

# *Margaritifera margaritifera* Stage 1 and Stage 2 Survey Guidelines



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# *Margaritifera margaritifera*

## Stage 1 and Stage 2 Survey Guidelines

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**Cover photo:** NPWS staff carrying out a Stage 2 survey for *Margaritifera* © Chris Wilson

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## 1. Introduction

The freshwater pearl mussel, *Margaritifera margaritifera*, is a scheduled species under the Wildlife Act and is also listed in the appendices to the Habitats & Species Directive [92/43/EEC]. [Note: both *M. margaritifera* and *M. durrovensis* are listed in Annex II and are recognised by the IUCN.] The effect of these legislative provisions is to give protection to both the animal and its habitat. One consequence is that any action that might have an adverse effect upon the mussel can only be carried out under license. This includes mussel survey work (or any other form of research on mussels), which can cause damage to the mussels.

Survey of adult *Margaritifera* is carried out with the animals *in situ* i.e. it is not permitted to remove live animals from where they are found, for purposes of survey. In order to minimise potential damage caused to mussels by survey, and to make comparison between survey results at different times and at different locations possible, a standard survey methodology has been developed, based on best practice and reliability. It involves four stages. These are outlined below. Those licensed to carry out *Margaritifera* survey work in Ireland are expected to use the methodology laid down in the following pages.

*Margaritifera* surveys are carried out for a variety of purposes. In many cases these surveys will be a part of ongoing conservation work by National Parks and Wildlife Service (NPWS) personnel. However, other organisations or individuals may also require to carry out mussel survey, for instance as part of environmental impact assessment. It is important to note that pearl mussels can be affected by impacts occurring in a river (or its catchment) at considerable distances upstream from their populations. Thus, survey can often be necessary not only in the immediate vicinity of where a development is proposed, but also downstream of that proposed development. This consideration is vital at the project scoping stage, and it is advisable that survey limits are designed in consultation with NPWS. If a living population of *Margaritifera* is found during an environmental impact assessment baseline survey, a Stage 1 survey would not be sufficient to make a proper assessment. Stages 2 and possibly 3 would need to be carried out, in addition.

This *Manual* presents the guidelines for Stage 1 and Stage 2 surveys.

## **2. Survey of *Margaritifera margaritifera***

Survey of *Margaritifera margaritifera* can only be carried out under license and it should be noted that survey without license would be construed as an illegal act, with potential implications in the event that survey results become the subject of legal proceedings. Applicants for Stage 1 and Stage 2 survey licences must be able to demonstrate a good understanding of *Margaritifera* ecology and a competency to survey.

### **Stage 1 survey**

Establishment of whether or no there are adult freshwater pearl mussels in a river. This is presence/absence survey based on searches of those sections of a river exhibiting features most likely to support pearl mussels. Recommendations on which features to look for are provided in these notes. In water less than 75 cm deep, a search can be based on the use of a "glass-bottomed" bucket and done by wading (working from the bank is not sufficiently reliable to be admitted as a basis for survey). But as this survey method is potentially destructive of mussels, once mussels have been found in a river Stage 2 methodology must be used.

### **Stage 2 survey**

Estimation of the adult mussel population of a river. Quantitative mussel survey cannot be reliably carried out using glass-bottomed bucket and waders. Snorkelling is required, involving specified numbers of transects/km of river bed when mussels are numerous, and an attempt to count all the mussels in 500m of the bed of each km of river channel when individuals are sparse.

### **Stage 3 survey**

Establishment of whether or no there is recruitment to the mussel population in a river. Survey methodology is potentially very destructive of mussels and can only be carried out using prescribed sampling techniques. License for Stage 3 survey will not normally be provided, unless an applicant is able to make an adequate case that Stage 3 survey is necessary. Stage 3 survey methodology is not included here, and it is considered that such survey should only be undertaken by a specialist of this survey technique.

### **Stage 4 survey**

Surveillance of mussel populations and mussel habitat (including host salmonids). This is effectively establishment of a monitoring procedure, combining survey techniques used in Stages 2 and 3 with recording of water quality parameters and detailed river channel character data, at prescribed intervals in time and space. License for Stage 4 survey will not normally be provided in cases where an applicant is unable to make an adequate case that Stage 4 survey is necessary. Stage 4 surveys will be designed in accordance with the specific requirements of the population to be monitored and in consultation with NPWS staff. Prescriptions for NPWS Stage 4 surveys are under development.

