

PEST FENCES: NOTES AND COMMENTS

Mike Aviss and Andy Roberts



Department of Conservation
Te Papa Atawhai

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PEST FENCES NOTES AND COMMENTS

Compiled by
Mike Aviss and Andy Roberts
for the Threatened Species Unit

Threatened Species Unit
Department of Conservation
PO Box 10-420
Wellington, New Zealand

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Wellington, New Zealand

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Cover credit: Can anyone tell us where the cartoon came from originally? It has
been saved long and lovingly, and we would like to give proper credit to the
artist.

FOREWORD

Since the advent of pastoral agriculture in New Zealand, fences have become a distinctive feature of our landscape. From simple single-strand 'hot wires' to two-metre high posts, wire and mesh, fences have been devised to effectively confine the movements of a range of domestic animals. Indeed, New Zealanders have earned something of an international reputation as designers of innovative and effective fences.

In the conservation arena fencing has largely been directed at excluding farm stock - principally cattle and sheep - from important reserves. Despite high construction and maintenance costs and the inherent weaknesses of fences, we owe much to the standard 8-wire post and batten fence in limiting the impact of large browsing animals on vegetation on conservation lands.

As a result of a number of important and exciting conservation advances which have been made on islands around the New Zealand coast in recent years, there is now a strong thrust to effectively conserve plant and animal associations on the mainland. Given that eradication of pests on the mainland is not technically feasible (at least currently), the challenge exists to design, maintain and improve fences to prevent or restrict pest re-invasion at selected mainland sites following intensive control. Even in the last year important advances have been made around the country as conservation managers use their experience and resourcefulness to erect fences to stop not just the large ungulates but also smaller mammals such as possums, stoats, rats and mice.

From a national perspective, the Threatened Species Unit sees a pressing need to disseminate topical information about the strengths and weaknesses of new fence designs so that developments may be quickly applied. This publication is an attempt to provide such information.

It is not intended that this booklet be taken as a comprehensive account of pest fences but rather, a collation of designs submitted by some people who are currently working to develop effective pest barriers. If this publication serves to improve the dialogue between people involved in designing and constructing pest fences it will have served a useful purpose. If there were an expressed demand, the Threatened Species Unit would consider producing a more comprehensive summary of recently developed pest fences.

Alan Saunders
Manager, Threatened Species Unit

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INTRODUCTION

Fences have long been an important tool in habitat management, particularly in keeping stock and vehicles off sensitive areas. With a little planning and ingenuity it has been shown that managers can design and build fences that keep out just about anything.

This bulletin is a collection of fence designs that are currently in use. All the contributors are currently involved in species and/or habitat management and are therefore well qualified to give advice on the worth of the designs they have submitted.

Many of the designs have been proven over a number of years, and some have been shown to be - dare I say it? - 100 % successful at keeping out particular species of pests. However, most fences are only expected to reduce the incidence of certain pests and therefore contingency plans are necessary for when the inevitable break-in occurs.

I have also included a couple of fences that, according to the authors, have been a failure. It's important to warn other managers of the need for sound planning and design, and using only appropriate materials. A cheap or poorly designed fence may be little more effective than no fence at all.

Each fence design needs to be able to cope with a variety of factors in addition to the Houdini abilities of the target animals. For example, wind loading, presence of non-target burrowing animals, salt spray (or other corrosive influences), the likelihood of theft of equipment (e.g. solar panels and batteries) and weak points (like gates and stream crossings) are all important factors that need to be considered.

To take one of these examples, corrosion is a major cost in maintenance of a fence and a major contributor to breaches of it. Corrosion can be managed (but not completely eliminated) by careful selection and use of materials, and preparation of them before erection of the fence. Timber treatment chemicals are corrosive to metal so weathering posts for six months before using them is a good idea. Keeping wire off the ground prolongs its lifespan too. This can be achieved by using timber or other corrosion resistant materials on ground level. Experiments trialing the Karori Sanctuary fence designs have shown that UV-stabilised PVC sheet is a great barrier to climbing animals. It also shows great promise as a below-ground barrier which will save any wire netting being buried at all. Its projected lifespan is 20 years plus.

By using electrics on a fence its effectiveness can be increased dramatically without a huge increase in costs. Electric fences have been shown to be very effective at repelling "hard to keep out" animals. However, they also have drawbacks, not least of which is that they break down and they require regular maintenance to ensure there are no shorts. Most pest barriers will need a backup of traps or poison bait stations to take care of the odd break-in, and electric fences are definitely no exception.

Something that has emerged clearly from many of the articles is the importance of planning and preparation for building - especially complicated designs and those fences that are being built in isolated locations. Fencing is a real art so it pays to have a bit

of experience before tackling a big one. Contracting the job out to experienced fencers is one option; getting professional advice or tuition is another.

This publication is designed to be a source of interesting - and perhaps useful! - information, not a definitive, inflexible document. Field managers are more than likely to design innovative variations to the designs published here. If you have any reactions to any articles published in this bulletin send them into the TSU and they can be incorporated into any updated bulletin we may produce when sufficient material warrants it. Thank you to all people who have contributed material for the bulletin. Some articles that were written about the same fence but by different people have been combined into one more complete article for the sake of clarity and accuracy. The names, addresses and phone numbers of contributors are appended for your information. Threatened Species Unit staff will also endeavour to help with updated information and further contact if so required.

