Achievements of Breeding Program of Common Carp in Hungary

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Sustainable Development of Aquaculture

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Carp in Europe and in Hungary

Carp breeding program in Hungary

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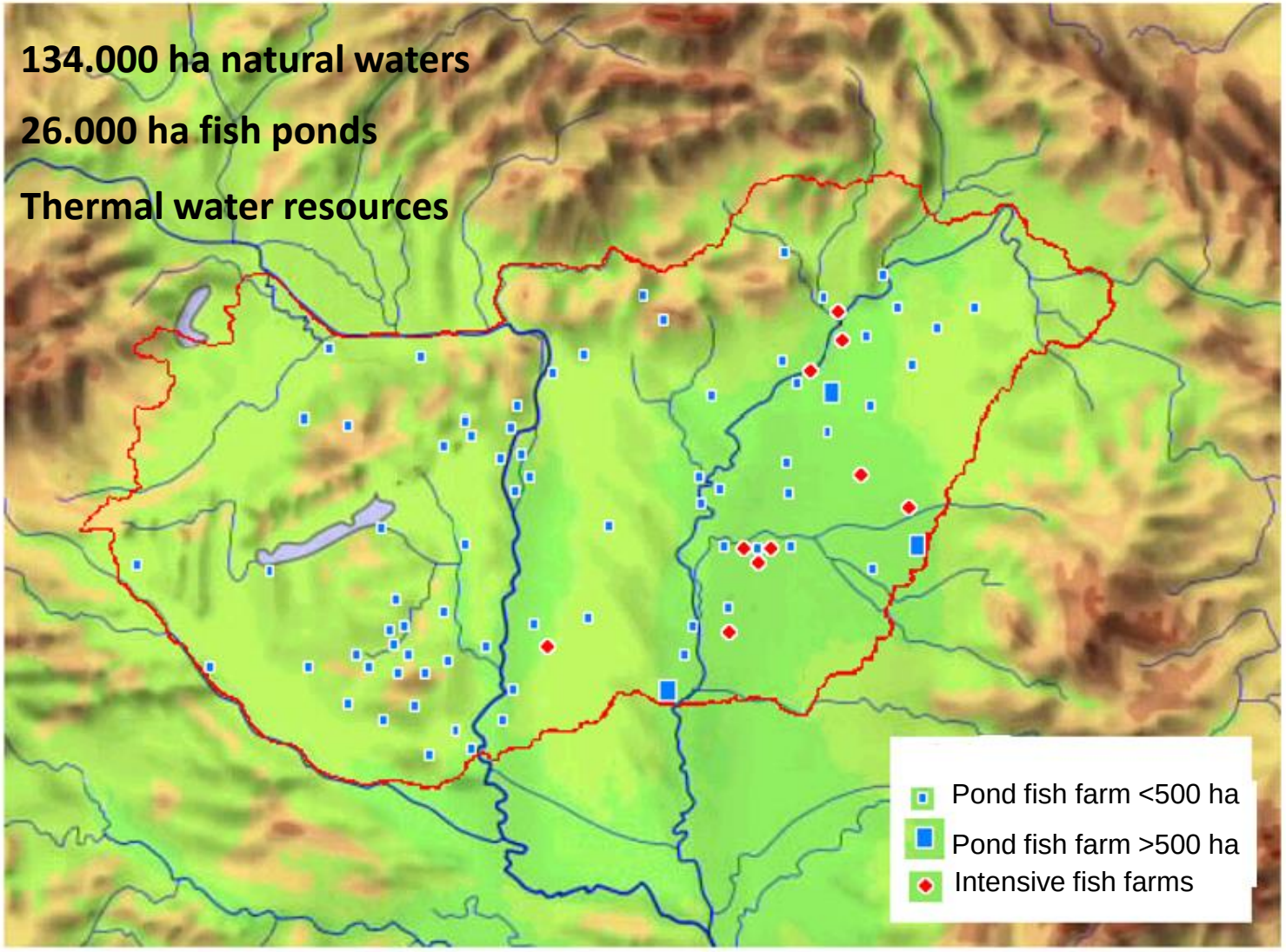
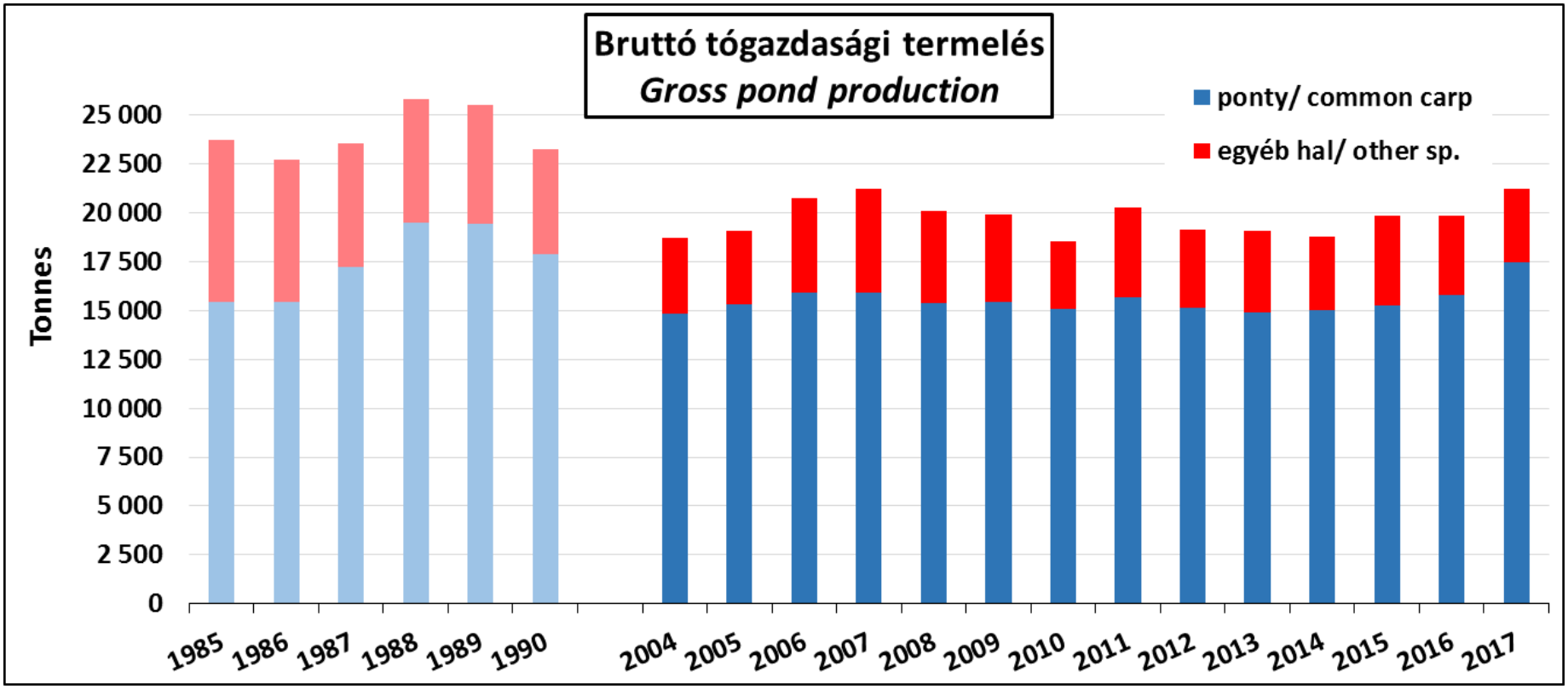
Future of carp breeding

