National evaluation of lamb chill risk and frequency of severe events

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Introduction

Quantification of lamb-survival responses in different regions and climatic conditions is needed to inform decision making in the sheep industry (Masters *et al*. 2023). Newly born lambs are vulnerable to extreme weather events, that cause rapid loss of body heat. A range of factors including weather conditions, landscape topography and shelter from vegetation and land features all affect proximal conditions, while the ewes condition, access to feed, and its behaviour affect milk supply and combined with size of the lamb affect its resistance to cold stress. Therefore, the different combinations of these factors result in a different level of risk and likelihood of lamb mortality. In this report, we have evaluated site and seasonal variability in chill risk index values pertaining to newborn lambs across a national grid for southern Australia.

Methods

To carry out a spatio-temporal assessment of chill risk, historic SILO weather data (Jeffrey et al. 2001) and NASA POWER wind data (Stackhouse *et al*. 2018) were sourced to provide point data for biophysical simulation modelling at 50 km × 50 km resolution across southern Australia. We interpolated the NASA POWER wind speed data to 0.05° to match the SILO weather data and compiled them into a APSIM met file format. Then, we took the data for the nearest point from the cells of the 50km grid. The cultivar of the pasture selected for simulations was based on a classification method outlined in Thomas *et al*. (2019). The chill index, or potential rate of heat loss from lambs' skin in $kJ/m^2/h$ was simulated for each location, on a daily time-step, using the GrassGro® pasture and ruminant grazing model. The number of days that chill index thresholds of various indicators were exceeded in each month was determined for each site. Chill index thresholds of 1100 (High) and 1200 (Severe) $kJ/m^2/h$ were applied in GrassGro® (Cowan et al. 2022).

Results

The seasonal trends in the number of days per month that the minimum threshold for High chill index (1100 $kJ/m^2/h$) is exceeded is shown in Figure 1. Risk areas in south-west WA, south-eastern SA, Victoria and elevated areas of NSW are highlighted. As might be expected, more southern regions, areas of higher elevation and areas adjacent to coastal regions that are west facing had greater incidence of High and Severe chill events. The occurrence of High chill days across southern Australia roughly doubled each month from May to June and again in July (Figure 1). High chill risk occurs across much of Tasmania for more than 9 days per month during the Winter months and is also common during Spring and Autumn. In the other southern states, High chill index is most frequent during July and August in prone areas.

