ON MILLIPEDES AND SENSE OF PLACE

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Tasmania has about 160 species of native millipedes. A few of these are widespread, occupying 40-50% of the State's land area, but most species have much smaller ranges. This is not the result of habitat loss. In Tasmania as elsewhere in the world, the natural distributions of individual millipede species are often no more than a few hundred or a few thousand square kilometres.

Another generalisation about millipedes is that many genera form mosaics, or patchworks, on the map. Each species in the genus lives in its own patch, and the patches don't usually overlap. (For examples, see the distribution maps for the genera *Atrophotergum*, *Bromodesmus*, *Dasystigma* or *Gasterogramma* on the Tasmanian Multipedes website, www.qvmag.tas.gov.au/zoology/multipedes/mulintro.html.)

With so many millipedes having small ranges, and with so many differently arranged species mosaics, the millipede species list for locality A is unlikely to be the same as the one for locality B, unless A and B are very close indeed. Furthermore, because millipedes live in the soil and plant litter and don't pay much attention to macrohabitat, localities A and B can look the same to our eyes, but have very different millipede faunas.

A good example is wet forest at ca. 600-900 m on dolerite. There are large areas of such forest in eastern and central Tasmania, often with *Eucalyptus delegatensis* (gumtopped stringybark) over *Bedfordia salicina* (Tasmanian blanketleaf), and a sparse ground layer of *Polystichum proliferum* (mother shieldfern). Picture yourself in that forest early on a cool morning, high up on a hill with no view yet because you're enveloped by mist. Where are you? Somewhere in the Eastern Tiers? The fringe of the Central Plateau? The Wellington Range?

You can tell where you are just by collecting and identifying the millipedes under logs and stones. No, your millipede-based location won't be as accurate as the one on your GPS screen. But it won't be wildly wrong, either.

Millipede ranges on the map

How close can you get? Let's do a mapping exercise to find out. We're going to build a millipede-based place-finder for Tasmania. If you're uncomfortable with geometry and numbers, please skip ahead two sections in this article.

For simplicity's sake we'll work with the Tasmanian mainland (Figure 1), without Bruny, Maria, Schouten and the Bass Strait and south coast islands. The total area is 64060 km^2.

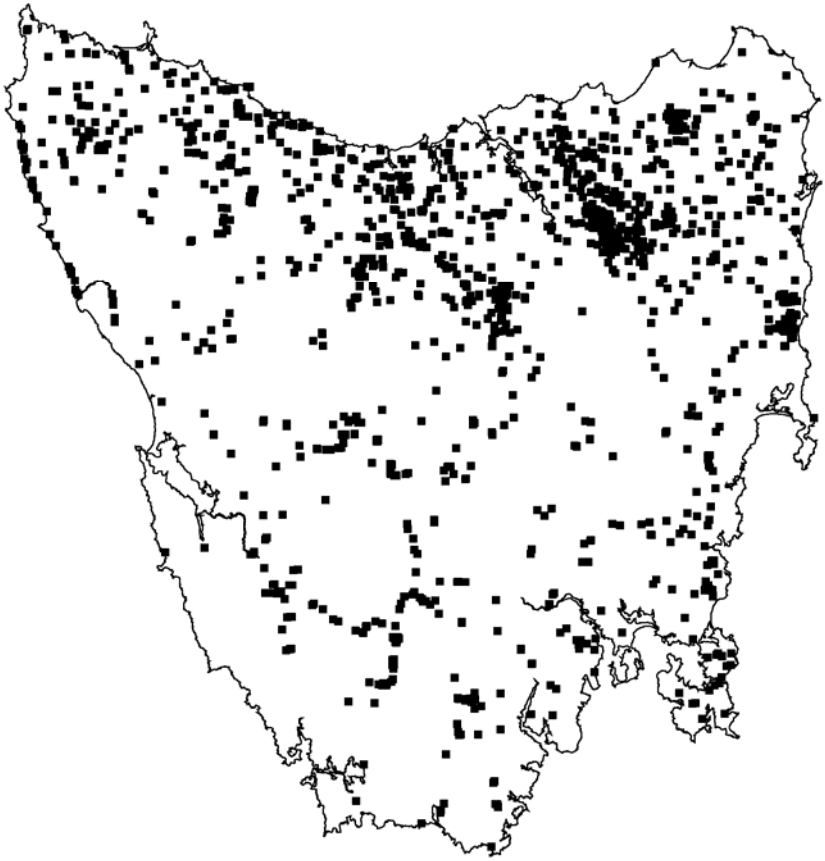

Figure 1. Mainland Tasmania with locality records for 27 millipede species.

