

US EPA ARCHIVE DOCUMENT

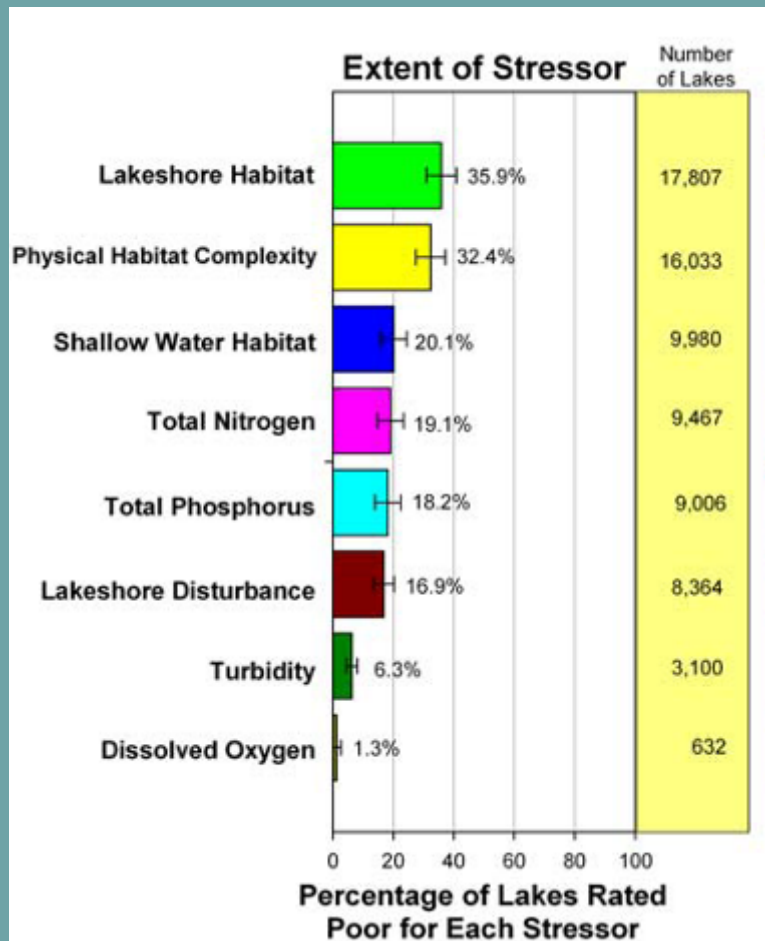
How much of a buffer is needed to mitigate the change to littoral habitat from lakeshore development?

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Removal of Lakeshore Vegetation 'Lakeshore Habitat' is the most widespread stressor to the nation's lakes

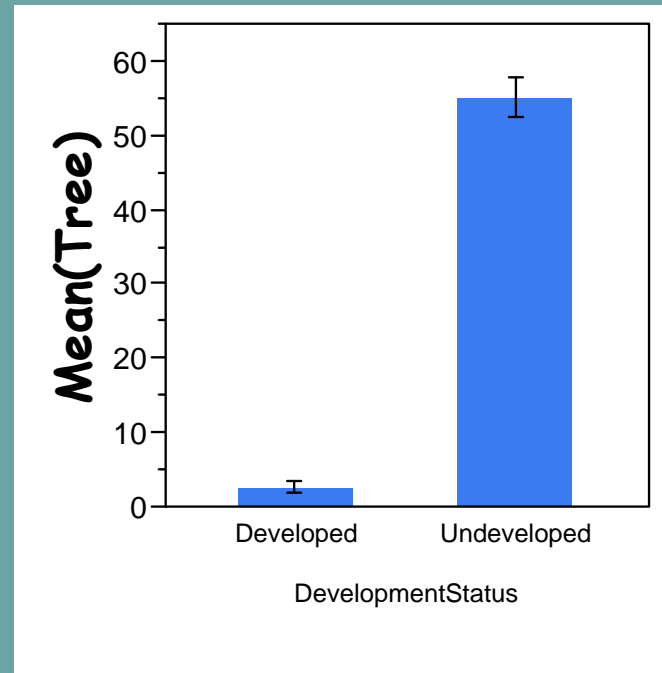


"Of the stressors included in the NLA, poor lakeshore habitat is the biggest problem in the nation's lakes; over one-third exhibit poor shoreline condition."

U.S. EPA, 2009. National Lakes Assessment, Draft Collaborate Survey of the Nation's Lakes

Vermont study found that unbuffered lakeshore development significantly changes aquatic habitat and biota

- 2005-2008
- 40 lakes
- 5 lake classes (Lg Oligotrophic, Lg Mesotrophic, Sm Oligotrophic, Sm Mesotrophic, Sm Dystrophic)
- 151 Unbuffered Developed Sites
- 234 Reference Sites

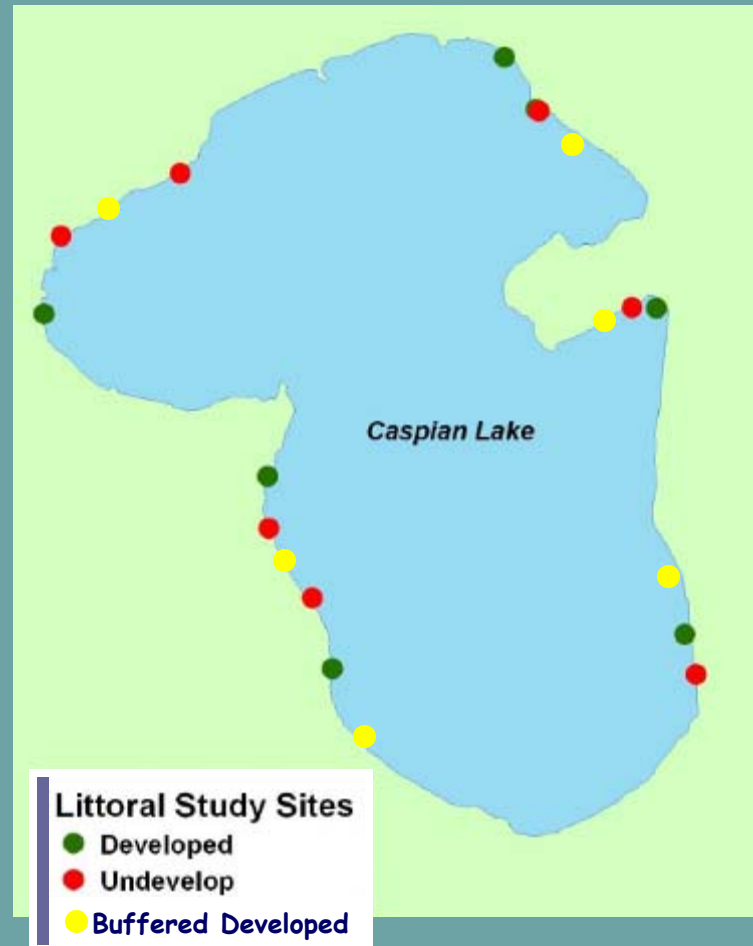


Studied sites with significantly less trees along the shore

2009 Sampled Buffered Developed Sites

- Returned to 8 Large Oligotrophic Lakes

- 48 sites



2009 Sampled Buffered Developed Sites

- Looked for sites meeting Maine's 40 yr old Shoreland Protection Act

- 100' setback
- Retain 12 points of trees in 25' x 25' buffer segments
- Don't cut veg under 3'
- $\leq 6'$ wide meandering path
- No canopy openings $> 250\text{ft}^2$

2009 Sampled Buffered Developed Sites

- Of 48 best buffered developed sites found, only 1 met Maine's law
- Settled for developed sites with narrow, but intact buffers



