EAST TENNANTS REEF SEAFAN STUDY

A REPORT TO Project AWARE (UK)
AUGUST 2001

Reef Research

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REEF RESEARCH
EAST TENNANTS REEF SEAFAN STUDY

FIELD REPORT

August 2001

STUDY TEAM 2000

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1. OVERVIEW AND METHODOLOGY

1.1 Introduction

The East Tennants Reef Pink Seafan Project is a long-term study conducting on-going research on the ecology of the East Tennants Reef, an offshore, subtidal reef within Lyme Bay, SW England. The study is primarily field research based: a monitoring station has been established on the reef and is periodically surveyed by teams of divers who collect spatial distribution, size and photographic data on seafan colonies and reef habitat changes.

Our research programme for the summer of 2000 was largely funded by a grant awarded by PADI Project Aware. The following report outlines work undertaken on the East Tennants Reef Seafan Project during July, August and September 2000 and details the subsequent data analysis together with outcomes of the survey.

1.2 Research team

In July 2000 three volunteers (Karen Webb, Anna Wood and Sari Tolvanen) joined Reef Research to assist with the East Tennants Reef Project. All were marine biology graduates and qualified divers but had no prior experience of working on a field based research programme. Jane Sunderland (a marine biologist and member of 1998's survey team) provided voluntary help on two days' diving. Colin & Lexie Munro, directors of Reef Research oversaw all diving and research activities. A local hard boat "*Miss Pattie"*, skippered by John Walker was used for all diving work.

1.3 Preparatory work

Karen, Anna and Sari joined *Reef Research* for an introductory week prior to the start of fieldwork. This time was used for familiarisation with Reef research diving rules and procedures, preparation of personal diving equipment and survey equipment, training on basic underwater photography techniques and a review of data collected in previous years' surveys. Throughout the week emphasis was placed on ensuring all team members understood the rationale of the East Tennant's Reef Project and were confident of the methodology to be used for collection of data in the field.

1.4 Diving survey

Over a three-week period spanning August and September 2001, we were able to conduct ten full days' diving. Where possible the team dived using Nitrox 36% in order to maximise dive time. As a result the quality and amount of work achieved on each survey dive was greatly improved in comparison with previous years. The following project goals were achieved

- All seafan colonies within the monitoring grid were re-mapped, noting newly settled seafans and those lost since last year.

- All seafan colonies within the grid were re-photographed using a Nikonos V underwater camera with 15mm lens (or 35mm lens with extension tubes for seafans less than 3cm in height), a Sea & Sea YS120 flash gun and Fuji sensia 100 ISO slide film.

- Branch clippings of seafans were collected for microscopic examination for developing eggs and larvae.

Survey work was conducted in blocks of 2-3 days' diving followed by one or two rest days. This allowed us time between dive blocks to develop photographs, write up field notes &

carry out maintenance / repairs where necessary. The above dive schedule proved useful in allowing us to maintain a check on work achieved and work outstanding throughout the survey period.

1.5 Data analysis

Image analysis

The survey team developed all slide films. The identity of individual seafans was confirmed with reference to field-notes & previous year's images. Individual images of every seafan within the monitoring station were scanned into a PC using a Polaroid SprintScan 35/LE slide scanner and images optimised using *Paintshop Pro* software. On each image up to 40 separate branches were coded following protocols set up in previous year's surveys. The length of each branch was measured using *SigmaScan*™ image analysis software. Each branch measurement was repeated twice to give a total of three measurements for each branch of a total of 41 seafans. Where possible branch measurements were compared with previous survey's data to obtain monthly growth rate figures. The overall height of each colony was recorded together with the width between the two furthest branch tips (where relevant).

Spatial / temporal mapping

The co-ordinates of each seafan colony within the monitoring station was transferred into a *Mapinfo* workspace, allowing us to build a map showing the relative position of all colonies found within the station during August & September's survey.

Microscopic examination of branch clippings

Branch clippings from a number of "small" (under 200mm height), "medium" (200 – 300 mm height) and "large" (over 300 mm height) colonies were maintained in seawater tanks and examined in the three weeks following survey work. Individual polyps were dissected & examined under a high power microscope for eggs or developing larvae. A combination of line drawings and photomicroscopy was used to record the results of each dissection.

