Poultry biodiversity preservation strategies in France

Daniel Guémené and collaborators

Syndicat des Sélectionneurs Avicoles et Aquacoles Français

Institut National de la Recherche Agronomique

Biodiversity : A definition

Biological diversity or biodiversity is the term given to the **variety within** and **between species** and the ecosystems within which they live and interact.

Genetic diversity refers to the **variety of genes within a species**. Within a species there may also be discrete populations with distinctive genes.

To conserve the genetic diversity within a species, different populations must be conserved.

Poultry biodiversity in France : What are we talking about ?

Poultry biodiversity:

- 10 Avian species being raised and the object of genetic selection programs in France.
- 130 poultry populations of 9 avian species taken in charge by SYSAAF in 2014.

Poultry biodiversity within species:

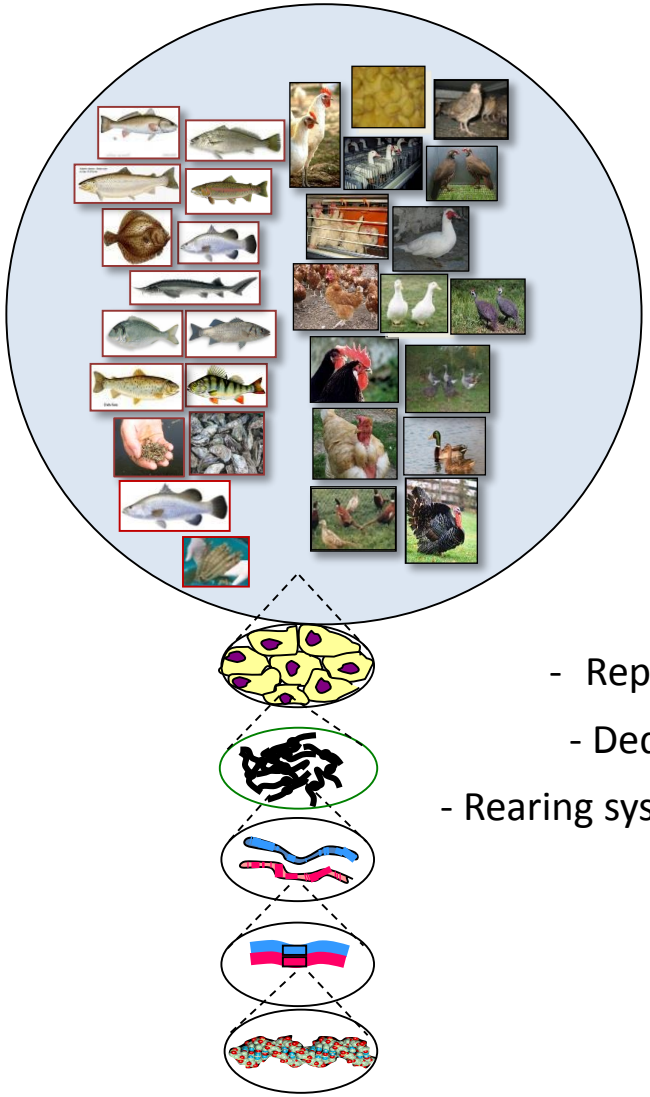
- Commercial lines: Pure lines & strains (intercross),
- Local pure breeds,
- Experimental lines (INRA - over 50 populations):
  - Divergent lines (Gallus, quails),
  - gene pool reservoir (genes of interest).

To conserve the genetic diversity within a species, different populations must be conserved.

SYSAAF's assignements: Technical support for the implementation of genetic programs

Providing technical expertise to poultry and aquacole breeding companies:

by delegation of ITAVI, for a specific list of species validated by the CNAG (National commission for genetic improvement).



➢ **Support for the implementation of dedicated genetic programs :**

- Design of breeding programs and broodstock genetic management,
- Data storage and genetic data treatment ("Herdbook"),
- Breeder choice for the next generation (n+1),
- Mating shame proposals in order to minimize inbreeding,

➢ **Support through secondary technical services :**

- DNA parental assignment,
- Dedicated analysis (Modelisation, simulation, etc…),
- Reproductive biotechnologies (Cryopreservation, Monosexing, sterilisation),
- Dedicated R & D programs to set-up technical Innovative strategies or tools,
- Rearing system, management and sanitary status of GP stocks audits (Label Rouge),
- Access to technical plateforms *[cryobank, genotyping, ploidie control]*,
- Litterature survey.

SYSAAF

SYSAAF : Technical support for the implementation of dedicated genetic programs

“Breeding sites”
Rearing
Pedigree reproduction
Incubation & hatching
Data collection
Data transfer

Internet
network

Central SYSAAF Database
(Data storage)

Internet
or
Local network

SYSAAF
[Treatment chain]
(Koala & OptivarPack)

Data treatment
Breeder choices
Mating shame
Genetic diversity

Syndicat des Sélectionneurs Avicoles et Aquacoles Français

Institut National de la Recherche Agronomique

Poultry biodiversity in France : What are we talking about ?

Poultry biodiversity:

- 10 Avian species being raised and the object of genetic selection programs in France.
- 130 poultry populations of 9 avian species taken in charge by SYSAAF in 2014.

Poultry biodiversity within species:

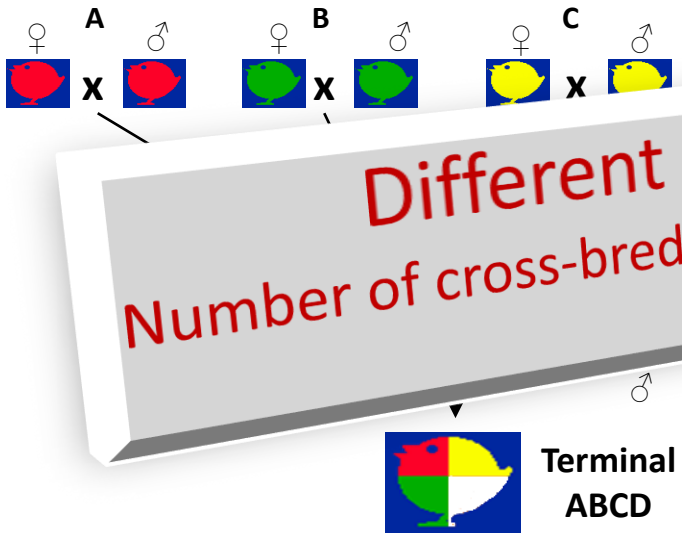
- Commercial lines: Pure lines & strains (intercross),
- Local pure breeds,
- Experimental lines (INRA - over 50 populations):
  - Divergent lines (Gallus, quails),
  - gene pool reservoir (genes of interest).

To conserve the genetic diversity within a species, different populations must be conserved.

Poultry biodiversity in France : What are we talking about ?

Commercial products: Pure lines & strains (intercross),

Poultry production scheme (4 line intercross)



Different strategies depending upon the markets

Number of cross-bred strains available on the field for Label Rouge productions:
40 broilers, 10 laying hens, 25 for the other poultry species.

- Over 100 commercial pure lines of 9 avian species taken in charge by SYSAAF in 2014.
- Plus over 60 commercial poultry pure lines.

- Worldwide production-markets.
- French specific markets:
  - Locally raised species,
  - Local production type (Label rouge),
  - Specific slow grow rate strains for organic production

SYSAAF : Technical support dedicated to Label Rouge"strains"

0980 0275 0275 0980 0367 0876 0367 0478 0569 0569 0785 0771 0178 0165 1277

Code of practice RefAvi® SYSAAF: "Mode de sélection des lignées et de production de reproducteurs parentaux avicoles". Reference 07-01 from the 01-02-2007 (38p) & its "Control notice". *Code of practice Label-Rouge (INAO) – Tripartite agreement "SYNALAF-OC-SYSAAF"*

Poultry biodiversity in France : What are we talking about ?

Local Breeds (pure)**:** Ornamental breeds not included,

- Local market,
- 47 Gallus, 63 Poultry breeds in total,

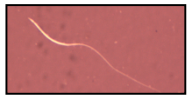
30 local poultry populations of 4 species taken in charge by SYSAAF in 2014.

Different strategies depending upon:

- Estimated risk of genetic losses,
- Depend upon population, size but also economic and social factors.

Ex situ vs. In situ

Poultry biodiversity conservation strategies in France





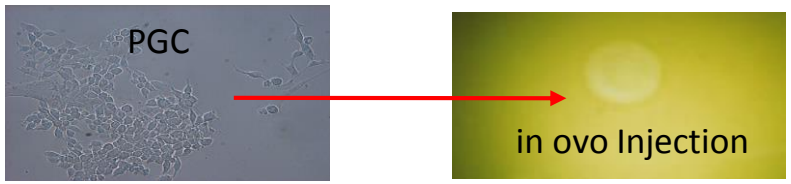

Ex situ vs *in situ* based:

Sperm cryopreservation: CRB-Anim program - Biological resource centre network
(French national poultry cryobanque)
- Local breeds, experimental lines & commercial pure lines.

Poultry Species	Breeds - Lines	Males	Straws
Gallus (Ind. Sperm)	36	641	29148
Gallus (Coll.)	4	32 (2x4x4) + 4	500
Total Gallus	40	677	29648
Common duck (Ind.)	5	155	1031
Muscovy duck (Ind.)	9	325	1164
Geese (Coll.)	1	17 Families	367
Guinea fowl (Coll.)	1	4 x 12	805
Nb species = 5	**56**	**1208**	**33015**

Biotechnology of reproduction: Research developments in process

- Sperm cryopreservation for turkey,
- IA for quails prior to sperm cryopreservation,
- Chimera production resulting from cryopreserved primordial germ cells.

