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Summary

Mosquito management activities undertaken by the City, in conjunction with the Peel Mosquito Management Group (PMMG), were subdued during season 2015/16, as predicted.

The sustained influence of the strongest El Niño event to be experienced for some years, resulted in a season of limited mosquito reproduction and abundance across the region. This in turn, reduced the need for mosquito management activities by the program. The 2015/16 season experienced record low mosquito abundance and the third consecutive season of well below average mosquito activity.

For the entire season, only nine (9) helicopter larviciding treatments were necessary over the period of July 2015 to June 2016 covering the comparatively small area of 723.5 hectares, the lowest in the last decade.

The 2015/16 season saw some significant improvements to helicopter availability and application equipment which will be important when inevitably conditions become more favourable for mosquito breeding. The program is continuing to build knowledge and capacity and can be considered to be at the forefront of broad scale mosquito management nationally.

As of 27th September 2016, the Australian Bureau of Meteorology released its most recent El Niño—Southern Oscillation (ENSO) update indicating that the outlook for 2016/17 will be more favourable for mosquito breeding. The ENSO Outlook remains at La Niña WATCH. It is likely that the coming season while being more favourable for mosquito reproduction compared to recent years will be moderate in terms of overall community impact.

Due to the expected environmental changes in the coming years, mosquito management is expected to become increasingly challenging therefore the City of Mandurah, PMMG and Department of Health will be required to utilise every available opportunity to ensure mosquitoes are managed effectively to reduce the disease risk and amenity impact on the community.

Disclosure of Interest
Nil

Previous Documentation

<table>
<thead>
<tr>
<th>Code</th>
<th>Date</th>
<th>Title</th>
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</thead>
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<tr>
<td>G.37/3/11</td>
<td>22 March 2011</td>
<td>Council Resolved to invite a peer review of the City's Mosquito Management Program</td>
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Background

The PMMG consisting of the City of Mandurah, Shire of Murray, City of Rockingham and the Shire of Waroona conducts mosquito management across the Peel Region, in partnership with the Department of Health Western Australia. This annual report provides a review of the Peel Mosquito Management Group's activities during the 2015/16 season with a specific focus on the City of Mandurah.

The purpose of this report is to provide a summary of mosquito management operations during the season, the environmental drivers of mosquito breeding cycles and to inform on the prevalence of mosquito borne disease. The report includes analysis of the season's tidal events, aerial larviciding treatments and adult mosquito abundance.

Mosquitoes in general pose significant health and lifestyle impacts to millions of people worldwide. Within the Peel region, the greatest health risk and nuisance factor to residents and visitors is from saltmarsh mosquitoes. This risk and the challenge the mosquito management program faces, is amplified by the fact that the vast majority of the City's residential suburbs and recreation facilities are within the established flight range of the two local species of saltmarsh mosquito in the Peel Region.

Mosquito management in the Peel Region requires a coordinated and collaborative approach and is undertaken by the PMMG, working in partnership with the Department of Health and the contracted Helicopter provider. This alliance is essential given the regional disease risk, extensive breeding habitat (estimated to be up to 600Ha), prolific mosquito breeding cycles and urbanisation within the Peel Region.

The program's primary focus is to reduce the risk of mosquito-borne transmitted disease via the targeted reduction of mosquito populations which in turn alleviates the impact of nuisance saltmarsh mosquitoes on City of Mandurah residents and the broader community.

Aerial larvicide treatments via helicopter is the PMMG's primary method for the reduction of saltmarsh mosquito larval populations and has the ability to successfully remove a high percentage of mosquito larvae that would, if untreated, emerge as mature adult mosquitoes and pose the risk of disease transmission in the community.

The extent of larval and adult saltmarsh mosquito abundance at any given time is heavily influenced by previous breeding intensity and adult abundance, environmental conditions prior to, during and following treatments, and the programs ability to carry out aerial larviciding treatments at the suitable times to optimise larvicide efficacy.
Key events and statistics from the 2015/2016 season

Below average reported cases of Ross River virus across the State, region and City.

