Ekōløgīk

Environmental Science & Consulting

Report: Rapid Frog Survey

by

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1. INTRODUCTION

1.1. ANURAN BIO-INDICATORS

Environmental and biodiversity pressures, globally, are mainly caused by severe habitat alterations or permanent habitat loss with simultaneous species declines and loss. Understanding these pressures require assessment of the state of the environment, and the use of ecological indicators are of tremendous value herein (Dale & Beyeler, 2001). A suitable indicator organism, group of organisms or taxon must meet certain qualifying criteria to be used as a surrogate for environmental health assessment. Dale & Beyeler (2001) stipulates 6 criteria for organisms to qualify as suitable environmental bio-indicator:

1) must be present for an extended time;
2) should be able to be sampled easily and cost-effectively;
3) be sensitive to stressors in the environment;
4) responses to such stressors should be predictable;
5) should be abundant in healthy eco-systems;
6) environmental responses should indicate a low level of variability.

Further to this list can be added that the organism, group or taxon should be generally exposed to the habitat under investigation while also being well studied and mostly well understood.

The increased use of Amphibians as bio-indicators World-wide are well documented (see Campbell et al. 2005; Collins & Storfer 2003; Galatowitsch et al. 1999; Hammer et al. 2004; Sheridan & Olson 2003 and Welsh & Ollivier 1998). As an appropriately representative taxon within a variety of ecosystems, amphibians (frogs, salamanders, newts and caecilians) are perfect bio-indicator surrogates for the following reasons:

a) Amphibian species are found everywhere on earth, except Antarctica. Many species are also active throughout the year;

b) They occupy a key trophic position as both predator and prey;
c) They are selective in the type of habitat they require;
d) Diverse feeding and breeding strategies linked to seasonally distinct functions allows them to exploit a wider spectrum of ecological niches than almost any other taxonomic class (except insects);
e) They are exposed to air, surface and aquatic environments and the unique morphology of their permeable skin and their biphasic life exposes them to a variety of environmental stressors;

All the above factors make amphibians entirely representative of the environmental diversity of a region and its environmental stressors.

The only amphibians found in South Africa, frogs, are substantial predators under normal abundance conditions, particularly of invertebrates. They also play a vital role as source prey for a wide diversity of predators including birds, mammals, snakes, and other frogs. Under these conditions, frogs play an intermediate role in the food web, being both predator and prey with a critical role in the stability of most ecosystem communities (Hirai & Matsui, 1999). Tadpoles, being mainly herbivorous, consume significant amounts of algae and vegetable detritus while simultaneously serving as a food resource for aquatic predators, both invertebrate and vertebrate. South Africa have a huge diversity of frogs with 159 currently known species representing 33 genera making this organism most suitable as bio-indicator species (Frost, 2021).

1.2. FROGS OF THE GARDEN ROUTE AND GEORGE AREA

The frogs around the Garden Route and George are reasonably well researched over the last 10 years and is rather abundant although not as diverse as in other parts of the country. Species occurring in the area does however use a wide range of different habitats (Du Preez & Carruthers, 2017). Based on a thorough desk top study of published literature Du Preez & Carruthers (2017), Minter et al. (2004), De Lange & Du Preez (2018) and from recent predictive modelling studies 18 frog species in 11 genera have been recorded in the Southern Cape, Garden Route region, detailed in Table 1

(Minter et al., 2004). This represents 9% of all species occurring in South Africa. One species is listed as Endangered according to the latest IUCN Red List for amphibians, this being *Afrixalus knysnae* (IUCN, 2021). This species is currently recorded at 10 sites within this region, the most western distribution recorded at a site in Kingswood Golf Estate, George, and the most eastern site at Covie Village near Nature's Valley (Unpublished thesis, De Lange, 2018).

Table 1: Frog species recorded in the Garden Route area. LC = Least Concern, EN = Endangered (IUCN Status)

Family	Species	Status
BREVICIPITIDAE	*Breviceps fuscus*	LC
	Breviceps rosei vansoni	LC
BUFONIDAE	*Sclerophrys capensis*	LC
	Sclerophrys pardalis	LC
	Vandijkophrynus angusticeps	LC
HELEOPHRYNIDAE	*Heleophryne regis*	LC
HYPEROLIDAE	***Afrixalus knysnae***	**EN**
	Hyperolius horstockii	LC
	Hyperolius marmoratus	LC
	Semnodactylus wealii	LC
PIPIDAE	*Xenopus laevis*	LC
PYXICEPHALIDAE	*Ametia fuscigula*	LC
	Amietia delalandii	LC
	Cacosternum nanum	LC
	*Cacosternum boettgeri/C.platys**	LC
	Strongylopus bonaespei	LC
	Strongylopus faciatus	LC
	Strongylopus grayii	LC
	Tomopterna delalandii	LC

*Minter et al. (2004) does not distinguish between these two species because of their cryptic nature and incomplete taxonomic data at time of publication of *The Atlas and Red Data Book*.