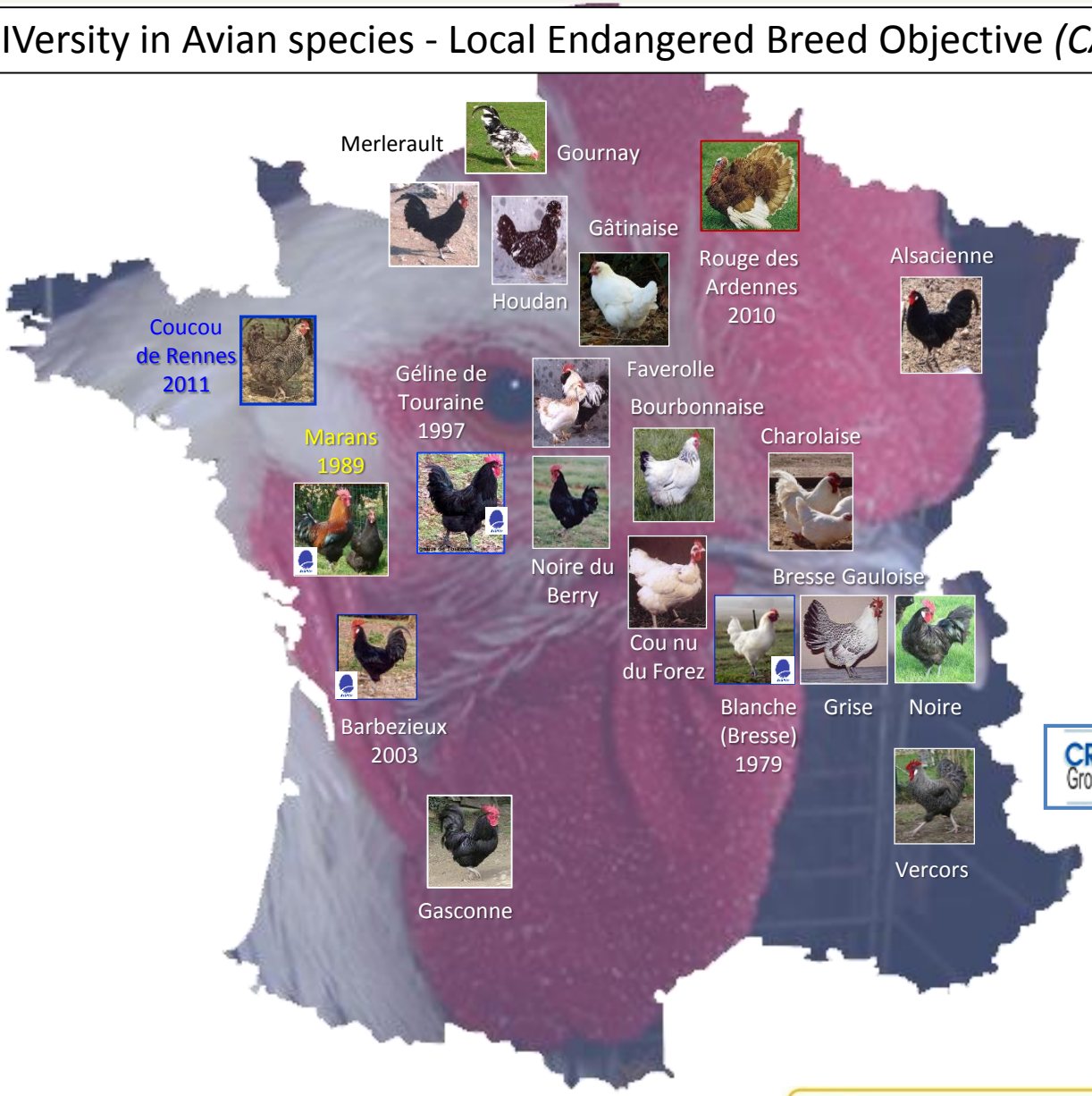







Poultry biodiversity conservation strategies in France

BioDivA : BIODIVersity in Avian species - Local Endangered Breed Objective *(CAS-DAR)*



ITAVI

Centre de Sélection de Béchanne

INRA SCIENCE & IMPACT

URLAF
Union des Races Locales Avicoles Françaises

CRYOBANQUE NATIONALE
Groupement d'Intérêt Scientifique

CRB ANIM

Syndicat des Sélectionneurs Avicoles et Aquacoles Français

Institut National de la Recherche Agronomique

BIODIVERSITE AVICOLE
Protection Races Menacées

SYSAAF

Poultry biodiversity conservation strategies in France

ValBioDi : Protective strategies to preserve endangered local poultry breeds.

- Pedigree population eliminated from the breeding site,
- Sperm cryopreservation,

- Settlement of a pedigree population in a breeding site,
- Sperm cryopreservation

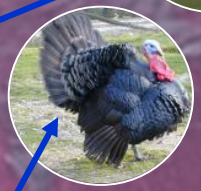
- Pedigree population raised in a breeding site,
- Sperm cryopreservation,
- Implicating farmers.

Géline de Touraine

Poule de Contres

Pintade Perle noire (Galor - Amboise)

Oie Blanche de Touraine



Dindon Noir de Sologne

Noire du Berry

Very limited remaining population
- Egg collection & incubation,
- Small population establishment,
- Sperm cryopreservation,
- Implication of new farmers.

- Pedigree population raised in a breeding site,
- Sperm cryopreservation,
- Implicating more farmers.

INRA SCIENCE & IMPACT

SYSAAF

BioDom Centre

URLAF
Union des Races Locales Avicoles Françaises

CRYOBANQUE NATIONALE
Groupement d'Intérêt Scientifique

Région Centre

SYSAAF

Syndicat des Sélectionneurs Avicoles et Aquacoles Français

Institut National de la Recherche Agronomique

Poultry biodiversity conservation strategies in France

BioDivA: BIODIVersity in Avian species - “Local Endangered Breed” Objective *(CAS-DAR)*

ValBioDi: Protective strategies to preserve endangered local poultry breeds.

CRB-Anim: Biological resource centre network.

Common objectives of these research programs:

- Successfully set-up in situ and/or ex situ conservation programs of local poultry breeds in France.

Different strategies:

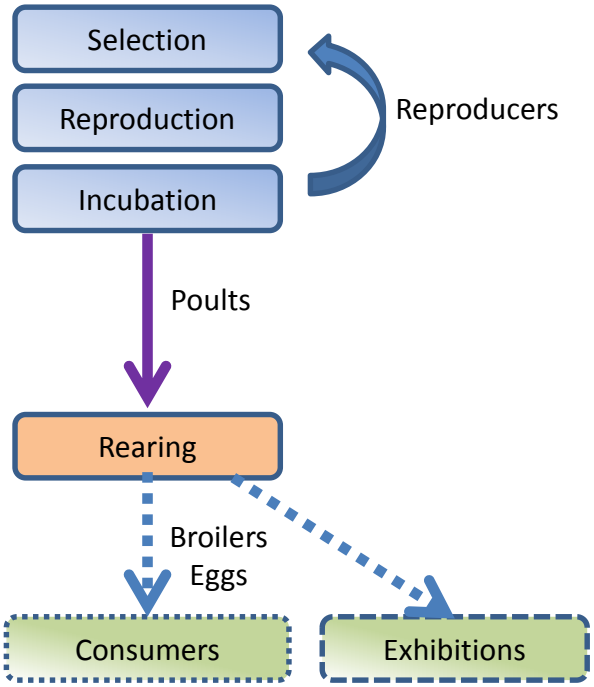
- *Characterisation of the breeding organisations for local breeds,*
- *Local breed phenotypic et genotypic characterisation,*
- *Setting in situ and/or ex situ conservation programs of local poultry breeds,*

- *How to access to financial supports for the local poultry endangered breeds, from the European Agricultural Fund for Rural Development (EAFRD) program within the Common Agricultural Policy (CAP) (2nd Pillar).*

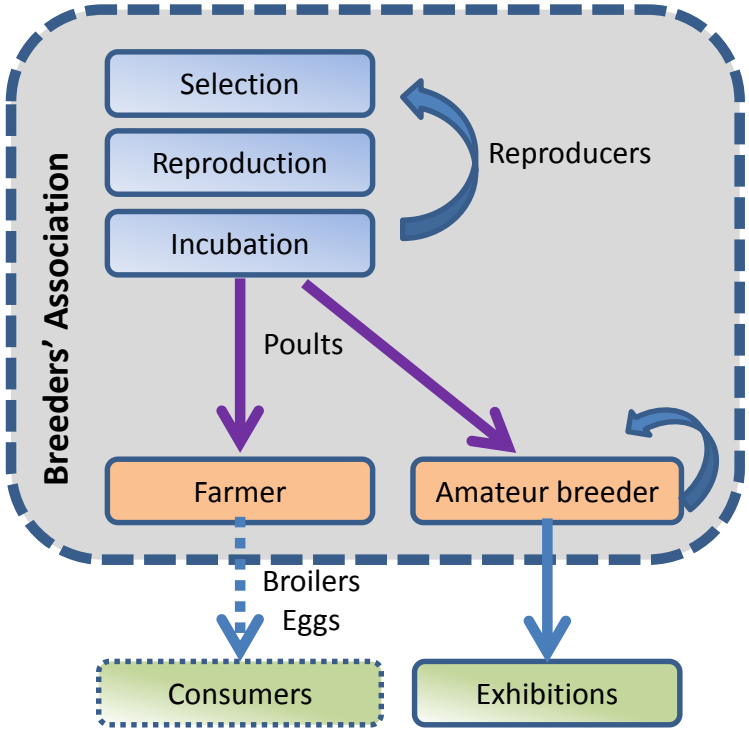
Poultry biodiversity conservation strategies in France

Characterisation of the breeding organisation

Individual initiative



Collective initiative (launching phase)

