2011 Clam Industry Workshop

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SELECTION FOR HEAT TOLERANCE IN CLAMS USING BIOMARKERS

WHY SELECTIVE BREEDING?

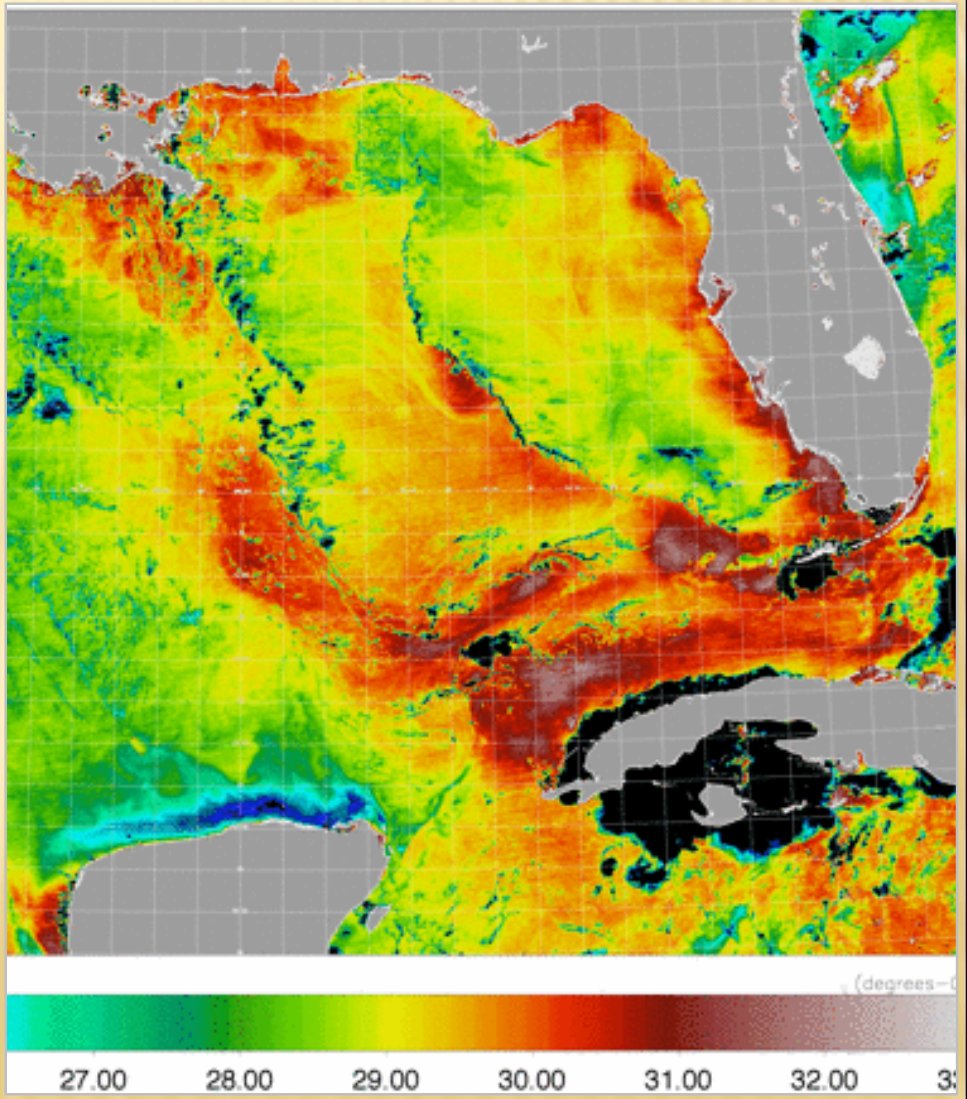
- Select desired traits
- Adapt to specific growing conditions

WHY SELECTIVELY BREED HARD CLAMS?

- Need a heat tolerant clam for Florida
  - Northern quahogs, *Mercenaria mercenaria*, are “living on the edge”
    - Near southern limit of their natural distribution
    - Summer water temperatures in growing areas regularly exceed 90°F
    - Temperature related mortalities observed in lab and field

WHY SELECTIVELY BREED HARD CLAMS FOR HEAT TOLERANCE?

