COPING STRATEGIES, HUSBANDRY SYSTEMS AND ETHICAL QUALITY IN AQUACULTURE

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Topics to be covered:

- Ethical quality in farmed fish
- Coping strategies and fish welfare
- Recent ETHIQUAL studies in carp, cod and seabass
- Implications for aquaculture husbandry
- Strategies for improving ethical quality in farmed fish

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Ethical Quality in Farmed Fish

- Welfare standards by which fish are reared are becoming increasingly important:
  - Production related
    - Production efficiency
    - Flesh quality
  - Stakeholder related
    - Public concern
    - Regulation

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Ethical Quality & Farmed Fish

- Consequently great interest has been generated in:
  - Welfare indices
  - Welfare friendly production systems and technologies
- Known to be species-specific
- But…behavioural variation within species must also be considered

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Coping Strategies and Welfare

- Within-population variation in behavioural and physiological responses to stressors
- Often highly consistent
  - Coping strategies or behavioural syndromes
  - Boldness and aggression often correlated
- So husbandry practices will impact differently on individuals within a population
- What are these differences and how can aquaculture systems cater for them?
  - Studies from ETHIQUAL

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Coping strategies: *Carp*

- 10 fish in covered shelter
  - 5 mins settling time
- Observed emergence
  - Unfamiliar & potentially dangerous environment
  - Fish fasted
  - Feed stimulus (smell of food) present

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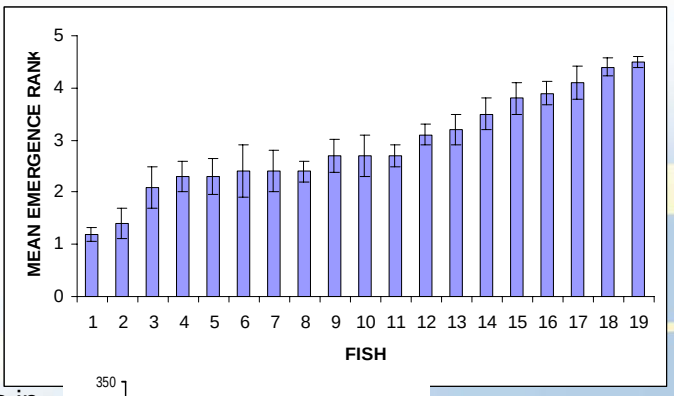
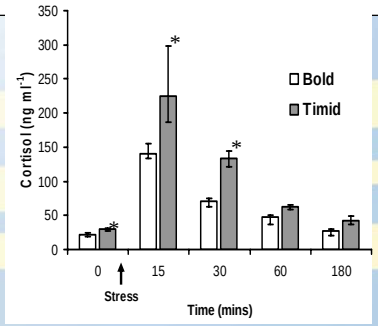
Coping strategies: *Carp*

- Consistent behavioural variation
  - ANOVA $F_{18,99=3.55,\ P<0.001}$
  - Fish in top third of distribution classed as "bold" ;bottom third as "timid"



Timid fish exhibit higher plasma cortisol levels in response to standard stressor (30 secs in air)
Kruskill Wallis H=40.75 and 3.5,
P<0.001 & P=0.06 respectively
(*p<0.05 Mann-Whitney U-test)



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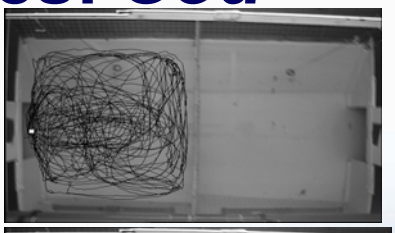
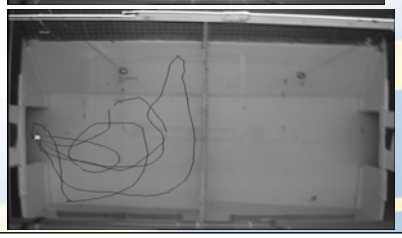
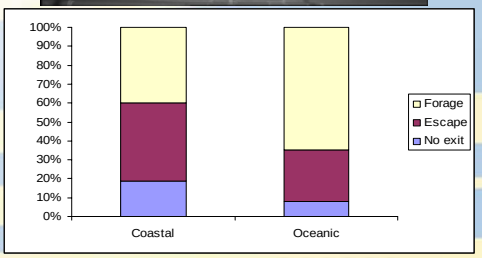
Coping strategies: *Cod*