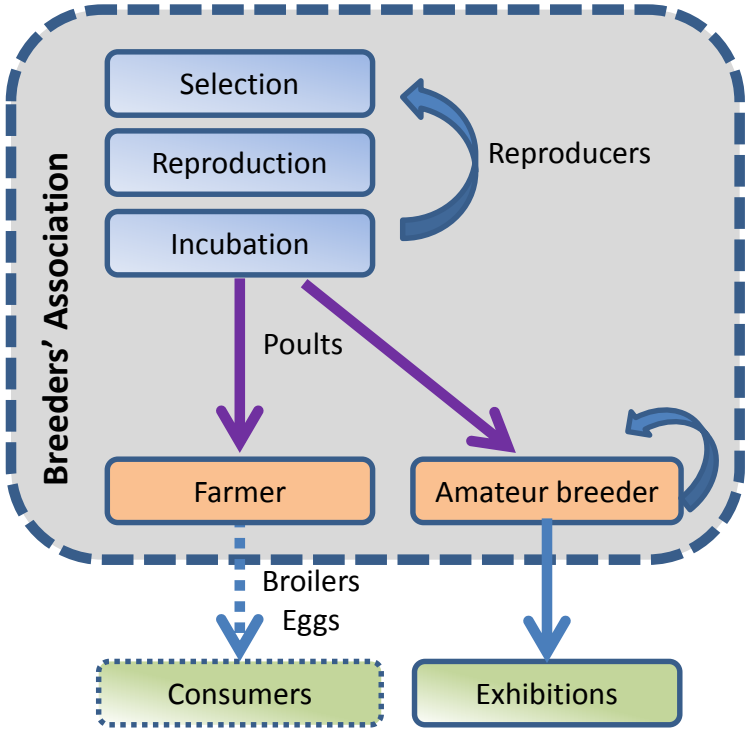


Local management by farmers (no pedigree)
Limited markets and direct sells

Poultry biodiversity conservation strategies in France

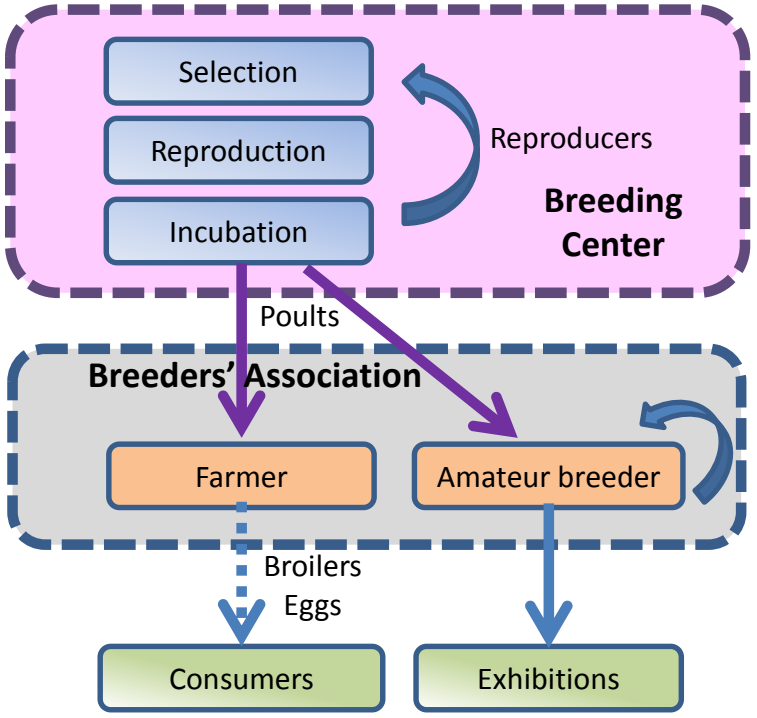
Characterisation of the breeding organisation

Collective initiative (launching stage)



Local management by farmers
(Semi-pedigree and/or park rotation)
Limited markets and direct sells

Collective initiative (Economic productive stage)



Centralized breeding flock management
(Pedigree - Data collection "Herdbook")
Larger markets and direct sells

SYSAAF : Technical support for the implementation of dedicated genetic programs

“Breeding sites”
Rearing
Pedigree reproduction
Incubation & hatching
Data collection
Data transfer

Internet
network

Central SYSAAF Database
(Data storage)

Internet
or
Local network

SYSAAF
[Treatment chain]
(Koala & OptivarPack)

Data treatment
Breeder choices
Mating shame
Genetic diversity

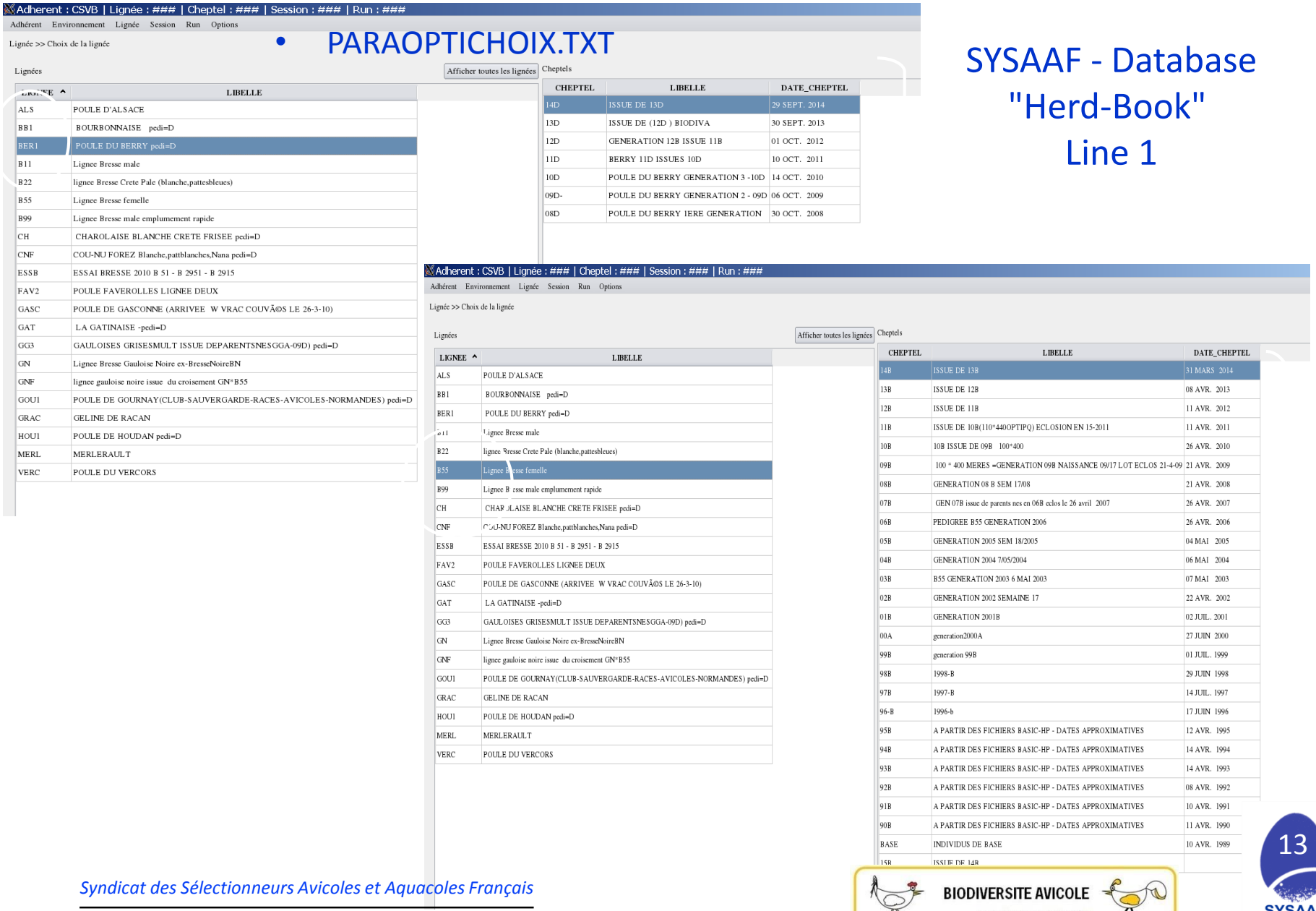
Syndicat des Sélectionneurs Avicoles et Aquacoles Français