I hope that through this publication we have been able to stimulate people into planning habitat and species protection programmes. Alternatively, if you are already in the process of planning a programme, then I hope that the material provided within leaves you with a more clear and shining path to follow.

Mike Avis
Threatened Species Unit
March 1994

CENTRAL NORTH ISLAND FENCES

LOCATION: Tongariro/Taupo Conservancy.

TARGET ANIMALS: Domestic stock, deer, horses, hares, possums.

BRIEF DESCRIPTION: Standard stock fence; deer fence; mesh hare fence.

CONTRIBUTOR: Cam Speedy.

The only predators we are fencing out at present [1992] are those that prey on a variety of plants (that is, browsers). These fences take four distinct forms:

1. Standard stock fencing:

We have done a lot of fencing using 8-wire post and batten fences. Posts are Number 2 rounds spaced at 400 m intervals with five battens per bay. Cost varies from around \$7.50 to \$8.50 per metre depending on the nature of the terrain, how much line clearing is required, bulldozer work requirements, etc.

2. Deer exclosures:

These are 22 x 22 m ring fences to completely exclude deer from a standard 20 x 20 m vegetation plot. We have 17 of them in different critical habitats around the conservancy. Basically, construction involves deer fencing with 22 Number 3 half-round 3-m posts, four Number 1 3-m strainers, and four Number 1 3-m rounds, covered in two spans of sheep netting with barbs on the top and bottom. This gives a 2-m high exclosure that keeps deer or horses out (depending on where you are). In two of the plots we have fine chicken mesh around the lower metre of half the plot and running across the middle of the plot. This effectively excludes deer and horses from the whole plot and deer, horses and hares from half the plot. This allows us to gauge the relative impacts of these species in grassland areas. Cost of a standard exclosure (1992 prices) was about \$800 for material only. Allow 3 x 3 person-days for building in the bush.

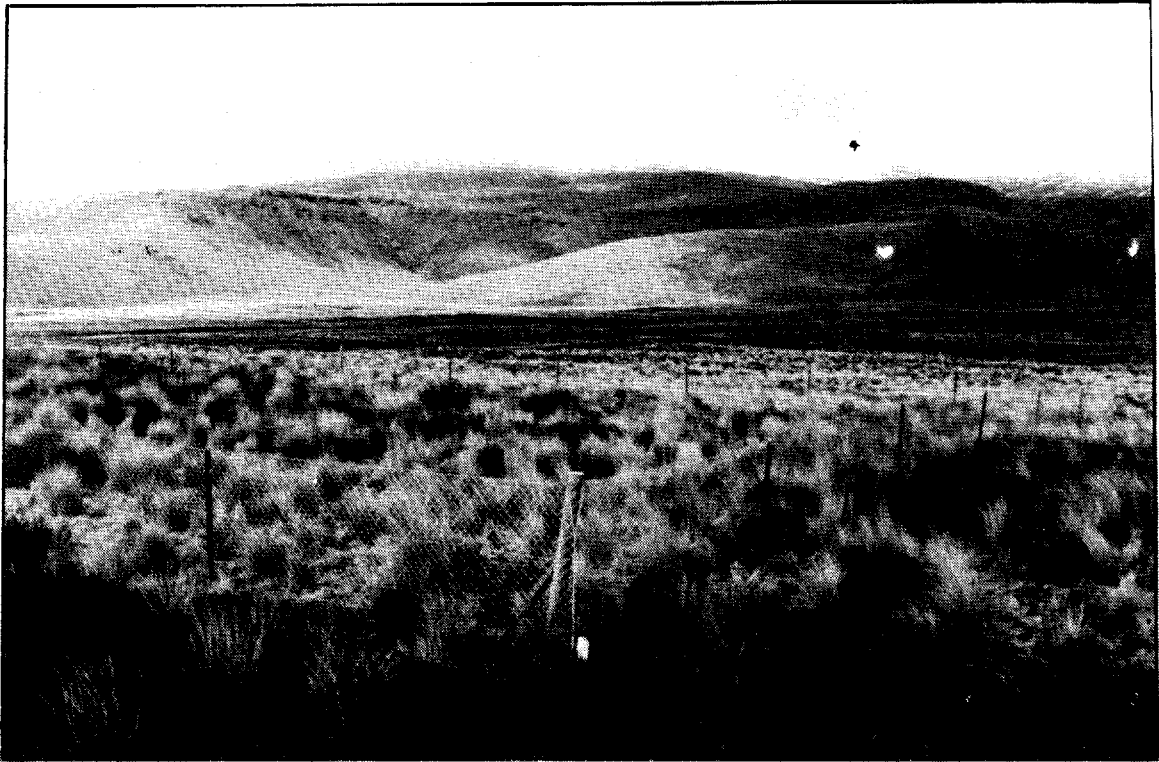
3. Hare exclosures:

We also have one 22 x 22 m hare exclosure (see photograph). The fence is 1.2 m high and is made from chicken netting, with 20 waratah stakes and four Number 2 posts used as corners. Cost for materials only was approximately \$350.

4. Possum shields:

We have three species of mistletoe which are heavily targeted by possums, even when possum numbers are low. Physical protection is the only way to make sure at least some individual plants survive. We use 600-mm sheet aluminium around the trunks of host trees, and their neighbours where appropriate. Cost of material is about \$2.50 per metre and - depending on the size of the host(s) - we need to use anything from 0.5 to 8 m on each specimen. Local power boards use the same for power poles. We had

good flowering last summer on those specimens that have been collared since winter 1991.



