Ecosystem-based approaches to habitat restoration

Report of

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Introduction

Background
To meet the 21st century challenges of declining natural environments and climate change, we need to embrace a new approach which explicitly recognises that a healthy natural environment and future economic growth and prosperity go hand-in-hand. Ecosystems-based solutions can help us achieve this. My involvement in landscape-scale habitat restoration projects in the SW for over 20 years with the UK Government’s countryside body for England, Natural England, has shown that we still face challenges of people understanding the need to respect critical ecosystem limits and recognising the value and range of benefits we get from the environment (‘ecosystem services’) such as clean water, timber, food, or well-being.

My visits to the US and Canada were planned because they have led in implementing ecosystem-based management, defining ecosystem integrity and tackling resource use, for example the case of logging old-growth forests. Wetlands internationally have been at the forefront of integrated management outside and inside protected areas and I hoped to contrast areas with different histories, so that in Europe I visited the mainline EU country France and ex-communist Bulgaria.

The Ecosystem Approach
The ecosystem approach was adopted as the primary framework for action of the Conservation on Biological Diversity (CBD) at its second meeting at Jakarta in 1995. The approach is described as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.

The rather comprehensive 12 Principles set out in the CBD Fifth Meeting (see box below, abbreviated and my emboldening) are more succinctly summarised in the UK Government’s Department of Environment and Rural Affairs (Defra) action plan ‘Securing a healthy natural environment : An action plan for embedding an ecosystem approach’ which was launched in late 2007:

- taking a more holistic approach to policy-making and delivery, with the focus on maintaining healthy ecosystems and ecosystem services
- ensuring that the value of ecosystem services is fully reflected in decision-making
- ensuring environmental limits are respected in the context of sustainable development, taking into account ecosystem functioning
- taking decisions at the appropriate spatial scale while recognising the cumulative impacts of decisions
- promoting adaptive management of the natural environment to respond to changing pressures, including climate change.

Healthy ecosystems are the building blocks of productive and resilient environments. People depend on productive land or oceans for ‘goods’ such as food and medicines, and essential ‘services’ such as the detoxification of pollutants, recycling of nutrients, control of pest outbreaks and diseases, and regulation of climate, atmospheric gases, and the water cycle. These essentials are called ‘ecosystem goods and services’. Healthy ecosystems provide these goods and services for free. If the ecosystem is damaged, for example by

1 http://www.cbd.int/convention/
habitat destruction, pollution, or overfishing, the delivery of goods and services is impaired. As a result there may be a loss of productivity, increases in outbreaks of undesirable species, and less resilience to disasters. I did not set out to look at ecosystem services as this is a sub-field in itself and much in vogue at the moment, but I did visit one project in Oregon which has advanced this approach.

Rather I am interested in how the approach can be applied to managing the environment. A technical but good summary of ecosystem-based management is: “Ecosystem management integrates scientific knowledge of ecological relationships within a complex socio-political and values framework toward the general goal of protecting native ecosystem integrity over the long term”3.

Another useful phrasing is from the Ecosystem-Based Management Planning Handbook4 which is: ‘An adaptive approach to managing human activities that seeks to ensure the coexistence of healthy, fully functioning ecosystems and human communities. The intent is to maintain those spatial and temporal characteristics of ecosystems such that component species and ecological processes can be sustained, and human well-being supported and improved”5.

### Convention on Biological Diversity 12 principles underlying the Ecosystem Approach

1: The objectives of management of land, water and living resources are a matter of societal choices.
2: Decentralization to the lowest appropriate level.
3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context.
5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
6: Ecosystem must be managed within the limits of their functioning.
7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
9: Management must recognize the change is inevitable.
10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

### Ecological Restoration

Ecological restoration is one of the activities which gives me most satisfaction in my work. Apart from controlling invasive species, one of the major projects I am involved in is restoring peatlands on Exmoor by blocking 19th and 20th century drains to restore a more natural hydrology and prevent peat (and thus carbon) loss. Restoration is simply defined as “…the process of assisting the recovery of an ecosystem that has been

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4 http://www.citbc.org/ebmplan.html
degraded, damaged, or destroyed.\textsuperscript{6} Active restoration contrasts to passive restoration which can just allow natural processes or facilitates it (e.g. Mount St Helens below). In each case, the intention is to return an ecosystem to its natural processes or trajectory before man’s (usually) detrimental influence. ‘Natural’ may need defining in this context, as few of the ecosystems I visited could be said to be truly natural. Even in the high mountains, glaciers are melting faster as a result of our carbon emissions and may destroy alpine zones, with species such as the marmot and wolverine, as they are squeezed higher up. Indirect effects are of course also going to occur. For example it is suspected that a recent increase in grizzly bear mortality was caused by a massive die off of whitebark pine trees, its nuts being the bear’s principal autumn food. Mountain pine beetles killed the trees but warm winters of the past decade (associated with warming) enabled the insects to move up the mountains into the higher whitebark pine forests. This is why the focus of the ecosystem approach on maintaining processes not just the individual species is so important.

**Aims**

I aim to examine how we can design the ecosystem approach into projects from the outset and which components of the approach are vital. Finding good examples of ambitious habitat restoration and how this has been integrated into decision making is a key part of my trip. Such projects would deliver multiple benefits to society and not be afraid of changing land management to do this. I also hope to gain knowledge of the institutions and partnerships linking those that provide the services (the land managers) to those that benefit from them so that my rather parochial view of the world from working in the SW of England and in particular in the small National Park of Exmoor.

**This report**

I kept a travel blog whilst away and this can be accessed at \url{http://flemmingulf.wordpress.com/}. Some of the text and photos may be duplicated here. Links are provided to websites as footnotes but a web-version of this report with active links will be posted there.

This report takes the most significant projects or places I visited, sets out some background and highlights ecosystem issues related to protected areas and ecological restoration.

\textsuperscript{6} \url{http://www.ser.org/content/ecological_restoration_primer.asp}
Bulgaria

Strandja: forest, coast and high nature value farming

Strandja (also ‘Strandzha’) is a low mountain massif spanning SE Bulgaria and the European part of Turkey, with 710m the highest Bulgarian point. The total area of the massif is approximately 10,000 km². About 10% is in the Strandja Natural Park⁷, the largest such area in Bulgaria, extending from the coastal landscape of the Black Sea into low mountains and hilly landscapes with steep river valleys. This contrast explains its mild and humid maritime climate, unique compared to other mountain ranges in Bulgaria. Its geographic position at the border of Europe, Asia Minor and the Mediterranean gives rise to a distinctive ‘Euxinian’ (or ‘Pontic’) flora restricted to parts of Bulgaria, Turkey, Russia around the Black Sea which escaped recent glaciations and has a strong component of Tertiary period relicts.

The Strandja Nature Park⁸ was designated in 2001 after some time as a protected area. The Park is mainly forested (80%) and with 21 settlements. About 10-12% is agricultural land, most now private property (54%), the rest owned or managed by the municipality (43%) with only 3% state owned following communism ending in 1989. The coastal parts of the regions are heavily developed with holiday resorts, while the interior of the park faces problems of village and land abandonment.

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⁷ Nature Parks are large areas combining biodiversity protection and sustainable development. Unlike National Parks in Bulgaria, settlements and structures are permissible with territory zoning depending on conservation significance.

⁸ http://www.strandja.bg/bg (website in Bulgarian language only)
I met Anja Borsje, an ex-colleague, ecologist and now setting up an eco-tourism business, in a tiny village in the middle of the forest. My tour involved: participating in a litter cleanup of the Veleka river and beach as a celebration of National Parks Day; walking a section of the stunning coastline; visiting flower-rich grasslands around her village and the monument (to the uprising) at Petrova Niva; seeing native *Rhododendron ponticum in the ‘Living Museum’* old forest at Kondolovo; and walking along the floodplain of the unspoilt Veleka river with a fantastic structure of bends, coarse woody debris and scrub and woodland. At Poda, a wetland centre on the edge one of the Burgas lakes (run by the Bulgarian Society for the Protection of Birds) with cormorants nest on giant disused and active electric pylons, I met Ivan Kamburov, an ecologist with Strandja Nature Park Directorate who explained the difference between the National Parks (3 of them) under the wing of the Environment & Water ministry, and Nature Parks (11) under the Forestry ministry.

**Protected area**

A management plan of the park has not yet been adopted. This is a significant problem for the management and protection of the park because of mass tourism development along the coastal areas of the park. The coastal grasslands in this zone are further threatened by construction in part because they are are seen by locals as wasteland, rather than being highly valued.

Illegal developments have taken place and the stakes can be very high with occasions of people making a stand against being exposed politically and even personally. Greater recognition of Strandja’s importance nationally and internationally may help to ensure greater protection.

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**Ecological Restoration**

**Abandonment.** A significant problem is significant depopulation in villages with many vacant houses. In Byala Voda in the heart of Strandja, only 14 are occupied all year and there are no children, with most villagers over 65. Houses are also being bought by foreigners or Bulgarians from towns on the coast with no rural skills as investments or for seasonal occupation. Livestock breeding traditionally dominated the region outside the forests. However, from the 1950s, the borders were strictly controlled and shepherds were not allowed to move their herds to the pastures along the Aegean Sea in Turkey. The socialist agriculture system promoted cattle breeding in large-scale state farms in the region. But after 1990 the liquidation of the state farms, the number of cattle in the region halved and continued to decline. The number of sheep decreased dramatically from over 18,000 in 1990 to 4,400 in 1999.

9 http://www.visitstrandja.com/index.htm
10 http://bspb.org/index.php
Such changes have imperilled High Nature Value farmland (see European Forum for Nature Conservation and Pastoralism\(^{11}\)). I saw limestone meadows full of wildflowers with rich edge habitat, and exceptionally diverse insects and birds. Yet young and middle aged scrub and encroaching woodland was very obvious. In places it seemed that open areas are sparse and maintained only by drought or shallow soils, with no active farmers.

**Awareness.** It is apparent that there is a lack of knowledge about the importance of Strandja nationally and internationally, as with wildlife generally in Bulgaria, and raising its profile would help give more weight. It was apparent whilst out walking in the rural areas (and in Central Balkans) that not many Bulgarians were enjoying the countryside, although this may be related to the poverty of the country generally.

**Forestry.** Forests cover about 80% of the Park, mainly oak with stands of oriental beech *Fagus orientalis* forest unusually occupying the valleys. The beech forest has *Rhododendron ponticum* as a locally dominant species, in places up to 80–90% cover growing often with evergreen Euxinian shrubs including cherry laurel *Laurocerasus officinalis* (both invasives in the UK!). However *R. ponticum* is native here (as it is in Spanish and Portuguese gallery forest and around the Meditteranaean into Turkey). Older forests are relatively abundant here compared to the rest of Bulgaria- nearly 30% of the Park area - but much forest is relatively young (average age of 75 years) and even aged with fuel as the primary crop (meaning larger trees are not as valued). There is interest in a different style of forestry focussing on individual tree selection (from Saarland/Alsace), which may help diversify the age structure.

