Freshwater fish: spotlighting—spotfishing

Version 1.0

This specification was prepared by Richard Allibone in 2013.

Contents

Department of Conservation
Te Papa Atawhai

Synopsis

A spotlight spotfishing survey is a rapid survey method for surveying areas of a stream of particular interest. It is a low effort fishing method designed to target small areas of interest for nocturnally active fish such as kōkopu species and can complement spot electrofishing of riffle areas. The surveys are conducted at night along the sections of stream of interest by two or more fish surveyors. As opposed to electrofishing, which is highly efficient at capturing fish from riffle habitats, the spotlighting method samples nocturnally active fish and is most effective in pool and run habitats where the calm water surface allows good visibility into the water. The spotlighting method is more difficult to apply in riffle habitats and even very experienced operators will find it difficult to effectively spot fish in riffles where water is faster and turbulent.

The method will not necessarily provide good data for comparison with other sites if the area surveyed is small. The reach length fished should be guided by the objective, but is generally in the order of 100–200 m to ensure a sequence of pool run and riffle habitat is surveyed and sufficient fishing effort is used to detect potentially rare species of interest. However, the method does not standardise for area or reach length; rather, this will be determined on a project-by-project or site-by-site basis. No nationally recognised standard method has been developed for spotlight spotfishing. Rather, the development of the method has been via the experience of individual operators and as an extension of electrofishing spotfishing methods.

The key aspect of spotfishing by spotlight is to sample enough stream habitat to provide confidence that the target fish species, such as kōkopu species, have been detected if present. No specific reach length can be given for spotfishing as the distance required to detect a species or to survey the area of interest will vary according the objective of the investigation.

Assumptions

- All fish of a species are equally likely to be seen and captured.
- All survey staff are equally capable.

Advantages

- A highly effective method for detecting nocturnally active fish that can otherwise be difficult to detect using daytime fishing methods.
- The size of fish observed and/or collected is not limited, unlike trapping methods that are limited to fish small enough to enter traps (and avoids predation in the traps).
- Equipment costs are low and the equipment may be used on other projects.
- The survey method, with best practice for handling fish, has little impact upon the fish aside from a short period of disturbance when the spotlight surveyors pass by.
- Health and safety aspects are more limited than for electrofishing.

- Training requirements are limited before the gear can be successfully used.
- Streams can be surveyed rapidly.
- Large areas of wadeable streams can be surveyed relatively rapidly when compared to electrofishing methods.

Disadvantages

- The site will require a daytime visit to first check suitability and locate a good access route.
- Best practice requires that surveys are undertaken at normal or low flows when the water is clear and on calm nights with no rain.
- Not suitable for all fish species.
- Survey work requires work at night.
- Quality of the fish survey data depends on surveyors' catching skills and water conditions.
- May be difficult to standardise results across multiple surveyors.
- Fish captures are limited to wadeable depths and large rivers cannot be surveyed.
- Riffle and cascade habitats are difficult to survey.
- May not be used in dark, tannin-stained waters.

Suitability for inventory

This method is suitable for inventory and will provide good presence/absence data for species that are common and are nocturnally active such as kōkopu species. When species are rare this method may fail to detect them if the reach surveyed is short or contains a high proportion of unsuitable habitat.

Suitability for monitoring

This method is not suitable for monitoring as the method does not provide any standardisation of effort.

Skills

- Good field skills and fitness suitable for working in forest areas at night
- Good navigation skills if field sites are away from access tracks
- Wading and walking in stream skills
- Fish capture, handling and competent fish identification
- Sound judgement with regard to stream, river and weather conditions to ensure safe operations are carried out

Fish identification skills must be appropriate to identify the adults of common fish species seen (the adult galaxiids—īnanga, banded kōkopu, shortjaw kōkopu, giant kōkopu and kōaro; redfin bully; salmonids), and preferably without the fish being caught. Juvenile fish of many species are harder to identify and will either need to be caught or counted as juvenile fish of a genera (e.g. *Galaxias, Anguilla, Gobiomorphus*).

Resources

Initial set-up for spotlighting:

- Spotlight—hunter's spotlight with standard 50 watt bulb or equivalent with LEDs
- Gelcel batteries, either 6–7 amphour or 18 amphour;12 volt
- Battery charger (trickle chargers appropriate for gelcel batteries)
- Map and/or GPS to record fishing site location
- Hand nets
- Fish measuring board
- Buckets
- Backpack for carrying batteries while spotting
- Fish identification guide book
- Pencil and waterproof paper or notebook
- Waders are optional but recommended where water temperatures are cold or where water quality is poor. If waders are used then staff should be trained in wader safety; see 'Wading safely' (olddm-566603) for guidance.[1]
- Other equipment appropriate for the field conditions

Minimum attributes

Consistent measurement and recording of these attributes is critical for the implementation of the method. Other attributes may be optional depending on your objective. For more information refer to 'Full details of technique and best practice'.

