SUCCESSFUL LOCALISED CONTROL OF MOSQUITOES AT CLUB PELICAN GOLF COURSE, COLOUNDRA WITH THE RESIDUAL SYNETHIC PYRETNRIN INSECTICIDE, BISTAR 80SC® APPLIED AS A NARROW BAND VEGETATION TREATMENT .

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Abstract

An efficacy trial to measure attenuation of mosquito abundance by residual barrier type treatment using Bistar 80SC® was conducted at Club Pelican Golf Course, Caloundra, Qld over September and October 2004. The vegetation fringing the tee-off area, fairway and green area of the 16th hole and tee-off area of the 17th hole were treated at the label rate (0.1% AI Bifenthrin SC) by Solo® back pack blower to produce an (approx.) 4 metre wide and 3 metre high residual barrier to mosquitoes dispersing from extensive salt-marsh and freshwater breeding sites south of the course.

Efficacy was measured by difference in mosquito abundance between the fairway margin and in adjoining riparian forest from 3 replicate pairs of baited light traps. Two Bistar 80SC®applications were assessed. The first made on 26 Sep 04 provided 75% attenuation (P = 0.035) of mosquitoes. The second, 8 weeks following, on 26 Nov 04 provided 92% attenuation (P = 0.020) on initial sampling.

The results of the trial demonstrated that this form of control was effective at attenuating a high proportion of mosquitos dispersing from un-protected to protected areas.

1.0 Introduction.

 The Club Pelican Golf Course is located in Caloundra City, Queensland. The course occupies a portion of land constrained on its southern boundary by a riparian forest buffer to Bells Creek. The creek drains into Pumicestone Passage approximately 1 km east of the golf course.

Significant portions of Pumicestone passage provide suitable habitat for the salt-marsh mosquito, *Ochlerotatus vigilax*. Extensive lands comprising native forest, plantation pine forest and agricultural land exist south and west of the general location of the golf course. This habitat provides opportunity for many fresh/brackish water breeding mosquito species.

Since it commenced operation several years ago, the golf course has been subject to seasonal infestation by mosquitoes particularly following tide/rainfall inundation of salt-marsh and subsequent production of *Oc vigilax.* The operators of the golf course have attempted to provide control of mosquitoes by use of larvicides to control breeding within their land and by supply of insect repellents to players. These measures however have not proved effective as the source of much of the mosquito activity lies outside golf course land and the frequent high intensity of seasonal mosquito attack.

The operators of the golf course, Titanium Golf, commissioned Mosquito Consulting Services Pty Ltd to conduct an efficacy trial of the residual synthetic pyrethrin, Bistar 80SC® (8% AI Bifenthrin as an aqueous suspension concentrate) to selected portions of the golf course as a means of reducing mosquito abundance.

2.0 Materials and Methods.

The efficacy of Bistar 80SC®was assessed by comparison of mosquito collections taken from areas required to be protected (treated) against areas un-protected (un-treated). The primary form of mosquito collection was by light trap.

2.1 Field Location

The areas of the golf course identified by the operator as most adversely effected by mosquito attack was the 16th hole tee-off area, southern margin of the fairway and green area and the 17th hold tee-off area. These lay adjacent to the course's southernmost boundary, bounded by the riparian forest buffer zone and are first in line to receive northward dispersing mosquitoes from their southern breeding sites.

Plate 1: Bells Ck and Golf Course Test Areas

17th Tee,   16th Green, Fairway, Tee   Bells Ck

2.2 Mosquito Light Traps

Mosquito trapping was undertaken by light traps of a standard type produced by H.A. Standfast. Plate 2 shows the trap design. Traps were baited with dry ice and the chemo-attractant, Octenol (1-octen-3-ol). Traps were operated from around 5:00pm to 7:00 am each night of operation.

Mosquitoes captured by light traps were collected into 70% alcohol. Collections were removed and identified by microscopy to species in the laboratory. Species and abundance was recorded for each trap location and date of collection (see Table 1).

Plate 2 Light trap at Un-controlled site 3 in riparian forest buffer to Bells Ck.

12 v battery

1kg Dry ice Inside

CO_2 gas out
Air in
(mosquitoes in)
Light
Octenol wick
Suction fan

Exhaust via wire mesh
Mosquitoes collected in 70% alcohol
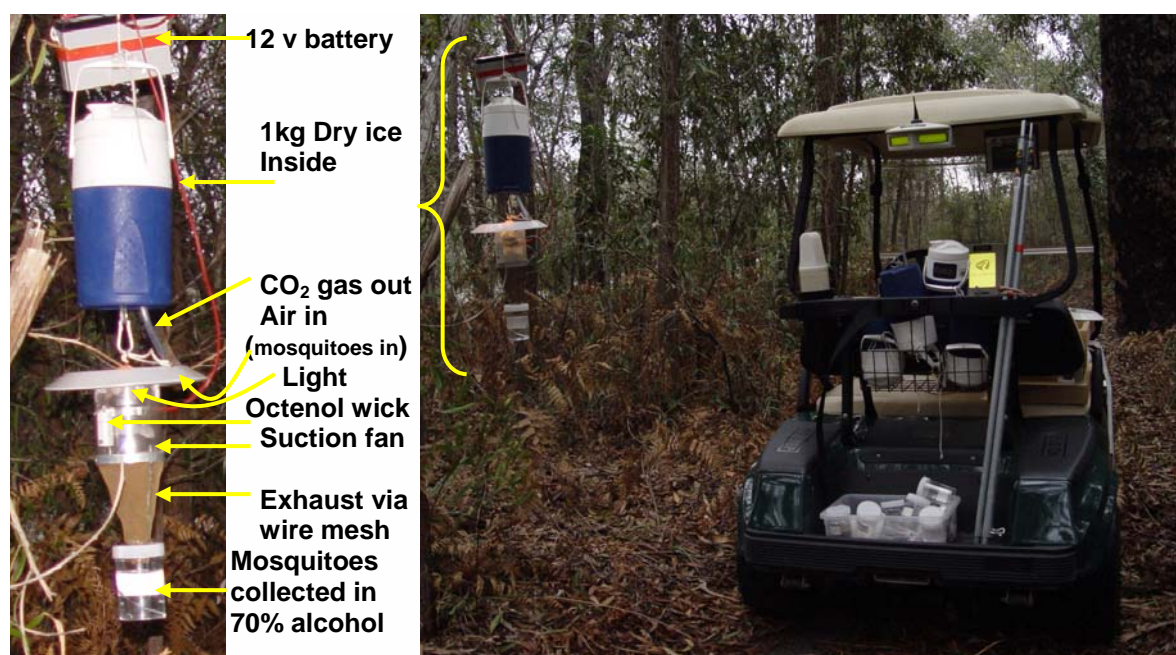
2.3 Trap locations

