

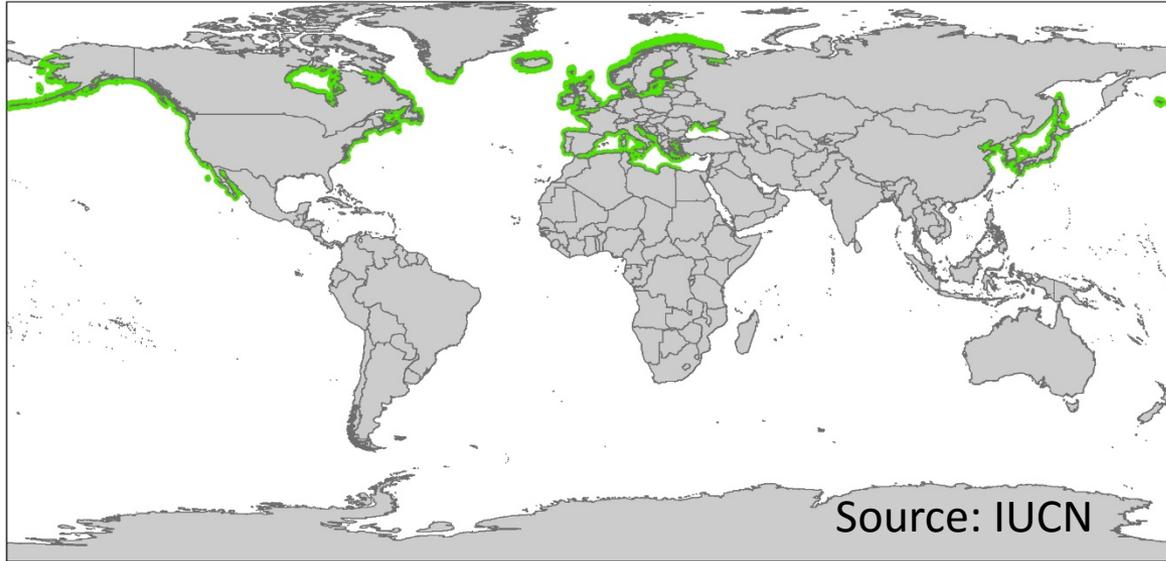
# Seascape photography: use of aerial remote sensing to quantify landscape-scale patterns of eelgrass (*Zostera marina*) in Halifax Harbour

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**DALHOUSIE  
UNIVERSITY**

## Global Distribution of Eelgrass



- Eelgrass (*Zostera marina*): widespread in Atlantic Canada
- Rooted flowering plant
- Moved from land -> sea ~100 million years ago
- Both clonal & sexual reproduction
- Perennial/annual forms



# Why is it important?

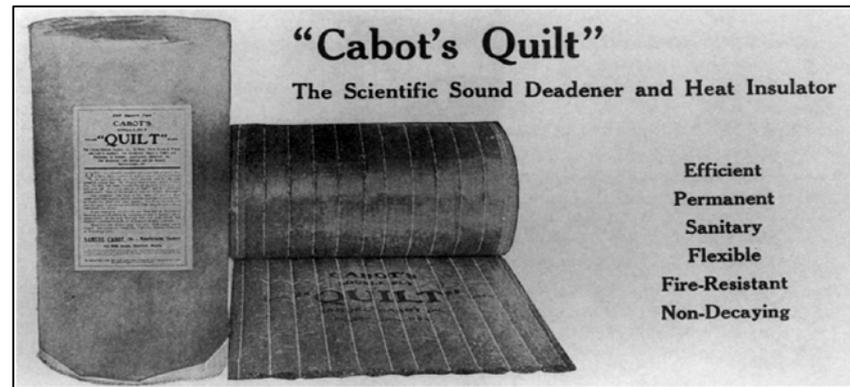
## “Ecosystem engineer”

- Primary production
- Food web
- Habitat
- Alters currents
- Sediments/erosion
- Nutrient cycling
- Ecosystem services



# In Nova Scotia:

- Harvested along South Shore NS for insulation, sound-deadening
- Exported to Boston: >400t/year in 1920s
- Later produced as “Seafelt” until early 1960s in Sable River, NS
- Used in Radio City Music Hall, Rockefeller Center in NYC



# Sensitivity and Threats



- Decline in distribution
  - Coastal development
  - Eutrophication, pollution
  - Climate change
  - Invasive species (e.g. **green crab**)
  - Disease
- Management\*
  - Ecosystem health indicator
  - Monitoring
  - Prediction
  - Habitat restoration

**\*Need to know where it occurs!**

## A Global Crisis for Seagrass Ecosystems

ROBERT J. ORTH, TIM J. B. CARRUTHERS, WILLIAM C. DENNISON, CARLOS M. DUARTE, JAMES W. FOURQUREAN, KENNETH L. HECK JR., A. RANDALL HUGHES, GARY A. KENDRICK, W. JUDSON KENWORTHY, SUZANNE OLYARNIK, FREDERICK T. SHORT, MICHELLE WAYCOTT, AND SUSAN L. WILLIAMS



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

Science

Sciences

Canadian Science Advisory Secretariat  
Science Advisory Report 2009/018

Gulf Region

## DOES EELGRASS (*Zostera marina*) MEET THE CRITERIA AS AN ECOLOGICALLY SIGNIFICANT SPECIES?

## Associations of concern: declining seagrasses and threatened dependent species

A Randall Hughes<sup>1,2\*</sup>, Susan L Williams<sup>1</sup>, Carlos M Duarte<sup>3</sup>, Kenneth L Heck Jr<sup>4</sup>, and Michelle Waycott<sup>5</sup>

