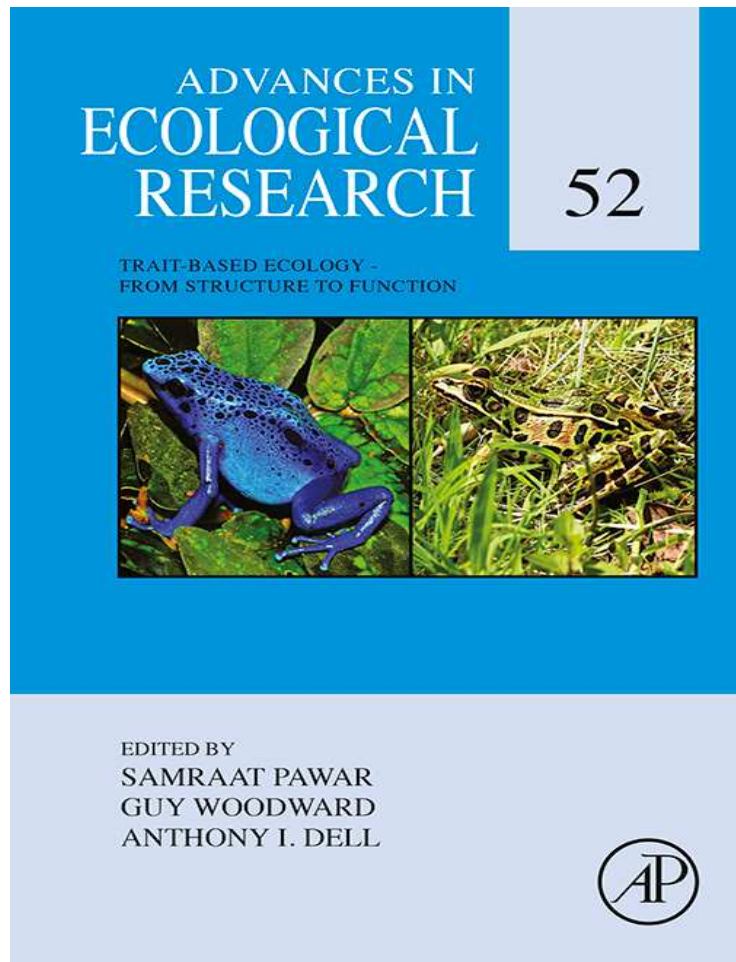


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# Population and Community Body Size Structure Across a Complex Environmental Gradient

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## Abstract

We monitored the invertebrate community of leaf litter in and around a drying intermittent pool bed to explore patterns of ecological organisation across a complex environmental gradient, with particular focus on population and community size structure. We measured the body size of 24,609 individuals from 313 taxa ranging over 6 orders of magnitude in size to explore how the functional properties of individuals, populations and communities are affected by moisture (aquatic vs. terrestrial) and light (diurnal vs. nocturnal), and how these properties change across the aquatic–terrestrial habitat transition that occurs as the pool bed dried. We found strong effects of moisture on some population (size structure) and many community (species richness, abundance, evenness, biomass and size structure) properties, with additional temporal effects across the aquatic–terrestrial ecotone. There was no difference between diurnal and nocturnal populations or communities. Our results facilitate understanding of how the physical environment influences functional attributes, and particularly the size structure, of natural populations and communities.



## 1. INTRODUCTION

Identification of ecological patterns that span habitats and domains of life, and that link attributes of individuals to communities and ecosystems, can offer considerable insight into the universal mechanisms that structure ecological systems (Dell et al., 2011; Nathan et al., 2008; Pawar et al., 2012; Schramski et al., 2015; Simpson et al., 2010). Similarly, identification of patterns and processes that are unique to particular habitats can shed light on the biological mechanisms that drive ecological complexity across landscapes. Such insights are essential for answering basic questions about how natural ecosystems operate, how humans are affecting natural systems and how these effects can be managed (Petchey and Belgrano, 2010). This is particularly true for predicting how ecological systems will respond to future environmental scenarios that are beyond the boundaries of those currently observed (Dell et al., 2014c; McGill et al., 2006).

Body size is a key trait of individuals, influencing many biological processes central to their ecology and evolution (Brown et al., 2004; Kalinkat et al., 2013b; Pawar et al., 2012; Peters, 1983; Schmidt-Nielsen, 1984).

Because size is so important to the ecology of individuals, patterns in the body size of co-occurring individuals have important implications for the functioning and dynamics of higher levels of ecological organisation, such as populations and local communities (Brose et al., 2006; Brown et al., 2004; Gaston et al., 2001; Kalinkat et al., 2013b; Petchey et al., 2008; White et al., 2007; Woodward et al., 2005a,b). Understanding the biological mechanisms that determine body size distributions across levels of ecological organisation (i.e. individuals, populations and communities) is central for testing and validating ecological theory (Pawar et al., 2012; Schramski et al., 2015) and for understanding and predicting effects of human activities that alter size distributions, such as hunting, fishing and conversion of native plant communities for agriculture or urbanisation (Achard et al., 2002; Angelsen and Kaimowitz, 2001; Estes et al., 2011; Jennings and Blanchard, 2004; Roman and Palumbi, 2003).

While there are universal biological and physical constraints on size structure that operate across environments (Brose et al., 2005, 2006; White et al., 2007; Woodward et al., 2005a), the physical environment can place additional constraints (Denny, 1990; Riede et al., 2011) and might affect size distributions in unique ways, such that different habitats should have unique signatures in their population and community size distributions (Brose et al., 2005, 2006; Yvon-Durocher et al., 2011). Frequently, there are substantial taxonomic differences between communities in different environments, such as between aquatic and terrestrial or nocturnal and diurnal environments, but how these differences influence the functional properties of populations and communities, such as their size structure, is not well understood (Chase, 2000; Link, 2002; Shurin et al., 2006; Yvon-Durocher et al., 2011). Because the physical environment affects properties of individuals—such as how they move, behave and interact—that influence higher levels of ecological organisation (Dell et al., 2011, 2014c; Denny, 1990; Kalinkat et al., 2013a; Pawar et al., 2012), effects of the physical environment should manifest as functional differences between populations and communities (Yvon-Durocher et al., 2011). Uncovering these patterns could help elucidate the drivers of structural and functional differences between communities from different habitats.

A key step in understanding the link between size structure and the physical environment is characterisation of patterns in real systems. However, little is known about (i) whether the physical environment influences these patterns in systematic ways, (ii) how size structures are related at different levels of ecological organisation (across individuals, populations and communities) and (iii) how patterns of size structure co-vary within sets of

interacting populations in a local community. We address each of these issues in this chapter.

We used the unique physical environment in and around a drying intermittent pool bed to assess how the physical environment (moisture and light) influences the size structure of populations and local communities. Intermittent pool beds periodically and predictably cycle between aquatic and terrestrial habitat in the same location, so they provide an opportunity to examine functional differences in local communities as they naturally transition from aquatic to terrestrial habitat during pool bed drying. Thus, they permit exploration of ecological differences between habitats in a way that avoids confounding sources of variation, such as differences in spatial or temporal scale, taxonomic resolution or sampling and laboratory protocols (Dell et al., 2014a; Yvon-Durocher et al., 2011). Importantly, the limited spatial and temporal scale of our study means that individual organisms were able to colonise anywhere in the sampled area (i.e. local communities in and around pool beds were drawing from the same species pool). We expected that moisture and light would affect population and community size structure because they both influence how organisms move, behave and interact. For example, physical constraints on movement are very different in water than on land (Denny, 1990) and differences in ambient light can affect how predators and prey detect each other (Dieguez, 2003; Fraser and Metcalfe, 1997; Gilbert and Hampton, 2001). Nonetheless, we had no prior expectations about how these compositional changes would affect population and communities size distributions, due primarily to the complexity of processes that link the ecology of individuals to the trait distributions of higher levels of ecological organisation.



## 2. FIELD EXPERIMENT METHODS

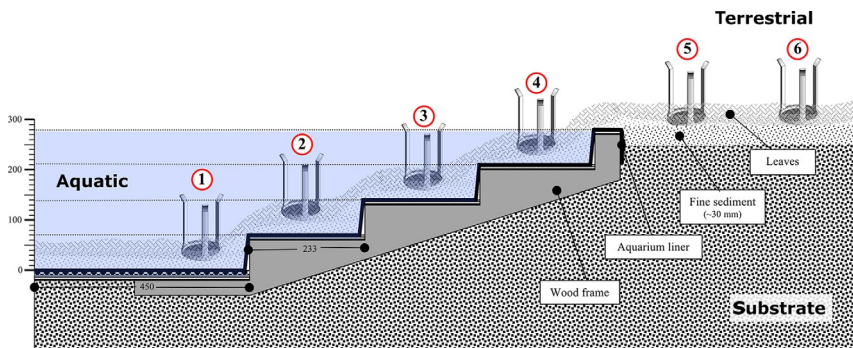
### 2.1 Study Site

Our study was carried out in Goondaloo Creek, a small stream in north-eastern Australia (Fig. A1). Annual surface flow within Goondaloo Creek is intermittent, resulting from the seasonal tropical climate of the region and the steep topography of the streambed. Surface flow normally commences with the onset of the wet season in January and ceases between March and May (depending on the extent of the wet season) after which numerous natural intermittent pools remain. Larger pools can persist for up to 5 months before drying, although the duration of each is variable and depends on their size, substrate, shading and groundwater seepage

(Dell et al., 2014a; Smith and Pearson, 1987). The experiment was undertaken within a small side channel of Goondaloo Creek that only experienced flooding during heavy rainfall (Fig. A1). The streambed at this site was composed of rocks interspersed with sand. Riparian plant species (Table A1) provided a canopy cover of about 50% across the creek bed. Under these conditions, most of the streambed receives at least a few hours of direct sunlight each day. Deciduous species provide a steady input of leaves into the stream bed from July to September (Smith and Pearson, 1987). During the wet season, flooding washes the majority of this litter downstream so that each year leaf packs within the streambed consist of recently abscised leaves. A diverse community of macroinvertebrates occupies the pools of Goondaloo Creek (Dell et al., 2014a; Smith and Pearson, 1987), and although fish have been recorded in its lower reaches, they rarely occur as far upstream as the study site (Dell et al., 2014a).

## 2.2 Experimental Pool Bed

An experimental pool bed was constructed in the dry season in 2001. We used this pool bed to control pool topography and its filling and drying regime. The pool bed consisted of a plywood frame embedded within the natural streambed, positioned where a natural intermittent pool bed normally formed (Fig. 1). Once embedded in the streambed, the frame was covered with rubber aquarium liner (JR'S Foam & Rubber Pty Ltd) and a 3-cm



**Figure 1** Profile view of one half of the experimental pool bed, which consisted of a wood frame embedded within the substrate of a natural streambed. Sampling trays were positioned at six levels (numbered), running from the centre of the pool bed into the surrounding terrestrial landscape. As pool depth decreased over time, levels 1–4 progressively dried (level 4 lost surface water on 7 October 2002, level 3 on 11 October 2002, level 2 on 15 October 2002 and level 1—and the entire pool bed—on 19 October 2002; see Table 1).

layer of natural sediment, excavated from the same location and passed through a 2.5-cm-mesh sieve. The wooden frame consisted of four flat concentric circular levels in a stepped design, so that the topography of the pool bed was radially symmetrical, with depth decreasing from the middle of the pool to its margins (Fig. 1). Burying the wooden frame within natural substrate removed any unnatural barrier to the movement of non-flying animals.

In June 2002—1 year following pool bed construction and when surface flow had ceased—accumulated leaf litter was removed and the sediment was evenly distributed over the wooden frame. Sampling trays (see section 2.4) were placed in and around the pool bed, and a disk of filter paper was placed in each tray to provide an estimate of substrate moisture content (see section 2.6). Sampling trays were distributed across six levels (18 trays per level). Four levels were within the inner margins of the pool bed, and therefore corresponded to pool depth, and two levels were outside the pool margins and represented more permanent terrestrial habitat (Fig. 1). Within the pool bed (level 4 and below), conditioned leaf litter (see below) was placed evenly across the substrate to a depth of approximately 3 cm. Dry leaves, which had previously been collected but not immersed in the natural pools, were laid around the margin of the experimental pool bed for a distance of about 1.5 m (levels 5 and 6). A ruler was placed vertically in the middle of the pool so that pool depth could be measured. Water level was maintained by slow dripping from a single irrigation nozzle (Pope™ Veriflow® Dripper) of rainwater gravity fed from a 9000-L polyethylene tank (Gough Plastics) located nearby. The tank was sealed against faunal colonisation, and water was filtered through a 0.005-mm sediment filter (RaiDance™) prior to delivery into the pool bed.

This method created a pool bed with a complex litter layer whose topography, volume, shape and substrate were known, which mimicked nearby natural pool beds, and whose water level could be reduced when desired by piercing the rubber pond liner at the desired level (Fig. A2).