ARAPAWA FENCES

LOCATION: Arapawa Island, Marlborough Sounds.

TARGET ANIMALS: Domestic sheep, wild goats and pigs.

BRIEF DESCRIPTION: Five-wire low impact electric fence (ineffective); sheep netting and barbed wire fence (replacement).

CONTRIBUTORS: Bill Cash and Willie Able.

1. Introduction

On the eastern side of Arapawa Island, facing Cook Strait, is the 1034-hectare Arapawa Island Scenic Reserve, encompassing about one-ninth of the island's total area. The reserve is botanically important, as it is the last remaining tract of bush of any significant size in the Cook Strait ecological region. One reason why the bush is so well preserved is that Arapawa Island has no possums. It does, however, have pigs and goats (the infamous Arapawa Island type!), so in 1984 it was decided to fence off as much of the reserve as possible. Once fenced, it was proposed that the reserve would be cleared of goats and, if possible, pigs.

2. The Fence

The initial fence design chosen was a 5-wire, 10-gauge electric fence powered by solar panels at each end. It followed the surveyed boundary and, as agreed by all involved, as little as possible native vegetation was removed. Outward Bound volunteers were used to help get material on site and to help build the fence. The location is isolated - an hour's boat trip and then another hour's hike up the hill to the fenceline.

The completed initial fence zigzagged through the bush, with a minimum of material actually brought to the site; live trees were used as fence posts and, occasionally, as tie-downs.

It is believed that one of the solar panels was stolen within three months. In the event this didn't matter, for what seemed to be a continuous supply of plant material - ranging from large trees to grasses - hit the fence, thus shorting the whole system. Also, because of the very exposed coastal location, salt buildup on the solar panel and wire caused problems. Since there was often no electricity passing through the system, pigs and goats walked through the fence at will. Because the whole system didn't work, the adjoining landowners, not surprisingly, declined to pay their agreed share.

3. The Replacement

Now - almost ten years later - this fence has had to be replaced. After discussions with the adjoining landowners it was agreed that the actual fence line would be as straight as possible. The plan was for a netting fence with double barbed wires at the top and

a single barbed wire at the bottom. A 2-m wide line was cleared through forest. A bulldozer was used in open areas to give the best line possible.

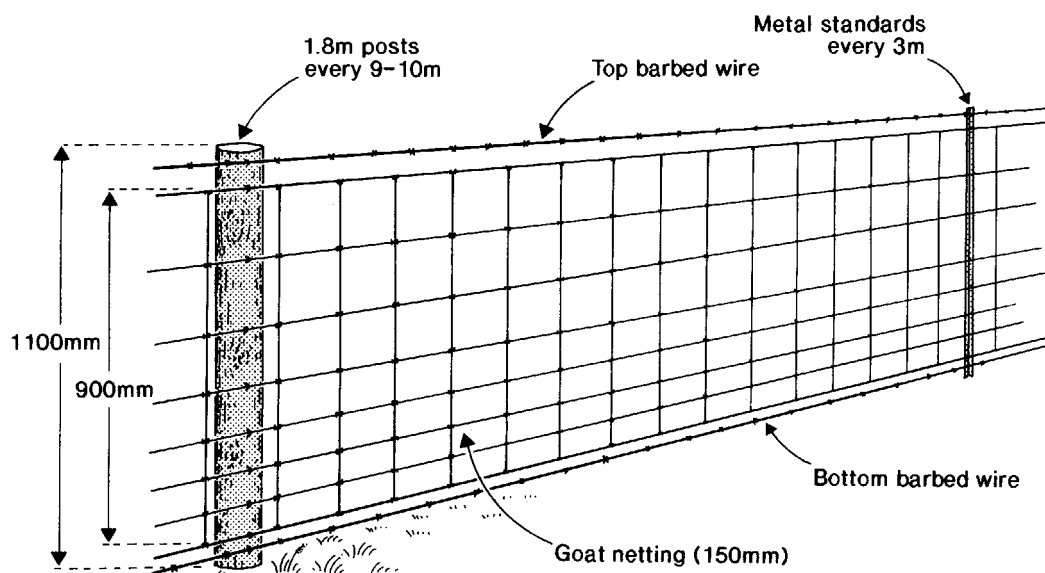
The fence took two months to complete. A helicopter was initially used to get materials and gear to the site. This allowed us to use chainsaws, rock drills plus a little powergel to get as straight a fence line as possible, with all the posts in the right spot and correctly aligned, no matter how rocky the ground.

In the second year of construction a hut was helicoptered in to the site. (It had in fact snowed in the first winter, during which we camped in tents.) There was a good track from the coast to the fenceline, so a four-wheeled bike was obtained to move staff and supplies up to the fenceline. The bike was also very handy when we were fencing in the open areas. One staff member was put through a fencing course (money well spent) and was put in charge of the fence construction.

The upgraded fence, in its current form, is made of standard 8-wire 150 mm boundary netting with barbed wire on the top and the bottom. Posts are 10 m apart, with warratahs in between, spaced at 3-m intervals and tie-downs are used as required. The whole fence is approximately 5 km long. It cost approximately \$8.10 per metre for materials only.

To date, the fence is working well, with no sign of animals getting through.

Goat netting is very quick to put up in conjunction with warratahs and is very strong. The 150 mm spaced netting we used excludes all but very young animals from passing through and also prevents goats from putting their heads through the netting and not being able to pull them out.