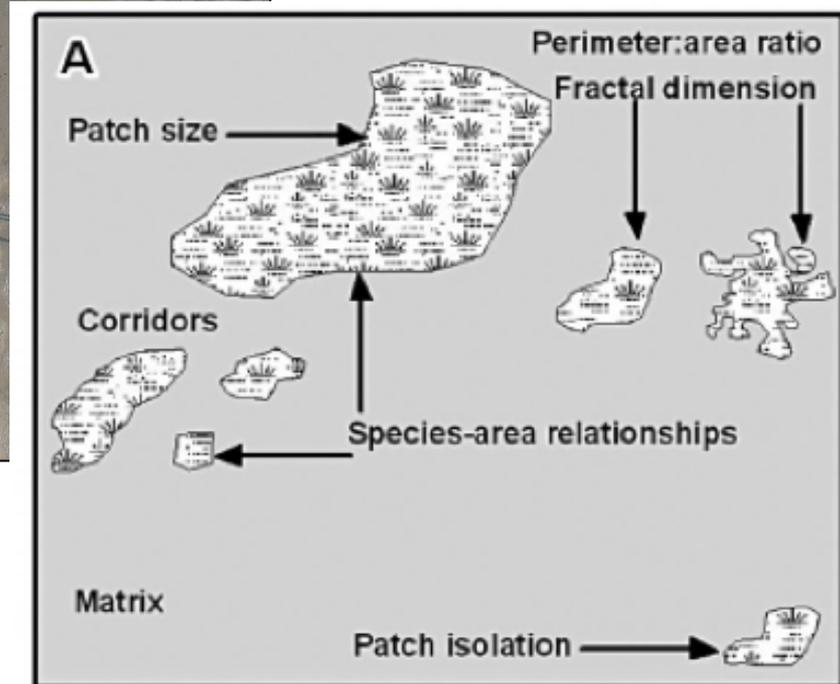
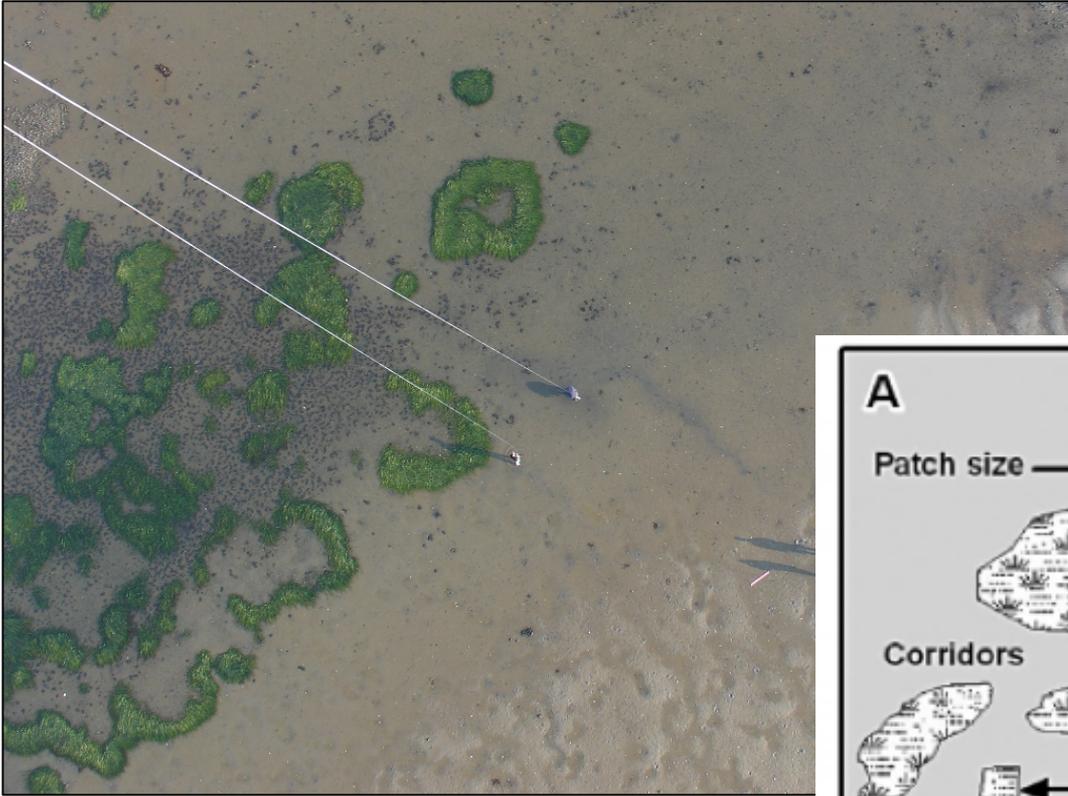
## Accelerating loss of seagrasses across the globe threatens coastal ecosystems

Michelle Waycott<sup>a,1</sup>, Carlos M. Duarte<sup>b</sup>, Tim J. B. Carruthers<sup>c</sup>, Robert J. Orth<sup>d</sup>, William C. Dennison<sup>e</sup>, Suzanne Olyarnik<sup>e</sup>, Ainsley Calladine<sup>a</sup>, James W. Fourqurean<sup>f</sup>, Kenneth L. Heck, Jr.<sup>g,h</sup>, A. Randall Hughes<sup>a</sup>, Gary A. Kendrick<sup>i</sup>, W. Judson Kenworthy<sup>i</sup>, Frederick T. Short<sup>k</sup>, and Susan L. Williams<sup>a</sup>

