Farming and conservation: two sides of the same coin?

The case of sturgeons

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World Sturgeon Conservation Society e.V.
W.S.C.S.
established 2003

Production and conservation prerequisites

Criterion	PRODUCTION	CONSERVATION
Aims	High yeld, fast and omogeneous growth, good CF, robustness to rearing conditions, early maturation, …	„wild-like“ animals, limited production, high biodiversity, natural behaviour (feeding, predator avoidance, learning, etc.…)

Aquaculture for production and Aquaculture for conservation have different prerequisites.

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Disease prevention	Transfer for optimization permissable	No transfer between populations

Conservation

The species is still existing

EXTANT

The species is no more existing

EXTINCT

- *Natural reproduction too rare*
- *Recovery time too long*

Protection/restocking

Cost-benefit analysis

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restocking

we have to take into consideration → **EX-SITU measures**

to produce suitable subjects for restocking the first thing to consider is the broodstock

WILD FISH → **BROODSTOCK** ← **FARMED FISH**

CONS
- Impact on the wild population
- Pathology
- Not easy catch

PRO
- High genetic diversity

CONS
- Limited genetic diversity
- Adaptation to captivity
- Hybrids/allochthonous
- Origine (??)
- Relatedness
- Pathologies

PRO
- Availability
- Infrastructures
- Competences
- Management

Sanitary control

PRODUCTION

CONSERVATION

BROODSTOCKS

SELECTION

Production

- Productive and marketing characteristics
- Availability
- Cost
- Adaptative pre-selection
- Health status

Conservation

- Origin (spp.- population, strains)
- No sib, no hybrids
- Different families
- Maximum genetics biodiversity
- Health status

MAINTENANCE

Production

- Farming conditions
- Commercial feed
- Sanitary control

Conservation

- Most natural conditions (low density)
- Separated controlled strains
- Special feed
- Sanitary control

The various steps that take place in the practice of controlled reproduction differ between aquaculture for production and that for conservation, starting from the selection and maintenance of broodstock

PRODUCTION | CONSERVATION

REPRODUCTION

SELECTION- MATURATION	
• Available/mature fish • Hormonal stimulation	• Breeding plan • Hormonal stimulation → natural maturation
FERTILIZATION	
• 1 ♀ x 2-3 ♂ • common batch	• 1 ♀ x 1 ♂ • Separated batches
STICKNESS REMOVAL	
• Clay, Talk, tannin	No removal of stickness
INCUBATION	
• Available T°C • MacDonald • Zugg-Weiss jars • Trout incubator	• Natural T°C • Yuschenko • Osetr • California tray

………….as well as in the techniques of reproduction and incubation

PRODUCTION

CONSERVATION

LARVAL REARING

Production

- Higher density
- Artemia/commercial dry food
- Standard tanks
- Available temperatures
- Ground water

Conservation

- Low density
- Different natural live food
- Training tanks:
  - Natural photoperiod
  - Natural fluctuating temperatures
  - Hydrodynamics- water velocity
  - Some predators
  - “home” water for homing imprinting

FINGERLING REARING

Production

- Tanks
- Higher density
- Commercial dry food
- Available temperatures

Conservation

- Fertilized ponds/big tanks
- Semi-wild conditions (T°C, lux, environment, etc.)
- Low density
- Natural food (zooplankton)
- Addition of necto-benthic organisms

………as well as in the techniques of larval and fingerling rearing

GENETICS

conservation

For species/population conservation

production

As support to production (artificial selection)

the goal is to maximize the amount of **genetic diversity** to be transmitted to the following generations

