Grasshopper Survey and Update Report

October 2021

Queensland Government

This publication has been compiled by Leanne Hardwick, Department of Agriculture and Fisheries.

We would like to acknowledge the producers who responded to the survey and willingly shared their observations, Australian Plague Locust Commission (Chris Adriaansen and Clare Mulcahy), Winton Shire Council (Gavin Baskett, Anne Seymour and Cathy White), and Department of Agriculture and Fisheries staff: Hugh Brier, Susie Brodie, Pieter Conradie, Debra Corbett, Lara Landsberg, Jenny Milson, Tim Moravek, Annette Reed, Khaled Saifullah, Michelle Smith and Richard Watts.

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Abstract

Increasing numbers of various grasshopper and locust species have been experienced across western and north-western Queensland over the last four years.

A *Grasshopper Impact Survey* was initiated in 2020 and re-done in 2021 to capture comparative data and key impacts across the affected regions. Issues focussed on in the survey included grasshopper distribution and numbers, resultant pasture damage, management responses and estimated economic impact. When grasshopper populations started emerging in 2018 producers were unprepared in terms of planning or budgeting for the impacts. However, this earlier experience allowed producers to be adaptive in their management practices during the population boom in 2021.

Adaptations included implementation of practices such as earlier weaning and culling; planned sales or earlier sourcing of agistment; delaying purchasing of stock in response to rain; forage budgeting and implementation of possible grasshopper control methods. These practices still came at a cost to producers. Based on the best available information provided through the 2021 producer survey, the total costs recognised by the 59 participating businesses is estimated at $18,343,500 for the 2020 and 2021 seasons. This figure is comprised of increased costs including agistment, transport, supplementary feeding, time, labour, and spraying. In addition, there were significant foregone opportunities through early weaning, delayed restocking and inability to retain stock numbers which, in turn, meant reduced wool clips and live weight turnoff.

Research into the ecology and life cycle of species and population prediction modelling is advocated to guide towards implementation of more timely management practices. Follow-up rainfall in areas previously impacted by grasshoppers resulted in substantial pasture response for some producers.

Introduction

Rainfall across western and north-western Queensland in early 2020 and 2021 created ideal hatching conditions for many grasshopper and locust species (e.g. Figure 1). These numbers caused substantial pasture damage. In 2020, following many enquiries from producers who reached out to the Department of Agriculture and Fisheries (DAF), it became evident there is limited knowledge and information available on the prevalent species. When numbers increased in 2021, DAF project officers and industry experts worked together to provide joint support to producers where possible.

Figure 1: Spur-throated locust (Austracris guttulosa) nymph. Photo: Leanne Hardwick, DAF Longreach

Australian Plague Locust Commission (APLC) staff and DAF entomologists and biosecurity officers provided critical support to on-ground DAF Animal Science staff and producers in technical areas around identification of species, information on the life cycles of documented grasshoppers and locusts, and suggested management options.

Part of the response also included formation of a Grasshopper Working Group (GWG). This group was initiated by DAF in collaboration with the APLC and National Resilience and Recovery Agency (NRRA) representatives to identify possible management options and ensure a coordinated response.

In 2020, the main species present were grasshopper species; the three most prevalent being (Figure 2), *Lagoonia* sp. (Figure 3) *Stropis* sp. and (Figure 4) *Yrrhapta* sp. In 2021, there were higher numbers of locusts and locust-like grasshopper species present, and this caused some confusion around available management options for producers. While there were chemicals registered for control of locusts, there were none registered for the dominant grasshopper species. As a result, the GWG sought the approval of Emergency Use Permits (EUP's) for two chemicals, *Fenitrothion* and *Fipronil*, thus enabling the option for producers to spray. Green Guard® was the bio-pesticidal alternative that was also recommended especially for producers of organic livestock and those who preferred a biological control to chemical control.

Figure 3: Lagoonia sp. Photo: Leanne Hardwick, DAF Longreach

Figure 2: Stropis sp. Photo: Leanne Hardwick, DAF Longreach

Figure 4: Yrrhapta sp. Photo: Leanne Hardwick, DAF Longreach

In addition to the EUP approvals, the GWG initiated the *2021 Grasshopper Impact Survey* for further investigation into the grasshopper impacts and collection of comparative data for western Queensland. The survey also provided support to producers and aimed to highlight key issues such as:

- species identification
- extent of grasshopper distribution
- resultant pasture damage, and
- estimates of economic impacts.

Collecting information on the damage caused to industry provides baseline data to support future scientific investigation. Investigative research of the species could also allow for a better understanding of the life cycles and ecology of the main grasshopper species, on which there is currently limited information. This would lead to a better understanding of population dynamics and assist with predicting future population increases. This, in turn, would allow for the implementation of more timely management decisions and mitigate large economic impacts.

Survey results

The Longreach DAF team engaged the GWG to provide input into the *2021 Grasshopper Impact Survey* and ensure accurate and tailored data was collected. The survey was open for two and a half months and initiated 59 responses from across multiple regions (see Figure 7). Observations from the survey are discussed throughout this report.

