Environmental impact assessment: monitoring from a platypus perspective

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ABSTRACT

Projects assessed as having the potential to adversely affect the environment can gain approval with the caveat that monitoring will be undertaken. The implications from such a decision are that adverse findings from monitoring will lead to the project at least, being subject to measures mitigating adverse impacts identified by the monitoring. With regard to the platypus, detection of adverse impacts by a monitoring program can be constrained by both limitations on the sampling techniques currently available (observations and/or capture by netting and/or assessment of important habitat variables) and by the nature of the data these sampling methods can provide. Capture techniques are the preferred method but capture using mesh ('gill') nets is limited by stream flows and the presence of fish and/or large woody debris ('snags'). Fyke netting, the other preferred method, is largely restricted to being used in small water bodies. Low numbers and variability of both captures and observations of the species in the wild are common limitations to the statistical adequacy of a monitoring program for the platypus. These constraints must be raised in the environmental impact assessment process so that decision-makers are aware that, depending on the species, monitoring programs may not necessarily be able to detect adverse impacts or separate human-induced impacts from those affected by natural perturbations. Approval with the precaution of monitoring should be made only if it can be concluded that the proposed monitoring study has the capacity to detect any adverse effects of the project and, in the instance that such adverse effects are detected, that these can be reversed or mitigated.

Key words: platypus, capture, environmental impact assessment, monitoring

Introduction

"The environmental impact assessment (EIA) shows that, environmentally speaking, this project is a *lemon*. It won't go ahead." How often is such a definitive decision made by a determining authority, on the basis of the findings of the environmental assessment process? Not often. Science, particularly biological science, deals with uncertainty and probability, whereas the environmental impact assessment process seeks certainty to inform decisions. Of course such certainty is not achievable in the real world and decisions are often made that "the environmental impact assessment process has identified a number of environmental issues. However, the project will proceed but will be subject to monitoring". Unfortunately, the detection of environmental impacts, or the lack of them, depends on the adequacy of monitoring programs. After a decision has been made, the onus is then placed on the proponents (i.e. their consultant scientists) to develop and justify the relevant monitoring program. This then moves the responsibility for protection of the environment from the decision-maker to the scientist. Unfortunately, for different species there are different constraints applying to possible monitoring programs. The constraints are often greater for species, like the platypus, where populations are small and/or where individuals are difficult to capture or observe. It is the author's contention that the decision-makers should be made aware of constraints applying to any mandatory monitoring program arising from their decision, **before** that decision is finalised. This should be done as part of the EIA process and decision-makers should recognise that current best practice monitoring for a species may not necessarily be able to detect adverse impacts, or be able to separate the effects of confounding natural perturbations from those attributable to the project in question. As an example, constraints on platypus monitoring are discussed in this paper.

In order to discuss monitoring programs for the platypus, it is first necessary to summarise the current methods, which include live capture and direct observation. These have been developed and practised by a number of workers over decades and are summarised here for the reader, including consultant scientists who may become involved in projects requiring monitoring of platypus populations. New, or modified techniques and methods will be developed but such advances can be facilitated by the availability of prior knowledge and experience. In other words, it should not be necessary for these consulting scientists to "reinvent the wheel".

Current monitoring methods

The distribution and abundance of platypuses can be assessed by visual observations of animals, usually around dawn or dusk, and/or by capturing animals in nets or traps during their foraging activities. Presence of the species can be detected by both observations and by capture, but absence is not necessarily indicated by non-capture or non-observation. Frequently, both methods need to be used. The author has experience of a number of instances where platypuses have been seen but not captured in an area or

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vice versa. Both observations and capture techniques can also yield qualitative estimates of numerical abundance, such as ‘rare’, ‘common’, and ‘abundant’, but quantitative estimates are more difficult to achieve (Grant 1992; Grant 2007). Observation and capture methods have benefits, disadvantage and limitations, which are discussed below and summarised in Table 1.