Example Reference Condition Lakeshore Sites



Large Oligotrophic Lake Class

Example Reference Condition Lakeshore Sites



Large Oligotrophic Lake Class

Example Reference Condition Lakeshore Sites



Large Oligotrophic Lake Class

Example Unbuffered Developed Lakeshore Sites



Large Oligotrophic Lake Class

Example Unbuffered Developed Lakeshore Sites



Large Oligotrophic Lake Class

Example Unbuffered Developed Lakeshore Sites



Large Oligotrophic Lake Class

Example Unbuffered Developed Lakeshore Sites



Large Oligotrophic Lake Class

Example Buffered Developed Lakeshore Sites



Large Oligotrophic Lake Class

Example Buffered Developed Lakeshore Sites



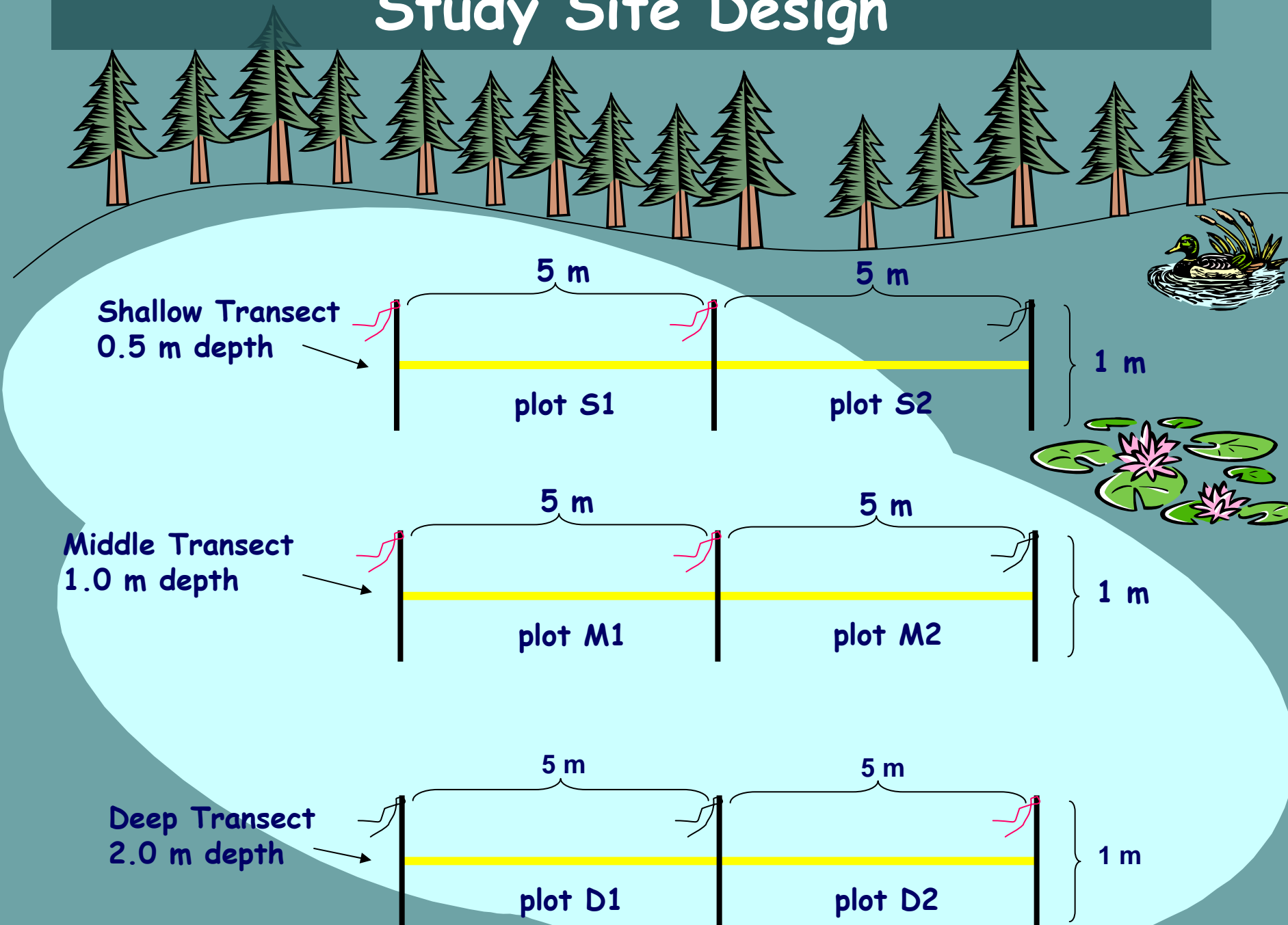
Large Oligotrophic Lake Class

Example Buffered Developed Lakeshore Sites



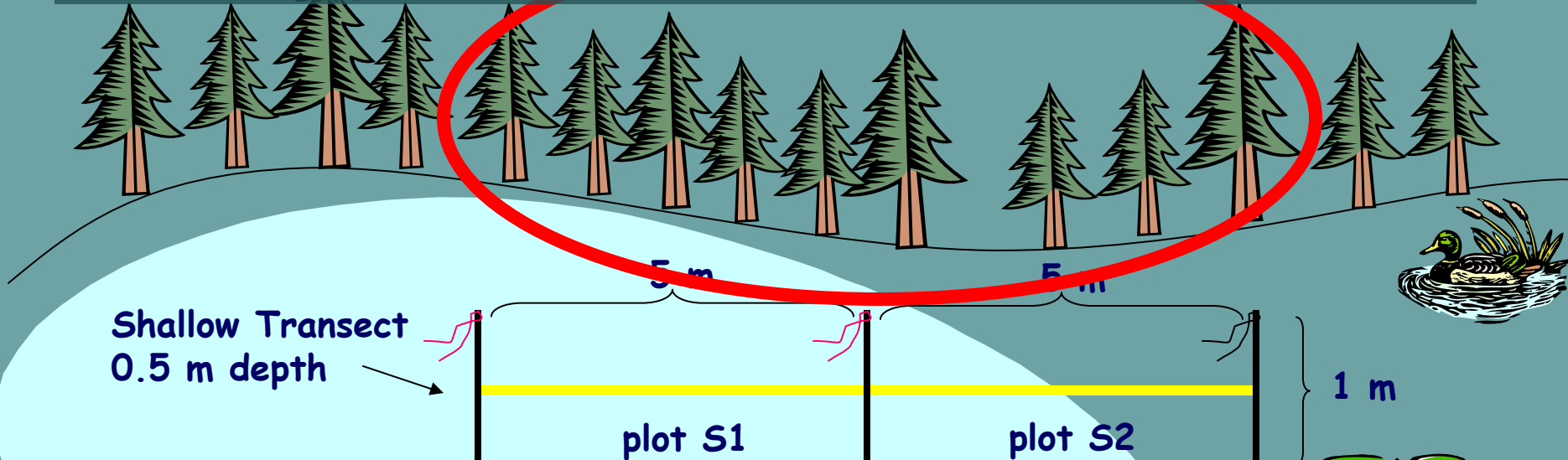
Large Oligotrophic Lake Class

Study Site Design

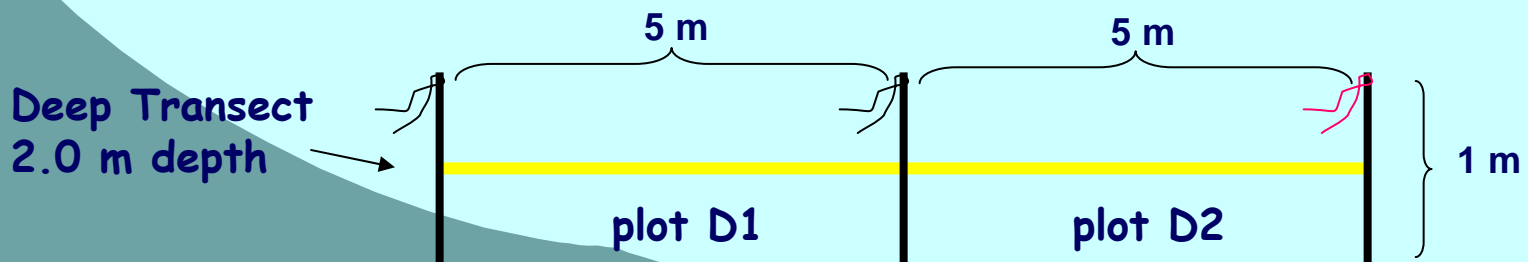




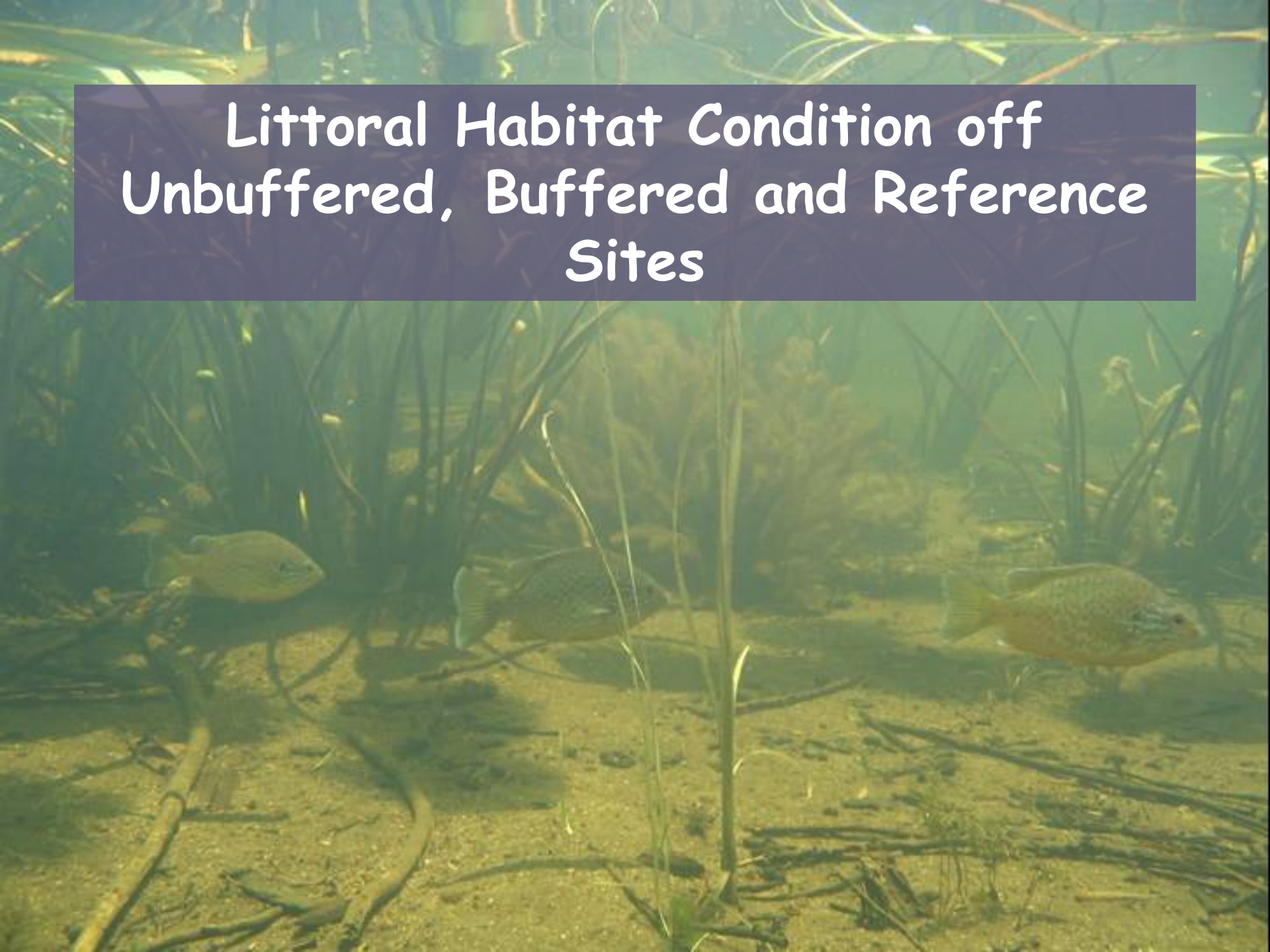
2009 Sampling went terrestrial



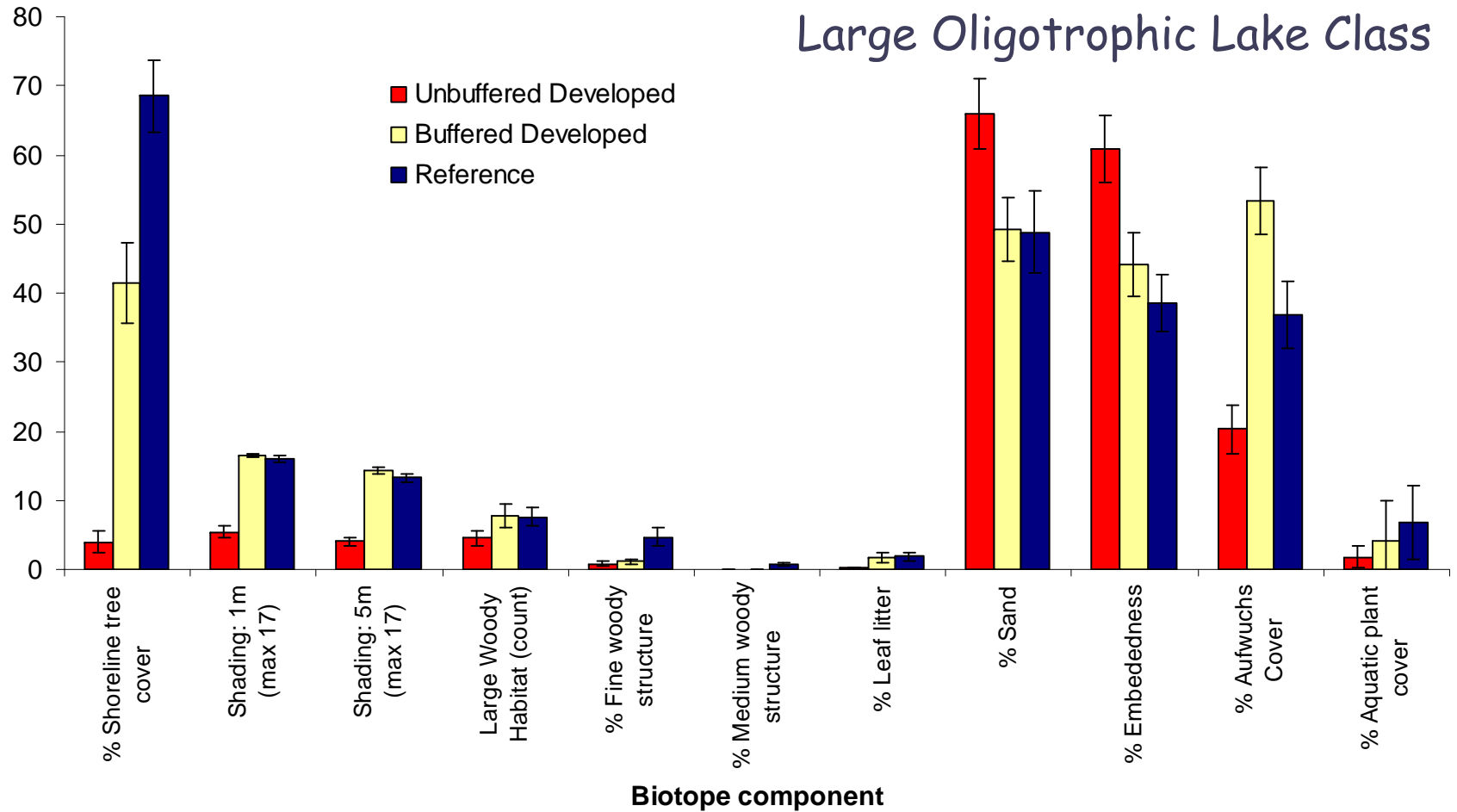
Recorded measurements in the 25'X25' riparian plot adjacent to the littoral site at reference, buffered developed and unbuffered developed sites

