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Short communication

Sexual reproduction in SE Asian seagrasses: the absence of a seed bank in *Thalassia hemprichii*

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Abstract

We report the absence of a persistent seed bank in *Thalassia hemprichii* in NW Philippine seagrass beds. The survival of buried seeds was assessed experimentally since such a capacity is a prerequisite for the formation of seed bank. We found a rapid germination of non-dormant seeds and development into seedlings. Such seedlings could not survive under buried conditions (5 and 10 cm) for longer than a week.

Keywords: Thalassia hemprichii; Seed burial; Germination; Seedling survival; The Philippines

1. Introduction

Thalassia hemprichii (Ehrenb.) Aschers. is among the most widely-distributed seagrass species in the SE Asian region, dominating in many mixed meadows (Den Hartog, 1970; Brouns, 1987; Nienhuis et al., 1989; Vermaat et al., 1995). Based on reconstruction of past flowering events, Duarte et al. (1997) estimated that flowering must be uncommon in this species and that meadows are probably largely maintained by vegetative propagation. However, *T. hemprichii* has been found to locally produce substantial quantities of fruits

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(Brouns, 1985; Rollon et al., unpublished), that have a potentially important role in the formation of persistent seed banks and (re-)colonization of unvegetated areas (Orth et al., 2000).

For some seagrass species seed banks play a major role in the persistence of the population over the years (e.g. annual *Zostera marina*, Hootsmans et al., 1987; *Zostera japonica*, Harrison, 1982; *Cymodocea nodosa*, Terrados, 1993). For *T. hemprichii*, and most other SE Asian seagrass species, however, the occurrence and longevity of seed banks is practically unknown.

In this paper, we demonstrate the absence of any persistent seed bank for *T. hemprichii* in the seagrass beds of Bolinao (NW Philippines). Furthermore, we experimentally assessed the survival of buried seeds since such a capacity is a prerequisite for the formation of any persistent seed bank.

2. Materials and methods

2.1. Seed bank

From each of the two shallow (∼0.5 m datum depth) mixed-seagrass meadows in Bolinao, NW Philippines: a clear-water Silaqui (16°26′18″N, 119°54′38″E; $K_d < 0.3\,m^{-1}$) and a turbid Carot (16°20′59″N, 119°59′7″E; $0.3 < K_d < 1\,m^{-1}$), 36 cores (diameter = 20 cm; core depth ca. 20 cm) were collected within ca. 320 m^2 of mixed-seagrass area. In the laboratory, the seagrass-sediment cores were sieved (mesh size = 1 mm) retrieving conical 8 mm (Den Hartog, 1970) *T. hemprichii* seeds if present. Presence of seeds was carefully checked (frequently using a stereoscope) among the rubble and organic debris after sieving. This exercise was done on three successive occasions: July 1999 (no fruits were observed); November 1999 (fruiting was high; cf. Rollon et al., unpublished) and; January 2000 (fruits were present in lower numbers).

2.2. Seed burial

In January 2000, when *T. hemprichii* fruits were available near Lucero (16°25′02″N, 119°54′29″E) at the northern shores of Santiago Island, a large number of fruits were collected from a small, monospecific patch of *T. hemprichii*, at a site with conditions similar to Silaqui.

In the laboratory, the fruits were allowed to open naturally, which occurred within 2 days for 50% of the fruits. Then, all the available seeds ($n \sim 2000$) were pooled and thoroughly mixed. The seeds were experimentally buried at 0, 5 and 10 cm levels in PVC tubes (total $n = 42$; diameter = 10 cm; height = 15 cm; closed at one end; 30 seeds in a tube) using 2 replicate tubes for each combination of sampling day and burial depth. The tubes plus the seeds were secured at a deeper (ca 2.5 m datum depth) portion of the clear-water site Silaqui. Six tubes (two for each burial level) were retrieved every second day for 2 weeks. For each harvest, the number of certainly dead (soft, rotten) seeds were counted. In the laboratory, 10 seeds (or now seedlings) were subsequently picked randomly to measure seed and/or seedling dimensions.

3. Results

In a total of 216 seagrass-sediment cores for all samplings in both sites, only 2 established (rooted and healthy) *Thalassia* seedlings were found. However, in all cases, no buried *T. hemprichii* seeds were found. Among the complex assemblage of organic debris, seed fragments could have been present but not a single and probably viable seed could (still) be recognized. This strongly suggests the absence of local seed bank in *T. hemprichii*.

