**CARBON FIXATION BY CULTURED CLAMS**

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**Eat a clam, save the Earth**

Every clam you eat represents about 3 grams of carbon removed from the atmosphere.

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**ABSTRACT**

Northern hard clams, Mercenaria mercenaria, are commercially cultivated in Florida, USA. The shells of the clams revolutionize carbon as calcium carbonate (CaCO$_3$), providing a long-term sink for atmospheric carbon dioxide. In addition to the clams sold to the market, there are discarded or dead clam shells, plus shell of associated organisms such as sponges (Dissorophus sp. and other species). We quantified all shell and fragments (rows) harvested by clam farmers near Cedar Key, Florida, including associated live shell collected with the clams and the culture material (mesh bags). The CaCO$_3$ content was quantified by combustion and shell production was standardized per clam, per unit area. Each harvested clam represented an estimated 2.9 g of incorporated carbon, including non-harvested shell (CaCO$_3$) 1.2 g/Life by weight. Clams in full production produced about 40,000 kg of integrated carbon per hectare per year, and the Florida clam industry produced about 554 metric tons of mineralized carbon in 2006.

**INTRODUCTION**

The culture of clams, oysters, and other molluscan shellfish is considered sustainable, in part because shellfish feed on natural populations of plankton, rather than requiring added feed. To this, we can add long-term carbon fixation in an environmentally benefit mollusk aquaculture.

Carbon dioxide (CO$_2$), a major greenhouse gas, dissolves in water and is incorporated by shell-producing organisms into calcium carbonate (CaCO$_3$). CaCO$_3$, from mollusks and other organisms can persist indefinitely as limestone. In contrast, the carbon contained in most plant and animal tissues returns to CO$_2$ in a few years, or even months. Molluscan shellfish aquaculture, therefore, has two products: food for humans, and long-term storage of greenhouse gases.

Shellfish aquaculture positions, however, to produce nearly the shells of the product species, but also associated or attached shell-bearing animals, such as other clams, oysters, mussels. The fate of molluskan shellfish aquaculture is conducted in areas that did not previously support large shellfish populations, so most of the associated shellfish (part of the production) that would not have otherwise occurred. This study was conducted to quantify shell production and carbon accretion with culture of the northern hard clam, Mercenaria mercenaria, at Cedar Key, Florida.

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**COQUINA - limestone from fossil shells**

**Sample Collection**

- 1 clam bag = 1 sample: N = 36
- market clams counted, subsample measured to estimate total shell weight
- all other shell material (retained on 5 mm mesh) from in clam bag collected
- bags with fouling organisms also collected

**Sample Processing**

1. Freeze samples to kill tissues
2. Warm-water tissue maceration to remove most soft tissues
3. Bleach to remove remaining tissues
4. Dry/reweigh shells & bags
5. Acid-wash bags to dissolve attached shell
6. Dry/reweigh bags to estimate attached shell mass

**Calculating Carbon per Clam Bag**

- a) harvested clams → A. count clams, measure subsample, use size, weight relationship to estimate shell mass
- b) dead /culled clams & other loose shell → B. process, dry & weigh
- c) oysters attached to bags → C. dry & weigh bags, acid-wash, reweigh

**Sum A through C multiply by 0.96 (fraction of shell that is CaCO$_3$) and 0.12 ($C$ as fraction of CaCO$_3$)

**Results**

- Harvested clams accounted for about 3/4th of the shell material over 5 mm
- Most non-harvested shell is dead or rejected hard clams, Mercenaria
- Remaining shell is mainly from oysters (below)

**By the Numbers**

- 921 clams per bag in these samples
- 22.5 kg of shell (CaCO$_3$ only) per bag
- 8965 kg/ha/year = (7170 kg/lease/y)
- including associated shell, 24.4 g of CaCO$_3$ of 2.9 g carbon, are fixed per clam
- 541 metric tons of carbon fixed in 2008 by Florida clam farms

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