1.3. TERMS OF REFERENCE AND AIMS OF STUDY

This report forms part of a Rapid Amphibian Survey and will detail the findings of a site survey determining the suitability of the site as frog habitat as well as the frog species composition at the site. This will include:

- Site description and condition.
- Description verified key vegetation at the site and landscape character.
- Evaluation of the site as habitat for frog species as indicated in the brief
- Acoustic analysis of frog species at the study site
- Determining the frog species community composition and diversity at the site.
- Description of identified frog species from the study site, based on acoustic spectrograms and photographs where possible.
- Conclusions based on the findings

2. METHODS

2.1. VISUAL SITE INSPECTION

2.1.1 Site visits

The study site was visited between 9 and 12 October 2021. Inspection of the site on 9 and 11 October was made in the early to late afternoon to ascertain the most effective location to deploy the Song Meter® and to record water level, water clarity, vegetation types and species. Many frog species engage in vocalisation bouts in the daytime, and an auditory survey was also made during these visits to determine preliminary frog community presence. September and October are also the start of the breeding season for many frog species in the Garden Route. The Campersdrift River situated on the eastern boundary of the development site will most likely sustain populations of other frogs not usually found in wetland habitats such as Painted Reed frogs (*Hyperolius marmoratus*), Cape River frog (Amietia delalandii), African clawed frog (*Xenopus laevis*).

2.1.2 Site description

The study site is a small wetland situated on erf 21028 George (Cape Farm Mapper, accessed 11 October 2021), at the junction of King George Road and Augusta Drive within a new housing development site with coordinates recorded as S33°57'33.8",

E22°26'41.4". The wetland has been disturbed by development construction and earthmoving machinery with a large part being modified by the disturbance. Recent rains in the area caused the wetland to fill up with water.

The vegetation consists of a large variety of hydrophytes throughout the site with large communities of *Polygonum* spp. and *Hydrocotyl* spp. Abundant *Pennisetum clandestinum* occurs across the site, along the edges of the water body and the entire property. Many young stands of *Typha capensis* are also present within the waterbody at varied maturity hights.

The wetland in its current disturbed state has seemingly shifted slightly eastward from the original location and is approximately 1700Sqm and irregularly shaped. No delineation was made during any site visit for this report although satellite imaging indicates that the historical size may have been as much as 2200 Sqm while almost completely circular in form (Figure 1).

