The following supplement accompanies the article

Increased larval planktonic duration and post-recruitment competition influence survival and growth of the bryozoan *Watersipora subtorquata*

Michael A. Sams*, Fletcher Warren-Myers, Michael J. Keough

*Corresponding author: m.sams@uq.edu.au

Marine Ecology Progress Series 531: 179–191 (2015)

Supplement 1

INTRODUCTION

Presented here are the supplementary methods and results of our experiment comparing the growth and survival of *W. subtorquata* colonies when they settle adjacently to conspecific settlers that developed from larvae of different planktonic durations. We did not find evidence of competition or interactions between individuals (below), so we only presented the effects of larval planktonic duration without comparison of adjacent pairs from different larval planktonic duration in the main paper. These comparisons are detailed below.

METHODS

Experiment 2: Colony performance adjacent to conspecific recruits

To examine the effects of larval planktonic duration on the performance of colonies when they recruit alongside conspecific recruits, we placed *Watersipora subtorquata* settlers of different larval planktonic durations onto plates so that they were arranged in adjacent pairs. Paired settlers were placed within 1 cm of one another, so that they would be likely to encounter their neighbour as they grew larger, and potentially compete for space. In conspecific colony experiments the number of larval planktonic duration comparisons we could do was limited by the number of larvae we obtained from spawning colonies. Rather than using all possible paired larval planktonic duration combinations, we only used a sub-set of them, which we considered to be the most informative comparisons. Adjacent colony pairs consisted of:

- Short natural larval planktonic duration (SN) vs. long natural larval planktonic duration (LN)
- Long natural larval planktonic duration (LN) vs. delayed larval planktonic duration (D)

These treatments allowed us to compare how both longer larval planktonic durations and delayed settlement influenced colony survival and growth. We then also compared the performance of colonies that developed from larvae of natural long (LN) larval planktonic duration but were adjacent to colonies of different larval planktonic duration (i.e. SN or D), to determine if their size and survival was differently affected by neighbouring colonies that developed from larvae of different planktonic duration. Each plate had a pair of adjacent colonies of either SN vs. LN or LN vs. D treatments located on the top and bottom half of the plate and separated by approximately 6 cm. Each treatment pair was randomly allocated to either the top or bottom of a plate. We ran two separate conspecific neighbour experiments,

the first from early June until mid-September (Experiment 1A), and the second from mid-September to December (Experiment 1B), 2011, using identical methods. In experiment 1A there were 22 SN vs LN pairs and 20 LN vs D pairs spread across 22 plates and five panels. In experiment 1B there were 24 SN vs LN pairs and 17 LN vs D pairs spread across 21 plates and five panels.

Experiment 2 survival and colony size analysis

We compared the survival of adjacent *W. subtorquata* colonies from different larval larval planktonic duration treatments within each adjacent pair treatment (e.g. SN v LN or LN vs D) as well as between colonies of natural long (LN) larval planktonic duration treatments that were adjacent to colonies of different larval planktonic duration treatments (i.e. SN or D), in separate survival analysis using the log-rank test and Kaplan Meier survival curves (see main paper for details).

We compared the size of colonies in the same way as survival in separate linear mixed effects models. However, we limited comparisons of size to those colony pairs in which both colonies survived at least up to seven weeks and, therefore, may have exerted effects on one another as many colonies had died after 7 weeks. In each comparison our linear mixed effects model consisted of three factors, larval planktonic duration (fixed with two levels: either SN vs LN, LN vs D or LN(SN) vs and LN(D) depending on which treatment pair was compared) and weeks (fixed with three levels: three, five and 7 weeks) and colony (random and nested within larval planktonic duration, with either 22 (SN vs LN), 20 levels (LN vs D) and 20 levels (LN(SN) vs LN(D)) in experiment 1A and 30 (SN vs LN), 14 levels(LN vs D) and 22 (LN(SN) vs LN(D)) level in experiment 1B, depending on the comparison). We analysed the two runs of the *W. subtorquata* neighbour experiment separately, as patterns of colony growth and environmental conditions between the experiments were very different.