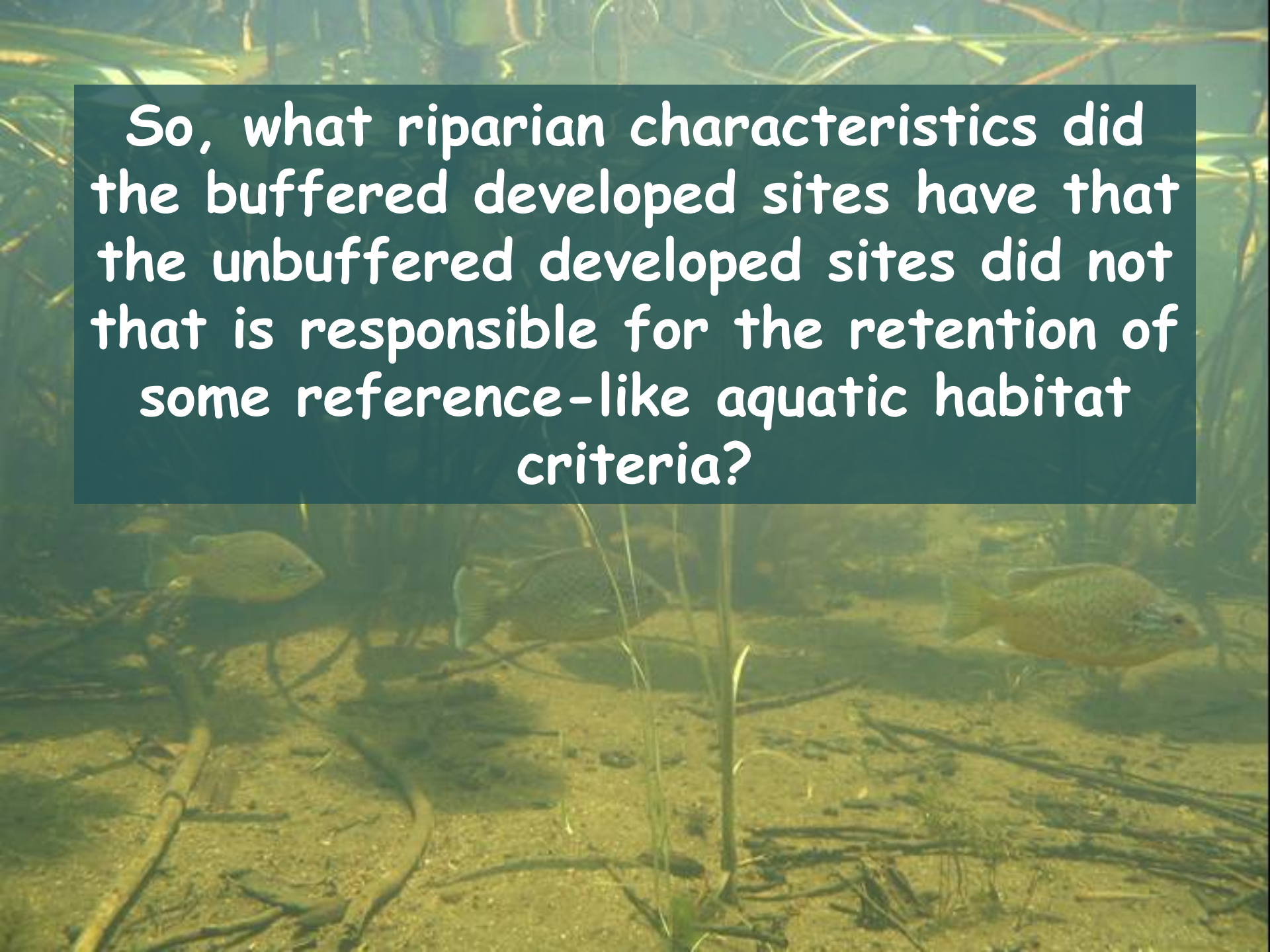


Littoral Habitat Condition off Unbuffered, Buffered and Reference Sites



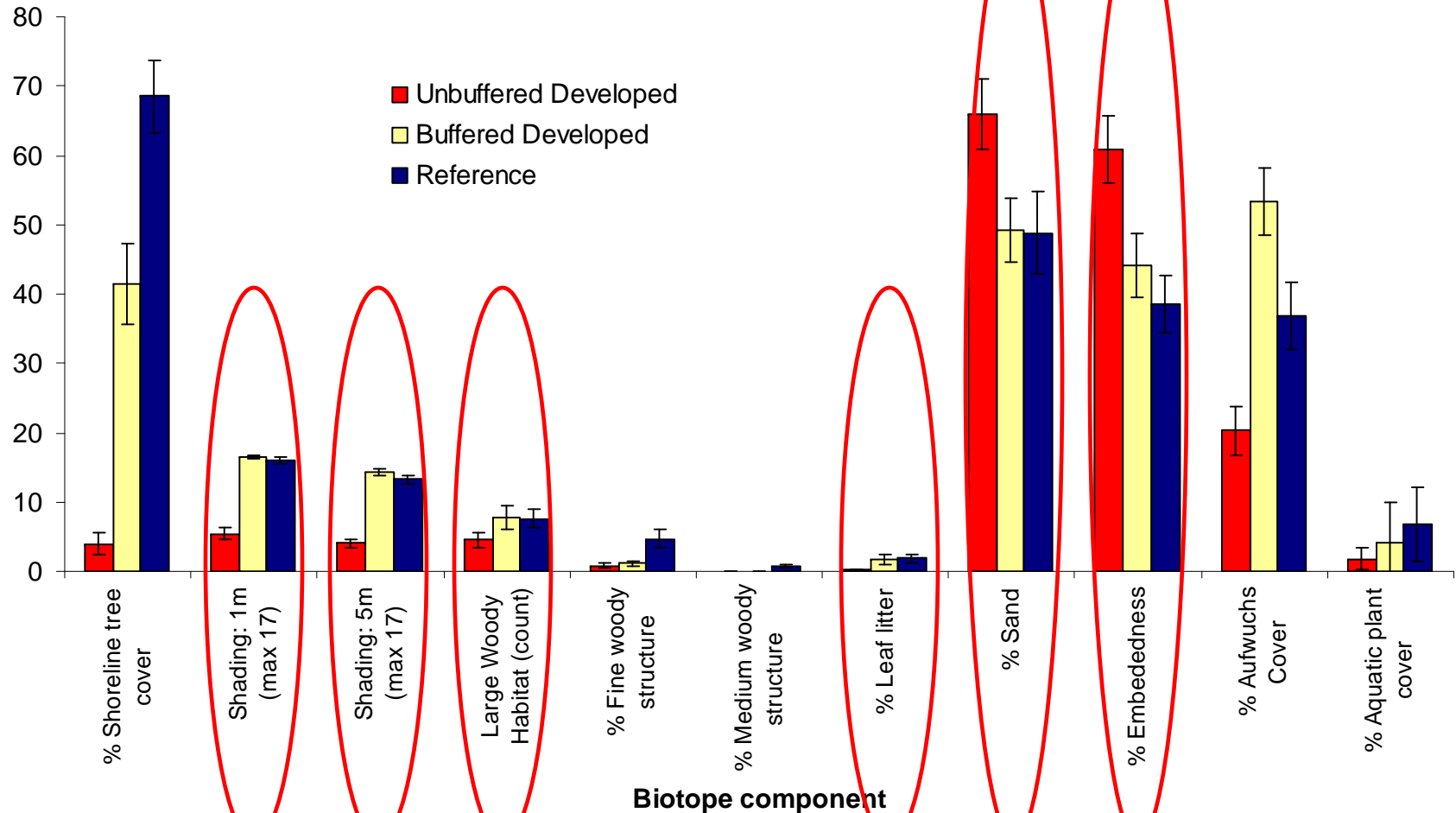
Buffered Developed Sites More Like Reference Sites



An underwater photograph showing a sandy riverbed with several small fish swimming. There are some green plants and sticks in the water. A dark teal rectangular box is overlaid on the top half of the image, containing white text.

So, what riparian characteristics did the buffered developed sites have that the unbuffered developed sites did not that is responsible for the retention of some reference-like aquatic habitat criteria?

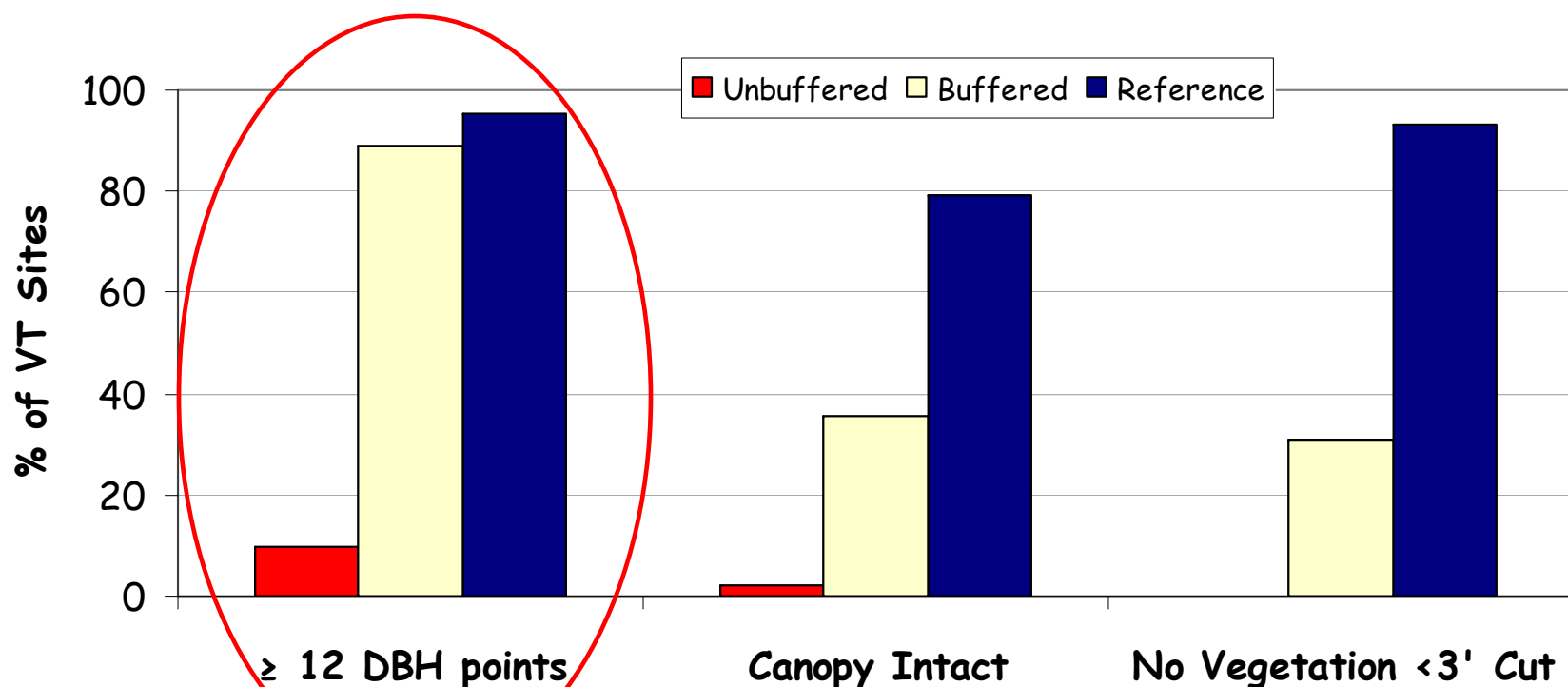
These 6 littoral habitat parameters retained their reference condition off buffered developed sites



These sites met Maine's 12 point criteria in the 25'X25' plot

Large Oligotrophic Lake Class

Percentage of VT Large Oligotrophic Lake Sites Meeting Maine's Shoreline Protection Act Standards