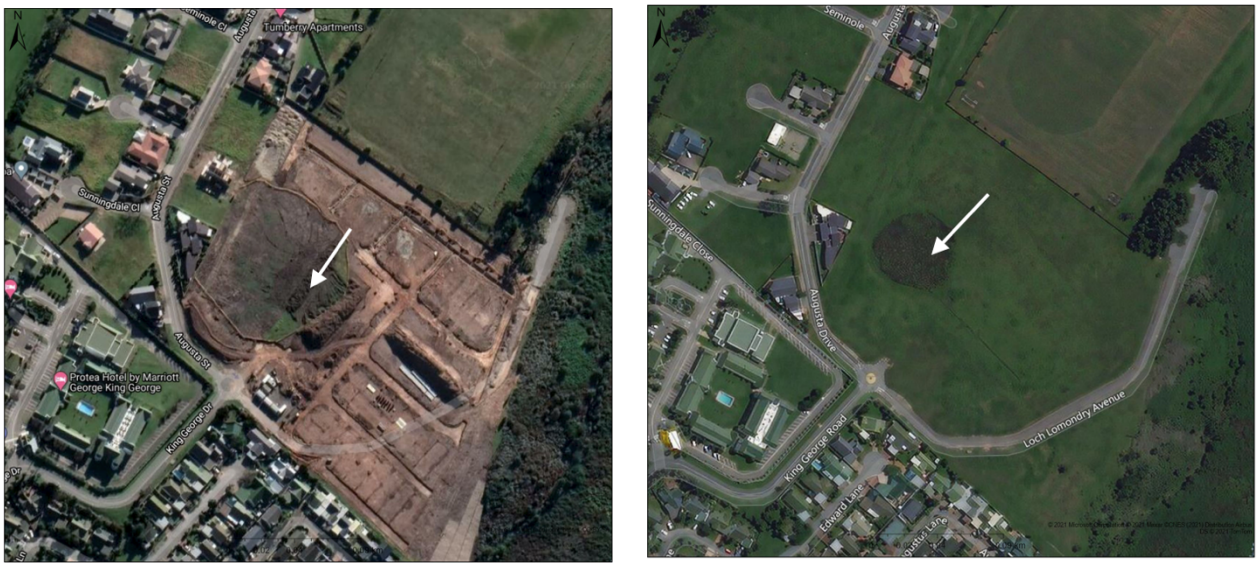


Figure 1: Study site depicted within the current development site (left) and as it was prior to development commencement (right)

2.2. FROG SPECIES SURVEY METHODS

To ensure that all frog species present at the time of the rapid survey were encountered a combination of acoustic monitoring and visual encounter surveys were followed, during both day and at nighttime.

2.2.1 Passive Acoustic Monitoring (PAM)

A fixed-point acoustic survey was conducted using an autonomous programmable acoustic recorder, Song Meter® SM2+ (Figure 2). PAM is extremely effective in its nature as an un-invasive survey method, allowing uninterrupted calling behaviour by frog species within a community. The Song Meter® was placed near the centre of the site and programmed to record for 10 minutes on every hour from 18h00 in the evening to 6h00 the following morning. The acoustic data was collected from 9 to 11 October 2021. A continuous recording period from 18h00 on 11 October 2021 to 6h00 on 12 October 2021 was also made as control.

Figure 2: Song Meter® SM2+ within protective housing, mounted against single post planted within the wetland site

As each frog species has a species-specific call, PAM provides an accurate way to determine which frogs are calling and the data can with great certainty inform on the community composition at the site. However only male frogs call, and males only call when reproductively active. For this reason, PAM should ideally be combined with other survey methods over a pro-longed period. This will enable determination of

species abundance information, reproductive success, and the sustainability of the habitat as breeding site.

2.2.2 Visual Encounter Surveys (VES)

Visual encounter surveys were undertaken during the day visits to the site to identify diurnal calling species, resting species within the base of vegetation and in order to do dip-netting for tadpole specimens. The breeding season for frogs in the Garden Route mainly starts in Spring and continues into the beginning of summer. Temporal breeding activity of all the species are however not always simultaneous. Tadpole presence therefore assist in identifying species that may not be calling anymore due to its breeding activity being finalised. Tadpole development after main breeding events assist in identifying species without visually encountering adults. Dipnetting was however also done on a minimal basis with general identification of the specimens. The visual encounter survey would also confirm acoustic identifications made from the PAM data analysis.

3. RESULTS

3.1. STUDY AREA AS HABITAT FOR FROGS

The official rainfall figures in George during the month of September 2021, as indicated by the South African Weather Service was 67mm. This visibly increased the water level in the wetland at the study site. Clear fresh water exists towards the centre of the area where the substrate is solid under foot, causing the wetland to retain the water body during the rainy season. Prolonged water retention in wetland systems is of utmost importance for frog species requiring pooled water as breeding medium. Tadpoles need the waterbody to develop after hatching. Depth of the water body varies between approximately 400mm towards the centre running out to empty at the edges.

Disturbance towards the edges of the wetland has made the underfoot conditions soft and muddy however with water pockets being less clear and higher concentrations of undissolved solids. These conditions will however suit toad species if the pools are deep enough as it conceals the tadpoles, making it less susceptible to predation.
The overall characteristic of the site suggests that it is a historical frog breeding habitat. The clear pools of water and the hydrophyte species present at the site indicates optimal anuran habitat. The fact that predator pressure is at a minimum at the site also makes the site ideal for egg deposition and tadpole development of many *Hyperoliidae spp*. and *Bufonidae spp*. The relative solid substrate of the area also enables the pools to form and remain for a prolonged period and coinciding with the breeding period from September to February. The *Polygonum spp*. and *Hydrocotyl spp*. of hydrophytes present at this site are also exclusively used by *Afrixalus knysnae* in its breeding processes. This species has very specialised habitat requirements to deposit its eggs and have its tadpoles develop. The water body characteristics, vegetation, and minimal predator presence it requires is optimal for its breeding activity at this site (De Lange & Du Preez, 2018).

