Presented at Puget Sound Shorelines and the Impacts of Armoring Workshop,
May 12-14 2009.
This presentation not peer reviewed.

‘Shoreline Armoring Impacts’ Massachusetts & Kauai, Hawaii

Jim O’Connell
University of Hawaii
Sea Grant Program on Kauai

Massachusetts

1500 Miles of Tidal Shore

78
Jurisdictions on all coastal landforms

Glacial-mineral coastal environment

KAUAI

110 Miles shore

2 Jurisdictions:
County - mauka SL
State – makai SL (beaches)

Volcanic-carbonate coastal environment

Regulations:

Massachusetts (post-1978 & all dunes) & Kauai (Ordinance) now prohibit armoring!

(w/o variance?)

*** MA to protect sediment source**

•Kauai to protect the beach
•(but HI-State has major jurisdiction)

Eastham - Morcaldi/Hatch/Rice Properties (proposed revetments)

pre-1978 buildings only!

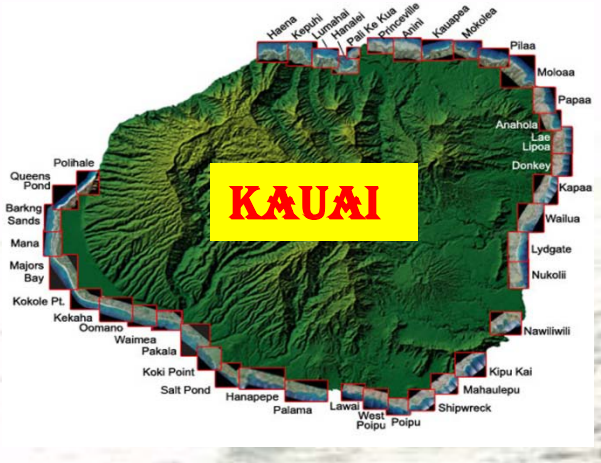
13 permitted revetments this year (2005)!

Loss of dry beach = 14 years!

non-structural erosion control <u>permitted for post-1978</u> buildings
(similar Impacts?)

(Jim O'Connell, UH Sea Grant Kauai)

