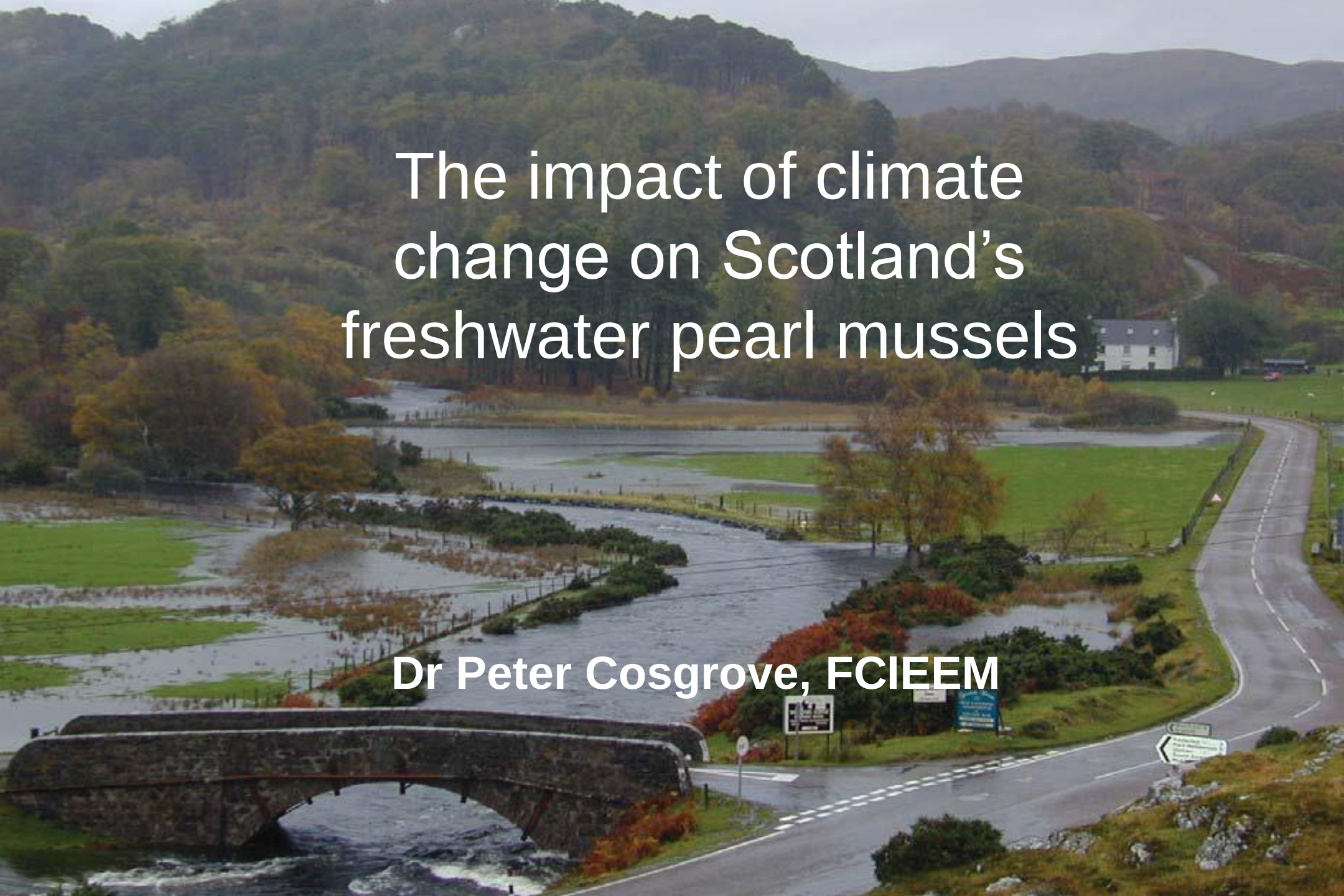


The impact of climate change on Scotland's freshwater pearl mussels

Dr Peter Cosgrove, FCIEEM

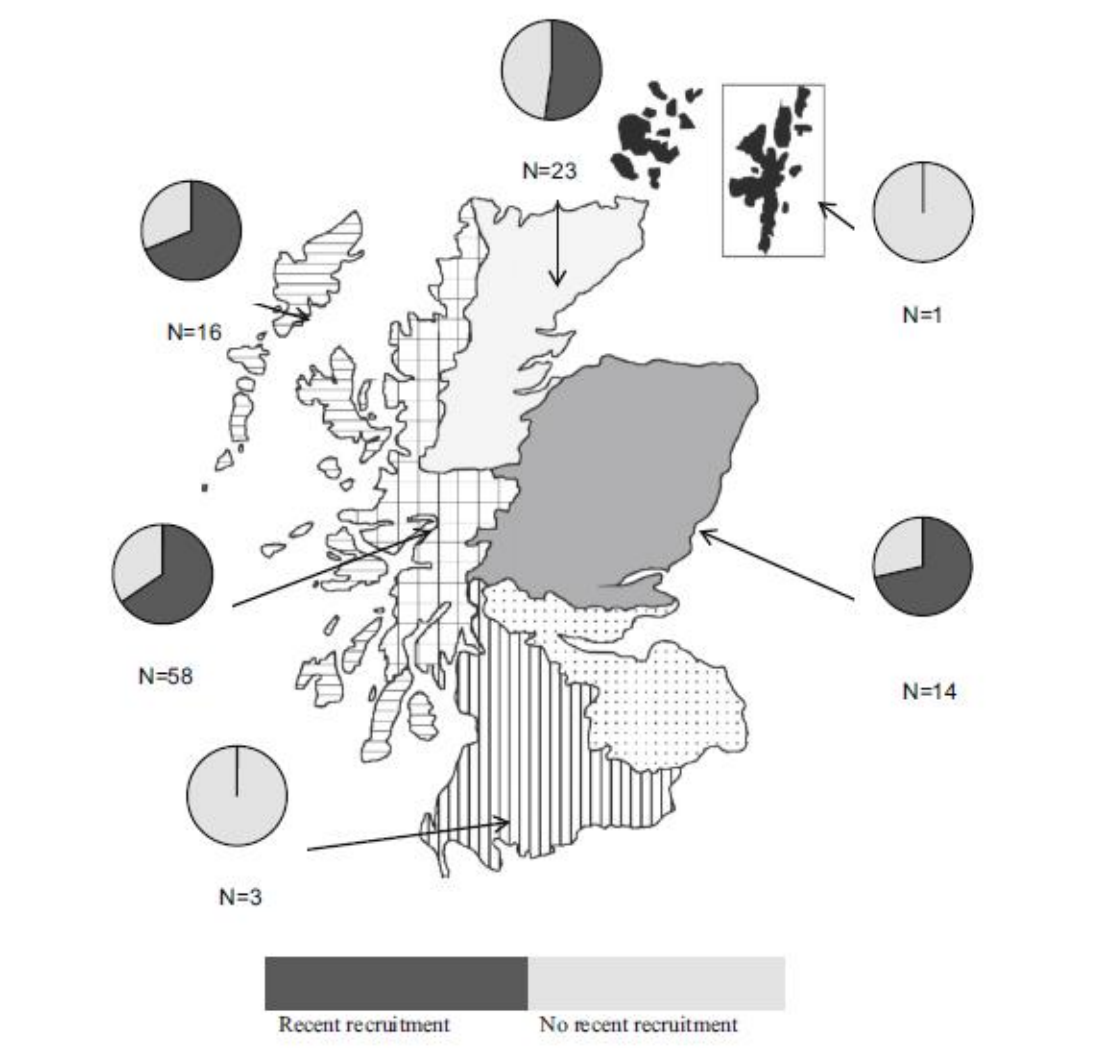
Historical human associations

- 55 BC Julius Caesar
- 16th Century – river bailiffs, lots jobs
- Rich folklore on pearl fishing & rivers
- Unparalleled historical info on their occurrence

Recent human associations

- Globally threatened species
- Legally protected in 1998
- 21 designated sites in Scotland
- Lots of research
- Scotland holds a large proportion of world pop

