THE HEDGES OF HARTLEPOOL
A CONDITION SURVEY

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“No component of the work in this thesis has been submitted in support of any application for another qualification, at this or any other University or Institute of learning. The contributions of others, in terms of provision of data and their analysis and interpretation, is acknowledged and described fully in the Methods section of this thesis”.

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ABSTRACT

A survey of 60 hedges was conducted in the Tees lowlands agricultural area west of Hartlepool within the limits of the Borough boundary.

The aim of the project was to establish a methodology to assess the condition of hedges in the Borough that would provide baseline information for later periodic survey reviews. It would also provide data that could be used by the Council and local partners in relation to meeting local Biodiversity Action Plan targets for Hedgerows.

The survey was conducted according to Defra's Hedgerow Survey Handbook: A standard procedure for local surveys in the UK (2007). This methodology is directly linked to BAP targets and specifies precise thresholds for criteria to meet favourable condition, enabling direct comparison with other surveys using the same methodology. All 19 essential elements were surveyed. Survey results were then extrapolated to arrive at an estimate for each parameter for hedges across the Borough.

Only 6 hedges m*et al*l criteria for favourable condition. All hedges passed criteria relating to height, width and the width of undisturbed ground adjacent to the hedge. The main reasons for failure were gappiness, the average height of the base of the canopy (legginess) and the percentage cover of nutrient enrichment indicator species (nettles and cleavers). Hedges were allocated a condition score ranging from 0-9 according to by how much they fail each criteria. From the lengths of hedge scoring very poorly (7, 8 or 9) it is estimated that 38km $\pm$ 8.8km of hedge in the Borough of Hartlepool is severely neglected. Scores are then used towards outlining a possible schedule of restoration to meet 2015 BAP targets for the Borough.

Hedges were then analysed according to the Hedgerow Regulations (1997) criteria and findings suggest that up to ten hedges (16%) might meet criteria for classification as Important hedges on account of their historical value and/or species richness coupled with associated features.

As a result of these findings a scoresheet was produced for evaluating hedges for allocation of funding in future restoration programmes for Hartlepool. This method will use the condition score alongside a heritage/biodiversity score (Herbi).

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INTRODUCTION

The United Kingdom has experienced widespread decline in the total length of hedgerows in the last 50 years through hedgerow removal related to agricultural intensification. Losses are well documented: 28,000 km were lost between 1978 and 1984 (Barr *et al.* 1986) and removal continued at the rate of 1.7% per annum between 1984 and 1990 (Barr *et al.* 1993). Net losses from 1984-1993 amounted to 158,000km in England (McCollin 2000).

Restoration schemes and planting are now creating more new hedge than is being removed and it is understood that neglect of hedgerows and their subsequent relegation to relict status is now the main problem contributing to the loss of hedgerows today. (McCollin 2000; Barr *et al.* 1993).

POLICY FRAMEWORK

The UK Biodiversity Action Plan (BAP) is one of the key national policies concerning protection of hedgerows as a habitat. Formerly called “Ancient and Species Rich Hedgerows,” the title was revised to simply “Hedgerows” in 2007, reflecting a broader remit than before.

BAP Targets are concerned with restoring hedgerows to “favourable condition” and bringing management regimes more in line with best practice for conservation. A principal target, T4 is to achieve “favourable condition” of 243,000km (35%) of hedgerows by 2010 and 348, 000km (50%) by 2015 (Defra 2007).

Individual hedgerows that have been designated as being Important under the Hedgerow Regulations 1997, have legal protection and permission for removal must be granted by a local authority. Hedges are listed as a boundary habitat of principal importance under the NERC Act section 41.

Planning policy statement 9 requires that LA s maintain, restore and enhance species and habitats and have objectives to ensure that biodiversity is conserved and enhanced and restored by sustaining or improving the quality and extent of natural habitat and contribute to rural renewal by enhancing biodiversity and green spaces. (ODPM 2005).

At a local level, the Tees Valley Wildlife Trust has developed an action plan for Ancient and Species Rich Hedgerows. Its main aims are setting targets for the lower Tees Valley based on the UK BAP that include raising awareness of the importance of Ancient and Species Rich Hedgerows. This will be delivered through: production of a leaflet on hedge management, advising landowners, conducting surveys on the extent of ancient and species–rich hedgerows and hedgerow trees and monitoring survey hedges on a five year cycle. Community involvement is an important element in the delivery of targets (URL 1).

The Tees Valley Hedgerow partnership meets several times a year and is currently in the process of updating The Habitat Action plan to account for the revision of the priority habitat to “Hedgerows” One of the main objectives of the partnership is to increase the number of hedgerows (and trees) “under a suitable management regime” through which their overall condition will be improved by encouraging farmers’ involvement in stewardship schemes (Harrison *et al.* 2008).

Durham has led a successful restoration programme that oversees restoration and allocation to landowners of (landfill tax) funds.

LOCAL SURVEYS

Two surveys have been conducted in Durham, a substantial one of the county in 1979 (Bailey 1979) and the latest in 2006, again countywide (Beeston 2007). In the Tees valley, Wildflower Ark have conducted extensive surveys of the extent Ancient and Species Rich hedges in Redcar and Cleveland (Harrison and Herring 2007) and Stockton (Allen *et al.* 2006).

There have been no documented surveys focussing on Hartlepool’s hedge resource.

THE AIM OF THIS SURVEY:

To write a report on the condition of Hartlepool’s hedges that can be used by Hartlepool Borough Council will assist in meeting the aims of the local Biodiversity Action Plan.

This will be achieved by the following objectives:

- Conducting a survey that would give an overview of the condition of the hedges of Hartlepool Borough and provide baseline information against which future surveys can be measured by Hartlepool Borough Council's countryside team.
- Establishing a methodology that is reproducible for future survey.
- Establishing an up to date database of local farming contacts and ascertain those who may consider restoration of hedges.
- Use of survey findings and literature as a basis for recommendations for local management initiatives.

1 LITERATURE REVIEW

Throughout the report the terms "hedge" and "hedgerow" are generally used interchangeably, however "hedgerow" at times is used to refer to the hedge-bottom in conjunction with the canopy.

1.1 Plants in the Hedgerow

The hedgerow is described by Dowdeswell (1987) as "a dynamic, interacting collection of plants." There have been between 500 and 600 species of plant recorded in hedgerows (Pollard *et al.* 1974) and around 200 species can be described as "hedge plants" (Barr 1995) although they are not exclusive to hedgerows. The 1990 Countryside Survey found more than forty shrub species and 270 herb species (Barr 1995) and there is a correlation between the number of shrubs in the canopy and species diversity in the hedge-bottom (Barr 1995). There has however, been a documented decline in the species diversity of the ground flora between 1978 and 1990 in the pastoral and arable landscape (Barr 1995).

Dowdeswell (1987) portrays the hedgerow as an ecosystem that is composed of a sequence of distinct but contiguous micro-habitats. Each component will provide suitable conditions for particular groups of plant species. These extend to the outer edge of the verge which is prone to disturbance; the inner verge with a greater abundance of species; the sides of a bank and/or ditch with associated variation in exposure and moisture; the immediate hedge-bottom and the shrub canopy and tree layer (Dowdeswell 1987). Cherrill *et al.* (2001) found a correlation of ground flora species-richness with increasing hedge bank height and hedge height but not width.

Theoretically hedge is subject to succession by which it will gradually become woodland (Barr 1995). Initially there will be an increase in species-richness as the hedge is colonised by field species associated with open conditions and woodland edge species, the propagules being transported by wind or birds. Later there will be an influx of species more typical of woodland, and larger broadleaved species that will eventually shade-out some of the original shrubs and ground flora, with a subsequent loss in diversity (Barr 1995). Factors affecting this process and which plants will colonise are: the direct and indirect

impacts of human activity; climate; soil; and location (Dowdeswell 1987) and the dispersal abilities of plants and landscape topography (Barr 1995). Assarted hedges - those that were once connected to woodland which has in due course been cleared for agriculture, are frequently found to retain a high number of woodland ground flora (Barr 1995).

The adjacent land use is known to influence the species-richness and composition. (Mercer *et al.* 1999) found that the land use on the *opposite* side of the hedge also influenced ground flora species composition. Combinations associated with greatest species-richness for the ground and canopy flora were: arable/road and arable/woodland also those featuring improved grassland, while an arable/arable combination was found to have “significantly lower” species-richness (Mercer *et al.* 1999).

1.2 Invertebrates

There are 1500 species of insect associated with hedges (Maudsley 2000), different species existing throughout the structure and utilising leaves, stems, bark, buds, flowers, fruits, seeds, galls, fungi, old wood and detritus for their food and life stages (Maudsley 2000; Pollard *et al.*1974), with plant diversity determining insect diversity. Any hedge will contain hundreds of species (Pollard *et al.*1974), but preference within shrub types varies greatly with over two-hundred species of insect and arachnids associated with hawthorn while holly has only ten (Maudsley 2000). Corbett (1995) estimates there are 149 insect species associated with hawthorn. Wasps, ants and bees (Hymenoptera) are most abundant, followed by flies (Diptera), aphids and leafhoppers (Homoptera), bugs (Hemiptera), beetles (Coleoptera) and thrips (Thysanoptera), (Corbett 1995), however the bees, hoverflies and butterflies are the most visible (Pollard *et al.*1974).

Of the fifty-four species of lowland UK butterflies alone, twenty-three breed in hedgerows and fifteen of those do so commonly and from the “smaller British Lepidoptera” fifty-three species are known to eat hawthorn and twelve “solely dependent on it”(Corbett 1995). More than one-hundred species of moth feed on hawthorn and almost as many on blackthorn according to Pollard *et al.* (1974). The brown hairstreak is “confined to hedgerows” and the black

hairstreak is reliant on blackthorn (Corbett 1995). The ermine moth is viewed as a pest, and can cause severe damage to hawthorn and blackthorn (Pollard *et al.* 1974).Other butterflies are more closely associated with the base layer and adjoining field margins. Hedge brown and meadow brown are attracted to bramble flowers (Pollard *et al.*1974).

Structure of the hedge is an influential factor as hedgerows with numerous layers are associated with a high faunal diversity (Maudsley 2000) as are features such as banks, verges and ditches; trees providing an additional layer and a special habitat for some insects (Maudsley 2000). Insects may utilise upper vegetation to feed and/or reproduce and spend winter in hibernation amongst the leaf litter (Maudsley 2000). Leaf litter inhabitants range from the smallest mites and springtails to millipedes, slugs and sylphid beetles which are prey to ground beetles, staphylinid beetles, harvestmen and centipedes (Pollard *et al.*1974).

A hedge rich in snail species (order Stylommatophora), is indicative of a hedge with centuries of history as these species are very slow to colonise (Corbett 1995).

The species and number of flowering plants in a hedge determines food availability throughout the year. Blackthorn flowers early and sallow is another spring flowering species attracting hive bees (*Apis mellifera*) and bumble bees (*Bombus sp.*) Hawthorn flowers in late spring while in summer bugs *Phytocoris* and *Psallus* are always found, and harvestmen (*Leiobunum sp*) and scorpion flies (*Panorpa sp*) are very common (Pollard *et al.*1974). Ivy, being a late flowering climber provides a source of nectar late in the summer (Corbett 1995).

1.3 Birds

Hedgerows are “one of the most important surviving elements of semi-natural habitat for birds.” (Hinsley and Bellamy 2000).

Of 91 “lowland terrestrial” bird species, 65 will breed in hedge and 23 will commonly do so. Twenty seven species habitually feed and nest in hedgerows and a further 16 others will use hedges for this purpose if present in high numbers (Sparks 1993).

The type of birds utilising hedge are mainly woodland and woodland edge species (Hinsley and Bellamy 2000), and hence in parts of the country where little natural woodland remains and the landscape is almost wholly given over to agriculture, hedges may be the only suitable habitat (Sparks 1993).

The intensification of agriculture, change in farming from mixed to arable use, and subsequent loss in optimal habitat, coupled with applications of herbicides, fungicides and pesticides are believed to have contributed to drastic decline in game species. Grey partridge, a BAP priority species (Url 2) is now at 20% of its pre-war population and locally extinct in some areas, and numbers of Red-legged partridge and pheasant are also greatly affected (Aebischer *et al.*1994).These species are forced into the field margin areas and hedgerows have assumed a new importance for their life-cycle.

Birds utilise hedgerows for a variety of functions that include: nesting sites; roosting sites; perches; song posts; food sources; shelter; cover for local movements and assistance in longer movements through landscape (Hinsley and Bellamy 2000; Sparks 1993).

Birds are to be found at greater abundance where hedge density is highest and they have therefore been affected by hedge removal, the extent of this varying according to species (Sparks 1993). Yellowhammer population has decreased by 37% between 1972 and 1996 (Url 2) and blue tit and great tits are believed to be averse to flying over vast open spaces, which then become a barrier to dispersal (Sparks 1993).The abundance and species richness of birds increases with an increase in woody species found in the hedge and there is also a positive correlation with hedge size/ height (Hinsley and Bellamy, 2000).

Adjacent features and ground vegetation are also significant factors affecting the utilisation of the hedge by birds, with different species having their own preferences for hedge size, shape, ground cover and other characteristics. Double the number of song-bird territories are to be found in tall as opposed to short hedges (Sparks, 1993), while blackbird has a preference for tall wide hedges with trees (Hinsley and Bellamy 2000) and the lesser whitethroat is one of the few warblers to prefer a taller hedge (Sparks, 1993).The mean nest

height for chaffinch is 1.26m, with nests in lower hedges shown to produce fewer young (Sparks 1993). The common linnet – a BAP priority species (Url 2) is however associated with lower hedges that are wide and dense. While corn bunting also a BAP priority species (Url 2), nest near to ground level in crops or low bushes, they are “rarely found in boundaries without hedges” (Hinsley and Bellamy 2000). The broader base of ground flora associated with tall and wide hedges tend to be rich in bird species (Sparks, 1993). Species preferring a dense ground flora include yellowhammer and whitethroat (Sparks, 1993). The presence and size of ditches can affect the abundance of insectivores such as song thrush (Hinsley and Bellamy 2000).

Cover is essential to survival rates of nestlings while parents are out foraging (Hinsley and Bellamy, 2000). For this reason cover and adjacent food supply are highly important factors in nest site selection. Partridge seek out nesting cover and brood rearing areas in the hedge-bottom and have slightly differing preferences: Grey partridge like a low hedge (Sparks 1993) and an elevated bank (Aebischer *et al.* 1994) with dead grass to provide cover and shelter while Red-legged partridge also prefer dead grass but with higher levels of tall vegetation comprising bramble and nettle along with leaf litter (Aebischer *et al.* 1994).

Food supply can be solely found in the hedgerow or birds can use it as a base for localised foraging in adjacent fields and there is also seasonal variation in species’ usage. Cirl bunting is usually found within 30m from the hedge in winter (Sparks 1993), and chaffinch, whitethroat, dunnock and blackbird also forage in close proximity to the hedgerow (Sparks 1993). In spring and summer Grey and Red-legged partridge use the hedge to nest, whereas in winter they use it for shelter and food (Aebischer *et al.* 2000). In winter the hedge supplies food and shelter for migrant species as well as residents: redstarts select tall mature hedges and whinchat prefer short and dense hedges (Hinsley and Bellamy 2000).

Other bird species have only limited occasional use of hedges or none at all. Some scrub and open-country species utilise hedges and hedge trees for perches, nest holes and song posts, but others; skylark and lapwing, are

purely open-country species avoiding hedges and will only “tolerate proximity of short ones” (Hinsley and Bellamy 2000), -assuming short in this instance refers to stature of the hedge. For owls and woodpecker, their choice of hedge as a nesting habitat is dependent on the presence of suitable mature or decaying trees in the hedgerow (Hinsley and Bellamy 2000).

1.4 Mammals

Mammals use hedgerows for shelter, food and as a movement corridor, with seasonal variations on different species’ usage of the hedge.

Common and pygmy shrews have both been frequently trapped in hedgerows (Packer 1993; Pollard *et al.*1974)), where they typically nest and prey on beetles, slugs, snails, spiders and other invertebrates, Packer (1995) reports that occasionally water shrews may be found in a hedge if there is water less than 3km away, suggesting they use the hedgerow for dispersal. Shrews have a preference for ground cover, nesting in the hedge and foraging in the fields (Tew 1994). Similarly bank voles require cover but may be found foraging in the fields later in the summer (Tew 1994), up to distances of 25m from the hedge (Packer 1995) where they may eat invertebrates as an alternative food source prior to the fruiting of hedge plants (Tew 1994). Packer (1995) adds that bank voles are “very dependent” on hedges in agricultural areas, although they are primarily a woodland species, and “can be found in arable hedgerows throughout the year.” Their main foods are seeds, berries and plant leaves (Tew 1994). Field voles are also found at lower densities in hedges but are mainly grassland animals (Packer 1993). Bats may utilise hollows in hedge trees for roosting and hedgerows for navigation. (Pollard *et al.*1974).

Woodmouse populations do exist solely in fields but they are found in greater numbers in the hedge. In spring, they use the hedgerow for shelter while foraging in the field (Packer 1995); summer preference is ranked as hedge over oilseed rape, over barley, over wheat; and winter preference is hedge over oilseed rape, over wheat over barley (Tew 1994), with a drop in numbers in the field at harvest time. Hedges are also a very important habitat for harvest mouse (a BAP priority species, (Url 2)), whereas although the yellow

necked mouse does occur in hedges, its main habitat is woodland (Packer 1995). The dormouse (a BAP priority species (Url 2)) is a deciduous woodland species associated with scrub and bramble (Packer 1995), but hedges are their second most important habitat (Packer 1995) and very important for the survival of the species (Packer 1995). Most dormouse populations are found in areas where woodland is well-connected to hedgerow at a distance of less than 500m (Packer 1995).

