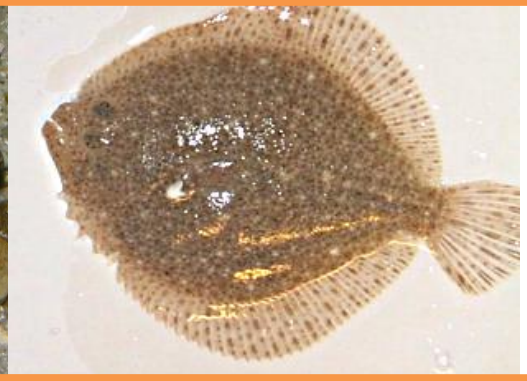

A comparative study of flatfish enhancement programs

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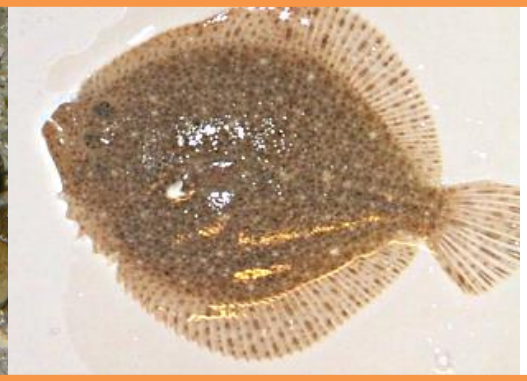
7th IFS, Sesimbra, Portugal, 2-7 Nov. 2008

Different origins, same goals

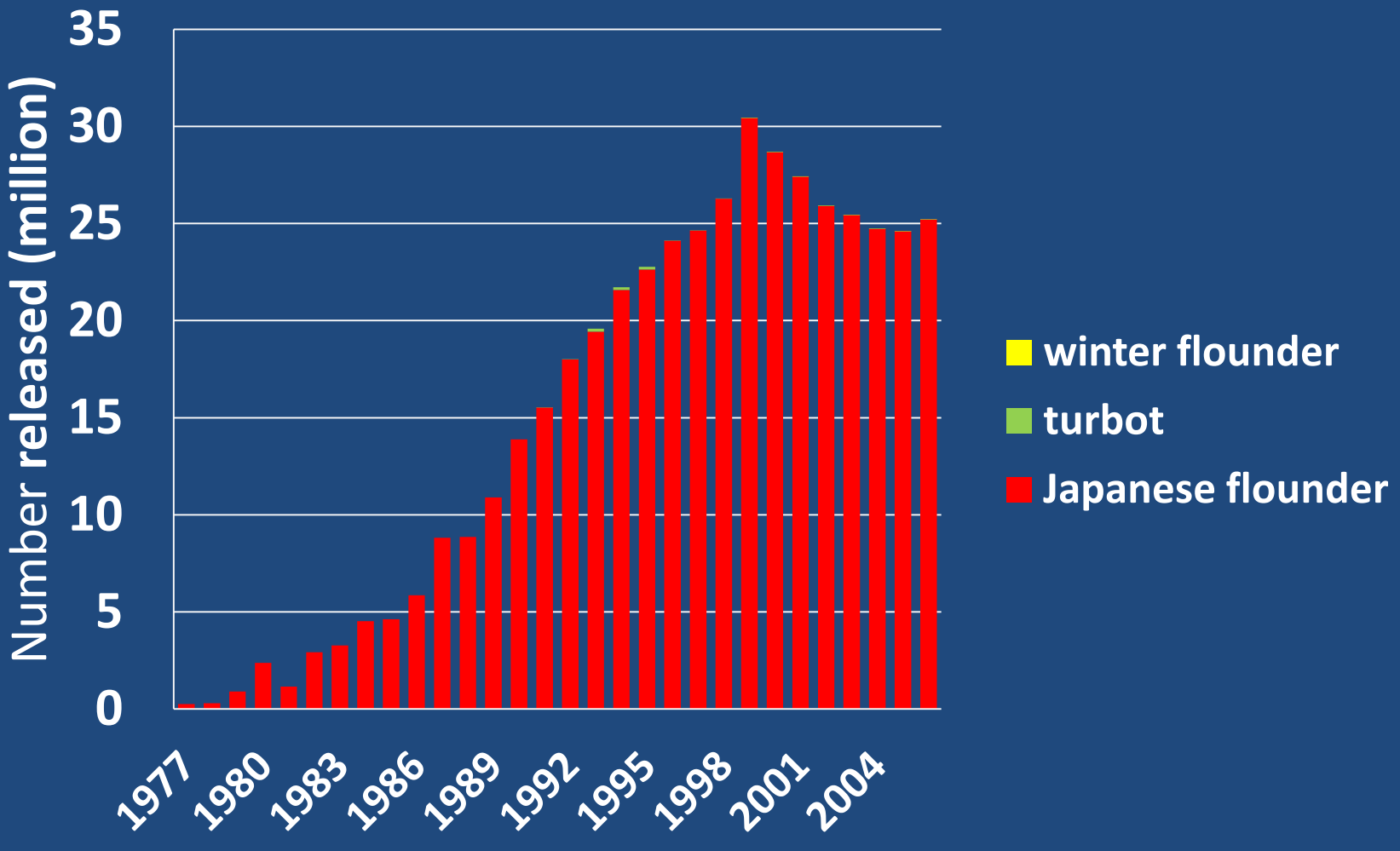
Augment natural supply of juveniles

and

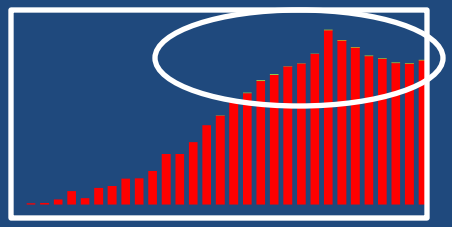
Optimize harvests by overcoming recruitment bottlenecks

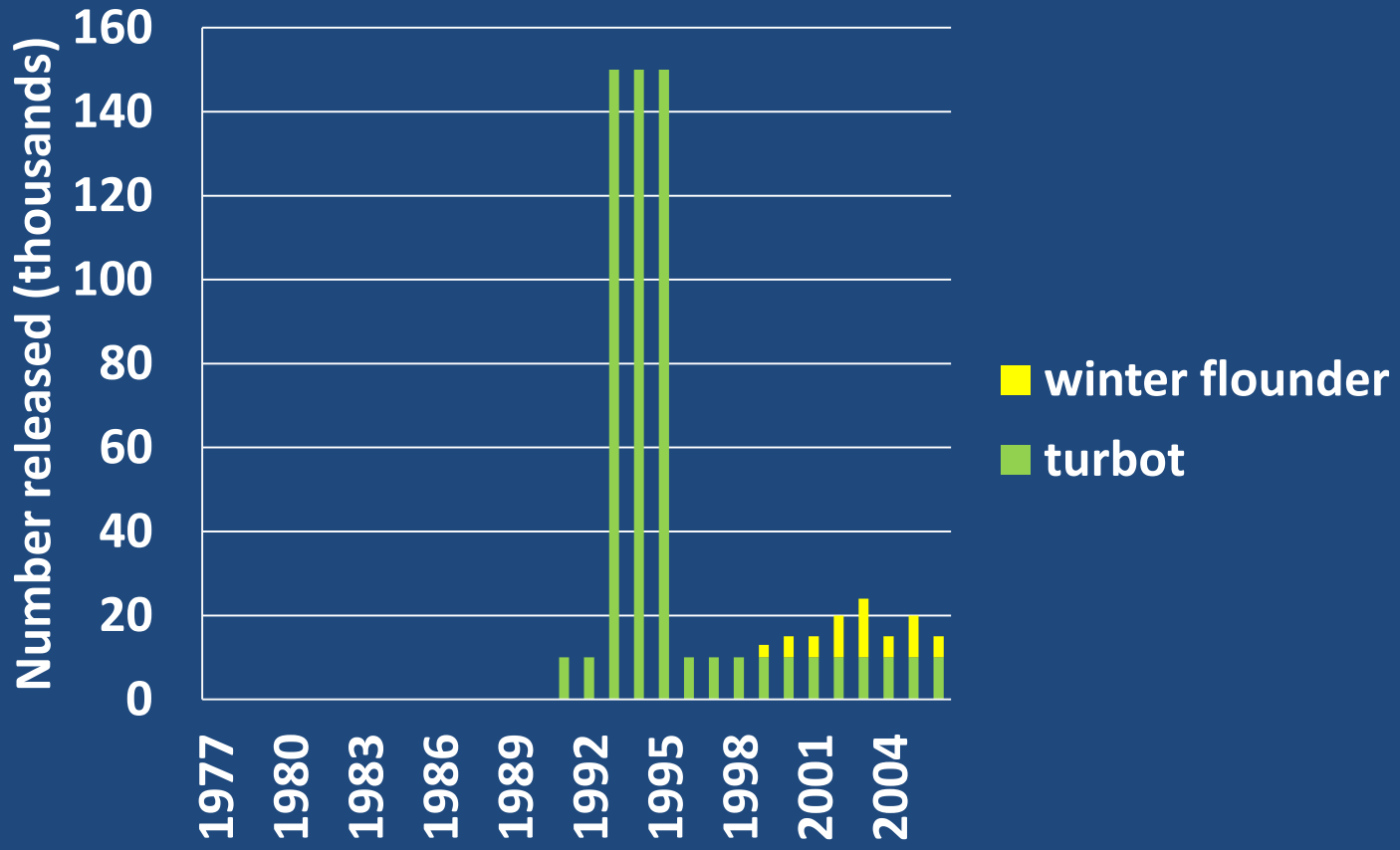


Stockings


Number released (million)
35
30
25
20
15
10
5
0
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
winter flounder
turbot
Japanese flounder

Stockings



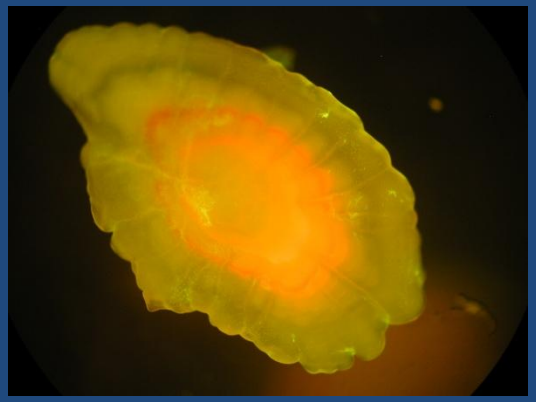

Number released (thousands)
160
140
120
100
80
60
40
20
0
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
winter flounder
turbot

“Responsible Approach”