- **Cod placed singly in covered box for 5 mins**
- **Exploration of novel, well lit tank for 25 mins recorded by Ethovision**
- **3 response categories identified**
- **Distribution different in coastal and oceanic stocks**
  - **Chi²=10.7, p=0.004**
  - **Family effect on foraging response for coastal but not oceanic stocks**



Forbes *et al* Unpubl.

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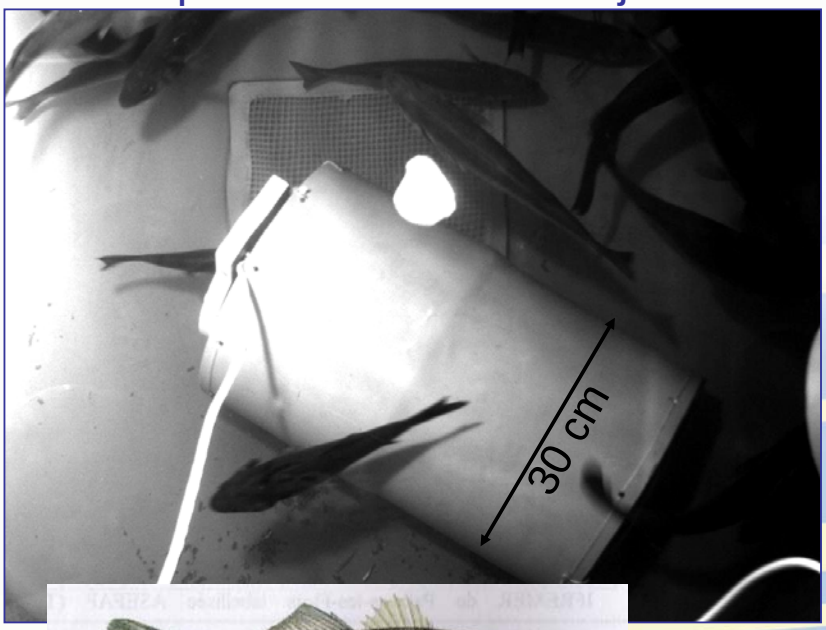
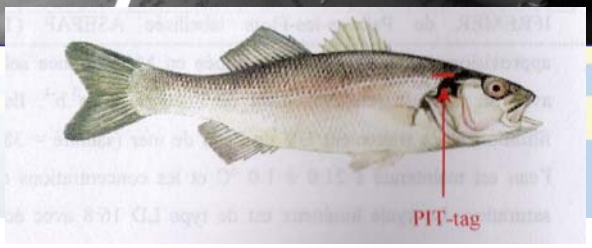
Coping strategies: *Seabass*

Exploration of a novel object





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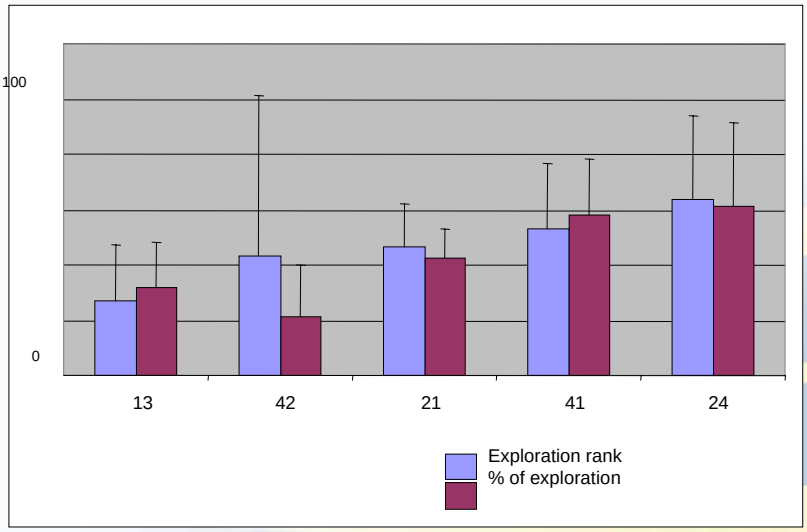
Coping strategies: *Seabass*



Begout-Anras Unpubl.

