نشست تخصصی فعالان و پرورش دهندگان ماهیان خاویاری کشور

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Optimization of broodstock management for all-year round obtaining of ovulated eggs for controlled reproduction and caviar production

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Content

- Main factors, determining sustainable development of sturgeon culture

- Brief assessment of climate changes impact on the critically important stages of
- sturgeon maturation and breeding

- Various types of intensive sturgeon farms

- Algorithm to control seasonality of reproduction, including femailes selection etc.

- Ultrasound screening of female readiness for wintering

Climate change

increase of temperature and frequency of abnormal phenomena

Broodstock management

- genetic diversity
- holding conditions
- ultrasound monitoring of
- maturation state
- Maturation control
- technology improvement

Main factors, determining sustainable development of sturgeon culture in the current context

Climate change

increase of temperature and frequency of abnormal phenomena

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- genetic diversity
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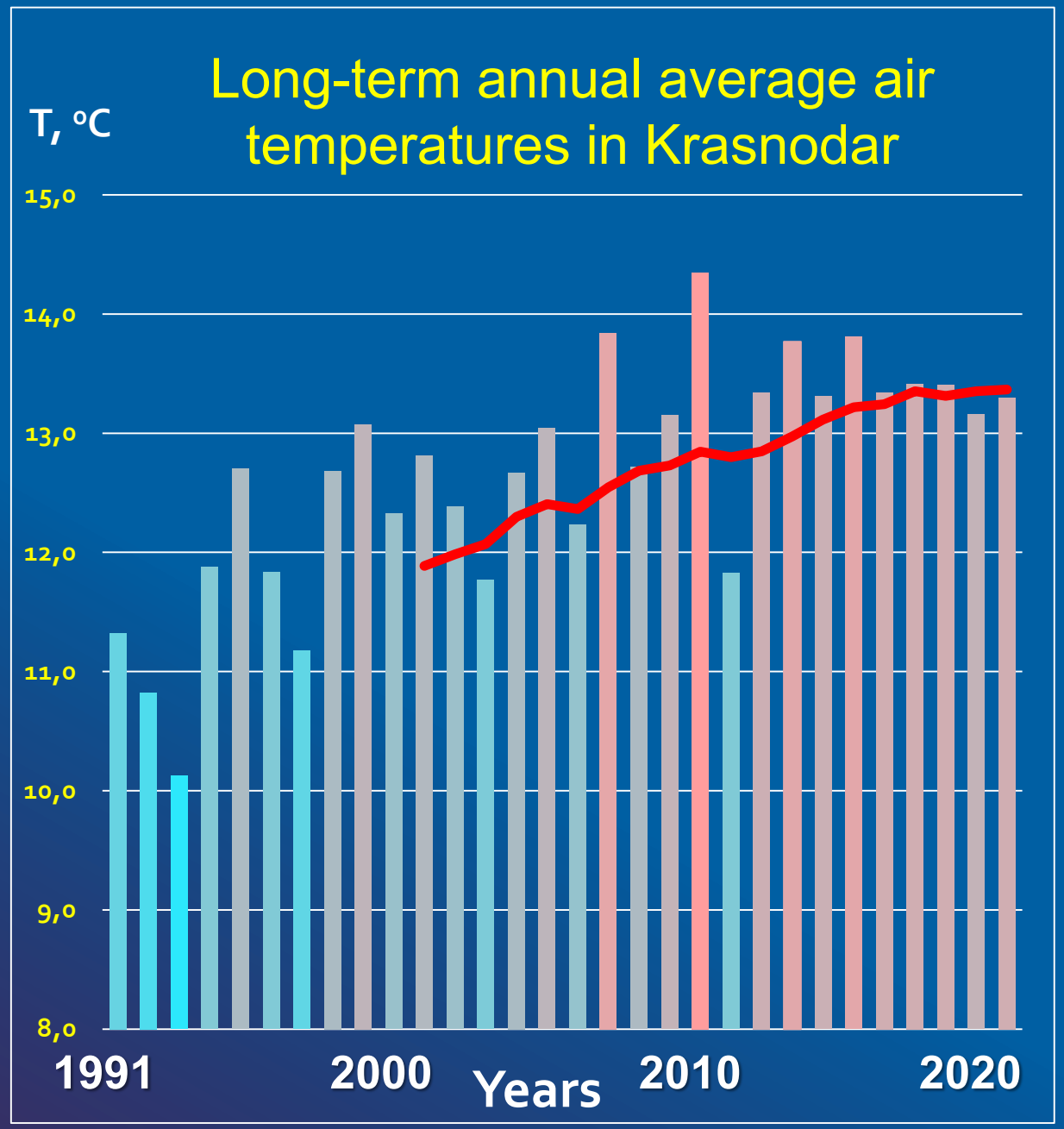
Main factors, determining sustainable development of sturgeon culture in the current context

Assessment of climate changes impact



For past 10 years average monthly temperatures of water in the Azov-Kuban basin exceeded (all year through) the long-term annual values till 2,5 °C for all the period of observations.

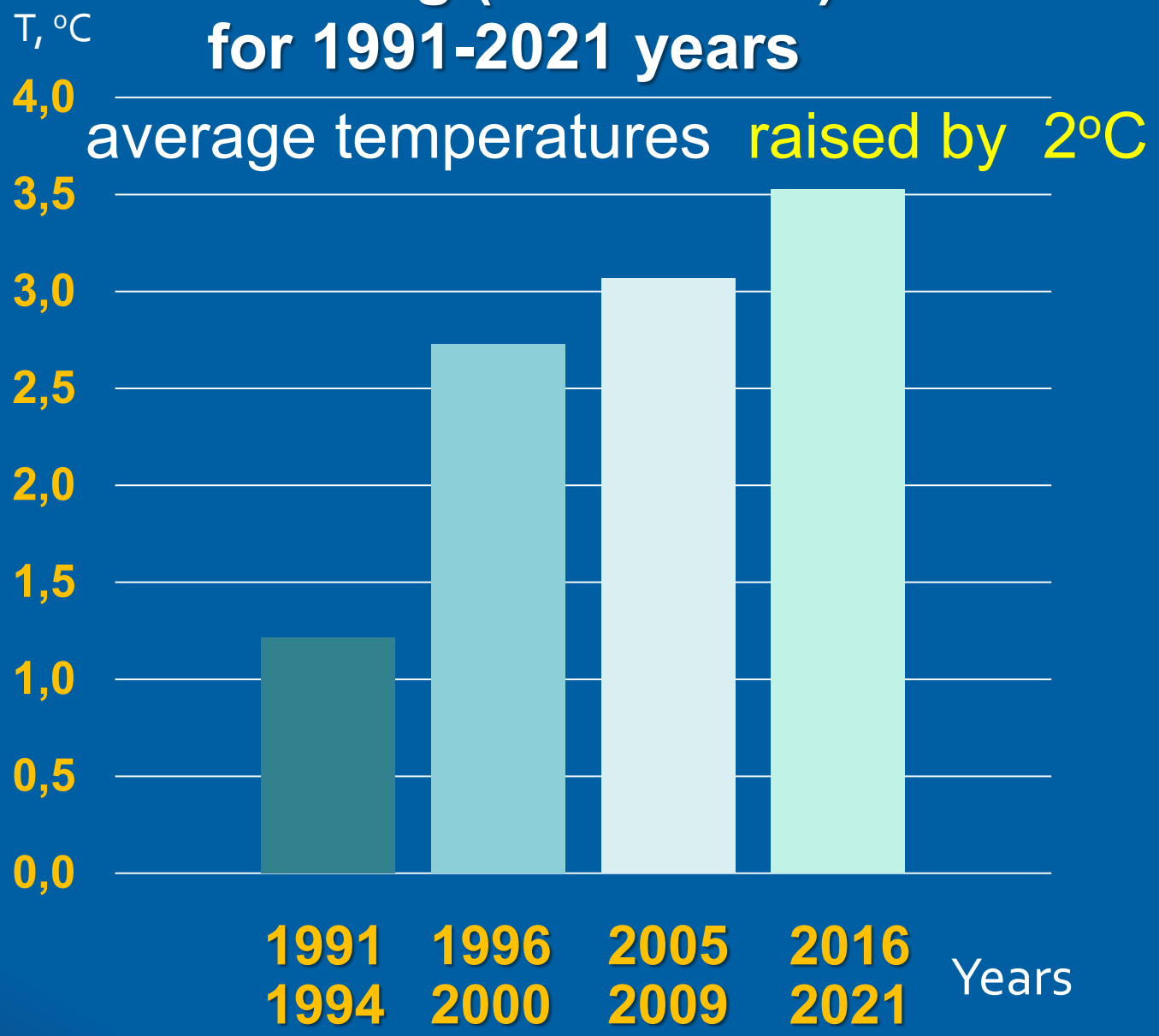
11 of 12 maximal average monthly temperatures in the entire history of observations was recorded **during past 20 years.**