The species we'll use are all Polydesmida, or flat-backed millipedes. I've chosen 27 relatively large species (15-30 mm long as adults). They're abundant and always among the first Polydesmida collected in their respective ranges. I've deliberately excluded from the list the many narrow-range Tasmanian species, like *Lissodesmus horridomontis*. If you find this species, you're northeast of Scottsdale in a block no bigger than about 150 km^2. I've also excluded low-abundance

species. Let's just see what we can do with some relatively widespread millipedes that are easy to find, and therefore – potentially – convenient geographic indicators. (For a taxonomic list of the 27 species, see the Appendix.)

There are 2228 locality records for the 27 species on the Tasmanian mainland (Figure 1). We first convert these records into approximate ranges by building a minimum convex polygon around the localities for each species. Next, we trim the polygons to remove the bits in the sea and the estuaries (Figure 2). The 27 species polygons now range from 820 to 30000 km^2, or from 1 to 47% of the Tasmanian mainland. They average 8500 km^2, or 13%.

Figure 2. Minimum convex polygons for the 27 millipede species, trimmed to coastline.

With all their many overlaps, the 27 species polygons form a highly irregular mosaic covering 60540 km^2, or nearly 95% of mainland Tasmania. There are 364 separate pieces in this mosaic. Some of the pieces are quite small, while others are long narrow bits not useful for our exercise. To make the mosaic a little more manageable, we'll discard all pieces with an area less than 50 km^2. The remaining mosaic (Figure 3) is made up of 134 pieces with a total area of 58230 km^2 (91% of mainland Tasmania). We haven't lost much: the widest gap between pieces is only about 12 km across.

Figure 3. Polygon set from Figure 2, excluding overlap polygons less than 50 km^2.

Analysing the overlaps

How many different millipede species do we need to collect before we have a good idea of where we are?

There clearly needs to be a trade-off. The more species we collect, the smaller the area defined by the overlaps of the ranges of those species, and the higher the accuracy of our millipede place-finder. However, some of the 134 overlap polygons in Figure 3 only contain one or two species. If we want to use more species to narrow down where we are, those one- and two-species polygons will drop off the map, and the total area available within which to locate ourselves will be smaller.

A reasonable compromise is four species. There are 80 overlap polygons containing four or more species (Figure 4), with a total area of 37480 km^2, which is 64% of our starting area and 58% of the Tasmanian mainland.

Within this set of 80 polygons, there are 193 different 4-species combinations. Each of these combinations represents a single polygon or a group of up to nine polygons in Figure 4. Conversely, a particular polygon or polygon group might be home to one to ten different 4-species combinations.

I'm nearly ready to answer the question "How close can you get?" with our millipede place-finder. The final wrinkle is that many of the 193 4-species combinations define a small set of slightly separated polygons. The effective area in these cases is that of a larger polygon tightly surrounding these separate ones. In Table 1 I list the size distribution of the effective areas of the 193 4-species combinations.

Table 1. Size distribution of polygon groups from Figure 4 as defined by the 193 unique combinations of four species (see text for explanation).

Size class (km^2)	Polygon groups
0-499	101
500-999	31
1000-1499	34
1500-1999	8
2000-2499	12
2500-2999	2
3000-3499	2
3500-3999	1
4000+	2

Figure 4. Reduced polygon set from Figure 3, showing overlap polygons containing locality records for four or more millipede species. The largest polygon group is diagonally hatched (see text).

Now to summarise. If you collect four of the 27 millipede species, the worst you'll do is locate yourself within a 7940 km^2 block in the Midlands (diagonal hatching in Figure 4). That block is 21% of the 4-species area in Figure 4, and 12% of the Tasmanian mainland.

Most of the time you'll do a great deal better. More than half of the 4-species combinations will place you within an area of less than 500 km^2, which is roughly 1% of both our 37480 km^2 "testing area" and the 64060 km^2 of mainland

Tasmania. You can think of that area as a square block roughly 22 km on a side. Two-thirds of the 4-species combinations will locate you within an area less than 1000 km^2, equivalent to a square block 32 km on a side, and a little less than 2% of the mainland of Tasmania.

