Recreational and tourism value of healthy rivers

Deliverable RQ12.2.5

Objective

This research investigated whether there is a link between the ecological health of rivers, wetlands and lakes across the Basin and the number of tourism and recreational visits to those locations. To do this we needed a robust method for identifying which environmental conditions and other relevant factors influence visitation rate. In this summary we explain how we approached this and describe what we found.

Visitation rate

We used bird species checklists posted to the citizen science website eBird (www.eBird.org) as a way of estimating visitation rate. When bird species checklists are posted to eBird they receive a time stamp, a geo-location and are tagged with an anonymous user-ID. To produce an indicator of birdwatcher visitation rate we divided each of the Murray Darling Basin's 28 main River Regions into its constituent sub-catchments (Figure 1) and counted the total number of checklists anonymous eBird users posted in each sub-catchment in each month between March 2013 and March 2019 (73 consecutive months). We call these counts of checklist posts 'Birder user Days' (BuDs) per sub-catchment per month. There are 3170 sub-catchments across the Basin, and between 17 and 529 sub-catchments per River Region. The dataset contains more than 230,000 data points, with each data point reporting the BuD count per sub-catchment per month. Figure 2 shows the sum of monthly BuD counts for sub-catchments across the Basin between March 2013 and March 2019.

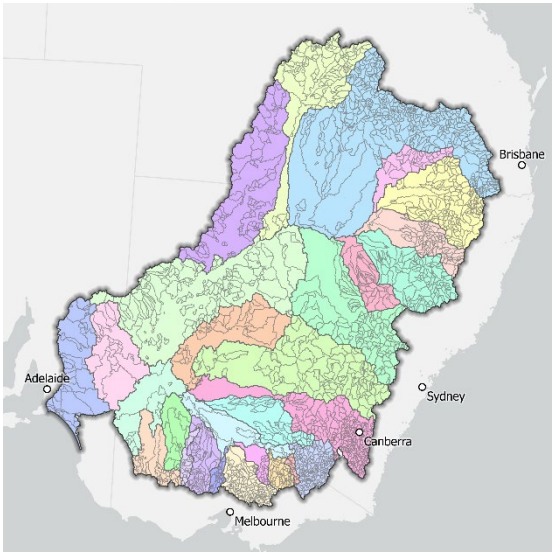

Figure 1: River Regions across the Murray Darling Basin, shown by colour. Grey outlines show sub-catchments within River Regions.

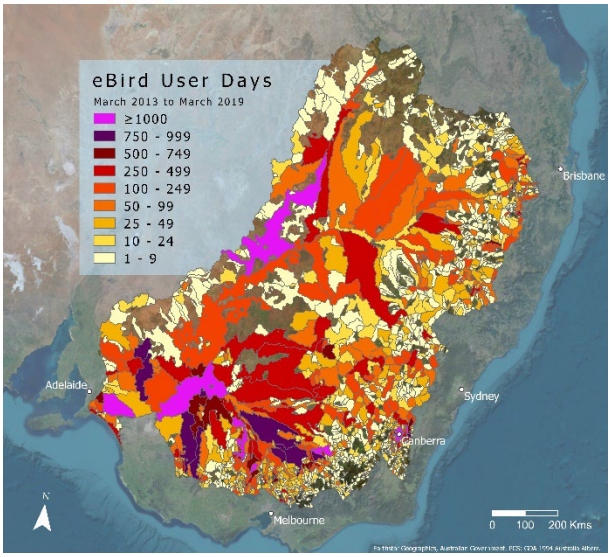

Figure 2: Total of monthly eBird user days (BuDs) per sub-catchment for the 73 consecutive months March 2013 to March 2019.

Factors that might influence visitation rate

Visitation rate could be influenced by many different factors. We needed to account correctly for as many of these factors as possible to identify whether visitation rate (as represented by BuD count per sub-catchment) might be influenced by changes in environmental condition.

For our analysis we used two different ways of representing environmental condition, both produced from satellite remote sensing. The first one (NDVi: nomalized difference vegetation index) provides a measure of the average greenness of the landscape. The second one (MNDWi modified normalized difference water index) detects water on the land surface and provides a measure of inundated ('wet') area. We used NDVi to report the average greenness of the landscape within each sub-catchment in each month and MNDVi to report the average percentage wet area within each sub-catchment in each month. Average landscape greenness and average percentage wet area vary across months within a sub-catchment and also vary between sub-catchments within the same month (Figure 3 and 4).

