Site and varietal choices for full flavour outcomes in a warm continent

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GOOD WINES COME FROM VINEYARDS located in favourable climates. However, apart from the encyclopedic work of Gladstones (1992), this subject is little explored and the links between environmental factors and grape and wine flavour continue to defy easy generalisation. On the one hand, grape flavour is not quantifiable in any unitary sense. The flavours in grapes undergo a conversion during fermentation and maturation, and wine quality is a question of reputation, taste and argument, none of which necessarily relates to palatability. On the other hand, the environmental variables are numerous and each of them difficult to properly assess.

The focus of the work presented here is on temperature, a most influential element determining plant performance and fruit flavour, especially in the Australian context. The critical notion put forward by John Gladstones, that it is the temperature in the maturation period which really matters, simplifies the task of matching sites between hemispheres and latitudes and across continents. This work has involved a more careful measurement of temperature than has been possible until recent years. The result is a considerable step towards selecting an environment to produce better grape flavours, which will in turn enhance our ability to make better wine.

BACKGROUND

This paper presents measures of environmental heat loads encountered during maturation by cultivars commonly grown in Australia and France. Some background information will help put the following charts in perspective.

Heat load is defined as degree hours in excess of 22°C summed for the 28-day period prior to harvest. The base of 22°C is chosen to provide the greatest degree of discrimination between environments. Heat loads decline quite dramatically in all environments in autumn, but the degree of heat and its speed of decline varies very considerably between sites according to latitude, continentality and position on the eastern or western margins of land masses.

Harvest dates for non-Western Australian locations are taken from Gladstones (1992) tables. Western Australian harvest dates are median dates calculated from actual maturity times provided by growers.

French data was provided by METEO, the French bureau of meteorology. Data for Australian states other than WA have been provided by the Australian Bureau of Meteorology in Melbourne. Data for Blenheim is from the New Zealand Bureau. West Australian data has been collected by the author using temperature loggers in the pre-vintage period of 1997, 1998 and 1999. The mode of collection is described elsewhere Happ (1999a).

The data are voluminous and are presented here only in summary form. They relate to a few, recent years. This reflects the fact that the gathering, processing and storing of up to 72 observations for each day over a period of three months has only become practical with the use of inexpensive electronic temperature loggers and cheap personal computers with storage and computational facility to cater for amounts of material previously regarded as absurd.

The advantages of using hourly temperatures rather than daily extreme temperatures are described elsewhere Happ (1999a).

SUGAR ACCUMULATION IN COOL RIPENING CONDITIONS

The possible biology, physics and plant economy factors behind the connection between heat load and grape flavour outcomes are canvassed in Happ (1999b) and are summarised here in brief. Apart from the extremes of raisining due to berry dehydration with extreme heat, low temperatures leading up to maturity do not slow sugar accumulation in the grape berry, but they dramatically enhance flavour retention. A significant proportion of the sugar may be derived from starch in the woody parts of the vine as a complement to potentially reduced amounts directly provided by leaves at lower temperatures. The utility of starch transfer obviously depends upon the relationship between crop level and the volume of stored starch reserves. It is probable that exceptional viticultural environments combine excellent thermal conditions for flavour retention and limit crop production to the extent where starch substrate and photosynthesis together provide sufficient sugar to the developing fruit.

The relative proportion of functioning versus senescent leaves and leaves of different ages is variable between environments. Leaf output at 22°C is about 10% less than at 28°C on older leaves according to Mullins et al. (1992), but environments in which temperatures only briefly rise above 22°C are variably cool for much of the time. There is a tension between environmental conditions that conserve flavour and those that will promote leaf output. It appears that the best environments resolve this tension without compromising sugar accumulation or fruit quality. These environments promote rapid sugar production and starch storage prior to veraison and switch to flavour retention afterwards, as temperatures cool.

Furthermore, it appears that an optimal berry composition, in terms of a balance between green vegetative and ripe flavours, may necessarily involve environmental conditions that are cool enough to trigger leaf senescence prior to fruit maturity.

HEAT LOADS FOR GROUP 3 VARIETIES

Figure 1 shows heat loads for the ripening month for Gladstones group 3 early ripening varieties, such as Pinot Noir, Chardonnay and Sauvignon Blanc. Other group 3 grape varieties are listed in the caption to Figure 1. The French sites Chablis, Pouilly-sur-Loire and Savigny-lés-Beaune are marked as benchmarks for quality performance and the heat loads experienced by these sites are tiny in the Australian context. Blenheim in New Zealand is a benchmark location for Sauvignon Blanc.