**Lessons learned**

- Increasing **appreciation of the value of the natural environment** should not be dismissed

- **Limits to exploitation** (maintaining ecological integrity) are important in national and international arenas and this protection **should be formalised** (eg in a Management Plan or policy)

- **Incentives for sustainable management** by grazing of High Nature Value farmland need to be in place before more commercialised ‘subsidy’ farming has the chance to dominate in response to raising living standards

\(^{11}\) [http://www.efncp.org/high-nature-value-farmland/](http://www.efncp.org/high-nature-value-farmland/)
Central Balkans: mountain grazing, bears and wolves

The Central Balkan National Park\textsuperscript{12}, established in 1991, forms the central part of the east-west Stara Planina mountain range extending from Serbia to the Black Sea (see map below). The Park is about 85km long and c. 71,700 ha in size (a little larger than Exmoor NP) with twenty peaks over 2,000 m. The boundaries, like other European National Parks, are drawn to encompass mainly semi-natural habitats, exclude settlements and other major infrastructure, although there is a weather station and radio tower on Botev Peak (Bulgaria’s highest at 2,376m).

Over half the Park is wooded with extensive beech and beech-fir characteristic of the Central European beech forest, with some Macedonian pine \emph{Pinus peuce} - a Balkan endemic. Above the forest tree line, the highest plateau slopes have sub-alpine shrub vegetation of Siberian Juniper \emph{Juniperus communis nana}, wortleberries \emph{Vaccinium} spp. and alpine meadows, grazed in the summer. About one-third of the Park is designated as nature reserves (shown in green on map below) to represent the main habitats.

I met Georgi Gugushev in Kalofer and discussed Park matters before touring a higher part of the Park with Head Ranger Anton Avramov followed by meeting a shepherd and a traditional farmer on the lower slopes.

\textbf{Protected area}

The Park is particularly important for protection of the brown bear, wolf, other carnivores such as wild cat and pine marten, together with birds such as the imperial eagle, and white-backed woodpecker. Bears have been protected in Bulgaria since 2002 (before which they were regulated by hunting) and numbers are thought to be 500-700 and have an Action Plan\textsuperscript{13}. Although bears are protected everywhere (but subject to some illegal

\textsuperscript{12} http://visitcentralbalkan.net/en/
\textsuperscript{13} http://www.lcie.org/Docs/Action\%20Plans/Bulgarian_Bear_Action_Plan_ENG.pdf
shooting and up to 10 allowed to be hunted each year), wolves are not protected outside National Parks where the Ministry make money from wolf licences.

In the Central Balkans bear numbers are c 200 and are being studied by Park staff. Within the Park illegal activities are kept low or non-existent by a network of area rangers who regularly patrol and know their patches well.

**Ecological restoration**

These grasslands have been grazed for 500-600 years by shepherds looking after their cattle and sheep for 2-3 months at a time, with families bringing food by horse where there is no track/road. There are also semi-wild ponies out all year despite the snow. If villagers need to catch them, they bring salt and lasso them, western style. The presence of cattle high up is a little controversial, as the treeline is perhaps 50-100m below what it would be.

So although we think of European mainland National Parks being much more pristine than ours, the influence of domestic grazing and therefore the numbers and timing of grazing is still an issue. Here control of grazing is by licences, issued by area rangers, which specify numbers, timing and the presence of both shepherds and guarding dogs (to avoid losses to predators).

Although I saw frequent signs of bare ground I assumed was heavy grazing pressure, apparently it was mainly natural as a result of snow cover and slow starting growth at higher altitudes (1500-2500m). In some small
areas localised tracking damage occurs by shepherds or illegal vehicle use. In one area repairs have been carried out by a series of stone dams, in a much more severe environment and slope than UK gully blocking.

Lessons learned

- A strong and well staffed national park service can achieve a high level of protection and management whilst still allowing traditional use
- Research is essential to understand key resources
- Wilderness is useful as a concept but in Europe at least, human use has affected most areas and needs accounting for and integrating into landscape management
Persina Nature Park\textsuperscript{14} is on the northern boundary of Bulgaria, along the Danube. The area has a very continental climate with temperatures of over 40\textdegree C in summer and cold winters. The Park is fairly recently established (2001). It covers an area of 21,760 ha and includes the Belene island group of 19 islands with a total area of nearly 7,000 hectares. Persina Island is the largest in Bulgaria (15 km x 6 km) and the fourth largest island on the Danube in Europe. The site is part of Ramsar, EU Birds and Habitats Directive Natura 2000 sites. Two small islands are designated as strict nature reserves to protect breeding sea-eagle.

Radoslava Dzhantova showed me around the new Persina Nature Park visitor centre funded by GEF (an independent financial organization providing grants to developing countries and countries with economies in transition). I then had a 4WD tour of the Belene prison island wetland restoration scheme guided by Stolyan

\textsuperscript{14} http://persina.bg/indexdetails.php?menu_id=14
Mihov (WWF) and Vesselin Koev, biodiversity expert with the Park. The next day we drove in the projects speed boat to see the flooded forests of the outlying islands and fringes of Persina island.

Protected area

About 60% of the land is owned by the state, mainly by the Ministry of Agriculture and Forestry, and the municipalities. About 7,600 ha is private property but is highly fragmented in 14,528 property lots in which the average size of lots is less than 2 ha with more than 70% of landowners less then 1 ha. This poses big problems for achieving change in management at the ecosystem level.

There is also a local development issue of a resurrected nuclear power station which is being planned for opposite the island. It will raise the temperature by 1-2°C for a 30-40km stretch from experience higher up the Danube. Apparently fish will be little affected, as they can move to other parts of the channel but may cause problems of warmer water incursions in the newly created wetland reserve leading to lack of oxygen. A major threat is pressure to dredge the channel to allow bigger boats to pass more frequently. This would cause shallowing either side of the deeper channel and lose sand bars and other habitats vital to the site. It could also prejudice the 6 million Euro investment in the Persina project.

Ecological restoration

Wetland. The wetland I saw on Persine Island is only six years old and control of water is achieved through three sluices, formed of up to 8m of concrete, to allow water in, and occasionally out, with a water level of about 20m ASL. The large size of the created wetland from intensive farmland was impressive. Water quality is improved by passing it into the island, one of the project’s aims and letting it out again. Wetland lakes are linked by pipes and in open water large carp are starting to colonise. The amount of Daphnia and young fry are also signs that the ecosystem is developing rapidly and that one of the goals – acting as a nursery for the Danube – will be achieved. The link between the river and wetlands behind the flood bank will then be more tangible.

I was extremely surprised there was little flood plain habitat generally long the river, despite my preconceptions about it being the the great river of Europe. A high flood bank extends along the Bulgarian and Romanian length of the Danube (and further) explaining the lack of a functioning flood plain ecosystem here. The project did start discussions with farmers in the hinterland of the Nature Park to try and achieve more nature friendly farming, but again the small-scale nature of farming by villagers, inability to deal with paperwork and short-term funding led to the project not achieving change in this area.
**Invasives.** Some problem invasives were present. A major one was an aggressive shrub called Indigo bush *Amorpha fruticosa* which was dominating the slightly drier land. I places however, higher water levels appeared to be killing it around the edges of the lakes. I had a glimpse of a golden jackal, with over 100 of these on the island and with a 5 leva bounty on their heads. However south east of here in Strandja and Greece they are considered endangered and in need of conservation! Also taking birds nests were over 1000 wild boar which swim across from the mainland. They are hunted in winter but the numbers cannot effectively be controlled.

*Indigo bush (top left) invading lake edge*

**Lessons learned**

- **Ecosystem limits need spelling out** so that decisions can be taken in full knowledge of the effects.

- **Political support for ecosystem protection is necessary**, otherwise development will always take precedence especially where poor countries are involved.

- **Long-term funding** is needed to build relationships and capacity.

- Wetland creation can be **remarkably rapid** compared to other ecosystems.
France

Mediterranean coastal wetlands: lidos, saltpans and dunes

The Languedoc Roussillon region forms the coastal strip of southern France, covering most of the Mediterranean region west of the Rhone valley to the southeastern limits of the Pyrenees. The coastal landscape has lagoons, marshes and dunes, extensive garrigues and vast areas of vines in the lowland plains, running up into mosaic landscapes of cultivated areas and garrigues to upland limestone plateaux. The coastal strip is heavily developed in places with Sète is a port and seaside resort in the Herault department.

Sete Lido
This is a 20km long narrow sand spit in front of the lagoon Etang du Thau, carrying the road between Sete and Marseillan along the beachfront and a mainline railway at the rear. Where the spit is at its widest there are vineyards, with the lagoon zone having salt pans and shellfish farming.

Submerged sediment bars act as some natural protection for the lido from erosion by south-eastern storm waves and seaward wind action. But erosion of the road and the low dunes and other vulnerable habitats has still occurred. This has been exacerbated by uncontrolled parking of campervans, access to the beach and heavy use of the dunes. In places erosion has been treated with hard defences of groynes, breakwaters and revetments.

Although groynes and breakwaters help locally to accumulate sand or protect the road, inevitably erosion is increased on adjacent stretches. Local soft defences such as wooden stakes and sediment refill have also been experimented with. The cost of maintenance, mainly of the road, was estimated as €250,000 per annum.

A major multi-partner scheme to remedy the problems was in its final stages when I visited with John Thompson of CEFE- CNRS16 and Mickael Debetencourt of Service Espaces Naturels, Thau Agglomération17. It is

16 http://www.cefe.cnrs.fr/
17 http://www.thau-agglo.fr/-La-protection-du-territoire-.html
a good example of a sensitive coast protection scheme with habitats, bolstered by new soft engineering techniques, providing this valuable ecosystem service. The solution involves constructing a new road on the landward side of the spit close to the railway, beach nourishment, dune restoration and the dedicated footpath/cyclepaths and some innovative beach protection (two submerged parallel ‘geotubes’ 3.5 m deep, extending for 1 km 350m off shore) to reduce the swell and therefore wave action at the shore, in an area with no natural defences. Restriction of parking by provision of only a few car parks will be controversial but beneficial in the long term allowing sand dunes to revegetate with less recreation pressure. The major winemaker Listel owns significant areas of vineyard along the back of the spit but this is not yet part of any restoration scheme.

Mickael and colleagues are involved in conservation of rare plants hydrologically affected by the road. As compensation a series of lagoons have been created and experiments are underway to assess the success of these to provide information on the design, construction, and management of small ponds/lagoons.

Protected Areas

I also toured three wetland sites managed by the Thau Agglomeration: Les Prés du Baugé, a 90 ha salt/fen meadow site on the inland edge of the lagoon; Les Salins de Villeroi, 193 ha of salt marsh derived from ancient salt pans close to Sete; and Les Salins de Castellas, saltmarsh and fossil dunes. Over half of land under Thau Agglo’s jurisdiction are semi-natural habitats of some importance. Two of these sites are managed by them on behalf of the the Conservatoire du Littoral18. This national public body was created by law in 1975 to protect coastal sites threatened by development, degraded and in need of recovery and suitable for opening for public access. It owns about 10% of the French coast in over 600 sites. The Conservatoire acquires land by agreement but is also empowered to confiscate or compulsorily purchase land. Management of sites is then generally handed over to a local conservation body, in some cases formed with the explicit purpose of managing the site.

Aside from development pressures along this coast, the management of these areas is typical of protected areas elsewhere. Management is specified in a detailed management plan which is prepared by Thau Agglo. Having examined some of the plans for these sites, I was impressed by how detailed they were, including specifying water level management and structures etc. They are subject to a detailed consultatation process and then form the template for management. A considerable effort has just recently finalized plans for 11 of the ‘espaces naturel’ sites managed by Thau aggro, with €300,00 committed to their conservation.