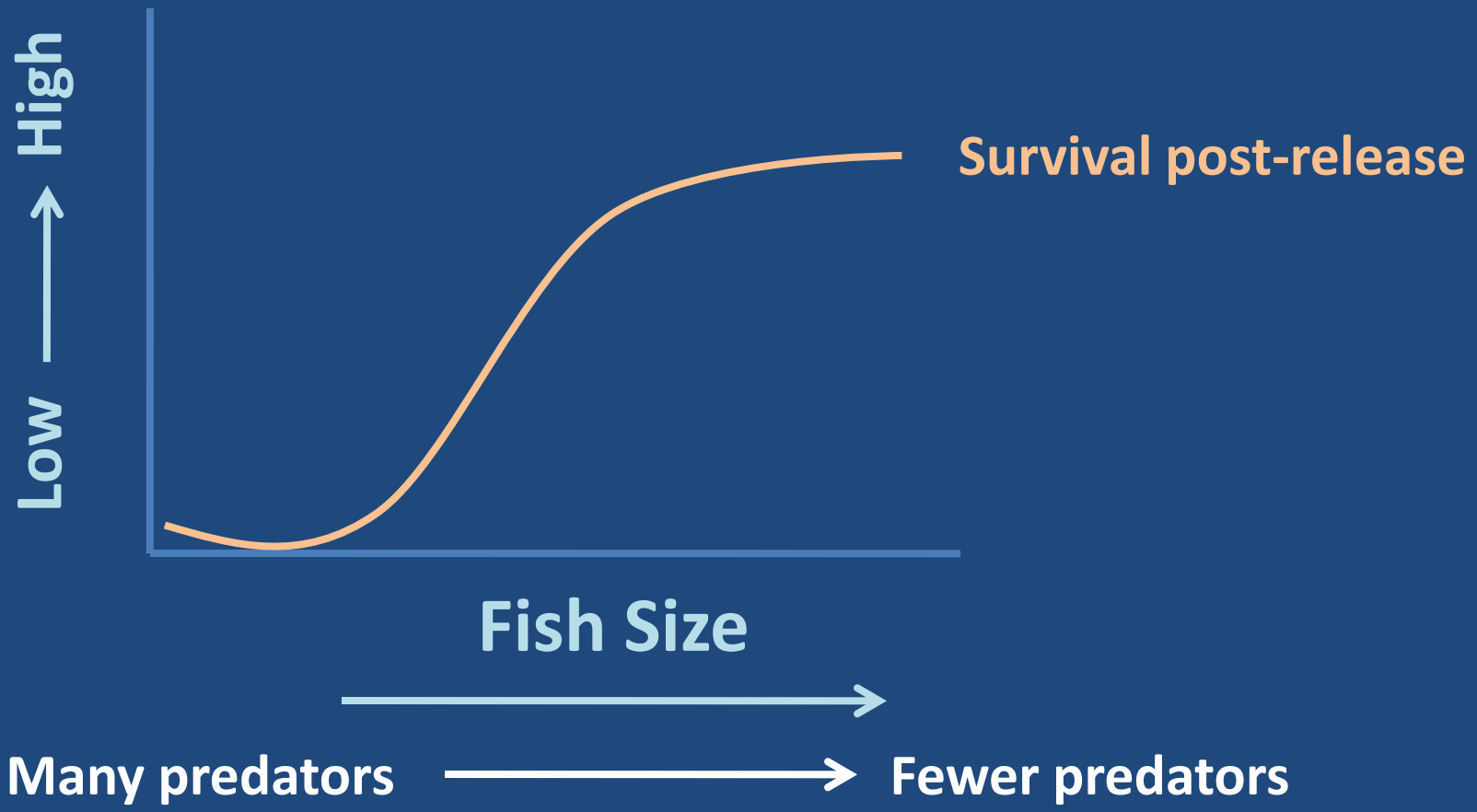
- Prioritize and select target species for enhancement
- Develop a species management plan
- Define quantitative measures of success
- Use genetic resource management
- Use disease and health management
- Form enhancement objectives and tactics
- Identify released hatchery fish and assess stocking effects
- Use an empirical process to define optimal release strategies
- Identify economic and policy objectives
- Use adaptive management

(Blankenship and Leber 1995)

Tagging techniques



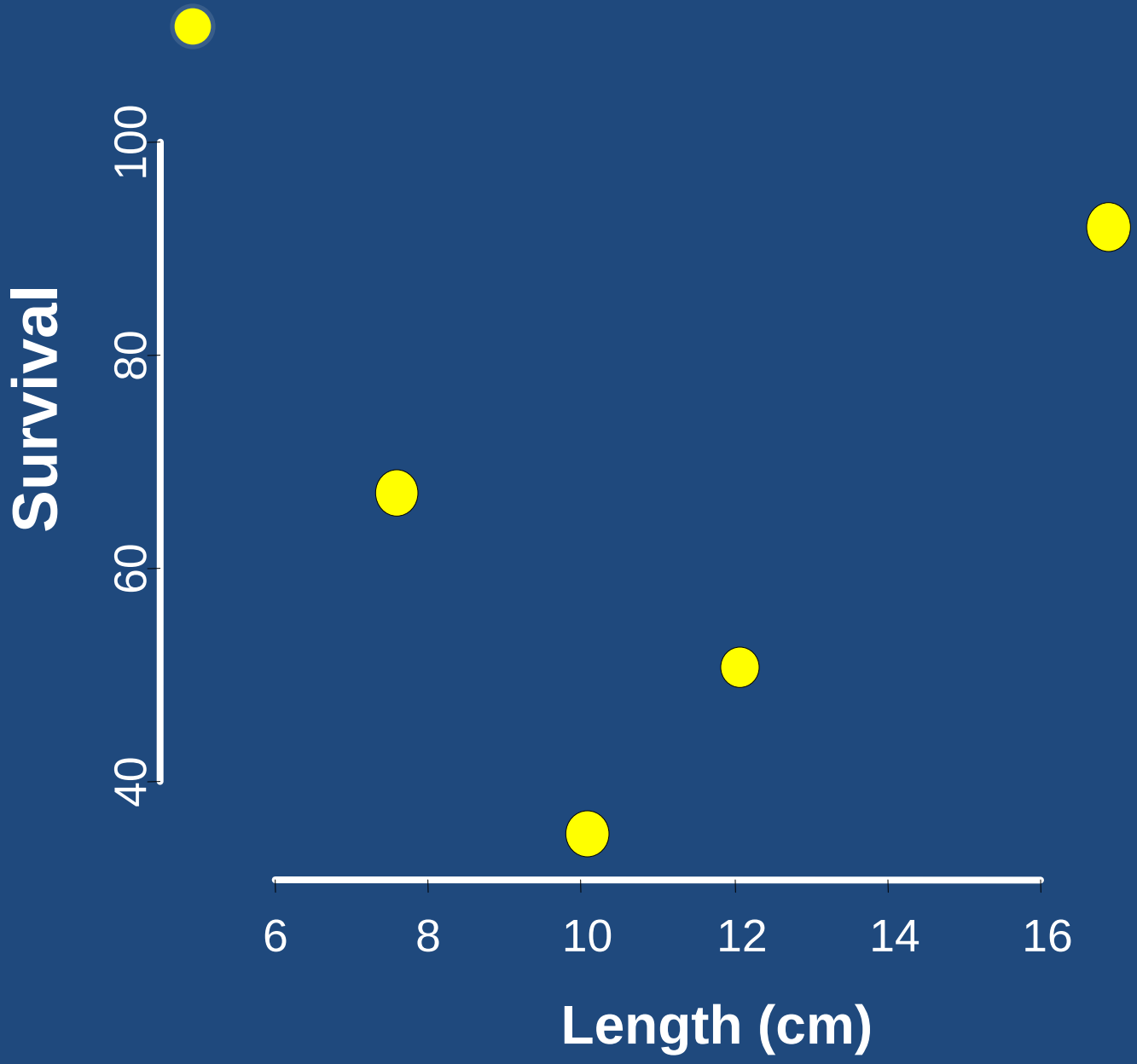
Size at release



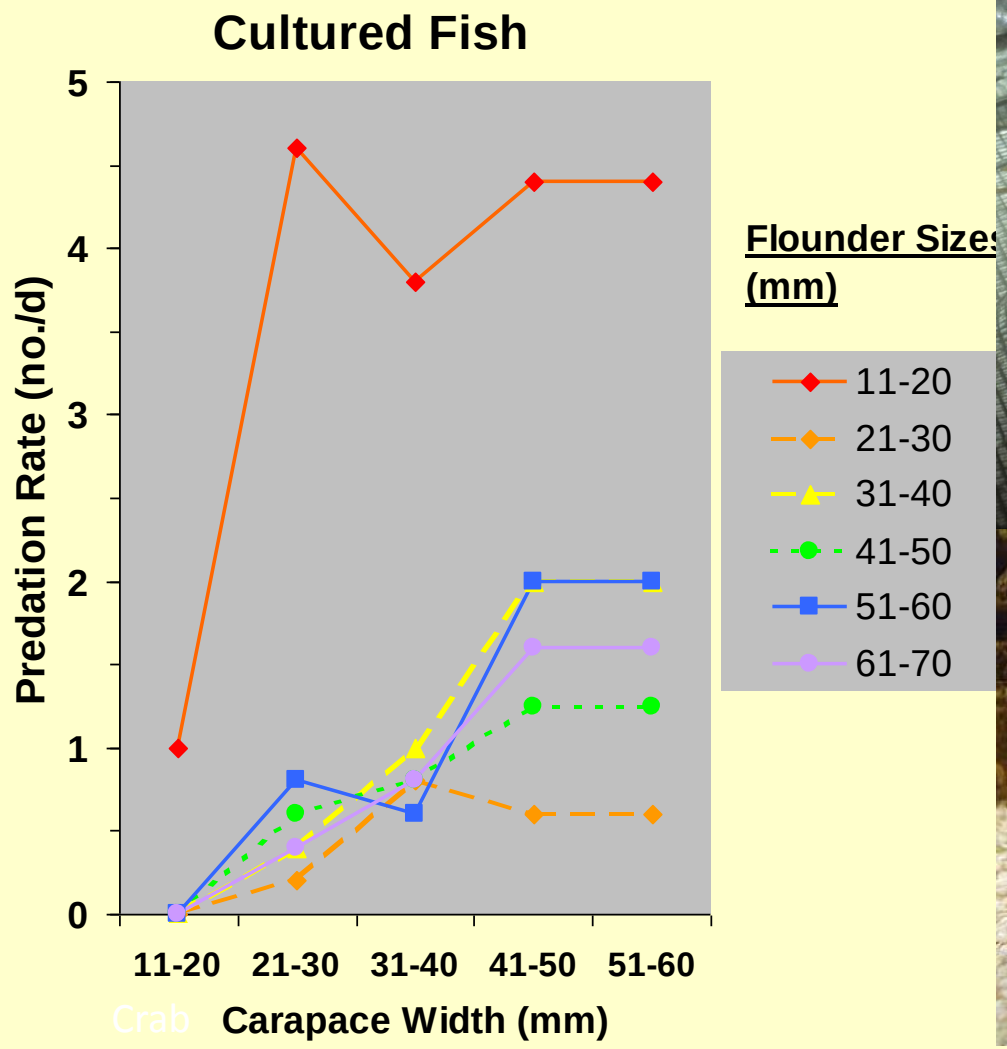
Size at release

Prey size functional response of sea-gull predator

(Sparrevohn et al. 2003; Sparrevohn & Støttrup 2006)