After 6 days of burial, the buried seeds or seedlings (those which were able to germinate even in buried conditions) in both 5 and 10 cm burial level had died (became soft, rotten

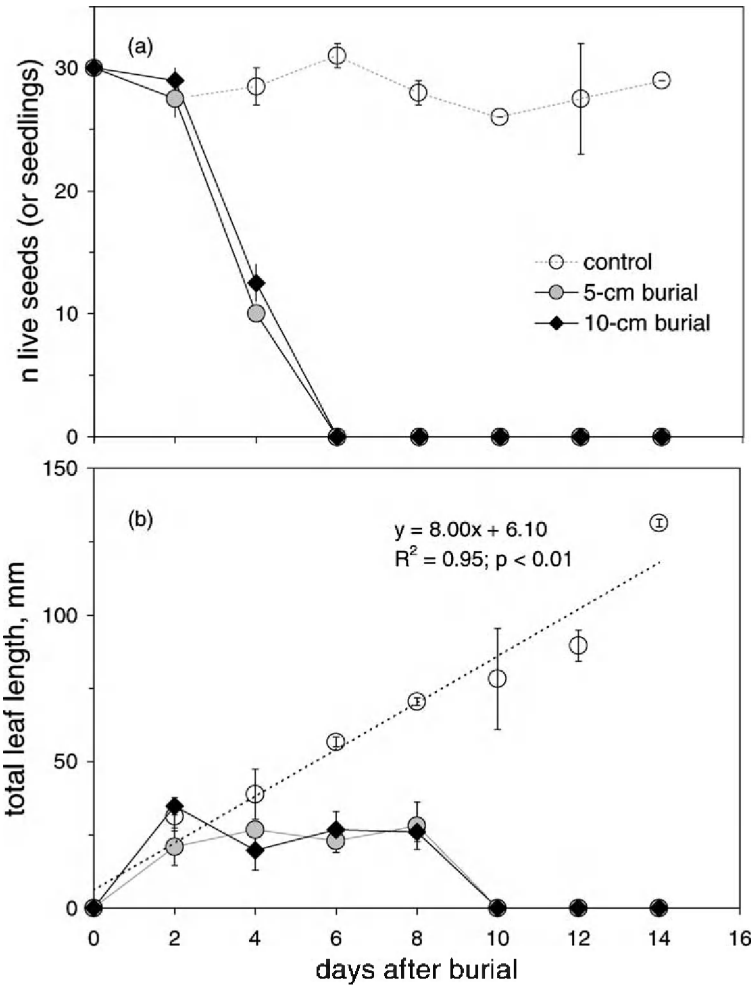

Fig. 1. (a) The number of viable seeds (or healthy, surviving seedlings) planted at different sediment depths (0, 5 and 10 cm) and recovered after successive periods of 2 days. Day 0 was on 17 January 2000. Values are mean ± S.E. from two replicate PVCs; (b) total leaf lengths (mean ± S.E.) of the germinated seeds (or seedlings).

and disintegrating), in strong contrast with control having a survival rate close to 100% (Fig. 1a). Thus, the seeds of *T. hemprichii* most probably do not survive a week of buried condition. Most (>75%) unburied seeds in the control tubes had germinated in the first 2 days and had commenced leaf elongation.

Those buried seeds that somehow had been able to produce leaves within the first 2 days (Fig. 1b) had ceased to grow since then. This was in strong contrast with the unburied seedlings, that had increased their total leaf lengths at an approximate rate of 8 mm per day (Fig. 1b).

4. Discussion

Although we have been able to collect considerable numbers of fruits at one specific site off Lucero, we have not found any buried seed in the two sampling sites that might be taken as evidence for the presence of a longer lived seed bank. Rather, we only found very few seedlings, which is conforming with our observations elsewhere in the Bolinao mixed seagrass beds (Rollon et al., 1999; Rollon et al., unpublished data). Therefore, we conclude that a persistent seed bank is absent, at least locally, for *T. hemprichii* in Bolinao. We cannot exclude the possibility that some viable seeds may have been transported beyond existing beds and met conditions favorable for longer time survival, but this seems quite unlikely (cf. Rollon et al., 1999; see also below).

The absence of a persistent seed bank can be caused (a) by a rapid transition from non-dormant seeds to seedlings, (b) by the inability of seedlings to survive buried in the sediment, possibly due to high respiratory oxygen requirements, or (c) by high seed and seedling mortality due to other causes (e.g. seed predation). Our experimental evidence suggests that the seeds indeed are not dormant (vis-a-vis Inglis, 2000; Orth et al., 2000), since germination occurred within days of release from the fruits. Also the high mortality of the buried seeds suggests that these seeds are not well suited to form a persistent seed bank. Since we selected seeds from fruits that had opened up and matured within 2 days, our selection for maturity may have caused a bias for early germination. The possibility that late germinating seeds are better adapted for buried survival cannot be excluded. In our view, however, this is unlikely because such seeds remain in positively buoyant, closed fruits until maturity and will not be buried yet. For seed predation we only have anecdotic observations of alpheid shrimps carrying seeds into their burrows (Nacorda, unpublished) and brittle stars manipulating seeds on the sediment in dispersal experiments (Lacap et al., 2002). Therefore, a balance of the fate of a cohort of seeds produced in a particular site cannot be made as yet.

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