The survey found that 2021 saw increased grasshopper impact through pasture damage and economic losses across large areas. This contributed to the elevated concern experienced by producers across the regions. Producers (59 survey respondents) have indicated a total land area of impact equating to a total of 1,308,545ha, an average of between 15,000 to 22,000 ha impacted per property.

Over the past four years, following spring and summer rainfall events, producer observations have indicated increasing grasshopper populations being observed in pastures in western and north-western Queensland (see Figure 5). Many producers indicated that 2021 posed the highest impacts.

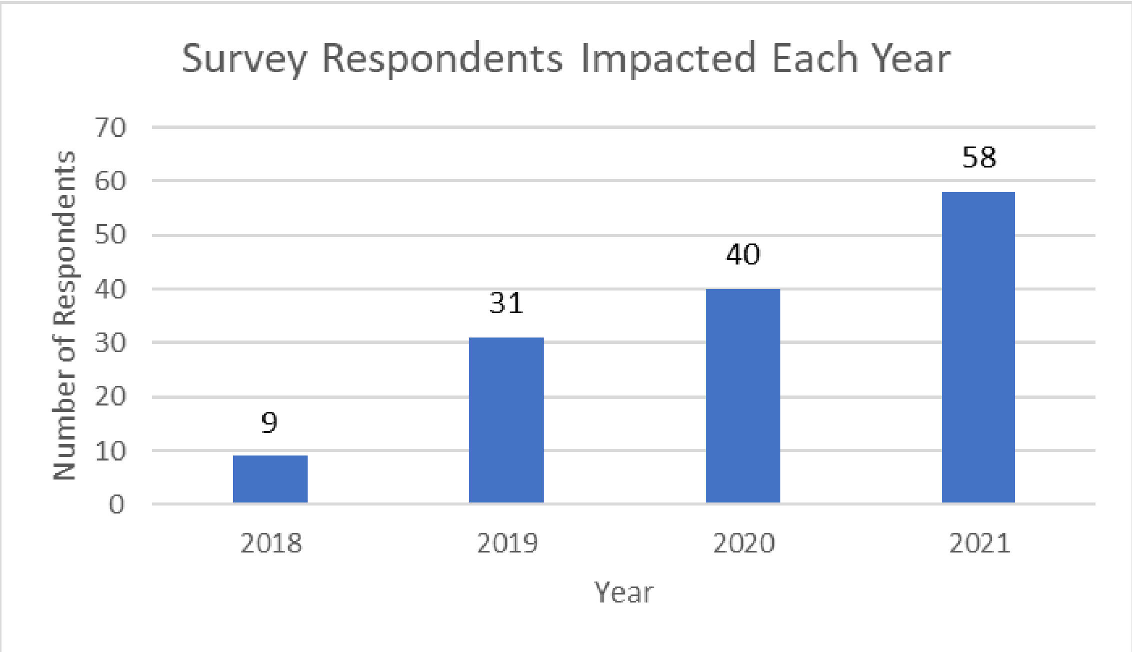

Figure 5: 2021 survey respondents impacted each year (2018 to 2021)

Note: only 58 of the 59 respondents answered this question

Grasshopper density levels are presented in Figure 6. These density level classifications were modified in response to feedback from the figures used in the 2020 survey. In 2020, the main grasshopper species encountered by producers were the ‘hopper’ types, which are unable to travel long distances. In 2021, this changed, with many producers observing both grasshopper and locust species, with grasshoppers still the most dominant.

