Visual encounter surveying (amphibians and reptiles)

DON'T FORGET

EQUIPMENT: Watch or stop-watch; digitometer (x 2); wide-beam spotlight (at night); linen bags (for live reptiles); plastic bags (for live frogs); aluminium screw-lid container with preservative solution (8–10% formalin for sampling for insecticide residue analysis); thermometer or whirling hygrometer; notebook; pencil; field guide.

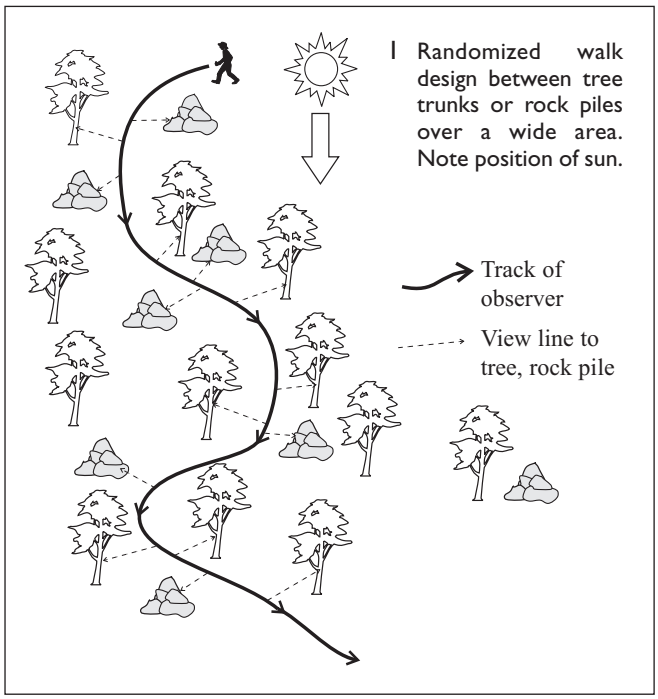
Select matched sets of replicate sites in treated and untreated areas.
Starting points for the walks along a transect or within a defined area should be randomized.
Lizard tree counts should be conducted during the period of basking (usually in the morning with sunshine between approximately 08.00 and 12.00 h).

Method

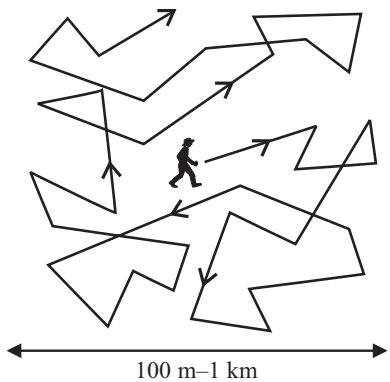
- Select transect design

  – randomized walk (point-to-point transect), e.g. from tree – first randomly selected – to tree in woodland over a wide area (1), or series of randomized compass directions (2) and walk distances (within a constrained area)

  – line transect: walk single or multiple, but parallel transects, at least 250 m apart (3).
- Whether at a specific time during daylight hours or within the first 2–4 h of darkness at night, record date, exact time of start of survey, air temperature and cloud cover (in octas – an octa is the amount of cloud cover currently visible imagining the sky is divided into eight equal parts, each part is one octa).
- Zero a digitometer for recording number of individuals of a species, or trees, rocks, etc., depending on the habitat niche selected and nature of the survey.
- Ensure that sun is behind (or at less than a right angle with line of vision) so that during period of basking (usually 2–5 h after sunrise), whether in full sunshine or part shaded in, say, open woodland, a reptile is in full, or virtually uninterrupted, vision from 5–12 m away.
- Walk at a steady speed.
- A pedometer can be used to record walked distance if the quadrat or transect has not previously been plotted.



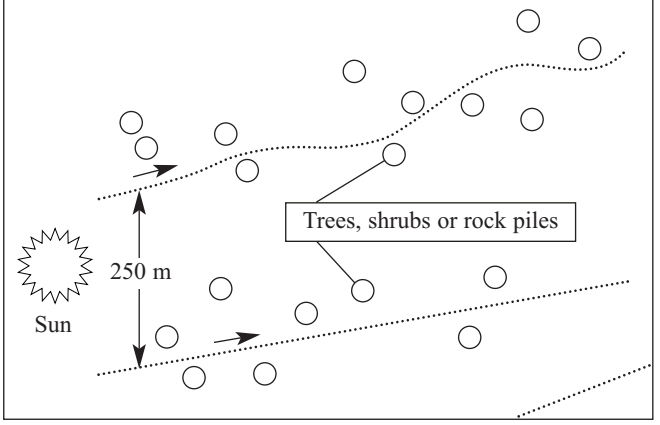
1 Randomized walk design between tree trunks or rock piles over a wide area. Note position of sun.