Ecological restoration

The main issues here were common to many sites I visited. **Water levels** were particularly important at Salins de Castellas where sluices control levels in different ‘ponds’ to enable flamingos to forage. **Invasive species** are always a problem and we examined Yucca spreading around a relict cottage at on some fossil dunes with the low shrub *Ephedra distachya* called ‘raisin de mer’ in France, an unusual conifer plant valuable for medicinal purposes.

At Les Prés du Baugé, the usual balancing of **grazing** and **cutting**, as well as the spread of *Phragmites*, was discussed but the vegetation in the less salty meadows was very familiar, resembling a tall, wet rush pasture but with abundant marsh orchid *Orchis palustris*.

### Lessons Learned

- **Management plans can be vital tools** but need good quality information and graphics, and sufficient resources and time for proper consultation.

- **Vision and boldness** may be needed to achieve new and sustainable solutions to major problems, including the braveness to see out short term flak.
Carmargue: pratincoles, mosquitoes and black cattle

The Camargue is one of the largest wetlands in the Mediterranean basin and forms the Rhone river delta. It is a Biosphere Reserve and Ramsar site. A Natural Regional Park\(^\text{19}\) extends to c 80,000+ ha within the central delta (see map) with a patchwork of private land (85%) and public reserves. The main reserves are: the Carmargue Reserve Naturalle\(^\text{20}\) of around 13,000 ha comprising the main lagoon (Etang de Vaccares), state-owned but managed by the private National Society for Nature Protection; the Étang des Imperiaux, a 2,800 ha reserve owned by a local community; and the 1844 ha Regional nature reserve of the Tour du Valat\(^\text{21}\) foundation.

Tour du Valat is a private charitable research body established by philanthropy, located on a 2,600 ha estate. It sets out to conserve the biodiversity of Carmargue wetlands, carry out biological research and utilise traditional activities for management.

\(^{19}\) State designation proposed by a region, mainly a planning tool.
\(^{20}\) http://www.reserve-camargue.org/
\(^{21}\) http://en.tourduvalat.org/la_tour_du_valat
Ecological restoration

Community involvement. Nicholas Beck, project manager for the Marais de Verdier\(^2\), showed me around this wetland, acquired only in 2003. It was managed as ponds for fish, grown for a year and sold up to Lyon, and shooting, mainly duck. Since then a significant investment in time has been made to seek the views of the local public and to come up with a management strategy to restore the area. The results have been spectacular and fast (as is the case with wetlands). The main wet area is a typical bird reserve with open water, reed, herons and loud warblers. Elsewhere other forms of use have been accommodated, normally considered unacceptable in reserves, e.g. hunting. Some areas are allowed to dry naturally and are being grazed by (traditional) black cattle, keeping water levels artificially high earlier in other areas for shooting and allowing ponies to graze across the whole site at low density.

The reward for this debate and the blank canvas of the site once fish farming ceased has allowed the creation of a substantial and diverse wetland. Collared pratincoles swirled overhead and appeared to be nesting in the dusty open areas, created by cattle trampling, as we looked at the cattle enclosure with fencing erected with rural development funds. Community use also includes fishing, with special provision for children, and walking.

Protected area

I visited the Reserve with Damien Cortez and Marc Thiebault to discuss reserve management. The mosquitoes were truly awful near any water or tree cover. However the landscape was fascinating - the main salt steppe habitat was strikingly similar in structure to heathland and the grassland was similar too, with soils, water levels and grazing being major influences. We looked at a grazing experimental area where short duration – heavy pressure cattle grazing is being compared to long duration – low intensity outside the fenced enclosure. To some extent this mimics the debate (see Grasslands National Park, below) about the benefits of ‘naturalistic’ grazing as intermittent but heavy, compared to heavy uniform ‘paddock’ grazed farmed livestock. Without serious research, preconceptions (often based on relevant experience, of course) will determine how we manage land and new thinking will not be easy to adopt. Nor will it be easy to persuade others outside managed reserves of the need for changes in management and the benefits of a more ecosystem process-based approach.

Despite the structural similarities, there are major differences including the extremely fragile ground surface (no vehicles are allowed on for about half the year) caused by summer drought and high winter water levels (bringing high salt levels). This alternation leads to a high amounts of bare ground with the characteristic flora

\(^2\) http://www.tourduvalat.org/notre_programme/gestion_integree_et_dynamiques_des_ecosystemes/gestion_participative_d_un_ma
rais
and fauna of the Carmargue. The amount of scrub was greater too on slightly higher ground, but as in the UK often a problem despite controlled grazing levels.

We also looked at the extremely rare habitat, Mediterranean temporary pools. The reserve has c 10 pools of the total of 50 in the Carmargue. They have a very rich and restricted flora (see starfuit *Damasonium polyspermum* photo) and fauna (we saw Southern Emerald damselfly *Lestes barbarus*) with many species being adapted to annual drying up and huge hydrological fluctuations within a year. This drying plays a key role in the way these ecosystems function.

**Lessons learned**

- Involving the community from an early stage has been extremely rewarding in the development of new habitat. Having the luxury of a blank canvas can lead to effective multiple use.

- Research questioning existing and testing new land management approaches is essential to adaptive management.
Pyrenees: naturalness, peat bogs and solidarity

The National Park\textsuperscript{23} represents the high mountain zone of the French Pyrenees, with the core of the Park (green in map below) between 1,000 m and the highest peak at 3,298m. It runs along the border with Spain and is 45,700 ha, with the southern part contiguous with the 15,600 ha of the Spanish Ordesa National Park. Jointly, they form the Pyrénées – Mont Perdu World Heritage Site.

I visited the Réserve naturelle nationale du Néouvielle (2,313 ha) with John Thompson and Pierre Goubet, a peatland specialist, and then participated in a office and field meeting with Pyrenees National Park staff about the conservation and monitoring of the small peat bogs (‘les tourbières’) found on the reserve.

Protected area
The 2006 law reforming National Parks of France saw the creation of Parcs Nationaux de France\textsuperscript{24}, a public body for France’s national parks under the Ministry for Nature Protection. Apart from unification of management and a common culture between parks, and the recognition of cultural heritage, ‘ecological solidarity’ became a core element of policy. It is seen as a different approach to the previous models of central and buffer zones or

\textsuperscript{23} http://www.parc-pyrenees.com/
\textsuperscript{24} http://eng.parcsnationaux.fr/
patch – corridor – matrix. It represents a balance between environmental and human use and places the protected area within its wider social, geographical and ecological zone.

In recognising both ecological and social issues as primary features of park policy, it provides for integrated management of landscapes in which human activities are an integral component and thus resembles much more closely the English National Park model. How this is done is unusual and very interesting. The national parks develop a Charter, a sustainable development statement. Priority is given to the protection of habitats, plant and animal species, landscapes and cultural heritage within the core area of the National Park, but outside this area in the six valleys forming the ‘aire d’adhésion’ of 206,400 ha (see pale green area on map), communes [the smallest administrative division in France] have the option of subscribing to the park’s charter. Apart from promoting sustainable development, this can then unlock funds and help with tourism. The key is that it allows the local communities to opt in, having seen what standards may be expected.

Ecological restoration

This is a mountain national park but traditional land use still continue here with grazing with sheep and cows and some forestry. About 20,000 cows and 150,000 sheep are pastured in the mountains with a surviving transhumance tradition. Despite its name, the Néouvielle reserve itself is not strictly ‘natural’. It is grazed by domestic livestock - we saw sheep on the drive up there as early as late May. There is also a hydro-electric scheme damming a glacial lake which had been created in the late 19th century.

Grazing levels. As in Central Balkans (see below) it is difficult early in the season to separate the effect of late snow cover and delayed vegetation growth from livestock. In this case we had the advantage of some exclusion plots (always a good idea as a visual demonstration of the effects, good or bad, of grazing animals). Grazing effects seemed significant (see photo) even at in early June. There appeared to be a strong chance of damaging levels of grazing on these high altitude and rare small peatlands but only more detailed monitoring across the grazing season would be able to tell and was the subject of the meeting with the National park staff. The control of grazing levels is seen as an important issue for the park, as elsewhere, and is sensitive given the traditions going back many years. Interestingly, grazing apparently has been ended in the Ordesa National Park.
Increased bare ground outside enclosure (to left)

**Lessons learned**

- Giving local communities an opt in to a national park buffer zone with its values is an attractive policy, but would need funding adequately.

- Grazing is essential for open habitats even at high levels. It is an issue everywhere, and to change long-established use requires effective demonstration by research effort of sustainable levels.
Burns Bog is the largest, southern-most domed peat bog on the west coast of North America, covering approximately 2,800 hectares of the Fraser River delta. It is considered the largest undeveloped urban wilderness in North America, 12 miles outside the centre of Canada's third largest city of Vancouver, in the suburb of Delta. An incredibly comprehensive Ecosystem Review ecosystem review in 2000 provides a fascinating scientific background to the site. It concluded that Burns Bog is distinct and unique on a global scale because of its morphology, chemistry, flora and large size. It has a much lower dome than European bogs considering the high rainfall and is chemically distinct from continental bogs because of oceanic influence.

About 2,000 hectares were purchased by the federal government, BC Province, Delta Corporation and Metro Vancouver. Delta and Metro Vancouver manage the Bog as an ‘Ecological Conservancy Area’ with the aim of restoring natural bog, ecological and hydrological processes. A Conservation Covenant was registered on the land title that ensures that the bog lands are maintained in perpetuity and managed as a functional raised bog ecosystem. A Management Plan for the Ecological Conservancy Area was completed in 2007.

I visited the bog in hot sunny conditions with Sarah Howie from Delta, Francis Buys and another Metro Vancouver colleague. We walked over the 2.5-4(-7.5)m deep peat dome through thinning lodgepole pine Pinus contorta into the open bog. I saw 1930s hand dug holes in the peat colonizing in places with water lilies and a Sphagnum edge, cranberry beds abandoned in 1998 starting to colonise with infrequent Sphagnum. Hand constructed blocks in the ditches

25 http://www.burnsbog.ca/
26 http://www.burnsbog.ca/conservation.html
28 http://www.corp.delta.bc.ca/
were holding back water and comprehensive non-automated dipwell monitoring was taking place.

Protected area

The bog appears well protected with staffing and organisations committed to its protection. There is also a recent proposal to submit for designation as an internationally important Ramsar site underway with associated land on the fringes. The nature of its urban setting (see air photo above) indicates that external influences will always be significant and there are a few threats, apart from water levels and invasives (see below), which are controversial or with the potential to affect the site.

A major threat is possibly the major infrastructure Gateway Project linking a major port development and improve Canada’s ability to trade with markets in the Indo-Pacific. The development includes the fought-over South Fraser Perimeter Road which runs along the northern perimeter of the bog with the potential to disturb the lagg zone, marginal land increasingly being recognized as important to ‘insulate’ and regulate the margins of the bog surface, as well as contribute pollution via nitrogen inputs to this ombrotrophic environment.

A very large (226 ha) landfill, owned by Vancouver and taking 40% of the region’s waste, is a major intrusion into the hydrological peat mass (see SW of bog in air photo). The tip is believed to have minimal effect (2007 Management Plan) but there are concerns about rubbish in the air (scattered plastic was present on the bog surface), methane (although some is recovered for energy) and possible leakage from the two-ditch (the inner ditch is pumped to treatment) containment system.

