Chromosome Manipulations

1) induction sterility
2) Transgenesis
3) Sex reversal
   3-1) Feminization
   3-2) Masculinization
4) Hybridization
5) Gynogenesis
6) Androgenesis

Chromosome Manipulations

مشکلات ایجاد بلوغ جنسی در دوره پرورش

- کاهش شدت تغذیه
- کاهش رشد
- افزایش حساسیت ابتلا به بیماریها
- تغییر در کیفیت گوشت
- تغییرات ظاهری و کاهش بازار پسندی
- تولید ماهی با اندازه متفاوت
- رها سازی در منابع آبهای طبیعی

Chromosome Manipulations

1) induction sterility

1. **Surgical**
2. **Irradiation**
3. **Hormonal**
4. **Hybridization**
5. **Polyploidy**

Triploid Hybrids

- Triploids where one diploid set of chromosomes comes from one species and one haploid set comes from another.
  - e.g. grass carp x common carp or rainbow trout x brook trout;
- Often show increased survival;
- Sterility is more sure;
- Can often reproduce the growth advantage of triploids without the mortality or deformity rates sometimes seen in triploids (e.g. coho x chinook salmon triploids)

Chromosome Manipulations

1) induction sterility

Polyploidy

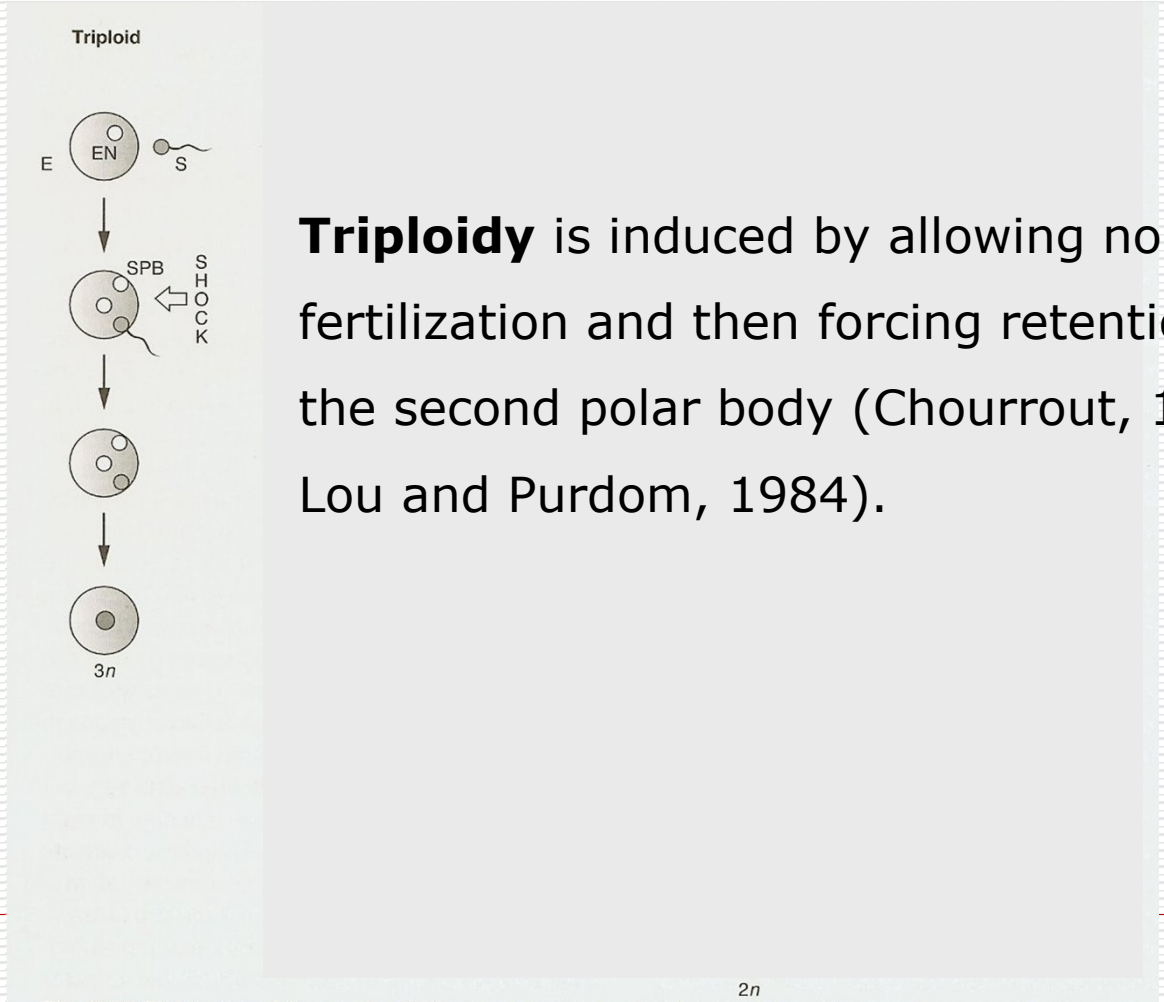
Polyploidy has been thoroughly studied in fish and shellfish.
The polyploid state refers to individuals with extra sets of chromosomes.
The normal and most common chromosome complement is two sets (diploid).
Triploidy refers to individuals with three sets of chromosomes and tetraploidy refers to individuals with four sets.