Kekaha - Kaumuali Hway

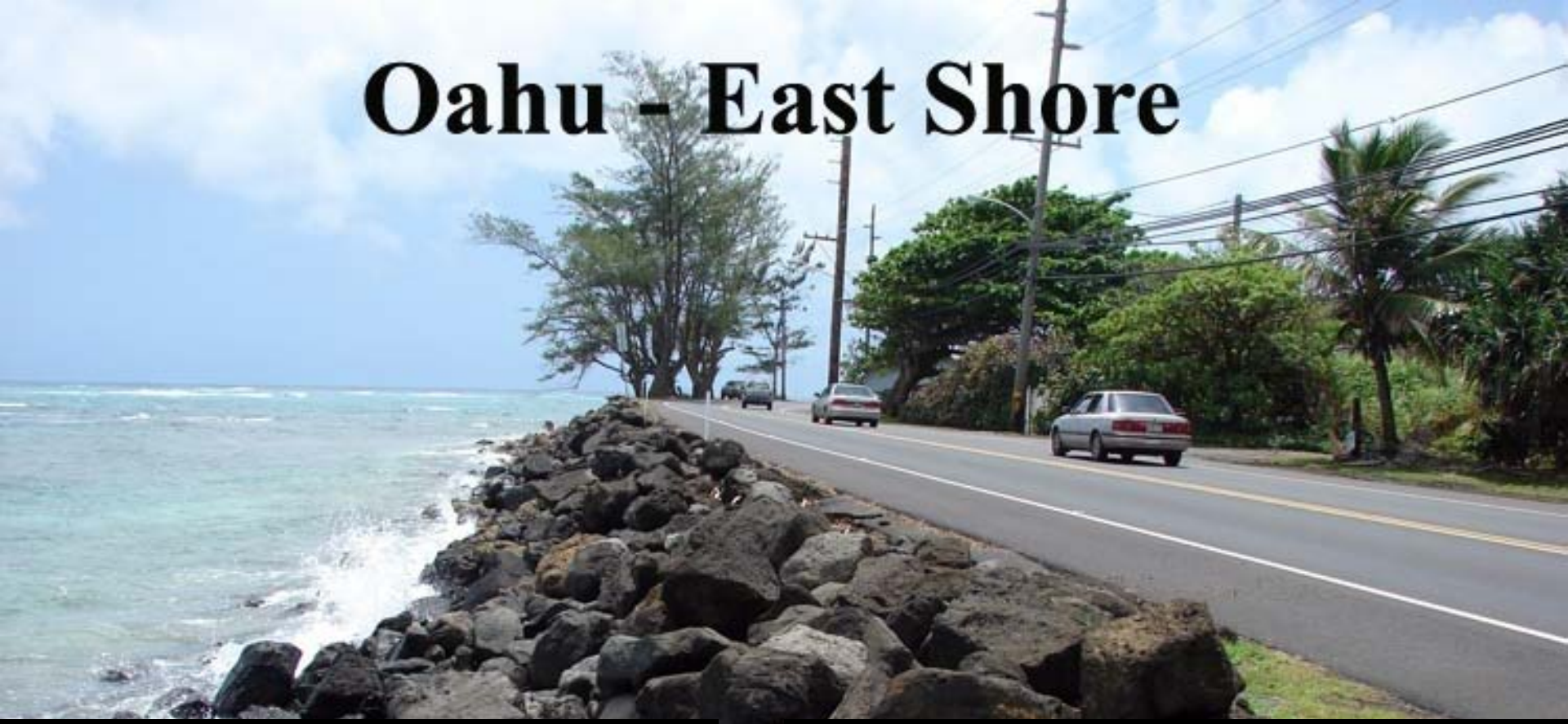


How many miles of beach/intertidal area lost or narrowed on Kauai?

Sept 29, 2008

(Jim O'Connell, UH Sea Grant on Kauai)

Oahu - East Shore



Oahu:

6.4 miles of sandy have been lost due to shoreline armoring with seawalls and revetments
(Fletcher et al, 1997).

Maui:

16 miles of coastline hardened (seawalls, revetments, bulkheads, etc).
*** 30% Maui's sandy shore significantly narrowed or lost**
(Surfrider Foundation 2008).

(Jim O'Connell, UH Sea Grant on Kaua

‘Sandy beaches are the backbone of Hawaii’s multi-billion dollar visitor economy which provides the bulk of the state’s jobs and income’
(University of Hawaii, SOEST).

HI Visitor Economy

$13 billion

171,900 jobs

(COEMAP, DLNR, 2000) $$$ 2009?

