EVALUATION OF SEAGRASS AS A WAVE ENERGY DISSIPATION ELEMENT

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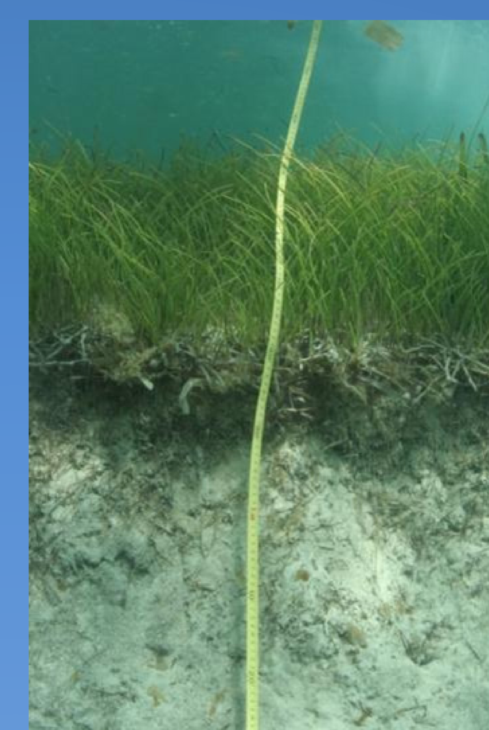
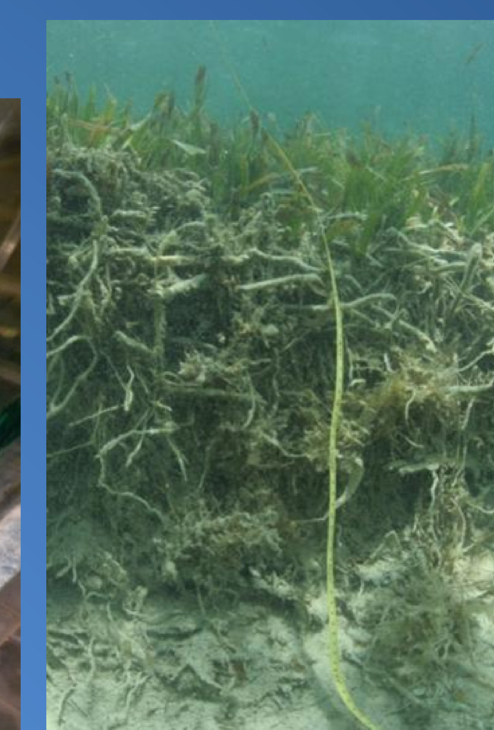
Edgar Mendoza, emendozab@ii.unam.mx
Jose Hoil, jhoilb@ii.unam.mx
Rodolfo Silva, rsilvac@ii.unam.mx
Cecilia Enriquez, cenriquezo@ii.unam.mx

In shallow water, particularly near the coast, the hydrodynamics are influenced by bottom friction which, increases with depth reduction and the complexity of the sea floor, mostly in the presence of vegetation. Although little is still known about the seagrass capability to reduce wave energy, it is known to increase the sediment stability in anthropogenically disturbed areas (Fonseca and Cahalan, 1992); hence the interest of evaluating their efficiency as a means for coastal protection.