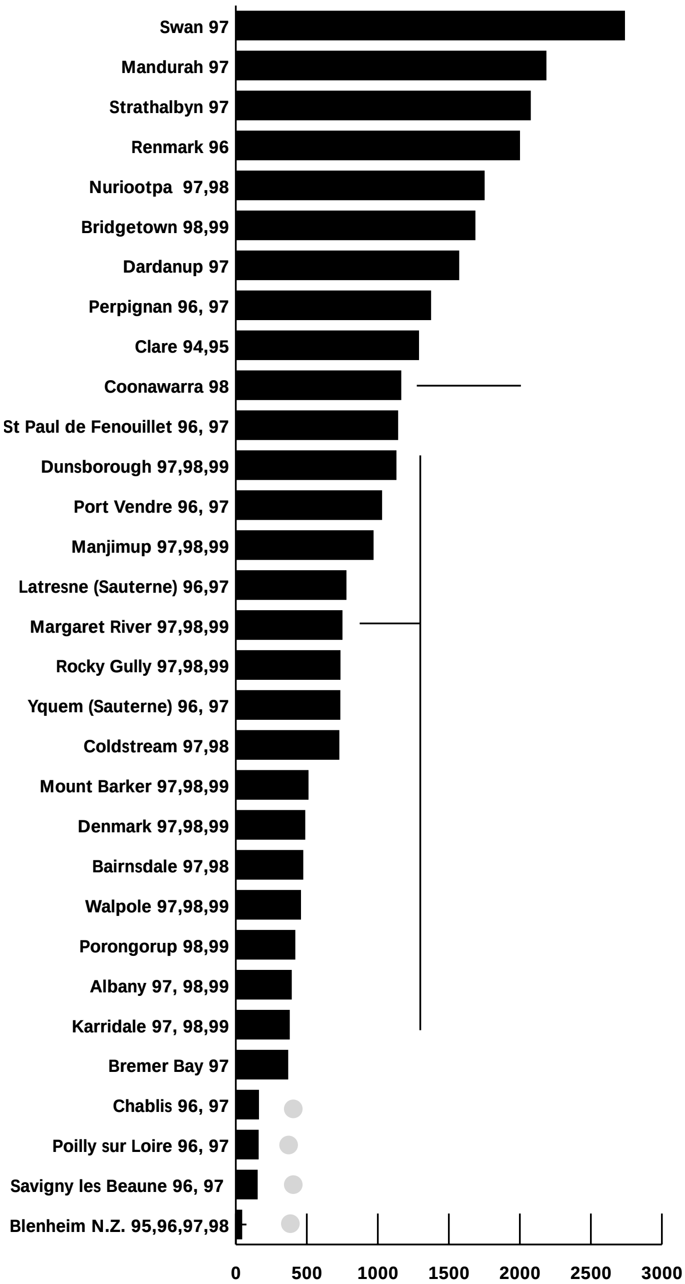


Figure 1. Heat loads for group 3. Pinot Noir, Pinot Meunier, Gamay, Dolcetto, Bastado, Tinta Carvalha, Tinta Amarella, Traminer, Chardonnay, Aligote, Melon, Sauvignon Blanc, Brown Muscat, Verdelho, Pedro Ximenes, Sultana.

In the case of Pinot Noir, its known tendency to raisin prior to harvest, a feature it shares with Shiraz and Touriga from quite different ripening groups, is aggravated by temperatures above 22°C. It is common in warm climates to pick sugar-ripe but flavour-green Pinot Noir, and the results are plainly inferior. The benchmark for Pinot Noir is Burgundy and the heat load for Savigny-lés-Beaune is representative of ripening conditions there. The same raisining tendency that occurs with Pinot Noir is uncommon in Chardonnay or Sauvignon Blanc when these varieties are matured under high heat loads. Despite the rather different spectrum of flavours these varieties exhibit when matured in such conditions, the descriptor *green* is less appropriate than the words *less generous*. The most expensive Chardonnays are produced in Burgundy under the same heat loads as Pinot Noir. The most aromatic and flavoursome Sauvignon Blanc originates in New Zealand or in France under ripening heat loads typified by Blenheim and Pouilly-sur-Loire, which are very similar to those in Burgundy—that is, negligible.

Generalising on the basis of information in this chart and those to be presented, benchmark quality expectation for natural wines from non-botrytised grapes of all varieties demands a heat load in the month of ripening of less than 500 degree hours.

In Western Australia, some extreme south coastal sites experience less than 500 degree hours of heat load in average and cooler years. Among the best Western Australian environments, in terms of the data collected for vintage 1997, 1998 and 1999, is Albany's environment, which experiences very moderate temperatures and high relative humidity as depicted in Figure 2, which relates to the 1999 vintage. The heat load in 1999 was 270 degree hours. Temperatures rarely exceeded 30°C. Relative humidity rarely fell below 60%. This area is well regarded for its performance in the production of flavoursome Pinot Noir and Chardonnay over a number of years. It shares with Burgundy an equable thermal environment, with a marked absence of high temperatures during ripening and a relatively low daily range about a mean of 19.2°C which is rather warmer than Dijon at 17°C. A number of other Australian locations have lower mean temperatures in the ripening cycle but higher heat loads e.g. Coonawarra (mean 18.1°C), Bairnsdale (mean 16.9°C) and Healesville for Coldstream (mean 17.9°C). The mean is a poor guide to heat load expectations. Average maxima are a better guide. For a discussion of the difficulties involved in summarising thermal phenomena see Happ (1999a).