Fisheries and aquaculture resources in Hungary

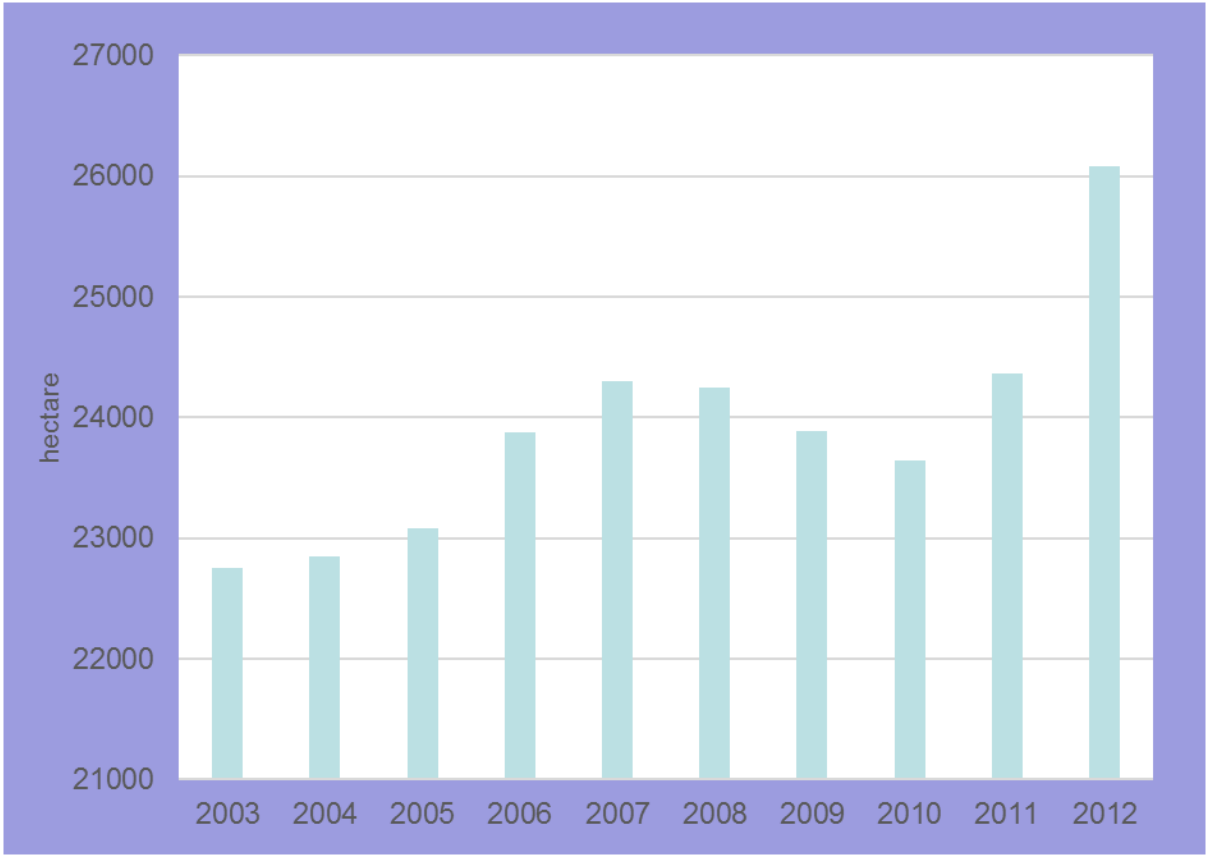


Aquaculture production 2004-2015

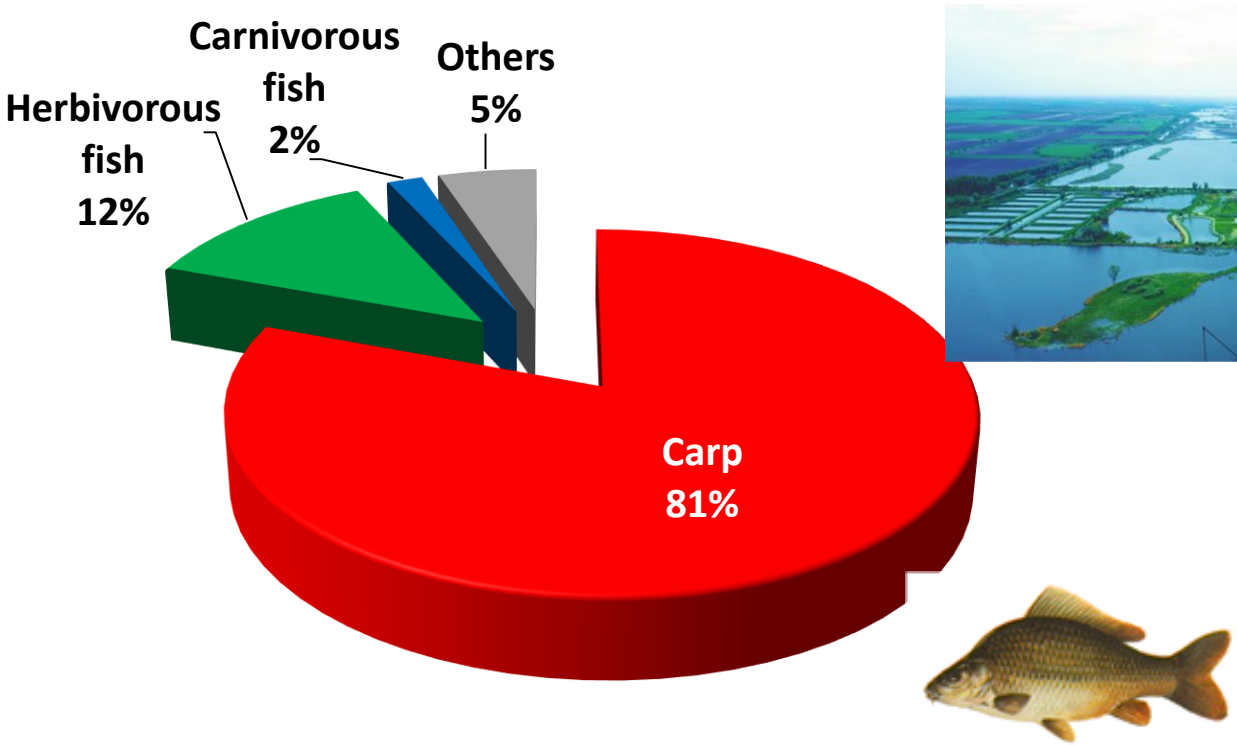
Proportion of carp in pond aquaculture



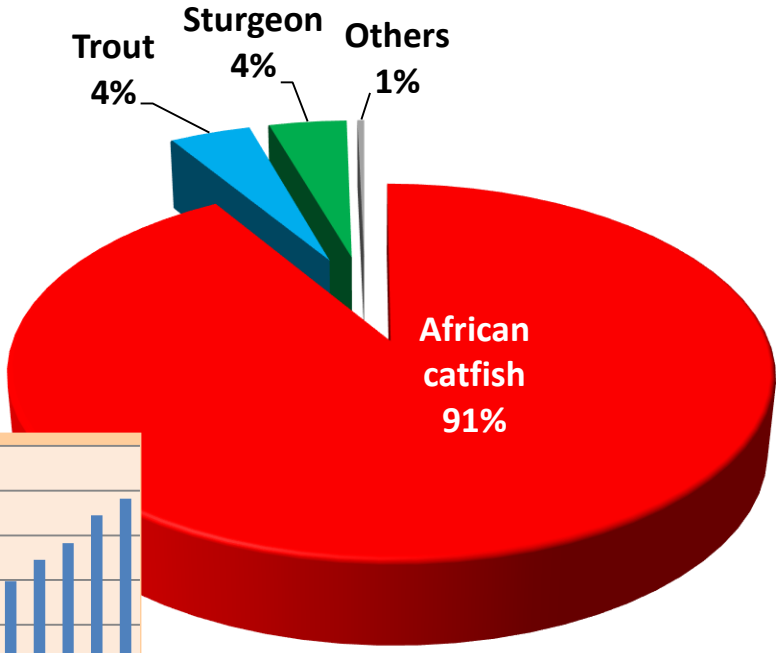
Fish pond area in Hungary

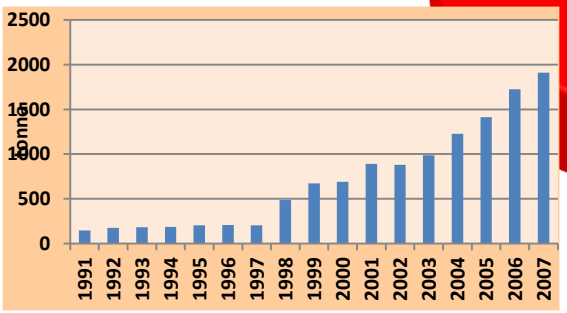


Fish production by species in ponds

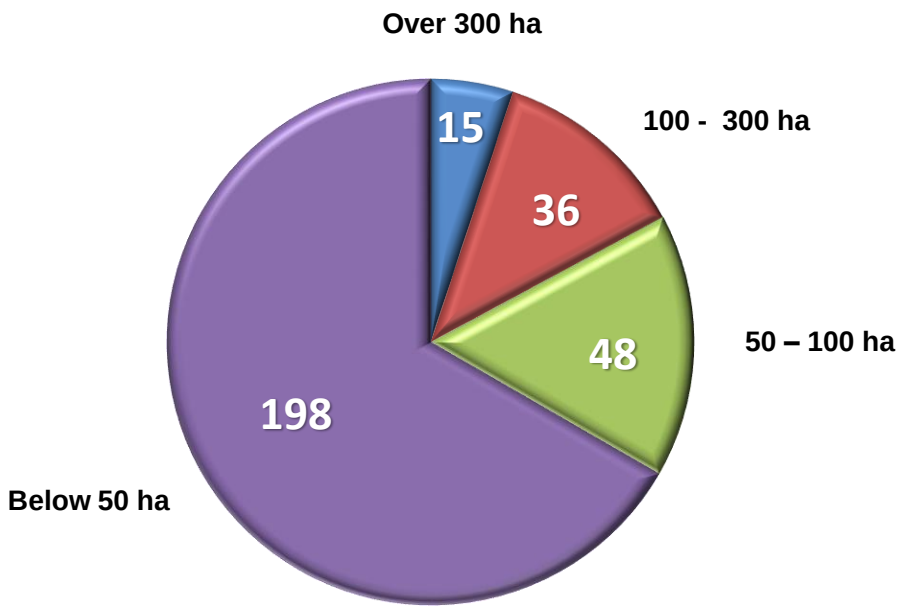


Fish production by species in intensive systems





Number of fish farms by size

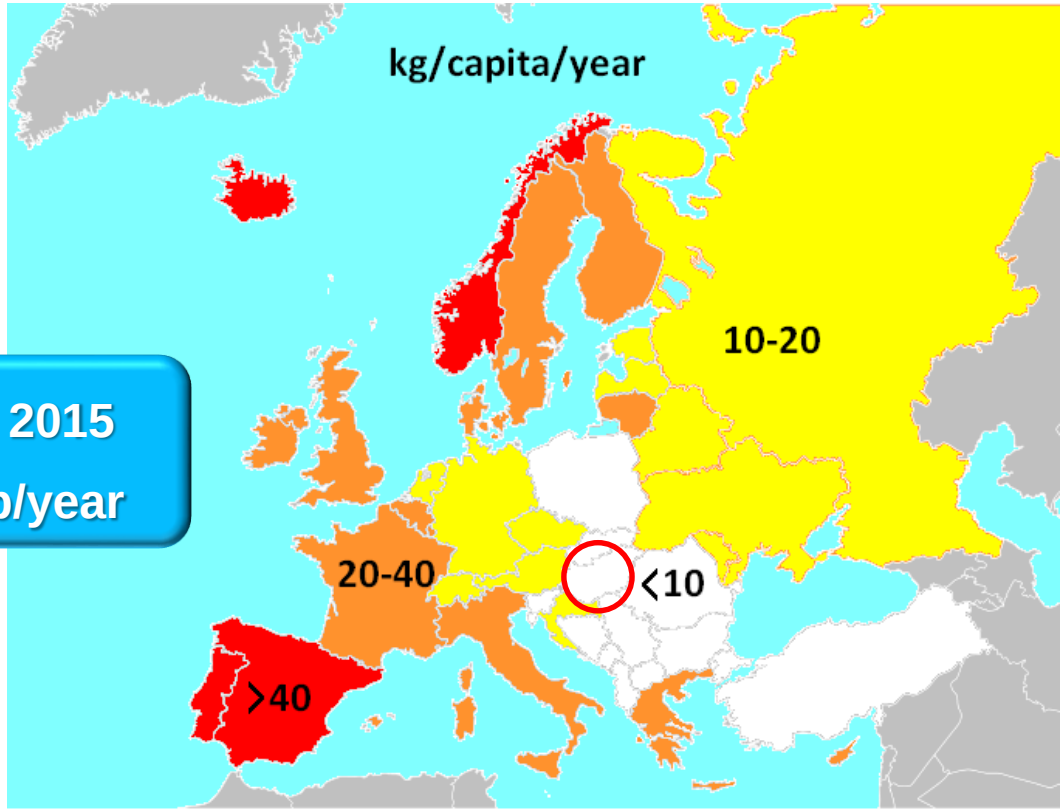


297 fish farms

Fish consumption in Europe

Hungary, 2015

6.0 kg/cap/year



Importance of the fish production sector