Mesh (‘gill’) netting

In deep, slow-flowing streams or in lakes, mesh nets with floats but no weights are normally used to capture platypuses; animals become entangled in the netting, bringing it with them to the surface, where they can breathe and from where they are retrieved (Grant and Carrick 1974; Grant *et al.* 2004a). This method is unsuitable where any significant flow is present (platypuses often pass under nets that have been lifted off the bottom by current), where large woody debris (LWD or ‘snags’) can snag nets and prevent animals from reaching the surface, or in places where large numbers of fish are caught in the nets. In the latter instance, entangled fish weigh the nets down so that netted platypuses cannot reach the surface. Where indigenous fishes occur in large numbers and/or where species of conservation concern are found, the risk of fish mortality can also make mesh netting unacceptable. In an increasing number of water bodies throughout the distribution of the platypus, feral fish species (especially common carp *Cyprinus carpio*) mitigate against the use of mesh nets (Grant 1993; Grant *et al.* 2004a). Where large numbers of fish are present, the chances of drowning platypuses are increased and/or platypuses avoid the nets due to the frequency of disturbance by constant attendance to the removal of entangled fishes. Mesh nets must be attended constantly from when they are laid until they are removed.

Mesh netting allows platypuses to be captured in a pool, reach or lake and can potentially yield estimates of their numbers. Nets are most effective in capturing platypuses if laid parallel to the stream flow. Laying nets in this way also reduces the accumulation of debris (Grant and Carrick 1974) but can result in some platypuses failing to be captured. Because nets are not weighted they do not represent a complete barrier and, where sections of net do not reach the bottom or are lifted by debris or by current, some platypuses may move under them. For this reason all animals present in a particular pool, reach or lake may not be captured and results of monitoring using this method are normally expressed as catch per unit effort (CPUE, e.g. animals/net hour; Grant 2006), rather than an absolute estimate of the numbers occupying the netted reach, pool or lake.

Fyke netting

Fyke nets are essentially wind sock-shaped fish traps (with several chambers separated by ‘valves’ that permit entry but not exit of platypuses and other species, including fish and turtles) laid in relatively shallow water with mesh ‘wings’ extending to the banks of the stream to direct foraging animals into the trap. These nets are also used in commercial eel

Table 1. Summary of sampling methods for the platypus

Method	Applicability	Limitations	Detect Presence/ Absence	Quantitative data	Breeding information	Condition information
Capture						
• Mesh (‘gill’’) nets	• Medium to large pools, dams, lakes • Potentially high capture rates	• Still or low flow only • Few/no fish present • Little/no LWD* present • Constant monitoring • Boat usually required	YES	• CPUE** • Possible mark-recapture estimates	YES - if sampling in breeding season	YES
• Fyke nets	• Small to medium sized streams • Not affected by: - presence of fish - presence of LWD • Intermittent checking • No boat required	• Less useful in large pools, dams and lakes • Movement between sites and/or • High number of personnel, depending on sites/distance • Presence of water rats	YES	• CPUE • No./km stream • Possible mark-recapture estimates	YES - if sampling in breeding season	YES
Observations	• Any water body • On foot or by canoe, kayak, boat • Not affected by: - presence of fish - presence of LWD	• Limited to 2-4 hr/day • Weather conditions • Season	YES	• Number Seen/ hour or /km	NO	NO

* **LWD** = Large woody debris, or ‘snags’ ** CPUE = catch per unit effort

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fisheries, both in Australia and overseas, but when used to capture platypuses, the hoops supporting the mesh walls of the trap, and the last compartment (cod-end) are held out of the water to permit captured animals to breathe (Serena 1994; Grant *et al.* 2004a). Fyke nets are normally laid in pairs, one facing upstream and one downstream (Serena 1994). This method is unsuitable in deep water and is normally limited to relatively narrow streams where the mesh wings can span the entire width of the stream. Fyke nets also have the advantage of being useable in water bodies where large numbers of fish are present. Captured platypuses make their way to the cod-end of the trap, which is held out of the water, while fish remain in the submerged sections of the trap. However, fyke nets have the disadvantage that the air spaces of the raised cod-end and/or top of the hoops can be submerged if the water level rises after a rainfall event locally or elsewhere in a catchment. In areas where the indigenous water rat *Hydromys chrysogaster* is present, these animals can be caught in fyke nets, from which they escape by chewing holes in the mesh sides. Any platypuses already captured, or others entering later, can then escape from the fyke nets through these holes. Attempts have been made to reduce this effect by setting baited cage traps along the banks of streams, where fyke nets are in use and water rats commonly occur, but with limited success in preventing them from entering the fyke nets (Melody Serena, Australian Platypus Conservancy, pers. comm.)

