net, is very necessary. "Twinkling" works surprisingly well on fields – especially with a vehicle, but also with someone walking or crawling. Fetching birds from further afield can sometimes be very frustrating – they can fly high and far in the wrong direction!

After catching, birds are best covered with lightweight material in the same way as shore waders, before extraction from the cannon nets and put in keeping cages.

Glossary

"jiggler" – string with rags just in front of the set, fastened by plastic to a peg at far end of net and moved by pulling from firing position or other hide in line with net.

"twinkling" – gently moving flock by approaching slowly. Ideally, flashes (twinkles) of wings are seen as the near birds fly to far side of flock.

Troubles with projectiles

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Users of UK cannon netting equipment will, at one time or another, have suffered from 'projectile trouble'. Although many readers will be aware of the *modus operandi* of cannon nets the uninitiated will need some explanation to understand what follows.

The nets (30 m long, 13 m wide) are carried from a furled position up and over birds on the ground by four heavy weights (projectiles) which are fired (by electrical detonation of explosive) from cannons placed behind or under the net. The metal projectiles (5 cm diameter, 16 cm long) are attached to the net by a projectile rope about 70–100 cm long which is in turn connected to other thinner ropes (the "traces": 3 to 5 to each projectile) which are fastened to the front edge of the net. The "trouble" with projectiles occurs when a projectile rope breaks when the net is fired – a projectile thus becoming a missile. When cannon netting on remote shores and firing out to sea or in large fields this is more annoying than dangerous although the cannon as a potential mortar does have considerable range. Nevertheless it is obviously highly undesirable and doubtless illegal to fire large lumps of metal around and every cannon netter does his best to ensure that the equipment is in good repair and that as a sensible precaution the cannons are not pointed towards places littered with people or their effects. Also a close watch is kept on the potential danger zone in front of the net to be sure that nobody is around when the net if fired. However, during the last few years cannon netting for gulls at rubbish tips has steadily increased (now almost a national sport!) and work at such sites presents a much more serious problem to those suffering from 'projectile trouble'. Everyone has doubtless noticed that many rubbish tips are sited as near as possible to human habitations thus ensuring that people experience the full benefits of wind-blown plastic and paper litter, the typical aroma of rubbish on a hot day, and the regular clamour of thousands of gulls coming to feed, squabble and deposit their guano over house, garden and washing line. Alternatively tips are sited near airfields or such that an airfield lies between tip and roost thus making sure the air strike problem continues. Obviously it is undesirable for projectiles to become missiles in such situations.

The Celtic Wader Research Group (CWRG) and its gull catching offshoots have been trying to overcome the projectile trouble for some time and we have now found the solution – hence this article. A history of the development of our projectile is of some interest because it describes the problems encountered and because some of the alternative forms made during trials may be of use, so . . .

The first projectile ropes were 8–12 mm diameter nylon rope spliced to form eyes round metal thimbles at both ends – the eye at the projectile end being spliced through a metal ring welded to one end of the projectile (Figure 1). The simplest form "trouble" with these ropes was due to poor splicing either because of inexperienced splicers not being much good at the job or because too few tucks were made into the standing rope. There should be at least five tucks with slippy nylon rope (a much longer splice is necessary than for hemp rope). However tightly the eye is spliced round the thimble the latter soon flips out of the eye after a few firings (simply because it receives severe strain in the opposite direction to that for which thimbles are designed to withstand during the first instant of firing the cannon; that is compression rather than extension). Whether or not the thimble is displaced, the projectile rope rapidly becomes abraded against the cannon barrel on firing and occasionally scorched by the explosive flash. Therefore projectile ropes have to be inspected regularly and replaced before they break. Because thimbles are useless in the situation described, our first modification (Figure 2) was to omit them and splice the rope tightly round the projectile ring (more tightly than shown in Figure 2). This worked well but the fairly rapid process of rope wear and tear continued. We then tried encasing the rope in PVC garden hose to stiffen it thus reducing wear but the hose soon broke. To gain both stiffness and strength we then used thicker rope, finally using the thickest nylon rope (about 22 mm diameter) which, when spliced round the projectile ring, would still go down the barrel without scraping the sides (Figure 3 – in practice the splice round the ring was much tighter than shown). This worked well and the thick ropes lasted longer than any other of the previous types but they still had to be replaced regularly.

The obvious alternative to rope was of course wire hawser so we got a yacht chandler to make two types of projectile hawser for trial. The first was of 4 mm diameter hawser bent round a thimble and 'spliced' with an aluminium block (Figure 4) by a special machine. We encased the hawser in plastic tube to stiffen it. The second type was made from the thickest hawser that could be bent round a thimble and yet still go down the barrel. This was about 6 mm diameter and the manufacturer sweated a good deal as he made it – wire hawser is difficult to bend into such a small eye. This type has an integral PVC case (Figure 5). Both hawsers worked well and lasted far longer than any rope and although we never broke either of them they eventually started to fray and to assume the form of an erratic corkscrew from being fired 'against the grain'.