1. 504 RRV cases recorded in WA compared to 1246 in 2014/15
2. 89 RRV cases recorded in the Peel Region compared to 240 in 2014/15
3. 40 RRV cases recorded in Mandurah compared to 100 in 2014/15

- Nine aerial larviciding treatments were undertaken between July 2015 - June 2016.
- A total of 723.5 hectares were treated compared with 2,382.8 hectares in 2014/15 (reduction of 69%).
- The average aerial treatment size for the 2015/16 season was 80 hectares compared to 140 hectares in 2014/15.
- August 2015 (283 ha) and May 2016 (104.9 ha) were the largest treatments completed.
- 2550kg of Prolink® Prosand applied via Helicopter.
- No liquid Bti (TEKNAR® 1200SC) applications.
- 4302kg of Bti Corn Cob Bti (Barmac® 200GR) applied via Helicopter.
- 90 Prolink Briquettes installed to breeding sites within the City of Mandurah
- Adult mosquito trapping by the Medical Entomology (DoH averaged 46 mosquitoes per trap (24hrs) between September 2015 and April 2016, a 61% drop compared with 2014/15 (118).
- Four GIS mapped complaints were recorded in comparison to 9 in 2014/15.

Comment

Historically the ENSO - El Niño Southern Oscillation Index has been linked with and provided some indication of the intensity of a season’s events in terms of local environmental conditions that are likely to drive mosquito breeding cycles. In the past El Niño events have coincided with seasons of lower mosquito abundance. Neutral seasons provide generally moderate conditions where La Niña seasons have seen the most challenging conditions for mosquito management in the Peel region.

Whilst the effects of these ENSO events are difficult to predict in terms of the nature and intensity of a particular season, local weather patterns and tide behaviour are clearly influenced by these and other climatic drivers that occur on global scale.

The 2015/16 treatment season commenced with the Australian Bureau of Meteorology’s July 2015 ENSO update reporting that international climate models predicted the El Niño event to strengthen through 2015, and persist into early 2016 which proved to be accurate.

The El Niño event was the strongest in some years and impacted regional weather patterns. These weather patterns influenced local tide behaviour, restricted saltmarsh mosquito reproduction cycles and negated the vast majority of tidal inundation and hatching events.

Following on from the infrequent tidal inundation events reported during the 2014/15 season, the regions saltmarsh wetlands received even less tidal inundation during the 2015/16 which resulted in breeding sites remaining dry or receiving minimal and brief inundation across the season.

Of the 26 El Niño events since 1900, around 50% have been followed by a neutral year, while 40% have been followed by La Niña. Climate modelling is suggesting that ENSO neutral levels will continue through to the end of 2016, though one international model suggests a La Niña late in the year is possible, with a repeat El Niño the least likely outcome.

Based on historical data this is likely to produce a more challenging season than those we have experienced for the last two years.
Weather Influences

Environmental drivers of local weather patterns and conditions play an important role in the ability for saltmarsh mosquitoes to sustain their breeding cycles in the Peel Region. Whilst tidal amplitude within the Peel Harvey system is typically less than 30cm, tides can vary greatly from astronomical and historical predictors.

Weather influences such as changes in barometric pressure on sea levels associated with low and high pressure systems, inflow from river systems, tropical cyclones reaching the mid-west, approaching cold fronts and wind forces either individually or as a combination of these events can have significant impacts on local tide behaviour. Tidal surges (Storm Surge) that are created as a result can inundate vast areas of breeding habitat and initiate the hatching of mosquito eggs that have the ability to remain in a dormant state and can hatch simultaneously across a number of days in their millions.

During season 2015/16 warmer than average temperatures were recorded through winter and spring 2015. This period also recorded very low rainfall across the South West Land Division (SWLD). Summer 2015/16 recorded near average temperatures however rainfall was generally above average. Autumn 2016 saw continued above average rainfall and temperatures drop below average.

Significant weather events such as summer storms and tropical cyclones that have the potential to disrupt the programs operations did not present during the 2015/16 season. These stable conditions proved unfavourable for recurring mosquito reproduction and spikes in mosquito abundance.

South West Land Division - Seasonal Weather Summary 2015 - 2016

<table>
<thead>
<tr>
<th>Season</th>
<th>Rainfall:</th>
<th>Maximum temp:</th>
<th>Minimum temp:</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter 2015</td>
<td></td>
<td>2nd Driest winter for southwest WA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun - Aug</td>
<td></td>
<td>Above to very much above average</td>
<td>Above average</td>
<td></td>
</tr>
<tr>
<td>Spring 2015</td>
<td></td>
<td>13th Driest for SWLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept - Nov</td>
<td></td>
<td>Highest for WA and SWLD</td>
<td>Highest for SWLD</td>
<td></td>
</tr>
<tr>
<td>Summer 2015/16</td>
<td></td>
<td>6th Wettest summer in the Lower Southwest</td>
<td>Near average /Above average</td>
<td></td>
</tr>
<tr>
<td>Dec - Feb</td>
<td></td>
<td>Near average /Above average</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autumn 2016</td>
<td></td>
<td>Above average; the wettest autumn since 2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>March - Apr</td>
<td></td>
<td>Below average</td>
<td>Above average</td>
<td></td>
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</tbody>
</table>
Tide Influences

The breeding cycles and seasonal abundance of saltmarsh mosquitoes in the Peel region are fundamentally linked to the localised sea level and tidal fluctuations that inundate the Peel Harvey Estuary saltmarsh wetlands.

