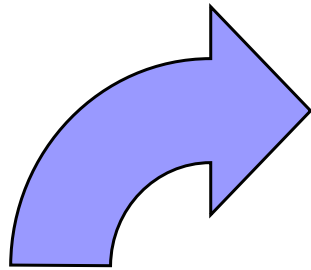


Development of aquaculture breeding programs in France

Pierrick HAFFRAY

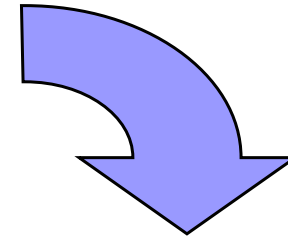
SYSAAF, Section Aquacole, Station SCRIBE, Campus de Beaulieu, 35 042 RENNES
Tel : 02 23 48 53 78 ; Fax : 02 23 48 56 60 ; Mel : haffray@beaulieu.rennes.inra.fr

Selection programme ?



Reproduction

- 200-600 families / generation



Familial rearing

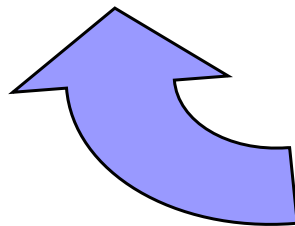
- Individual tagging at 50 g of 100 to 1000 fish / family

Genetic evaluation

- Individual indexation (BLUP)
- Proposition of best candidates

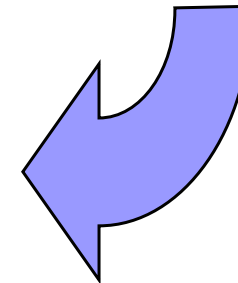


Family selection



Grow-out and phenotyping

- Challenge test
- Slaughtering 15-30 fish / family
- Gutted yield, fillet yield, fillet clour



French aquaculture

- **4500 companies (900 MEuros) : 700 fish (2500 sal.) et 3800 moll. (10 400 sal.)**

| | | | | | |
|-----------------|-------------------------|-------------------|---------------------|-------------------------|-------------------|
| Rainbow trout | 35 000 T + 200 T caviar | Meagre | 100 T | Flat oyster | 1 000 T |
| Brown trout | 4 500 | Tilapia | 100 T | Scallop | 200 T on 13 000 T |
| Brook trout | 350 T | Red drum | 300 T | Abalone | 20 T |
| Atlantic salmon | 1 900 T | Siberian sturgeon | 340 T + 40 T caviar | Schrimp (New caledonia) | 2 000 T |
| Sea bass | 5 000 T | Common carp | 6 000 T | Japanese shrimp | 50 T |
| Sea bream | 1 900 T | Pacific oyster | 128 600 T | Pearl oyster | 200 MEuros |
| Turbot | 800 T | Blue mussel | 58 600 T | | |

- **Highly diversified but : stable, fragile and SMEs**
- **Pioneering research :**
 - in trout genetics and reproduction early 70's
 - in marine aquaculture and hatchery technologies since 1976
 - in mollusc genetics since 1995



SYSAAF ?

- French association of poultry (15) and aquaculture (16) breeders
- Technical expertise (7 geneticists & biologists, 1 veterinarian)
 - Advise in breeding and selection (methods, traits, programs)
 - Data management and data treatment (VCE, PEST)
 - Sperm freezing and ploidy control (flow cytometry)
 - Scientific and sanitary survey
 - R&D and improvement of breeding procedures
 - Training
- Selection :
 - **155 poultry lines** : Chicken, turkey, Pekin and Moscovy ducks, Guinea fowl, quail, phaisant, red or grey partridge
 - **11 fish lines** : rainbow trout, brown trout, sea bream, turbot, sea bass



French companies involved in breeding in aquaculture

• Selection :