April 11, 2009

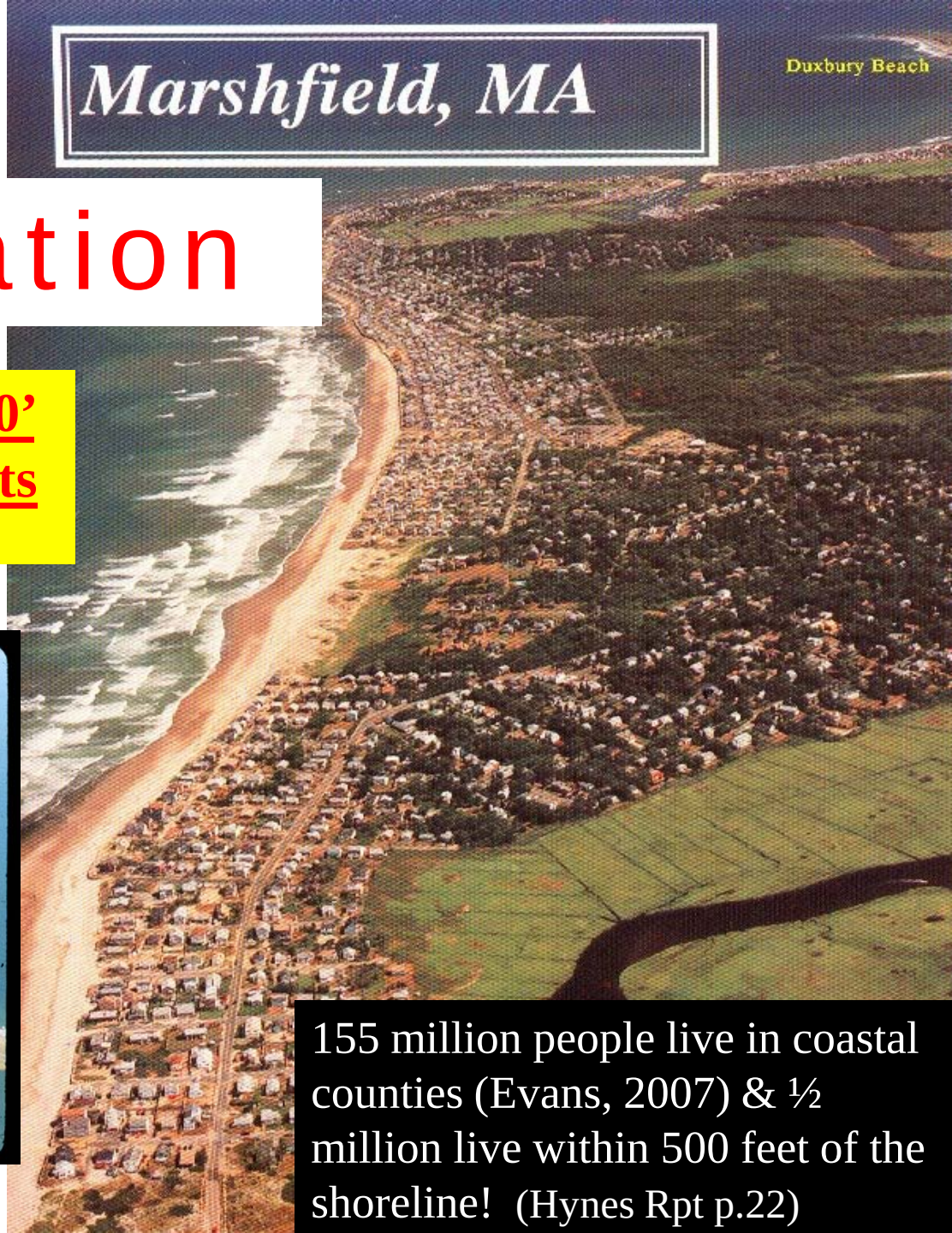
Jim O’Connell
UH Sea Grant

KAUAI, HI

(Jim O'Connell, UH Sea Grant)

70% population

36,000 people live within 500' of Shoreline in Massachusetts
(Hynes Rpt, p.23)



155 million people live in coastal counties (Evans, 2007) & ½ million live within 500 feet of the shoreline! (Hynes Rpt p.22)

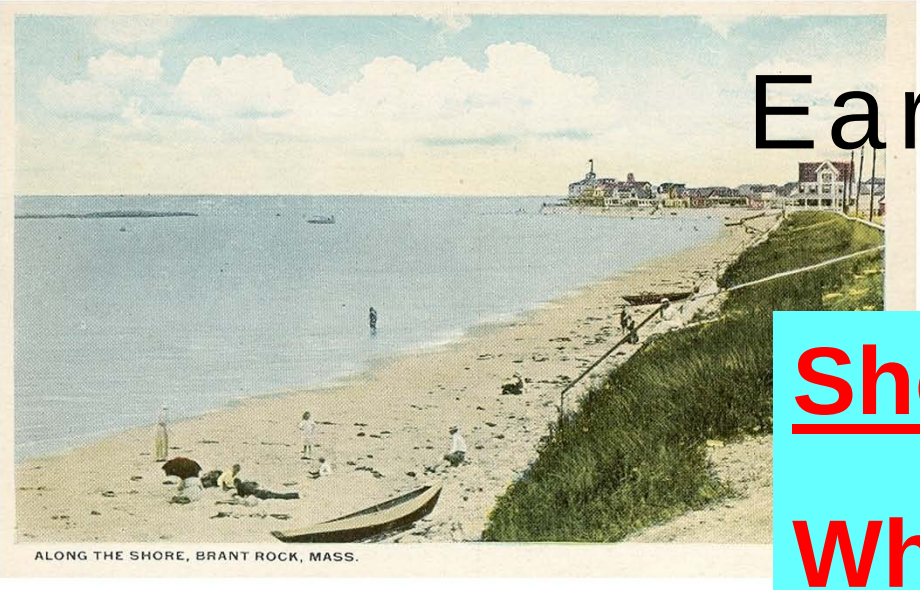
Nantasket Beach, Hull, Massachusetts

(MA has extensive experience in armoring)