2. RESULTS OF 2000 SURVEY

To facilitate data analysis growth rates have been determined across three size "classes" which roughly equate to the quantitative sizes "small", "medium" and "large".

2.1.1"Small" fans (0 – 50mm)

Monthly growth rates

Growth rate between May and August 2000 was measured in six seafans in the smallest size class (i.e. those less than 50mm in May 2000). Four of the six colonies were a single main stem so only one measurement was available. The other two colonies were a main stem with one side branch, and for these seafans both branches were measured. Figure1 gives a graphic representation of growth rates for all six seafans in the smallest size class. Across this class the mean monthly growth rate varied from –0.1mm / month (colony Ad3) to 10mm / month (colony Dd3). The minimum growth of any single branch amongst fans in this size class was –1.4mm / month (Ad3), while the maximum observed growth rate of any single branch was 10mm / month (Dd3).

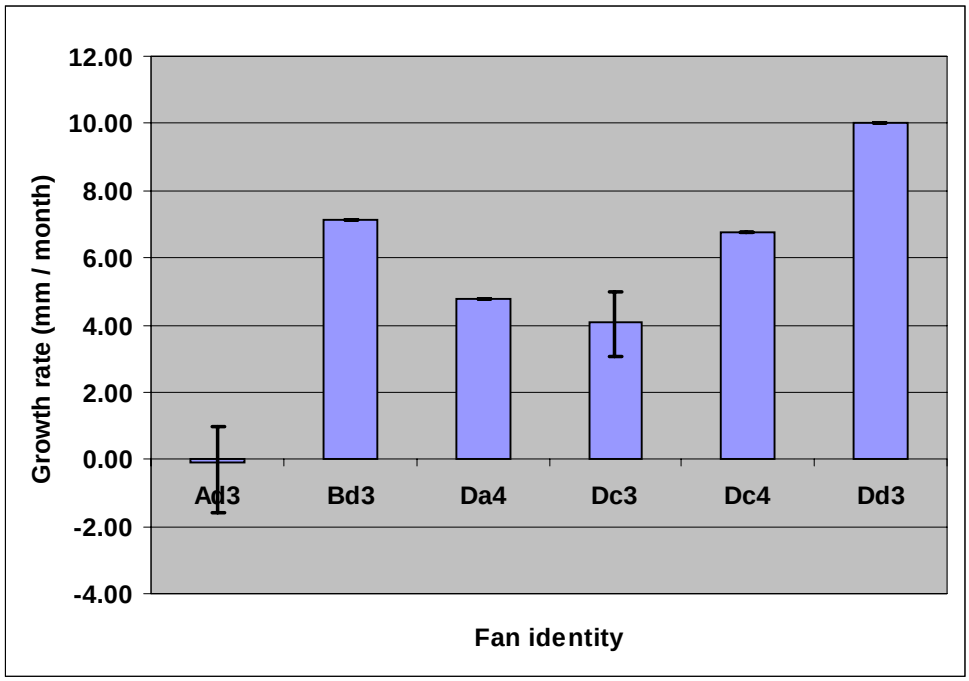

Figure 1 Showing mean, maximum and minimum monthly growth rates during the period May to August 2000 for seafans in the size class 0 – 50mm.

Change in height

All seafans in the 0 – 50mm size class & for which measurements were possible showed an increase in height between May and August 2000, as shown in Figure 2. The smallest change occurred in Ad3, which grew only 1.62mm. The greatest height increase (30.05 mm) was observed in seafan Da4.