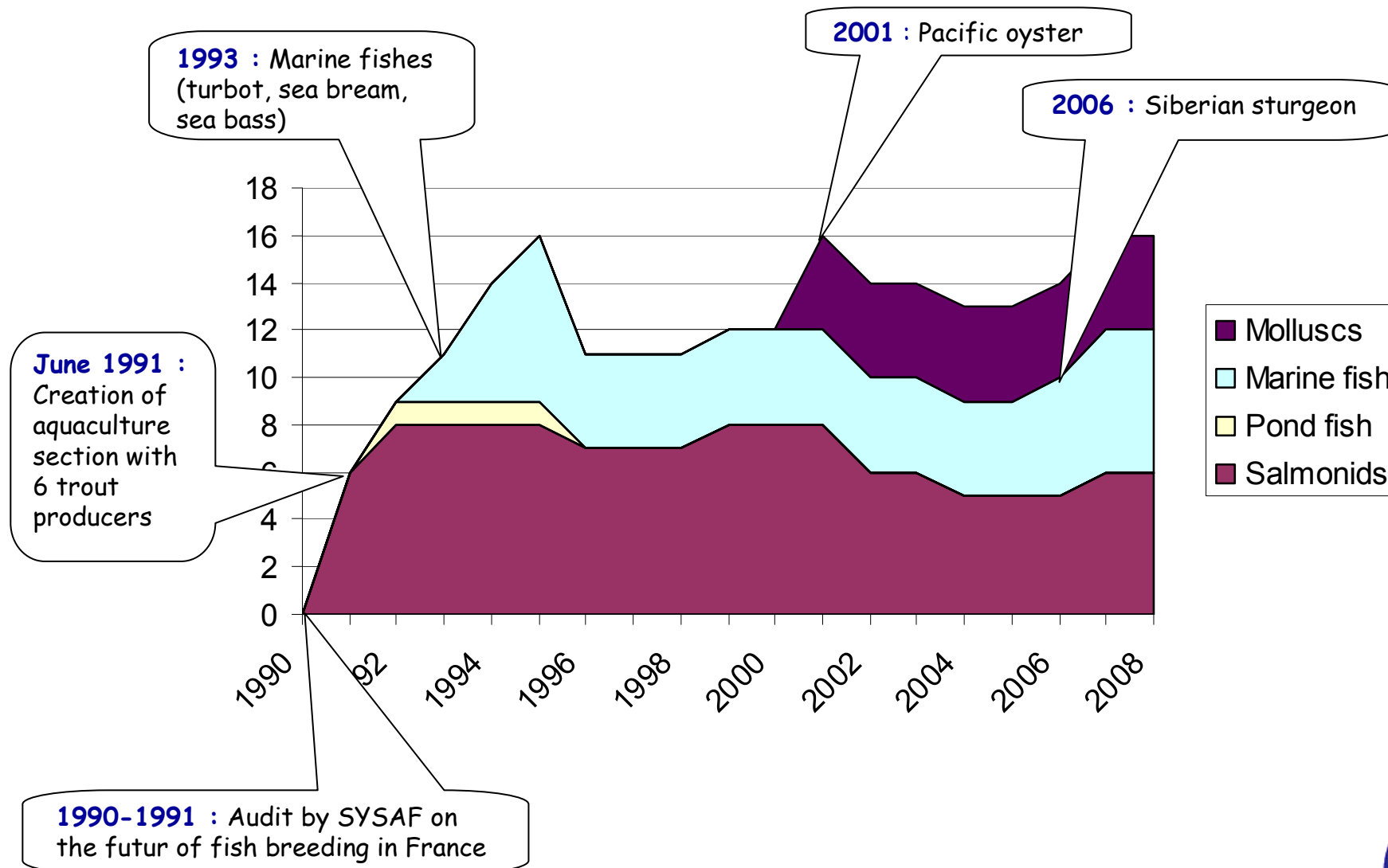
- Font Rome Pisciculture (07), rainbow trout
- Les Aquaculteurs Bretons (29), rainbow trout
- Les Aquaculteurs Landais (40), rainbow trout and brook trout
- Pisciculture des Fontaines (38), rainbow trout, brown trout and brook trout
- Viviers de France (40), rainbow trout
- Ecloserie Marine de Gravelines (59), sea bass
- Ferme Marine du Douhet (17), sea bream
- France Turbot (85), turbot
- Ecloserie de Guyenne (33), Siberian sturgeon

• Hatcheries :