RESULTS

Experiment 2A

SN vs LN

In Experiment 1A, adjacent *W. subtorquata* colonies that developed from larvae different natural planktonic durations survived equally well ($df = 1$, $\chi^2 = 0.2$, $p = 0.642$). Most colony mortality occurred in the first 8 weeks and 68.5 % of colonies survived beyond the end of experiments at 13 weeks (Fig. S1-1a). Growth profiles of *W. subtorquata* colonies also did vary with natural larval planktonic durations (effect of larval planktonic duration and time on colony size: $F_{2,40} = 1.061$, $p = 0.356$). At seven weeks adjacent colonies from natural short and long larval planktonic duration had mean size of 1.18 ± 0.17 mm^2 (Fig. S1-2a).

LN vs D

Similarly, survival of adjacent colonies from natural (LN) and delayed (D) long larval planktonic durations also did not differ ($df = 1$, $\chi^2 = 0.3$, $p = 0.597$), with most colony mortality occurring before seven weeks and 65 % of colonies surviving beyond the end of experiments at 13 weeks (Fig. S1-1b). Colony growth also did not differ between adjacent *W. subtorquata* colonies from both long natural and delayed larval planktonic duration treatments (interactive effect of larval planktonic duration and time on colony size, $F_{2,36} = 0.885$, $p = 0.421$). At seven weeks adjacent colonies from natural and delayed larval planktonic duration had mean size of 0.96 ± 0.15 mm^2 (Fig. S1-2b).

LN(SN) vs LN(D)

The larval history of neighbours did not affect the performance of focal colonies derived from long natural larval planktonic periods (Figs. S1-1c & S1-2c). There was no difference in survival (df = 1, χ^2 = 0.08, p = 0.78), or growth (larval planktonic duration x time, $F_{2,40}$ = 2.30, p = 0.11) when they were adjacent to colonies that developed from larvae of either short natural (SN) or delayed (D) planktonic duration.

Experiment 2B

SN vs LN

W. subtorquata colonies that developed from larvae of longer natural planktonic duration (SN) survived worse than those that developed from shorter natural planktonic durations (df = 1, χ^2 = 13.6, p = 0.000). Only 61 % of colonies from larvae of longer planktonic durations survived to 8 weeks and only 17 % survived beyond the end of experiments whereas 78 % of colonies from shorter larval plankton larval durations survived until the end of experiments (Fig. S1-3a). *W. subtorquata* colonies that developed from longer natural larval planktonic durations were also significantly smaller than adjacent colonies that developed from shorter larval planktonic durations ($F_{1,28}$ = 9.427, p = 0.005). Colonies increased considerably in overall size over time ($F_{1,56}$ = 238.03, p = 0.000) but differences between them remained consistent (interaction of larval planktonic duration and time on colony size, $F_{1,56}$ = 1.317, p = 0.276). At seven weeks colonies that developed from larvae of natural short planktonic durations were 2.5 times larger (16.47 ± 3.03 mm^2) than colonies that developed from larvae of natural long planktonic duration (7.80 ± 1.48 mm^2) (Fig. S1-4a).

LN vs D

Watersipora subtorquata colonies that developed from either natural or delayed longer larval planktonic durations did not exhibit differences in performance. Survival of colonies was similar (df = 1, χ^2 = 0.4, p = 0.545), and only 12 % of colonies survived to 8 weeks and only 8 % until the end of experiments at 13 weeks (Fig. S1-3b). Growth was also similar (overall size: $F_{1,12}$ = 1.272, p = 0.281 and larval planktonic duration x time on colony size: $F_{2,24}$ = 0.927, p = 0.409) (Fig. S1-4b). At seven weeks colonies had a mean size of 5.17 ± 0.75 mm^2.