3.2. DIVERSITY OF FROGS EXPECTED AND OBSERVED

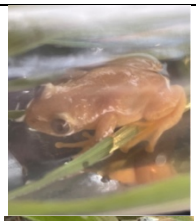
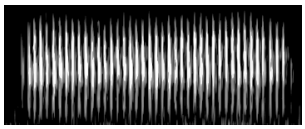
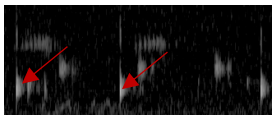
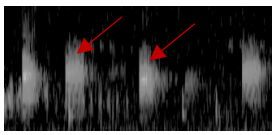
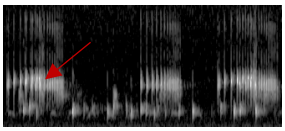
Based on the analysed acoustic data collected by the Song Meter® as well as the VES survey and tadpoles collected, the frog species generally found within the bioregion is compared to the actual species detected and indicated in Table 2. This comparison is made to indicate the relative diversity at the site compared to the George area records. The likelihood of detecting a species at the site is also indicated by way of a rating between 0 and 5, 0 being not probable and 5 being most probable. Confirmed detection or observation is indicated by way of a "C". Photographs and illustrations of the acoustic spectrograms of the species encountered is depicted in Table 3.

Table 2: List of frogs expected at the site compared to species that have been detected, either by way of VES or PAM. A rating between 1 and 5 is indicative of the probability of presence at the site.

Family	Species	Status	Expected	Confirmed
BREVICIPITIDAE	Breviceps fuscus	LC	3	
	Breviceps rosei vansoni	LC	0	
BUFONIDAE	Sclerophrys capensis	LC	4	
	Sclerophrys pardalis	LC	1	
	Vandijkophrynus angusticeps	LC	0	
HELEOPHRYNIDAE	Heleophryne regis	LC	0	
HYPEROLIDAE	Afrixalus knysnae	EN	5	C
	Hyperolius horstockii	LC	3	
	Hyperolius marmoratus	LC	3	
	Semnodactylus wealii	LC	1	
PIPIDAE	Xenopus laevis	LC	0	
PYXICEPHALIDAE	Ametia fuscigula	LC	0	
	Amietia delalandii	LC	0	
	Cacosternum nanum	LC	5	C
	Cacosternum boettgeri/C.platys*	LC	4	C
	Strongylopus bonaespei	LC	3	
	Strongylopus faciatus	LC	4	
	Strongylopus grayii	LC	5	C
	Tomopterna delalandii	LC	3	

It must be noted that some of the species expected at the site and indicated as 3.4 and 5 but not encountered during this survey, may only be present later in the year as their breeding periods differ from the current season. Rain frogs (*Breviceps spp.*) and the Sand frogs (*Tomopterna spp.*) mainly appear after good rains in December, January and February. The site does however show good potential as habitat for these species during this time. Should the water level rise because of more rain, the toad species (*Sclerophrys spp.*) will also utelise the site to deposit their eggs.

Table 3: Species encountered at the study site

Scientific name	Common name	Photograph	Acoustic Spectrogram signature
Afrixalus knysnae	Knysna leaf-folding frog (adult)		
	Knysna leaf-folding frog (tadpole)		
	Knysna leaf-folding frog 9folded leaf nest)		
Strongylopus grayii	Clicking stream frog	None	
Cacosternum nanum	Bronze Caco		
Cacosternum platys	Flat Caco	None	

3.3 SIGNIFICANT SPECIES DETECTION

A significant result from the survey however is the fact that ***Afrixalus knysnae*** was detected, and in abundance. This site is without doubt a locality with some of the highest abundance of this species within the greater George area. The acoustic data indicates many males calling during the three nights of recording. The calls dominate the soundscape for more than 60% of the recording intervals. VES furthermore confirmed the species presence as calling males were observed, a female was captured and released. Many nests of folded leaves enclosing the eggs were also observed while tadpoles were collected with minimal sampling effort during the site visits.