2 Randomized walk design within constrained area

- For initial (exploratory) surveys, record the exact time that specimens of each species are observed, and also the air temperature and cloud cover at set intervals, e.g. 15 min.
- Record the number of animals seen on or by rocks, trees and bushes, or on bare ground between them, depending on species and habitat type; with more than one observer, each should be 10–20 m apart, depending on density, type and height of vegetation.
- Note any other important information that may have affected the numbers sighted, e.g sudden rain, different vegetation type or change in habitat, survey joined by a further observer.

3 Line transects for visual encounter surveys



OTHER CONSIDERATIONS

Survey for reptiles during uniform behaviour, such as morning basking or first 2–3 hours of darkness after sunset.

With the sun behind you, your shadow may disturb a basking lizard whose movement usefully gives away its presence; at night, light may disturb a snake, lizard or amphibian.

Time spent surveying a site depends on the density of animals per unit area, or density of refuges, e.g. trees per unit area.

Aim to count enough refuges to be statistically meaningful (e.g. a minimum of 25 occupied trees).

Amphibian and reptile groups and species active during the day and at night differ.

For crocodiles and turtles, or frogs (all have eyes that reflect light at night) at lake or stream edges or by river banks, observations can be made from a boat, and distance may have to be measured from a scaled map later.

To record roadkills (amphibians, toads in particular during migrations, and reptiles crossing roads, especially at night, killed by passing vehicles), count the number of dead or maimed amphibians and reptiles in a length of road after a set time period, e.g. 24 h, noting previous evening's sunset air temperature, and weather over the period since the previous count. This can be useful in a long-term study over several years, or if a single road travels through an area of uniform habitat only part of which has been treated with pesticide. Roadkill numbers per kilometre can be compared in treated or untreated sections of the road over 5 or 10 km lengths.

For surveys that do not account for area density, record the number of specimens seen in relation to the number of refuge/basking sites, e.g. trees. For example, in woodland, trees are counted, and the number on which there are basking arboreal lizards (noting the species) is recorded. This gives the proportion of trunks occupied by lizards. The number of refuge/basking sites, in this case trees, that needs to be counted depends on the numbers of animals recorded during the surveys and is constrained by density and size of the woodland stand. For example, it might be necessary to count as many as 300 trees if the proportion occupied is low. On the other hand, the total number of trees available may be limited by low tree density and overall stand size. With a higher proportion of trees occupied, as few as 50 might be counted, especially if the tree density is low. At completion of the survey, recording the exact end time gives the duration, and thus also sighting frequency (number of specimens per unit of time), particularly counting individuals when more than one on a tree.

Patch sampling (amphibians and fossorial reptiles)