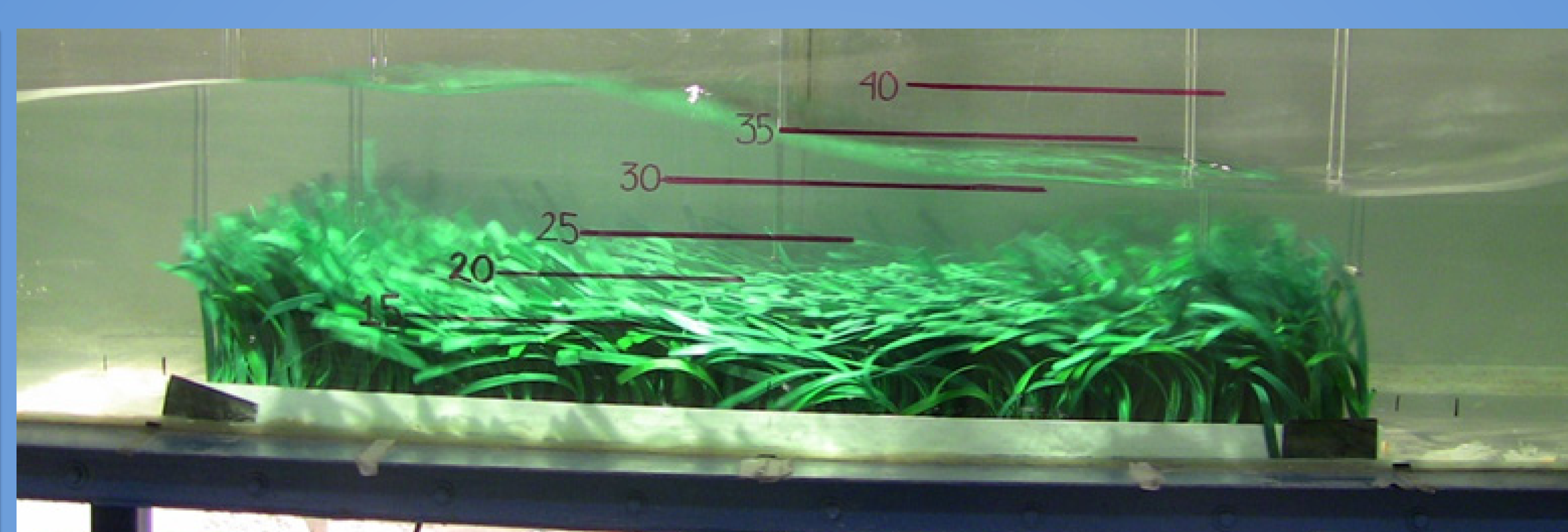




The work described in this poster aims to determine the performance of a patch of seagrass in terms of the energy loss of the waves travelling through it; to do so several wave conditions, water depths and different vegetation densities were tested in laboratory experiments using a synthetic hand-made seagrass patch.

A small scale model of synthetic seagrass was designed to represent the physical characteristics of *Thalassia testudinum* leaves; groups of four leaves were stuck together and fixed at the bottom allowing only the upper part to move freely with waves.

The wave flume at the National University of Mexico was prepared for experiments with a 128 cm long submerged seagrass patch, the leaf length was 25 cm and densities of 500, 800 and 1500 leaves per square meter were tested.



The wave conditions inside the flume were measured by 9 wave gauges. Incident, reflected and transmitted waves were the main values of interest. In addition, two Vectrinos were settled to get a view of the velocities prior to and after the seagrass.