- Agriculture production: 3.2 % of GDP
- Fish production: 0.8% of the total agricultural production
- Fish production: 2.3 % of the gross production value of animal husbandry
- Other economical importance
    - Supply of healthy food
    - Angling and recreation
    - Environment protection, ecological services
    - Contribution to rural development
    - Water management

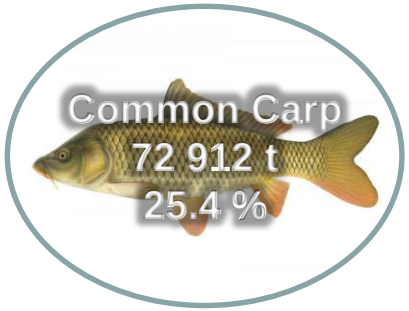
Relevance of carp in EU aquaculture (2016)

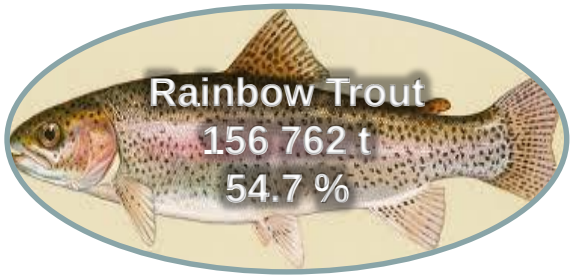
Total European aquaculture production: 1 292 597 t

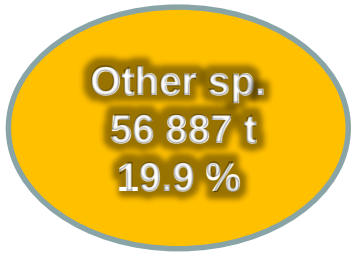
Marine: 77.8%
(1 006 035 t)

Freshwater: 22.2%
(286 563 t)

