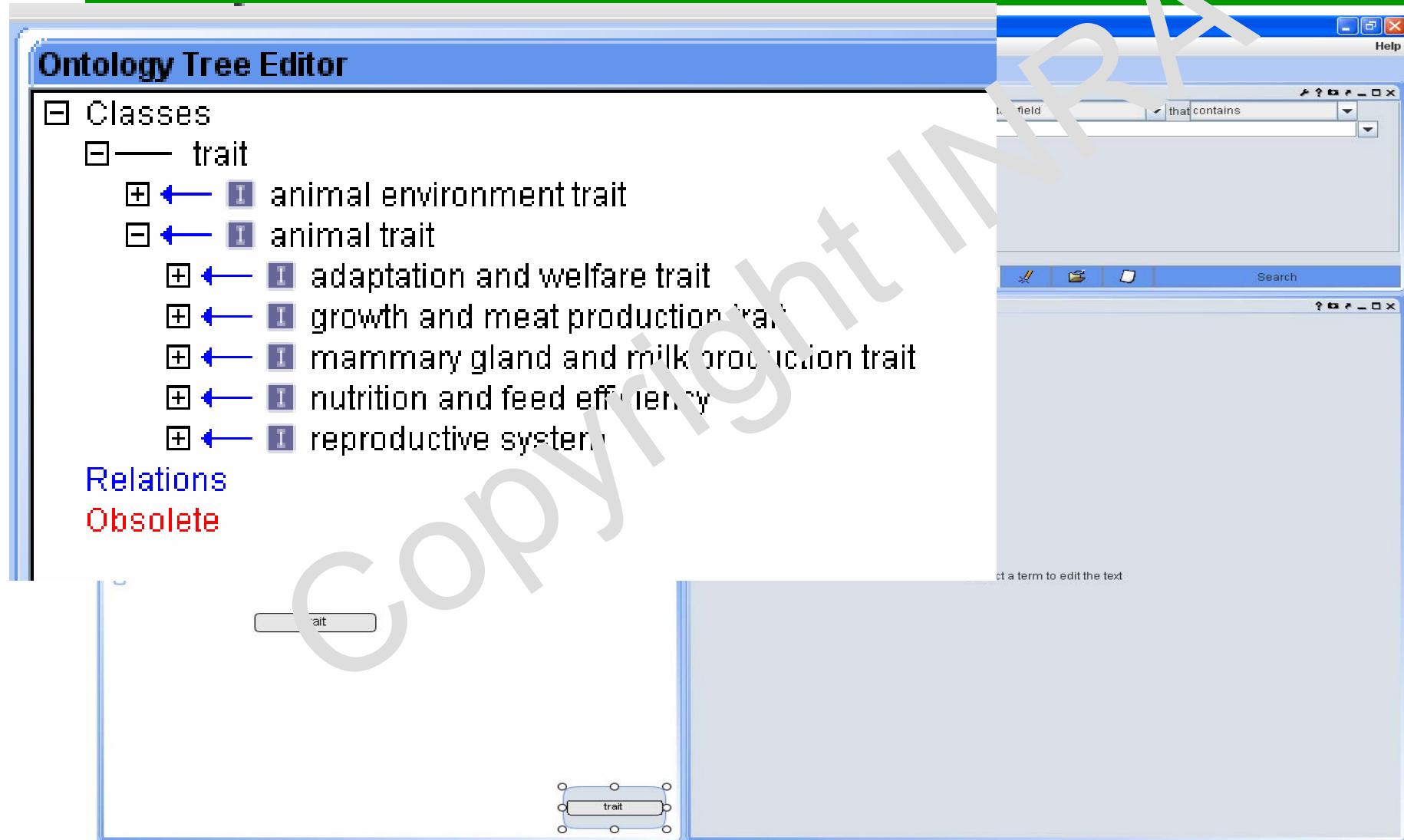


	Cattle	Sheep	Goat	Pig	Horse	Rabbit	Poultry	Rainbow trout	Mouse	Zebrafish
Adaptation and welfare trait (MC Salaün)	×	×	×	×	×	×	×	×	×	
Reproductive system (A. Fatet)	×	×	×	×	×	×	×	×	×	×
Nutrition and feed efficiency (J. Vernet)	×	×	×	×	×	×	×	×	×	×
Mammary gland and milk production (C. Hurtaud)	×	;	;	;	;	;	;	;	;	
Growth and meat production (J. Bugeon)	×	×		;	;	;	;	;	;	;