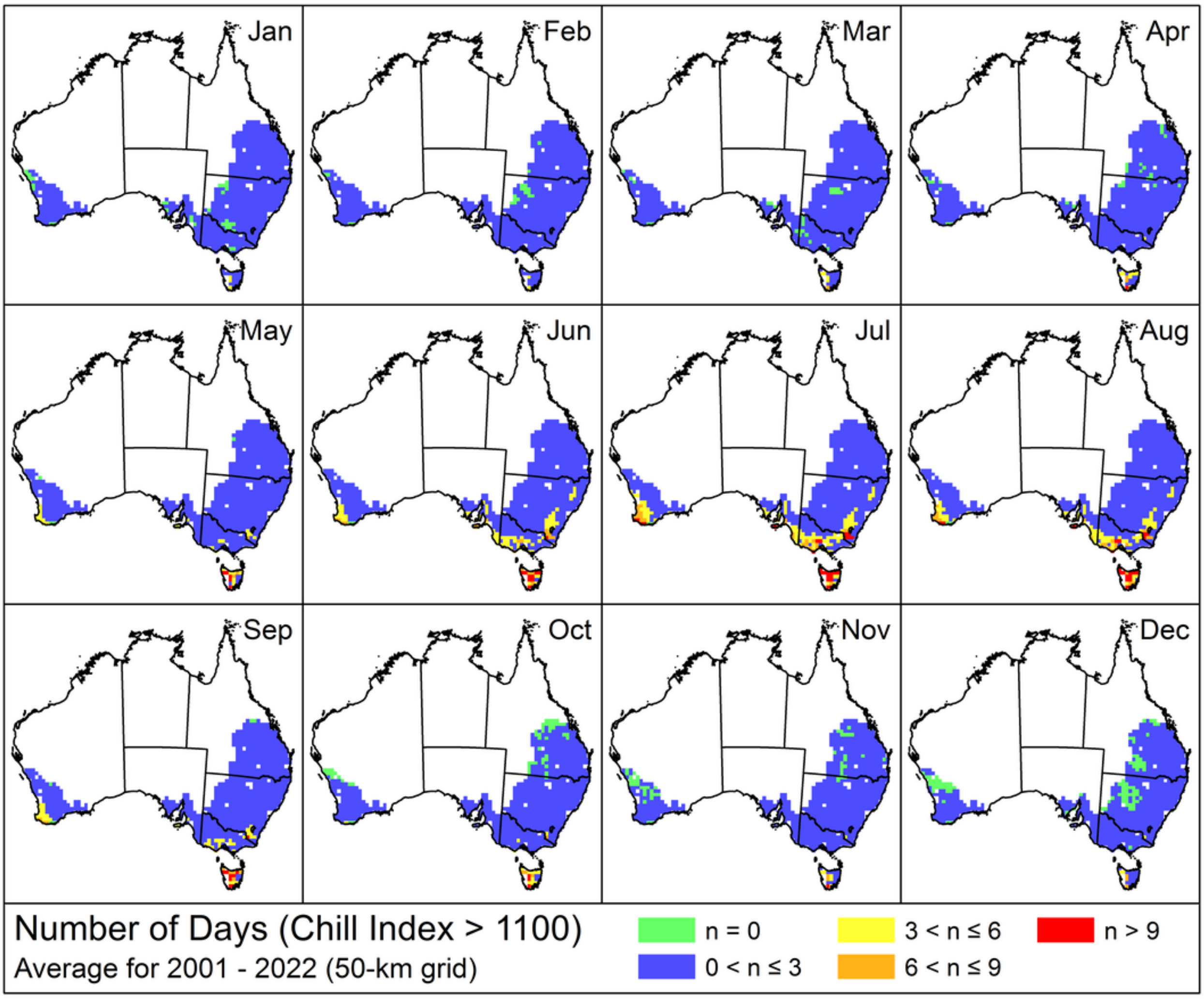

Figure 1. The number of days in each month that the minimum threshold for High chill index (1100 $kJ/m^2/h$) was exceeded, averaged annually from 2001-2022.

The episodic nature of incidence of High chill risk is demonstrated in Figure 2. In some cases, events had a wide distribution across the continent, such as during July 2021. In contrast, in June 2019 the incidence of High chill risk was above average across WA, but more typical in eastern Australia. A comparison of individual years also highlights the anomalies that we might expect with the episodic nature of weather events, for example May 2017 had a more widespread incidence of High chill risk, than June or July of that year in NSW.

The incidence of Severe chill risk is reasonably uncommon across southern Australia, except in Tasmania during July where a Severe chill risk was modelled for more than 9 days per month in 4 out of the 6 years presented. During July 2021, the occurrence of Severe chill risk was well above average for both south-west WA and southern NSW.