The vertical line in the body of Figure 1 linking Dunsborough and Karridale shows the spread of heat loads in the Margaret River region, which is only 100 kilometers in its north to south extent. The black horizontal line, which extends from that vertical, locates a vineyard 7 km south of the township of Margaret River. It is apparent that heat loads for this varietal group double between Karridale and that vineyard, and increase by as much again at Dunsborough. Data not presented here show a further strong increase as one moves east of Dunsborough towards Busselton. These are dramatic and influential differences.

Although Margaret River is warm over much of its planted area in terms of the needs of group 3 varieties, its warmest parts were on a par with the experience of Coonawarra in 1998. Coonawarra is highlighted in each of the following charts as a means of illustrating the relatively dramatic decrease in heat loads as vintage progresses in the south-eastern portion of the continent by comparison with what is experienced in Western Australia. Whereas heat loads are very high for early varieties in Coonawarra, they all but disappear for late varieties. This experience of rapidly declining temperatures differentiates eastern from Western Australia in autumn and tends to be associated with greater variations in temperature between years. This pattern of difference between easterly and westerly environments is even apparent when one compares Albany to the east and Karridale in the west of Western Australia.

HEAT LOADS FOR GROUP 4 VARIETIES

Data for the Rhine Valley in Germany have not been obtained but one would expect low heat loads given the latitude, certainly lower than is experienced in Western Australia. Ice wine is produced from frozen berries in late season.

In Western Australia, Mt Barker has a moderate heat load for the period of maturity of Rhine Riesling and it is recognised as a premium producer of wines from that variety.

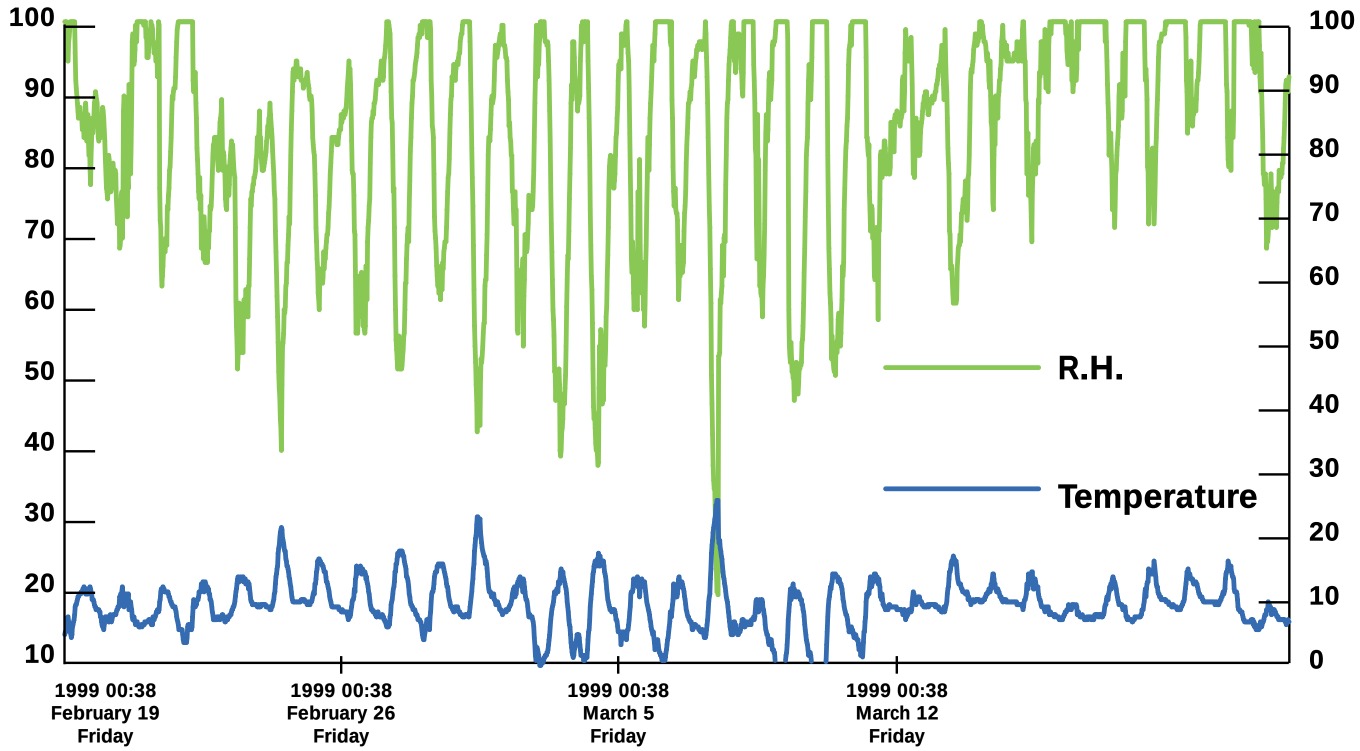
The Sauternes area in Bordeaux is of interest in that flavours due to the fungus *Botrytis cinerea* apparently tolerate warmth. Perhaps moderate warmth promotes fungal growth. In any event the Sauternes wines appear to be produced from grapes which ripen with heat loads slightly in excess of 500 degree hours. Sauternes is the only known exception to the 500 degree hour rule expounded above. In Australia the botrytised Semillon wines from the Riverina probably ripen at still greater heat loads. On the other hand, Mt Barker in Western Australia can produce excellent botrytised styles with heat loads less than 500 degree hours with better natural acidity.

