Freshwater Fisheries Habitat Sustainability Strategy

TE WAI MĀORI

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Executive summary

This strategy describes the concept of *habitat sustainability*, identifies the threats to freshwater fish habitat and proposes actions to address those threats.

It has been developed to help iwi prioritise their efforts in seeking to protect and enhance freshwater fisheries.

For the purpose of this strategy habitat sustainability is defined to mean the ability of a freshwater feature and its component parts to support healthy, viable populations of freshwater fish now and in the future.

Risks to habitat sustainability vary according to species but in general terms are:

- physical disturbance to beds and river margins (through activities like "drain clearing").
- elevated water temperature (from removal of stream side vegetation, reduced depth or warm industrial discharges).
- excessive sediment loads (i.e. overly turbid water).
- Presence of pest fish compete for food with, or prey, on native fish.
- obstruction to fish migration (e.g. poorly designed culverts, dams and other structures placed in river beds).

The overall goal of this strategy is to promote habitat sustainability by ensuring that (a) risks to habitat are appropriately managed; and (b) opportunities for habitat restoration and enhancement are taken by iwi, regulatory agencies, landowners and the wider community. The objectives are:

- to better manage migration routes between large areas of sustainable inland habitat and the sea;
- to better manage habitat in the coastal and near coastal areas that are the preferred habitat of most freshwater fish; and
- to improve accessibility to, and restocking of good quality habitat that is currently inaccessible.

The strategy seeks to promote these objectives by focusing on three priority species – eels, inanga, and koura. The strategy identifies (a) improving fish passage, (b) riparian planting/protection; and (c) control of pest fish as priority actions. More specific actions are identified for each priority species. These actions require iwi to participate in local government, Resource Management Act and Department of Conservation processes as well as taking direct, "on the ground" action through the establishment of stream care groups and the like, or in the participation in the efforts such groups as already might exist.

Habitat sustainability

To be sustainable, a fish's habitat must contain all the physical, chemical, and biological features needed to enable the fish to complete its life cycle.

Habitat sustainability requires the maintenance of habitat features within a range that reflects the fish's natural tolerances. These include:

- water quality (including temperature, pH, turbidity, dissolved oxygen levels);
- water body structure and flow (including substrate, inorganic nutrient levels, depth, water velocity); and
- vegetation and cover (including aquatic and land based plants).

In addition, a sustainable habitat will contain the full complement of *ecosystem components*. In particular, it will include the *plants and animals* that provide critical ecosystem services including those forming food sources[1] and other services critical to the life cycle of fish (such as those that host parasitic juveniles of kakahi/freshwater mussel).

Habitat sustainability will, however, often be species-specific. That is, what is a healthy habitat for one species of fish may be unsustainable for another. In that sense, the *biomass*[2] in a particular environment is not necessarily a good indicator of habitat quality. This is particularly true with the presence of introduced species – the presence of which can indicate the unsustainability of habitat for native fish.

Conversely the composition of the fish community (particularly the diversity of native fish species or the presence of particular sensitive native species) can be a good indicator of habitat sustainability as fish populations in degraded habitats are usually dominated by one or few very tolerant species.

Finally, the habitat sustainability of New Zealand's freshwater fish is reliant on accessibility to migration routes. Because many freshwater species are diadromous (migrate between the sea and freshwater at various stages of their life cycles) the unimpeded linkage of freshwater habitat to the sea is critical to sustaining fish populations.

For the purposes of this report habitat sustainability is defined as follows.

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[1] The fundamental food species in the aquatic food chain are called macro invertabrates. Macroinvertebrates are bugs without backbones being various types of tiny animals including insects, crustaceans, molluscs, worms, leeches and anemones. In good quality streams there may be 30 or more different types of macroinvertebrates in one small area, and there may be many thousands of individuals per square metre of streambed

[2] The *biomass* is the total weight or mass of all fish in a particular area.

Habitat sustainability means the ability of a fresh water feature and its component parts to support healthy, viable populations of freshwater fish now and in the future.