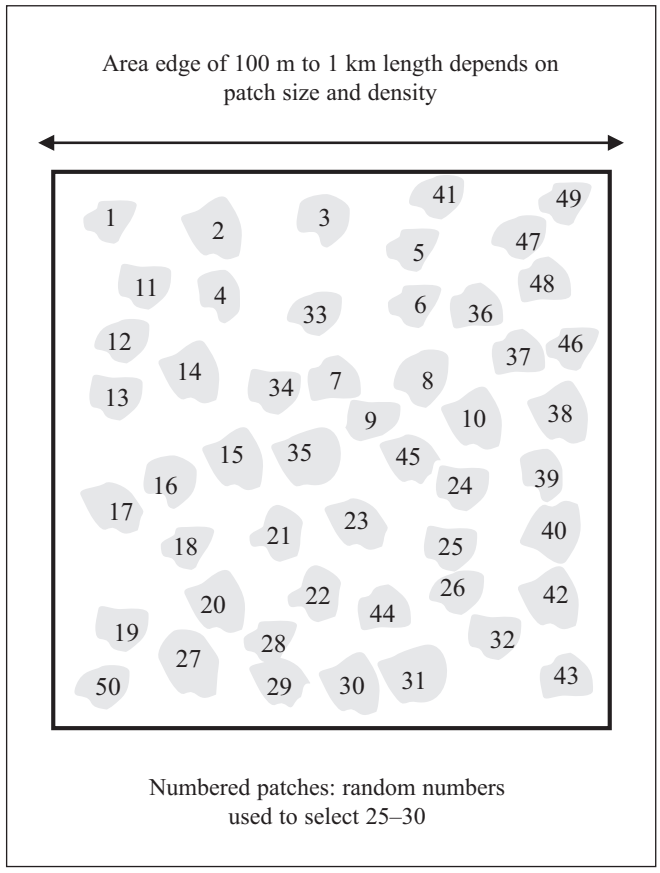
DON'T FORGET

EQUIPMENT: Random numbers table; watch; compass; digitometer; linen bags (for live reptiles); plastic bags (for live frogs); aluminium screw-lid container with preservative solution (8–10% formalin for sampling for insecticide residue analysis); thermometer or whirling hygrometer; notebook; pencil; field guide.

Certain amphibian species (and fossorial reptiles) are associated with particular microhabitats provided by individual or a small assemblage of logs, rocks or single bushes; these are definable as individual patches, and in effect represent separate quadrats. Randomized patch sampling is especially useful for inventorying and monitoring species restricted to a particular microhabitat, and comparing numbers and species in areas treated and untreated with pesticides.

Method

- Certain amphibian species (and fossorial reptiles) are associated with particular microhabitats provided by individual or a small assemblage of logs, rocks or single bushes; these are definable as individual patches, and in effect represent separate quadrats. Randomized patch sampling is especially useful for inventorying and monitoring species restricted to a particular microhabitat, and comparing numbers and species in areas treated and untreated with pesticides.
- Define areas for sampling in contaminated and uncontaminated zones, and record number of patches in them – this gives patch density.
- Decide at the outset the number of patches to be sampled in an area. As in the case of quadrats, 25–30 will provide adequate data for statistical comparison of matching areas with patched microhabitats.
- Number patches and use random numbers to select patches for sampling.



- Select a minimum of 30 patches per area (or per sampling period for site monitoring).
- Remove or break up the material making up the patch, e.g. turn over rocks, separate out logs or search bushes; record the numbers of each species sampled, ensuring that all of the animals associated with each patch are included. Record the total time to complete the task.
- Record in a notebook the location of the patch within the survey area, the date, time of start and end of sampling, weather conditions, air temperature and relative humidity.

OTHER CONSIDERATIONS

Total dismantling or destruction of a patch is involved with this method, and so on grounds of habitat conservation it should only be conducted when the patch is one of many over a large area of habitat.
Animals that escape from a patch before being counted bias the relative abundances of species, and so should be noted before detailed counts start and added to the total.
Although simpler statistically, the same number of patches do not have to be sampled in each area, nor do areas need to be the same size, although ideally they should be of similar overall patch density.
A single observer should, if possible, sample patches in matching areas to minimize inter-observer sampling error.

Breeding site surveying (amphibians)

DON'T FORGET

EQUIPMENT: Watch; thermometer or whirling hygrometer; waders or hip boots; wet suits; long-handled dipnets; headlamps and spare batteries (night surveys); plastic bags (for live frogs); linen bags (for live reptiles); aluminium screw-lid container with preservative solution (8–10% formalin for sampling for insecticide residue analysis); coloured flagging for marking site; waterproof data sheets; notebook; pencil; field guide.

Method

Note that this technique is effectively a visual encounter survey: line transect, but is specifically applied to amphibian breeding sites, which are distinctive rainy season phenomena.

- Select the survey area at random within matched sites in pesticide-treated and untreated areas in relation to amphibian breeding sites, and record habitat characteristics (pond, stream, lake, etc.).
- Select sites in random order, and make 6–9 surveys during the breeding season, each consisting of 2–5 1 km transects (species at densities of 1–5 ha^{-1}).
- During daylight surveys, note the position of the sun in relation to the location of animals in water and basking at the edge of the bank.
- For visual encounters:

  – walk along the pond edge at a steady preferred speed (a pedometer can be used to record the walked distances in the case of an unplotted transect), and record the species, number of individuals, location and time of each frog seen, or heard (after darkness)