Upgraded Arapawa Fence

TE PAKI PIG FENCE

LOCATION: Te Paki, Northland.

TARGET ANIMALS: Horses, cattle, pigs.

BRIEF DESCRIPTION: Posts and steel standards, pig netting and barbed wire; posts and steel standards and 9-barbed wire.

CONTRIBUTOR: Mike Aviss.

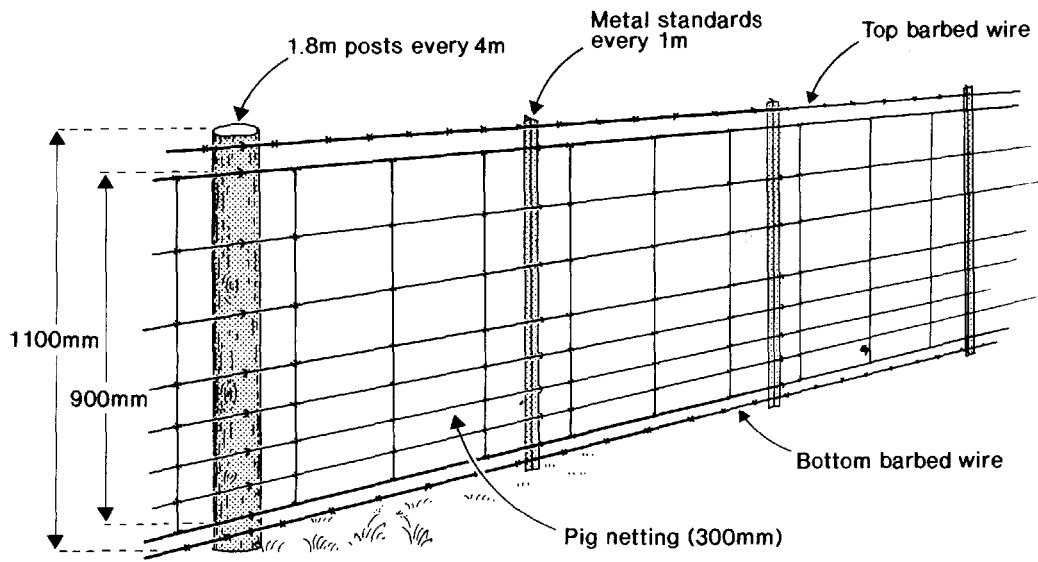
Three pig and stock enclosure plots were created at discrete localities in Te Paki for the purpose of protecting threatened flax snail colonies. Two of the fenced plots are approximately 100 m x 100 m, while the third is only 20 m x 20 m. All plots are located on steep, uneven terrain in coastal broadleaf forest.

The first two fences, made from posts, standards, pig netting and barbed wire, are very effective at excluding both pigs and farm stock. They have a post about every 4 m (depending on ground contours) with a metal standard every metre. The bottom barbed wire is as close to ground level as possible, following the contours. The pig netting is very close to the barbed wire and also follows all contours. Finally the fence is topped off with a second barbed wire. All wires are tied to every standard and stapled to every post. The fence is approximately 1100 mm high - i.e., it uses standard length posts.

Before building the fence a 2 m wide fenceline was cleared of all obstructions, including any trees that looked like they might topple on to the fence. This has not completely stopped wind-fall damage, but it has certainly reduced it to a manageable level. Ongoing monitoring is necessary for any wind falls but so far only one has threatened one of the fences. A tall ponga fell on and broke the top barbed wire, but it did not damage the stronger pig netting, which held until repairs could be made. A suggestion to strengthen the top barbed wire would be to string a No. 8 wire just below it. Situations to avoid with pigs are holes under the fence or soft earth that could easily be removed by a rooting pig.

The third fence, which was supposed to have been erected to the same design standard as the others, was made without pig netting. All other features are the same except the netting, which was replaced with eight barbed wires. A matter of months after completion of the fence small pigs were getting through and on one occasion I saw two large dogs passing through the fence without any problem at all. Barbed wire may be useful on long runs that are easier to strain, but I doubt that strands of barbed wire alone will ever be satisfactory at excluding pigs.

These fences cost approximately \$15 per metre for materials only (1990).



Te Paki Pig Fence

CAPE LAMBERT FENCE

LOCATION: Cape Lambert, Marlborough Sounds.

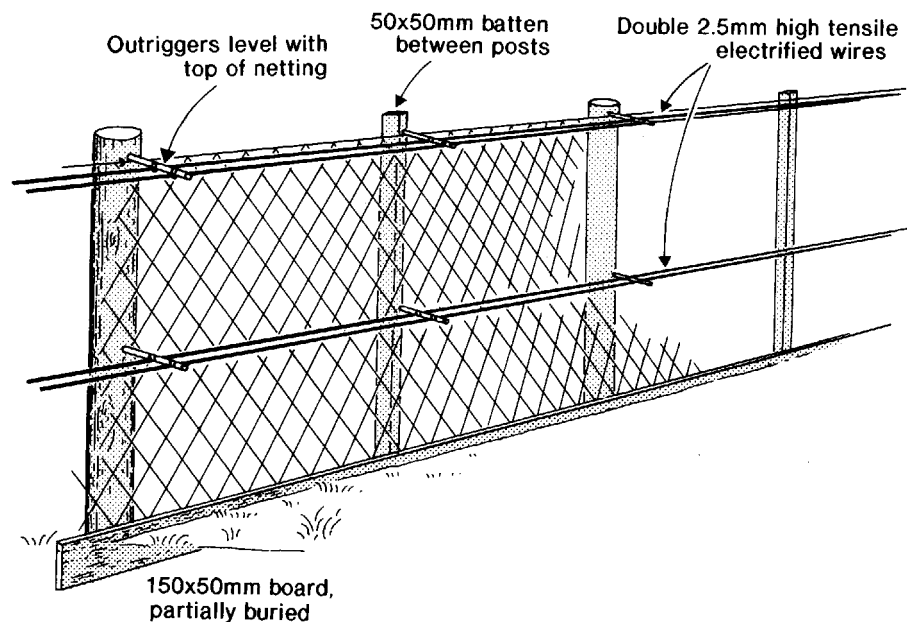
TARGET ANIMALS: Possums, goats.