### 3. Stage 1 survey

**Objective:** to establish whether adult *Margaritifera margaritifera* are present in a river

**Location of survey:** river channels, *Margaritifera margaritifera* does not normally occur in standing waters.

**Definition of a river channel:** for purposes of this survey, a river channel is defined as the bed and permanently-submerged fraction of the banks of a permanently-running river, or tributary of a river, depicted in blue on a Discovery Series map. Each tributary is to be taken as a discrete river for purposes of survey, from its source to its point of confluence with a more major tributary or, in the case of the main channel of a river, to its confluence with the sea. The presence or absence of pearl mussels in one river of a catchment does not allow either positive or negative extrapolation regarding the presence of mussels in another river of that catchment. All rivers in a catchment need to be individually assessed.

**Stage 1 survey equipment:** in water up to 75 cm deep, survey can be carried out using a bathyscope, or glass-bottomed bucket. A home-made viewing bucket is often superior to a commercial bathyscope. Viewing buckets can be made by cutting the base out of a large bucket and replacing this base with a sheet of Perspex, attached using a waterproof sealant. Alternatively, a simple plastic aquarium can be used. Survey should be carried out from within the river channel. It is recommended that the river worker wear either a dry suit or thigh waders. Chest waders are not recommended for safety reasons. Wearing of a life jacket is also essential when wading, and is considered a mandatory part of Stage 1 survey equipment. For safety reasons survey work should not be carried out alone: A second worker should remain on the bank at all times, monitoring the safety of the river worker. The bank worker can also record the data being collected by the river worker. In water more than 75 cm deep survey using glass-bottomed bucket and waders is impractical and cannot be recommended on safety grounds. If Stage 1 survey has to be carried out in water more than 75 cm deep, it is necessary to employ snorkeling as the survey method, as in Stage 2 survey. An underwater torch is required for areas permanently under deep shade.

#### **Before going in the water:**

1. Categorise the rivers in the survey area:
  - a) high priority rivers: rivers with prior mussel records
  - b) moderate priority rivers: rivers with no prior records but with either igneous or sandstone bedrock underlying *at least one third of their length*; rivers flowing from lakes
  - c) low priority rivers: rivers with either igneous or sandstone bedrock for less than one third of their length

Rivers which fall into category c) are probably unsuitable for *Margaritifera margaritifera*. Tidal stretches of rivers are also unsuitable for these mussels.

2. Select survey stations from stretches of river that are:
  - a) below the mountainous initial source of the river, into the reaches marked in Discovery Series maps with a strong blue line.
  - b) close to and below reaches of 200 m contour lines (i.e. below brown areas, into green areas).
  - c) away from contour lines that lie close together (i.e. large waterfalls or deep ravines).
  - d) upstream of any part of the channel that is under saline influence.
  - e) in stretches with variation in river bed, i.e. pools followed by riffles, not a deep, even glide.
  - f) 50 cm and over in depth.
  - g) in stretches with overhanging trees.
  - h) away from river beds of solid rock, preferably in areas where gravel and/or boulders are present,
  - i) at the exit point of lake outflows.
  
3. Record the location of the selected survey stations on a map and mark out the river channel in 1 km sections on that map. The map should be made so that the selected survey stations can be located in the field. It is advisable to make three copies of the map, one to retain as a record, one to use in the field and a third potentially for use in Stage 2 survey.
  
4. Estimate the time allocation required for survey of the rivers that fall into categories 1a) and 1b) (above), on the following basis:
  - a) in Stage 1 survey the minimum unit of survey is one selected station, requiring survey of 300 m of river channel, which takes 1-1.5 hours to survey in the river, plus travel time to and from the survey station.
  - b) in Stage 1 survey, at least one unit of 300 m requires to be surveyed within each 2 km of river channel.
  
5. Record details of a proposed river survey on the "*Margaritifera margaritifera* stage 1 survey planner" sheet (copy attached).
  
6. Gauge whether conditions are suitable for survey:
  - a) for safety reasons survey cannot be reliably carried out when rivers are in flood.
  - b) survey cannot be reliably carried out under conditions of poor visibility, for instance:
    - when a river is recovering from heavy rains or is highly coloured
    - when it is raining
    - in overcast (i.e. more than 60% cloud cover) conditions, or at dawn or dusk.