Three replicated pairs of light traps were established between the 16th hole tee-off area and green. Three traps were located approximately 1 m inside the tree line on the southern margin of the 16th fairway and spaced at approximately 100 m intervals. Three traps were located within the adjacent riparian vegetation margin between the fairway and Bells Ck. Plate 3 shows the locations of these traps.

Plate 3: Light trap and treatment locations.
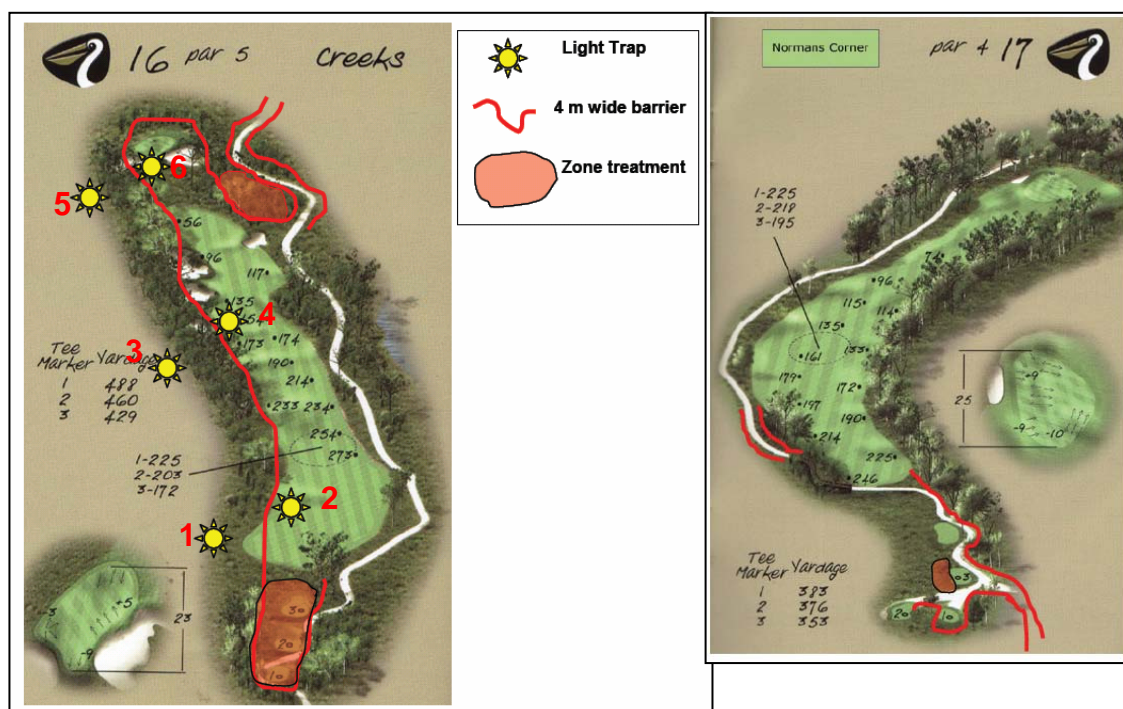
Pre-treatment trapping was undertaken to assess the general level of mosquito activity and measure the relative abundance of mosquitoes for the fairway margin (protected) area and riparian forest (un-protected) area traps. The objective was to adjust trap locations, before treatment, to attempt to minimise any significant differences between mosquito collections from protected and un-protected areas and allow post-treatment differences in trap collections to reflect the effect of the treatment alone and not any underlaying bias produced as an artefact of arbitrary trap placement.

2.4   Barrier application

Bistar 80SC®was applied per the label directions as a 0.1% active aqueous mix to fringing vegetation to tee-off, fairway and green areas (see plate 3 for treatment areas). Application was made using a Solo® back pack power sprayer operated at low engine speed and flow rate of 3 l/min to deliver large droplets (> 200μ) to vegetation surfaces. The application was made to a width of approximately 4 metres and a height of 2.5-3 metres by spraying shrubs, small trees and long grass along the fairway margin. Plate 4 shows the application method. Standard application rates were maintained by observing a "point of run-off" technique. The first application was made on 27 September 2004. A re-treatment was undertaken on 25 November 2004.

Plate 4: Application of Bistar 80SC®
along 16th fairway.

2.5   Weather Monitoring

Rainfall is a major determinant of mosquito activity. Measurements of rainfall and other weather parameters including wind strength were recorded by the Golf Course operator's automated weather station (Plate 4). Data from the weather station logger were provided to assist with interpretation of trapping results.