Rabbits will often create burrows on hedgebanks (Packer 1995) whereas Brown hare (a BAP priority species (Url 2)) use hedges to rest and shelter whilst foraging in field margins in the vicinity (Aebischer *et al.* 1994; Packer 1995). Hedgehogs are also regular inhabitants (Pollard *et al.* 1974), nesting in summer and hibernating in winter (Packer 1995). Badgers use the hedgerow as a corridor for movement and entrances to sets can be found in hedgerows, hedges are an important edge habitat for foraging (Packer 1995).

The abundance of small mammals ensures a plentiful food supply for several predators that utilise the hedgerow. Fox earths are frequently found in hedgerows (Packer 1995), and polecats use woodland edge as a major habitat (Packer 1995), while stoats and weasel hunt along the length (Pollard *et al.* 1974) with weasel using hedgerows exclusively in winter and spring.

A couple of deer species make use of hedge in the lowland agricultural setting: roe deer- a woodland animal, uses hedgerows and ditches for cover (Pollard *et al.*1974; Packer 1995) as they move through the landscape and muntjac deer select arable land as habitat and hedges are probably an important feature within these habitats (Packer 1995).

1.5 Reptiles and Amphibians

Records do not generally link amphibians with hedgerows but there is some evidence of reptiles using hedge as part of their habitat, particularly grass snake, slow worm and common lizard (Sparks 1993).The common toad however may use agricultural land if there is adequate cover and may hibernate under hedges particularly if found within around 0.5-2km of a pond (Sparks 1993) and it also uses ditches for dispersal. Pollard *et al.* (1974) mention the importance of ditches' suitability for amphibians, as a source of

moisture to avoid desiccation, and that these animals may be “rarely recorded” but are probably often concealed by cover. Banks are also important features for amphibians which utilise existing burrows for hibernation (Pollard *et al.* 1974) whereas reptiles do likewise and also can be frequently seen basking in the sun from spring to autumn avoiding only the hottest part of the day (Pollard *et al*.1974).

Grass snake and adder also hibernate in old mammal burrows in hedges and Pollard *et al*. (1974) discuss hedges in cultivated areas being vital for connectivity of habitat and breeding areas for adders (vipers *sic*.).

1.6 Wildlife Corridors

Much has been written about hedges in the context of wildlife corridors, with varying viewpoints. Land and wildlife managers maintain hedges’ value as movement corridors for game mammals, birds and squirrels (Noss 1993) but the verdict of Simberloff (1992) is that there is no empirical evidence to support the idea of corridors.

Part of the disagreement may lie in differences in definition of a corridor and problems relating to differences of scales between types of habitats under consideration. Definitions should also distinguish whether they are discussing features that exist naturally within the landscape such as rivers, or those created purposely to assist dispersal of species. Many studies are focussed on larger scale corridors such as the optimal width of strips of forest to connect two isolated larger areas of forest (Moseley *et al.* 2006). Noss (1993) describes corridors as a “swath of habitat through which non-domestic organisms can move”. Functions are: allowing daily and seasonal movement of animals; the dispersal and exchange of genetic material between populations; and also the longer range (spatially and temporally) of population shifts of species for example in response to factors like climate change (Noss 1993) or reversal of the effects of habitat fragmentation (Moseley *et al*. 2006).

Even the value of genetic exchange is under dispute with proponents maintaining that flow of genetic material assists the genetic diversity of a population and reducing “the expression of harmful recessive genes through

inbreeding" (Noss 1993) but others arguing that this can lead to losses of "genetically distinct populations within species" (Noss 1993).

The idea that hedges afford protection for several species of bird flying along them (Noss 1993) in landscapes with otherwise little natural habitat is not under question and Simberloff *et al* (1992) assert that linear habitats are valuable for wildlife in their own right irrespective of whether they also act as corridors. Of hedges, Noss (1993) states that these narrow corridors.

> *…may support species of little conservation significance at regional or global scale of concern but are important in sustaining species diversity and a number of ecological functions in an intensively managed landscape.*

1.7 Hedge Management

Structure/Size

Game birds prefer a hedge less than 2m high (Sparks 1995), but the bulk of fruit production occurs above 2m and "taller, thicker" hedges are more beneficial for birds (Sparks 1995). A higher hedge is better for butterflies (Corbett 1995) and taller and wider hedges are associated with greater diversity in woody species (Britt 1995) However some studies recommend a height not greater than 2m to avoid shading out of ground flora (and crops), but this is again in contrast with others that associate ground flora species richness with increased height and width (Britt 1995).

Shape

There is little agreement on the ideal shape for a hedge with some suggesting that an "A" shape is a poor habitat for birds (Sparks 1995). Untrimmed hedges are preferable for many species –double the number of thrush species can be observed in untrimmed hedges (Sparks 1995). If the top of the hedge is chamfered, there is less danger of a thicker layer of trimmings acting as a mulch and suppressing ground flora (Corbett 1995).

Hooper, in 1992 concluded that a hedge size to suit both farmers and wildlife would be up to 4m high and 2m wide with only the sides trimmed (Corbett 1995) and Pollard *et al.* (1974) suggest a compromise would be reached in

having a range of hedges of different sizes and under different management regimes on a farm.

Implications of a Gappy Hedge

Relict hedges are likely to support fewer invertebrate species than managed ones because of the reduced structural complexity and plant diversity. (Maudsley 2000).

Small mammals and their predators prefer a “dense, well-connected hedge” (Britt 1995) this is especially important for dormice which need a continuous hedge to disperse between woodlands (Corbett 1995).

Hedge bottom management

Drift spray from herbicides and pesticides leads to an “impoverished” hedge-bottom flora and a corresponding reduction in invertebrates (Maudsley 2000) and bird numbers (Britt 1995). The adverse effects of these on native ground flora allow encroachment by more vigourous opportunistic weedy species such as cleavers *Gallium aparine* and nettles *Urtica dioca* whose growth is further encouraged by effects of fertilisers (Britt 1995).

The cutting regime of grass margins affects insect abundance. Summer cutting is detrimental and autumn cutting has a negative effect on the survival of invertebrates over the winter (Maudsley 2000).

Cutting regime

Frequent trimming is detrimental leading to a loss of vigour of the plants with gappiness, premature ageing and death (Sparks 1995). Reductions in butterflies and moths are caused by a regime of regular summer flailing (Britt 1995; Maudsley 2000), but these recovered when the timing was moved to autumn (Maudsley 2000).

The appearance of a flailed hedge is not pleasing but the practice causes “little or no permanent damage” according to Pollard *et al.* (1974).

Hawthorn is well documented as only flowering on the previous year’s growth (Britt 1995; Pollard *et al.*1974) and therefore cutting every 2 or 3 years is generally recommended (Britt 1995; Sparks 1995; Pollard *et al.*1974). The

time to do so is late winter, after the birds have been able to gain maximum benefit from berries and before the nesting season (Britt 1995; Pollard *et al*. 1974), however some insects that lay eggs in autumn will be affected by this (Maudsley 2000) although the 2-3 year frequency should offer some mitigation.

If particularly considering the dormouse then frequency should be low as to avoid disturbance and trimming on alternate sides should be considered (Britt 1995).

Similarly on a farm scale it is recommended that not all hedges are cut in the same year (Pollard *et al.* 1974).

Hedge Trees

Trees can shade out the shrub layer eventually leading to gaps and cutting hedges containing saplings becomes a slower process. (Pollard *et al*.1974) Nevertheless saplings should be allowed to grow (Sparks 1995) and the value of trees in enhancing species diversity is not under dispute. A solution to the above is corner planting (Pollard *et al*.1974).

Old dead trees should be left to decay and become a habitat for specialised invertebrates such as the lesser stag beetle (Clements and Tofts 1992) and if felling is necessary a large stump should be left and allowed to rot (Corbett 1995).

Enhancing Biodiversity

In reviewing literature on wildlife and hedgerow management Britt (1995) compiles the following points as important:-

- “Hedges should be individually managed” to achieve their highest potential.
- Protection of hedges with “diverse structure”, and those that may be of ancient origin or derived from ancient woodland.
- Awareness of the quality of species present.
- Operating at landscape scale to improve connectedness between woodlands, water sources and hedges. Maudsley (2000) stresses that

at landscape level the population disturbance affecting individual hedges may threaten sub-populations with localised extinction.

- Gapping up should only use locally sourced plants and plants other than those already growing should be considered.
- Ideally there should be a “strip of undisturbed herb vegetation” next to the hedge to encourage bumble bee and butterflies, and extended “buffer zone” of grassy field margin that can be sown with wildflower seeds.

1.8 Restoration

Leggy hedgerows are generally undermanaged and are at risk of becoming relict: “once (the hedge) has started to thin out and become bare at the base or comprise little more than an intermittent line of shrubby trees the end is in sight unless action is taken.” (Url 6)

Techniques

Restoration is usually by laying or coppicing with or without planting of gaps (Url 6). Overgrown hedge needs to be prepared for laying in advance by “siding up” - cutting sides right back towards (about 15cm from) the interior stems, then leaving for at least one year (Url 6). The appearance will be drastic and there is potential for misunderstanding by the public, so advance publicity is advised (Url 6). Laying is good for structural diversity and thus beneficial to invertebrates and ideally should be done on a rotational basis along the length of hedge (Maudsley 2000; Url 3). The optimum stem size for laying is 5-10cm (Brooks 1988; Henry *et al.* 1994) or 5-15cm, of a 2.5-3m high hedge (Url 4). There is a tradition of many different regional styles of hedgelaying (Pollard *et al.*1974), most of which need re-laying after fifteen years (Pollard *et al.*1975; Url 6).

Coppicing can be “less stressful” for the shrub and is the only option for stems thicker than this (Url 6). Stems should be cut diagonally to within 10cm of ground level, between October and February (Url 4). This needs to be repeated every 12-15 years (Pollard *et al.*1974).

Dealing with gaps

If a gappy hedge lies in a grazed area it is worthwhile fencing it off to allow any seeds present to germinate and sprout (Url 6). Problems can occur with planting up gaps owing to compacted ground and buried stones and other material as well as a lot of roots (Url 6) and alleged “thorn sickness in the soil” (Henry *et al.* 1994). Concern about the latter is a reason why blackthorn is often planted in hawthorn hedges with recommendations to at least dig in manure; (Url 6; Url 5) or even remove topsoil and replace it (Url 6). Research by Henry *et al.* (1994) found removal of topsoil to be unnecessary.

A single row of quicks is adequate for gaps under 2m, with double rows for those over 2m (Url 5). The distance between plants and rows should be 25cm (Wildig *et al.* 1994), 25-30cm (Url 5), others recommend closer planting to compensate for losses through browsing by animals. Newly planted whips should be pruned immediately down to 10-15cm to promote new growth at base level (Url 5). Watering in the first season, particularly during dry spells, greatly enhances survival rates (Url 5) Henry *et al.* 1994).

Where much of the hedge has become trees “crownlifting” may be required – cutting off lower tree branches to about seven metres (Url 6). This will improve light conditions for new planting. Laying is also used as a solution to gaps (Url 6).

Tree planting

Tree saplings should be included in new planting, every ten to fifteen metres (Url 5) and saplings should be marked to prevent cutting when hedge is trimmed. There is an “ideal ratio” for succession of trees in a hedge of “six saplings: three young trees: two medium trees: one mature tree” (Url 5).

2 METHODOLOGY

2.1 Selection of Survey Area

The survey area was decided by use of an OS explorer (1:25000) map. Areas that were built up were excluded as were areas outwith the boundary of Hartlepool Borough. One km grid squares that were partially built–up were included if this amount did not exceed 25% and there were visible field boundaries in the square suggesting land use was of a predominantly agricultural nature. Likewise squares which were crossed by the Borough boundary were included if the area within the boundary was at least 75 %. This resulted in a total of exactly 50 km squares lying to the west of the town of Hartlepool, and including the villages of Hart, Elwick, Dalton Piercy, Greatham and Newton Bewley. These were loosely termed “hedged squares”

2.2 Sample Selection

From the 50 km squares a sample of fifteen was selected using a computerised random number generating system. A further five were selected as contingency, to be brought into use in case of access problems. The fifteen km squares from which survey hedges were selected, represents 30 % of the total hedged area of 50 km^2. The sample areas were not stratified in any way because the total survey area of 50km^2 is relatively small and there is little variation in landscape type, geology or character, within the area. Land is lowland agricultural, between 30m and 140m in elevation, lying solely within the Tees Lowlands Area of the Natural England area profiles. An image showing the spread of the fifteen sample squares across the survey area is found in appendix I.

2.3 Permission to Access

Local knowledge, mapwork and consultation with the Rights of Way staff enabled a list of landowners and farmers to be drawn up from whom it would be necessary to seek permission for access. As precise boundaries of farms were not always known, and are subject to change, and the exact location of hedges was not yet selected, all farms within each of the fifteen km squares were contacted as far as possible.

A letter explaining briefly the purpose and aims of the survey was sent to farmers/landowners asking for the recipient to telephone to either agree to or decline access. Over 40 letters were sent to which about eight initially responded. Of these only one declined. The rest had then to be contacted by telephone and from this only three declined interest in the project.

2.4 Selection of Hedges

A grid of nine cells was sketched on a transparency (3 x 3 cells) and superimposed upon each of the 15 x 1km squares, and the centre point of each cell marked. Other surveys (Beeston 2007) using this method have then selected the nearest hedge to this centre point, therefore planning a total of nine hedges per km^2. As resources and time were limited for this project, four hedges per km square were selected by identifying those closest to the centre points of alternate cells in the grid. This same procedure was applied to all of the fifteen squares. In order to verify that these were hedges and not other forms of field boundary, digitised aerial photographs were examined and at the same time a GIS shapefile was created of all the sample hedges. This procedure allowed individual maps for each of the sample squares to be printed off for use in the field showing selected hedges highlighted for ease of identification. An example is shown in appendix II. In cases where access was denied, or there was a built-up land feature, adjacent cells within the grid would be brought into use and the hedge closest to that centre point identified.

The length of the hedge to be surveyed was determined by the number and location of immediate connections, as per the methodology of the Hedgerow Survey Handbook, (Defra 2007), which stipulates that where a hedge is joined by another hedge or more this is termed a “node” and for survey purposes a hedge is the hedged length between two nodes (although it could be a hedge that is unconnected at one or both ends). A hedge could be anything from 20m to over 1km in length. Hedges less than 20m in length are not deemed long enough for survey purposes. These factors therefore had also to be taken into account in selecting the survey hedges.

2.5 Selection of Survey

The survey was based on the “Hedgerow Survey Handbook: A standard procedure for local surveys in the UK” produced by Defra, 2007 edition. A copy of the form used is in appendix III. The survey was selected as one that would provide comprehensive baseline information on the condition of hedges in the Borough of Hartlepool, and could be used as a basis for periodic surveys aimed at ascertaining the extent to which hedges may have been brought into favourable condition in line with Biodiversity Action Plan targets. As a methodology promoted by Defra for usage nationally, it will also enable results to be compared with other surveys from other areas.

2.6 Training in Survey Techniques

A training day was held to familiarise Hartlepool Borough Council Countryside staff and volunteers with the questions on the survey form, procedure and species identification. This was conducted by Hartlepool staff, the project author and a consultant from Wildflower Ark, experienced in surveys and the training of volunteers to survey hedges. Health and safety issues were also covered.

Prior to this it was decided that only the Essential Assessments would be conducted, with one exception; hedgerow/margin management, and that these would be more than adequate to ascertain the condition of the survey sample hedges and therefore obtain a representation of Hartlepool’s hedges. Assessment of ground flora, although very interesting would require botanical skills well beyond the level of even the more experienced of the group. (Durham’s 2006 survey was conducted entirely by botanists (Beeston 2007)). It was decided to survey one side of the hedge, not two, because it would be simpler in terms of access, consent and time factors.

Surveyors worked in pairs with one member of staff teamed up with one or more volunteers. For the first 1km square of the survey the first two hedges were surveyed together as a group to practice method and ensure similar interpretation of the survey form and hedge characteristics was being employed across the group. Teams were supplied with 2x 2m length piping sections marked at 50cm intervals, a 30m measuring tape, map of the square

to be surveyed enlarged to fit A4 paper and showing the four hedges clearly marked, and 4 laminated species ID charts (an example is shown in appendix IV). Teams kept in contact by mobile phone.

2.7 Attributes Recorded

The following *attributes were assessed and recorded. Only side A was surveyed on each hedge for ease of access and time constraints.*

Hedgerow type: shrubby, line of trees or shrubby with line of trees.

Length: this was not recorded in the field but left to be measured using GIS

Connections: end 1, end 2 and total.

Extent of survey: 30m section was surveyed as opposed to the whole hedge (for the following aspects).

Adjacent land use: all relevant categories were ticked if applicable however the grassland category was simplified from three types: unimproved, semi-improved and improved to simply grassland, as lack of training in this area meant that identification could not be reliable.

Associated features: bank height to nearest 25cm, average herb vegetation height to nearest 5cm, and fence. Ditch category was later simplified to yes or no.