DBH = 2"-4" = 1 point, DBH >4"-12" = 2 points, DBH >12" = 4 points

Immediate Shoreline Vegetation Viewed from Lake During Summer



Reference



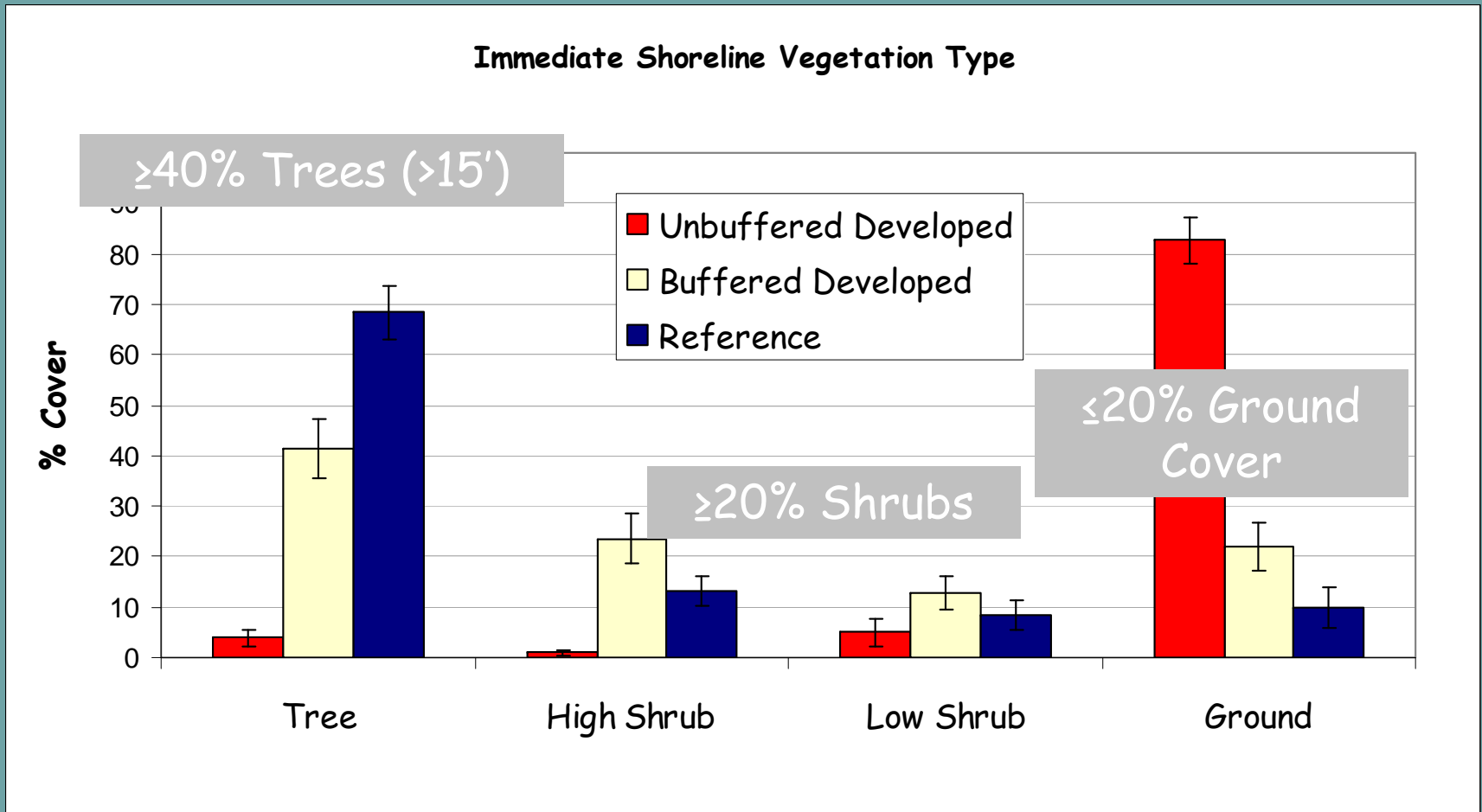
Unbuffered
Developed



'Buffered'
Developed

IMMEDIATE SHORELINE Main features were that trees ($\geq 15'$) made up at least 40% of the vegetation, shrubs made up at least 20% and ground cover made up no more than 20%

Large Oligotrophic Lake Class



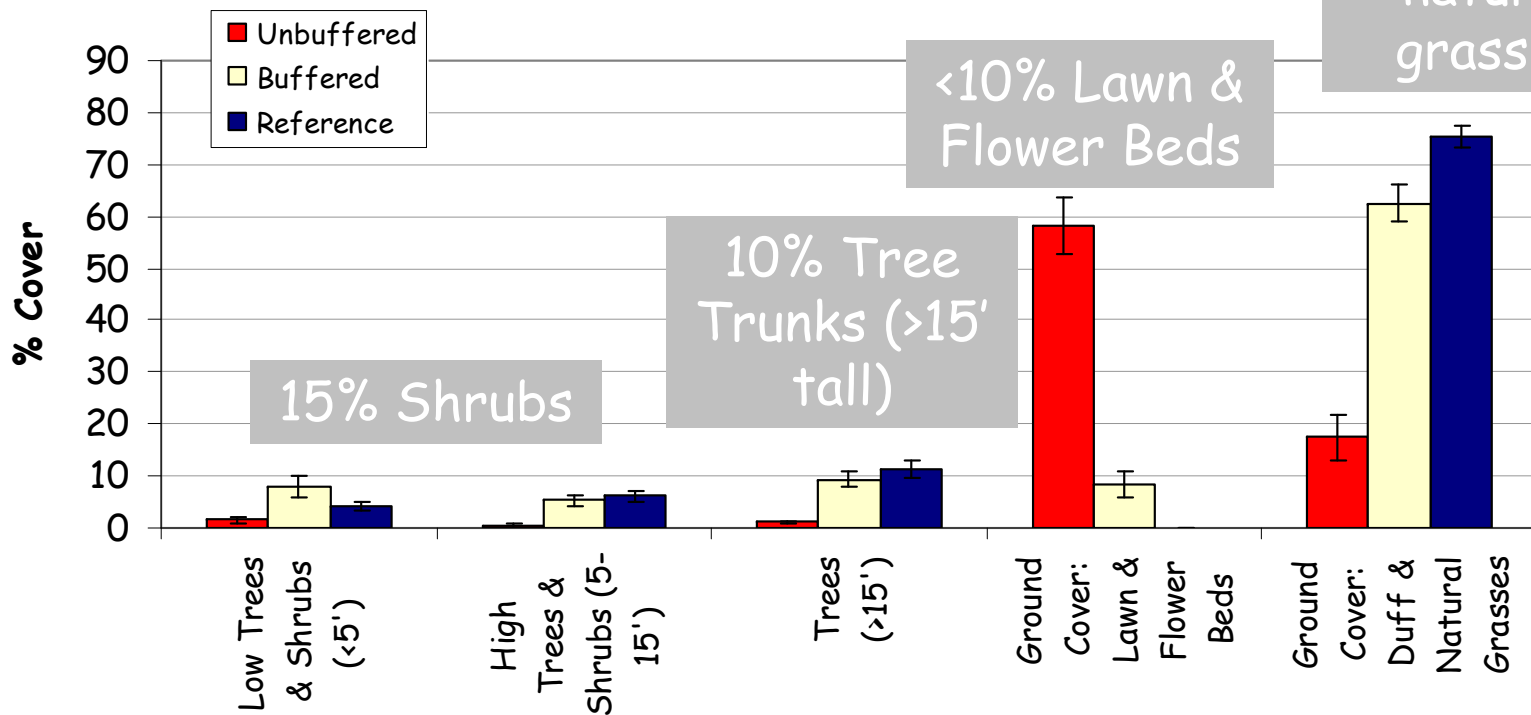
25'x25' riparian plot vegetative cover
(viewed at knee height after leaf off)



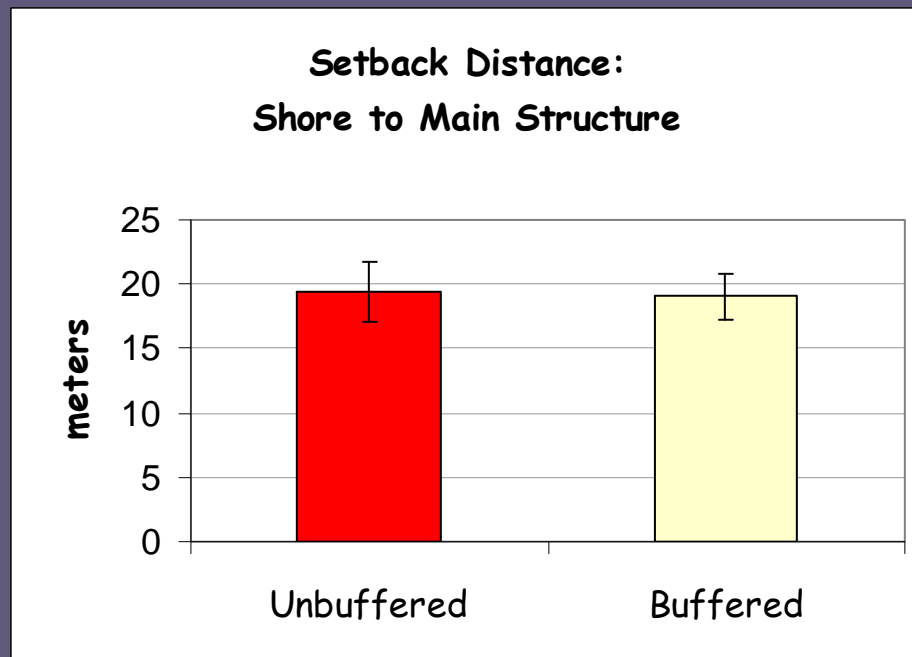
25'X25' RIPARIAN PLOT Main features were that duff and natural grasses made up 60-80%, shrubs 15%, tree trunks 10%, and lawn/flower beds less than 10%

Large Oligotrophic Lake Class

Large Oligotrophic Lakes - Nearshore Plot Vegetation



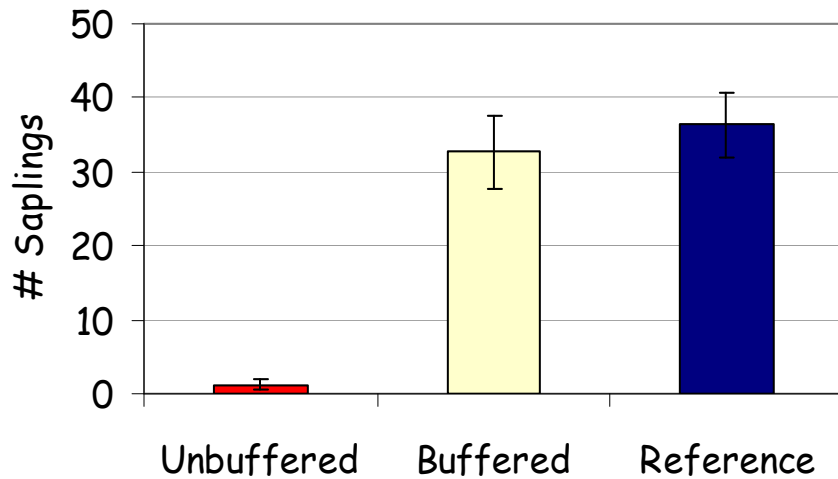
Average setback distances were the same for developed sites, whether buffered or unbuffered