There may be some variation in the capacity of different varieties to retain flavour with increasing heat. Skin thickness varies between varieties, as does susceptibility to raisining. The Spanish variety Tempranillo and the Bulgarian Melnik have notably thick skins. There is reason to try such varieties in Australia at various heat loads to resolve this issue.

Largely ignored varieties from group 4 which might be excellent subjects to plant south of Margaret River and along the south coast of WA include the Hungarian Hárslevelű, Sercial from the Isle of Madeira, Tempranillo from Spain, and Malbec and Muscadelle from Bordeaux.

The exposure to sunlight of the berries of non-vigorous Rhine Riesling appears to invoke a phenolic firmness in the wines, as it does with a number of white varieties. Is there a canopy management lesson here for warmer climates and the management of white varieties? Berry temperatures are heavily dependent upon exposure that in turn depends

Figure 2. Temperature and relative humidity in the ripening window for Pinot Noir, Albany 1999



upon shoot density, disposition and interrow shading factors. Flavour variations due to differences in berry exposure are likely to be most obvious to an observer when ambient temperatures are favourable to flavour retention and exposure is the main variable. How much warmer are exposed berries in ambient air temperatures of about 20°C? Is flavour, on balance, adversely affected? Canopy management dicta and grape flavour considerations might well conflict. This should not be a difficult area to research.

HEAT LOADS FOR GROUP 5 VARIETIES

Vignonet for Saint Emilion marks the warm limit for benchmark quality locations, which include Cote Rotie and Hermitage, Pauillac, and Begadan (the most maritime location in the Haut Medoc). Whereas Coonawarra is decidedly too warm for group 3 and 4 varieties its ripening conditions, while a little cooler than French benchmarks, are ideal for fruit flavour expression with Shiraz. Lookout Hill in the Grampians in Victoria gives some indication of the excellent ripening conditions for Shiraz in parts of that state. The preferred planting zone on the West Coast is south of Margaret River; the zone includes the Middlesex area south of Manjimup at the warm margin and becomes slightly more extensive, taking in Rocky Gully as one moves east towards Mt Barker and points further east as yet uncharted.

The potential for midseason varieties like Merlot and Cabernet Franc in Western Australia across these extensive areas is enormous. Neither variety presents at its best in warm ripening environments.

As previously noted, seasonal variability becomes greater as one moves east away from the influence of the Indian Ocean and more under the influence of the continental land mass. South Australia is relatively unprotected from the influx of hot dry air from the interior and seasons are variable. The consistency of cool Western Australian locations with grape varieties from this and other groups is an advantage derived from the dominant easterly movement of the air masses at this latitude. The price of consistency, related to warm autumns and long growing seasons, may well be leafy aromatics due to the presence of actively photosynthesising leaves, in turn associated with the lack of a chill factor in autumn to give the vine a clear signal to shut down. These are problems of westerly, maritime, low-latitude locations that could require careful selection of soil types, canopy and row arrangement, and irrigation and fertilisation regimes to minimise the problem. Alternatively, varieties which do not produce the heavily vegetative flavours associated with the presence of working leaves may be a better choice. It is common for wine tasters to suggest that the green vegetative flavours appearing in grapes and wines are related to an excess of tannin. An alternative interpretation is that green flavour accents provide their own astringent sensation which heightens astringency due to acidity and tannins.

The lack of white varietals that can take advantage of cool ripening conditions mid to late season is a matter of concern in terms of potential unrealised. Roussanne, Marsanne and Viognier are prime candidates for trial, and many more interesting prospects are available in Italy, Spain, Portugal and doubtless in Eastern European countries that until recently have been inaccessible.

HEAT LOAD FOR GROUP 6 VARIETIES

The benchmark locations for performance with varieties like Cabernet Sauvignon are those sites in Bordeaux that are marked, but particularly Pauillac and Begadan. In Western Australia the preferred planting zone again lies to the south of Margaret River where heat loads are appropriately low.

An observation with respect to the performance of Bordeaux red and white varieties in the north of Margaret River is counter current to the temperature theme and admittedly rather speculative. Perhaps heat loads between 500 and 1000 degree hours may be associated with the production of wines with firm flavours not necessarily due to acid or tannin. Perhaps sugar ripeness precedes flavour ripeness. Perhaps the persistence of green herbaceous notes is related to the presence of too many working leaves at harvest. Paradoxically these compounds appear to diminish at still higher heat loads unless the grapes are harvested at low sugar levels. Limited experience at Karridale suggests that heat loads below 500 degree hours allow a flavour ripening to proceed in better relation to accumulating sugars to result in a reduction in leafy aromatics. Bordeaux varieties may not be alone in their tendency to exhibit firm flavours in marginally warm ripening conditions. Pinot Noir seems to be a case in point.