Monthly total rainfall (mm) and monthly maximum temperature (degrees Celcius) also vary within and between sub-catchments. These factors might also influence visitation rate so were included in our analysis. We also included in our analysis other potentially influential factors that varied between sub-catchments but remained unchanged for a given sub-catchment over the 73-month duration of our analysis. These factors were: road travel time from the nearest major city, distance to the nearest local town, average resident population

in the sub-catchment and the shortest distance from the sub-catchment to features such as national parks, internationally important wetlands and important bird areas. Our analysis recognised that visitation rate to a given sub-catchment would likely vary by month of the year and might also vary between years. We summarise the BuDs dataset and the factors that might influence visitation rate in Figure 5.

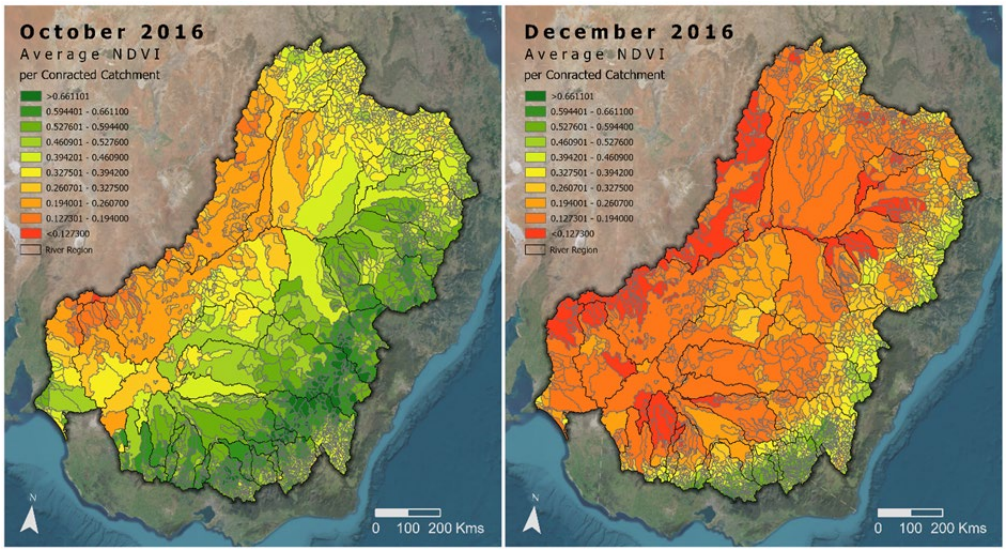

Figure 3: Average NDVi 'landscape greenness' for sub-catchments across the Basin in October and December 2016.

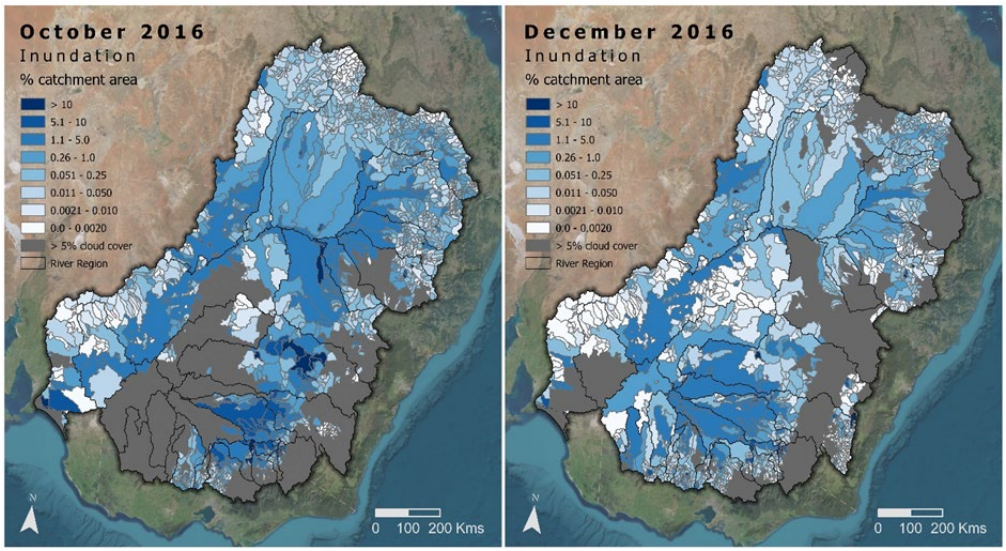

Figure 4: Percentage inundation area for sub-catchments across the Basin in October and December 2016. Sub-catchments with less than 95% of their area visible (due to cloud cover) are shown in grey. These were regarded as 'missing data' in our analysis.