BRIEF DESCRIPTION: Posts, chain-link netting - electrified.

CONTRIBUTOR: Mike Hawes.

The fence consists of wooden posts, spaced 3-4 m apart; 900 mm chain-link netting, (70 rolls @\$110.70 per roll for 2 km of fence), 3 additional high-tensile wires, a wooden ground board and electric wires to Gallagher specifications (see illustration).

Fence erected to a stock-proof stage (no electrics or ground boards) required \$8400 labour to complete 2 km of fence. Cost of materials for the complete fence: about \$10 per metre. This can be reduced if lighter grade 'chicken' wire is used instead of chain-link.



Cape Lambert Possum Fence

WAIKATO FENCES

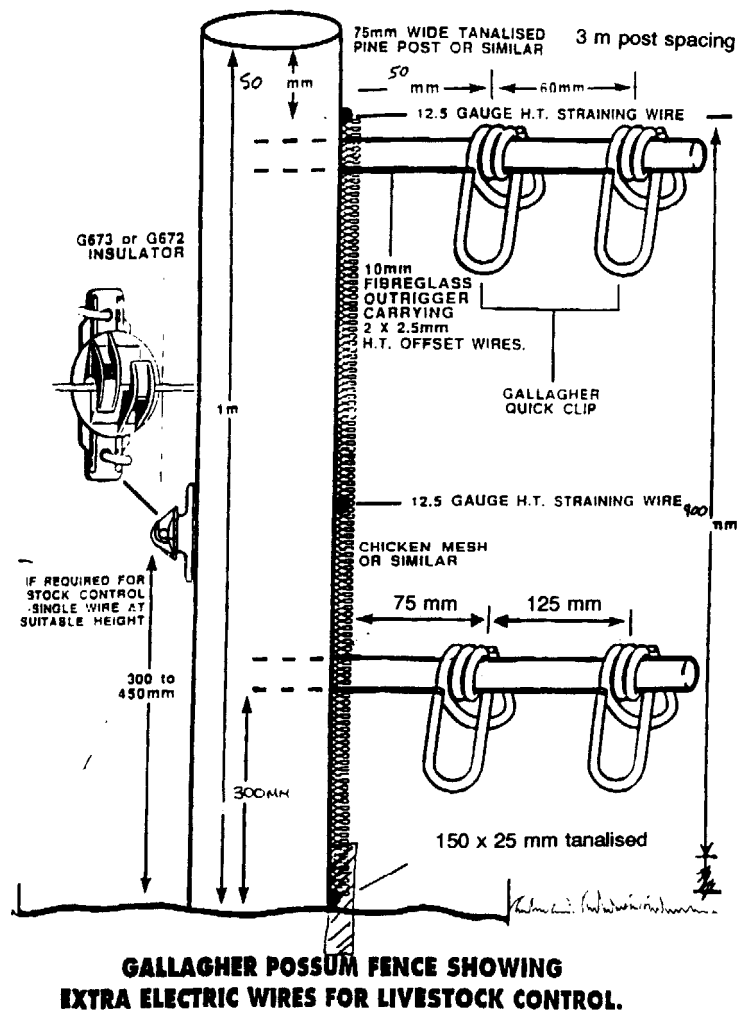
LOCATION: Waikato Conservancy.

TARGET ANIMALS: Possums.

BRIEF DESCRIPTION: 1 m high electrified post and chain-link netting fence.

CONTRIBUTOR: Simon Kelton.

The Mk IV design (with the additional single hot wire on the non-possum side to prevent stock damaging the fence) cost in late 1992 \$5.85/m all up for materials. Given that it should cost no more than a conventional fence to erect, it is envisaged that \$3.50/m and 11 C/m will cover construction costs and line laying respectively - a total of \$9.46/m. Line clearance costs will depend on location. [This is basically the same as the Cape Lambert fence - see the preceding note.]



CROMWELL CHAFER RESERVE FENCE

LOCATION: Molyneux River, Cromwell.

TARGET ANIMALS: Rabbits.

BRIEF DESCRIPTION: Post and wire netting, 1100 mm high and buried 600 mm below ground.

CONTRIBUTOR: Bruce McKinlay.

1. Introduction

The Cromwell chafer beetle, *Prodontria lewisi*, was first described as being found on the sandhills of the Molyneux River in 1903. Because of the very limited habitat of the chafer and its apparently highly specialised habitat requirements, the Cromwell chafer was, in 1977, declared to be in imminent danger of extinction. In 1983, the Reserve, comprising 81.29 hectares, was gazetted. The soils of the reserve are described as Cromwell sandy loam and Cromwell sand, and they are very light, easily diggable, well-drained soils. As a result, a rapidly increasing rabbit population thrives in the reserve. Vegetation is sparse and is dominated by the natives *Poa laevis* and *Raoulia* sp as well as introduced species such as sweet vernal (*Anthoxanthum* sp.) and St Johns wort (*Hypericum perforatum*).

