Forestry

Forestry and resource management: NIWA's role

In the context of the Resource Management Act, NIWA can offer a range of skills to the forestry industry, to help it meet its obligations in the sustainable management of the environment and of the forestry resource itself.

IN A WORLD that is running out of wood for its future generations, New Zealand finds itself in a unique position. With over one million hectares of land covered by a rapidly-renewable resource called *Pinus radiata*, forestry has developed into a billion-dollar-a-year export industry, employing tens of thousands of people. Predictions suggest that, by the turn of the century, the industry will be New Zealand's major export dollar-earner.

With such a prominent role in this country's economy, the benefits of the industry are easy to identify. However, forestry also has a direct impact on the environment, affecting a complex network of ecosystems.

Resource Management Act

In the early days of European settlement, logging of native timber continued, unchecked, for decades. There was virtually no consideration of its long-term effects. Nowadays, the introduction of *Pinus radiata* has allowed the industry to become a highly-mechanised, efficient and profitable business. Moreover, since the passing of the Resource Management Act (RMA), it is an industry charged with taking a responsible attitude towards the impacts its operations may have upon the environment.

A gully recently harvested of its crop of Pinus radiata. *Continued monitoring will show how the harvest has affected the stream's physical and biological characteristics*

While the visual impacts of forestry must be taken into consideration, under the terms of the Act, the protection of aquatic ecosystems is of primary concern. Forestry operations can affect streams, rivers and lakes, as well as coastal waterways. The RMA puts the onus on the industry to monitor its operations and define likely impacts, with a view to either avoiding, minimising or providing some sort of mitigation of these impacts.

Forestry and ecology

The science of ecology relates to (a) the habitats and mode of life of living organisms and (b) the relationship of these organisms to their surroundings. With regard to aquatic ecosystems, the natural order can be affected by forestry operations in a number of ways, including:

- reduced shade (leading to higher stream temperatures in summer);
- increased sediment run-off;
- increased nutrient input (leading to eutrophication in lakes);
- altered physical and biological habitat (affecting food and environment);
- altered flow regime;
- ecotoxicity (from herbicide input during reafforestation).

Faced with the possibility of these impacts and given the requirements of the RMA, it is in the interests of the forestry industry to take the initiative in fulfilling their responsibilities. Should this not happen, the Act provides the means to stop, or place controls on, any activity, e.g. logging, that can be shown to be having a detrimental impact.

It is very encouraging that a number of major companies in the industry, have wasted no time in accepting their accountability and in recognising the expertise which NIWA can provide, to assist them.

Specialised knowledge

Collecting and recording data to document the effects of forestry does not, in itself, identify problems, let alone provide answers. The skilled ecological knowledge and interpretation of an experienced aquatic biologist is needed to achieve a real understanding of forestry's impacts.

Specific knowledge of a particular type of environment permits NIWA's biologists to

predict not only whether ecological impacts will occur but also the nature and extent of those impacts. For example, stream ecosystems are studied by focusing on invertebrates such as insect larvae, snails and worms, all of which play an important part in the functioning of the ecosystem. Much is now known about their habitat requirements and tolerances. It is known, for instance, through such studies, that filter-feeding organisms, such as caddisflies, are particularly susceptible to sediment discharge. These invertebrate groups are essential components of the food chain and, in particular, are considered high-quality food for trout.

In conjunction with the study of invertebrates, the physical characteristics of the stream are also monitored. It is here that the relationship between NIWA and its clients is epitomised, by the development of self-monitoring programmes, such as taking "black-disc" measurements (see inset next page) to assess water clarity, which directly involve the client in the study process. In addition to minimising costs, self-monitoring has the advantage of providing forest managers with instant feedback on the impacts of their management.