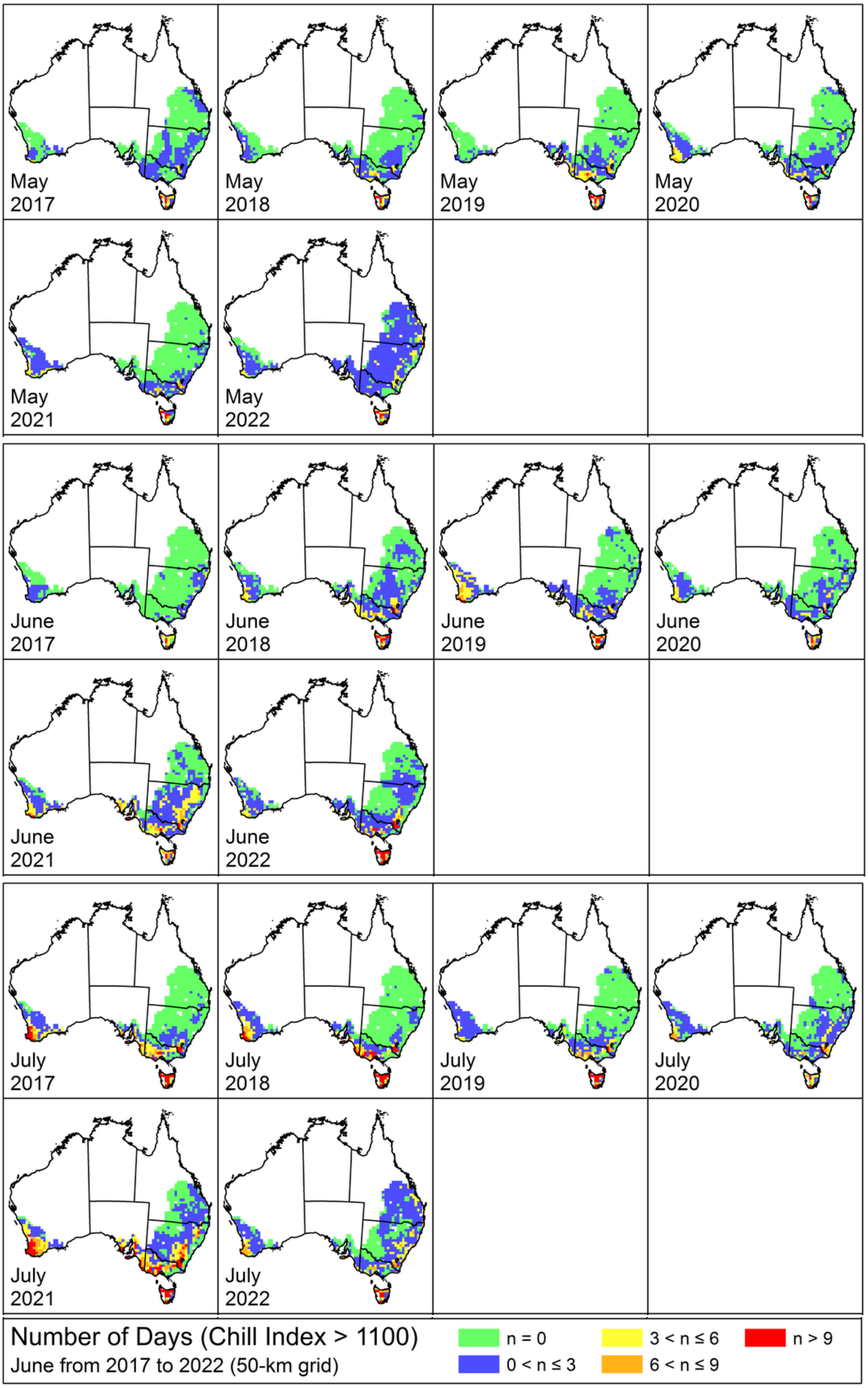

Figure 2. The number of days in each month that the minimum threshold for High chill index (1100 kJ/m^2/h) was exceeded, shown for May, June and July each year from 2017-2022.