Our aim is to reduce rabbit numbers and then maintain them at, or approaching, zero.

2. Current Situation

The reserve has approximately 5 km of fence around its edge. This fence creates a boundary that does not reflect changes in soil type. Rabbits are known to traverse the area and are adept at burrowing under fences where the netting stops at ground level or alternatively where the netting is bent out at ground level and covered with a layer of dirt.

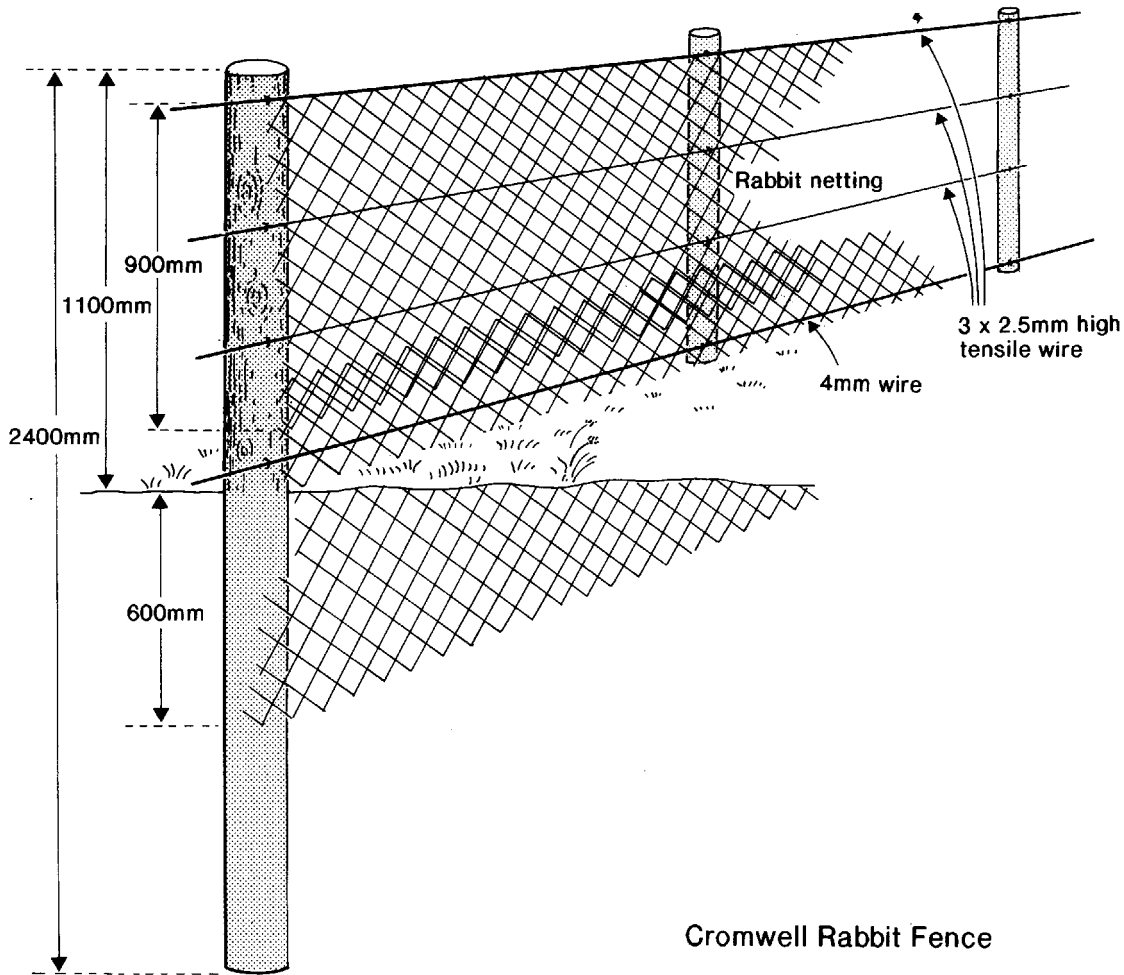
3. Fence Specifications

The fence is constructed using 2.5 m deer posts every 2 m. The posts are driven in so that they stand 1100 mm above ground. The bottom wire is No. 8 and there are three strands of high tensile wire. Standard rabbit netting comes in rolls 900 mm wide, so two widths are required with an overlap. A trench is dug adjacent to the fence posts and the netting is laid in the trench to a depth of 600 mm and is stapled to the posts. The netting is fixed to the posts and wire above ground by standard staples and clips. Finally the trench is refilled.

The reserve is situated in country that is not grazed, so the fence does not need to have a barb to keep cattle out.

4. Future

We have recently completed the full replacement of 1.3 km of the original boundary fence and are now dealing other parts that do not need complete replacement. In these situations the existing fence needs to be strengthened in some places and, in all cases, to have the netting buried. We will now be able to use other rabbit management techniques without having immigration of rabbits from adjoining lands.



BURWOOD BUSH FENCES

LOCATION: Burwood Bush, Te Anau.

TARGET ANIMALS : Mustelids, possums, cats.

BRIEF DESCRIPTION : 1300 mm high, chain-mesh netting, 3x and 2x electric wires on fibreglass outriggers, top and bottom wires on separate solar power systems.