## 2.3 Leaf Packs

We focused on litter communities because leaf packs occur within nearby natural intermittent pool beds throughout the year (Dell et al., 2014a; Smith and Pearson, 1987), serve as food and microhabitat for many aquatic and terrestrial invertebrates (Davies and Boulton, 2009; Dudgeon and Wu, 1999; Murphy and Lugo, 1986; Reddy, 1995; Richardson, 1992) and are



easily manipulated. Leaves of multiple species were collected from the streambed in the dry season prior to sampling. A garden vacuum (Flymo™ Garden Blower Vac) was used to collect recently fallen leaves, and no leaves were collected from existing dry pool beds. Leaves were shaken vigorously over a 2.5-cm-mesh sieve to remove fine detritus and animals and to standardise initial leaf fragment size. Decomposition is inhibited when litter is dry (Reddy, 1995), so leaves were sealed in lightproof plastic garbage bags and stored in an air-conditioned room until required. One month prior to the start of the experiment, approximately three quarters of the leaves were immersed in a nearby natural pool to leach soluble compounds and allow initial colonisation of leaves by microbes, flora and fauna (Webster and Benfield, 1986; Xiong and Nilsson, 1997).

## 2.4 Sampling Protocol

Sampling trays allowed effective sampling at day and night and in both aquatic and terrestrial environments and allowed sampling of the entire community. Sampling trays were constructed from a 16-cm length of 10-cm-diameter PVC pipe with three guide legs cut out at the top and 0.05-mm heavy duty nylon mesh (Australian Filter Specialists) attached to the base (Fig. 1). Each tray sat embedded in the substrate with the three legs visible from the surface. Sampling involved taking a core of habitat (surface area of  $78.54 \text{ cm}^2$  and volume of  $2356 \text{ cm}^3$ ) from within the trays, minimising escape of flying, burrowing and crawling animals (Figs. 1, A2 and A3). This involved pushing a 10-cm diameter  $\times$  30-cm high, sharpened galvanised steel cylinder with a clear plastic lid through the litter and sediment within the guide legs until it lay flush with the base of the sampling tray to form a seal (Fig. A3). The entire assembly was removed from the pool bed and was placed in 95% ethanol preservative, after first removing the disk of filter paper that was used to estimate substrate moisture levels (see section 2.6, Fig. A3).

## 2.5 Sampling Schedule

Once filled, the experimental pool bed remained full for 96 days before sampling to allow for colonisation of the inhabiting community (Table 1). Sampling was undertaken on nine occasions over 56 days, beginning when the pool bed was full and ceasing 32 days after total surface water loss. Sampling was more frequent during pool drying, to capture the rapid ecological changes that occur (Dell et al., 2014a). Separate diurnal and nocturnal



**Table 1** Details of Sampling Schedule and Its Relationship to Pool Depth

Sample <sup>a</sup>	Date	Days Since Pool Filled	Days Until Pool Dried <sup>b</sup>	Max. Pool Depth <sup>c</sup>	Level					
					1	2	3	4	5	6
1	25 September 2002	96	−24	245	−24	−20	−16	−12		
2	5 October 2002	106	−14	249	−14	−10	−6	−2		
3	9 October 2002	110	−10	173	−10	−6	−2	2		
4	13 October 2002	114	−6	108	−6	−2	2	6		
5	17 October 2002	118	−2	34	−2	2	6	10		
6	21 October 2002	122	2	—	2	6	10	14		
7	29 October 2002	130	10	—	10	14	18	22		
8	9 November 2002	141	21	—	21	25	29	33		
9	20 November 2002	152	32	—	32	36	40	44		

Sampling occurred on nine occasions, each including both diurnal and nocturnal sampling. ‘Level’ shows surface water at each sampling level (1–6, see Fig. 1) in relation to sampling date: blue (black in the print version) means the community was submerged, and brown (dark grey in the print version) means no surface water was present. Values within ‘Level’ denote days until loss of surface water for all immersed communities (blue (black in the print version) cells) and days after loss of surface water for all dry but previously immersed communities (brown (dark grey in the print version) cells): day 0 is loss of surface water for that level.

<sup>a</sup>Each sample consisted of separate diurnal and nocturnal samples.

<sup>b</sup>With day 0 equating to total loss of surface water from the pool bed.

<sup>c</sup>Pool depth (mm) measured from the top of the ~30 mm layer of sediment placed above the aquarium liner (see Fig. 1).

sampling was undertaken on each occasion, with diurnal samples always taken prior to nocturnal samples (Table 1). On each of the 18 (9 × 2) sampling occasions a single sampling tray was randomly selected and removed from each of the six levels in and around the pool bed (Fig. A3). Each set of six samples therefore represented a transect running from the middle of the pool bed laterally into the dry streambed, across the aquatic–terrestrial ecotone at the pool’s margins (Fig. 1). Samples on the outside the pool bed (level 6) were taken first and those in the middle of the pool bed (level 1) taken last, to minimise disturbance effects.

Drying of the pool was initiated on October 6th (Table 1), about 5 days after the last of the nearby (~500 m) natural pools had dried. Drying involved stopping the flow from the rainwater dripper and piercing the rubber pond liner at a lower level each day to prevent the pool from refilling with any rainfall. The rate of drying was approximately 2 cm/day, which corresponded to 4 days between each of the four levels within the pool (Fig. 1 and Table 1) and reflected drying rates of nearby natural pools (Dell et al., 2014a; Smith and Pearson, 1987).

## 2.6 Pool Depth and Relative Moisture

Daily pool depth was measured by reading from the ruler placed in the pool bed. A point estimate of the 'relative moisture' of the substrate within each community was obtained at the time of sampling. This was done gravimetrically, by measuring the amount of water retained in 3.2-cm-diameter disks of absorbent, non-biodegradable glass microfibre filter paper (GF/B Whatman<sup>®</sup>) placed within each sampling tray during initial construction of the pool bed (Dell et al., 2014a). The filter paper disk was placed into a small airtight plastic jar and returned to the laboratory for processing within 3 h. The filter paper was removed from the jar and placed onto a 4-cm square aluminium tray. Larger pieces of fine sediment and detritus stuck to the paper were carefully removed with forceps. The weight of the aluminium tray and the moist filter paper was measured on a balance accurate to 0.001 g; the tray and its contents were then placed in an oven at 60 °C until constant weight (>48 h). Following this, the weights of the aluminium tray and the dry filter paper were determined separately. Relative moisture was calculated by dividing the mass of water soaked up by the filter paper divided by the mass of the dry filter paper.

## 2.7 Sample Processing

In the laboratory, each sample was elutriated so that lighter material (animals, leaves, small sticks, sediment and fine organic matter) flowed onto a stack of four nylon mesh sieves (1, 0.5, 0.25 and 0.05 mm; Australian Filter Specialists). The remaining material (large sediment and sticks) was periodically examined for animals (none found) and was retained for later determination of organic and inorganic content.

Material retained in the 1-mm sieve was sorted under a magnifying lamp in a white plastic tray containing approximately 5 cm of water. Any organisms found were placed into a vial with 70% alcohol, together with other individuals that were apparently of the same taxon. The remaining contents of the sorting tray were again washed back through the four sieves and the material integrated with material remaining on the sieves after initial elutriation. Material retained on the 1-mm sieve was again sorted as above. Samples with a heavy detritus load were processed in this way several times until only a small amount of material remained in the 1-mm sieve after washing. When no additional organisms were apparent, the sediment and detritus remaining on the 1-mm sieve were combined with the other material from that sieve size collected at prior stages of processing, including during initial

elutriation. This material was placed in an aluminium tray for measurement of organic and inorganic loads.

Material retained in the 0.5-mm sieve was extracted by flotation using Ludox™, a colloidal silica solution, diluted with distilled water to a specific gravity of 1.15. Flotation extraction involves placing the sample in the Ludox solution for 30 min, after which there was a clear separation of a scum containing individuals and other organic matter floating on top and heavier sediment at the bottom. The supernatant was poured back over the three remaining sieves (0.5, 0.25 and 0.05 mm) and the entire process repeated twice. Each time the inorganic material removed from the sample was added to an aluminium tray that held similar material from the 0.5-mm sieve. Following elutriation, material retained in the 0.5-mm sieve was placed into 70% ethanol for later processing in a Bogorov tray under a stereo-dissecting microscope. Non-animal waste material (inorganic and organic) was combined with similar material from this size class for measurement of organic and inorganic loads (see [section 2.9](#)).

Material retained in the 0.25-mm sieve was elutriated and sorted in the same way as the 0.5-mm material, except that every individual was mounted directly onto glass slides in groups of similar taxa. Specimens were cleared and mounted in Hoyer's medium (10% Gum Arabic, 16.7% distilled water, 66.6% chloral hydrate and 6.7% glycerine). The sediment and detritus that remained after individuals were removed from the Bogorov tray were placed into an aluminium tray for quantification of organic and non-organic loads (see [section 2.9](#)).

Material retained in the 0.05-mm sieve was processed as above to determine organic and inorganic loads, but due to the very long times required not all of the 108 samples were processed for fauna (data not shown here).

## 2.8 Taxonomic Identification and Body Size

The identity and body size of all organisms  $>0.250$  mm (in the longest dimension) were determined. Unmounted specimens were identified, counted and measured in a glass dish under a stereo-dissecting microscope. Every individual was assigned to the lowest possible taxonomic level (most to species or genus, [Fig. A4](#)) using published keys and expert knowledge, and its life stage, sex (if possible) and maximum body length (excluding appendages) were determined. Length of unmounted specimens was estimated from a 0.5-mm grid pasted to the bottom of the glass dish. Mounted specimens were processed similarly, but were identified and measured under

a high-power microscope with a graticule eyepiece. International experts confirmed identifications for most taxa, using preserved specimens or photographs.

Wet mass estimates were calculated for every individual collected. Because weighing all organisms was impractical, we converted individually measured body lengths to wet mass using published length-weight and dry-wet mass regressions (see [Dell et al., 2011, 2013, 2014c](#); [Pawar et al., 2012](#)), using a two-step algorithm: first, body length was converted to body mass (ideally wet, otherwise dry or ash-free-dry) using 364 published size-mass regressions; second, all remaining dry masses (dry or ash-free-dry) were converted to wet mass using 10 published taxon-specific conversion ratios. This method of wet mass estimation is scalable to large numbers of individuals and was underpinned by a richer set of literature data and regressions than previous studies.

## 2.9 Organic and Inorganic Loads

We measured the amount of organic and inorganic material within each of the four size classes of material from each sieve (i.e. 1, 0.5, 0.25 and 0.05 mm). To do this, following removal of organisms from the sample, material from each sieve was placed separately in an aluminium tray and dried to constant mass at 45 °C (~5–6 days) before being weighed to 0.01 g. Samples were then placed in a muffle furnace at 550 °C until they attained constant mass, and then weighed. This process provided both organic and inorganic load estimates for the four size classes of material.



## 3. DATA PROCESSING AND ANALYSIS

### 3.1 Habitat Categories

We categorised communities by three environmental drivers: moisture, light and days until/after drying ([Table 2](#)). We used five moisture categories: 'aquatic' (surface water present), 'terrestrial' (never previously immersed), and 'wet', 'moist' and 'dry' (based on the relative moisture content of previously immersed samples that did not currently have surface water present) ([Fig. 2](#) and [Table 2](#)). Communities were also categorised as either 'diurnal' or 'nocturnal', depending on the time of the day they were sampled. All 'aquatic' communities were also categorised by the number of days until loss of surface water to calculate 'time until drying', and all previously immersed communities were categorised by the number of days since loss of surface

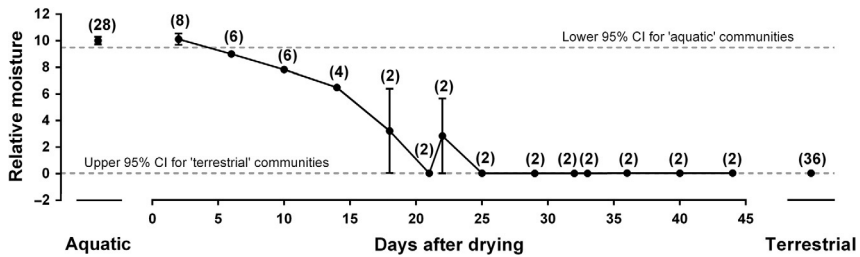
**Table 2** Environmental Categorisations Used to Group Communities for Analysis (See Main Text for More Detail)

Habitat	Description
<b>Moisture</b>	
Aquatic	Sediment layer covered by surface water
Wet	No surface water, relative moisture higher than lower 95% CI of 'aquatic' communities
Moist	No surface water, relative moisture in between lower 95% CI of 'aquatic' communities and higher 95% CI of 'terrestrial' communities
Dry	No surface water, relative moisture lower than higher 95% CI of 'terrestrial' communities
Terrestrial	Inorganic or organic substrate never covered by surface water, representing the permanent terrestrial environment surrounding intermittent pool beds
<b>Light</b>	
Diurnal	Sample collected between 10:00 and 14:00
Nocturnal	Sample collected between 22:00 and 02:00
<b>Habitat transition</b>	
Days until drying	The number of days until loss of surface water for that community, for communities that had surface water
Days after drying	The number of days since surface water loss for that community, for all previously immersed communities that currently did not have surface water

water to calculate 'time after drying'. These categorisations were defined for each level, not the entire pool bed (Table 1 and Fig. 1).

### 3.2 Functional Richness/Evenness/Divergence

Using individual body size as the functional trait, we calculated three components of each community: functional richness, functional evenness and functional divergence, following Mason et al. (2005). These measures provide a quantitative and continuous measure of the functional trait (i.e. body size) distribution within local ecological communities. Here, we used  $\log_{10}$  transformation of body mass as the measure of body size. Functional richness is the proportion of niche space filled for a character and is expressed as



**Figure 2** Changes in relative moisture  $\pm$  SE within communities following surface water loss. For comparison, relative moisture values for ‘aquatic’ and ‘terrestrial’ communities are shown, with horizontal grey-dotted lines showing lower and upper 95 CI bounds, respectively. See Table 2 and main text for additional details of habitat categories. Error bars are SE. Values in parentheses are number of replicate communities within each category. Day=0 represents loss of surface water for that community, not the entire pool bed.