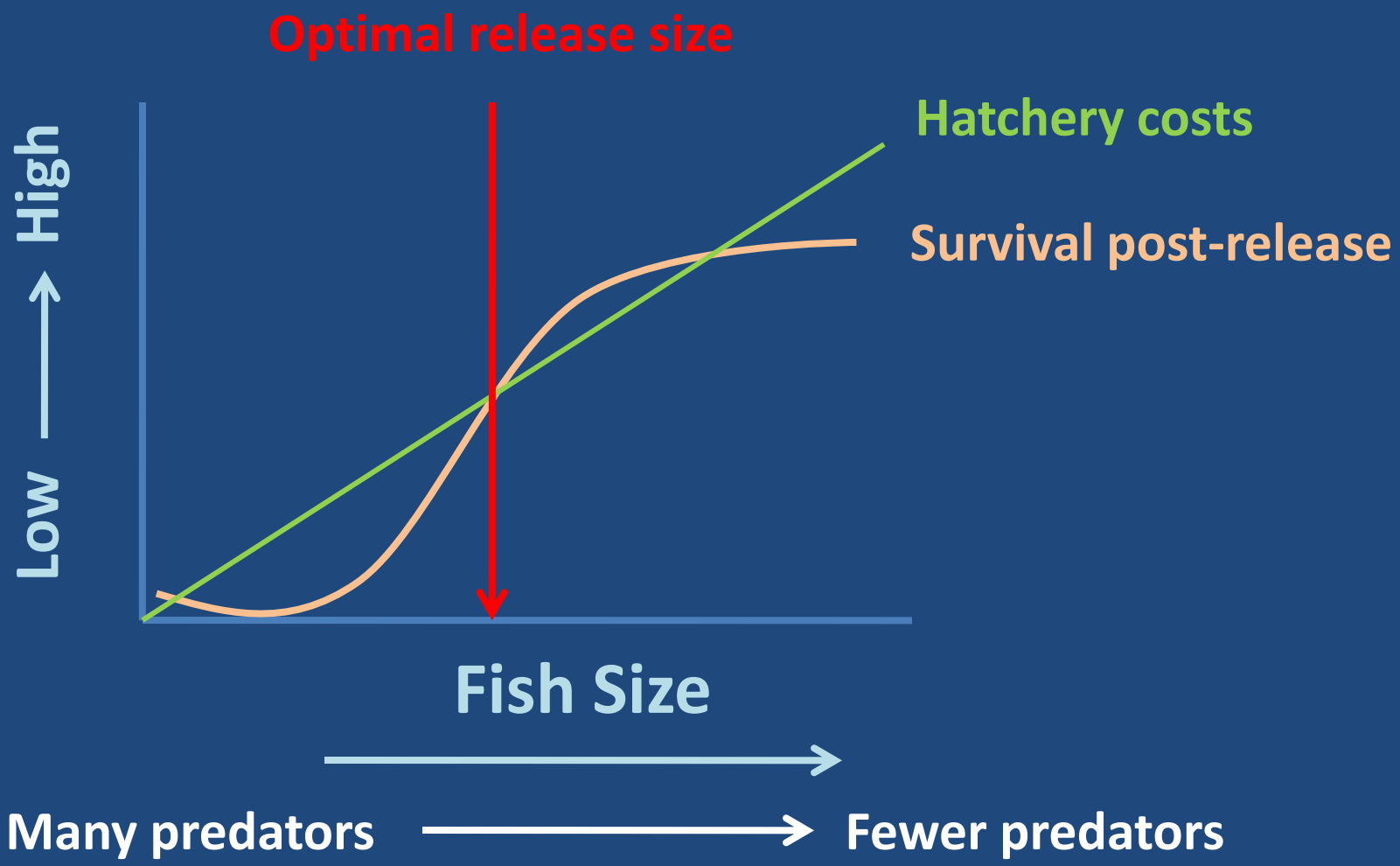


Size at release

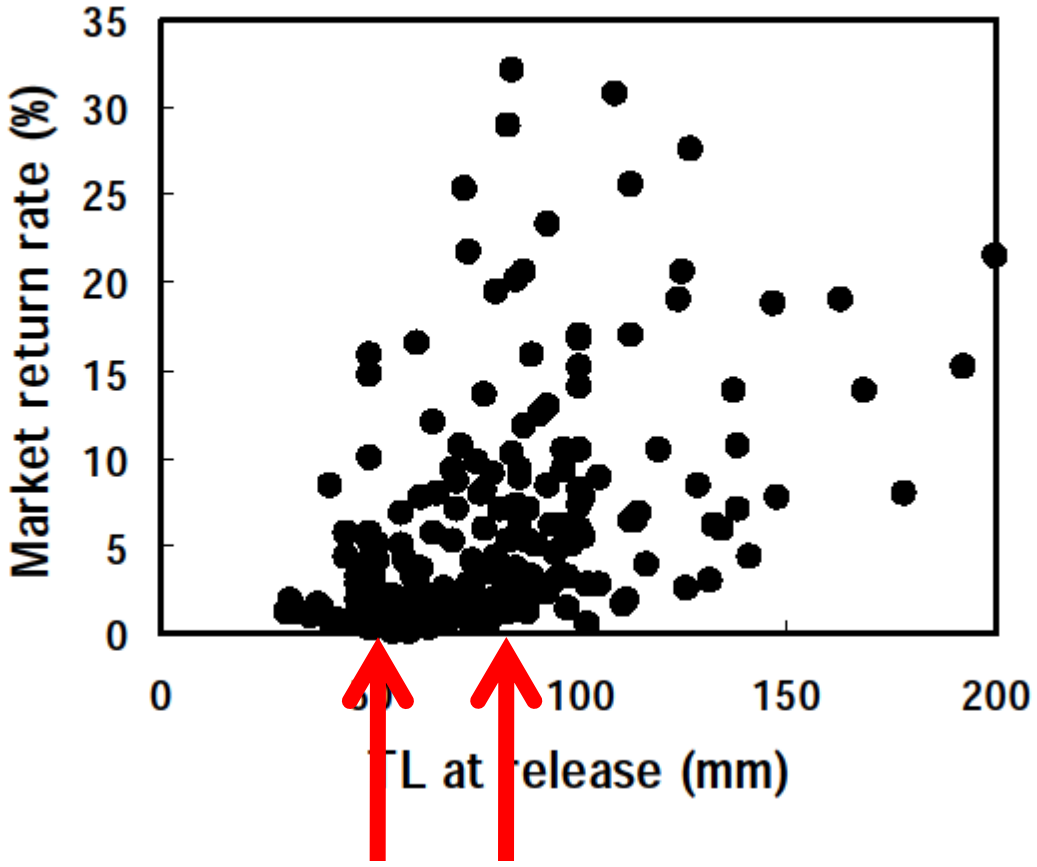


Crab

Size at release



Size at release



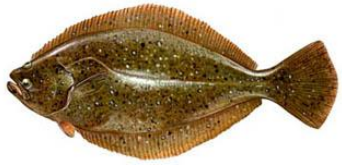
(Yamashita & Aritaki)

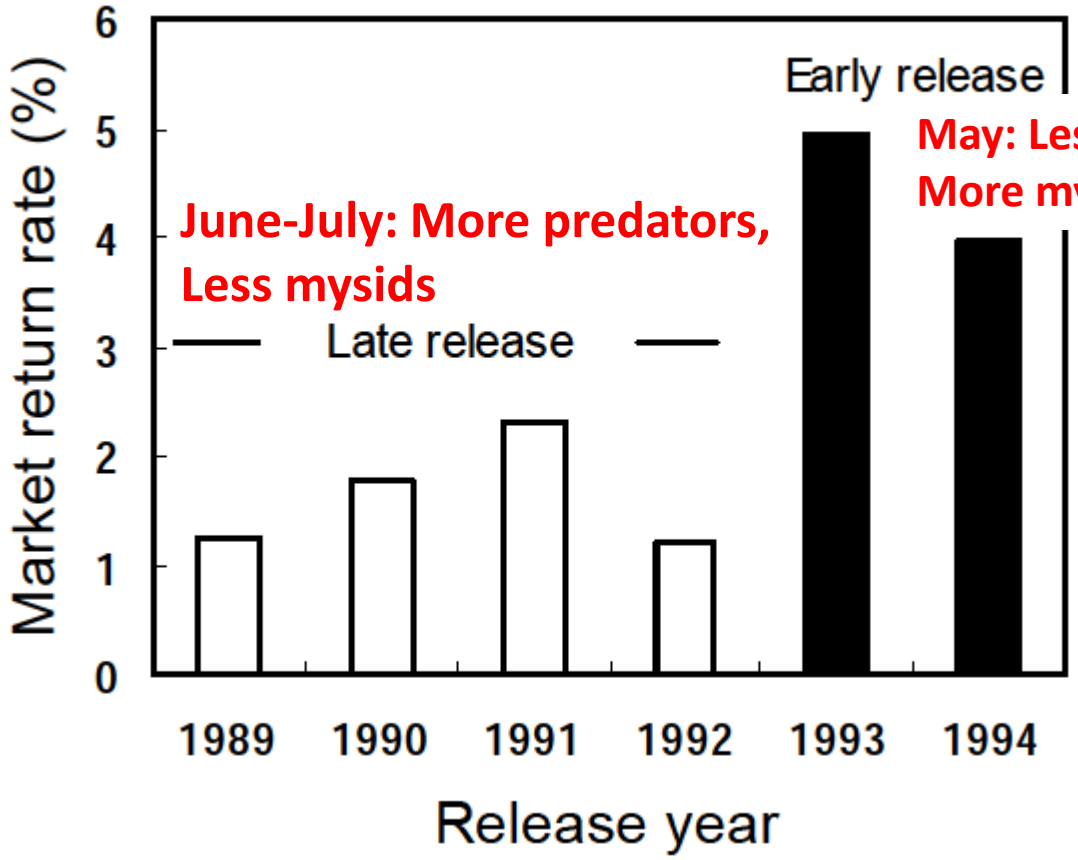
Release season

- "Timing is everything"
  - When prey are most abundant
  - Predators least abundant
  - In synchrony with wild population
- Will vary by latitude and the natural seasonal progression of wild populations
- Usually this means at the beginning of the warming season for age 0 fish

Release season

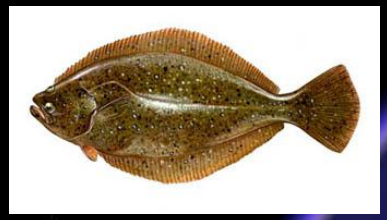
"Timing is everything"





(Yamashita & Aritaki)