Tide levels can vary greatly from predicted tide heights, with tidal surges of 40cm above predicted heights being a regular occurrence within the Peel Harvey Estuary. These tides known as Storm Surge tides, do not always accompany a storm front or rainfall, but in fact can occur in seemingly calm weather having been generated by weather events that may not have any direct impact on local conditions such as tropical cyclones to the north.

Tidal inundation to the saltmarsh breeding grounds during the key months of 2015/16 was extremely limited when compared to season 2014/15. The vast majority of storm surge events were short lived and resulted in water levels returning to normal levels and in some cases dropping to below predicted levels with breeding sites drying out within a day or two.

On many occasions although tides did peak close to or above the trigger heights, the fact that wetlands were predominately in a dry state reduced extended pooling or seepage to the egg laden floods zones.

Figure 1 below provides a comparison of tidal activity during season 2015/16 and past seasons. The significant reduction of tides ranging from 0.70m up to and greater than 1.00m is clearly shown particularly when comparing data from 2011/12 (one of the worst seasons to date) with the events of 2015/16. The reduction in tides ranging from 0.80m and higher can be considered as the decisive and significant factor in terms of why season 2015/16 was significantly different when compared to most other seasons.

![Tide Height & Frequency Comparison - 2011/12 - 2015/16](image)

Figure 1 – Tide Data Comparison 2011/12 – 2015/16
(Data Courtesy Mandurah Ocean Marina Department of Transport)
The relationship between these significant SST's, the level of dependency or need for broad scale aerial treatments and the subsequent scale of aerial treatments is directly linked with the ensuing level and intensity of mosquito abundance and their ability to reproduce. The frequency and intensity of tidal inundation is a pivotal element in any season as not only do these more significant (>0.90m) surges inundate vast areas of breeding ground but in doing so typically result in an incalculable one off hatching of mosquito larvae.

The lack (160 days) of any significant tidal inundation from mid-October 2015 to mid-March 2016 captured in Figure 2 on the following page lead to no aerial treatments being required.

Surveillance and ground based treatments were undertaken by field officers following minor tides surges and isolated hatching events during this period. The highest surge that occurred within this period was on 19th January (0.89m). The ensuing inundation to wetland breeding sites was limited and resulted in officers treating small isolated areas of larvae on some of the most southern breeding sites.

The storm surge tide recorded on 26 April of 1.08m was the highest for the season but again did not persist with water levels reducing within 24 hours of the event. The seventh (7th) and second largest aerial treatment for the season was completed seven (7) days after this event.

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**Figure 2 – Trigger Tide Frequency Comparison**

October 10th 2015 – March 12th 2016
Season 2015/16 Aerial Larviciding

Aerial larviciding is the main technique that the program employs to achieve targeted and effective management of saltmarsh mosquito populations on a regional scale.

The application of both granule and liquid larvicide products is carried out via helicopter as this is the most effective broad scale application method that allows these treatments to be completed within the limited timeframes of the mosquito larvae lifecycle stages. The speed of this technique provides the ability to apply the different larvicides in the best possible weather conditions, and be timed to have the best effect taking into account water levels and mosquito larvae development stages. Aerial larviciding allows application in an unobtrusive manner with minimal ongoing impact to wetland and saltmarsh habitats.

In some situations there may only be a window of less than a day for effective application to occur. Decisions about which product will be used and the timing of the treatments are carefully considered during treatment preparation taking into account a number of factors and the distinct larvicide mode of action and characteristics with the aim of achieving the maximum reduction in mosquito populations.

The two active ingredients of larvicides used, S - methoprene and Bti, (Bacillus thuringiensis israelensis) are the most environmentally appropriate and approved products available and are utilised by mosquito management programs world-wide.

As in previous years, granular larvicides were predominately the most effective and widely used formulation due their suitability for local breeding site and weather conditions.

The targeted use of these larvicides provided reliable high mortality rates and consistent reduction in larval populations.

The nature of the season played its part in terms of which, when and how often a particular larvicide was used. The programs use of Bti granule continued through season 2015/16 as did the strategic use of the S - methoprene granule which has been a mainstay for the programs aerial larviciding program.