ATOL : Structure



1) Hierarchy



ATOL : Structure



1) Hierarchy

OBO-Edit version 2.1-beta10: atol_v2.4.obo

File Edit Layout Editors Viewers Search Tools Metadata Reasoner Summary Config

Ontology Tree Editor

Classes

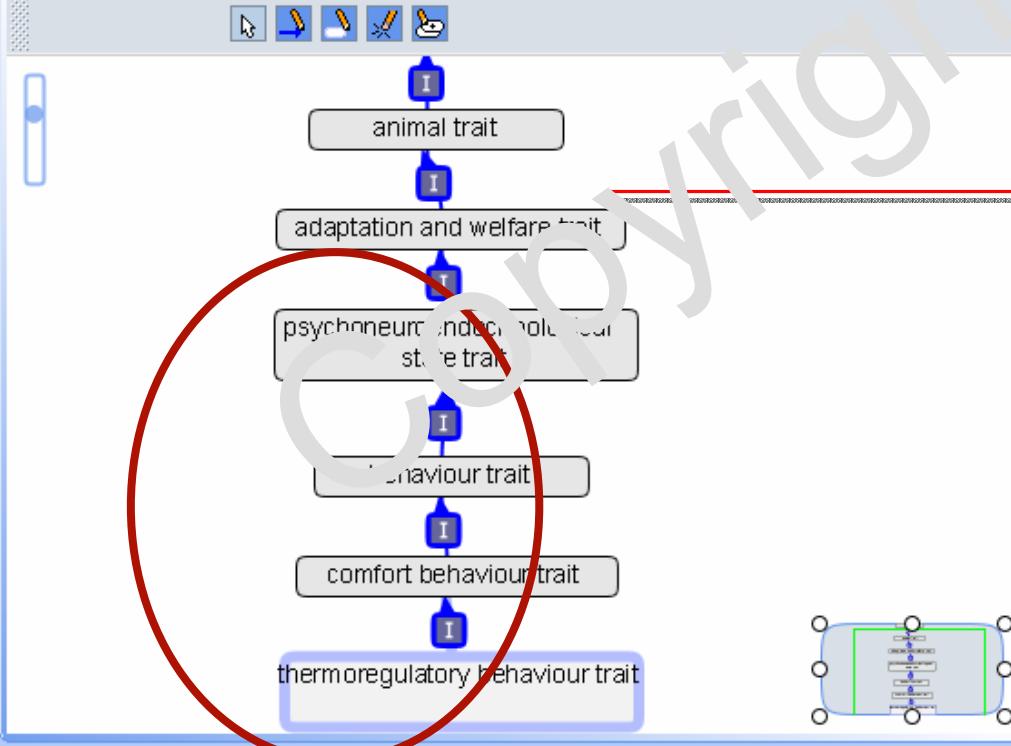
- trait
 - animal environment trait
 - animal trait
 - adaptation and welfare trait
 - animal performance trait
 - health trait
 - psychoneuroendocrinological state trait
 - behaviour trait
 - comfort behaviour trait
 - allo-body care trait
 - auto-body care trait

Verification Manager Search Panel

Search Panel

Select terms that have the value ID:0001692

Graph Editor

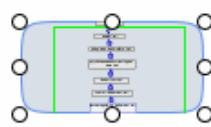


KIND OF RELATION

...is a...

...is a part of ...

...is a standardisation of...



Commit

Revert

ance

ATOL : Structure



2) Definition and identification

Diagram illustrating the ATOL structure for defining and identifying a thermoregulatory behaviour trait.

Ontology Tree Editor: Shows the class hierarchy under the "trait" category, including "animal environment trait", "animal trait", "adaptation and welfare trait", "animal performance trait", "health trait", "psychoneuroendocrinological state trait", and "behaviour trait". The "behaviour trait" node has children: "comfort behaviour trait", "allo-body care", "auto-body care", "thermoregulatory behaviour trait", "ingestive behaviour", "motor activity trait", "relational behaviour", "cognitive functions", "emotional function", "painful responses", "reflex responses", "rhythm trait", "sensory capacities", and "stress responses".

Text Editor (3 warnings): Displays the definition of the "thermoregulatory behaviour trait". The ID is PH:0000829, the Namespace is file:C:/Documents and Settings/hurtault/My Documents/ATOL/ontology/ATOL.owl, and the Name is "thermoregulatory behaviour trait". The definition is: "any measurable or observable characteristic related to physiological and behavioral adjustments to maintain a stable and constant central temperature, whatever the surrounding temperature, or to display a variation of temperature dependent on the surrounding".

