PEST CONTROL: ACHIEVING ECOLOGICAL AND ECONOMIC SUSTAINABILITY- A NEW APPROACH

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SUMMARY

Assigning contestable property rights by using contracts with payments based on the absence pests could result in a more efficient allocation of scarce resources in dealing with pest problems. Effort would be targetted at those areas where pest absence is desired because the goals of pest controllers, government, farmers and conservationists would be in concordance. This approach could give greater transparency to the decision making process and could also encourage innovation in methods to control pests. Ecological and economic sustainability with respect to pest control would thus be more likely to be achieved.

ABSTRACT

Biological pests detrimentally affect many agricultural and ecological values. Possums, goats, thar, deer, pigs and *Pinus contorta* are some of the many pests in New Zealand. Except on small islands it is not generally possible to eradicate any widespread pest. It however can be feasible to reduce and maintain pest numbers at ecologically and agriculturally acceptable levels. Control mechanisms which are economically sustainable need be put in place for perpetuity if long term ecological sustainablity is to be achieved. Present control mechanisms generally rely on a value being put on individual pests (through the value of fur, meat, etc), by the use of some form of bounty, or by using poisoning programmes. It is argued that these give incorrect economic signals which may result in inefficient use of resources. It is normal to place a positive value on those things that are wanted and a negative value on those things not wanted. With regards to pests their destruction is desired. It therefore follows that a positive value should be placed on their absence and and negative value on their presence. Bounties and by-products however place a positive value (to the pest controller) on the presence of the pest. There is a need to relate incentives to pest controllers to the values at stake and the results achieved. Creating transferable property rights to the absence of pests could result in an economically efficient solution to ensuring long term and sustainable pest control. The maximum tolerable population level (TPL) of pests and the willingness to pay to achieve this level needs to be established by those seeking pest control. Pest controllers would then competitively tender for the right to reduce to and then maintain the TPL in a particular area. Payment schedules would be such that the marginal rate of return would increase until the TPL was reached. Effort would therefore be targeted at achieving and maintaining TPL. It is considered that this approach will be more likely to result in ecological and economic sustainability objectives being met.

Key Words:
Resource economics, bounties, tradeable property rights, pest absence, competitive tenders.

INTRODUCTION

Biological pests detrimentally affect many agricultural and ecological values. Possums, goats, thar, deer, pigs, *Clematis vitalba* and *Pinus contorta* are some of the many pests now in New Zealand. The large majority of pests are introduced and have generally been deliberately introduced for some "economic" purpose. These purposes have included perceived benefits for fur, meat or sporting potential. Subsequently because of the ecological damage or threat to agriculture they are now regarded as pests.

Except on small islands it is not generally possible to eradicate any widespread pest. It however can be feasible to reduce and maintain pest numbers. Control mechanisms will need be put in place for perpetuity if the values at risk are to be protected and sustained in the long term. This control will need to fulfil both ecological and economic sustainability criteria if the control is to be carried out in perpetuity.

ECOLOGICAL AND ECONOMIC SUSTAINABILITY

Ecological systems are generally in a continual state of flux and change. Introduction of new species to ecological systems results in changes to the dynamics of that system. If the change is significant, and contrary to what is desired, then that species is considered to be a pest. It therefore follows that the purpose of controlling pests is the maintenance

and/or restoration of the previous ecological dynamic, in both natural and agricultural settings. If the ecological attributes of the system are to be sustained then the pest will have to be controlled to levels below that at which unacceptable changes occur. If the pest can not be exterminated it then follows that any control undertaken has to be in perpetuity. In the absence of biological control any attempt to deal with the problem will therefore require a long term commitment to providing sufficient resources to ensure an adequate level of control.

Economic sustainability with respect to pest control at a minimum requires that the long term benefits (both market and non-market) of pest control is equal or greater than the costs incurred in achieving that control. Ideally however in order to maximise societal welfare benefits any effort put into pest control should fulfil economic efficiency criteria. Economic effiency is achieved when the output of wants (including pest control) is maximised from the limited resources available. A fundamental condition for economically efficient resource use is that marginal benefits should equal marginal costs.

TRADITIONAL APPROACHES

The traditional approach to dealing with most animal pest problems has been to use, either singly or in combination, commercial, recreational and waged hunting; bounties; and/or poisoning programmes. All these approaches, for example, have been used with possums. In the past fur trapping provided the major form of control on the possum population. However with the fall in fur prices in the 1980's hunting pressure on possums declined markedly.