Period of winter water temperatures (below 8°C):

- duration decreased to 20 days (on 15 %);

- shifted to 16 days earlier date.

Average water temperatures of wintering (below 8 °C) for 1991-2021 years



	Dec.	Jan.	Feb.
1991	0.3	0.2	-4.3
	-1.2	0.1	-0.3
	2.3	-1.0	-0.8
	-1.4	2.8	-1.6
	0.7	1.7	5.6
	2.7	-2.3	1.4
	2.3	-1.5	0.9
	1.8	0.5	0.0
	6.4	2.9	4.7
2000	3.5	0.0	3.2
	-0.4	2.0	2.8
	-3.5	-1.7	6.6
	2.6	2.0	-1.5
	3.0	4.1	3.8
	5.0	4.5	1.4
	2.2	-5.9	-1.4
	1.9	6.2	1.1
	1.2	-3.7	1.4
	4.5	-0.6	5.4
2010	7.2	0.1	3.4
	5.7	-0.1	-1.3
	2.3	-0.2	-5.1
	0.8	4.5	5.7
	4.5	0.9	2.6
	4.4	2.1	3.5
	-1.2	0.2	7.1
	5.2	0.6	1.4
	2.7	1.4	3.0
	4.0	2.9	3.1
2020	4.1	2.3	3.8

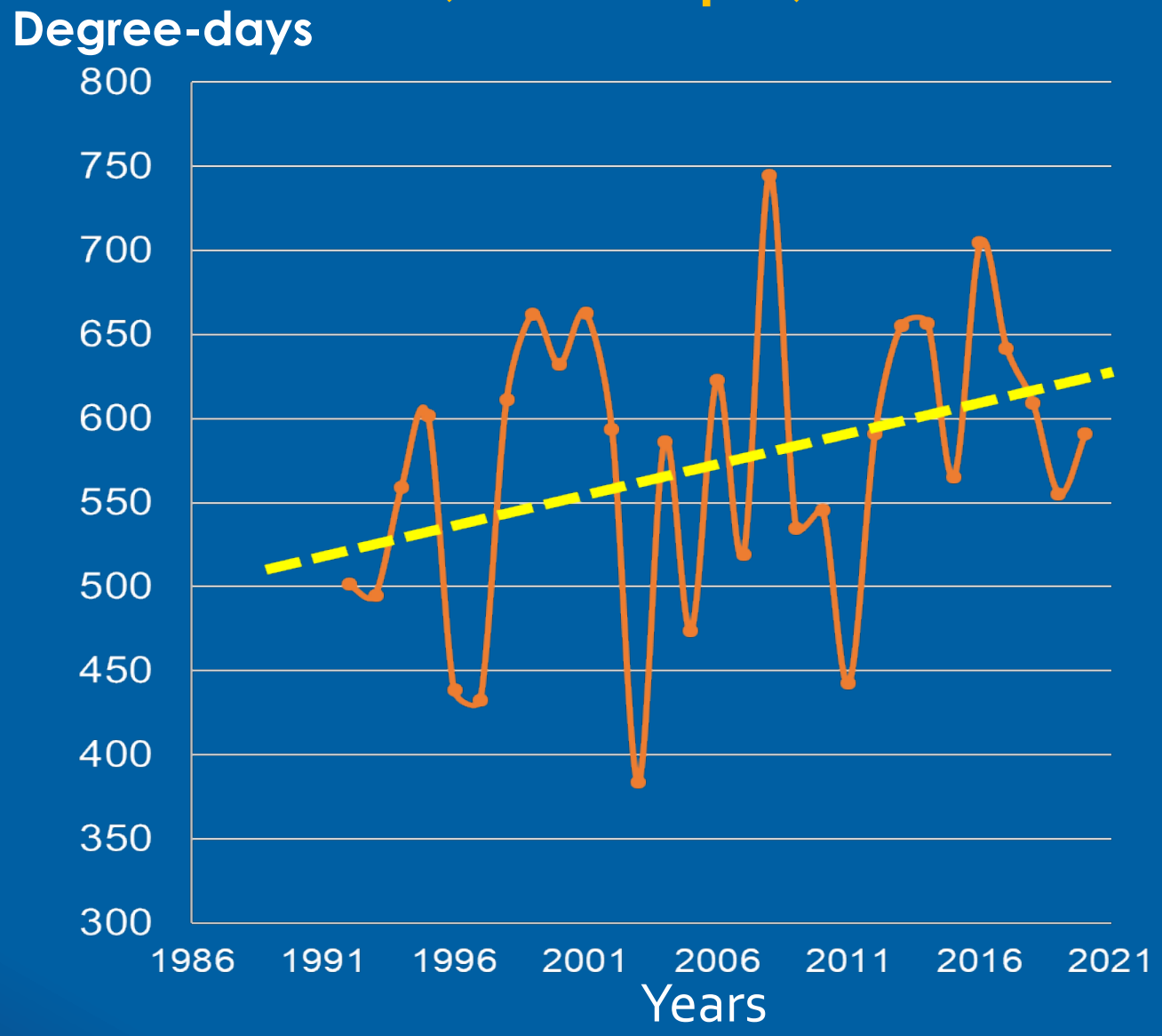
Impacts of wintering conditions change

Such «warm» winters with short-term periods of subzero air temperatures ($\Sigma < -200$ °C), lead to considerable decrease in trophoplastic reserve of females incommensurable with the rates necessary for gonad maturation completion.