The question must be asked as to whether alternative varieties like Tannat and Kadarka might provide more agreeable flavours than Cabernet Sauvignon, Merlot and Cabernet Franc where firm, green herbaceous flavours are too intrusive. Still other varieties drawn from a later maturity group would have the additional advantage of cooler ripening conditions. This possibility would appear to apply particularly to the most fashionable and fastest growing portion of the Margaret River region, the northern and north-eastern portions.

HEAT LOADS FOR GROUP 7 VARIETIES

Orange and Pujaut are indicators for ripening temperatures for this varietal group from the appellation known as Châteauneuf-du-Pape, where Grenache is dominant in the blend. Châteauneuf is a pimple of a hill that creates excellence, surrounded by a plain awash in mediocrity. Yields are low, ripening temperatures are curtailed by the Mistral. Cassis on the Mediterranean coast produces wines of great reputation from Mourvèdre, also known in Australia as Mataro.

It is a mistake to assume that wines from these grape varieties inherently lack flesh, zest, aroma and elegance. Heat loads at Nuriootpa and Strathalbyn are very moderate for these late-maturing varieties and recently this fact has been 'discovered' by winemakers and the wines enthusiastically received. The performance of trial plantings of Petit Verdot, Mataro, Grenache, Souzao, Nebbiolo and Graciano in Margaret River is most encouraging. Fruit intensity is excellent and tannins are well concealed. Ripening proceeds without difficulty and vintage occurs between late March and mid April. It would be a mistake, however, to plant these late varieties in situations where ripening is likely to be irregular, crop level is excessive or management favours irrigation and fertilisation to excess.

Late-ripening grapes can provide quality wines in locations where earlier varieties would not. They offer the opportunity to extend super-premium production into warmer inland areas where midsummer temperatures are much warmer, humidity a great deal less and disease pressure negligible. By virtue of their late ripening time, these varieties escape the heat that damages grape flavour. We need to expand the list of varieties available by importing and trying more late varieties. In doing so, we must observe that their flavour potential, along with grapes from any other ripening group, will reveal itself only in environments where thermal conditions are appropriate. Perhaps McLaren Vale, and most definitely Margaret River, provides this opportunity, whereas Merbein does not.

The long growing season on the West Coast provides generous conditions to enable late varieties to perform with regularity and distinction. Good ripening conditions persist into autumn. The West Coast's capes are also less affected by summer downpours originating in tropical cyclones that frequently affect locations to the north and as far east as South Australia. In the southernmost parts of Margaret River, good thermal conditions exist for the ripening of early and late grape varieties, giving this area

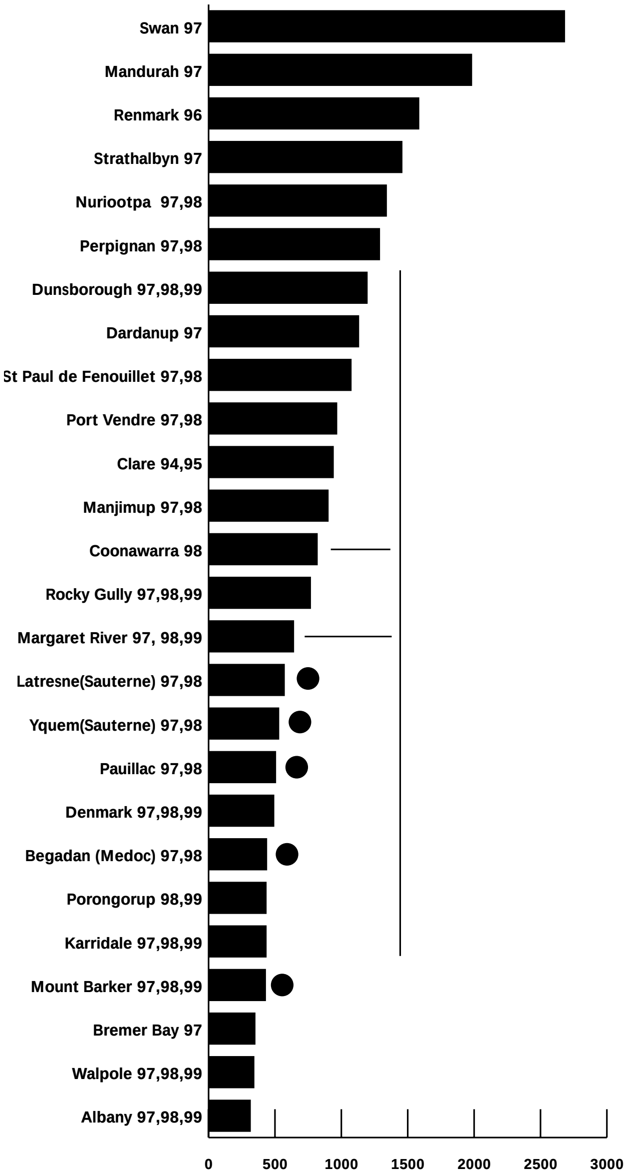


Figure 3. Heat loads in the ripening month for group 4 varieties Malbec, Tempranillo, Zinfandel, Tinta Madiera, Pinotage, Semillon, Muscadelle, Riesling, Furmint, Leanyka, Harslevelu, Sercial, Malvasia Bianca