$FR_i = \frac{SF_i}{R}$ , where  $FR_i$  is the functional richness in community  $i$ ,  $SF_i$  is the niche space filled by the individuals within the community and  $R$  is the relative body size range (i.e. the largest range in the set of communities). Functional richness is independent of abundance, since a section of niche space is considered occupied even if only very little abundance occurs within it. Functional evenness indicates the evenness of the distribution of individuals in niche space and applies only to the distribution of abundance in occupied niche space. Evenness is measured directly by dividing the occupied niche space into 100 narrow categories and applying Pielou’s evenness index (Pielou, 1966) to the abundance contained within each category. Functional divergence indicates the degree to which the abundance distribution in niche space maximises divergence in functional characters within the community and is calculated by the equation:  $\frac{2}{\pi} \arctan \left\{ 5 \times \sum_{j=1}^N \left[ (\ln M_j - \overline{\ln x})^2 \times A_j \right] \right\}$ , where  $M_j$  is the body mass value of the  $j$ th functional character category,  $A_j$  is the proportional abundance of the  $j$ th functional character category and  $\overline{\ln x}$  is the abundance-weighted mean of the natural logarithm of character values for the categories. A community with high functional divergence will have the most abundant species occurring at the extremities of the functional character range, while a community with low functional divergence will have the most abundant species occurring towards the centre of the functional character range. Functional divergence can change without a change in either functional richness or functional evenness.

### 3.3 Statistical Analysis

We initially used two-way ANOVA to examine the influence of moisture and light on properties of populations (mean body size, range, standard deviation and skewness), communities (richness, abundance, evenness, biomass, functional richness, functional evenness and functional divergence) and inorganic/organic loads within samples. Because this preliminary exploratory analysis revealed only a single significant interaction between moisture and light (functional evenness), for clarity of interpreting results, we used a one-way ANOVA followed by Tukey post hoc tests to explore differences between the five moisture categories, while unpaired *t*-tests were used to compare differences between the two light categories. Analyses were undertaken in GraphPad Prism (version 6.0). In analyses where populations had different variances (i.e. the *p*-value of the Bartlett's test is small), we used the Geisser–Greenhouse correction prior to analyses.

Only minor differences were found between samples based on their organic or inorganic load (Fig. A5), so no attempt was made to standardise population and community attributes by organic or inorganic loads because it is difficult to know *a priori* what would be the best measure to standardise values by (i.e. organic, inorganic or some combination of both). We are exploring the effects of organic and inorganic loads on species richness, abundance and body size elsewhere.



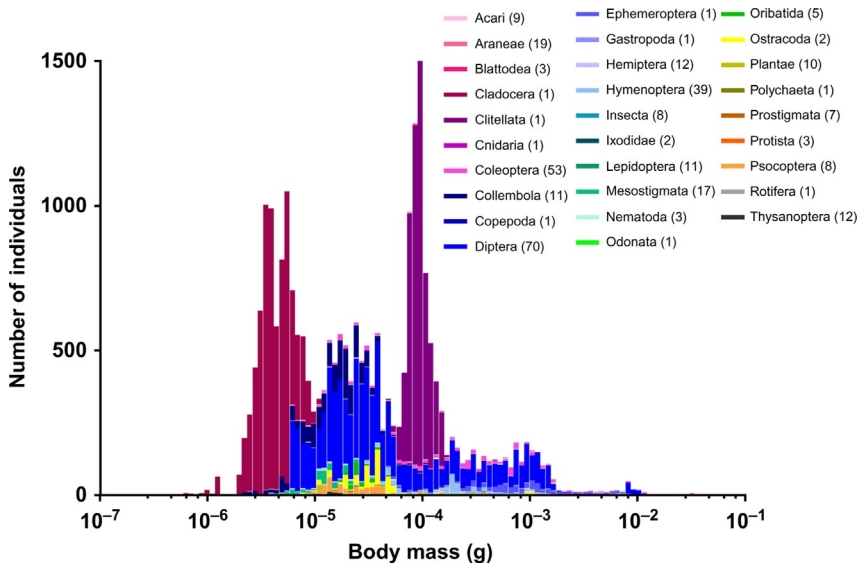
## 4. RESULTS

A taxonomically and ecologically diverse suite of taxa was collected in and around the experimental pool bed, with a total of 24,609 individuals from 313 taxa ranging over 6 orders of magnitude in body size (Fig. 3 and Table A2). Arthropods were by far the most common taxa found, including 70 dipteran species, 53 beetle species, 39 hymenopteran species (including ants and wasps) and a large diversity of mites (Fig. 3 and Table A2). The body size distribution of the entire community showed three peaks, corresponding to a single cladoceran species at approximately  $4.00 \times 10^{-6}$  g (*Ceriodaphnia cornuta*), dipterans at approximately  $3.55 \times 10^{-5}$  g and a haplotaxida annelid at approximately  $8.91 \times 10^{-5}$  g (Fig. 3).

### 4.1 Richness, Abundance, Evenness and Biomass

When categorised by moisture, systematic and significant effects on species richness, abundance, evenness and biomass within local communities were

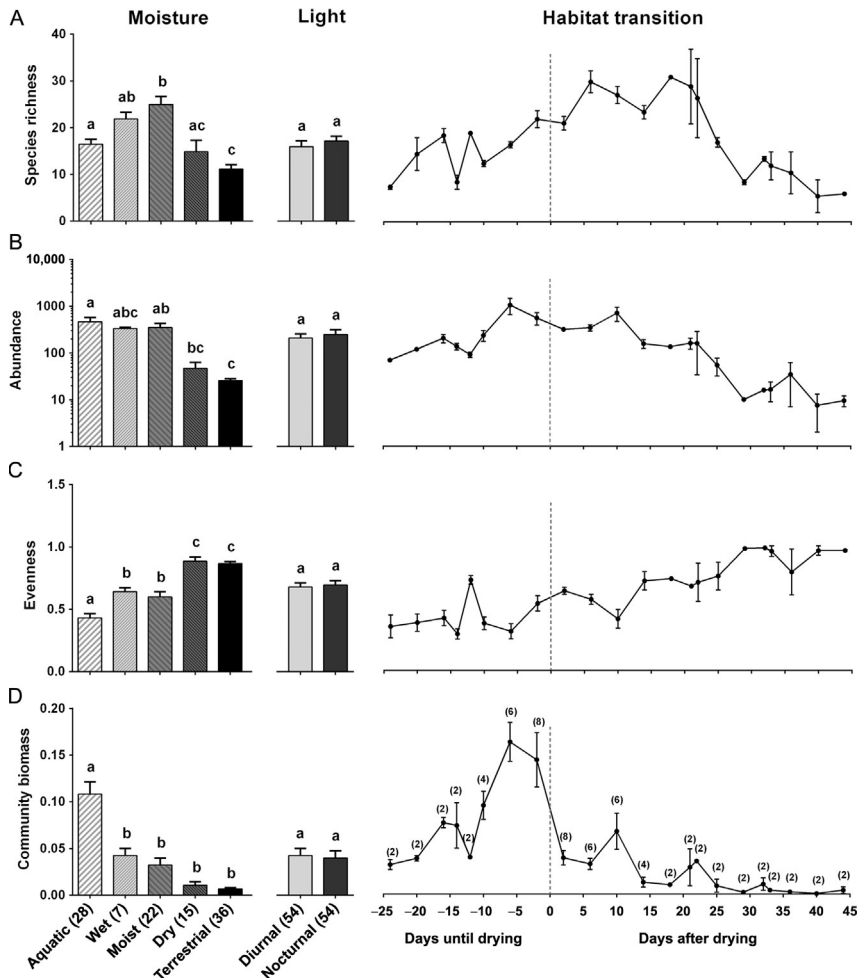




**Figure 3** Body size frequency distribution for all 24,609 individuals from all 313 species recorded in the study. Values in parentheses are total number of species within that taxon.

evident (Fig. 4). Richness was highest in ‘moist’ communities and was significantly lower in both ‘aquatic’ and ‘terrestrial’ communities (Fig. 4A). ‘Wet’ and ‘dry’ communities, which had relative moisture levels intermediate between immersed (aquatic) and permanently dry (terrestrial) communities (Fig. 2 and Table 2), also had intermediate numbers of species (Fig. 4B). Whether communities were diurnal or nocturnal had no effect on species richness (middle panel in Fig. 4A, paired  $t$ -test,  $t(53)=1.394$ ,  $p=0.456$ , two-tailed). Analysis of the full habitat transition from 25 days prior to drying until 44 days after drying revealed that richness increased from early on in ‘aquatic’ communities until after surface water loss (left panel in Fig. 4A). Across the temporal aquatic–terrestrial transition richness peaked at about 5–20 days following surface water loss, confirming that richness was highest in ‘moist’ communities. Patterns in family and order richness (data not shown) were qualitatively and quantitatively similar to species richness, suggesting that the physical environment did not systematically constrain the families or orders of species within the local communities.

Total abundance within local communities generally decreased as surface water was lost and the substrate dried, with ‘terrestrial’ communities having significantly lower total abundances than ‘aquatic’ and ‘moist’ communities



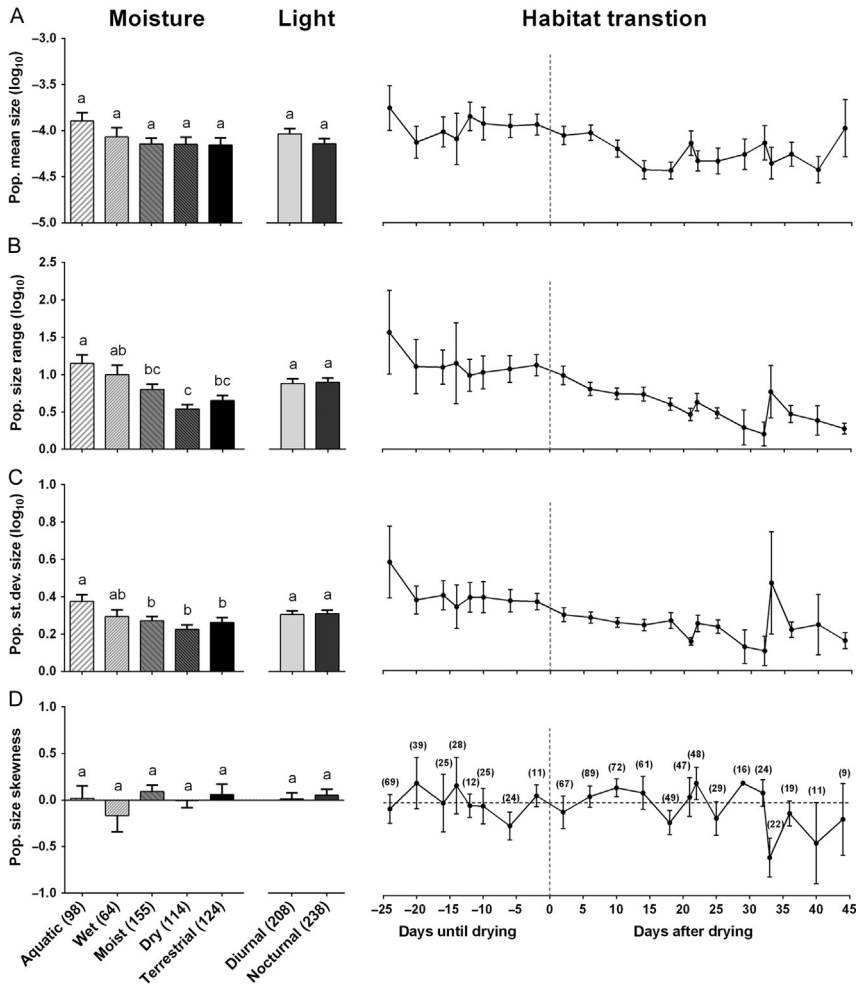
**Figure 4** Effect of moisture, light and habitat transition on average (A) species richness, (B) total abundance of individuals, (C) Pielou's evenness index and (D) community biomass within local communities. Error bars are SE. See Table 2 for details of habitat categories. Values in parentheses are total number of replicate communities within each habitat category (habitat transition does not sum to 108 because it excludes communities from levels 5 and 6, which were permanently terrestrial). Grey-dotted line in habitat transition panel at day = 0 represents loss of surface water for that community, not the entire pool bed. Within each habitat category (i.e. moisture and light), different letters above the error bars denote significant differences between habitats ( $p < 0.05$ ) as determined by ANOVA followed by post hoc Tukey test (moisture) or  $t$ -test (light).

(Fig. 4B). Whether communities were 'diurnal' or 'nocturnal' had no effect on their average abundances (Fig. 4B, paired  $t$ -test,  $t(53) = 1.804$ ,  $p = 0.598$ , two-tailed). Abundance over the aquatic–terrestrial habitat transition largely mirrored patterns found for species richness, with abundance increasing in aquatic habitats as the habitat was ending (days until drying) and decreased in non-aquatic communities as the habitat developed (days after drying) (Fig. 4B). Unlike richness, average abundance within local communities peaked just prior to surface water loss and then decreased in non-aquatic communities as the habitat aged (Fig. 4B) and dried (Fig. 2).