Pre-spawning holding of breeders

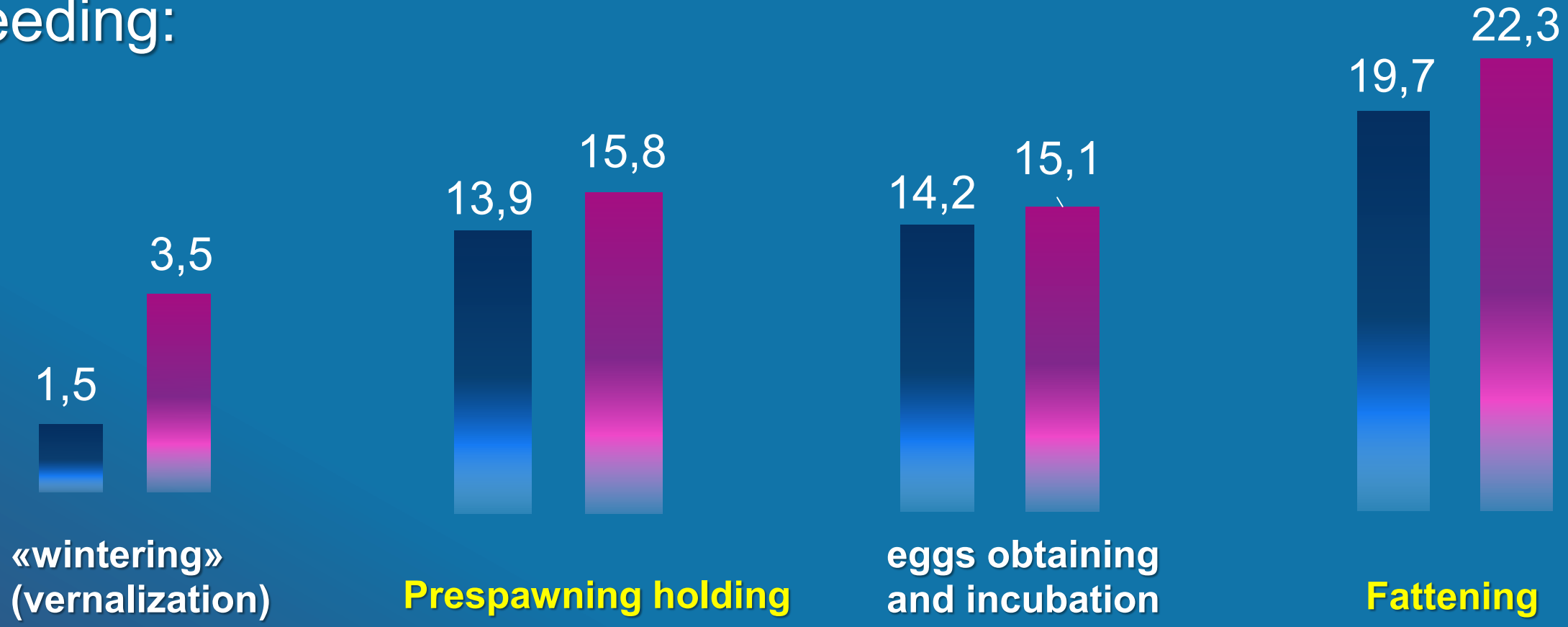
Pre-spawning effective accumulated thermal sum exclusively in March Increased more 70 degree-days!

Dynamics of accumulated thermal sum changes for pre-spawn period (March-April)



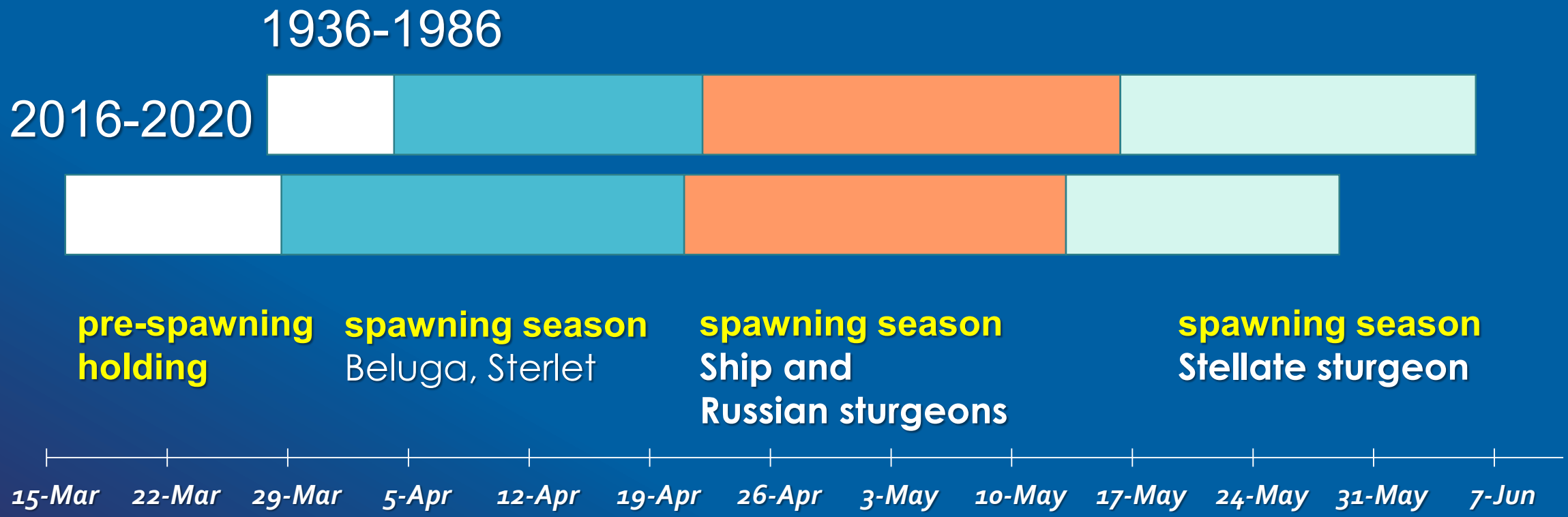
Assessment of climate changes impact

Seasonal temperature changes show the highest effect during the critically important stages of sturgeon maturation and breeding:



At such too early spring eggs extraction and incubation - at as well very considerable temperature fluctuations (without thermo regulation) during start of spring – the survival rate of embryos and output of pre-larvae

At 4 Federal Sturgeon hatcheries duration of spawning season for Russian, ship and stellate sturgeons has decreased by 20%.