Release habitat



Release micro-habitat

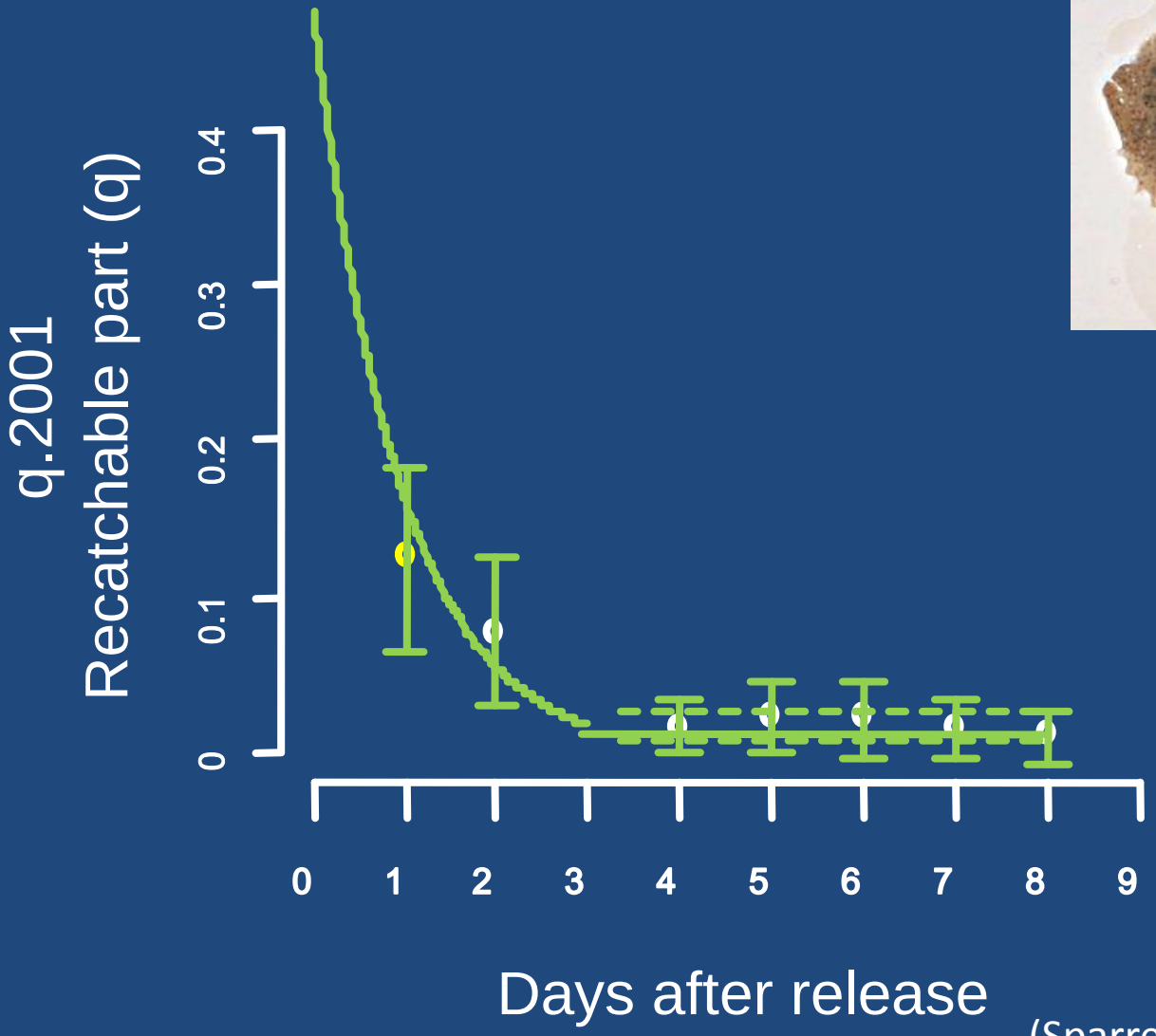
- Appropriate for wild flatfish
- Suitable type and amount of prey exist
- Offers predator refuge
- Area that provides high survivorship but has low accessibility for the wild population

SANDY, SHALLOW ZONES

Release Methods

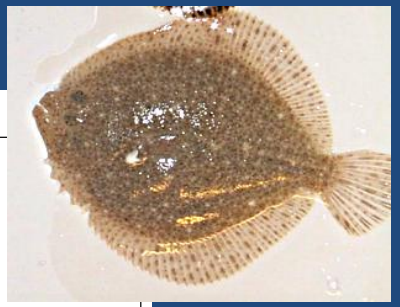
High Initial Mortality

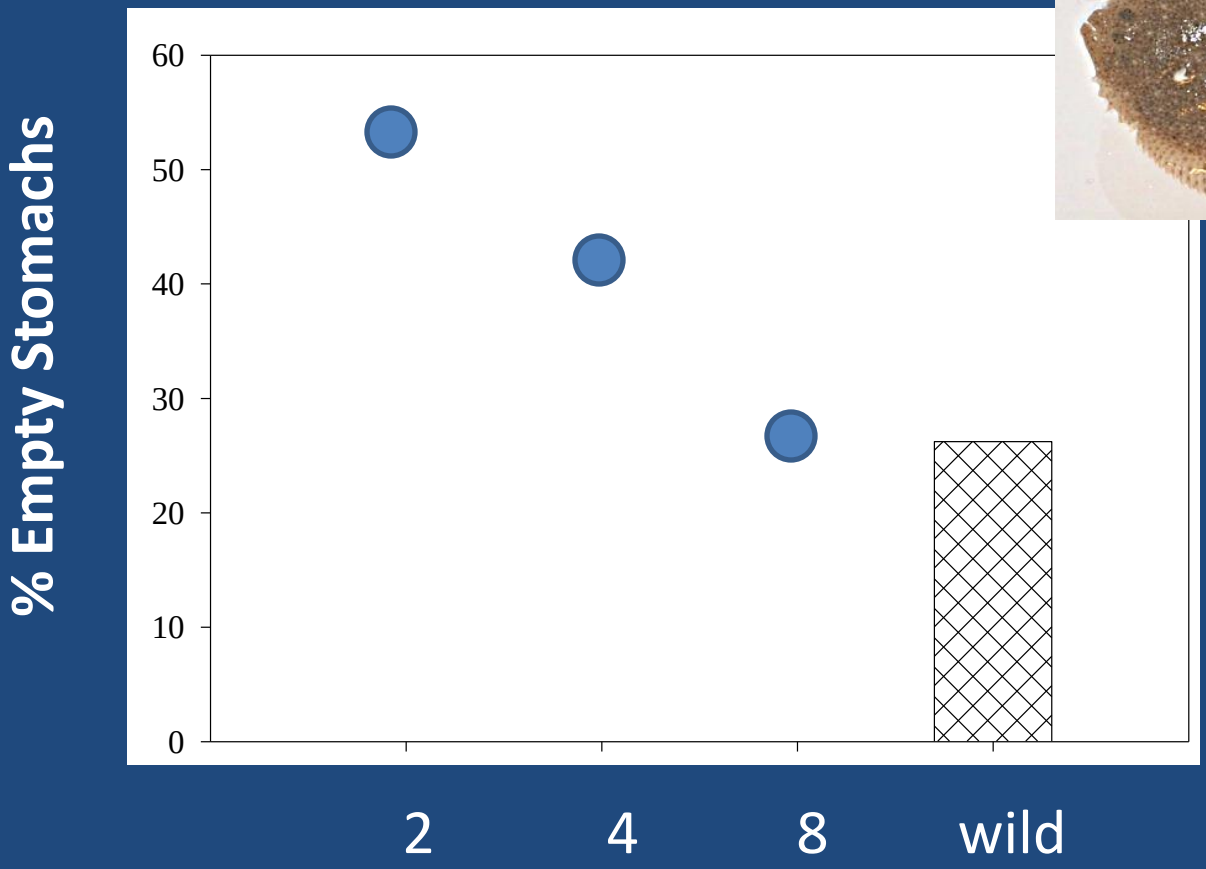
10 cm TL



(Sparrevohn & Støttrup 2007)