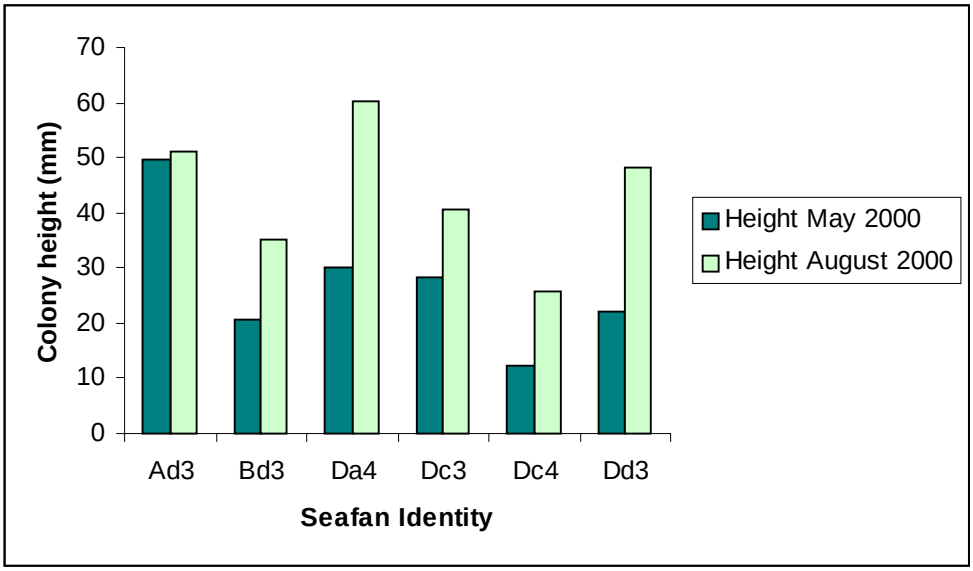

Figure 2 Showing the height of seafans in the size class 0 – 50mm for May and August 2000.

2.1.2 “Medium ” fans (51 – 200mm)

Monthly growth rates

Growth rate between May and August 2000 was measured in eight seafans in the “medium” size class (i.e. those fans between 51 and 200mm height in May 2000). The number of branches occurring on each seafan is highly variable within this size class, and the number of branches measured within each individual colony ranged from 1 (Bd2) to 48 (Da3). Total number of measurements made for each medium seafan is shown in table 1.

Seafan ID	**Ab4**	**Ba8**	**Bc3**	**Bd2**	**Ca4**	**Da3**	**Dc1**	**Dd1**
Number of branches measured	16	21	19	1	9	48	10	30

Table 1 Showing the number of branches measured on all fans within the size class 51 – 200mm

Figure 3 gives a graphic representation of growth rates for all eight colonies measured in the medium size class. Across this class the mean monthly growth rate varied from –1.04mm / month (colony Bc3) to 9.38 mm / month (colony Bd2). The minimum growth of any single branch amongst fans in this size class was –14.5 mm / month (Bc3), while the maximum observed growth rate of any single branch was 17.97 mm / month (Dd1).

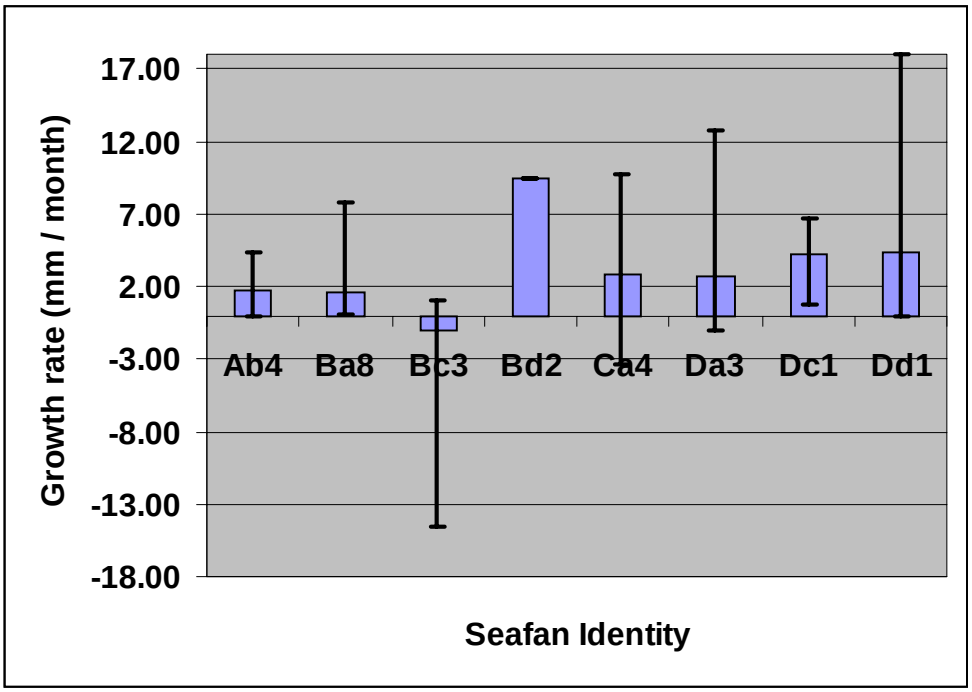

Figure 3 Showing mean, maximum and minimum monthly growth rates during the period May to August 2000 for seafans in the size class 51 – 200mm.