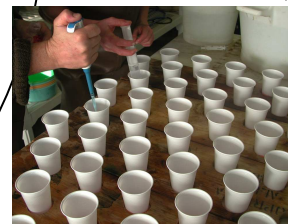
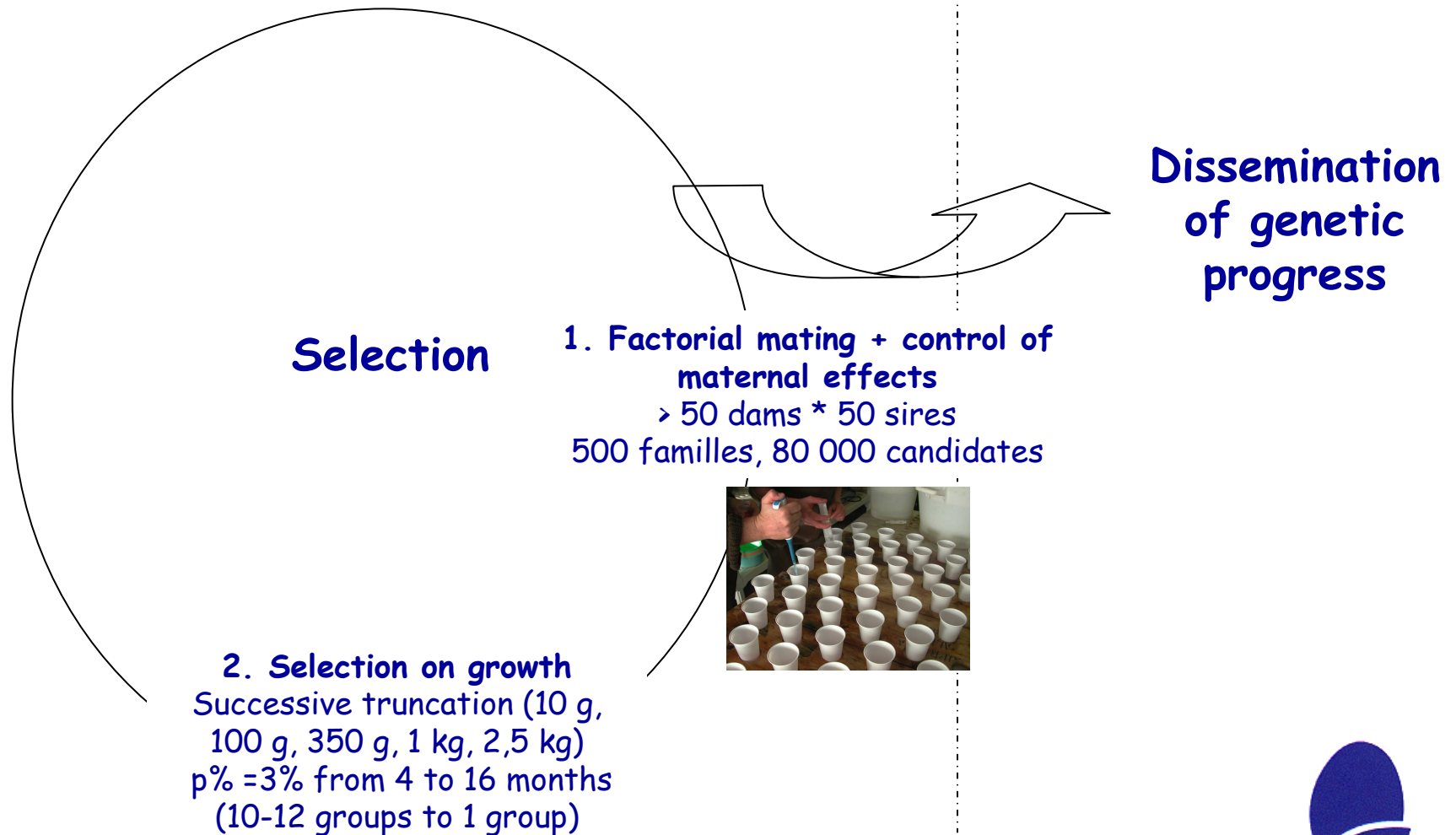
- Esturgeonnière (33), Siberian sturgeon
- Poissons du Soleil (34), sea bass and meagre
- SATMAR (50), Pacific oyster
- SODABO (85), Pacific oyster
- Vendée Naissain (85), Pacific oyster
- Grainocéan (17), Pacific oyster
- APPMA 06 (06), brown trout



A short story of aquaculture in SYSAAF...