Methods to Induce Triploid

- Direct Method
- Indirect Method

Polyploid Induction in Fish

Direct Method



Triploidy is induced by allowing normal fertilization and then forcing retention of the second polar body (Chourrout, 1980, 1984; Lou and Purdom, 1984).

Fig. 7.10 The timing of the shocks that are needed to create triploids, tetraploids, gynogens and androgens. See the text for the abbreviations and explanations. E, egg; S, sperm; EN, egg nucleus. After Tave (1990b)

Direct Method

- Physical shocks

  Thermal shock

  Cold Shock
  Heat Shock

  Hydrostatic Pressure

- Chemical treatments

جدول ضمیمه ۲ - مروری بر شوکهای دمایی استفاده شده توسط محققین مختلف

ردیف	ماخذ	گونه مورد تحقیق	دمای شوک (°C)	زمان اعمال شوک پس از لقاح	مدت اعمال شوک
۱	Stanly (1975)	کپور معمولی	۳۵	۱min	۱-۱۰min
۲	Chourout,D.(1982)	قزل آلای رنگین کمان	۲۴،۲۶،۲۸	۲۵min	۵-۳۰min
۳	Refstie(1982)	ماهی آزاد کوهو	۰/۵-	۰/۵-۱۰min	۴h
۴	Thampson,D.(1984)	قزل آلای رنگین کمان	۲۸	۴۰min	۱۰min
۵	Purdom,C.(1985)	قزل آلای رنگین کمان	۲۸	۳۰min	۱۰min
۶	Linhart,o.(1986)	کپور معمولی	۰-۴	۵-۱۵min	۶۰min
۷	Chourrout,D.(1986)	قزل آلای رنگین کمان	۲۶	۲۵min	۲-۲۰min
۸	Hollebeq(1986)	کپور معمولی	۳۵-۴۰	۱-۵min	۳۰Sec-۳۰min
۹	Linhart(1986)	لای ماهی	۰-۴	۵min	۲۵min
۱۰	Disney(1987)	قزل آلای رنگین کمان	۲۹	-	۱۰min