  – from a boat, the distance travelled along the lake edge or river bank may have to be measured between known points from a scaled map later (see lake or stream edge or river bank transects on Visual Encounter Surveying method sheet).
- For calling amphibians, select a series of consecutive transects of 1 km length along a lake or stream edge. Transects should be spaced far enough apart for sounds from one not to interfere with another. Separation distance will have to be greater for very loud species than for quieter ones. As a separate exercise, the minimum length of distance should be measured (between approximately 100 and 500 m) at which each frog species can no longer be heard clearly – a mean and standard deviation for six distances per species. At night, note the number of calls for the first 2–3 h of darkness after sunset. As in visual encounters (see method sheet), record the species and number of individuals, habitat or microhabitat, location and sighting time of each frog seen, or calls heard as part of a chorus.
- For species that cannot be identified, collect voucher specimens by detecting the position visually during the day or locating calling individuals at night, and catching them manually or with a hand net on the shore or in water at the edge of the water body. Surveying should continue until no further species are recorded, and duration of time noted.
- At the end of surveys, record the exact time, air temperature, cloud cover (in octas, an octa is the amount of cloud cover currently visible imagining the sky is divided into eight equal parts, each part is one octa) during the day, and other weather conditions that may affect visual encounters and nocturnal calling, e.g. afternoon rainstorm.

OTHER CONSIDERATIONS

For amphibians in linear habitats, e.g. pond and lake shorelines, and along streams counted from calling individuals, detection distance does not need to be calculated – calling-male density (male:female ratio previously determined) is calculated as numbers per kilometre of linear habitat.
Time spent surveying a site depends on population levels and density of refuges.
Amphibian (and reptile) groups' activity differ during the day and at night, and during different seasons of the year due to rainfall and temperature.
To estimate population size from female anurans, record egg masses (annual recording during breeding season in a specific water body), count the number of spawn clumps (frogs) or egg strings (toads) along a lake or pond edge, and give size or length category (eggs in clumps or strings are usually too numerous to count individually, and a proportion is not fertile), after previously determining mean and standard deviation of number of eggs from a statistically meaningful number, e.g. six, of clumps or strings.

Complete species inventorying (amphibians and reptiles)

DON'T FORGET

EQUIPMENT: Linen bags (for live reptiles); plastic bags (for live amphibians); screw-lid containers with preservative solution (8–10% formalin for sampling for insecticide residue analysis); wide-beam spotlight (at night); machete; rake; snake stick; pedometer; compass; altimeter; notebook; pencil; field guide.

Inventorying is more easily done during daylight hours, but amphibians and certain lizard and snake species are visually more readily encountered when active at night. Therefore, day and night surveys are required for complete inventorying.

VISUAL ENCOUNTER – for most reptiles, and some species of amphibian

Method

- Record habitat characteristics (woodland, grassland, swamp, riverine habitat, primary rainforest, etc.).
- Whether during daylight hours or at night, record the date, exact time of start of the survey, air temperature and cloud cover (in octas, an octa is the amount of cloud cover currently visible imagining the sky is divided into eight equal parts, each part is one octa).
- During daylight surveys, ensure that the sun is behind or at less than a right angle with line of vision so that during period of basking (usually 2–5 h after sunrise) animals sighted are in full vision from 5–12 m away.
- Walk across the habitat at a steady speed searching constantly and recording the number of animals seen on or by rocks, trees and bushes, and on bare ground between them; with more than one observer, each should be at least 10–20 m apart, depending on density, type and height of vegetation. Time spent walking and/or area covered depends on the number of animals recorded in relation to vegetation height, cover, quality and quantity.
- Record the exact time that individuals of each species are seen, and their behaviour, e.g. basking, hunting, mating, etc.
- Distances walked can be measured with a pedometer; alternatively paces can simply be counted to record distances walked, each pace being taken to measure approximately 1 m, or from previous calibration by the individual observer recording the mean number of paces taken over a measured distance of 100 or 1000 m.

MICROHABITAT SEARCHES – for many amphibian species, and additional species of reptile, especially fossorial forms (see also quadrat and transect block microhabitat sampling method sheet)

Method

- Searches in woodland with varied habitat components may involve turning stones (rocky areas), raking through leaf litter (forests with leaf litter carpet layer), probing holes and crevices with sticks (rock piles and hollow trees), splitting or dismantling old and rotten logs (fallen trunks in forests), removing epiphytes (overgrown forest trees), etc. Time spent searching and the area covered depends on the number of animals recorded, quality and quantity of vegetation cover and number of observers; searching need not continue when no further species are recorded.
- Collect voucher specimens of any species that cannot be identified.
- Note any other important information that may have affected numbers sighted, e.g sudden rain, change of habitat or different vegetation type, unseasonably dry (or wet) or cold (or warm) weather.