Following on from recent seasons the PMMG continued to remain proactive with early aerial treatments. The first and largest aerial treatment took place on 27 July 2015 whilst the last treatment of the 2015/16 season was completed on 30 June 2016. In terms of the number and timing of aerial treatments required during season 2015/16, treatments were few in number with five (5) of the nine (9) treatments completed in the last quarter of the season. Only the months of August 2015 and June 2016 required more than one treatment to be executed. No aerial treatments were necessary during the hotter summer months of November 2015 through to February 2016. This is a very unusual event and as previously discussed was associated with the reduced tidal inundation events. This resulted in record low levels of the summer saltmarsh mosquito species Aedes vigilax. This species is notorious for its aggressive biting habit and ability to disperse far from breeding areas and is the main pest mosquito active in the summer months particularly in the Peel region.
The average and total area of all (9) aerial treatments completed was also well down from previous years and is detailed within Figure 4 above. The first treatment of the season was the largest treatment undertaken for the entire season with all but one of the remaining eight (8) requiring less than 100 hectares of treatment.

The fact that three (3) of the aerial treatments were completed after April 2016 allowed the program to target the first cohorts of Aedes camptorhynchus which are typically active in the cooler months with the change to cooler temperature triggering this species reproduction cycles. These treatments allow the program to reduce the numbers of this mosquito before the onset of winter weather which promotes their breeding cycles but limits the programs ability to target the build-up of larval populations that fuel adult populations heading into spring.

In terms of larvicide use during season 2015/16, the granular Bti was again the dominant option with almost 60% of the total area treated with this larvicide.

The weather and tide environments that presented following the majority of aerial applications provided ideal conditions for optimal larvicide performance.

![Figure 4 - Comparison of Hectares treated 2015/16 – 2011/12. *Aerial larviciding was not available to the PMMG post April in season 2011/12.](image1)

![Figure 5 - Breakdown of Hectares by larvicide type](image2)
Helicopter Services

The Department of Health with the support of the PMMG have introduced a number of innovative improvements and changes to helicopter operations. These changes have increased availability of the helicopter services and improved larvicide applications for all local governments involved in mosquito management in WA.

Following an exhaustive tender process in 2015 and receiving a number applications, the Department of Health awarded the contract to long term provider Heliwest Group. Within this new contract two innovative developments have become available to the PMMG and other local governments for the next three years with the option of a two year extension.

The first of the additions sees the ability for two Bell 206 Jet Ranger helicopters to be made available to local governments across the south west for aerial larviciding potentially on the same day in the same region. This will assist in allowing extensive applications to hundreds of hectares in one day that in the past could only be managed over consecutive days with a single aircraft and if the following day’s weather was suitable.

This improvement provides a contingency plan should there only be one day in which suitable weather conditions present for larvicide application or aircraft flight. A further opportunity presents in the form of the ability for two different larvicides to be applied on the same day at the same time which allows targeted larvicide application to multiple larval growth stages or different site characteristics.

Access to two helicopters also allows aerial application of larvicides in two different localities on the same day. This will remove previous and potential future complications during the planning and timing of aerial applications particularly when small windows of suitable weather present and treatment options are limited. This is an important aspect given that the requirement for broad scale aerial mosquito treatments across the SW region typically occur at the same time.

The second and most notable development will see both primary and secondary helicopters operating with Isolair 4500 granular broadcaster hoppers incorporating AGNAV granular flow control impeller gate technology which enables improved flow control based on GPS derived ground speed and selectable present calibration for different larviciding products. This automated system, the first of its kind in the country, has been designed to provide a consistent and reliable feed of larvicide materials to predetermined treatment areas via both manual and automated activation.

This new system is a vast improvement on the previous equipment used and whilst the old system has served the programs needs well, the new approach provides a range of efficiencies in calibration and application that will be a huge help to the program and has not been available until now.

The equipment improvement and increased helicopter availability will place the DoH and PMMG in a favourable position in terms of increased capability and improved resources to increase mosquito management effectiveness.

This will be especially important when more challenging environmental conditions present in future seasons.
Figure 6 - provides a view of the granular flow controller unit that was developed in partnership between Lee County Mosquito Control District in Florida USA and Canadian based suppliers of GPS Navigation equipment, AGNAV.

Figure 7 - the AGNAV GUIA GPS navigation system that controls the GFC.

Figure 8 - the traditional sliding gate flow mechanism as supplied by the hopper manufacturer.

Figure 9 - Hopper fitted with GFC.
Aerial Application Assessment Work

The City and PMMG members continued to work with the Department of Health and the Helicopter contractor to refine the operation and accuracy of the larvicide disbursal system.