Problem for most broodstocks at hatcheries:

Spontaneous selection at early spring female maturation at simultaneous decrease in duration

of optimal spawning temperatures

For effective use of large farmed broodstocks at hatcheries control on seasonality of maturation can became the **key technological element** of the technological scheme

VARIOUS TYPES OF INTENSIVE STURGEON FARMS

- RAS or warm-water farms

or combine (mixed):

- RAS and flow-through (or concrete and plastic tanks)
- RAS and cages, small ponds
- flow-through (tanks) +RAS
- cages + RAS
- flow-through (tanks) + small ponds
- cages in warm water + small ponds
- tropical and subtropical sturgeon farms

Holding of broodstock and rearing of juveniles at natural temperature is conducted, as distinct from all sturgeon hatcheries in the basin, at the farm which is located in the upper part of the river higher than all large industrial facilities, near historical natural spawning grounds

Thermal, hydro-chemical regime and periods of spawning campaign conducting meet the parameters during natural spawning

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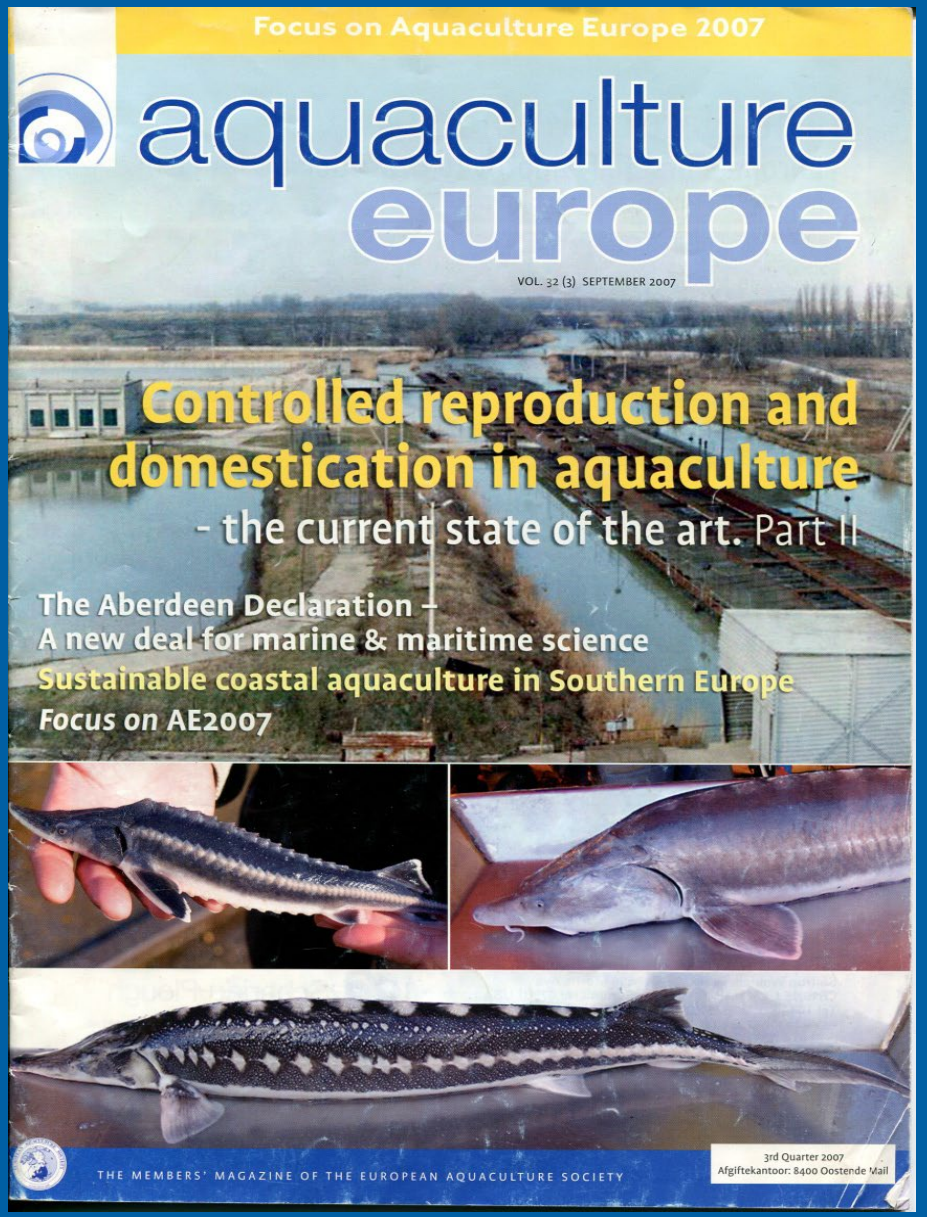
Warm-water cage farm

Unit for prespawning holding of breeders at lower temperatures


Focus on Aquaculture Europe 2007
aquaculture europe
VOL. 32 (3) SEPTEMBER 2007
Controlled reproduction and domestication in aquaculture
- the current state of the art. Part II
The Aberdeen Declaration –
A new deal for marine & maritime science
Sustainable coastal aquaculture in Southern Europe
Focus on AE2007
THE MEMBERS' MAGAZINE OF THE EUROPEAN AQUACULTURE SOCIETY
3rd Quarter 2007
Afgiftekantoor: 8400 Oostende Mail

Unit of juveniles' rearing

Cage line

…and rearing of younger age groups from October to April

Open pond recirculation system

ALGORITHM to control seasonality of reproduction

- Selection of the most mature – ultrasound
- Polarization index - biopsy

Transition to «wintering»

- Holding at low temperature at pre-spawn state to avoid over riping

  Assessment of «sum of cold»

Transition to spawning regime

- Holding at elevating temperature at (LTR)
- Control on «sum of temperatures»

Spawn

Thermal regime of wintering selection :

< 3

The average temperature < 3 °C

Allowable temperature of wintering.

Long-term holding at this temperature requires step by step transition to spawning regime

3-5

Average temperature of wintering - 3-5 °C

Preferred (optimal) temperature of wintering for all species at obtaining ovulated eggs for caviar or for eggs fertilization

6-7

Average temperature of wintering - 6-7 °C

Permissible for following caviar production. During wintering at this temperature weak fish have a risk for the eggs atresia initiation.

> 8

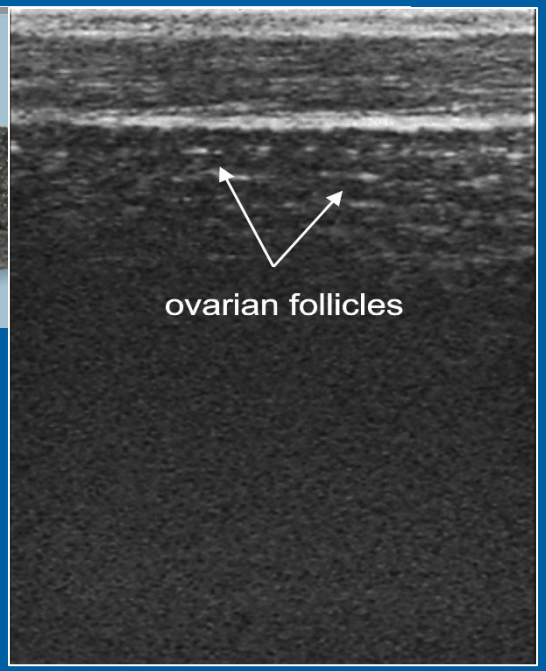
Average temperature of wintering - 8 °C or above

regime cannot be considered as wintering.

The probability of mature eggs resorption at wintering and pre-spawning holding is high; a part of the oocytes of females loss their ability to ovulate

Fish at stage 4th are transferred to holding at low temperatures (4ºC lower than the lowest limit of spawning temperatures), with feed deprivation for further maturation of oocytes and avoiding atresia.