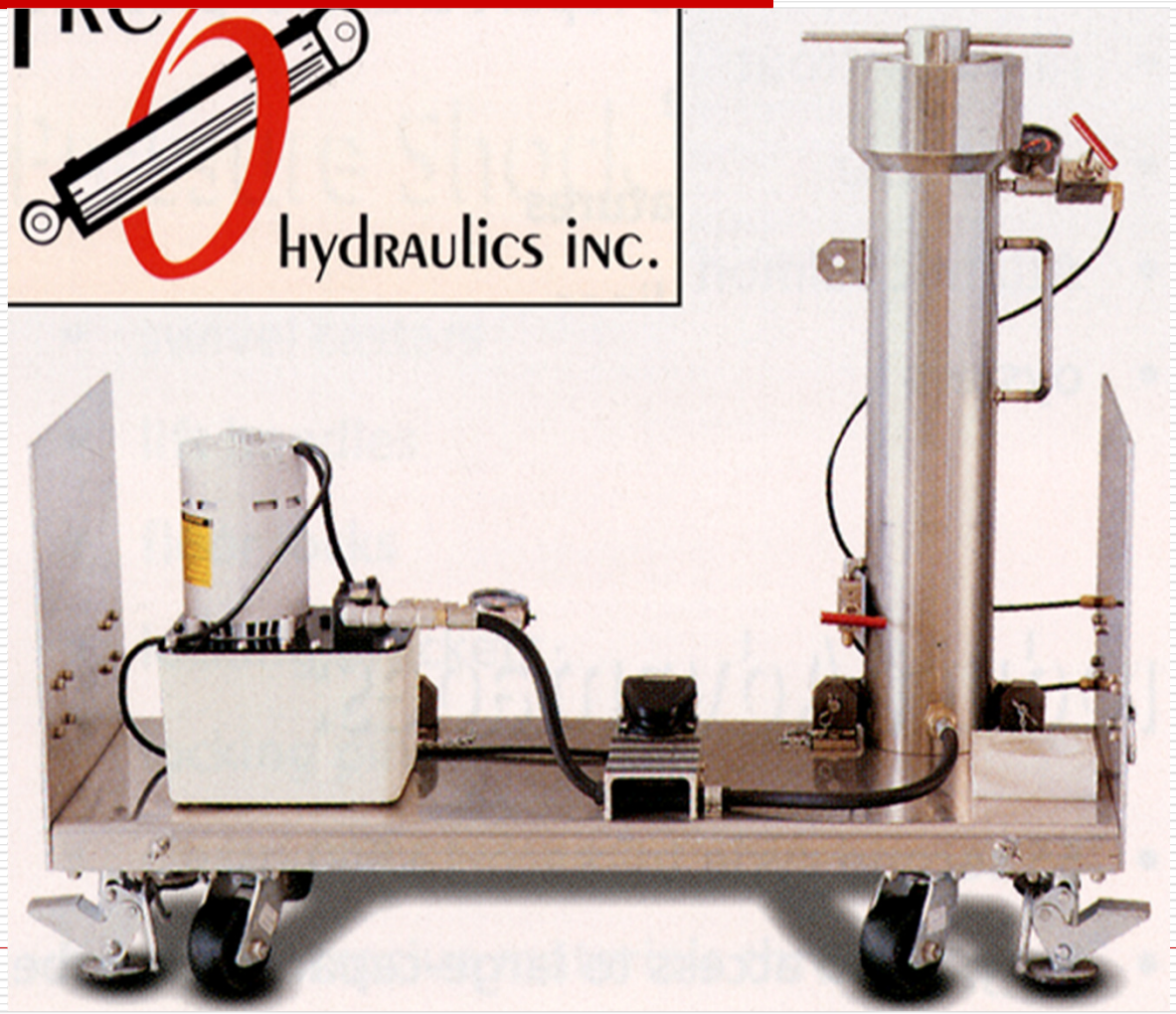
Direct Method

- Triploidy successful depends largely on three factors

	Shock intensity	Time of shock initiation	Duration of treatment
Heat shock	26-28 C	20 -40 min (300-600 CTM)	10 -20 min
Hydrostatic Pressure	7000 – 10000 psi	(300-600 CTM)	3-10 min (5)