LN vs SN or D

Though there were differences in the survival and growth of colonies due to different larval planktonic durations, these differences didn't alter the effect of these colonies on their neighbours (Figs. S1-3c & S1-4c). Colonies from larvae of natural long planktonic duration did not have different survival (df = 1, χ^2 = 0.89, p = 0.34) or colony size (main effect: $F_{1,38}$ = 0.64, p = 0.43, larval planktonic duration x time: $F_{2,38}$ = 2.30, p = 0.11) when they were adjacent to colonies from larvae of short planktonic (SN) duration or delayed planktonic (D) duration (Figs. S1-3c & S1-4c)

DISCUSSION

Even though increased larval planktonic duration led to decreased survival and growth of *Watersipora subtorquata* colonies in Experiment 2B, differences in performance between colonies from different larval planktonic duration didn't alter their interactions with adjacent conspecific colonies in either experiment 2A or 2B. The relatively small size of colonies in the first seven weeks of growth in both experiments 2A and 2B meant that space was not limiting throughout the first seven weeks of conspecific experiments and few *W. subtorquata* colonies made direct contact with adjacent conspecific colonies at any time during either Experiment 2A or 2B. Even without direct contact it is possible for competition to occur indirectly between *W. subtorquata* colonies through the disruption of flow or reduction of food available to neighbours. Such effects have been observed in other bryozoan species (Best and Thorpe 1986), but have not been well studied for *Watersipora subtorquata*. The lack of any difference in size or survival of colonies that were adjacent to conspecific settlers of differing larval planktonic duration at any time suggests that neither direct nor indirect effects occurred between conspecific settlers of different larval planktonic durations in these experiments.

LITERATURE CITED

Best MA, Thorpe JP (1986) Feeding-current interactions and competition for food among the bryozoan epiphytes of *Fucus serratus*. Marine Biology 93:371–375