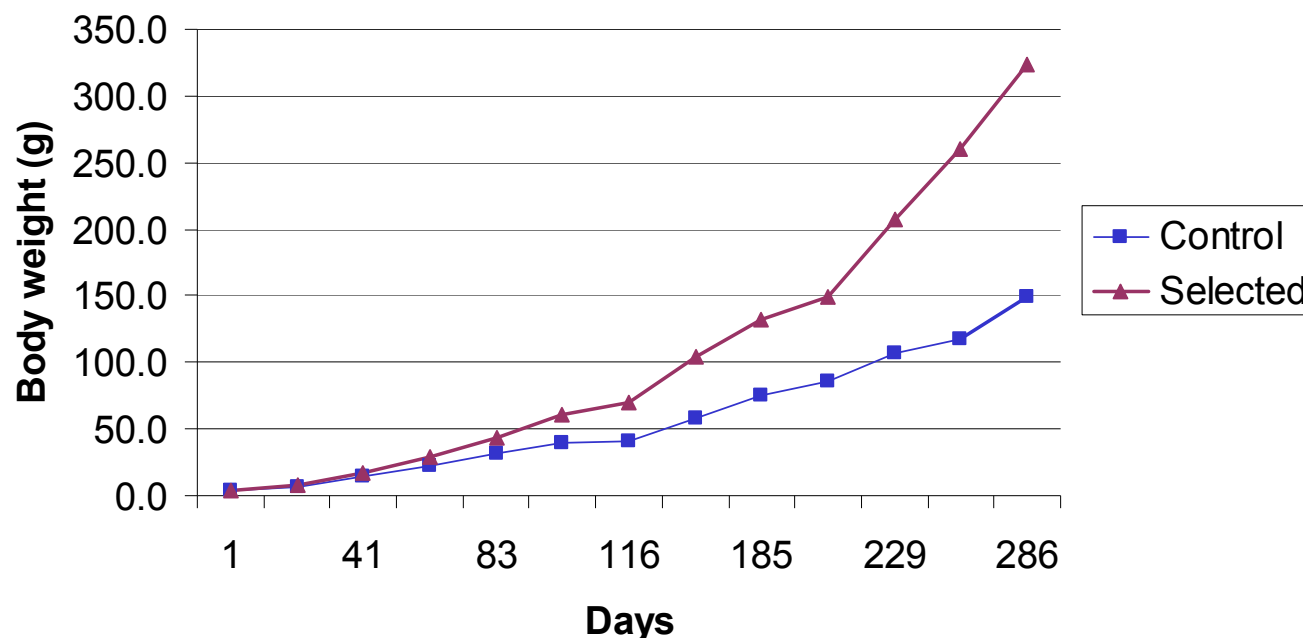


Initial individual « Prosper » type of selection programs (1993-1996)



Realised gain of Prosper selection on growth (Chevassus et al., 2004)

- + 120 % after 4 generations \Leftrightarrow + 1 σ / generation



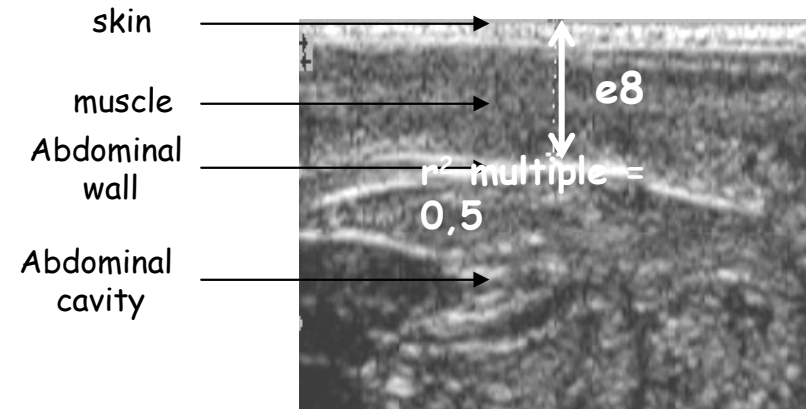
- Better valorisation by long cycle of production
- Prosper cost / Family selection / % gain \Leftrightarrow 8-10 K€ vs 100 k€

Validation of indirect technologies to measure quality traits

(coll. INRA)