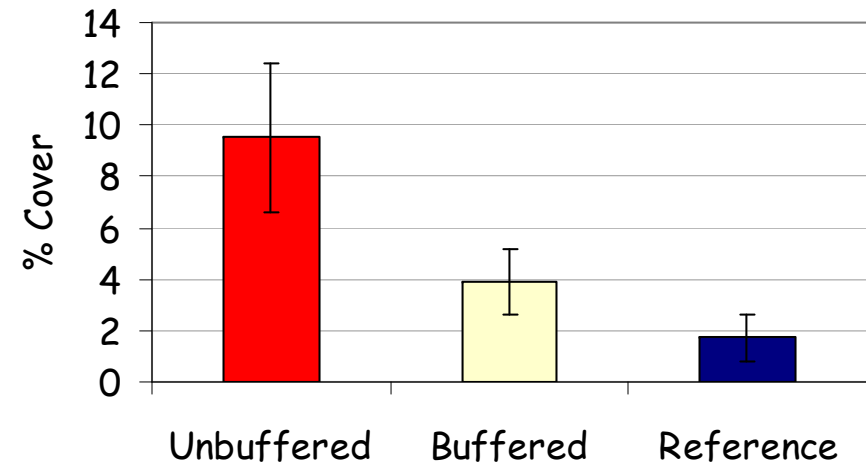
~20m (66')

Buffered Developed Sites Had More Tree Saplings and Less Impervious Surfaces Than Unbuffered Developed Sites

Nearshore Plot Tree Saplings



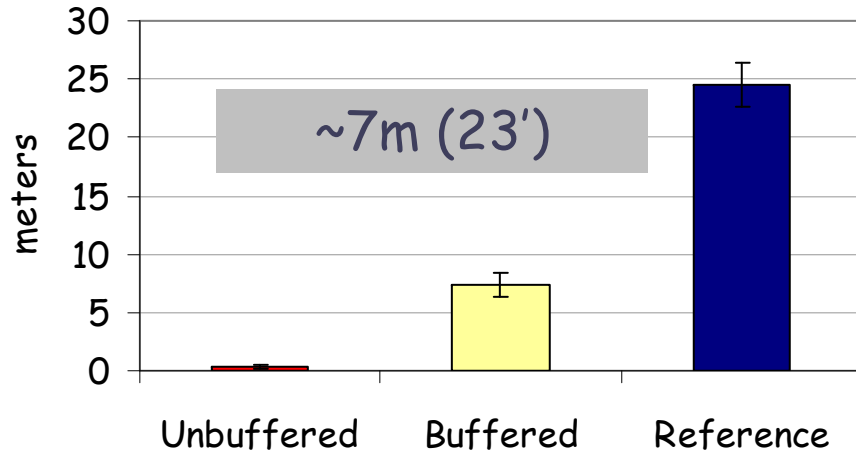
Nearshore Plot Impervious Surfaces



>30 saplings/25'x25'
riparian plot

<5% of 25'x25' riparian
plot impervious

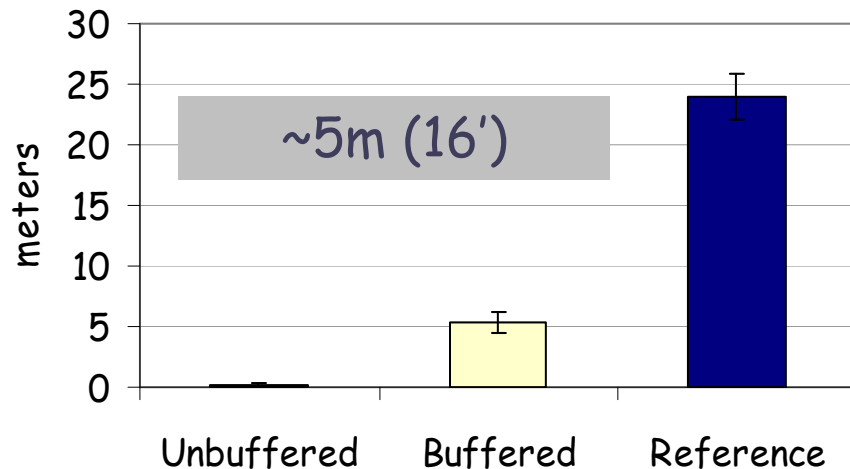
Average Width of Intact Buffer



**Maximum buffer width measured was 30.5 m (100 ft)*

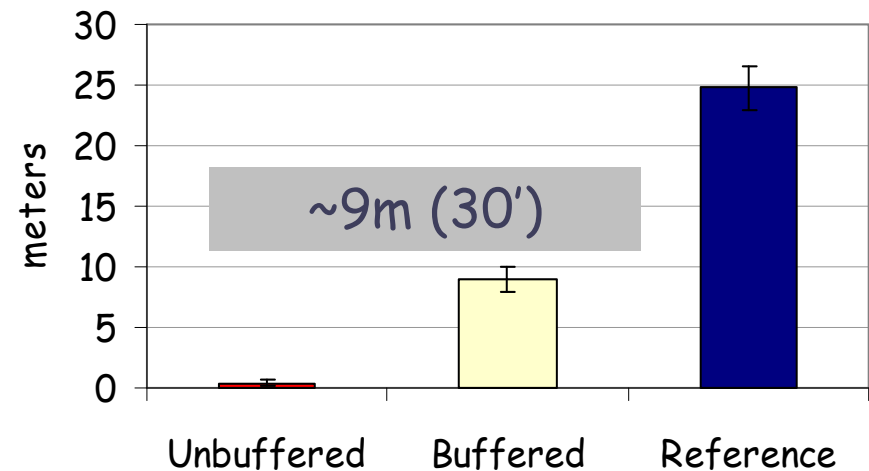
**Buffered Developed Sites
Had Wider Intact
Buffers Than Unbuffered
Developed Sites**

Narrowest Width of Intact Buffer



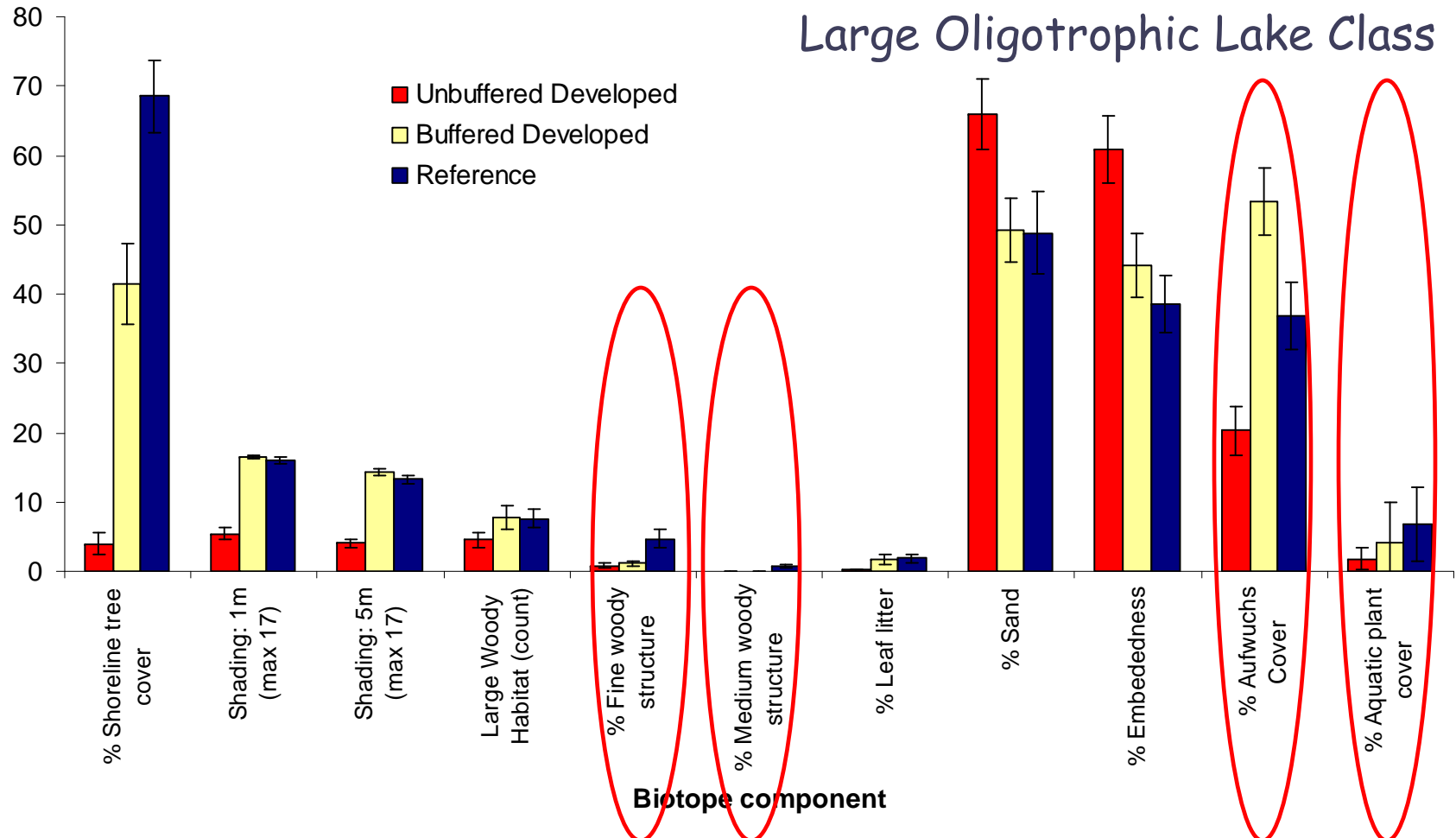
**Maximum buffer width measured was 30.5 m (100 ft)*