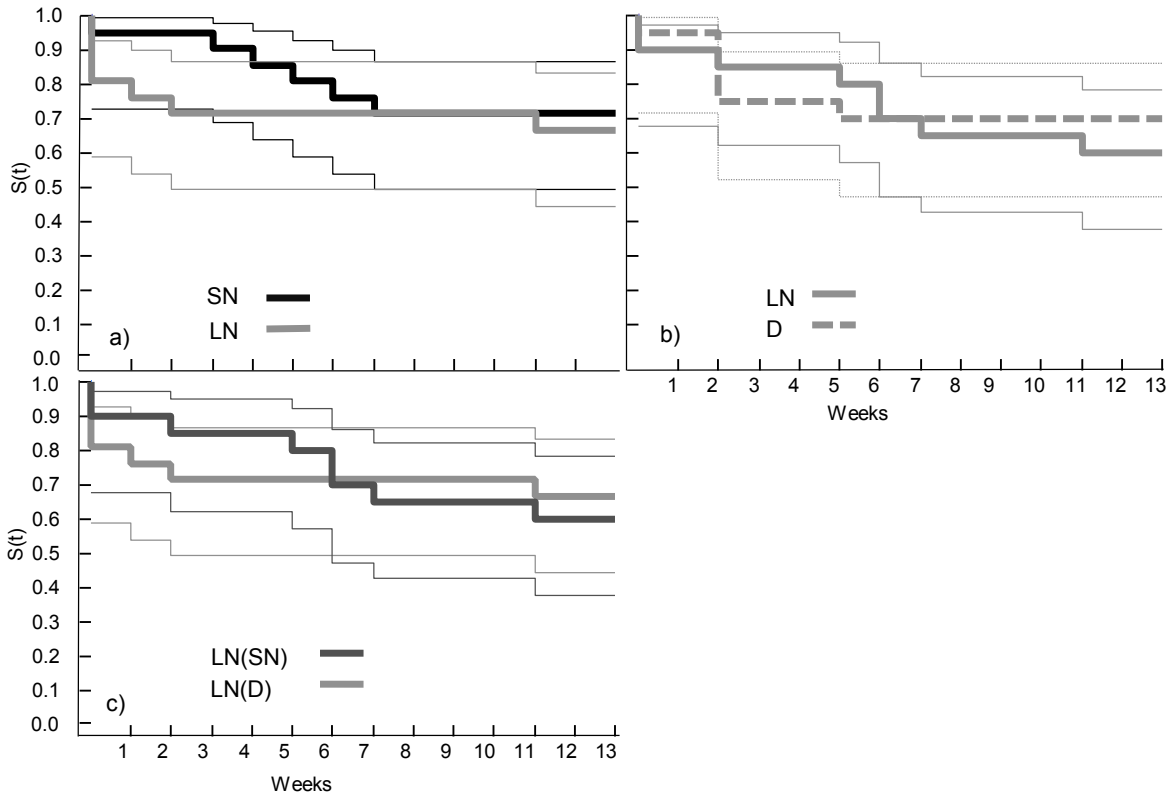

Fig. S1-1. Survival of *Watersipora subtorquata* colonies that developed from larvae of natural short planktonic durations (SN), natural long planktonic durations (LN) or delayed planktonic durations (LR) during winter months (June to September, Experiment 1A). Colonies occurred in adjacent pairs of either (a) natural short (SN) and natural long (LN) or (b) natural long (LN) or delayed (D) larval planktonic durations treatments. Survival of colonies that developed from natural long (LN) larval planktonic durations but were next to conspecific colonies of either natural short (SN) or delayed (D) larval planktonic durations are shown in (c).). Survival is shown with Kaplan-Meier survival curves, where *S(t)* represents the proportion of individuals surviving at each time step. Large lines represent estimate of the proportion of individuals surviving while fine lines represent 95 % confidence limits around these estimates