## Extinction risk assessment of the world's seagrass species

Frederick T. Short<sup>a,\*</sup>, Beth Polidoro<sup>b</sup>, Suzanne R. Livingstone<sup>b,1</sup>, Kent E. Carpenter<sup>b</sup>, Salomão Bandeira<sup>c</sup>, Japar Sidik Bujang<sup>d</sup>, Hilconida P. Calumpong<sup>e</sup>, Tim J.B. Carruthers<sup>f</sup>, Robert G. Coles<sup>g</sup>, William C. Dennison<sup>f</sup>, Paul L.A. Erftemeijer<sup>h</sup>, Miguel D. Fortes<sup>i</sup>, Aaren S. Freeman<sup>a,2</sup>, T.G. Jagtap<sup>j</sup>, Abu Hena M. Kamal<sup>k,3</sup>, Gary A. Kendrick<sup>l</sup>, W. Judson Kenworthy<sup>m</sup>, Yayu A. La Nafie<sup>n</sup>, Ichwan M. Nasution<sup>o</sup>, Robert J. Orth<sup>p</sup>, Anchana Prathep<sup>q</sup>, Jonnell C. Sanciangco<sup>b</sup>, Brigitta van Tussenbroek<sup>f</sup>, Sheila G. Vergara<sup>s</sup>, Michelle Waycott<sup>t</sup>, Joseph C. Zieman<sup>u</sup>

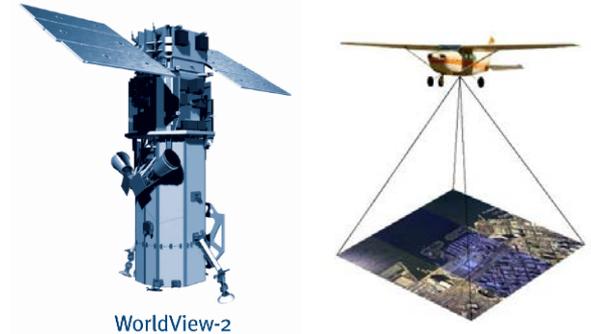
# Landscape ecology



Wedding et al. 2011

# *Zostera* “landscapes”

- Multi-scale hierarchical spatial structure
  - Landscape ecology models
  - Shoot < Patch < Landscape
  - Characterize & quantify landscape structure
- Difficulty of collecting fine-scale, broad-extent data
  - Direct sampling?
  - Remote sensing?
  - Remote sensing?