OTHER CONSIDERATIONS

With the sun behind you with visual encounter surveying, your shadow may disturb a basking lizard that usefully gives away its presence.
Time spent surveying a site depends on the density of refuges, e.g. trees, or density of animals, a longer time or smaller area possibly needing to be walked in denser stands of trees, or for microhabitat block searching in thick ground vegetation.
The activity of different amphibian and reptile groups varies; some are only active during the day or at night depending on whether they are diurnal or nocturnal species; most amphibians are only active during seasonal rains; certain reptiles aestivate during warm dry periods of the year, others hibernate during winter months. Surveying and microhabitat searching for species to make up complete inventories should, therefore, be spread through the year, and conducted consecutively during different months.

Quadrat and transect block microhabitat sampling (amphibians and certain reptiles)

DON'T FORGET

EQUIPMENT: Random numbers table; quadrats: map of sampling area; metre measuring tape; 8 m square twine and four pegs; transect segments; 100-m measuring tape; string; stakes; flags to mark transects; watch; compass; digitometer; linen bags (for live reptiles); plastic bags (for live frogs); aluminium screw-lid container with preservative solution (8–10% formalin for sampling for insecticide residue analysis); thermometer or whirling hygrometer; notebook; pencil; field guide.

QUADRAT BLOCK

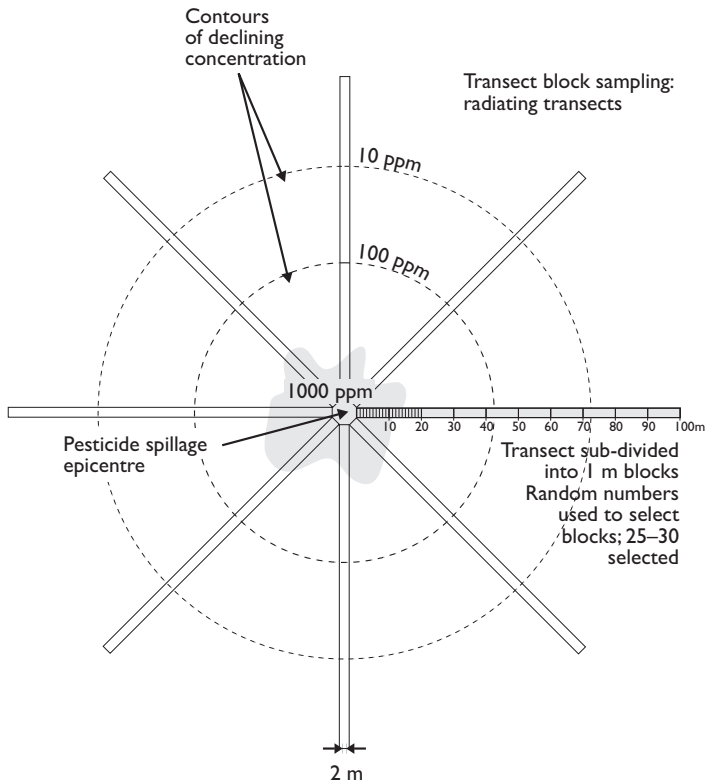
Method

- Represent area of interest as a rectangular grid of numbered quadrats, e.g. 100 x 100 m (1 ha) in 1 m^2 blocks, or 1000 x 1000 m (1 km^2) in 10 m^2 blocks.
- Locate sampling quadrats within the grid by use of a random numbers table, with minimum departure from the ideal due to local topography.
- For a single dense population of a relatively small-sized species of around 3 individuals m^{-2}, select quadrats of 1 x 1 m (point sample); for a larger-sized, more widely dispersed amphibian (and fossorial reptile) multispecies populations, select 8 x 8 m quadrats (broad sample).
- Decide at the outset the number of quadrats to be sampled, 25–30 will provide adequate basic data for statistical comparison between areas.
- Choose the location of a quadrat from numbered squares on the horizontal and vertical axes using respectively the first and second digit of a three-digit random number, and drop a 1 x 1 m quadrat frame, or lay out an 8 x 8 m quadrat using stakes and twine.

