

# Genetic characteristics of common carp (*Cyprinus carpio*) in Ireland

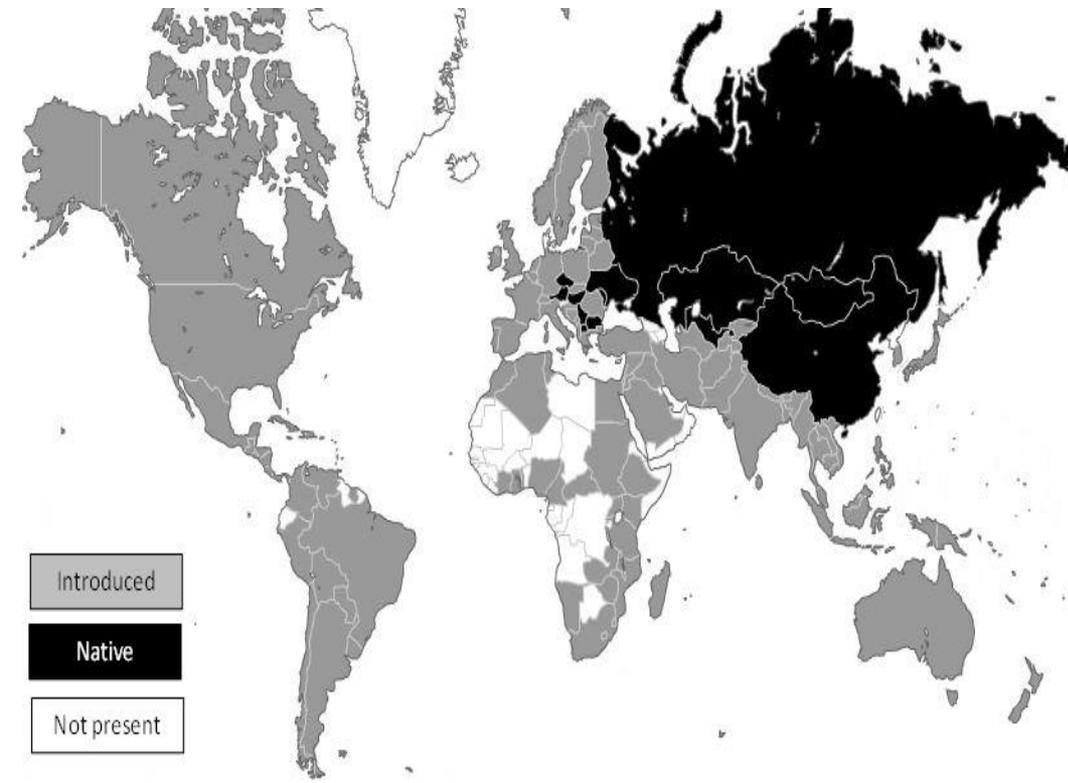
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# Background to the species



- \* Originated in Ponto-Caspian Basin c. 2MYA
- \* Cultured & domesticated for over 2000 years
- \* Truly wild populations almost extinct, majority are now 'feral'
- \* Third most important FW aquaculture species in world
- \* Many translocations, now most widespread FW fish in the world
- \* Invasive in certain regions of abnormally high abundance e.g. Australia, N. America