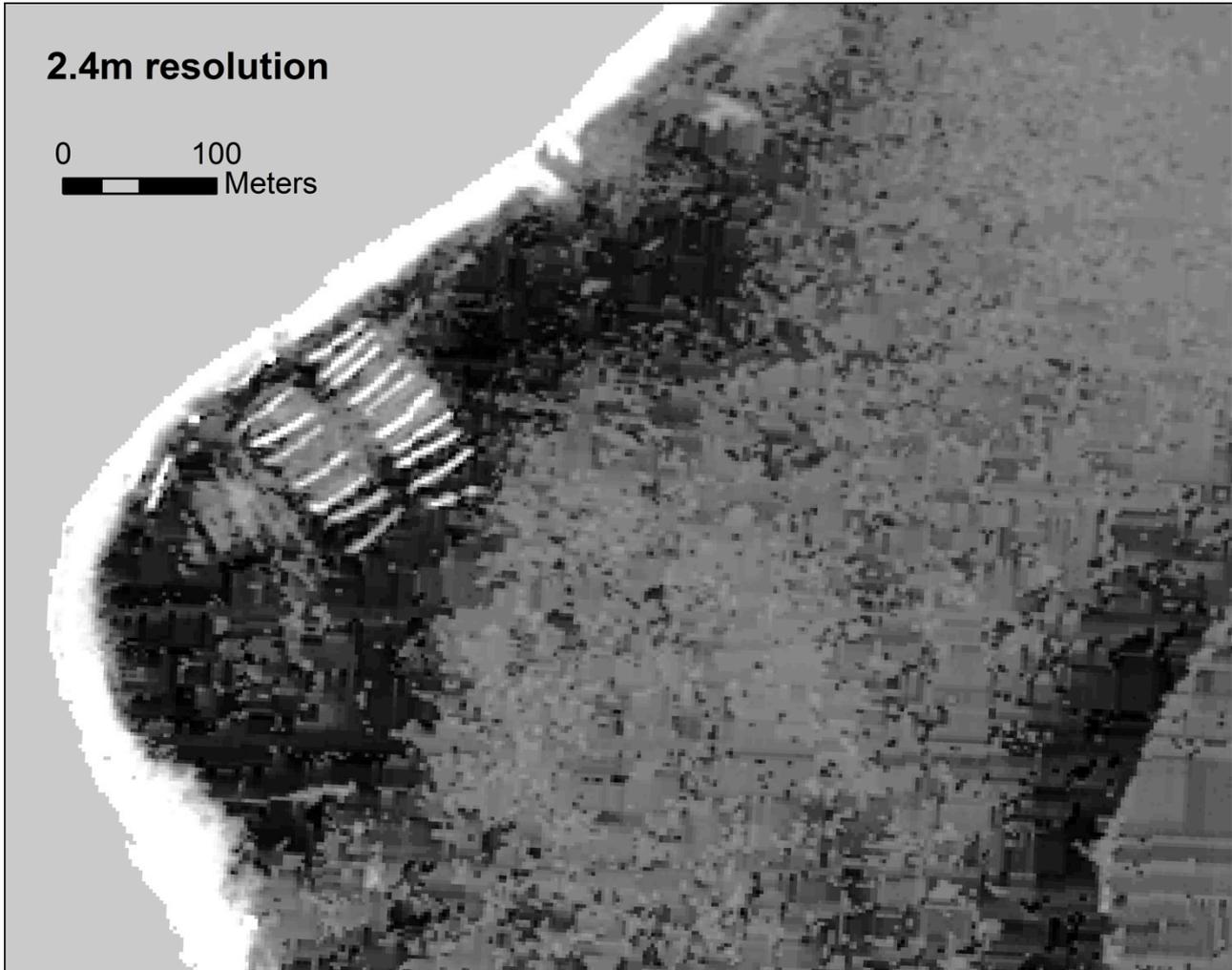
Shoot

Patch

Landscape

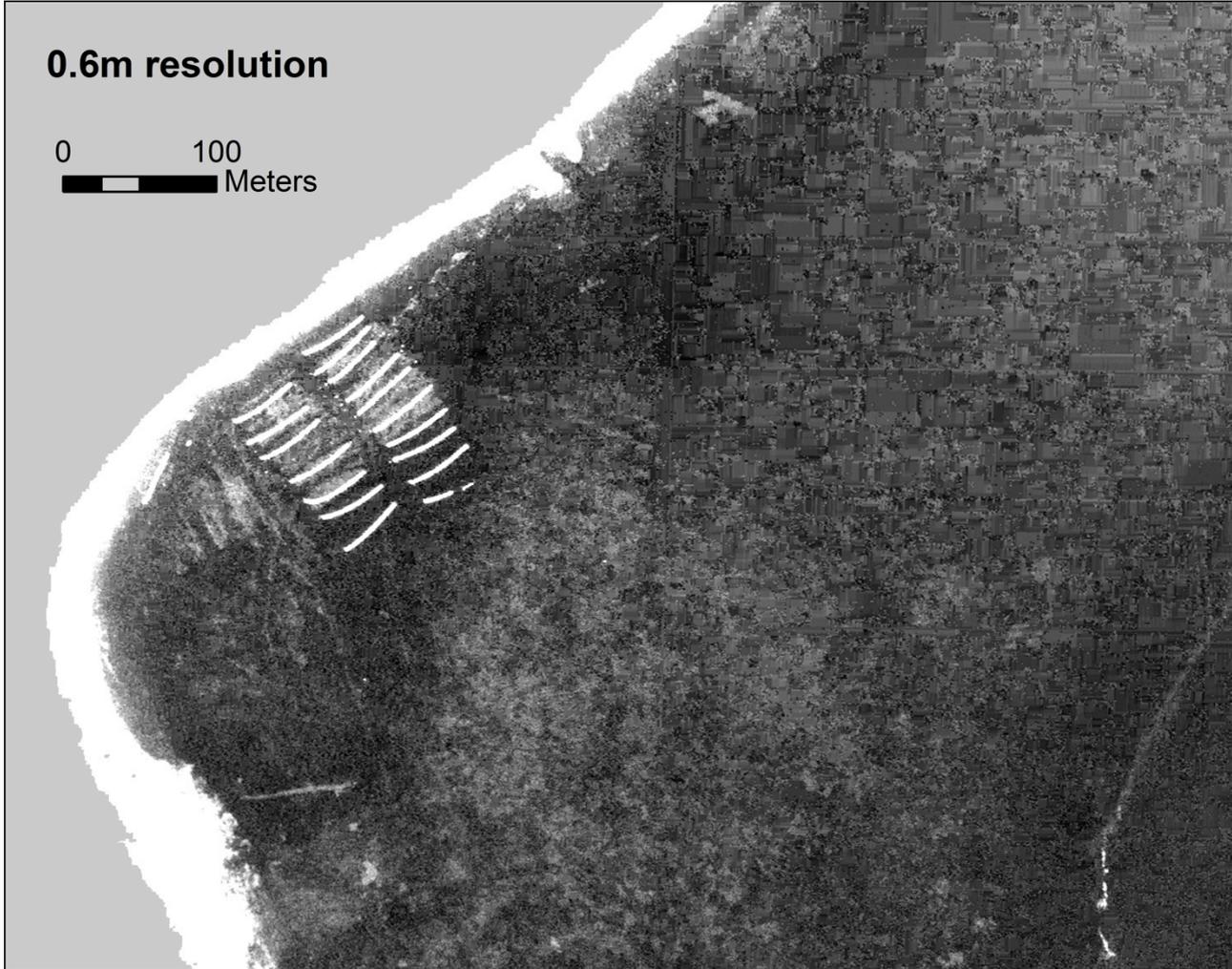
**2.4m resolution**

0 100  
Meters



**0.6m resolution**

0 100  
Meters



- *“Landscape photography is the supreme test of the photographer – and often the supreme disappointment.” – Ansel Adams*



*Birds on a Beach – Ansel Adams*

## Seascape

- *“~~Landscape~~ photography is the supreme test of the photographer – and often the supreme disappointment.” – Ansel Adams*



