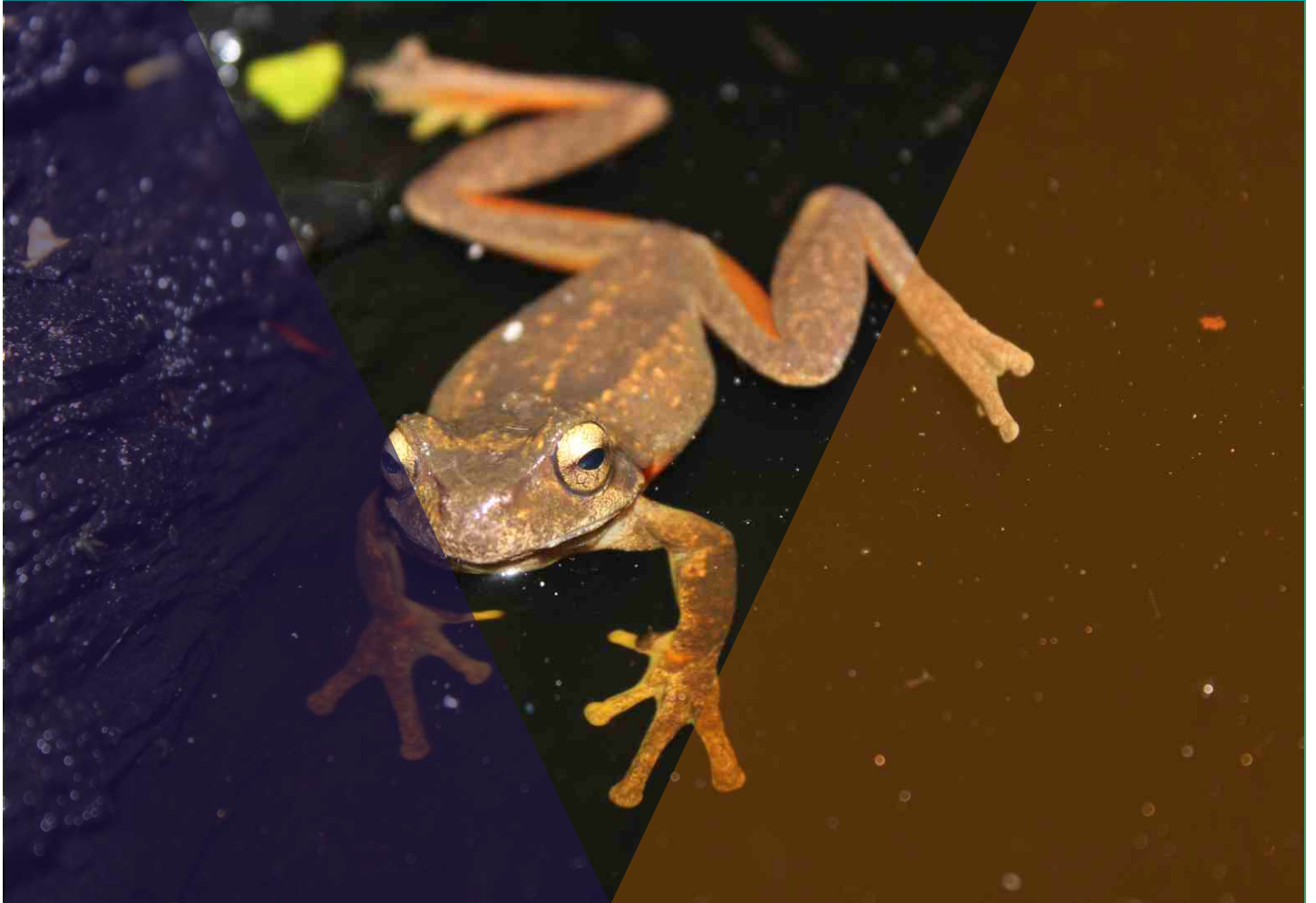


Forest Protection Survey Program

Survey Guideline Frog Survey (V5.0)



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Cover photo: Watson's Tree Frog, Louise Durkin

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Frog Survey

Context

Frog species targeted for survey include Giant Burrowing Frog, Watson's Tree Frog, Blue Mountains Tree Frog, Alpine Tree Frog, Booroolong Tree Frog and Martin's Toadlet.