Change in height

In each of the eight colonies measured an increase in height was observed between May and August 2000, as shown in Figure 4. The smallest change occurred in Dc1, which grew only 0.98mm. The greatest height increase (49.9 mm) was observed in colony Dd1.

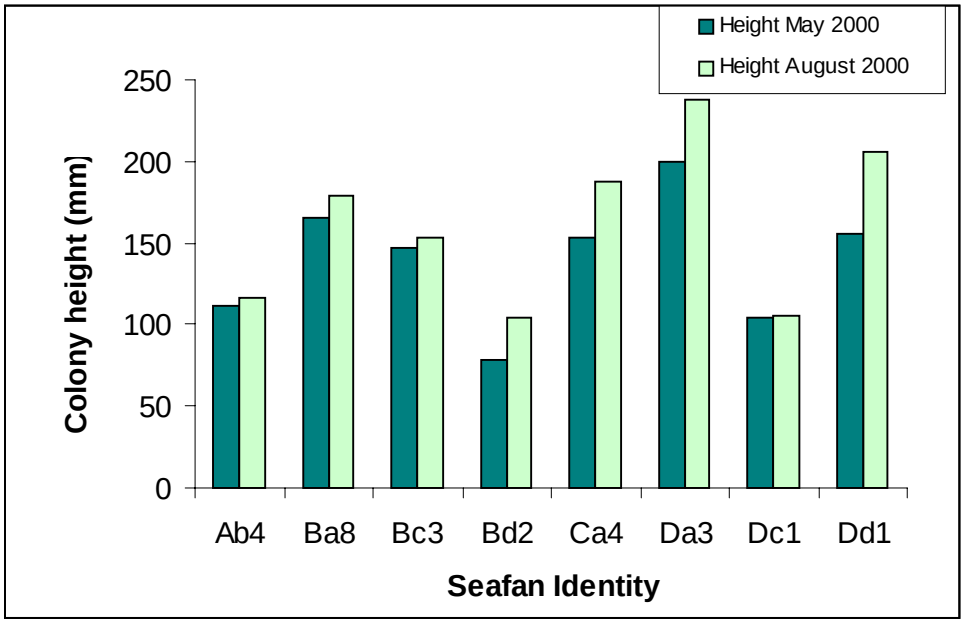

Figure 4 Showing the height of seafans in the size class 51–200mm for May and August 2000.

Change in width

In all colonies except Bc3 an increase in width was observed between May and August 2000, as shown in Figure 5. The greatest increase in width occurred in colony Da3; the seafan's diameter was measured as156.63mm in May 2000 and 198.77 in August.

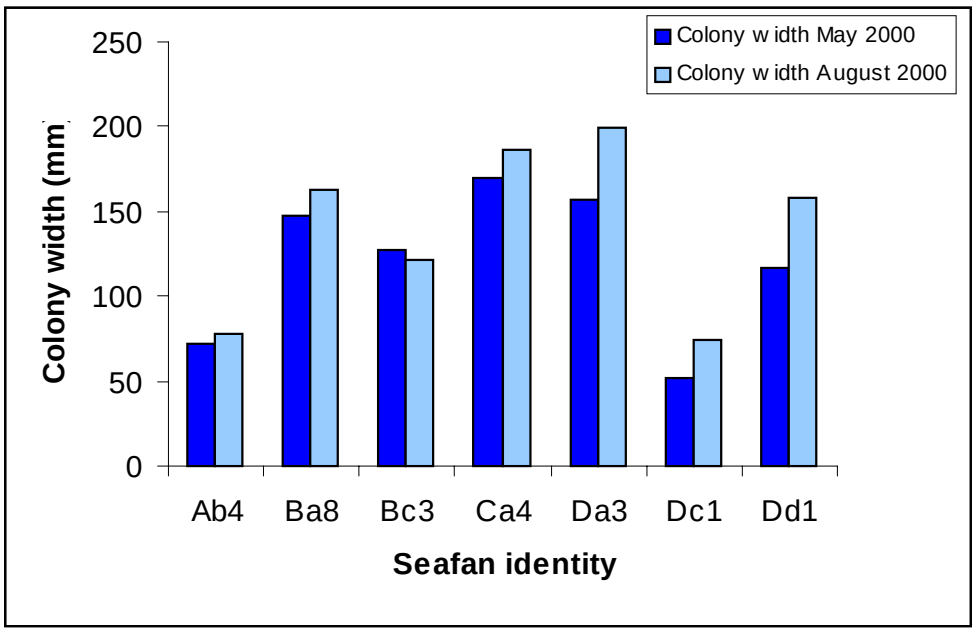

Figure 5 Showing the width of seafans in the size class 51–200mm for May and August 2000.