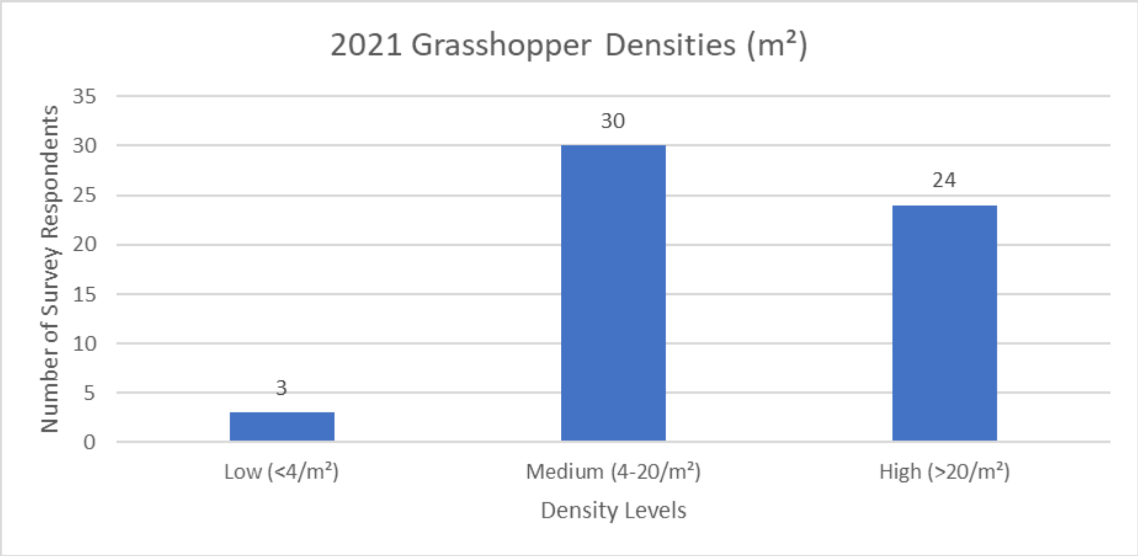

Figure 6: 2021 Grasshopper Densities observed by survey respondents

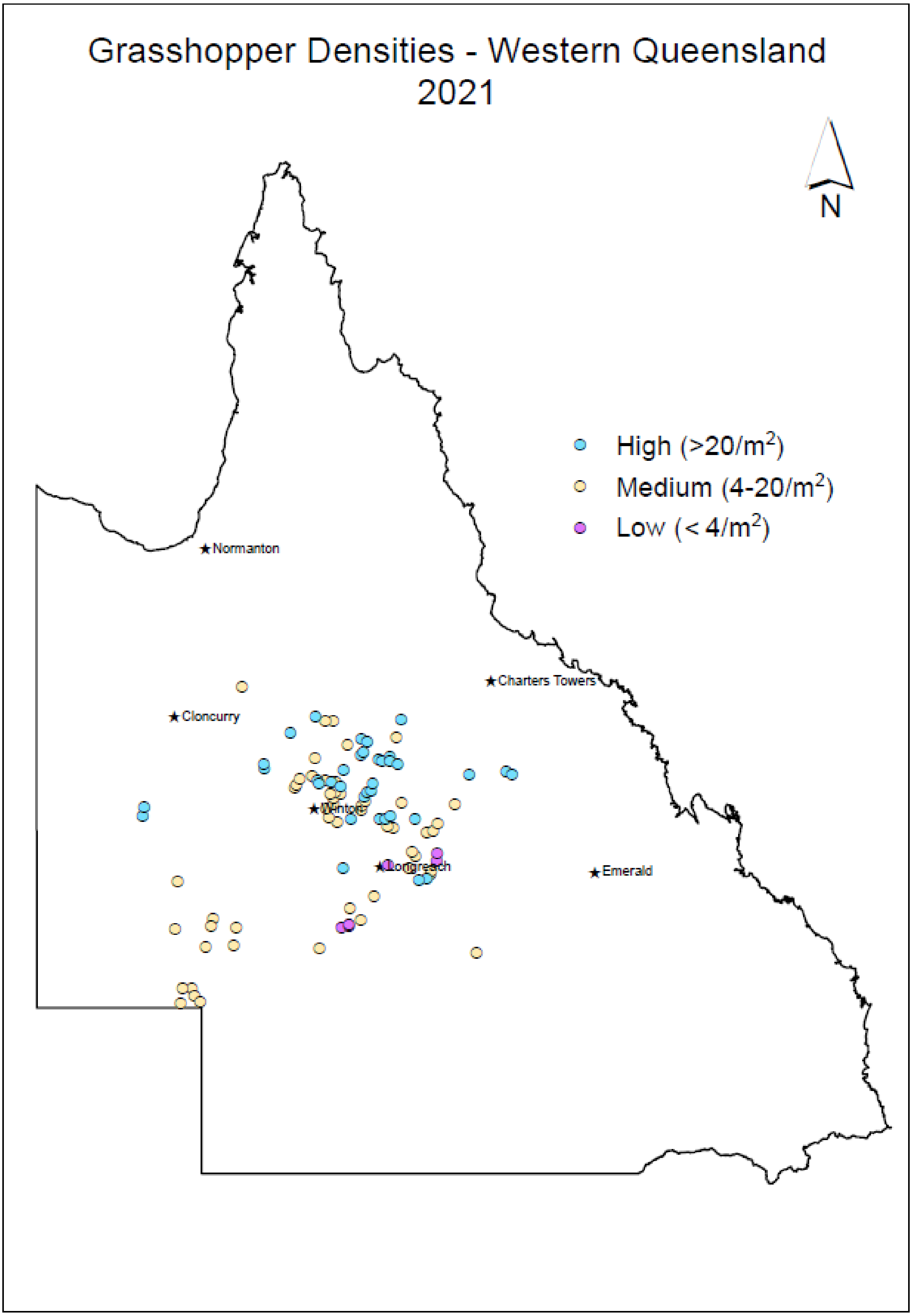

Figure 7: Grasshopper and locust densities and distribution. Map credit: Debra Corbett, DAF Rockhampton

The 2021 survey included photos of species to assist producers with identification. Producers were also asked to send in any photos or grasshopper specimens for identification. Observations are reflected in Figure 8 and show increased occurrences of ‘flying’ species (spur-throated locust, northern Austroicetes and Australian plague locust) this year. The large densities of these species and their resulting impact were of high concern.