DOC staff must complete a 'Standard inventory and monitoring project plan' (docdm-146272).

Minimum attributes to record:

- Site location
- Area fished
- Average wetted width
- Estimate of area fished

[1] http://www.doc.govt.nz/Documents/parks-and-recreation/places-to-visit/tongariro-taupo/wade-safely-brochure.pdf

- Fishing date and time of day
- Number of people conducting the survey
- Fish caught
- Fish observed but not caught
- Weather and water conditions during survey

National protocols for assessing habitat in wadeable streams have been developed by Harding et al. (2009) and most regional councils will have appropriate standardised methods that could be adopted. Note that many of these methods won't be applicable to large non-wadeable streams and rivers.

Data storage

Data collected during the field phase of the spotlighting work should be transcribed to spreadsheets as soon as possible after collection to ensure data are not lost and errors and omissions identified and corrected where possible. Data should be retained on hardcopy field sheets and in electronic format. This allows field data to be checked if electronic data are lost or questioned. The spreadsheet should record all site location details, fishing date, time, number of surveyors, area surveyed and habitat data.

A consistent data table in a spreadsheet programme is recommended so that data from multiple sites can be compared without the need for reformatting. For each reach fished, it is recommended that the following data be stored in spreadsheets:

- Species of fish observed
- Number of each fish species observed or an abundance scoring (rare, occasional, common abundant)
- Number of individuals of each fish species collected (as opposed to observed)
- Individual fish lengths and weights (if data collected)

Summaries of all fish survey data should also be entered into the New Zealand Freshwater Fish Database (NZFFD) administered by the National Institute of Water and Atmospheric Research (NIWA). The NZFFD is an important national repository for presence/absence data and represents a valuable resource for a range of different applications including research, impact assessments and threatened species monitoring. As a minimum, site location, fishing method and species collected should be recorded in the database forms. Data can be entered electronically using the Freshwater Fish Database Assistant software, which is freely available from the NIWA website.[2]

[2] http://www.niwa.co.nz/our-services/databases/freshwater-fish-database

Analysis, interpretation and reporting

Seek statistical advice from a biometrician or suitably experienced person prior to undertaking any analysis.

Analysis of the raw data can include the following:

- Species diversity
- Estimated fish density within survey reach
- Estimated individual fish species densities within the survey reach
- Length frequencies for each fish species where individuals were collected and measured
- Biomass per m^2 for each fish species where fish weights were collected
- Condition factor for each individual fish where length and weight data was obtained

The data collected at any one site may be compared with the data from other sites to compare fish species diversity and the abundance of individual fish species using the categorical abundance classes.

The results can be presented in a number of ways depending on whether the data are being analysed for a single site or multiple sites:

- Table and/or graphs with total species diversity at sites
- Length frequency graphs for each fish collected and measured

Case study A

Case study A: the distribution of fish in the urban gully system streams of Hamilton City (Aldridge & Hicks 2006)

Synopsis

The fish fauna of the urban and peri-urban areas around Hamilton were assessed using a variety of fish methods, Gee's minnow trapping, fyke netting, electrofishing and spotlight spotfishing. The sampling was done in conjunction with water and habitat quality assessments to determine the fish species using the urban and peri-urban streams, the health of these streams and to assess restoration and management options for the streams.

Forty-one sites were fished, all by Gee's minnow traps and fyke nets, and in addition 14 sites were also sampled by spotlighting and 10 sites by electrofishing. Thirteen fish species (eight native and five introduced) were captured during the survey. Of the thirteen species caught, seven (six native and one introduced) were observed and/or caught by spotlighting. The spotlight observation and captures included the capture of giant kōkopu that were too large to enter Gee's minnow traps.

Objectives

- To assess the fish fauna, water and habitat quality of urban and peri-urban streams around Hamilton. Spotlighting was used to provide additional fish survey data for the fish fauna assessment.

Sampling design and methods

For the spotlighting, 13 sites from the 41 available were selected for fishing. These were small, shallow streams with clear water; streams that were highly turbid and deep were excluded from the spotlight survey. Sites were surveyed over 4 nights in summer during low flow periods. The length of stream surveyed varied from 30 m to 104 m. Fish observations either determined abundance scores (rare, occasional, common abundant or very abundant) or were total fish counts for each species.