Above:
Part of an environmental study looking at the effects of forestry on streams. NIWA staff measure benthic metabolism and current velocity

Above left:
Stream showing the results of forest harvesting: reduced shade, increased sediment runoff, altered flow regime

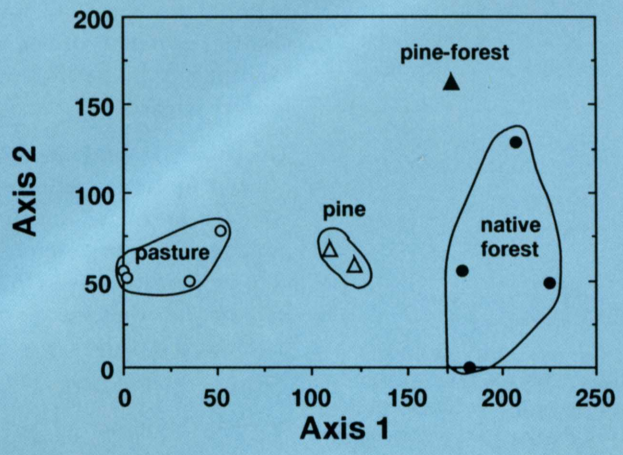
Clues from invertebrate communities

Communities of invertebrates living in streams (technically known as benthic invertebrate communities) can provide a guide to the effects of forest management practices. We call this biomonitoring.

One method involves comparing communities within an area, from a range of streams whose catchments have been exposed to different levels of disturbance.

This diagram shows the results of a statistical test (Detrended Correspondence Analysis) on data gathered from the Whatawhata experimental area, near Hamilton.

It shows the similarity between invertebrate communities from streams of the same land use, and the progressive shift from the native condition with land use change to pine forest and pasture. Each symbol represents data from a separate community.



Estuaries - a special concern

Stream ecosystems represent only one area where the techniques developed by NIWA's scientists facilitate direct monitoring of ecological impacts. Some environments, such as those of estuaries, are especially sensitive. Forest harvesting in catchments surrounding these areas requires meticulous documenting of impacts and careful environmental management.

Public interest in environmental issues has increased greatly over recent years and estuarine environments frequently attract public attention when pollution or degradation threatens. Estuaries attract industries such as aquaculture and also support a variety of activities for leisure-users in addition to providing a unique habitat for wildlife. Where a complex ecosystem like this is possibly at risk, through forestry, the techniques devised by NIWA to monitor, record, and predict the outcome of such a situation, address the resource management issues in seeking to minimise the impact of forestry operations.

By studying the physical aspects of the estuary, over a wide area, sediment types can be identified and, with aid of modelling techniques, potential areas of sediment accumulation predicted. A survey of the biological community is the first step towards implementing a monitoring programme and it is essential that monitoring takes place before any impacts occur, in order to provide a base-line against which to assess any impact.

Research is the key

Because NIWA is actively conducting research into the functioning of aquatic ecosystems, this state-of-the-art knowledge is constantly being applied, for the benefit of NIWA's clients. For example, research into riparian management and rehabilitation of degraded environments has direct applications for mitigating against forestry impacts.

The knowledge and inter-disciplinary expertise offered by NIWA represents the most cost-effective means of not only monitoring the impacts of forestry operations but also being able to predict and help to minimise those impacts; in other words, complying with the requirements of the Resource Management Act.

NIWA is utilising its unique skills to work successfully with the forestry industry, to address the responsibilities of today's resource management issues, for a better tomorrow. ■

Further information

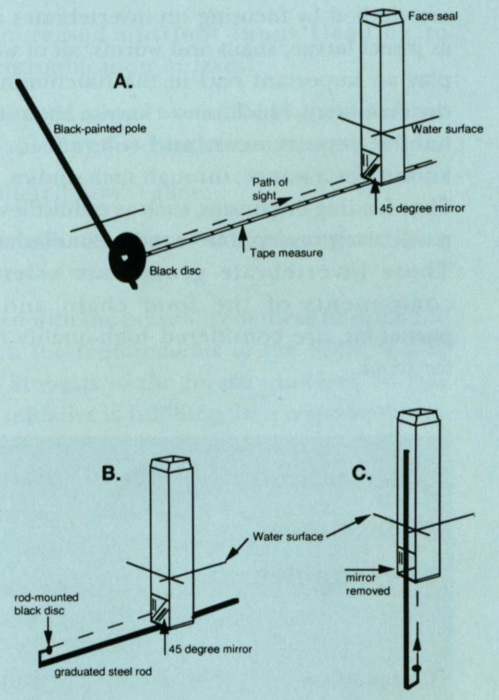
For more information about the services NIWA can provide to the forestry industry, contact: Jim Cooke, NIWA, PO Box 11-115, Hamilton (Tel: 07 856 7026; Fax: 07 856 0151)

The black disc

The black disc developed by NIWA is a simple, robust, low-tech, low-cost, field instrument for assessing water clarity. It is useful in clear, shallow and fast flowing rivers.