Field commissioning and testing of the new Isolair 4500 granular broadcaster hoppers incorporating AGNAV granular flow control commenced in November 2015 and continued to be undertaken on days of suitable weather through to July 2016.

Assessment of the dispersal configuration and on ground capture quantities and profile of granular larvicides was completed at the Murray airfield.

Whilst challenges have been experienced, it is important to acknowledge that the working group has developed a thorough understanding of the complexities and variables of the new application equipment and its performance in different scenarios.

In terms of this research and development within this aspect of mosquito control, the level of investigation and development work undertaken and the implementation of the new AGNAV granular flow control system places the program and its stakeholders at the forefront of aerial application nationally and internationally.

Further testing and refinement of the application equipment will be continued during the coming season, with a second AGNAV granular flow control system recently retro fitted to the pre-existing Isolair 4500 granular broadcaster hoppers. The second system will undergo commissioning during the 2016/17 season.
Adult Mosquito and Virus Surveillance

As in previous years the City of Mandurah and the DoH completed 22 adult mosquito trapping rounds throughout the season. A total of nine (9) static traps are utilised. Peel Region trapping data is vital to the mosquito management program as it monitors adult mosquito populations, allows species identification, mosquito borne disease detection and evidence of the success or failure of aerial treatments undertaken within the Peel region.

Based on season results, on average 46 mosquitoes were trapped on a fortnightly basis from September 2015 – April 2016. In comparing season 2015/16 against past seasons within the graph below, it was a season of record low mosquito abundance which is consistent with previous seasons when El Nino events have presented along with the direct impact of the programs operation.

Saltmarsh mosquito populations peaked in August 2015 following with breeding of the cooler temperature preferring species Aedes camptorhynchus through winter and into spring. The populations then steadily declined through to November and remained in low numbers throughout summer before a spike in numbers following the April aerial treatment and the onset of the cooler autumn months. The almost complete absence of the aggressive summer saltmarsh mosquito, Ae vigilax, during the hotter months was no doubt welcomed by the community. This mosquito is the primary species of nuisance and discomfort during the warmer summer months where outdoor pursuits of both sporting and leisure peak in the region and can appear in great numbers following a significant tide event.

Figure 12 details seasonal average adult trap counts since 1999/2000. Season have been coloured coded to represent and indicate those years when ENSO events have presented in there three forms.

It is clear from this information that no two season are the same and that the “good” and “bad” seasons in terms of the level and impact of mosquito populations come and go but on the whole the “bad” seasons are limited in longevity and frequency when compared to the “typical” and “good” seasons.

Figure 13 provided by the Department of Health’s Health Atlas illustrates the fluctuations and crossover of the two main saltmarsh mosquito species during season 2015/16.
As discussed earlier the abundance and decline of Aedes camptorhynchus can be clearly seen along with the significantly low abundance of Aedes vigilax indicted in red which was maintained across the entire season via aerial treatments completed in March and April.

The spike in Aedes camptorhynchus in early May 2016 followed the storm surge tide recorded on the 26th April of 1.08m and was the highest for the season. Larval counts of 1500/ m² were recorded following the tide event and resulted in the second largest treatment for the season being completed.

Figure 14 below details the monthly mosquito populations between September 2015 and April 2016 against the long term monthly mean.

Figure 15 Historic abundance and seasonal fluctuations of adult Aedes camptorhynchus and Aedes vigilax during season going back to the year 2007. (Courtesy DOH Health Atlas)
Virus Surveillance

Mosquito Borne Virus surveillance is undertaken by the DoH Medical Entomology section with the aim of identifying arbovirus activity - viruses transmitted by mosquitoes.

Polymerase Chain Reaction (PCR) testing is utilised to isolate arbovirus's from samples of mosquitoes that are trapped in the nine Peel region traps along with 12 others traps extending southwards from Harvey to Busselton.

The detection of any virus that poses a risk to public health allows the prediction of mosquito-borne virus outbreaks which can have a substantial impact on public health. Upon detection of arboviruses, the Department of Health notifies local governments and issues media statements and warnings to the general public to ensure residents and travellers take precautions to avoid mosquito bites. This covers both RRV and BFV state wide as well as MVE and Kunjin virus that are active in the states northern half.

Whilst this surveillance provides important information and is undertaken in conjunction with the fortnightly trapping program, virus isolation is only conducted on a percentage of the mosquito populations so it cannot be a definitive pre warning of risk and must be considered in conjunction with human case data.

During season 2015/16, no virus isolations were detected in the Peel region, however detections were obtained in the Leschenault region in March 2016.