### **Recommended Stage 1 survey procedure**

Initiate survey at the most downstream location on the river channel that has been selected as a survey station. On arrival at a selected survey station:

1. Record the grid reference of the point selected for entry to the river channel as accurately as possible, using at least 6 figure grid reference obtained from a Discovery Series map, and preferably a much more precise reading obtained from a hand-held GPS device.
2. Entering the water at the selected location, wade UPSTREAM for 300 m systematically searching the riverbed for living mussels or mussel shells. (It is recommended that searching for *Margaritifera margaritifera* is only carried out by personnel who have been on a training course that includes mussel identification and demonstration of field survey techniques for freshwater mussels).
3. Record information on mussel numbers (including absence of mussels) and habitat, using the data sheet supplied. It is convenient if the river worker can relay the data to a bank worker for recording purposes.
4. N.B. It is necessary to record visibility at each station surveyed.
5. Once mussels have been found at one survey station in a river, and data on numbers and habitat recorded, there is little benefit to be derived from searching at further stations. The river should be exited and further searching left to Stage 2 survey. **If large numbers of mussels are encountered, the observer should leave the river immediately, because wading is not a suitable method for surveying large mussel populations, as a result of the damage which may be caused to mussel populations by trampling.**
6. If no mussels are encountered after 1-1.5 hours have been spent in the water at that station, giving particular attention to the immediate vicinity of boulders and under overhanging trees, mussels can be deemed to be absent from that section of river channel.
7. If no mussels are encountered at the first survey station, move to a survey station selected in the next kilometre section of river upstream and repeat the survey procedure. If no mussels are encountered move upstream once again to a selected survey station in the next kilometre section of river channel. Repeat this process until one station has been surveyed in each kilometre of river for which survey stations have been selected. If there are still no positive records, carry out surveys at any further stations selected as potential sites for mussels until either all have been examined or mussels are located.

### **Recording Stage 1 survey information**

In order to standardise survey results, it is recommended that they are recorded on the *MARGARITIFERA MARGARITIFERA STAGE 1 SURVEY DATA SHEET*, of which a reference copy is attached. One copy of each completed form should be lodged in the NPWS Regional Office with responsibility for the area in which the surveyed water body/bodies are located. A second copy should be sent to Dr Áine O Connor, NPWS, 7 Ely Place, Dublin 2.

## 4. Stage 2 survey

**Objective:** to estimate the numbers of adult *Margaritifera margaritifera* in a river.

### **Introduction**

Stage 2 survey is designed to be carried out following completion of a Stage 1 survey that has identified the presence of living *Margaritifera* in a river. Whether or no Stage 2 survey is carried out following on from Stage 1 survey, Stage 2 survey requires availability of a map of the potential mussel locations in the river channel that is to be surveyed. Production of the necessary map should be carried out as described for Stage 1 survey. If a Stage 1 survey has been completed, the river sections where no *Margaritifera* were found can be ignored in Stage 2 survey. The section(s) where *Margaritifera* was found, and sections not surveyed in Stage 1 but identified as potential habitat during Stage 1 preparation, should be surveyed in Stage 2.

### **Stage 2 survey equipment**

Stage 2 survey should not be attempted by wading, using a glass-bottomed bucket or its equivalent; as that method is unreliable as a basis for estimation of mussel numbers and is unacceptably destructive to mussel populations. For Stage 2 survey, snorkelling is the recommended technique (see also under "Survey in exceptionally shallow or deep water" below). Applicants for a license to carry out Stage 2 *Margaritifera* survey work are advised that a recognised snorkelling qualification is necessary.

Essential to snorkelling for freshwater mussels are: a wet suit or dry suit, snorkel plus mask, weight belt plus appropriate weights, underwater torch and a stout stick of c 1m in length (to aid in anchoring the observer while searching). Additional items might usefully include a "goodie bag" (for dead shells), floating rope, metal link chain (for potential use in following transect lines), plastic "click" counters. Short fins would normally be preferable to long fins when snorkelling in rivers.

For safety reasons it is essential that survey work is not carried out by individuals working alone. In river channels up to 3 m wide, teams comprising a minimum of two individuals, one in the river and the other on the bank (hereafter referred to as the "bank manager"), are advisable at all times. In river channels over 3 m wide it is advisable to have two team members snorkelling (see below), plus a bank manager, to ensure reliability of survey results.

### **The role of the bank manager**

The bank manager is a vital member of the Stage 2 mussel survey team. He/she should become familiar in advance with the stretch of river to be surveyed. The bank manager is ideally placed to co-ordinate the fieldwork, organising the entry and exit points of snorkelling stretches, completing the field forms and ensuring transfer of the collected data to the survey data sheets.