Average evenness was lowest in 'aquatic' communities, intermediate in 'wet' and 'moist' communities and highest in 'dry' and 'terrestrial' communities (Fig. 4C). As with richness and abundance, whether communities were diurnal or nocturnal had no effect on evenness (Fig. 4C, paired  $t$ -test,  $t(53) = 0.855$ ,  $p = 0.726$ , two-tailed). Across the habitat transition evenness increased in aquatic communities as the habitat dried (days until drying) and continued to increase in non-aquatic communities as the habitat aged (days after drying), confirming results when communities were grouped into moisture categories (Fig. 4C). Average community biomass, quantified as the total mass of all individuals within each local community, was also strongly affected by moisture (Fig. 4D), but not light (Fig. 4D, paired  $t$ -test,  $t(53) = 0.525$ ,  $p = 0.821$ , two-tailed). Biomass was significantly higher in 'aquatic' communities than in other non-aquatic communities, where surface water was absent (Fig. 4D). This pattern was confirmed in the habitat transition panel, where biomass showed a distinct peak immediately prior to drying, and by a general decrease in biomass after surface water loss as the habitat dried (far right panel in Fig. 4D).

## 4.2 Population Size Structure

To examine effects of the environment on properties of the mean size structure of populations, we combined data for replicate communities within each habitat group (e.g. data from all 28 'aquatic' replicates were grouped prior to analysis). The mean of population average body size was not significantly affected by moisture (Fig. 5A, ANOVA,  $F(4, 550) = 1.796$ ,  $p = 0.128$ ) or light (Fig. 5A, unpaired  $t$ -test,  $t(444) = 1.355$ ,  $p = 0.176$ , two-tailed), despite an apparent decrease in population average body size across the habitat transition following surface water loss (Fig. 5A). The average range of body sizes within populations was highest in 'aquatic' communities; lowest in 'dry' communities; and intermediate in 'wet', 'moist' and

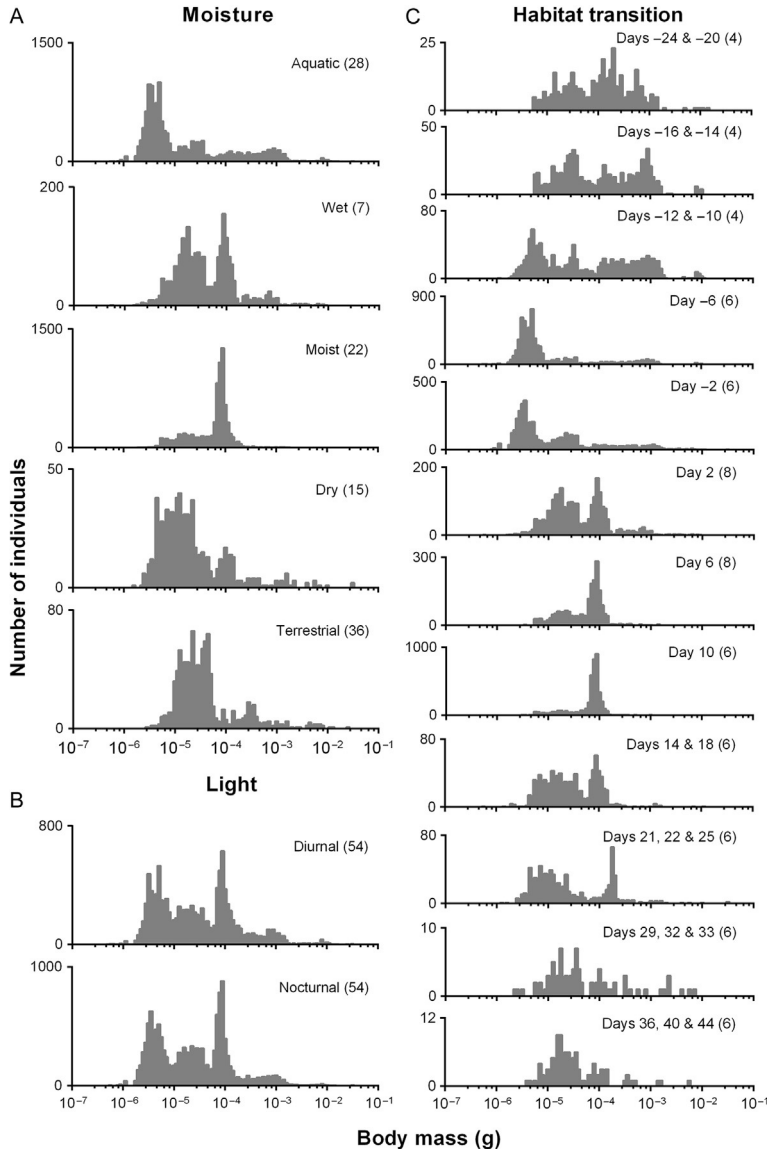


**Figure 5** Effect of moisture, light and habitat transition on average population size distributions within local communities: (A) mean size, (B) standard deviation in size, (C) size range (i.e. maximum–minimum size) and (D) the skewness of the population distributions. Error bars are SE. See Table 2 for details of habitat categories. Values in parenthesis are total number of populations included within each habitat category (total number of replicate communities within each habitat category, whose data were combined, are the same as for Figure 4). Grey-dotted line in habitat transition panel at day=0 represents loss of surface water for that community, not the entire pool bed. Within each habitat category (i.e. moisture and light), different letters above the error bars denote significant differences between habitats ( $p < 0.05$ ) as determined by ANOVA followed by post hoc Tukey test (moisture) or  $t$ -test (light).

‘terrestrial’ communities (Fig. 5B). There was no significant difference between ‘diurnal’ and ‘nocturnal’ communities in the average population body size range (Fig. 5B, unpaired  $t$ -test,  $t(253)=0.148$ ,  $p=0.883$ , two-tailed), and following surface water, the average size range decreased continuously, until a peak approximately 33 days following surface water loss (right panel in Fig. 5B). The standard deviation of average population body size (Fig. 5C) followed a similar pattern to average size range (Fig. 5B), except that the standard deviations of means of population body sizes of ‘dry’ communities were not significantly lower than those of ‘wet’, ‘moist’ or ‘terrestrial’ communities. The average skewness of population distributions was centred around zero for all habitats, indicating that body sizes in all habitats were generally symmetrically distributed within populations, and we found no significant effect of moisture (Fig. 5D, ANOVA,  $F(4, 285)=0.679$ ,  $p=0.607$ ), light (Fig. 5D, unpaired  $t$ -test,  $t(253)=0.428$ ,  $p=0.669$ , two-tailed) or habitat duration on skewness (Fig. 5D). The average skewness of population size distributions decreased slightly long after surface water loss, but was highly variable across the entire habitat transition (right panel in Fig. 5D).

### 4.3 Community Size Structure

Our examination of distributions of mean population size structure (Fig. 5) weighted all taxa equally regardless of abundance, so we also examined distributions of individual body size for all individuals across all local communities within each habitat type (Fig. 6), thus weighting abundant taxa more heavily than rare taxa. Strong effects of moisture on the shapes of the community-level size distributions were apparent (Fig. 6A). The size distribution of all ‘aquatic’ communities combined had a high peak at small sizes ( $\sim 5.01 \times 10^{-6}$  g), while ‘terrestrial’ communities had a single broader peak centred around  $4.47 \times 10^{-5}$  g (Fig. 6A). Like ‘aquatic’ and ‘terrestrial’ communities, ‘moist’ communities also had a high peak, centred around a mass of approximately  $8.91 \times 10^{-5}$  g and caused by the appearance of many individuals of a single earthworm taxon (Fig. 3). The size distribution of ‘wet’ communities resembled a combination of ‘aquatic’ and ‘moist’ communities, with the highest peak that occurs at small sizes in the ‘aquatic’ distribution absent and the single peak at large sizes in the ‘moist’ communities not being as distinct (Fig. 6A). The ‘dry’ community size distribution resembled a combination of ‘wet’ and ‘moist’ communities, or possibly the disappearance of the very large single peak in the ‘moist’ communities. Although



**Figure 6** Effects of (A) moisture, (B) light and (C) habitat transition on community body size distributions. Data are for all local communities combined, for that habitat group, and data for some sampling dates in habitat transition are grouped due to lack of data.

the shape of ‘dry’ distribution looks similar to ‘terrestrial’ communities, the locations of the peaks do not match (Fig. 6A). There were no discernable differences between the size distributions of ‘diurnal’ and ‘nocturnal’ communities when data from all communities were combined (Fig. 6B), with

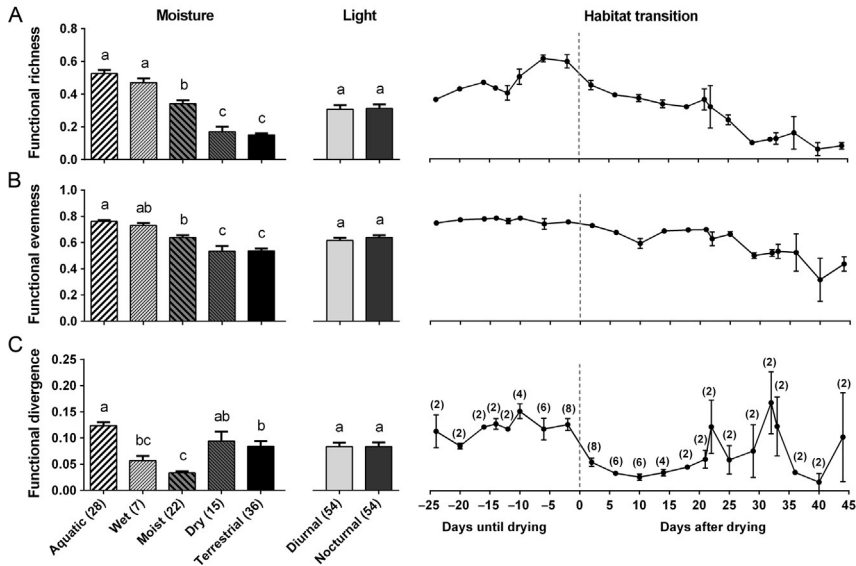
three peaks apparent, corresponding to the three peaks observed when the data were categorised by moisture (Fig. 6A).

The habitat transition panel shows that the size frequency distributions of individuals in 'aquatic' communities did not all have equivalent shapes (Fig. 6C). Long before the habitat dried (i.e. 24–10 days prior to drying, top three panels in Fig. 6C), the communities had a broad and relatively even size distribution. As the disappearance of the aquatic habitat approached (days –6 to –2), a peak at lower sizes appeared and dominated the shape of the community size distribution, corresponding to the appearance of the cladoceran *C. cornuta* (Fig. 3). As surface water disappeared, so did the *C. cornuta* peak, and a second peak at greater size appeared at day 2 (due to the appearance of the annelid; Fig. 3), becoming the main feature of the size distribution on day 6 and day 10. As the non-aquatic habitat aged and dried (Fig. 2), the abundance of this earthworm declined until on the last few sampling days the distribution of individual sizes within the community was broad and relatively evenly distributed (bottom four panels of Fig. 6C).

#### 4.4 Functional Richness/Evenness/Divergence

Functional richness (the amount of niche space filled by species in the community) and functional evenness (the evenness of abundance distribution in filled niche space) were highest in 'aquatic' and 'wet' communities, were lowest in 'dry' and 'terrestrial' communities and had intermediate values for 'moist' communities (Fig. 7A and B). Functional divergence, indicating the degree of niche differentiation within a community, was also highest in 'aquatic' communities, but unlike richness and evenness was lowest in 'moist' communities and again high in 'dry' and 'terrestrial' communities (Fig. 7C). Whether communities were 'diurnal' or 'nocturnal' did not significantly affect their functional richness (paired *t*-test,  $t(53)=0.570$ ,  $p=0.868$ , two-tailed), functional evenness (paired *t*-test,  $t(53)=1.704$ ,  $p=0.390$ , two-tailed) or functional divergence (paired *t*-test,  $t(53)=0.014$ ,  $p=0.990$ , two-tailed) (Fig. 7A–C). Habitat transition impacted functional richness in local communities, showing patterns not evident in analysis of moisture categories alone: richness increased as the aquatic habitat came closer to disappearing (days until drying) and then decreased progressively in non-immersed communities (days after drying) (Fig. 7A). Functional evenness was not affected by habitat transition for immersed communities and decreased slowly with increasing habitat age once surface water was lost (Fig. 7B). There was substantial variation in the effect of habitat transition





**Figure 7** Effects of moisture, light and habitat transition on average (A) functional richness, (B) functional evenness and (C) functional divergence within local communities. Error bars are SE. See Table 2 for details of habitat categories. Values in parentheses are total number of replicate communities within each habitat category (habitat transition does not sum to 108 because it excludes communities from levels 5 and 6, which were permanently terrestrial). Grey-dotted line in habitat transition panel at day = 0 represents loss of surface water for that community, not the entire pool bed. Within each habitat category (i.e. moisture and light), different letters above the error bars denote significant differences between habitats ( $p < 0.05$ ) as determined by ANOVA followed by post hoc Tukey test (moisture) or  $t$ -test (light).

on functional divergence, with ‘days until drying’ not appearing to have an important effect, and divergence being minimal in young non-aquatic communities (Fig. 7C).



