Study of the transcriptomic content of the Eurasian perch eggs: research of links with its quality

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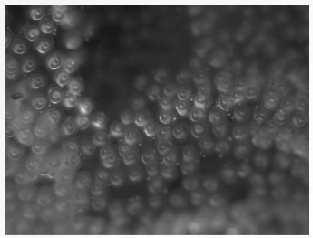
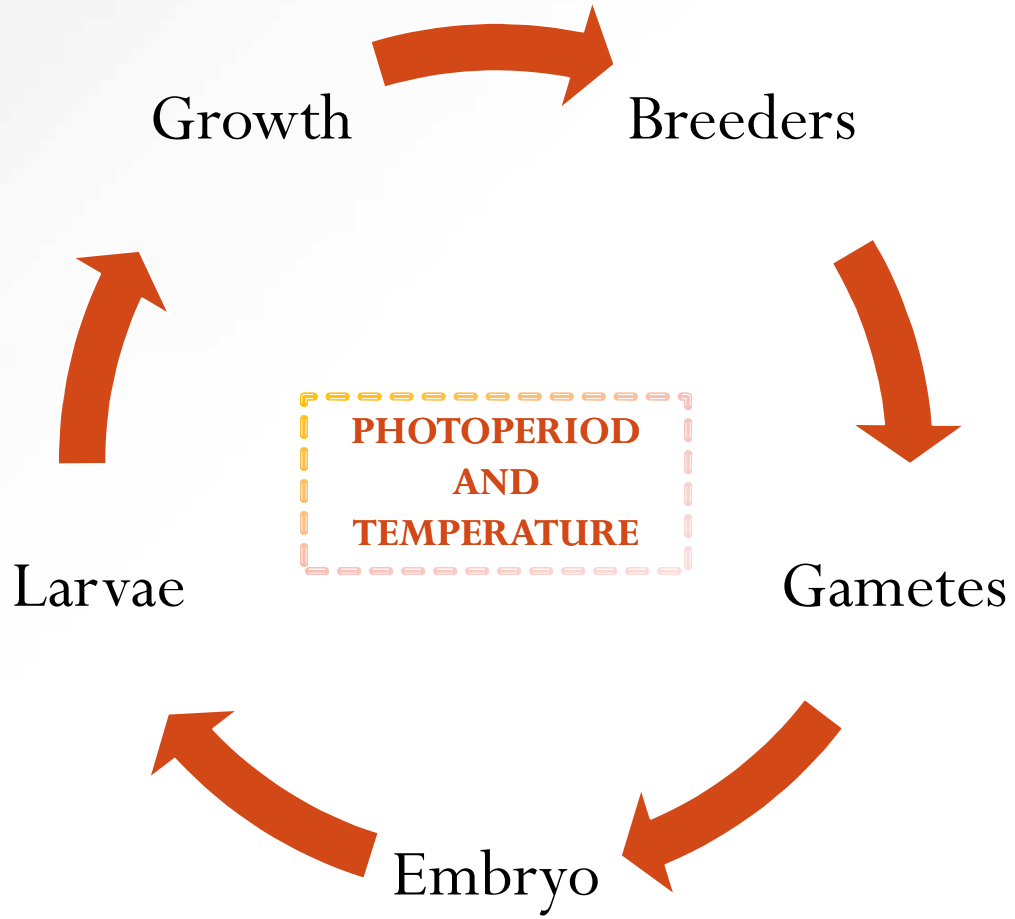
Reproductive cycle