For some time I had been thinking of using steel rod instead of either rope or hawser to connect projectile to traces but I had some misgivings about a long metal rod cartwheeling in the air while there were birds about although I doubted whether the danger (to birds) was any greater than from rope or hawser. In any case the projectile is usually near its zenith and already over most of the birds before they leave the ground. Eventually the 'trouble with projectiles' was discussed at the October 1977 Wader Study Group meeting and we found out that Ron Little had also been thinking about using steel projectile rods. He was sure that a hinge between rod and projectile was essential and he agreed to weld some rods to our projectiles for trial (Figure 6). He used 6 mm mild steel rod and these were not strong enough – we soon broke one and severely bent others but others were fired many times without failure. About that time (winter 1977–1978) an expert welder happened to be attending a series of lectures on birds that I was giving . . . so I asked him if he could make us strong projectile rods and he agreed. Some were hinged to satisfy public opinion and my own qualms and some were straight and merely welded into a hole drilled into the end of the projectile. We first used 12 mm rod which bent quite easily so we then used 15 mm diameter mild steel. Both types (Figures 7 and 8) worked well so after prolonged trial we decided that the hinge (Figure 7) served no useful purpose and got our welder to make as many projectiles as we required with straight projectile rods (Figure 8). These rods have an eye at the outer end which just protrudes from the muzzle of the set cannon and this is connected by a strong D-shackle to the net traces. This system works well and we no longer suffer from 'projectile troubles'.

One factor of interest is that we now generally set the cannons beneath the furled net and not (as is usually done) behind it. The projectile then pulls the net up and over the cannons. When the net is fully stretched on jump ropes the rear edge falls about 1m in front of the cannons. This method was developed for rubbish tip work for various reasons which are described in the 'Cannon Netting Code of Practice' (*Bulletin* 23: 5). It enables the net to be set in a narrower space than with cannons positioned behind the furled net.

Spin off? The old style projectile weighs about 3.1 kg: the new ones with metal rod are near 3.9 kg. I think the original design was selected fairly arbitrarily when the Wash Wader Ringing Group built its own cannon netting equipment probably from a North American design. The lighter projectiles are too light and often fail to stretch a wet net to its fullest extent. The new heavier projectiles are more satisfactory in this respect and it is quite probable that a still heavier projectile of perhaps 4.5 kg might be even more satisfactory

