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2014 DRAGONFLY SURVEY

OLIFANTS & GA-SELATI RIVERS

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SUMMARY

- Dragonflies (order Odonata) have potential as taxa suitable for monitoring the biodiversity and water quality of the perennial water bodies (rivers and dams) on Palabora Mining Company lands and surrounding areas.
- A pilot survey was conducted to assess the time and skill required to survey dragonflies accurately, and to assess the variation in adult dragonfly communities. 5 sites in each of 4 river sections were sampled along the Olifants and Selati rivers.
- Surveys recorded only presence / absence, at species level. Communities were described according to three biodiversity indices: species richness, the Shannon-Wiener index, and the Dragonfly Biotic Index (DBI). Indicator species were identified using the IndVal method.
- Significant variation was found between river sections in terms of species richness and Shannon-Weiner diversity, but not DBI. Indicator species were identified for three of the four sections. Habitat diversity was clearly a factor driving higher diversity in the various sections.
- Overall the results indicate that dragonfly diversity is sensitive to river habitat diversity, and that this taxa can provide a useful indicator of overall diversity for river sections. Certain species may also have value as indicators of changes in diversity.
- Repeated and more intensive sampling would be required to determine if dragonfly communities and / or species are also a good indicator of changes in water quality.
- While dragonflies can be sampled relatively rapidly and at low cost, there is a large species pool in and around PMC, and a high level of identification skill is required for effective monitoring of them.

INTRODUCTION

Dragonflies (order Odonata) have been used for assessing the quality of aquatic ecosystems, and provide a potential tool for monitoring both biodiversity and water quality in the aquatic ecosystems on Palabora Mining Company (PMC), and downstream of PMC. Sixty-six percent of African dragonflies are found in riverine systems (Clausnitzer *et al*., 2012) and they have been ranked ranks in the top 20% in terms of suitability as an indicator of aquatic ecosystem quality (Clark and Samways, 1996). They are increasingly used as indicators, of aquatic ecosystem quality and biodiversity, as they can be identified relatively easily and in many cases have well-known habitat requirements (Suhling *et al*., 2015). Also, a recent method was developed to prioritise freshwater sites based on the presence of adult male dragonflies, which has great value in even selecting biodiversity hotspots (Simaika and Samways, 2009a,b).

A dragonfly survey was conducted on PMC to:

1. Determine the variation in adult dragonfly communities at a range of riparian sites, and how accurately this variation can be assessed using a rapid survey method.
2. To determine causes in differences found in dragonfly communities between sites.
3. Assess the practical suitability of the method used.

METHODS

Surveys of dragonflies of the Olifants and Ga-Selati rivers were conducted during the month of October 2014. The reaches of these rivers on PMC, and directly up- and downstream were divided into four sections (Figure 1).