The DoH provided a media statement to local authorities within the region to assist with localised media relations to residents and visitors to the area following the detection of Ross River Virus (RRV) activity in local mosquito populations which were very low at the time.

The City in collaboration with the DoH continued to trap and supply mosquito samples from within residential areas of Mandurah. The primary aim of supplying these samples from residential trapping surveillance over the last two seasons has been to investigate the degree and abundance of container breeding mosquitoes and whether they are posing a significant disease risk in addition to the saltmarsh mosquito vectors.

Figure 16 - Aedes notoscriptus - backyard and urban freshwater mosquito

The low abundance of saltmarsh mosquitoes during the season provided consistent samples of freshwater species such as Aedes notoscriptus (5950), however no positive virus isolations were detected.

Whilst this and similar attempts have yet to validate this species as an additional source of virus transmission, its poor vector capacity under experimental conditions and singular isolation of RRV from Aedes notoscriptus collected in Darwin may suggest this species does not pose a significant public health risk at this point in time.

However this species preferred breeding habitat is within natural and artificial containers and is typically found in residential backyards and actively seeks blood meals throughout the day. The potential for this species to contribute to disease transmission cannot be ruled out based solely on the results of the project over the last two years. Future attempts to investigate virus activity within residential mosquito populations may be considered in season where multiple isolations and human case numbers are more prevalent.
Human Cases of Mosquito Borne Disease – Notifiable and Laboratory Reported

Mosquito Borne disease surveillance is undertaken state wide by the DoH via initial patient presentation to general practitioners and subsequent blood tests that return positive tests for the virus. Notifications are then forwarded to local government Environmental Health Officers who follow up case details.

This information is then passed back to the Department’s Mosquito Borne Disease Control Branch for data collation and analysis.

A complex range of environmental factors influence the prevalence of virus in any given year. Given the constant risk of mosquito borne disease, the program’s efforts to significantly reduce mosquito populations is the primary intervention in regards to minimising interaction between mosquitoes and the public.

A focus must also be maintained in educating the public as there are times that disease risk can be high despite lower abundance of adult mosquitoes.

Season 2015/16 recorded a decline in reported cases on previous years with case numbers well below long term monthly averages during the higher risk months. This outcome is likely to be a combination of virus activity drivers, extremely low abundance of vector mosquitoes and the increase in community engagement and awareness in terms of protecting themselves against mosquito bites.

The fact that cases of Ross River virus continued to be reported within the Peel Region during a season of exceptionally low mosquito abundance underpins the challenges faced by state and local government health agencies in physically reducing the risk of mosquito borne disease even at times when the environment drivers are of supportive and restrictive nature.

2015/16 Ross River Virus Case Statistics:
- Confirmed human cases across the State - 493
- Confirmed human cases across the Peel Region - 78
- Confirmed human cases across Mandurah - 40

Figure 17 below provides a yearly comparison of Ross River Virus cases in the Peel Region from 2003 to 2016 as supplied by the Department of Health’s Health Atlas. The last major breakout of Ross River disease was in 2013.

(Courtesy DOH Health Atlas)
Figure 18 outlines monthly case numbers of Ross River Virus reported in Mandurah during season 2015/16. As previously discussed although there were no virus detections from pools of tested mosquitoes, human cases were reported in every month except May 2016.

(Courtesy Department of Health’s Health Atlas)
Community Engagement

In terms of community feedback, as expected very few complaints (4) about mosquitoes were received by the City. A number of residents contacted the City to commend the program for how well mosquitoes were being managed and their ability to enjoy outdoor activities without being adversely impacted by biting mosquitoes. Whilst the feedback was welcomed it was important that residents were made aware of the influential environmental conditions have on mosquito breeding and how this is likely to change in the coming years.

The City continued to utilise the email network database to provide subscribers with information on mosquito abundance, mosquito borne disease and mosquito management activities. The 450+ subscribers include individual addresses, a number of schools, sporting clubs and community organisations. Whilst the nature of the season resulted in only three updates being provided the timing of these emails was felt appropriate and beneficial in terms of providing meaningful information.

Feedback to the emails has been largely positive and the ability to provide information more rapidly is a positive due to the rapidly changing conditions and outcomes in mosquito management.

Figures 19, 20 and 21 detail the Fight The Bite campaign undertaken by the Department of Health

The program also utilised social media outlets in the form of the City’s Facebook page and Twitter account to provide update on the programs activities and reminders about personal protection, information about the topical Zika virus and information on how to keep backyards free from mosquito breeding in fresh water sources.