Where logistically feasible, frog surveys may be undertaken alongside surveys targeting other taxa. This may include identifying potential breeding locations of the target frog species, for subsequent survey while e.g. retrieving camera traps for terrestrial mammals, or nocturnal frog surveys on the same night and at the same location as spotlighting for arboreal mammals and/or doing call playback for owls.

Objectives

To detect presence and record abundance of target frog species at survey locations within, and immediately adjacent to, selected survey sites.

Survey effort

A 'survey site' is the broad location where surveys are to be conducted. Contractors are provided with survey site data. All survey sites must have a Site ID recorded in the datasheet.

A 'survey location' is a discrete location where specific survey methods are conducted, e.g. a waterbody or stream reach, or where one or more acoustic recorders are established, and where either or both adult frogs and tadpoles may be present. All survey locations must have a SiteID2 recorded in the datasheet.

It is important to employ survey techniques most suited to the biology and ecology of each target species, to maximise the chances of detection. Survey techniques to be used for each of the target species are listed in Table 1.

Table 1. Survey methods to be used for each of the six target frog species.

Scientific name	Common name	Call survey and visual spotlight search	Tadpole survey	Remote acoustic recorder survey	Maximum search distance outside survey site boundary
<i>Heleioporous australiacus flavopunctatus</i>	Giant Burrowing Frog	Yes	Yes	Yes	500 m or 1km (see text)
<i>Litoria booroolongensis</i>	Booroolong Tree Frog	Yes	Yes	No	500 m
<i>Litoria citropa</i>	Blue Mountains Tree Frog	Yes	Yes	No	500 m
<i>Litoria watsonii</i>	Watson's Tree Frog	Yes	Yes	Yes	300 m

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<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	Yes	Yes	No	500 m
<i>Uperoleia martini</i>	Martin's Toadlet	Yes	No	No	500 m

Each site to be surveyed for frogs should be reconnoitred once during the day to identify potential locations for later survey effort using any of the three survey techniques outlined below. During initial daytime reconnaissance of survey sites, surveyors should bring appropriate equipment to conduct tadpole surveys at potential breeding locations when they are first located. If the survey site is prioritised for survey of either Giant Burrowing Frog or Watson's Tree Frog, surveyors should bring remote acoustic recorders, programmed and ready for deployment during the reconnaissance visit, to install at potential breeding locations if/when they are identified.

The total number of, and distance between, survey locations per survey site will vary according to the size of the survey site and availability of habitat that meets the habitat requirements of the target species. The number of survey locations per survey site should be limited to as many as can be realistically surveyed by a pair of observers in one night. The number of survey locations may be reduced in larger survey sites with extended walk-in distances, or where access is difficult due to terrain and vegetation.

Surveyors should aim to maximise coverage of the survey site, prioritising within the survey site itself before searching for potential survey locations beyond survey site boundaries. The maximum distances outside survey site boundaries to be surveyed for each frog species are listed in Table 1..

- When targeting the Giant Burrowing Frog, if 2nd or high-order streams are being surveyed, survey locations may be located up to 1 km outside site boundaries; if 1st order streams or sites away from streams are being surveyed, survey locations may be located up to 500 m outside survey site boundaries.
- When targeting the Watson's Tree Frog, survey locations may be located up to 300 m outside survey site boundaries. For all other frog species listed in Table 1, survey locations may be located up to 500 m outside survey site boundaries.

Each survey location shall be subject to up to three nights of call survey and visual spotlight searching and tadpole survey. The three survey nights may be consecutive or non-consecutive and must occur during favourable conditions for surveying frogs (see Spotlight and Call Survey section, below). Call surveys must occur during appropriate times of year for each species, when adult males are likely to be calling at occupied locations (Table 2).

Less than three visits to conduct call surveys and visual spotlight searches and/or tadpole surveys would be required when surveying for either the Watson's Tree Frog or the Giant Burrowing Frog. For these species, remote acoustic recorders should be deployed at potential breeding locations. Whether nocturnal call surveys and visual spotlight searches are conducted is at the discretion of the surveyor and should be assessed on a case-by-case basis. For example, at some survey sites only a small number (1-3) of potential breeding locations may be located during reconnaissance, which can be adequately surveyed using remote acoustic devices. At other survey sites, multiple potential breeding locations may be present, and surveyors may opt to deploy a mix of remote acoustic recorders (e.g. at rain-filled hollow logs or pools in the interior of sites), coupled with nocturnal call surveys and visual spotlight searches (e.g. at more accessible sites like roadside culverts). Tadpole searches for these two species may be conducted during two visits rather than three – once during reconnaissance and recorder deployment, and once during recorder retrieval.