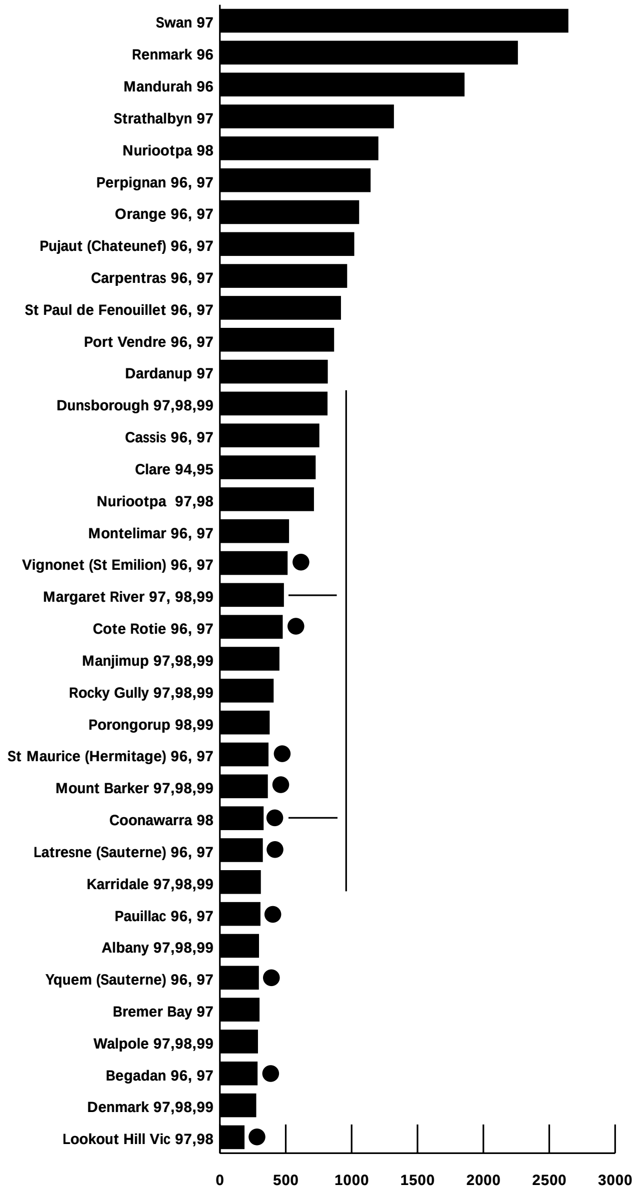


Figure 4. Heat loads for group 5 varieties Merlot, Cabernet Franc, Shiraz, Cinsaut, Barbera, Sangiovese, Touriga, Chenin, Roussanne, Marsanne, Viognier

unparalleled versatility combined with marked potential to accumulate flavour. Enough chill occurs to curtail leaf activity, and vegetative flavours are subdued. If ever there was a site suited to varietal evaluation offering excellent scope across the full range of possibilities, it exists in the Karridale–Augusta area of Margaret River.

SUMMARY

The relationship between minimal heat loads and maximum wine quality is not a speculative proposition; its validity is amply demonstrated in Figures 1, 3, 4, 5 and 6. Sites are arrayed in terms of decreasing heat loads for each of the varietal groups, 3 to 7. With minor exceptions, all the great appellations in Bordeaux, Burgundy and the Rhône experience cool ripening conditions in the ripening period of their respective cultivars regardless of the fact that the thermal environments in the lead up to ripening are obviously very different. The same appears to apply to quality wine environments in Australia and New Zealand.

While it is apparent that the absence of significant heat loads during maturity is a pre-condition for maximal flavour development it is nevertheless to be expected that, due to the range of other factors operating, appropriate heat loads cannot guarantee results. Disease status, crop level, moisture supply and so on will all play a part.

If flavour maximisation depends upon heat load minimisation, regardless of variety, this relationship becomes a rule for site and varietal selection to meet wine quality and style criteria. This simple notion provides a tool that can save much time and effort in the quest to make better wine. The quest for better sites to produce quality wine then becomes a matter of the prediction of maturity date and the monitoring of thermal conditions leading up to