By effectively excluding most people from the main bog (but promoting interpretation and education at the nearby Delta Nature Reserve29) the harmful effects of fires and trampling on the delicate bog surface are minimized.

Ecological restoration

Hydrology. In the short to medium term, the restoration of the bog surface by restoring more natural hydrology is the primary task and recognized in the Management Plan:

‘The Scientific Advisory Panel believes that a focus on maintenance and restoration of healthy ecological processes is fundamental to the sustainable management of Burns Bog’

The bog has more than 110km of ditches, over five times the channel length of the 1930s before major peat exploitation. In this raised bog situation, the Ecological Review estimates these ditches have an effect at over 100m, verified here surprisingly by tree ring studies. This is considerably greater than we estimate on our UK blanket bogs where the effect of ditches on shallow slopes is considered to be no more than low 10s of metres. The net effect is that 38% of the bog is affected by drainage. Restoration efforts using ditch blocking have been concentrated on the public lands forming most of the bog surface and started in 2006. Capital funds of CAN$150,000 is estimated to be required to implement the ditch-blocking programme. The wetness of the site and delicate bog surface of at least the central parts appears to prevent more mechanised ditch blocking; the blocks I saw were done by hand with peat dug from adjacent pits, supported by wooden planks. Around the fringes, beavers are helping (see Attachment 4 in Management Plan) by making their own dams!

Where drainage has reduced water levels, significant vegetation change has taken place with expansion of lodgepole–salal Gaultheria shallon vegetation where the pine trees - normally stunted in undisturbed bog-

29 http://www.burnsbog.org/bog/
appear to have been given a new lease of life, maturing into large trees and new saplings emerging from the ground layer.

**Invasives.** Commercial cranberry beds on the bog surface, abandoned in 1998, have left large, rectangular lowered cuts with little *Sphagnum* but lots of potential. These, and blueberry cultivation around the periphery on drier ground, have left a legacy of introduced species including large cranberry *Oxyccocus macrocarpus* on disturbed peat and Highbush blueberry *Vaccinium corymbosum* in the extensive lodgepole pine-salal vegetation. The understorey of this vegetation resembles UK bogs with high cover of *Sphagnum capillifolium*, pleurocarpous mosses and dwarf shrubs although the dominants are salal and Labrador tea *Ledum groenlandicum*.

On drier ground where disturbance or drainage has had major effects, European birch *Betula pendula* is spreading into paper birch *Betula papyrifera*-salal vegetation. On the disturbed margins, such as along the power line, the ubiquitous Evergreen Blackberry *Rubus laciniatus* is a problem (but has deliciously attractive fruit) as is Scotch broom *Cytisus scoparius*.

**Lessons Learned**

- Restoration is focused on hydrological and ecological **ecosystem processes** which have been given **primary importance** from an early stage, in part by **detailed scientific understanding** (from the Review) and involvement of experts (via the Scientific Advisory Panel)

- The **integrity** of the **immediate surroundings** is important, in this case the habitat is the lagg.

- Full **control of management**, here by ownership, is critical in conserving such a fragile habitat.
Gulf Islands: first nations, deer and boats

The Gulf Islands National Park Reserve \(^{30}\) (GINPR) was established in May 2003 and lies in the Strait of Georgia between Vancouver and the southern tip of Vancouver Island in the southern Gulf Islands region of British Columbia, Canada. It is very similar to the San Juan Islands which lie on the other side of the US/Canada border south towards Seattle (see section x ).

The Gulf Islands (including the Park itself) zone has been almost entirely modified, before 1932, by agriculture and homesteading followed by forestry, agricultural and rural-residential development. The terrestrial landscape now is predominately a matrix of second growth forests (by 2002, almost 80 percent of the forest was logged), small pockets of mature and old growth forest, and development. The Park is made up of 3500 ha of land on 15 islands and over 50 islets, and 2600 ha of intertidal and nearshore subtidal marine areas. As well as the many islets, five complete islands are protected and on a few larger islands up to just over 40% is included. Outside the current National Park, acquisitions in a core area are seriously considered on a willing seller/willing buyer basis. In the

surrounding area the Provincial administration could acquire land but this is unlikely so a Land Trust\textsuperscript{31} is a more likely purchaser. The active approach to land acquisition contrasts strongly to England where the coalition government sought to divest the publicly owned and heavily cared for NNRs and forest estate, a decision recently reversed.

I met with Rob Walker the first day, toured the recently constructed ‘green’ GINPR HQ, attended a Parks Advisory Board meeting and met and gave a presentation to Park staff. The following day we toured Portman Island and Sidney Spit in a powerful boat to see some of the issues such as deer pressure, other invasives, midden sites, and discussed balancing objectives in managing Parks.

**Protected Area**

The Park is relatively young. The process to formally establish Gulf Islands National Park Reserve was completed in 2010 after being initiated in 2003 by the governments of Canada and British Columbia. The ‘Reserve’ part of the name reflects that unresolved First Nations interests exist and ongoing negotiations with First Nations are taking place at various levels. The Park is also tackling negotiations over 300+ third party interests (e.g. moorings and anchorages, First Nation culturally important middens), designating marine areas and amending regulations. A State of the Park 2003-2008 report\textsuperscript{32} has provided a start, whilst the Park is being managed under ‘Interim Management Guidelines’.

Parks Canada wish to reach out to urban Canadians but this is difficult with no NPs close major centres. Discussions are ongoing over Bowen Island, close to Vancouver, where islanders want park status to protect the land from development.

The Park have moved away from using contractors to employing staff this year and this has improved relations with the public as staff can be trained to handle queries and form an arm of the Park’s outreach programme.

**Cultural Heritage.** The Park has considerable involvement in, and high sensitivity to, cultural heritage with First Nations burial sites and human remains present, together with traditional uses of resources such as shellfish. There are also abundant middens (shell deposits), many of which are on the shore and subject to erosion from wave action (enhanced by boat use) and visitor trampling. A major survey programme has been completed (184 archaeological sites have been identified including culturally modified trees and homesteads) and the challenge is now to develop management strategies which can combine preservation, rehabilitation and resolving conflicts.

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\textsuperscript{31} For UK readers: Land trusts, also known as land conservancies, are charitable organizations committed to the permanent protection of lands with natural, recreational, scenic, historical or agricultural value. In Canada & US they can be local, regional or nationwide and most have charitable status

\textsuperscript{32} http://www.pc.gc.ca/eng/pn-np/bc/gulf/ne.aspx
Ecosystem Restoration

Aims & objectives. This Park appears to be the protected area most like a UK national park/protected areas, by virtue of the extent of human use. Similar issues include, for example, the priority to be given to wild versus cultural heritage features or the appropriate target state to restore. The development of explicit, stakeholder involved management plans or guidelines which are then acted upon are important. Ownership control over the land is of course a massive benefit over the UK experience but local decisions about objectives still occur. For instance, the same debates about objectives arise in a less-wild Park such as this. I saw the issue of reverting to pre-agriculture forest versus maintaining settlement-created clearings on Portman Island as well as some orchard restoration as a cultural legacy (although the decision had been taken not to maintain trees after they have died naturally).

Invasives. Scotch broom and Himalayan Blackberry (especially on Portman Island) are some of the major invasives and these are obviously ubiquitous in the Region (see Burns Bog also). Locally deer pressure can be extraordinarily high and on Sidney Island (Sidney Spit) introduced 1500 fallow and native black tailed deer have caused significant problems removing all understory. This is demonstrated by exclosures (see photo. of 1300 fallow on Sidney island but still residual high numbers On the c. 900 ha island, 1500 animals were thought to be present. Non-exclusive ownership of the island meant significant co-operation over a year long, highly organised and expensive control programme in 2008/9. It removed over 1300 deer, yet deer continue to be hyper-abundant with densities well over 100 deer/km². In some other national parks, densities of 1-4 deer/km² are used as a management target.

Lessons Learned

- Debates about priorities afforded to wild versus cultural heritage features can be resolved by clear and agreed aims, objectives and management guidelines
- Collection of good baseline data is invaluable as is a explicit monitoring programme and applied research
- Ownership control over the land helps in difficult management choices and allows managers to be confident enough to carry out mandated management to allow ecosystem functioning or respect ecological carrying capacity.
San Juan Islands: development and shorelines

31

The San Juan Initiative\(^{33}\), part of a west coast Ecosystem Based Management (EBM) Network\(^{34}\) focussing on community based initiatives, has now ended. The San Juan islands lie on the US side of the straight separating Vancouver Island from the mainland, in the Puget Sound inland sea (see map below). There are nearly 200 islands and they form the smallest county of the state, but with 650 km of shoreline and nearly 20 percent of the shoreline of Puget Sound. They are extremely attractive, heavily used for recreation and developed whilst being regarded as one of the best-functioning ecosystems on the US west coast. The area (including the Canadian side) supports the southern resident orca population, the only resident orcas in the contiguous United States.

I met Amy Windrope, co-ordinator for the Initiative on genteele Bainbridge Island across from Seattle and linked to the Olympic Peninsula mainland via a pontoon bridge.

The San Juan Initiative was a pilot effort to improve ecosystem protection in a manner that supports community values, respects property owner rights, and builds local capacity for ecosystem protection. A large group (22 members) of Council-appointed local citizens as well as federal and state agency representatives and tribes with resource management responsibility in the Islands oversaw the process. The project set out to assess the effectiveness of shoreline protection, particularly as affected by developments like rock armouring, boat facilities and shoreline clearance. Over 25 public workshops were held to engage land owners, real estate and construction industry professionals, and the general public.

\(^{33}\) http://www.westcoastebm.org/San_Juan_Initiative_files/shapeimage_3.png

\(^{34}\) http://www.westcoastebm.org/Home.html
Amy captured the project excellently stressing how it linked science, management and community, all essential elements of an ecosystem approach. The consultation started with blank sheet, but focussed down on critical issues through presentations on the science. It was then honed down into a few issues that could practically could be dealt with by the steering group. The consultation involving the local community yielded by far the best input, from groups that owned and worked in the shoreline zone, compared to the general public including visitors who swell the islands numbers massively in the summer. Like my experience on Exmoor, she found no substitute for one-to-one meetings to collect information about management issues. Planning inconsistencies, multiple permitting, differing interpretations from agencies involved and lack of compliance/enforcement were some of the surprising findings.

Amy hopes that the results are development of a more flexible approach, targeted to where protection is really needed like eel-grass beds and feeder bluffs supplying sediment to beaches, both of which form shelter and spawning grounds for young fish. This is quite critical as an estimated 1/3 of the total Puget Sound shoreline is occupied by over 800 miles of bulkheads and other hard structures. The project should also have yielded hopefully improved clarity and consistency, appreciated by regulators and residents alike, and now embedded in the regulatory system.

Protected area
There is no National Park here like on the Canadian side. However in San Juan County voluntary marine protected areas for eight species of fish and southern resident killer whales have been established through citizen action via the Marine Resources Committee. Work here on ecosystem functioning was also very relevant to the new marine protected areas being established in the UK. In 1990, the Washington Department of Fish and Wildlife and the University of Washington established five small marine reserves in the San Juan Islands of Puget Sound. They took this action to protect marine biodiversity and to provide undisturbed habitats for scientific research in a region heavily affected by fishing. A decade later, studies show that the San Juan Islands Marine Preserves contain larger and more plentiful fish than unprotected areas. Production of young fish is much greater in the reserves, because both the number and size of fish are larger.