(Jim O'Connell Univ HI Sea Grant)

Old
New
Now adding toe rip-rap = further 'displacement' loss
JUN 3 2004
(Jim O'Connell)

replacing old vertical concrete seawalls with revetments = additional <u>displacement,</u> etc



Early 1900s

Shoreline Armoring

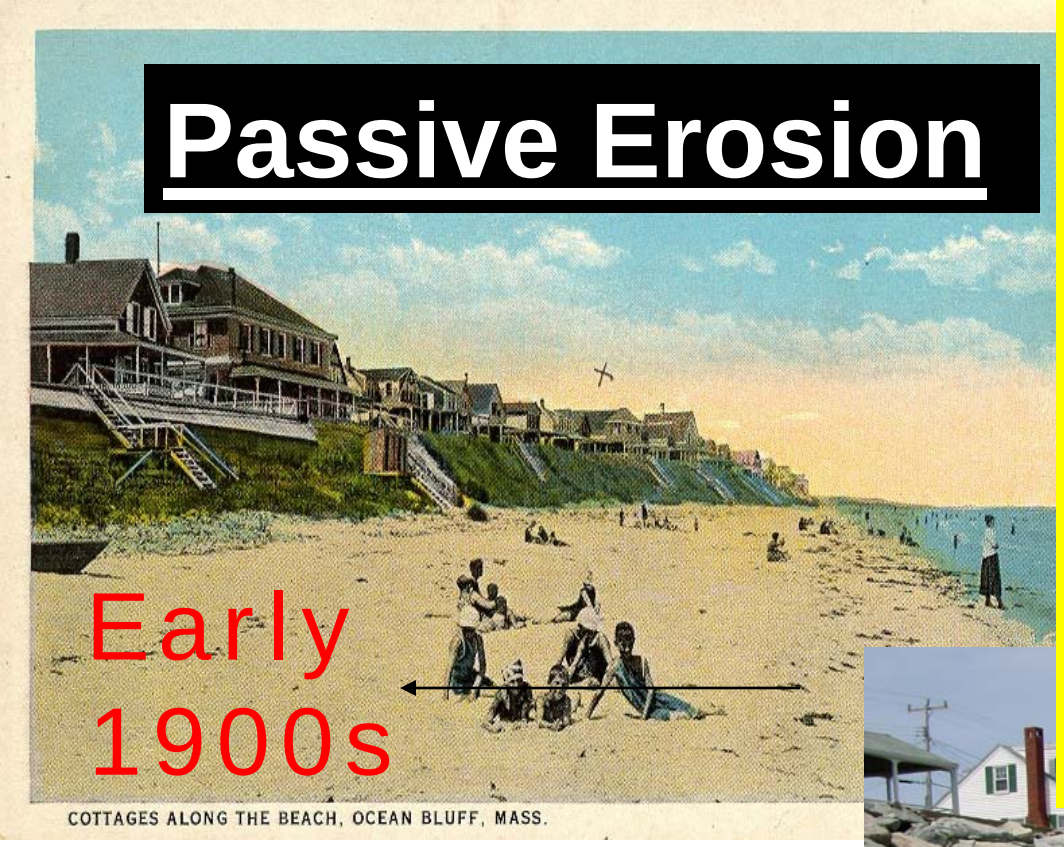
What do we lose?

What do we gain?

2006

Jim O'Connell, University of HI Sea Grant

Passive Erosion



Losses:

- *Access*
- Recreation
- Habitat (sandy beach)

- **Gains:**
- Storm damage reduction
- Habitat (rocky/cobble intertidal)
- Financial security (1st house)
- Community – financial gain?

(Jim O'Connell, UH Sea Grant)

‘Effects of ARMORING’

‘Pros and Cons’

(categorize)

* **Physical Effects** (protects & destroys)
* **Biological Effects** (destroys &/or change as habitat changes)
* **Habitat Effects** (eliminates or changes habitat)
* **Ecological effects** (ecosystem services)

(Dept Ecology, 1994, V.7)

•**Financial Effects** (adds and subtracts: Kriesel & Friedman, 2002)

Impacts of shoreline armoring are *site specific*!