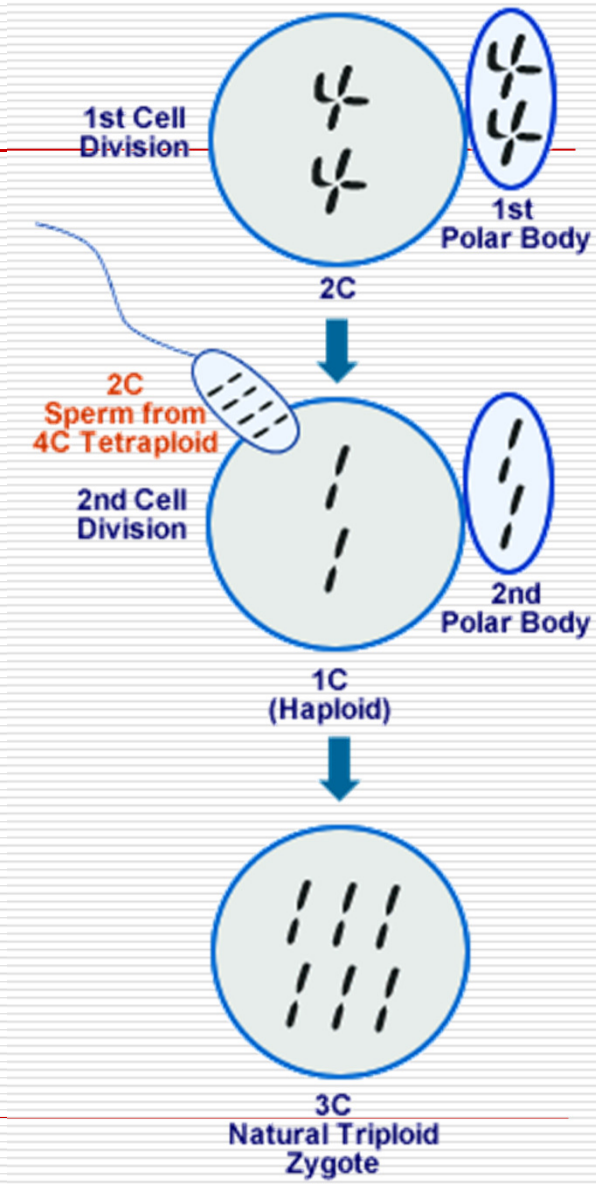
Direct Method

Direct Method

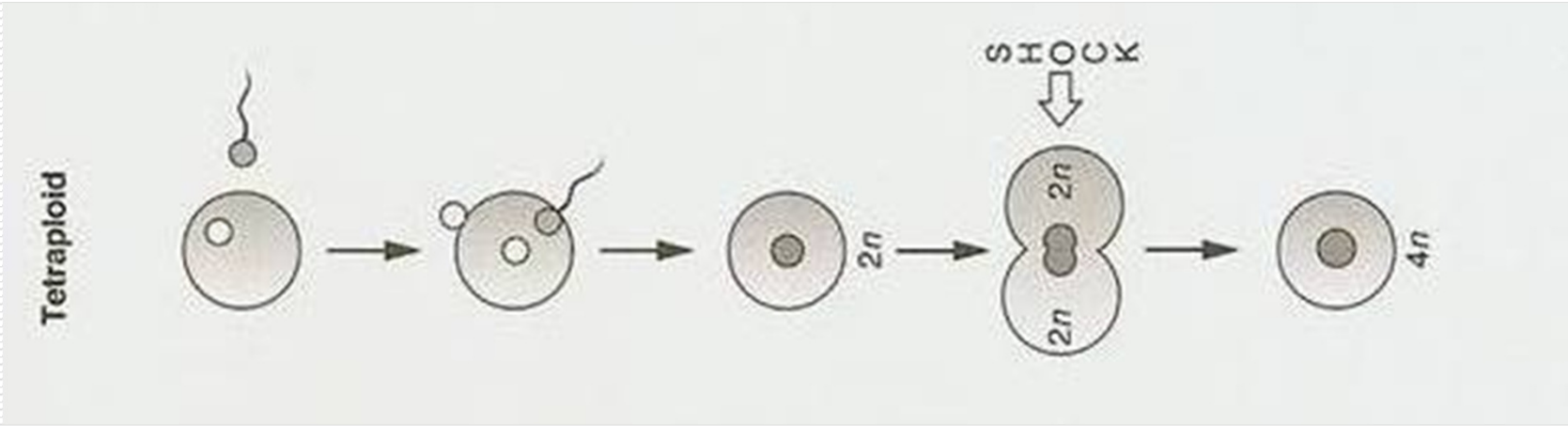


Indirect Method

4n * 2n ⟶ All 3n

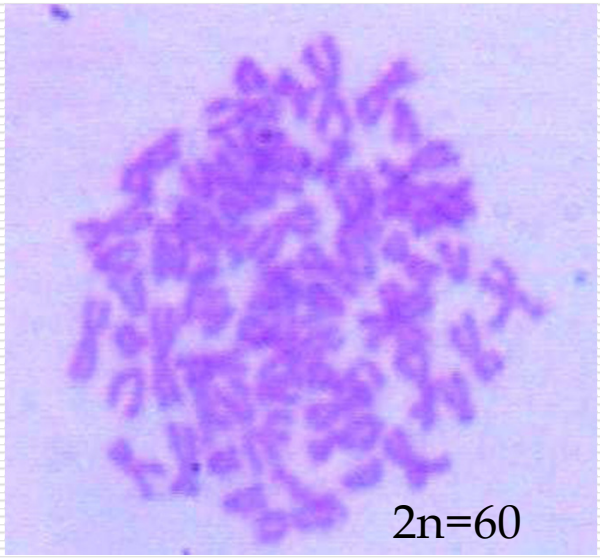


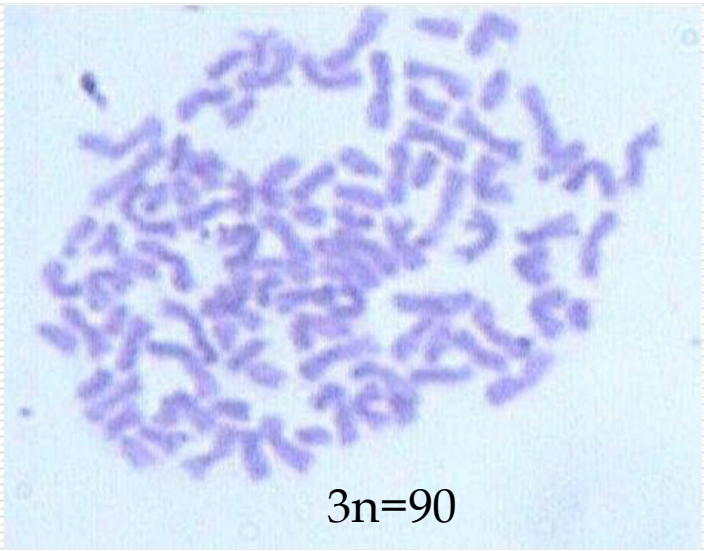
Induction Tetraploid