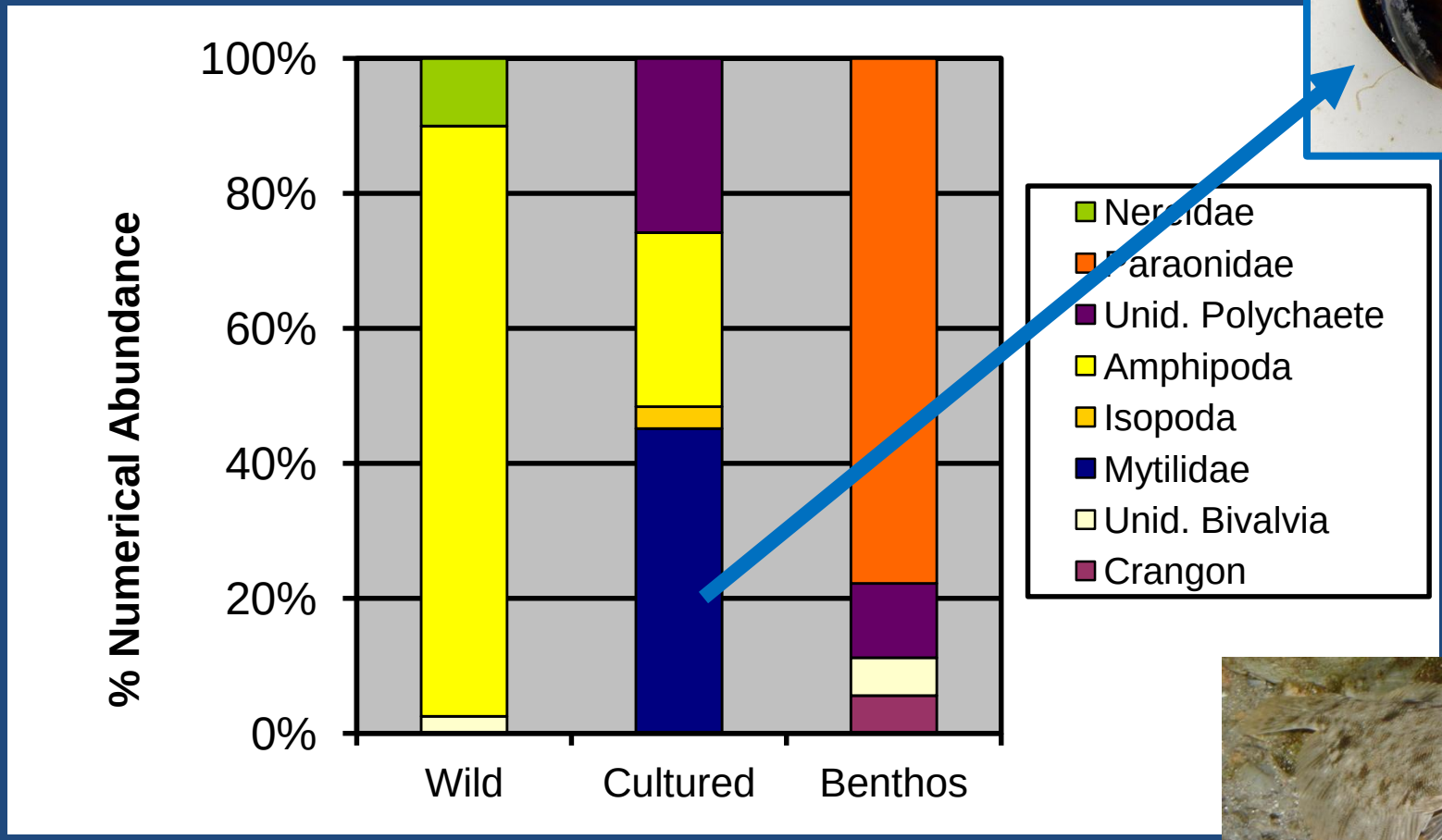
Delay in feeding





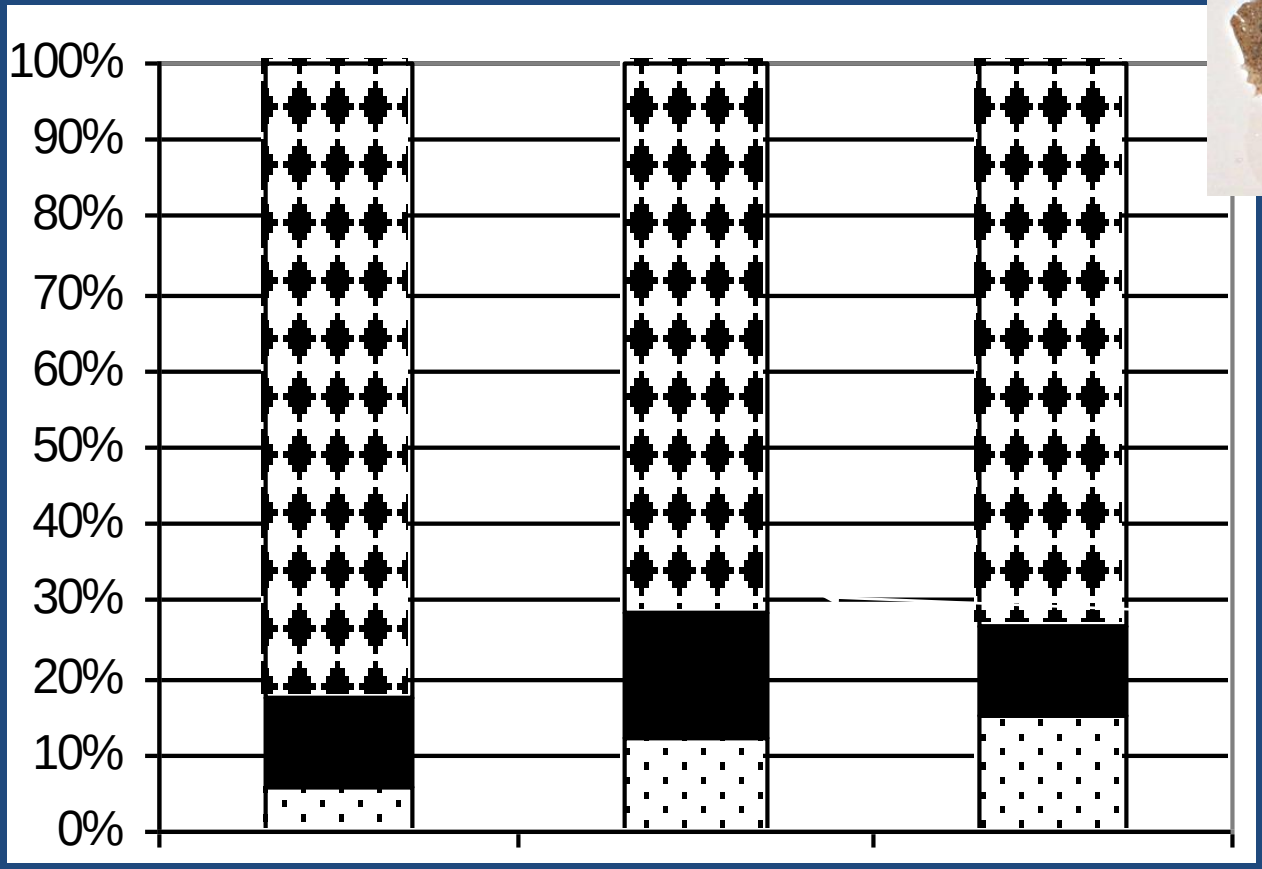
(Støttrup & Hvingel 1998)

Poor prey selection



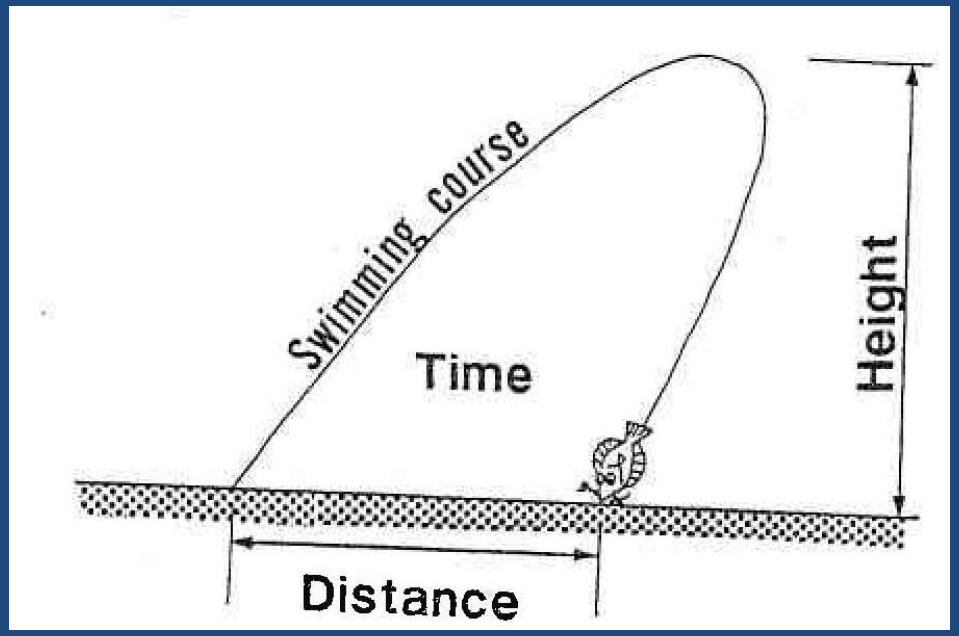
(Fairchild, unpublished data)

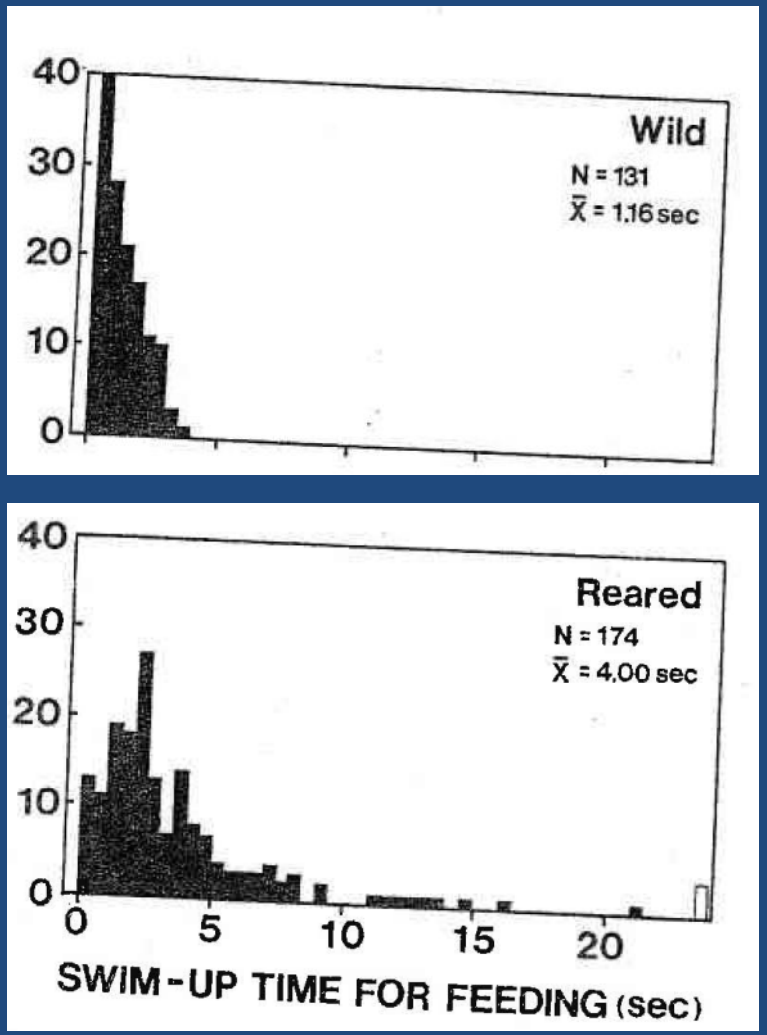
Foraging learning curve



(Støttrup & Hvingel 1998)