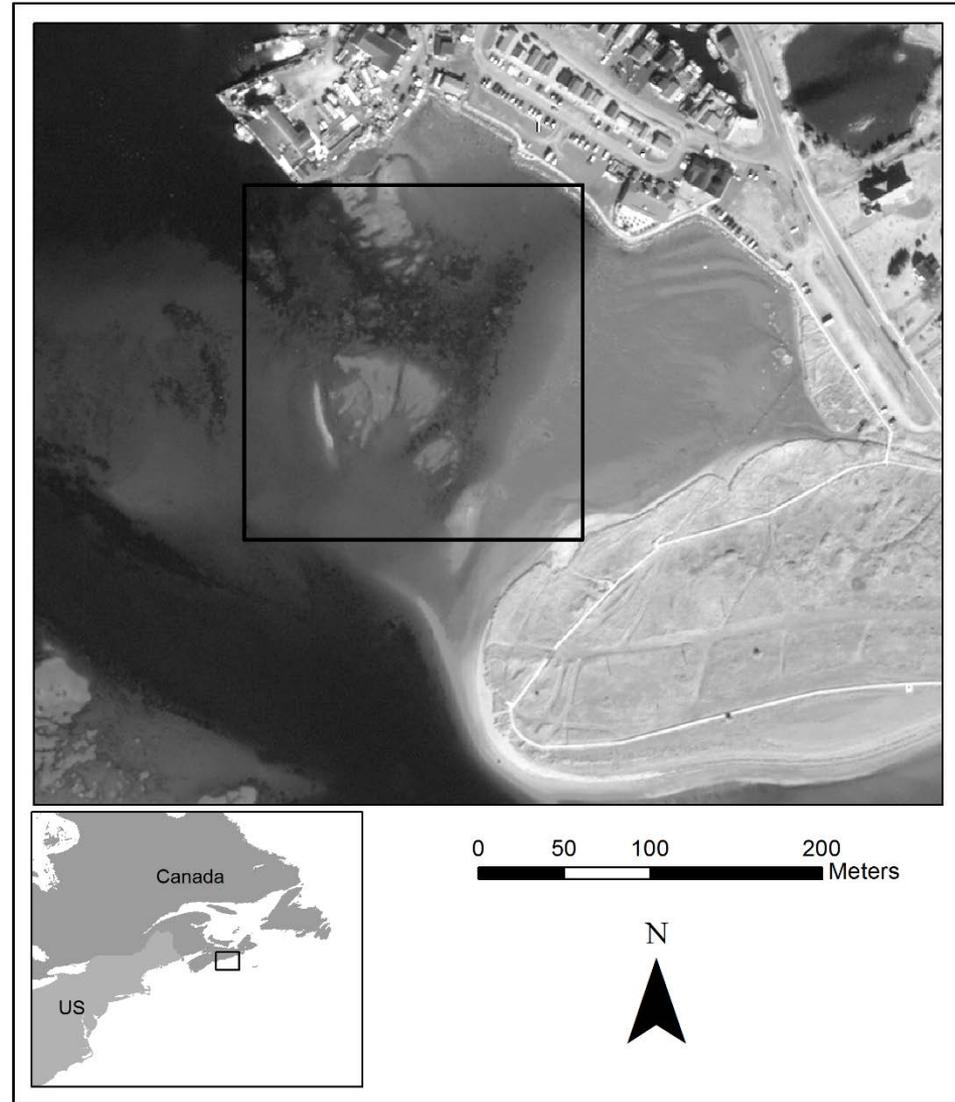
*Birds on a Beach – Ansel Adams*

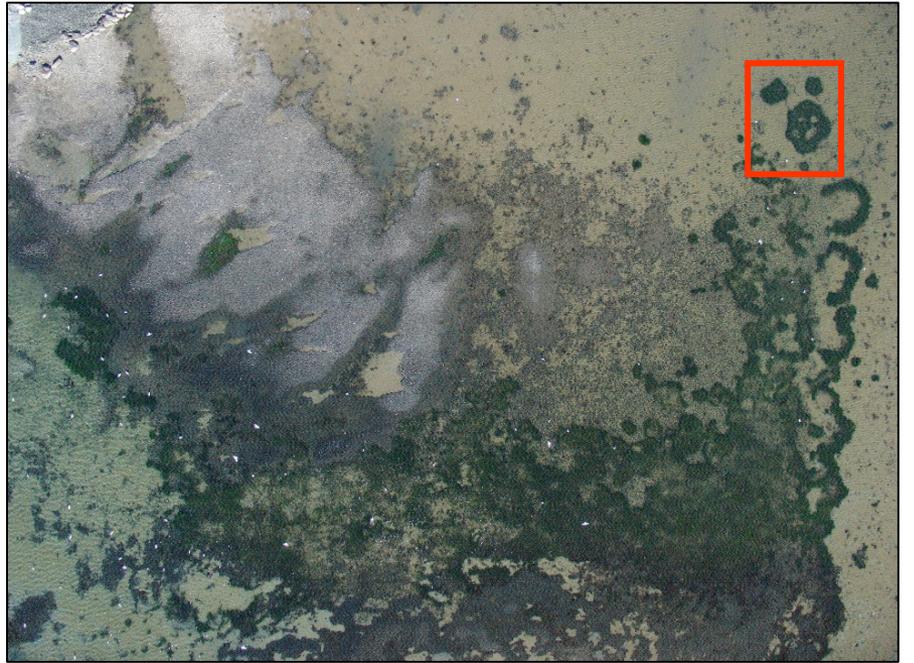
# Aerial photography: DalBlimp

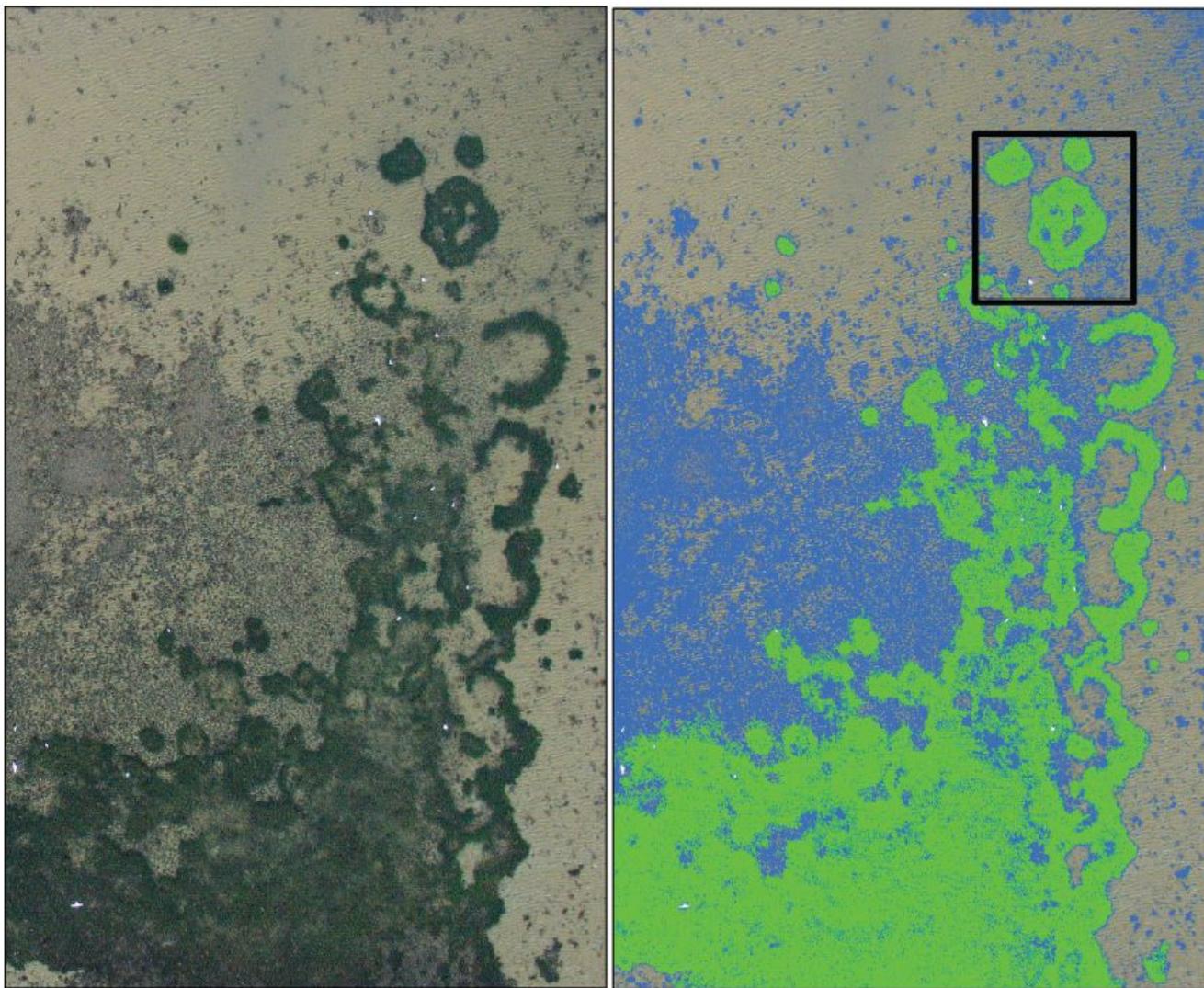


# Case Study: Eastern Passage, NS

- McCormacks Beach
- Shallow subtidal eelgrass/mussel landscape