CONTRIBUTOR: Ron van Mierlo.

I would tend to describe the Burwood fences as predator 'resistant' rather than predator 'proof'. Animals do get in. However, having held a total of nearly 100 takahē of all ages for varying periods since the 1985/86 season (including nests and young chicks), we've had no losses through predation.

In the almost nine years since construction of the first 10-hectare enclosure we have caught about eight weasels and eight stoats within our enclosures, in covered Fenn traps set along the inside fence perimeter and at prime-looking trap sites within the bush. We are reasonably sure these animals got into the enclosure after our initial trapping of the fenced blocks.

I think that they get over the fence, despite probably touching the electrics on the way. We've stepped up the pulse-rate on our fence energisers - which probably helps.

Possums also get over, though they aren't as much of a problem to us. I think if cats had got in we'd have lost some birds, or found sign.

The only other general comment I'd make is that this type of fence requires a HIGH degree of maintenance - replacing netting corroded at ground level, checking and fixing shorts and other electrical problems, and clearing grills in front of culverts and occasional repairs after flooding.

The fibreglass outrigger rods we've used tend to break down in sunlight; then, possibly combined with frost action and after about six to eight years, they break when snow piles up on the wires.

Burwood Bush predator-proof fence

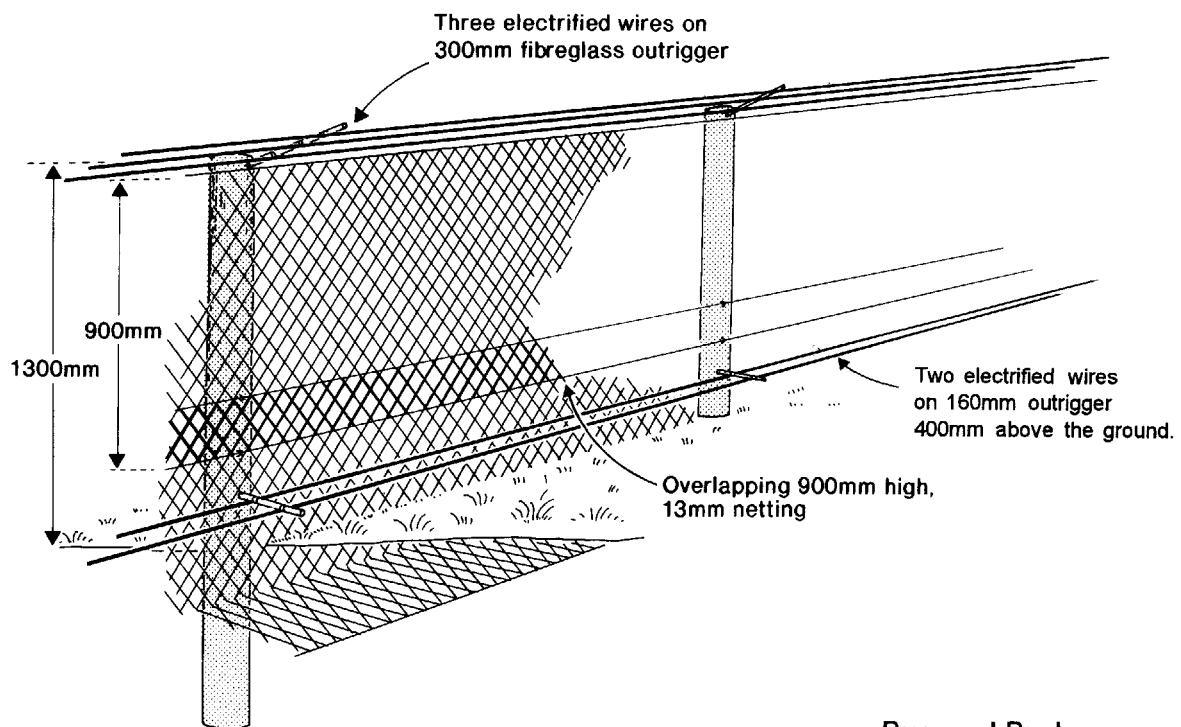
Electric wires powered by solar powered energizer and battery unit. Gives approximately 6000 volts at 1-second intervals. The inside wires need to be close to the netting (the earth) to prevent stoats running up the fence so fast that they don't get a shock. Where necessary, insulators are used between the posts to either keep the electric wires from touching the netting or bringing it closer to the netting.

Acid and boggy soils corrode the light netting in three to five years, so where this has occurred (450 m in 5.8 km) the netting is being replaced with chainmesh netting. Takahe can cut holes in the netting if they choose.

Grass and tussock need to be kept off the electric wires to stop electricity leakage. After cutting back, regrowth is kept under control by spraying.

With the electric wires so close to the netting there are often shorts caused by such things as spiders, dragonflies, mice and redpolls. The largest animal to have been killed is a rat.

Total fence length is 5.8 km with 26.4 km of electric and earth wires. Two solar systems are used. One powers the top wires; the inside and the outside wires are live, with the middle wire being an earth wire. The other solar unit powers the bottom electric wires with the fence acting as the earth. This works well except that a short between the top electric wire and the fence creates a circuit between the two systems and is not good for the energizer units.