Exploratory behaviour by 5 non-triggering fish
-Bold or timid behaviour?

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Implications for aquaculture

- …of being bold
  - reduced stress response
    - may flourish in an aquaculture environment
  - poorer welfare for proportion of population
- …of being aggressive
  - selection for fish which are not stressed by aquaculture:
    - highly aggressive environment
      - poor welfare

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Strategies for improving ethical quality

- Define conditions that guarantee welfare, and regulate accordingly
  - Challenging as many variables influence welfare
- Develop litmus tests for welfare applicable on farms
  - e.g. Fin/body condition, growth, colour, behaviour, feed Intake
- Develop/use husbandry systems that maximise welfare
- Use fish that flourish on farms
  - Separate boldness and fast growth from aggression
    - Phenotypic or genotypic selection

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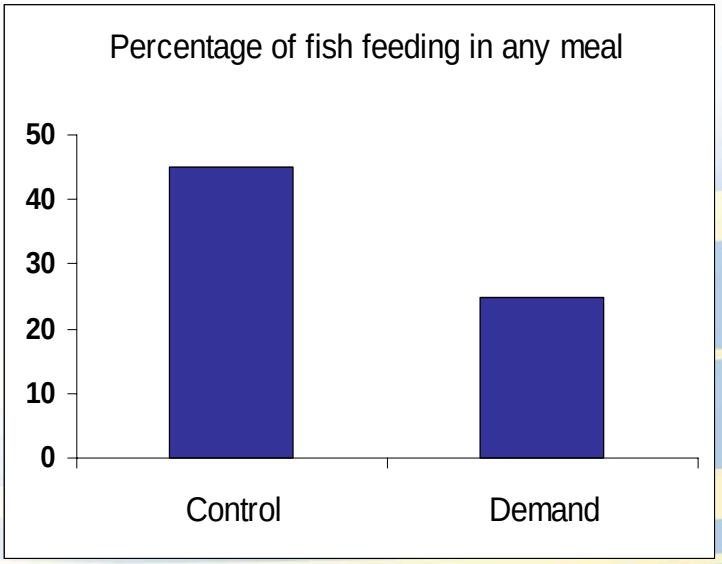
Strategies for improving ethical quality

-*Husbandry systems that maximise welfare*

- **Demand feeding**
  - **Salmon, seabass and seabream fed to demand show less scramble competition and no overt fighting**
    - Andrew *et al* 2002, Noble *et al* Unpubl**.**



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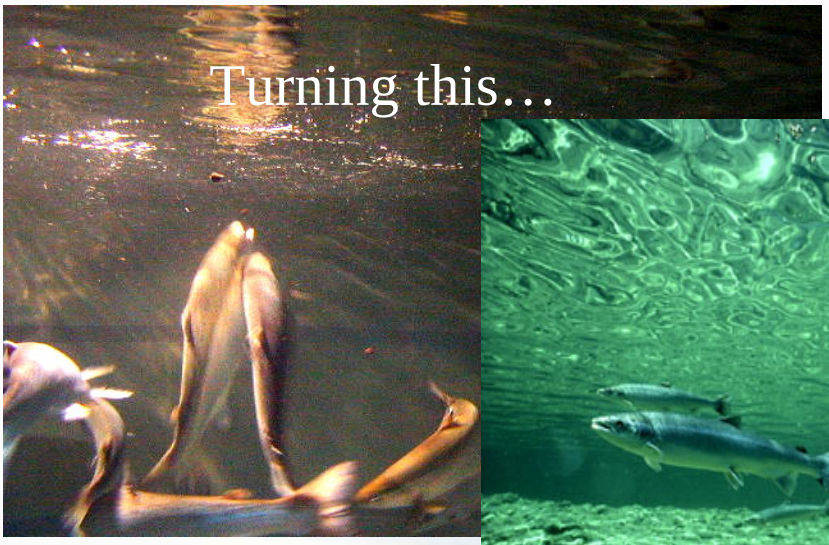
Strategies for improving ethical quality