Aquaculture = 100%







Common Carp by countries

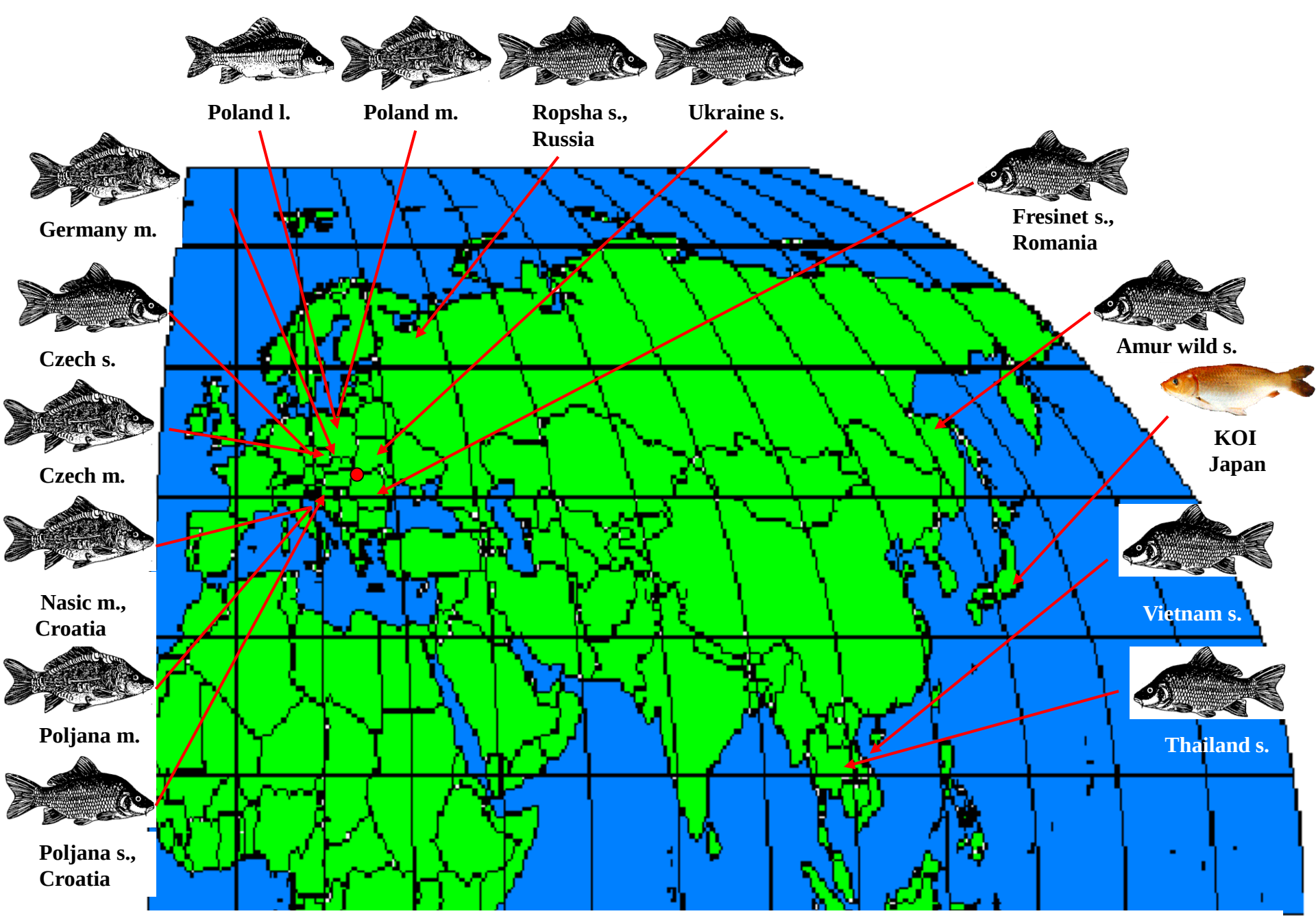
Carp breeding program in Hungary

- Establisment of the live gene bank: 1962
- Original objectives:
  - maintaining, completing and preserving the strains of common carp;
  - production of hybrids with enhanced productivity
  - gene exchange

Dr. János Bakos, founded the live gene bank of common carp in early 60-ies and maintaned until late 80-ies in HAKI, Szarvas, Hungary

Hybrid Szarvas 215

Hungarian races and strains of live common carp gene bank at HAKI, Szarvas



Foreign races and strains of live common carp gene bank at HAKI, Szarvas

Hungarian and foreign carp strains

Bakos and Gorda, 2001

Hungarian strains

Bikal mirror carp
Dinnyés mirror carp
Felsősomogy mirror carp
Göd mirror carp
Hortobágy mirror carp
Nagyatád mirror carp
Palkonya mirror carp
Sumony mirror carp
Szarvas mirror carp
Szarvas red mirror carp
Szeged mirror carp
Tata scaly carp
Tisza wild

Szarvas 22 mirror carp
Szarvas P33 scaly carp
Szarvas P31 scaly carp
Szarvas P34 scaly carp
Szarvas 215 mirror carp

Foreign strains

Amur wild carp
Czech scaly carp
Czech mirror carp
Fresinet scaly carp
German mirror carp
Nasic mirror carp
Polish linear carp
Polish mirror carp
Poljana scaly carp
Poljana mirror carp
Ropsha scaly carp
Ukrainian scaly carp
Vietnam scaly carp

Hungarian and foreign carp strains

Today

Maintenance cost: appr. 30 M HUF/year = 100.000 EUR

Hungarian strains

Bikal mirror carp
Dinnyés mirror carp
Felsősomogy mirror carp
Göd mirror carp
Hortobágy mirror carp
Nagyatád mirror carp
Palkonya mirror carp
Sumony mirror carp
Szarvas mirror carp
Szarvas red mirror carp
Szeged mirror carp
Tata scaly carp
Tisza wild
Duna wild

Foreign strains

Amur wild carp
Czech scaly carp
Czech mirror carp
Fresinet scaly carp
German mirror carp
Nasic mirror carp
Polish linear carp
Polish mirror carp
Poljana scaly carp
Poljana mirror carp
Ropsha scaly carp
Ukrainian scaly carp
Vietnam scaly carp

Cryo-preserved Gene bank of Common carp

- Carp sperm cryopreservation protocols developed
- Gene bank of sperms of Carp strains established

Cryopreserved carp sperm-bank of HAKI

No.	Strain	Sperm cryopreserved straws
1.	Sumonyi mirror	331
2.	Szarvasi mirror	0
3.	Palkonyai mirror	332
4.	Felsősomogyi mirror	392
5.	Szarvasi red	251
6.	Amuri wild	589
7.	Szarvasi 2	418
8.	Szarvasi 15	291
9.	Szarvasi P 33	376
10.	Hortobágyi mirror	126
11.	Tatai scaly	336
12.	Szegedi mirror	394
13.	Dinnyési mirror	42
14.	Nagyatádi mirror	207
15.	Bikali mirror	376
16.	Varászlói mirror	246
17.	Tiszai wild	1.018
18.	Dunai wild	800
19.	Fresinet scaly	292
20.	Vietnami scaly	418
21.	Ropsa scaly	334
22.	Nasici mirror	166
23.	Ukrán scaly	0
24.	Thai scaly	0
25.	Poljanai scaly	377
26.	Poljanai mirror	
27.	Czech scaly	0
28.	Polish mirror	125
29.	Polish linear	41