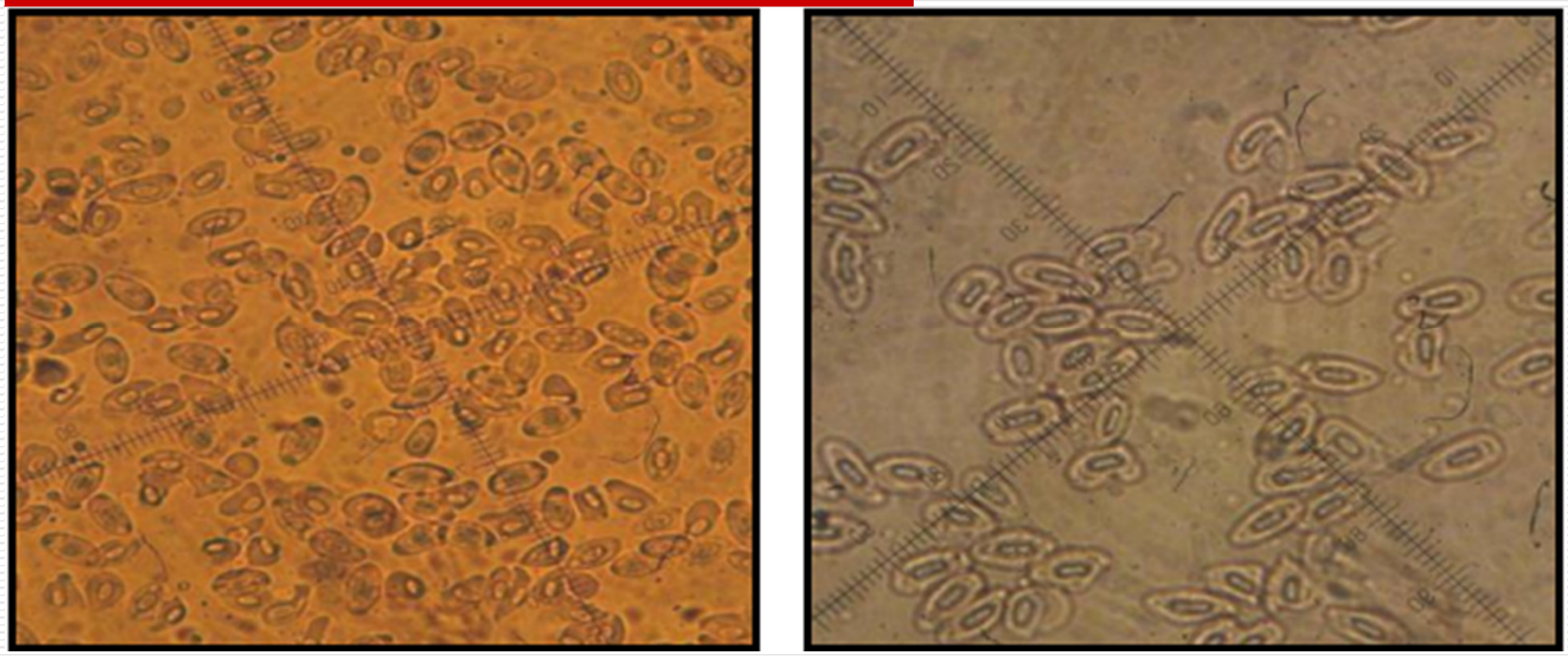
Ploidy Determination

Karyotyping, the actual visualization and enumeration of chromosomes, is, of course, the most accurate method for determining ploidy level.
cell-size measurement with a blood smears.
Flow cytometry