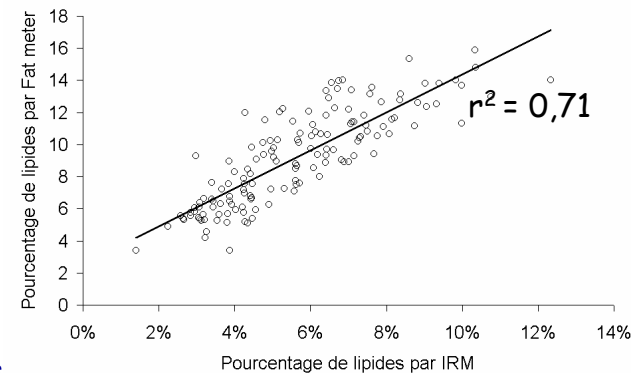
- Prediction of gutted yield

Ultrasound 7,5 MHz



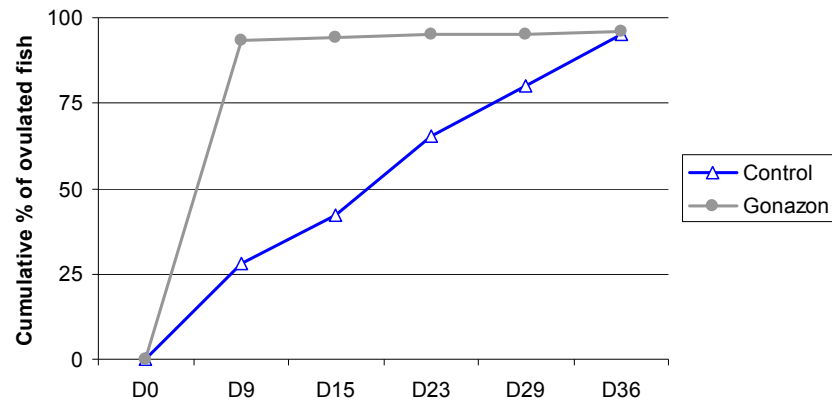
- Prediction of fat in the filet (Dourin *et al.*, 1998)

Torry Fish Fat Meter
(microwaves)

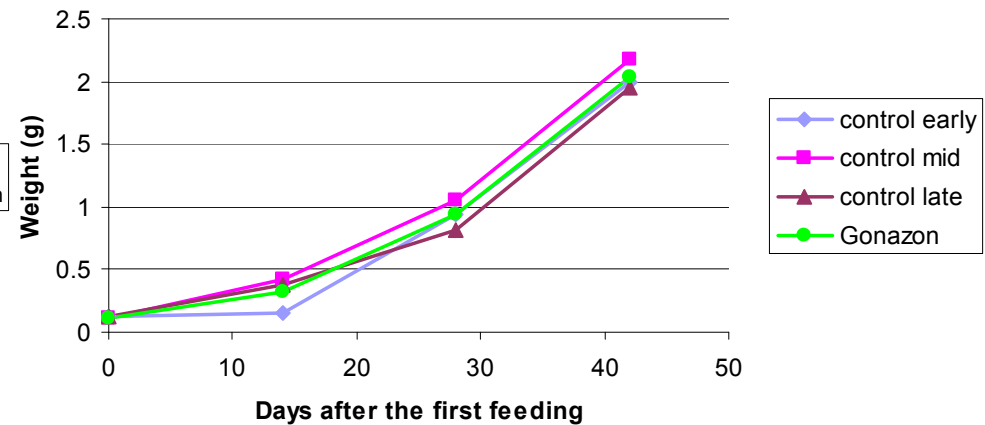


Validation and development of GnRH for female synchronisation (Haffray et al., 2005)

- Need to limit environmental factors in breeding and decrease cost of selection
- Demand by Intervet to register Gonazon™ (azagly-nafarelin) to EMEA (collaboration with INRA)
- 1750 females rainbow trout, Atlantic salmon, Arctic charr



Cumulative ovulation rate in salmon in the control (n = 105) and in the treated group (n = 104) from D0 to D36



Rainbow trout growth from first feeding to day 42 of treated group progenies (Gonazon™) vs control groups composed at D9 (early), D23 (mid) or D36 (late)

Integration of quality traits in individual Prosper type of selection programs (1996-1997)

Dissemination
of genetic
progress

3. Qualitative indexation of
1500 candidates and
selection de 400 dams
and 200 sires at 16
months
Individual tagging

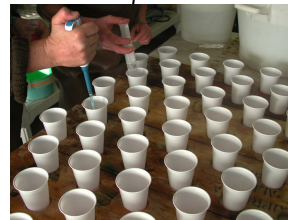


Selection

2. Selection on growth
Successive truncation (10 g,
100 g, 350 g, 1 kg, 2,5 kg)
p% = 3 % from 4 to 16 months
(24 groups to 1 group)