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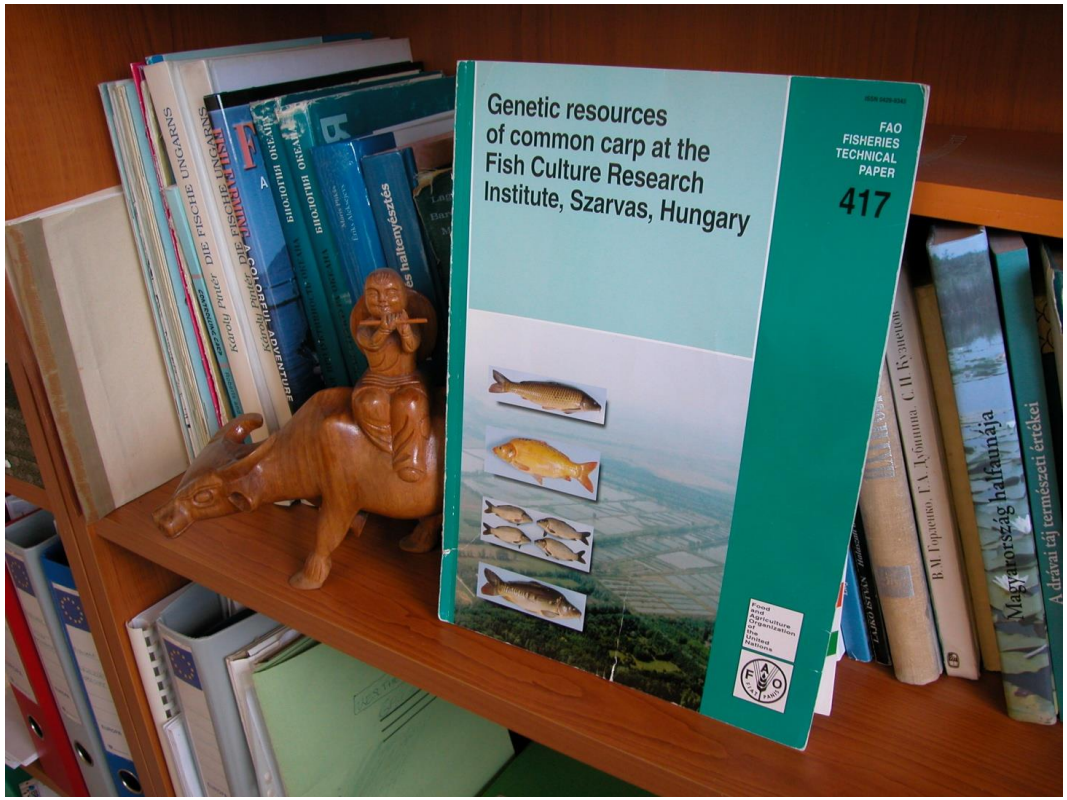
Basic information was published by FAO

Bakos and Gorda, 2001



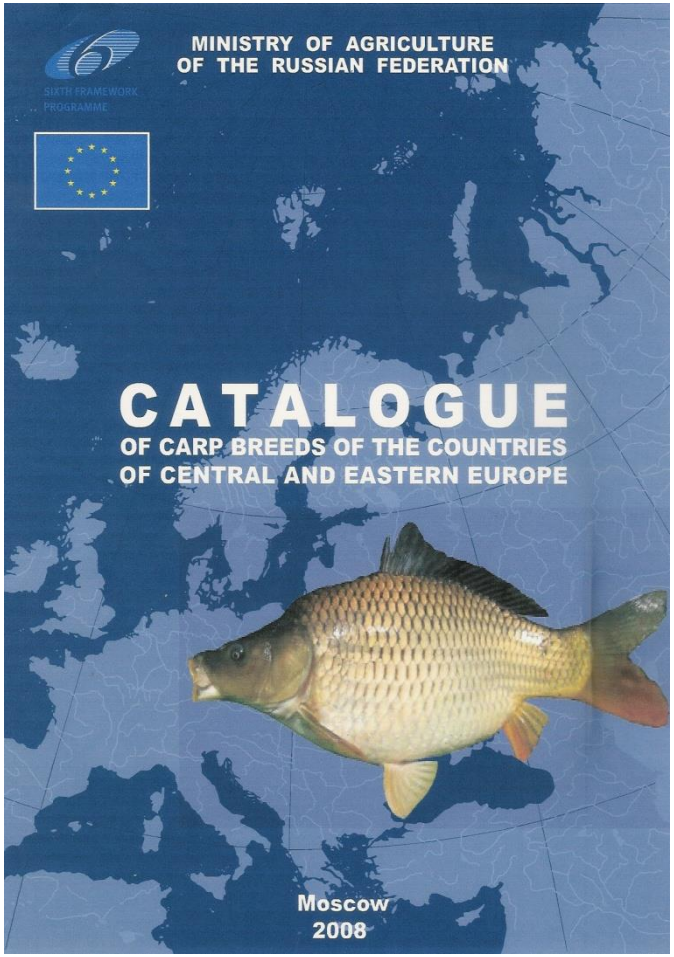
http://www.fao.org/DOCREP/005/Y2406E/Y2406E00.HTM

Catalogue of carp breeds of the countries of Central and Eastern Europe.

The most recent „inventory" of carp strains.

(by Bogeruk, 2008 in frame of the EUROCARP project)

Plan to publish on internet by FAO



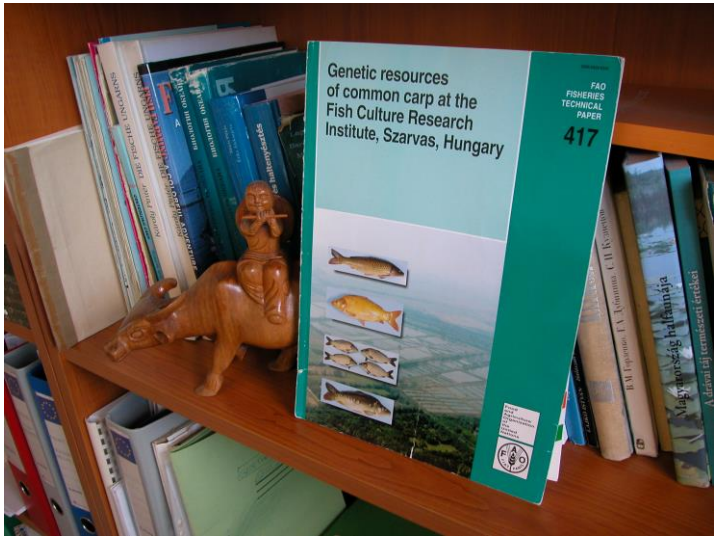
All together 60 „national strains" and 25 „foreign strains" described in 7 major carp producing countries.

Table 1: Genetic resources of common carp in major European carp producing countries, based on Bogeruk, 2008.

Country / Strains	Belarus	Czech Republic	Hungary	Moldova	Poland	Russia	Ukraine
National	3	14	14	3	7	13	6
Foreign	5	8	NR	NR	11	1	NR
Total	**8**	**22**	**14**	**3**	**18**	**14**	**6**
Cryo-bank	NR	Yes	Yes	NR	NR	NR	NR

NR – not reported

Methodology of live gene bank maintenance is available. Results of Carp performance tests are published.



Reviews in Aquaculture (2009) **1**, 163–173 doi: 10.1111/j.1753-5131.2009.01012.x

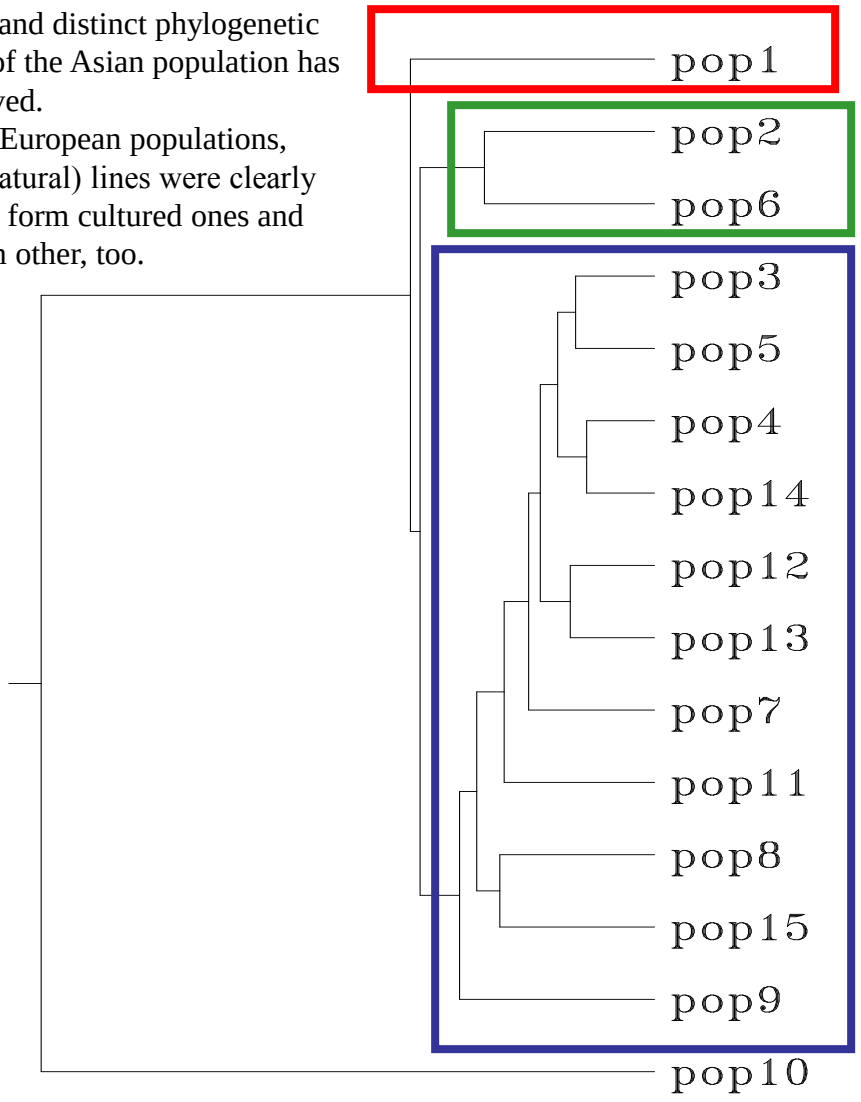
Use and exchange of aquatic resources relevant for food and aquaculture: common carp (*Cyprinus carpio* L.)