Graph Editor: Shows the semantic graph structure. Nodes include "animal", "adaptation", "psychoneuro", "state", "behaviour trait", "comfort behaviour trait", and "thermoregulatory behaviour trait". Relationships are indicated by arrows between these nodes.

Search Panel: A search interface showing results for the term "thermoregulatory behaviour trait". The results list includes "INRA:PHASE / INRA PHASE".

Annotations: A large orange callout box highlights key concepts: **Thermoregulation**, **Genes**, **Epigenetic regulation**, **mRNA**, **Proteins**, and **QTL**.

Bottom Right: Text indicating "Grenoble, France".

ATOL : Structure



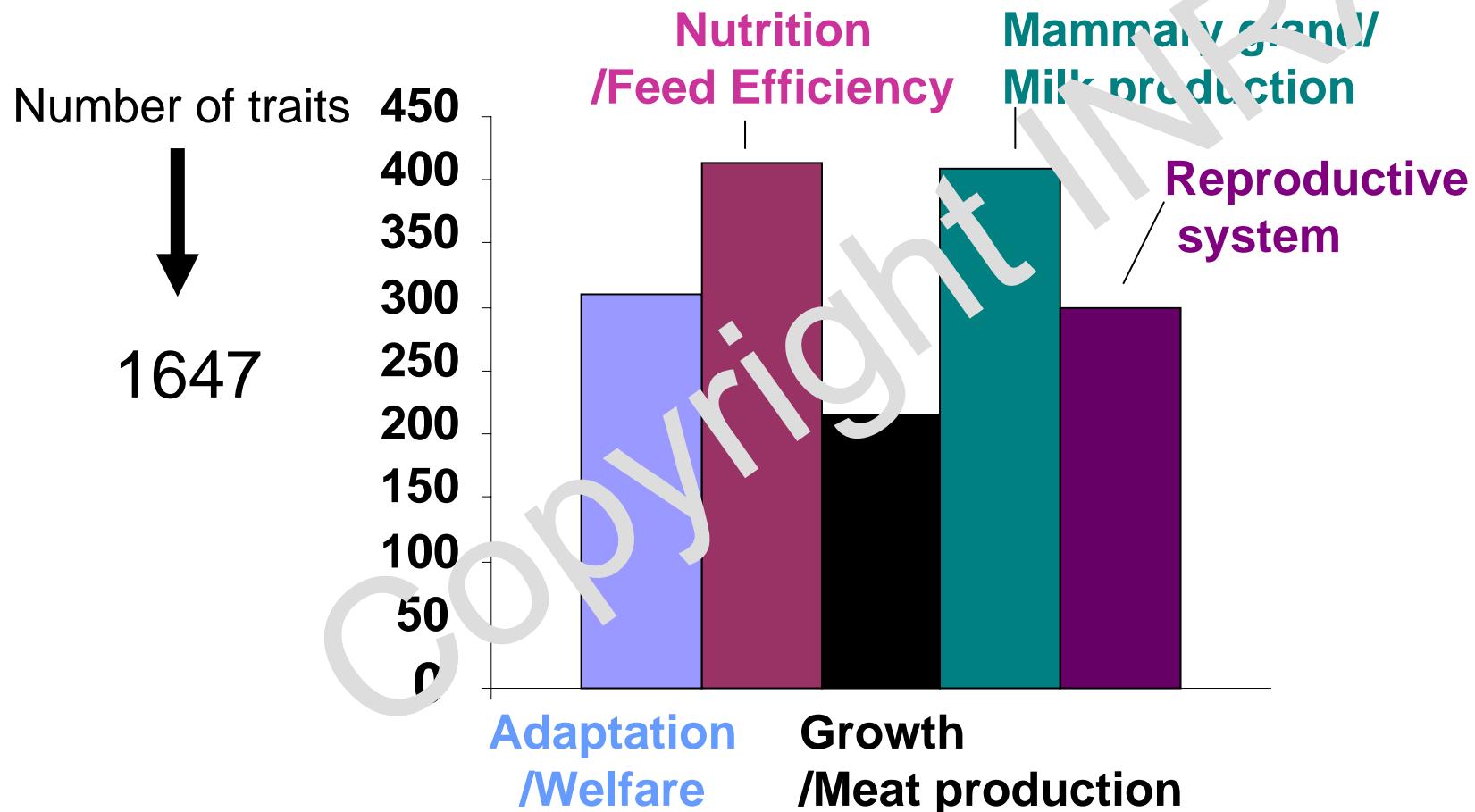
3) Species

A screenshot of the OBO-Edit version 2.1-beta10 software interface. The title bar shows "OBO-Edit version 2.1-beta10: atol_v2.4.obo". The menu bar includes File, Edit, Layout, Editors, Viewers, Search, Tools, Metadata, Reasoner, Summary, Config, and Help. The top left contains the "Ontology Tree Editor" showing a tree structure under the "Classes" section, with "trait" as the root node branching into "animal environment trait", "animal trait", "adaptation and welfare trait", "animal performance trait", "health trait", "psychoneuroendocrinological state trait", "behaviour trait", "comfort behaviour trait", and "allo-body care trait". The main workspace displays a "Search Panel" with the query "Select terms that have the value [ID:0001692]". Below this is a table with two columns: "Xrefs" and "Subsets *". The "Xrefs" column lists species names with their common names in parentheses: Cattle (Cattle), Chicken (Chicken), Goat (Goat), Horse (Horse), Mouse (Mouse), Pig (Pig), Poultry (Poultry), Rabbit (Rabbit), Rainbow_trout (Rainbow_trout), Sheep (Sheep), Turkey (Turkey), and Zebrafish (Zebrafish). The "Subsets *" column contains checkboxes, many of which are checked (indicated by a blue square with a white checkmark). A red oval highlights the "Subsets *" column. At the bottom are "Commit" and "Revert" buttons.

Xrefs	Subsets *
Cattle (Cattle)	<input checked="" type="checkbox"/>
Chicken (Chicken)	<input type="checkbox"/>
Goat (Goat)	<input checked="" type="checkbox"/>
Horse (Horse)	<input checked="" type="checkbox"/>
Mouse (Mouse)	<input checked="" type="checkbox"/>
Pig (Pig)	<input checked="" type="checkbox"/>
Poultry (Poultry)	<input checked="" type="checkbox"/>
Rabbit (Rabbit)	<input checked="" type="checkbox"/>
Rainbow_trout (Rainbow_trout)	<input type="checkbox"/>
Sheep (Sheep)	<input checked="" type="checkbox"/>
Turkey (Turkey)	<input type="checkbox"/>
Zebrafish (Zebrafish)	<input type="checkbox"/>