## 5. DISCUSSION

The intermittent pool bed provided a complex environmental gradient at limited spatial and temporal scales, and we were able to sample effectively across this entire gradient. Our study is thus unlikely to include many of the possible confounding sources of variation of other comparative studies of ecological systems across diverse habitats (Dell et al., 2014a). It remains to be determined how closely our system mimics other habitats globally, but it is nonetheless clear that the unique environmental characteristics of

intermittent pool beds, with distinct aquatic–terrestrial boundaries in both space and time, make them valuable study systems for important basic and applied questions in ecology (Dell et al., 2014a).

## 5.1 Moisture

We identified strong and systematic effects of moisture on a number of key attributes of population and community size structure, due probably to at least two mechanisms. First, within terrestrial habitats, differences in moisture can strongly influence the strength and outcome of ecological interactions and, subsequently, the functional structure of populations and communities (Allen et al., 2014; Hawkins et al., 2003; Lensing and Wise, 2006; McCluney and Sabo, 2009; McCluney et al., 2012; Melguizo-Ruiz et al., 2012; Spiller and Schoener, 2008; Verdeny-Vilalta and Moya-Laraño, 2014). Water is an essential resource, and limitations to water availability in terrestrial ecosystems can alter the movement and behaviour of individuals, ultimately influencing growth and mortality of populations (Hawkins et al., 2003; McCluney and Sabo, 2009; Spiller and Schoener, 2008; Verdeny-Vilalta and Moya-Laraño, 2014). Second, moisture levels determine whether a habitat is aquatic or terrestrial, and, therefore, the nature of the environmental and functional constraints for individuals, populations and communities. For example, trophic interactions in pelagic food webs tend to be more size structured than on land, due to differences in the mechanics of prey capture (Denny, 1990; Yvon-Durocher et al., 2011), and as pelagic environments have relatively little habitat heterogeneity, being much larger or smaller than predators is a common way to avoid predation (Chase, 1999; Denny, 1990; Yvon-Durocher et al., 2011). Such effects are likely to have important consequences for populations and community size structure (Hairston and Hairston, 1993; Pawar et al., 2012; Yvon-Durocher et al., 2011).

We failed to find significant effects of moisture on the distribution of the mean body sizes of populations, probably due to the large number of species of very different sizes within local communities. However, we did identify effects on the range and the standard deviation of average population body sizes within communities. The mean, range and standard deviation of population body sizes in aquatic communities were on average greater than those of terrestrial communities, possibly because of the greater size structure of feeding relationships in many aquatic systems (Chase, 1999; Denny, 1990; Yvon-Durocher et al., 2011). The mean skewness of population size

distributions was centred around zero, indicating that the size distributions of most populations were symmetrical (Gouws et al., 2011). However, there was some evidence of temporal change in skewness across the habitat transition and during the terrestrial phase, which appears to be a novel result. Despite their importance for life history theory and macroecology, very few comparative studies of intraspecific size structure across multiple species exist (but see Gouws et al., 2011). We could find no studies that examine effects of the physical environment on animal population size structure across local landscapes, nor any that explore the size structure of multiple interacting species within local communities. This, therefore, is apparently the first analysis of such patterns, and we see this as a fruitful avenue of future research.

Moisture had significant effects on most aspects of the size structure of individuals within communities and on functional richness and evenness. A number of biological mechanisms could be responsible for these patterns, including those affecting the ecological interactions of the component species (see above). One potential mechanism is the effect of consumer search space dimensionality, which likely differs between aquatic and terrestrial habitats (Pawar et al., 2012, 2013). Whatever biological mechanisms are causing different peaks in our community size distributions, it is clear that within the transitional habitats (i.e. 'wet', 'moist' and 'dry'), both aquatic and terrestrial species were present. Unless 'aquatic' individuals alter their size as they transition from wet to dry, which appears unlikely, they should maintain body sizes (and size distributions) in these non-aquatic environments that resulted from selection in their preferred aquatic habitat. Thus, 'aquatic' taxa remaining in the terrestrial environment might be expected to have functional traits (i.e. size structure) that were optimised within the aquatic habitat. Counter to this argument, of course, is that traits that facilitate aquatic taxa to persist in the terrestrial environment following drying might be size-dependent. Either way, this is an issue that warrants further investigation.

## 5.2 Light

There were no functional differences between diurnal and nocturnal populations and communities in any of the attributes we measured. Most species in most habitats exhibit diel variations in their activity and location, including freshwater pond macroinvertebrates (Florencio et al., 2011; Gilbert and Hampton, 2001; Hampton and Duggan, 2003; Hampton and Friedenberg, 2002), and while a variety of ecological and evolutionary

processes may drive these patterns, asymmetries in the detection capabilities of predators and prey appear to be a key driver (Brewer et al., 1999; Fraser and Metcalfe, 1997; Gergs et al., 2010; Gilbert and Hampton, 2001; Kronfeld-Schor and Dayan, 2003; Sana et al., 2008). Light effects on detection distance can even be size-dependent (Dieguez, 2003; Jara, 2007). Compositional shifts between day and night do not necessarily result in functional differences in the size structure of populations and communities, if species are replaced by similar-sized ones (our methods of sampling and analysis would not have identified such effects). Uncovering additional non-size-based functional effects would require monitoring of real functioning communities, for example, with modern non-invasive tracking methods (Dell et al., 2014b). If such a pattern were evident, it would have implications for a convergence of functional organisation between diurnal and nocturnal communities (Losos, 1992; Losos et al., 1998; Melville et al., 2006; Wiens et al., 2010). Alternatively, our spatial scale of sampling may have been too coarse to capture the diel movements of small litter invertebrates, which likely have small home ranges (Jetz et al., 2004). Our sampling method captured an entire volume of habitat, including all the benthic and pelagic/aerial microhabitats above the sampling tray. Traditional sampling methods that have identified diel variations, such as sweep nets or grab samples, generally only capture single microhabitats. Therefore, even if in our study animals were moving between these microhabitats over a 24-h period, we could not have captured these effects.

Direct observations throughout our study of large organisms (too large to be retained in our samples) suggested that the pool bed supported a different suite of species during the day (skinks, diurnal snakes) than at night (frogs, toads, large spiders, nocturnal snakes). Perhaps these larger species periodically move from shelters in the riparian zones into the streambed to forage, in contrast to leaf packs, which likely provided sufficient shelter for smaller invertebrates during both active and inactive times.

### 5.3 Habitat Transition

Although the ecology of the aquatic phase of intermittent pool beds has been extensively studied, relatively little is known about their ecology once surface water has disappeared or about the population and community dynamics that occur across the aquatic–terrestrial habitat transition during pool drying (Dell et al., 2014a; Steward et al., 2011). This is surprising considering the recognised human and ecological importance of these habitats globally

(Larned et al., 2010; Steward et al., 2012). The diverse invertebrate taxa we recorded in and around the pool bed following surface water loss (Fig. 3 and Table A2) are typical of similar habitats elsewhere (Dell et al., 2014a; Steward et al., 2011, 2012; Williams, 1987), showing that once surface water is lost, pool beds can support a rich and abundant community that may be as well adapted to the ephemeral nature of its terrestrial habitat as is the aquatic fauna to its (Adis, 1992; Adis and Junk, 2002; Dell et al., 2014a; Lambeets et al., 2008; Steward et al., 2011, 2012; Tamm, 1984). Survival of this community is probably facilitated by the higher moisture content persisting in dry pool beds (for ~20 days in this study) compared to the surrounding terrestrial landscape, and also the rich nutritional resource that previously immersed detritus and remaining aquatic organisms represent to new colonists (Dell et al., 2014a; McLachlan and Cantrell, 1980; Stehr and Branson, 1938; Williams, 1987).

We found strong impacts of moisture, and thus pool drying, on richness, abundance, biomass and evenness within local communities. Even within the aquatic community, as the pool dried local communities became richer, more abundant and had higher total biomass, as remaining aquatic fauna that did not aestivate or move elsewhere became concentrated into a decreasing area of habitat (Williams, 1987). Clearly, loss of surface water does not immediately negatively impact species richness as might be expected from previous studies of these habitats as ephemeral aquatic systems (Dell et al., 2014a). Instead, community richness, abundance and biomass peaked across the aquatic–terrestrial temporal ecotone, eventually declining as beds dried completely. This pattern is caused by the occurrence in the habitat transition of taxa from adjoining aquatic and terrestrial habitats (Dell et al., 2014a; Larned et al., 2010). The lower community evenness in aquatic than non-aquatic communities was due to greater dominance by a few taxa, but the biological mechanisms responsible for this are currently unclear.

## 5.4 Summary

Our data set is unusual in its comprehensive size-explicit description of individuals, populations and communities spanning a complex environmental gradient, albeit in a single pool bed. It offers a new perspective on how functional attributes of populations and communities might vary between habitats (Dell et al., 2014a), which to date has been hampered by a lack of high-quality empirical data (Yvon-Durocher et al., 2011) and potential confounding sources of variation from different sampling and analytical

methods (Dell et al., 2014a). Using this data set, we identified strong effects of moisture on properties of populations (size structure) and communities (species richness, abundance, evenness, biomass and size structure), along with temporal effects across the aquatic–terrestrial ecotone. There were no functional differences between diurnal and nocturnal communities at the scale of our samples. Further studies of this nature are required to develop a functional understanding of ecological systems, of effects of human activities that are altering the size structure of natural ecosystems, for making quantitative predictions about such effects, and for developing management practices to ensure ecosystem survival in the face of global change.

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## APPENDIX

**Table A1** Common Riparian Plants Found at the Study Site

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<i>Brachychiton australis</i>
<i>Cassine melanocarpa</i>
<i>Cochlospermum gillivraei</i>
<i>Cupaniopsis anacardioides</i>
<i>Diospyros geminata</i>
<i>Drypetes diplangia</i>
<i>Geijera salicifolia</i>
<i>Kailarsenia ochreatea</i>
<i>Lophostemon grandiflorus</i>
<i>Mimusops elengi</i>
<i>Pleigynium timorense</i>
<i>Pongamia pinnata</i>
<i>Sterculia quadrifida</i>

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**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Protista	NA	NA	NA	Protista sp. Z	2	0.1438	0.1438	0.1438
Protista	Heterokontophyta	Bacillariophyceae	NA	Bacillariophyceae sp. A	1	0.0006		
Protista	Rhizopoda	NA	NA	Rhizopoda sp. A	2	0.0566	0.0477	0.0654
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. A	2	0.0099	0.0093	0.0105
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. B	1	0.0105		
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. C	1	0.0105		
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. D	2	0.0105	0.0105	0.0105
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. E	1	0.0105		
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. F	1	0.0105		
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. G	1	0.0105		
Plantae	Chlorophyta	NA	NA	Chlorophyta sp. H	1	0.0105		
Plantae	Chlorophyta	Chlorophyceae	Cladophoraceae	Cladophora sp. A	2	0.0105	0.0105	0.0105
Plantae	Chlorophyta	Chlorophyceae	Cladophoraceae	Pithophora sp. A	9	0.0105	0.0105	0.0105
Animalia	Annelida	Clitellata	NA	Haplotaxida spp.	5413	0.0888	0.0464	0.6887
Animalia	Annelida	Polychaeta	NA	Polychaeta sp. A	2	0.0842	0.0828	0.0857



Animalia	Arthropoda	Arachnida	NA	Acari sp. B	1	0.0248		
Animalia	Arthropoda	Arachnida	NA	Acari sp. C	1	0.0058		
Animalia	Arthropoda	Arachnida	NA	Acari sp. D	4	0.0279	0.0212	0.0315
Animalia	Arthropoda	Arachnida	NA	Acari sp. E	1	0.0099		
Animalia	Arthropoda	Arachnida	NA	Acari sp. G	1	0.0027		
Animalia	Arthropoda	Arachnida	NA	Acari sp. H	1	0.0055		
Animalia	Arthropoda	Arachnida	NA	Acari sp. I	1	0.0068		
Animalia	Arthropoda	Arachnida	NA	Acari sp. K	1	0.0190		
Animalia	Arthropoda	Arachnida	NA	Acari sp. L	1	0.0095		
Animalia	Arthropoda	Arachnida	NA	Mesostigmata sp. F	9	0.0217	0.0042	0.0731
Animalia	Arthropoda	Arachnida	NA	Mesostigmata sp. G	9	0.0131	0.0042	0.0177
Animalia	Arthropoda	Arachnida	NA	Mesostigmata sp. H	1	0.0072		
Animalia	Arthropoda	Arachnida	NA	Mesostigmata sp. I	2	0.0126	0.0114	0.0139
Animalia	Arthropoda	Arachnida	NA	Mesostigmata sp. J	2	0.0119	0.0099	0.0139
Animalia	Arthropoda	Arachnida	NA	<i>Oribatida</i> sp. A	1	0.1165		
Animalia	Arthropoda	Arachnida	NA	Prostigmata sp. A	1	0.0093		
Animalia	Arthropoda	Arachnida	Araneidae	<i>Cyrtophora moluccensis</i>	2	0.4689	0.4301	0.5077
Animalia	Arthropoda	Arachnida	Ascidae	<i>Cheiroseius</i> sp. A	113	0.0096	0.0020	0.0182
Animalia	Arthropoda	Arachnida	Bdellidae	Bdellidae sp. A	7	0.0458	0.0224	0.0941

