CODE • EFABAR

The commitment
to responsible breeding

Species Specific Template
Code EFABAR
AQUACULTURE

Code EFABAR 2020

Company: _____

AQUACULTURE

1. Impact and structure of breeding in the EU aquaculture industry

Aquaculture encompasses many hundreds of species, each with different biology and life cycles, breeding systems and management requirements. Breeding of aquaculture species is a relatively recent activity in Europe when compared with other livestock production. Several stages of development of breeding programmes are underway depending on species, volume of production, country and the know-how acquired in reproduction and zootechnical procedures. The genetic improvement of farmed fish has developed rapidly since the mid-1980s. Currently, over 70% of EU fish production (especially salmon, rainbow trout, turbot and in a less extent halibut, sea bass and sea bream) is from selected stocks using methods of selection validated by the scientific community. These methods are based on optimized mass selection, family-based selection and genomic selection. The methods used by breeders depend on the genomic resources, knowledge on trait architecture and ability to control mating design for a given species.

Investments since the mid-1980s led to the initiation of the domestication and selection of Atlantic salmon, rainbow trout, charr, sea bass, sea bream, turbot halibut, sturgeons, meagre. Trials on other aquatic species, e.g. sole, common carp, sparid, tench, cod, perch, sander, European catfish, red porgy are underway. Similarly, genetic selection of cupped oyster, Manilla clam and abalone were initiated mostly to produce more resistant seeds to diseases. Where the main farmed species are concerned, European breeders are world leaders. They provide fertilised egg, fry and seeds to countries within and outside the EU, all around the Mediterranean basin (trout, bass and bream, oyster, Manilla clam), Middle East (bass, bream, trout), Southern America (salmon and trout) and China (turbot, sturgeon).

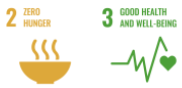
Aquaculture species, from the breeder's perspective, produce large numbers of eggs at a single spawning (from several thousands to millions). They are, or can be, reproduced through artificial fertilisation by shipping eggs and milt for the most important species, except for some new farmed species, in domestication. Thus, for the species produced industrially (e.g. salmon, turbot, trout, bass and bream) the breeding sector tends to be evolving towards a small number of breeding companies per species that use up-to-date methods of evaluation. Many companies are new investing in internal skill sets to manage the genetic and mating structures of their breeding populations. Some of these companies also invest in the breeding of tropical species (shrimp, tilapia) for tropical markets. Salmon breeding is now using genomic selection mostly to fight against diseases such as sea lice. Trout, sea bass, sea bream, Pacific oyster are now following the same path with first candidates selected last year with medium density SNP chips. For turbot, sturgeons, Manilla clam the priority is to develop SNP-arrays and sequence the genome of some species before the possibility of genomic selection can be explored. For species with more limited market size, (charrs, carp, catfish, etc.) more simple mass selection is applied in conjunction with DNA-based parentage assignment to manage inbreeding. For these species, breeding programs are mostly developed by specialised breeding companies which are also involved more in the production of juveniles. Other breeding programs are part of integrated companies that are involved in growing, slaughtering and/or processing.

Breeding companies include many traits in their breeding goals. Where disease is not an issue, growth (to some extent, processing yields) and feed efficiency are the traits that are prioritised in selection. However, since most of the production is developed in open water systems selecting to improve disease resistance is a key factor in all aquaculture production systems.

Sustainable production is becoming a major focus across livestock, in order to ensure that efficient and high output systems are environmentally friendly. As a result, the United Nations have agreed on 17 sustainability development goals to be addressed by various industrial and production systems

(https://sustainabledevelopment.un.org/). Aquaculture production systems have the ability to directly address 9 of these goals, as summarised below:

Goal 1 - No poverty and Goal 8 - Decent work and economic growth: Aquaculture is an upcoming industry in many countries, and in coastal and remote areas. As such, the industry provides job opportunities, and the aquaculture breeding and genetics sector maintain and improve economic development and decent revenues to the population living in the coastal and remote areas.



Goal 2 - Zero hunger and Goal 3- Good health and well-being: Aquaculture, including selective breeding, has a major role in producing food with high overall nutritional value (e.g. high protein and fatty acids) and with desirable/essential nutrients (e.g, omega 3 fatty acids).