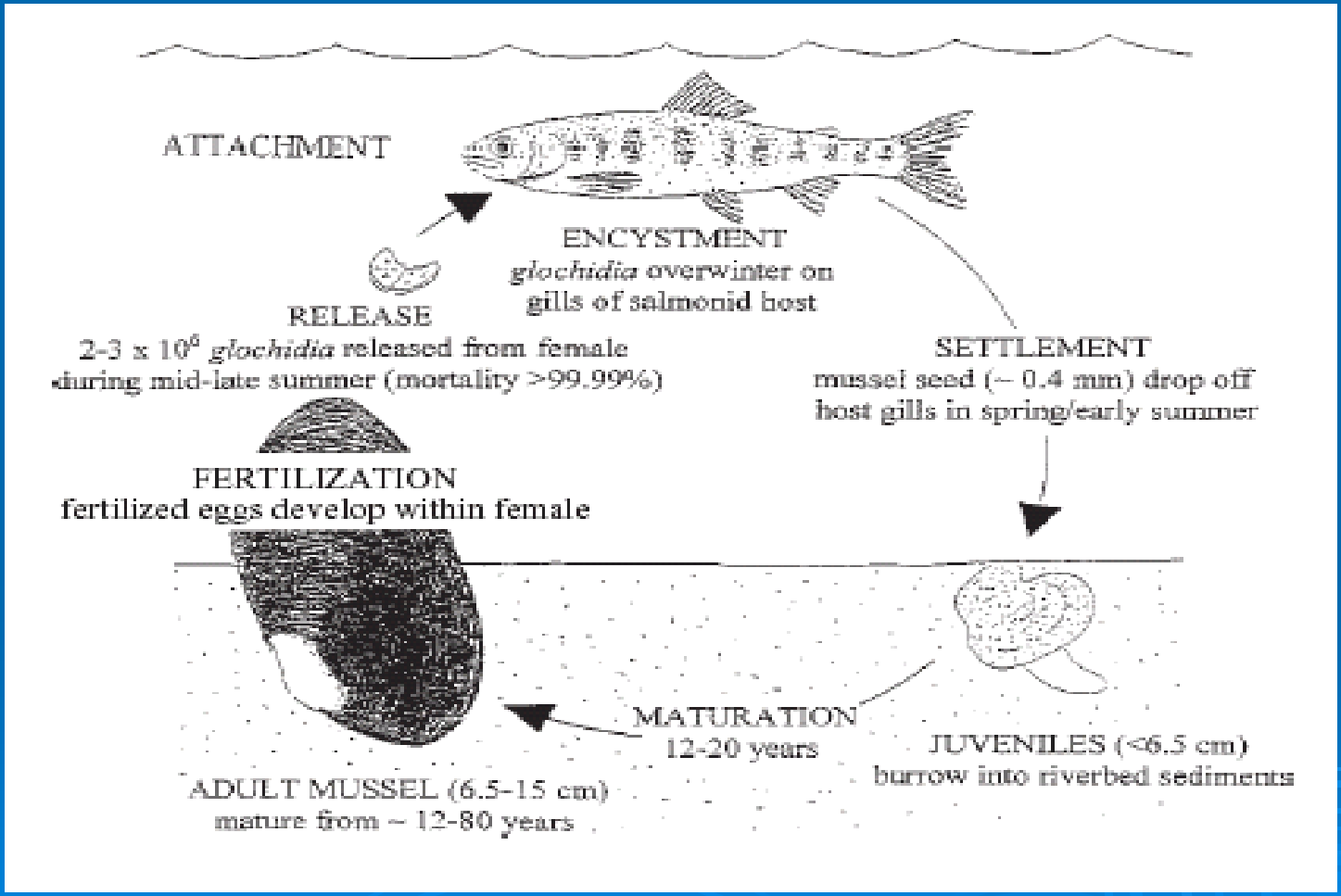
Current Scottish status 2013-2015



- 184 known historic river pops
- Extinct = 69 rivers
- No successful recruitment = 44 rivers
- Successful recruitment = 71 rivers

Cosgrove *et al*. 2016. *Biodiversity Conservation* 25: 2093-2112.

Complex lifecycle



Hastie & Cosgrove 2001. *Freshwater Forum* 15: 85-96.

Climate change factors likely to affect FWPM populations

- Temperature
- Precipitation
- Sea level rises
- Habitat reduction
- Decline in host fish stocks
- Human activity

Cosgrove *et al.* 2012. River Conservation & Management.

Temperature

Influences:

- Growth
- Longevity
- Reproductive success

Up to 5ºC summer increase

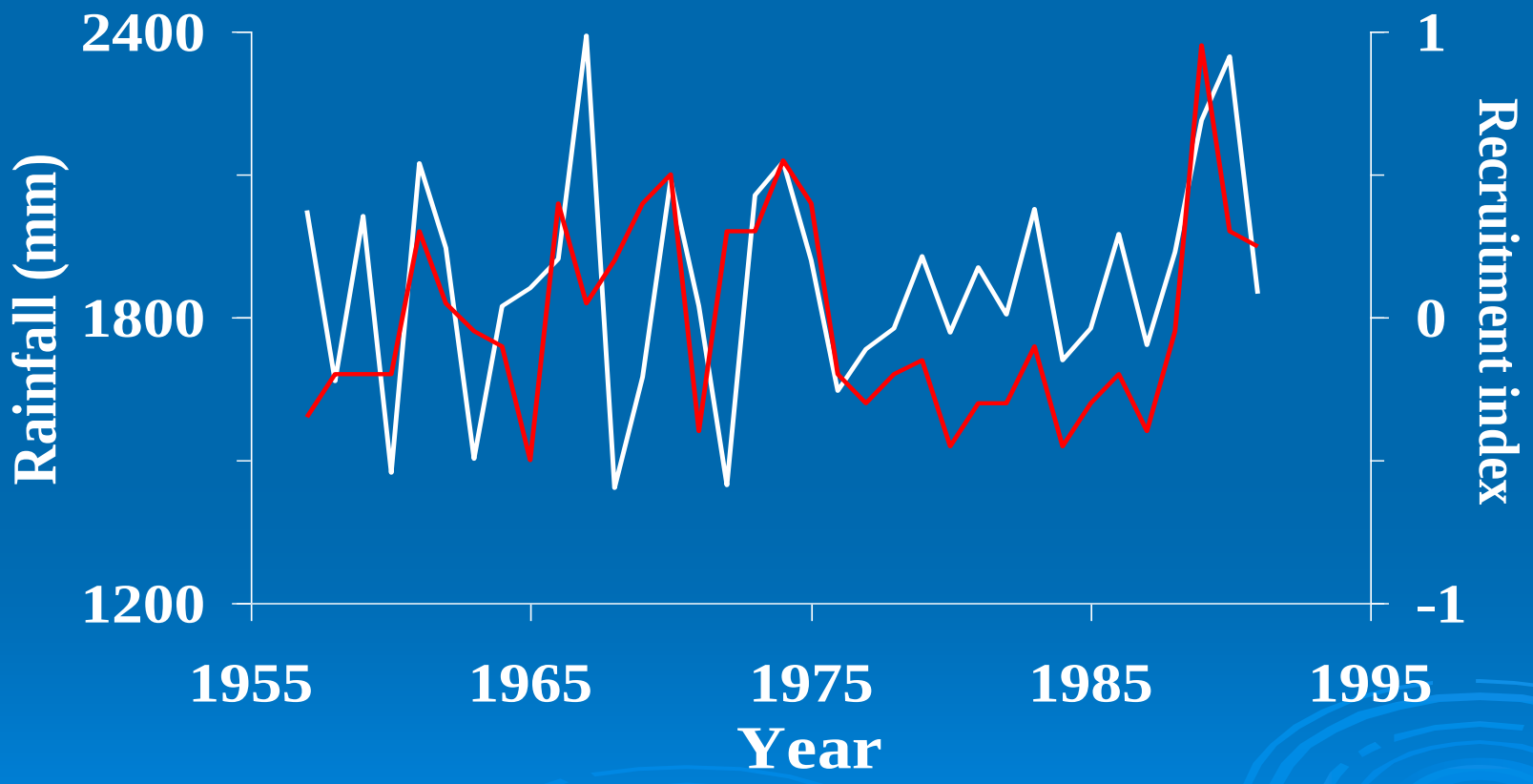
Complex effects:

- Speed up growth rates
- Reduce longevity
- Increase recruitment, but may decouple timings of FWPM & fish reproduction
- >90% of extant pops shallow & so susceptible to extreme temp rises

Precipitation

- Summer = up to 40% decrease
- Winter = up to 60% increase
- Greater no' of storm events
- Close match between rainfall & recruitment success
- Drier summers & low flows = bad for recruitment
- Increased flows +ve effects
- Extreme floods –ve effects

Historical precipitation and mussel recruitment patterns in the River Kerry, NW Scotland (1955-1995).



Hastie *et al*., 2003. *Ambio* 32: 40-46.

Natural flood amelioration

Of Scotland's 71 extant fwpm populations:

- >90% in small & shallow streams
- >90% have sizable lochs in mid-upper catchment
- Lochs dramatically 'dampen down' severity of flood & temp effects

Habitat reduction

Several influences include:

- Loss of fine substrate material by being washed out of rivers
- Substrate habitats becoming more unstable & consequently unsuitable for FWPM
- Impacts on host fish pop