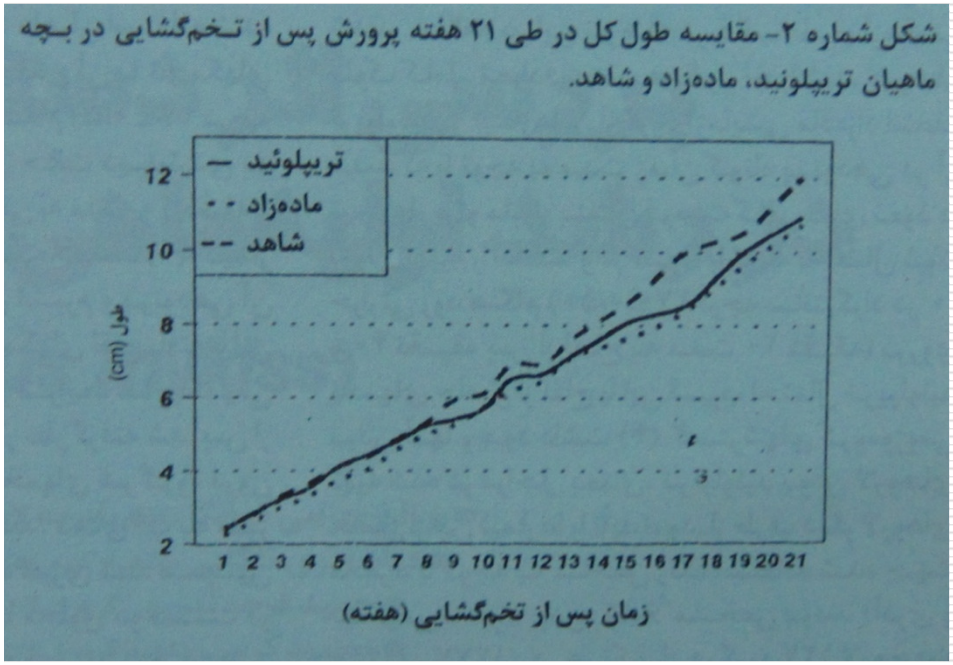


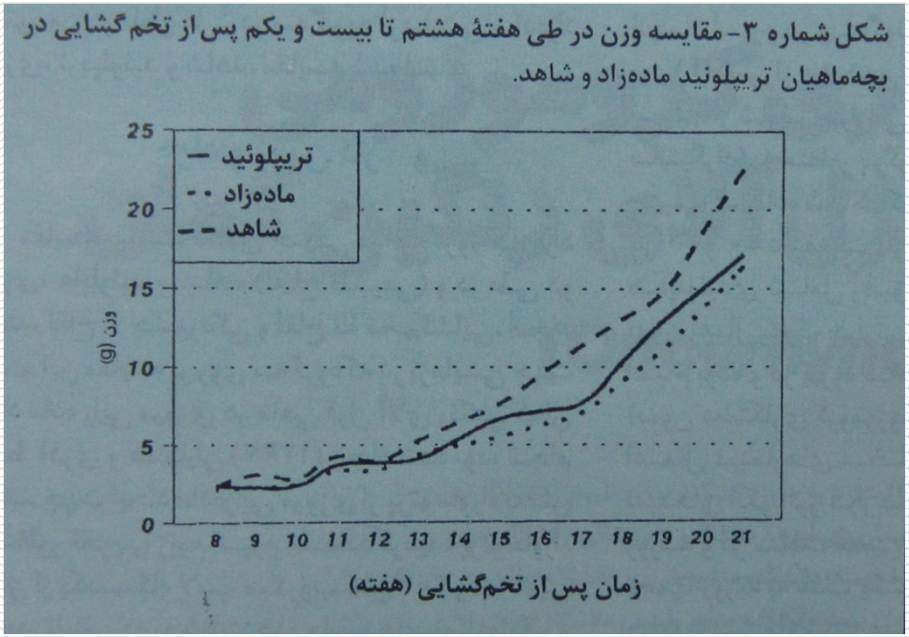
Ploidy Determination



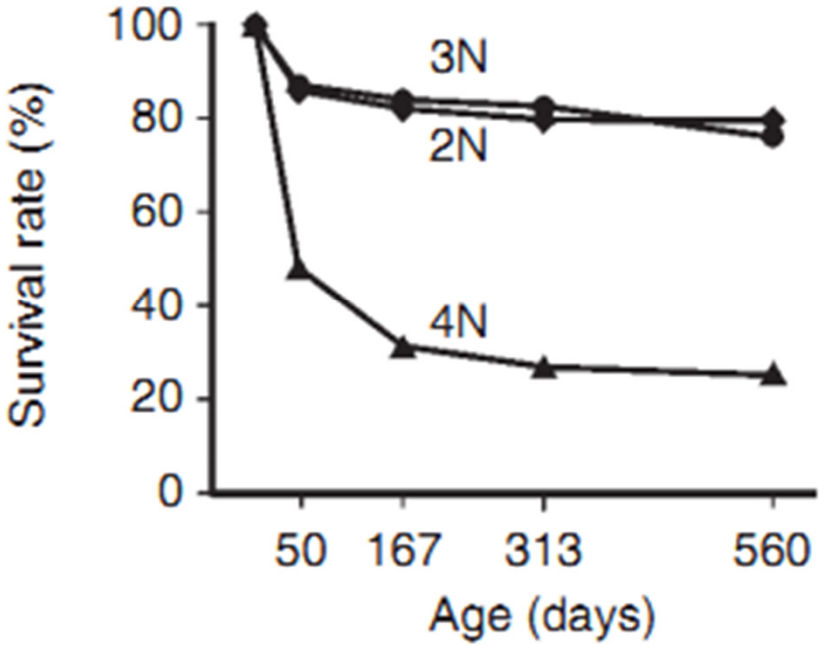