Undisturbed ground: average width (m) of undisturbed ground and of perennial vegetation from the centreline of the hedge- to nearest 50cm.

The above category was marked N/A if hedge was adjacent to grassland, woodland or road.

Nutrient enrichment ground flora indicator species: the % cover of nettles, cleavers and dock within a 2m band alongside the hedge-to the nearest 5%.

Recently introduced ground flora and woody species were noted if applicable.

Hedgerow shape: the closest resemblance was circled from the pictures.

Dimensions: average height (m) and average width at the widest point in the canopy to the nearest 25cm.

Integrity: gaps- the total length of gaps was ascertained from pacing out gaps while walking along the entire hedge; the percentage to be calculated once length of hedge was determined using aerial photos and GIS. It was noted whether there were gaps exceeding 5m.

The height of the base of the canopy was measured at the centre of the hedge- to the nearest 25cm. This was obtained by assessing the average height above the ground at which lateral growth occurred with new sprouting growth.

Isolated hedgerow trees: the species and diameter were noted.

Species: Woody species and their percentage cover in the 30m survey section were noted. Rose species were grouped into one category because of identification difficulties.

Hedgerow/ margin management: was included because it was straightforward to survey and provides information of any management techniques employed recently, between two and ten years ago, and over ten years ago. Surveying was from visual inspection.

2.8 Method of Selecting The 30m Section Within The Hedge

The method was standardised for ease of replicability for future years, to the following:-

Hedges that were obviously over 100m in length: from the start point surveyors paced out 30m in long strides, then set a pole to identify this as the start point of 30m section and measured a further 30m along the length using the tape-measure for accuracy.

Hedges that were estimated to be around 70-100m in length: surveyors paced out 20m before starting the 30m section.

Hedges less than around 70m: surveyors judged, by striding the length of the hedge a section that was approximately equidistant from each end, which was then measured using the tape.

If a hedge dramatically changed character along the length, the 30m section was not moved to reflect this is any way but differences were noted in the notes/difficulties section.

2.9 Quality Assurance

We worked in small teams with a small core group of three leaders and around six volunteers, and because of limited resources leaders would not be on the same team together. Volunteers worked with different leaders on different days, as recommended in literature, but as the main responsibility was with the leaders, swapping teams in such a way would do little to identify errors which may have evolved in the leaders' technique. After the main survey we therefore repeated surveying on three hedges, (5% of the sample) using leaders and volunteers that were visiting that particular hedge for the first time. For ease of access these tended to be adjacent to roads or otherwise have public access. The agreement between the surveys is covered in the results and discussion section.

Points were checked against the initial survey forms and the findings are reported in the results and discussion.

2.10 Data Storage and Analysis

Farm data is held in Excel files accessible only to the Countryside Staff Team.

Survey data was entered into Excel spreadsheets for initial evaluation, calculations and analysis. Statistical work was done using SPSS software.

2.11 Scoring of Hedges

A scoring system was devised in order to enable comparison between hedges and quantify the assessment of condition beyond simply passing or failing to meet the criteria. The scoring system is specific to these survey hedges in that it is created in response to the results obtained and does not extend to all criteria assessed. As all hedges uniformly passed the criteria for height, width and width of herbaceous border there was no need to include these elements in the scoring. The pertinent criteria were: integrity- both gappiness and height of the base of the canopy, and cover of nutrient enrichment indicator species. Hedges passing these criteria were allocated a zero score while those failing

were allocated points on the following basis (table 1). The maximum score is 10.

N.B. The scoring deviates from the Hedgerow Survey Handbook methodology in the requirement for the height of the base of the canopy to be less than 50cm. In this scoring system hedges have not failed the criteria if they were on the 50cm threshold, and have not been allocated any penalty points. This makes for easier comparison with other local surveys. Durham's 2006 survey also passed hedges in the 50cm height bracket (Beeston 2007).

Table 1: Method of Scoring Hedges Failing to Meet BAP Criteria

Gaps	Height of Canopy	Nutrient Enrichment Indicator Species
10-19% = 1 point	75cm= 1 point	20-29% = 1 point
20- 29% = 2 points	100 cm= 2 points	30- 39% = 2 points
>30% = 3 points	125 and over= 3 points	40-69% = 3 points
		70 and over = 4 points

2.12 Calculation of the Estimated Length of Hedge in Hartlepool Borough

Using GIS and digitised aerial photographs, a shapefile was created of the hedge lengths in ten 1km grid squares. The total length of hedge for each square was determined resulting in ten values. The mean and the standard deviation of these values was calculated enabling an estimate to be determined for Hartlepool.

3 RESULTS

Results are presented grouped into main topics. At the end of each topic section the most significant findings are extrapolated to present estimates of that topic for Hartlepool Borough.

3.1 Dimensions and Characteristics

Length

Sixty hedges were surveyed, four from each of the selected grid squares. The total length of hedge was found to be 17572m. The range of lengths was from 37m to 1009m (figure 1).

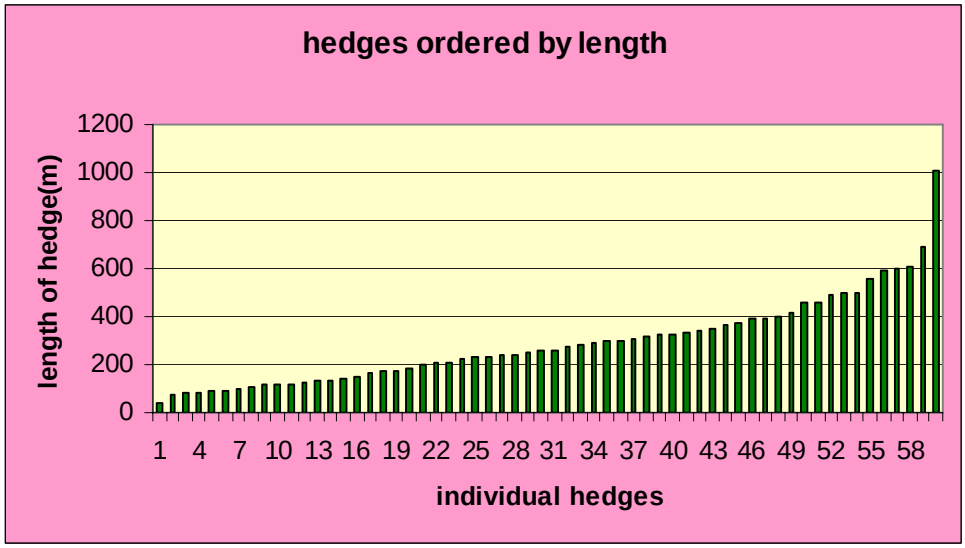

Figure 1: Distribution of Survey Hedges by Length, n=60

There is one outlier of 1009m. This can be seen more clearly when the distribution of lengths is grouped as a histogram in figure 2, and the modal length bracket is 201m.

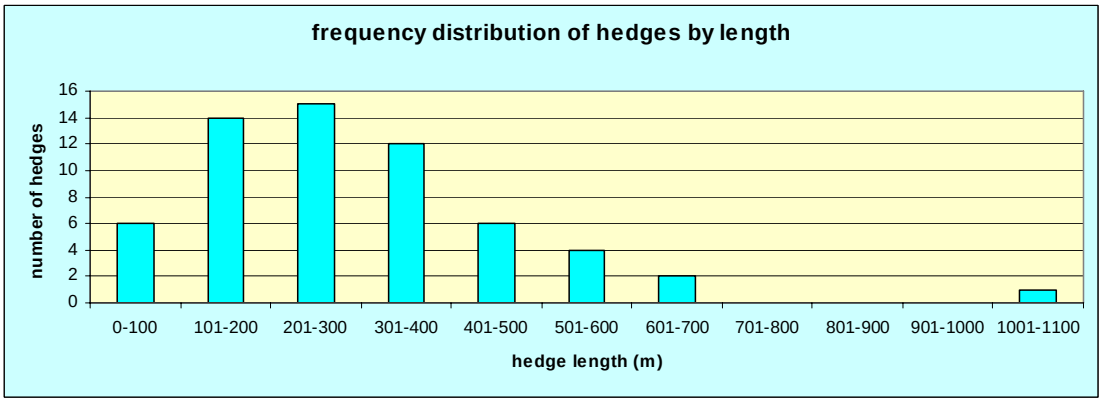

Figure 2: The Frequency Distribution of Survey Hedges by Length (Grouped), n=60

Dimensions

Hedgerows need to be at least 1m high and 1.5m wide to be in favourable condition for the Hedgerow Survey. All survey hedges met these criteria. The mean height was 3.5m and width was 3.1m. One hedge was considerably higher at 15m (figure 3) and could probably be reclassified as a line of trees.

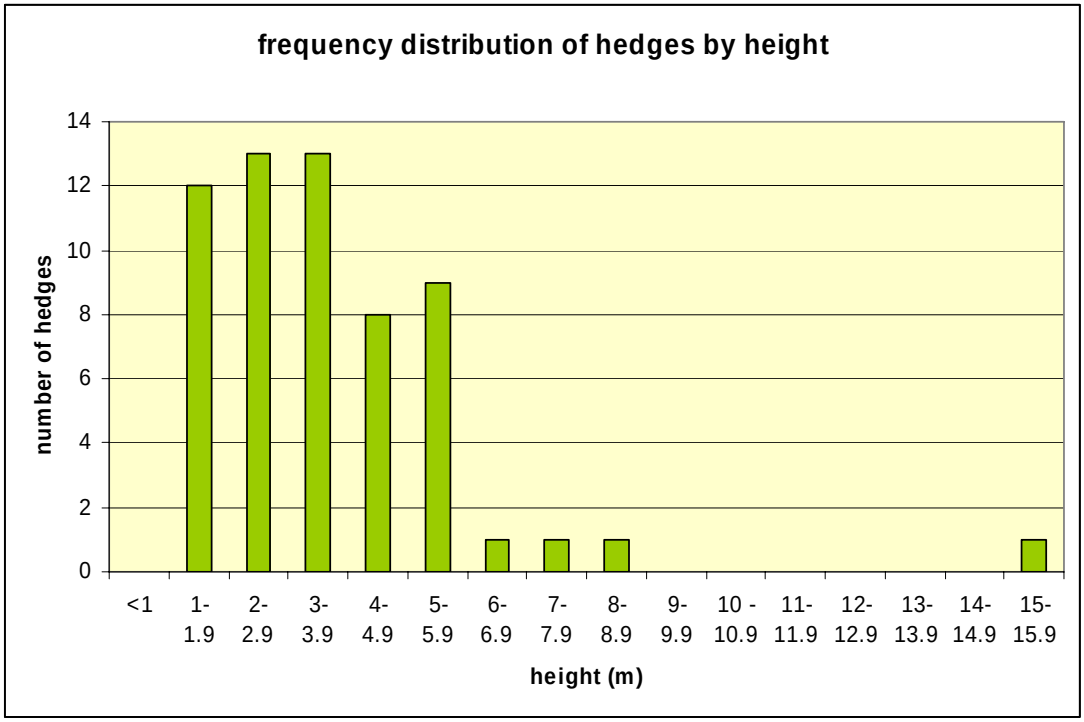

Figure 3: Frequency Distribution of Hedges According to Height, n= 59

Hedge Type

In the Hedge Survey Handbook hedges are classified into 3 types: the distribution of the survey hedges according to each type is shown in figure 4.

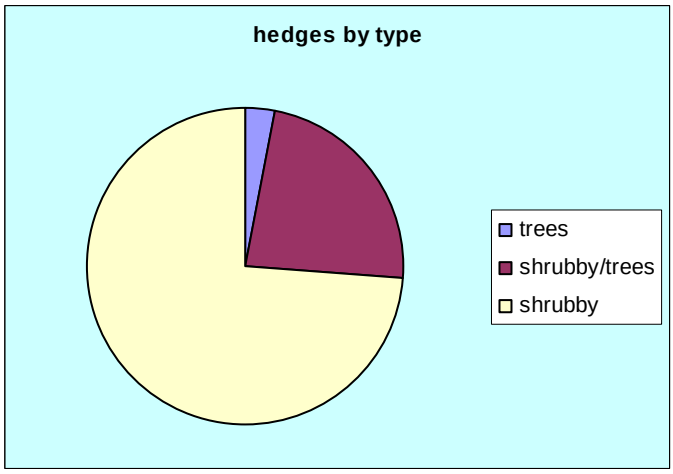

Figure 4: Survey Hedges by Type, n=60

The most frequently found type was *shrubby*, with 44 hedges at 12895m total (74% by length), followed by 12 hedges classified as *shrubby with a line of trees* totalling 4058m (23% by length) and only 4 hedges classified as a *line of trees*, 619m in total (3% by length).

Connectivity

The total number of connections for each hedge was recorded and results ranged from 0 to 5 with a median value of 3 connections (figure 5).

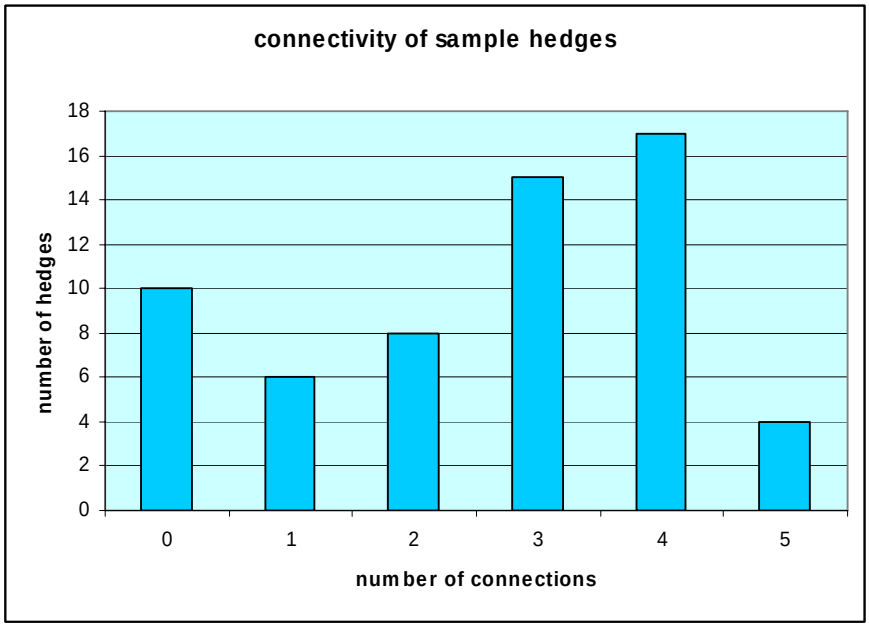

Figure 5: Frequency Distribution of Hedges According to Number of Connections, n=60

Associated Features

This survey covered the essential elements of the associated features assessment and none of the more detailed optional assessments. Findings are summarized in table 2.

Table 2: Associated Features of Survey Hedges, n=60

	Number	Length (m)	Percent of Total
No Features	6	1992	11.3
Fence Only	23	5438	31.0
Bank Only	4	1154	6.5
Ditch Only	2	760	4.3
Fence And Bank	17	5976	34.0
Fence And Ditch	3	723	4.1
Bank And Ditch	2	599	3.4
Fence, Bank And Ditch	3	930	5.3
Totals	60	17572	

Fences were found in 46 out of the 60 hedges, ditches in ten, while 11.3% of the length had no features at all. In addition to simply noting the presence of a bank, its height was also estimated. One hedgerow was on a far taller bank, more resembling an embankment. (fig.6)

There was no association found between hedges with banks and those with ditches, $X^2 = 0.217$, df = 1, P= 0.641.

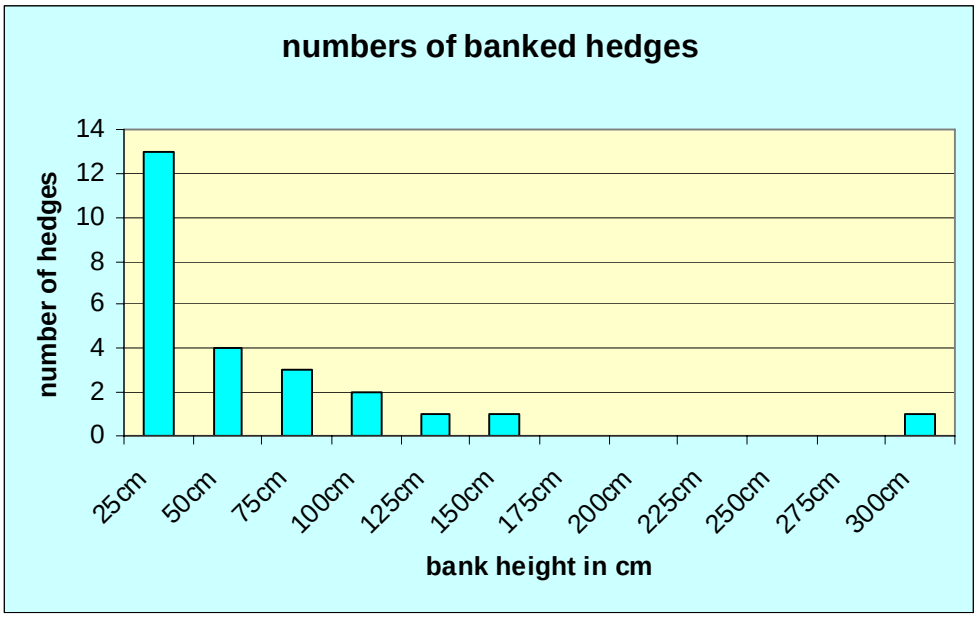

Figure 6: Numbers of Banked Hedges Arranged by Bank Height (cm), n=26

Adjacent Land Use

The land-use immediately adjacent to the hedge was noted (and only that on the side surveyed), but this does not include features such as woodland that may occur abutting the hedgerow as the survey does not request this information. Categories were slightly simplified (see methodology).