**Plate 4. Club Pelican's
automated weather station**

Weather station data for Sep, Oct and Nov is reproduced in Appendix 1.

2.6 Statistical Analysis

For each collecting night, mosquito numbers from light traps in the un-protected areas and protected areas, respectively, were combined to calculate the mean number of mosquitoes per trap and standard deviation. These values were analysed for distribution normality and statistically significant difference using a standard t-test with a 95% ($P < 0.05$) confidence interval. Control efficacy was described as a per % reduction by the formula:

$$\% \text{ Reduction} = \frac{\text{Mean \# Untreated} - \text{Mean \# Treated}}{\text{Mean \# Untreated}} \times 100$$

The statistical analysis and graphing was performed using SigmaStat® software.

3.0 Results

3.1 General trapping results

The barrier assessment was based on a total of 30 trap nights which produced 5,370 mosquitoes from 19 species and 6 genera. Table 1 shows the raw collection data for the barrier assessment.

Table 1: Light trap data from treated barrier trial

Club Pelican Golf

| Mosquito Collections	Pre-treatment 26-27 Sep 04						27-28 Sep 04						7-8 Oct 004						21-22 Oct 04						1st retreatment 25-26 Nov 04						total
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	
Oc vigilax	184	29	81	147	55	63	9	1	1		1		9		3		2		1			1			824	7	376	51	452	60	2357
Oc procax							1				1										1				280	4	72	9	120		488
Oc notoscriptus	3	3	6	1	1																				8						22
Oc gahnicola	2		3	12	1	5					1	1			2	2		1	1		2	2									35
Oc alternans																											2				2
Oc vittiger																														1	1
Cx annulirostris	2			1	1	1														1		1	1	1	360	5	316	15	184	21	910
Cx sitiens																					1						16		12	1	30
Cx orbostiensis	22	3	9	8	5	3									1				6		10	1	3		32		8				112
Cx cylindricus	5	2	8	7															4		7		1		8						42
Cx australicus																							1								1
Ve funerea																									160	6	72	30	40	18	326
Ve Marks sp No 122																									80	3	40	27	28	12	190
An atratipies													2		1		1								1						5
An annulipies													1									1						1		2	5
Cq xanthagaster						1																					8		8		17
Cq linealis	27	6	12	22	12	3	9						14		2			2	16	3	16	7	7	8	96	3	40	4	80	5	394
Cq variegata																					2										2
Ma uniformus		2	1	2	3		1				1		48		12	1	16	1	69	13	62	38	59	18	40	1	24	4	12	3	431
	245	45	120	200	79	75	20	1	2	0	3	1	73	0	19	3	18	4	100	18	102	51	73	26	1888	30	974	141	936	123	5370

The pre-treatment trapping on 26-27 Sep 04 produced 764 mosquitoes (including 559 *Oc vigilax*). The subsequent three collections produced together only produced 514 mosquitoes.

Rainfall in the month prior to treatment was recorded at 12.8 mm. There was no rainfall recorded for 37 days post treatment. Over the next 36 days a total of > 300 mm of rain was recorded.

Over the assessment period, *Oc vigilax* was the most abundant mosquito. It represented 44% of the total. It was followed by *Culex annulirostris* - 17%, *Mansonia uniformus* - 8%, *Cquillettidia linealis* - 7%, and *Varrallina funerea* – 6%. The above species collectively represented 82% of the total. The remaining 14 species made up the balance. Around 80 % (by number) of the mosquitoes collected came from 20% of the species represented.

3.2 Pre-treatment trapping comparison.

Graph 1 shows the comparison between the numbers of mosquitoes collected from the finally selected trap sites. Across the 6 trap sites 764 mosquitoes were collected. Analysis of the numbers collected from the chosen un-protected and protected trap locations showed no significant difference with $P > 0.05$ (actual $P = 0.581$). This result indicates there were no underlying bias in collections from one site of the barrier to the other and post-treatment results should be a reflection of barrier efficacy.

Graph 1: Pre-treatment trapping for un-protected and protected site selection.

Club Pelican Golf
Pre-treatment difference between
3 Unprotected and 3 protected LT sites
26-27 Sep 04
All Mosquito spp.

P = 0.581
Not sig difference between sites

Pre-treatment Unprotected site Vs Protected site
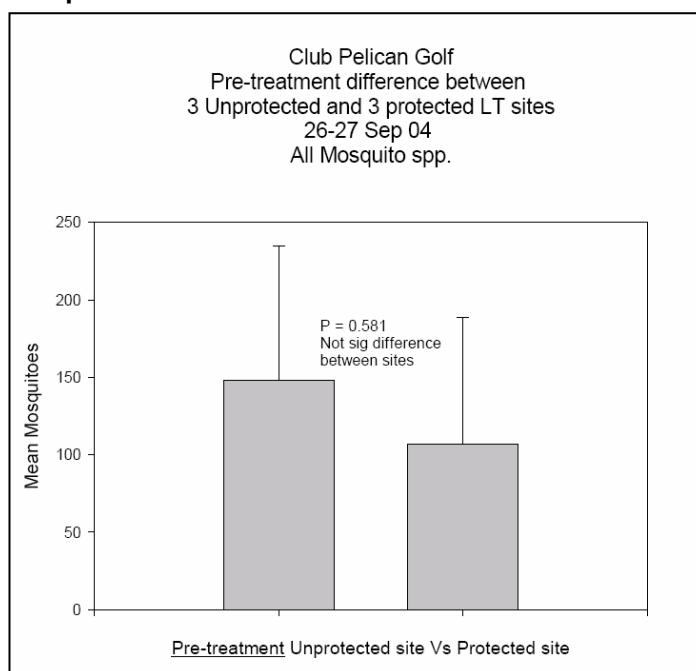
3.3   Post-treatment trapping comparison

Graph 2 shows the treatment performance on the three occasions trapping was undertaken following the initial treatment in September.