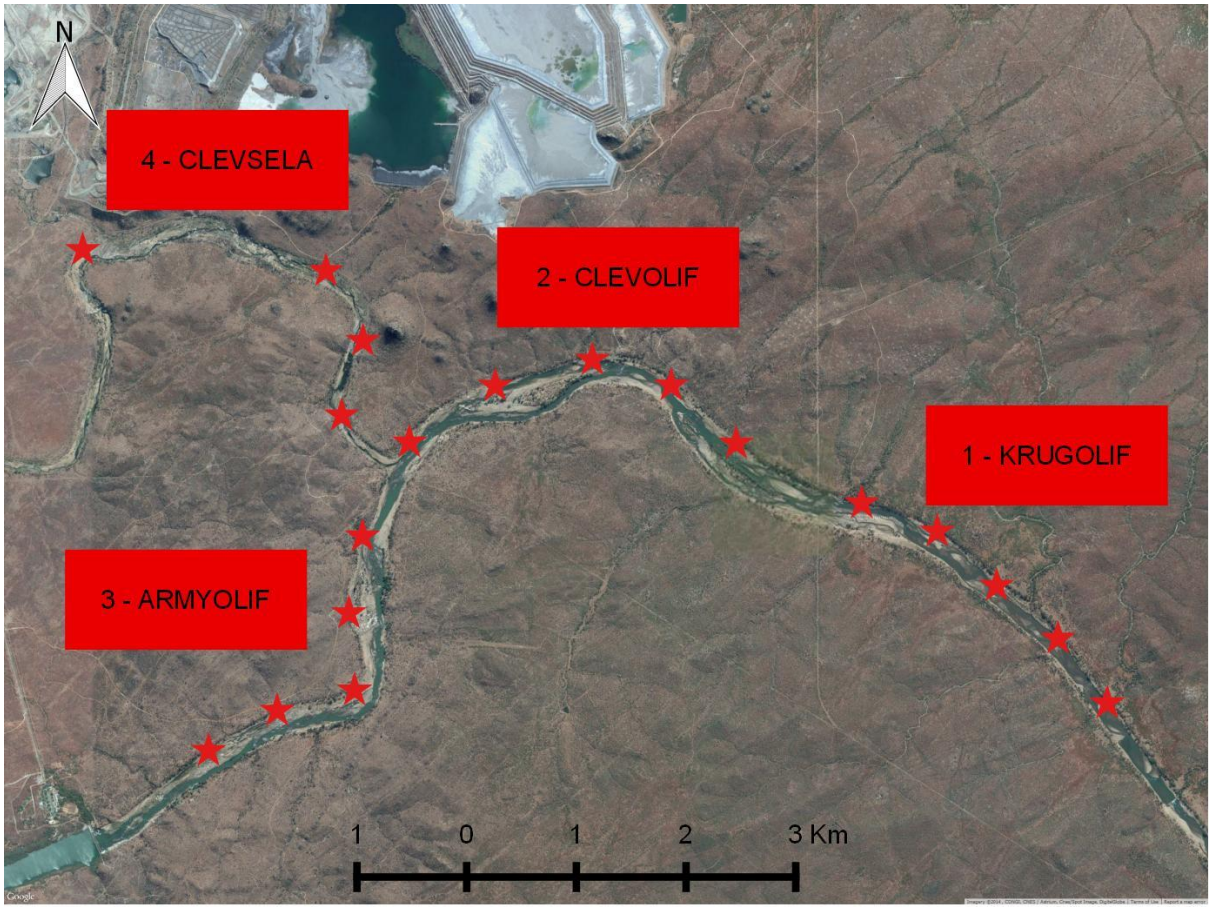

Figure 1: Satellite imagery showing different river regions (1-4) where dragonflies were surveyed. OLIF and SELA are abbreviations for Olifants and Ga-Selati rivers, respectively. KRUG refers to Kruger National Park, CLEV refers to Cleveland Nature Reserve and ARMY is the section of the Olifants River bordering the SANDF SAWONG land. Red stars show sample sites.

Five sample sites per selected per section, located at approximately equal distances from one another on the northern banks of both rivers. Sites were at least 800m apart. 100m transects were walked downstream upon arrival at each site, along the water's edge. Both still and flowing water bodies were sampled, and only adult male dragonflies recorded. Dragonflies encountered away from the water, i.e. not using a riparian habitat, were not recorded. Both damselflies (Zygoptera) and dragonflies (Anisoptera) were recorded.

Only species presence was recorded and these data used to calculate species richness per site, Shanno-Weiner diversity per section, and Dragonfly Biotic Index (DBI) per section. DBI is:
"A compound index based on three criteria: geographical distribution, conservation status and sensitivity to change in habitat. It ranges from a minimum of 0 to a maximum of 9. A very common, widespread species which is highly tolerant of human disturbance scores 0. In contrast, a range-restricted, threatened and sensitive endemic species scores 9…" (Samways, 2008).

Indicator species for each section were identified using IndVal (indicator value analysis).

RESULTS AND DISCUSSION

A total of 29 species were recorded in the four sections (Appendix 1 provides the species and DBI values). This about a fourth of the total number of species found in north-eastern South Africa (Clausnitzer *et* al., 2012). Total species richness and mean species richness per site were highest along the Olifants River in Cleveland and the Selati River section, and lowest along the Olifants downstream of Cleveland (Figure 2).