Continued

**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Arachnida	Cunaxidae	Cunaxidae sp. A	4	0.0193	0.0149	0.0230
Animalia	Arthropoda	Arachnida	Cunaxidae	Cunaxidae sp. B	9	0.0160	0.0052	0.0218
Animalia	Arthropoda	Arachnida	Cymbaeremaeidae	<i>Scapheremaeus</i> sp. A	4	0.0257	0.0217	0.0359
Animalia	Arthropoda	Arachnida	Eupodidae	Eupodidae sp. A	7	0.0173	0.0119	0.0262
Animalia	Arthropoda	Arachnida	Eupodidae	Eupodidae sp. B	1	0.0190		
Animalia	Arthropoda	Arachnida	Ixodidae	<i>Haemaphysalis bancrofti</i>	2	2.3798	0.1018	4.6577
Animalia	Arthropoda	Arachnida	Ixodidae	<i>Haemaphysalis novaeguineae</i>	1	0.0221		
Animalia	Arthropoda	Arachnida	Laelapidae	<i>Cosmolaelaps</i> sp. A	9	0.0242	0.0044	0.0429
Animalia	Arthropoda	Arachnida	Laelapidae	Laelapidae sp. A	37	0.0181	0.0084	0.0329
Animalia	Arthropoda	Arachnida	Laelapidae	Laelapidae sp. B	27	0.0202	0.0060	0.1676
Animalia	Arthropoda	Arachnida	Laelapidae	Laelapidae sp. C	5	0.0108	0.0048	0.0252
Animalia	Arthropoda	Arachnida	Laelapidae	Laelapidae sp. D	3	0.0100	0.0072	0.0114
Animalia	Arthropoda	Arachnida	Linyphiidae	<i>Laperousea</i> sp. A	2	1.5948	1.5375	1.6522
Animalia	Arthropoda	Arachnida	Linyphiidae	Linyphiidae sp. A	2	0.2133	0.0326	0.3940
Animalia	Arthropoda	Arachnida	Linyphiidae	Linyphiidae sp. B	5	0.2847	0.0600	1.0394
Animalia	Arthropoda	Arachnida	Liodidae	Liodidae sp. A	1	0.0194		

Animalia	Arthropoda	Arachnida	Miturgidae	<i>Cheiracanthium</i> sp. A	2	0.2909	0.0326	0.5492
Animalia	Arthropoda	Arachnida	Ologamasidae	Gamasiphinae sp. A	14	0.0170	0.0096	0.0344
Animalia	Arthropoda	Arachnida	Ologamasidae	<i>Gamasiphis</i> sp. A	6	0.0186	0.0114	0.0344
Animalia	Arthropoda	Arachnida	Ologamasidae	Ologamasidae sp. B	15	0.0057	0.0030	0.0110
Animalia	Arthropoda	Arachnida	Ologamasidae	Ologamasidae sp. C	2	0.0073	0.0055	0.0090
Animalia	Arthropoda	Arachnida	Oonopidae	<i>Ischnothyreus</i> sp. A	5	1.5603	1.0394	1.8295
Animalia	Arthropoda	Arachnida	Oonopidae	<i>Ischnothyreus</i> spp.	3	0.9425	0.0759	1.4280
Animalia	Arthropoda	Arachnida	Oonopidae	Oonopidae sp. A	4	0.0660	0.0406	0.0759
Animalia	Arthropoda	Arachnida	Oonopidae	Oonopinae sp. A	7	0.4233	0.0989	1.0394
Animalia	Arthropoda	Arachnida	Oonopidae	<i>Orchestina</i> sp. A	27	0.3477	0.0198	1.3235
Animalia	Arthropoda	Arachnida	Phytoseiidae	Phytoseiidae sp. A	2	0.0093	0.0072	0.0114
Animalia	Arthropoda	Arachnida	Podocinidae	<i>Podocinum</i> sp. A	4	0.0194	0.0135	0.0233
Animalia	Arthropoda	Arachnida	Salticidae	<i>Lycidas</i> sp. A	9	1.8530	0.9541	4.6284
Animalia	Arthropoda	Arachnida	Salticidae	<i>Maratus</i> sp. A	2	1.6080	1.6080	1.6080
Animalia	Arthropoda	Arachnida	Salticidae	<i>Opisthoncus</i> sp. A	2	6.5518	2.2836	10.8201
Animalia	Arthropoda	Arachnida	Scheloribatidae	Scheloribatidae sp. A	133	0.0393	0.0109	1.0605
Animalia	Arthropoda	Arachnida	Scheloribatidae	Scheloribatidae sp. B	2	0.0200	0.0183	0.0217
Animalia	Arthropoda	Arachnida	Scytodidae	<i>Scytodes thoracica</i>	5	5.9621	1.5375	13.0337

Continued

**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Arachnida	Tetranychidae	Bryobiinae sp. A	1	0.0030		
Animalia	Arthropoda	Arachnida	Theridiidae	<i>Dipoena</i> sp. A	1	0.0108		
Animalia	Arthropoda	Arachnida	Theridiidae	<i>Euryopsis elegans</i>	4	1.3070	0.0600	4.4785
Animalia	Arthropoda	Arachnida	Theridiidae	Theridiidae sp. A	12	0.4906	0.0198	2.1641
Animalia	Arthropoda	Arachnida	Theridiidae	<i>Theridion</i> sp. A	3	1.3177	0.0716	2.4534
Animalia	Arthropoda	Arachnida	Zodariidae	<i>Habronestes</i> sp. A	1	23.9778		
Animalia	Arthropoda	Branchiopoda	Daphniidae	<i>Ceriodaphnia cornuta</i>	7169	0.0041	0.0005	0.0396
Animalia	Arthropoda	Copepoda	NA	Cyclopoida sp. A	28	0.0146	0.0022	0.1325
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. A	11	0.1229	0.0064	0.1638
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. B	1	0.6844		
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. C	4	0.1446	0.0346	0.2514
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. D	5	0.2078	0.1344	0.3962
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. E	1	0.3787		
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. F	10	0.1923	0.0171	0.6755
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. G	2	0.1389	0.0917	0.1861
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. H	3	0.7848	0.0059	2.2919

Animalia	Arthropoda	Insecta	NA	Coleoptera sp. I	1	0.0765		
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. J	1	0.0512		
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. K	1	0.5988		
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. L	2	0.1608	0.1298	0.1918
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. M	3	0.0573	0.0461	0.0772
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. N	3	0.0870	0.0784	0.0957
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. O	38	0.0183	0.0040	0.0390
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. P	1	0.0354		
Animalia	Arthropoda	Insecta	NA	Coleoptera sp. Y	1	0.1240		
Animalia	Arthropoda	Insecta	NA	Collembola sp. A	22	0.0602	0.0197	0.1003
Animalia	Arthropoda	Insecta	NA	Diptera sp. A	12	0.0218	0.0056	0.0435
Animalia	Arthropoda	Insecta	NA	Diptera sp. AA	1	0.0461		
Animalia	Arthropoda	Insecta	NA	Diptera sp. AB	2	0.2619	0.0359	0.4879
Animalia	Arthropoda	Insecta	NA	Diptera sp. AC	5	0.0407	0.0335	0.0473
Animalia	Arthropoda	Insecta	NA	Diptera sp. AD	1	0.1947		
Animalia	Arthropoda	Insecta	NA	Diptera sp. B	2	0.0655	0.0059	0.1252
Animalia	Arthropoda	Insecta	NA	Diptera sp. C	1	0.0583		
Animalia	Arthropoda	Insecta	NA	Diptera sp. D	6	0.1993	0.0512	0.4230

*Continued*

**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Insecta	NA	Diptera sp. E	1	0.0218		
Animalia	Arthropoda	Insecta	NA	Diptera sp. F	1	0.0773		
Animalia	Arthropoda	Insecta	NA	Diptera sp. G	5	0.0361	0.0078	0.1064
Animalia	Arthropoda	Insecta	NA	Diptera sp. H	2	0.0219	0.0171	0.0266
Animalia	Arthropoda	Insecta	NA	Diptera sp. I	2	0.5224	0.0389	1.0060
Animalia	Arthropoda	Insecta	NA	Diptera sp. J	1	0.0197		
Animalia	Arthropoda	Insecta	NA	Diptera sp. K	1	0.0190		
Animalia	Arthropoda	Insecta	NA	Diptera sp. L	14	1.1037	0.1464	1.4171
Animalia	Arthropoda	Insecta	NA	Diptera sp. M	1	1.9622		
Animalia	Arthropoda	Insecta	NA	Diptera sp. N	13	0.1038	0.0628	0.1521
Animalia	Arthropoda	Insecta	NA	Diptera sp. O	7	0.0958	0.0512	0.1778
Animalia	Arthropoda	Insecta	NA	Diptera sp. Q	1	0.0893		
Animalia	Arthropoda	Insecta	NA	Diptera sp. R	10	0.0239	0.0062	0.0339
Animalia	Arthropoda	Insecta	NA	Diptera sp. S	15	0.0351	0.0054	0.1385
Animalia	Arthropoda	Insecta	NA	Diptera sp. T	13	0.0896	0.0665	0.1098
Animalia	Arthropoda	Insecta	NA	Diptera sp. U	1	0.0207		

Animalia	Arthropoda	Insecta	NA	Diptera sp. V	1	0.0529		
Animalia	Arthropoda	Insecta	NA	Diptera sp. W	1	0.4076		
Animalia	Arthropoda	Insecta	NA	Diptera sp. X	7	0.0681	0.0298	0.1409
Animalia	Arthropoda	Insecta	NA	Diptera sp. Z	1	0.4645		
Animalia	Arthropoda	Insecta	NA	Hymenoptera sp. Q	1	0.2929		
Animalia	Arthropoda	Insecta	NA	Hymenoptera sp. R	1	0.0285		
Animalia	Arthropoda	Insecta	NA	Hymenoptera sp. S	1	0.0433		
Animalia	Arthropoda	Insecta	NA	Insecta sp. A	1	0.0986		
Animalia	Arthropoda	Insecta	NA	Insecta sp. B	2	0.0263	0.0208	0.0319
Animalia	Arthropoda	Insecta	NA	Insecta sp. C	2	0.1915	0.1883	0.1947
Animalia	Arthropoda	Insecta	NA	Insecta sp. D	1	0.0784		
Animalia	Arthropoda	Insecta	NA	Insecta sp. E	1	0.0314		
Animalia	Arthropoda	Insecta	NA	Insecta sp. F	1	0.0285		
Animalia	Arthropoda	Insecta	NA	Insecta sp. G	1	0.0490		
Animalia	Arthropoda	Insecta	NA	Insecta sp. J	1	0.0495		
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. A	9	0.4649	0.0427	1.2563
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. B	2	1.3081	0.1697	2.4466
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. C	5	0.2494	0.0957	0.3454

*Continued*



**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. D	15	0.0492	0.0121	0.1934
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. E	1	0.0398		
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. F	1	0.2546		
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. G	1	0.1947		
Animalia	Arthropoda	Insecta	NA	Lepidoptera sp. H	1	0.0138		
Animalia	Arthropoda	Insecta	NA	Psylloidea sp. A	1	0.0346		
Animalia	Arthropoda	Insecta	NA	Psylloidea sp. B	1	0.0040		
Animalia	Arthropoda	Insecta	Aderidae	Aderidae sp. A	1	0.2904		
Animalia	Arthropoda	Insecta	Aeolothripidae	Aeolothripidae sp. A	2	0.0386	0.0092	0.0679
Animalia	Arthropoda	Insecta	Aeolothripidae	Aeolothripidae sp. B	4	0.0326	0.0184	0.0486
Animalia	Arthropoda	Insecta	Aeolothripidae	<i>Desmothrips</i> sp. A	7	0.0260	0.0065	0.0529
Animalia	Arthropoda	Insecta	Archipsocidae	<i>Archipsocopsis</i> sp. A	69	0.0429	0.0072	0.3368
Animalia	Arthropoda	Insecta	Baetidae	<i>Cloeon</i> sp. A	528	1.1888	0.0427	7.0558
Animalia	Arthropoda	Insecta	Bethylidae	Bethylidae sp. A	1	0.0177		
Animalia	Arthropoda	Insecta	Bethylidae	Bethylidae sp. B	2	0.0533	0.0501	0.0565
Animalia	Arthropoda	Insecta	Bethylidae	Bethylidae sp. C	1	0.4473		

Animalia	Arthropoda	Insecta	Blattidae	Blattidae sp. A	1	4.4896		
Animalia	Arthropoda	Insecta	Blattidae	Blattidae sp. B	1	30.1411		
Animalia	Arthropoda	Insecta	Blattidae	Blattidae sp. C	2	0.1888	0.1697	0.2079
Animalia	Arthropoda	Insecta	Braconidae	Microgastrinae sp. A	1	0.7162		
Animalia	Arthropoda	Insecta	Carabidae	Carabidae sp. A	3	1.3497	0.6119	2.6860
Animalia	Arthropoda	Insecta	Carabidae	<i>Perigona</i> sp. A	2	1.9552	1.7684	2.1419
Animalia	Arthropoda	Insecta	Carabidae	<i>Tachys spenceri</i>	1	1.1865		
Animalia	Arthropoda	Insecta	Cecidomyiidae	Cecidomyiidae sp. A	194	0.0381	0.0056	0.0814
Animalia	Arthropoda	Insecta	Cecidomyiidae	Cecidomyiidae sp. K	1	0.0406		
Animalia	Arthropoda	Insecta	Ceraphronidae	Ceraphronidae sp. A	4	0.0398	0.0172	0.0515
Animalia	Arthropoda	Insecta	Ceraphronidae	Ceraphronidae sp. B	2	0.0384	0.0335	0.0433
Animalia	Arthropoda	Insecta	Ceraphronidae	Ceraphronidae sp. C	1	0.0172		
Animalia	Arthropoda	Insecta	Ceraphronidae	Ceraphronidae sp. D	1	0.0078		
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. A	343	0.0181	0.0055	0.0493
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. B	3	0.0363	0.0239	0.0455
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. C	6	0.0125	0.0063	0.0191
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. D	17	0.0237	0.0054	0.0775
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. E	12	0.0180	0.0065	0.0455