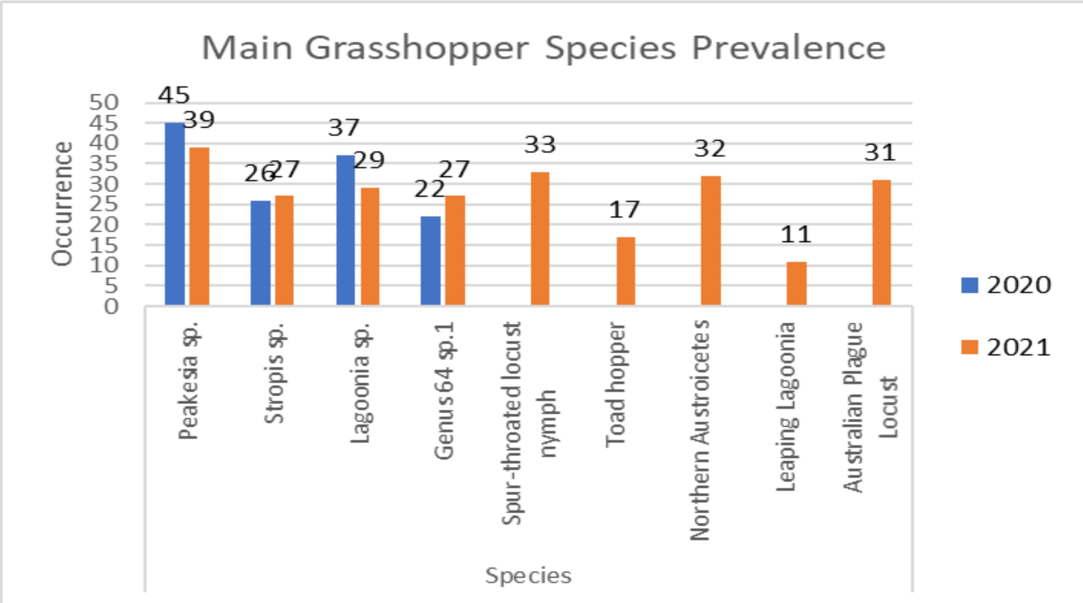

Figure 8: 2020 and 2021 main grasshopper species observed

Interestingly, the survey results don’t indicate a distinct relationship between the rainfall amount received and the densities of grasshoppers experienced (Figure 9). However, producer observations indicated there were varying impacts with differing rainfall amounts especially when existing pasture conditions were varied. One producer stated that ‘*country that had 200mm or less over the past three months (January to March) was impacted heavily by grasshoppers from late February through all of March whilst country with established pasture and more ground cover and higher rainfall had been less impacted overall*’. Impacts were observed by many producers to be more evident to ‘*areas of shorter, new green growth pasture and herbage*’. Others indicated that grasshoppers were on all areas of their property regardless of rainfall; no distinction was made on pasture growth stage in these cases.

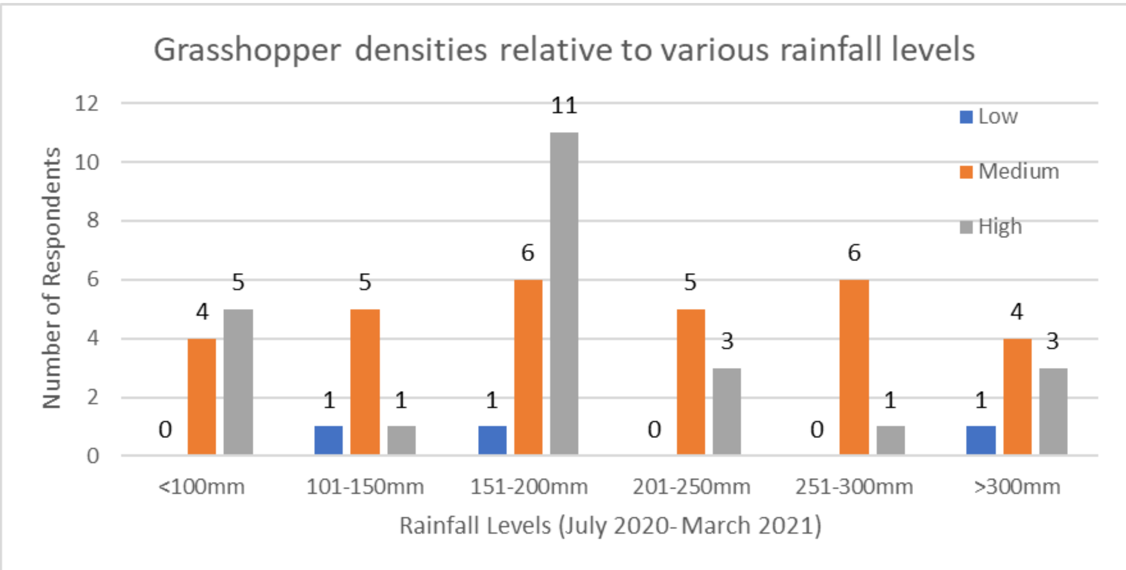

Figure 9: Relationship between grasshopper densities and varying rainfall levels

Producers were asked to comment on when they received their first rainfall followed by when they first observed grasshoppers. This is represented in Figure 10. This graph shows that rainfall was key in initiating grasshopper numbers across the region. Producers were then asked to provide their observations of grasshopper impacts on varying areas of different rainfall and on differing pasture species and land types. This observational data is summarised below.