- Prepare for global climate change
  - Water temperatures in harvest areas have already increased by over 0.5°F in last 30 years
  - Water temperatures are predicted to increase by another 3.5°F in next 100 years

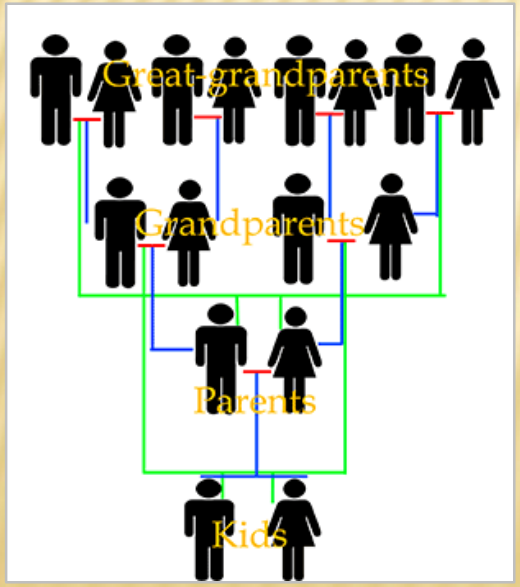


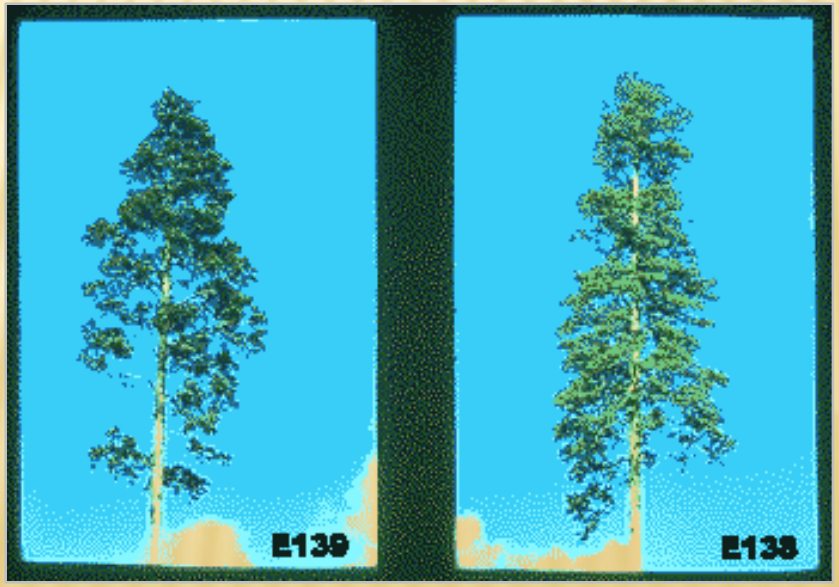
WHY DO WE THINK WE CAN SELECTIVELY BREED HARD CLAMS ?

- Clam families differ
  - Scarpa lab challenge (hi T): One family had 93% survival compared to 28% and 39%
  - Baker lab challenge (hi T, low S, low O_2): One family survived almost 3 days longer

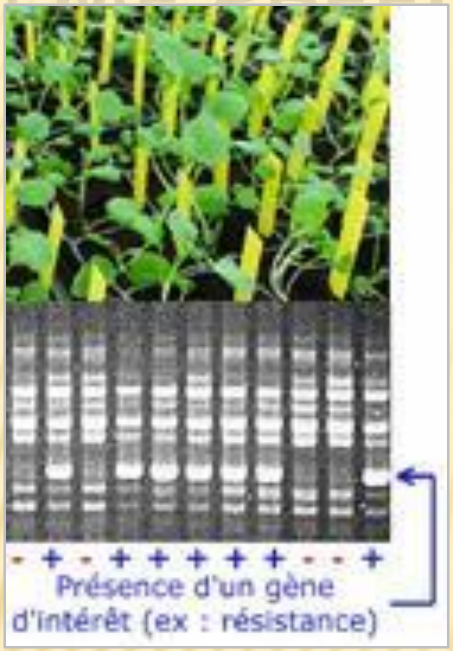
CAN WE USE TRADITIONAL METHODS TO BREED HARD CLAMS FOR HEAT TOLERANCE?

- It could take a long time
  - Heat challenge clams
  - Breed survivors
  - And so on….
- It could be cost-prohibitive
  - Many families
  - Large amount of space & labor