**Fig 1.** Current global distribution of common carp (presence or absence per country)

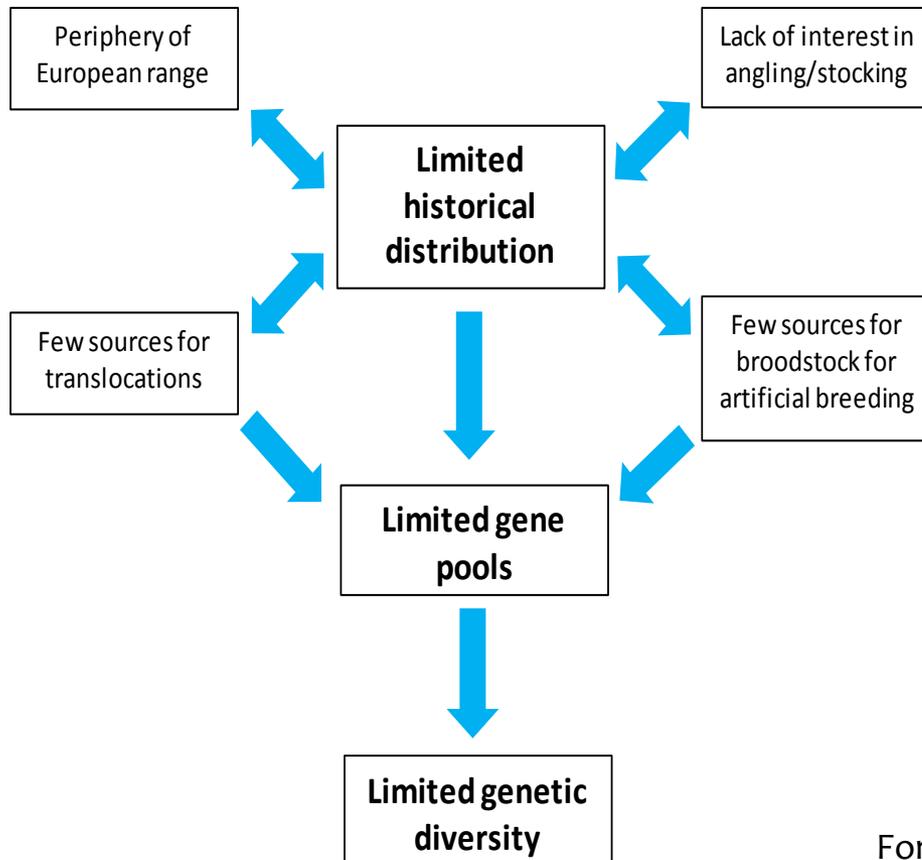
# History of carp in Ireland

- \* First recorded introduction in 1628
- \* Many small scale introductions in 17<sup>th</sup>, 18<sup>th</sup> & 19<sup>th</sup> centuries
- \* Majority of populations died out by 20<sup>th</sup> century
- \* Carp distribution c. 1950 was **extremely limited** (just ten locations)
- \* Distribution has steadily increased since then due to recreational angling
- \* Carp translocated & bred from very few sources
- \* Majority of carp in Ireland would not have persisted without human intervention...



**Fig 2.** Example of a 7.7kg common carp caught by angling from Cork Lough, Cork City for genetic analysis during this study

# Genetic consequences of limited historical distribution?

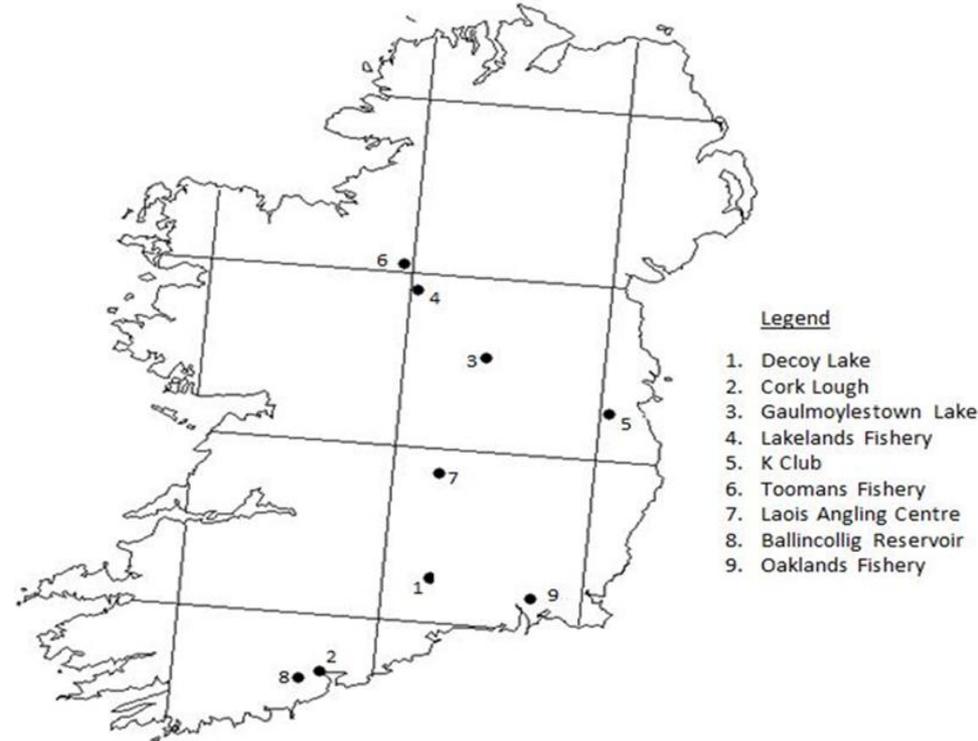


\* What are the genetic consequences of such a history?