A further survey result of significance is the acoustic confirmation of the presence of ***Cacosternum platys.*** This detection obtained from the acoustic data seems to indicate a range shift of the species east of its known localities (Du Preez & Carruthers, 2017,

Minter et al. 2004). This cryptic species is extremely difficult to visually locate, and extensive surveys are required. The large number of calls however recorded with PAM, undoubtedly confirms its presence. The find is significant enough to report and may be useful in taxonomic studies. And to update the occurrence records of the Atals for South African Species.

4. DISCUSSION AND CONCLUSIONS

4.1. SURVEY CONDITIONS

Although the survey was conducted on a rapid basis, the species abundances are very high. The diversity in relation to the rest of the bio-region is very low. Detection of the various species both acoustically and visually was relatively easy and as expected for the habitat type and the area in which the site is situated. The breeding activity is well underway as the calling activity is prolific and large numbers of tadpoles are present. No adverse weather conditions were experienced, making the recordings very clear and the survey easy to conduct.

4.2. LIMITATIONS OF THE STUDY

The study site is severely disturbed as result of the construction work and earthwork taking place on the property. No reference conditions or data prior to the commencement of the work exists and thus no comparisons can be drawn to the habitat conditions prior hereto. The rapid nature of the survey also can not advise on the number of individual frogs per species at the site or the survival rate of tadpoles over the breeding season for further sustainable population data.

4.3 SPECIES PRESENCE

Habitat fragmentation is the biggest threat to frog species survival. The IUCN working group on Amphibians lists the protection of habitat as the most crucial factor in the conservation of *Afrixalus knysnae*. The species only exists on a total area of occupancy of less than 27km^2. This small footprint of the occurrence of the species is directly as

result of habitat loss. Early records of the species indicated localities throughout the Southern Cape region, with Knysna as its centre of endemism. The large and rapid expansion of the area for development of luxury estates have however had an adverse effect on its traditional habitat. The current opinion is that this resulted in a westward shift of the species, and thus more sites are being discovered in the George area. Studies on the species are ongoing and large gaps in the knowledge base herein still exists. The vulnerability of the species to habitat loss is clear. Its breeding season is also extremely short and a time when the species are particularly at risk of anthropogenic disturbances. The folded leaf nests are particularly difficult to identify and human and animal movement through wetlands and parklands where standing water may lead to opportunistic breeding activity is often at high cost to the species.

Although *Cacosternum platys*, *Cacosternum nanum* and *Strongylopus grayii* are not on any endangered lists, their presence indicates the relative health of terrestrial aquatic systems. The continuous removal or diminishing of their habitat will ultimately lead in the same direction as that of *A. knysnae*. These habitat losses ultimately lead to the disappearing of wetlands systems vital for the collection and filtration of freshwater into lotic systems for human consumption.

4.4 OVERALL CONCLUSIONS

The nature of ephemeral wetlands such as the system at the study site is the challenge it poses to environmental surveys during dry seasons. Most frog species estivate in the drier months within substrate of vegetation or soil structures and does not present itself during environmental surveys. This often leads to misinterpretation of species counts and presences during EIA's and can lead to irreparable damage to habitat types during development or conversions of land for development. Development with proper management of wetlands is vital if the decline in wetland systems and frog species are to be halted. The amendments to the National Environmental Management Act (998 (Act No. 107 of 1998) pertaining to the protocols prescribed in respect of specific environmental themes for assessment of environmental impacts was promulgated for this very purpose (Government gazette 1150, October 2020).

In conclusion this report would suggest that a specialist study be conducted to ascertain the impacts the development will have on the sustained availability of the habitat present at the site and its impact currently and in future on the survival of the *A. knysnae* (EN) population at this habitat. It is further suggested that a comprehensive management plan be commissioned to protect the habitat for *A. knysnae* should the development proceed and then to determine the conditions under which the development should proceed. The management plan should also include the habitat management after the development have concluded and include all such role-players as required herein. Rehabilitation of the wetland is currently still possible with minimal effort but the development on its current trajectory of construction will have severe implications for the habitat and the survival of *Afrixalus knysnae* at the site.

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Declaration by Specialist scientist

DECLARATION OF INDEPENDENCE BY SPECIALIST

I, Ferdi de Lange, hereby declare that I:

- acted as the independent specialist in compiling this document;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- I do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations and any specific environmental management Act;
- have no and will not have any vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence.

Signature

Date: 13 October 2021