Institut National de la Recherche Agronomique

Poultry biodiversity conservation strategies in France

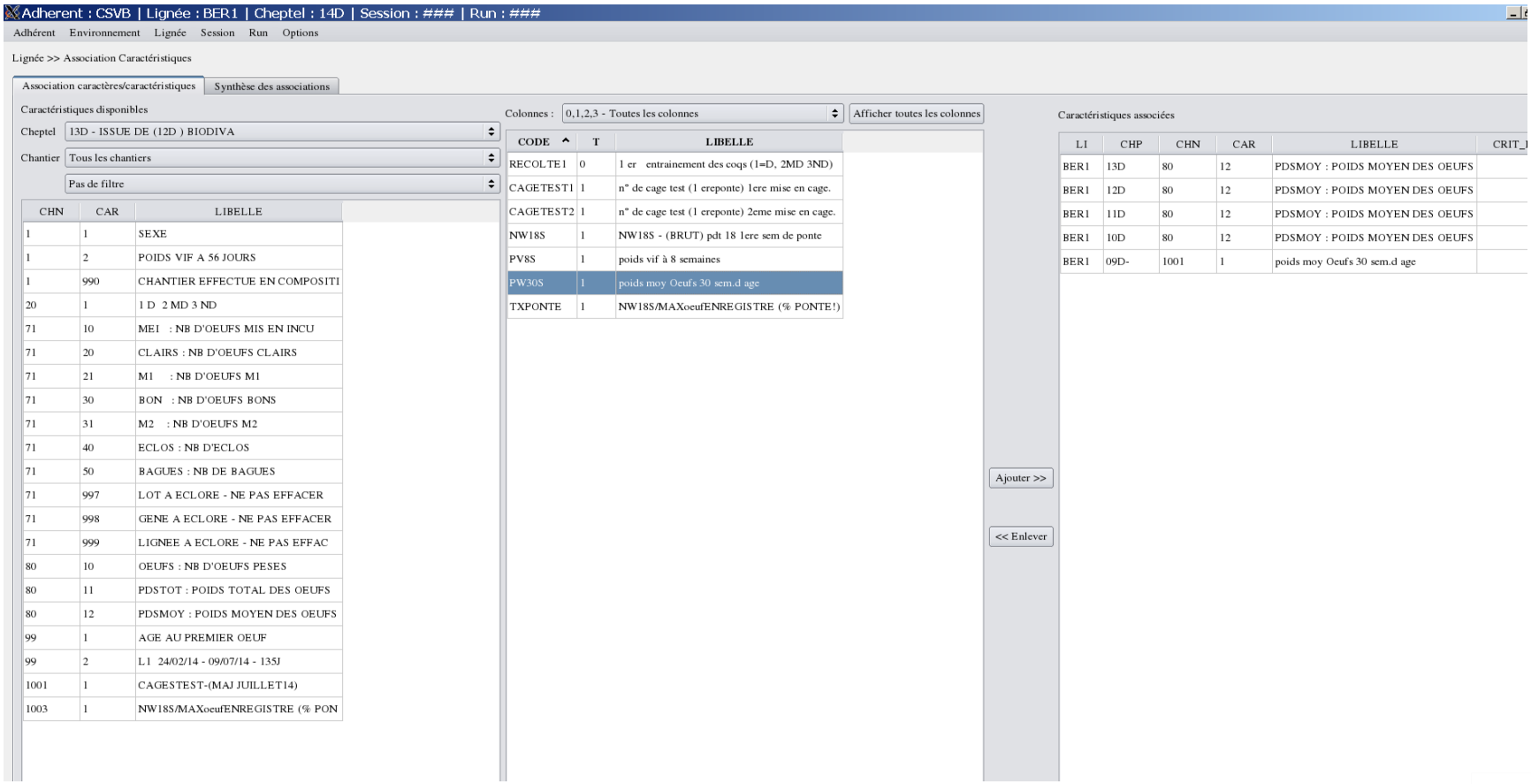
- PARAOPTICHOIX.TXT

SYSAAF - Database "Herd-Book" Line 1



SYSAAF - Database = "Herd-Book" : One flock (Generation) of Line 1

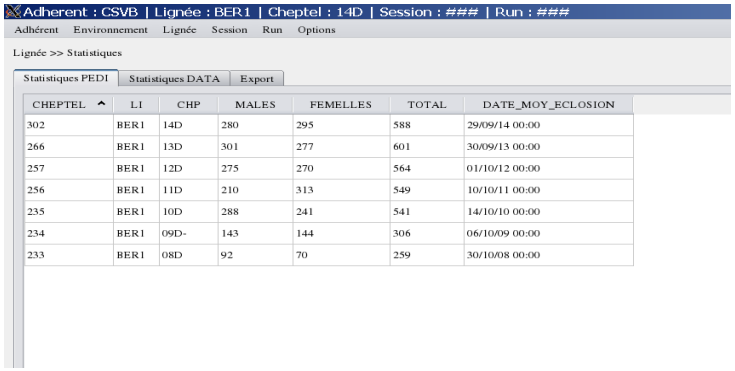
Registered characters



Poultry biodiversity conservation strategies in France

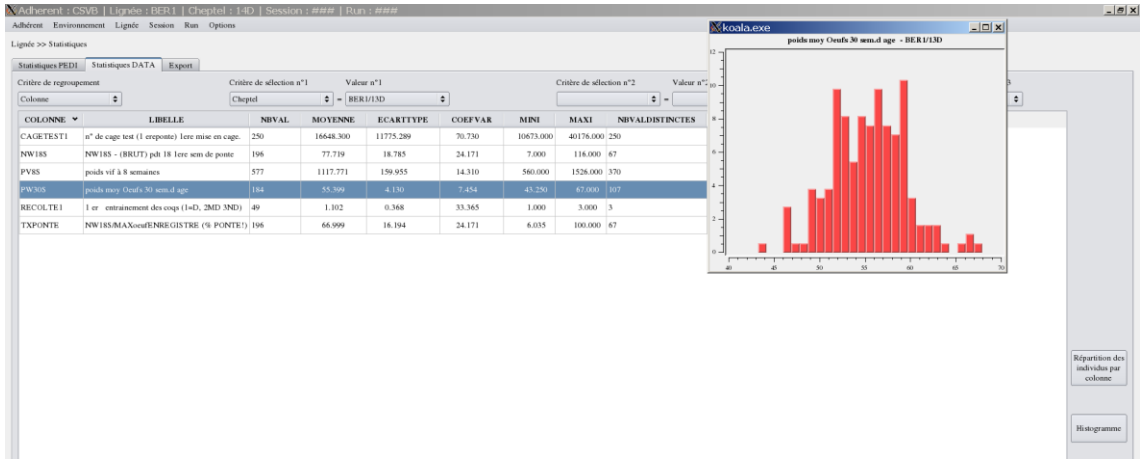
SYSAAF - Database = "Herd-Book" : Line 1

Pedigree statistics



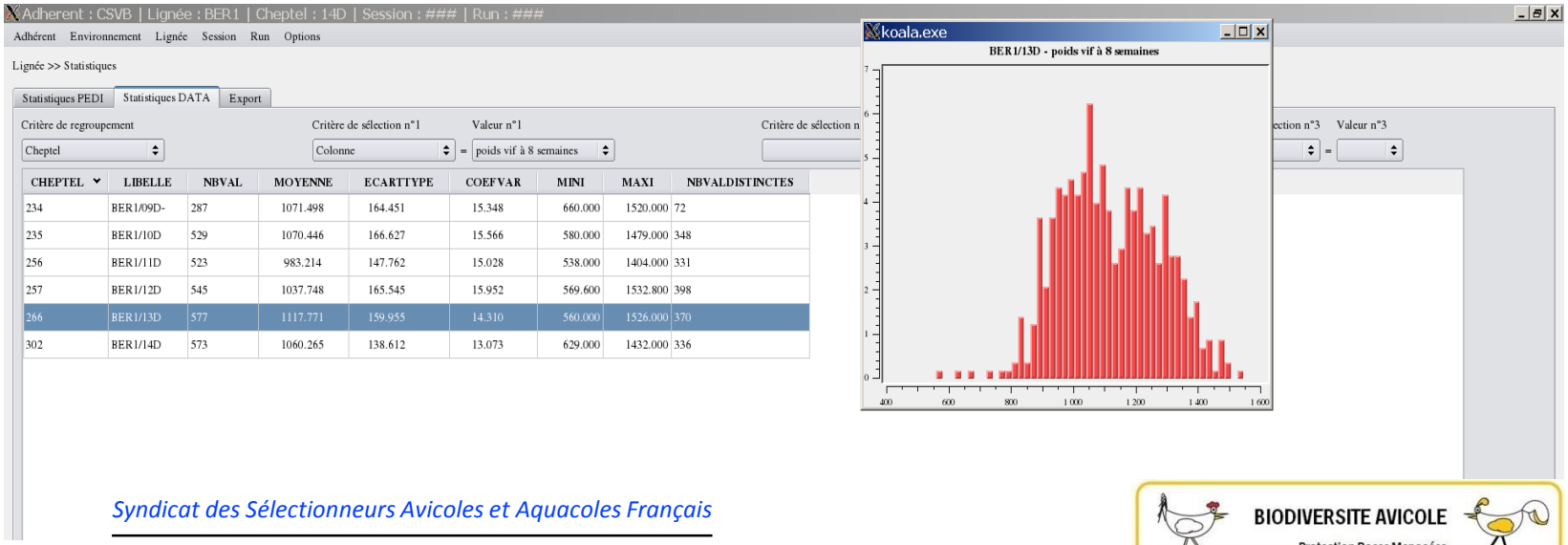
CHEPTEL	LI	CHP	MALES	FEMELLES	TOTAL	DATE_MOY_ECLOSION
302	BER1	14D	280	295	588	29/09/14 00:00
266	BER1	13D	301	277	601	30/09/13 00:00
257	BER1	12D	275	270	564	01/10/12 00:00
256	BER1	11D	210	313	549	10/10/11 00:00
235	BER1	10D	288	241	541	14/10/10 00:00
234	BER1	09D-	143	144	306	06/10/09 00:00
233	BER1	08D	92	70	259	30/10/08 00:00

Data' statistics of one flock (generation)



COLONNE	LIBELLE	NBVAL	MOYENNE	ECARTTYPE	COEFVAR	MINI	MAXI	NBVALDISTINCTES
CAGETEST1	n° de cage test (1 ereponte) 1ere mise en cage.	250	16648.300	11775.289	70.730	10673.000	40176.000	250
NW18S	NW18S - (BRUT) pdt 18 1ere sem de ponte	196	77.719	18.785	24.171	7.000	116.000	67
PV8S	poids vif à 8 semaines	577	1117.771	159.955	14.310	560.000	1528.000	370
PW30S	poids moy Oeufs 30 sem.d age	184	55.399	4.130	7.454	43.250	67.000	107
RECOLTE1	1 er entrainement des coqs (1=D, 2MD 3ND)	49	1.102	0.368	33.365	1.000	3.000	3
TXPONTE	NW18S/MAXoeufENREGISTRE (% PONTE!)	196	66.999	16.194	24.171	6.035	100.000	67

'Data' statistics of all flocks

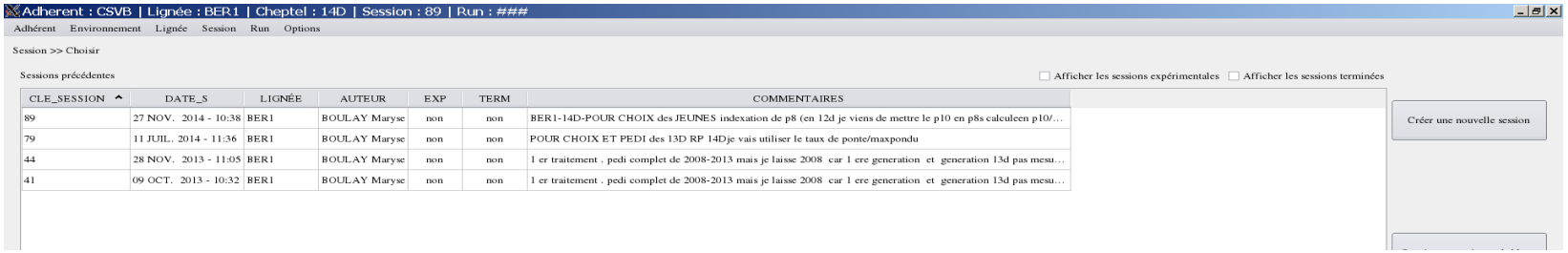


CHEPTEL	LIBELLE	NBVAL	MOYENNE	ECARTTYPE	COEFVAR	MINI	MAXI	NBVALDISTINCTES
234	BER1/09D-	287	1071.498	164.451	15.348	660.000	1520.000	72
235	BER1/10D	529	1070.446	166.627	15.566	580.000	1479.000	348
256	BER1/11D	523	983.214	147.762	15.028	538.000	1404.000	331
257	BER1/12D	545	1037.748	165.545	15.952	569.600	1532.800	398
266	BER1/13D	577	1117.771	159.955	14.310	560.000	1526.000	370
302	BER1/14D	573	1060.265	138.612	13.073	629.000	1432.000	336