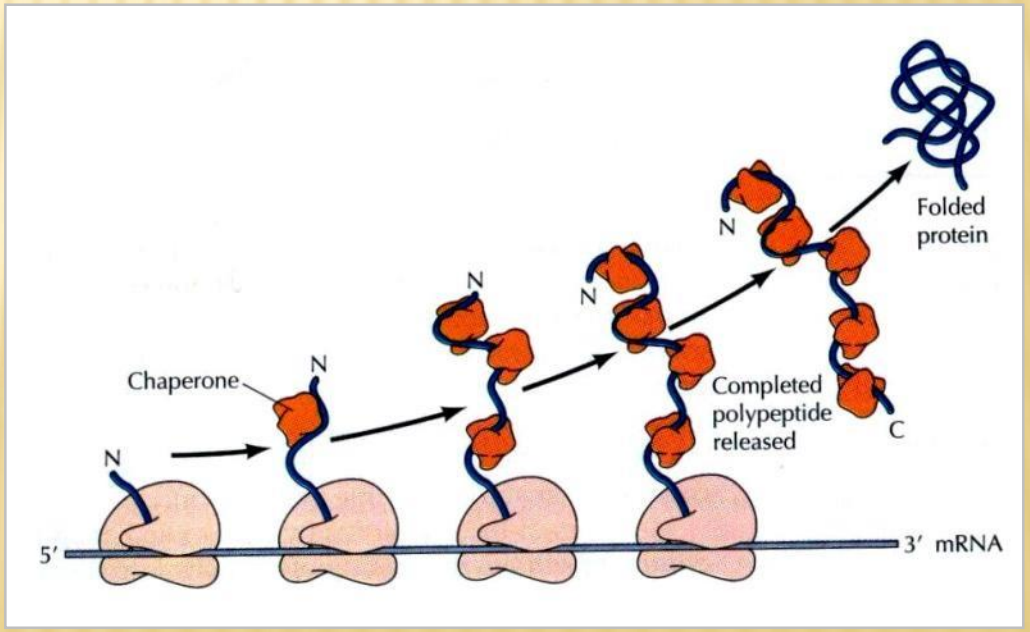
CAN WE SPEED UP THE PROCESS?



- Marker assisted selection
  - Select parents based on markers associated with trait of interest
    - Physiological
    - Molecular
    - Genetic
  - Reduces the number of generations , families, time and space required to select for a trait

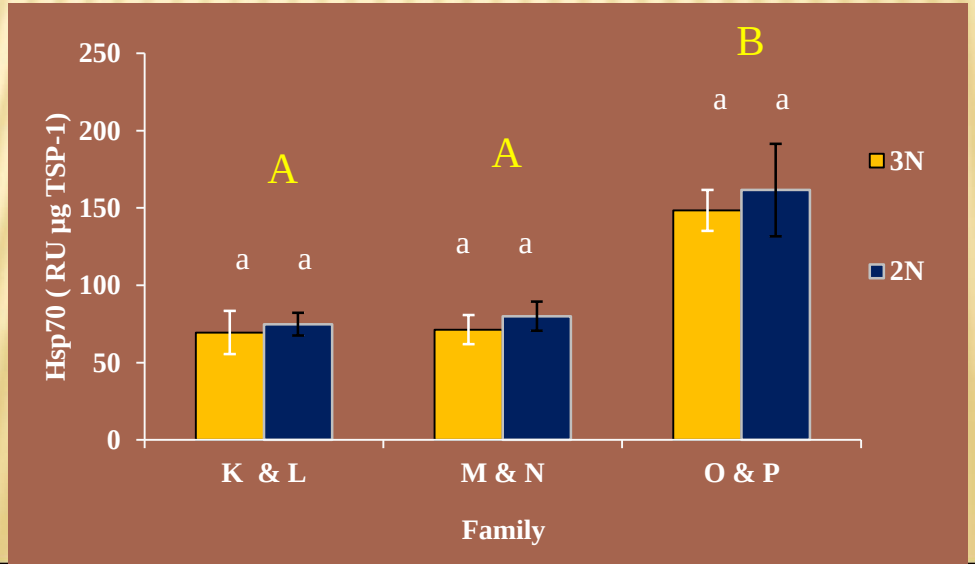
WHAT MARKER CAN WE USE TO SELECT FOR HEAT TOLERANCE IN HARD CLAMS?

- "Heat shock" proteins (Hsp)
  - Form, transport, and degrade proteins in cells
  - Cognate Hsp – Cellular housekeeping
  - Inducible Hsp – Increase in response to protein-damaging stressors
    - Temperature
    - Salinity
    - Oxygen



WHY MIGHT HSP BE A GOOD MARKER FOR HEAT TOLERANCE IN HARD CLAMS?

- Level of cognate Hsp is associated with survival following temperature challenges
  - Family with 2x Hsp had 93% survival (compared to 28% and 39%)
  - Other studies suggest that Hsp levels are inherited



El-Wazzen, 2008

WHAT ARE WE PLANNING?