Lessons learned

• Talking one to one with users and residents is a key step in restoration projects
• Thorough research helps provide basis for firm conclusions particularly where they may have significant commercial or other effects
Washington State forests: giant trees, owls and woody debris

The Pacific North West appears to be dominated by two rural industries, forestry (up to 20% of employment on the Olympic Peninsula until the 1980s), and salmon. My visit to Washington State illustrated, like on Vancouver island, the hugely controversial issues of these forests: old-growth forest protection and sustainable management of forests. Over half of the State is forested (see map below) mainly on the Olympic Peninsula and along the Cascades Range. Rainforest on the Pacific coast receives 4445 mm rain per year (twice what Exmoor’s blanket bog receives) and areas in the rains shadow on the eastern side of the State only 470mm. The semi-desert threshold is usually considered to be 400mm!

Washington State illustrates the complexity of forest protection and management (see map). Federal forests (3.84 million ha) are managed, by the National Parks Service (0.404 million ha), most by the US Forest Service as National forests (3.237 million ha), with smaller areas of c 24,000 ha by the Bureau of Land Management, Department of Defence or US Fish and Wildlife Service. Native American tribes manage 688,000 ha. State Forests (nearly 1 million ha) represent c. 13% of forests and form an outer ‘ring’ around the inner ring of national Forest surrounding the Olympic National Park (see NW part of map above). About 10% of State lands, which are held to provide revenue for public spending on education etc, is specially protected as State Parks for recreation or as forested conservation or wildlife areas. Private forests represent about 4.7 million ha with half of this is managed industrially, but generating 73% of all timber.

From Statewide Forest Resource Assessment & Strategy For Washington State. Washington State DNR (June 2010)
Ecological restoration

Old-growth. The unique confluence of climactic and soil conditions makes Western Washington trees grow quickly, to enormous proportions and to extraordinarily long-lived ages. Some trees are 1,000 to 2,000 years old. Numerous trees in Olympic National Park have been recognized as national champions for their overall size, including the 18-foot diameter, 191-foot tall Sitka spruce the Quinault Lake Spruce (see photo). This area also holds ‘Miracle Acre’, a grove of 350 years old 85m tall Douglas firs with the largest biomass of any stand in the Pacific NW.

A considerable amount of old growth was lost on the Olympic Peninsula in the 1970s and 1980s as a result of timber harvest activities on private, state, and federal lands. The majority of native forests in the northern part outside the National Park were harvested in the 1920s and 1930s and very little old-growth forest remains there. State trust lands were harvested from the late 1960s to the late 1980s, including old-growth and continued until the listing of the northern spotted owl in 1990. Forests in those landscapes are currently a mix of young managed stands (15 to 40 year old), forest stands that regenerated from the 1921 windstorm, and existing old-growth. Since 1990, habitat losses substantially reduced because of spotted owl conservation policies and other state and federal regulations.

In Washington, about 88,000 ha is estimated as probable or potential old growth. Nearly two thirds of this is on the Olympic Peninsula within the Olympic Experimental State Forest. Two declining species, the Northern
spotted owl and the marbled murrelet, are particularly characteristic of old growth forests. A considerable effort has gone into defining habitat for spotted owl with current work revolving around mapping ‘Structurally Complex Forest’ stands in particular later stages where this is undergoing niche diversification or has become ‘Fully Functional’ - see late stages of development in diagram below. These stands have coarse woody debris, cavity trees, tree litter, soil organic matter, and diversity of forest floor plant communities are evident, as well as the wildlife that use this type of habitat. Multiple canopies of trees are present. Large and small trees have a variety of diameters and heights. The Fully Functional forest has large-scale habitat elements such as rotting, fallen trees, or “nurse logs,” onto which trees and other vegetation grow.

**Sustainable forestry.** My impression of areas of commercial forestry was that ecosystem limits appear to be exceeded, possibly also in State forests where cutting is permitted, particularly in respect of soils and compaction, biomass removal and damage from tracks/roads. Although not as severe as the forests I saw on Vancouver Island, where up to 20% of the forest is affected by road creation and brash is bulldozed into large piles and burnt so it doesn’t affect replanting density.

![Large-scale river restoration, Quinault River](image)

**Debris.** Salmon are big business here and riparian strip retention is largely enforced even in commercial forests, although not necessarily at optimum width for biological functioning. In some flood plains massive funds have been spent on introducing large debris in river restoration schemes. On the Quinault River a major scheme\(^35\) has begun with $1.2 million spent creating ‘engineered logjams’ to halting the erosion of remaining spawning habitat for a sockeye salmon population. This science-based habitat restoration plan has been led by the Quinault Indian Nation (QIN). Creating these ‘islands’ will encourage sediment retention, increase the roughness of the river and initiate forest development. Side channel creation and initiating the replacement of red alder with conifer forest are also part of the scheme. The scale was spectacular and not obvious from the photo, with 10-15m piles driven 5m deep into the sediment, massive logs cabled in and trees planted on the top.

**Fire.** Not forestry, but a quick look at Mima Mounds Natural Area Preserve\(^36\) illustrated the problems with changes in fire frequency. It is a stunning c. 300 ha isolated native prairie remnant with mysterious, regularly spaced six to eight foot tall mounds. Their origin is unclear despite many possible explanations. They were probably kept open in the past by fire by Native Americans to maintain the abundance of camas bulb, as other prairies were. Trees and scrub are establishing on these remnants as fire has declined and the delicate soils present particular challenges in getting material off (helicopters have been used).

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\(^{36}\) Established in 1972 by Washington State by the Natural Areas Preserve Act. The system of Natural Area Preserves was to protect highest quality examples of native ecosystems and rare plant and animal species – as well as other natural features of state, regional or national significance
Lessons learned

- **Retention of ecosystem processes** are very important, eg. in forests old-growth, in rivers the retention of woody debris

- **Ecosystem limits are necessary** to avoid damage from commercial exploitation.

- **A species approach not sufficient** to maintain habitat if natural or driven declines result in local or regional extinctions

- If a strong enough **economic interest can be integrated with protecting biodiversity**, major funds can be raised for habitat restoration
Mount St Helens: lupins and lava

This area, one of a series of active volcanoes in the Cascade range including Mount Rainier and Mount Hood and has a long history of management as a forest ‘preserve’ from 1890 and in the Gifford Pinchot National Forest. However this did not spare it from extensive clear cutting of virgin forest with extensive road network, railroads and some mining. Pressure to bring the area into a monument or scenic preserve started in the 1960s, gathered pace with small victories, but failed to achieve wilderness status. The 1980 eruption led to renewed calls for an enlarged monument, which triumphed over timber interests nearly two years later with President Reagan establishing a 44,500 ha National Volcanic Monument.

May 18th 1980, after a few months of activity, ended 123 dormant years with a cataclysmic eruption. The northern side of the volcano was blown out with a huge landslide (the largest in recorded history) and lateral blast; pyroclastic, debris and mud flows swept down. The ash column formed a 72km wide mushroom cloud and ash circled the earth, giving rise to worldwide cooling estimated at c. 0.10 °C. The eruption destroyed 388 km² and damaged 595 km² of forest; 8 km of land to the north was buried under 150m of rock and debris.

I stopped here on the way down to Oregon from Northern Washington. I hiked a trail in the SW of the Monument from Blue Lake to the South Fork of the Toutle River and went on a short guided walk from the Johnson Ridge Observatory.

Protected area

The Monument was established to preserve the volcano and allow for its aftermath to be scientifically studied. Resisting a natural desire to want to interfere with the recovery, this appears to have
been achieved. The Monument is administered by the US Forest Service - part of the US Dept. Of Agriculture. This has led to budget constraints due to reduced logging production and increased costs of fire-fighting leading to dramatic reductions in funds for maintenance of facilities. There is a current campaign and debate to make the area a National Park so that the area would get more money, upkeep and promotion.

**Ecological restoration**
The Park illustrates the importance of giving natural processes a high priority and I think the value of this type of natural laboratory cannot be overestimated. It also shows how impressive natural recovery can be if we accept longer time scales than would normally apply. In the UK we saw this at a small scale after the Great Storm of October 1987 and January storm three years later, where a rush to clear up of fallen trees was proved unnecessary as a substitute for natural regeneration.

![Blast zone above Toutle River](image1)  ![Dead trees at edge of pool created by mudflow](image2)  ![Unaffected old-growth forest](image3)

**Lessons learned**
- **Intervention in restoration is not always necessary**, nature can achieve impressive change give sufficient time
- Speeding-up restoration can be initiated by a bottom-up ecological process approach eg coarse debris introduction
The Willamette Valley in North-western Oregon lies between the Cascade Range to and the forested Coast Range mountains. The fertile soils and good climate have allowed agricultural expansion since European settlement and more recently, significant population and industrial growth centred on Portland in the North. The Willamette River and its tributaries represent the 13th largest river in the contiguous USA. The entire river basin includes huge land area, a population of around 2.5 million, and around 75 percent of Oregon’s economic activity. I visited the State to talk to the Willamette Partnership and to meet the US Fish and Wildlife Service to discuss measures they are taking to restore wildlife outside protected sites.

**Ecosystem Services and the Partnership**

The Willamette Partnership[^38] is a non-profit organisation seeking to bring together partners to change how the environment is valued, managed, and regulated. The Partnership includes a diverse grouping of conservation, city, business, farm, and science organisations, including for example the wastewater management company for the Tualatin River Basin, the Oregon Business Council, NGOs such as Defenders of Wildlife, some private companies such as a real estate development company, a community volunteer organisation action, local law firms, and the state’s universities. I met Devin Judge-Lord, who explained the general approach, and after a working lunch, toured a site with Bobby Primovich.

The project emerged out of wetland mitigation ‘banking’ but has expanded to using other types of interventions, including buying restoration on private lands by transferring credits accumulated by mitigation required elsewhere in the catchment. It is an investment scheme rather than

[^38]: http://willamettepartnership.org/
a funding one (these already exist) which is standards-based. A highly sophisticated system has been built around existing wetlands, salmonid habitat, prairie habitat and riparian habitat tools (with more to be added) and including project tracking, verification of standards and monitoring. Close high level stakeholder engagement is a key feature.

I toured a site to see typical riparian strip planting showing how new habitats can be created in intensive agricultural systems on a significant scale, associated with the river corridor. The scale of planting is such that contracts for commercial supply of trees have led to new businesses being set up helped by facilitation of the project.

Lessons learned

- **Being part of an existing scheme can represent a minimum standard or an eligibility criterion**

- **Additionality needs to be assured** otherwise there are no net benefits

- **Long term** contracts are seen as essential

- Other agencies including voluntary bodies can develop a role as verifiers, monitoring or stewardship (=care and maintenance)

- The regular high level stakeholder group was presented only with decisions by co-ordinators rather than acting as a talking shop

Baskett Slough NWR wetlands and uplands

The Willamette Valley National Wildlife Refuge Complex, made up of three National Wildlife Refuges (NWRs) including Baskett Slough, was created in the 1960's to provide wintering habitat and sanctuary for the dusky Canada goose and other waterfowl and migratory birds. Unusually for North American geese, Dusky Canada geese nest on Alaska’s Copper River Delta and winter almost exclusively in the Willamette Valley. Habitat loss, predation and hunting have caused a decrease in populations. The three refuges also protect some of the last remaining historically abundant habitats and plants in the valley such as wet prairie n vesper sparrow. Outside these sites it is an area which resembles parts of eastern England in the mix of arable farmland and settlements, with little habitat remaining for wildlife. I met USFWS staff in Portland and had a brief introduction to their work, followed by a visit to Baskett Slough NWR and a tour of some restoration sites.