Photos: Yannick Ladore

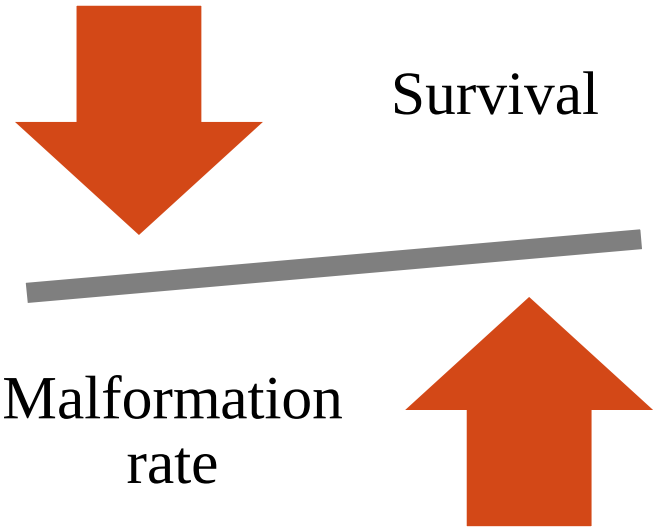
Modulating factors

Intrinsic

- Breeder size
- Rank of spawn
- Genetics
- Level of domestication

Extrinsic

- Environment
- Stress
- Nutrition



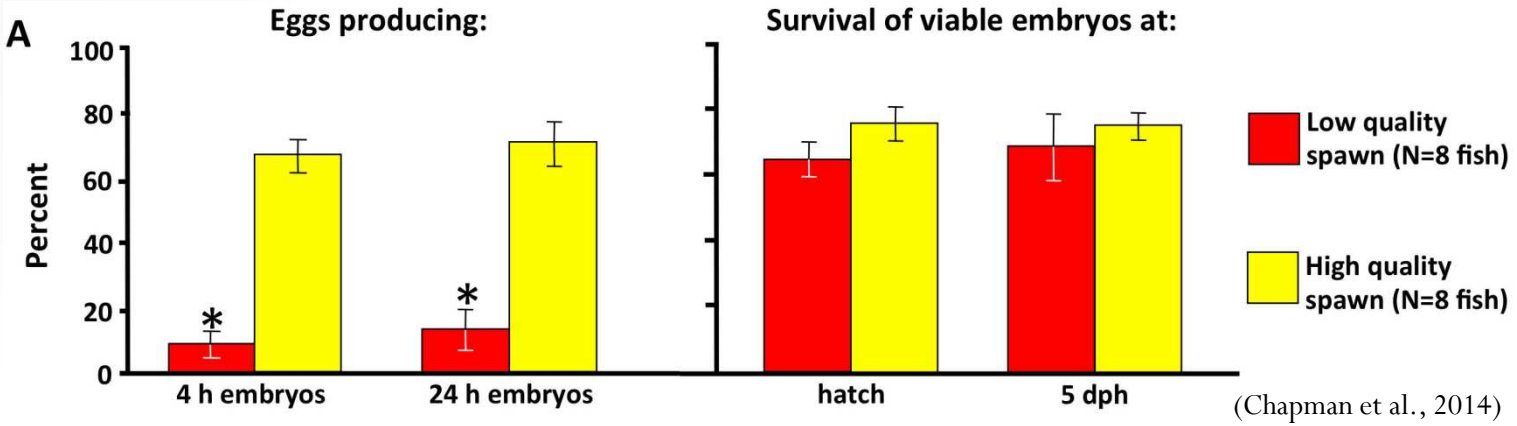
Early development failure

- Major problem in fish breeding programs

- Example Striped Bass:

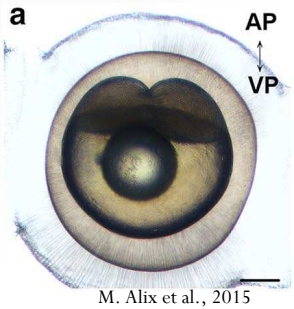
  >50% until 4h = high quality

  <30% until 4h = low quality



(Chapman et al., 2014)