During season 2015/16 the DoH rolled out a number of communication projects as part of the “Fight the Bite” campaign. The Peel region was selected as one of the first regions to see the Fight the Bite message via a number outlets which included;

- Newspaper advertising in regional papers
- Radio advertising
- Shopalite boards (Mandurah Forum)
- Train station advertising (this one is not in the attachment)
- Billboard
- The West online
- Direct Mail out

The City and PMMG has and will continue to support the Fight the Bite initiative and its development over the coming seasons through its media and community engagement activities.
In assisting with future community engagement the PMMG and the City’s Strategy & Marketing section also developed a distinguishable logo during season 2015/16. The aim of the logo is to provide an identifiable emblem to assist with community and stakeholder’s engagement and the association between the PMMG’s abbreviated title when delivering formal and community communications.
Outlook for Season 2016/17

As of the 27th September 2016, the Australian Bureau of Meteorology released the following ENSO information update;

“Temperatures in the central tropical Pacific Ocean continue to be below average, but remain El Niño–Southern Oscillation (ENSO) neutral. Most international climate models surveyed indicate the Pacific is likely to remain at ENSO neutral levels through to the end of 2016, though one international model suggests a La Niña late in the year is possible. A La Niña WATCH remains in place, but if La Niña does develop it is likely be weak.”

Based on this shift and change of ENSO status, the history of ENSO cycles would indicate a more active season ahead for 2016/17 than the previous season. This will no doubt bring and see an increase in local weather events relating to more frequent and intense tidal inundation, increasing mosquito reproduction cycles and abundance. Recognising this, the program is conscious of the need and expectation and focus for effective and consistent broad scale mosquito management over the coming season within the Peel region.

It is also a reminder that at some point in the next two to five years a La Niña event is likely to return in some form and once more dictate the environment conditions.

These global events can evolve and change quickly and although they are a useful guide, our local and regional environmental conditions have an even greater influence on the program’s operations and performance and accepting that conditions may not present as predicted is a fundamental aspect of monitoring these drivers and operating mosquito management programs.

Figure 22 below provides an historic summary of ENSO events and their cyclic nature. Based on the duration and strength of the 2015/16 El Niño and its counterparts, the prediction of a mild La Niña would appear to be appropriate in viewing the El Niño and La Niña event recurrence and timeline.
Economic Implications
Mosquito-borne diseases such as Ross River Virus and Barmah Forest Virus are estimated to cost approximately $5,000 per case in medical expenses and loss of earnings. The number of cases in the City would greatly increase if there was no program in place to manage mosquito numbers.

The cost on the reputation of Mandurah and the Peel Region is difficult to assess but the management of mosquitoes is an important function in ensuring an acceptable lifestyle for residents and visitors.

The administration of the PMMG is an essential part of the partnership that assists in managing mosquitoes in the region. The group met on four occasions during the 2015/16 mosquito management season as well as attending regional meetings relating to mosquito management matters.

These meetings were attended by local government officers and elected members from each PMMG members as well as representatives from the DoH. The meetings allow open and informed discussion and are always positively focused.

These meetings allow for ongoing collaboration between the members and the implementation of improvements within the program. Examples of key discussions during 2015/16 included:

- Mosquito Borne Disease notification updates
- Mosquito abundance and disease isolation updates
- LG reports on mosquito breeding and treatments
- Environmental conditions
- Treatment updates
- Budget reviews

In addition to the DoH contributions indicated in Figure 22 the PMMG is also supported by the Department via the provision of all costs associated with the helicopter services. This service is provided throughout the state with the Peel Region is the primary user. Without this financial assistance the PMMG would require substantial increases in budgeting allocation.

Further to the allocation for larvicide costs, the City of Mandurah contributed an estimated $265,000 in labour, vehicles, equipment and resources for public education during the course of the 2015/16 season.

A total of $105,486.33 including carryover stock value was expended on the procurement of larvicides by the PMMG during season 2015/16. With the following contributions made by partners.

<table>
<thead>
<tr>
<th>Agency</th>
<th>2015/2016 Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Health</td>
<td>$87,058.00</td>
</tr>
<tr>
<td>City of Mandurah</td>
<td>$47,533.67</td>
</tr>
<tr>
<td>Shire of Murray</td>
<td>$28,555.02</td>
</tr>
<tr>
<td>Shire of Waroona</td>
<td>$1000.00*</td>
</tr>
<tr>
<td>City of Rockingham</td>
<td>$10,969.31</td>
</tr>
<tr>
<td><strong>Total Income for 2015/2016</strong></td>
<td><strong>$174,116.00</strong></td>
</tr>
</tbody>
</table>

Figure 23 - Peel Mosquito Management Group
Larvicide/Operations Budget - 2015/16
The 2013/14 state budget provided $4 million over 4 years to support management opportunities and competitive research into improving outcomes with regard to mosquito management. The proposal was for a funding scheme to be available from 2013 – 2017, on an annual basis.