Although platypuses can leave the water and move along the bank to by-pass the wings of fyke nets, most individuals foraging along a stream where fyke nets are in use are caught, yielding a quantitative estimate of animals/unit of stream length (e.g. number/km of stream; Serena 1994; Gardner and Serena 1995; Serena and Williams 1997). Fyke nets have been used along the shallower edges of larger streams and in lakes, with the placement of wings opportunistically directing foraging platypuses into the entrance. In this instance numbers of captures are again normally expressed as CPUE.

If captured animals are marked, normally using microchips (Passive Integrated Transponder tags; Grant and Whittington 1991; Grant 2004a), population estimates can be made (Grant and Carrick 1978). However, failure to meet some assumptions for use of such mark-release-recapture estimates needs to be addressed. For example, unequal catchability of some individuals and between sexes and ages has been found, along with considerable mobility of many individuals, but with others in a population being relatively sedentary (Grant 1992, 2004a, 2007). Capture of platypuses can provide a range of other biological information which may be important in monitoring studies, including an indication of breeding as evidenced by the occurrence of lactating females (Grant *et al.* 2004) and/or by the presence of newly emerged juveniles (Grant and Temple-Smith 1998). Assessment of physical condition is also possible in captured animals, including tail fat storage condition (Grant and Carrick 1978; Hulbert and Grant 1983; Booth and Connolly 2008) and pelage condition.

Observations

Direct observations have been most often used to determine presence or absence of platypuses (Rohweder 1992; Bryant 1993; Rohweder and Baverstock 1999), but it is also possible to obtain a CPUE estimate (or observation/unit effort; e.g. numbers seen/km paddled or /hour of observation; Grant 2008). Observations are not limited by stream flows, LWD or the presence of fish and/or water rats, but are affected by weather conditions, time of day and season of the year. For example, a choppy water surface and glare from the sun early in the morning or late afternoon can reduce the chance of seeing platypuses. Easton *et al.* (2008) reported that cloud cover increased the numbers of platypuses seen, although this factor alone constituted only 4% of the total variability in numbers of platypuses observed in that study.

Most sightings are made around two hours before dark or after first light when platypuses leave their burrows to forage or before they retire (Grigg *et al.* 1992). However, even within that time frame, observations closest to dawn and to darkness are often the most productive for platypus sightings (Grant 2008). In some areas, and at different times of the year, more platypuses may be seen in the morning compared to evening (Rohweder 1992; Grant 2008), although in others there may be no difference (Bryant 1993). In two separate studies, observations were more productive in winter than in summer (Grant 1983; Easton *et al.* 2008), while in another the reverse was the case (Grant 2008). As a result, observations used in monitoring studies should occur both morning and evening and sampling should be carried out in more than one season. Unfortunately observations provide no information on either breeding or body condition.

Figure 1 shows the currently available sampling methods that can be used, alone or in combination, in platypus monitoring studies. Because of the advantage of being able to obtain information on breeding and/or body condition, capture is the preferred sampling method. Sampling should ideally be carried out during the breeding season when lactating females are most likely to be detected (November-January in New South Wales) and/or when juveniles have emerged from the nesting burrows but have not begun to disperse from their natal area (late January to early April in New South Wales: Grant 2007; Grant *et al.* 1983; Grant and Griffiths 1992; Grant *et al.* 2004b). Observations alone are preferred only where there are limitations to the use of capture methods. However, observations may be an important adjunct to capture, especially if capture rates are low or where environmental conditions (especially increased flows) change within a sampling period or from one sampling period to another, affecting the use of capture methods.