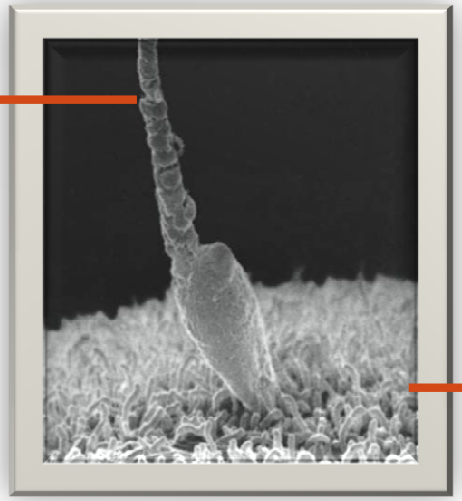
Fertilization and egg content



M. Alix et al., 2015

SPERMATOZOA

- Genetic material
- Centrioli



OOCYTE

- Genetic material
- Transcripts
- Proteins (enzymes)
- Lipids
- Organelles
- Metabolites

Oogenesis in the literature

- Primary oocyte growth
- Cortical granule formation
- Vitellogenesis
- Other events (nuage, vitelline envelope formation, intercellular junctions, pigment formation, intramitochondrial crystals, annulate lamellae)

(Wallace and Selman, 1990)

- Primary oocyte growth
- Cortical alveolus stage
- Lipids inclusion
- Vitellogenesis
- Maturation
- Ovulation

(Tyler and Sumper, 1996)

-Growth
Previtellogenic
Vitellogenic (regulation, yolk protein formation, lipid deposition, vitteline envelope formation)
- Maturation (competence, MIH production, resumption of meiosis, cytoplasmatic maturation)
- Ovulation

(Patino and Sullivan, 2002)

- Oogonia formation
- Oogonia proliferation and transition into meiosis
- Secondary growth
- Vitellogenesis (lipid acumulation, vitellogenins, uptake of vitamins, egg envelop proteins)
- Maturation and hydration
- Ovulation

(Lubzens et al., 2010)

Oogenesis

- Growth
  - 1st
  - 2nd
  - } Previtellogenic growth (mRNA, CHO, proteins)
  - Vitellogenesis (lipids, vitamins)
- Maturation
  - Meiosis resumption
  - Cytoplasmic maturation (synthesis of proteins from vitellogenin)
- Ovulation
  - Metaphase II oocyte released from its follicule