Results

The spotlight surveys detected seven species, longfin eel, shortfin eel, banded kōkopu, giant kōkopu, īnanga, common smelt and trout (species not provided). The majority of fish were given abundance scores and were either: common, abundant or very abundant. When small numbers of eels and kōkopu were found, these were counted and length was estimated. Four giant kōkopu were observed and these ranged in length from 100–300 mm. Banded kōkopu were classified as abundant at one site and another four were captured at two other sites. The numbers of the two kōkopu species seen and/or caught while spotlighting was greater than the numbers reported in the catches from the Gee's minnow traps, fyke nets and electrofishing when all these methods were combined.

Limitations and points to consider

The study completed 13 spotlight spotfishing sites in 4 nights and fished an estimated total of 1059 m of stream habitat, indicating substantial lengths of small streams can be surveyed rapidly by spotlighting. The length of the streams fished varied from 30 m to 104 m meaning the fishing effort was not standardised and comparisons among the catches would not be readily achieved. However, as an inventory method the spotlighting observed the majority of the native fish present and provided additional information of the populations of key species of interest so was a worthwhile component of the whole survey programme.

Apart from kōkopu species and eels, few if any of the fish observed were captured and the study did not collect information on some species aside from abundance scores.

The survey was effective at providing data on the kōkopu species that the other methods did not. Some caution must be applied to this, as for instance, the electrofishing surveys covered only 445 m of stream, so sampling area varied among the methods. However, regardless of the sampling effort the capture of large giant kōkopu by spotlighting is something that the Gee's minnow trap and electrofishing methods will not achieve. Gee's minnow traps are limited by the size of fish that can pass through the trap entrance. The spotlighting method is not subject to this size limitation.

The spotlight surveys were limited to small streams and those that had clear water. This limitation restricted the use of the method to approximately one-third of the study sites. Photos in the study report indicate the water clarity in some streams was very poor and this poor water clarity is a significant limitation on the use of spotlighting.

References for case study A

Aldridge, B.M.T.A.; Hicks, B.J. 2006: The distribution of fish in the urban gully system streams of Hamilton City. Client report prepared for Environment Waikato and Hamilton City Council. CBER contract report 48. http://cber.bio.waikato.ac.nz/Hicks_PDFs/CBER_48.pdf

Full details of technique and best practice

Spotlight spotfishing has two key elements: it is a night-time method of fishing using spotlights, and fishing is restricted to single-pass surveys over a reach of particular interest.

For each spot site reach, a site visit is recommended prior to the fishing operation to assess the area to be fished. For short reaches with readily available road access, a daytime assessment can be a simple stop while driving past to view the site. The daytime assessment needs to check the water conditions at the site to see if the conditions are suitable for spotlighting—most importantly that the streambed in the pools, backwaters and runs is visible. If the streambed cannot be seen it will not be possible to see all (or any) fish during the spotlighting survey. This daytime visit can select the fishing reach and mark the upstream and downstream limits in a manner that can be recognised at night. The assessment of the stream reach should confirm the stream is wadeable for the majority of the area of interest although deep pools can be included and surveyed.

If the survey needs individual fish capture details, a habitat map should be drawn up with each pool and run numbered, and an estimate of area made for each habitat unit and the total area of stream to be surveyed. However, for spotfishing, habitat mapping is not usually undertaken, but area fish should be measured or at least estimated. The daytime site assessment should also consider safety issues for night-time work and pay particular attention to riparian vegetation that may represent a hazard at night, and the ease with which the stream can be accessed and walked in the dark. This visit should also determine whether access permission is required from landowners adjacent to the stream of interest.

There is some debate as to whether spotlight fishing should be avoided on nights with a full moon and clear skies, as brighter nights may make fish more cautious and light sensitive, and therefore more difficult to capture. Fishing should avoid nights when there is rain or strong winds, as either of these can cause rippling of the water surface and reduces water visibility and survey effectiveness.

Therefore, the ideal spotlighting night is a calm, overcast night on a new moon when stream flows are low and water is clear.

Night-time spotlighting should not commence until an hour after dark. This allows the nocturnally active fish time to leave their daytime cover and take up feeding positions in pools and runs. The survey team should set up their survey equipment (spotlights, head lamps, catching equipment, etc.) away from the study reach to prevent disturbance of the site prior to fishing. Buckets for placing the captured fish in should be carried along during the survey. This avoids walking the stream prior to undertaking the survey, which would disturb the fish.