Continued

**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. F	31	0.0171	0.0059	0.0455
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. G	25	0.0178	0.0056	0.0455
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. H	5	0.0178	0.0060	0.0424
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. I	1	0.0784		
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. M	4	0.2316	0.0359	0.6907
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. N	1	0.4879		
Animalia	Arthropoda	Insecta	Ceratopogonidae	Ceratopogonidae sp. O	1	0.0312		
Animalia	Arthropoda	Insecta	Ceratopogonidae	Forcipomyiinae sp. A	966	0.0295	0.0054	0.2426
Animalia	Arthropoda	Insecta	Chironomidae	<i>Chironomus vitellinus</i>	4127	0.3828	0.0054	10.1779
Animalia	Arthropoda	Insecta	Chironomidae	<i>Djalmabatista</i> sp. A	1	0.1495		
Animalia	Arthropoda	Insecta	Chironomidae	<i>Paramerina parva</i>	699	0.1130	0.0054	0.8763
Animalia	Arthropoda	Insecta	Chironomidae	<i>Polypodium</i> sp. A	113	0.0633	0.0056	0.2967
Animalia	Arthropoda	Insecta	Chironomidae	Tanypodinae sp. A	7	0.2428	0.1435	0.3540
Animalia	Arthropoda	Insecta	Corylophidae	Corylophidae sp. A	3	0.0352	0.0312	0.0433
Animalia	Arthropoda	Insecta	Cosmopterigidae	Cosmopterigidae sp. A	3	0.3151	0.2800	0.3454
Animalia	Arthropoda	Insecta	Culicidae	<i>Aedes notoscriptus</i>	2	0.1168	0.0146	0.2191

Animalia	Arthropoda	Insecta	Culicidae	<i>Anopheles annulipes</i>	39	0.0845	0.0056	0.5270
Animalia	Arthropoda	Insecta	Culicidae	<i>Anopheles farauti</i>	12	0.0392	0.0105	0.2192
Animalia	Arthropoda	Insecta	Culicidae	<i>Anopheles</i> spp.	5	0.0191	0.0088	0.0387
Animalia	Arthropoda	Insecta	Culicidae	<i>Culex annulirostris</i>	41	0.1051	0.0062	0.6408
Animalia	Arthropoda	Insecta	Culicidae	<i>Culex halifaxii</i>	30	0.1355	0.0056	0.8782
Animalia	Arthropoda	Insecta	Culicidae	<i>Culex quinquefasciatus</i>	152	0.1141	0.0056	1.0745
Animalia	Arthropoda	Insecta	Culicidae	<i>Culex</i> sp. A	66	0.2399	0.0056	4.3651
Animalia	Arthropoda	Insecta	Curculionidae	<i>Xyleborus</i> sp. A	5	0.0730	0.0312	0.2212
Animalia	Arthropoda	Insecta	Diapriidae	Diapriidae sp. A	1	0.0335		
Animalia	Arthropoda	Insecta	Diapriidae	Diapriidae sp. B	1	0.0485		
Animalia	Arthropoda	Insecta	Diapriidae	Diapriidae sp. C	2	0.0477	0.0407	0.0547
Animalia	Arthropoda	Insecta	Dipsocoridae	<i>Cryptostemma</i> sp. A	56	0.0489	0.0048	0.7956
Animalia	Arthropoda	Insecta	Dytiscidae	<i>Chostonectes gigas</i>	1	5.0231		
Animalia	Arthropoda	Insecta	Dytiscidae	<i>Copelatus irregularis</i>	9	11.3991	10.0077	13.5577
Animalia	Arthropoda	Insecta	Dytiscidae	Dytiscidae sp. A	1	0.1722		
Animalia	Arthropoda	Insecta	Dytiscidae	<i>Hydaticus consanguineus</i>	2	5.4116	2.8589	7.9642
Animalia	Arthropoda	Insecta	Dytiscidae	<i>Platynectes</i> sp. A	1	13.5577		
Animalia	Arthropoda	Insecta	Ectopsocidae	<i>Ectopsocus</i> sp. A	2	0.2652	0.2323	0.2981

Continued

**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Insecta	Ectopsocidae	<i>Ectopsocus</i> sp. B	1	0.2223		
Animalia	Arthropoda	Insecta	Encyrtidae	Encyrtidae sp. A	1	0.0529		
Animalia	Arthropoda	Insecta	Entomobryidae	<i>Acanthocyrtus</i> sp. A	196	0.0229	0.0059	0.1553
Animalia	Arthropoda	Insecta	Entomobryidae	Entomobryidae sp. A	1	0.1676		
Animalia	Arthropoda	Insecta	Entomobryidae	Entomobryidae sp. B	1	0.0521		
Animalia	Arthropoda	Insecta	Entomobryidae	Entomobryidae sp. C	5	0.0179	0.0093	0.0248
Animalia	Arthropoda	Insecta	Entomobryidae	Entomobryidae sp. D	132	0.0178	0.0059	0.0368
Animalia	Arthropoda	Insecta	Entomobryidae	Entomobryidae sp. E	31	0.0205	0.0078	0.0398
Animalia	Arthropoda	Insecta	Entomobryidae	Entomobryidae spp.	17	0.0155	0.0013	0.0325
Animalia	Arthropoda	Insecta	Entomobryidae	Entomobryinae spp.	1	0.0266		
Animalia	Arthropoda	Insecta	Eulophidae	Entedoninae sp. A	1	0.0383		
Animalia	Arthropoda	Insecta	Eulophidae	Tetrastichinae sp. A	2	0.0366	0.0140	0.0592
Animalia	Arthropoda	Insecta	Eulophidae	Tetrastichinae sp. B	1	0.0105		
Animalia	Arthropoda	Insecta	Flatidae	<i>Dascalina</i> sp. A	1	0.0784		
Animalia	Arthropoda	Insecta	Formicidae	<i>Cardiocondyla nuda</i>	1	0.3501		
Animalia	Arthropoda	Insecta	Formicidae	<i>Crematogaster</i> sp. A	1	1.4659		

Animalia	Arthropoda	Insecta	Formicidae	<i>Iridomyrmex anceps</i>	3	0.6876	0.6304	0.7162
Animalia	Arthropoda	Insecta	Formicidae	<i>Monomorium laeve</i>	5	0.2665	0.0383	0.3499
Animalia	Arthropoda	Insecta	Formicidae	<i>Ochetellus glaber clarithorax</i>	4	0.5158	0.3311	1.0512
Animalia	Arthropoda	Insecta	Formicidae	<i>Odontomachus</i> sp. A	2	8.2489	8.2489	8.2489
Animalia	Arthropoda	Insecta	Formicidae	<i>Oecophylla smaragdina</i>	18	6.8768	5.7040	9.0423
Animalia	Arthropoda	Insecta	Formicidae	<i>Opisthopsis haddoni</i>	2	4.3771	4.0258	4.7285
Animalia	Arthropoda	Insecta	Formicidae	<i>Paratrechina longicornis</i>	2	0.4635	0.3501	0.5768
Animalia	Arthropoda	Insecta	Formicidae	<i>Paratrechina</i> sp. A	164	0.1917	0.0288	1.3541
Animalia	Arthropoda	Insecta	Formicidae	<i>Pheidole impressiceps</i>	34	0.9838	0.6583	1.3763
Animalia	Arthropoda	Insecta	Formicidae	<i>Pheidole</i> sp. A	1	3.0960		
Animalia	Arthropoda	Insecta	Formicidae	<i>Solenopsis</i> sp. A	39	0.0641	0.0290	0.3311
Animalia	Arthropoda	Insecta	Formicidae	<i>Spinctomyrmex</i> sp. A	1	3.6995		
Animalia	Arthropoda	Insecta	Formicidae	<i>Tapinoma</i> sp. A	3	0.4634	0.3127	0.7463
Animalia	Arthropoda	Insecta	Formicidae	<i>Tetramorium simillimum</i>	60	0.3150	0.0383	0.5768
Animalia	Arthropoda	Insecta	Geometridae	Geometridae sp. A	1	7.2359		
Animalia	Arthropoda	Insecta	Geometridae	Geometridae sp. B	1	3.9274		
Animalia	Arthropoda	Insecta	Hemicorduliidae	<i>Hemicordulia intermedia</i>	10	1.3295	0.1580	3.2553
Animalia	Arthropoda	Insecta	Hydraenidae	<i>Hydraena</i> sp. A	174	0.1228	0.0069	0.9486

Continued

**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Insecta	Hydraenidae	<i>Hydraena</i> sp. B	2	4.4938	4.3717	4.6158
Animalia	Arthropoda	Insecta	Hydraenidae	<i>Hydraena</i> sp. C	2	0.5779	0.4462	0.7096
Animalia	Arthropoda	Insecta	Hydraenidae	<i>Hydraena</i> sp. D	1	0.0383		
Animalia	Arthropoda	Insecta	Hydraenidae	<i>Hydraena</i> sp. E	2	0.2630	0.2630	0.2630
Animalia	Arthropoda	Insecta	Hydrophilidae	<i>Enochrus deserticola</i>	168	0.6229	0.0055	6.1085
Animalia	Arthropoda	Insecta	Hydrophilidae	<i>Enochrus maculiceps</i>	1	0.9935		
Animalia	Arthropoda	Insecta	Hydrophilidae	<i>Hydrochus</i> sp. A	3	0.2942	0.2439	0.3293
Animalia	Arthropoda	Insecta	Hydrophilidae	<i>Sternolophus marginicollis</i>	54	6.9787	0.3454	66.8695
Animalia	Arthropoda	Insecta	Isotomidae	<i>Acanthomurus</i> sp. A	446	0.0119	0.0014	0.1354
Animalia	Arthropoda	Insecta	Latridiidae	<i>Metophtalmus</i> sp. A	1	0.0473		
Animalia	Arthropoda	Insecta	Lepidopsocidae	Lepidopsocidae sp. A	1	0.0133		
Animalia	Arthropoda	Insecta	Lepidopsocidae	<i>Thylacella</i> sp. A	152	0.0796	0.0048	0.4860
Animalia	Arthropoda	Insecta	Liposcelidae	<i>Embidopsocus</i> sp. A	1	0.1239		
Animalia	Arthropoda	Insecta	Liposcelidae	<i>Liposcelis</i> sp. A	158	0.0244	0.0059	0.0992
Animalia	Arthropoda	Insecta	Phlaeothripidae	<i>Baenothrips moundi</i>	1	0.0340		
Animalia	Arthropoda	Insecta	Phlaeothripidae	<i>Haplothrips</i> sp. A	2	0.0211	0.0162	0.0260

Animalia	Arthropoda	Insecta	Phlaeothripidae	<i>Holothrips</i> sp. A	1	0.2647		
Animalia	Arthropoda	Insecta	Phlaeothripidae	Phlaeothripidae sp. A	1	0.0312		
Animalia	Arthropoda	Insecta	Phoridae	Phoridae sp. A	1	0.4366		
Animalia	Arthropoda	Insecta	Platygastridae	Platygastridae sp. A	8	0.0397	0.0285	0.0784
Animalia	Arthropoda	Insecta	Platygastridae	Platygastridae sp. B	10	0.0325	0.0140	0.0485
Animalia	Arthropoda	Insecta	Platygastridae	Platygastridae sp. C	1	0.0312		
Animalia	Arthropoda	Insecta	Platygastridae	Platygastridae sp. D	1	0.0140		
Animalia	Arthropoda	Insecta	Platygastridae	Platygastridae sp. E	3	0.0368	0.0368	0.0368
Animalia	Arthropoda	Insecta	Pseudocaeciliidae	Pseudocaeciliidae sp. A	4	0.0380	0.0100	0.0909
Animalia	Arthropoda	Insecta	Pseudococcidae	<i>Geococcus coffeae</i>	1	0.0299		
Animalia	Arthropoda	Insecta	Pseudococcidae	Pseudococcidae sp. A	1	0.0325		
Animalia	Arthropoda	Insecta	Pseudococcidae	Pseudococcidae sp. B	1	0.0038		
Animalia	Arthropoda	Insecta	Pseudococcidae	Pseudococcidae sp. C	1	0.0255		
Animalia	Arthropoda	Insecta	Psychodidae	Phlebotominae sp. A	5	0.1484	0.0356	0.4230
Animalia	Arthropoda	Insecta	Psychodidae	<i>Psychoda</i> sp. A	3	0.0434	0.0335	0.0583
Animalia	Arthropoda	Insecta	Psychodidae	Psychodidae sp. A	78	0.0592	0.0059	0.3452
Animalia	Arthropoda	Insecta	Psychodidae	Psychodidae sp. B	90	0.0708	0.0059	0.3579
Animalia	Arthropoda	Insecta	Psychodidae	Psychodidae sp. C	1	0.0841		