Zsigmond Jeney[1] and Zhu Jian[2]

Three high quality hybrids have been produced in HAKI using the strains in the live common carp gene bank

Relationships of carp lines using microsatellite markers

- A basal and distinct phylogenetic position of the Asian population has been proved.
- Among European populations, “wild” (natural) lines were clearly separated form cultured ones and from each other, too.



Amur scaly (Asian wild line)

Danube scaly (European wild lines)

Tisza scaly

cultured carp lines kept in gene bank

- The cultured lines in Hungary showed closer genetic relationship to each other according their known breeding history.
- Inbreeding effects at a certain extent could be observed as a result of the loss of heterozygosity.

koi ← outgroup

Hungarian carp strains were included into the Common carp genome project (cooperation with Chinese institutions)

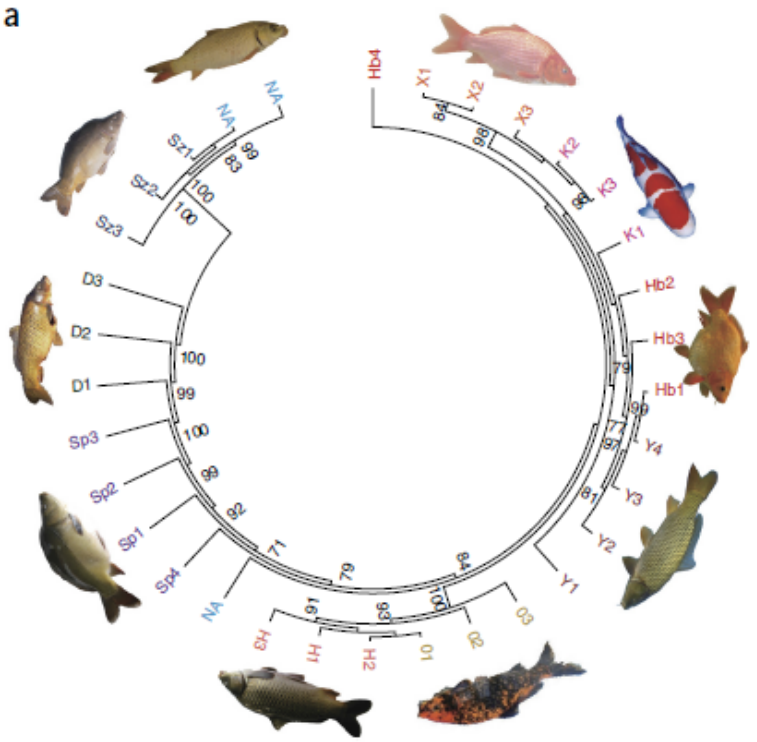
ARTICLES

nature genetics

OPEN

Genome sequence and genetic diversity of the common carp, *Cyprinus carpio*

Peng Xu[1,10], Xiaofeng Zhang[2,10], Xumin Wang[3,10], Jiongtang Li[1,10], Guiming Liu[3,10], Youyi Kuang[2,10], Jian Xu[1,10], Xianhu Zheng[2,10], Lufeng Ren[3], Guoliang Wang[3], Yan Zhang[1], Linhe Huo[3], Zixia Zhao[1], Dingchen Cao[2], Cuiyun Lu[2], Chao Li[2], Yi Zhou[4], Zhanjiang Liu[1,5], Zhonghua Fan[3], Guangle Shan[3], Xingang Li[3], Shuangxiu Wu[3], Lipu Song[3], Guangyuan Hou[1], Yanliang Jiang[1], Zsigmond Jeney[6], Dan Yu[3], Li Wang[3], Changjun Shao[3], Lai Song[3], Jing Sun[3], Peifeng Ji[1], Jian Wang[1], Qiang Li[1], Liming Xu[1], Fanyue Sun[5], Jianxin Feng[7], Chenghui Wang[8], Shaolin Wang[9], Baosen Wang[1], Yan Li[1], Yaping Zhu[1], Wei Xue[1], Lan Zhao[1], Jintu Wang[1], Ying Gu[2], Weihua Lv[2], Kejing Wu[3], Jingfa Xiao[3], Jiayan Wu[3], Zhang Zhang[3], Jun Yu[3] & Xiaowen Sun[1,2]



Duna wild carp and Szarvas 15 contributed to the „genetic diversity" of the carp genome. (Xu P. et al, 2014). The preliminary genom is a major source of information for further studies on economically important characteristics and supports the genom-based breeding technologies in aquaculture.