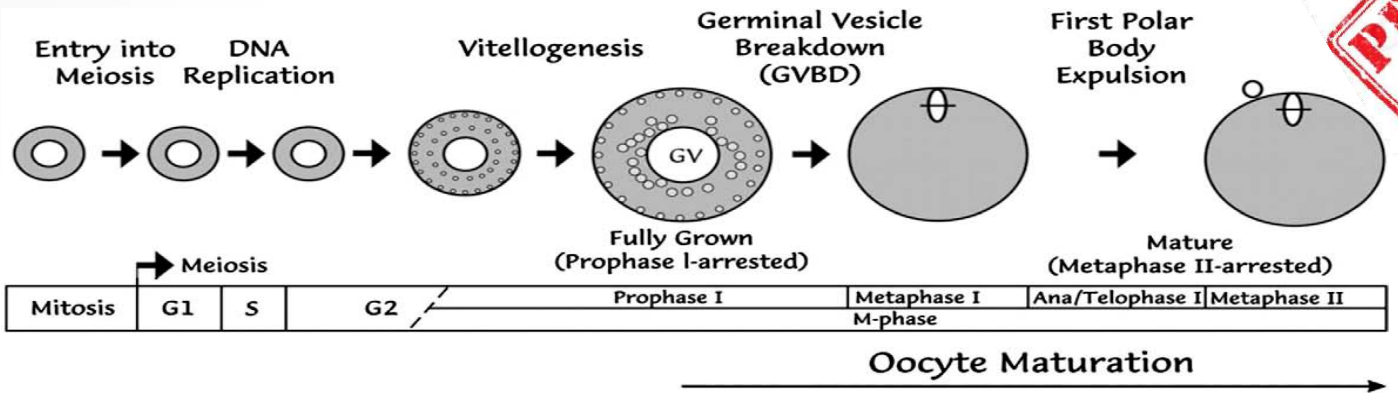


Image: Lubzens et al., 2010

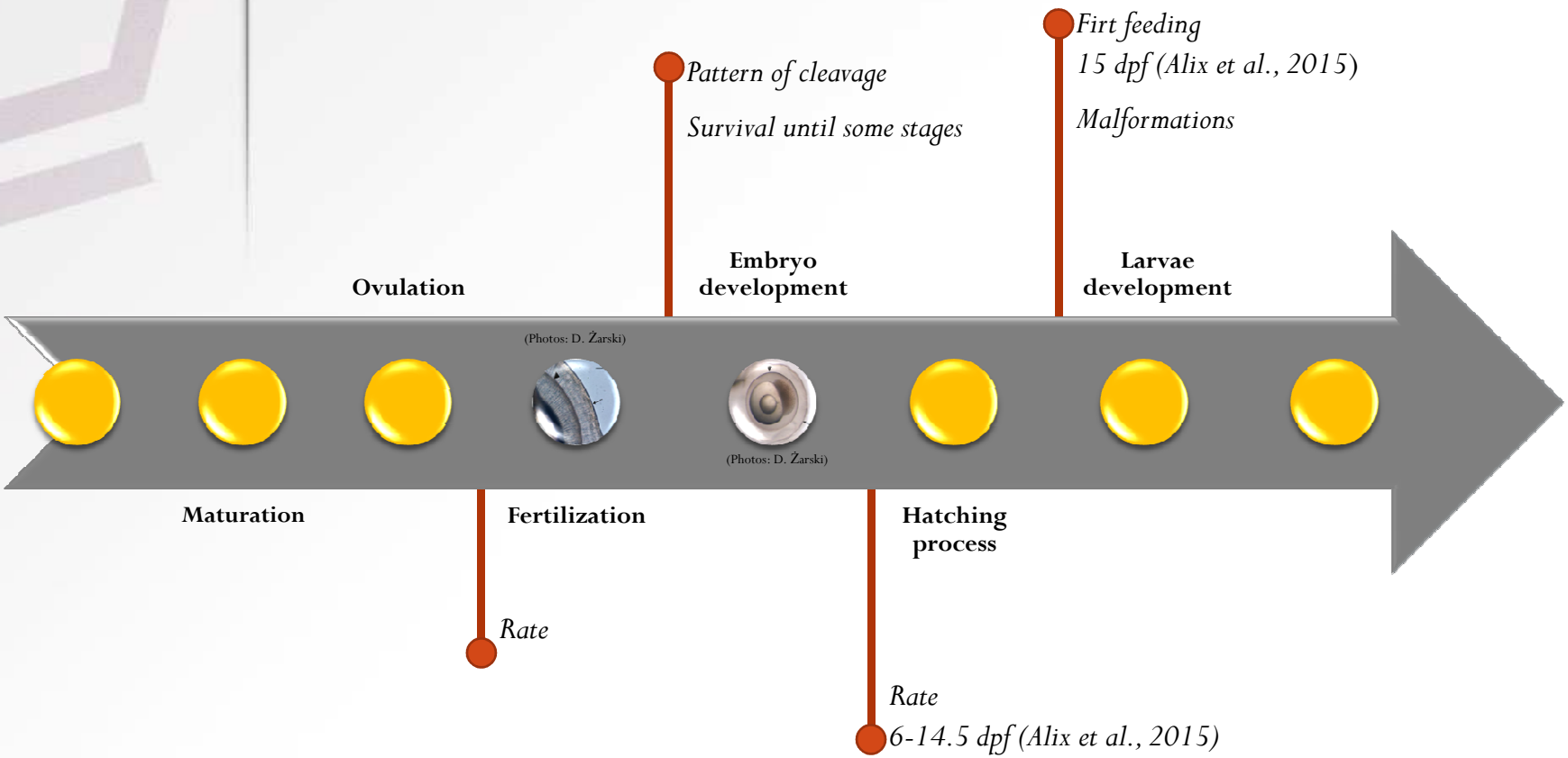
What is egg quality?