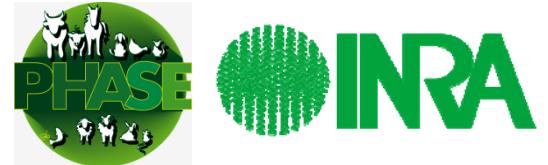
Ontology : ATOL

not still finished, need always to be improved

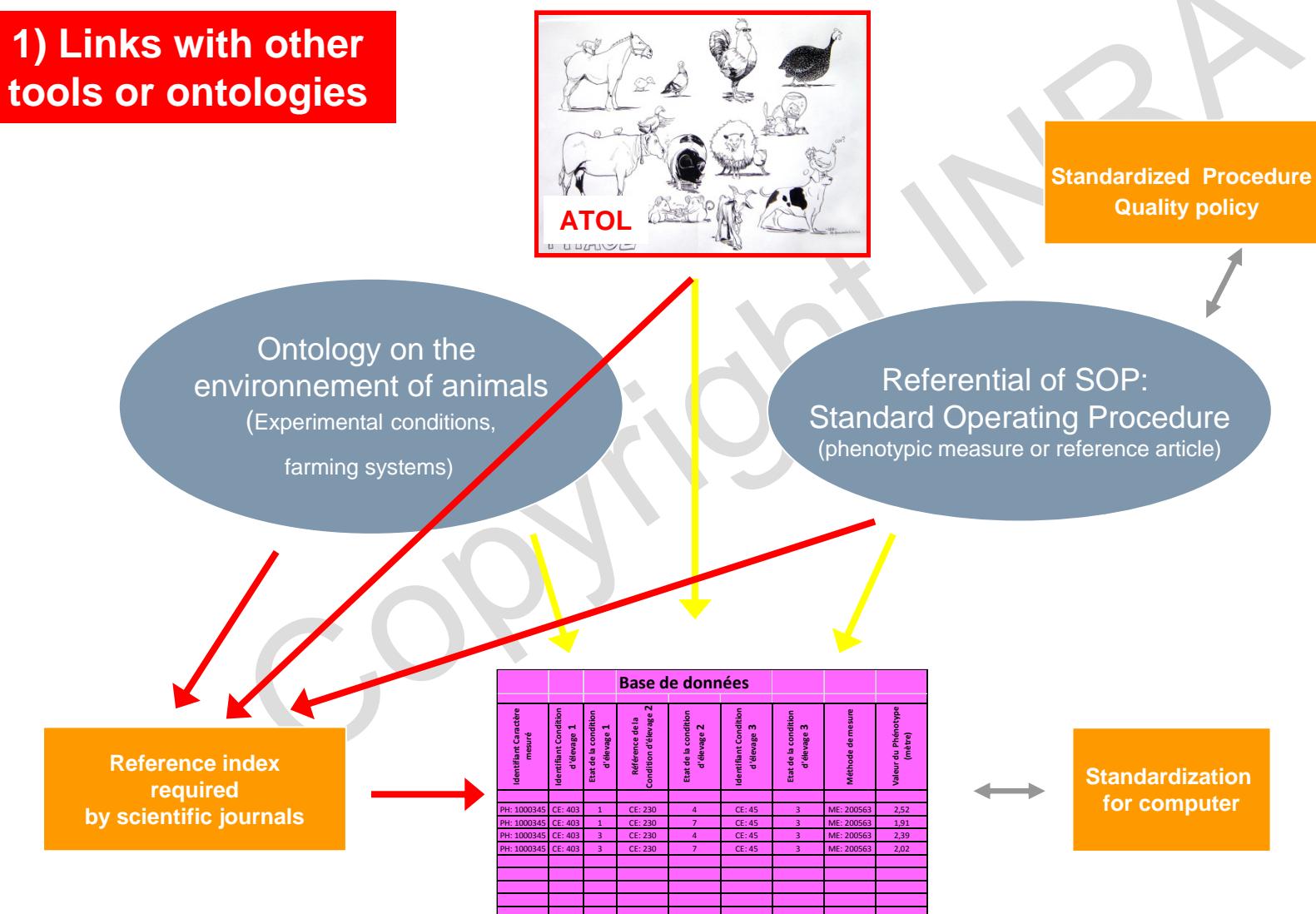


improvement : new traits, definition, validation by species, relationships

ATOL : perspectives



1) Links with other tools or ontologies



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ICAR June 22-23 Bourg-en-Bresse, France

ATOL : perspectives



1) Links with other tools or ontologies



Ontology on the environnement of animals

On going on fish in European project Aquaexcel

Reference index required by scientific journals

Standardization for computer

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ICAR June 22-23 Bourg-en-Bresse, France

ATOL : perspectives



1) Links with other tools or ontologies



Standardized Procedure Quality policy

Referential of SOP: Standard Operating Procedure (phenotypic measure or reference article)