-*Husbandry systems that maximise welfare*



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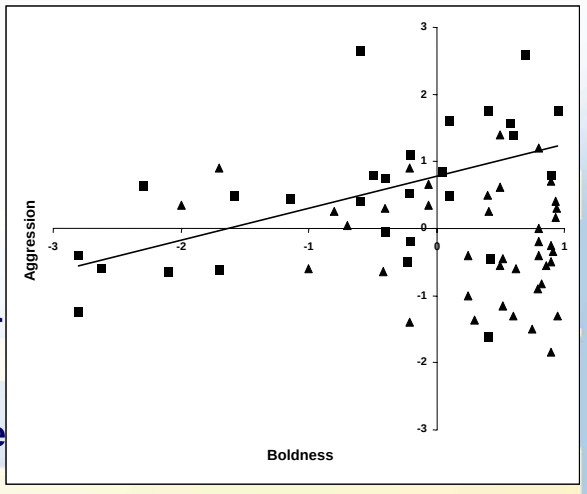
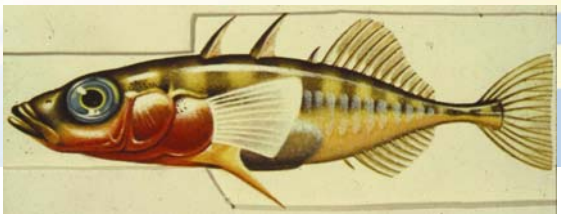
Strategies for improving ethical quality

-*Separating boldness from aggression*

- **Natural selection demonstrates that specific environmental pressure can produce fish which are bold but not aggressive**
- **Scottish stickleback populations**
  - **Boldness in a novel environment**
  - **Aggression toward conspecifics**
  - **Squares and line: abundant predators**
  - **Triangles: few predators**
- **Low predator environment selected for bold but non-aggressive individuals**
- **If selecting for fish which arent stressed, don't necessarily have to use fish which fight all the time**
- **But can selective breeding simulate this phenomenon……?**



after Bell 2005



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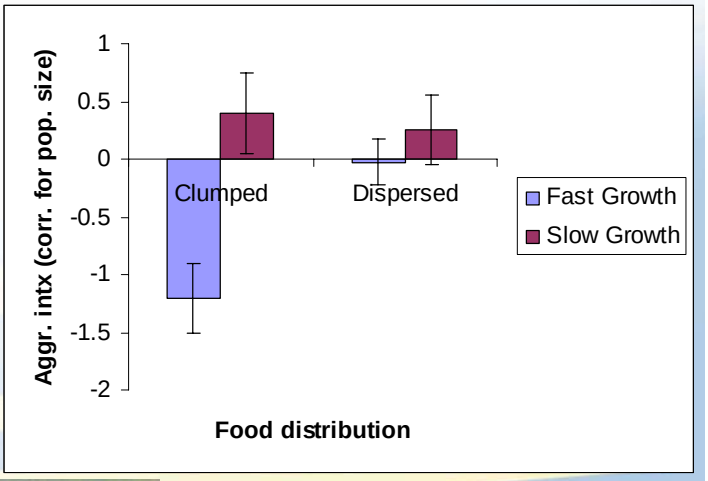
Strategies for improving welfare

-*Separating fast growth from aggression*

- **Selection experiment in medaka**
  - **Measured affect of feeding and selection regimes on aggression**
  - **NSD between dispersed or slow growth-clumped**
  - **Diff btw fast & slow growth clumped p<0.05**
- **Demonstrates that if selecting for high growth, don't have to pay the price in aggression**
- **Selective breeding in aquaculture could emulate this in order to develop fast growing, low aggression/high welfare populations**



after Ruzzante & Doyle 1991

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Conclusions:

- Within population variation in stress response does exist
- Implies different individual welfare status
- ETHIQUAL is measuring these in several aquaculture species
- Potential strategies to improve welfare status within populations are possible
  - Provision for high standards of ethical quality

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