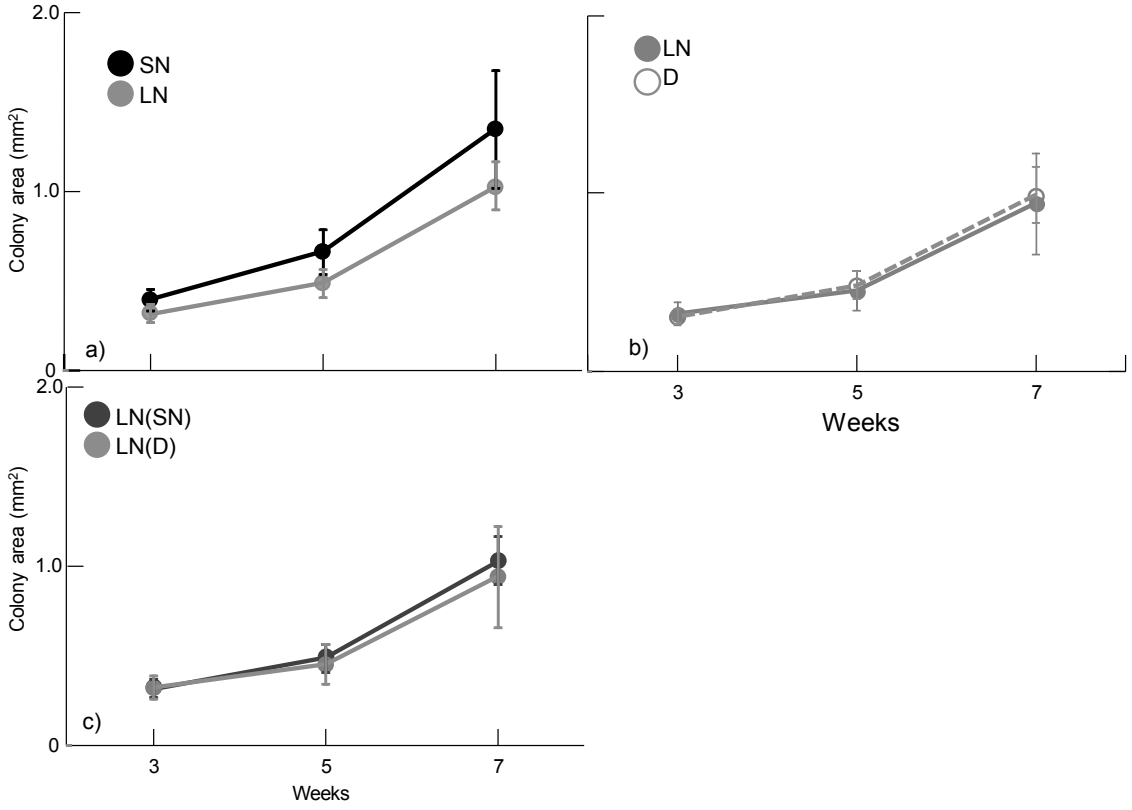

Fig. S1-2. Mean colony size ± SE of neighbouring pairs of *Watersipora subtorquata* colonies that developed from larvae of natural short planktonic durations (SN), natural long planktonic durations (LN) or delayed planktonic durations (D) during winter months (June to September, Experiment 1A) over the first seven weeks of growth post- settlement. See Fig. S1-1 for further details.