Eurocarp project: Disease and stress resistant carp

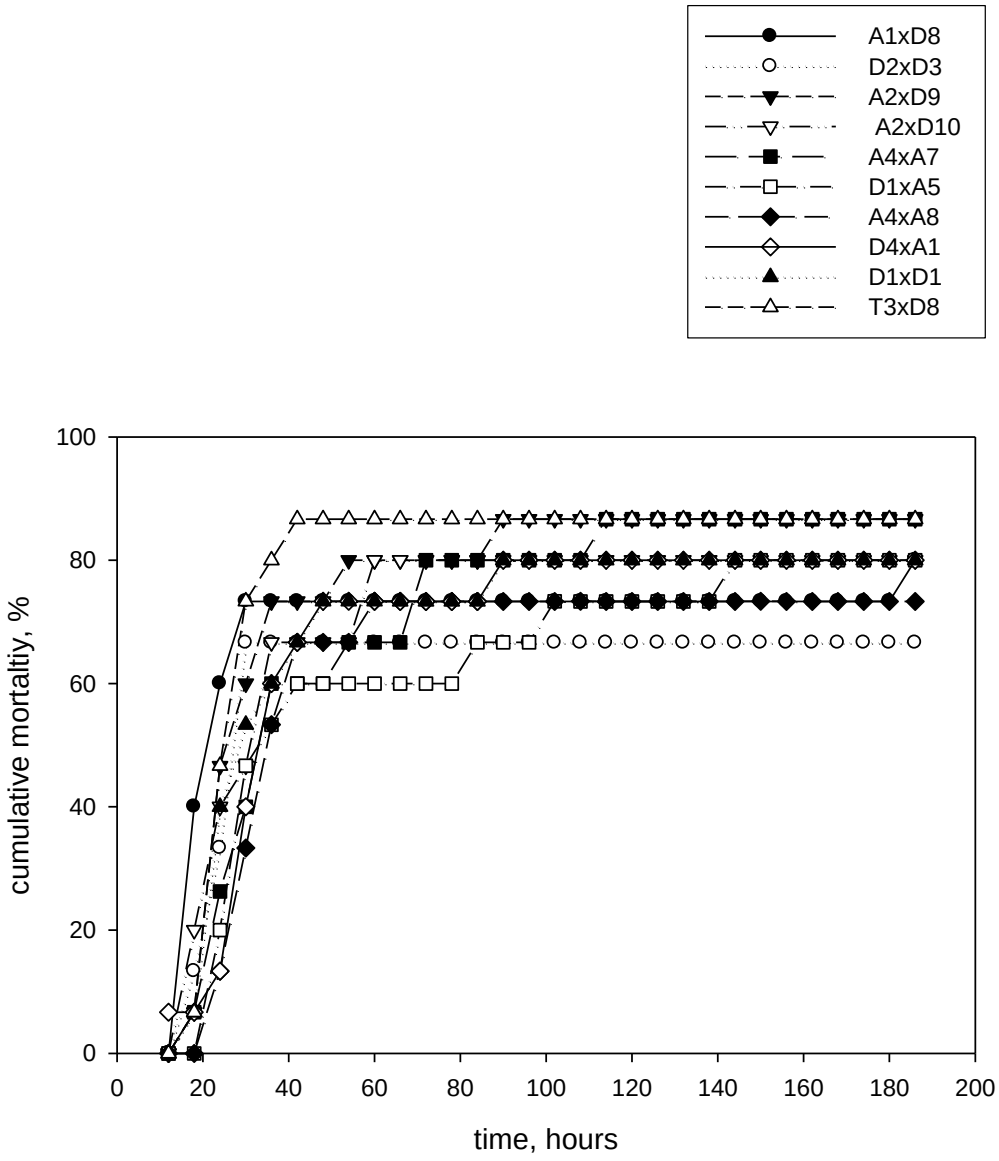
Eurocarp Project

http://eurocarp.haki.hu/

The Eurocarp project resulted in disease and stress tolerant carp varieties

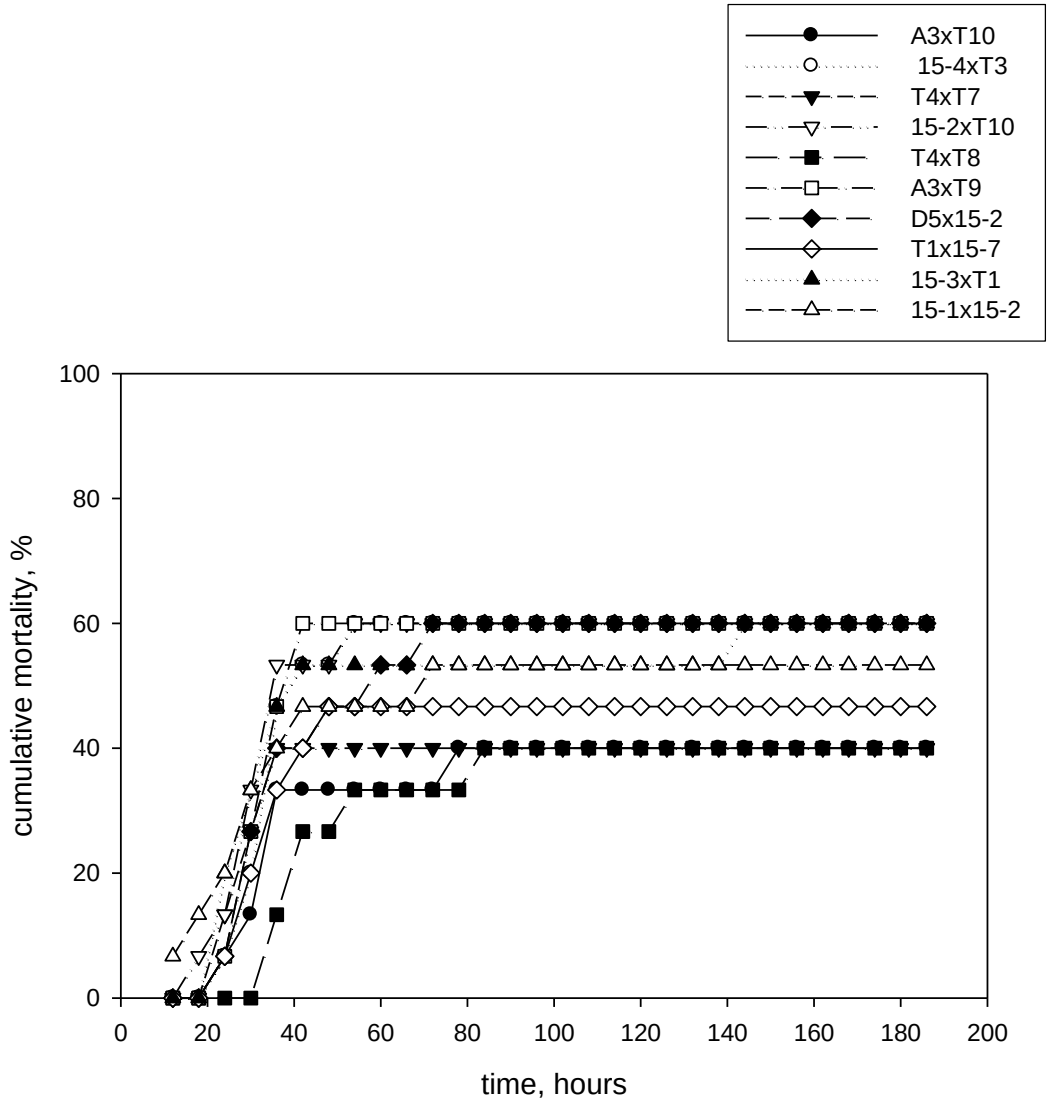
	Duna	Amur	Tata	15
Duna	D1xD1	A1xD7	T1xD3	15-1xD9
	D1xD2	A1xD8	T1xD4	15-1xD10
	D2xD3	A2xD9	T2xD5	15-2xD1
	D2xD4	A2xD10	T2xD6	15-2xD2
	D3xD5	A3xD1	T3xD7	15-3xD3
	D3xD6	A3xD2	T3xD8	15-3xD4
Amur	D1xA5	A1xA1	T1xA7	15-1xA3
	D1xA6	A2xA2	T1xA8	15-1xA4
	D4xA1	A4xA7	T4xA3	15-4xA9
	D4xA2	A4xA8	T4xA4	15-4xA10
	D5xA3	A5xA9	T5xA5	15-5xA1
	D5xA4	A5xA10	T5A6	15-5xA2
Tata	D2xT1	A2xT7	T2xT3	15-2xT9
	D2xT2	A2xT8	T2xT4	15-2xT10
	D3xT3	A3xT9	T3xT5	15-3xT1
	D3xT4	A3xT10	T3xT6	15-3xT2
	D4xT5	A4xT1	T4xT7	15-4xT3
	D4xT6	A4xT2	T4xT8	15-4xT4
15	D1x15-3	A1x 15-9	T1x15-7	15-1x15-1
	D1x15-4	A1x15-10	T1x15-8	15-1x15-2
	D2x15-5	A2x15-1	T2x15-9	15-2x15-3
	D2x15-6	A2x15-2	T2x15-10	15-2x15-4
	D5x15-1	A5x15-7	T5x15-3	15-5x15-9
	D5x15-2	A5x15-8	T5x15-4	15-5x15-10

A. hydrophila infection



Cumulative mortalties of the most susceptible families of common carp challenged with *Aeromonas hydrophila*