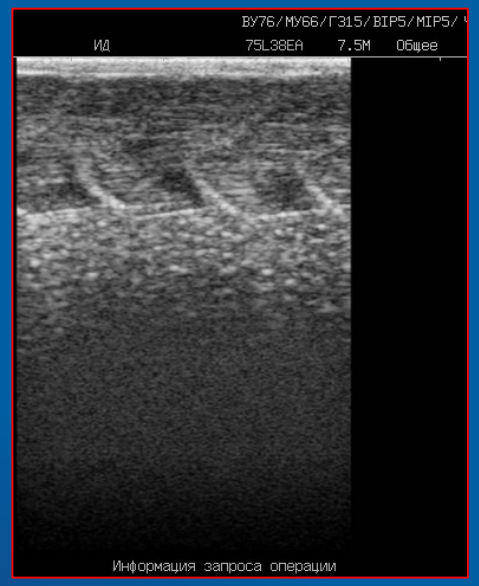
Stage 3-4



Stage 4 incomplete

ULTRASOUND SCREENING OF FEMALE READINESS FOR WINTERING

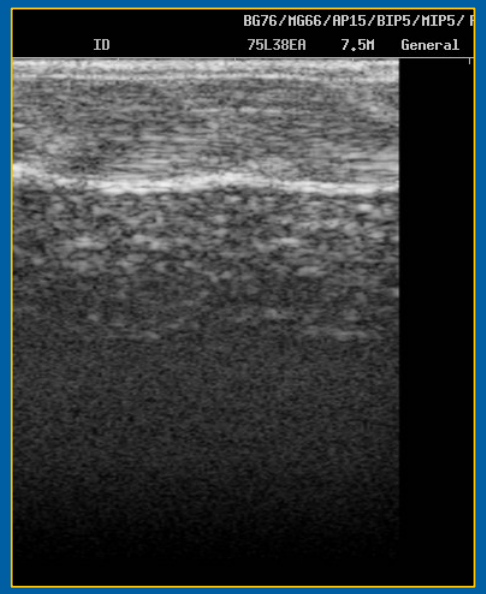
Fattening is required



III – IV maturity stage

Small eggs of species specific size

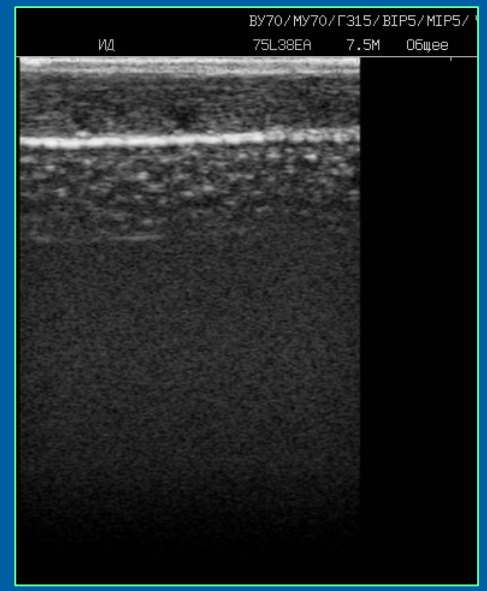
Fattening is desirable



early IV stage

The accumulation of necessary amount of nutrients is not completed

Ready for wintering



IV incomplete

Gonads status is optimal for transition to wintering and successive spawning

no obvious rowing of oocytes;

very light hyper echoic top of the echogram of the gonad and the oocytes do not accumulate a sufficient supply of fat and other nutrients;

during the wintering of such a female, changes in the gonads will not occur, the females will remain insufficiently mature

Regime of holding at low temperature (wintering):

Species	Planned period of spawn	T °C holding.	Required «sum of cold»	
			min	opt
Beluga	October-December	3-3.5	160	200
	January-March	4-5		
	June-August	5-6		
Russian and Siberian sturgeon, Russian sturgeon x Siberian sturgeon (Lena population)	October-December	3.5-4.5	140	180
	January-March	5-6		
	June-August	6-7		
Stellate sturgeon	October-December	6-7	150	220
	January-March	7-8		
	June-August	7-8		
Sterlet, hybrids sterlet and beluga	October-December	4-6	80	110
	January-March	6-7		
	June-August	7-8		

Transition to spawning temperature regime

- Methods of transition of sturgeon from the state of reservation to spawning temperatures regime is speies specific and depends on the duration of fish holding at low temperatures.
- As experience has shown, the transition of sturgeon to final stage of sexual cycle after long-term holding at low temperatures could not be performed by simple linear temperature increase.

- Further it is expedient to align with established total balance of spawning temperatures effect, that is presented below

Exclusiuvely for caviar

EXPRESS-

Optimal conditions for conducting:

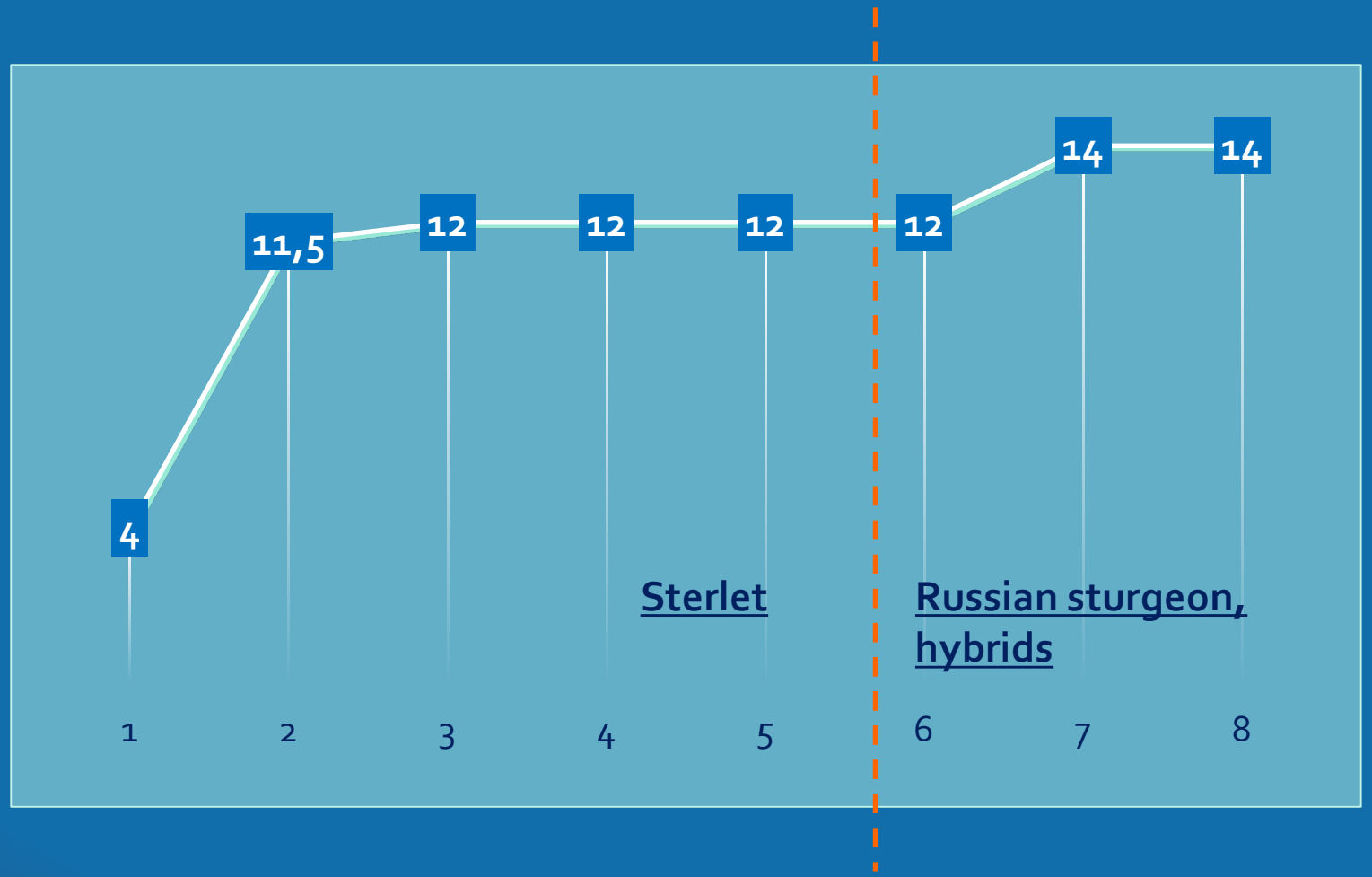
- **Short wintering**
- **The most mature fish at autumn assessment**