Reference index required by scientific journals

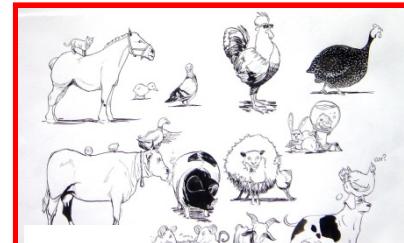
Standardization for computer

Database on methods : first draft



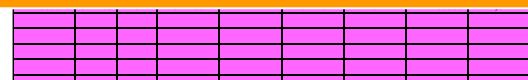
A	B	C	D	E	F	G	H	I
1	PHASE			Recensements des données par la Cellule Qualité du département PHASE				
Base de Données des Modes Opératoires techniques								
Unit	Species	Method	Biologic substrate	Procedure	Contact person	Publication		
17	GPL	lapin, souris	observation	glande mammaire	whole Mount - Montage in toto	M. Charlier (madi.charlier@jouy.inra.fr), C. Hue-Beauva	NON	
18	NUAGE	Poisson	dosage	aliment - matière première	glucose	Détermination de l'amidon	breque@st-pee.inra.fr	oui
19	NUAGE	Poisson	dosage	féces	Cr203	Détermination de l'oxyde de chrome	breque@st-pee.inra.fr	oui
20	NUAGE	Poisson	dosage	aliment-matière première-poisson-féces	matière sèche	Détermination de la matière sèche - microscopie par étuve	Marie-Josée.Borthaire@st-pee.inra.fr	oui
21	NUAGE	Poisson	dosage	muscle	amino	Détermination de la teneur en acides aminés libres - Chromatographie « phases inverses »	breque@st-pee.inra.fr	oui
22	NUAGE	Poisson	dosage	plasma	acide aminé	Détermination de la teneur en acides aminés libres dans le plasma	breque@st-pee.inra.fr	oui
23	NUAGE	Poisson	dosage	aliment-matière première	acide aminé	Détermination de la teneur en acides aminés - Hydrolyse en phase liquide	breque@st-pee.inra.fr	oui
24	NUAGE	Poisson	dosage	aliment-matière première-tissus	acide aminé	Détermination de la teneur en acides aminés libres - Séparation par chromatographie liquide d'acides aminés (HPLC)	breque@st-pee.inra.fr	oui
25	NUAGE	Poisson	dosage	plasma	acide aminé	Détermination de la teneur en acides aminés libres totaux - Spectrophotométrie par absorption	breque@st-pee.inra.fr	oui
26	NUAGE	Poisson	dosage	aliment-matière première-poisson-féces	énergie	Détermination de l'énergie brute	Marie-Josée.Borthaire@st-pee.inra.fr	oui
27	NUAGE	Poisson	dosage	aliment-matière première-tissu-féces		Détermination de l'indice de peroxyde - Méthode au thiocyanate de fer	stephanie.fontagne@st-pee.inra.fr	oui
28	NUAGE	Poisson	dosage	aliment-matière première-poisson-féces		Détermination des cendres brutes	Marie-Josée.Borthaire@st-pee.inra.fr	oui
29	NUAGE	Poisson	dosage	aliment-matière première	lipide	Détermination des lipides (Soxtherm)	larroquet@st-pee.inra.fr	oui
30	NUAGE	Poisson	dosage	muscle	lipide	Détermination des Lipides selon la méthode de Folch	larroquet@st-pee.inra.fr	oui
31	NUAGE	Poisson	dosage	aliment-matière première-poisson-féces	azote	Détermination des protéines (azote total)	Marie-Josée.Borthaire@st-pee.inra.fr	oui
32	NUAGE	Poisson	dosage	plasma		Détermination des protéines par la méthode de Bradford	Christiane.Vachot@st-pee.inra.fr	oui
33	NUAGE	Poisson	dosage	aliment-matière première-poisson-féces	phosphore	Détermination du phosphore total	breque@st-pee.inra.fr	oui
34	NUAGE	Poisson	dosage	œufs-larves	azote	Dosage de l'azote ammoniacal et de l'azote urique dans les œufs et larves	Christiane.Vachot@st-pee.inra.fr	oui
35	NUAGE	Poisson	extraction	foie	ARN	Extraction d'ARN totaux du foie de poissons	Elisabeth.Plagne-Juan@st-pee.inra.fr	oui
36	NUAGE	Poisson	traitement échantillon	muscle-féces		Lipophilisation	Marie-Josée.Borthaire@st-pee.inra.fr	oui
37	NUAGE	Poisson	dosage	foie		Mesure de l'activité de l'uricase dans le foie (1.7.3.3)	Christiane.Vachot@st-pee.inra.fr	oui
38	NUAGE	Poisson	dosage	foie	NAD	Mesure de l'activité de la Glucose-6 Phosphatase (3.1.3.9)	Christiane.Vachot@st-pee.inra.fr	oui
39	NUAGE	Poisson	dosage	foie	NADH	Mesure de l'activité de la glutamate déshydrogénase (GDH) (1.4.1.2.)	Christiane.Vachot@st-pee.inra.fr	oui
40	NUAGE	Poisson	dosage	foie	NAD	Mesure de l'activité de la Phosphoenol Pyruvate Carboxykinase dans le foie	Christiane.Vachot@st-pee.inra.fr	oui
41	NUAGE	Poisson	dosage	foie	NAD	Mesure de l'activité de la pyruvate kinase dans le foie (PK 1.2.4.1)	Christiane.Vachot@st-pee.inra.fr	oui
42	NUAGE	Poisson	dosage	foie	NADPH	Mesure de l'activité de l'hexokinase (2.7.1.1) et de la glucokinase (2.7.1.2)	Christiane.Vachot@st-pee.inra.fr	oui
43	NUAGE	Poisson	dosage	aliment-matière première-muscle	acide gras	Séparation des acides gras par chromatographie en phase gazeuse (CPG)	larroquet@st-pee.inra.fr	oui
44	NUAGE	Poisson	dosage	muscle	lipide	Séparation des lipides neutres et polaires sur mini colonne de silice	larroquet@st-pee.inra.fr	oui
45	PAIB	toutes espèce	technique	tous	peptides	Dessalage des protéines et peptides par Zip Tip® C4 ou C18	V. Labas	non
46	PAIB	toutes espèce	technique	tous	peptides	Digestion des protéines en gel	V. Labas	non
47	PAIB	toutes espèce	technique	tous	peptides	Digestion des protéines standard en solution	V. Labas	non
48	PAIB	toutes espèce	technique	tous	peptides	Enrichissement des phosphopeptides	V. Labas	non