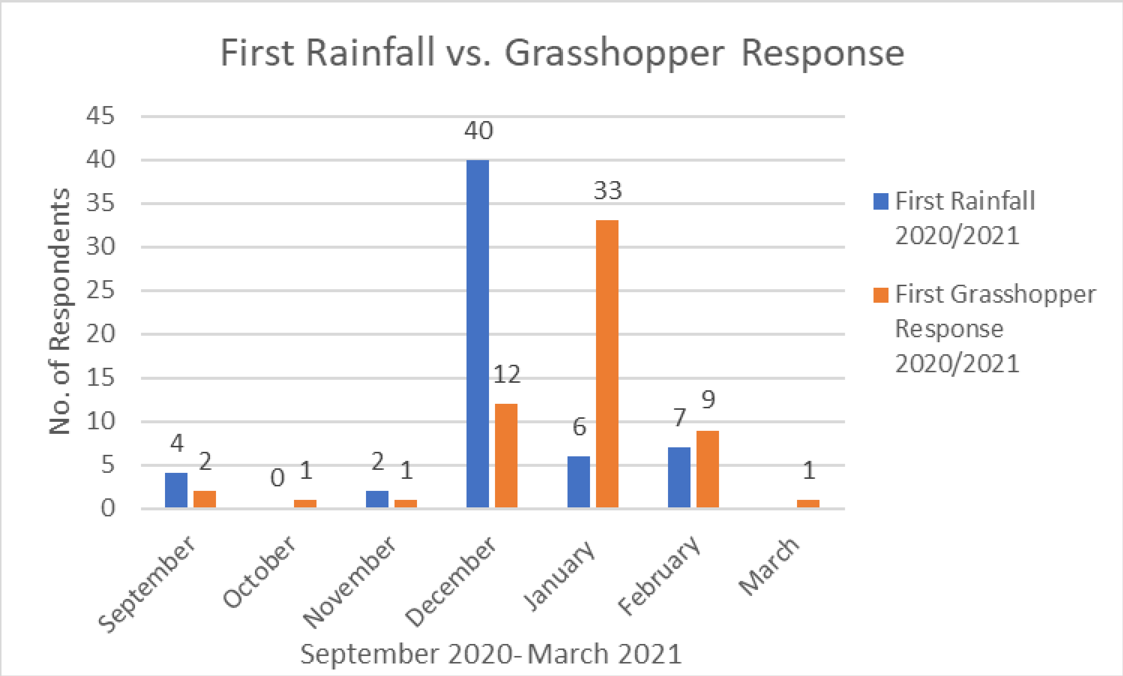

Figure 10: Relationship between rainfall and grasshopper response

Producer observations:

- Grasshoppers were observed around two weeks following rainfall – particularly following summer rainfall events and warmer temperatures.
- Land type, not rainfall, was the determining factor for species and impact. Grasshoppers ate out one land type/pasture species and moved onto the next; they '*decimated spinifex and moved onto buffel and river grasses*'.
- Producers noted that, after follow-up Christmas rainfall, areas that had received early initial rainfall and established healthy pastures, were less impacted than other areas.
- The general response from producers for areas that received initial rainfall over the Christmas period was that '*the grasshoppers were everywhere'.*
- Observations on properties that received varying falls across the area over the Christmas period, indicated that the grasshopper numbers and impact was more significant in lighter rainfall areas with shorter, new growth of pasture and herbages.
- Many producers identified that buffel grass seemed to be less effected; one producer's observation being that this could be due to quicker growth response and establishment, as well as pasture preference by grasshoppers.

Economic impact

As a result of impacts experienced across properties, economic costs to businesses were recorded. These occurred as a result of:

- early weaning
- forgone livestock weight gain and re-stocking opportunities
- foregone wool clip
- agistment, and
- other costs (defined below).

The economic impact can be viewed below in Figure 11. The main economic components impacted for grazing businesses are the foregone opportunities relating to the inability to restock and retain stock. These have a major bearing on business resilience in the western region as properties strive to re-build to full potential following drought.