Egg quality can be defined as the egg´s potential to produce a viable fry (Kjørsvik, 1990).

Good egg quality are usually defined as those which exhibit low levels of mortality at fertilization, eying, hatch and first-feeding and those which produce the fastest-growing and the healthiest fry and old fish (Bromage et al., 1992).

Egg quality or oocyte developmental competence can be defined as the ability of the egg to be fertilized and subsequently develop into a normal embryo (Bobe & Labbé, 2010).

Assessing egg quality



Indicators of egg quality

Marine fish:
sink X float

Freshwater fish:
translucid X
white or opaque

Morphological

- Size (Kjorsvik and Lonning, 1983; Kjørsvik et al., 1990; Brooks et al.,1997; Bobe & Labbé, 2010)
- Oil droplets (Żarski et al., 2011)
- Cortical reaction (Żarski et al., 2012)
- Blastomere morphology (Bromage et al., 1994; Shields et al., 1997; Vallin et al., 1998; Kjorsvik et al., 2003)

Specie specific

Practices can interfere

Bad quality

Indicators of egg quality

Biochemical

- Proteins (Nguyen et al., 2012)
- Proteomic (Castests et al., 2012)
- Lipids (Henrotte et al., 2010; Luo et al., 2015)
- Hormones (Skaalsvik et al., 2015)
- RNA (Aegerter et al., 2005)
- Ovarian fluid analysis: **pH** (Fauvel et al., 1993); **proteins** (Rime et al.,2004); **osmolality**, **conductivity** (Skaalsvik et al., 2015); **enzymes** (Lahnsteiner et al., 1999; Lahnsteiner et al., 2001)

Early development

- Maternal-to-zygotic transition (MZT) / Midblastula transition (MBT)
  - Maternal transcript destabilization
  - Zygotic genome activation

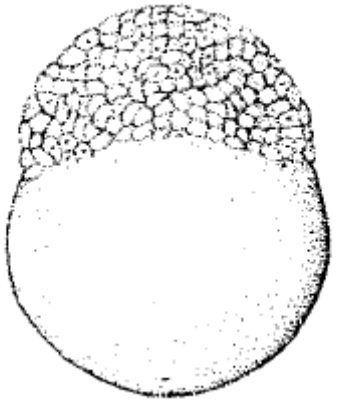


Image: Kimmel et al., 1995

Basic cellular functions

- Cellular metabolism
- Nuclear and cellular divisions
- Intercellular adhesion

(Chapman et al., 2014; Tadros & Lipshitz, 2009; Pelegri, 2003)

First goal of the project

Defining the molecular portrait of a developmentally competent egg

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Zebra fish; Rainbow trout, Eurasian perch, and European seabass