2.1.3 “Large” fans (200mm+)

Monthly growth rates

Growth rate between May and August 2000 was measured in three seafans in the “large” size class (i.e. those fans over 200mm height in May 2000). The number of branches measured on “large” colonies Ba2, Dd2 and Ba7 was 45, 63 and 33 respectively.

Figure 6 gives a graphic representation of growth rates for all three colonies measured in the largest size class. In all colonies the mean monthly growth rate was less than 0.73mm / month, with colony Ba2 showing a negative monthly growth rate (-0.19mm / month). The maximum growth of any single branch among the three fans in this size class was 8.73mm / month (Ba7) and the minimum growth –3.61mm / month (Dd2).

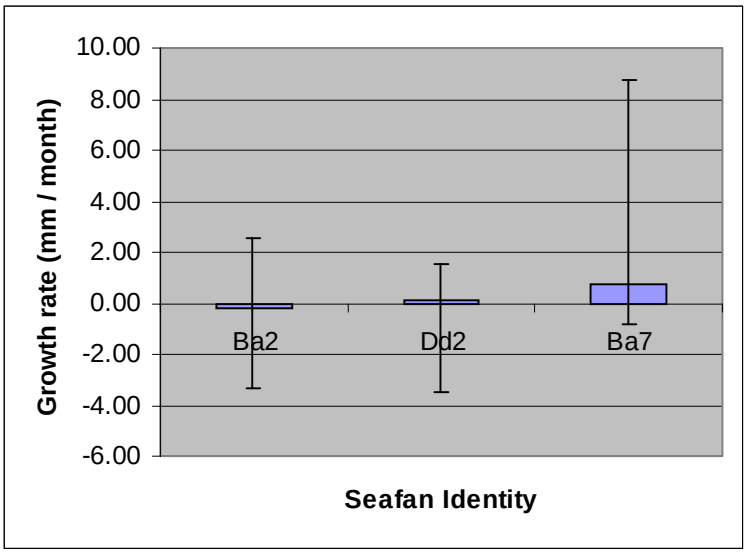

Figure 6 Showing mean, maximum and minimum monthly growth rates during the period May to August 2000 for seafans in the size class 200mm and larger.

Change in height

Between May and August an increase in height was observed in all three large seafans; height increases were 0.45mm, 9.36 and 12.33 for colonies Ba2, Dd2 and Ba7 respectively.

Change in width

Over the three-month period colonies Dd2 and Ba7 showed an increase in width (10.66 and 8.18 mm increase respectively). The width of colony Ba2 was reduced by 2.56 mm

2.2 Recruitment & Mortality

Thirteen new seafan colonies were recorded within the monitoring station in August and September 2000. The new colonies found ranged in height from 14mm (Cd7) to 90mm (Bd6). Six colonies, which had been observed in previous surveys, could not be found during survey work. Four of these six were small / juvenile colonies (Dc4, Ca7, Ca6 and Ad8). The other two seafan colonies lost (Ad7and Ca5) were over 170mm in height. The locations of all colonies found within the grid during survey work conducted in May and August 2000 are shown in Figures 7 & 8.