Equipment required by the bank manager for his/her use in the field includes: mobile phone, digital camera, hand-held GPS, safety rope, clipboard, maps, the bank manager

field forms and survey data sheets. To accompany the information recorded on the data sheets, it is advisable for the bank manager to photograph entry and exit points and overall riverine habitat, and to record the grid references at which each photograph is taken. These photos should be stored electronically, with the information from the data sheets.

It is easier for the bank manager to record mussel numbers observed by the team member(s) in the water, than for those in the water to do this themselves. From observation of the team member(s) snorkelling, the bank manager can also ensure that patches of river bed are not inadvertently omitted from survey. He/she should also be responsible for the safety of snorkellers, ensuring they are visible to him/her at all times. The most convenient data recording procedure is for the bank manager to use the field form to take down the information supplied by the snorkellers and later transfer that information to the survey data sheets.

### **Before you go into the water**

Estimate the time allocation required for survey of each target river. Decisions do not have to be made regarding choice of sample stations to examine in a river during a Stage 2 survey, if the locations at which mussel populations can be expected to occur in that river have been identified on a map produced for Stage 1 survey. In circumstances where such a map has not been made, it requires to be compiled before Stage 2 survey commences, as detailed under Stage 1 survey.

Except under conditions where dense mussel populations occur (see below), the mussels in 500 m of each kilometre of river channel require to be counted, in Stage 2 survey, in order to produce reliable population estimates. One unit of 500 m of river channel can usually be surveyed by snorkelling in approximately 1.5 hours. So it is frequently possible to cover four km of river channel (i.e. 4 survey units of 500 m) per day. It is important to recognise that this estimate assumes a reconnaissance survey has already been undertaken to locate accessible water entry and exit points (once identified these access points should be recorded for future reference). A reconnaissance survey itself can be expected to take a day per river (or more, dependent upon length). However, this should only be regarded as a rough a guide to the time required for survey per kilometre - density of mussels, width of river channel, visibility and water depth can all influence the time required for survey. Conditions optimal for survey are as described for Stage 1 survey. N.B. if visibility is less than 50 cm survey cannot be reliably carried out.

### **Recommended Stage 2 survey procedure**

Population estimates of *Margaritifera* from river channels of more than 3 m wide cannot be regarded as reliable if based on the snorkelling activity of one person. These wider rivers are best surveyed by two or more snorkellers working in a line, with each snorkeller covering approximately 2 m across the channel. Since river channel width data should be available from Stage 1 survey it should be possible to decide whether how many snorkellers are needed for Stage 2 survey before going into the field.

Using the grid references of potential mussel locations identified on the survey map, it is usually most practical to start Stage 2 survey at the point furthest **upstream** that a potential mussel location has been identified in a river channel.

Once in the water, living mussels of reproductive age/size should be searched for and counted. Empty and/or broken mussel shells and dead individuals should be recorded separately. For ease and efficiency of operation it is advisable to carry out snorkelling in a **downstream** direction. An exception would be smaller, shallower streams, where sediment can be disturbed by snorkelling. These should be surveyed in an **upstream** direction. In most cases, all mussels observed in 500 m of each km of river channel should be counted. Numbers can then be estimated, for a given kilometre of channel length, from the numbers observed in the 500 m surveyed. In rivers where mussel populations are extremely dense, each kilometre of river channel should be divided into 100 m units of length and a series of five sample counts taken in each 100 m. The transect of river bottom over which each sample count is made should be 2 m long and the full width of the river channel. The width of the channel should be recorded at each location a sample count is made. An overall population estimate for each km section of river can then be extrapolated from the results of these counts. Thus, whether a 500 m stretch is surveyed, or a set of transects is counted, the final result will be a population estimate per kilometre. Note: in cases where mussels are being counted along transects, the full kilometre section of river should be snorkelled, to assess which stretches of channel have an equivalent mussel population density, to maximise accuracy of population estimates.

It is advisable for a sketch map of the river channel to be drawn in the field during survey, on which the distribution of mussels and their habitat can be marked in more detail than can be achieved using the survey map produced for Stage 1 survey. This is most easily carried out by the bank manager from information supplied by the team member in the water. The bank manager should also ensure that a photographic record is taken of the river sections surveyed for future reference.

### **Stage 2 survey in exceptionally shallow or deep water**

In extremely shallow (i.e. less than 25cm) water, snorkelling is not practical. To count mussels in stretches of river where the water may be this shallow it is necessary either to schedule survey for times when deeper water is present or wade in the river using a glass-bottomed bucket. At locations where mussels are numerous, it is not acceptable to wade in the river to count the mussels and at such locations it is necessary to schedule survey for times when the water is deeper and counting can be carried out by snorkelling.