Some features of land use were not found at all: river, canal, lake/pond, or railway. Results are shown in figure 7. The number of hedges is greater than 60 because some hedges had two categories, for example, path and arable. The *other* was a stream.

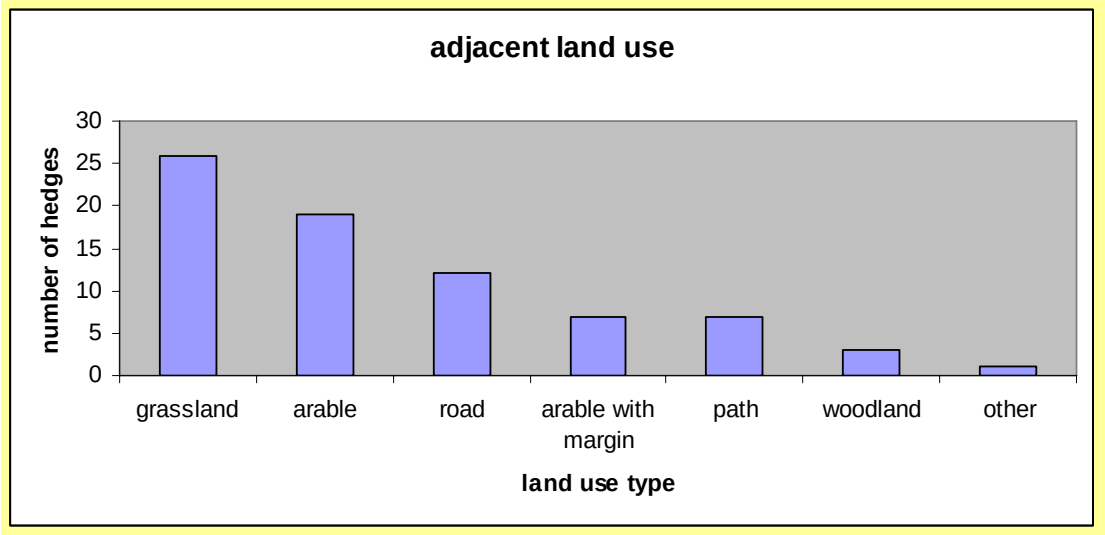

Figure 7: Hedges by Number According to Adjacent Land-Use.

Of the main land uses 6451m (34.9% by length) was next to grassland, and 6133m (36.7%) was adjacent to arable land, of which 2364m had a margin (13.4% of total by length). In addition 3890m of hedge were adjacent to roads (22.1% by length) and 1470m were next to woodland (8.3%).

Estimates for Hartlepool

- Length of Hedge

  Estimation of total length of hedge in the Borough of Hartlepool:

  The mean length of hedge per km square was calculated as 4926m or 4.9km,(sd =1.14) There are exactly fifty hedged squares (excluding built-up area) therefore the total length of hedgerows in Hartlepool is estimated to be 245km (+/- 57km).The length surveyed was therefore between 5% and 10% of the total resource.

- Characteristics

  Table 3 is a summary of the main findings relating to hedge characteristics and their equivalent lengths estimated for Hartlepool.

Table 3: Survey Results and Estimates of Hedge Characteristics for Hartlepool Borough.

		Survey Results	Estimated Total for Hartlepool
Type:	**shrubby**	12895m	179.8 km (± 41.8 km)
	line of trees	619m	8.6 km (± 2.0 km)
	shrubby/trees	4058m	56.6 km (± 13.2 km)
Features:	**bank**	8659m	120.7 km (± 28.1 km)
	ditch	3012m	42.0 km (± 9.8 km)
Adj. land-use:	**arable**	6133m	85.5 km (± 19.9 km)
	arable with margin	2364m	33.0 km (± 7.7 km)
	grassland	6451m	90.0 km (± 20.9 km)
	road	3890m	54.2 km (± 12.6 km)

3.2 Condition of Hedges

In addition to dimensions the following criteria are assessed to establish condition according to the Hedgerow Survey Handbook (2007). These are listed with threshold figures are given in brackets.

Integrity: percentage gaps (less than 10%), gap length (not exceeding 5m) and height of the base of the canopy (below 50cm);

Percentage cover of nutrient enrichment indicator species (20% given as a guidance figure that should not be exceeded);

Percentage cover of non-native woody species and ground flora (not exceeding 10% for each);

The average width of undisturbed ground (at least 2m from centre of hedge).

Hedges Passing and Failing Criteria

All hedges passed the width of undisturbed ground criteria and no hedges were found to contain any non-native species, and the only non-native ground flora observed was a stand of a few red-hot-poker plants beside a hedge that was located on the edge of a village. The three main elements of significance in failing the condition survey were gaps, canopy height and cover of nettles and cleavers. Dock, the third nutrient-enrichment indicator species was only found in two hedgerows and only at very low cover. A breakdown of the hedges under the essential criteria is demonstrated graphically in figure 8. The length of hedgerow applying to each element is shown in figure 9.

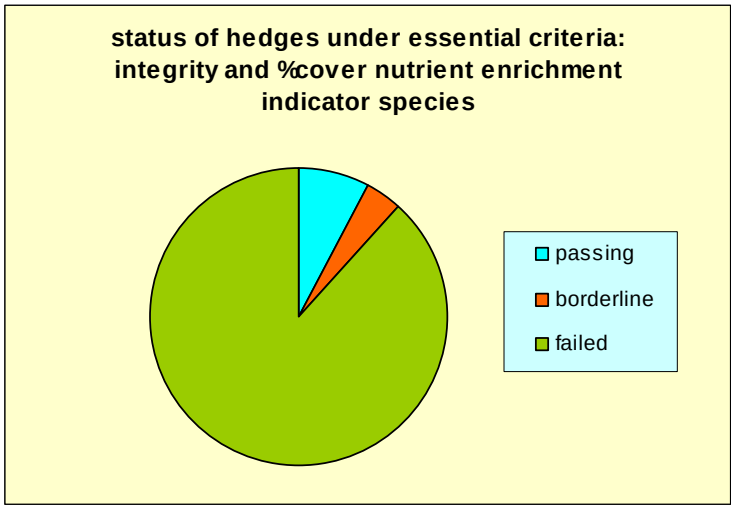

Figure 8 Hedges Under Essential Criteria: Integrity and n.e. Species, n=58

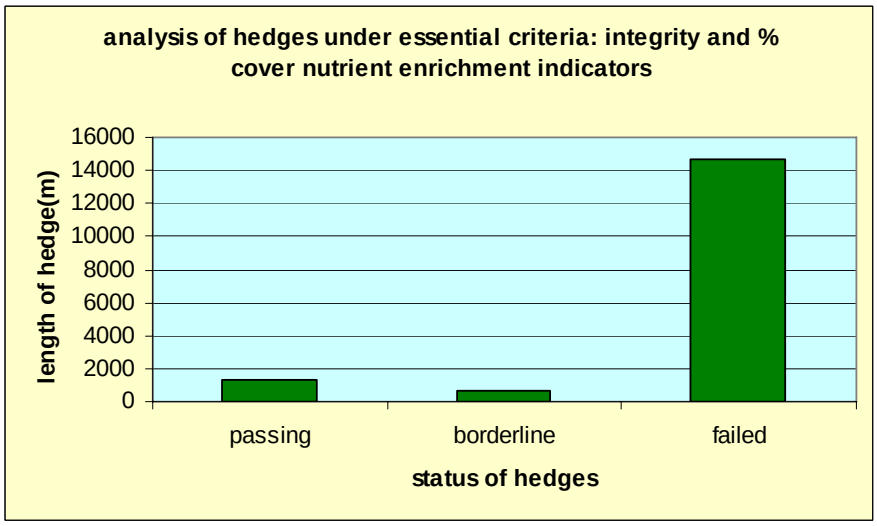

Figure 9: Length of Hedge Analysed Under Essential Criteria and Their Status, n=58

Of the hedges that failed, the number of criteria failed per hedge by length is illustrated in figure 10.

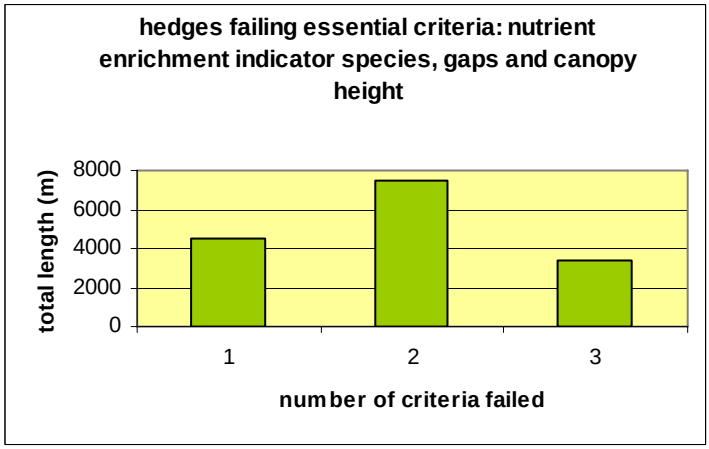

Figure 10: Length of Hedgerows by Number of Criteria Failed, n=52

Of those that failed, two hedges could be considered borderline as they only failed by being exactly on the threshold of 20% cover for nutrient enrichment indicator species (threshold figure is only a guideline for this element, as no "suitable thresholds have been developed" defra (2007)). These are therefore also included as hedges *meeting* essential criteria, (fig. 11). The number of hedges assessed was 58, and the borderline hedges have therefore been counted twice.

Therefore six hedges passed **all** criteria, (10% by number) with a total length of 1309m.

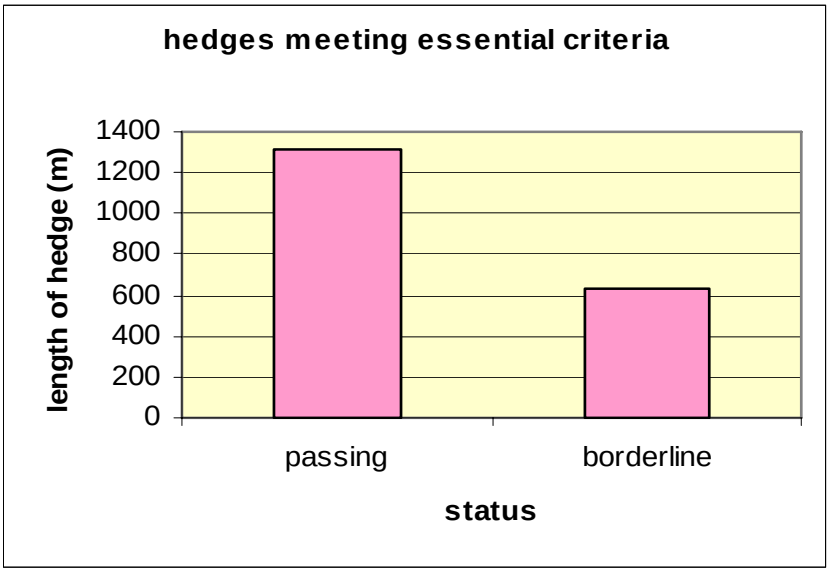

Figure 11: Hedges Meeting Essential Criteria of Integrity and Percentage Cover Nutrient - Enrichment Indicator Species, n=8

Estimates of Results for Hedges in Hartlepool

A summary of the results for relating to numbers of criteria passed and failed and extrapolated to give an estimate for Hartlepool is given in Table 4.

Table 4: Results Against Criteria (Gaps, Canopy Height and Cover of Nutrient Enrichment Indicator Species) with Estimated Totals for Hartlepool.

	Length of Hedge - survey	**Length of Hedge - 37 - Hartlepool Estimate**
Passing	1309m	18.0 km ± 4.2 km
Borderline	634m	8.8 km ± 2.0 km
Failing	14639m	204.0 km ± 48.0 km
Failing 1 criteria	4496m	63.0 km ±15.0 km
Failing 2 criteria	7437m	104.0 km ± 24.0 km
Failing 3 criteria	3340m	46.6 km ±10.8 km

3.3 Gaps

Although only 50% of hedges by number had gaps within, when lengths are taken into consideration the percentage is much higher, (figure 12).

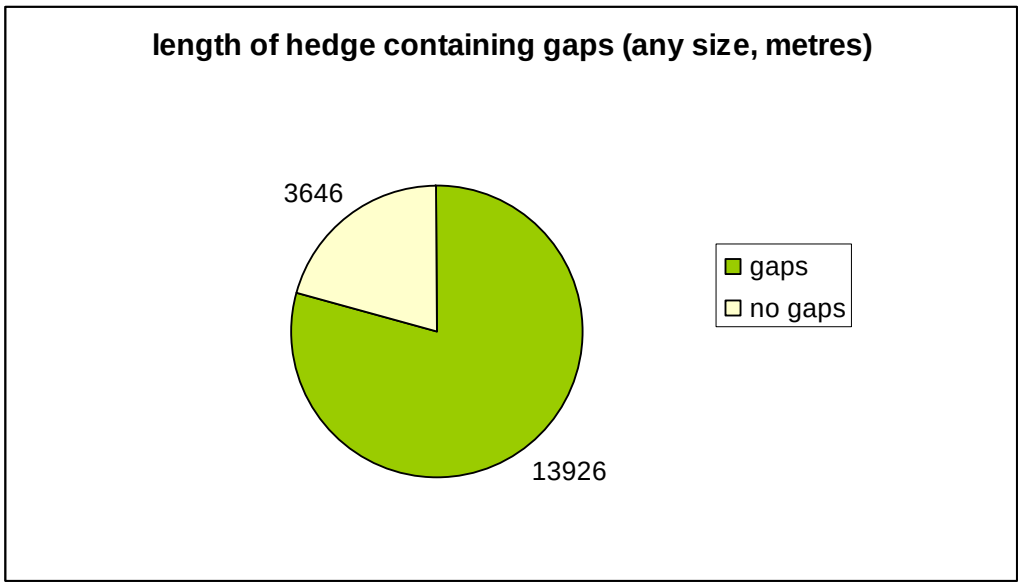

Figure12: Proportion of Hedges Containing Gaps, by Length. n=59

When viewed this way hedges containing gaps make up over 79% of the sample.

As the gap length for each hedge is known this can be totalled and the cumulative length of gaps themselves is 2022m, which is 12% of the survey sample length.

However there were relatively few hedges that were extremely gappy (>50%), and most (35 hedges) had less than 10% gaps (fig. 14).

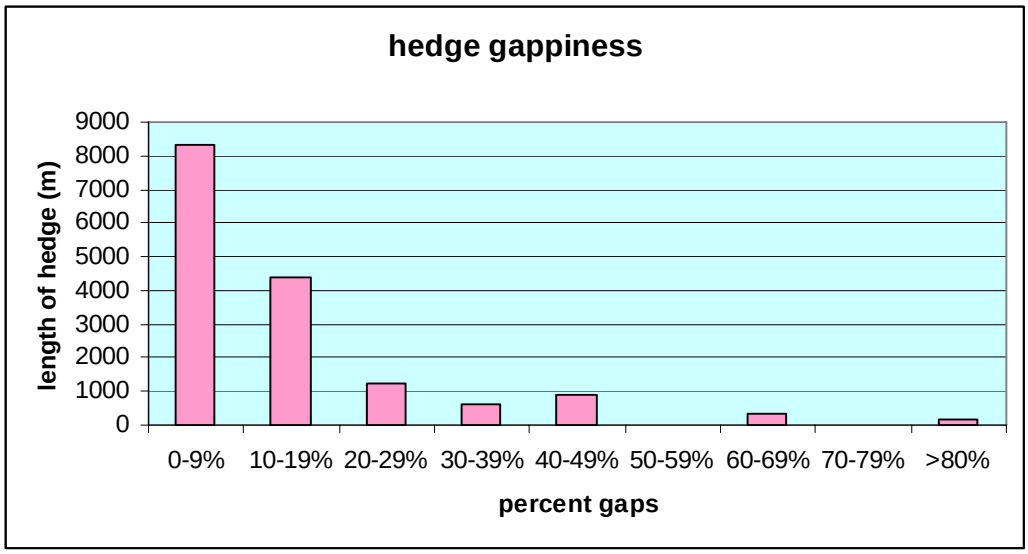

Figure 13: Total Length of Gappy Hedge, by Percentage of Gaps, n= 59

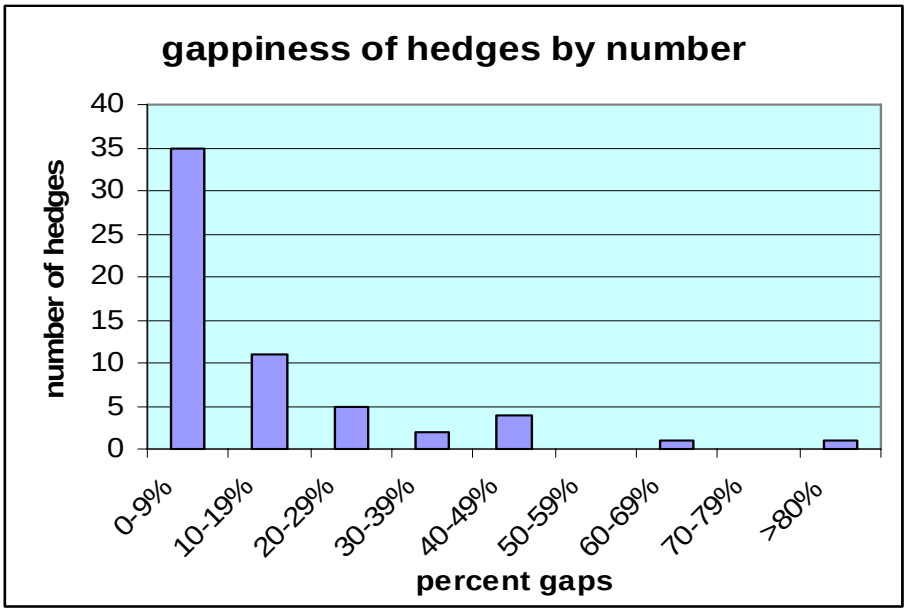

Figure 14: Hedges Arranged by Percentage Gaps, Showing Numbers of Each Band, n=59

There was no association between gappiness and adjacent land use, X^2 = 3.993, df = 2, P= 0.136

Estimates for Gappy Hedges in Hartlepool

The length of hedge in Hartlepool that would be expected to pass this criteria with less than 10% gaps is 144.6km ± 33.6km (table 5). However for gappy hedges the total length of gaps alone would be expected to be 28.1km ± 6.6km.