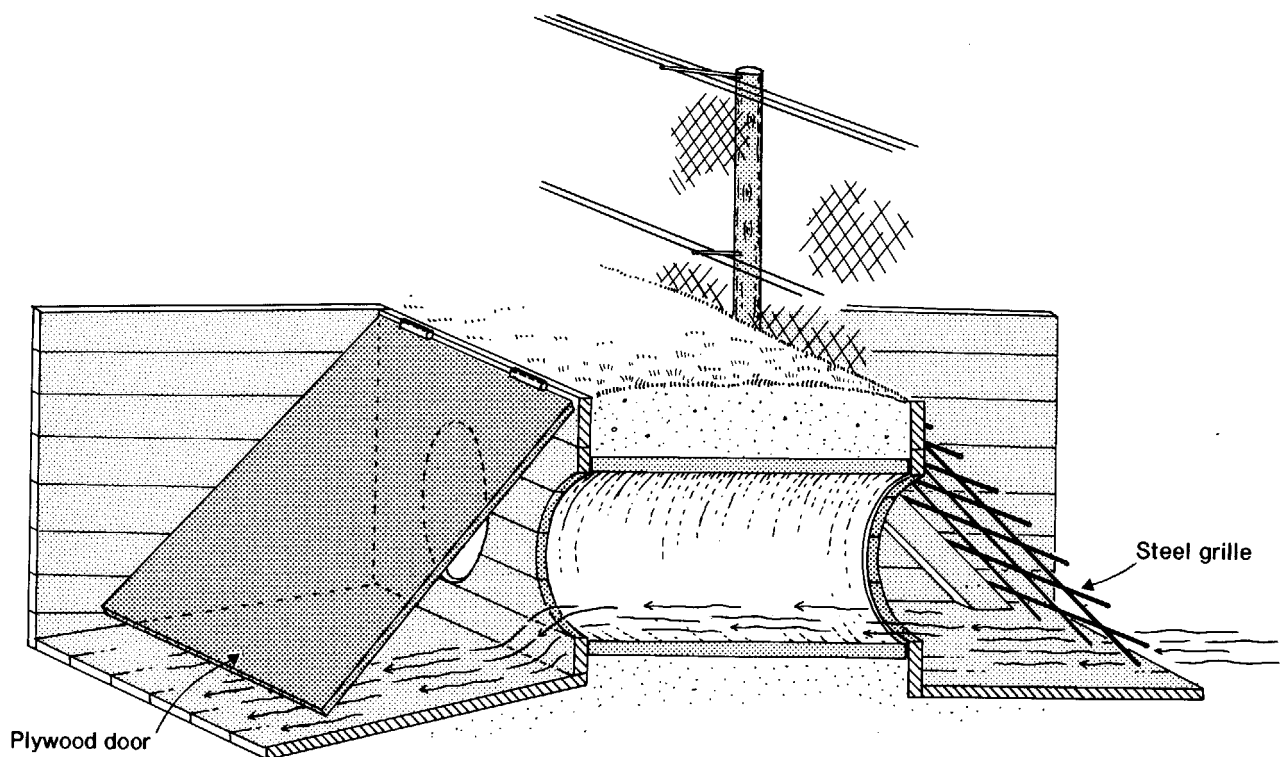


Culverts:

Top culvert: Stream flows into enclosure. Three 10 mm steel rod grills fit neatly together and lie on a downstream angle in front of the culvert pipes. The rods are spaced at 12 mm intervals. They often get blocked with beech leaves and tussock after flooding. Longer grills lying at an angle closer to horizontal would help reduce this problem. The grill is in three sections, so it can easily be lifted out during periods of high flow.

Bottom culvert: Stream flows out of enclosure. The pipes open into an enclosed section on the downstream side. A neatly fitting plywood (17 mm thick) door opens with the water flow, allowing no gaps for the entrance of animals. A widely spaced steel rod grill lying in front of the culvert collects large items of debris that could keep the flood door open after flooding.

Note: Above and in the flood channel to the side of both culverts, chainmesh netting has been used to strengthen the fence against flooding.



Section through bottom culvert

Fence construction :

- Cut vegetation off the fenceline and smooth out lumps; bulldoze line only where necessary.
- Plough line with a large single furrow plough (turn to the outside of the fence).
- Drive posts on the inside edge of the furrow, 4-6 m apart.
- String up and attach high tensile wires and drill outrigger holes.
- Roll out netting and Gerrard clip both widths to the bottom wire.
- Lift up top roll of netting and clip to the top wire.
- Push bottom roll of netting into trench.
- Staple netting to posts.
- Push furrow turf back into trench, watching that netting is not pulled down.
- String out and strain electric wires.
- Work on gates, culverts, stiles, corners, etc as required.
- Erect and wire up electric fence unit.

Approximately \$10,000 per km of fence in 1988. This includes all materials, ploughing out fence line, and fencing contractor to drive posts, string out and attach high-tensile and electric wires. Does not include cost of chainmesh netting to replace corroded areas of bottom netting (600 mm wide x 12.5 mm mesh x 1.6 mm gauge x 450 m costs \$5,214 + GST, ex factory). Construction would also involve a team of four erecting fence at a rate of 1-2 km per month (very dependent on terrain, experience of workers, etc.). If machinery can't get to the site, obviously costs would be far greater. The Burwood Bush pens have moderately easy access and terrain. Steel gates sitting neatly in a steel frame and attached to two posts were put into the fence for vehicle and machinery access. They have the same profile as the fence and are wired to the electric outriggers with lacing wire. Stiles that can be pushed to the ground after use are used for people access.

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