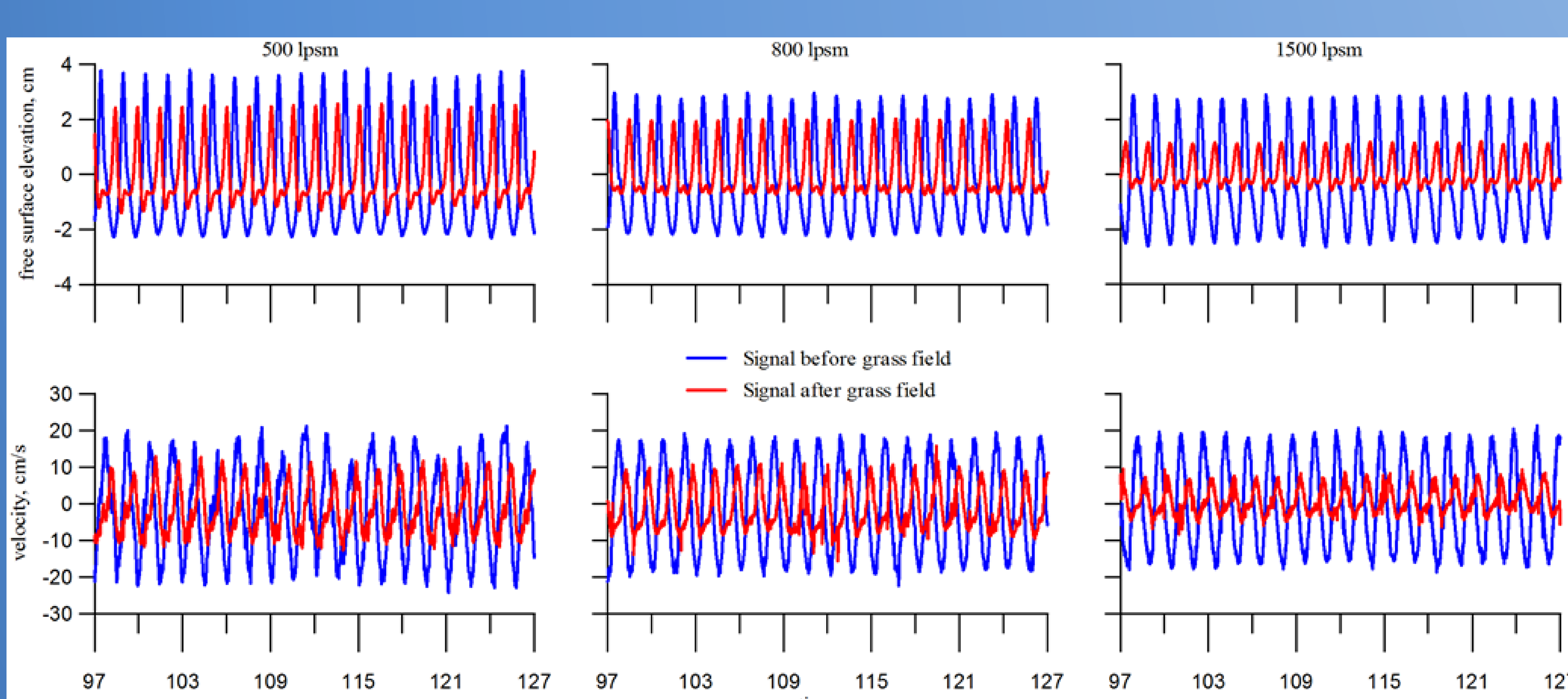


Figure 1 Comparison between transmitted and incident free surface signals (top) and velocities measured before and after the seagrass model (bottom).

In general, the waves transmitted through the seagrass are considerably smaller than the incident waves (see the top panel of Figure 1) which, in turn, shows potential energy loss. The velocity measurements reveal also kinetic energy loss; as shown in the bottom panel of Figure 1 where the registered velocities after the seagrass are, mostly, lower than the ones recorded before the grass field.

The incident waves are plotted versus transmitted ones in Figure 2.

The wave steepening increases in some tests.

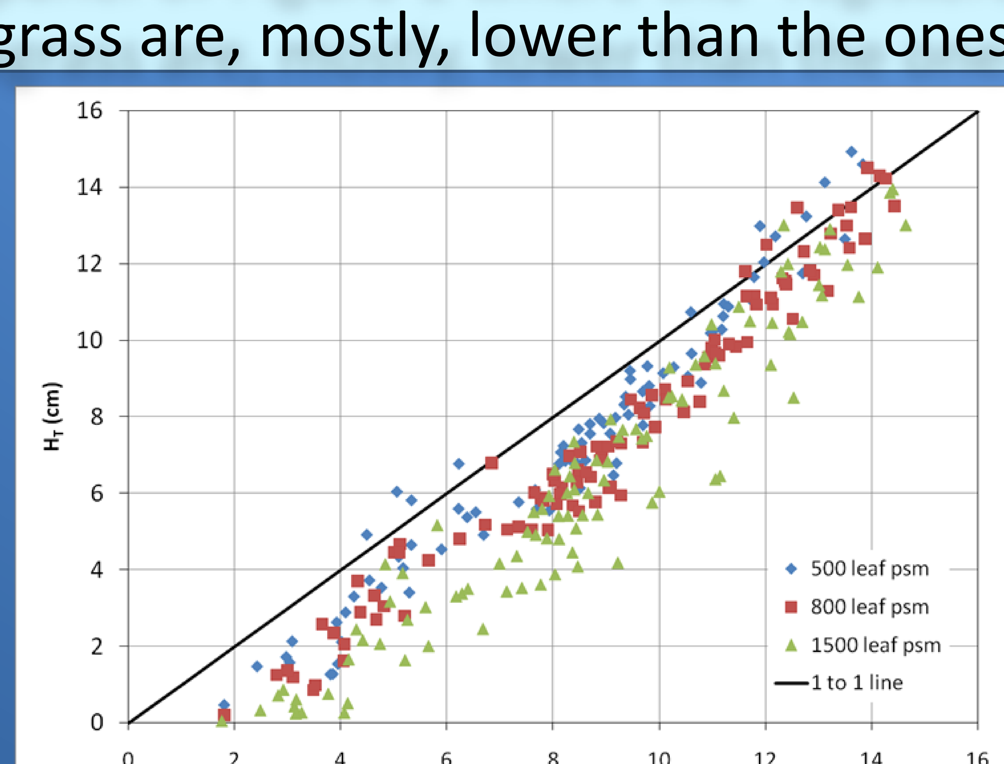


Figure 2 Comparison of incident and transmitted waves

The combination of energy losses show the total energy dissipated by the seagrass. The potential energy, *PE*, was computed by assuming linear theory

$$PE = \frac{1}{16}\rho g H^2$$

while for the kinetic energy estimation, *KE*, a transfer function, *TF*, from linear theory to measured values was used.

$$KE = \frac{1}{16}\rho g H^2\, TF \qquad TF = \frac{u_m^2 + w_m^2}{u_{LT}^2 + w_{LT}^2}$$

subscripts *m* and *LT* denote measured and linear theory, respectively. The total energy, *TE*, is found adding *PE* and *KE*.