First goal of the project

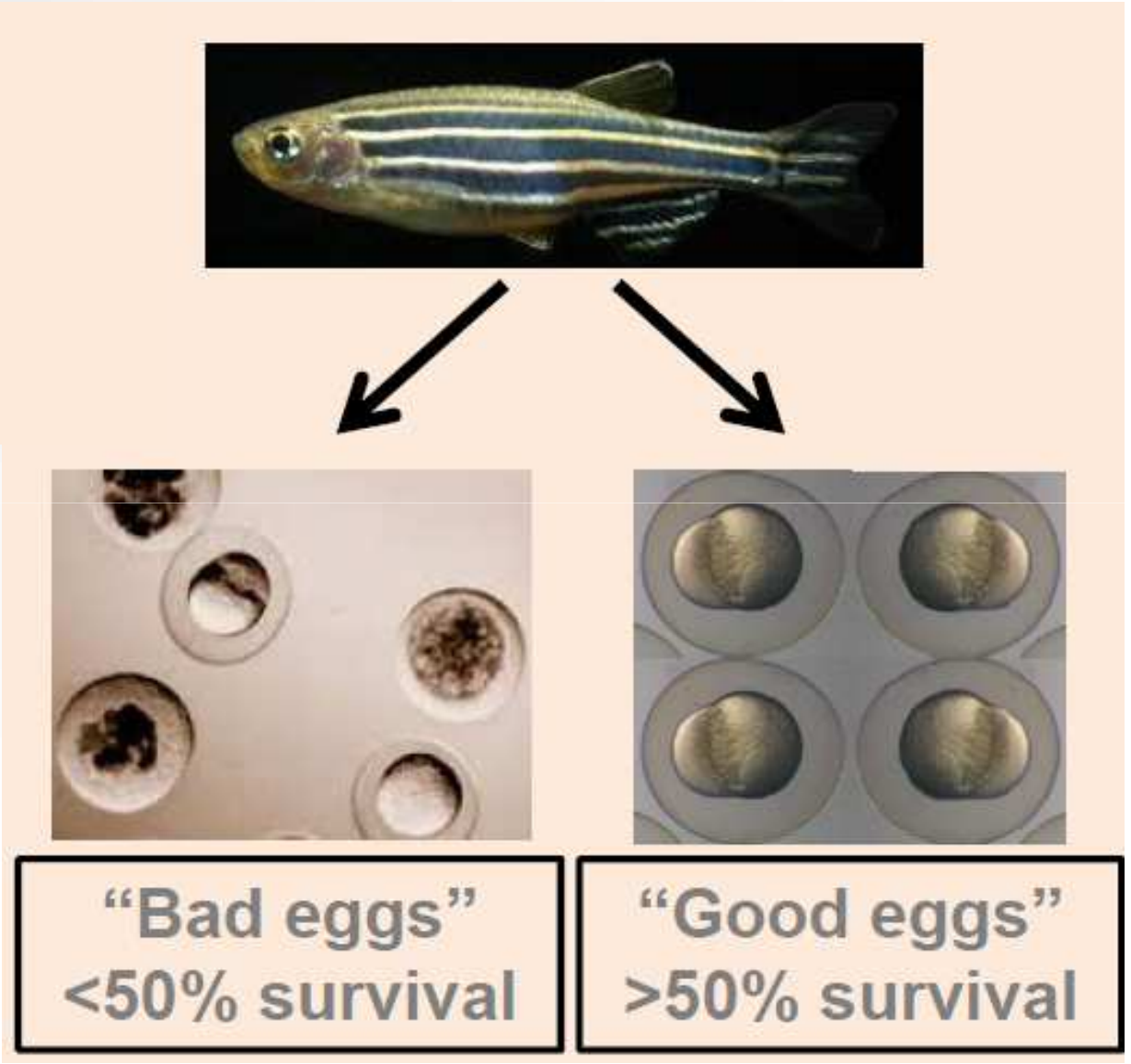