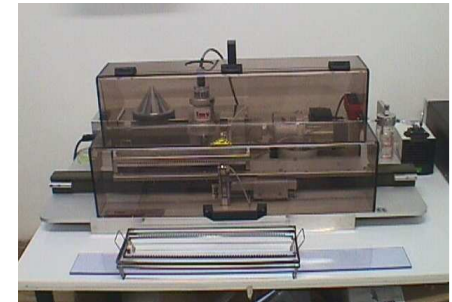
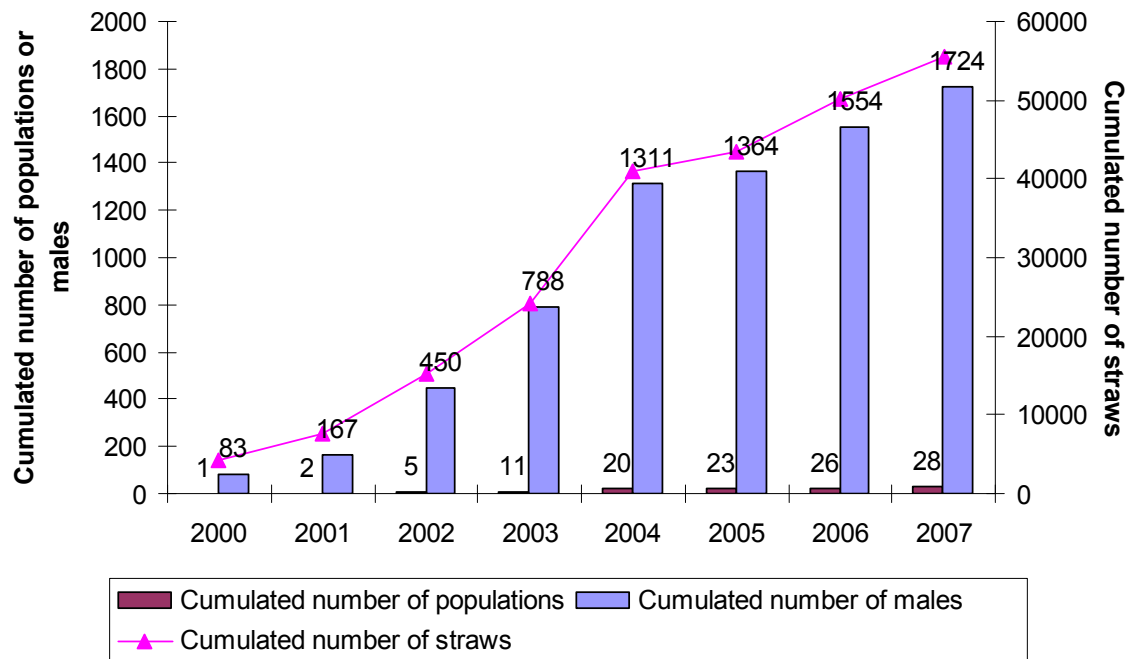
4. Hormonal synchronisation
of ovulation