Graph 2: Post treatment trapping from un-protected and protected sites

Club Pelican Golf
Post-treatment difference
Un-protected Vs Protected

T'ment 27 Sep 04

■ Unprotected
▨ Protected

66%

92%   94%

27-28 Sep   7-8 Oct   21-22 Oct
P = 0.265   P = 0.132   P = 0.012
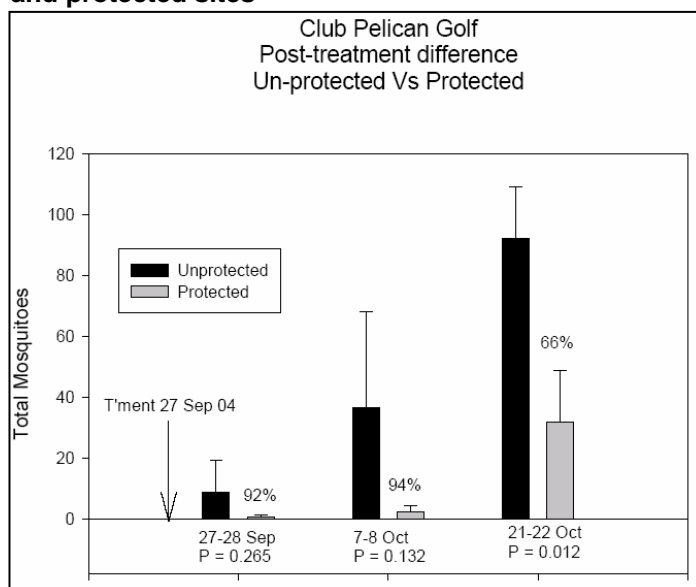
The analysis of collections on the first two post-treatment sampling occasions indicate there was not a statistically significant difference between un-protected and protected sites with $P > 0.05$ (actual $P = 0.265$ & 0.132

respectively). The overall numbers of mosquitoes collected on those occasions were 27 and 117 respectively.

On the 3rd trapping occasion, 21-22 Oct, mosquito numbers had increased to a total of 370. Calculation gave a reduction of 66% and $P < 0.05$ (actual $P = 0.012$).

When the data from the three trapping occasions was grouped, the overall performance of the 1st application was 75% control with strong statistical certainty of $P = 0.035$ (see graph 3).

Graph 3: Overall treatment efficacy assessment from 1st application.
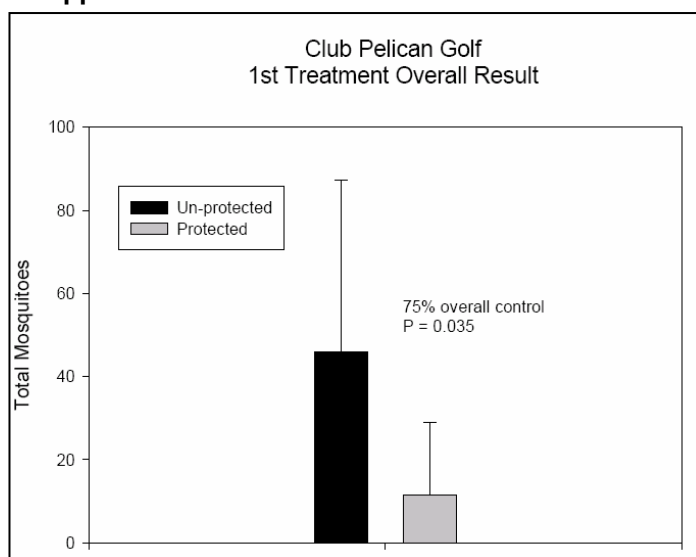
3.4   Re-treatment Assessment

Re-treatment of the barrier occurred on 25 November 2004 (approx 8 weeks following the first). The treatment and assessment methodology was unaltered and the same areas were treated per the first application. Mosquito numbers had greatly increased from those collections made previously. A total of 4,092 mosquitoes were collected from the 6 traps in one night. The striking increase in mosquitoes followed several large thunder storms that yielded around 300 mm of rain over the preceding 3 weeks.

Plate 5: Re-treatment collections from 25-26 November 2004
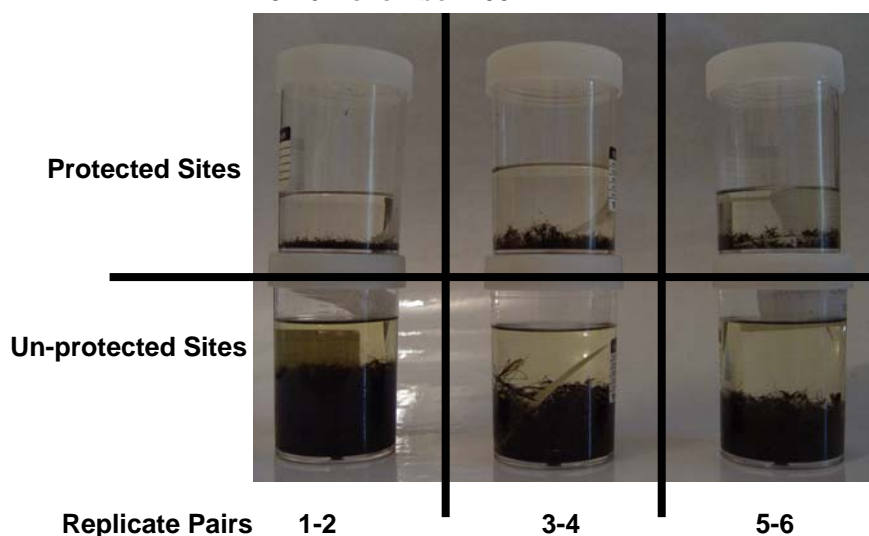
Plate 5 provides a visual comparison of collections between the three unprotected and protected sites. For the statistical treatment, Graph 4 shows the comparison between un-protected and protected trap locations. The re-treatment provided 92% reduction in mosquitoes with a strong statistical confidence (P = 0.020).