Bounties have been placed on possums in the past and it has been suggested that it may be appropriate again as a way of dealing with this and other animal pest problems. A bounty however would not discriminate between a possum killed in an important wildlife refuge or shot from the side of the road. The problem with bounties, as with commercial and recreational hunting, is that people are encouraged to kill pests in areas where they are easy to kill, which may not necessarily be areas where killing pests has significant environmental benefits. Only when pest numbers are reduced to a level that requires the same amount of effort as the 'next' area will the focus of attention expand. It is also in the pest controllers' interest as a group to ensure that breeding populations remain in all areas to supply future income. For example when fur prices were high possums were deliberately introduced into previously possum free areas, with the result that almost all mainland New Zealand is now affected by possums. Bounties on other pests could encourage 'ranching' of those pests with their release into new areas. For example wild pigs are being illegally released into areas previously free of pigs because of their recreational value to hunters. Placing a bounty on wild pigs would accelerate this activity.

Waged hunting and poisoning programmes, although generally carried out with the best intentions and despite being closely monitored, also have no inherent mechanisms to ensure that resources are used in the most efficient manner. Audits are bureaucratic and cumbersome, even in the best command and control systems.

NEGATIVE AND POSITIVE VALUES

It is normal to place a positive value on those things wanted, and a negative value on those things not wanted. With regard to pests their destruction is desired. The conservation and agricultural objective is to be free of pests (or at least to have considerably fewer pests). It therefore follows that a positive value should be placed on their absence and a negative value on their presence. Bounties, fur trapping, recreational control, and even poisoning programmes however place a positive value on the presence of pest species (to the hunter or control agency) and as a result give the wrong economic signals for achieving conservation and agricultural goals. Acting in a rational manner pest controllers will maximise their return by harvesting at the maximum economic yield of pests. This maximum economic yield however is unlikely to result in a population in concordance with the maximum environmentally tolerable level of pests desired.

HIGH AND LOW VALUES

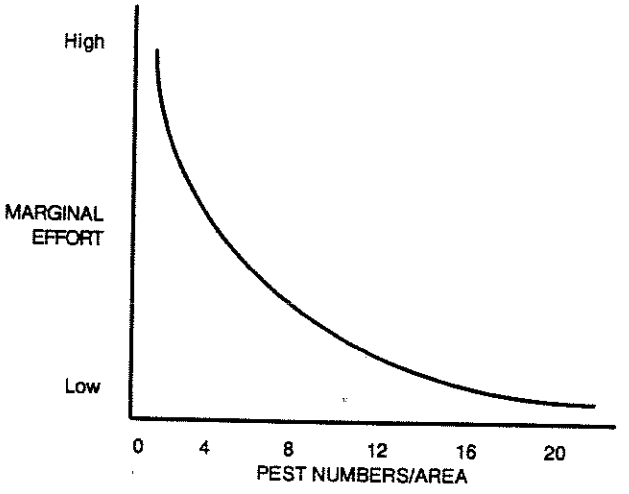
The degree of pest absence desired varies with the values that are threatened by the pest. For example with possums only low numbers can be tolerated in kamahi-rata or pohutukawa forest, within national parks, or in areas adjacent to high producing dairy land. High numbers however may be acceptable in gorse covered land with no nearby grazing.

The use of bounties and fur trapping in reducing pest numbers does not recognise the variation in value ascribed to different environments. The correlation between pest controller effort and environmental value is low or random and therefore inherently inefficient in allocating scarce resources. What is required is a system that will efficiently concentrate high pest control effort into areas of high environmental value and not promote effort in areas of low value.