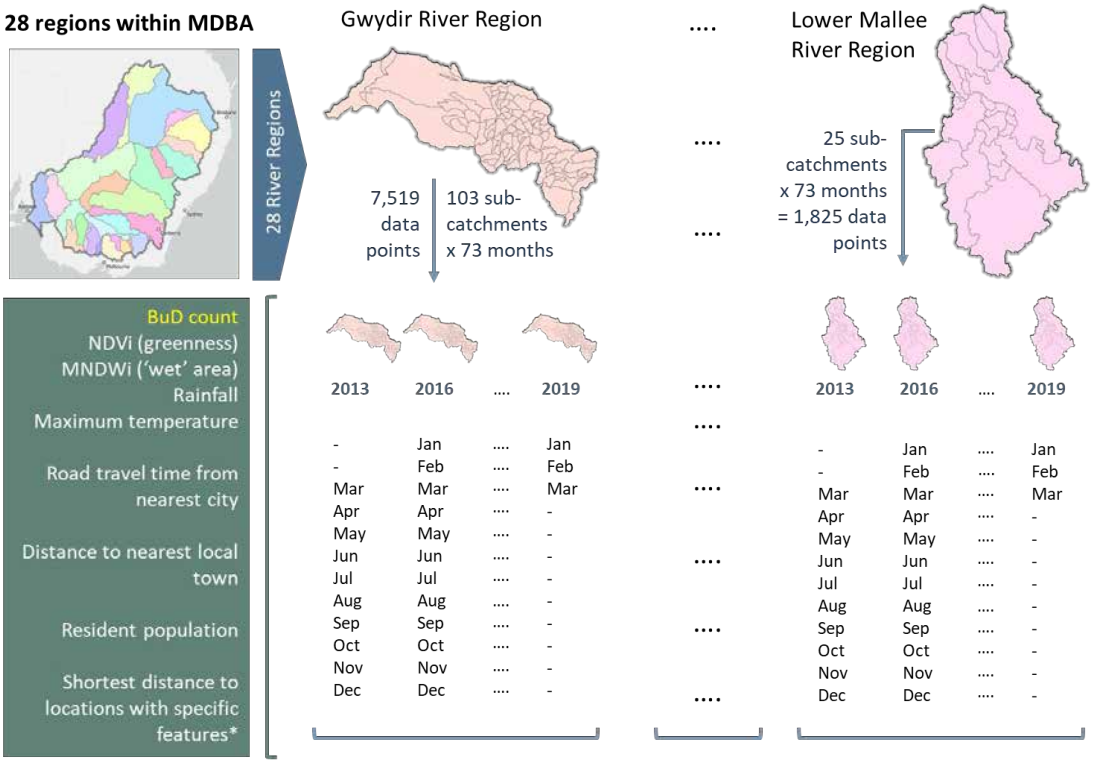

Figure 5: Summary of data on BuDs and factors that might influence visitation rate (*features such as national parks, internationally important wetlands and important bird areas).

Analysis

Our analysis used the BuDs dataset and the information on factors that could potentially influence visitation rate to predict expected visitation rates to sub-catchments in River Regions across the Basin for the 73-month analysis time frame. The strength and importance of the different driving factors was adjusted automatically by computer software until the best fit was obtained between predicted visitation rates and the actual visitation rates as represented by monthly BuD counts. Once 'best fit' was obtained we could see which driving factors were important for producing that fit. We could then say that these factors were likely to be associated with the observed changes in visitation rate. The analysis was carried out separately for River Regions across the Basin. Figure 6 compares the 2013 to 2018 'best fit' predicted annual totals of BuD counts for sub-catchments in the Murray Riverina Region with observed annual total BuD count data for the same region.