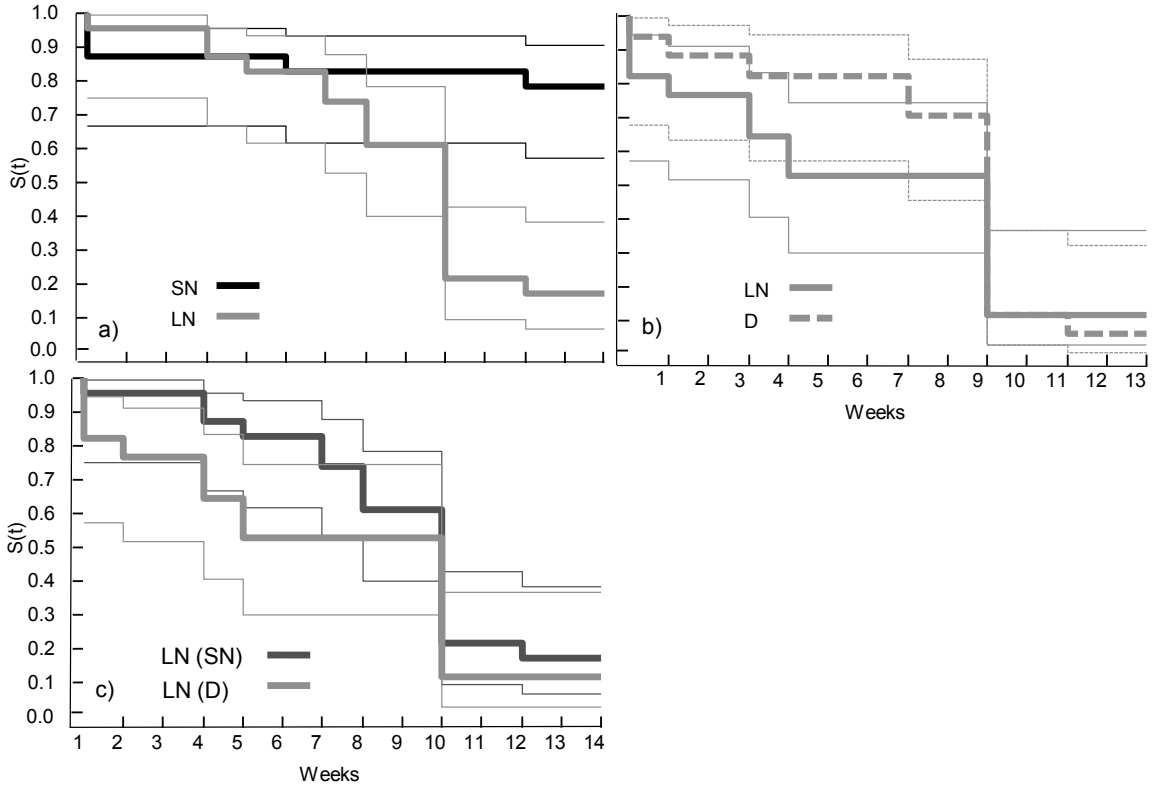

Fig. S1-3. Survival of *Watersipora subtorquata* colonies that developed from larvae of natural short planktonic durations (SN), natural long planktonic durations (LN) or delayed planktonic durations (D) during spring/summer months (September to December, Experiment 1B). See Fig. S1-1 for further details

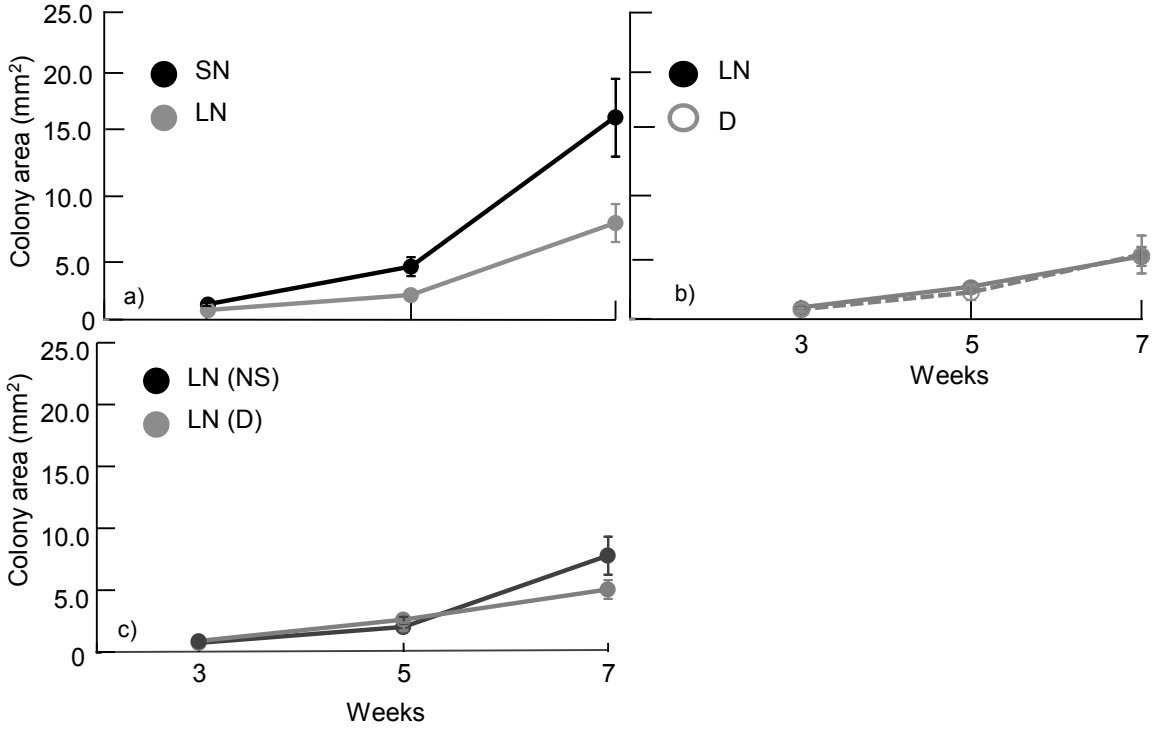

Fig. S1-4. Mean colony size ± SE of *Watersipora subtorquata* colonies that developed from larvae of natural short planktonic durations (SN), natural long planktonic durations (LN) or delayed planktonic durations (D) during spring/summer months (September to December, Experiment 1B) over the first seven weeks of growth post- settlement. See Fig. S1-1 for more details.