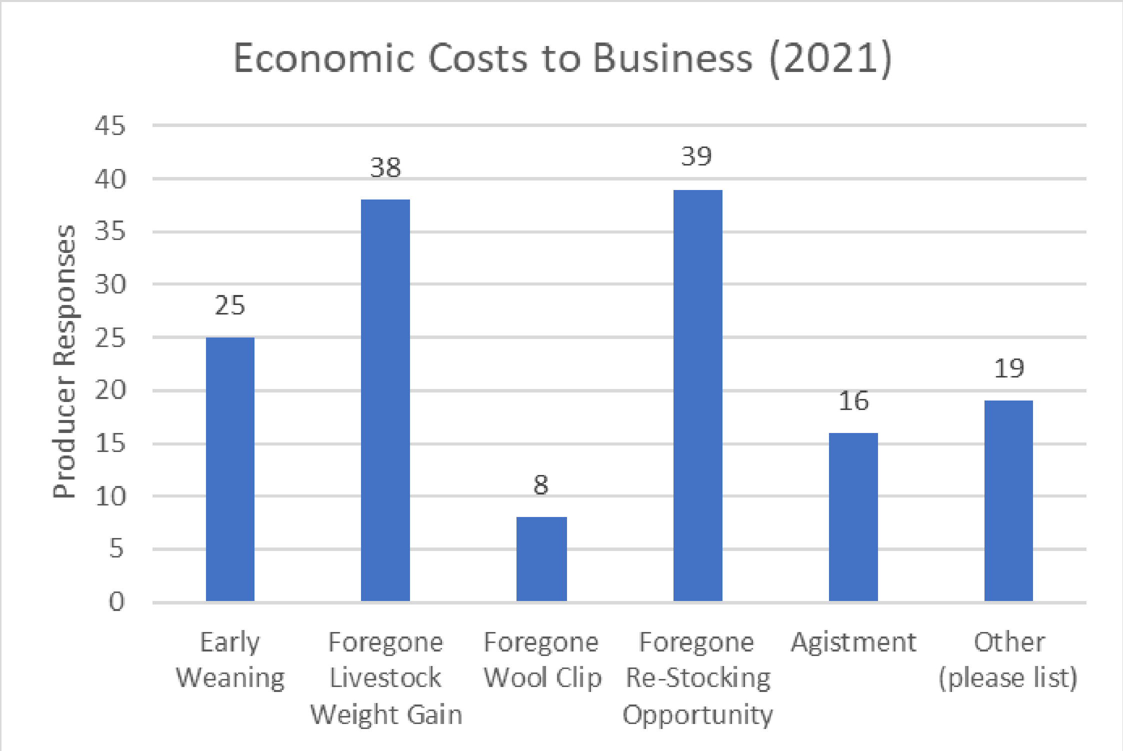

Figure 11: Main economic costs resulting from grasshopper impact in 2021

Note: Other costs include chemicals and spraying, time and labour, supplementation/feeding, transport, forced sales, degradation to pasture, mustering.

To further flesh out the costs to business, producers were asked to provide estimates of the costs attributed to agistment and then to all other costs excluding agistment. Producer responses are represented below in Figure 12 and Figure 13.

Figure 12 represents a comparison of the costs paid by producers for agistment in 2020 and 2021 as a result of impact on pasture from grasshopper numbers. It shows an increase in agistment costs from 2020 to 2021. One producer explained that one of the increases in agistment cost was because they were unwilling to bring stock back to their property until the full extent of grasshopper damage was known.

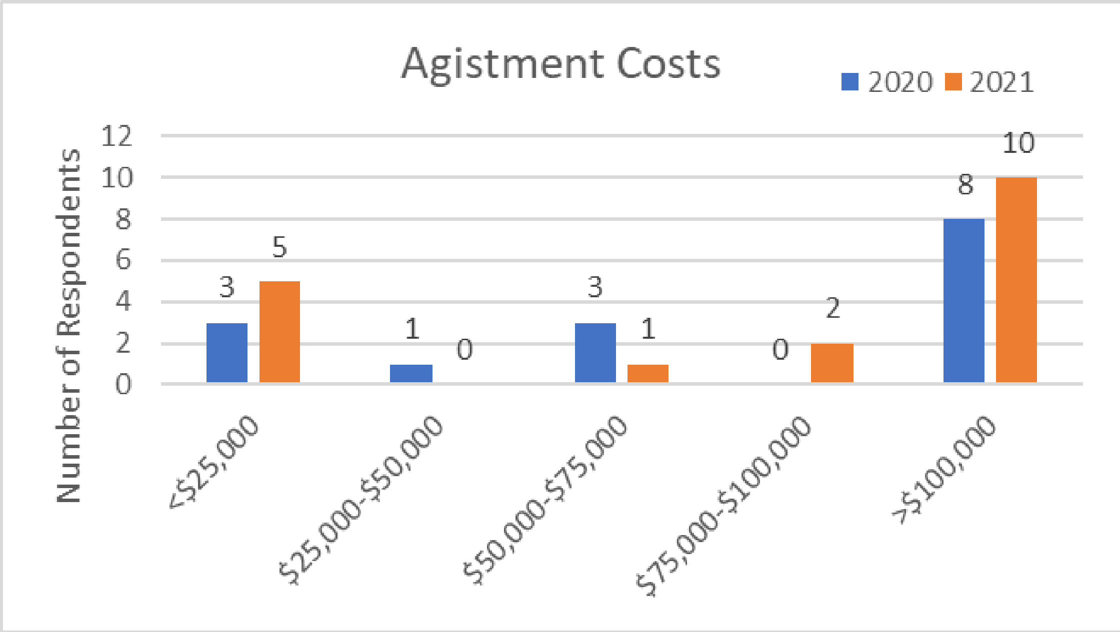

Figure 12: Cost to businesses attributed to agistment in 2020 and 2021

Figure 13 represents the difference in estimated costs (excluding agistment) experienced as a result of grasshopper impacts between 2020 and 2021.