For further information consult: Brazier *et al.*, 2012. A History of common carp (*Cyprinus carpio*) In Ireland: A Review

# Genetic methods

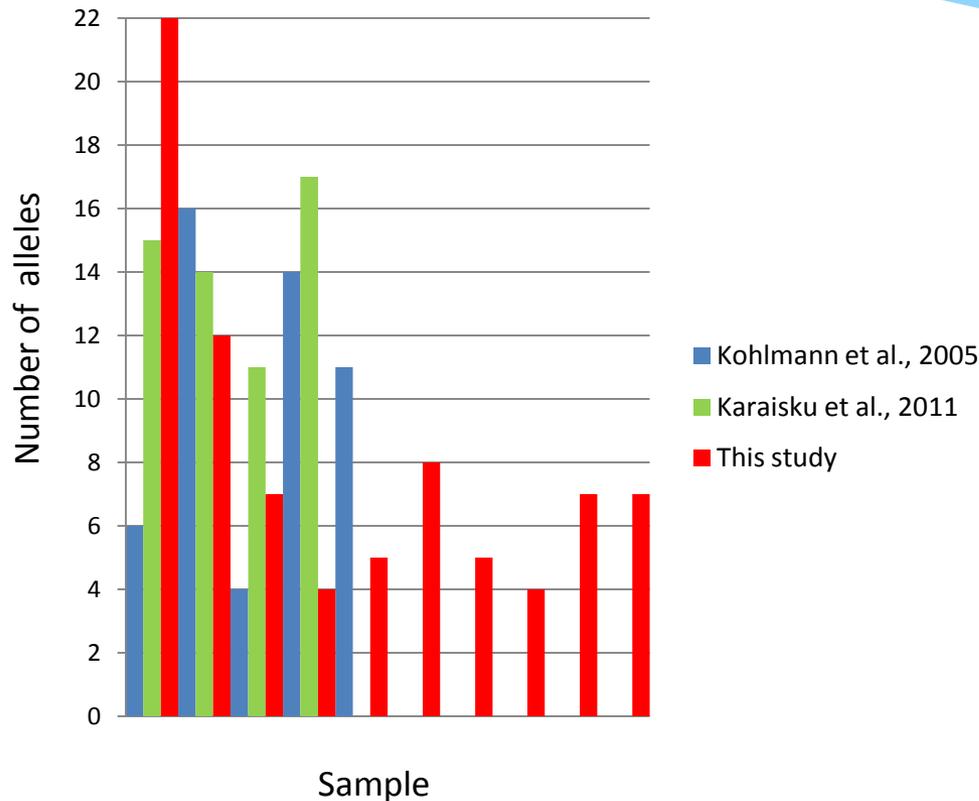
- \* Assessed genetic diversity & structure of 500+ carp from nine Irish waters & a farmed UK strain
- \* Sites chosen based on sampling feasibility & knowledge of site histories
- \* Seven microsatellite DNA loci used to provide genetic baseline for Ireland
- \* DNA extracted from non-lethal fin clip and scale samples



**Fig 3.** Map showing Irish sampling locations for common carp for genetic study

# Main findings

## - Low genetic diversity



- \* Generally low genetic diversity when compared with most other studied feral European carp populations
- \* Certain populations in Ireland have relatively high diversity due to recent mixing of strains e.g. Decoy Lake

**Fig 4.** Comparison of number of alleles at MFW7 microsatellite for feral European and Irish common carp samples. Each vertical bar represents a sample