Are the values similar for these beaches & banks?

(physically; ecologically; financially)

‘Site-specific’ affects of armoring differ:

e.g. Source of Hawaii vs. Massachusetts beach sand vs. potential Impacts?

(Jim O’Connell, UH Sea Grant)

Armoring effects will differ due to seasonal beach changes

Same beach --
4 months apart

<u>High energy</u> shores with large seasonal changes in beach width, volume & composition:

Habitat Important?

Armoring impacts differ with armoring types & location
SEP 28 2005
(Jim O'Connell)
UH Sea Grant

(L. Strode)

Impacts of Armoring depends on:

1. Type of Landform: sediment source?
2. Sediment Composition of beach and inter-tidal area
3. Seasonal Beach Changes (physical & biological)
4. Tidal Range (width of intertidal area)
5. Wave Energy (open ocean vs. estuarine)
6. (= Biological - Habitat)
7. Placement (landward vs seaward)
8. Type of Armoring

site-specific

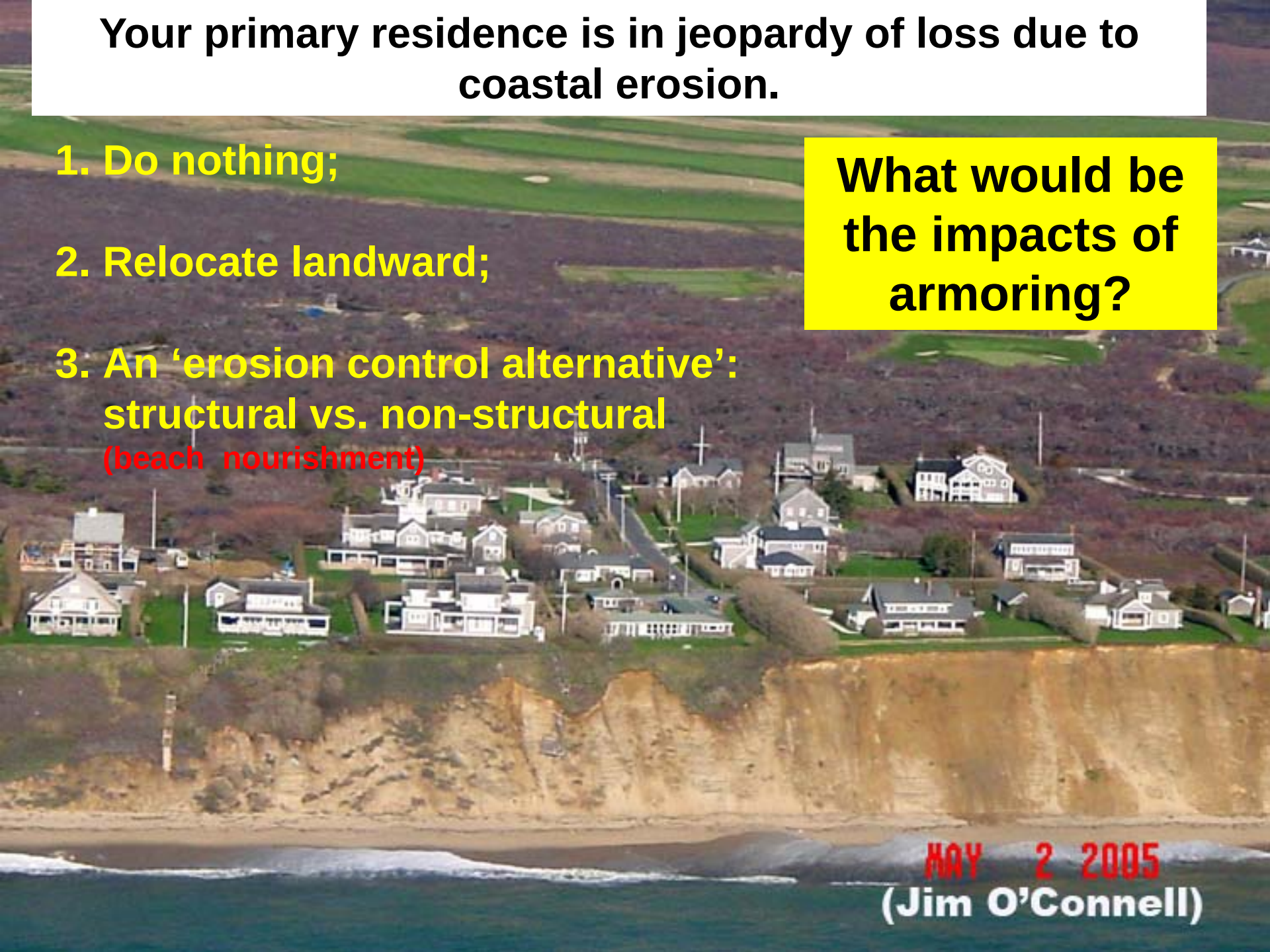
Your primary residence is in jeopardy of loss due to coastal erosion.