Although the methods used to collect data on platypus distribution and abundance are well known and tested under a variety of field conditions, the limitations discussed above indicate that the currently available methods can place constraints on the planning and execution of a

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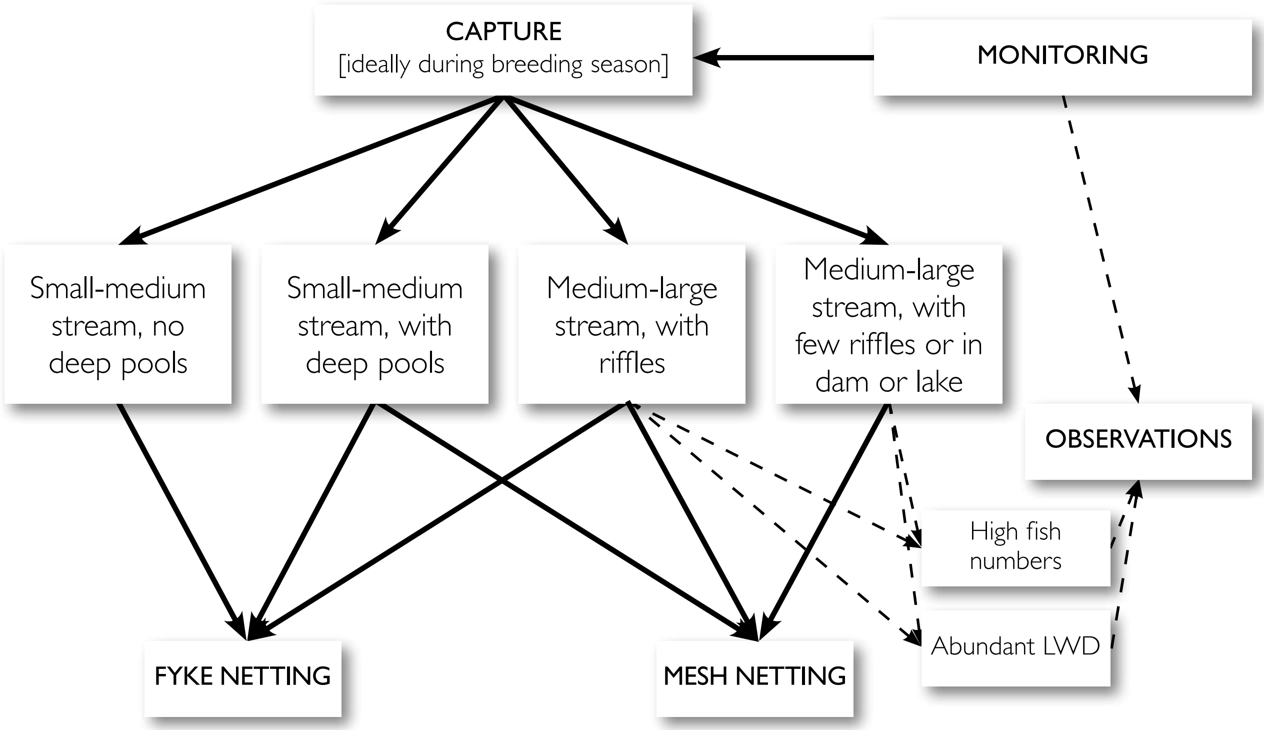

Figure 1. Preferred (←———) and alternative (← – – – – –) sampling for monitoring studies

monitoring program. For example, in a large stream where fyke netting is unsuitable and there are large numbers of fish and/or LWD is widespread (also making mesh netting inappropriate), observation would be the only possible monitoring tool. However, considering that platypuses may live and breed for up to 21 years in the wild (Grant 2004a), observational data may not be definitive in allowing detection of an adverse effect. Such data could indicate no apparent ill effect of a project, with platypuses being observed in similar numbers/unit of observation before and after a project has occurred, when in fact the animals present may not represent a viable breeding population in the long term.

MONITORING PROGRAMS

Even if routine capture with fyke and/or mesh netting is possible, a number of constraints still impinge on the ability of a monitoring program to detect the presence or absence of detrimental effects on a platypus population. Several potentially confounding effects are discussed below which may reduce or negate the capacity of a monitoring program to detect adverse effects.