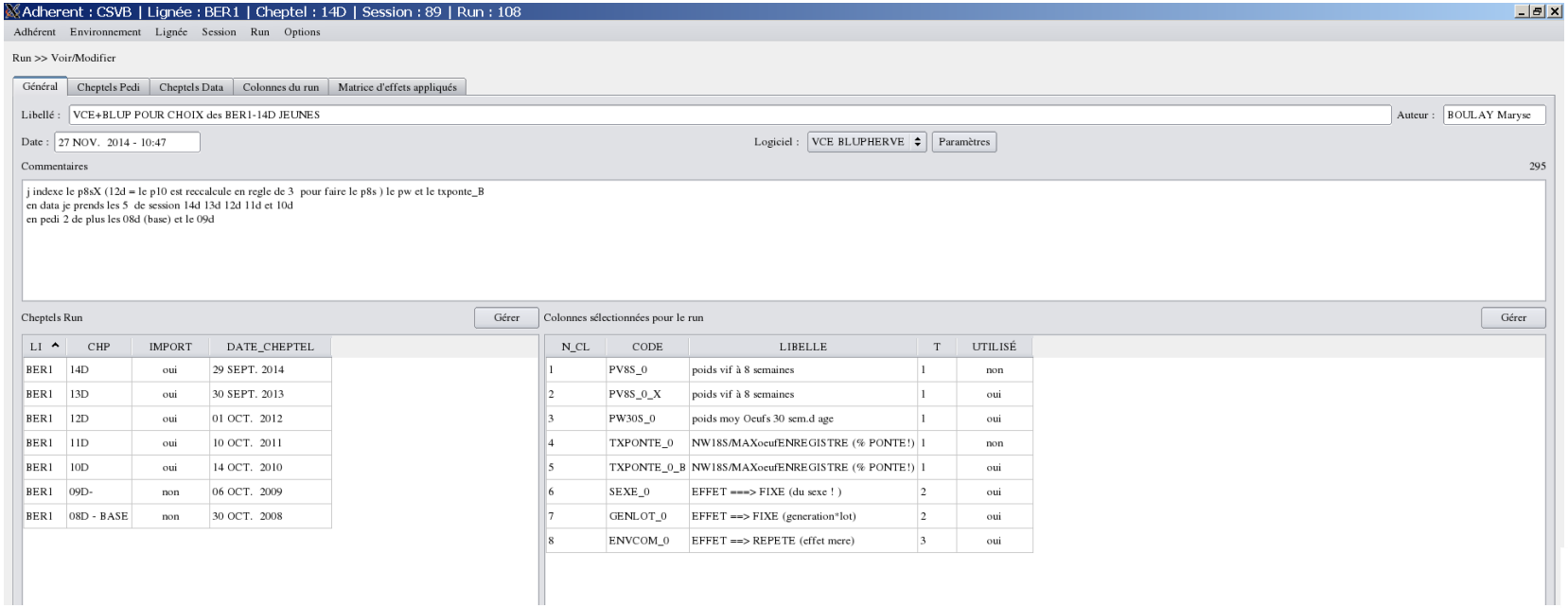
Poultry biodiversity conservation strategies in France

SYSAAF - Database = "Herd-Book" : Line 1

Session of data treament



Data treatment (h² Rg , VGs)



SYSAAF - Database = "Herd-Book" : Line 1

Results:

cheptels

GENERATION # 1	BER1.09D
GENERATION # 2	BER1.10D
GENERATION # 3	BER1.11D
GENERATION # 4	BER1.12D
GENERATION # 5	BER1.13D
GENERATION # 6	BER1.14D

The more recent generation is the flock : BER1.14D

Pedi:

2385	1468	1580	0	2	327704	5	BER1	13D
2386	1468	1580	0	0	327703	5	BER1	13D
2387	1468	1580	0	2	327702	5	BER1	13D
2388	1468	1580	0	1	327701	5	BER1	13D
2389	1456	1777	0	1	327168	5	BER1	13D
2390	1543	1694	0	2	327282	5	BER1	13D
3032	2114	2093	0	1	344690	6	BER1	14D
3033	2062	2272	0	2	344635	6	BER1	14D
3034	2016	1916	0	2	344570	6	BER1	14D
3035	2010	2274	0	2	344609	6	BER1	14D
3036	2078	2387	0	1	344455	6	BER1	14D
3037	1907	2400	0	1	344452	6	BER1	14D

Data (normalises)

0.224	-0.233	0.529	2	4	334	2385
0.742	0.555	-1.301	2	4	334	2387
0.278	99	99	1	4	334	2388
0.881	99	99	1	4	389	2389
0.334	-0.649	-2.601	2	4	367	2390
1.455	99	99	1	5	450	3032
0.784	99	99	2	5	499	3033
0.233	99	99	2	5	411	3034
0.53	99	99	2	5	500	3035
0.383	99	99	1	5	533	3036
1.53	99	99	1	5	416	3037

Genetic parameters

HERITABILITIES & GENETIQUES CORRELATIONS:

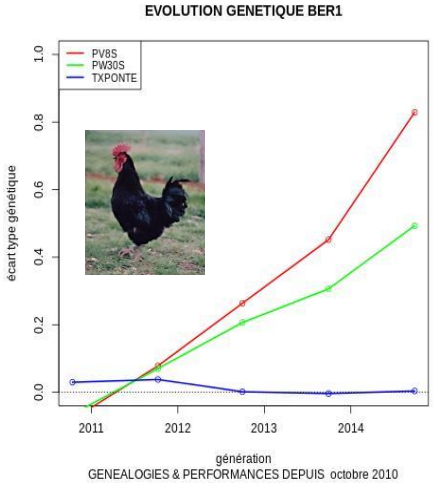
PV8S_X	PW30S	TXPONT_B
0.681	0.607	-0.315
0.607	0.775	-0.371
-0.315	-0.371	0.499

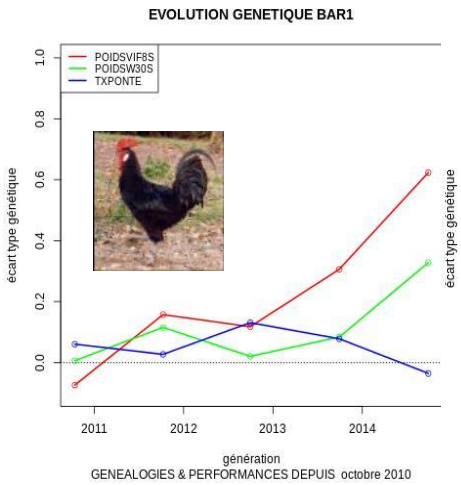
Individual genetic values

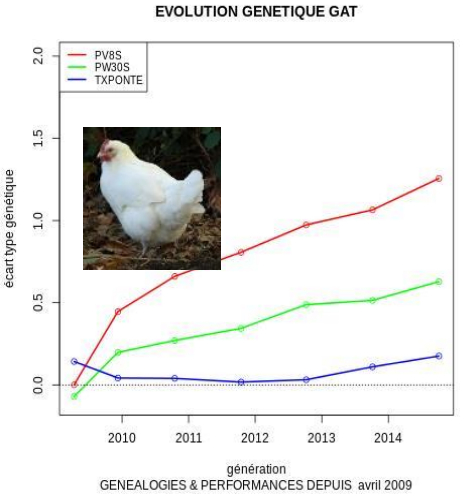
2385	327704	320461	320601	2	5	0.430011	0.151716	0.452191
2386	327703	320461	320601	0	5	0.529764	0.436895	0.141807
2387	327702	320461	320601	2	5	0.785461	0.806950	-0.503902
2388	327701	320461	320601	1	5	0.057024	0.149829	0.290505
2389	327168	320441	320805	1	5	0.432575	0.020623	0.347190
2390	327282	320536	320723	2	5	0.547868	0.131385	-1.115024
3032	344690	327267	327225	1	6	1.558315	0.621323	-0.394511
3033	344635	327721	327452	2	6	1.597199	1.251620	-0.066997
3034	344570	327449	327177	2	6	1.382719	0.983487	-0.211802
3035	344609	327413	327450	2	6	1.445060	0.680432	-0.329612
3036	344455	327190	327702	1	6	0.740070	0.692438	-0.304459
3037	344452	327159	327256	1	6	1.738041	1.660169	-0.958579

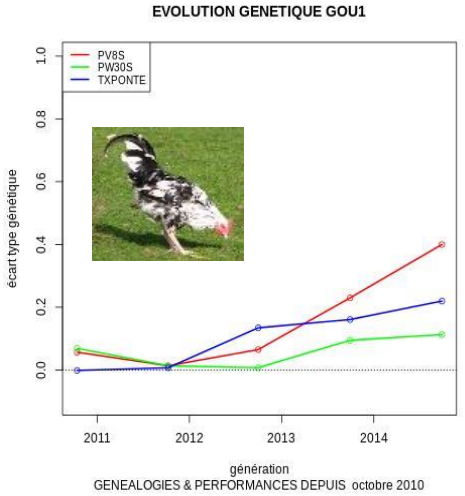
Poultry biodiversity conservation strategies in France