In water deeper than 2.5m, visibility will be so limited that counting mussels by snorkelling becomes unreliable. Occasional deep pools may be surveyed by snorkel-diving, if visibility permits, but continuous deep stretches (i.e. where the water is 2.5m deep or deeper) require scuba diving, together with a strong, artificial light source. Applicants for license to survey by scuba-diving are required to provide evidence that they have obtained appropriate scuba-diving qualifications.

## **Recording Stage 2 survey information**

A separate record should be kept of the survey results for each km section of river surveyed during a Stage 2 survey, using the field forms. Recommended formats for field forms and Stage 2 survey data sheets are shown in the accompanying **BANK MANAGER *Margaritifera* Stage 2 survey Field Form** and **MARGARITIFERA MARGARITIFERA STAGE 2 SURVEY DATA SHEET**. These allow for recording details of the locations where the river channel was entered and exited in survey of a one kilometre section of river channel, together with a record of what was observed in that section. It is assumed that habitat data for each kilometre of river surveyed are recorded on the sketch map of the river, made in the field as survey progresses.

Individuals licensed to carry out Stage 2 *Margaritifera* survey are reminded that copies of completed Stage 2 data sheets are required by the licensing authority as a condition of the license. Failure to provide completed forms at license renewal, or at request of the licensing authority, will result in suspension of license until such time as the completed record sheets are provided.

## **Appendix 1: EXPLANATORY NOTES FOR STAGE 1 AND STAGE 2 SURVEY DATA SHEETS**

**Approximate length of channel surveyed** – Estimate length of channel surveyed, calculated from Discovery Series map (e.g. 80 metres). (N.B. In Stage 1 survey, please leave river once living mussels are found).

**Catchment** - The name of the largest river into which the surveyed river flows.

**Channel section number** - Divide the river into a series of 1 km sections to be surveyed and number them from upstream section down (e.g. Avonmore 3).

**Comments** - Any additional remarks the observer wishes to make on the river section surveyed.

**Contact Address** – Give postal address of license holder.

**Date of Survey** - Day, Month and Year of Survey (e.g. 10<sup>th</sup> July 2001)

**Grid Reference of channel entry site** - Give 6 digit grid reference from the Irish grid for the point where survey commenced, either from a Discovery Series map or from use of global positioning system (GPS) equipment.

**Grid Reference of channel exit site** - Give 6 digit grid reference from the Irish grid for the point where survey finished, either from a Discovery Series map or from use of global positioning system (GPS) equipment.

**Hours of Survey** - State the time survey started and finished, e.g.. 9.30am to 3.30pm.

**License number** - Give current *Margaritifera* survey license number.

**Method used (Stage 2 survey)** – Note which method was used: a count of all mussels seen/500 m, OR 5 transect counts/100 m. If transects are counted, enough detail should be given on the accompanying map to allow the transect sites to be reliably relocated.

**Mussel Population Category** - Tick either: 1. Abundant (in some areas it was difficult to avoid trampling on them); 2. Present (living mussels were found, but were not abundant); 3. Dead shells only (no living mussels found but shells or fragments of shells were present); 4. No evidence (no living mussels or shells found).

**Name of Surveyor** - Full name of licensed surveyor, as given on current license.

**Number of dead shells collected** - If dead shells are collected as part of the survey record the number of shells taken from river, e.g. 5 complete shells, 7 single valves (half shells).

**River Name** - Give the name that appears on the Discovery Series map, not a local name.

**Total number of living mussels of reproductive age/size (Stage 2 survey)** – Record the total number of living mussels over 3 cm (i.e. not juveniles) that were counted in this channel section. The estimated population for the full kilometre should then be given.

**Visibility underwater**- Water visibility should be measured using a Secchi disc. This is a white plastic disc 20 cm in diameter, which is weighted and attached to a cord at its centre. The cord should be marked at 5 cm intervals. The disk is lowered into the water and the depth at which the disc is no longer visible should be recorded. N.B. if visibility is less than 50 cm survey cannot be reliably carried out.

**Weather Conditions** - Record number of hours of sunshine and number of hours of rainfall during the survey.

## **Appendix 2: EXPLANATORY NOTES FOR STAGE 1 AND STAGE 2 SURVEY DATA SHEETS (NPWS surveys)**

**Algae (%)** - Give % cover of filamentous algae coating river bed.

**Approximate length of channel surveyed** – Estimate length of channel surveyed, calculated from Discovery Series map (e.g. 80 metres). (N.B. In Stage 1 survey please leave river once living mussels are found).