Goal 12 - Responsible consumption and production and Goal 13 - Climate action and Goal 6 - Clean water and sanitation: Fewer resources in for the same level of output in production, and better management of natural resources. For example, selecting for increased feed efficiency (i.e. more protein produced for less feed input), managing waste products and finding alternative uses for waste products and minimizing carbon footprint.

Goal 14 - Conserve and sustainably use the oceans, seas and marine resources and Goal 15 - Life above land, biodiversity issues and management of genetic resources: This includes management of escapees and methods to prevent breeding of escapees with wild populations.

2. Introduction

Give a brief description of the governance policy of the Breeding Company (BC)[1] regarding the societal challenges as mentioned in the Code EFABAR General Document. Besides the 6 pillars of the Code EFABAR, take also Food Security into consideration.

[1] Breeding companies include all organisations responsible for breeding and reproduction of farm animals (e.g., primary breeding, herdbook keeping, artificial insemination, embryo technology, hatchery, (grand) parent genetics, data recording).

3. SUSTAINABILITY

A. Food Safety and Public Health

Breeding Element	Has the BC implemented this element in its breeding program, directly or indirectly? Yes/No	If yes, how has the BC implemented this element in its breeding program? If no, does the BC plan to address this element in its breeding program in the next 3 years? If no, why not?
Reduction of use of antibiotics and anti-parasites	*To be filled by the company*	*To be filled in by the company*
Meat quality (related to food safety and public health, for instance by minimizing the spreading of zoonotic diseases		
Suppression antifungals treatments (in producing all-female salmonids)		

Management element	Yes/No	If yes, give a short explanation If no, explain why not?
Has the BC a biosecurity policy on its own premises (to avoid spreading zoonoses) and is it implemented?		
Has the BC an antimicrobial policy on its own premises and is it implemented?		
Has the BC, as part of their biosecurity processes, procedures to reduce the potential risk of contamination from staff and equipment?		
Has the BC a method for screening prior to breeding and screening eggs/fish/larvae prior to transport for bacterial/fungal infections and is it implemented?		

B. Genetic diversity

Breeding Element	Has the BC implemented this element in its breeding program, directly or indirectly? Yes/No	If yes, how has the BC implemented this element in its breeding program? If no, does the BC plan to address this element in its breeding program in the next 3 years? If no, why not?
Initiation of domestication or genetic selection of new species with an initial large genetic variation		
Management of genetic variability in selected lines to limit inbreeding		
In-situ conservation of genetic resources		
Mid-term live backup		
Long-term cryo-banking of genetic resources (sperm, oocyte or larvae)		

Management Element	Yes/No	If yes, give a short explanation If no, explain why not?
Does the BC have or contribute to a gene bank for commercial breeds?		
Does the BC contribute to the conservation of genes of rare and threatened breeds?		

C. Resource Efficiency

Breeding Element	Has the BC implemented this element in its breeding program, directly or indirectly? Yes/No	If yes, how has the BC implemented this element in its breeding program? If no, does the BC plan to address this element in its breeding program in the next 3 years? If no, why not?
Improving growth rate, but not at the expense of species biology		
Feed efficiency		
Ability to use feed substitutes with vegetal ingredients or alternative sources		
Survival rate to limit loss of feed and energy		
Improve yields at processing (gutting, filleting, trimming) or yield of edible part (shellfish)		

Management element	Yes/No	If yes, give a short explanation If no, explain why not?
Has the BC a resource efficiency policy on its own premises?		
Has the BC procedures for processing of or reuse of residual products?		

D. Environment

Breeding Element	Has the BC implemented this element in its breeding program, directly or indirectly? Yes/No	If yes, how has the BC implemented this element in its breeding program? If no, does the BC plan to address this element in its breeding program in the next 3 years? If no, why not?
Feed efficiency (decrease of water pollution)		
Production of sterile fish or shellfish (to prevent potential negative effect of escapees and improve feed efficiency)		
Genetic resistance to diseases (to limit the release of drugs and the contamination of wild populations)		
Genomic traceability of escapees		
Increase capacities to fix or synthetize w3-fatty acids (limitation of fishing pressure on wild stocks and improve Human health)		

Management element	Yes/No	If yes, give a short explanation If no, explain why not?
Has the BC an environment policy on its own premises and is it implemented?		
Has the BC procedures to feed only to satiation (to minimise waste of feed)		
Has the BC procedures to monitor disease outbreaks or parasite levels on site?		
Has the BC has a policy to reduce carbon footprint?		