Genetic value evolution 2015

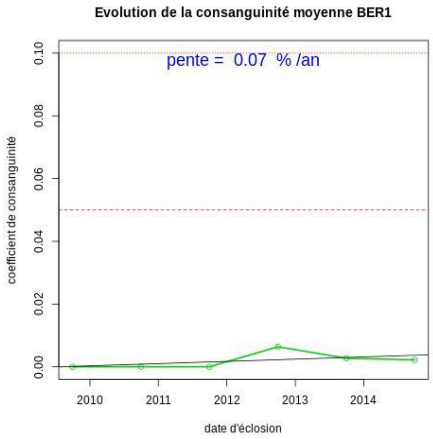


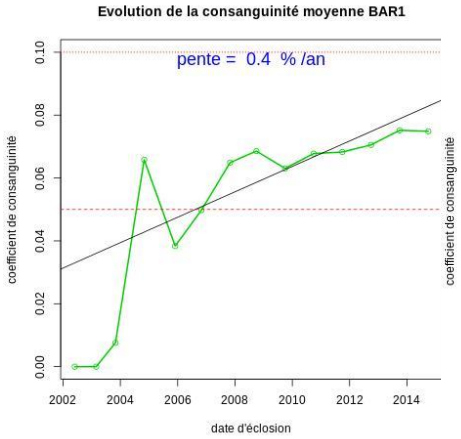


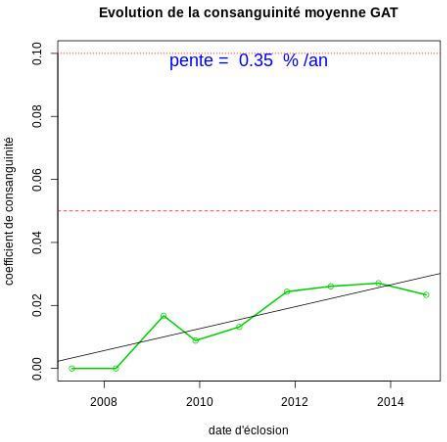


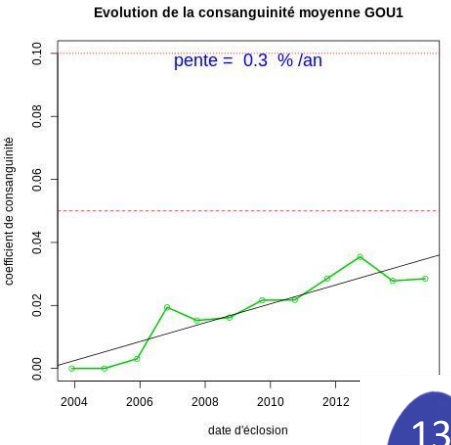


Consanguinity evolution









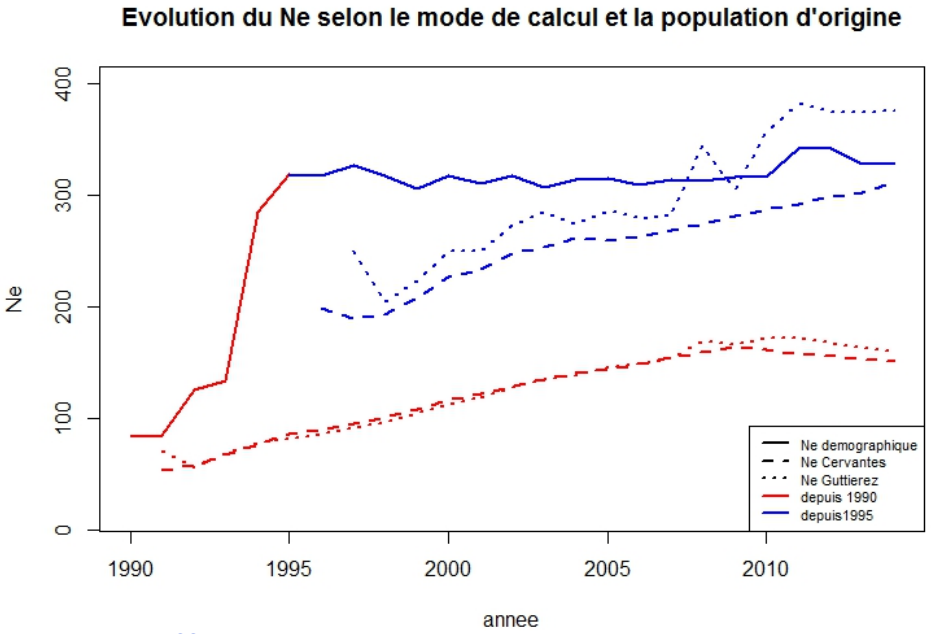
Syndicat des Sélectionneurs Avicoles et Aquacoles Français

Institut National de la Recherche Agronomique

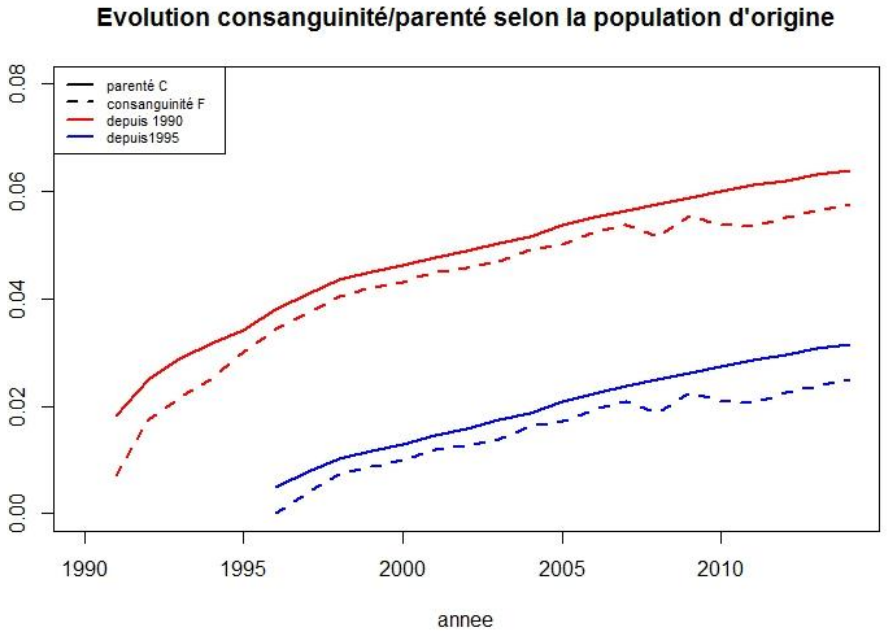
BIODIVERSITE AVICOLE
Protection Races Menacées

SYSAAF

Poultry biodiversity conservation strategies in France

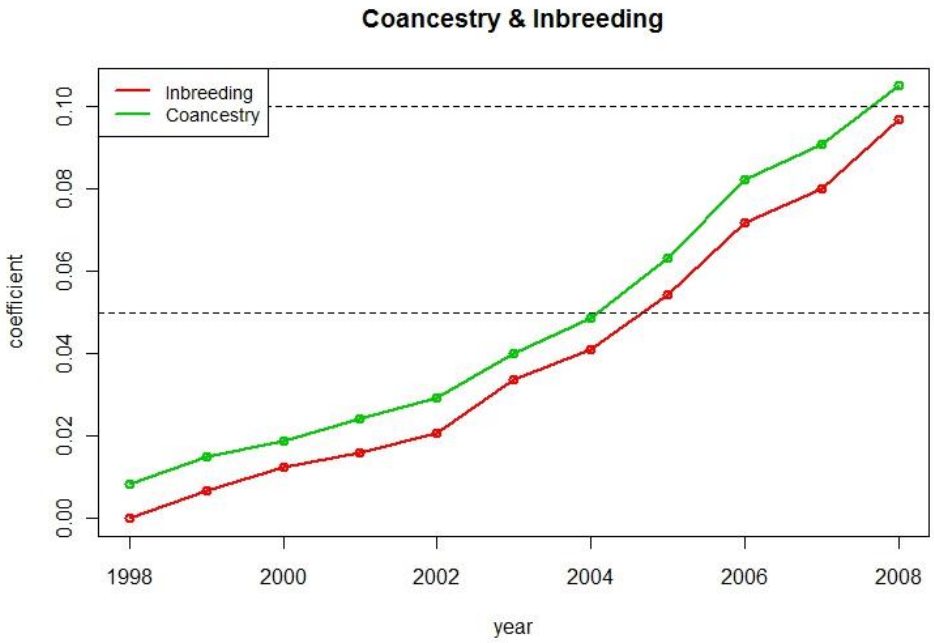


Effective population size depending on pedigree knowledge

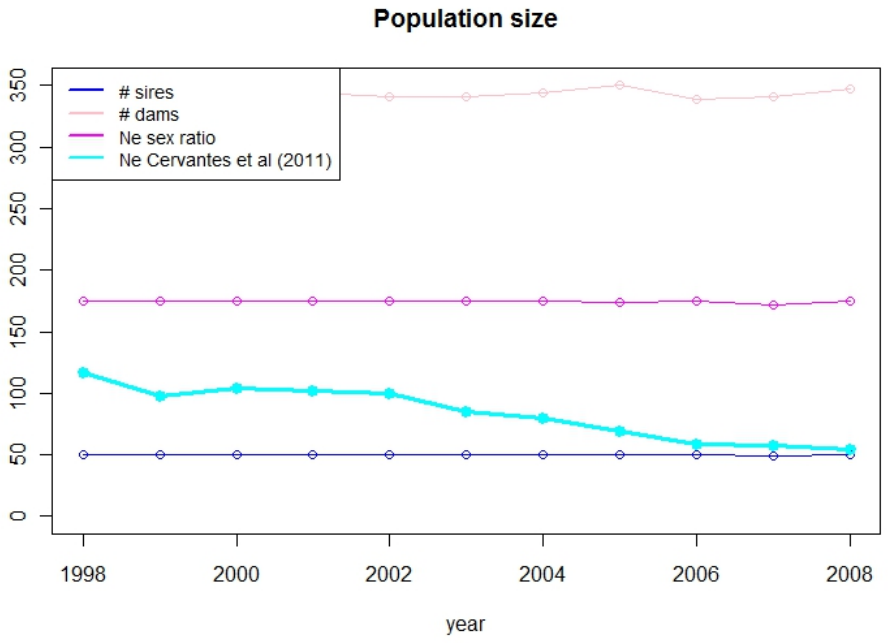


Consanguinity level vs Rate of increase
What's matter more?