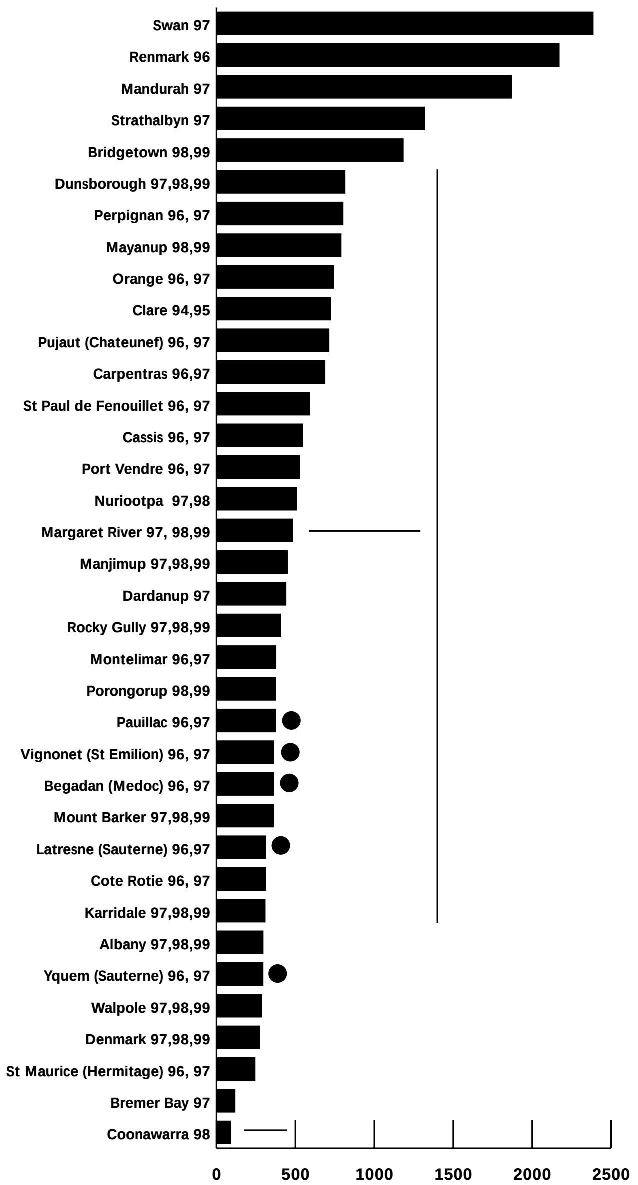


Figure 5. Heat Loads for group 6 varieties Cabernet Sauvignon, Tannat, Kadarka,Corvina, Nebbiolo, Ramisco, Mourisco Tinto, Alvarelhao,Valdigue, Ruby Cabernet, Columbard, Palamino, Dona Branca, Rabigato

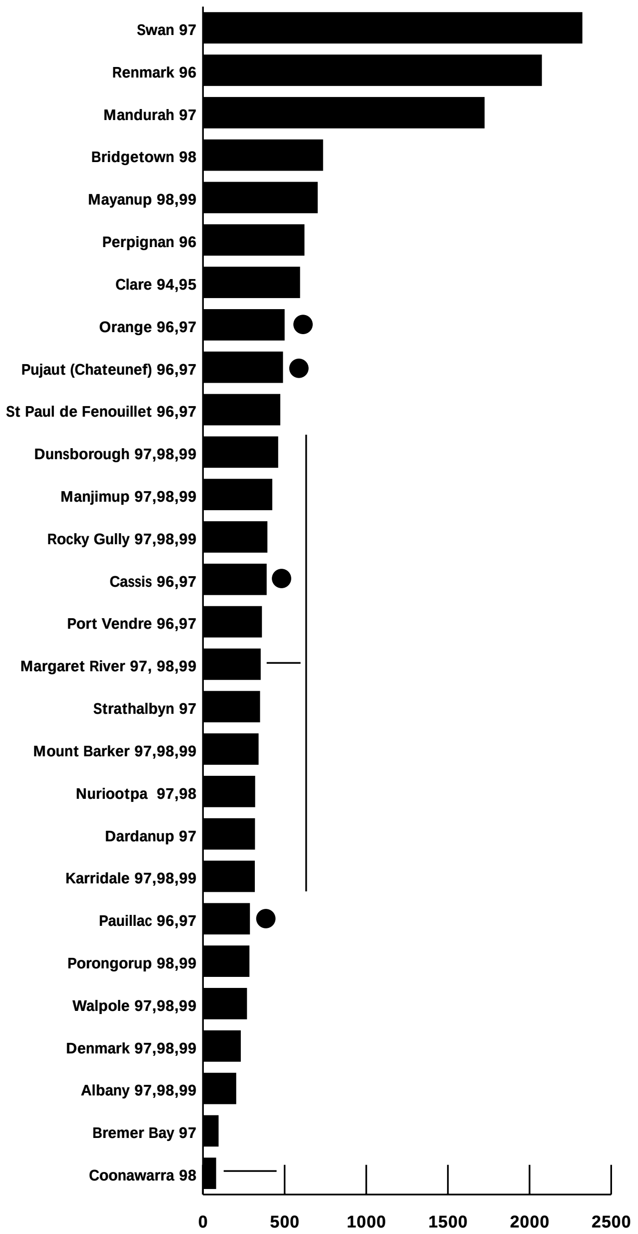


Figure 6. Heat Loads for group 7 varieties Aramon, Petit Verdot, Carignan, Grenache, Mataro, Fresia, Negrara, Grignolino, Souzao, Graciano, Monastrell, Muscat Gordo Blanco, Trebbiano, Montils