A sustainable habitat will:

- comprise vegetation and a physical structure that remains in a natural or semi natural state and not be subject to physical modification to an extent, or with a frequency, that reduces the ability of the habitat to provide the ecosystem services necessary to sustain fish population at all life stages
- comprise water with a chemical, temperature and turbidity profile that is within the tolerance of the full range of native fish naturally found in that water body
- have no, or very low populations, of introduced pest fish
- be accessible to upstream and downstream migration.

Key issues – risks to habitat sustainability

Freshwater fish habitat is vulnerable to a range of risks. These risks will vary according to species but in general terms will be as follows.

Physical disturbance to beds and river margins. In-stream cover (such as boulders, large woody debris and aquatic vegetation) and riparian vegetation provides habitat for invertebrates, velocity refuges, hiding places from predators and attachment sites for adhesive fish eggs. Removal or modification of the beds and margins of rivers and lake beds reduces the ability of habitat to support fish. Furthermore, mechanical disturbance to water ways (by, for example, the use of diggers) can result in direct and indirect mortality as fish are physically struck with buckets and/or removed from the water channel along with the target debris. Food sources (macro invertebrates) can also be adversely affected.

In addition, the removal of riparian vegetation reduces bank stability, increases sedimentation and summer water temperatures (see below). Deposition of leaves and other organic matter from riparian vegetation can be an important source of nutrients in nutrient poor systems. Their removal can alter the nutrient balance.

Riparian vegetation can absorb nutrients from agricultural and urban run-off and its removal can result in elevated nutrient levels.

Some of the most common activities that present a risk to the physical state of freshwater fisheries are stream cleaning, stream straightening/channelling, piping of open water courses, and gravel and shingle extraction.

Elevated water temperature. Fish like all cold blooded animals are unable to internally regulate their core body temperature. Therefore, temperature exerts a major influence on the biological activity and growth. To a point, the higher the water temperature, the greater the biological activity. However, fish, aquatic insects, zooplankton and other aquatic species all have preferred temperature ranges. As temperatures get too far above or below this preferred range, the number of individuals of the species decreases until finally there are few, or none. In other words, freshwater fish are tolerant of temperature change only within a certain range. Elevated temperatures cause fish to move to other habitat or in extreme cases cause death and population decline.

Elevated water temperature can result from decrease in shade (i.e. the removal of stream side trees and other overhanging vegetation), decrease in water depth (as may result from, channel widening or sediment build up, or reduction in flow[3]), or from thermal discharges such as discharges from industrial facilities that are not sufficiently cooled. New Zealand's freshwater fish generally require water less than 25° C over the summer months.

Chemical state of water - Water quality is affected by dissolved gases, minerals and organic material in the water. The introduction of pollutants can affect this directly, for example, by adding toxic chemicals to the system, or indirectly, for example by adding so much organic material that the oxygen content of the water becomes severely depleted.

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[3] Reduction in flow may in turn be the result of abstraction or diversion of natural flows into urban stomwater systems

Water pollution from agricultural sources[4] is a major cause for concern. Many perfectly legal activities (commonly permitted as of right through local authority plans) can present a risk of pollution if carried out inappropriately. Examples of pollutants include sprays from arable crop management, fertilisers (nitrates, phosphates, potassium) from crop and grassland management; cowshed effluent applied to land, milk washings and silage liquor. These later, organic materials remove dissolved oxygen from the water and can kill fish through asphyxiation. Fertilisers can cause over-enrichment (eutrophication) of aquatic systems and resultant loss of sensitive plant and animal species, algal blooms and reduced fish productivity. At certain concentrations these nutrients can encourage the growth of nuisance aquatic plants. These plants can choke up waterways and out-compete native species.

Excessive sediment load – The sediment load in a waterway affects the water's *turbidity*[5]. The turbidity, or cloudiness, of water is important for freshwater fish for several reasons.

High concentrations of particulate matter can modify light penetration, cause shallow lakes to fill in faster, and smother benthic habitats. As particles of silt, clay, and other organic materials settle to the bottom, they can suffocate newly hatched larvae and fill in spaces between rocks which could have been used by aquatic organisms as habitat. Fine particulate material also can clog or damage sensitive gill structures, decrease their resistance to disease, prevent proper egg and larval development, and potentially interfere with particle feeding activities. If light penetration is reduced significantly, macrophyte[6] growth may be decreased which would in turn impact the organisms dependent upon them for food and cover. Reduced photosynthesis can also result in a lower daytime release of oxygen into the water.