E. Animal Health and Welfare

Breeding Element	Has the BC implemented this element in its breeding program, directly or indirectly? Yes/No	If yes, how has the BC implemented this element in its breeding program? If no, is the BC aware of the importance of this element and will it address this element in its breeding program in the next 3 years? If no, why not?
Monogenic traits/defects		
Disease resistance and survival		
Fish and shellfish robustness		
Improve ability to cope with farming practices (different environment and climate change)		
Preventing external and/or internal malformation		
Prevention of sexual maturation		
Multi-traits and balanced breeding goal		

Management element	Yes/No	If yes, give a short explanation If no, explain why not?
Has the BC a biosecurity policy on its own premises (to avoid diseases and the spreading of diseases to other premises) and is it implemented?		
Has the BC a welfare policy on its own premises making a reference to the Five Freedoms and is the welfare policy implemented?		
Has the BC procedures to minimise stress when handling individuals, for example when collecting phenotypes, treatments (e.g. vaccination) or sorting?		
Has the BC a policy on how to handle its animals prior to and during transport and is it implemented?		

4. TECHNOLOGIES

A. Breeding technologies

Element	Is the BC using these breeding technologies in its breeding practices? Yes/No	If yes, give a short explanation. If no, why not? Any examples?
Pedigree tracing		
Genomic selection		
Marker assisted selection		
Sib/progeny testing to improve disease resistance		
Transgenesis		
Metabolomics, proteomics, transcriptomics		
Gene editing		
Tracking escapees		
Novel ways of DNA sampling (e.g. robotics?)		
Exploring automated phenotype collection technologies (e.g. robotics?)		

B. Reproduction Technologies

Element	Is the BC using these (reproduction) technologies in its reproduction practices? Yes/No	If yes, give a short explanation. If no, why not? Any examples?
Collection of semen and oocytes (attention for welfare)		
Artificial fertilisation		
Semen, oocyte and/or larvae cryopreservation (attention to management and conservation of genetic resources)		
Synchronization of ovulation and sperm production by hormones		
All-female monosexing (to limit negative effect of sexual maturation on animal welfare and improve flesh quality)		
Sterilization by triploidiztion (to limit negative effect of sexual maturation on animal welfare, gentic contamination of wild populations and improve flesh quality)		
Inter-specific hybridization		
Production of tetraploid parents to produce triploids progenies		
Sterilisation by alternative methods e.g. Gene Editing		
Karyotyping/FISH-test		

C. Product Quality

Breeding Element	Has the BC implemented this element in its breeding program, directly or indirectly? Yes/No	If yes, how has the BC implemented this element in its breeding program? If no, does the BC plan to address this element in its breeding program in the next 3 years? If no, why not?
Improvement of body or shell conformation and morphology		
Improvement of skin or shell colour		
Improvement of flesh quality, lipid content or composition of the fillet or the edible part		
Improvement of and colour of the fillet or the edible part		
Proposal of new product by the domestication of new species		
Prevention of external and/or internal malformation (appearance)		

D. Monitoring technologies

Element	Is the BC exploring new technologies? Yes/No	If yes, give a short explanation. If no, why not? Any examples?
Exploring new monitoring technologies to improve welfare and robustness		

E. Innovation and public perception

Element	Is the BC investing in innovation? Yes/No	If yes, give a short explanation. If no, why not? Any examples?
Does the BC invest in research and development, and/or collaborate with research institutes on traits important to the breeding program?		
Does the BC take a proactive approach to adopting new techniques and technologies?		
Does the BC take action to engage with society?		

5. Certification

We herewith declare that the content of this template expresses the breeding and reproduction policy of the company

Place:
Date:

Name and signature:

European Forum of Farm Animal Breeders (EFFAB)
We herewith state that this template complies with the CODE EFABAR Version 2020

Place: Brussels
Period of validity:

Ana Granados Chapatte, EFFAB, Director