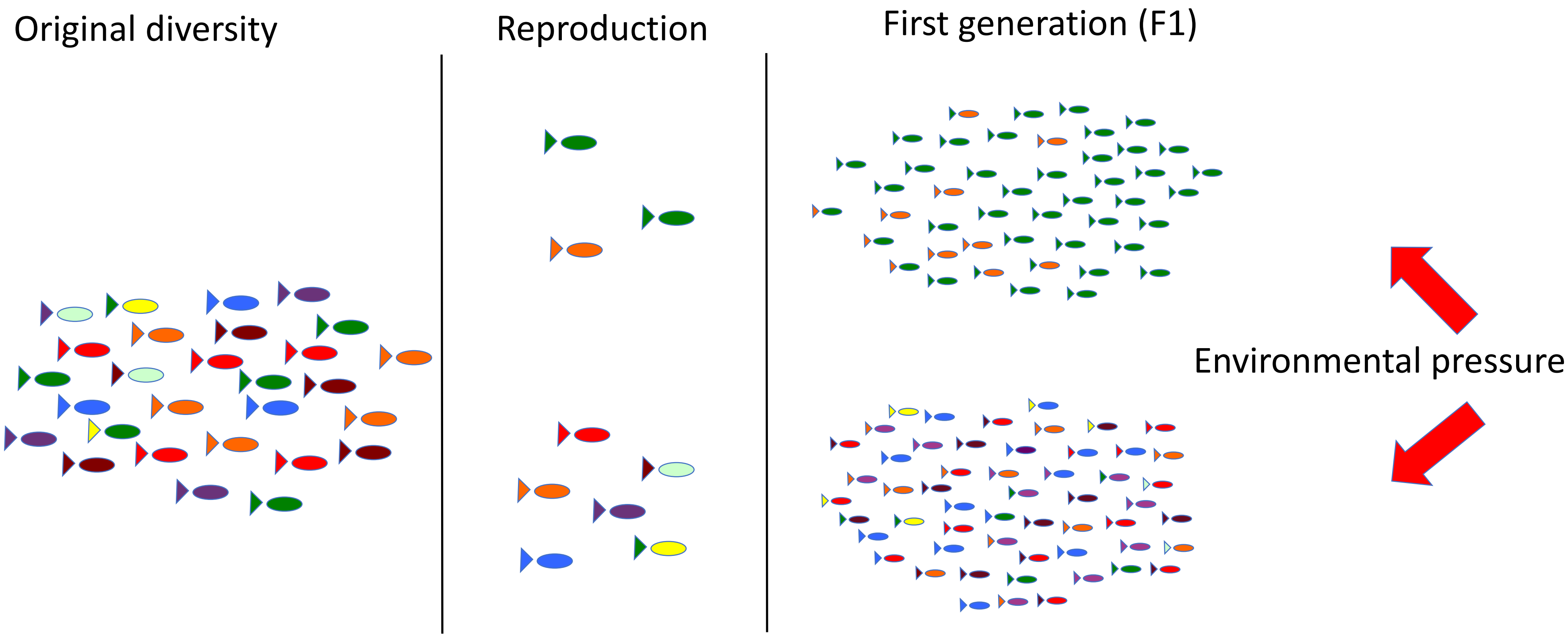
the goal is to **select heritable traits** of interest, creating pure lines in which alternative genetic variants (alleles) are removed.

- Management of residual genetic diversity
- Selection of source populations for restocking
- Post releasing monitoring

But…..