Graph 4: Re-treatment Assessment
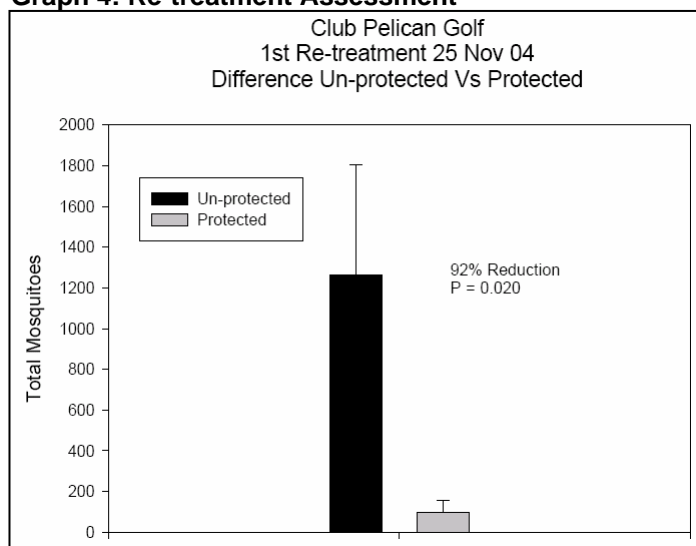
4.0   Discussion

Pre-treatment trapping on 26-27 September had shown there were reasonable numbers of mosquito present to give good data on the initial treatment's efficacy. On the evening following the treatment however (the first assessment trapping night), strong winds suppressed mosquito activity

sharply. The collections diminished from 764 to 27 over the intervening 24 hours.

Continuation of dry windy weather to mid October kept the general mosquito population relatively low with the collection total raising to only 370 a month post-treatment. For the assessment collection taken on 21-22 October, however a statistically significant difference was recorded. This provides opportunity for a re-assessment of the treatment's performance for previous collections.

A statistically valid result on the 21-22 October would indicate that, had the mosquito population remained relatively high over the preceding time, the results would likely also have been significant. The poor confidence value recorded in the first two post-treatment collections was likely a function of a lack of mosquitoes to challenge the treatment rather than a reflection of poor treatment efficacy.

The re-treatment protocol was identical to the first treatment. The results following re-treatment gave 92% control with high statistical certainty with abundant mosquitoes to challenge the treatment. It is considered reasonable to conclude that the first treatment would also have provided more clear evidence of efficacy had more mosquitoes been present to smooth out the statistical vagaries.

The overall treatment efficacy for the 1st treatment was recorded at 75% (P = 0.035). This result is considered a characterisation of successful control. The re-treatment result of 92% (P = 0.020) also is consistent with a claim of successful control.

5.0   Conclusions

The technique of applying Bistar 80SC$^{®}$ as a residual barrier treatment to attenuate passage of mosquitoes from southern breeding sites into the golf course has been shown to be effective in the context of this study. It provides for practical applications lasting 6-8 weeks.

The relatively recent availability of this product provides an opportunity for the golf course operators to select it to manage dispersing mosquitoes as need dictates. It should be considered part of an integrated mosquito management strategy for the golf course that also includes controlling mosquito breeding on-site and providing information to players on mosquito activity.

6.0   Recommendations

- Bistar 80SC®barrier treatments should be made to the areas identified in this report as required.
- Periodic measuring of control efficacy should be maintained and reported to the operators to ensure treatments remain effective.
- Barrier treatments should only be used corresponding to the seasonal appearance of mosquitoes in pest numbers.
- Barrier treatments should be considered as one aspect of an integrated mosquito management program for the golf course that also includes control of on-site mosquito breeding and providing information to players and staff.

7.0   Acknowledgements

The author wishes to thank Ben Marshal and other Club Pelican staff for their assistance with course access and advice, Staff of Amalgamated Pest Control for providing the application service and their interest. Thanks also to Caloundra City Council – Vern Butterworth for discussion on experimental design.

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5 December 2004

Appendix 1
Raw Data: Club Pelican Golf Course Weather Station
Sep, Oct, Nov 2004.