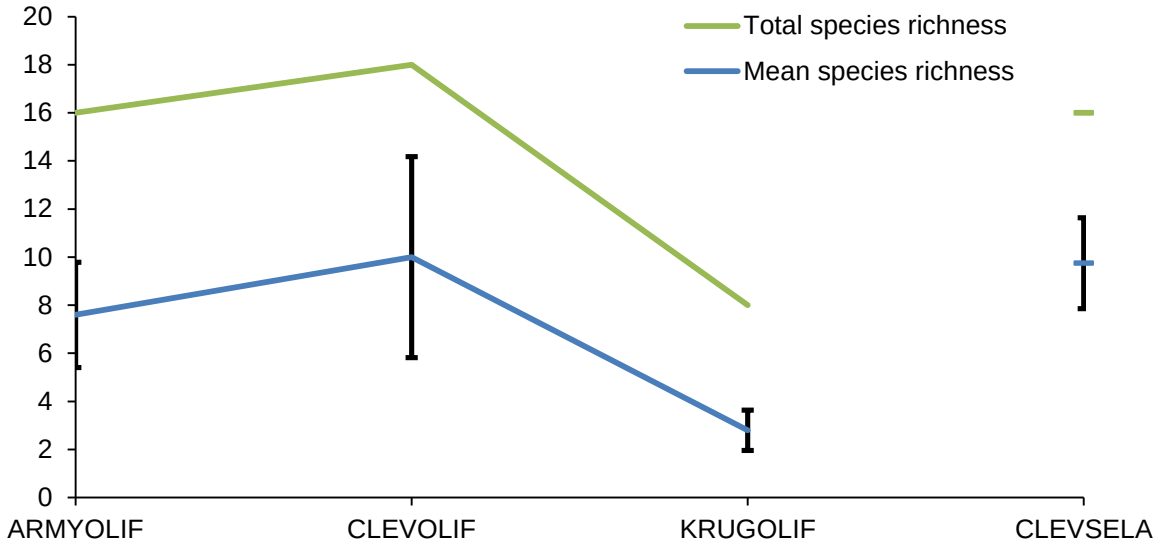

Figure 2: River region-specific total species richness and mean species richness values per site, for dragonflies recorded along the Olifants and Ga-Selati Rivers. Error bars indicate standard deviation from the mean.

The large standard deviations for sites along the Olifants in Cleveland indicate that a greater diversity of habitat for dragonflies in this section. A one-way ANOVA showed that differences in species richness between the four sections were statistically significant ($F = 7.88$; $p = 0.002$).

DBI values showed an inverse trend to that of species richness, with the section along the Olifants in Kruger National Park (KNP) having the highest value (Figure 3). While the other regions had more species, many of these were tolerant species not sensitive to water or habitat quality. This shows that high species richness does not necessarily equate to more pristine habitats with better water quality. However differences in DBI were not statistically significantly different ($F = 0.16$, $p = 0.92$; Bartlett statistic (corrected) to compare standard deviations = 1.326, $p = 0.72$).

Figure 3: River region-specific mean Dragonfly Biotic Index (DBI) values for 2014's dragonfly (Odonata) surveys. Error bars indicate standard deviation from the mean.

Shannon-Wiener diversity was lowest for the Olifants in KNP, and very similar for the other three sites (Table 1). Shannon-Weiner values range from 0 to infinity, with 0 indicating dominance by 1 species and higher values indicating both higher species richness and a more even abundance by all species present.

Table 1: Shannon-Wiener diversity index values for the four river sections. Refer to Figure 1 for explanation of river region abbreviations.

River region	Shannon-Wiener/-Weaver diversity index
CLEVOLIF	2.7
CLEVSELA	2.6
ARMYOLIF	2.6
KRUGOLIF	1.9

The diversity values in Table 1 follow a similar trend to the species richness values in Figure 2, and it is likely that the diversity of habitats along the Olifants in Cleveland was responsible for both higher species richness and more species evenness.

Indicator value analysis identified indicator species for three of the sections (listed here in descending order of significance):

- *Paragomphus genei* (Green Hooktail) for ARMYOLIF;
- *Pseudagrion massaicum* (Massai Sprite) for CLEVOLIF;
- *Africallagma glaucum* (Swamp Bluet) for CLEVSELA.

Common in Kruger National Park (and the strongest indicator at ARMYOLIF), the Green Hooktail (Figure 4) favours moist, gravel or sandy shores of savanna rivers with low water levels, and occasionally pools and reservoirs. Its flight period spans from November to June and is one of few species encountered during the 2014 surveys that has a DBI value of three (Samways, 2008).