1. Factorial mating + control of
maternal effects
> 50 dams * 50 sires
500 familles, 80 000 candidates



Sperm freezing

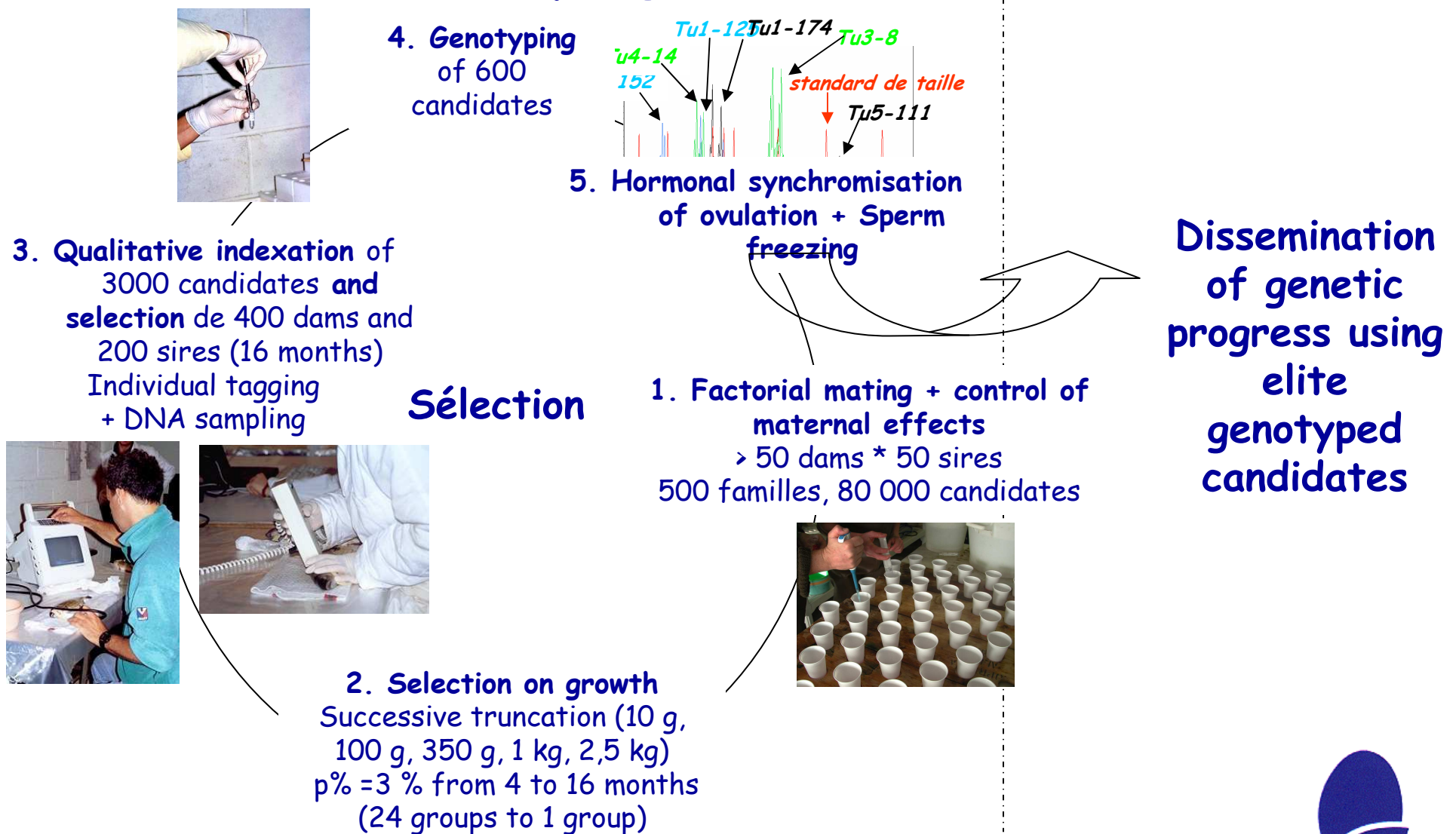
- Development of StorFish, CryoFish, OvaFish, ActiFish media (Licence INRA-IMV-SYSAAF) and standardisation of procedures
- On farm freezing (55480 straws)



- **Collective cryobank in 2009 at URCEO**

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Integration of fingerprint in Prosper type of selection programs (1998-2006)