39 http://www.fws.gov/WillametteValley/Baskett/index.html
**Baskett Slough.** This is the most northerly of the three Valley refuges and includes 100 ha of farmed fields, rolling oak covered hills and shallow wetlands. Through cooperative agreements with local farmers, refuge fields are planted to grow ryegrass, fescue, corn and pasture mixes as preferred food for wintering Canada geese. During the winter months thousands of geese feed on the planted crops. These farming operations help reduce off-refuge crop damage by migratory birds. There is also a program of restoring croplands to native habitats. This process, which takes a number of years, includes clean-up of the fields of weeds and residual crops, site preparation for planting of native species and maintenance of the developing habitats.

**Partners for Fish and Wildlife.** This scheme in the Willamette Valley focuses on restoring oak woodland, grassland, riparian, wetland, and wet prairie habitat and at risk species which depend on them. These declining habitat types support unique and significant biological diversity and are primarily in private ownership.

The suppression of fire following European settlement in the Willamette Valley has dramatically altered oak woodlands and savannah. The refuge complex is selectively restoring these areas by removing invading Douglas fir trees that will eventually overtop and shade out the oaks. In addition, oak trees and shrubs are thinned in order to maintain an open grassland understory. Most treatment areas are selected to provide benefits to threatened and endangered plant species.

**Lessons learned**

- No substitute for **knowledgeable, helpful people on the ground long-term** to achieve acceptance and influence.

- **Multiple tools** help give landowners choice of restrictions/level of involvement

- Owned areas give control and allow messages to **spread out of protected areas as the change becomes accepted**
Montana prairies: dog towns and ferret camp

Bison on APF Reserve  UL Bend Prairie dog town  Dry short-grass prairie & bison

In northeastern Montana American Prairie Foundation\textsuperscript{40} (APF) is involved in a major effort to protect prairie that once dominated central North America by assembling a million+ ha wildlife reserve. Called the American Prairie Reserve and currently c. 49,000 ha, the APF is acquiring further private land. Linking this land with publicly owned grasslands (see map below) will create the largest wildlife reserve of any kind in the continental United States, assuming that unified management links the different ownerships.

I spent 3 days in Montana at the APF Prairie Reserve, visiting the UL Bend National Wildlife Refuge (part of Charles M Russell National Wildlife Refuge\textsuperscript{41}, CMR NWR) to learn about prairie, participate in the autumn black-footed ferret survey and tour other parts, including Fort Peck Reservoir & dam and the Elk Viewing Area. Just getting there was some achievement with a long drive from Bozeman across dull, cultivated prairie into Montana ‘breaks’ territory which has highly eroded, badlands topography and a limited network of gravel and dirt roads. These dirt roads are impassible in wet weather, due to the "gumbo". This soil is extremely thin and on dirt roads when wet it clings to anything it comes in contact with, including tyres of vehicles. Apparently it is caused by bentonite in the soft sedimentary rocks that outcrop throughout the Breaks. Three days before we arrived the area had a large unseasonal downpour leaving most roads impassable, but we just managed to get to UL Bend in a 4x4.

Protected area

Part of the public lands which link geographically to the APF reserve is the CMR NWR, a 4,450 km\textsuperscript{2} reserve (a little larger than Somerset), and the Upper Missouri River Breaks National Monument (1,530 km\textsuperscript{2}) created somewhat controversially by President Clinton 10 years ago at the end of his Presidency. Local fears of declines in grazing opportunities and economic declines stirred a considerable anti-campaign. Things have quietened down now to the extent that there is a ‘friends’ group. However, I witnessed a reprise of this in advance of a

\textsuperscript{40} http://www.americanprairiereserve.org/
\textsuperscript{41} http://www.fws.gov/cmr/
visit by a politician about a similar but larger monument possibly being created from State lands in the local area. Local vehement expressions of disapproval were displayed on the route through the small town of Malta (see pic). The attitudes of local farmers very much resemble those of the older farming sector I have been working with on Exmoor. Their livestock and farming skills are great but the isolated nature of the communities and the resistance to change means that new ideas and approaches take some time to come through. Progress made in sharing understanding of modern environmental goals can quickly be set back by proponents of anti-state influence stirring up antagonism. Employing farmers directly in conservation enterprises helps with appreciating the local culture and problems. But providing overall goals are shared, making economic and practical links with younger farmers, who are more open to ideas, is a good strategy.

Reserve v. domestic grazing. Part of the sceptical attitude amongst locals is that there will be negative economic impacts from loss of grazing as well as associated retail sales and that conservation groups as well as non-resident buyers are replacing family-oriented farms with absentee owners, who contribute little to the locality. APF research appears to show that regional economic impacts of eliminating cattle grazing on the proposed reserve would be offset by conservation management expenditure. This is not accepted by the locals, it appears. An open and participative ecosystem services analysis could perhaps demonstrate whether the economic benefits of conservation activity are justified. An alternative approach to developed prairie restoration locally is being taken by the Nature Conservancy \(^{42}\) manages the 24, 280 ha Matador Ranch north of the CMR near Zortman, Phillips County. The ranch is leased out to local farmers at discounted rates, and they agree to take certain conservation actions on their own grazing land in exchange. As part of the partnership, they protect prairie dog colonies and sage-grouse leks, control invasive plants and agree not to plough their grazing land during their leases.

Ecological restoration issues

Large-scale processes: Large areas of native prairie are needed to sustain both the ecological processes, perhaps insulated from farming activities, to adequately support keystone species such as bison and prairie dogs and the associated ecosystem with its ferruginous hawks, burrowing owls, sage grouse, larks and wildflowers.

Keystone species. The UL Bend prairie dog town is c. 400 ha which seemed impressive as we drove along a dirt road to ‘Ferret Camp’ where , is being studied. Prairie dogs were once common but are considered as a pest by

\(^{42}\) http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/montana/placesweprotect/matador-ranch.xml
farmers and have disappeared by poisoning, recreational shooting and destruction of habitat by tillage, together with more recently epizootic of sylvatic plague (transmitted by fleas and the same bacteria, *Yersinia pestis*, as bubonic plague) which was introduced into North America after 1900. Prairie dogs are considered a keystone species of the Great Plains in that their colonies support up to 30 other species. They form prey for other charismatic animals such as ferruginous hawks and black footed ferret (BFF). Their burrows support burrowing owl and BFF. Nutrient cycling, plant species and vegetation structure is altered by their presence.

**Reintroductions.** The BFF is the the rarest land mammal in North America. Populations of declined throughout this century to near extinction by the late 1970’s for the same reasons as the prairie dog, plus the canine distemper. Large complexes, probably several thousand ha, of prairie dog colonies are required to maintain sustainable, breeding population of Black-footed Ferrets which prey on prairie dogs and utilize their burrows for shelter and denning. It has been estimated that about 40 60 hectares of prairie dog colony is needed to support one Black-footed Ferret, and females with litters have never been found on colonies less than 49 hectares.

A small remnant population of c. 100 animals or less was discovered in 1981 near Meeteetse, in northwestern Wyoming, but was decimated by canine distemper and plague. Eighteen black-footed ferrets were captured 1985-1987 to start a captive breeding population. More than 6,000 black-footed ferrets have been born in captivity and since 1991, ferrets have been reintroduced at sites in eight Western U.S. states including here at UL Bend. The species is listed on CITES Appendix I and in listed in the U.S. Endangered Species Act.

### Lessons learned

- **A diversity of approaches** may be warranted, with different levels of intervention or control over land, to combine achieving major landscape level change with bringing communities on board

- **A wider acceptance of conserving ecosystem processes and keystone species**, such as the prairie dog will be needed to extend the approach beyond inevitably limited

- **Long-term research** is essential to understand biological systems and interactions

- **Isolated farming communities** may need **different approaches**, because of resistance to change
Grasslands are one of the world’s most threatened ecosystems. North American tall-grass prairie (rich soils and adequate rainfall) has been reduced to 1%, and mixed-grass and short-grass prairie (poor soils and lack of rainfall) to 20-30% of their former range. In Saskatchewan, 17-21% of original native prairie remains intact. The Northern Great Plains ecoregion containing these grasslands extends from Canada down to Nebraska (see map with locations of some protected areas.

Grasslands National Park[43] was established in 1981 after a protected area in SW Saskatchewan was mooted since the 1950s. Following disputes between the two levels of government over oil and gas exploration, and water management, a 1988 Federal-Provincial agreement proposed a of c. 920 km² Park (slightly smaller than Dartmoor NP) in two blocks (see map below).

The Park represents prairie grasslands in the Canadian National Park system. Just over 60% of the proposed Park extent has been acquired to date in a patchwork with parcels ranging from 3-204 km². The Park is a mixture of native prairie, previously Provincial owned but leased out for grazing, and purchased land usually tilled.

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I stopped in the Parks Canada local HQ at Val Marie, a tiny Prairie town just over the Canadian border from the the middle of nowhere in NE Montana. I walked through some badlands on a trail overlooking the Frenchman Creek valley and briefly met Rob Sissons, a Park ecologist to discuss prairie restoration. I also drove along the Frenchman River Valley Ecotour, a self guided drive into the heart of the West Block. I did not dare not get out at the prairie dog town in case I was carrying any fleas from UL Bend! The next day I met Professor Cormack Gates at the University of Calgary to talk about stakeholder relationships, losses of prairie, sage grouse and oil & gas development.

Protected area

**Land acquisition.** The land the Park wishes to acquire -it currently owns c. 60% -is explicit and set out as part of its establishment. It is public knowledge and is coupled with a ‘willing seller – willing buyer’ approach to acquisition. Land that is bought is sometimes let back to the farmer for a limited period to ease the transition and to help restoration, but with the unambiguous intention of removing it from commercial grazing management.

**Ecological restoration**

**Natural processes.** in mixed-grass prairie, droughts associated with the semi-arid continental climate have been the most severe natural process, with floods, wildfires and grazing helping to generate further diversity of ecosystem structure, function and composition. Wild fires ignited by lightning and aboriginal peoples occurred almost anywhere and anytime outside the winter, while sedentary and migratory herds of bison added variable patterns of grazing intensity, duration and frequency across the region. European settlement has, in a very short period of time, threatened ecosystem integrity through cultivation, species losses, wild fire suppression, alien species invasions, and altered grazing regimes.

**Clear objectives.** Management of the NP is set out in a recent management plan[^1]. One of the central aims is to restore ecological processes at the landscape-level for ecological integrity and this then places importance on the role of burning and grazing. Burning is seen as a key part of management of ungrazed prairie in the absence of natural fires with a target of at least 75 hectares/year. As land was acquired in the 1980s, domestic grazing was stopped. Subsequently domestic grazing by permit has been resumed as a temporary measure until native bison grazing can replace it but at the same time a major research programme is looking at its value for restoring diversity (see below). The Plan’s objectives lead to ambitious targets for restoration, for instance 30-40 ha per year of the remaining previously cropped land by seed collection and spreading.