Remote acoustic recorders for Giant Burrowing Frog and Watson's Tree Frog should collect at least 28 nights of data per device unless advised otherwise.

Table 2. Known peak calling periods and larval periods for target frog species. Source: Anstis (2018), FrogID database (Rowley and Callaghan 2020). *may call anytime during this period after large rainfall events

Common name	Peak calling period	Larval period
Giant Burrowing Frog	Aug – May*	Jan – Nov
Booroolong Tree Frog	Sep – Dec	Sep – Feb
Blue Mountains Tree Frog	Sep – Dec	Sep – Mar
Watson’s Tree Frog	Aug – May*	Sep – Mar
Alpine Tree Frog	Sep – Dec	Nov – Feb
Martin’s Toadlet	Sep – Oct	Oct – Mar

Surveyors should employ the most suitable combination of methods for the target species. For example, call surveys are suitable for Watson’s Tree Frogs under favourable conditions, but tadpole surveys and remote acoustic recorders capturing time periods around significant rain events are more likely to detect Giant Burrowing Frogs.

Recommended time spent on call surveys is given below.

Contractors are required to record a track log of the reconnaissance effort from the start to the end of all activity on the survey site. The track log is to be converted to a GIS shapefile and submitted with the shapefile attributes as outlined in the shapefile template provided.

Contractors are required to submit at least one georeferenced photo of all target fauna observations and to include the general habitat area in which it is found in the sequence of photos.

Surveyor requirements

Field survey teams of at least two people.

Surveyor are required to be experienced and competent in conducting field surveys for amphibians. This includes:

- familiarity with all frog species that may occur in the survey site
- ability to identify frogs to species, both visually and aurally
- specialist knowledge and experience in tadpole identification, or access to an experienced team member who can train less experienced surveyor
- ability to recognise the preferred habitat of target species
- adherence to all hygiene and handling protocols

Survey equipment

- 2x Spotlights or bright headlamps
- Low-light torches/headlamps (for animal ID)
- Playback equipment (e.g. MP3 player with speaker)
- Recordings of frog calls for playback
- Sound recording device (for unknown frog calls)
- Dip-nets for larval sampling (e.g. 30 cm diameter, fine mesh, long handle)
- Digital camera (with carry case, spare batteries, spare storage card) suitable for high quality macro-photography and, where possible, capable of including georeferencing data with each photo
- Water-tight containers or snap-lock bags for viewing/carrying tadpoles
- Frog handling bags
- Measuring callipers
- 10x hand-lens or binocular microscope
- Larvae key/s or reference (e.g. Anstis 2002)
- Gloves – single-use, non-latex, unpowdered
- Hand and equipment disinfectant/wash — e.g. 1% sodium hypochlorite solution
- Boot and vehicle tyre/wheel arch disinfectant/wash – e.g. 1% sodium hypochlorite solution
- Reflective safety vests (for road/track walking transects)
- 2x GPS
- 2x time-keeping devices
- 2x hand-held compasses
- Appropriate spare batteries for all equipment
- Frog Survey Datasheet/forms on electronic-based pro-formas
- Back-up hard copy of datasheet/form on waterproof paper on clipboard

Survey location selection

Potential survey locations within survey sites should be determined in advance via a combination of desktop assessment, field reconnaissance or during other fieldwork (e.g. habitat and sign surveys or when setting/retrieving cameras).

Some survey locations may have more than one acoustic recorder positioned at a location. In these situations a separate survey details record is to be entered for each acoustic recorder located at the same survey location (datasheet field SiteID2).

During daytime survey site visits, survey effort should focus on likely macro-habitat and microhabitat used by the target species. Some frog habitat may intersect with the existing road network and be accessible by vehicle, however much of the frog habitat present in or adjacent to a site may be away from roads, for example along drainage lines, standing water in fallen logs, or ponds. Every effort should be taken to locate all potential frog survey locations throughout the site. These can then be targeted during nocturnal surveys if terrain and vegetation thickness allow reasonably safe access at night or sampled with a remote acoustic recorder if night-time access is unsafe.