As turbidity increases and the length of time water remains turbid increase, fish show correspondingly increased signs of stress including behavioural change, reduced growth rates and eventually death. The level at which turbidity is lethal varies according to fish species. Research has shown that the New Zealand smelt is one of the world's most sensitive fish to turbidity. Inanga are also sensitive. Whereas banded kokopu and redfinned bullies have been shown to tolerate extreme turbidity. Eels are also known to be highly tolerant of turbidity.

Any activity that increases erosion in the catchment can result in increased sediment loads in waterways. Common causes are forestry (i.e. logging) and land clearance (usually for agriculture) but urban development, including road construction is another significant contributor. Direct works in, or adjacent to, water ways such as channel modification and clearing of riparian vegetation can be a further significant sources of sediment. High concentrations of bottom feeding fish (such as introduced carp) also increase turbidity by stirring up bottom sediments.

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[4] Pollution also results from urban uses (industrial, sewage and stormwater discharges) which can contain a wide range of contaminants (including heavy metals, organohaline compounds and organic nutrients) with a wide range of potential effects. However these are generally not as widespread as those from agricultural uses

[5] Turbidity is a measure of the cloudiness of water. Suspended sediments is a primary determinant of turbidity but phytoplankton can also be a major source particularly in lakes.

[6] A macrophyte is an aquatic plant that is large enough to be seen with the naked eye; in other words, they are larger than most algae.

Predation and competition for food – The presence of pest fish in many of New Zealand's water ways has a significant impact of native freshwater fish. As discussed above, some species modify habitat by increasing turbidity (e.g. carp) or by excessive browsing on new plant growth[7] (e.g. rudd). Others (such as Gambusia and perch) prey on, or are aggressive towards, freshwater fish and/or compete with native fish for food.

Pest fish can reduce native fish populations and/or reduce the health and growth rates of native fish by taking preferring food sources.

Accessibility – Many of our water ways both large and small impede fish migration. The most common structures that impede upstream fish migration are dams, weirs, floodgates and culverts, but anything that increases flow velocity, decreases depth, or poses a physical barrier has potential for impeding fish migration. Downstream migration is similarly impeded by diversions, physical barriers or structures that reduce flow velocity.

Hydro dams are frequently identified as barriers to fish migration. They are a significant issue but so too are the many culverts, fords and bridges over small streams which, in terms of habitat, are as important as large rivers. Although bridges generally have the least impact on fish passage, if designed with concrete aprons (with overhangs or small waterfalls) they can create a significant obstacle.

[7] This can result in the collapse of macrophyte beds and consequently reduce water quality)

Strategy Overview

The state of New Zealand's freshwater habitat varies considerably. Habitat can be categorised as follows.

- habitat exposed to regular or intermittent physical damage through activities commonly associated farming and forestry.
- habitat in a constant *degraded state* as a result of past physical modification and/or point and non point source pollution (including high sediment loads).
- habitat that has the physical and chemical conditions to support viable populations but which have become *depopulated* because of either (a) the presence of pest species (including in some cases invasive aquatic plants); and/or (b) structures have impeded migration.
- good quality, sustainable habitat,

Unfortunately the later category is uncommon. Many of New Zealand's large protected areas with catchments where vegetation cover remains intact (such as national parks and reserves and other undeveloped lands) are located in upland areas not the coastal and lowland areas that are the prime freshwater fish habitat (remembering that a great many native species spend part of their life in the sea). Diadromous fish populations that do inhabit protected habitat inland are often exposed to the risks and stresses of migrating to and from this habitat via highly modified, at risk or degraded lowland and coastal systems.

Goal

The overall goal of this strategy is to promote habitat sustainability by ensuring that (a) risks to habitat sustainability are appropriately managed; and (b) opportunities for habitat restoration and enhancement are taken by regulatory agencies, landowners, iwi and the wider community.

Objectives

In recognition of the particular characteristics of New Zealand's freshwater fisheries, the following objectives will be pursued to give effect to this goal. Objectives include:

- to better manage migration routes between large areas of sustainable inland habitat and the sea;
- to better manage habitat in the coastal and near coastal areas that are the preferred habitat of most freshwater fish; and
- to improve accessibility to, and restocking of good quality habitat that is currently inaccessible.