Table 5: Survey Total Lengths of Hedge Affected by Gaps and Estimates for Hartlepool

gappiness	Survey length of hedge	Estimated length for Hartlepool
0-9 %	10370m	144.6km ± 33.6km
10- 19 %	4386m	61km ± 14.2km
20- 29 %	1250m	17.4km ± 4.05km
30- 39 %	599m	8.35km ± 1.9km
40- 69%	1156m	16.1km ± 3.7km
>70%	151m	2.1km ± 0.49km

3.4 Nutrient Enrichment Indicator Species

Nettles and cleavers cover combined (measured in 30m section) affected over 11,000m of hedgerow to the extent that it failed to pass the criteria. While twenty four hedges (40 %) did pass, (table 6) the figure was only 33% by length. Also a considerable number of hedges (fifteen hedges) failed with very high cover (over 70%) nutrient-enrichment indicator species (figs. 13 and 14).

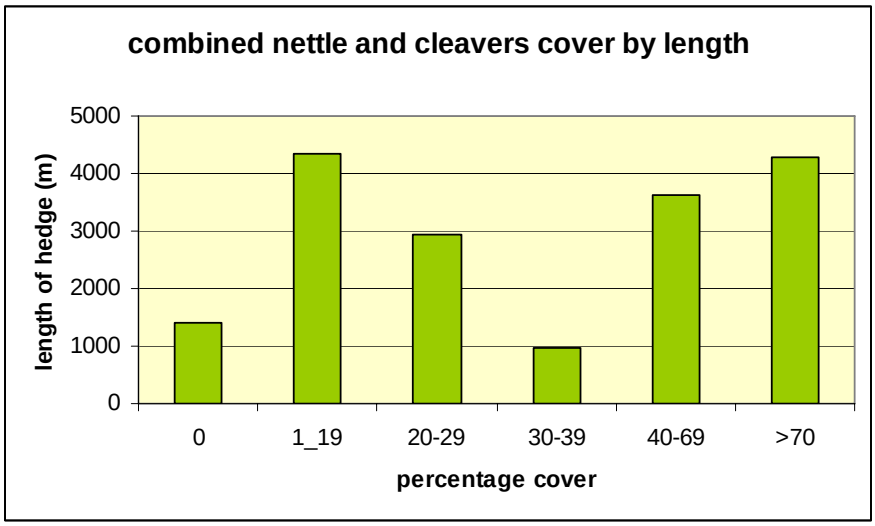

Fig 15: Percentage Cover n.e. Indicator Species by Hedge Length, n=60

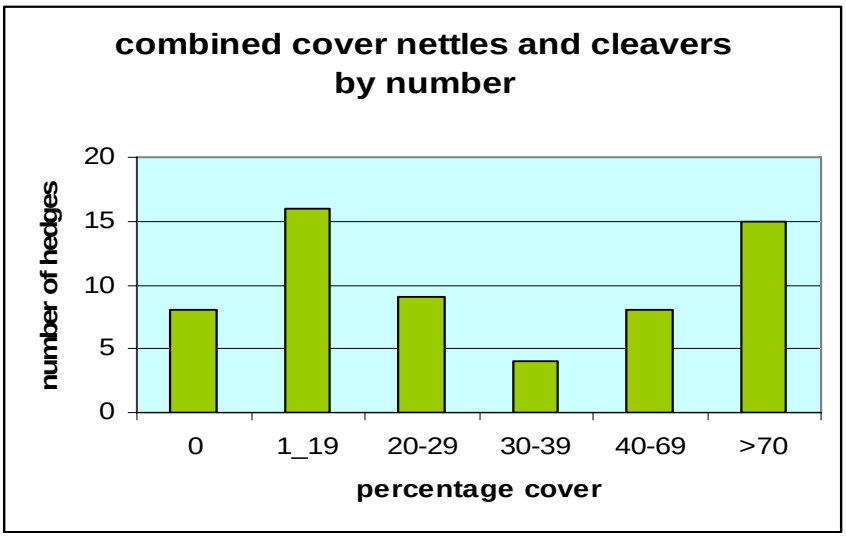

Figure 16: Percentage Cover n.e. Indicator Species by Number, n=60

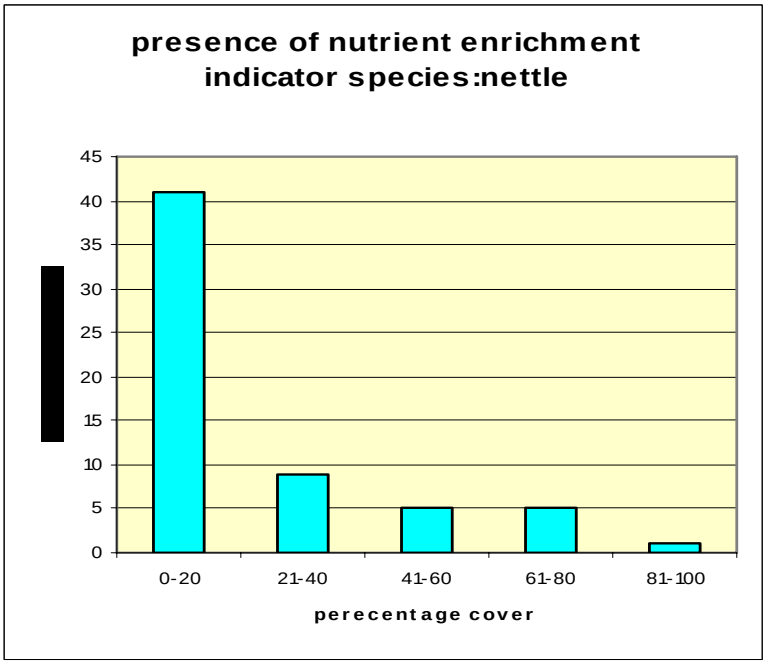

Figure 17: Numbers of Hedges with Nettle by Percentage Cover, n=60

When these are separated into constituent parts of nettles and cleavers (docks were not found), there is a strong similarity between species in the percentage of cover recorded in hedges (figs. 15 and 16).

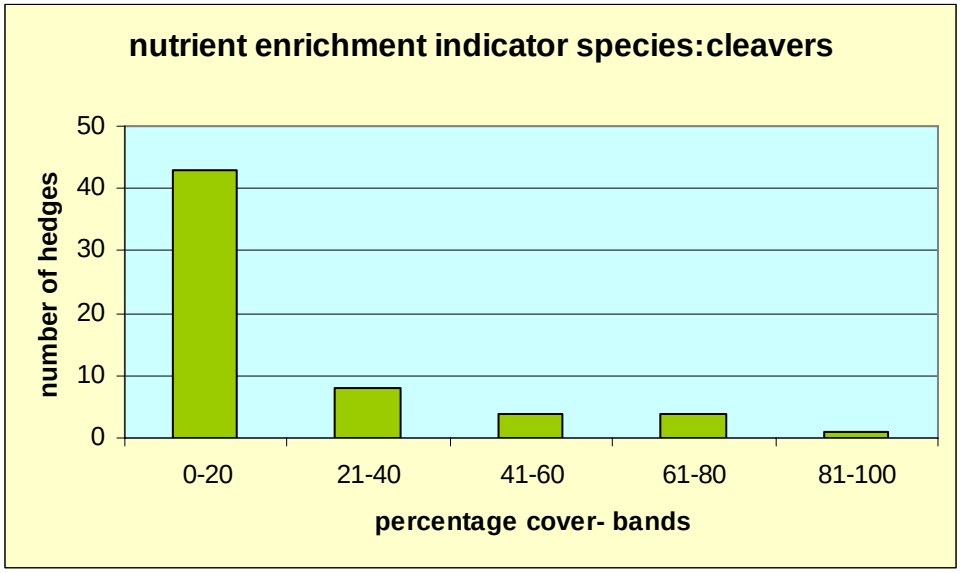

Figure 18 : Numbers of Hedges with Cleavers by Percentage Cover, n=60

There was no association between gaps and ranked nutrient enrichment indicator species cover, $X^2 = 5.972$, df = 4, P= 0.201.

Nor was an association found between adjacent land use and ranked nutrient enrichment indicator species cover, $X^2 = 13.993$, df = 8, P= 0.106

Estimates Relating to Nutrient Enrichment Indicator Species Cover in Hartlepool

The proportion of survey hedges affected by nettles and cleavers and the lengths in Hartlepool that may be potentially affected at different levels of cover is summarised in table 6.

Table 6: Nutrient Enrichment Indicator Species Cover, n=60

Cover Combined Nettles and Cleavers	No. of Hedges	Lengths	% of Total Length	Estimated Total Length for Hartlepool
0%	8	1414	80.%	19.7 km ± 4.6 km
1-19 %	16	4366	24.8%	60.9 km ± 14.2 km
20-29 %	9	2937	16.7 %	40.9 km ± 9.5 km
30-39 %	4	959	5.4%	13.4 km ± 3.1 km
40-69 %	8	3633	20.6%	50.6 km ± 11.8 km
> 70 %	15	4283	24.3%	59.7 km ± 13.9 km

3.5 Height of the Base of the Canopy

The threshold figure for the average height of the base of the canopy is 50cm, the distribution of hedges is illustrated by number figure 17 and length figure 18 arranged in intervals of 25cm, (*Survey Handbook specified that hedges were measured to nearest 25cm)* It can be seen that the majority of hedges (31) fail to meet the criteria, a further 22 hedges are at the threshold and strictly speaking would fail also while only 5 hedges are below the threshold figure.

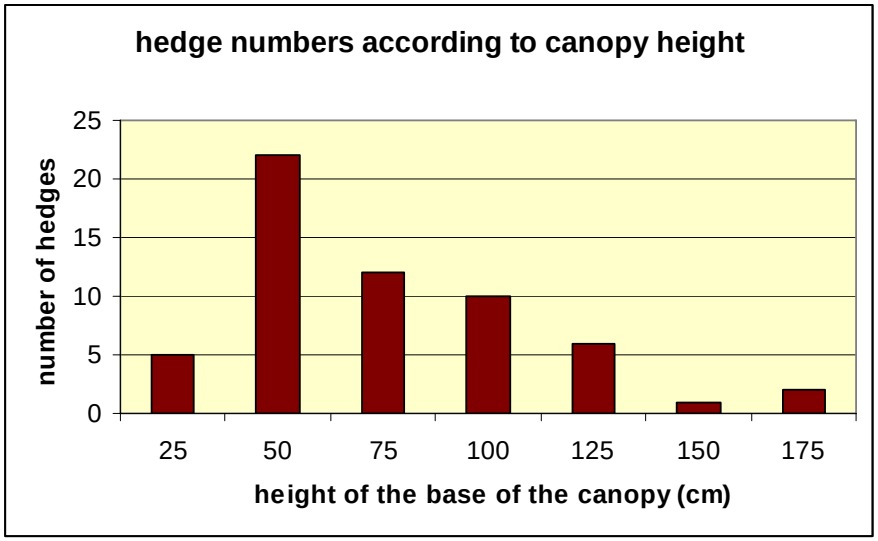

Figure 19: The Number of Hedges According to Height of the Base of the Canopy, n= 58

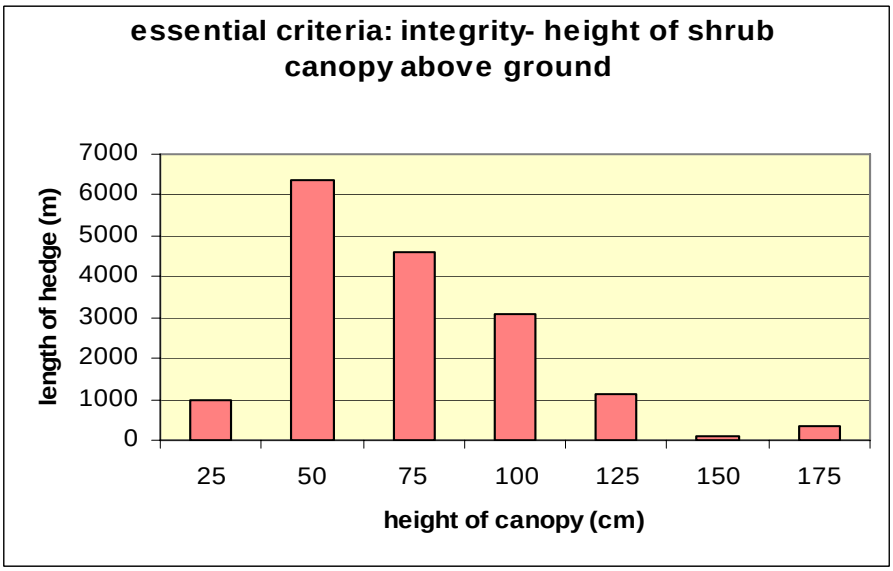

Figure 20: The Lengths of Hedge According to Height of the Base of the Canopy, n=58

There was no association found between canopy ht (passing or failing) and gappiness (passing or failing) $X^2 = 1.149$, df = 1, P = 0.284.

Estimates Relating to Canopy Height for Hartlepool

The estimated length of hedge in Hartlepool with an average base of canopy height exceeding 50cm would be 133.2km ± 31km. More detail can be seen in table 7.

Table 7: Summary of Results for the Average Height of the Base of the Canopy, n=58

Height of the Base of Canopy	Length of Hedge	Estimated Total for Hartlepool
< 50cm	1003m	14.0 km ± 3.3 km
50cm	6385m	89.0 km ± 20.7 km
75cm	4592m	64.0 km ± 15.0 km
100cm	3060m	42.7 km ± 9.9 km
>100cm	1542m	21.5 km ± 5.0 km

3.6 Management of Hedgerows

Hedge shape

Hedges were surveyed for closest match to 4 shapes: these are an indication of how much management the hedge is subjected to. Three of the shapes were fairly well distributed across the sample, however the “intensively managed” category was only found to apply to 2 hedges with a combined length of 407m (only 2.3% of total survey length), (figure 19). It has therefore been excluded from hypothesis testing.

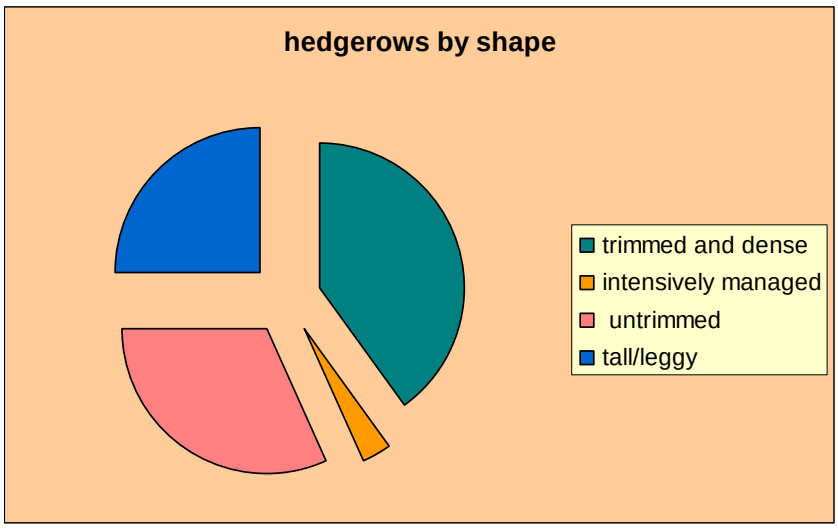

Figure 21: The Proportion of Survey Hedges According to Shape Category, n=60

The chart shows that the majority, (40% of the hedges) were classed as trimmed and dense; in terms of length this amounted to 7525m. It should be noted that trimmed does not imply closely clipped hedges and the illustrations referred to in the field are within the survey form in the appendix. The trimming could have taken place in the past at a point between 2-4 years and while straggly new growth may look untidy the hedge retains a basically managed profile. The second most common shape, with 5998m of hedge was the untrimmed category. Leggy hedges were easy to identify and accounted for 3642m of hedge.