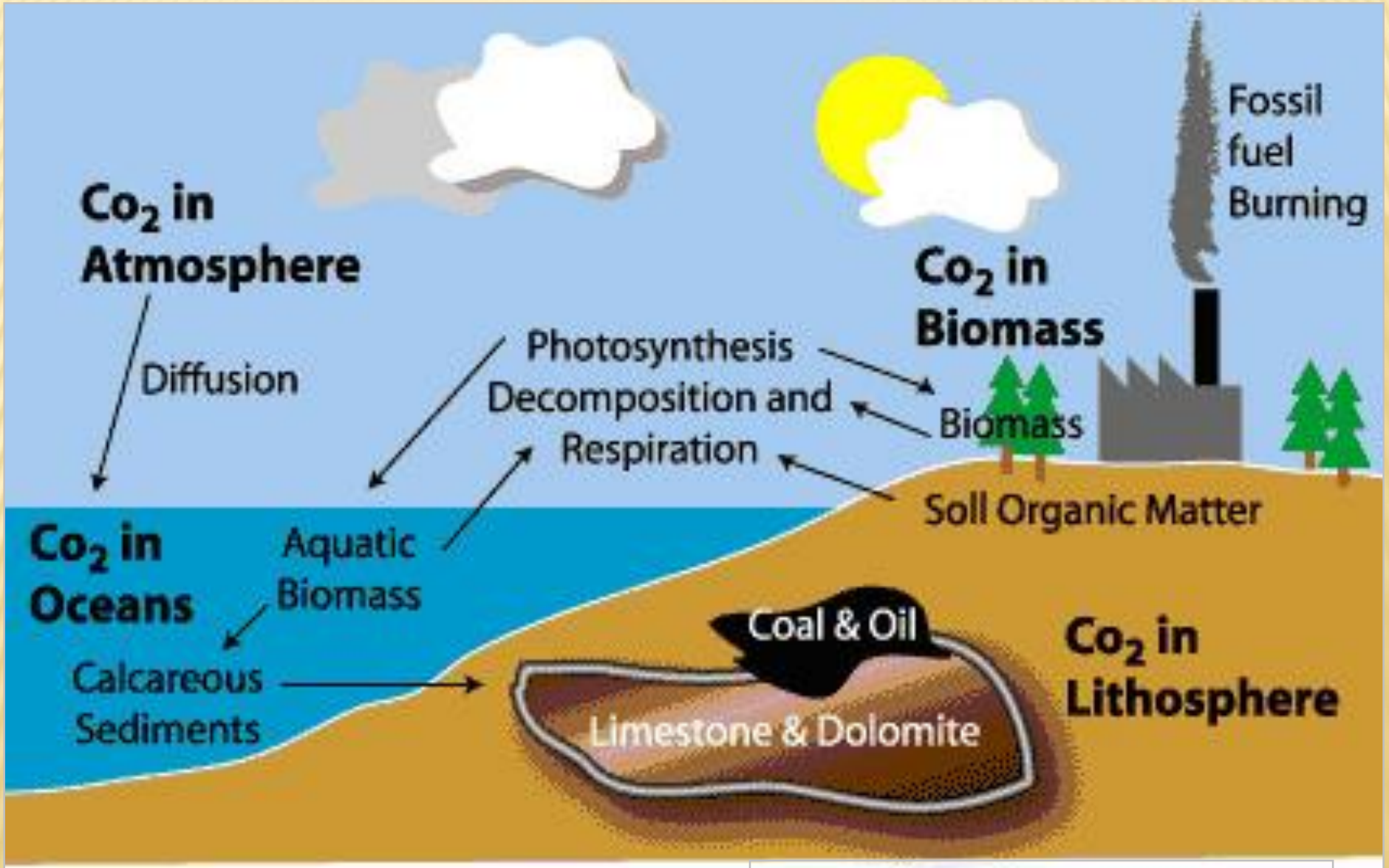
- Overall goal:
  - **Assess if markers (e.g., Hsp, metabolic characteristics) can be used in selective breeding for heat tolerant hard clams**
- Specific objectives:
  - Determine if markers are consistently associated with temperature tolerance (survival, production, product quality)
  - Determine if marker levels are inherited in hard clams
  - Provide information to you
- What we're not doing:
  - Producing heat-tolerant clam strains

STAY TUNED….AND KEEP CLAM

And now for something completely different.....