Continued



**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

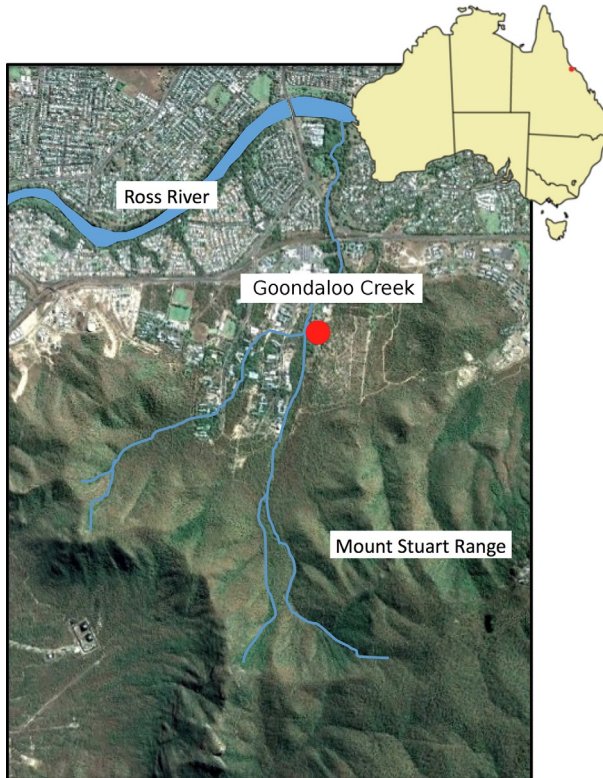
Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Insecta	Psychodidae	Psychodidae sp. D	1	0.0643		
Animalia	Arthropoda	Insecta	Psychodidae	Psychodidae sp. E	36	0.0289	0.0060	0.1052
Animalia	Arthropoda	Insecta	Psychodidae	Psychodidae sp. F	5	0.0259	0.0074	0.0402
Animalia	Arthropoda	Insecta	Psychodidae	Psychodidae sp. G	3	0.0400	0.0149	0.0711
Animalia	Arthropoda	Insecta	Ptiliidae	<i>Nephanes</i> sp. A	1	0.0123		
Animalia	Arthropoda	Insecta	Scarabaeidae	Melolonthinae sp. A	3	4.9041	3.9076	5.6758
Animalia	Arthropoda	Insecta	Scirtidae	<i>Pseudomicrocara orientalis</i>	1	7.8667		
Animalia	Arthropoda	Insecta	Scirtidae	<i>Scirtes</i> sp. A	6	1.7882	0.3701	3.9076
Animalia	Arthropoda	Insecta	Scirtidae	Scirtidae sp. A	1	0.9841		
Animalia	Arthropoda	Insecta	Sminthuridae	<i>Sminthurides pseudassimilis</i>	689	0.0243	0.0016	0.6056
Animalia	Arthropoda	Insecta	Staphylinidae	Aleocharinae sp. A	1	0.6039		
Animalia	Arthropoda	Insecta	Staphylinidae	<i>Astenus</i> sp. A	7	1.2888	0.9009	1.5373
Animalia	Arthropoda	Insecta	Staphylinidae	<i>Myllaena</i> sp. A	2	0.6307	0.6039	0.6575
Animalia	Arthropoda	Insecta	Staphylinidae	<i>Myllaena</i> sp. B	4	0.3388	0.1606	0.6039
Animalia	Arthropoda	Insecta	Staphylinidae	Oxytelinae sp. A	1	1.3159		
Animalia	Arthropoda	Insecta	Staphylinidae	Oxytelinae sp. B	1	0.2250		

Animalia	Arthropoda	Insecta	Staphylinidae	Pselaphinae sp. A	4	0.2076	0.1385	0.2830
Animalia	Arthropoda	Insecta	Staphylinidae	Staphylinidae sp. A	1	0.0565		
Animalia	Arthropoda	Insecta	Staphylinidae	Staphylinidae sp. B	1	0.0339		
Animalia	Arthropoda	Insecta	Staphylinidae	<i>Stenus</i> sp. A	2	1.7951	1.3159	2.2744
Animalia	Arthropoda	Insecta	Syrphidae	<i>Eristalis</i> sp. A	11	8.7403	0.2059	15.6122
Animalia	Arthropoda	Insecta	Tabanidae	<i>Tabanus</i> sp. A	2	0.0207	0.0192	0.0222
Animalia	Arthropoda	Insecta	Tabanidae	<i>Tabanus</i> sp. B	7	2.6829	0.1360	11.2126
Animalia	Arthropoda	Insecta	Thripidae	<i>Frankliniella schultzei</i>	7	0.0372	0.0131	0.0515
Animalia	Arthropoda	Insecta	Thripidae	<i>Pseudodendrothrips</i> sp. A	19	0.0233	0.0086	0.0939
Animalia	Arthropoda	Insecta	Thripidae	Thripidae sp. A	11	0.0201	0.0068	0.0916
Animalia	Arthropoda	Insecta	Thripidae	Thripidae sp. B	12	0.0222	0.0128	0.0305
Animalia	Arthropoda	Insecta	Thripidae	Thripidae sp. C	8	0.0654	0.0120	0.1322
Animalia	Arthropoda	Insecta	Tipulidae	Tipulidae sp. A	14	0.5891	0.0162	2.1214
Animalia	Arthropoda	Insecta	Triozidae	<i>Trioz</i> sp. A	1	0.4377		
Animalia	Arthropoda	Insecta	Veliidae	<i>Microvelia</i> spp.	17	0.1007	0.0054	0.4424
Animalia	Arthropoda	Insecta	Veliidae	<i>Microvelia</i> ( <i>Austromicrovelia</i> ) <i>torresiana</i>	1	0.8676		
Animalia	Arthropoda	Insecta	Veliidae	<i>Microvelia</i> ( <i>Picaultia</i> ) <i>paramega</i>	3	0.3824	0.2482	0.4614

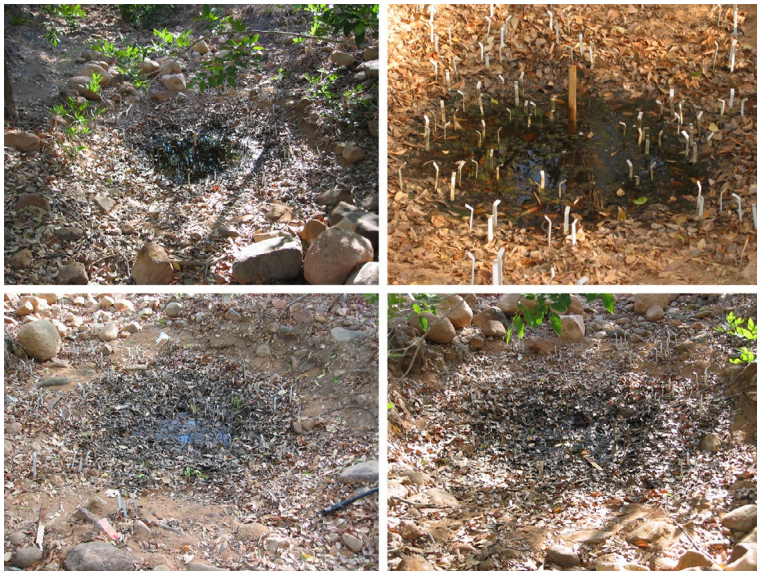
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**Table A2** Abundance and Body Size (Mean, Minimum and Maximum) of All Taxa Recorded—cont'd

Kingdom	Phylum	Class	Family	Species	Abund.	Wet Body Mass (mg)		
						Mean	Min	Max
Animalia	Arthropoda	Ostracoda	Cyprididae	<i>Cypretta</i> sp. A	439	0.0300	0.0046	0.0699
Animalia	Arthropoda	Ostracoda	Cyprididae	<i>Stenocypris major</i>	56	0.5313	0.0215	1.1540
Animalia	Cnidaria	Hydrozoa	Hydridae	<i>Hydra</i> sp. A	1	0.1053		
Animalia	Mollusca	Gastropoda	Planorbidae	<i>Segnitila</i> sp. A	5	12.5835	0.8866	33.2935
Animalia	Nematoda	NA	NA	Nematoda sp. A	2	0.0828	0.0828	0.0828
Animalia	Nematoda	Adenophorea	Dorylaimidae	<i>Aporcelaimus</i> sp. A	1	0.0052		
Animalia	Nematoda	Adenophorea	Mermithidae	<i>Hexameris</i> sp. A	3	6.8772	0.9430	10.4997
Animalia	Rotifera	NA	NA	Rotifera sp. S	1	0.0741		



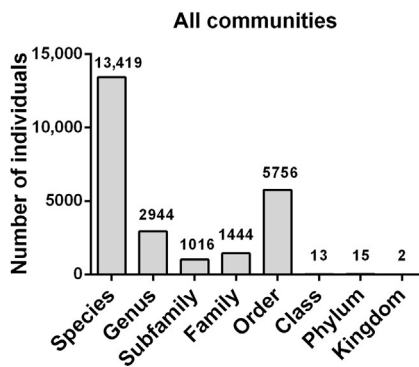
**Figure A1** Location of study site (red (grey in the print version) dot) within Goondaloo Creek, in the foothills of the Mount Stuart Range, Townsville, Queensland, Australia.



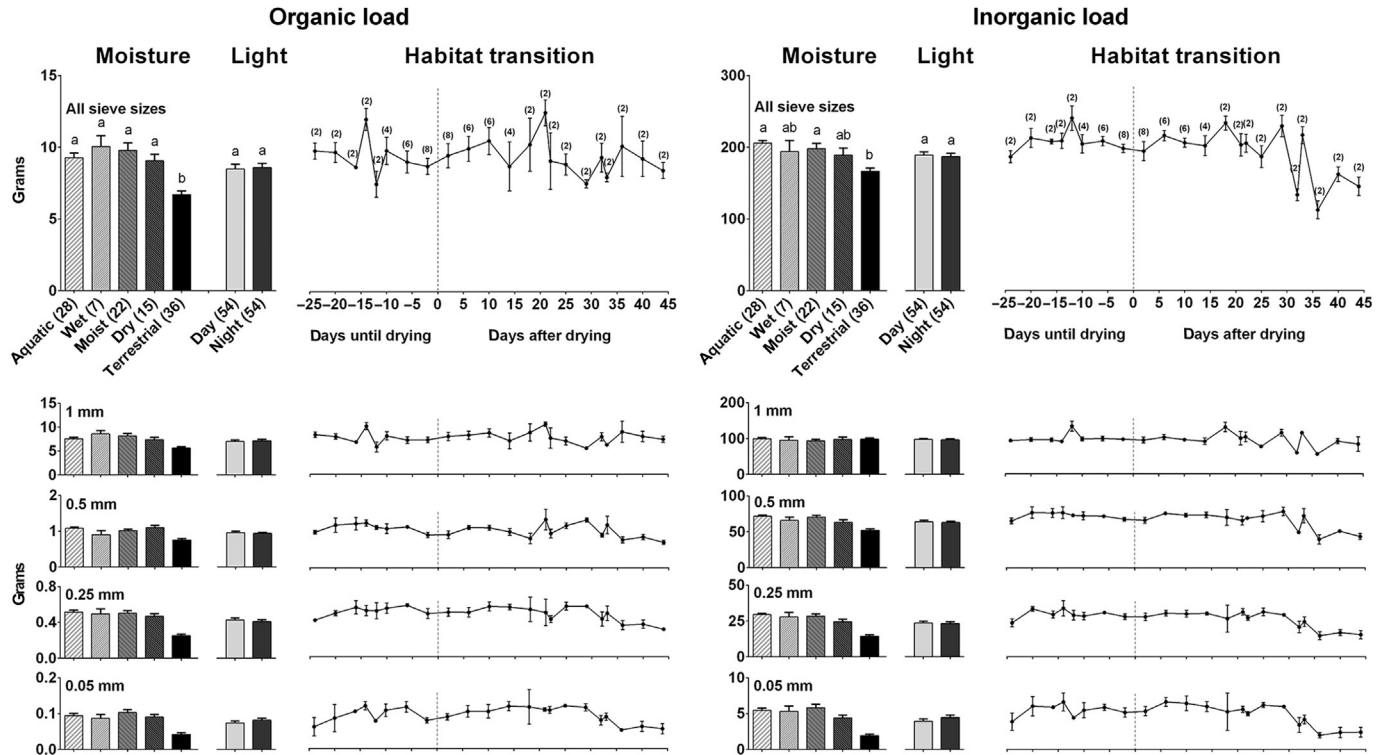
**Figure A2** Photos of the experimental pool bed at various stages of drying.



**Figure A3** Method of sampling used in the study, which provided a total core sample of  $\sim 2356 \text{ cm}^3$ . See main text for a detailed description of sampling methods.



**Figure A4** Level of taxonomic resolution of identification for all individuals recorded in the study.



**Figure A5** Effects of moisture, light and habitat transition on amount of organic (left) and inorganic (right) loads within local communities. Top panels show total values for all sieve size classes, and bottom four panels show amounts retained within each of the four stacked sieves of different sizes: 1, 0.5, 0.25 and 0.05 mm. Error bars are SE. See [Table 2](#) for details of habitat categories. Values in parentheses are total number of replicate communities within each habitat category (habitat transition does not sum to 108 because it excludes communities from levels 5 and 6, which remained permanently terrestrial). Grey-dotted line in habitat transition panel at day = 0 represents loss of surface water for that community, not the entire pool bed. Within each habitat category (i.e. moisture and light), different letters above the error bars denote significant difference between habitats ( $p < 0.05$ ) as determined by ANOVA followed by post hoc Tukey test (moisture) or  $t$ -test (light).



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