Survey locations may be natural or artificial and could comprise water bodies that form potential frog breeding locations. These include flowing, stationary or ephemeral water bodies such as streams, ponds, swamps, road-side ditches, culverts, fire dams, quarries, rain-filled stumps and logs, banks along water courses, wet forest and rainforest gullies, depending on the target species.

The area of consideration for survey should prioritise key habitat locations within or adjacent to survey sites.

For all species except the Giant Burrowing Frog, survey locations must be within a site or within 500 m of a survey site boundary.

When targeting Giant Burrowing Frog, if suitable habitat for survey is not found within or within 500m of a site, then reconnaissance may be conducted up to one kilometre downstream of survey site boundaries where a second or higher order stream is being reconnoitred. If suitable habitat is subsequently found downstream of a survey site, then surveys of potential breeding locations may be conducted along streams. If a first order stream is being surveyed, survey locations should be within the survey site or within 500 m of the survey site boundary.

Conducting the surveys

Targeted frog survey methods comprise multiple survey techniques, applied during repeated site visits. Initial daytime reconnaissance allows potential breeding locations to be located within or immediately adjacent to survey sites, and the most efficient access routes for nocturnal call surveys to be identified.

During daytime reconnaissance, the first tadpole survey should be conducted. If the site is prioritised for targeting the Giant Burrowing Frog or the Watson's Tree Frog, surveyors should bring remote acoustic recorders, programmed and ready for deployment, to install at potential breeding locations when they are identified.

When potential breeding locations of target frog species are identified, their locations should be recorded with a GPS.

Call survey and visual spotlight search

This method combines passive listening for calling males, call playback aiming to elicit a response, followed by actively searching the locations for target frog species.

To maximise likelihood of detection, surveys should be carried out during the breeding season of the target species, when frogs are most active. Target months for calling males and larval stages are listed in Table 2.

Surveys should be carried out after dark, and when conditions are favourable for detecting frogs, such as after rainfall, under conditions of low wind and elevated humidity and temperature.

Rainfall is particularly important when surveying for the Watson's Tree Frog and the Giant Burrowing Frog. For these two species, call surveys and visual spotlight searches should be conducted when:

- Within 10 days of large rainfall events (10+ mm)
- Midnight temperatures > 8°C

- Relative humidity > 60%
- Still or light wind conditions

Detection probability for the Watson's Tree Frog at occupied locations drops from very high to near zero once these conditions are no longer present. Detection probabilities for the Giant Burrowing Frog are unknown, although calling may occur throughout the year following rainfall (R. Bilney pers. comm.).

Observers should approach the survey locations quietly and avoid using lights once within ~ 10-20 m of the site. Once within ~ 5 m of site, conduct timed passive listening and call playback:

- 5 minutes passive listening
- 1 minute call playback
- 2 minutes passive listening
- 1 minute call playback
- 2 minutes passive listening

Document all frog species heard calling before, during and after call playback.

At the completion of this ~10 minute call survey, conduct a visual spotlight search for adult frogs. Record the start and end times of this active search. The duration of a visual spotlight search will be dependent on the size of the locations being searched, from approximately two minutes (roadside puddles, water in fallen logs) to up to 10-30 minutes (along continuous stream reaches and riparian habitat).

Surveyors must adhere to hygiene protocols to prevent the spread of the pathogen causing chytridiomycosis. If it is necessary to capture detected frogs to identify to species (e.g. if located by spotlighting only), a new clean zip-lock bag or similar container must be used for each frog. Surveyors must only handle frogs when wearing new, clean non-latex gloves, and gloves must be changed between handling different individuals. Any equipment that comes into contact with captured frogs must be disinfected, cleaned and thoroughly dried between captured individuals.

Move on to the next pre-identified location within the survey site and repeat the above steps.

Tadpole survey

Tadpoles of many frog species may be more detectable at breeding locations than adults (e.g. Brown et al. 2007). The temporal window within which they persist at a location before metamorphosis can be relatively long. For example, adult Giant Burrowing Frogs are cryptic and unpredictable callers, while their tadpoles can take up to 11 months to develop (Anstis 2018), and during this time occupy aquatic habitat making them more observable than their burrowing adult counterparts, who spend at least 97% of their lives underground (Penman et al. 2008).