Capture variability

Figure 2 shows the variable numbers of platypuses captured using mesh nets during a single session of netting in one pool during March and December in the upper Shoalhaven River during eight non-drought years (1984-1991). At each sampling period, river and climatic conditions were comparable[1] and in all instances three 25 m nets were used and were in the water for the same period of time[2]. Such variability in capture rates commonly occurs when capturing platypuses using mesh nets, so that conclusions based on capture data from sampling before and after a disturbance such as a development project must be interpreted cautiously.

Easton *et al.* (2008) also found considerable monthly/seasonal variations in numbers of platypuses captured in fyke netting, probably indicating differential mobility of platypuses within streams through the year.

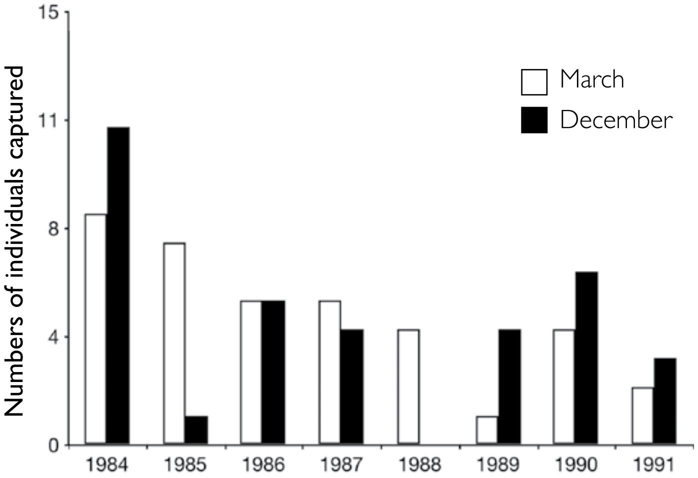

Figure 2. Variation in numbers of platypuses captured in standard mesh netting in a single pool in the upper Shoalhaven River during non-drought years. Data for December 1988 was deleted due to the occurrence of higher flows during the sampling on that occasion. Grant, unpublished data.

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[1] December 1988 value deleted as some flow at that time was lifting nets slightly above the bottom.

[2] 1 hour before dark until 5 hours after dark.

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Capture numbers

The numbers of platypuses captured in a single night of either mesh or fyke netting are almost always lower than 20 individuals (e.g. Fig. 2). In small streams, capture rates are often much lower (less than 5/net night). The maximum number of platypuses captured per night at four sites on the upper Nepean River in the southern tablelands of New South Wales was four, with zero captures occurring at some sites (Fig. 3) (Grant 2006). While captures during the breeding season can provide useful information by confirming breeding (presence of lactating females and/or emerging juveniles) and captures at other times can provide information on body condition, very low capture rates make the interpretation of population data very tentative indeed. For example, would a mean number of three platypuses captured in sampling before a project, and a mean of two after the project, indicate that the project was having a significant effect?

In small streams, such as the upper Nepean River example above, the total population and foraging mobility of platypuses in the system mean that the numbers of platypuses caught during any sampling period are likely to be too low for statistical analysis of the data, irrespective of netting effort. In such instances, positive capture data only serve to show that the species still occupies the water body. Sampling during both the period when most breeding females would be lactating (November to January in New South Wales) and when juveniles are leaving the nesting burrows but have not dispersed from their natal area (late January to early April in New South Wales) must be included in any monitoring studies where numbers of captures are likely to be small. Such sampling should at least provide an indication of whether or not breeding and recruitment are occurring during both baseline and monitoring sample periods.