TRANSECT BLOCK

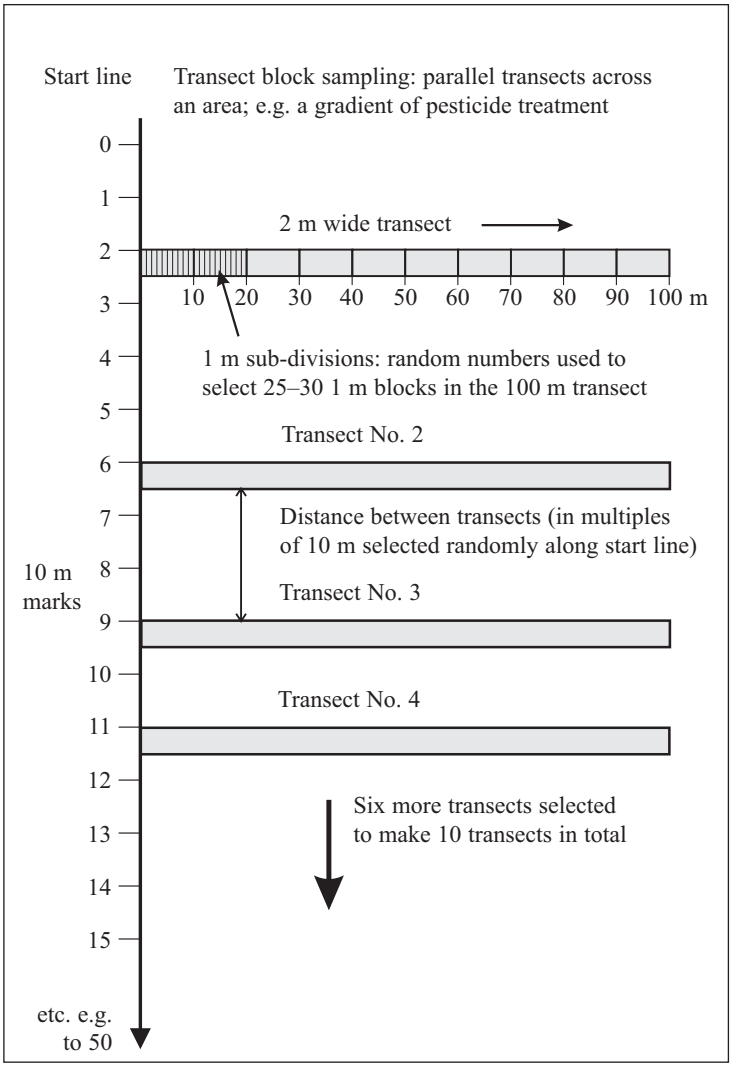
Method

- Place a starting line of string of suitable length, e.g. 500 m.
- Mark out the line of string at uniform intervals, e.g. 10 m, using readily seen flags of, for example, high-coloured plastic strips.
- Use random numbers to separate apart by 1–10 m, 25 to 30 parallel (or 8 radiating) transects of 100 m long by 2 m wide extending perpendicularly from the starting line across a gradient area of interest.
- Divide each transect into 100 sub-sections of 1 x 2 m.
- Decide at the outset the number of transect blocks to be sampled; 10 sub-sections will provide in all 250–300 data blocks.
- On the basis of 250–300 data blocks, use random numbers of 1–100 to choose the location of 10 blocks from those numbered along each 100-m transect, with minimum departure from the ideal due to local topography.
- Use twine to mark out block transversely.



BLOCK LITTER INSPECTION

- Remove litter from 30 cm outside the quadrat or transect block edge (to see escaping animals), and progressing from the edge to the centre inside the block, remove litter and ground cover in strips parallel to the boundary twine until the entire area is covered, recording the time taken to do so.
- Record the numbers of each species seen.
- Record in a notebook the location of the quadrat within a grid or segment along the transect, and also the date, time of start and end of sampling, weather conditions, air temperature and relative humidity, vegetation type, aspect (slope), and the canopy, herb, litter, rock and log cover.