Patrick Baker (UF), Shirley Baker (UF)

LONG-TERM CARBON STORAGE BY CLAM AQUACULTURE



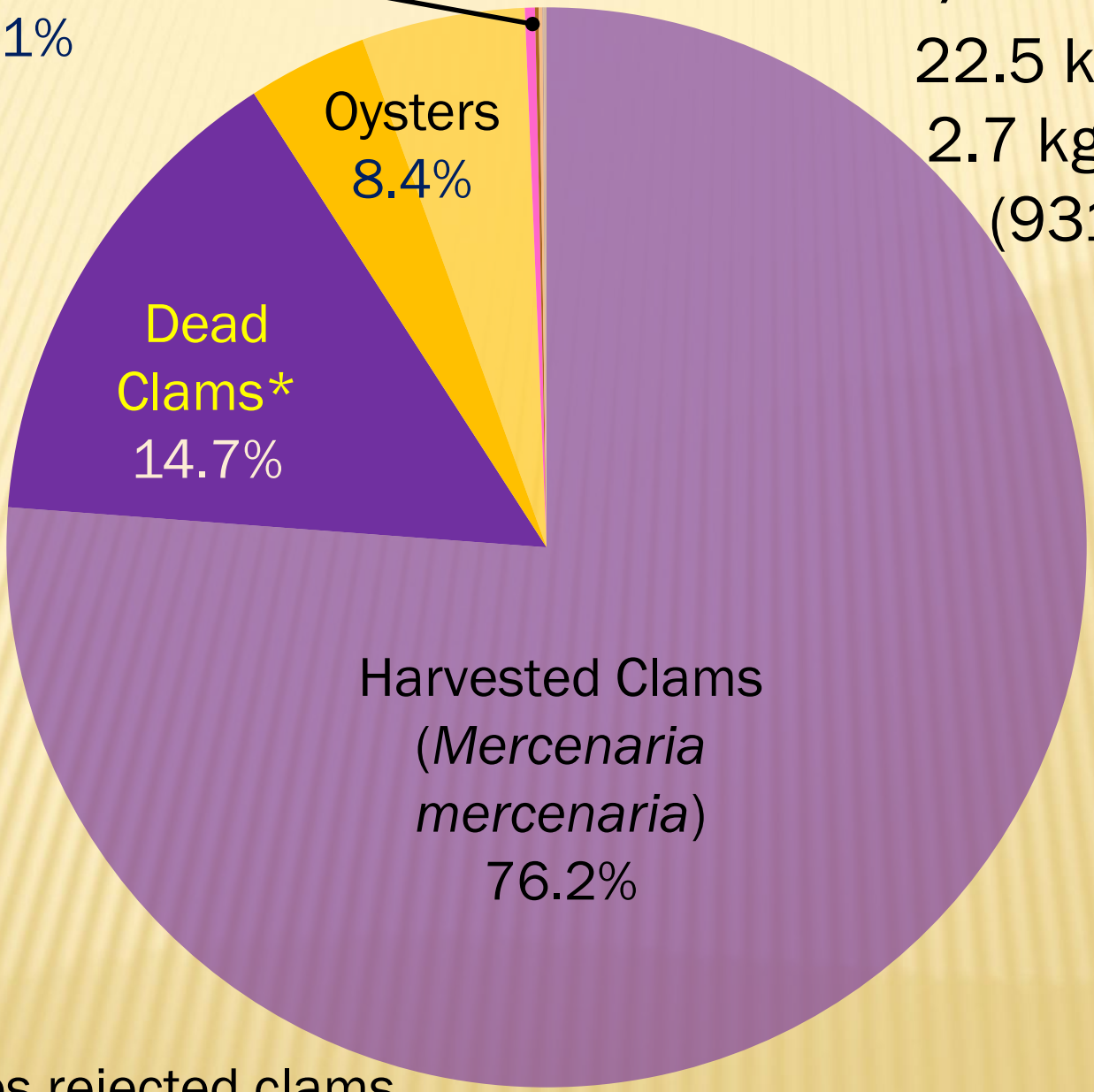
(source: EUROPA, European Union)

CARBON IN SHELL FROM CLAM FARMING

- 1 clam bag = 1 sample N = 36
- market clams counted, subsample measured to estimate total shell weight
- all other shell material (> 5 mm) from in and on clam bag collected
- shells cleaned, dried, & weighed
- 96% of shell is $CaCO_3$, 12% of $CaCO_3$ is carbon

ALL SITES, ALL SPECIES

22.5 kg $CaCO_3$ or
2.7 kg C per bag
(931 clams)



*includes rejected clams

BY THE NUMBERS

- 931 clams per bag
- 2.7 kg of carbon in $CaCO_3$ per bag
- **10,034 kg /ha/y** = (8027 g/lease/y)

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Eat a clam, save the Earth

Photo:
Florida
DACS

Every clam you eat represents about 3 grams of long-term carbon storage.

It's easy being "green"

ACKNOWLEDGEMENTS

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Mike Smith & crew, Cedar Key Aquaculture Farms
Jon Gil & crew, Southern Cross Sea Farms
Many others....

...and these three guys