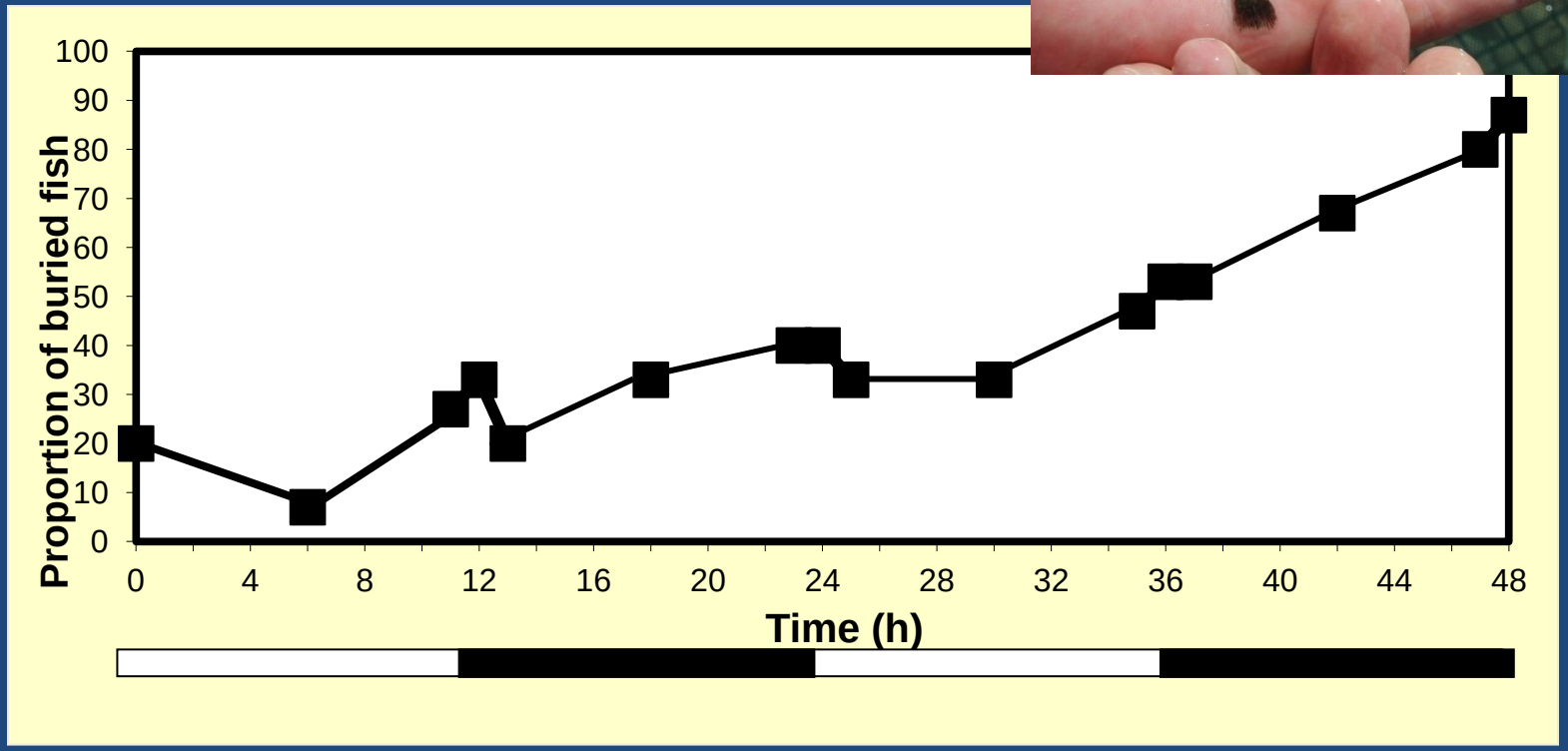
Abnormal feeding behavior





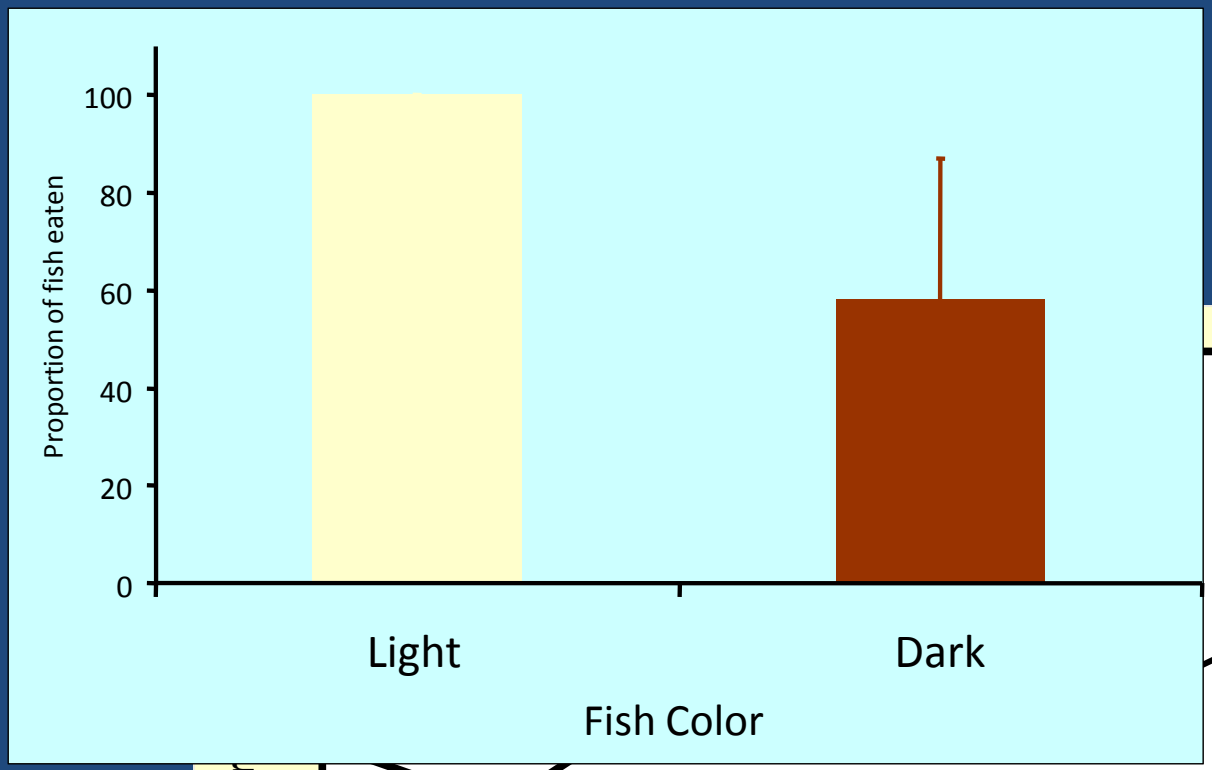
(Furuta 1998)

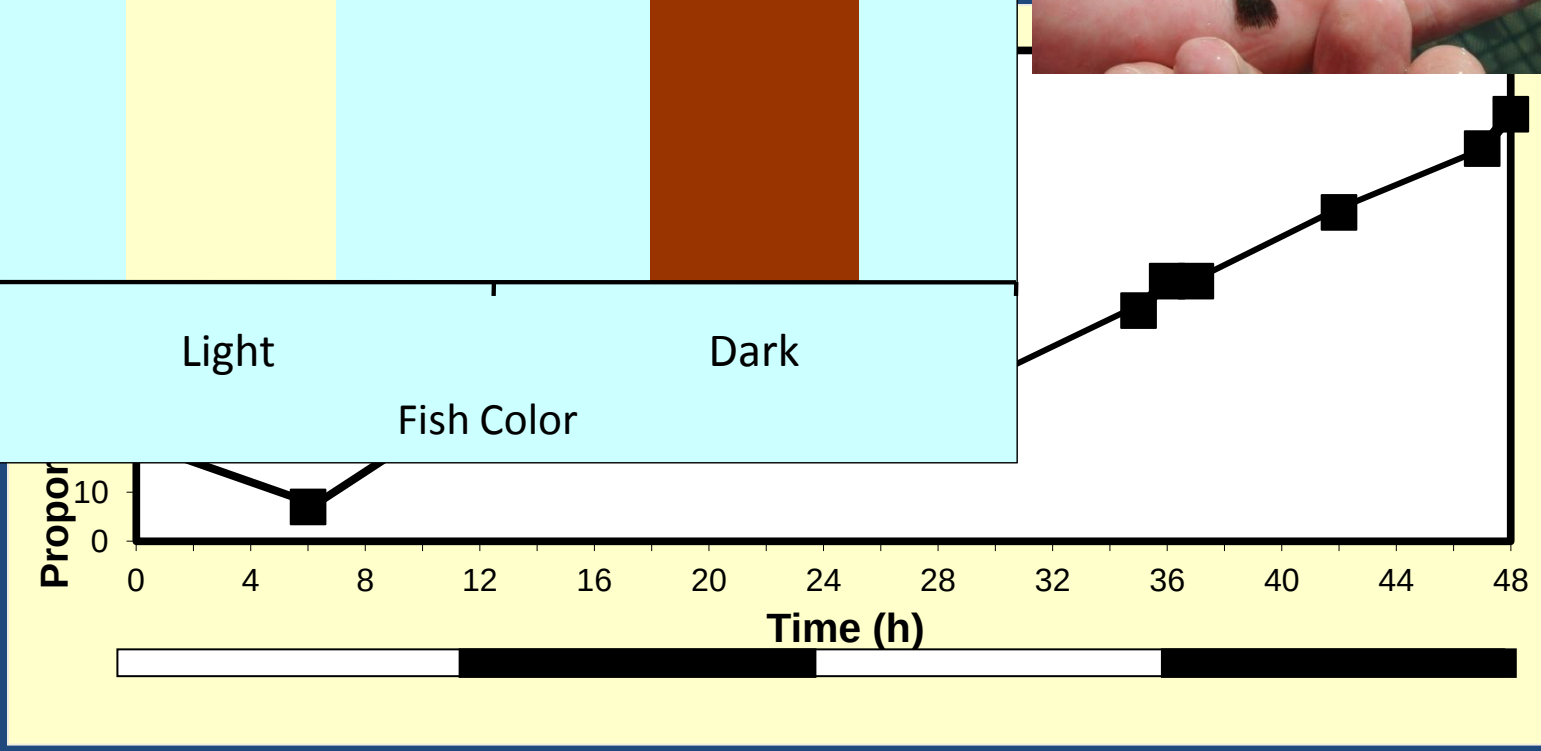
Non-cryptic behavior



(Fairchild & Howell 2004)

Non-cryptic behavior





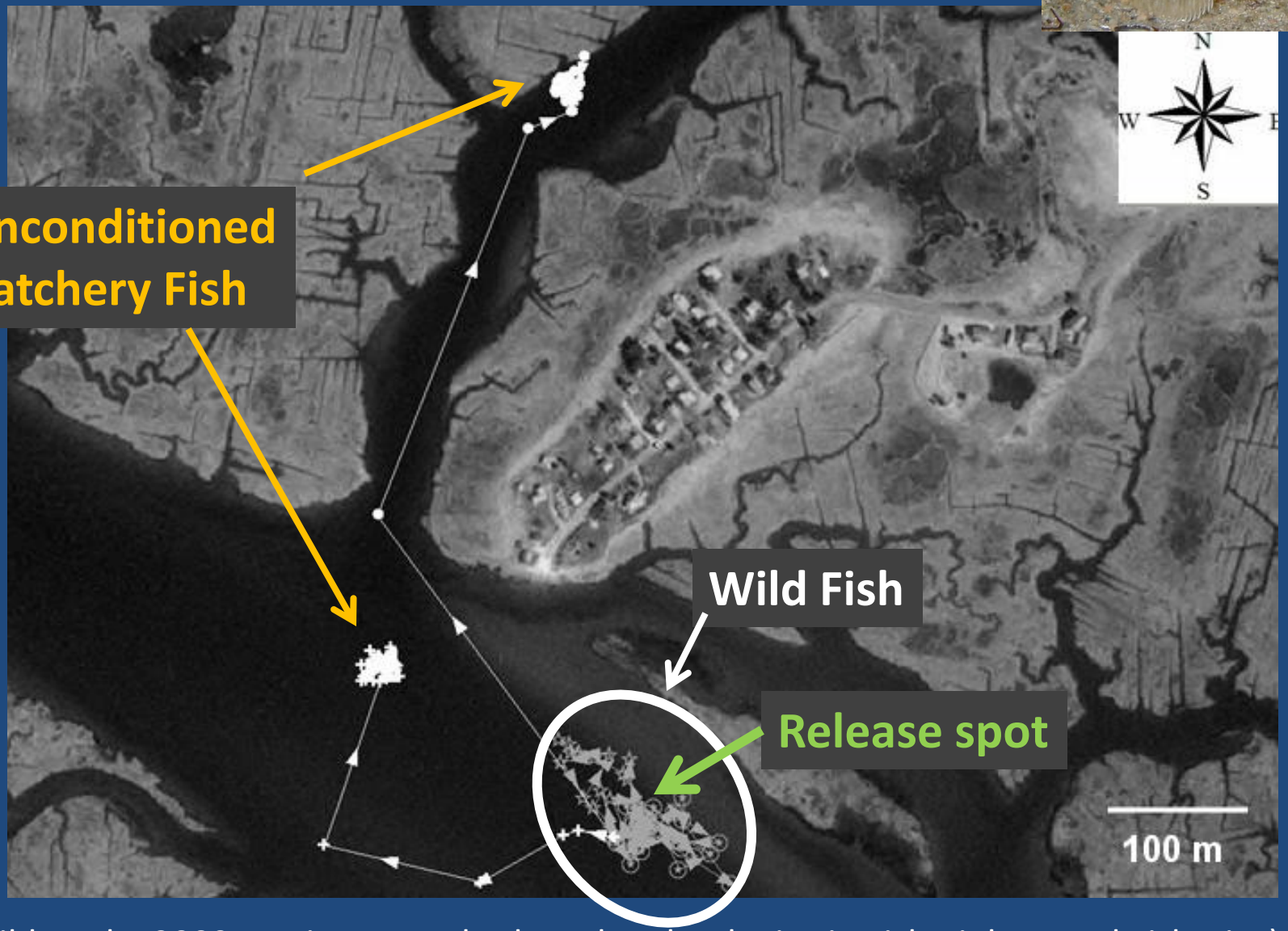
(Fairchild & Howell 2004)