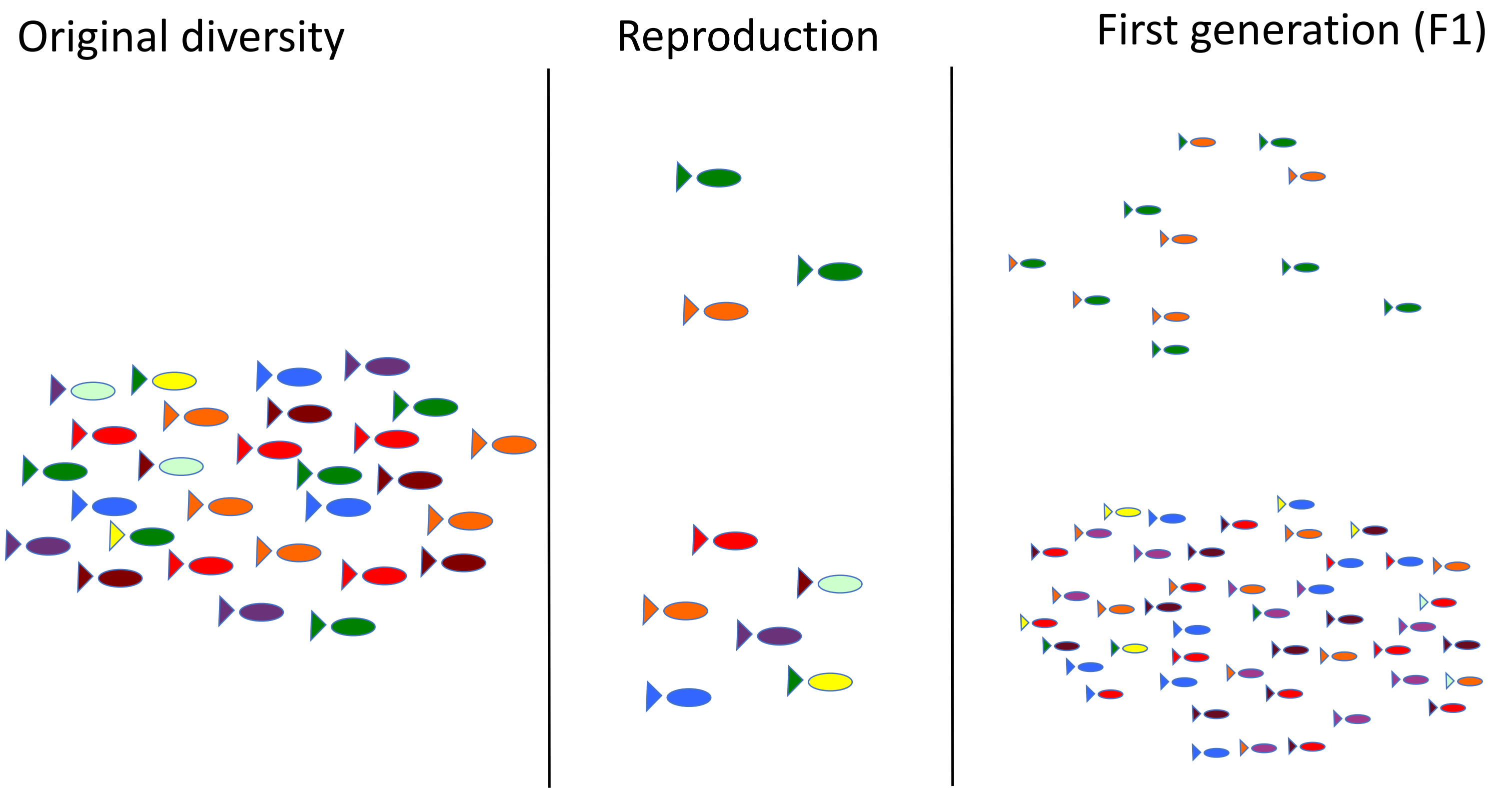
In both aquacultures, genetics is of the utmost importance, even if with different objectives: the maintenance of the maximum biodiversity for the conservation and the selection of the suitable heritable characteristics for the production

The loss of ***variability*** (***adaptability***) at population (stock) level = **loss of adaptive potential**



The reproduction made with few animals leads to a genetically monotonous progeny, while the use of numerous reproducers leads to a progeny with a high biodiversity. The latter is useful in the case of an environmental pressure that can decimate the monotonous population, while the one with greater genetic diversity has more chances to survive more numerous

Very relevant is the loss of ***variability*** (***adaptability***) at population (stock) level = <u>**loss of adaptive potential**</u>



Important to minimize the impact of catastrophes (e.g. pollution, extreme weather and diseases)