Selected populations can be endangered through careless management…

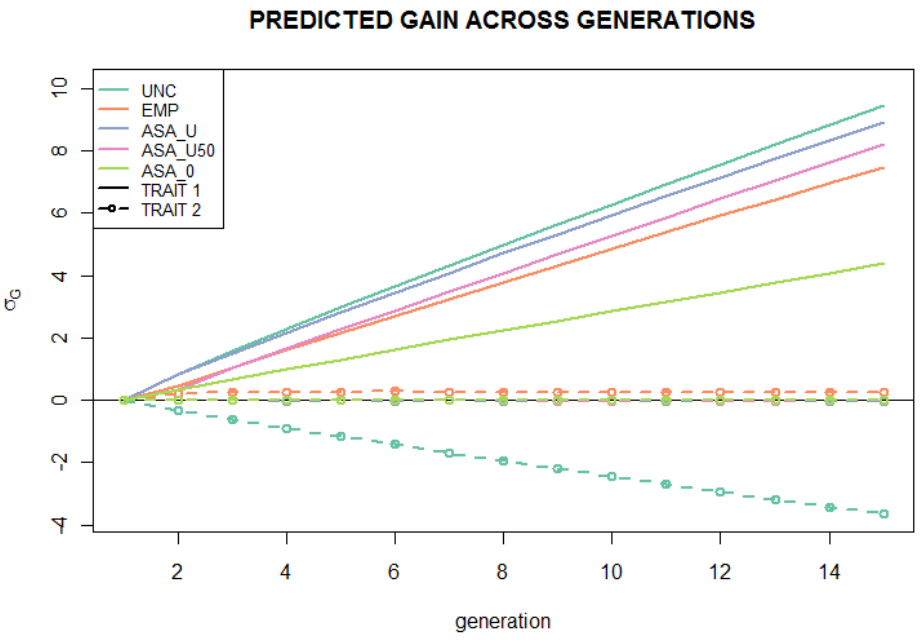


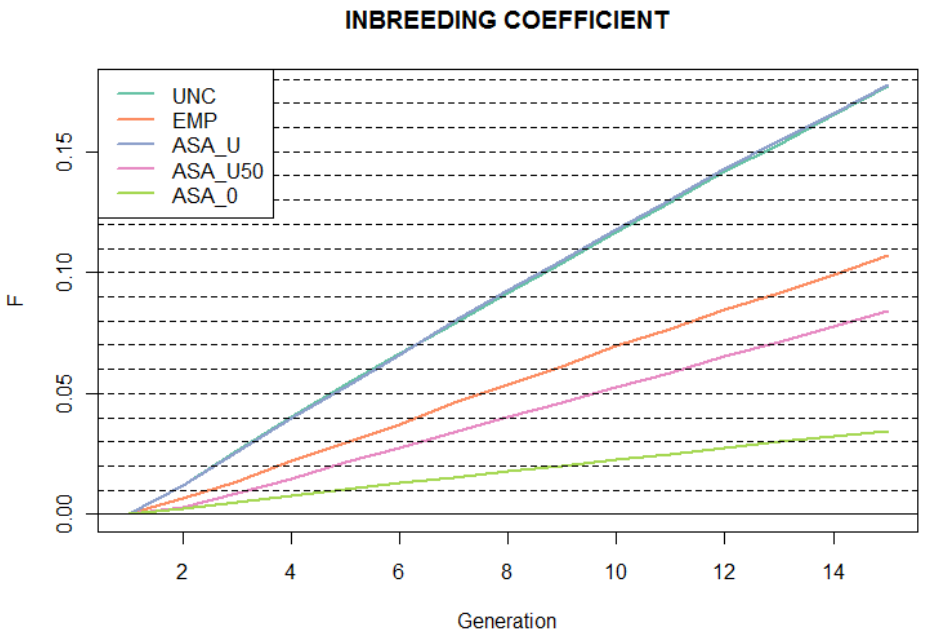
The inbreeding rate is 1% per year.



The effective population size decreases.

Poultry biodiversity conservation strategies in France





Some gain can be achieved, even with a conservative management of the coancestry.

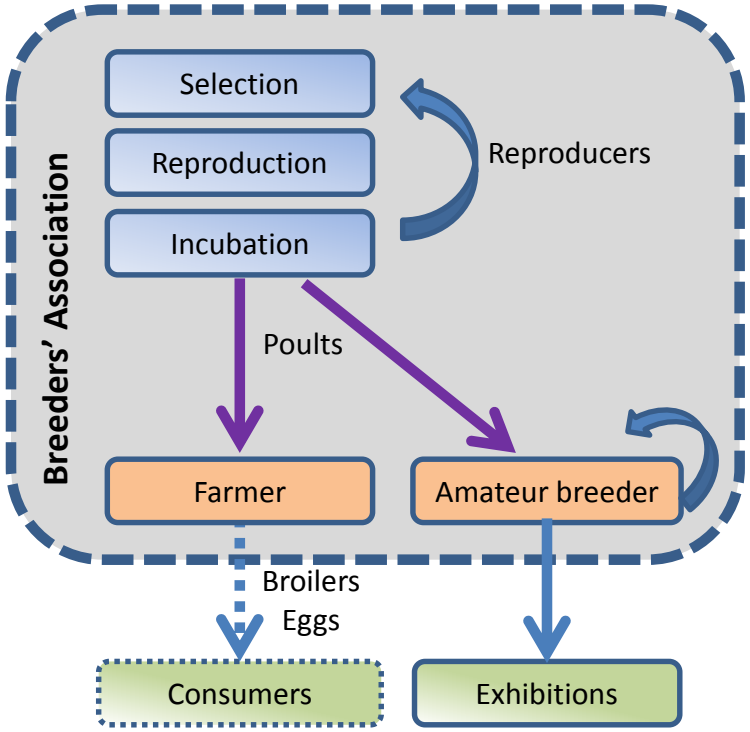
Some characters being antogonist (*e.g.* reproduction *vs.* growth)

As far as inbreeding is concerned, ASA_U50 outperforms EMP as well.

Poultry biodiversity conservation strategies in France

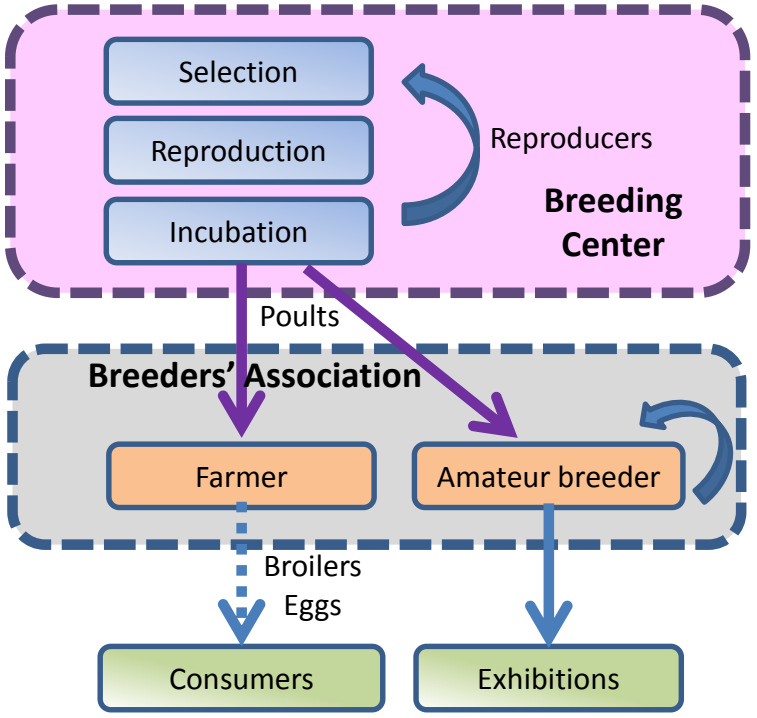
Characterisation of the breeding organisation

Collective initiative (launching stage)



Local management by farmers
(Semi-pedigree and/or park rotation)
Limited markets and direct sells

Collective initiative (Economic productive stage)



Centralized breeding flock management
(Pedigree - Data collection "Herdbook")
Larger markets and direct sells

EU's Rural development policy for the period 2014-2020

The 2013 reform leaves in place many of the key features of rural development policy from 2007-2013 known as the "second pillar" of the Common Agricultural Policy (CAP), such as a Financial support for the local endangered breeds.

In particular, as in the past, the policy will be implemented through **national and/or regional rural development programs (RDPs)** so called

European Agricultural Fund for Rural Development (EAFRD) instrument, established by Regulation (EC) 1290/2005).

Criteria for 2014-2020:

- A list of eligible local breeds at risk of being lost for agriculture should be established and notified to the EC,
- The number of breeding females for a specific breed should be known,
  - ✓ **These two criteria have to be attested for by a recognized scientific body.**

✓ **A recognized technical organism should register an keep up-to-date a herd-book.**

✓ **This recognized technical organism should provide proof that it has the necessary competences and knowledge to identifying the animals from the endangered breeds.**

A multi-indicator approach to assess the degree of endangerment of a local breed

Definition: "local breed" was in the sense of the French regulation (*Code Rural*, Article D-653-9): "*a breed mainly linked to a specific territory by its origins, its location or its use*"; "territory" meaning an area much smaller than the whole country.

A multi-indicator approach:

1 - Identification of the various causes of threat of abandonment,

2 - For each cause, define one of more indicators :

- That make sens in the context,
- Few and easy to inform,
- Not susceptible to generate pernicious effects,

3 - In order to combine these indicators of different nature, the observed values were converted into scores on a scale of **0 (no threat) to 5 (maximum threat)**, the way to convert depending on the indicator.