1) Links with other tools or ontologies



Standardized Procedure
Quality policy

Reference index
required
by scientific journals

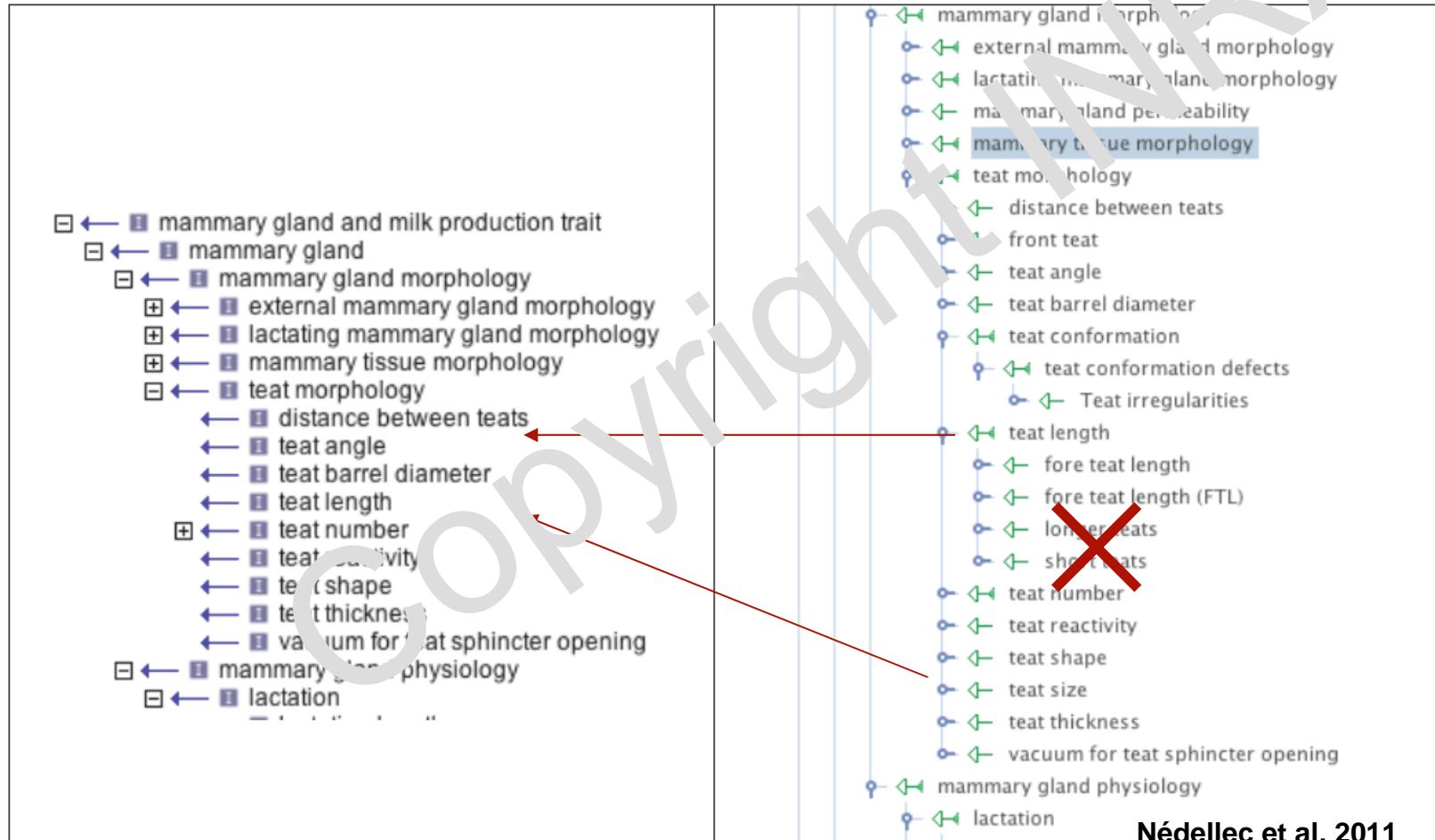


Work between experts from ATOL and experts of semantic research

Addition of new traits

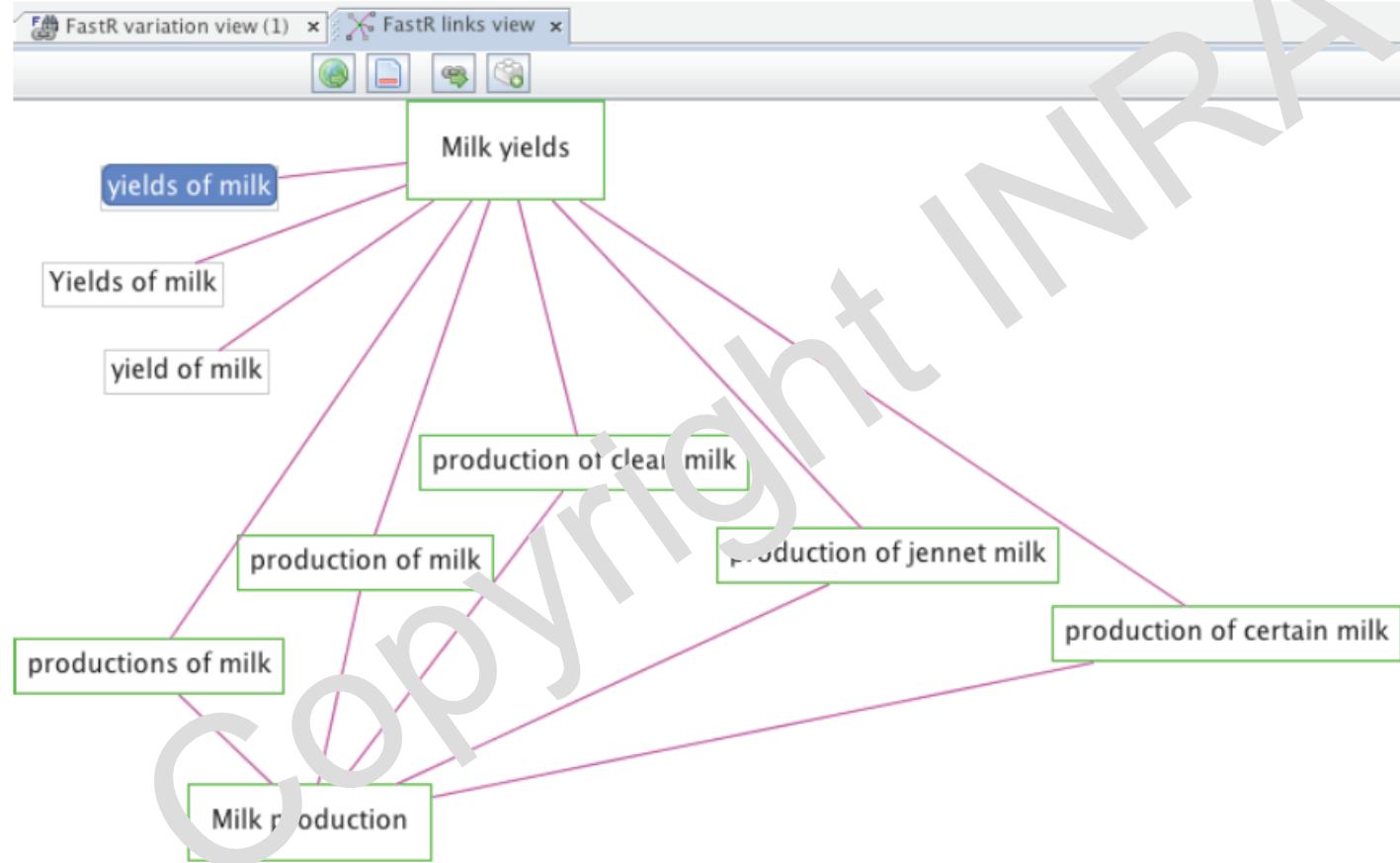


ATOL 2.3



Work between experts from ATOL and experts of semantic research

Addition of synonyms



Nédellec et al, 2011

Conclusion



All species

New traits

Ontology Tree Editor

- Classes
 - trait
 - + ↪ I animal environment trait
 - + ↪ I animal trait
 - + ↪ I adaptation and welfare trait
 - + ↪ I growth and meat production trait
 - + ↪ I mammary gland and milk production trait
 - + ↪ I nutrition and feed efficiency
 - + ↪ I reproductive system
 - + ↪ I Egg quality

Relations

Improvement

Egg quality

ATOL : Thanks for your attention