Recommended duration of pre-spawning holding:

- **Sterlet – from 3 to 5 days**
- **Russian sturgeon – from 5 to 8 days**

An increase in the duration of holding in this case leads to the onset of resorption

TRANSITIOIN TO THE SPAWNING REGIME:



NORMAL

for obtaining both caviar and fertilized eggs

Requires long-term holding at pre-spawning temperatures till the accumulation of required amount of thermal content

differences in the readiness of fish for spawning (maturity) are leveled due to different duration of their pre-spawn holding

TRANSITION TO THE SPAWNING REGIME:

TRANSITION TO THE SPAWNING REGIME

REGIME AFTER LONG-TERM PRE-SPAWNING HOLDING FEMALE

Is used at:

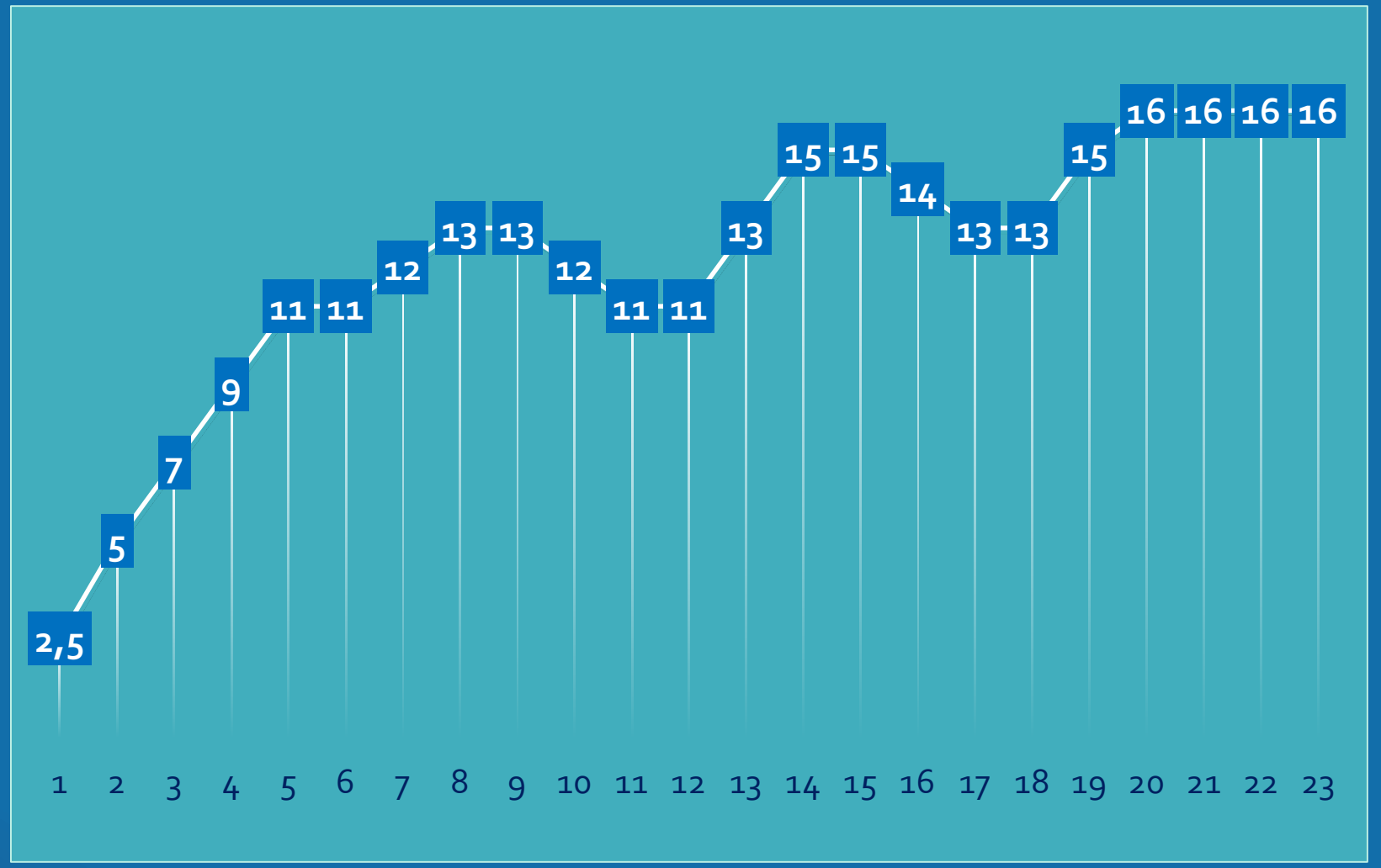
- **controlled sexual cycle ;**
- **long-term wintering at low temperatures**

Conditions:

Prolonged wintering

Low temperature of water (1,5 – 2 °C) during more than 80 days

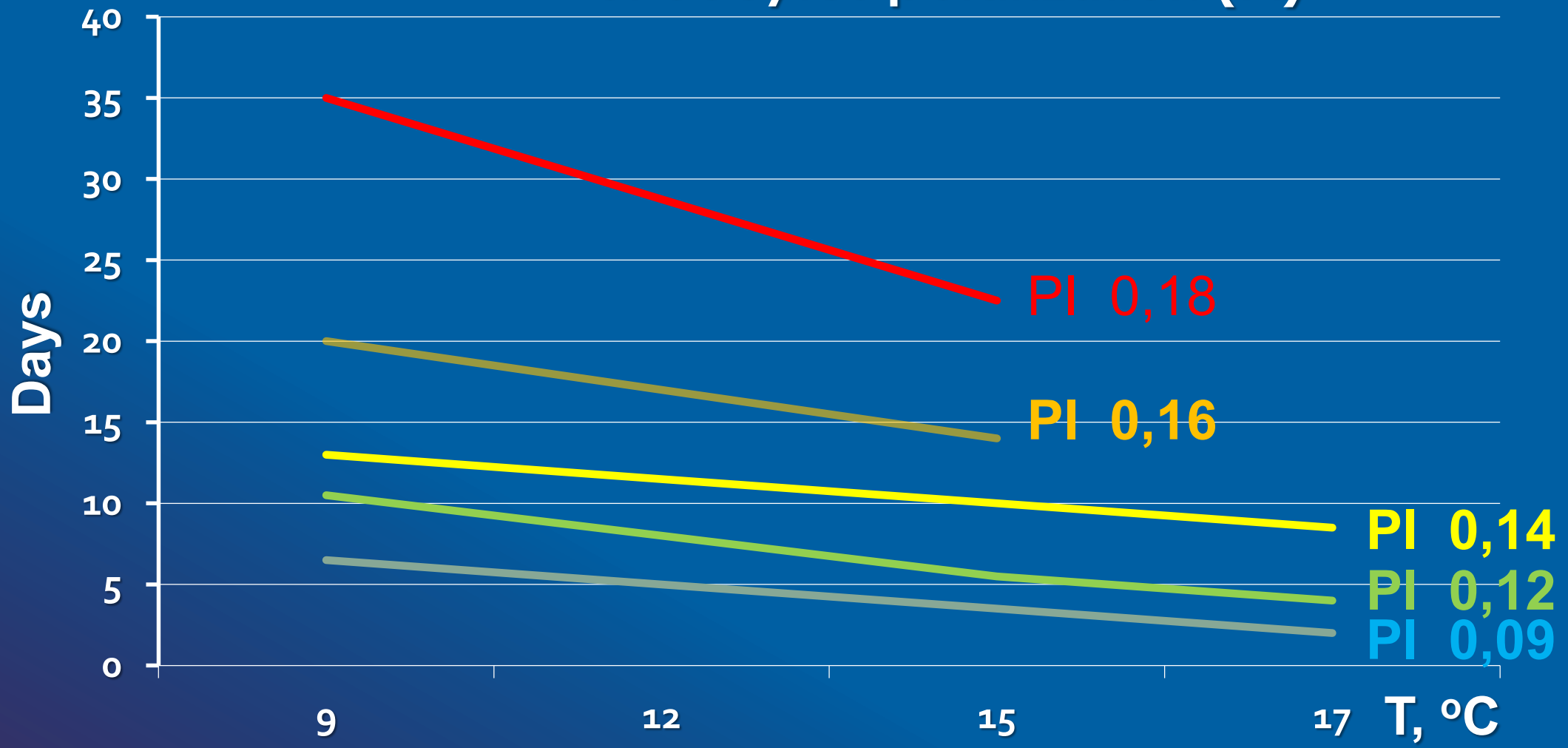
Simple linear increase in temperature is inadmissible and could lead to fish mortality



OPTIMAL VALUES OF SUM OF TEMPERATURES AT TRANSITION TO SPAWNING REGIME: (DEGREE-DAYS)

- Beluga: 120-180;
- Russian sturgeon: 150-200;
- Siberian sturgeon: 130-160;
- Stellate sturgeon: 250-300;
- Sterlet: 110-160.

The main parameter related to duration of pre-spawn holding is a sum of spawning temperatures, (in degree-days) and depending on water temperature and coefficient of oocytes polarization (PI)



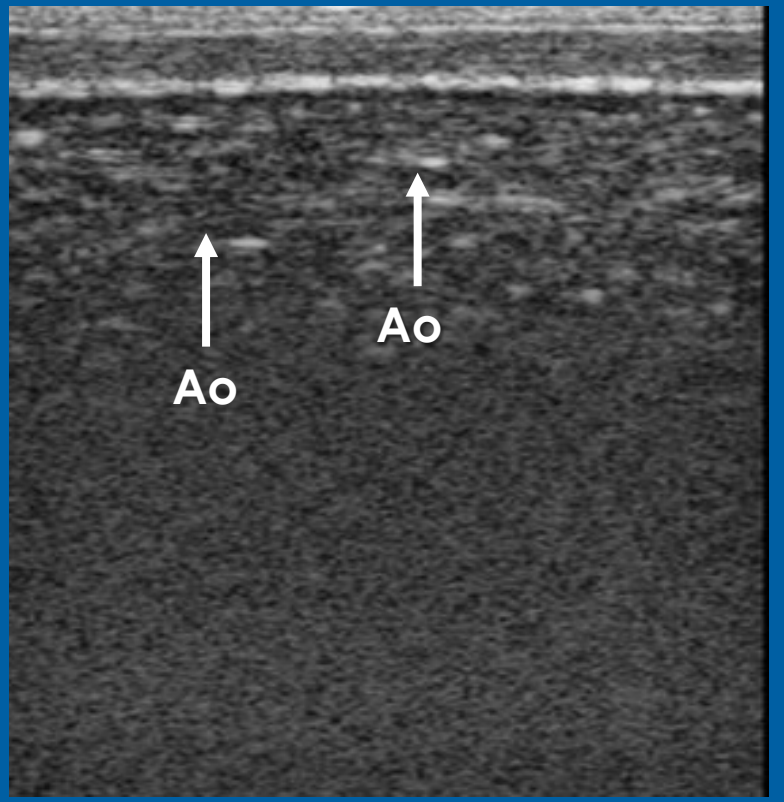
K_n (PI)	Required sum of temperatures (degree-days)
0.18	410-500
0.17	350-400
0.16	260-300
0.15	210-250
0.14	170-200
0.13	120-150
0.12	90-100
0.11	60-70
0.09	30-50

Onset of oocytes atresia – ultrasound control

The degeneration of mature oocytes can be hardly visualized at the beginning.

distortion in form of mature oocytes.

On echograms, they appear as slightly prolonged (flattened) with violated arrangement of the rows.

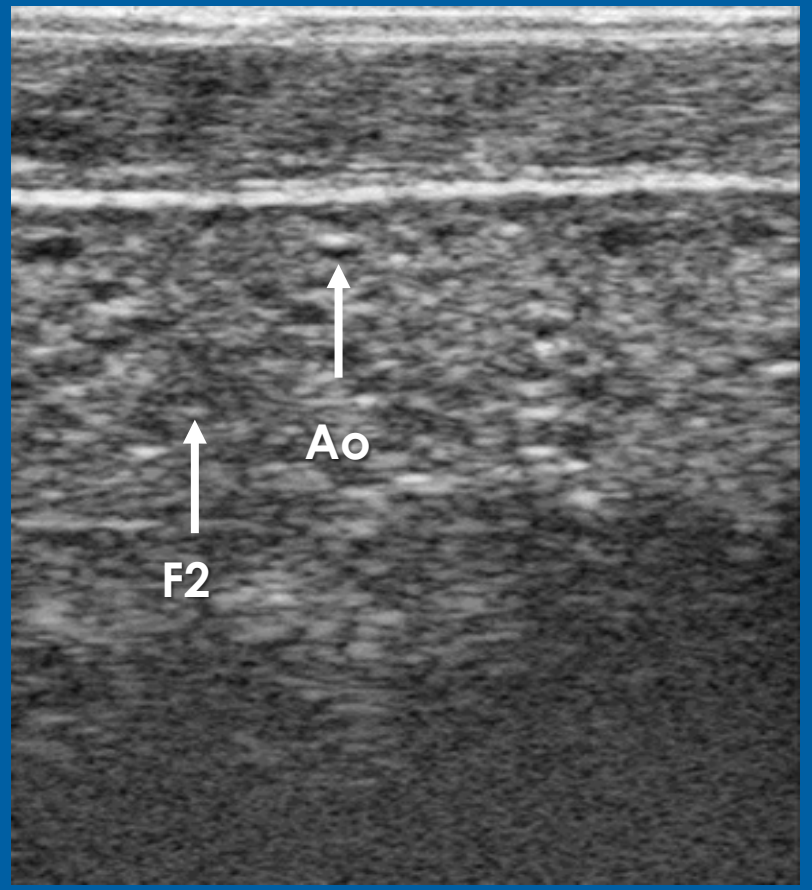


Ao – onset of oocytes atresia

Total atresia of ripe oocytes in mature females at long-term (above 20 days) holding at temperature > 15°C