Fish surveys usually start from the downstream end of the reach, but either upstream or downstream is possible and may depend on access to the site. Fishing a site entails two or three people, depending on the width of the stream, walking carefully along the reach spotlighting the water 0–1.5 m in front and to the side, and looking for fish illuminated by the spotlight. Streams wider than 7 m are best fished with three surveyors as this reduces the amount of cross-channel movements undertaken by individual survey team members. This in turn reduces the amount of disturbance in the water from footsteps and can reduce the disturbance of fish. Spotlights should not be shone further ahead than 1.5 m when surveying as this may disturb fish outside the immediate area where the operator can effectively see and catch them. Care must be taken to survey all areas of the stream including hard to fish riffle areas, along the stream edges and amongst overhanging vegetation and banks. Progress may be slow as each area is searched, although as a general rule experienced surveyors can still move rapidly through a study reach. Team members should progress upstream through the site at the same pace. This may require team members to wait while difficult habitats are searched by other team members.

As surveyors encounter fish, any fish of the species of interest can be captured to confirm their identity and measure them if length information is required. Captures are usually made by the surveyor continuing to shine the spotlight on, or to the side of, the target fish and moving closer to it in a careful manner to avoid disturbance in the water. Once close enough to the fish to attempt netting it, the surveyor can use handheld dip nets to capture the fish. The capture requires the use of two hand nets. When the fish is within reach, the spotlight must still be shone on the fish either by a second person or by the netting person by holding the spotlight between their knees (in shallow water) or holding the spotlight handle in their mouth. Alternatively, some individuals have used a high power headlamp to illuminate the fish at this stage. Hand nets can be placed at the head and tail of the fish. Kōkopu will often not move while the nets are being placed in front and behind them and can be quickly scooped out using the net placed at their tail end. On other occasions, the fish can be very gently nudged from the head or tail by one net to scare them into the other net. The key factors here are to ensure the nets are open and, as most kōkopu sit near the streambed, that the nets are touching the streambed to prevent the fish escaping under the nets. The capture technique is the most critical skill that requires some practice, especially in areas where the water current is strong as flowing water will close the upstream net quickly.

Fish captured can be placed back in the stream at the capture site or retained in buckets if the surveyors wish to avoid the potential for double counting of individuals.

The surveyors should record the number of fish of each species caught and any length or weight information collected for those fish. Additional fish counts can be made of fish seen but not caught.

All fish handling should be done following best practice, which includes minimising the unnecessary handling of individual fish and wetting hands prior to handling fish to avoid damaging skin or surface mucus layer. When returning fish to the water from live buckets, lids should be removed from the bucket and the bucket submerged in water allowing fish to swim free.

References and further reading

Aldridge, B.M.T.A.; Hicks, B.J. 2006: The distribution of fish in the urban gully system streams of Hamilton City. Client report prepared for Environment Waikato and Hamilton City Council. CBER contract report 48. http://cber.bio.waikato.ac.nz/Hicks_PDFs/CBER_48.pdf

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Bowie, S.; Henderson, I. 2002: Shortjaw kokopu (*Galaxias postvectis*) in the northern Tararua Ranges. Department of Conservation Science Internal Series report number 30.

David, B.; Closs, G.P.; Arbuckle, C. 2002: Distribution of fish in tributaries of the lower Taieri/Waipori Rivers, South Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, *36*, 797–808.

Harding, J.S.; Clapcott, J.E.; Quinn, J.M.; Hayes, J.W.; Joy, M.K.; Storey, R.G.; Greig, H.S.; Hay, J.; James, T.; Beech, M.A.; Ozane, R.; Meredith, A.S.; Boothroyd, I.K.G. 2009: Stream habitat assessment protocols for wadeable rivers and streams of New Zealand. School of Biological Sciences, University of Canterbury, Christchurch. http://www.cawthron.org.nz/coastal-freshwater-resources/downloads/stream-habitat-assessment-protocols.pdf

McCullough, C.D.; Hicks, B.J. 2002: Estimating the abundance of banded kokopu (*Galaxias fasciatus* Gray) in small streams by nocturnal counts under spotlight illumination. *New Zealand Natural Sciences 27*: 1–14.

Studholme, B.; Barrier, R.; Jack, D. 1999: Shortjawed kokopu (*Galaxias postvectis*) conservation status in Nelson/Marlborough—year one. Interim report, Department of Conservation, Nelson.

Appendix A

The following Department of Conservation documents are referred to in this method:

docdm-146272	Standard inventory and monitoring project plan
olddm-566603	Wading safely