# Main findings

## - Genetic structure (simplified!)

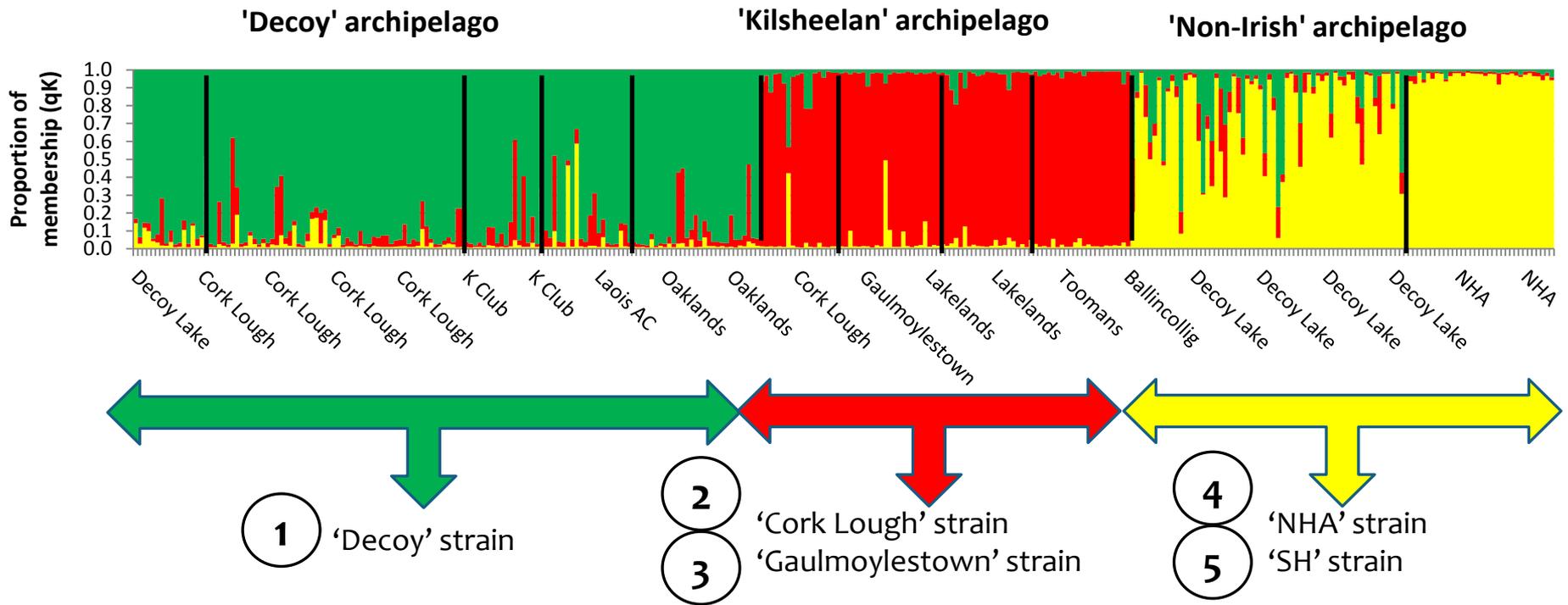


Fig 5. STRUCTURE plot showing five genetic strains of common carp in Ireland identified within three archipelagos

# Main findings

## - High genetic differentiation

- \* High genetic differentiation between strains in Ireland primarily due to;
  - isolation & lack of gene flow
  - different origins

**Table 1.** Pairwise matrix of genetic differentiation ( $F_{ST}$ ) estimates for the five strains (derived through MSA software)

Strain		1	2	3	4	5
Established	1 'Decoy'	-	<i>0.0001</i>	<i>0.0001</i>	<i>0.0001</i>	<i>0.0001</i>
	2 'Cork Lough'	0.1362	-	<i>0.0001</i>	<i>0.0001</i>	<i>0.0001</i>
	3 'Gaulmoylestown'	0.1252	0.0781	-	<i>0.0001</i>	<i>0.0001</i>
Recently introduced	4 'NHA'	0.2519	0.3246	0.2365	-	<i>0.0001</i>
	5 'SH'	0.1860	0.2208	0.1461	0.1520	-

# Main findings

## - Low effective population sizes

**Table 2.** Effective population size estimates for samples in this study (derived through LDNe software)

<b>Sample</b>	<b><i>n</i></b>	<b><math>N_e</math></b>	<b><math>N_e</math> 95% C.I.</b>
Decoy Lake	75	70.1	46.7 - 119.1
Cork Lough	72	54.6	34.4 - 104.4
NHA	25	27.6	12.1 - 175.8
Gaulmoylestown	25	n/a	56.9 -infinity
Lakelands	18	n/a	54.4 - infinity
K Club	31	20.8	10.5 - 51.8
Toomans	16	129.9	16.3 -infinity
Laois AC	19	n/a	3049.1 -infinity
Ballincollig	12	n/a	3.3 -infinity
Oaklands	29	n/a	656.3 -infinity

- \* Samples indicate relatively low  $N_e$  for most populations
- \*  $N_e$  inversely related to rate of genetic drift
- \*  $N_e \geq 50$  needed for short term viability,  $\geq 500$  needed for long term viability

# Factors responsible for observed genetic characteristics

## Genetic characteristics

- \* Low genetic diversity in Irish samples
- \* Complex genetic structure
- \* High genetic differentiation between strains
- \* Low effective population sizes

## Proposed main factors

- \* Limited historical distribution
- \* Limited sources of stocking & breeding material
- \* Limited gene pools & genetic diversity
- \* Natural factors e.g. genetic drift
- \* Isolation of populations
- \* Peripheral nature of carp in Ireland

# Significance of study?

- \* Genetic baseline

- allows genetic monitoring, enables better breeding programme design, allows comparison of strains re: angling value/potential

- \* Management plan

- new genetic insights can be used to help form contemporary management plan for Irish waters



Any  
questions  
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