**Landscape:**  
27.9% Eelgrass  
29 patches

25.1% Bivalve  
29,000 patches

47% Sediments



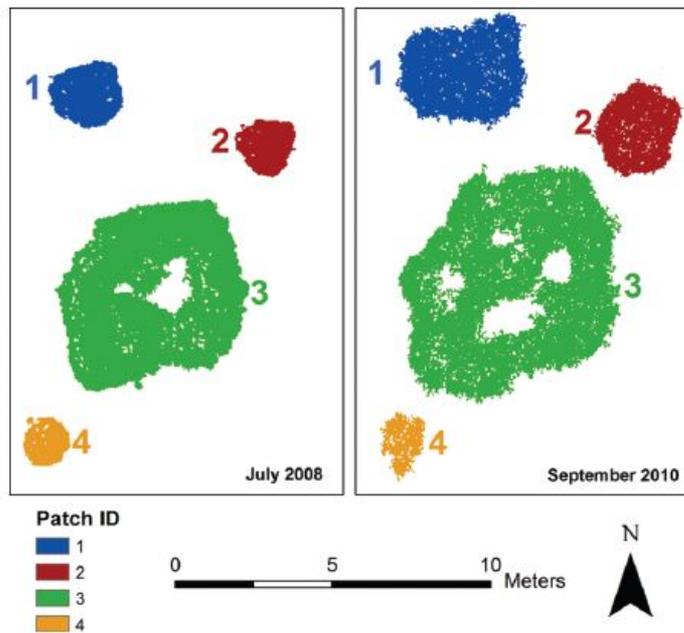
0 5 10 20  
Meters

A horizontal scale bar with four segments, labeled with the numbers 0, 5, 10, and 20, followed by the word 'Meters'.