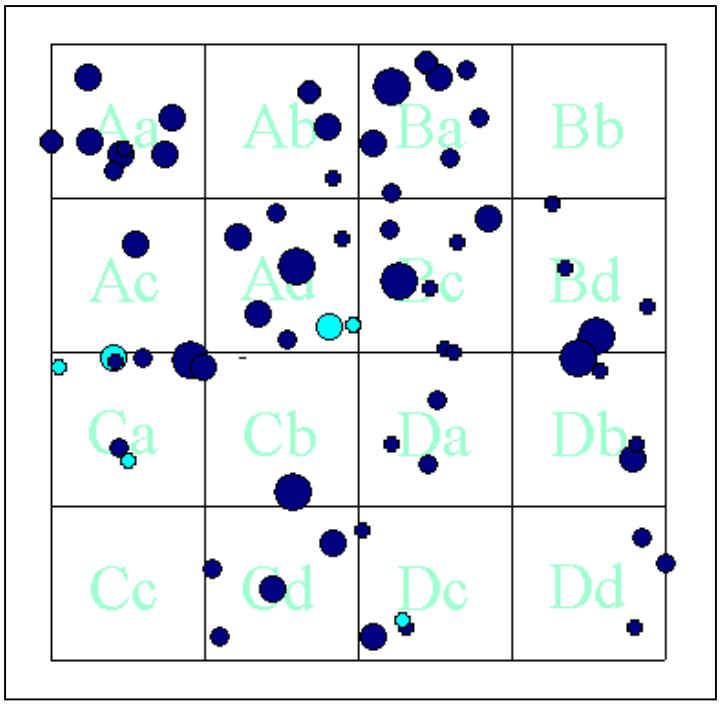

Figure 7. Positions of seafan colonies May 2000. A blue circle represents each colony. Circle size relates to qualitative size estimate of each seafan. Light blue circles indicate those colonies which could not be relocated in August's survey work.

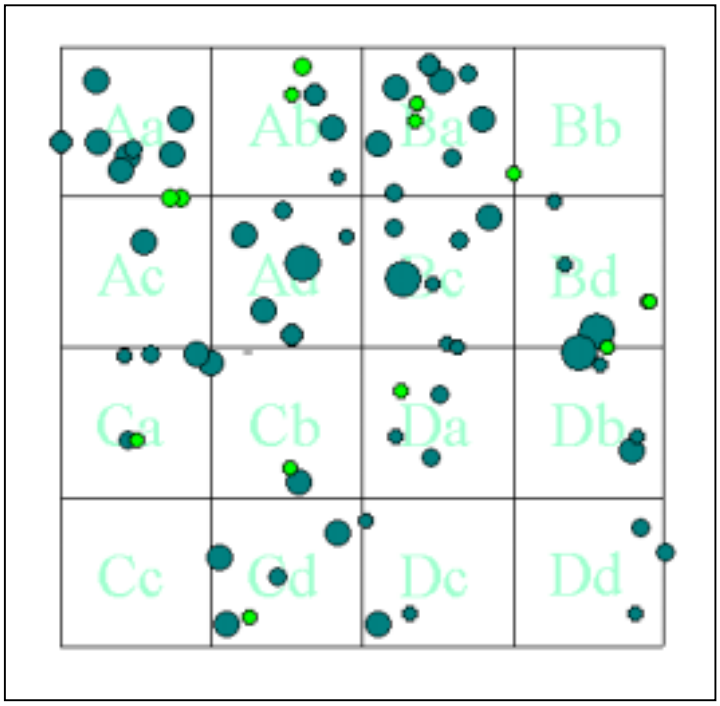

Figure 8. Positions of seafan colonies August 2000. A green circle represents each colony. Circle size relates to qualitative size estimate of each seafan. Light green circles indicate new colonies found during August's survey work.

2.3 Eggs & Larvae

Spherical structures were observed in some, but not all polyps dissected. It was thought that the structures observed were gametes but it was unclear whether they were eggs or sperm vesicles. The structures observed were less than 0.1mm in size.

3. DISCUSSION

Considerable effort was put into the analysis of seafan images obtained in August and September and consequently the data set gained from 2000's survey work is far superior to results obtained in previous years of the East Tennants' Reef Seafan Study. Since images of the majority of seafans within the grid had also been collected in May 2000, work undertaken in August and September enabled us to clarify growth patterns over the summer period May to August / September 2000

3.1 Growth

3.1.1 General patterns

It is becoming clear that branch growth is highly variable, both between and within individual colonies across all class sizes. In several cases the mean monthly growth rate was far greater than expected; in five colonies (Da4, Dd3, Da3, Dd1 and Ba7) some branches were measured to be growing at rates exceeding10mm/month (measured over a three month period). In some branches no measurable growth was recorded over the same period. Negative growth was also observed in a number of branches. (It is thought most likely that negative branch growth occurs as the direct or indirect result of predation by species such as *Tritonia nilsodhneri*).