Widest Width of Intact Buffer



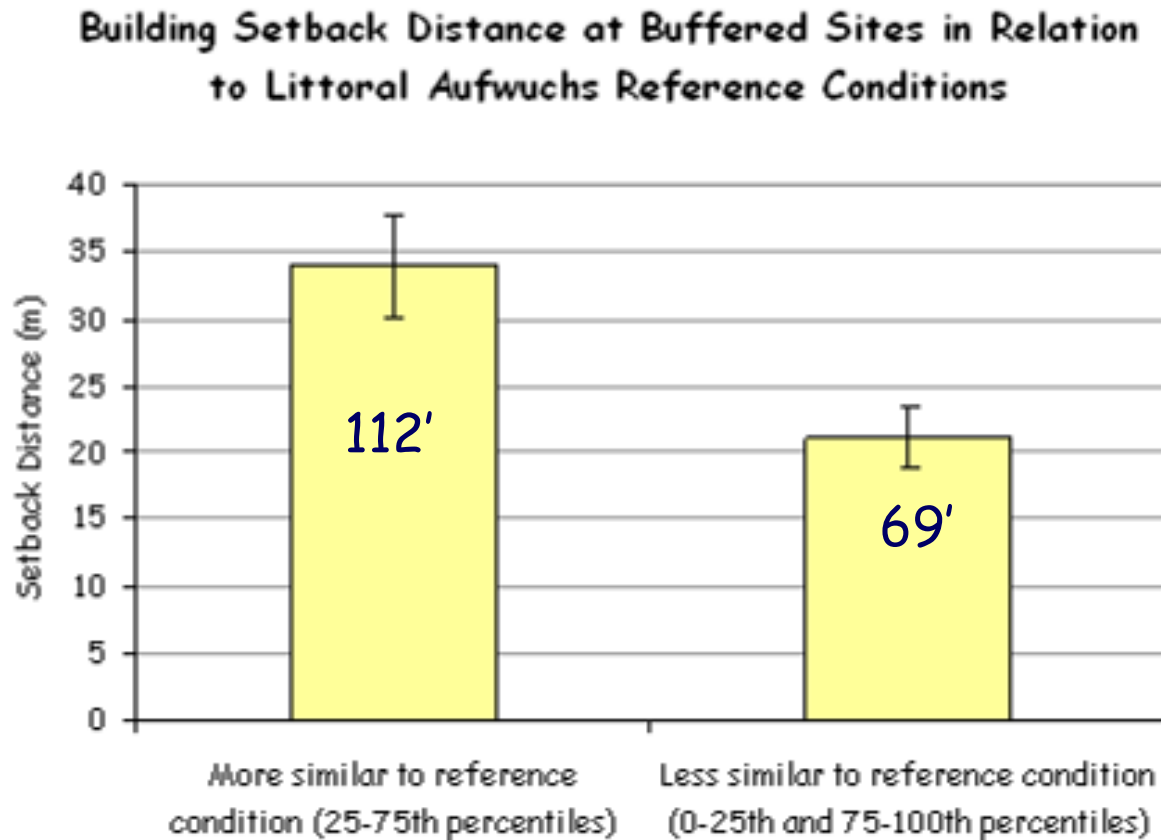
**Maximum buffer width measured was 30.5 m (100 ft)*

What about the 4 littoral habitat parameters that were still significantly different from reference when development was buffered?



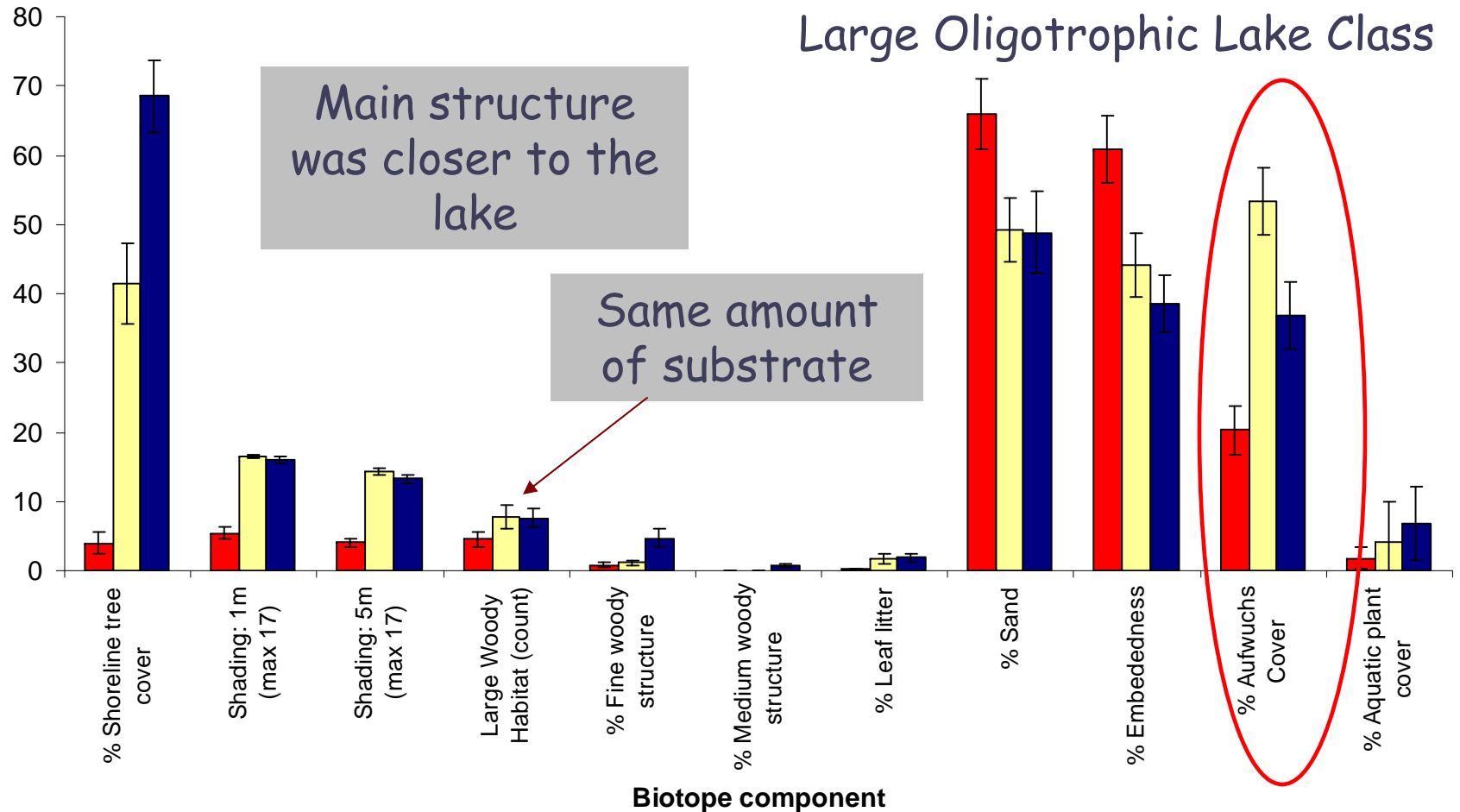
Buildings were set back further from the lake at the buffered developed sites where there was no change in aufwuchs

112'
instead of
overall
average of
66'



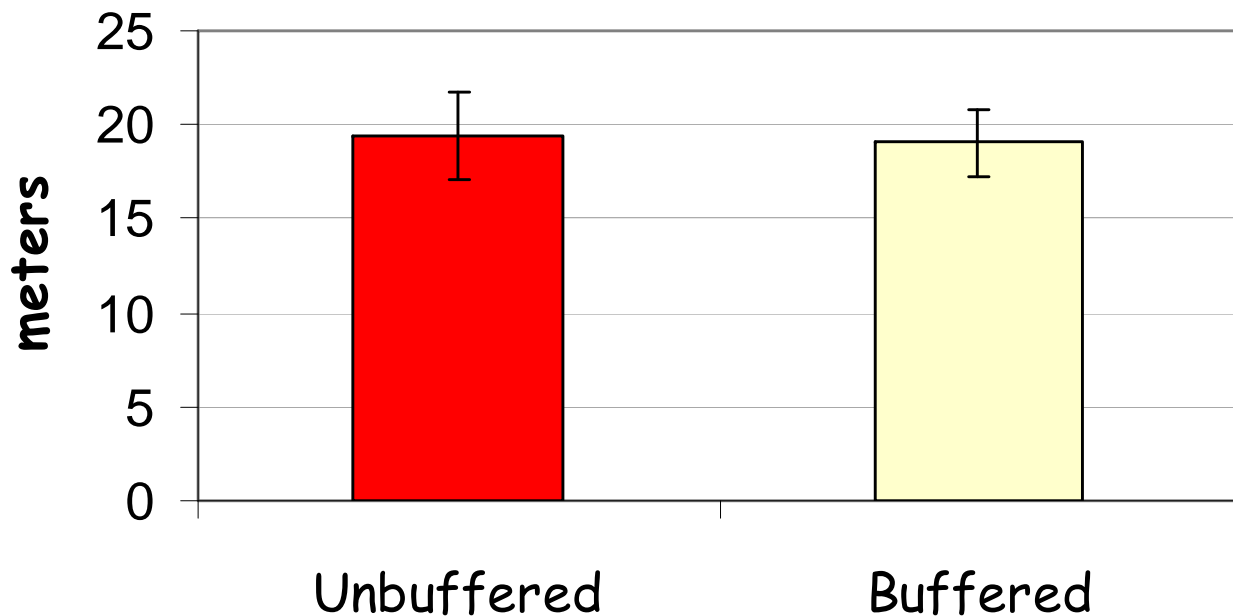
Nutrient runoff from the impervious roof area could be absorbed into the ground before entering the lake

When we had included all the buffered developed sites, we had seen significantly increased aufwuchs growth



Whereas, there was no difference in mean setback distance when all the buffered developed sites were used and we saw an overall increase in mean aufwuchs from reference