There was found to be an association between whether a hedge passed or failed the height of the base of the canopy attribute and hedge shape $X^2 = 10.560$, df = 2, P= 0.05

There was no association between shape and presence of a ditch: $X^2 = 4.291$, df = 2, P = 0.117

Older management techniques such as laying were also noted and it was found that about a third of hedges had been laid at some point (table 8) although none was thought to have been within 2 years whereas planting and gapping appeared to be consistently employed as a management technique over time (table 8).

Table 8: Number of Hedges Under Management Regimes, n=60

Signs of Management	Trim/ Flailed	Coppiced	Laid	Planting/ Gapping	Pollard	None
Up to 2 years	29	1		14		26
2-10 yrs	24	2	3	10	1	25
> 10 yrs		3	21	8		31

Table 9: Management of Hedge Bottom by Number of Hedges, n=60.

Signs of Management	Mown	Herbicide	Grazed	None
Up to 2 years	4	3	5	47
> 2 years	1	1	2	55

Estimate of Length of Hedge Under Management

Survey results can be used to estimate the lengths of hedge under management or otherwise for Hartlepool (table 10).

Table10: A Summary of Hedges by Shape with Hartlepool Equivalent Lengths, n=60

	Number	Length	% of Total	Estimated Total for Hartlepool
Trimmed/Dense	24	7525m	42.8	104.9 km ± 24.4 km
Intensively Mgd.	2	407m	2.3	5.67 km ± 1.3 km
Untrimmed	19	5998m	34.0	83.6 km ± 19.5 km
Tall/Leggy	15	3642m	20.7	50.8 km ± 11.8 km

3.7 Species

In the north of England a species rich hedgerow is considered to be one in which there are 4 or more shrub/woody species and this is assessed from the 30m section. The modal number of species was 2, (fig. 23), and would generally be comprised of a very high percentage of hawthorn and a much smaller percentage of either rose, ash, elder or blackthorn. The mean number of species, per 30m section was 2.8. There were sixteen species-rich hedges and of those five hedges had six or seven species. The Handbook specifies climbers not be included apart from rose. Rose *sp.* was in fact the second most commonly found species–occurring in 40% of hedges, after hawthorn (in 87% of hedges) (fig.22). Other species found were whitebeam, large leafed lime, gooseberry, guelder rose, ivy and bramble. Bramble occurred more frequently than recorded, as it was not a focus of the survey, and was often found occupying gaps. The other species mentioned were either found as a single sapling or spotted outwith the 30m section.

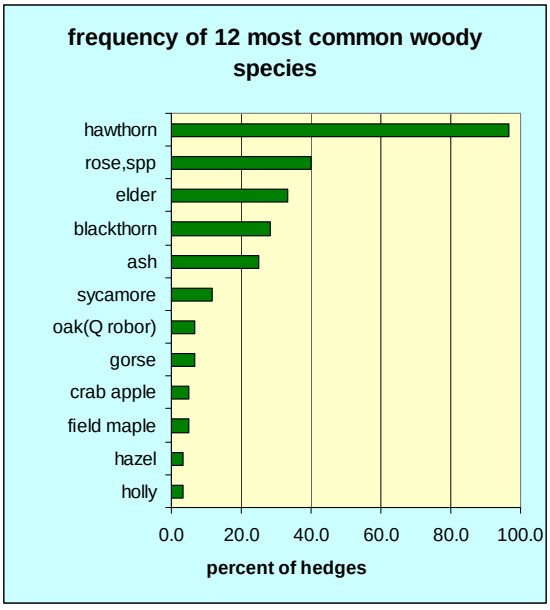

Figure 22: Species Most Frequently Found in 30m Section, n=60

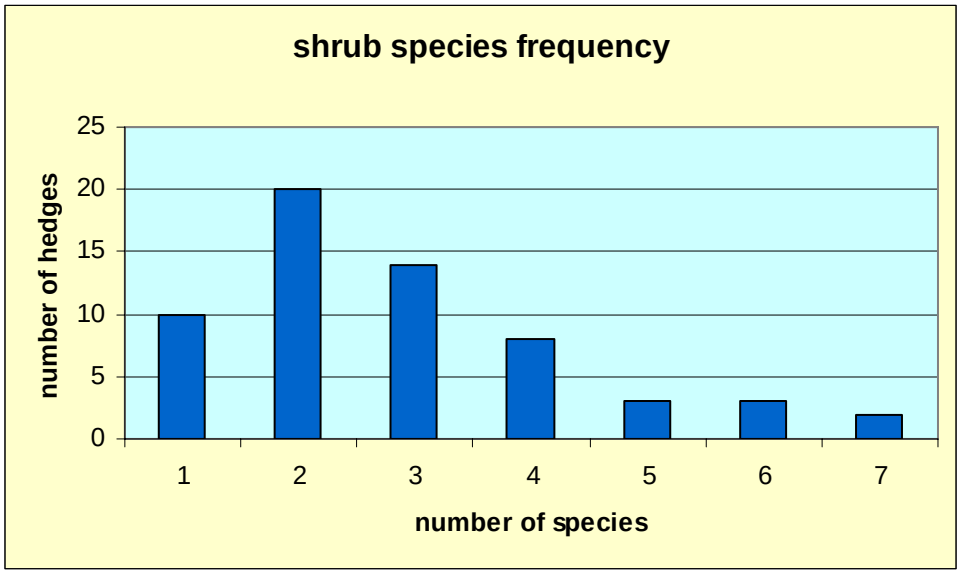

Figure 23: Number of Shrub Species per Hedge in 30m Section, n=60

Trees

Twelve tree species were noted in the survey, six of these found in more than one hedge. Ash was the most common with a total of 143 trees in 29 hedges, followed by blackthorn: 21 trees in two hedges; sycamore, 18 trees in seven hedges; hawthorn, 15 trees in nine hedges and eight trees of both elm *sp.* and oak occurring in three and six hedges respectively. Other species encountered were elder, hazel, beech, whitebeam, crab-apple and horse chestnut. A total of 222 trees were recorded in 40 hedges giving a mean of 3.7 trees per hedge across the sample and 5.55 trees and 1.55 species per hedge of those containing trees. Diameters were also noted to gauge ages (figure 24).

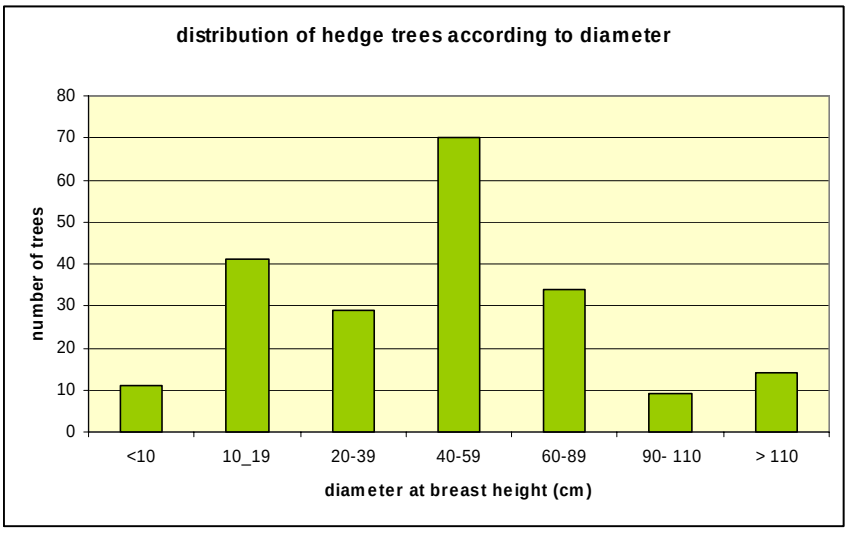

Figure 24: Trees Arranged According to the Diameter Measured at Breast Height, Includes Coppiced Stools (Measured at Ground Level), n=208

3.8 Scoring of Hedgerows

The scoring system based on meeting essential criteria was applied to the hedges (see methodology) with a 0 score indicating that the hedge had passed all criteria. No hedges got the maximum score of 10 (table 11). The median score was 3 (figure 25) which can be classed as a low fail (table 12).

Table 11 : results of scoring applied to survey hedges, n=58, and Hartlepool Borough estimated lengths.

Score	No. of Hedges	Length (m)	% of Total	Estimate for Hartlepool
0	6	1309	7.4	18.3 km ± 4.2 km
1	6	1661	9.4	23.1 km ± 5.4 km
2	11	3508	20.0	48.9 km ± 11.4 km
3	5	1282	7.3	17.9 km ± 4.2 km
4	9	2939	16.7	41.0 km ± 9.5 km
5	5	1492	8.5	20.8 km ± 4.8 km
6	6	1664	9.5	23.2 km ± 5.39 km
7	7	1811	10.3	25.3 km ± 5.9 km
8	1	232	1.3	3.2 km ± 0.7 km
9	2	684	3.9	9.5 km ± 2.2 km

Comparison of cumulative lengths between groups (table 12), enables the potential extent of neglect to be considered as well as the length of hedge of relatively high quality.

Table 12: Extent of Failure of Survey Hedges to Meet BAP Favourable Condition Thresholds , n=52, and Estimates for Hartlepool

Score	No. of Hedges	Length	% of Total	Estimate for Hartlepool
low fail (1-3)	22	6451m	36.7	89.9 km ± 20.9 km
medium fail (4-6)	20	6095m	34.7	84.9 km ± 19.8 km
high fail (7-9)	10	2727m	15.5	38.0 km ± 8.8 km

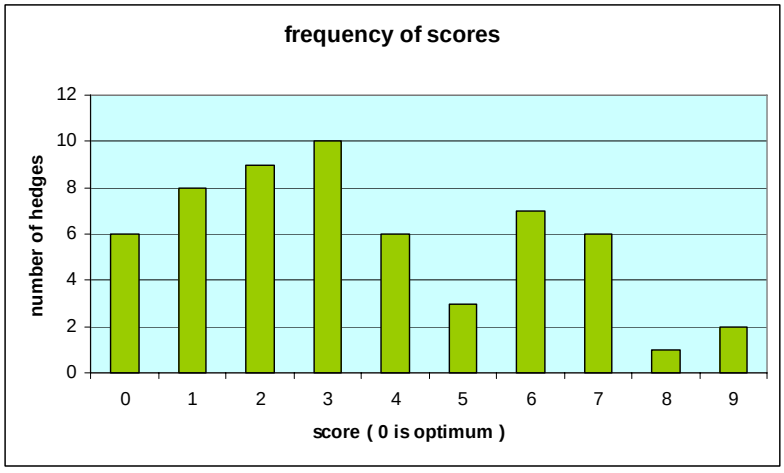

Figure 25: distribution of hedges by number according to condition score

3.9 Quality Assurance

Three hedges were surveyed, with eighteen possible points of disagreement on each form. There were 12 discrepancies out of a possible 54 therefore agreement overall was good at 78%.

Recurring areas of disagreement were bank height: (disagreement whether no bank or a 25cm bank), width of hedge, height of the base of the canopy, and types of management between two and ten years ago.

4 DISCUSSION

An overview of findings is covered, followed by a review of positive and negative findings and the limitations of the survey. The Hedgerow regulations (1997) are then applied to survey hedges and the results compared with condition scores. The discussion then focuses on how the results of the condition survey could be used to plan a restoration programme for hedges in the Borough of Hartlepool. A second scoring system is proposed that takes account of the heritage and biodiversity value of individual hedges.

4.1 Hedge Profiles

Type

There was a close similarity with Durham in proportions of hedge for each hedge type with 74% of hedges categorised as shrubby, 23% as shrubby with a line of trees and 3% as a line of trees whereas the 2006 Durham survey found 80%, 17% and 3% respectively, Beeston (2007).

Associated features

Low banks of under 1m in height and mainly around 25cm were are feature of 49% of hedges by length (fig 4) and these results are similar to Bailey's (1979) findings of 56% of hedges having banks with those being mostly below 0.7m. By 2006 the percentage of hedges with banks in Durham had dropped to 33% (Beeston 2007).

Harrison and Herring (2007) surveying Heritage Hedgerows in Redcar and Cleveland found banks in 76% of the hedges surveyed. This high figure may be explained by the fact that survey hedges were pre-selected as having being in existence by 1750-1857.

By contrast there were proportionately fewer ditches found in Hartlepool at 17.1% of hedgerows, than were in Durham at 25% and 37% in 2006 and 1979, respectively (Beeston 2007)(Bailey 1979). However in Redcar and Cleveland Harrison and Herring (2007) found ditches in 17% of hedgerows, a remarkably similar figure to Hartlepool. No association was found in Hartlepool between hedges with ditches and banks and the Redcar and Cleveland data would support this finding for that region also.

Losses in Durham's hedge resource are estimated by Beeston (2007) as 21% (±16%) since 1979 with Tees Lowland hedge removal being "more prolific" than in some other parts of the region.

Dowdeswell (1987) explains that many banks pre-date hedgerows and were boundaries that could have been quickly created in medieval times and "banks and narrow lanes" are a feature of old assarted hedge (Pollard *et al.*1974).The question is therefore how did Hartlepool manage to retain a level of 49% banked hedge during periods of agricultural intensification while Durham experienced a 23% loss in banks (in line with estimates of hedge loss)? It may be that hedges next to roads were less likely to have been removed and that there is an association between banks and older roads and lanes in Tees Valley but less so in Durham. This may be an area for further investigation.

Adjacent land use

A greater percentage of the Hartlepool survey hedges were adjacent to roads (22.1%) than in the Tees Lowland Natural Area section of Durham's 2006 survey (around 10%) (Beeston 2007). An explanation for this difference could be that although hedges were randomly selected, survey was for one side of the hedge. If the hedge was surveyed from the field side the adjacent land use would reflect this, however in cases of problems with access these hedges would be surveyed from the road side.

There were strong similarities in proportions of grassland adjacent to survey hedges between Hartlepool at 35% and Durham, 38% (Durham grassland categories have been grouped together to enable comparison) (Beeston 2007). Arable land was adjacent to in 37% of hedges for Hartlepool and 43% in Durham.

Hedge density

The "total length of hedge in a given area" will exert an influence on the total number of species and abundance (Clements and Tofts 1992). The density of hedge per hedged square for Hartlepool was estimated as 4.9km ± 1.14 /km^2 which is lower than the Durham figure of 6km /km^2. Taking non-hedged squares into consideration an approximate density for the Borough is 2.45km

± 0.57km per km^2 and this is fairly close to the national average density of 2.91km/ km^2 but still somewhat less than the Durham adjusted figure of 3.5km / km^2 (Beeston 2007).

Management

Very few hedges appeared to have had any recent (within the last 2-10 years) structural management such as coppicing or laying. Farmers were not contacted as to whether they were taking part in any form of Environmental Stewardship that may involve hedges. All hedges that showed evidence of laying (21 hedges) had been so more than ten years ago (table 8). The thickness of the stems mainly indicated that this was decades if not hundreds of years previously. Neglect has superseded removal as the main contributor to loss of hedge in the UK (Barr *et al.* 1993) and a minimum level of management is necessary for hedges to remain sustainable (Barr and Gillespie 2000).

A small number of hedges (those likely to have scored 8 or 9) were observed to be closer to a line of trees than a hedge. Three hedges had an average height of the base of the canopy of 1.5m or more (figure 19). It may not be possible to successfully restore them and Brooks and Agate (Url 6) recommend that extremely neglected hedge can be turned into a “shelter belt or woodland corridor” which can then “be managed for coppiced products or timber”. One of these was on a ROW and likely to be both ancient and an Important Hedge under the 1997 Hedgerow Regulations (see 4.5) and works would have to be sympathetic to public sensibilities.

Farmers can access funding for hedge management under the Environmental Stewardship Entry Level Scheme, this covers work such as cutting regimes that favour wildlife conservation. Funding for capital works however is only available under the Higher Level scheme and even then only for maintenance of hedgerows of very high environmental value, those of particular historical or landscape interest or those that support populations of Target species of birds, insects or mammals linked to the area profile (Url 7). With few people now available skilled in hedgelaying techniques and lack of a support

framework being widely available it is not surprising that hedges are effectively being abandoned.

4.2 Positive Findings

Species Richness

Sixteen hedges (26.7%) were found to be species rich; of these three had six and two had seven species. Most hedges (30%) however were composed of only 1 or two species.

Bailey (1979) found very similar results in County Durham with hedges mostly containing one or two species, up to a maximum of seven but with a mean of 1.75 species. Beeston (2007) in County Durham recorded a maximum of nine species, (however *Rosa sp.* were counted individually), and a mean of three species. When an adjustment was made to account for the *Rosa sp* in order to compare with the 1979 survey, the mean was found to be 2.9 species, Beeston (2007) which is very similar to the mean in the Hartlepool sample of 2.8 shrub species per 30m section.

Some interesting and unexpected results were found in terms of species composition and diversity of character. One gappy hedge consisted almost entirely of gorse, which on closer inspection turned out to have been laid. Pollard (1974) states “it is quite possible to lay almost any shrub” and claims to have seen “elm, blackthorn, ash, maple, sycamore and holly”. Gorse, when it did occur was usually dominant or certainly abundant for that particular hedge. This reflected findings by Beeston (2007).

From the small percentage of hedges in which hawthorn was not dominant, two of those were gorse and the other was 99% ash. In both the former cases the hedge was entirely composed of gorse at one end and later changed to blackthorn with a small amount of hawthorn. Of these one contained many trees including examples of ash and sycamore that had been laid.

Hedges Passing Favourable Condition Criteria

All hedges surpassed the minimum requirements for height and width.