September 2004

Daily Summary Station1

1/09/2004 - 30/09/2004   5/10/2004

Date	Temp. °C Avg	Min	Max	RH % Avg	Min	Max	Solar Rad. MJ/m² Total	Min	Max	Wind kph Avg	Min	Max	Dew Pt. °C Avg	Min	Max	Rain mm	ET mm
1/09/2004	14.0	9.8	18.7	85	57	94	1.900	0.000	0.967	1.0	0.0	11.4	13.0	6.0	17.0	5.6	1.2
2/09/2004	14.4	6.8	21.6	68	41	91	5.552	0.000	0.858	3.9	0.0	20.6	9.3	2.9	15.3	0.0	3.8
3/09/2004	14.7	8.1	21.0	77	50	94	5.287	0.000	1.122	3.5	0.0	22.3	12.0	6.3	16.1	0.8	3.7
4/09/2004	15.0	9.7	21.5	81	54	95	3.746	0.000	1.296	1.6	0.0	12.0	13.2	9.3	20.1	4.3	2.8
5/09/2004	13.5	5.9	22.8	80	51	98	4.874	0.000	0.997	1.5	0.0	16.0	11.4	5.7	18.3	0.3	3.5
6/09/2004	14.5	6.8	23.5	79	50	95	5.679	0.000	0.874	1.7	0.0	20.0	12.0	6.0	20.7	0.0	4.2
7/09/2004	16.8	8.3	25.4	78	48	95	5.140	0.000	1.020	1.4	0.0	12.5	14.4	8.4	22.8	0.0	4.0
8/09/2004	19.7	14.8	24.1	80	63	93	2.674	0.000	1.271	2.2	0.0	18.3	18.4	14.3	23.8	0.8	2.4
9/09/2004	19.1	15.3	21.7	83	73	91	0.889	0.000	0.277	2.0	0.0	14.8	18.5	13.3	21.5	1.0	0.9
10/09/2004	14.8	6.9	23.8	66	21	93	6.013	0.000	0.912	2.5	0.0	19.4	8.4	-1.8	16.3	0.0	4.2
11/09/2004	15.0	6.4	24.6	74	39	95	5.826	0.000	0.894	1.5	0.0	13.7	11.3	5.4	17.6	0.0	4.1
12/09/2004	16.8	7.6	26.0	56	14	98	5.926	0.000	0.972	4.8	0.0	29.8	5.7	-8.2	22.8	0.0	4.2
13/09/2004	14.0	8.5	21.3	53	28	91	5.586	0.000	1.135	4.0	0.0	22.9	4.4	-5.3	12.6	0.0	3.7
14/09/2004	14.5	9.1	21.3	73	43	92	5.393	0.000	0.989	2.7	0.0	21.2	10.8	5.1	16.8	0.0	3.7
15/09/2004	15.8	7.4	25.8	72	30	95	5.962	0.000	0.953	1.8	0.0	13.1	11.1	5.2	21.6	0.0	4.3
16/09/2004	16.0	6.9	25.0	67	24	93	6.080	0.000	0.916	2.5	0.0	30.4	9.6	0.9	19.8	0.0	4.3
17/09/2004	15.6	7.2	24.8	77	44	95	6.050	0.000	0.926	1.7	0.0	14.3	12.7	7.2	21.3	0.0	4.5
18/09/2004	17.4	7.8	27.7	74	32	96	5.642	0.000	0.951	2.1	0.0	16.6	13.8	7.7	24.7	0.0	4.3
19/09/2004	18.3	10.3	28.9	74	30	94	5.257	0.000	1.070	1.8	0.0	20.6	14.9	7.5	21.7	0.0	4.0
20/09/2004	17.4	9.4	28.1	78	44	95	5.568	0.000	1.099	3.4	0.0	22.3	15.0	9.1	24.4	0.0	4.2
21/09/2004	18.7	9.3	23.8	73	42	94	5.687	0.000	1.303	3.2	0.0	19.4	13.1	6.8	19.0	0.0	4.1
22/09/2004	16.1	9.2	24.0	72	39	96	6.290	0.000	0.940	2.2	0.0	18.9	11.9	8.0	19.6	0.0	4.6
23/09/2004	17.4	8.0	27.8	71	32	95	5.360	0.000	1.038	1.7	0.0	16.0	12.9	7.9	24.8	0.0	4.0
24/09/2004	20.7	11.9	31.9	67	24	93	5.960	0.000	0.908	4.7	0.0	25.8	15.7	6.5	23.4	0.0	4.7
25/09/2004	21.0	14.8	25.4	87	50	87	5.689	0.000	1.240	4.7	0.0	19.4	18.7	13.4	19.6	0.0	4.3
26/09/2004	19.8	13.0	27.3	78	54	94	4.949	0.000	1.183	2.0	0.0	15.4	17.9	13.3	24.1	0.0	3.9
27/09/2004	21.9	17.3	28.8	76	50	92	5.213	0.000	1.321	2.3	0.0	16.0	19.8	15.7	24.7	0.0	4.1
28/09/2004	21.6	16.1	28.5	75	51	94	6.197	0.000	0.922	2.4	0.0	15.4	19.2	14.9	24.8	0.0	4.9
29/09/2004	20.7	13.5	28.5	72	41	94	6.382	0.000	1.084	2.4	0.0	15.4	17.0	11.8	24.0	0.0	4.9
30/09/2004	21.1	14.0	29.3	69	38	93	6.510	0.000	0.952	2.9	0.0	18.3	17.0	11.6	24.8	0.0	5.1
Avg/Total:	17.1	9.9	25.0	73	42	94	158.961	0.000	1.012	2.5	0.0	18.4	13.4	7.2	20.8	12.7	118.7
Min:	13.5	5.9	18.7	53	14	87	0.889	0.000	0.277	1.0	0.0	11.4	4.4	-8.2	12.6	0.0	0.9
Max:	21.9	17.3	31.9	85	73	96	6.510	0.000	1.321	4.7	0.0	30.4	19.8	15.7	24.8	5.6	5.1