That's a remarkable result, and you may be wondering how much error there is in this exercise. The answer is "some, but not much". Almost all the 27 species used have been carefully mapped over the years, and range extensions from new discoveries are highly unlikely to be more than 30 km. Most of the small overlap polygons in the final set of 80 are in the best-sampled parts of Tasmania. Even if the mapping was slightly in error, the majority of 4-species combinations would still represent tiny areas – perhaps 5% of mainland Tasmania instead of 2%.

And the 42% of the Tasmanian mainland outside our 27-species, 80-polygon mosaic? The white spaces in Figure 4 are rich in narrow-range "landmark" species like *Lissodesmus horridomontis*. If you can find and identify any of these species, you can quickly place yourself on the map.

Sense of place

I've shown above, by means of a geometric exercise, that knowing Tasmania's millipedes is a good way to know Tasmania. There are many other ways. Geologists recognise particular geographically restricted rock formations. Botanists recognise small-range plants and plant communities. Limnologists know the special characteristics of particular rivers and lakes. Climbers know an assortment of individual hills and mountains – generally as friends, sometimes as opponents.

All of this knowledge is part of a larger natural history. As naturalists we're aware that on an island as naturally diverse as Tasmania, every place becomes strongly distinctive as we begin to pay attention to the plants, animals and landforms of the place. We don't have to create special places. They already exist, waiting to be appreciated for their distinctiveness.

In recent years, many social commentators have celebrated "sense of place" as something that enriches our personal lives and provides an anchor for community living. I'm sure it does. However, the "place" they're referring to is typically a human construct. It's the town in which you grew up, or the roads along which you habitually travel. It's an accident of human history that put you or your antecedents on a certain part of the map of Tasmania. The natural backdrop to town and family histories is just that – backdrop, scenery, a view through a window.

The artificial "places" of Tasmania are emotional and intellectual overlays on a landscape already highly particularised in the absence of people. Sometimes the overlays are congruent with the underlying mosaic, but after 35 years of talking with Tasmanians about Tasmania, I've come to the conclusion that this kind of

geographical congruence is very rare. The mental maps in most heads show towns, roads, historical features and a few silhouetted hillshapes. It's possible to love "places" in Tasmania and be completely ignorant of anything but what people have done there, sometime in the last 200 years.

The country/city divide may or may not be getting wider in Tasmania, but there's an even deeper division on this island that's not often recognised. It's the difference between bushworkers, bushwalkers and field naturalists on the one hand, and the great majority of the population on the other. Both groups have an understanding of "place", but in only one of the groups is that understanding based on the natural reality of Tasmania.

APPENDIX

The spatial analysis summarised in this article was carried out in ArcView GIS using a convex hull generator and a shapefile splitter from Jenness Enterprises (www.jennessent.com/arcview/arcview_extensions.htm). Millipede locality records are for specimens in the Queen Victoria Museum and Art Gallery, the Tasmanian Museum and Art Gallery and the Department of Primary Industries and Water (New Town collection), supplemented by project records compiled by the author. The 27 native Polydesmida species chosen for analysis are listed below. For more information on these species, follow the links from the species checklist on the Tasmanian Multipedes website: www.qvmag.tas.gov.au/zoology/multipedes/mullist.html.

Dalodesmidae

Atalopharetra bashfordi Mesibov, 2005
A. johnsi Mesibov, 2005
Bromodesmus catrionae Mesibov, 2004
B. militaris Mesibov, 2004
B. rufus Mesibov, 2004
Dasystigma bonhami Mesibov, 2003
D. huonense Mesibov, 2003
D. margaretae (Jeekel, 1984)
D. tyleri Mesibov, 2003
Gasterogramma austrinum Mesibov, 2003
G. imber Mesibov, 2003
G. plomleyi Mesibov, 2003
G. psi Jeekel, 1982
G. rusticum Mesibov, 2003
G. tarkinense Mesibov, 2003
G. wynyardense Mesibov, 2003
Lissodesmus adrianae Jeekel, 1984
L. alisonae Jeekel, 1984
L. cornutus Mesibov, 2006
L. hamatus Mesibov, 2006
L. modestus Chamberlin, 1920
L. perporosus Jeekel, 1984
Tasmanodesmus hardyi Chamberlin, 1920
Tasmanopeltis grandis Mesibov, 2006

Paradoxosomatidae

Aethalosoma solum Jeekel, 2006
Somethus mesibovi Jeekel, 2006
Somethus tasmani Jeekel, 2006