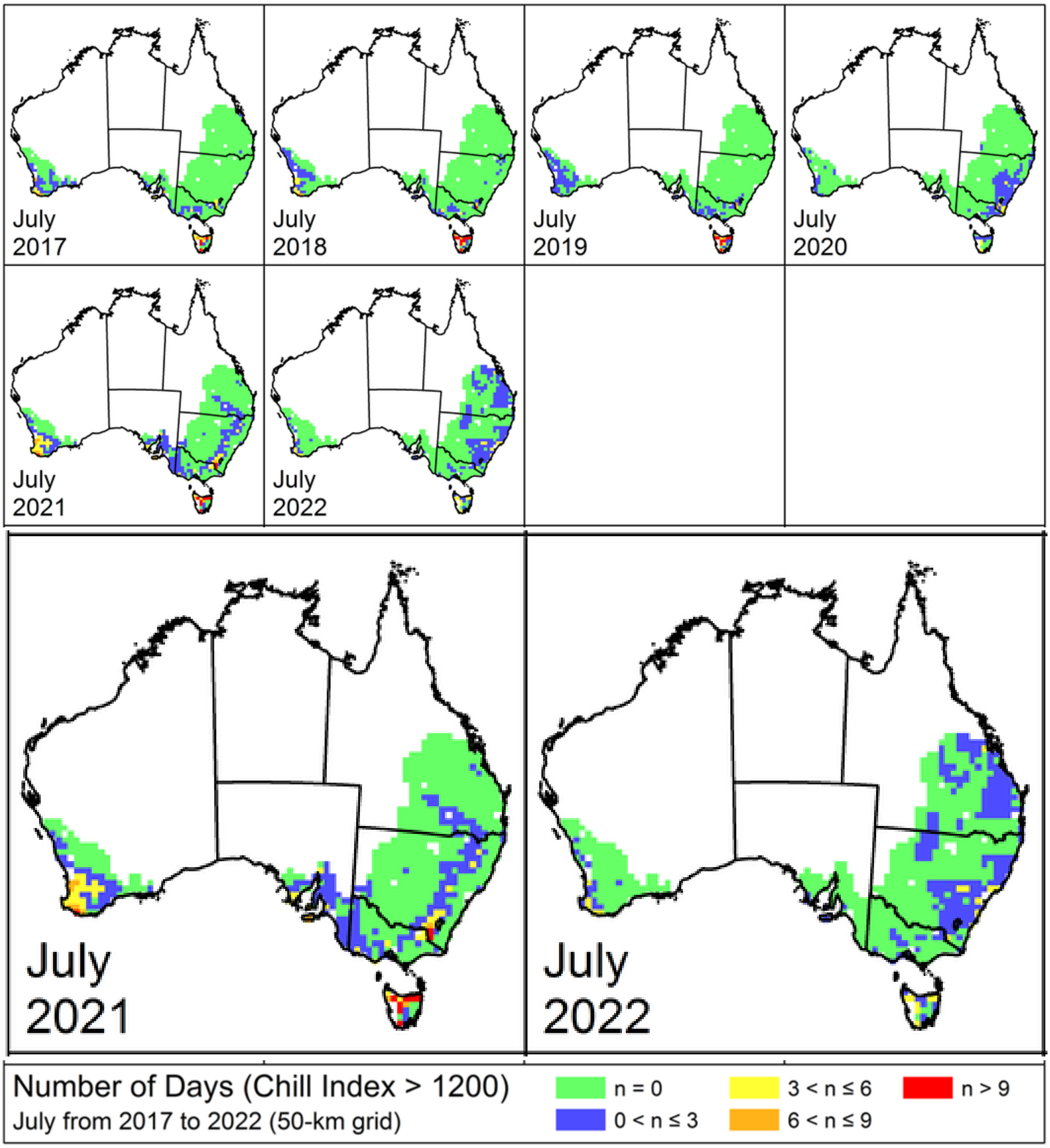

Figure 3. The number of days in each month that the minimum threshold for Severe chill index (1200 kJ/m^2/h) was exceeded, shown for July each year from 2017-2022.

Discussion/Conclusions

The economic implications of chill risk during lambing carries uncertainty, because the level of protection offered in paddocks differs widely, and there is variability in the resilience of lambs associated with their size, nutrition and ewe behaviour at lambing. This research quantifies the incidence of High and Severe chill risk across southern Australia. Mapping chill index highlighted some patterns, but also the highly variable and episodic nature of High or Severe chill risk events. Areas where high chill risk is rare, even during winter months, were identified. Developing the methods to quantify chill risk at any location across Australia makes site-based assessment of chill risk much more accessible and can be used to underpin future economic analyses and digital tools to support decision making around the provision of suitable environments and the value of strategic and tactical responses to episodic weather events during lambing.

References

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Acknowledgments

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