Tadpoles in pre-identified potential frog breeding locations should be surveyed by visual searches of aquatic habitat and dip-netting.

Surveyors should carefully examine aquatic habitat for the presence of tadpoles before disturbing the water with a dip-net, as some larvae are strong swimmers and can avoid capture.

Dip-netting should be conducted during the day, to optimise the surveyors' ability to identify tadpoles to species where possible. Dip-netting should focus on suspected microhabitat, such as shallow water with habitat structure and cover for tadpoles (e.g. logs, rocks, leaf litter or vegetation). If surveying pool habitats along a stream, tadpole sampling should be conducted in all pool habitats along approximately 500 m stream lengths, if available.

The number and length of dip-net sweeps is unprescribed and at the discretion of the surveyors, with the aim of sampling as much of the likely tadpole habitat at a location as practicable.

Captured tadpoles should be placed in containers with water from the site for identification. A new, clean container must be used to temporarily hold tadpoles. Containers must be disinfected, cleaned and thoroughly dried between use at different sites. Observers should be familiar with the locally-occurring frog species and the diagnostic features of their tadpoles.

Detailed, high quality photographs, and where possible georeferenced photos, should be taken of identified or suspected target species tadpoles. Photographs should document lateral, dorsal and ventral views of

tadpoles, and mouthparts if possible. Observers should record which photos are of which individual tadpoles at which survey sites. Tadpoles not suspected to be a target species do not need to be photographed.

Remote acoustic recorder survey

For surveys targeting the Giant Burrowing Frog and Watson's Tree Frog, remote acoustic recording devices are to be installed at potential breeding locations. Suitable devices include Song Meters, Audiomoths or digital sound recorders (e.g. Olympus L3, LS-7 or similar).

Standard settings for Remote Acoustic recording are:

- Deploy one recording device per potential breeding location, up to a maximum of five devices per location. If less than five potential breeding locations can be located (e.g. only one or two), only deploy recording devices at these one or two locations.
- Recording devices shall be deployed with a minimum of 50 m distance between each unit, with no maximum distance prescribed, provided they are deployed within a survey site or within a certain distance of survey site boundaries, as described in section 'Site Selection'.
- Environmental variables do not need to be reported for remote acoustic recorder surveys.
- Recording devices should collect acoustic data at survey locations for 28 nights. On occasion surveyors may be directed to record for more or less than 28 nights of recording.
- Devices should be securely fixed (e.g. with cable ties) to a tree, post or stem at potential breeding sites, elevated at least 1 m above ground to capture sound from the surrounding area.
- Recording devices should be set to record for 10 minute periods, three times per night. The 3 x 10 minute recordings should be spaced evenly over the first half of each night, beginning no earlier than one hour before local sunset.
- Contractors are required to analyse recordings and to report observations resulting from audio analysis.
- Where multiple single or chorus calls are recorded of the same (any frog) species at the same recorder location on the same survey:
 - Report the first observation identified in the earliest 10 minute recording
 - And report the last observation of that species in the latest 10 minute recording for that recorder location for that survey effort.
 - Do not submit records for every call recorded where there are multiple calls for the same species.
 - This will result in a maximum of two records for that species at that recorder location
- Audio recordings are to be retained by the surveyor for future reference. Any audio recordings are to be provided to DEECA upon request.
- Audio recordings are to be in *.wav format.

Visual inspection of spectrograms is adequate until recogniser algorithms for these species are developed. See Figure 1 for example spectrograms of frog breeding locations with calling Giant Burrowing Frogs, with the distinctive call structure around 0.3 kHz.