Release strategy: *In-situ* conditioning

Cages (conditioned)

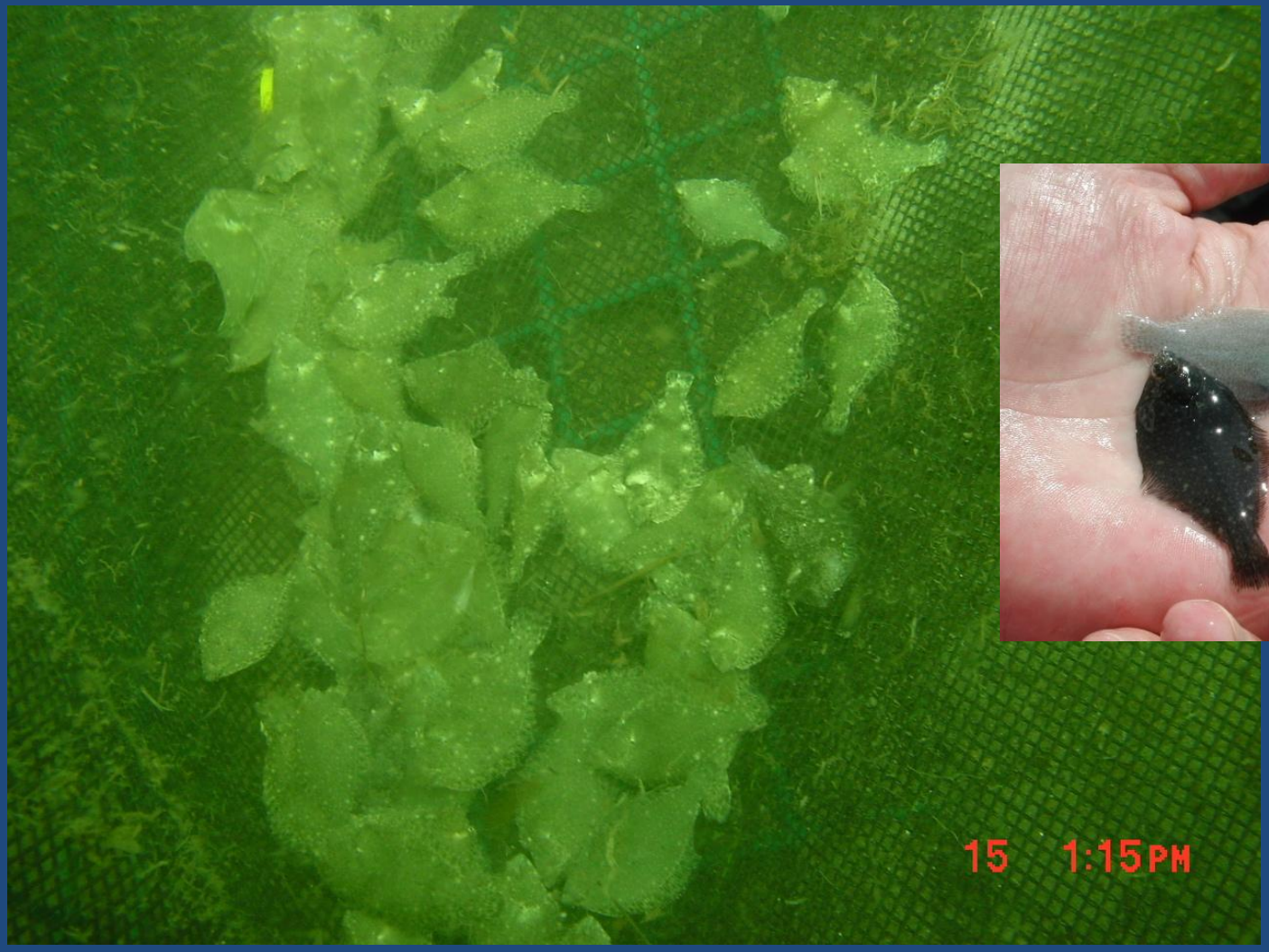
Direct release (Naive)

Higher site fidelity

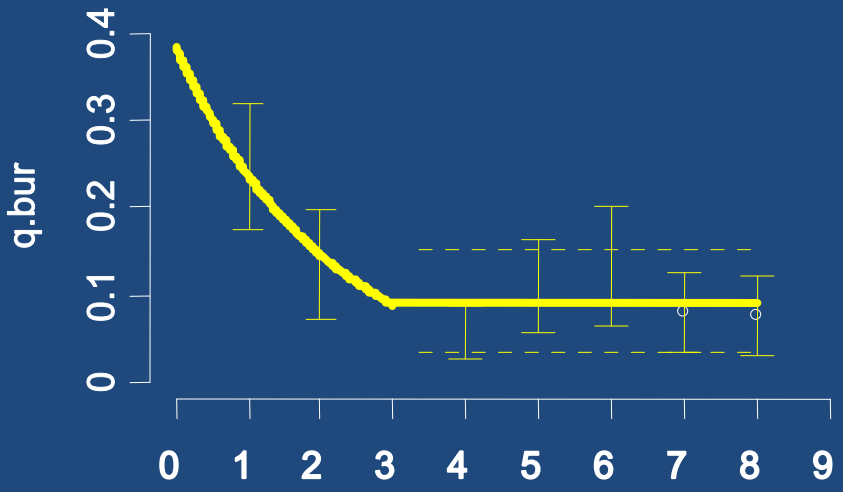


(Fairchild et al. , 2009, Reviews: Methods and Technologies in Fish Biology and Fisheries)