**Invasives.** Much deeded land had been cultivated or sown before with species now considered serious invasives of prairie like crested wheatgrass *Agropyron cristatum* and smooth brome *Bromus inermis*, and these

have also spread to adjoining native prairie. A significant programme of controlling invasives by herbicide, allowing grazing to reduce their vigour and controlled burning occurs.

**Structure and functioning.** The Park has a significant role in the reintroduction of the only Canadian colony of black-footed ferret, into a 200 ha black-tailed prairie-dog town. This will be insufficient in the long-term (see Montana) so promoting prairie dogs towns and sympathetic management of the surrounding private and other prairie lands will be needed.

**Adaptive management.** Intact northern mixed-grass prairie outside the Park is grazed at moderate to high intensity for beef production, limiting its wildlife value. Ungrazed prairie, since abundant native large grazers have gone, in protected areas are also thought to be less diverse. As with other grasslands, intermediate levels of disturbance often promotes diversity. Combined with the lack of other disturbance such as fire, the lack of native grazing animals makes it difficult to assess the prairie’s value under pre-European contact conditions. Bison may have grazed it very intensively for short periods of time and then left it ungrazed for very long periods of time, in between fires. As part of the goal of restoring grazing-induced heterogeneity in mixed-grass prairie the park introduced 72 bison in 2006 with numbers now around the 160s. A long-term goal is to have a self-sustaining herd of bison perhaps numbering a thousand, but only with consolidation of fragmented land holdings and amalgamation of grazing blocks. In 2006 the Park instigated a major long-term project to study the effect of different grazing treatments in the East Block Grazing Experiment. Grazing intensity and pattern change in many different grassland and wildlife indicators will be studied, with significant collaboration with academic institutions. This sort of research should help to inform native prairie management on both sides of the border and may be very useful in guiding appropriate grazing of the majority of prairie outside NP land which is leased land (to graziers) under Federal or State/Province control.

**Lessons learned**

- **Ambitious goals can be achieved** by a series of smaller steps providing quantitative shorter term targets are planned for
- **Ownership control is very helpful** to restoration of a large-scale ecosystem
- **Focused research** is vital to help adaptive management and the earlier started, the better

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45 http://www.grazingbiodiversity.org/
The world’s First National Park\(^\text{46}\) designated in 1872 with an area of 8,987 km\(^2\) (twice the size of Somerset) to incorporate most of the then known geothermal activity. It is considered part of a larger Greater Yellowstone Ecosystem\(^\text{47}\) amounting to 16,000 km\(^2\) ostensibly based on the range of grizzly bears, including five National Forests, the National Elk Refuge and the Grand Teton National Park (see map left).

I made an unscheduled detour from my trip to the Montana Prairies to the north-eastern corner of the National Park with a one day hike along Specimen Ridge above the Lamar Valley bracketed by two very cold nights, and met Lyn and Brian Chan, both working for the National Park.

\(^{46}\)http://www.nps.gov/yell/index.htm
\(^{47}\)http://www.greateryellowstone.org/
Protected area

Wilderness experience. Encountering big animals like elk and bison is dramatic but very soon for me became distasteful, with people jumping out of cars parked willy-nilly and getting too close to the animals. This ‘front-country’ experience demands considerable interventionist management and education to avoid habituation and accidents involving both cars and humans. It is the experience of most visitors and as visitor numbers increase causes more problems for the Park, but to me considerably lessens the wilderness experience. The contrast with a ‘back-country’ hike was phenomenal. One hour from the road, I came across a 300+ bison herd, grazing freely in a bowl of grassland and wetland surrounded by snow-capped mountains, and I found myself (too) close to a bull bison and a pronghorn. It is difficult to describe how great the spiritual refreshment this gave me, but even for a non North American it evoked a strong feeling of how the first pioneers must have felt.

Ecological restoration

Ecosystem processes and species recovery are intricately interwoven at Yellowstone. The reintroduction of the wolf in the mid 1990s has had a significant effect on the numbers, distribution and behavior of elk, their main prey, and may have effects on habitats via a ‘trophic cascade’. The recovery of plains bison here is no doubt has had major ecological effects. At historic previous abundance levels, it has been described both as a keystone species and at the landscape level, as an ecosystem engineer (see American Bison plan48), responding to, and creating heterogeneity. I saw the effects of bison dunging, lying and foraging creating regeneration niches for seedling establishment and short turf suitable for other species.

The plains bison declined from probably tens of millions prior to European settlement down to 200 at the turn of the 19th century, with the last free-ranging herd at Yellowstone. Recently estimates of 20,500 animals in North American conservation herds are paralleled by up to 430,000 in private commercial farmed herds. Yellowstone now has c 3, 600 bison and they range outside the Park in the winter to the north and west. Their conservation is governed by their own management plan which is needed, despite being a free-living herd, partly because of the presence of brucellosis and its risk to the livestock industry.

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If native ecosystem restoration is to be achieved with ecological processes intact including animal movements and predation, large bison populations will be needed across extensive landscapes. Even in the huge Greater Yellowstone Area, bison range into areas outside protected landscapes with diverse land-use and ownership. Conserving the wild character and genetic diversity of animals in the presence of commercial herds is another challenge and cannot be done in isolation within protected areas.

Lessons learned

- Aims of re-establishment of populations of large native animals could be as much for **effect on ecological processes** as their value in themselves.

- **Ecological restoration planning is a dynamic process**, best achieved incrementally following an ecosystem approach involving biological and social elements, engaging stakeholders, considering economic conditions, and **cultivating long-term partnerships**.

‘The implementation of an ecological restoration project does not guarantee its objectives will be attained or its goals achieved. Outcomes of restoration projects involving complex systems can be unpredictable. Restored ecosystems are dynamic and require evaluation over many years.’

*American bison Status Survey and Conservation Guidelines 2010, IUCN*
Rockies: large animal crossings and fossils

Banff National Park was Canada’s first national park in 1885 and the third in the world (after Yellowstone, and Royal in Australia). It is part of the Canadian Rocky Mountain Parks UNESCO World Heritage Site which also includes Jasper, Kootenay and Yoho National Parks, together with three provincial parks in BC. It also subsumes the previous World Heritage Site of the Burgess Shales, a quarry of Cambrian fossils which has been called the world’s most significant fossil discovery. With Waterton Lakes NP, the five national parks protect more than 12 percent of the Canadian Rocky Mountain region’s area (see map).

The park has more than three million visitors each year, 8000 permanent residents, and has three ski areas. It is bisected by the Trans-Canada Highway (TCH) (and the Canadian Pacific Railway) Canada’s Pacific Gateway project (which includes the South Fraser Perimeter Road on the edge of Burns Bog), seen as vital to the Canadian economy by facilitating global supply chains between North America and Asia.

After a 10 hour guided hike up to Walcott Quarry in Yoho National Park with the Burgess Shale Geoscience Foundation, the next day I toured crossings on the TCH with a road engineer and Alan Dibb of Parks Canada. We then drove across Kootenay National Park to look at other crossing plans and fire effects on my way to Radium Hot Springs and west to Vancouver.

Protected area


50 http://www.burgess-shale.bc.ca/
The 2000 Canadian National Parks Act states that the National Parks ‘...shall be maintained and made use of so as to leave them unimpaired for the enjoyment of future generations’. It also states that maintenance of ecological integrity through the protection of natural resources shall be the first priority when considering park zoning and visitor use in a management plan. This is a useful policy statement which puts ecological integrity as central, not always the case.

Ecological restoration
Canada’s Rocky Mountain front has the richest diversity of large mammals remaining in North America. It is among the continent’s last remaining undisturbed natural areas, and provides an important landscape link with the United States. The grizzly bears in Banff and Yoho National Parks are part of a regional ecosystem called the Central Rockies Ecosystem (see map above), which is experiencing intensive exploration and development of coal, oil and gas, cattle production, timber harvesting, housing and highway development, and outdoor recreation.

American national park. In response to high and rising traffic volumes and economic pressures, sections of the Trans-Canada Highway (TCH) have been upgraded from a two-lane to a four-lane divided highway (‘twinning’) in Banff National Park and more recently in Yoho. Future plans are being developed for the Highway 93-South road to Radium in Kootenay NP. It is a clear negative influence on maintaining ecological integrity of the park ecosystem, which is Parks Canada’s mandate, as set out in the Management Plan\(^{51}\) (approved 1997, amended 2004).

In order to attempt to protect wildlife which was being isolated by the road and suffering significant casualties, the construction of wildlife crossing points began in the mid 1980s east of the Bow Valley Parkway. A series of 11 underpasses were built with a 2.4 m high fence along each side of the highway. Overpasses were mainly open span cement bridges (costing CAN $300,000). Underpasses were about six times cheaper. The next stretch in 1997 involved two wildlife overpasses and 11 additional underpasses with overpasses each costing $1.85 million! Fencing was also upgraded to include a buried apron to prevent animals from tunneling under the fencing.

Large scale and long-term research is needed to determine whether mitigations are reducing risks of road-related mortality of wildlife, improving the permeability of the highway for all organisms, and providing for the long-term sustainability of populations in the area. World leading studies have been carried out here dating from 1996, when research began to show that the underpasses were very effective for elk, deer and coyotes, but that large carnivores like wolves, cougars, black and grizzly bears were reluctant to use them. This research that led to the building of two overpasses during the second phase. The scale of casualties is large even

\(^{51}\) http://www.pc.gc.ca/pn-np/ab/banff/docs/plan1/plan1a.aspx#bnpplan
including mitigated sections of the TCH. Since 2005, there have been 57 large carnivore mortalities, 45 medium-sized carnivore mortalities and 428 ungulate mortalities on roads. However animal use increases with time, proving their effectiveness, as habituation occurs, before use levels off.

The new section I visited involves spending nearly a third of the budget on reducing the negative impacts of a larger highway. The merits of this expensive approach are being considered on a stretch of the Kootenay National Park highway, although funding is an issue.

Lessons learned

- **Fragmentation can be very serious** but is only obvious where large animals (and humans where roads are involved) are involved

- Restoration of animal passage across boundaries can be extremely **expensive to remedy**

- Large crossing structures are possible and will be used by animals quickly after establishment but the inevitable fencing required can be visually oppressive
Conclusions

The closeness of many of the fundamental principles of the ecosystem approach to my thinking - as an ecologist with a science background - made the idea of a Fellowship on the ecosystem theme very attractive. However this means it is difficult to rule out that the lessons I have learned do not just reinforce my preconceptions/views. This is particularly tangible with the impact of large mammal (bison) grazing and the role they have in prairie grassland or the mosaic of habitats in Yellowstone. This could be considered to parallel the approach of managing open heathlands in the UK via domestic grazing in the absence of native graziers (except red deer), which forms part of my work in Exmoor National Park with Sites of Special Scientific Interest (SSSI). The fundamental differences are of course many, not least derived from ownership, which means conservation can really be the primary purpose of North American parks.