1. Do nothing;

2. Relocate landward;

3. An ‘erosion control alternative’: structural vs. non-structural (beach nourishment)

What would be the impacts of armoring?



Shoreline Armoring Impacts

Benefits

Main Property Owner Concerns?

- Stabilize upland
- Maintain property value (front house only)
- Protect infrastructure

Detriments

- Source sediment loss
- Erosion of beach
- Direct loss of resource (displace)
- Decrease (change) ecological value
- Loss beach access
- Swimming hazard
- Navigation hazard
- Adjacent property impact

Quantify Impacts & Balance Outcome

(Jim O'Connell, HI Sea Grant)

Beach exists
No dry Beach
Coastal erosion management dilemma!
Beach access loss; sand impoundment; placement loss; habitat loss (change); marine organisms (change); ecological exchange; adjacent property affects; valuable upland protected.

Mitigation(?)
Passive Erosion of beach
condition placed on permit to build a revetment to maintain public access along the shore!
MAY 20 2004
(Jim O'Connell)

Passive Erosion

Maintaining shoreline public access was impossible: permit condition negated.

Habitat
(food chain?)

Oct 12, 2008
(Jim O'Connell, UH Sea Grant Kauai

Monk Seal

ARMORING:
Changes habitat
thus ecological
services thus
marine organisms.

MITIGATION:

Beach compatible sand over revetment

<u>armoring</u>:
=loss of source sand for downdrift barrier beaches
=more rapid landward migration & disintegration

Placement loss:
(vertical seawall vs. revetment)

end scour

adjacent property impacts

mitigation(?):
tapering returns; fiber rolls

barrier beach disintegration

* dunes can not form
* overwash prevented

proposal to rebuild
dike & nourish

proposed armoring (revetment) to protect road

- **Impacts Analyzed (EA):**
- Climate/topography/soils
- Natural hazards
- Aquatic Resources
- Water Quality
- Botanical resources
- Avifaunal & feral mammals
- Historic/archaeological/Cultural
- Visual resources
- Air quality & noise
- Social & economic factors
- Infrastructure/utilities
- Transportation
- Conformance w/Plans & Policies