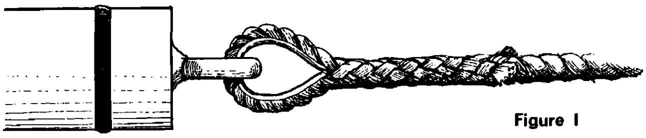


Figure 1

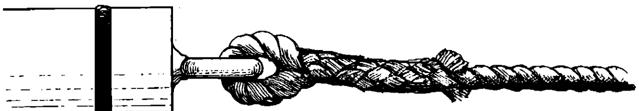


Figure 2

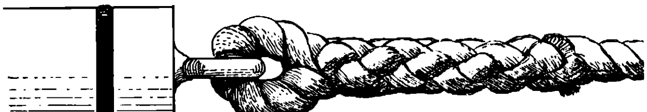


Figure 3

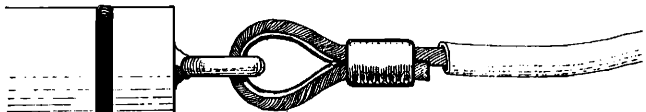


Figure 4

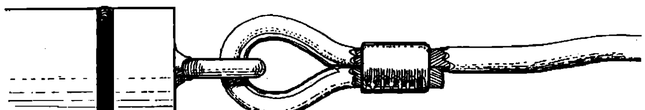


Figure 5

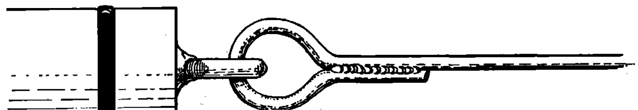


Figure 6

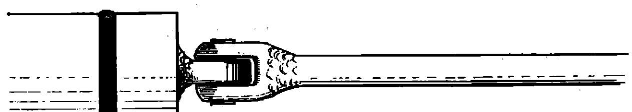


Figure 7

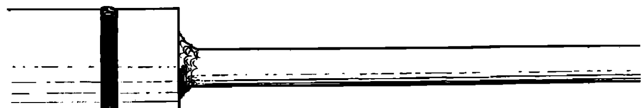


Figure 8

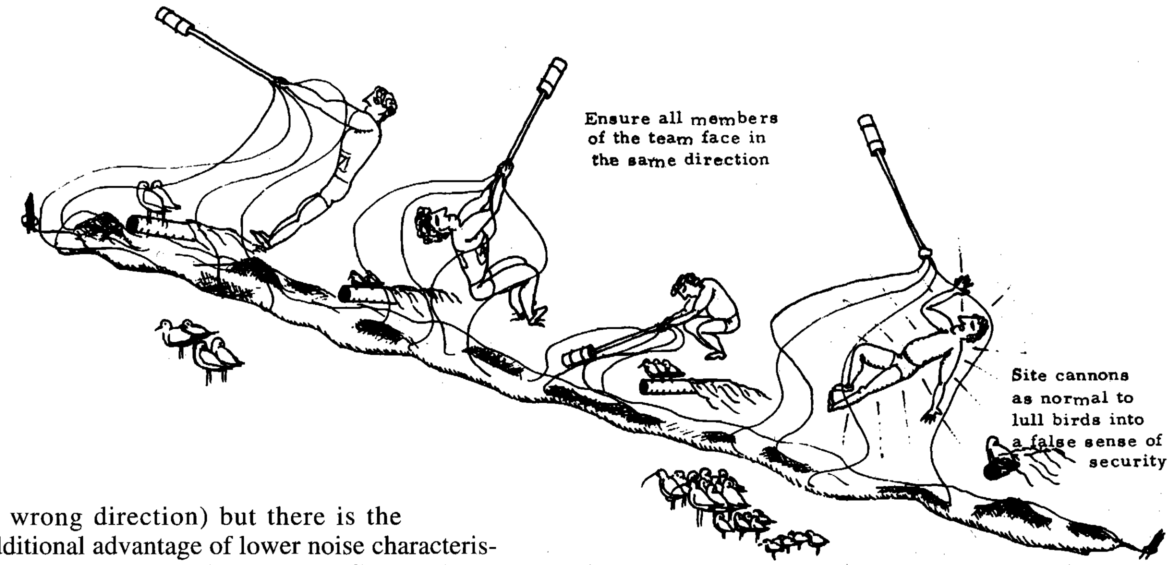
though I must say such a weight requires trial before someone rushes off and builds a complete set!

I conclude by recommending that on the grounds of safety and efficiency that all projectile ropes are discarded and replaced by either hawser or better by steel rods. I know a welder who will make them for you but they will cost you a little (write to me) and we cannot enter into the export business.

Obviously many people have been involved in discussion, trial and manufacture during the development of the projectile and thanks are due to all of them especially my colleagues of the Celtic Wader Research Group and to various itinerant Midland gull catchers; also Ron Little, Clive Minton and welder Geoff Humpage. Ray Bishop drew the figures.

Alternative cannon-netting

The new design of projectile may allow a new form of propulsion in case of electrical or mechanical failure of the cannons or shortage of explosive. Four hammer-throwers are required (spares may be useful in case of injury due to release



in wrong direction) but there is the additional advantage of lower noise characteristics than conventional equipment. Current developmental problems mainly concern synchronising the launching, and camouflaging the new cannon-substitutes. A further announcement will appear if these difficulties are ever overcome. Thanks to Nick Davidson for the technical drawing of this equipment printed above.

Projectiles again

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In December 1978 I reported on new developments in cannon net projectile design and recommended use of a straight metal rod in place of a variety of ropes, hawsers, hinged rods – a gamut of ramshackle contraptions which had been devised during the search to eliminate "troubles with projectiles" (Green 1978). Since then we have used rods (type 8 in the previous note) on many occasions without any failures. Several other groups have changed to rods and everyone seems to find them superior to the older designs – indeed they have the added advantage of spreading the net more efficiently because they are heavier. The rod is 7/8 inch (15 mm) diameter welded into a hole drilled into the end of the projectile. The end protruding from the barrel is fashioned into a circular loop which is welded into position. The net traces are attached to the loop either by threading the spliced trace loops through it or with a shackle. There has been a good deal of concern in the past about the strength and reliability of shackles but we seem to have overcome this problem by using shackles made from steel of the same diameter as the rod. Overall these measure about 4½ × 2½ inch diameter about 1¼ inch (4.5 cm). The strength of this equipment probably contains very large safety margins and so far we have not experienced any failures – the shackles have not even bent!

We generally set the net laid over the barrels as described previously (Green 1978) and take care to arrange the shackles so that the curve of the 'D' lies in the projectile loop and the net traces are round the shackle pin. The shackle is folded back towards the traces so the whole thing moves smoothly on firing. Incidentally a slow motion film shows that the projectiles cartwheel very soon after firing (within two-three projectile lengths of the barrel) and when the net setting method described is used the long rod moves more or less vertically about the point of balance.

The rods do sometimes get bent when they land on rock or if the heavy end penetrates soft sand or mud so that a "whipping" effect occurs. We straighten them with a heavy hammer and I am told that mild steel rod of this size is very unlikely to show fatigue and fracture in these circumstances. Obviously if very severe bending occurs the metal may either require heating before being straightened or the rod replaced. If a bend occurs near the weld careful inspection of the weld should be made for signs of weakness – if in doubt replace the rod. Needless to say high-quality welding is essential.

Besides manufacturing our own equipment we have now built several sets of projectiles for other groups and we have also adapted old projectiles by cutting off the old ring, drilling a hole and welding a rod into place.