OTHER CONSIDERATIONS

Quadrats of 8 x 8 m are selected for broad sampling, rather than 10 x 10 m, since 25 x 25 feet quadrats have been used in most comparable studies previously.
The transect starting line need not be straight; it can encircle an area of pesticide spillage or follow an altitudinal contour on the side of a valley.
An alternative to long transects divided into 100 units are shorter transects; each sub-section is sampled along its entire length; 25–30 short transects will provide adequate data for statistical comparison between areas.
Another alternative is to choose fixed distances (e.g. 10 m) either along the start line or the transect lines, but not both.
To avoid obstacles such as fallen trees or rocks coming within a block, record zero animals in the case of a quadrat or, for a transect block, it is useful to have a pre-plan to move the block either 10 or 15 m on along the transect.

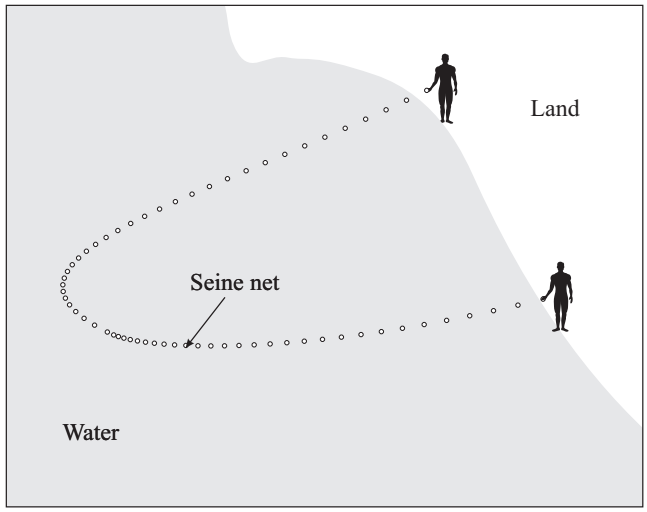
Quantitative sampling of amphibian larvae (and aquatic reptiles) – pond seining

DON'T FORGET

EQUIPMENT: Cast net usually 3–4 m long and 1–1.5 m wide, with mesh size of 1.5–7 mm (a much larger seine net 13–14 m long by 2 m wide, and mesh size of 7–13 mm can be used); lead weights along lower edge; floats on the upper edge; wooden pole 2.5 cm thick attached along length of upper edge; boots; watch; water temperature thermometer; headlamp (at night); linen bags (for live reptiles); plastic bags (for live amphibians); aluminium screw-lid container with preservative solution (8–10% formalin for sampling for insecticide residue analysis); notebook; pencil; field guide; method sheet for seining from chapter 10 (Fish).

Method

- Record the exact time of start of observations, air and water temperature, moon phase (clear sky) and cloud cover (in octas – an octa is the amount of cloud cover currently visible imagining the sky is divided into eight equal parts, each part is one octa).
- The seine net should be dragged slowly through the water from one pond edge to the other, allowing a few minutes between seines. (For further details on seining method, see chapter 10.)
- Record the number of individuals of a species in square metres of bottom sampled, i.e. distance travelled multiplied by seine net width.



- Capture of specimens should continue until no further species are added (this may be one sweep in a small pond or many at the edges of a lake).
- At the end of the observation period, record the exact time, air temperature, and also illumination – daylight cloud cover (sunny or overcast), darkness (dry, raining or cloudy).
- Note any other important information that may have affected numbers recorded, e.g sudden rain or decrease in temperature.

OTHER CONSIDERATIONS

Aquatic amphibians and reptiles sampled will mainly include frogs and occasionally freshwater turtles. Return the species once identified. Net seines will sometimes include fish, which should be returned to the water.
Numbers are strongly influenced by weather conditions, especially rain.
Net seining may not be required for simple monitoring of numbers, especially at night, when many species can be seen at the surface with eyes reflecting light from a wide-beam torch.

Quantitative sampling of amphibian larvae (and aquatic reptiles) – dipnetting

DON'T FORGET

EQUIPMENT: Small hand net about 10 cm wide with bendable frame (or wire mesh sieves or kitchen strainers with a handle); boots; watch; water temperature thermometer; headlamp (at night); linen bags (for live reptiles); plastic bags (for live amphibians); aluminium screw-lid container with preservative solution (8–10% formalin for sampling for insecticide residue analysis); notebook; pencil; field guide.