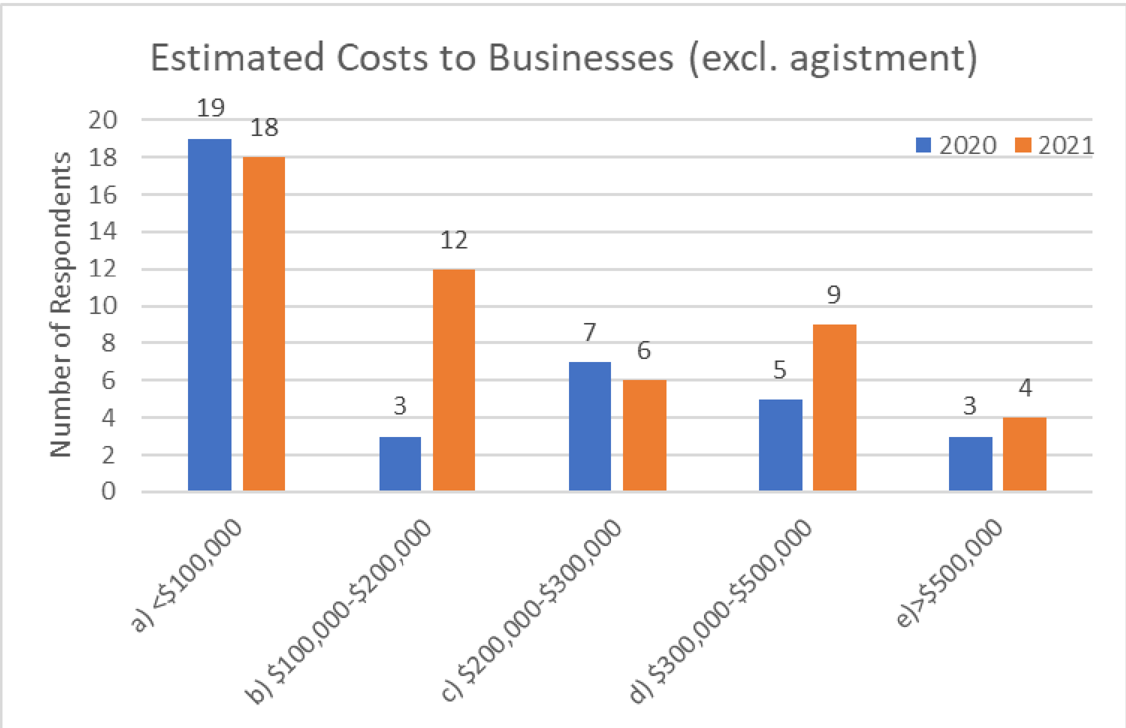

Figure 13: Costs to businesses (excluding agistment) as a result of high grasshopper numbers in 2020 and 2021

Note: Costs (excluding agistment) include chemicals and spraying, time and labour, supplementation/feeding, transport, forced sales, degradation to pasture, mustering, early weaning, forgone livestock weight gain, foregone woolclip, forgone restocking opportunities.

Other non-financial concerns of producers were raised during the survey. This included:

- depletion of the seed bank and leaving soil bare as well as the increased risk of erosion
- pasture loss and concerns for increased undesirable species
- impacts of mental health on station staff; one producer stating this and qualifying it by saying '*the only green area on the property this year around the house was decimated'.*

Figure 14 represents the costs to business in relation to the area impacted on properties. The graph shows that the more hectares that were affected the higher the costs were to businesses. These costs result from a combination of agistment and other business costs including foregone opportunities for restocking (thus reducing potential wool clip and liveweight gains), forced early weaning, as well as increased costs of supplementary feeding, stock and feed transport, time and labour, plus spraying for grasshopper control. More detailed overall data was also identified. DAF economists estimated the cost to producers based on the best available information provided through the producer survey and with input from Extension Officers. The total cost to the businesses of the 59 producers who participated in the 2021 survey equated to $18,343,500 for the two years 2020 and 2021. Property area affected (for the 59 respondents) was estimated to total 1,308,545 ha. Therefore, the total cost per hectare, based on the responses provided within the survey, was estimated at $14.02/ha over the two years.

