Artificial Reefs: the good, bad, and ugly

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Despite a lack of public funding, Budy Bob continues his artificial reef program alone.
The Good
Create fishing opportunities near ports.

Before
- Shore
- Fish distribution
- Natural reefs

After
- Artificial Reefs
Ecosystem Services:
Aesthetics
Fishing & Diving
Fishing tackle & bait
Charter fees, vessels
Licenses
Hotel/housing
Fuel/gas/oil
Rental Cars
Restaurants, Supermarkets

Tourism & Real Estate
Waterfront properties
Tourism Industry
Ramps & docks
Resident recreation
Non-residents

Supporting Marine Industries
Transportation
Boating
Electronics
Communications
Fishing Tackle
Newspaper, Magazine & TV Media
Dockage, storage

South Florida
Reef Economics
2001
28,300,000
person-days spent on reefs

$ 4,395,000,000
Sales

$ 2,047,000,000
Income

71,300 jobs

Johns et al. 2001
Fishing and Diving (snorkel & SCUBA) contribute about equally to reef use in SE Fla

<table>
<thead>
<tr>
<th></th>
<th>Palm Beach</th>
<th>Broward</th>
<th>Miami-Dade</th>
<th>TOTAL</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Diving (Snorkel and SCUBA)</td>
<td>2.5</td>
<td>4.9</td>
<td>3.3</td>
<td>10.7</td>
<td>47%</td>
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<tr>
<td>Fishing</td>
<td>1.8</td>
<td>4.5</td>
<td>5.9</td>
<td>12.1</td>
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<tr>
<td>TOTAL</td>
<td>4.2</td>
<td>9.4</td>
<td>9.2</td>
<td>22.8</td>
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$ Value (millions) residents and visitors

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<th>TOTAL</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diving (Snorkel and SCUBA)</td>
<td>$27</td>
<td>$68</td>
<td>$16</td>
<td>$112</td>
<td>53%</td>
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<tr>
<td>Fishing</td>
<td>$9</td>
<td>$57</td>
<td>$30</td>
<td>$97</td>
<td>47%</td>
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<tr>
<td>TOTAL</td>
<td>$36</td>
<td>$126</td>
<td>$47</td>
<td>$209</td>
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</table>

(Johns et al. 2003)
8 hours after sinking by a hurricane

One month later
Assumption: Habitat Limitation - Adding more habitat increases the supply of fish.

Artificial reef performance depends on reef **structure** (size, materials, and composition), **location**, and the **life history** of targeted species.
Fishing for species attracted to artificial reefs is not a problem from a fishery perspective, unless the population is overfished.

Artificial reefs can accelerate overfishing by concentrating remaining adults and making them easier to locate and more vulnerable to fishing.

Under overfishing, habitat is not limiting. The limiting factor is total reproduction based the abundance & size of reproductive females.
Predicted species characteristics that influence population responses to artificial reefs

More Production  More Attraction

- Reef Availability: Low to High
- Fishing Intensity: Low to High
- Population Controls: Limited to Recruitment Limited
- Reef Dependency: Obligatory to Partial or Opportunistic
- Behavior: Territorial to Home Ranging
- Habitat: Demersal to Midwater/Surface
MEAN ABUNDANCE-REEF SIZE REGRESSION
RESIDENT SPECIES

Y = 31.3 X + 95.4
R² = 0.60
Artificial Reefs
Production Rigs (all sizes)
Natural Reefs

Courtesy of Tracy Villareal, U. Texas at Austin
Artificial reefs are a drop in the ocean.

Detail from Landsat satellite image, Gulf of Mexico. Individual vessels are bright spots at end of sediment trails.
The Bad
Adrian Harrold of Rocky Mount, N.C., reads on Pine Knoll Shores, N.C., Friday, among tires washed on the beach from an artificial reef which was damaged by Hurricane Bonnie.
Do No Harm

ARTIFICIAL REEF DAMAGE

The principal parts of Dade’s artificial reef program, with wreck, location and status:

- **Almirante**, South Dade: turned upside down.
- **Andro**, Haulover: deck twisted.
- **Arida**, Key Biscayne: flattened and crushed.
- **Belcher Barge**, Key Biscayne: no damage.
- **Belzona Barge**, Key Biscayne: missing.
- **Belzona Two**, Key Biscayne: was moved, lost roof.
- **Biscayne**, Key Biscayne: extensive damage.
- **Blue Fire**, North Dade: lost bottom, hull collapsed.
- **C-One**, Sunny Isles: no damage.
- **Conception**, Sunny Isles: broken into three pieces, middle collapsed.
- **Doc DeMilly**, South Dade: no damage.
- **Lakeland**, Key Biscayne: collapsed.
- **Miracles Express**, Key Biscayne: reduced rubble.
- **Miss Kartina**, Miami Beach: broken.
- **Norwal**, Haulover: extensive damage.
- **Orion**, Key Biscayne: lost pilot house.
- **Patricia**, Miami Beach: broken.
- **Proteus**, Key Biscayne: broken and moved.
- **Radio antenna**, Miami Beach: no damage.
- **Rio Miami**, Key Biscayne: no damage.
- **Shamrock**, Miami Beach: lost pilot house.
- **Sheri-Lyn**, Key Biscayne: broken in half.
- **South Seas**, Key Biscayne: stem broken off.
- **Sta. Anna**, SE of Key Biscayne: no damage.
- **Tarpon**, SE of Key Biscayne: devastated.
- **Tenneco Oil platform**, Dade-Broward line: lost legs, leaning.
Conflicts between artificial reefs and endangered sea turtles