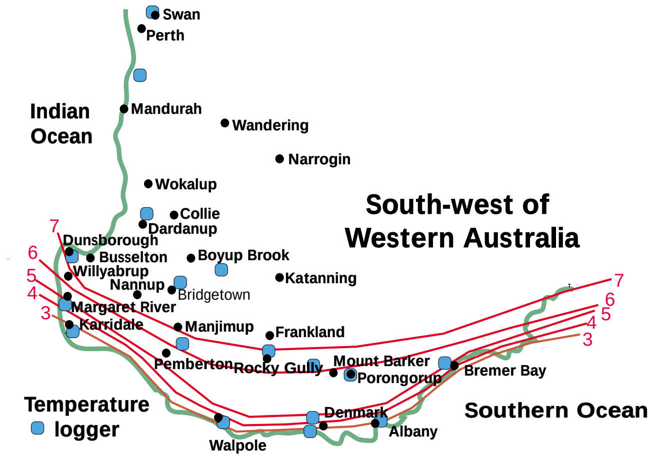


Figure 7. Limits for ripening particular varietal groups with less than 500 degree hours in excess of 22°C in the ripening month in a moderately warm year like 1998

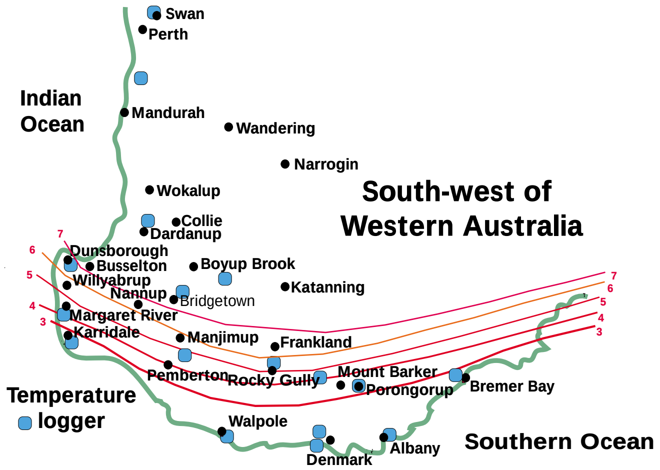


Figure 8. Limits for ripening particular varietal groups with less than 500 degree hours in excess of 22°C in the ripening month in an average year

that date. Critically, varieties are seen as a source of flavour alternatives depending upon environmental factors rather than offering inherent attributes regardless of the conditions under which they are grown. Finally, varieties are numerous. The pool of potential flavours is much greater than we currently imagine.

RECOMMENDATIONS FOR WESTERN AUSTRALIA

Figure 7 has been compiled from the data already presented. Figure 8 is generated from data from the slightly warmer year 1998. Taken together, these maps suggest that the zone where the most advantageous ripening conditions occur in Western Australia for varietal groups 3 to 7 borders the South Coast and is at its widest in the vicinity of Frankland. This width of approximately 140 km should be compared with a distance of 450 km between Dijon and Marseilles. The zone contracts towards the south in warm years and expands in cool years. Its size is conditioned by the competing influence of air from the Australian landmass and air from the Indian and Southern Oceans. The zone has no Pyrennees, no Mistral sweeping down from an alpine mountain range, no Mediterranean Sea between it and a hot place. At worst there is a hot dry wind blasting out of a dry interior. Humidity falls to 25% and the mercury climbs to 40°C. The vines are left almost visibly gasping, and leaves at the top of the canopy and in the vicinity of the bunches may be discoloured or entirely lost. With good fortune these environmental insults are confined to the period before veraison.

A proposal to plant vines outside this favoured zone make little sense while land is inexpensive within it. Having located within it, the sensible thing to do is take into account the influence of ripening temperatures on grape flavour and choose varieties accordingly. If the range of varieties then seems small, as indeed it should, it can be increased by exploring the flavour choices between Portugal and Persia, and north into Hungary and the Ukraine. There are 15,000 named varieties, of which probably 2,000 will ripen late enough to offer real potential in warmer areas. The notion that we already have everything that is useful is shortsighted in the extreme. Funds employed in importing another clone of Pinot Noir could be better spent unless one intends to grow that variety in Tasmania.

Of course, anyone can plant anything anywhere, and the last thing that should be done is to stop that process cold. To do so would be to suggest that we know all there is to be known about the interaction between grape variety and environment. That is not the case. There will be sites where local factors modify to some extent the broad expectations indicated above. One should not underestimate the impact of factors like crop level, picking time and soil depth in determining flavour intensity at harvest in dry climates. The list could go on. There will always be exceptions to a rule, an aberration in a basic pattern determined by fundamental atmospheric factors like temperature, relative humidity, wind speed, soil and moisture supply. Australia is a low latitude landmass with unique environmental circumstances that will produce individual wine styles. Understanding the influence of environmental factors is critical in maximising the flavour choices available in the raw material, the grape. Vineyard design and management factors are obviously important. In the end price, inspired marketing and plain skullduggery will also play its part. The human factor can never be discounted. But that is another story. wij

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