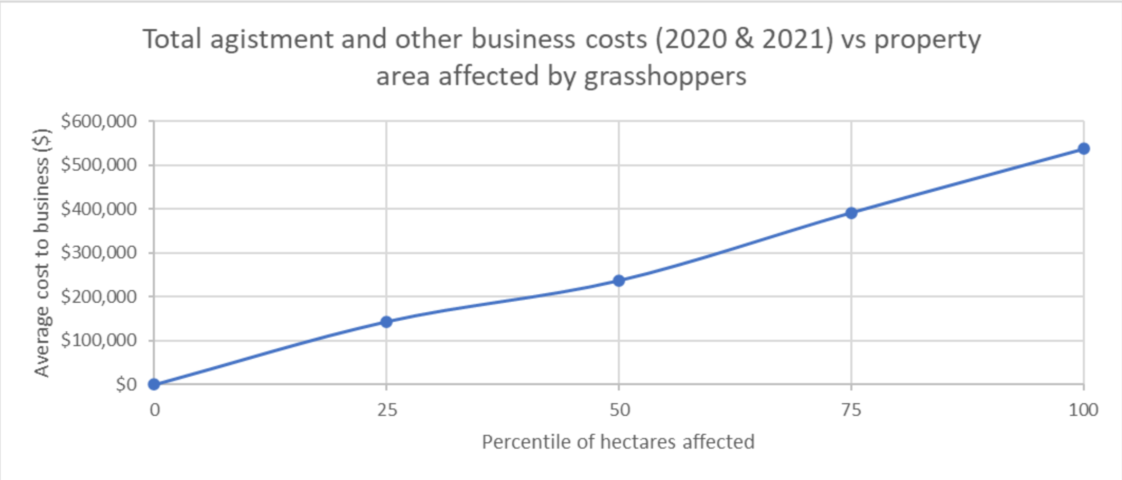

Figure 14: Business costs in comparison to the area of property affected by grasshoppers

Management options and future research

The GWG instigated EUP's for the two chemicals *Fenitrothion* and *Fipronil* to allow an option for producers to spray grasshoppers on pastures in the Mitchell grass bioregion. One producer stated that they had been '*fortunate enough that the rules were changed to use chemical spraying to combat the advance'* (of the grasshoppers). This same producer identified species that '*hatched in clusters and grew up to fly'* which indicates the species were locusts or other flying species (that were not observed in all areas). An option for producers to use on organic-certified properties was *Green Guard*®, a bio-insecticide containing a naturally occurring Australian fungus, *Metarhizium anisopliae* var. *acridum,* mixed with a spray oil. This fungus can also occur naturally in the environment under ideal conditions.

Whilst the opportunity to spray became an option for producers, considerations were made around the constraints of application. This included cost: benefit analysis of chemical application, withholding periods for livestock, organic status and potential risk to the ecology of the environment. Producers had to adhere to strict application guidelines as identified on the product labels.

Grasshopper numbers began to decline in March/April with the onset of colder weather and the assumed increase in predator populations. Colder weather as explained in Rentz *et al. (2003)*, causes species to go into a diapause state, meaning their development becomes suspended. This is an insurance policy against climate variations (Rentz *et al. (2003*).

Observations from producers indicated an increase in predator numbers in the area. Rentz *et al. (2003)* explains that there are many natural predators for grasshoppers and locusts including birds, lizards and spiders, as well as parasites such as flies, wasps and spiders (Figure 17) and pathogens including fungi and bacteria. Figures 15 and 16 indicate the density of Ibis that were found on a producer's dam on a property near Winton. The producer explained that ibis were around in small numbers on the dam in 2020, however this year, the number of birds and nests had increased. Increasing predator numbers over the years in line with an increase in grasshopper numbers could mean there is potential to maintain grasshoppers and locust numbers to manageable levels in the future.

Figure 15: Ibis in large numbers flying over dam. Photo credit: Harry Elliott Winton

Figure 16: Ibis nests around producer dam. Photo credit, Harry Elliott, Winton

Figure 17: Spur-throated locust nymph caught in spider web. Photo credit: Leanne Hardwick, DAF Longreach

Producers who received substantial follow-up rain after the suppression of grasshopper and locust numbers observed phenomenal pasture response in areas that had previously been impacted by grasshoppers.

Another outcome of the GWG meetings has been to investigate options for research into grasshopper incursions. One producer provided detailed observations stating that they '*think it takes at least 1-2 inches of rain for the eggs to hatch and needs the right temperature*'. This coincides with potential research questions to better understand the life cycle and ecology of multiple species. A second potential research stream is to develop models that predict timing and scale of future population increases.

Conclusion

Investigations into the increasing populations of grasshoppers over the past four years have been an insightful means of collecting data and learning more about producer concerns and observations. Concern from producers on the impact to their business has been increasing since 2019. Impacts to businesses through forgone opportunities and degradation to pastures have been reported.

As in 2020, the cooler weather in March/April 2021 contributed to reduced activity of grasshoppers. In 2021, it was observed that an increase in predators also assisted in a decrease in the grasshopper populations.

The aim for the future is to continue to support producers through increased knowledge and a better understanding of population predictions of when the grasshopper numbers may increase.

DAF has continued to provide assistance to producers throughout 2021, and the GWG oversaw two chemical control EUP's put in place in the short term as well as the option of *Green Guard*®. The continued collection of data through producer surveys in 2020 and 2021 has provided baseline data to support further research. In the long term, this observational data will enable further investigation into the life cycles and ecology of the dominant grasshopper species. It is also envisaged that modelling will assist predictions of population explosions in the future.

Reference list

Rentz, DCF., Lewis, RC., Su,YN., Upton, MS 2003, *A Guide to Australian Grasshoppers and Locusts*, Natural History Publications, Malaysia