Sea level rises

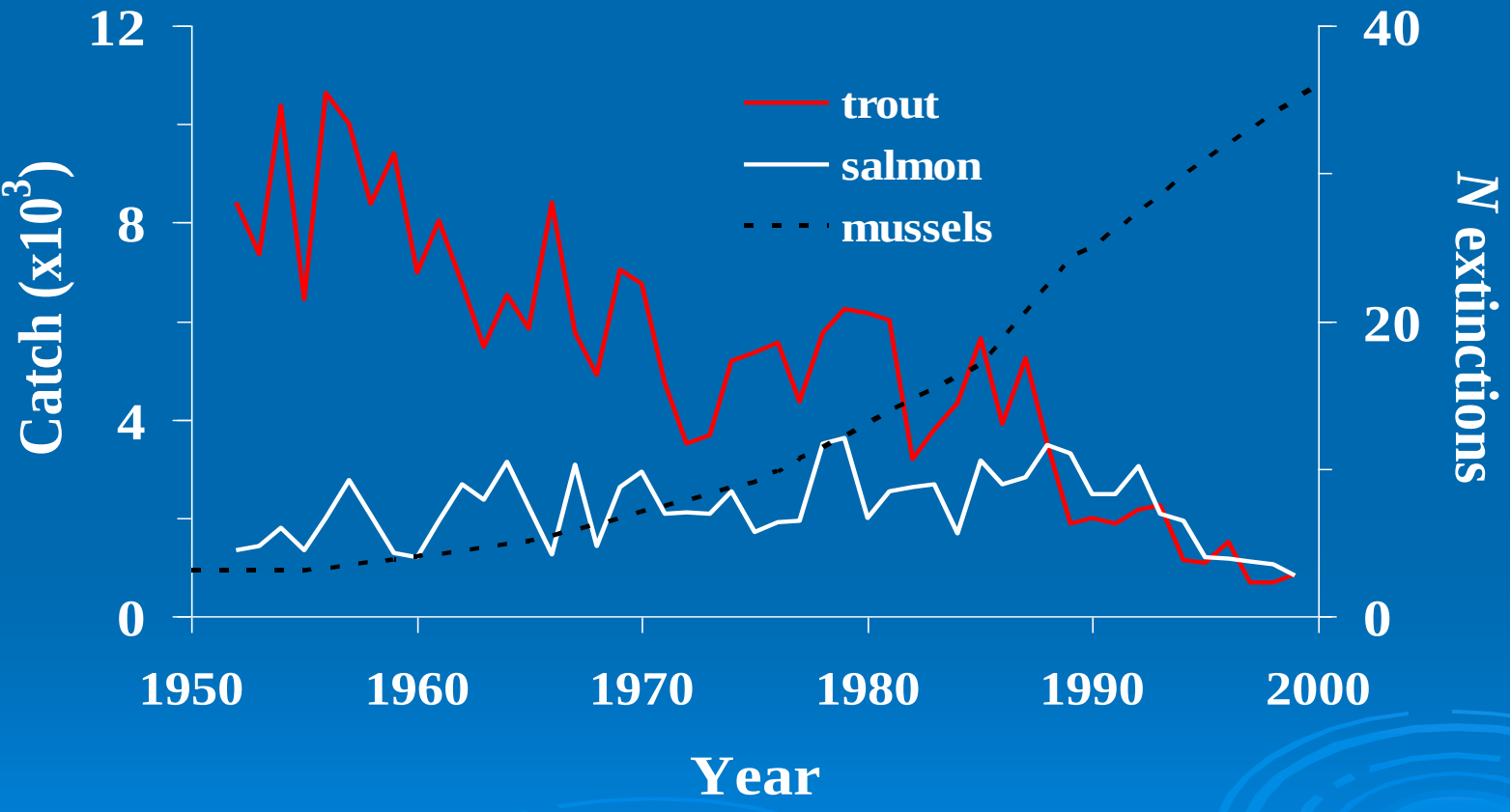
- FWPM can’t tolerate saline conditions & so some pops in lower reaches under threat
- Predicted 0.5m rise in sea level likely to impact <10 pops

Decline in host fish populations

Several influences :

- Most FWPM pops already show signs of reduced recruitment. So, declines in host fish likely to result in further declines in FWPM recruitment
- Many FWPM rivers have host fish populations below critical threshold levels
- Likely to be particularly pronounced in small streams, with v limiting suitable habitat

Coincidental declines of salmonids and pearl mussels in NW Scotland (1950-2000).



Hastie & Cosgrove, 2001. *Freshwater Forum 15*: 85-96.

Human activity

- There are many adaption & mitigation proposals to address CC threat e.g. hydro schemes, channel dredging, bank reinforcement, flood defences etc.
- CIEEM members assess these river engineering schemes.

Climate change & FWPMs

- Extreme scenarios = bad news for all pops.
- Less extreme scenario = +ve & -ve effects, complex. Not as simple as CC = doom & gloom.
- Small streams in catchments without lochs worse affected & likely to be lost.
- CIEEM members should be aware of CC threats to FWPM and consider this in their EcIA work.