$$TE = PE + KE$$

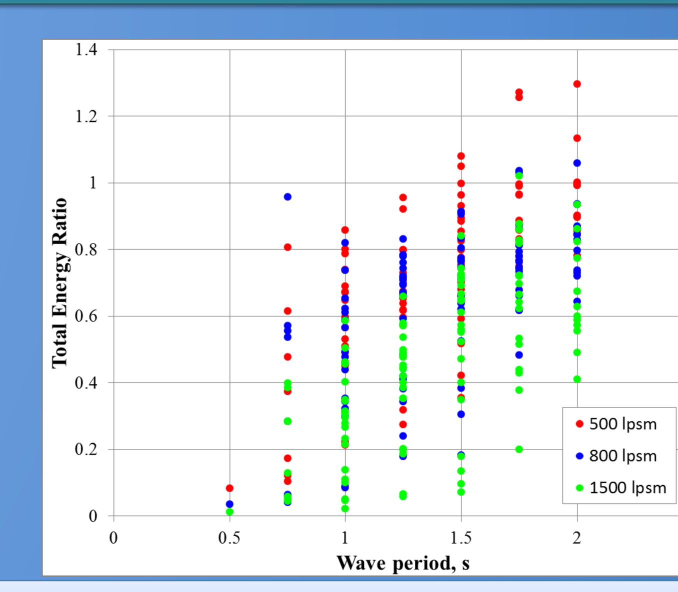


Figure 3 Total energy ratio versus wave period.

The total energy ratio, *TER*

$$TER = \frac{TE_a}{TE_b}$$

(a and b stand for after and before the seagrass), that gives the energy dissipation efficiency of the seagrass patch has been plotted against the wave period (Figure 3). It is clear that for the great majority of the tests, the total energy is reduced.

In terms of design, a simple model has been derived from best fit analysis to compute the *TER* as a function of the relative length of the leaves, *l/h* (see Figure 4).

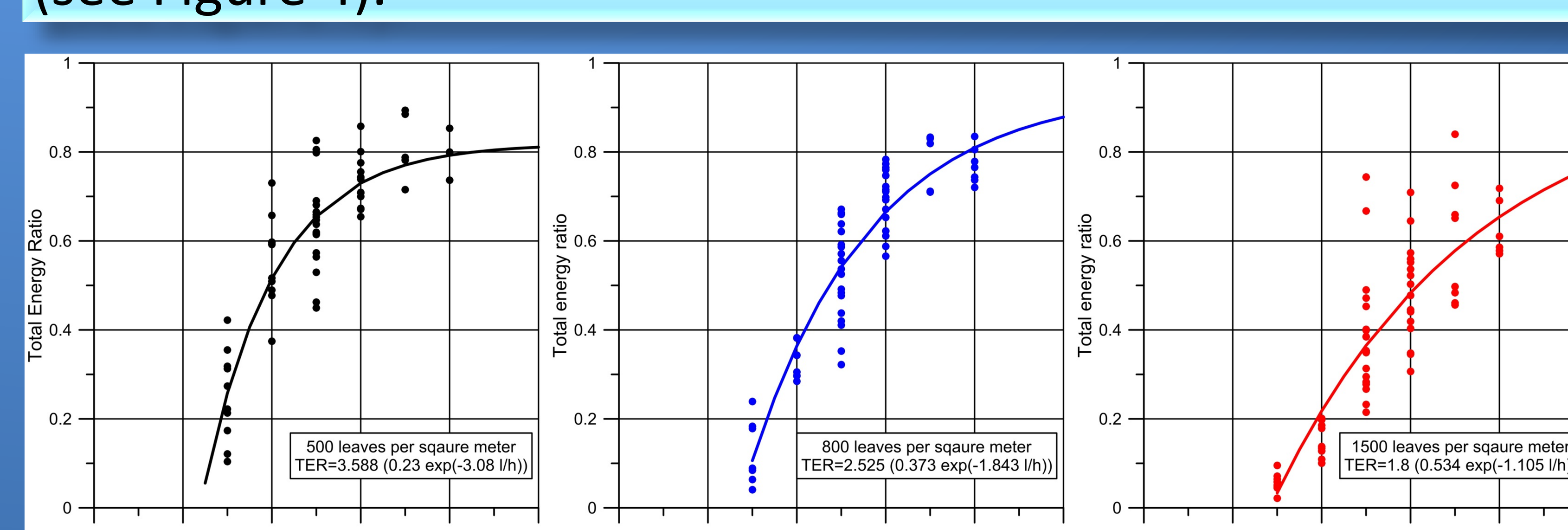


Figure 4 Best fit models for TER estimation

REFERENCE
Fonseca and Cahalan. (1992). A preliminary evaluation of wave attenuation for tour species of seagrass. Estuarine Coastal Shelf Sci. 35:565-576.

Circuito Escolar, Edificio 5, Cub. 408
Ciudad Universitaria, Coyoacán
04510, México, DF, México

www.ii.unam.mx

INSTITUTO DE INGENIERÍA UNAM