**Average width of river (metres)** - It is most important to note this carefully, as rivers over 3 metres in width require two snorkellers in a stage 2 survey. A simple observation of either < 3 metres or > 3 metres will suffice. An estimate of the maximum width would also be helpful.

**Average depth of river (m/cm)** - Indicate whether average river depth is greater than 75 cm, between 50 cm and 75 cm, or less than 50 cm.

**Bank vegetation** - Record percentage of bank (of river section surveyed) covered in each of the following vegetation categories: vegetation taller than 2 m; vegetation less than 2 m; unvegetated and/or eroding.

**Catchment** - The name of the largest river into which the surveyed river flows.

**Channel section number** - Divide the river into a series of 1 km sections to be surveyed and number them from uppermost section down (e.g. Avonmore 3).

**Comments** - Any additional remarks the observer wishes to make on the river section surveyed.

**Contact Address** - Give postal address of license holder.

**Current license** - please confirm you are licensed to carry out Stage 1 or 2 *Margaritifera* survey, as appropriate.

**Date of Survey** - Day, Month and Year of Survey (e.g. 10<sup>th</sup> July 2001)

**Grid Reference of channel entry site** - Give 6 digit grid reference from the Irish grid for the point where survey commenced, either from a Discovery Series map or from use of a GPS.

**Grid Reference of channel exit site** - Give 6 digit grid reference from the Irish grid for the point where survey finished, either from a Discovery Series map or from use of a GPS.

**Hours of Survey** - State the time survey started and finished, e.g.. 9.30am to 3.30pm.

**Method used (Stage 2 survey)** - Note which method was used: a count of all mussels seen/500m, OR 5 transect counts/100m. If transects are counted, enough

detail should be given on the accompanying map to allow the transect sites to be reliably relocated.

**Microhabitat (% of each) where mussels are present** - Give approximate percentages of each of the following: boulders/gravel/sand (potentially suitable micro-habitat); bedrock/cobbles (unsuitable microhabitat); silt (unsuitable microhabitat). Definitions of these categories are as follows:

- bedrock: solid rock covering a portion of the river bed
- boulders: rock over 25 cm in diameter
- cobbles: rock between 2 cm and 25 cm
- gravel: sediment particle between 2 mm and 2 cm in diameter
- sand: particles between 0.125 mm and 2 mm, coarse enough to fall to the river bed when disturbed
- silt: sediment with particle size less than 0.125 mm, clouds water when disturbed.

**Microhabitat (% of each) where mussels are absent** - Record percentage cover by river bed microhabitats as above, where mussels are absent.

**Mussel Population Category (Stage 1 survey)** - Tick either: 1. Abundant (in some areas it was difficult to avoid trampling on them); 2. Present (living mussels were found, but were not abundant); 3. Dead shells only (no living mussels found but shells or fragments of shells were present); 4. No evidence (no living mussels or shells found).

**Name of Surveyor** - Full name of licensed surveyor as given on current license.

**Number of dead shells collected** - If dead shells are collected as part of the survey, record the number of shells taken from river, e.g. 5 complete shells, 7 single valves (half shells). The dead shells should then be sent, in a dry condition, to Dr Áine O Connor, 7 Ely Place, Dublin 2, for curation and transfer to the collections of the National Museum of Ireland (NMI have agreed to maintain this material for future reference). Shells from each provenance should be separately packaged and accompanied by a label indicating: river of origin; locality (nearest town or bridge named on Discovery Series maps); grid reference (6 figure); date of collection; name of collector.

**Overhanging trees (%)** - e.g. 50% of right bank, 20% of left bank. Left and right banks of a river are based on the surveyor looking upstream. Overhanging trees should only be considered, not bushes such as gorse.

**River Name** - Give the name that appears on the Discovery Series map, not a local name.

**Salmonids observed** - Presence of salmonid fish is most important for *Margaritifera* and observations of their abundance should be recorded when possible. N.B. Salmonid fry can be confused with small fish such as minnows, so care should be taken to ensure correct identification.

**Total number of living mussels of reproductive age/size (Stage 2 survey)** - Record the total number of living mussels over 3 cm (i.e. not juveniles) that were counted in this channel section. The estimated population for the full kilometre should then be given.

**Visibility underwater** - Water visibility should be measured using a Secchi disc. This is a white plastic disc 20 cm in diameter, which is weighted and attached to a cord at its centre. The cord should be marked at 5 cm intervals. The disk is lowered into the water and the depth at which the disc is no longer visible should be recorded. NB If visibility is less than 50 cm survey cannot be reliably carried out.