Overall there appeared to be a trend of positive growth across all three size classes monitored. Mean monthly growth rates were positive in 14 of the seventeen colonies measured. Each of the size classes contained one colony where mean monthly growth was measured as a negative value. Comparisons of colony height in May 2000 against colony height in August 2000 showed that all seafans had increased in height over the three-month study period. Comparisons of colony width in May 2000 against colony width in August 2000 indicated an increase in width for eight colonies, while the width of two colonies had decreased. Measurements of width were not made in the smallest size class where most seafans were comprised of a single stem only.

3.1.2 Class specific patterns

With the exception of colonies Ad3 and Bd2, seafans in the smallest size class appeared to have the highest mean monthly growth rates while colonies in the largest size class appeared to have the lowest mean monthly growth rate. It is thought possible that the smallest (youngest) seafans grow relatively rapidly with the following results; 1) minimal time is spent at the height the faunal turf where the risk of smothering from silt or faunal overgrowth is high and 2) colonies quickly reach a height where filter feeding polyps are able to utilise feeding currents in the surrounding water column. We believe that large (older) colonies may divert energy which is used for growth in younger colonies, into processes such as reproduction and tissue repair.

The greatest variation in branch growth rates occurred in seafans within the mid-range size class (51 – 200mm). For most seafans within this group branch growth rates were measured for between 10 and 20 branches. It is possible that within these well branched colonies energy is split between optimising feeding currents (and therefore maximising branch growth) and

reproduction. As a result some areas of the colony exhibit rapid growth while other branches appear not to have grown from one survey period to the next.

In previous studies of *Eunicella verrucosa* populations elsewhere in the UK, average growth "rates" of 6mm per annum (Bullimore, 1987) and 10mm per annum (Fowler & Pilley, 1992) have been cited for *Eunicella verrucosa* populations. Since growth is highly variable within and between colonies we believe that providing a single figure for "average growth rate" is an oversimplification of what appears to be a highly complex process. We believe that it is more meaningful to summarise our findings as follows;

- Figures for growth rate will vary depending on the measure used. Patterns of growth, as measured by change in height, are different to those obtained from growth as measured by change in both height and width, which in turn are different to those obtained by measuring the change in many individual branches averaged across a single colony.

- Most colonies in the 0 –50 mm size range comprise just one single stem. The highest monthly growth rates were observed in these smallest seafans

- Seafans in the size class 51 – 200mm are mainly well branched. Within this size of colony growth rates are highly variable between individual branches.

- The lowest monthly growth rates are apparent in the largest seafans.

Within this study it was possible to make some size comparisons with images of seafan colonies obtained in 1999 and 1998 in the hope of estimating annual growth rates. However the poor quality of some images from previous years' surveys, as well as the fact that only a limited number of images were available, meant that data obtained was insufficiently detailed to allow definite conclusions on annual growth patterns to be made.

3.1.3 Points for consideration

1. Straightforward comparisons of branch measurements through time, such as have been used in this study, can give a useful and easily measurable indication of growth rates. It is however important to remember that total colony "growth" will include increases in branch thickness, increases in the number of polyps within the colony and accumulation of biomass. The detailed measurement of these growth indicators is considered beyond the scope of this study.

2. When making comparisons of growth patterns between size classes it is important to note that the class divisions used in this study have been set using entirely arbitrary height limits. Our methodology has two clear limitations which are important to bear in mind when considering class specific patterns

    i) Whilst colony height is easily measured it may not be the most appropriate or ecologically significant attribute on which to group seafan colonies. While biomass, reproductive status or age are likely to be more realistic attributes on which to base colony groups, these factors are not readily measured in *Eunicella verrucosa* populations.

    ii) The boundaries for each size class are determined by nothing more concrete than our own estimation of "small", "medium" and "large" colonies in terms of measured height. It is hope that as our data set grows we will obtain clearer

statistical evidence for the most appropriate points at which to draw height class boundaries.

3. The figures quoted in this study relate to mean monthly summer growth rates of *Eunicella verrucosa.* Since the species reaches its northern distribution limit in the South Western UK it is likely that our summer time conditions provide the optimum conditions for UK populations of the species, and it is likely that growth is at a maximum during the summer months. By measuring the species growth between May and August it is likely that we have observed a rate of monthly growth which is not sustainable all year round. (i.e. it would be inappropriate to multiply our summer monthly growth rates by 12 to give an annual growth rate).