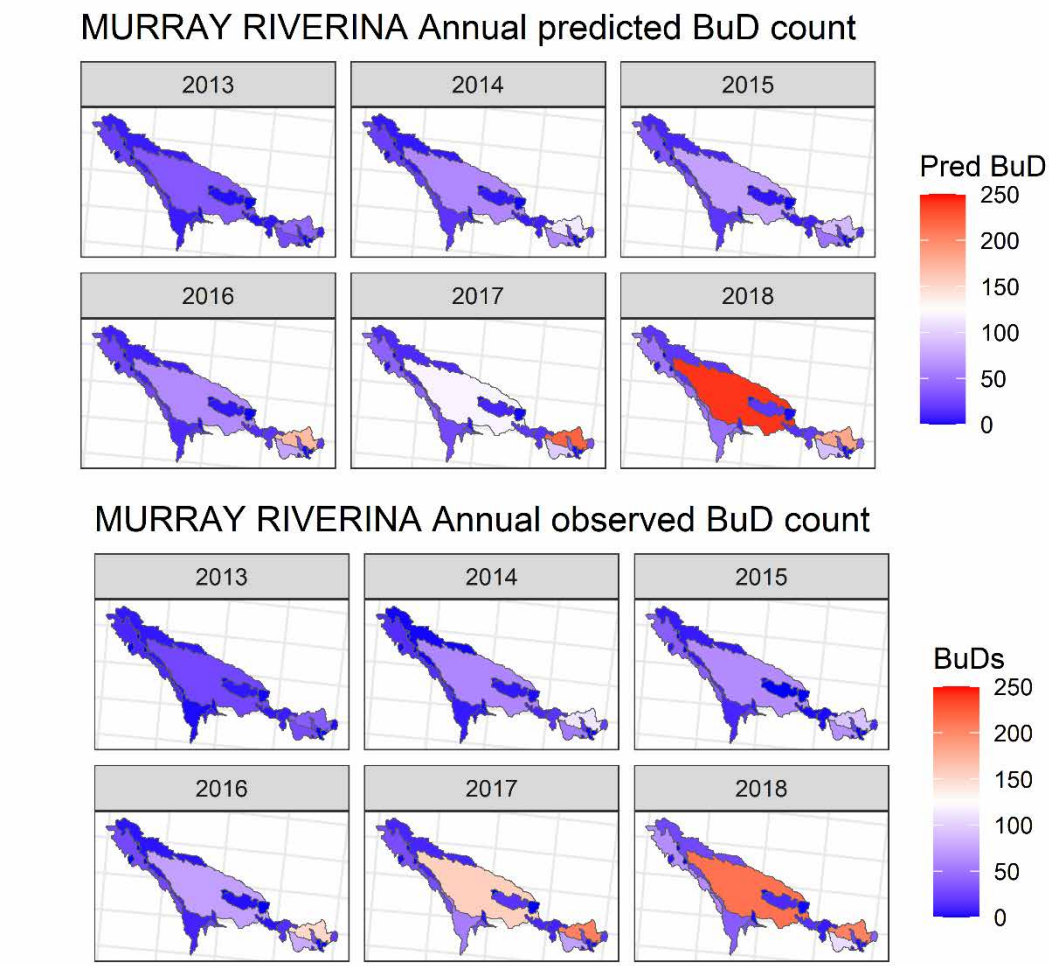

Figure 6: Predicted (a) and observed (b) annual total of average monthly BuD counts for sub-catchments in the Murray Riverina Region (2013 to 2018).

What did we find?

Results from our analysis were quite variable across the Murray Darling Basin's main River Regions. This is not surprising as the impact of environmental condition and other potential drivers on visitation rate as represented by BuDs could reasonably be expected to differ between the northern and southern sections of the Basin, and between River Regions that are relatively accessible from Sydney, Canberra, Melbourne and Adelaide and more remote areas further inland.

When percentage wet area (rather than landscape greenness) was used to represent environmental condition, an important positive association between percentage wet area and visitation rate (as represented by BuDs) appeared consistently for the Murrumbidgee, Murray Riverina, Upper Mallee and Border Rivers regions. An important positive association between

percentage wet area and visitation rate also appeared for the Lachlan, Macquarie-Bogan and Billabong – Yanco Creeks regions in some of our models but not in others. The Benanee – Willandra Creek region was the only River Region across the whole Basin where negative association appeared between percentage wet area and visitation rate.

What does this tell us?

We learnt several things from this analysis. Firstly, we learnt that BuDs from the eBird citizen science website provide a way of estimating bird watching-related visitation rate across the Murray Darling Basin. Published academic research has shown how eBird data can be supplemented with separate surveys to estimate visitation rates for other forms of outdoor recreation too, besides birdwatching. (This is something we would like to try another time).

Secondly, we learnt that for at least some sub-catchments in major River Regions in the Basin percentage inundation area is positively associated with BuD visitation counts. Whilst we are confident in saying that in these Regions there is a positive association between percentage inundation area and BuD visitation counts, we cannot – at this stage – say for sure that increasing inundation area (obviously within limits) causes visitation rates to increase. We will be investigating this further in remaining research within Theme 4 RQ12.2.

Thirdly, when we analyse the data for complete sub-catchments (rather than for individual visitation sites) it seems that the positive association between percentage inundation area and BuD visitation counts is more consistent than that between landscape greenness and BuD visitation counts. This remained the case even when our visitation prediction models accounted for the percentage of irrigated agricultural area with each sub-catchment (to differentiate it from NDVI greenness measure).

What will we do next?

The next stage of our research will use a similar approach but will focus on visitation rates to individual sites to investigate whether BuD visitation counts at individual lakes and wetlands across the Basin appear to be associated with – or actually driven by – changes in environmental condition at those sites.