Erythrocytes of diploid (left) and triploid (right) brown trouts (×40 magnification, each unit 2.5 μm)

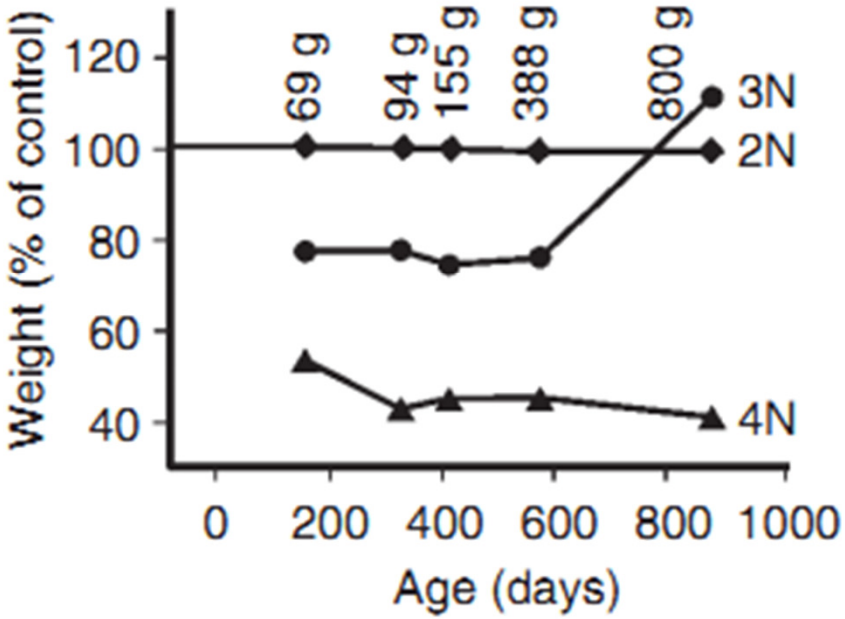
Growth of Diploid, Triploid and Tetraploid