The hedges meeting conditions were not the same as the sixteen species rich hedges. Of the six hedges passing all the criteria and found to be in

favourable condition two were species rich. Over one third of arable fields had an obvious margin (table 3) and all hedges passed the criteria for a 2m strip of undisturbed ground adjacent to the hedge. These findings are especially encouraging in terms of the cover and habitat they provide for small mammals, game birds and a variety of nesting birds.

Management

Extremely over-managed hedges are not estimated to be a problem in Hartlepool as the survey recorded only two intensively managed hedges (fig.21). Neither were hedge-bottoms overgrazed or affected by herbicide spray drift in significant numbers.

Gaps

Hartlepool's hedges did not perform badly for gappiness, for although gaps were present in the majority of hedges, 35 hedges (58 %) had less than 10% gaps and therefore passed the criteria in comparison with Durham where gappiness was a much greater issue and only 21% of hedges had less than 10% gaps (Beeston 2007).

Trees and Adjacent woodland

Two hundred and twenty two trees were counted in forty hedges out of sixty. Eighteen veteran trees (those greater than 1m in diameter) were recorded signifying that 30% of hedges contained a veteran tree. This compares favourably to Durham where the figure is 13% for veteran trees (Beeston 2006). These figures include the large coppiced stools of ash and elm which were a feature of some hedges and are multi–stemmed with a total diameter of at least 1.5m. Large and veteran trees are a particularly valuable habitat for roosting birds, owls, bats, bees and wasps and stag beetles Clements and Tofts (1992). The proportion of adjacent woodland was found to be higher in Hartlepool at 8% than in Durham at 1% (Beeston 2007). This is encouraging in terms of species dispersal and overall connectivity of the hedge network.

4.3 Less Positive Findings

Lack of Management and Implications of Neglect

Although there was evidence of trimming of almost half the hedges, the lack of management of the structure of the hedge by coppicing and laying is a threat to the total hedge resource in Hartlepool. Table 12 shows that 15.5% of the survey hedges failed the condition criteria with a “high fail” score of 7-9 points. The equivalent estimate for hedges in Hartlepool failing at this level is 38km ± 8.8km. There is a strong possibility these particular hedges are or could become relict through lack of management and neglect and almost 50km of hedge could be lost in Hartlepool.

Nutrient Enrichment Indicator Species

Although there was no association found between adjacent land-use and cover of nettle and clover in this instance and also in work by Cherrill *et al.* (2001), documentary evidence shows that aggressive species are taking over in arable field boundaries, exacerbated by use of fertilisers, to the detriment of native ground flora species (Barr 1995). Sixty percent of hedges had nutrient enrichment indicator species cover exceeding 20% (table 6), more than 10% greater than found in Durham. A quarter of hedges surveyed had over 70% cover of combined nettles and cleavers in the 30m section. The presence of a margin had little effect on the extent of nettle and cleavers cover. Seven arable fields were recorded as having a margin but these had only two adjacent hedges with less than 20% cover nutrient enrichment indicator species, and three had over 50% cover.

4.4 Limitations

There were some difficulties, especially at the beginning of the survey, with species identification. Blackthorn posed a few problems at this stage as surveyors were unaware of the huge variation in leaf size, colour and texture and its similarity to Bullace (*Prunus domesticus*). The training session of a half day to cover everything was probably too short to get an adequate grounding in species identification on top of familiarisation with the survey form and learning survey techniques. However the majority of hedges contained only the most common, recognisable species and it was only the hedges that were

particularly species-rich which may have been very occasionally under-recorded.

The survey form at eight sides was overlong and could be cumbersome in the field.

It was difficult at times to get average measurements of the hedge dimensions. When measuring width using a plastic pipe the point at which the pole emerges on the other side of the hedge cannot always been seen clearly and this type of measurement is therefore subjective and considerable variation could be expected between surveyors and locations within the 30m section. These assessments are further complicated by the extent of straggly growth and how much of it to take in to account. This is bourne out by the QA exercise where there was poor agreement on this attribute.

The average height of the base of the canopy was found to be the most difficult to assess. Hedges that appeared to have good structural integrity and plenty growth near ground level were found to be hollow on closer inspection, with a high canopy in the centre and long trailing shoots on the outer edges. Clearer guidance on these matters in the Hedgerow Survey Handbook would be appreciated.

The requirement of assessing criteria banded into intervals of five percent or to the nearest 25cm was problematic in some instances, particularly in assessment of the average height of the base of the canopy. Measurement is to the nearest 25cm and the threshold is “base of leafy growth less than 0.5m from the ground in a shrubby hedgerow” Defra (2007). Applying this threshold automatically fails all hedges in the 50cm bracket. In Durham’s survey consultants interpret this as “less than or equal to 0.5m” (Beeston 2007), however they were working to a draft version of the 2007 Handbook and it is possible that the threshold was modified for the final version.

The QA exercise revealed some discrepancies in recording of the average height of the base of the canopy however although they were not an exact match they still gave an indication of the general *extent* of legginess. Other differences such as whether there is of a bank of 25cm or no bank illustrate the variable nature of these features. Surveyors were not necessarily aware

that a bank may not run along the whole hedge and at such low levels it can be difficult to differentiate between uneven ground and a bank. Generally, given the aforementioned problems in obtaining averages from uneven natural, growing features a 78% agreement could be considered to be a good result.

Whether *census or a sampling approach is used the final products of survey will be estimates of surveyed features……observer error, spatial inconsistencies and aggregations, definition problems plus with sampling there will be some statistical error associated with population estimate from a sample.* (Barr *et al.* 1995)

4.5 Applying Hedgerow Regulations (1997) Criteria to Survey Hedges

Testing the survey hedges under the hedgerow regulations criteria:

Although the 30m section is surveyed under a different methodology under the Regulations (a 30m section surveyed for every 100m of hedge length), it is possible using the survey results, to make a rough estimate of how many of the survey hedges would meet Regulations criteria for classification as Important hedges.

Hedges need to contain a specified number of woody species from a list (of 56 species) in the schedule 3 of the Hedgerow Regulations. These include hawthorn, blackthorn and elder and are therefore not limited to the more unusual species that may be observed. Sixteen of the 22 species noted in the Hartlepool survey are to be found in the list.

The regulations criteria for number of woody species are reduced by one species count for a list of places north of the Humber of which Hartlepool is one. A summary therefore of the “northern”criteria is:

- 6 woody species from the list, or 5 woody species if Lime (large or small leaved), black poplar or wild service tree is found.
- 5 woody species from list ***plus*** 3 additional features (described below)
- 4 woody species from list ***plus*** 4 additional features (described below)

Additional features:-

- Gaps <10% over length of hedge
- 1 tree per 50m length (min DBH =20cm if single trunk, or 2 X 15cm DBH trunks if multi-stemmed) DBH is diameter at breast height.
- A bank or wall along more than 50% of length
- A ditch along more than 50% of length
- Connections totalling 4 or more where
  Hedge =1
  Woodland =2
  Pond = 2
- A parallel hedge within 15m
- At least 3 species of ground flora from the list

Hedgerows adjacent to a Rights of Way (ROW), Bridleway or road are prioritised under the regulations: they only need to contain 4 species (no reduction for N.England) and 2 other associated features from a list very similar to the above.

The number of survey hedges that are likely to meet the criteria above is shown below. (As ground flora were not surveyed it is not possible to include that element of assessment of the hedges.) The findings of the trial are:

- One hedge is very likely to meet the Important Hedgerow criteria on the grounds of it lying on a Parish Boundary. This was seen on a current O.S. map while the Regulations stipulate that the parish boundary must be “historic” and should date from before 1850. The age of the line of the current boundary would therefore need to be established.

  It is quite possible that many more of the survey hedges co-incide with pre-1850 parish boundaries. This can be checked with the Tithe maps which exist for the parishes of Hart and Elwick Hall (Marchant 1994), showing boundaries of land apportionments in Hart, 1841, Thorpe Bulmer in 1838, and Dalton Piercy, Throston, Elwick and Elwick Hall in

1839. Unfortunately there is insufficient time to study these maps but it is something that can be annexed to future surveys.

- Five hedges are highly likely to meet the Important hedge criteria because of their species richness alone (greater than 6 woody species). In addition they had many of the other associated features and were adjacent to roads or Rights of Way and are probably ancient hedges. Two had seven woody species *and* were adjacent to a ROW. Two had six woody species *and* were adjacent to a ROW. None of the five had scored well in the condition scoring. Three scored four points, one scored five and one seven, where 0 is the optimal score and 10 is the poorest.
- Five hedges are close to meeting the criteria and are worth further investigation. Some are short by one element of the additional features and may benefit from surveying of features such as ground flora species, that were not covered by this survey. Others have many of the features and are short by one woody species and resurvey by botanists is recommended. Of the five, two were hedges that had scored very well in the condition scoring, with a zero score.
- Only one hedge out of seven containing four species was adjacent to a road or ROW, none of the three hedges with five species were. However two of the three hedges with six species were adjacent to a road or ROW as were both of the hedges containing seven species.

  Twelve hedges were adjacent to roads or ROW but had insufficient species or additional features to suggest they may be considered to be Important hedges or worthy of further investigation.

<u>Conclusion</u>

It is clear that assessment of hedges under the Handbook methodology, although covering some of the same elements covered by the Regulations relating to features with significance for biodiversity, does not serve as a means of highlighting hedges that have potentially high value for wildlife and cultural reasons.

4.6 Considerations for Restoration in Hartlepool

The Hedgerow BAP targets

There are nine targets relating to hedgerows, hedge trees and herbaceous ground flora.

Those relating specifically to hedgerows are:

- T1, to maintain the extent of hedgerows across the UK.
- T4, Achieve “favourable condition” of 243,000km (35%) of hedgerows by 2010 and 348, 000 (50%) by 2015.
- T5, Reverse the unfavourable condition of over-managed hedgerows across the UK by reducing the proportion of land managers who trim most of their hedges annually to 60% by 2010
- T8, Achieve a net increase in the length of hedgerows of an average of 800km per year in Great Britain to 2010 and 2015

(quoted from the Hedgerow Survey Handbook, Defra, 2007)

The percentage in T4 relates to the proportion of hedges.

Implications for Hartlepool

A concerted programme of restoration, planting and modification of hedge management regimes will be required to meet the BAP targets

The survey estimates that only 7.4% of Hartlepool’s hedge resource is in favourable condition. It follows that 92.6% (226 km ± 54.7 km) is in unfavourable condition to varying degrees. It is probably unfeasible to attempt to meet the 2010 T4 target of 35% (67.6km ± 15.7km) with less than two years remaining and more realistic to aim for the 2015 target of having 50% of hedgerows meeting favourable condition. This would entail restoration work on 42.6 % of the Borough’s hedgerows involving a total of 104.37km ± 24.28km.

A timetable for restoration ?

There is a similarity between criteria in lengths of hedge in the survey failing in the lowest brackets: around 4400m failing with 10-19% gaps; around 3900m having nettles and cleavers cover between 20 and 39%; and around 4600m of

hedge with a base of canopy height of 75cm (tables 5, 6 and 7 respectively). Using the 104.37km ± 24.28km figure as above, the upper end estimate would therefore be 128.7km and dividing this into three equal parts it follows that:

- 43 km of hedge could be restored for gappiness (planting). Over a seven year period this works out as just over 6km per year. However with a modal percentage of gaps below 10% (figure 12) the figure to be planted annually would only be around 600m.
- 43 km of hedge could be restored for legginess (laying or coppicing) at 6km /year as above. This could be split equally to 3km between coppicing and laying. The season for laying is mid October – Feb/ March (Brooks and Agate Url 6), thus an estimate of a 13 week season would require 230m to be laid per week. Brooks and Agate (Url 6) suggest that a pair of novice trainees could lay 9m of hedge over 2 days (with chainsaw assistance from a skilled worker) and a skilled worker is capable of 40m per day using a chainsaw but for a hedge in fairly good condition. If we therefore estimate that a skilled worker dividing their time between assisting volunteers and hedgelaying, could manage to lay around 20m per day then it would require a dedicated team of six volunteers and two skilled workers working for 13 weeks to complete this task comfortably.
- 43 km of hedge could be managed to reduce nettles and cleavers cover. Defra (Url 8) advise cutting or spot treatment or wick application of herbicide.

This is only intended to be an indication of likely human resources involved in bringing the least neglected hedges back into favourable condition to meet BAP target T4.

Bringing the hedges that scored 1 or 2 for condition would be the most straightforward but would these also be the optimum hedges to rejuvenate for Biodiversity value? The comparison in section 4.4 showed that the six potentially “Important” hedges under the regulations scored poorly in the condition score (4-7) and would not have been considered for restoration in

this scenario. It is feasible that these potentially important hedges could fall further into neglect and become derelict.

Considerations at Landscape Scale

Hooper (1990) discusses the concept of “key” hedges and “ideal” hedges. Key hedges are those considered to be important in the historical and heritage context such as those on parish boundaries. Ideal hedges are those of particular value for biodiversity. He suggests key hedges can become ideal hedges through appropriate management (Gillespie 1995)

Similarly Clements and Tofts (1992) highlight the importance considering landscape scale in planning restoration schemes, proposing a system of examining the landscape to identify “spine hedges” (Clements and Tofts 1992) These are long hedges running across an area perhaps for several kilometres, to which shorter hedges are connected. The spine hedges may traverse several farm boundaries along their course. Resources should be directed towards integrating improved management for biodiversity along the whole length of the hedge (Clements and Tofts 1992). This should result in a well-connected principal corridor of high value to wildlife.

It seems therefore that there is a need for a system that supplies more comprehensive information about the heritage, associated features and other indicators of hedges’ value for wildlife. While the Defra favourable condition criteria are based on sound principles the Hedgerow Regulation assessment draws attention to possible important features of the landscape that may otherwise have been overlooked.

Scoring Systems

In the context of losses of 121,000 km of hedge in Britain (1984-1990) Clements and Tofts in 1992 developed the Hedgerow Evaluation and Grading System (HEGS) to assist decision making about which hedges should be retained in connection with development proposals. Although there were evaluation schemes in existence mainly at a regional level the aim of Clements and Tofts was to produce a standardised survey that “eliminates individual bias on the part of the surveyor” that could be used to compare between and within sites on a national basis (Clements and Tofts 1992). They

did concede however, that a “user-friendly, mechanistic scheme” will be unable to account for every factor and the surveyor’s judgement may be called upon at times (Clements and Tofts 1992).

Their survey scores hedges for elements relating to “conservation value” with four scores per hedge: structural, connectivity, diversity and associated features. The surveyor then works through a type of flow chart to arrive at a final score ranging from -4 through to 1+. There are two advantages to their system over a straightforward condition assessment. One is the value accorded to associated features and the second is the practicality of a one-page sheet for fieldwork (appendix V)

A Combined Condition, Heritage and Biodiversity Scoring System for Hartlepool

It has become apparent that an additional system to a condition survey is likely to be needed to identify Hartlepool’s best hedges and prioritise them for restoration to meet 2015 BAP targets.

Consequently I have developed a compact survey system that attempts to cover the most important elements relating to condition and at the same time records many of the Hedgerow Regulations criteria. The form is in appendix VI.

Condition scoring for gaps, height of the base of the canopy and nettles and cleavers cover is exactly as in this survey (2.11) while points (the Herbi score) are awarded for the Heritage value of the hedge, associated features, connectivity and proximity to woodland and ponds, and whether next to a ROW. Some weighting has been given to reflect the relative importance of some features. The justification of awarding a Parish Boundary 3 points while a bank is only allocated 1, lies with the rarity and cultural significance of the former.

It is designed to be used in Hartlepool only because it was created partly in response to this survey’s results, for example in that there is no requirement for measurements of the width of undisturbed ground or herbaceous vegetation because this survey indicated this was not an issue for Hartlepool. In addition appropriate local parish tithe maps dating from circa 1839 are

readily available (section 4.5) so finding historical records need not be an onerous task. Although Clements and Tofts (1992) assert “simple additive schemes appear to lack the discriminatory power to rank the majority of hedges in a plausible way” or may “mask the route by which the grade was achieved” the usage of the two contrasting scores simultaneously should be adequate to enable comparisons to be made between hedges on a farm scale and across the Borough.

The Herbi score may also have a secondary function of identifying potentially Important hedges for more detailed survey by the Planning Department.

Subsequent consultation with a representative of Durham County Council revealed that applications for funding by field Boundary restoration Grants via the *Durham Hedgerow Partnership* are heavily oversubscribed and the Partnership utilise an excellent comprehensive scoring system for applications to assist with allocation of funds accounting for types of works planned; proximity to ROW, recreational sites and villages; a range of historical elements; designations and Nitrate vulnerable Zones. (S.Mullinger pers. comm. 2008)

The Farmers’ Perspective

Doubleday *et al.*(1994) discuss the difference that knowledge of hedges’ heritage and particular importance to wildlife can make in farmers’ attitudes towards conservation. “Understanding of a hedge’s historic character increases farmers’ appreciation of a hedge” and “farmers will be less inclined to remove hedges if they appreciate that they are performing a useful function such as giving shelter or acting as refugia for beneficial insects” (Doubleday *et al.* 1994). However when farmers were initially contacted some voiced antipathy towards former Stewardship type initiatives and many were unaware of current programmes.