October 2004

Daily Summary Station1

1/10/2004 - 31/10/2004   2/12/2004

Date	Temp. °C Avg	Min	Max	RH % Avg	Min	Max	Solar Rad. MJ/m² Total	Min	Max	Wind kph Avg	Min	Max	Dew Pt. °C Avg	Min	Max	Rain mm	ET mm
1/10/2004	21.6	14.1	28.7	66	36	93	6.008	0.000	1.231	2.8	0.0	21.7	18.3	12.7	22.5	0.0	4.6
2/10/2004	21.3	15.2	30.2	54	18	86	6.806	0.000	0.983	4.9	0.0	27.5	11.9	-0.1	22.7	0.0	5.0
3/10/2004	19.2	11.6	26.6	68	36	89	6.510	0.000	0.974	2.5	0.0	21.7	14.5	8.2	20.1	0.0	4.9
4/10/2004	20.8	12.8	30.8	72	31	94	8.495	0.000	0.971	1.9	0.0	14.8	16.9	11.2	24.9	0.0	5.1
5/10/2004	20.5	13.4	29.0	74	35	94	5.254	0.000	1.099	2.3	0.0	16.0	17.6	9.1	23.8	0.0	4.1
6/10/2004	20.8	11.6	30.4	55	20	91	8.852	0.000	0.987	2.1	0.0	18.9	10.4	1.5	20.3	0.0	5.1
7/10/2004	18.8	10.2	26.6	74	52	92	6.081	0.000	1.184	2.3	0.0	20.0	16.0	8.5	21.9	0.0	4.7
8/10/2004	24.8	14.3	37.6	57	11	94	6.261	0.000	1.036	4.1	0.0	26.6	13.6	-10.6	26.9	0.0	4.8
9/10/2004	19.4	12.8	26.1	67	33	93	6.930	0.000	0.985	2.9	0.0	21.7	14.3	7.7	21.0	0.0	5.1
10/10/2004	20.8	15.9	25.3	65	47	84	6.858	0.000	1.025	5.3	0.0	25.8	15.9	10.5	19.7	0.0	5.1
11/10/2004	20.0	12.3	26.4	84	36	89	7.161	0.000	1.072	2.8	0.0	17.7	14.2	8.9	22.3	0.0	5.3
12/10/2004	18.6	10.2	27.0	71	44	94	6.964	0.000	0.994	1.8	0.0	16.0	14.6	8.9	24.7	0.0	5.2
13/10/2004	19.6	10.5	27.7	71	43	94	7.114	0.000	0.987	2.2	0.0	13.7	15.7	9.1	24.4	0.0	5.4
14/10/2004	21.0	13.0	29.5	70	37	94	7.127	0.000	0.991	2.9	0.0	21.7	17.0	10.6	24.4	0.0	5.5
15/10/2004	22.5	15.1	31.4	69	33	91	6.862	0.000	0.961	2.8	0.0	17.1	18.5	12.6	22.7	0.0	5.7
16/10/2004	21.9	20.0	24.6	72	55	88	2.972	0.000	1.419	7.0	0.0	24.0	18.9	15.0	22.8	0.0	2.4
17/10/2004	21.0	14.3	25.9	64	46	90	3.399	0.000	1.461	6.1	0.0	24.0	15.8	12.2	20.9	8.1	2.7
18/10/2004	17.9	14.2	19.9	86	77	93	1.459	0.000	1.517	3.1	0.0	24.0	18.3	12.7	21.4	18.8	1.2
19/10/2004	20.5	17.9	26.8	83	55	93	4.272	0.000	1.226	3.8	0.0	21.7	20.0	15.8	24.8	5.3	3.7
20/10/2004	18.7	16.6	22.2	86	75	93	2.070	0.000	1.387	0.7	0.0	13.1	18.9	16.3	23.0	8.4	1.9
21/10/2004	19.7	14.2	27.0	70	35	92	4.815	0.000	1.530	2.6	0.0	21.2	15.5	8.0	20.7	0.5	3.4
22/10/2004	22.6	12.7	33.3	66	23	94	6.630	0.000	1.264	2.4	0.0	18.3	16.9	8.3	25.8	0.0	5.3
23/10/2004	26.9	19.0	37.5	61	19	87	7.191	0.000	1.299	3.0	0.0	23.5	20.2	9.3	26.7	0.0	5.9
24/10/2004	24.5	19.1	32.4	76	44	93	6.593	0.000	0.938	2.3	0.0	17.7	22.6	18.2	29.3	2.5	5.5
25/10/2004	23.1	18.4	27.0	75	56	88	6.347	0.000	1.314	3.8	0.0	20.6	21.1	13.9	25.8	0.0	5.2
26/10/2004	23.4	20.8	27.5	75	55	87	5.671	0.000	1.540	2.2	0.0	16.6	21.4	17.9	23.7	0.0	4.8
27/10/2004	25.0	22.1	30.0	78	60	92	4.543	0.000	1.371	1.9	0.0	13.1	23.9	21.1	27.5	0.8	3.9
28/10/2004	24.2	18.8	31.6	63	20	88	6.337	0.000	1.195	4.5	0.0	24.0	18.3	4.0	24.2	0.0	4.9
29/10/2004	21.1	19.2	24.4	80	51	66	5.483	0.000	1.487	7.2	0.0	29.8	15.1	12.1	18.7	0.0	4.9
30/10/2004	19.2	17.1	21.0	73	58	91	2.727	0.000	1.338	5.8	0.0	24.6	16.3	12.7	20.4	6.3	1.9
31/10/2004	19.7	14.3	24.3	69	46	92	6.991	0.000	1.206	4.5	0.0	21.7	15.6	10.7	22.2	9.3	5.0
Avg/Total:	21.2	15.2	28.0	70	41	90	177.983	0.000	1.193	3.4	0.0	20.7	17.0	10.2	23.2	49.0	136.1
Min:	17.9	10.2	19.9	54	11	66	1.459	0.000	0.938	0.7	0.0	13.1	10.4	-10.6	18.7	0.0	1.2
Max:	26.9	22.1	37.6	86	77	94	7.191	0.000	1.540	7.2	0.0	29.8	23.9	21.1	29.3	18.8	5.9