EFFORT AND THE PEST POPULATION

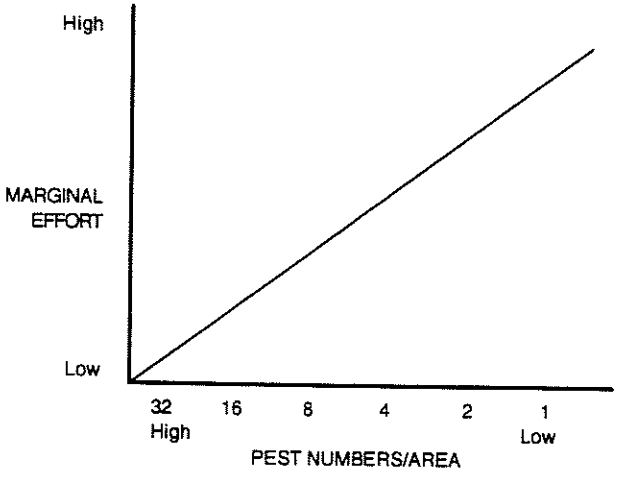
Except on small islands it is generally not possible to eradicate any widespread pest. It however can be feasible to reduce and maintain pest numbers in selected areas. It is very easy to kill the first pest but the effort required to kill subsequent pests increases with each pest killed. When there are 1000 pests in an area it is relatively easy to find one. If there are only 10 pests in that area it takes considerably greater effort to find one. Using economic terms the "marginal cost" (MC) of finding an additional pest is high when there are few pests and low when there are many. Graphing the effort by the number of pests present would probably result in a hyperbolic curve (fig 1).

Figure 1 Marginal effort required to kill one extra pest vs pest density



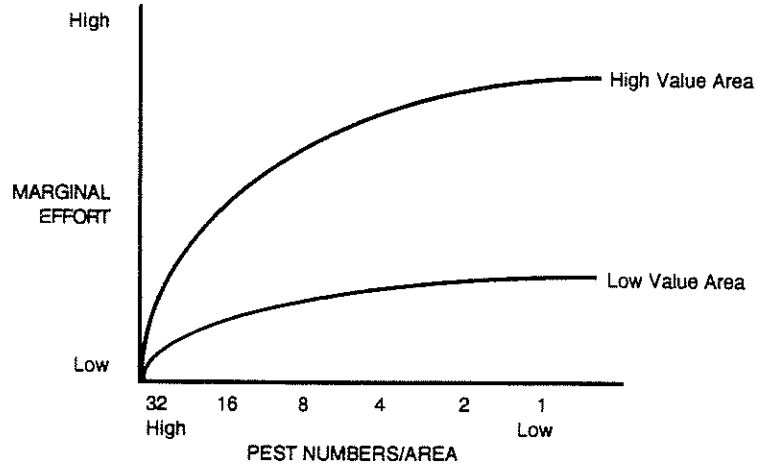
The marginal cost can also be represented by a straight line (Fig 2) if the pest numbers are plotted on a geometrically regressive scale. (This makes it easier to conceptualise what follows.) Effort or cost can be represented in terms of dollars spent (on person/hours and resources used.)

Figure 2 Marginal effort required to kill one extra pest vs pest density



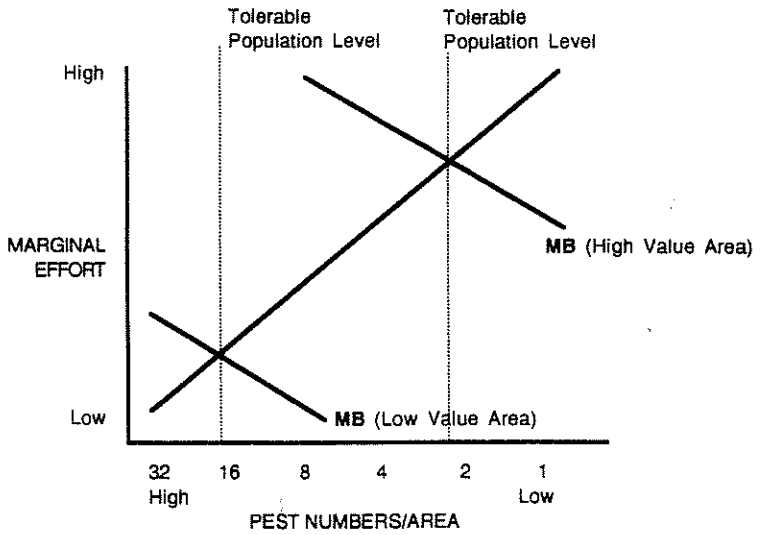
The benefit derived from pest absence, and consequently willingness to pay (WTP) for pest absence, will increase with increasing pest absence. This benefit (and WTP) will be higher for high value areas than for low value areas. The marginal benefit (MB) however will decrease as pest populations are reduced (Fig 3).