**Water-weed (%)** - Give % water-surface cover by bottom-rooting macrophytes.

**Weather Conditions** - Record the number of hours of sunshine and number of hours of rain during the survey.





**Appendix 5. MARGARITIFERA MARGARITIFERA STAGE 1 SURVEY DATA SHEET**

Please fill in one form for each 300m section of river channel surveyed. Lodge one copy of each completed form in the local NPWS Regional Office and send one copy to Dr Áine O Connor, NPWS, 7 Ely Place, Dublin 2.

<b>River Name</b>		<b>Hours of Survey</b>	
<b>Catchment</b>		<b>Date of Survey</b>	
<b>Channel section number</b>		<b>Name of Surveyor</b>	
<b>Grid Reference of channel entry site</b>		<b>Contact Address</b>	
<b>Grid Reference of channel exit site</b>		<b>License number</b>	
<b>Approximate length of channel surveyed</b>	<b>Comments</b>		
<b>Visibility underwater</b>	< 50cm                      > 50cm		
<b>Weather conditions</b>	<b>Sunshine</b> (no. hours)		<b>Rain</b> (no. hours)
<b>Mussel Population Category (please tick)</b>	1 Abundant	2 Present	3 Dead shells only                      4 No evidence
<b>Number of dead shells collected</b>			

**Appendix 6: MARGARITIFERA MARGARITIFERA STAGE 2 SURVEY DATA SHEET**

Fill in one form for each km section of river surveyed. A copy of the sketch map made for that stretch of river should be attached.

Lodge one copy of each completed form in the local NPWS Regional Office and send one copy to Dr Áine O Connor NPWS, 7 Ely Place, Dublin 2.

<b>River Name</b>		<b>Hours of Survey</b>	
<b>Catchment</b>		<b>Date of Survey</b>	
<b>Channel section number</b> (from Stage 1 survey)		<b>Name of Surveyor</b>	
<b>Grid Reference of channel entry site</b>		<b>Contact Address</b>	
<b>Grid Reference of channel exit site</b>		<b>License number</b>	
<b>Approximate length of stretch of channel surveyed</b>		<b>Visibility underwater</b>	< 50cm > 50cm
<b>Weather conditions</b>	<b>Sunshine</b> (no. hours)		<b>Rain</b> (no. hours)
<b>Number of dead shells collected</b>			
<b>Method used</b> (please tick in correct box)	<b>All mussels in 500m counted</b>		<b>5 x 2m counts made</b> (mark locations on accompanying map)
<b>Total number of living mussels of reproductive age/size</b>	<b>Counted</b>	<b>Estimate for kilometre section</b>	

**Appendix 7: MARGARITIFERA MARGARITIFERA BANK MANAGER FIELD FORM**

<b>BANK MANAGER <i>Margaritifera</i> Stage 2 survey FIELD FORM</b>						
River name:	River channel section No:			Date of survey:		
County:	Entry point (grid ref.):			Time of entry:		
	Exit point (grid ref.):			Time of exit:		
Name of bank manager:						
Average depth of section (circle):				>75cm	50-75cm	<50cm
Visibility underwater (circle):				>50cm	30-50cm	<30cm
Weather conditions:		No hours sun:		No. hours rain:		
Channel subsection	Number mussels in channel			Number empty shells in channel		
	left side	mid-channel	right side	left side	mid-channel	right side
Subsection 1 length of subsection:						
Subsection 2 length of subsection:						
Subsection 3 length of subsection:						
Subsection 4 length of subsection:						
Subsection 5 length of subsection:						

**Appendix 8: MARGARITIFERA MARGARITIFERA STAGE 1 SURVEY DATA SHEET (NPWS surveys)**

Please fill in one form for each 300m section of river channel surveyed. Lodge one copy of each completed form in the local NPWS Regional Office and send one copy to Dr Áine O Connor, NPWS, 7 Ely Place, Dublin 2.