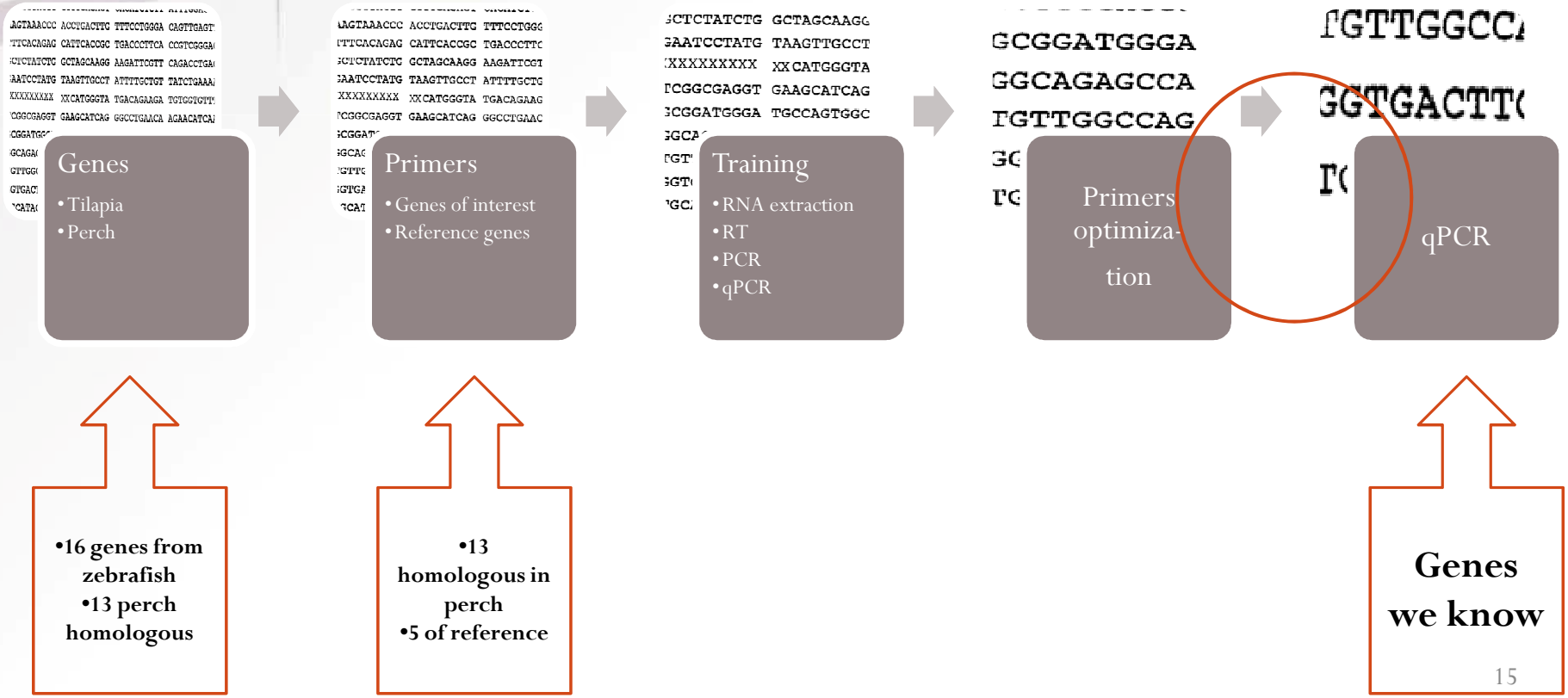