Figure 3 Relationship of total benefit derived vs pest density achieved



While the benefit derived from each subsequent pest killed increases, the additional benefit derived is less than the additional benefit derived from killing the previous pest. Economic efficiency is maximised when marginal benefit equals marginal cost (MC) (Fig 4). That is when the difference between costs and benefits is greatest.

Figure 4 Relationship of marginal benefit and marginal cost vs pest density achieved for high and low value areas.



CONTESTABLE OR TRADEABLE PROPERTY RIGHTS

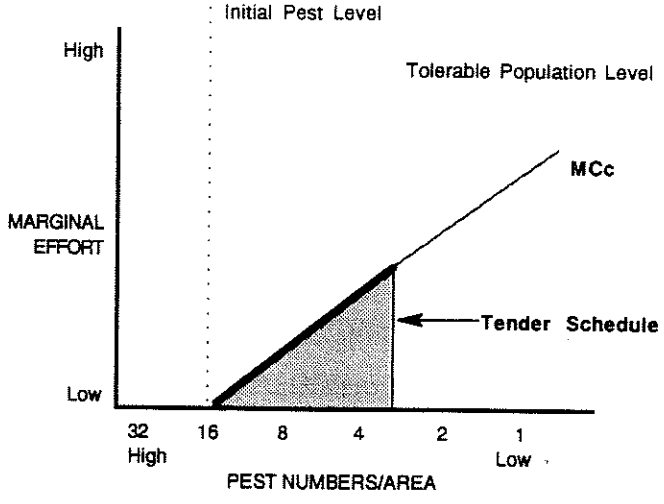
One possible approach that may achieve economic efficiency would be the development of an institutional arrangement that assigns contestable or tradeable property rights to the absence of pests. A method to achieve this would be through a system of transferable licences to rights for the absence of pests. 'Pest blocks' would first need to be valued in terms of 'pest freeness' desired for conservation or agricultural purposes. In other words the maximum tolerable pest population that each environment or block could sustain without unacceptable damage or disease threat occurring has to be defined. There has to be a concordant willingness to pay for this benefit by government, farmers, tourist operators, and/or conservationists.

The value placed on an area, or the desire for an area to be free of pests, has to be equal or greater than the effort or cost required to achieve the desired level of pest control. If it is less then the level of control desired will have to be re-evaluated, or resources redeployed.

Pest controllers will kill pests until the marginal benefit (MB) to them equals their marginal cost (MC). This point of equality needs to coincide with the target or tolerable population level (TPL). The TPL (which is derived from the marginal costs and benefits of those paying for the control of pests). To achieve the most cost effective control the actual payment schedule to the pest controller should equal the marginal cost of the pest controller. However it is very difficult for people other than pest controllers to know what this marginal cost will be in every (or any) situation, given the variability of "pest blocks" for topography, vegetation cover, distance from population centres, etc. These factors have a profound influence on the amount of effort (or cost) required to kill a pest, or achieve and maintain "pest freeness".

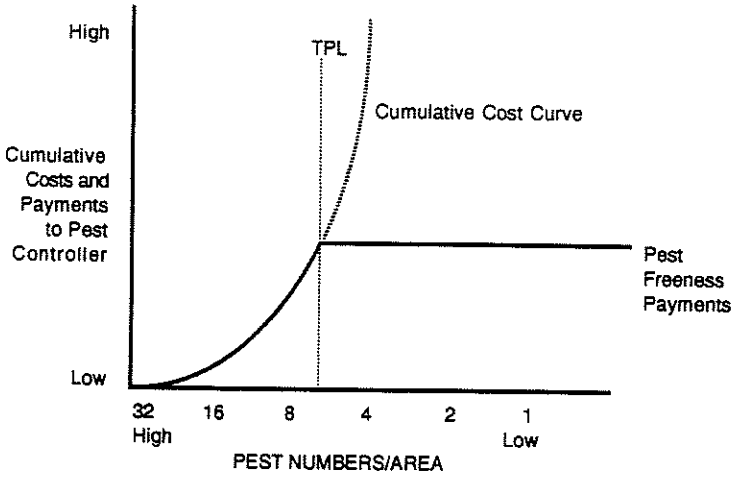
A simple way of overcoming the problem of estimating the marginal cost of pest controllers would be to allow pest controllers to competitively tender for the right to achieve and maintain pest absence in a particular area. The pest controller is the expert and s/he knows how much it is worth to them to control pests in a particular area. In a competitive situation the tender schedule for the right to keep areas free of pests should equal the marginal cost of the pest controller. For areas requiring reductions in pest numbers the tender schedule would increase inversely to the number of pests remaining up to the target or tolerable population level. Until the tolerable population level is achieved the 'marginal rate of return' would increase for the pest controller for each pest absent from the area (Fig 5).