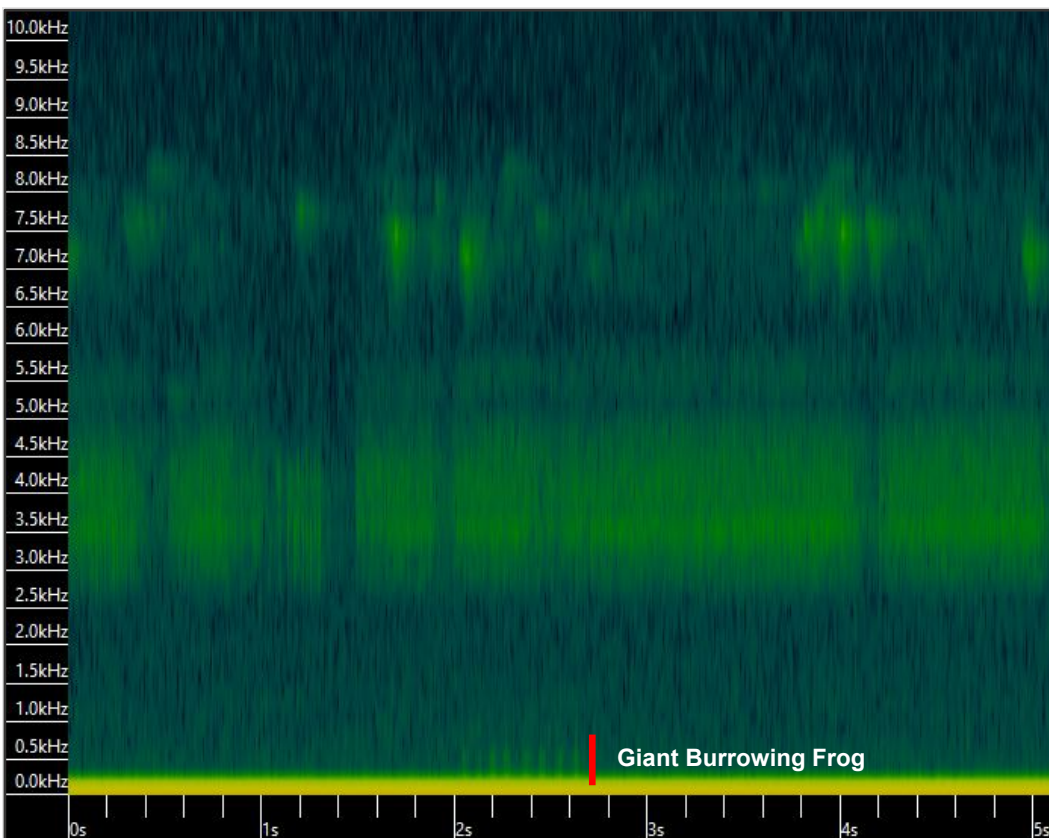
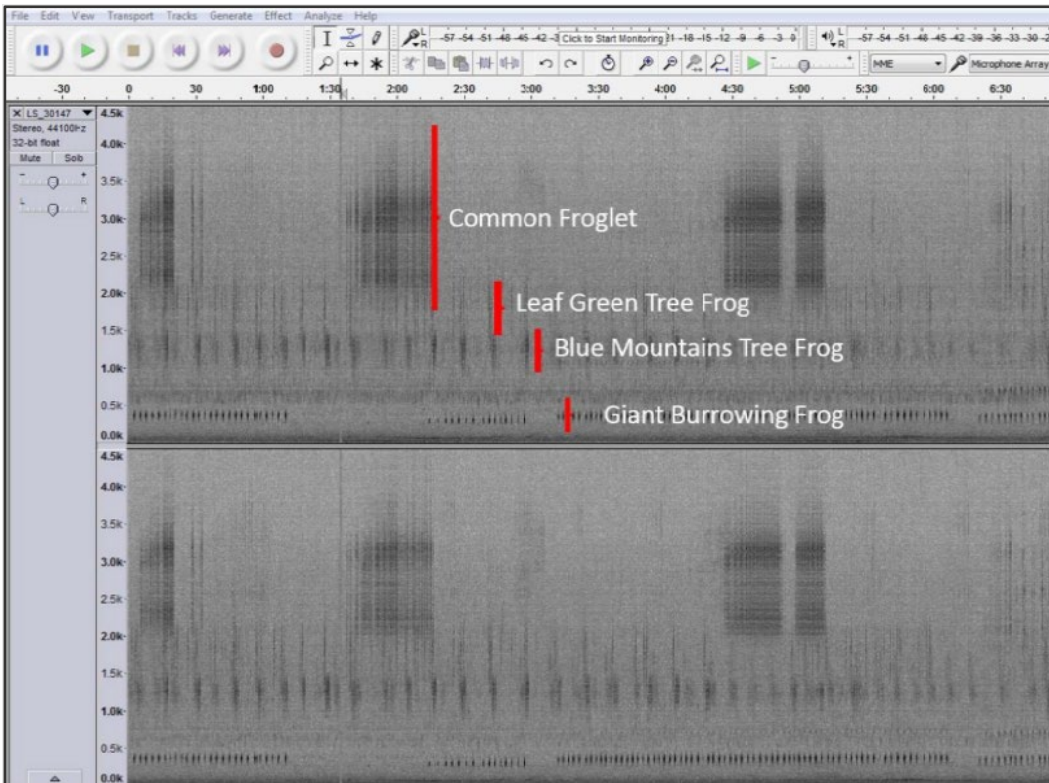