November 2004

Daily Summary — Station1

1/11/2004 - 30/11/2004 — 2/12/2004

PAGE 83 — PELICAN WATERS GC — 8754375855 — 4:09

Date	Temp. °C Avg	Min	Max	RH % Avg	Min	Max	Solar Rad. MJ/m² Total	Min	Max	Wind kph Avg	Min	Max	Dew Pt. °C Avg	Min	Max	Rain mm	ET mm
1/11/2004	19.8	13.2	25.9	75	49	93	7.873	0.000	1.132	2.4	0.0	17.7	18.8	12.5	21.1	0.0	6.0
2/11/2004	21.5	12.9	28.3	75	45	94	7.685	0.000	1.170	2.0	0.0	19.4	18.7	13.0	25.8	0.0	8.1
3/11/2004	22.7	17.3	30.1	77	50	93	5.058	0.000	1.456	2.3	0.0	20.8	20.8	12.4	26.0	18.3	4.1
4/11/2004	23.2	17.8	28.9	79	57	94	7.422	0.000	1.130	1.7	0.0	15.4	22.0	18.9	27.1	0.3	6.2
5/11/2004	22.6	18.4	26.6	84	59	94	4.666	0.000	1.277	1.4	0.0	20.0	22.4	19.5	27.1	23.9	4.1
6/11/2004	23.3	19.5	28.7	86	61	94	4.374	0.000	1.558	1.4	0.0	18.3	23.9	20.8	28.9	7.6	4.3
7/11/2004	22.0	19.7	25.9	90	73	95	1.484	0.000	1.032	0.8	0.0	12.0	23.4	21.5	26.4	52.6	1.8
8/11/2004	22.0	17.6	27.6	86	61	95	4.897	0.000	1.420	1.4	0.0	12.0	22.3	18.4	27.5	21.6	4.1
9/11/2004	20.4	15.4	29.3	88	56	95	4.887	0.000	1.456	2.0	0.0	29.2	20.8	15.6	27.6	57.2	4.1
10/11/2004	20.1	14.2	24.8	82	62	96	8.024	0.000	1.566	3.5	0.0	20.6	19.1	15.4	23.5	0.0	4.5
11/11/2004	22.4	16.6	27.4	76	54	93	8.570	0.000	1.431	2.2	0.0	16.0	20.4	18.5	24.2	0.0	5.1
12/11/2004	26.1	18.3	33.6	69	38	93	6.856	0.000	1.471	2.9	0.0	26.3	22.3	17.4	27.6	1.5	5.6
13/11/2004	24.1	16.1	32.3	76	37	94	7.814	0.000	1.012	1.5	0.0	13.1	22.0	14.2	29.3	0.0	6.4
14/11/2004	22.5	16.2	27.8	65	37	91	8.129	0.000	1.077	2.8	0.0	18.9	17.3	4.5	26.1	0.0	6.1
15/11/2004	22.4	15.0	29.3	75	50	94	7.866	0.000	1.143	1.7	0.0	13.1	20.0	14.1	27.7	0.0	6.2
16/11/2004	24.4	17.3	30.5	78	56	94	8.002	0.000	1.161	2.1	0.0	13.7	23.1	18.5	27.9	0.0	6.6
17/11/2004	25.4	21.6	30.3	72	50	88	7.595	0.000	1.207	2.1	0.0	14.3	22.7	18.3	28.9	0.0	6.1
18/11/2004	24.0	17.5	29.1	89	43	94	8.432	0.000	1.195	1.8	0.0	13.1	20.1	14.5	27.4	0.0	8.5
19/11/2004	24.5	19.1	29.8	85	39	88	8.408	0.000	1.105	1.7	0.0	14.8	19.7	14.7	25.1	0.0	6.6
20/11/2004	23.5	17.7	28.9	71	47	93	7.209	0.000	1.507	2.8	0.0	17.7	20.3	15.5	28.5	0.0	5.8
21/11/2004	22.2	18.9	26.8	79	54	94	4.890	0.000	1.190	3.2	0.0	17.1	20.9	17.5	25.7	8.8	4.1
22/11/2004	20.3	18.8	24.8	89	68	94	2.521	0.000	1.498	1.8	0.0	18.9	21.3	18.5	25.6	21.3	2.2
28/11/2004	21.9	16.0	27.4	67	48	89	1.977	0.000	0.899	1.3	0.0	10.8	17.4	14.4	20.3	0.0	1.4
29/11/2004	22.3	13.2	30.4	72	40	94	8.613	0.000	1.070	1.9	0.0	15.4	18.7	13.8	24.0	0.0	6.7
30/11/2004	23.9	16.6	31.4	70	36	91	8.572	0.000	1.058	2.4	0.0	20.0	20.4	15.3	25.2	0.0	6.8
Avg/Total:	22.7	17.0	28.7	78	51	93	157.924	0.000	1.249	2.0	0.0	17.1	20.7	16.2	26.2	210.8	127.3
Min:	19.6	12.9	24.6	65	37	88	1.484	0.000	0.899	0.8	0.0	10.8	16.8	4.5	20.3	0.0	1.4
Max:	26.1	21.6	33.6	90	73	96	8.613	0.000	1.566	3.5	0.0	29.2	23.9	21.5	29.3	57.2	6.8

WE ARE MISSING SOME DETAILS

23/11/04   WE HAD SOME RAIN.   APPROX   45mm