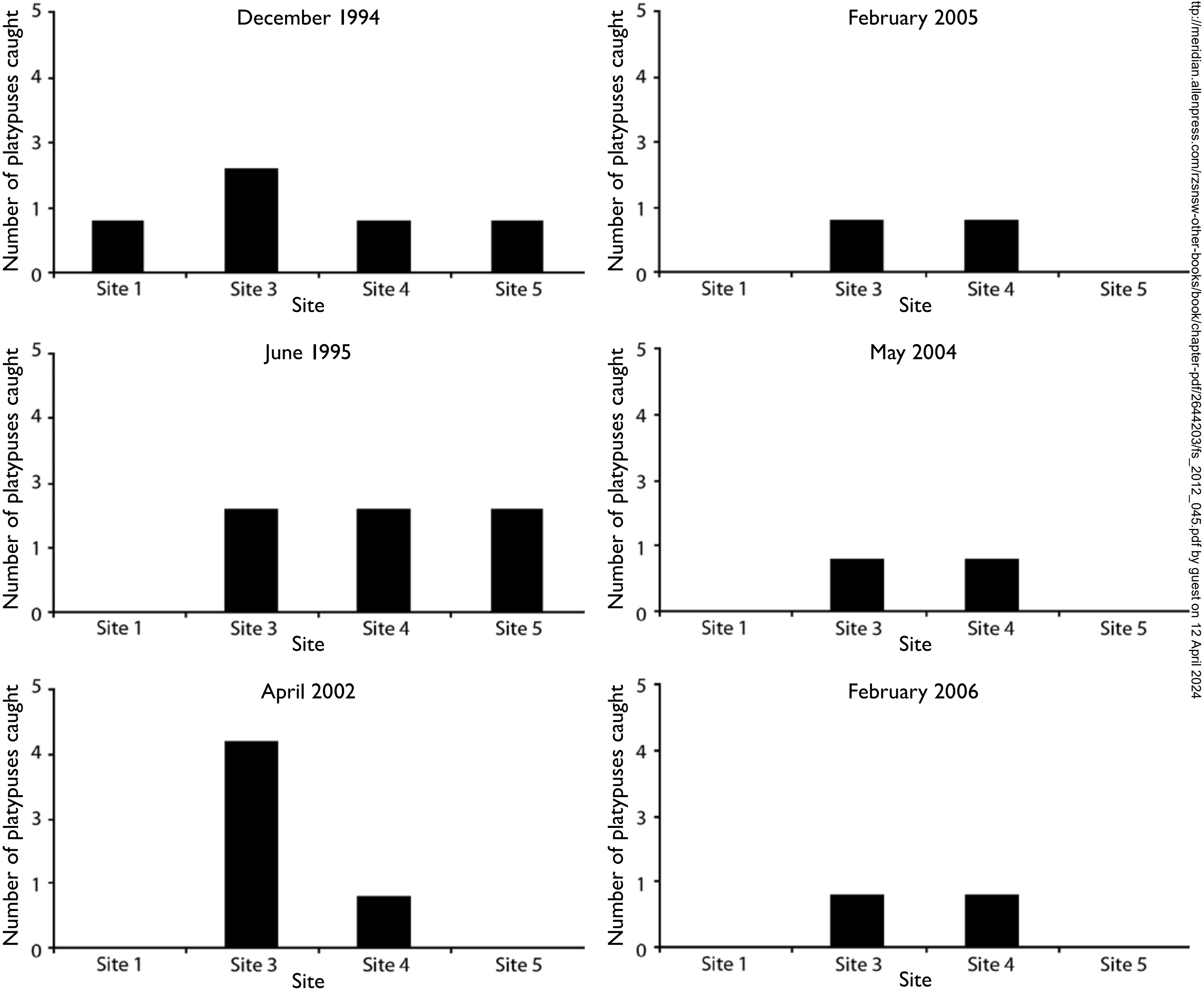

Figure 3. Numbers of platypuses captured in a single mesh netting session at four separate sites on the upper Nepean River in NSW during sampling trips between 1994 and 2006. All sites were sampled on each trip; i.e. no data column in a graph represents zero captures in that netting session. From Grant, 2006.

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Variability of sightings

As discussed above, monitoring of platypuses by observations is normally the least preferred method for a monitoring study (Table 1). On the other hand, observational monitoring has the least number of restrictions on its use and is often the most appropriate for involvement of stakeholders (e.g. community groups) in the monitoring process, due to fewer requirements for equipment and authorisation (e.g. ethics, fisheries, wildlife approval). Unfortunately, both occurrence (numbers of sites, observation sessions, kayak transects, in which at least one platypus is seen) and numerical (numbers of individual platypuses seen per site, observation session, kayak transect) data arising from observations may also be variable. Figure 4 shows such variability in transect counts of platypuses in the lower Hastings River (Grant 2008). Such within-site variability again indicates that data arising from observational monitoring must be interpreted cautiously.