Better cryptic abilities

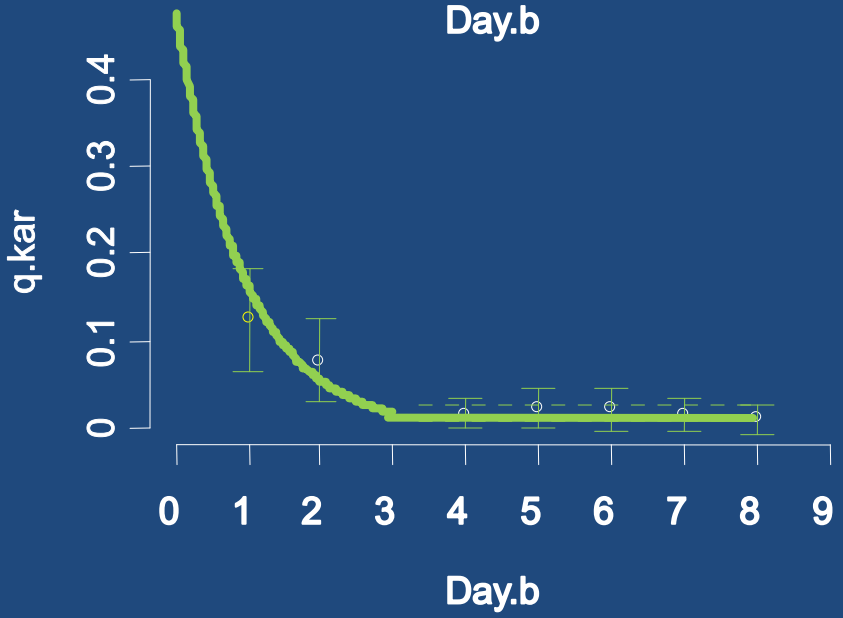


Higher survival



62 %

10 cm conditioned

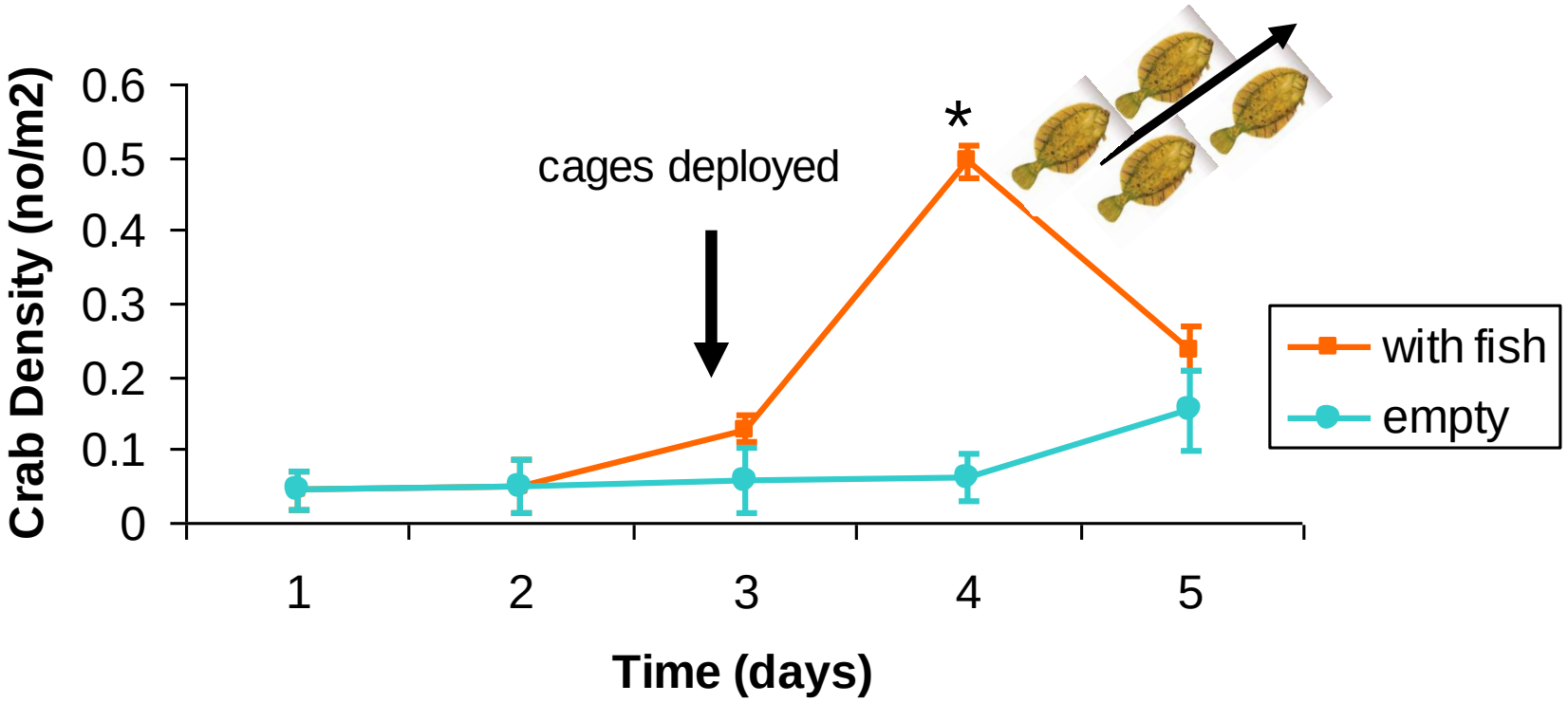


34 %

10 cm naive

(Sparrevohn & Støttrup 2007)

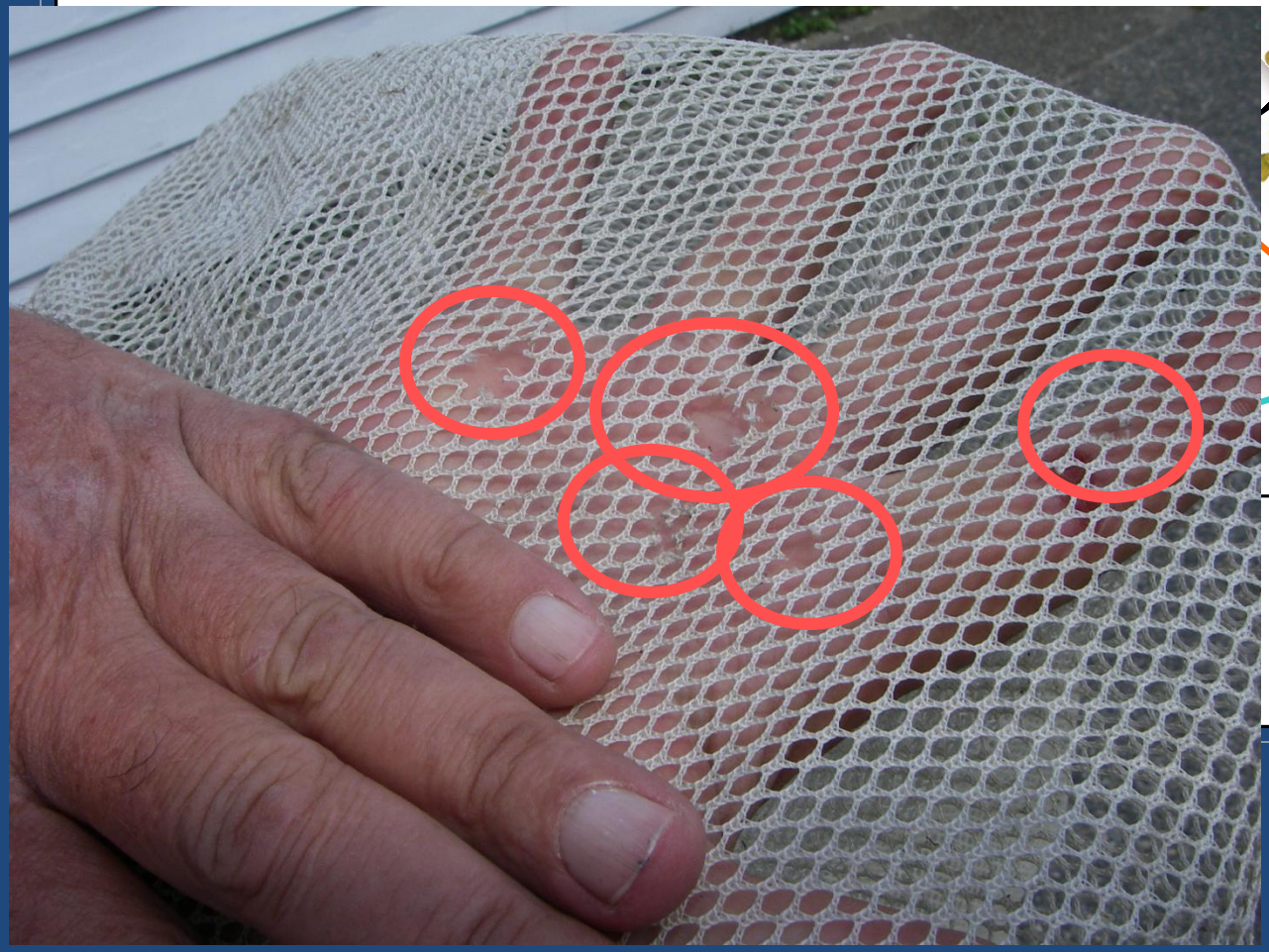
Not without drawbacks…

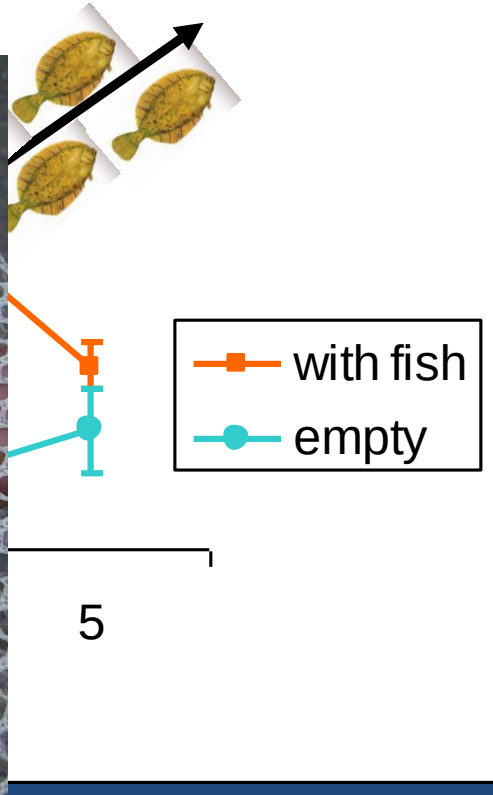


(Fairchild et al. 2008)

Not without drawbacks…

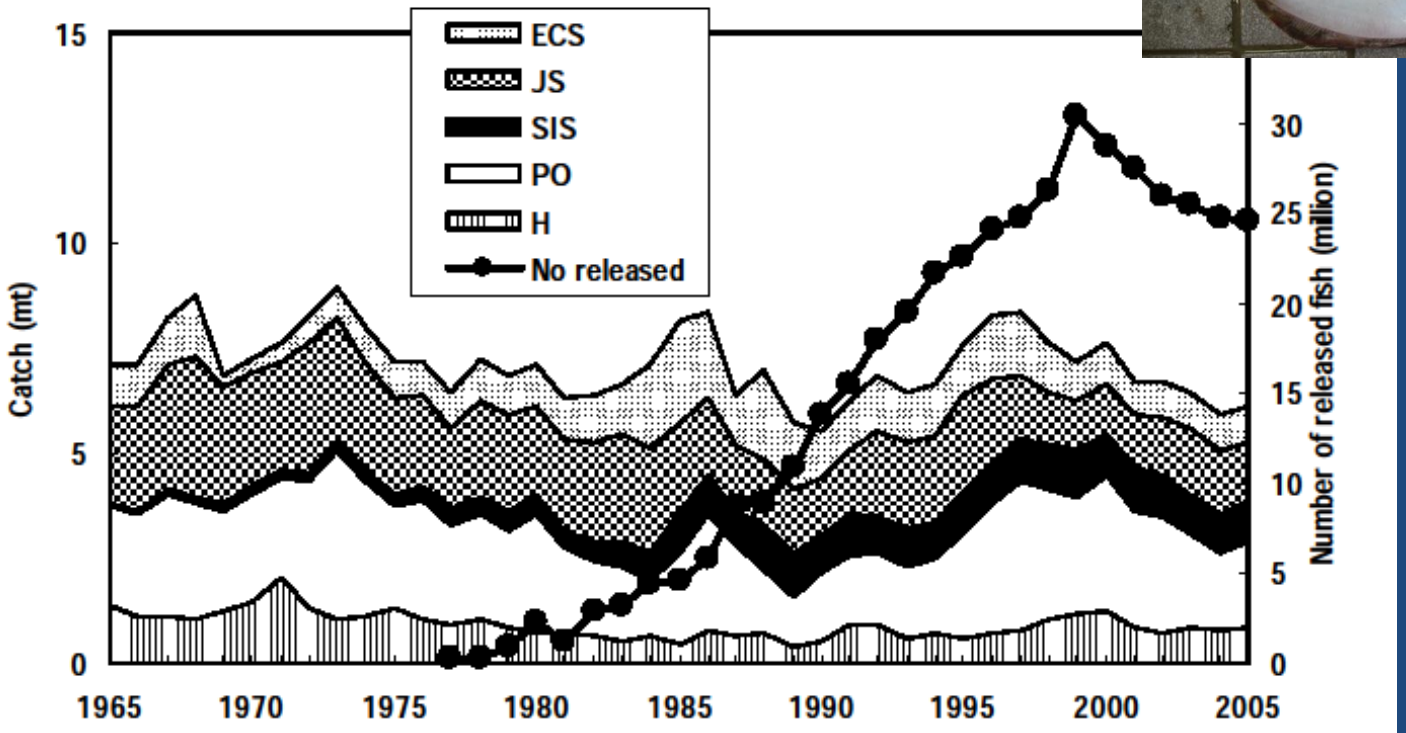
Are green crabs attracted to acclimation cages containing winter flounder?





(Fairchild et al. 2008)

So why bother?



(Yamashita & Aritaki)

Flatfish Enhancement Model?

- Find appropriate release sites and season based on survey data.
- Pilot-scale stocking of large age 0 fish.
- Use conditioning methods to overcome initial mortality.
- Assess success and apply active adaptive management.
- Scientifically test methods.
- Calculate economic feasibility.

Muito obrigada