Entanglement and entrapment of sea turtles on artificial reef structures

- Growing number of reports of sea turtle mortality on artificial reef structures.
- Most mortality is never witnessed or reported.
- **Entanglement** occurs in lost gear (anchor line, fishing line)
- **Entrapment** occurs in structural elements.
- Design considerations should include potential for sea turtle entrapment.
Entrapment occurs in structural elements. Artificial reef modules with closed tops may increase entrapment risk.
Conflicts between artificial reefs and sea turtles

Sea turtle hatchling predation over artificial reefs adjacent to nesting beaches

- Artificial reefs deployed on sand close to shore in shallow water off sea turtle nesting beaches may increase the predation risk to hatchling sea turtles.

- Several studies have shown higher predation of hatchling turtles traversing areas of with bottom structure, such as saballerid reefs and patch reefs.
The little house at the bottom of the sea.

Two-and-a-half miles offshore, a hundred feet down, is an unusual housing development. In an area once virtually empty of life, families of Florida fish now live in coral-covered cylinders that were once gas station storage tanks — sandblasted clean and lowered into the sea as environmentally approved artificial reefs. Algae form, fish gather and a food chain begins — good for the environment and the local fishing industry.

Do people really do all that so fish can have a population explosion?

People Do.
Spirit of Miami, Boeing 727, deployed 1993

Anchors away
Vandals destroying system that steadies sunken jetliner

By JIM HARDIE
Special to The Herald

Crime has hit new depths in Dade County — 68 feet below the Atlantic Ocean surface.

Dade County authorities say vandalism to the newest and most popular artificial reef is not only illegal but potentially dangerous.

Last Sept. 8, the shell of an old Boeing 727-100 jetliner was sunk in 68 feet of water off Key Biscayne. It became an instant hit with scuba divers and is developing into one of the most popular plane. If currents or shifting sands cause the plane to move slightly, it can be tightened by twisting the turn-buckles.

Some divers have been taking advantage of the system and removing the turn-buckles. So far they have disabled three of the 10 anchors.

“The plane is county property, it belongs to all of the citizens. It is an ocean bottom owned by the State of Florida,” Mostkoff said. “Vandals are committing a crime: Damage to county property.”
Spirit of Miami “found” in 2010, 17 years later
Turkey’s biggest reef, an Airbus A300, sunk off coast of Kuşadası to boost diving tourism sabahdai.ly/1c4qTRq
6:20 PM - 4 Jun 2016
“Ships used as artificial reefs must be deployed at least a quarter of a mile away from natural reefs.”

“Mercedes”

Broward County (Fla) Artificial Reef Program Promotional Brochure
2002 Sinking of Spiegel Grove – Key Largo

The Ugly

Capsizing barge with Rapa Nui Reef modules
7 June 2015 – Deerfield Beach, FL

Miami Herald
www.nydailynews.com
Luxury liner: In 1980, this Rolls Royce was pushed off Palm Beach as an artificial reef. While regulators no longer allow cars to be used, hundreds of cars and school buses have been sunk in state waters.

Water wings: Flipped over by a firefghter’s anchor, this DC-4 served as a reef off Fort Lauderdale Beach. World War II planes downed in the South Pacific led to modern-day artificial reef programs.
Almost Unsinkable: The Brandywine, one of three drug boats that were sunk Friday to form an artificial reef, proved tough to send down. Water cannons were employed to fill the hull enough to sink it in about 140 feet of water.

New course is charted for seized drug vessels

Ships are sunk for artificial reef to the Miami River, didn't go to its watery grave easily on Friday, despite fiery explosions that drew cheers from boatloads of spectators.

U.S. Coast Guard officers and boats went down in minutes.

"This event completes the circle of our campaign against drugs," said Gov. Jeb Bush, who was joined by several community leaders and about two dozen
Explosives damage structural integrity and create diving hazards.
Explosives are unnecessary for ship deployment. The concussion kills fish underneath and nearby.
On March 30, 1985, the freighter MERCEDES was deliberately dynamited and sunk, becoming an artificial reef and diving wreck.
CONCLUSIONS

• Do No Harm.
• Have clear, relastic goals and expectations.
• Beware of other agendas (public relations, media, waste disposal).
• Understand the biology, ecology and population limitations of target species.
• Remember that artificial reefs are one tool best used as part of an comprehensive, integrated, holistic ecosystem-based approach to conservation and management.
• Artificial reefs are not a panacea – alone they will not solve overfishing.
• Other measures may be more appropriate and effective for conservation and restoration (protecting nursery habitat, marine reserves.
• Ecosystem capacity to support recreational angling is finite.