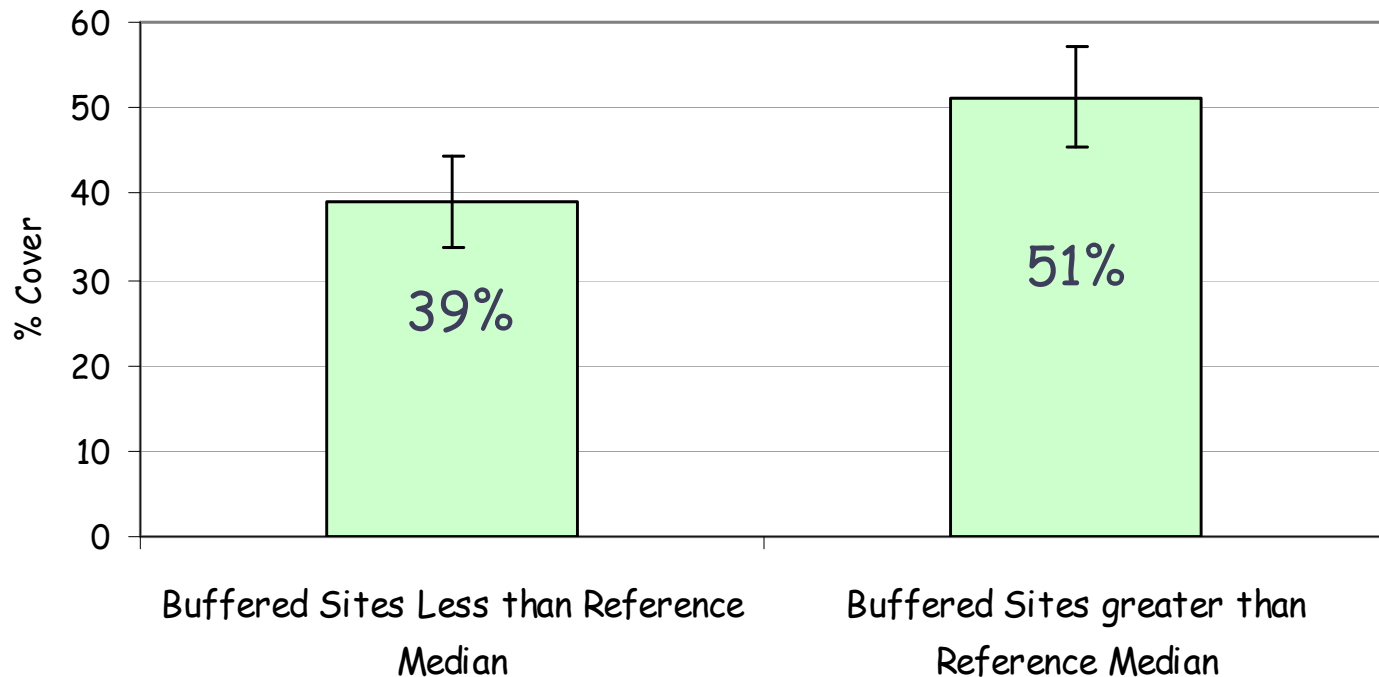
Setback Distance: Shore to Main Structure



~20m (66')

Buffered developed sites that had greater proportions of mature trees (>15') along the immediate shore, had no change in fine woody structure from reference

Shoreline Tree Cover at Buffered Sites in Relation to Fine Woody Structure Reference Condition



No change to the following littoral habitat parameters: shading, large woody structure, leaf litter, sand and embeddedness, were achieved when the lakeshore property:

- IMMEDIATE SHORELINE (*viewed from lake in summer*):
 - Trees ($\geq 15'$) made up at least 40% of the vegetation
 - Shrubs made up at least 20%
 - Ground cover made up no more than 20%
- The width of the intact buffer was
 - 9m (30') at it's widest
 - 7m (23') overall
 - 5m (16') at it's narrowest
- Main structures were set back an average of 20m (66')
- Closest structures were set back an average of 17.5 m (57')

No change to the following littoral habitat parameters:
shading, large woody structure, leaf litter, sand and
embeddedness, were achieved when the lakeshore property:
(Continued)

• 25'X25' RIPARIAN PLOT (*viewed knee height in late fall*):

- Duff and natural grasses/ferns made up 60-80%
 - Tree trunks 10%
 - Shrubs 15%
 - Lawn/flower beds less than 10%
- >30 saplings (<2' diam) in 25'X25' riparian plot
- <5% of the 25'X25' riparian plot was impervious
- Maintained the minimum of 12 DBH points allowed by Maine's shoreland protection act

No change to aufwuchs was achieved when the lakeshore property met the additional criteria of:

- Main structures were set back an additional 14m back (34m or 112')



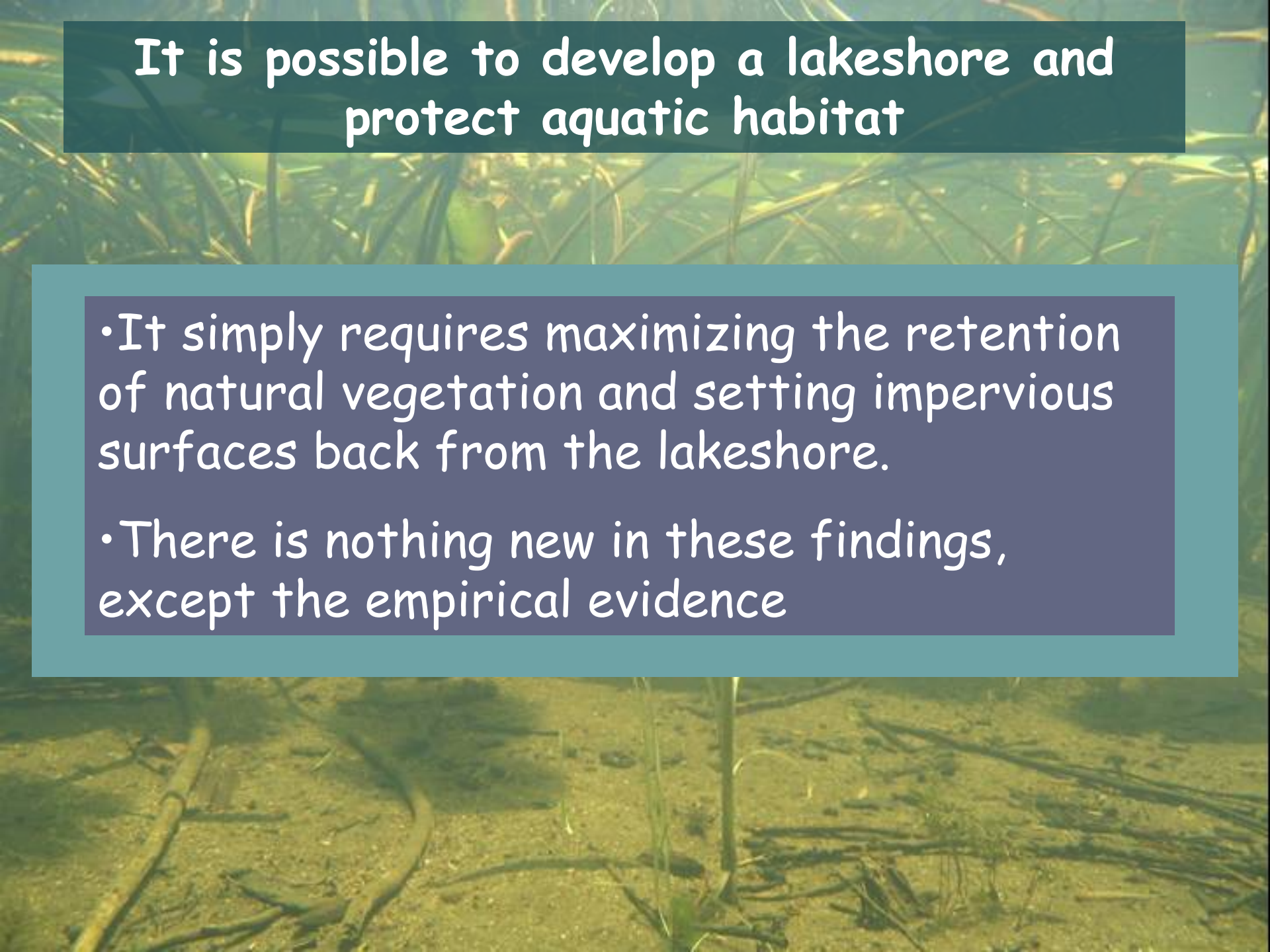
No change to fine woody structure was achieved when the lakeshore property met the additional criteria of:

- Trees (>15') made up an additional 10% more of the immediate shoreline (for a total of 50%)



We were unable to determine how to achieve no change to medium (4-10cm diam) woody structure and aquatic plants

- Medium woody structure, likely a function of:
 - Immediate shoreline tree cover (ref =70%, buffered developed =40%)
 - Even at reference there was very small amounts of this size class of wood in the littoral zone
- Aquatic plant cover at buffered sites had competing and opposite influences:
 - Increased nutrients vs reference, would increase plant cover
 - Increased removal vs reference, would decrease plant cover

An underwater photograph of a lakebed. The water is clear, showing a sandy bottom with several long, thin sticks and pieces of wood scattered across it. Some green, leafy plants are growing from the bottom. The lighting is natural, coming from above, creating a slightly hazy atmosphere.

It is possible to develop a lakeshore and protect aquatic habitat

- It simply requires maximizing the retention of natural vegetation and setting impervious surfaces back from the lakeshore.
- There is nothing new in these findings, except the empirical evidence

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