Priority species

As noted above habitat is subject to a number of threats. Some of these threats are more significant for some species than for others. Eels, for example, are relatively tolerant of poor water quality whereas koura are known to be relatively intolerant. Similarly, a pest fish species that poses a threat to one freshwater fish species may not pose a threat to other species and visa versa.

On the other hand, some threats are common to a number of species. Impediments to migration are a problem for eels, lamprey and inanga. Riparian vegetation (whether native or introduced) is critical to just about every freshwater fish species.

For other species such as mullet and flounder little is known about habitat issues although degraded quality of harbours is thought to be a problem.

It would be difficult for this strategy to address all 50-odd freshwater fish species (some are after all specific to particular waterways). However, analysis of threats demonstrates that a focus on maintaining habitat for three key species will ensure the widest range of benefits to freshwater fisheries generally. Key species are:

- eels;
- inanga; and
- koura.

The approach taken by this strategy focuses, at least in the initial stages, on threats to eel, inanga and koura but is expected that other freshwater species will benefit.

Priority actions

As indicated by the previous discussion of habitat risks, any number of actions could contribute to the sustainability of eel, inanga and koura habitat. To deliver the goal of this strategy, however, it will be necessary to focus effort on those matters that are most important or offer best potential return on investment.

Although the habitat of each of the species discussed in this strategy requires particular action, actions can be summarised into three over-riding priorities. These are:

- removal of impediments to fish migration and, where this is not practical, remedial measures to ensure fish passage;
- riparian planting and protection of riparian vegetation from grazing and trampling and other physical disturbance; and
- eradication, and where this is not practical, the control of pest fish populations and distribution.

Greater detail about priority species and actions is set out in the following pages.

Strategy: Inanga (Whitebait)

Habitat Issues

- Although found nationwide, inanga have specific habitat preferences. Most recorded inanga habitat is less than 20m altitude and less than 10 km of the coast. Inanga feed in relatively slow flowing waters. Pools, slow runs, or backwaters are their preferred habitats. Best inanga habitat is also associated with areas that have overhanging vegetation or macrophyte beds. Such habitat has been reduced and is under continued risk of modification.
- Inanga have little climbing or jumping ability. Floodgates pose a particular barrier to inanga because they are designed and operated to exclude the pulse of the tidal water. They are closed against the incoming tide meaning juvenile inanga cannot migrate using the natural tidal flow but must instead fight that flow. Poorly designed culvert pipes under, for example, roads and farm tracks are the other major impediment to inanga migration.
- Inanga spawning mostly occurs in the lower reaches of waterways (near the upper limit of salt water/tidal influence) on the autumnal spring tides and in spring. Spawning occurs amongst bank-side vegetation (often grasses) subject to tidal inundation in specific sites used year after year. Eggs develop in the litter layers near the water's edge over a 2-4 week period. These limited spawning sites and the eggs laid there are particularly vulnerable to damage by cattle trampling and grazing[8].
- Pest fish pose a thread to inanga. Gambusia (mosquito fish) in particular, are known to be aggressive towards inanga. Such aggression probably results in the exclusion and displacement of inanga from the shallow, food rich habitat. Gambusia are thought to be transferred illegally in an attempt to control mosquitos.

Objectives

(a) Secure protection of remaining inanga habitat and spawning areas

(b) Increase the extent of viable inanga habitat by:

- enhancing access for up stream inanga migration
- restoring degraded habitat
- controlling pest fish

Priority actions

<u>Habitat protection</u>

- Encourage and support the identification and protection of specific inanga *spawning areas* in conservation management strategies and regional planning documents. Ensure spawning sites that are critical to the welfare of key customary fisheries are included.

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[8] The Department of Conservation does fence and protect some key spawning areas.