Figure 5 Reduction Phase - Tender Schedule offered by the pest controller equals the Marginal Cost of the pest controller



Effort above the tolerable population level however would have a zero marginal rate of return. Effort by the pest controller would consequently be targetted at achieving the tolerable population level as this would give the pest controller the greatest financial return for effort expended (Fig 6). For areas requiring maintenance of pest numbers the tender offered would be a single figure. This would be paid only if the pest density was at or below the required level.

Figure 6 Pest Freeness Payments received by the pest controller



The pest controller's tender will be influenced by whether the marginal cost is high or low (because of access problems, topography, etc) and the degree of pest control desired. Tender schedules would also reflect the value of residual products such as fur. In areas where high pest numbers are tolerable, and the pest has a marketable by-product, it is conceivable that a resource rental could be paid by the pest controller for the right to harvest pests. All other things being equal the returns received by pest controllers should be equal for each unit of effort expended, whether or not access was easy or difficult, or the tolerable population level of pests was high or low.

The term of pest block contracts for areas requiring reduction in pest density would be for the estimated period required to achieve that reduction. Contracts for areas requiring maintenance of pest densities would tend to be long term. However in the initial years of any scheme contracts should probably be relatively short term in order that the market for pest freeness gain knowledge and experience. Time will be required for those providing the service (pest controllers), and those buying the service (government, farmers, conservationists, etc), to determine or establish their marginal costs and benefits, and thus fine tune the appropriate ranges for their tender schedules or willingness to pay.

Because the contracts to blocks would be transferable this would encourage the use of the most effective techniques for getting rid of pests. Those who are able to maximise their returns would move into the industry and those who were inefficient and ineffective would move out. Efficient pest controllers would buy out inefficient pest controllers. Innovation would also be encouraged by the desire to maximise returns. Control mechanisms used would be up to the 'pest block' owner (whether they be hunters - recreational or professional, private individuals or companies) and they would be free to choose the most appropriate control method. (There may have to be some form of oversight to ensure that the values sought to be protected were not harmed by the method to achieve pest freeness.)

'Poaching' of pests would also be encouraged as this would be to the benefit of both the 'poached' neighbour and the 'poaching' block owner. 'Poachers' would be protecting their property right to the absence of pests from the threat of wandering pests.

Whatever the approach used for controlling pests there should be monitoring undertaken to determine the effectiveness of the method. Monitoring of pest numbers when using a property rights approach may require a greater degree of accuracy than that required with other approaches because of the sliding scale nature of the payment system. To ensure that the 'transaction costs' of this approach are minimised, and also ensure that the pest monitoring is seen as unbiased by both the pest controller and the payer, the right to monitoring pest numbers should also be contestable. This would result in policy, regulatory and implementation activities being kept separate. A quality assurance scheme may be needed for those undertaking monitoring.

Another advantage of a property rights based approach is that of greater transparency. The rationale for values placed on areas would need to be explicit, and the costs incurred in achieving a stated objective would be more visible.

BIOLOGICAL CONTROL

Biological control, if suitable control agents can be found, can have a dramatic influence on pest numbers. Biological control however is species specific while methods such as trapping or poisoning are site specific. Site specific controls are amenable to transferable property rights while species specific controls are not, given their almost all or nothing nature. Biological control requires considerable amounts of research and success is uncertain. Because of the high costs of research and the uncertainty of outcomes it is financially a high risk area. Investment in biological control research is inhibited at present because of the dispersed nature of the benefits (given the existing institutional arrangements). If, however, future income for a specified period could be guaranteed by the absence of pests this may encourage venture capital funding of organisations (such as the Crown Research Institutes or universities) to research biological control methods in greater depth. Conditions attached to site specific contracts would need to acknowledge the possibility of successful biological control methods being introduced.

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