The black disc reflects no light. When the disc disappears, this is a measure of visibility - a good measure of distance that sighted animals can see under water. The black disc method for assessing visual water clarity conforms to the theory of visibility for a large, dark object and provides a simple means for predicting the effect on visual water clarity of a turbid inflow to a river.

An underwater viewer with both side and end windows, and a removable 45° mirror, is used for the observations.



A. Horizontal observations in natural waters with discs of larger sizes fitted to a pole. Two people are normally needed for this measurement: one to hold the disc and one to make the observation. (Vertical observations with the larger black discs are made by one person.)

B. Horizontal observations in turbid water with a small disc fixed permanently to a blackened steel rod.

C. Vertical observations in turbid water with a small rod-mounted black disc.

Using the black disc - an adaptation

IN JANUARY 1993, Environment Waikato began a Regional River Monitoring Programme to investigate the water quality of the region's rivers. Currently, 70 sites throughout the Waikato region are monitored monthly for a variety of parameters, including visual clarity measured with the black disc developed by NIWA. Existing water quality monitoring programmes (Waikato River, Piako/Waitoa, Coromandel, Ohinemuri) will be gradually incorporated into the regional network over the next few years.

The problem

The usual two-person method for measuring black disc clarity at wadeable depths in rivers is often impractical because, frequently, only one person is available. How can the disc be mounted so that it can be viewed, without interference to the light field, while at the same time the observer holds a tape measure taut to record viewing distance? To make things more difficult, often all this must be done in strong currents. One solution has been to drive a black-painted stake into the stream bed, as a support for black discs. However, this is not an option in bedrock or boulder bed streams, and this method is rather inconvenient for routine monitoring.

The solution

Technical staff from Environment Waikato's Environmental Quality unit have developed a system to overcome some of these problems. The apparatus is basically a tripod which can be set up quickly, and which is stable in a range of flow and bed conditions. A main central pole holds a sliding black disc and measuring tape attachment points. A pair of extendable, "spiked" steel legs are each attached by a ball joint to a third sliding attachment. All three recommended black disc sizes (20, 60 and 200 mm, depending on water clarity) can be screwed on and off the black disc holder. The measuring tape holder is attached such that the tape zero mark is aligned with the leading edge of the black disc. The screw-in system for the black discs eliminates lateral disc movement. It also allows the disc holder to be angled against the flow, which can further stabilise the tripod system in certain flow conditions.

The entire system weighs only about 5 kilograms. It is easy to carry and can be operated by one person. For extra stability in high flows and on hard substrates, a selection of steel base plates of differing size and weight can be used.

Initially, a steel, retractable, builder's measuring tape was used with the system, but after a few days of field use, the retraction mechanism seized and the tape became useless. A recent modification is a hook placed on the measuring tape holder allowing for the use of non-retractable vinyl tapes.

The system has some limitations. For example, it is difficult to stabilise the tripod on smooth, hard rock river beds in fast flows, and it is not designed for deep rivers (>1.5 m) or lakes.

The cost

Environment Waikato currently operates two such devices. These were constructed for a cost of around $500. For further information contact Harley Prowse or Brett Moore at Environment Waikato, PO Box 4010, Hamilton East. (Tel: (07) 8567184; Fax: (07) 856 8089; e-mail: harleyp@wairc.govt.nz)

Taking a black disc reading in the Umangawha Stream, Colville, Coromandel Peninsula. (This photograph illustrates some not-so-obvious factors which need to be considered when performing a reading. (a) The operator is casting a shadow across the line-of-view of the disc; (b) he is viewing the disc with insufficient water background (i.e. it is too close to the bank); (c) the measurement is being made in a still pool, where sediment settling characteristics are different; flowing water is preferred; (d) the location is not truly representative, because of the local impact of the ford.