Method

- Gripping a small hand net by the handle, plunge it into the water, and sweep through the water from one side of the body to the other. This movement represents one standard sweep. The number of individuals of a species is recorded with each sweep.
- Record the number of individuals of a species caught in relation to the number of standardized sweeps. Alternatively, over a period of time, the number of sweeps made in an hour can be determined. This can range from 20 to 50 sweeps, and the mean number per hour requires standardization.
- Record the exact time of the start of net-sweeping, air and water temperatures, moon phase (clear sky) and cloud cover (in octas – an octa is the amount of cloud cover currently visible imagining the sky is divided into eight equal parts, each part is one octa).
- For amphibian larvae (tadpoles), estimate the water volume sampled per sweep (area of net opening multiplied by sweep length) to determine volume density.
- Capture of specimens should continue, changing the path of sweep swaths each time or position on water edge after, say, every 5–10 sweeps, until no further species are added.
- Sample all microhabitats in a pond with the net.
- At the end of the observation period, record the exact time, air temperature, and also illumination – daylight cloud cover (sunny or overcast), darkness (dry, raining or cloudy).
- Note any other important information that may have affected the numbers recorded, e.g sudden rain or decrease in temperature.

OTHER CONSIDERATIONS

Aquatic species sampled will mainly include amphibian larvae.
Any fish caught should be returned to the water.
Numbers captured depend on volume density.
Numbers are strongly influenced by weather conditions, especially rain, also whether daylight or in darkness.

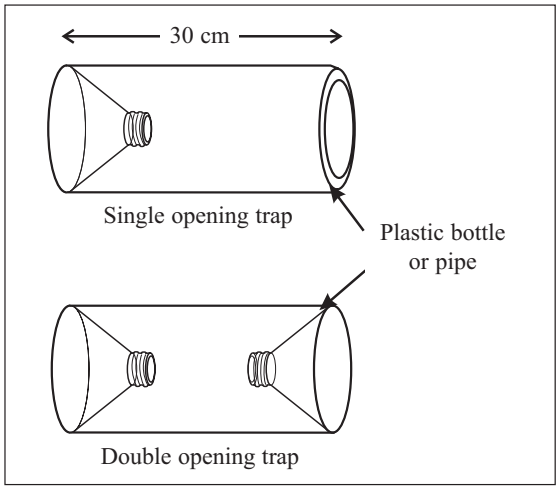
Quantitative sampling of amphibian larvae (and aquatic reptiles) – trapping

DON'T FORGET

EQUIPMENT: Cylinder traps (e.g. 0.5 m long by 0.3 m diameter, or 25 x 10 cm), funnel extends inwards at either or both ends; boots; watch; water temperature thermometer; headlamp (at night); linen bags (for live reptiles); plastic bags (for live amphibians); aluminium screw-lid container with preservative solution (8–10% formalin for sampling for insecticide residue analysis); notebook; pencil; field guide.

Method

- Each trap is constructed from a used 1-litre plastic squash bottle. For a single funnel-ended cylinder trap, the bottle is cut into two halves by a circular incision at the point where it begins to taper towards the neck. The screw-top is cut off and the top (funnel) half inverted into the bottom half to form a trap. Paper-clips may be used to hold the funnel in place. A series of holes is punched into the tap to allow expulsion of air when sinking the tap into water. A length of string with a knot at the end is threaded through a hole from inside approximately halfway down the side of the lower half of the trap. When placed in a pond, the trap is tied to a stick to prevent drifting and to mark its position.



- Place the trap in a pond and record the exact time of the start of observations, air and water temperatures, moon phase (clear sky) and cloud cover (in octas – an octa is the amount of cloud cover currently visible imagining the sky is divided into eight equal parts, each part is one octa).
- Record the number of individuals and species caught in relation to time over, say, 6, 12 or 24 h periods depending on amphibian density and trap effectiveness, established beforehand.
- Trapping should continue until no further species are added.
- At the end of the observation period, record the exact time, air temperature, and also illumination – daylight cloud cover (sunny or overcast), darkness (dry, raining or cloudy).
- Note any other important information that may have affected numbers recorded, e.g sudden rain or decrease in temperature.

OTHER CONSIDERATIONS

Amphibians sampled will mostly be tadpoles of frogs and toads.
Any fish caught should be returned to the water.
Numbers captured are density-dependent.
Numbers are strongly influenced by weather conditions, especially rain.
Trapping may be calibrated by recording the numbers caught in an enclosure into which a known number of larvae have been placed.