F 6-2 stage

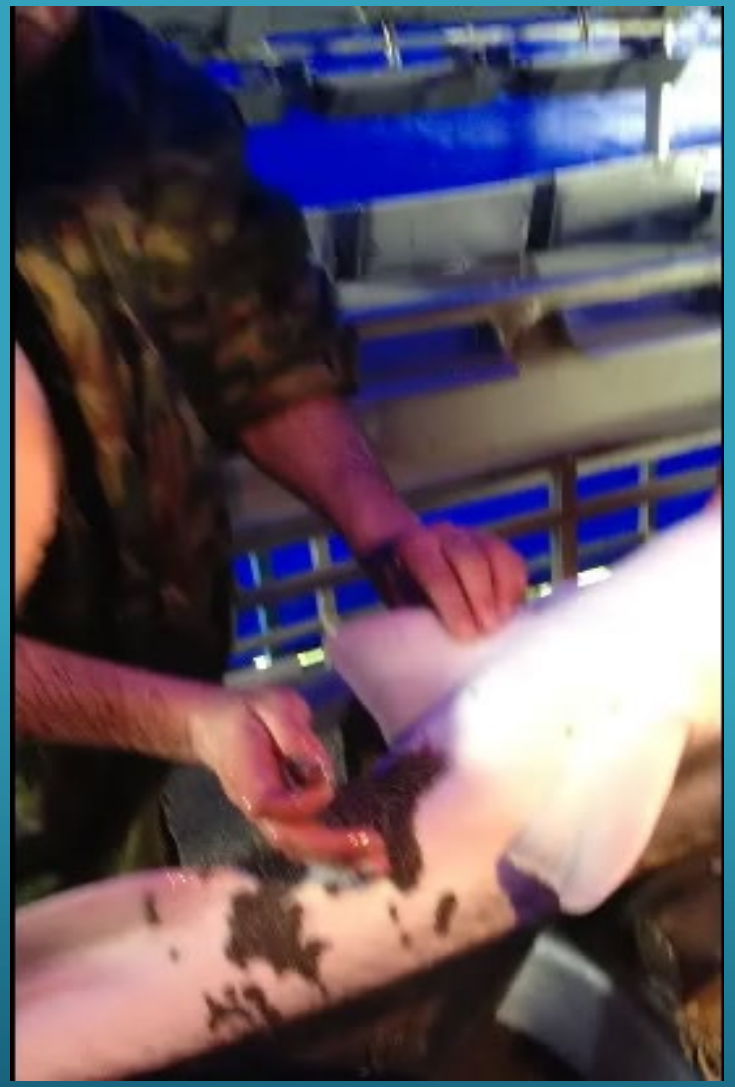
F 2 stage



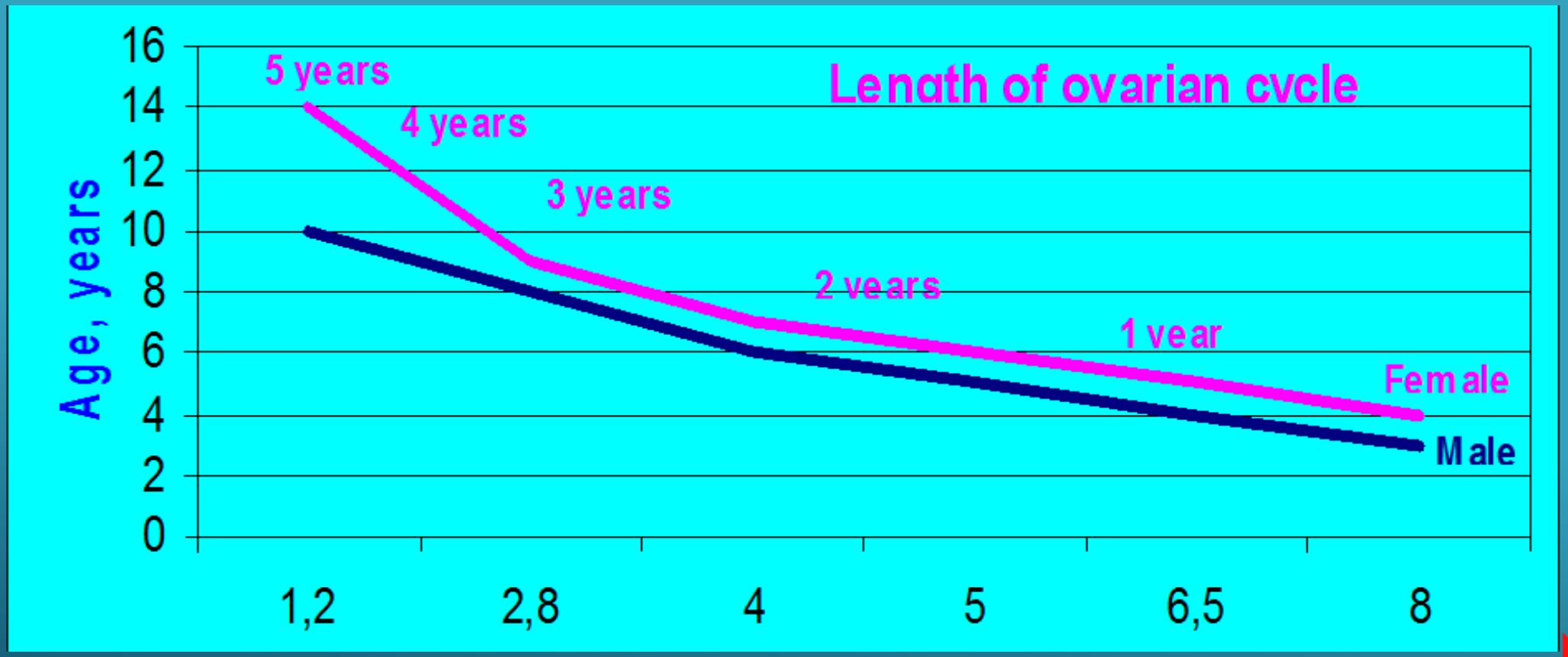
Ao – total oocytes atresia

Along with this, at planning of production cycle, it is necessary to consider the generative structure of all the broodstock and specific features of gametogenesis, for instance parameters, depending on the termal conditions of fish holding:

- Age at the first maturity;
- Duration of inter-spawning intervals;
- Synchronicity in gonad development;



Age at puberty of broodstock *A. stellatus in different conditions*



Conclusion

Application of various schemes of thermo-regulation allows to perform shifting in reproductive cycle of brood fish during different periods of time.

Planning of all-year round eggs obtaining should be built on the development of the optimal thermal schemes with account to specific and individual peculiarities of the fish.

Control on seasonality should be based on the evaluation of the functional maturity of the fish and avoid possible disturbances of gametogenesis.

Thanks for your attention

با تشکر از توجه شما!