This method was applied on 178 French local breeds, from 10 different species: cattle, sheep, goats, pig, horses, donkeys, chicken, turkey, goose and common duck.

Gallus	Guinea fowl	Turkey	Geese	Common duck	Mucovy duck
47	0	3	9	4	0

A multi-indicator approach to assess the degree of endangerment of a local breed

(Verrier E. and RAMAGE consortium members, 2015)

The 6 indicators used to assess the degree of endangerment of a local breed:

1 - the current number of breeding females,

2 - the evolution of the number of breeding females during the last 5 years or generations, according to the species,

3 - the proportion of crossbreeding (Not appropriate for poultry species),

4 - the effective population size,

5 - the organization of breeders and the technical support,

6 - the socio-economic context.

- **Indicator 1** is the Main indicator : Note 1 to 5.

- **Indicators 2 to 6** are Modulatory or secondary indicators - The breed is considered as weakened if :

  - mean of the 5 notes > 2.5 or at least 2 notes ≥ 4

  If so, the thresholds were increase of 20%.

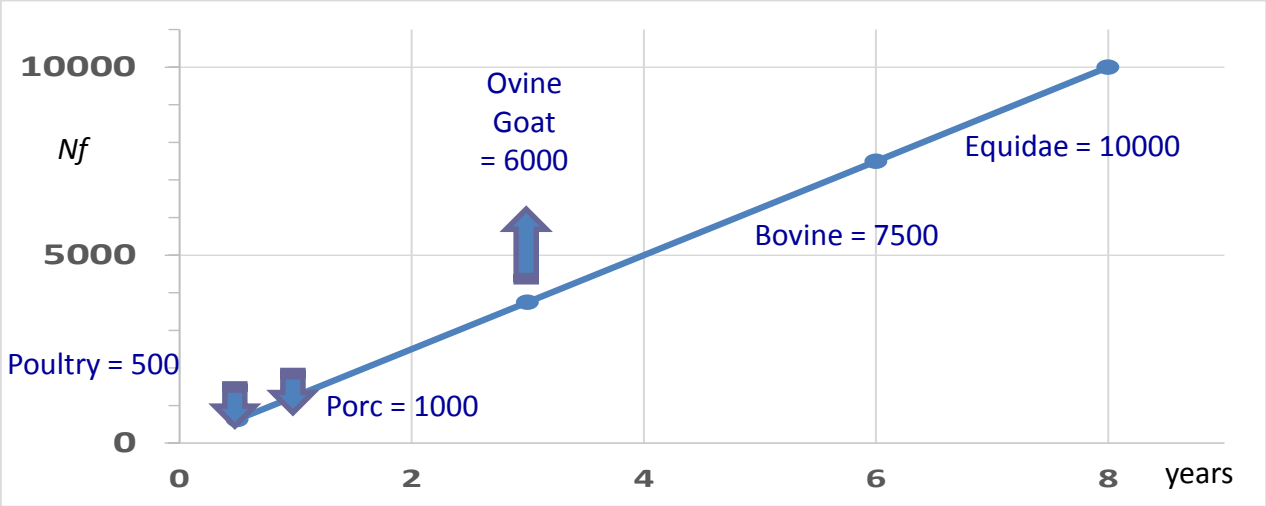
Poultry biodiversity conservation strategies in France

Rural development policy for the period 2007-2013 (2014) within the Common Agricultural Policy (CAP)

- Financial support for the local endangered breeds through the **European Agricultural Fund for Rural Development (EAFRD) instrument**, established by Regulation (EC) 1290/2005.

ANNEX IV

THRESHOLDS FOR ENDANGERED BREEDS (REFERRED TO IN ARTICLE 27(4))



COMMISSION REGULATION (EC) No 1974/2006 of 15 December 2006

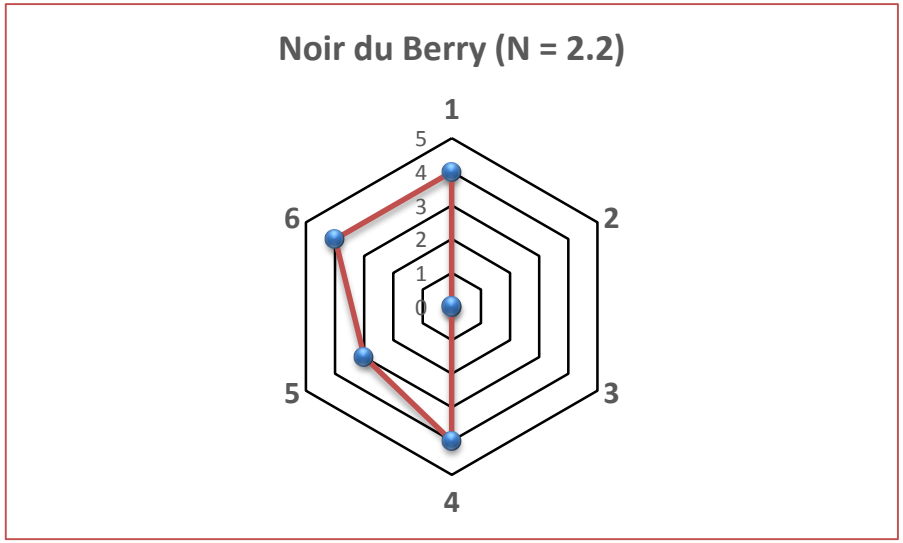
Logic = Rate of increase of the consanguinity

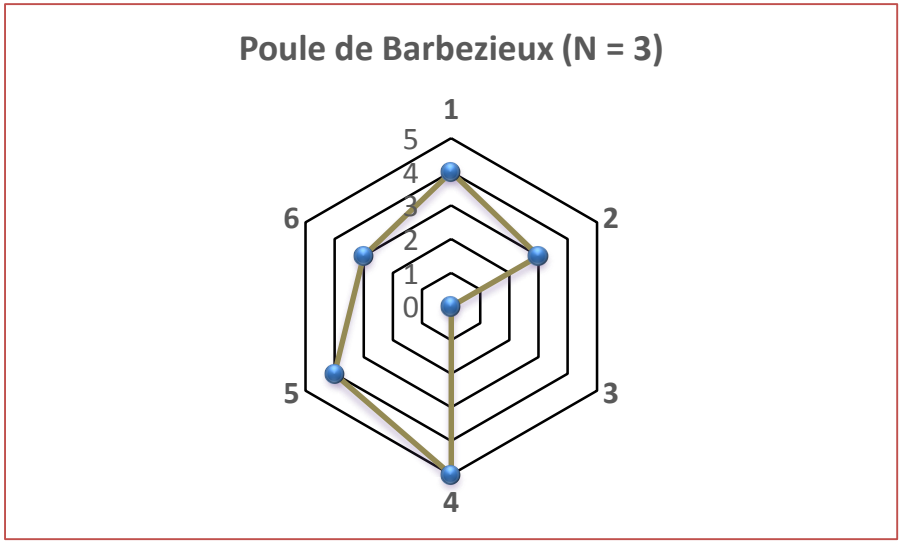
Demographic logic = The weaker is the capacity of demographic boost, the higher is the threshold of eligibility

Poultry = 500

ans

A multi-indicator approach to assess the degree of endangerment of a local breed





Indicators:

1 - Number of breeding females,

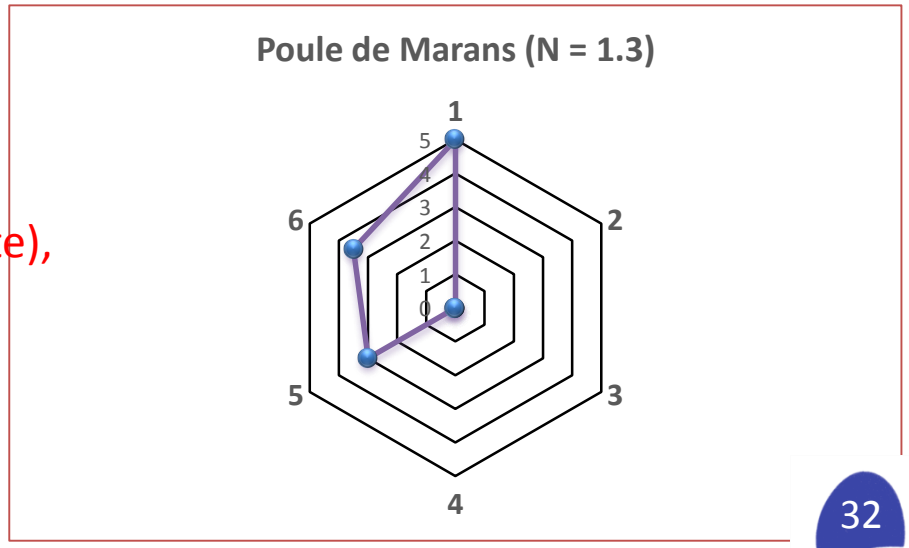
2 - Evolution of Nf (5 generations),

3 - Proportion of crossbreeding (Not appropriate),

4 - Effective population size,

5 - Organization and technical support,

6 - Socio-economic context.



EU's Rural development policy for the period 2014-2020

Financial support for the local endangered breeds.

To be implemented through **national and/or regional rural development programs (RDPs)** so called **European Agricultural Fund for Rural Development (EAFRD) instrument**, established by Regulation (EC) 1290/2005).

Not adequate for poultry species:

- To be paid to the farmers
- Limited amounts per bird (0.03 L.U./hen & 0.014 / others poultry
- Important additional cost for pedigree.

Activation of the delegated acts: (Proposal submitted to the commission)

- To be paid to the breeders' association,
- Fixed amount of money per breed (Corresponding to estimated additional cost),
- Commitments :
  - Commercialisation,
  - Pedigree knowledge (Herd-book),
  - Minimum number of males (20), females (100) and offspring (500) per generation,

Acknowledgment

Poultry biodiversity preservation strategies in France

Grazie per la vostra attenzione

Daniel Guémené and collaborators

Syndicat des Sélectionneurs Avicoles et Aquacoles Français

Institut National de la Recherche Agronomique