At the initial contact stages with farmers for this project it was stated that participants would be informed of the findings of the survey. To this end a letter was sent to all those initially contacted containing a summary of the results and an invitation to phone in and receive their individual hedge(s) scores, if applicable (appendix VII). In addition there was a slip that could be

completed and returned (postage paid) if the recipient wished to be informed of local restoration initiatives, and also indicate whether they would consider hedge restoration on their own farms. There is also signposting to Defra's Environmental Stewardship web pages on hedgerows.

This information can then be used as a starting point by Hartlepool Borough Council to establish a database of local landowners sympathetic to the ethos of restoration, and fulfils one of the aims of this project. The farmers may also appreciate having a point of contact.

4.7 Conclusion and Recommendations

In 1987 Dowdeswell asserted that the "future welfare of hedgerows and verges rests mainly in the hands of four groups of people" these are: farmers, Local Authorities, conservation organisations and the public.

This is still the case after 20 years and is even more pertinent today judging by the apparent extent of neglect of hedgerows and their subsequent relegation to relict status in recent years in the UK. The findings of this survey show that Hartlepool's hedges are also part of this trend and generally in a state of neglect with 90% failing the condition survey to some degree and 17% in a very poor condition.

A reversal of this trend would require action in two areas: a concerted remediation programme to restore hedges to favourable condition and a move towards a different kind of management of hedgerows that is sustainable and also accepted by the farming community. Hedges need to be considered at least at the farm scale or better at landscape scale with cutting alternating between hedges on a 3-5 year rotation. Cutting should take place late winter before the nesting season and hedges can be managed to different heights. Coppicing can be carried out in preparation for future laying. Planting should use local stock and trees planted. Measures need to be agreed with farmers as to how to halt the spread of nettles and cleavers in the hedge-bottom, and so to increase the width of field margins as a compensatory measure.

The Defra Hedgerow Survey (2007) methodology proved to be an apposite means of assessing the condition of the hedges and for periodic resurveying.

The findings summarised in 4.7 above and reported and discussed in the text fulfil the project aim of producing a report of the condition of Harlepool's hedges.

I would also make the following recommendations:-

- For future periodic (5 yearly) reviews of the same hedges the same survey methodology (that of the Defra's Hedge Survey Handbook, 2007) should be used.
- Contact should be maintained with farmers who were involved in this survey and responded positively to the letter asking them if they wished to receive information about hedgerow restoration and whether they would consider restoration of their hedges. In addition, other farmers in the Borough could be contacted explaining the findings, raising awareness and enabling them to opt in to a restoration initiative. From the pool of potentially interested parties and once funding sources have been identified, the hedges on these farms can be assessed using the Condition / Herbi score sheet (appendix VI). This should help prioritise hedges for restoration.
- For Hartlepool Borough Council to instigate a secondary tranche of hedgerow restoration and habitat enhancement, along their extensive Right of Way (ROW) network of which there is a total of 96km, along 104 paths.

I would recommend use of Condition survey/Herbi scoring (VI) in order to prioritise hedgerows where funding may be limited and set up some kind of schedule. This would fulfil some of the some of the objectives of Planning Policy Statement 9: Biodiversity and Geological Conservation (2005), in which regional and local government are obliged to promote sustainable development through ensuring that "biological diversity is conserved and enhanced" and particularly to contribute to rural renewal by "enhancing biodiversity in green spaces….so that they are used by wildlife and valued by people….recognising that healthy functional ecosystems can contribute to a better quality of life and to people's sense of well-being".

To this end there may be opportunities for people already regularly using the ROW to become involved in surveying and restoration of the hedges, along with regular volunteers and for a health and well-being remit to be built into the strategy.

These recommendations fulfil the objectives of this project.

REFERENCES

Aebischer, N. J., Blake, K.A. & Boatman, N.D. (1994) Field margins as habitat for game. *British Crop Protection Council Monographs* 58: 95-104

Allen, M., Harrison, J. & Herring, H. (2006) *Ancient Hedgerows of Stockton*. Botanic Centre, Middlesbrough

Bailey, A.J.(1979) *Hedges in Durham County: A Botanical and historical survey.* Durham County Conservation Trust Ltd.

Barr, C. & Gillespie, M. (2000).Estimating hedgerow length and pattern characteristics In Great Britain using Countryside Survey data. *Journal of Environmental Management* 60 :23-32

Barr, C.(1995) Plants and Hedgerows. In C.Barr, C Britt and T. Sparks (eds) *Hedgerow Management and Wildlife*. ITE/ADAS, UK

Barr, C., Benefield, C., Bunce, B., Ridsdale, H., Whittaker, M. (1986) *Landscape changes in Britain.* Institute of Terrestrial Ecology, Huntingdon, UK

Barr, C., Gillespie, M. & Howard, D.(1993) *Hedgerow Survey 1993.* (Stock and change estimates of hedgerow length in England and Wales, 1990-1993) ITE, Cumbria.

Beeston, R. (2007) *Durham Hedgerow Survey.* Durham County Council.

Britt, C., Barr, C., Sparks, T. (1995) Overall conclusions on the effects of management on wildlife. In C.Barr, C Britt and T. Sparks (eds) *Hedgerow Management and Wildlife*. ITE/ADAS, UK

Cherrill, A., Mercer, C., McClean, C. & Tudor, G. (2001) Assessing the Floristic Diversity of hedge Networks: a landscape perspective. *Landscape research* Vol.26, 1 55-64

Clements, D. and Tofts R. (1992) *Hedgerow evaluation and Grading System (HEGS)* Countryside Planning and Management. UK

Corbett, S. (1995) Invertebrates and Hedgerows. In C.Barr, C Britt and T. Sparks (eds) *Hedgerow Management and Wildlife*. ITE/ADAS, UK

Defra (2007) *Hedgerow Survey Handbook.* A standard procedure for local surveys in the UK. Defra, London.

Department of the Environment (1997) *The Hedgerow Regulations: a guide to the Law and Good Practice.* HMSO. London
Doubleday, O. P., Clark, A.& McLaughlin, B. (1994) Hedges- A farmer's view. *British Crop Protection Council Monographs* 58: 377-384

Dowdeswell, W. (1987) *Hedgerows and Verges*. Allen and Unwin, London.

Gillespie, M. (1995) Data on Current Hedgerow Management. In C.Barr, C Britt and T. Sparks (eds) *Hedgerow Management and Wildlife*. ITE/ADAS, UK

Harrison, J.(Chair) *Unpublished minutes.* Tees Valley Hedgerow Partnership (2008)

Harrison, J. & Herring, H. (2007) *Heritage Hedgerows of Redcar and Cleveland.* Botanic Centre, Middlesbrough.

Henry, T., Bell, A.C. & McAdam, J.H. (1994) The effects of restoration strategies on the flora and fauna of overgrown hawthorn hedges and methods of repairing gaps in overmanaged hawthorn hedges. *British Crop Protection Council Monographs* 58: 341-346

Hinsley, S. & Bellamy, P. (2000) The influence of hedge structure, management and landscape context on the value of hedgerows to birds: A review. *Journal of Environmental Management* 60: 33-49

Marchant, J. &A. (1994) *Tithe maps of Hartness the parishes of Hart and Elwick Hall.* Christian Inheritance Trust.

Maudsley, M.J. (2000). A review of the ecology and conservation of hedgerow invertebrates in Britain. *Journal of Environmental Management* 60, 65-76

McCollin, D. (2000) Editorial: Hedgerow policy and protection_changing paradigms and the conservation ethic. *Journal of Environmental Management* 60: 3-6

Mercer, C., Cherrill, A., Tudor, G. & Andrews, M. (1999). Hedgerow plant communities: relationships with adjacent land use and aspect. *Aspects of Applied Biology 54, Field margins and buffer zones: ecology, management and policy.*

Moseley, D.G., Ray, D. and Bryce, J. (2006). A Forest Habitat Network for the Atlantic Oakwoods in Highland Region, Scotland. *Botanical Journal of Scotland*, 57(1&2), 197-209.

Mullinger, S. (2008) Durham County Council (pers. comm.) also http://www.durham.gov.uk/durhamcc/usp.nsf/pws/ETS+Projects+-+County+Durham+Hedgerow+Partnership+-+Field+Boundary+Restoration+Grant+Scheme

Noss, R.(1993) Wildlife Corridors. In D. Smith and P. Cawood Hellmund (eds) *Ecology of greenways.* Minnesota Press, Minneapolis

Office of the Deputy P.M.(2005)*Planning Policy Statement 9: Biodiversity and Geological Conservation*. HMSO. UK
Packer, J.(1995) Mammals and Hedgerows. In C.Barr, C Britt and T. Sparks (eds) *Hedgerow Management and Wildlife*. ITE/ADAS, UK

Pollard, E., Hooper, M.D.& Moore, N.W. (1974) *Hedges*. Collins and Sons, Glasgow

Simberloff, D., Farr, J., Cox, J. & Mehlman, D. (1992). Movement Corridors: Conservation Bargains or Poor Investments? *Conservation Biology 6* (4)

Sparks, T. (1995) Amphibians, reptiles and hedgerows. In C.Barr, C Britt and T. Sparks (eds) *Hedgerow Management and Wildlife*. ITE/ADAS, UK

Sparks, T. (1995) Birds and hedgerows In C.Barr, C Britt and T. Sparks (eds) *Hedgerow Management and Wildlife*. ITE/ADAS, UK

Tew, T.E., Todd, I.A & MacDonald, D.W. (1994) Field Margins and small mammals. *British Crop Protection Council Monographs* 58: 85-94

Wildig, J., Griffiths, B. & Milsom, T. (1994) Problems with the re-establishment of hedges in the Cambrian mountains Environmentally Sensitive Area. *British Crop Protection Council Monographs* 58: 347-350

Url:1 http://www.teeswildlife.org/species%20plans/Ancient%20and%20Species%20Rich%20Hedgerows%20Draft%20Action%20Plan.doc (accessed online 25/08/08)

Url 2 : http://www.defra.gov.uk/erdp/docs/nechapter/nesection12/ne121.htm#bap (accessed 4/9/08)

Url 3: http://www.buglife.org.uk/conservation/adviceonmanagingbaphabitats/sancientandspeciesrichhedgerows.htm accessed 24/08/08

Url 4: http://www. ruralni.gov.uk/fieldboundaries_cmb.pdf Department of Agriculture and Rural Development. N. Ireland (accessed online 04/09/08)

Url 5: http://www.ruralni.gov.uk/ae_man_boundary_8_1_cmb.pdf Agri -environment Scheme Management Plan. Department of Agriculture and Rural Development. N. Ireland (accessed online 4/09/09)

Url 6: Brooks, A., and Agate, E. (1986-2008) online book at http://handbooks.btcv.org.uk/handbooks/content/chapter/64

Url 7: http://www.defra.gov.uk/erdp/schemes/hls/handbook/appendix1-index.htm

Url 8: www.defra.gov.uk/erdp/docs/national/annexes/annexx/brekland2.htm (contains guidance for management of nettles and cleavers)

Appendix I Map showing the spread of sample squares across the Borough

Appendix 1
Spread of sample squares throughout the Borough

HARTLEPOOL
BOROUGH COUNCIL

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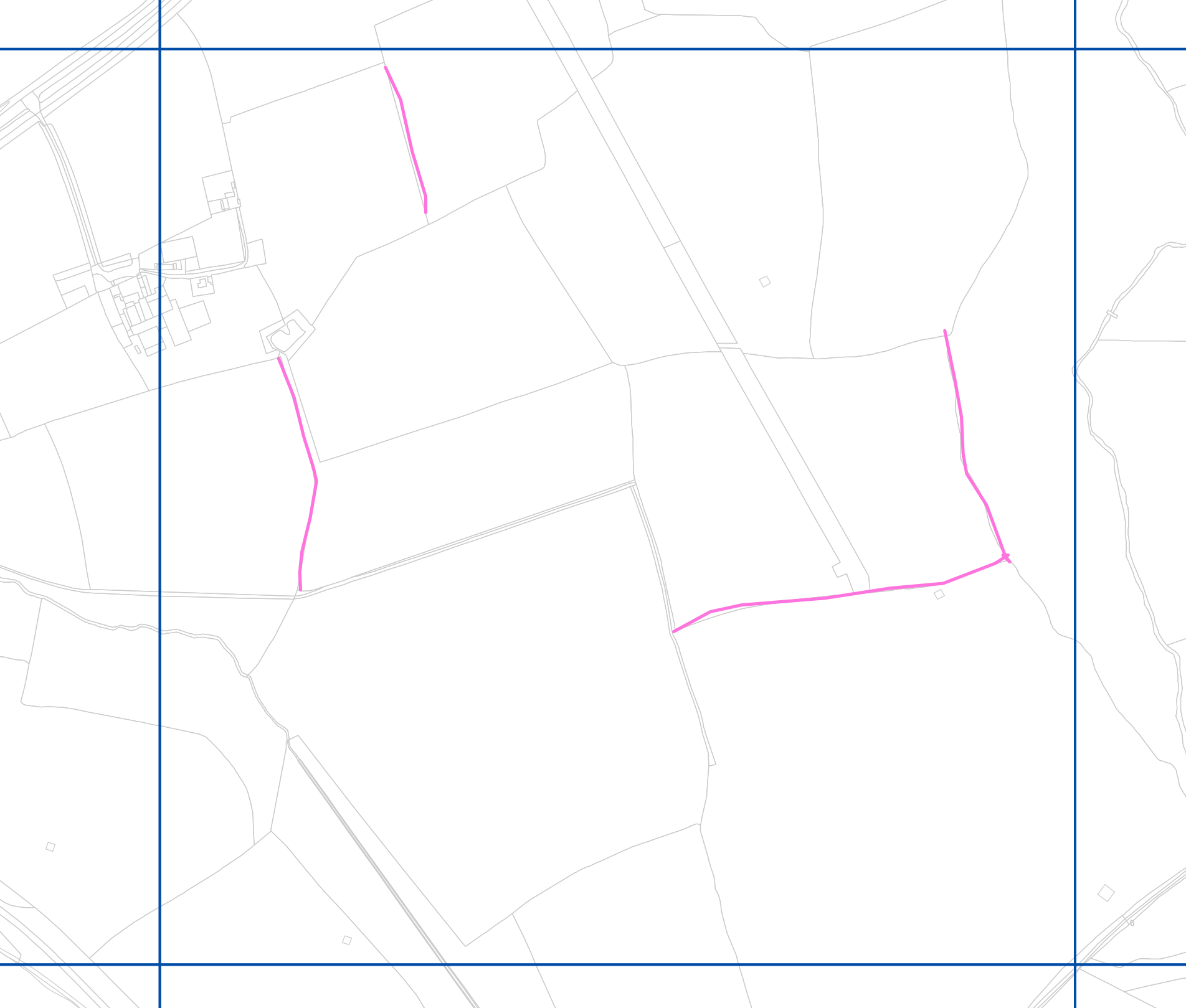
(100023390) (2008)

Sub Title:	Hedge Survey 2008
Scale:	1:75,000 at A4 size
Date:	4th September 2008
Drawn By:	Parks & Countryside/C Renton

Appendix II Map for use in field showing 4 survey hedges in an enlarged 1 km square



Appendix III Copy of the Survey form used in the field (Defra 2007)

(N/A for PDF format)

Appendix IV Example of one of the species ID charts

(N/A for PDF Format)

Appendix V Copy of HEGS scoring form

(N/A for PDF format)

Appendix VI Copy of combined Condition/Herbi scoring sheet

GRID REF.	HEDGE REF.	SCORES
FARM		CONDITION HERBI
	LENGTH (m)	
DATE	WIDTH (m)	☐ ☐
SURVEYOR	HEIGHT (m)	

HERITAGE HEDGE — Score 3 ⇨ ☐

POND (WITHIN 1 KM FROM END) — Score 3 ⇨ ☐

WOODLAND AT ENDS — Score 2 per end ⇨ ☐

ADJACENT LAND USE

ARABLE ☐ — If field margin score 1 ⇨ ☐

GRASSLAND ☐ grazed ☐

WOODLAND ☐

ROAD ☐

PATH ☐ — If ROW / Bridleway score 2 ⇨ ☐

CONNECTIONS end 1 ___ end 2 ___ — total number ⇨ ☐

BANK ALONG HALF OF LENGTH OR MORE y / n — if yes score 1

DITCH ALONG HALF OF LENGTH OR MORE y / n — if yes score 1, total ⇨ ☐

SHRUB SPECIES IN 30M SECTION (ENTER % COVER)

Hawthorn	_____	Holly	_____	other _____	_____
Rose	_____	Sycamore	_____	other _____	_____
Blackthorn	_____	Gorse	_____	other _____	_____
Ash	_____	Elder	_____		

total number of species ⇨ ☐

ENTER TREE SPECIES NUMBER	Any trees > 1 m diameter ? Y / N	if at least 1 tree per 50m length of hedge score 2 ⇨	☐

% COVER NETTLES		% COVER CLEAVERS		COMBINED	0 0 - 19 %	1 20 – 29 %	2 30 – 39	3 40 – 69	4 > 70 %

GAPS > 5m y / n	TOTAL LENGTH OF GAPS (whole hedge)		% GAPS	0 0 – 9 %	1 10 – 19%	2 20 – 29 %	3 > 30 %

AVERAGE HEIGHT AT THE BASE OF THE CANOPY (cm)	0 0 – 50cm	1 75cm	2 100cm	3 > 100cm

LAYED recent ☐ past ☐	COPPICED recent ☐ past ☐	TRIMMED recent ☐ past ☐	PLANTED recent ☐ past ☐

Appendix VII Letter to farmers summarising findings

(N/A for PDF format)