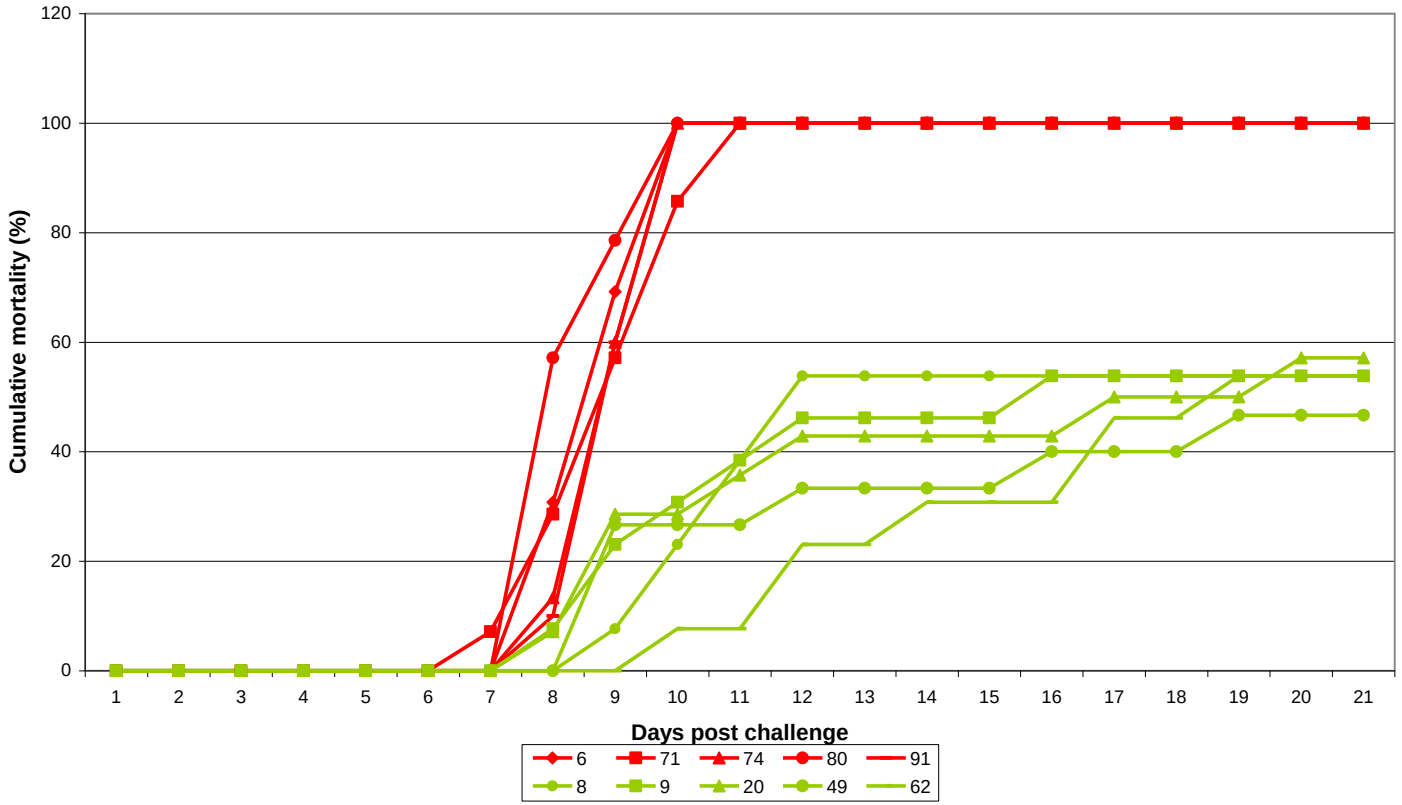
A. hydrophila infection



Cumulative mortalties of the most resistant families of common carp challenged with *Aeromonas hydrophila*

KHV challenge study

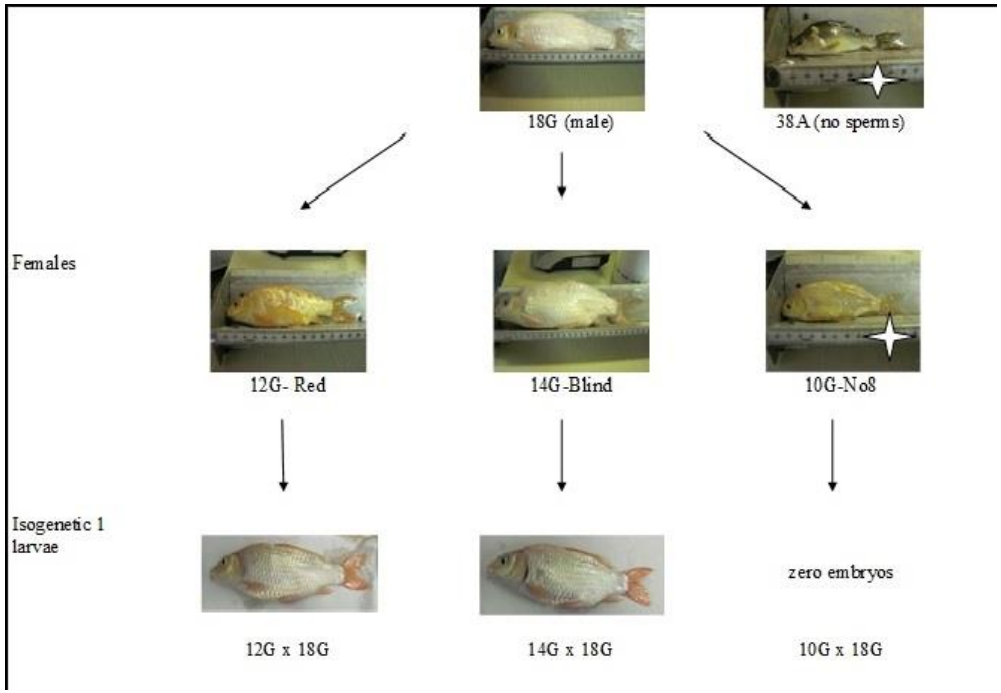
Cumulative mortality of the five most sensitive families (red lines) and five most resistant families (green lines).



Female / Male		Duna					Amur					Tata					15				
	N°	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Duna	1	X							X									X			
	2	X							X									X			
	3		X									X							X		
	4		X									X							X		
	5			X									X								
	6			X									X								
	7						X							X							
	8						X							X							
	9							X									X				
	10							X									X				
Amur	1				X		X														X
	2				X		X														X
	3					X									X		X				
	4					X									X		X				
	5	X														X					
	6	X														X					
	7									X		X									
	8									X		X									
	9										X									X	
	10										X									X	
Tata	1		X							X									X		
	2		X							X									X		
	3			X									X							X	
	4			X									X							X	
	5				X									X							
	6				X									X							
	7							X							X						
	8							X							X						
	9								X									X			
	10								X									X			
15	1					X		X									X				
	2					X		X									X				
	3	X														X		X			
	4	X														X		X			
	5		X																		
	6		X																		
	7										X	X									
	8										X	X									
	9						X						X								X
	10						X						X								X

The lowest and highest crosses against bacterial (X and X) and viral infections (and)

X-10 L-B X- 10H-B - 10 L-V 10 H-V



NAIK-
HAKI

Two isogenic carp lines were produced in NAIK-HAKI in 2016, by traditional method. They are maintained by HAKI.

Genetic resources were used for re-establishment purposes:
Resettlement of 3 Croatian strains

- Nasice mirror carp
- Poljana mirror carp
- Poljana scaly carp

Lost Croatian carp strains were returned to Croatia from the live gene bank of HAKI

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Future of carp breeding

- Common carp will remain the second largest cultured freshwater species in Europe. However, KHV represents major risk to this prognose.
- Genetic resources of common carp exist in Europe. Methods of ex-situ live gene banking are available.
- Maintenance of live gene banks is costly and the market is not always able to “finance” it. This is especially true in case of a “low market value” fish, like common carp.
- Breeding programs will be applied when carp production will be organised into industry, similar to trout production.
- Risk related to the introduction of “very viable exotic and ecologically flexible” species like common carp should be carefully studied in advance to avoid negative effects of the transfer/introduction.


Thank You for Your attention!
Hvala!