In response to this commitment, the DoH established the Funding Initiative for Mosquito Management in Western Australia (FIMMWA). The City in association with the PMMG has continued to pursue a number of matters it believes could be addressed through the FIMMWA funding which have the potential to provide practical opportunities to improve the operations of the PMMG.

The PMMG was again successful in securing $23,053.63 of FIMMWA funding that was awarded to undertake a number projects and secure Fight The Bite educational resources. A key project currently in progress that will hopefully be completed in the coming season will see a new tide gauge monitoring station installed in the lower reaches of the Serpentine River. The Serpentine River traverses through three local government boundaries that see's the PMMG undertaking ground surveillance and aerial larviciding treatments along and within adjacent wetlands that stretch some 17km from the river's mouth at the northern end of the Peel Inlet.

The DoH is currently working with the Department of Transport and Main Roads WA to undertake a similar installations of tidal monitoring equipment to enhance the Department of Transport’s Storm Surge surveillance network within the Swan River. Both projects will provide more accurate and timely information for local governments that rely on tidal information that is currently only available from existing stations some distance from the location of mosquito breeding sites under their management.

Again via direct funding from the FIMMWA scheme the extension to aerial application of larvicides past the traditional April end and extending through the months of May, June and July continued in season 2015/16. The aim of this extension was to minimise populations of saltmarsh mosquitoes over the winter months to reduce larval numbers and egg loading prior to Spring when typically untreated breeding has resulted in the abundance of the winter species. The success so far has been very positive allowing early inroads into mosquito populations.

The City continues to make recommendations to the DoH regarding building the capacity of the aerial aspect of mosquito management and will continue to advocate for improvements as part of current and future contracts for the provision of helicopter services.

**Strategic Implications**

The following strategies from the City of Mandurah Strategic Community Plan 2013 – 2033 are relevant to this report:

**Environment:**
- Protect and ensure the health of the natural environment and waterways.
- Increase scientific understanding and knowledge of the marine and estuarine environment.

**Social:**
- Ensure the provision of quality health services and facilities.
Conclusion

The 2015/16 season experienced exceptionally low levels of saltmarsh mosquito breeding due to the favourable environmental conditions associated with the El Nino weather event that presented.

Nine (9) aerial larviciding treatments were initiated following the mostly minor tidal inundations and this assisted in ensuring mosquito populations remained consistently low lessening the risk of mosquito borne disease.

Despite mosquito abundance being very low, people did continue to contract mosquito borne disease. This reiterates the importance of the community being responsible and vigilant about protection from mosquito bites regardless of the extent of mosquito activity. The City will continue to support and embrace the Department of Health’s “Fight the Bite” communications program whilst maintaining more localised and “news from the front” information and communications via the various media and marketing outlets both traditional and electronic.

The City and the PMMG is confident that the developments and new application equipment injected into the program during season 2015/16 will provide an improved and capable capacity to meet the challenging task of managing mosquitoes in the seasons ahead.

The Seasonal Outlook for season 2016/17 based on the decline of the El Niño event is likely to provide conditions similar to the 2014/15 season with mild to moderate saltmarsh mosquito breeding and the potential for higher mosquito abundance than has been experience by the community over the last few years.

Note: Subject to Committee’s consent, The City’s Senior Mosquito Management Officer will make a presentation on this item at the meeting.

Recommendation

That Council:

1. Receives the City of Mandurah Mosquito Management Program: 2015/16 Annual Report

2. Approves the release of these reports to the following key stakeholders:
   - Residents of the City of Mandurah via access at Administration Centre and Library, “City Voice”, website and media releases
   - Department of Health
   - The Minister for Health and local Parliamentary Representatives
   - Peel Mosquito Management Group member local governments
   - Peel Development Commission
   - Department of Environment and Regulation
   - Residents and Progress Associations
   - Mandurah Environmental Advisory Group

3. Notes the City’s support for the Department of Health Fight the Bite Campaign.

4. Acknowledges the support provided by the Department of Health in the implementation of improvements in the Peel Mosquito Management Program.

5. Supports ongoing efforts to improve the aerial larviciding capacity of the mosquito management program.

6. Acknowledges the importance of the State Government’s ongoing commitment to the annual programs, and in accordance with the Dawesville Channel Environmental Review and Management Programme.