Image: Caroline Cheung

Steps of the analysis



Samples available

2013

- 3 wild
  - 28 spawns
- 1 domesticated
  - 8 spawns

2014

- 2 wild
  - 14 spawns
- 1 mixed
  - 7 wild
  - 23 domesticated

2015

- 1 wild
  - 25 spawns
- 1 domesticated
  - 23 spawns

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Categories

- **I – No fertilization**
- **II – Fertilization rate lower than 30%**
- **III – Early mortality (more than 50% between 24 and 48 hours post fertilization – hpf)**
- **IV – Low hatching rate (0-30%)**
- **V – Medium hatching rate (30-60%)**
- **VI – High hatching rate (higher than 60%)**

M. Alix, in process

Second goal of the project – Microarray analyze

- New categorization
  - Maximize the differences
  - Easier to associate with the phenotype
  - Reliable results

Microarray analyze

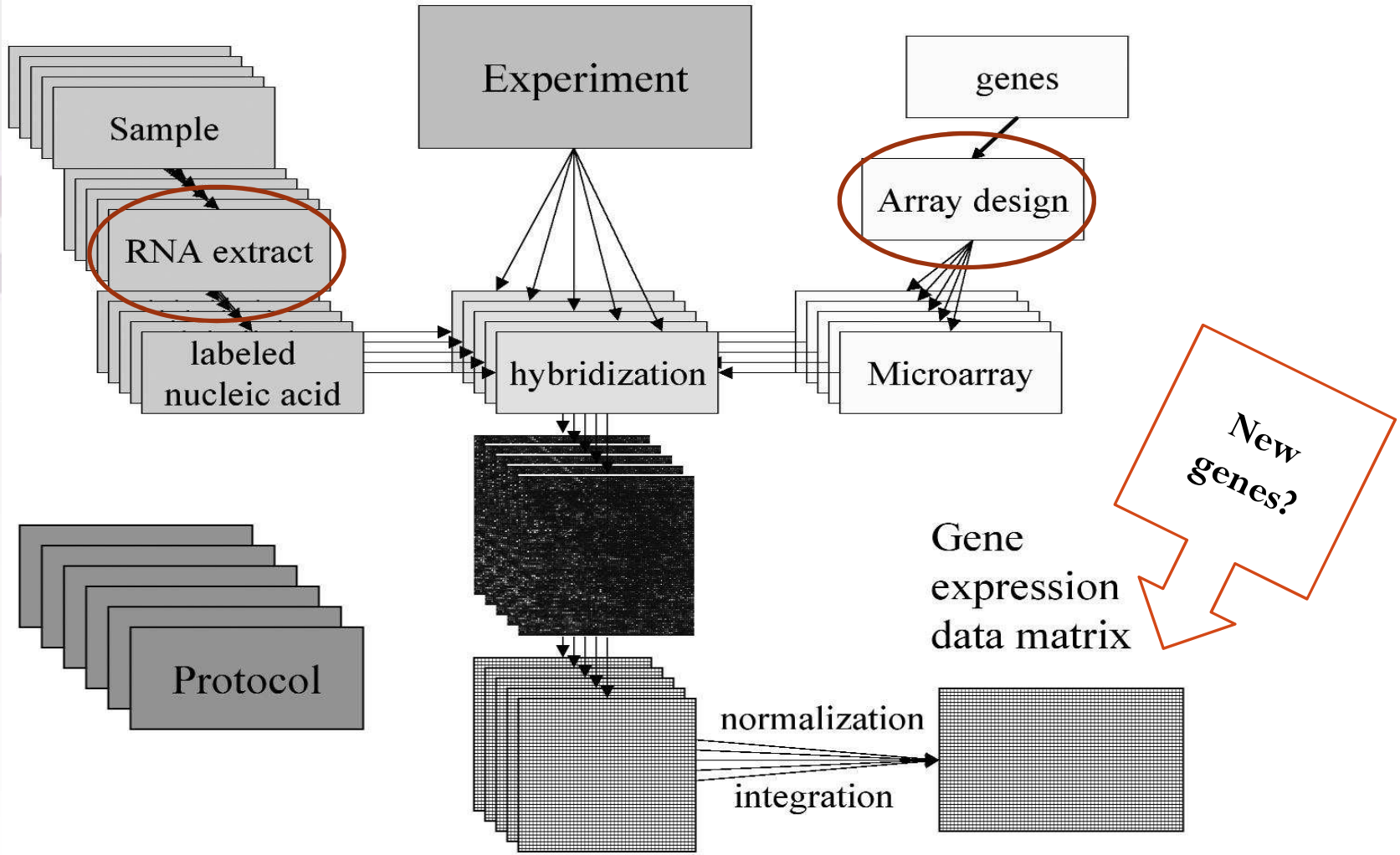

Image: Ball and Bazma, 2006

Samples available

- Genes from Maternal Legacy Project

Are the molecular mechanisms conserved?

Samples available

- Genes from microarray analysis

There are new genes that are specific for egg quality on perch?

Perspectives

- Modulating factors affecting the gene expression

Thank you for your attention

Questions? Suggestions?

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