<b>River Name</b>		<b>Hours of Survey</b>	
<b>Catchment</b>		<b>Date of Survey</b>	
<b>Channel Section Number</b>		<b>Name of Surveyor</b>	
<b>Grid Reference of start of channel section</b>		<b>Contact Address</b>	
<b>Grid Reference of end of channel section</b>		<b>Current license (please tick)</b>	
<b>Weather conditions</b>	<b>Sunshine</b> (no. hours)	<b>Rain</b> (no. hours)	
<b>Mussel population Category (tick)</b>	1 Abundant      2 Present      3 Dead shells only      4 No evidence		
<b>Number of dead shells collected</b>			
<b>Microhabitats in stretches where mussels are present, indicate % of each</b>	<b>Potentially suitable</b> (boulders/gravel/sand)	<b>Unsuitable -</b> bedrock/cobbles	<b>Unsuitable -</b> silt
<b>Microhabitats in stretches where mussels are absent, indicate % of each</b>	<b>Potentially suitable</b> (boulders/gravel/sand)	<b>Unsuitable -</b> bedrock/cobbles	<b>Unsuitable -</b> silt
<b>Average width of river (please tick)</b>	>3m	<3m	

**MARGARITIFERA MARGARITIFERA STAGE 1 SURVEY DATA SHEET (NPWS surveys)**  
**(continued)**

<b>Average depth of river (please tick)</b>	<b>&gt;75cm</b>	<b>50-75cm</b>	<b>&lt;50cm</b>	
<b>Visibility under-water</b>	<b>&gt;50cm</b>	<b>&lt;50cm</b>		
<b>Bank vegetation</b>	<b>&gt;2m high (%)</b>	<b>&lt;2m high (%)</b>	<b>Unvegetated / eroding (%)</b>	
<b>water-weed (%)</b>	Where mussels are present		Where mussels are absent	
<b>algae (%)</b>	Where mussels are present		Where mussels are absent	
<b>Salmonids observed (please tick)</b>	<b>&lt;10cm abundant</b>	<b>&lt;10cm few</b>	<b>&gt;10cm abundant</b>	<b>&gt;10cm few</b>
<b>Crayfish observed (please tick)</b>	<b>Comments</b>			

**Appendix 9: MARGARITIFERA MARGARITIFERA STAGE 2 SURVEY DATA SHEET (NPWS surveys)**

Fill in one form for each km section of river selected for survey. A copy of the sketch map made for that stretch of river should be attached. Lodge one copy of each completed form in the local NPWS Regional Office and send one copy to Dr Áine O Connor, NPWS, 7 Ely Place, Dublin 2.

<b>River Name</b>		<b>Hours of Survey</b>	
<b>Catchment</b>		<b>Date of Survey</b>	
<b>Channel Section Number (from Stage 1 survey)</b>		<b>Name of Surveyor</b>	
<b>Grid Reference of start of channel section</b>		<b>Contact Address</b>	
<b>Grid Reference of end of channel section</b>		<b>Current license (please tick)</b>	
<b>Approximate length of section of river channel surveyed</b>			
<b>Weather conditions</b>	<b>Sunshine</b> (no. hours)	<b>Rain</b> (no. hours)	
<b>Method used (please tick in correct box)</b>	<b>All mussels in 500m counted</b>		<b>5 x 2m counts made (mark locations on accompanying map)</b>
<b>Total number of living mussels of reproductive age/size</b>	<b>Counted</b>	<b>Estimate for kilometre section</b>	

**MARGARITIFERA MARGARITIFERA STAGE 2 SURVEY DATA SHEET (NPWS surveys)**  
**(continued)**

<b>Number of dead shells collected</b>			
<b>Microhabitats in areas where mussels are present (% of each)</b>	<b>Potentially suitable</b> (boulders/gravel/sand)	<b>Unsuitable -</b> bedrock/cobbles	<b>Unsuitable -</b> silt
<b>Microhabitats in areas where mussels are absent, indicate % of each</b>	<b>Potentially suitable</b> (boulders/gravel/sand)	<b>Unsuitable -</b> bedrock/cobbles	<b>Unsuitable -</b> silt
<b>Average width of river (please tick)</b>	<b>&gt;3m</b>	<b>&lt;3m</b>	
<b>Average depth of river (please tick)</b>	<b>&gt;75cm</b>	<b>50-75cm</b>	<b>&lt;50cm</b>
<b>Visibility under-water</b>	<b>&gt;50cm</b>	<b>30-50cm</b>	<b>&lt;30cm</b>
<b>Bank vegetation</b>	<b>&gt;2m high (%)</b>	<b>&lt;2m high (%)</b>	<b>Unvegetated / eroding (%)</b>
<b>water-weed (%)</b>	Where mussels are present		Where mussels are absent
<b>algae (%)</b>	Where mussels are present		Where mussels are absent
<b>Salmonids observed (please tick)</b>	<b>&lt;10cm</b>	<b>&gt;10cm</b>	
<b>Comments</b>			