proposed revetment EA = FONSI

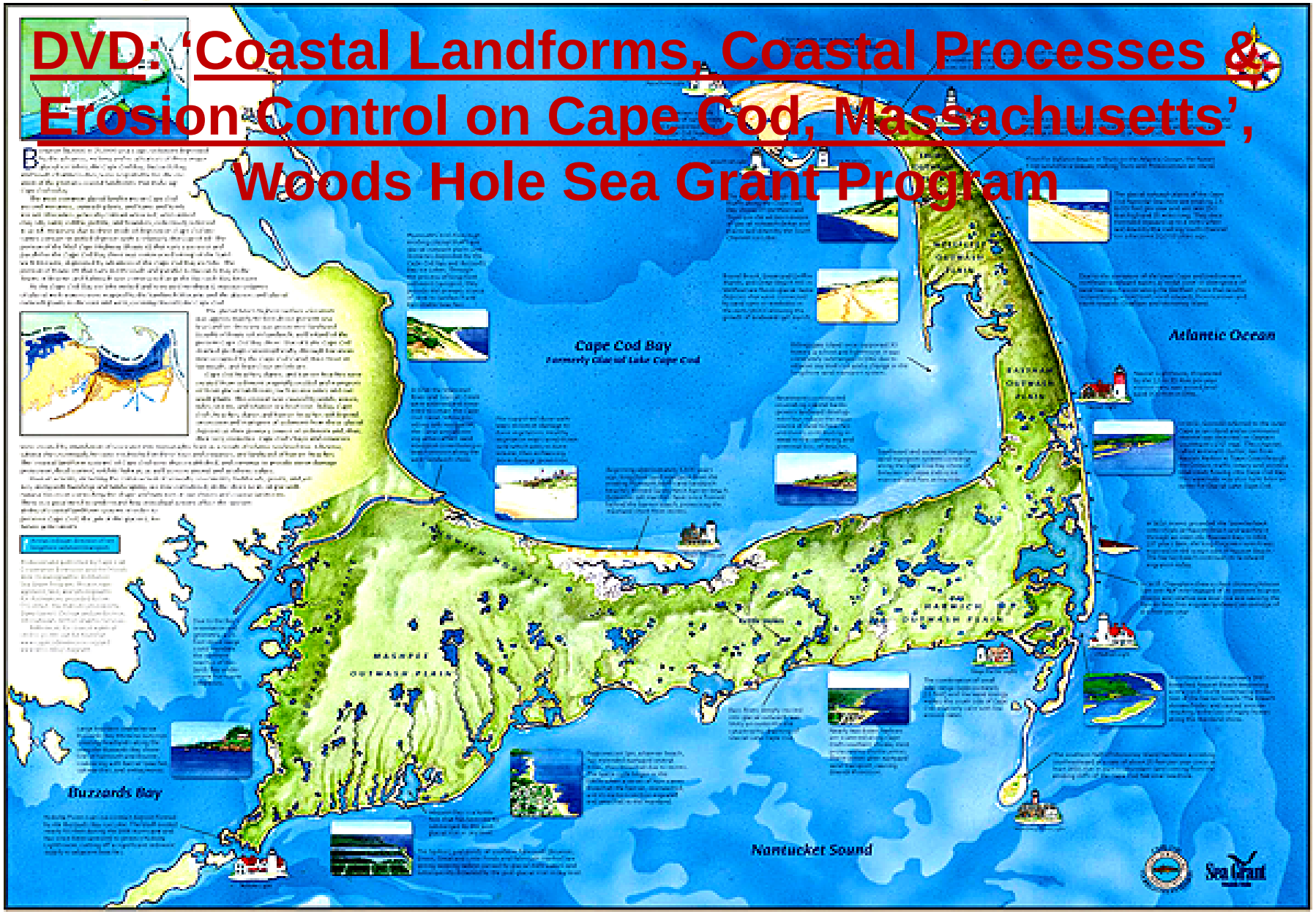
- **Impacts Analyzed (EA):**
- Climate/topography/soils – NI
- Natural hazards – NI (+)
- Aquatic Resources – NI (nothing highly endangered or of high ecological value)
- Water Quality - NI
- Botanical resources – NI (no state/ or fed listed threatened or endangered species)
- Avifaunal & feral mammals - NI (monk seal close by: halt work)
- Historic/archaeological/Cultural - NI
- Visual resources - NI
- Air quality & noise – short-term
- Social & economic factors – NI (+)
- Infrastructure/utilities - NI
- Transportation - short-term (LT +)
- Conformance w/Plans & Policies - OK

U.S. Coastal Zone contributed $4.5 trillion to the U.S. economy in 2005

(U.S. Commission on Ocean Policy)

‘Littoral Cell Management’
Which beaches will we decide to lose – which will we save!?

Cape Cod Landforms and Coastal Processes



DVD: 'Coastal Landforms, Coastal Processes & Erosion Control on Cape Cod, Massachusetts', Woods Hole Sea Grant Program

covered & vegetated revetment

Very low erosion rate:

Storm-induced erosion concern

Erosion Control Alternatives

- <u>Structural</u>

- Revetments (rip-rap; gabions; concrete; geo-textiles)
- Seawalls
- Bulkheads
- Groins
- Breakwater
- Perched beach
- Dikes/levees

- <u>Non-structural</u>

- Fiber rolls (?)
- Beach nourishment
- Bank nourishment (re-grade; vegetate; terracing)
- Dune building
- Beach de-watering
- Salt marsh building
- Sand/snow fence (?)
- Beach scraping
- Gnd H2O discharge
- relocation

(Jim O'Connell, WHOI Sea Grant & CCCE)