- Encourage the identification of “at risk” spawning sites (noting that the Department of Conservation protects some spawning sites)
- Encourage and support initiatives to protect spawning areas (either permanently or temporarily during spawning times) from stock trampling. Promote the use of temporary electric fencing and other low tech/low costs means of protecting sites from stock at critical times.
- Promote and support inanga habitat restoration (being riparian planting and fencing of slow moving lowland waterways) by regional councils and *landcare, streamcare* and similar community groups.
- Encourage regional and district councils to promote restoration and distribute habitat restoration guidelines and to require stream restoration as mitigation for other adverse effects of their activities.
- Advocate through the RMA process for habitat protection and the control of habitat damaging activities including:
    - ensuring regional plans have rules controlling stream clearance;
    - ensuring practical conditions are placed on applications that mitigate effects of habitat disturbance such as only clearing one side of a stream at a time and avoiding key migration periods (autumn); and
    - ensuring significant habitat such as wetlands and waterways with intact riparian vegetation are recognised and protected in district and regional plans.
- At the national level, advocate for better protection of habitat in the New Zealand Coastal Policy Statement and other relevant national policies and strategies.

<u>Migration</u>

- Encourage regional councils to require culvert pipes to be designed to facilitate inanga passage (and ensure regional councils offer advice and guidance on how this can be achieved.)
- Support the retrofitting of rock ramp fish passes on existing poorly designed culverts to improve access.

<u>Pest fish</u>

- Advocate for and support research into effective and practical methods of controlling Gambusia populations and Gambusia colonisation of new habitat.
- Ensure Gambusia are identified in regional pest management strategies and appropriate management efforts are committed.
- Encourage regulatory agencies (Department of Conservation and regional councils) to better address illegal transfer of Gambusia (including providing of warning signs, taking of prosecutions, enhanced monitoring and taking rapid remedial action when new populations are discovered).

Strategy: Tuna (Eels) and Piharau (Lamprey)

Eels and lamprey are dealt with together because, although their migratory cycles are opposite[9], the habitat issues they face are similar.

Habitat Issues

- Hydro dams (and other large structures such as regional council operated flood control schemes) pose an insurmountable barrier for upstream migration meaning that good habitat cannot be reached by young eels[10] (or adult lamprey)
- Downstream migration (eel escapement) is impeded by hydro dams and other large structures meaning (a) that mature eels cannot breed; and (b) mature eels are killed in turbines in an attempt to migrate[11].
- Eels can be "out competed" for food (such as bully and koura) by pest fish such as perch and catfish. In habitat populated by these pest fish eel numbers are low and/or eels are in poor condition. Catfish are easily spread probably in eel nets and boat trailers.
- Eel habitat (such as wetlands) continues to be lost or damaged from drainage works and similar activities.

Objectives

(a) To increase the area of viable eel and lamprey habitat by:

- by overcoming barriers to up stream migration
- enhancing opportunities for escapement
- reducing pest fish

(b) To enhance the quality of eel habitat (including reducing risk that intermittent in stream works and drainage works pose for eel populations).

Priority actions

Escapement

- Encourage and promote research to the most effective ways to provide for the escapement of eels. Research needs to consider eel by-passes, trap and transfer, screens over intakes, lighting near intake structures, and the opening of spillways at peak migration times.
- Ensure that regional policy statements and plans address the issue of eel/lamprey escapement with relevant policies and methods
- Ensure that appropriate conditions are placed on resource consents for significant damming and diversion of water and that eel/lamprey escapement and mortality is monitored and reported.

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[9] Eels migrate to the sea to breed whereas lamprey migrate into freshwater to spawn.

[10] It has been estimated that hydro electric dams have blocked access to 35% of the total longfin habitat

[11] A study of the Patea Dam found that 0% of female longfins and 28% of male longfins survive passage through the turbines. The figures for shortfins are about 1% for females and 28% for males.

Up stream migration

- Work with regional councils, electricity generators and the Eel Enhancement Company (EECo) to ensure that “trap and transfer” systems are in place enabling eels to migrate up-stream of hydro dams and similar structures.
- Encourage regional RMA documents to address the issue of up stream eel migration and provide for appropriate conditions on resource consents for significant damming and diversion of water.
- Lobby for changes to the management and design of flood control systems operated by regional councils.

Pest Fish

- Encourage and promote research into practical means of controlling pest fish that compete with eels for food – particularly *Brown* bullhead catfish and perch.
- Establish and support local programmes to control pest fish populations in high value eel habitat.
- Promote cleaning of eel nets and boat trailers after use and before reuse in different water ways.
- Promote the identification of pest fish in regional pest management strategies and the direct control of such fish or, where practical, eradication.