Possible causes of erosion of genetic diversity

Founder effect: the loss of genetic variation that occurs when a new population is established by a **small number** of individuals

Preferential mating: not all breeders are represented in the following generation/some individuals are **over-represented**

Adaptation to captive condition: increase in frequency of traits giving **good fitness in captivity**

countermeasures

1) Minimize the number of (new) generations in captivity (++ older broodstock)

2) Equalize family sizes (spontaneous reproduction- random choice)

3) Fragmenting stocks and rearing them in different conditions (places)

Family based breeding plan

Priority		pelv.Nac18	Nac8.matto	Nac7.Nac6	Nac8.Nac31	Nac33.Nac11	O2.matto	Nac26.Nac29	Nac19.Nac17	Nac28.Nac17	Nac16.Nac23	Nac19.Nac31	Nac16.Nac30	Nac33.Nac9	Nac8.Nac17	Nac12.Nac27	Nac3.740
9	pelv.Nac18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Nac8.matto	0,34831	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Nac7.Nac6	0,41622	0,4386	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Nac8.Nac31	0,40331	0,24551	0,42529	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Nac33.Nac11	0,35165	0,35714	0,32571	0,35673	0	0	0	0	0	0	0	0	0	0	0	0
11	O2.matto	0,17708	0,17978	0,37297	0,34807	0,34066	0	0	0	0	0	0	0	0	0	0	0
23	Nac26.Nac29	0,46961	0,47305	0,44828	0,49412	0,39181	0,43646	0	0	0	0	0	0	0	0	0	0
32	Nac19.Nac17	0,35789	0,30682	0,35519	0,35196	0,32222	0,32632	0,3743	0	0	0	0	0	0	0	0	0
31	Nac28.Nac17	0,37968	0,4104	0,26667	0,39773	0,32203	0,37968	0,35227	0,28649	0	0	0	0	0	0	0	0
16	Nac16.Nac23	0,42105	0,36364	0,39891	0,35196	0,43333	0,33684	0,32961	0,3617	0,35135	0	0	0	0	0	0	0
29	Nac19.Nac31	0,34737	0,375	0,38798	0,2514	0,38889	0,35789	0,43017	0,19149	0,41622	0,37234	0	0	0	0	0	0
8	Nac16.Nac30	0,41935	0,39535	0,41899	0,34857	0,40909	0,3871	0,40571	0,38043	0,35912	0,19565	0,38043	0	0	0	0	0
17	Nac33.Nac9	0,41436	0,42515	0,33333	0,36471	0,18129	0,39227	0,32941	0,32961	0,32955	0,35196	0,32961	0,37143	0	0	0	0
30	Nac8.Nac17	0,36667	0,20482	0,37572	0,21893	0,28235	0,3	0,42012	0,19101	0,24571	0,34831	0,35955	0,36782	0,32544	0	0	0
7	Nac12.Nac27	0,31148	0,34911	0,38636	0,33721	0,38728	0,3224	0,37209	0,33702	0,35955	0,33702	0,29282	0,35593	0,32558	0,39181	0	0
18	Nac3.740	0,38624	0,37143	0,37363	0,34831	0,27374	0,39683	0,37079	0,29412	0,3587	0,39037	0,34759	0,39891	0,29213	0,35593	0,34444	0
25	Nac8.740	0,3587	0,2	0,41243	0,24855	0,29885	0,30435	0,47977	0,30769	0,38547	0,37363	0,37363	0,39326	0,34104	0,22093	0,36	0,20442
24	Nac15.Nac13	0,35829	0,3526	0,35556	0,39773	0,32203	0,31551	0,39773	0,34054	0,35165	0,37297	0,39459	0,41436	0,31818	0,34857	0,32584	0,3587
26	Nac28.Nac23	0,38542	0,41573	0,26486	0,42541	0,3956	0,35417	0,32597	0,34737	0,14439	0,24211	0,38947	0,3871	0,33702	0,33333	0,36612	0,40741
13	Nac3.matto	0,33679	0,19553	0,34409	0,30769	0,28962	0,20207	0,35165	0,3089	0,3617	0,29843	0,36126	0,34759	0,34066	0,30387	0,32609	0,21053
20	Nac33.740	0,3587	0,31765	0,34463	0,3526	0,18391	0,34783	0,39884	0,2967	0,34078	0,37363	0,36264	0,38202	0,20231	0,31395	0,36	0,16022
27	Nac12.Nac17	0,37705	0,37278	0,36364	0,37209	0,31792	0,37705	0,34884	0,21547	0,22472	0,33702	0,37017	0,34463	0,34884	0,23977	0,24138	0,3
12	Nac3.Nac6	0,42391	0,43529	0,22034	0,39884	0,29885	0,40217	0,36416	0,35165	0,27374	0,3956	0,37363	0,42697	0,2948	0,37209	0,34857	0,22652
19	Nac16.740	0,44385	0,3526	0,46667	0,36364	0,36723	0,37968	0,48864	0,35135	0,40659	0,25405	0,36216	0,23757	0,35227	0,38286	0,35955	0,23913
21	Nac16.Nac29	0,41053	0,34091	0,40984	0,34078	0,35556	0,32632	0,22905	0,34043	0,32973	0,1383	0,34043	0,19565	0,30726	0,32584	0,29282	0,36898
14	Nac24.Nac29	0,37634	0,38372	0,35196	0,41714	0,35227	0,33333	0,23429	0,33696	0,30387	0,30435	0,36957	0,37778	0,30286	0,35632	0,32203	0,34426