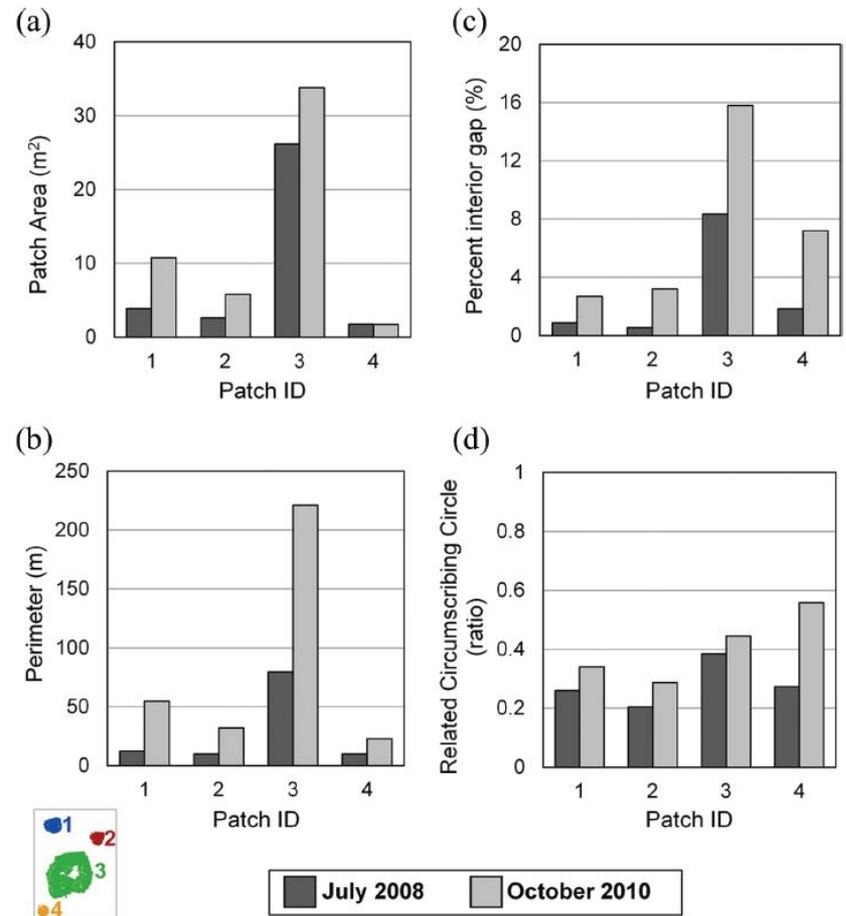
 Eelgrass  
 Bivalve

**Figure 2.** Map showing the raw unclassified imagery (*left*) with classified bivalve and eelgrass patches superimposed (*right*). The area of interest for patch-scale analysis is outlined at right. The spatial resolution of the imagery is 0.045 m.

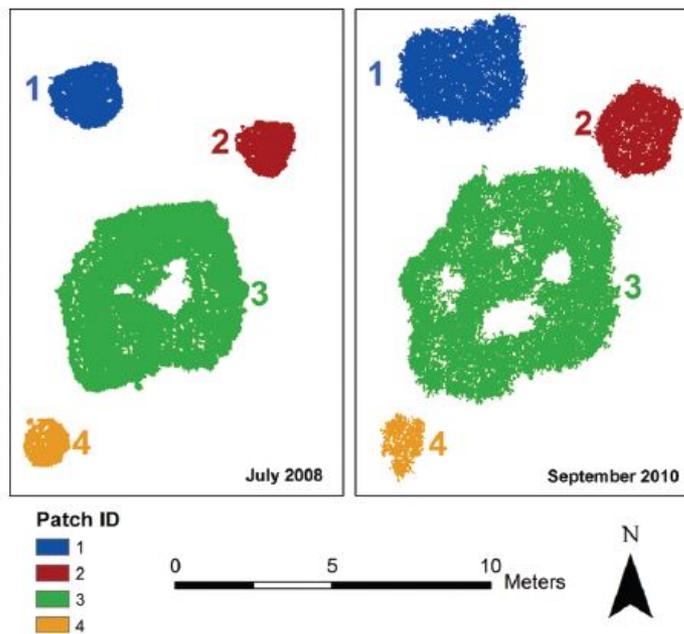
# Patch-level landscape metrics



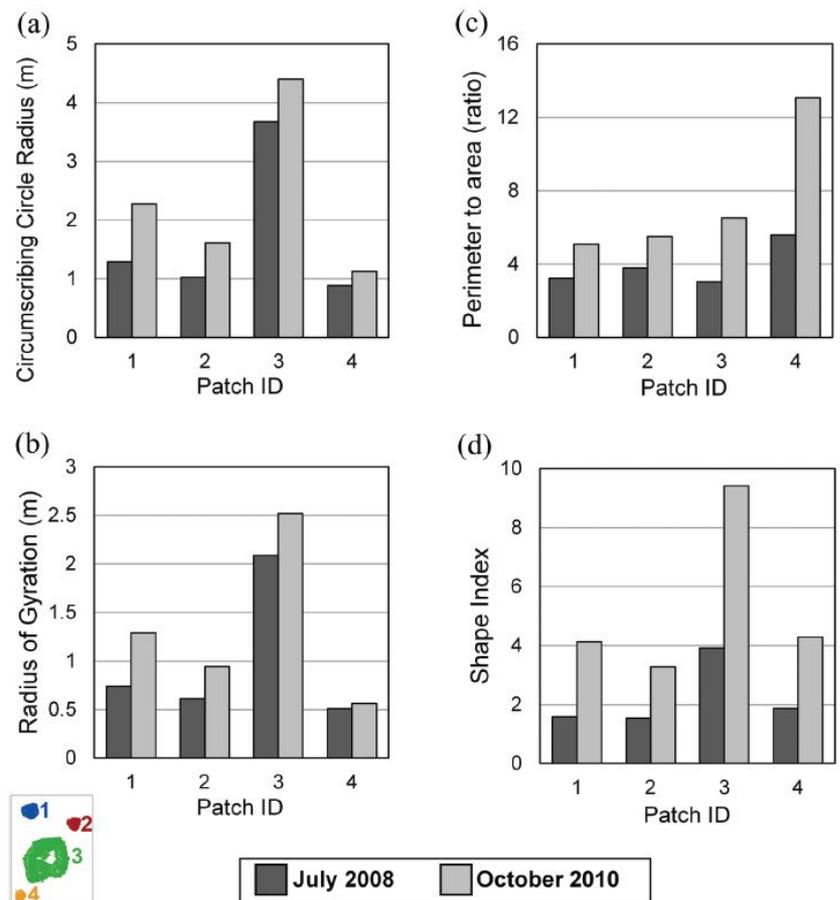
**Figure 3.** Depiction of the temporal change in four selected patches from imagery collected on 8 July 2008 (*left*) to 20 September 2010 (*right*). The spatial resolution (i.e. pixel edge length) of the 2008 and 2010 images are 0.0353 m and 0.0368 m, respectively.