Indirect methods

Platypuses depend on the water bodies in which they live for their food supply (mainly benthic aquatic macroinvertebrates; Faragher *et al.* 1979; Grant 1982; McLachlan-Troup *et al* 2010). Several studies have identified a range of riparian and instream habitat variables associated with the presence, but not numbers, of platypuses (e.g. Bryant 1993; Grant 2004b; Grant and Bishop 1998; Rohweder 1992; Serena *et al.* 1998). It can be inferred that a decrease in food availability and deterioration of habitat quality attributable to a project would be expected to impact adversely on platypus survival and/or reproduction. However, although habitat variables and availability of macroinvertebrate food items can be measured quantitatively, these measurements cannot yet be used to estimate numerical changes in a platypus population.

Discussion

Given the constraints discussed in relation to the current best practice of the study of platypus populations, can a monitoring program be designed that can reliably detect significant adverse impacts, or lack of such impacts, on populations exposed to a human-produced perturbations and separate effects of natural perturbations from human-induced ones? Probably not, although it should be possible to detect gross population trends. Monitoring programs utilising current methods, particularly observations rather than captures, could miss subtle and/or long-term trends. It is the responsibility of consultant scientists developing environmental impact assessment documents, such as Reviews of Environmental Factors (REF) or Environmental Assessment Reports (EAR) to inform the decision-makers of the constraints applicable to any monitoring programs that might be specified as a caveat to a decision for the project to proceed.

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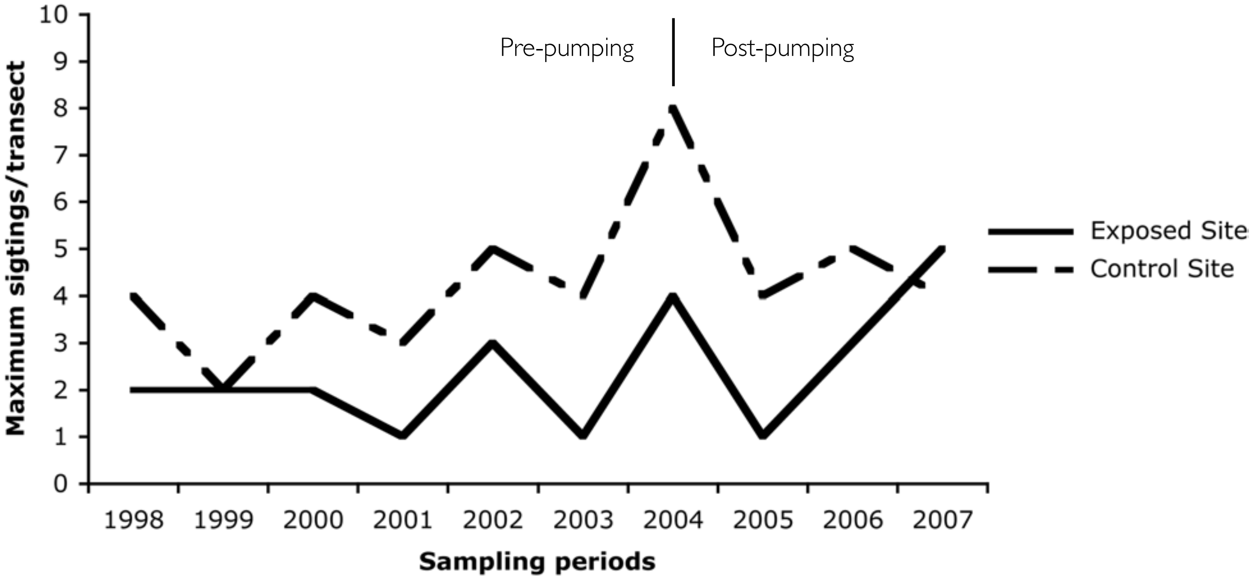

Figure 4. Numbers of platypuses observed in 1.5 km kayak transects in the lower Hastings River upstream (Control site) and downstream (Exposed site) of the water offtake for the Hastings-Port Macquarie water supply scheme in the period leading up to and after the commencement of augmented water extraction from the river (from Grant, 2008).

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