Maximize the diversity transmitted minimizing the number of crosses

Genetics focusing on aquaculture interests

- The long life cycle of sturgeons makes **very difficult the selection** of pure lines with classical methods. *For other species it is different.*

- Genetics could accelerate this process **if the genes responsible of the trait of interest are known**. In this case a **breeding plan** could be established by selecting the breeders through genotyping. (**<u>GENETICALLY ASSISTED BREEDING</u>)**

- The recent revolutionary innovations given by the **next generation sequencing** technologies allow the simultaneous characterization of tens of thousands loci.

- The possibility to efficiently explore the genomes looking for **associations between phenotype and multi-locus genotypes** opens new perspectives for **assisted breeding (**also on the long living sturgeons).

Commercial aquaculture

The preservation of **genetic diversity** must represent a **priority** also from the **production point of view:**

In fact, **loosing diversity** means:

- loosing possible **new phenotypes** of commercial interest
- decreasing the **potential of surviving** in case of dramatic events such as pollutions, deseases, climate changes etc.
- accelerating **adaptation** to the **present** captive conditions, decreasing the potential to survive or the fertility in different plants/conditions after translocation

Production and conservation: a joint strategy

Involve commercial farms for:

- broodstock maintenance
- rearing of stocking material
- actively participating in releases
- participating in reproductions with maximized genetic output
- obtaining offspring also for production