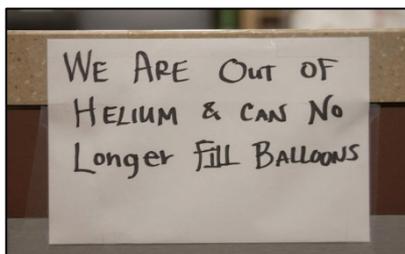
# Patch-level landscape metrics



**Figure 3.** Depiction of the temporal change in four selected patches from imagery collected on 8 July 2008 (*left*) to 20 September 2010 (*right*). The spatial resolution (i.e. pixel edge length) of the 2008 and 2010 images are 0.0353 m and 0.0368 m, respectively.



# Helium shortage = rising prices



## The Ballooning Cost of Helium...

Incognito expresses his concern about the diminishing supplies of helium and its rising cost.

I received my gas bill this week — not my domestic bill but for the gases we use in the laboratory (was shocked when I got my lab domestic bill, I was more shocked when I received the laboratory bill. We managed to use too helium than we did in the last billable period but the cost has risen by over 20%!). My immediate reaction was to ring around a few alternative suppliers — one wouldn't quote for re-charge saying that they couldn't guarantee supply and the other quoted me \$806 per gas for a 4" latex cylinder. (Wow!)

I'd heard nothing from colleagues regarding a 'shortage' and the end of this non-renewable resource so I did a little digging to get some facts. Turns out that facts are a little difficult to come by when it comes to helium and figures vary quite widely. However, I've managed to gather the following fairly reliable data:

Helium is found in varying concentrations (up to ppm to around 7% by volume) in deposits of natural gas produced in suitable sedimentary rock formations and mined as the radioactive product helium-4, which is the result of the decay of the heavy elements thorium and uranium. Helium is naturally abundant in air at 5.2 ppm by volume, but this is too low for cost effective recovery. Consequently, it is refined from the natural gas deposits using fractional distillation of the liquid gases under low temperature and high pressure (helium has the lowest boiling point of all the elements). The crude helium is further refined by exposure to continuously low temperatures, which causes the remaining impurities (nitrogen and methane) to precipitate and the gas is finally scrubbed over activated charcoal to produce gas sufficiently pure for use in a wide variety of applications.

Of the 100 million standard cubic metres of gas refined in 2008 the most up-to-date figures I could find around 24% was used for cryogenics (mainly for cooling superconducting magnets in MRI imaging instruments) and around 20% for controlled atmospheres, which includes applications for growing silicon and germanium, in titanium and zirconium production and for our own use in gas chromatography. Other more minor uses include welding, industrial leak detection, flight control and diving (it — and for filling our party balloons of course!).

The main deposits with a worthwhile concentration of helium are found in a cluster in North America, around the Texas pan handle. While there are other producing fields with reserves in Poland, Russia, Qatar and Algeria, 80% of the world's helium supply is currently stored in the Bush Dome reservoir in the Clifts Field near Amarillo, Texas, USA.

In 1996, the US government passed a law that stated that the facility — the US National Helium Reserve — must be completely sold

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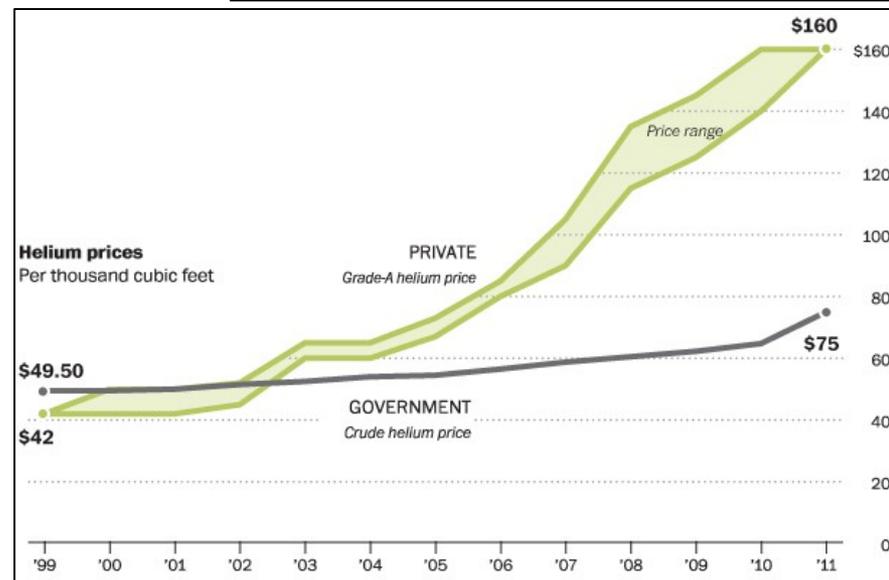
NATURE | COMMENT

## Resources: Stop squandering helium

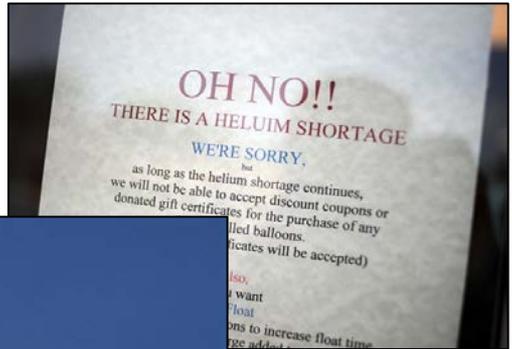
William J. Nuttall, Richard H. Clarke & Bartek A. Glowacki

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Nature 485, 573–575 (31 May 2012) | doi:10.1038/485573a  
Published online 30 May 2012



# Helium shortage = rising prices



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# Thanks!



Questions?

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