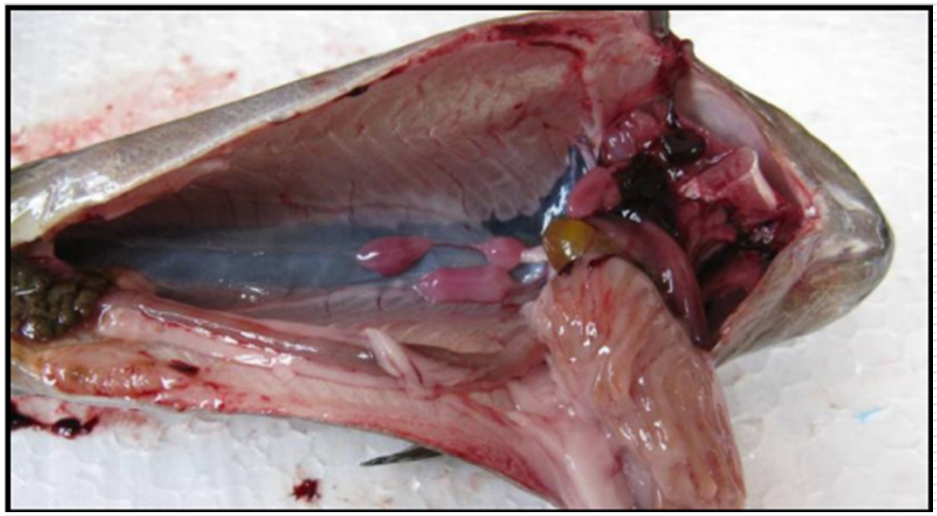
Growth of Diploid, Triploid and Tetraploid





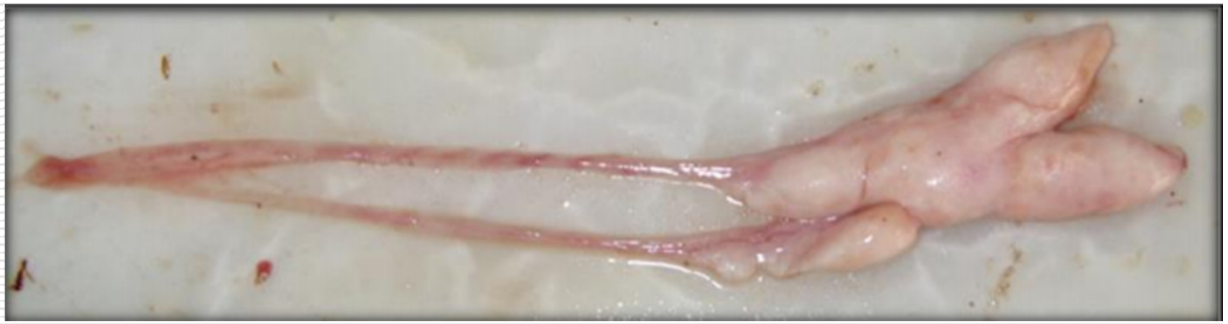
Problems with Triploids

- For many species triploids are not allowed by law (e.g. sea bass in Europe);
- Although sterile many triploids differentiate and develop gonads to some extent (mosaics) , so growth advantage is not always there;



Macroscopical appearance of triploid ovarium in the female brown trout on the 19th month post-fertilization

Macroscopical appearance of triploid testis in the male brown trout on the 19th month postfertilization



All female triploid