Benefits

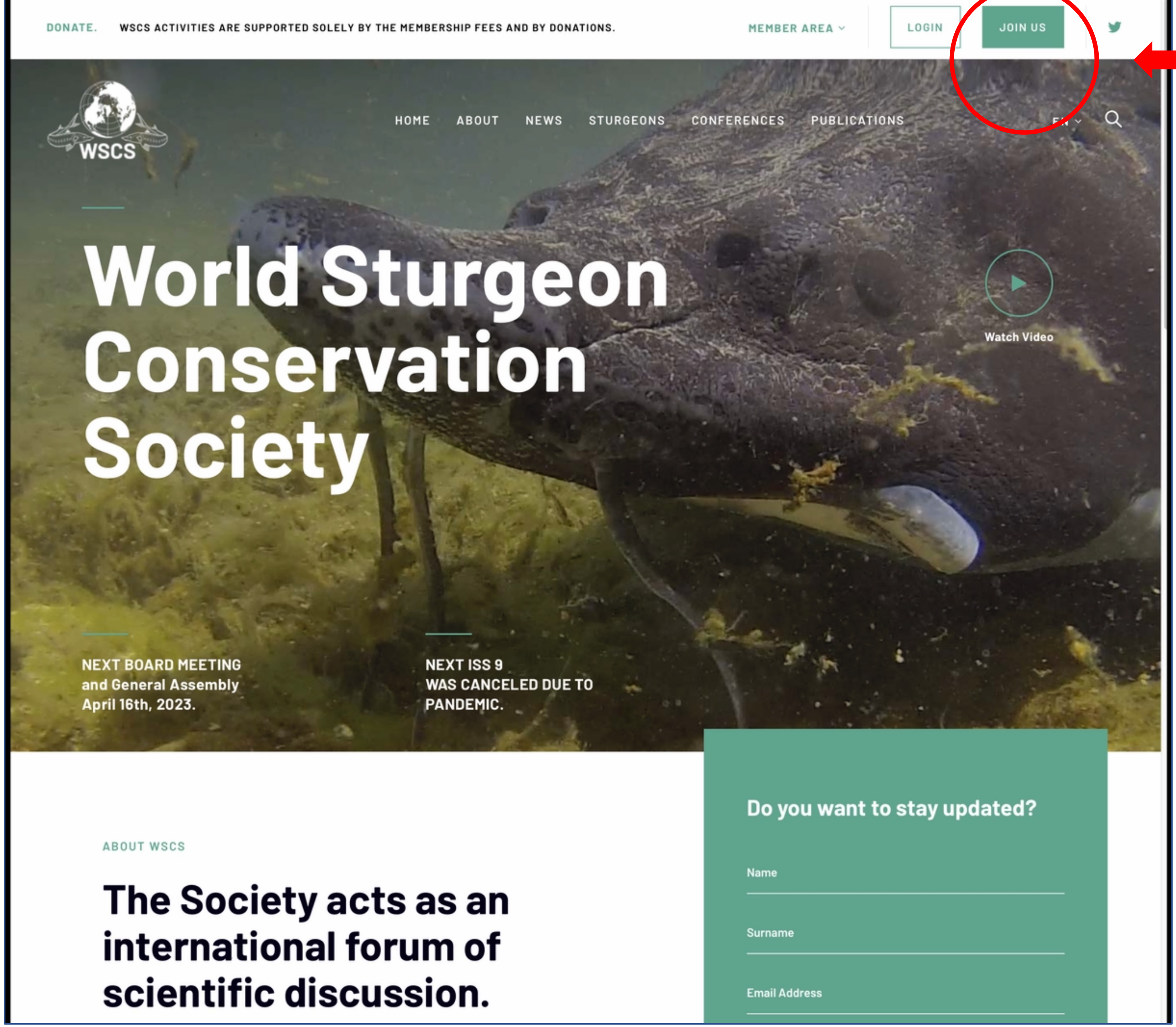
- Increased **exchange of experiences** on rearing practices
- **Cost sharing** for rearing and broodstock maintenance (economic compensation to farmers)
- Public reckognition for involvement in conservation “**green label**”

Adverse impact

- fish of **exotic origin or hybrids** from production farms utilized for releases, which produces massive challenges for conservation programs in some regions.

It seems that a very good project for the conservation of sturgeons, and not only for these species, is in your intentions on the Danube in the area of Vukovar, a this would be a very good project for sturgeons and for the conservation of the biodiversity in general.

You also had a good example of breeding a species of sturgeon, the beluga (Huso huso) in the Poljiana facility with some growth success.



The WSCS is always available to support you in all initiatives for the protection and recovery of sturgeons, and that if you want to become a member you are welcome

https://www.wscs.info

Hvala na pažnji

Thank you for your attention

World Sturgeon Conservation Society e.V.

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