Figure 4: A Green Hooktail *Paragomphus genei* photographed in the Limpopo Province, South Africa. Source: OdonataMAP at http://vmus.adu.org.za/.

The colourful Massai Sprite *Pseudagrion massaicum* (Figure 5) is common throughout South Africa but, is only active from October to May. This damselfly prefers well-vegetated ponds, pools and sluggish reaches of rivers, with lilies, reeds and sedges, and an abundance of submerged water weed and floating algal mats (Samways, 2008). With a DBI value of one, it is also much more tolerant to a wide range of aquatic conditions compared to the Green Hooktail, conditions typical of CLEVOLIF.

Figure 5: The Massai Sprite *Pseudagrion massaicum* from the Limpopo Province showing its vividly-coloured thorax, head and eyes. Source: OdonataMAP at http://vmus.adu.org.za/. Photo taken by V. Zessnitz.

Scarce in winter (dry season), the Swamp Bluet *Africallagma glaucum* (Figure 6) is also common throughout South Africa. It prefers pools, dams and still parts of streams and rivers where conditions are swampy and with an abundance of short grasses and sedges where it glides swiftly across and closely to the water (Samways, 2008). Its preferred habitat is typical of the CLEVSELA river region.

Figure 6: A colourful Swamp Bluet *Africallagma glaucum* from the Limpopo Province. Source: OdonataMAP at http://vmus.adu.org.za/. Photo taken by G. Diedericks.

A lack of indicator species at KRUGOLIF was not surprising considering the low macrohabitat- and microhabitat diversity, and the lack of lentic (still water) habitats, and the abundance of marginal vegetation and sand-dominated shores.

MANAGEMENT RECOMMENDATIONS

The annual monitoring of dragonfly communities can provide a useful tool for monitoring the overall biodiversity of the perennial rivers on and around PMC. Monitoring the abundance of selected indicator species may also have value, although further surveys would be needed to confirm this. Additional surveys are also recommended in order to determine whether dragonflies would be a good indicator of water quality in these rivers at an appropriate monitoring frequency (annually or twice per year). Surveys to determine whether the biodiversity and water quality of dams on PMC can be monitored using dragonflies are also worth pursuing.
More intensive monitoring following a spillage of pollutants into the Selati River would enable us to better understand the impacts of PMC (and the other industries upstream) on dragonfly species, and the overall diversity of large river ecosystems such as the Selati and Olifants.
The most significant disadvantage for using dragonflies for monitoring is the high level of observer skill required to identify the diverse species pool found in the Phalaborwa area. The *Orthetrum* genus is specifically difficult to tell its members apart and different identification guides are required in the field when surveying.

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APPENDIX

Dragonfly (Odonata) species encountered at the different river regions of the Selati ('SELA) and Olifants ('OLIF) rivers in order of descending DBI value. Asterisks note presence at the specific region(s). DBI – Dragonfly Biotic Index Value from Samways (2008).

Species (Latin name)	DBI	ARMYOLIF	CLEVOLIF	KRUGOLIF	CLEVSELA
Pseudagrion gamblesi	4			*	
Trithemis donaldsoni	4	*			
Brachythemis lacustris	3				*
Mesocnemis singularis	3				*
Orthetrum caffrum	3		*		
Paragomphus genei	3	*			
Pseudagrion acaciae	3	*	*	*	*
Ictinogomphus ferox	2	*	*		
Orthetrum chrysostigma	2				*
Phaon iridipennis	2	*	*		
Platycypha caligata	2				*
Pseudagrion commoniae	2	*			*
Pseudagrion hamoni	2		*	*	
Pseudagrion sublacteum	2	*	*	*	*
Africallagma glaucum	1		*		
Anax imperator	1	*	*		*
Elattoneura glauca	1	*	*		
Nesciothemis farinosa	1	*	*		*
Orthetrum julia	1		*		
Orthetrum trinacria	1				*
Pseudagrion kersteni	1				*
Pseudagrion massaicum	1		*		
Pseudagrion salisburyense	1	*	*		*
Trithemis annulata	1	*	*	*	*
Crocothemis erythraea	0	*	*		*
Ischnura senegalensis	0		*		
Pantala flavescens	0	*		*	
Trithemis arteriosa	0	*	*	*	*
Trithemis kirbyi	0	*	*	*	*