3.2 Recruitment and mortality

Over the summer period the number of seafans recruited within the monitoring area was greater than the number lost from the same area of reef. However two of the colonies lost from within the grid were medium / large colonies and it is questionable whether they can be considered "replaced" by a newly recruited colony. Previous results from the monitoring project have suggested that the survival rate of newly recruited colonies is around 50%. The Net gain of colonies over the period May to August 2000 is calculated as 0.5 colonies, using the formula

Net gain = (No of recruits x survival rate) – No mortalities

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The loss of four small colonies from the monitoring area between May and August 2000 is consistent with the results of previous surveys of the East Tennants monitoring station, which have shown a high turnover of small, newly recruited colonies.

It is uncertain whether the large number of recruited colonies counterbalances the loss of biomass which results from the mortality of two medium / large colonies Ad7 and Ca5. Further understanding of growth, recruitment and mortality rates will hopefully enable us to address such questions.

When considering recruitment and mortality patterns within the monitoring area it is important to be aware of the difficulties in obtaining accurate figures for each value. The number of recruits can easily be underestimated since very small seafans are extremely difficult to pick out against the background turf in which they grow. Similarly the number of mortalities (particularly amongst the smallest seafans) can be overestimated due to the difficulty of relocating individual seafan colonies. On almost every return visit to the monitoring station colonies we have thought "lost" have subsequently "re-appeared". Inaccuracies in data collection are thought in part to be due to the effects of Nitrogen narcosis and have been reduced since divers have been able to use Nitrox for survey diving. In addition we are now more careful to make "double checks" during data collection, particularly when searching for recruits and recording mortalities.

3.3 Eggs and larvae

The discovery of gametes within some seafan polyps was considered an important and exciting step in helping to develop our understanding of the reproductive processes of *Eunicella verrucosa.* The gametes found were much smaller than those studied in other Eunicella species and we have become aware that further studies of reproduction must consider structures on a much smaller scale than had previously been expected. We have also

gained an improved understanding of the physical structure of polyps within which the gametes are contained.

3.4 Education

Since the completion of fieldwork in September 2000 we have aimed to disseminate information on the ecology of seafans through the following means

- Presentation of results and discussion of the East Tennants Reef Monitoring Project at the annual Marine Conservation Society Conference in October 2000.
- Continued development of the Reef Research Seafan web page
- Delivery of a lecture on the use of image based data in underwater monitoring and survey work to Marine Biology students at Plymouth University
- Delivery of a talk on Reef Research's East Tennants Reef Seafan Study to a local dive club
- Advising on the content of the MarLIN website in relation to *Eunicella verrucosa*
- Completion of an article about the project for the MCS's quarterly magazine

In all of the above we have aimed to provide positive promotion of Project AWARE as sponsors of our research.

3.5 Training

The work conducted in August/September 2000 enabled us to continue recruiting recent graduates to assist with fieldwork while providing them with training in scientific diving, data collection and analysis techniques. Following their time spent with us Karen Webb went on to work as a diving scientist with the British Antarctic Survey. Sari Tolvanen is currently working as a marine biological survey diver for a marine station based in Ireland. Anna Wood continues to work as a voluntary marine surveyor. We continue to receive numerous enquiries from graduates and enthusiastic divers keen to assist us with the East Tennants Reef Study.

4. FURTHER WORK

We have little doubt that the significant improvement in both the quality and volume of work achieved during the summer of 2000 was due to the generous financial support received from PADI Project AWARE. We are now keen to ensure continued support for the project in order to maintain data quality whilst continuing to build our ecological understanding of the East Tennants Reef communities. We hope that future work will enable us to concentrate on

a) developing our current model of growth rates for Pink Seafans on East Tennants Reef, in particular building on our existing data set for annual growth rates
b) identifying the reproductive period of seafans, the size at which they become fertile, and estimate the number of colonies reproducing each year
c) determining whether local populations may be reproductively isolated, and so potentially highly vulnerable
d) recording and describing the settlement and metamorphosis of seafan larvae
e) continuing to provide training in scientific diving to students, graduates and enthusiastic divers
f) continuing to disseminate the results of our research as widely as possible.

5. REFERENCES

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Fowler, S.L. and Pilley, G.M, 1992. Report on the Lundy and Isles of Scilly marine monitoring programmes 1984 to 199. Report to English Nature.