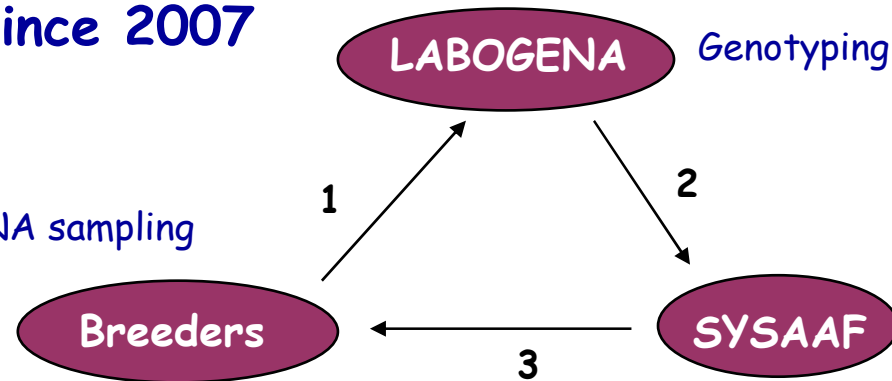


Transfer of DNA fingerprint

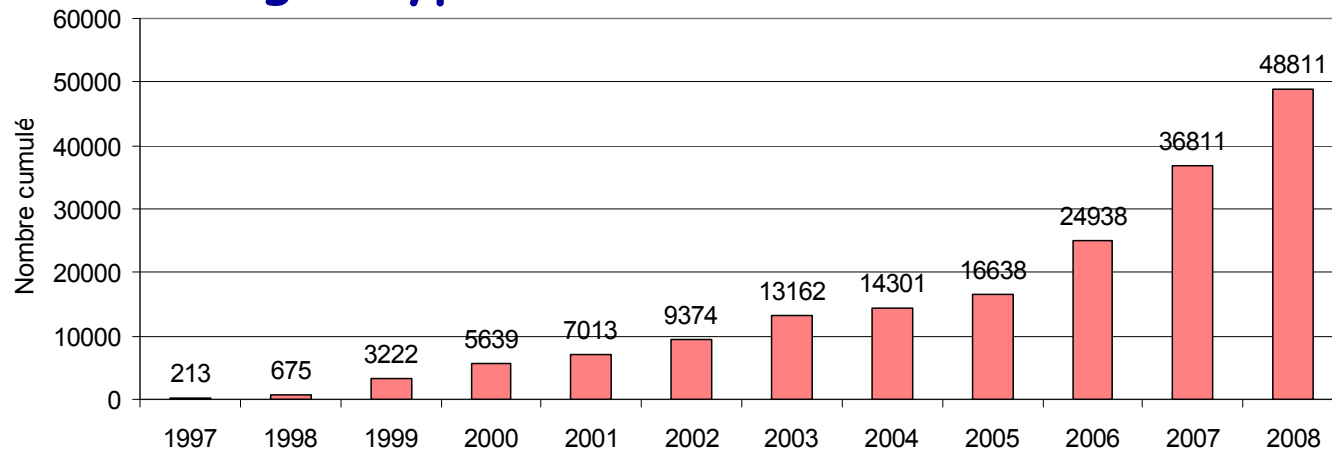
- Development and automation of markers in turbot, trout, sea bream and sea bass
- Member of LABOGENA since 2007



DNA sampling



- 48 811 fish genotyped since 1997



Proposition of optimised mating based on genealogy and EBV

Syndicat des Sélectionneurs Avicoles et Aquacoles Français



SYSAAF

Data management

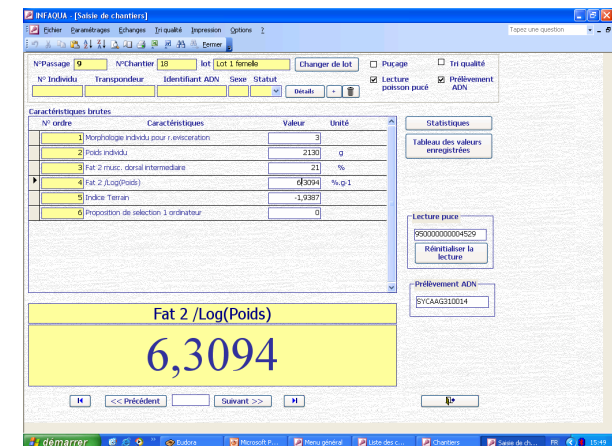
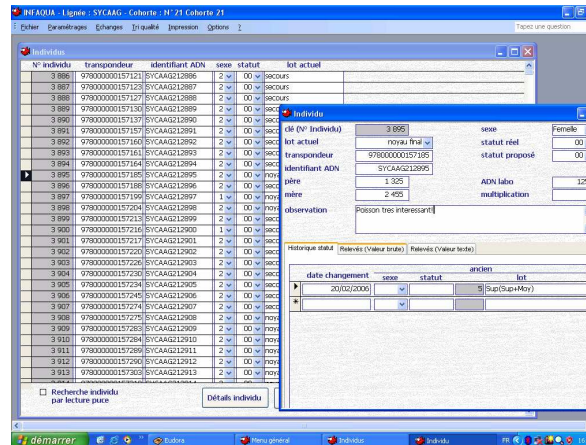
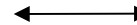
Aquaculture
breeding
company



SYSAAF
Aquaculture
office



SYSAAF
Head office



- ACCESS data base per breeding company saved on SYSAAF server
- Data treatment (VCE, PEST)

Syndicat des Sélectionneurs Avicoles et Aquacoles Français



18 years experience in transfer in breeding in aquaculture

- **Transfer of Prosper individual selection procedure (6 species, 11 lines) that contribute to 70% to 100% French production ⇒ > + 10-15 % expected weight gain / generation**
- **Selection on quality traits (gutted and fillet yield)**
- **Management of the national genetic resource**
- **Consolidation of a network :**
 - 15 SME,
 - 20 technicians et biologists
- **Interface between research and users**
- **Adapted to French situation (SMEs, number of species)**