Habitat protection

- Encourage and support landcare and streamcare and similar environmental and community groups that work to fence off waterways and replant riparian vegetation.
- Ensure that regional councils monitor and report the effectiveness of voluntary protection initiatives such as Fonterra’s Clean Streams Accord and take corrective actions when necessary to support such measures.
- Advocate through the RMA process for habitat protection and the control of habitat damaging activities including:
    - ensuring regional plans have rules controlling stream clearance;
    - ensuring practical conditions are placed on applications that mitigate effects of habitat disturbance such as avoiding key migration periods (autumn); and
    - ensuring significant habitat such as wetlands and waterways with riparian vegetation intact are recognised and protected in district and regional plans.

Strategy: Koura (Freshwater crayfish)

Habitat Issues

- Koura inhabit a wide range of aquatic habitat types but, being bottom dwellers, are in all cases are vulnerable to physical disturbance to the beds of streams and lakes.
- Catfish have been distributed intentionally and accidentally into many lakes and rivers of the North Island[12]. Koura are known to form a significant part of adult catfish diet.
- Koura are susceptible to water quality changes particularly bottom water dissolved oxygen and ammonia levels. Riparian vegetation plays and important role in mitigating the effect of non point source discharges that are the primary source of contaminants[13].

Objectives

To maintain and enhance the quality of koura habitat by:

- protecting habitat from undue damage and disruption
- maintaining or restoring good riparian buffers along the margins of streams and lakes that support koura fisheries
- controlling the spread and population size of pest fish.

Priority actions

Habitat protection

- In addition to the matters identified in respect of eel habitat:
    - Ensure that RMA documents include provisions that recognise and, where possible protect, koura habitat from activities in the beds of rivers and lakes.
    - Ensure individual resource consents for significant projects contain appropriate conditions to protect/replace or restore koura habitat.

Non point source discharges and riparian buffers

- Ensure regional councils have effective measures in place to address non point source run off from agricultural land with particular emphasis on managing dairy shed effluent disposal to land and ammonia-rich fertiliser application.
- Promote the use of farm, plans and similar tools where whole of farm land use can be considered to ensure good catchment management and waterway protection.

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[12] Catfish are now widespread throughout the Waikato River catchment, occurring as far upstream as Lake Aratiatia. More recently, catfish have become naturalised in Lake Taupo.

[13] Ammonia in waterways generally comes either use of ammonia-rich fertilisers, waste waters or animal wastes (dung and urine).

- Where regional councils use voluntary measures (or permitted activity standards) to control non point source discharges insist on regular monitoring and reporting of compliance and water quality.
- Encourage and support initiatives that protect enhance and/or restore riparian vegetation including those effort of environmental and community groups.
- Ensure regional councils have rules in place to control the removal of any vegetation (native or exotic) in the riparian margin

Pest Fish

- Encourage and support initiatives to manage brown bullhead catfish as outlined in the eels section above.

Implementation

This strategy takes a two-pronged approach to implementation.

Involvement in statutory processes

The first prong is to influence existing statutory processes to promote better public management of fish habitat.

There is already a number of statutory functions and process that seek to (or are capable of) advancing the interest of habitat sustainability. This strategy can be delivered by iwi:

(a) Consulting with, and making representations to, regional councils and territorial authorities outside of statutory processes to highlight the issues and opportunities for habitat protection and restoration.

(b) Statutory submissions on:

- local authority *RMA documents* (regional policy statements, regional and district plans) in accordance with the priorities identified in this strategy
- resource consent applications
- local authorities' *strategic plans* – principally long term council community plans (LTCCP's)[14]
- regional councils' regional pest management strategies
- the Department of Conservation's conservation management strategies

Hands-on projects

The second prong involves working on the ground and helping others to work on the ground to improve habitat.

- The stewardship of Maori land and other land hand held by iwi organisations offers the opportunity to advance the goals and objectives of this strategy directly in day to day management.
- It is also important to note that there are many conservation and community groups already working on habitat protection and restoration. There is an opportunity to work closely with these groups to help identify priority areas and to lend direct assistance in fencing/planting programmes.

[14] LTCCPs direct where local authorities plan to spend funds over a 10 year period.