Figure 1. Top: Spectrogram of calls of four frog species, including the Giant Burrowing Frog. Source: Forestry Corporation of NSW. Bottom: Spectrogram showing a brief call by the Giant Burrowing Frog.

Frog handling and hygiene protocols

These survey guidelines do not include detailed frog handling and hygiene protocols or advice on pathogen and disease management. The following precautionary procedures should be employed by all persons undertaking survey work, following Murray et al. (2011) and NSW DECC (2008):

- Spray bottles and tubs of pre-mixed disinfectant should be prepared. To achieve a dilution of 1% sodium hypochlorite, add 250 ml commercial bleach (4% sodium hypochlorite) to 750 ml water.
- thoroughly clean and disinfect footwear at the start of fieldwork and between each sampling location.
- thoroughly clean and disinfect nets, balances, callipers, bags, scalpels, headlamps, torches, wetsuits and waders etc between each sampling location.
- re-usable items should be in contact with wet bleach for at least one minute between locations.
- spray/flush vehicle tyres with a disinfecting solution in high risk areas where necessary.
- only handle frogs when necessary, and minimise of the risk of pathogen transfer between frogs by:
 - using a new pair of disposable non-latex gloves for each sample, and
 - Bags and gloves must not be re-used. Dispose of these single-use items in a resealable plastic container.

Data reporting requirements

Data requirements are outlined in the 'DataEntry_FROG' spreadsheet template. .

Data requirements are outlined throughout this guideline and in the datasheet/forms. Complete all required fields on the datasheet/forms for each target observation.

- record any further survey location identifying information that may assist in relocating the survey location in the future
- record a GPS track log for all reconnaissance and survey work on each survey site and submit as a Track Log shapefile.
- record and submit (georeferenced) photos
- report each unique survey activity (i.e. each night of Spotlight and Call Survey search, or each 28-night remote acoustic recorder survey) on separate rows in the Survey Details worksheet of the 'DataEntry_FROG' spreadsheet/form template.
- Ensure the survey SiteID is entered correctly according to the survey package and in the format xxx-xxx-xxxx
- Assign and record a unique SiteID2 to each survey location surveyed
- Record your observations in the ObsAttributes worksheet, with each observation being entered on a separate row.
- Ensure all mandatory fields are completed and in the correct format, failure to do so will result in submitted data being returned for review.
- A comprehensive list explaining the data entry fields and whether they are mandatory or optional can be found in the DataFieldsExplained page.
- Ensure the CommonName field in ObsAttributes is entered correctly according to the TaxaIDLookup.
- Spelling of species common name in the CommonNameField must match the spelling in the Victorian Biodiversity Atlas reference list otherwise the TaxonID column will not be automatically populated.
- Audio File names are required to be standardised to be in Australian Eastern Standard Time YYYYMMDD_HHMMSS.wav. e.g. 20210717_173022

Please Note: Surveyors are expected to submit highest quality data. Please ensure you double check your data entry before submitting data. Submitting incorrect or incomplete information will result in a delay to reporting and may impact on the program outcomes.

Useful References

Anstis, M. (2002). Tadpoles of South-eastern Australia. A Guide with Keys. New Holland, Sydney.

Anstis, M. (2018). Tadpoles and Frogs of Australia. Second edition. New Holland, Sydney.

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Department of Environment and Climate Change (NSW) (2008). Hygiene protocol for the control of disease in frogs. Information Circular Number 6. DECC (NSW), Sydney South.

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Rowley, J.J.L. and Callaghan, C.T. (2020). The FrogID dataset: expert-validated occurrence records of Australia's frogs collected by citizen scientists. *ZooKeys* 912: 139–151.