Of course the sheer scale of the land helps thinking at an ecosystem level across administrative boundaries. The home ranges or seasonal movement habits of such large animals as grizzly bears or bison mean that even Yellowstone needs agreements outside the protected area. And of course serious agreements may be needed to guarantee political support (e.g. the Memorandum of Understanding for the Northern Sage Brush Steppe Initiative – signed by Alberta, Montana and Saskatchewan agencies) when the chips are down. A pinnacle of achievement may be near to being reached in parts of the Prairies and Yellowstone where new thinking introduced incrementally has allowed individual parks to start reassembling natural ecosystem processes (as opposed to continuing with interventionist management such as elk harvesting) via recovery or introduction of keystone species such as bison and predators such as the wolf.

Ecological Integrity

One of the key ecosystem approach principles is ecological integrity. That this should have precedence has not always been clear such as in the debate about logging old-growth forest. A good example of it been given high priority is in Canadian National Parks. It is now a core principle and built in to standing guidance\(^{52}\) and is incorporated into all management plans. In part its origin was a panel investigation into disputes about the amount and nature of development in the Bow Valley area close to Banff town, in Banff National Park. The recommendations, included in the April 1997 Management Plan, were that ecological integrity was the number one priority, established measurable ecological integrity indicators and set the framework for limits to development. Ecological integrity in the Canada National Parks Act means “...a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes.”

Adaptive management

This is an important principle and which is commonly used in ecosystem based management. Of course most of us would say that we use this approach in any case, but often we base our management recommendations on our perceptions, personal experience, or anecdotal interpretations of management practices. The recent movement to base decisions on evidence-based assessments of ecosystem responses (see Centre for Evidence Based Conservation), which originally came from approaches to systematic reviews, is very relevant. It echoes cogent arguments for the use of randomised trials in policy making (see Ben Goldacre\(^ {53}\), The Guardian). The development of more robust and consistent grazing management recommendations on prairies such as the large-scale grazing experiments in Grasslands National Park are a good example. There is no substitute for

\(^{52}\) http://www.pc.gc.ca/eng/progs/np-pn/ie-ei.aspx

\(^{53}\) http://www.guardian.co.uk/commentisfree/2011/may/14/bad-science-ben-goldacre-randomised-trials

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proper trial, error and monitoring. It can be expensive and takes time, features which prevent it being adopted widely in financially squeezed organisations or poorly resourced countries.

**Stakeholder involvement**

Genuine dialogue is necessary as part of the planning process of restoration projects and this can be done via the management planning approach or through existing institutions. The structuring of different stakeholder involvement is important, so that for example government may need to be slightly aside affected interests as they retain a licensing or statutory role. However stakeholder participation needs to be on the basis that they really represent their sector, and need to respect the process and bring an open mind to the dialogue. The evidence based approach and technical advice need to inform the process too.

**Other impressions**

The big three recurring ecosystem management problems, nearly omnipresent in areas I visited, were water levels, invasive species and the role of grazing. This is even in reserves or national parks where ‘complete’ control by ownership is assumed. In some cases this is because of long-established traditions (mountain grazing in Central Balkans or Pyrenees) or because of external influences either beyond the protected/project area boundaries at the margins (eg bison and grizzlies ranging into farmland or forest outside Yellowstone) or by major transport corridors (eg Banff). Both these sorts of influences together with the effects of climate change, or even past or current predator control, mean that none of the area could be considered very ‘natural’, even if they are spectacular and perhaps the closest we have.

On a minor but reputational point, government agencies in the US such as USFWS, or the Canadian NPS, are able to base their work on applied science and seem to be very credible, supported by sufficient funding and well-regarded. This is in stark contrast to this country.

In conclusion, I would say that despite the longer toe-hold of the ecosystem approach in North America, there a few projects that have incorporated all elements of an integrated ecosystem approach into all stages. Burns Bog would perhaps come close but for the lack of wider stakeholder involvement. Perhaps a fragile and high fire-risk site, with no public access and wholly owned by public bodies, can achieve this. The Canadian National Parks would also where they have been through the management planning process recently. The critical factors in successful projects appears to be a sound basis in science or evidence, a commitment and willingness to work collaboratively using adaptive management, over a long time frame. Once this commitment is established, innovation and advancement will follow. The best, succinct quote to sum up (source unknown) that I noted down in my research is the following:

> ‘Ecological restoration planning is a dynamic process, best achieved incrementally following an ecosystem approach involving biological and social elements, engaging stakeholders, considering economic conditions, and cultivating long-term partnerships’

**Footnote**

The learning points from a trip as diverse as this will take a little while to sink in. The opportunity to learn about different cultures, institutions and ways of doing things has been invaluable. I hope to achieve a wider community benefit to return the faith of the Trust. The most rewarding part of the trip, apart from trapping black-footed ferrets to gain information to help their recovery, was organized by the Sir Winston Churchill Society of Vancouver Island.
After talking to enthusiastic and interested pupils from Esquimalt High School in the city of Victoria, I toured some remnant Garry oak vegetation in built up areas with Mayo McDonough, President of the Society. We visited the Mayor’s Grove of Beacon Hill Park to see a hawthorn tree (I had done a Masters degree in eastern Canada on hawthorn trees in the early 1980s!) planted on September 6th 1929 by Churchill. The tree was looking a bit sickly but I was able to provide enough advice to spur Mayo into action. Within a few days of me leaving Canada, she had organised an arboriculturalist visit and a few weeks later, the local council carried out some restorative works to carry the tree gracefully into its old age.
Appendices

Appendix 1 - Itinerary

**Bulgaria**

28 May  London — Burgas flight. Drive to Bjala Voda, near Malko Tamavo and meet Anja Borsje and Dave of visitStrandja, a local Ecotourism business.

29 May  National Parks Day at Veleka River and participate in beach clean up; coastal walk from Silistar to Sinemorets

30 May  Chapel blessing ceremony Bjala Voda; tour of habitats Zvedets & Petrova Niva

1 June  Tour of oak forest at Kondolovo and Veleka river at Kosti; meet Ivan Kamburov of Strandja Nature Park Directorate at Poda Wetland centre near Burgas.

2 June  Drive to Kalofer. Meet Georgy Gugushev, Central Balkans National Park. Evening walk up to beech forest.

3 June  Tour of National Park with Anton Avramov & G. Gugushev. Evening walk up White River gorge.

4 June  Drive to Gabrovo. Meet Gergana Staneva, Central Balkan Park Directorate. Drive to Persina Nature Park, Belene. Tour of Visitor Centre and wetland restoration with Stoyan Mihov WWF and Veselin Koev.

5 June  Boat trip of Danube river islands and wetland with Stoyan and Vesselin. Drive to NW Bulgaria, nr Montana.


7 June  Meet Kiril Georgiev, Wilderness Fund. Sofia- Barcelona (flight)

8 June  Rest day in Barcelona

**France**

9 June  Barcelona-Montpellier (train) Meet Dr John D Thompson, CEFE, CNRS

10 June  Tour of coastal wetlands Sete-Beziers with John Thompson and Mickael Debetencourt, Service Thau Agglomération

11 June  Tour of Carmargue wetlands with staff from La Tour de Valat Research Centre, nr Arles.

12 June  Rest Day in Montpellier.

13 June  Drive to Pyrenees. Meet Pierre Goubet and site visit to Reserve Naturelle de national Neouville Pyrenees National Park

14 June  Meeting with Pyrenees National Park staff at Tarbes and joint site visit at Reserve Naturelle de national Neouville. Drive Tarbes- Montpellier.

15 June  Tour of CEFE insititute. Rare plant monitoring at Bois des Aresquiers, Conservatoire du Littoral site at Frontignan and discussions with John Thompson.
16 June Montpellier-London (flight).

Canada & US
17 Aug London – Vancouver (flight).
17-29 Aug [Holiday in Vancouver and Vancouver Island with son].
30 Aug Tour of Burns Bog, with Sarah Howie Corporation of Delta and Frances Buys, MetroCanada. Drive to Chillwack Lake, BC.
31 Aug Walk in old-growth forest, Chilliwack Lake. Drive to Seattle, Washington State.
1 Sept Ferry to Bainbridge Island to meet Amy Windrope, ex Coast EM Network. Drive to Olympic Peninsula.
3 Sept Tour of Olympic national Forest at Quinault Lake area and river restoration at Quinault River.
4 Sept Rest day in Portland, Oregon.
5 Sept Drive to Mount St Helens National Volcanic Monument. Hike up from Blue Lake Trail head through old-growth forest nearly into blast zone. Overnight in Cougar.
7 Sept Early morning walk on Jackson Bottom wetland creation site. Meet Devin Judge-Lord and Bobby Primavich, Willamette Partnership. Tour of river restoration site.
8 Sept Rest day. Drive to Cape Meares and Cape Lookout State Parks on Oregon coast.
9 Sept Drive to Portland to US Fish & Wildlife Service office, Portland. Talk to staff. Tour of Basket Slough, part of Finley National Wildlife Refuge and farmed land restoration sites. Drive up Columbia River Scenic Area gorge into Idaho.
10 Sep Drive to Yellowstone National Park, Gardiner, Montana. Meet Judy and Brian Chan, landscape architect and ranger at YNP. Dinner and overnight at Ranger Station in -3°C!
11 Sept Walk along Specimen Ridge in YNP. Dinner & discussions with the Chans.
12 Sept Drive to Bozeman, Montana. Meet Steve Forrest, WWF and Renee Cunningham, Univ. of California intern. Drive to American Prairie Reserve field station, nr Zortman, Lewistown.
13 Sept Meet Bryce & Christine Chistiansen and Dennis Linghor, American Prairie Foundation. Tour of prairie, bison and drive to ‘ferret camp’ at UL Bend (adjacent to CM Russell Wildlife Refuge) to meet Randy Matchett, USFWS. Helped repair electric coyote fence. Evening and night catching black footed ferrets.
<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tr>
<td>14 Sept</td>
<td>Drive to Fort Peck, near Glasgow to attend abortive meeting, viewed dam, returned to Zortman. Quick chat and beer with APF staff. Drive to US/Canada border south of Val Marie, Saskatchewan.</td>
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<tr>
<td>16 Sept</td>
<td>Drive to Calgary, Alberta. Meet Cormack Gates, professor at the University of Calgary to discuss stakeholder, oil/gas and sage grouse.</td>
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<td>17 Sept</td>
<td>Rest day in Calgary with Anna Bowes.</td>
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<td>18 Sept</td>
<td>Drive to Field, Kootenay National Park. Guided hike with Burgess Shale Geoscience Foundation to Walcott Quarry.</td>
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<td>19 Sept</td>
<td>Blogging in Banff. Short hike toward Johnson Canyon and drive Bow Valley Parkway. Attended evening 125 yr anniversary celebration talk by Banff National Park staff.</td>
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<td>20 Sept</td>
<td>Meet Alan Dibb and Gerry at Lake Louise. Tour of Trans Canada Highway Crossings, Kootenay National Park across to Radium Hot Springs via fire affected forest. Drive across Rockies to Columbia Valley, BC.</td>
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<tr>
<td>21 Sept</td>
<td>Drive through Kamloops and Fraser Valley to Vancouver. Ferry from Tsawwassen to Victoria, Vancouver Island.</td>
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<td>22 Sept</td>
<td>Talk to grade 10 students at Esquimalt High School, Victoria arranged ny Sir Winston Churchill Society of Vancouver Island (SWCSVI). Lunch and discussion with SWCSVI at West Bay Marina, Victoria.</td>
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<td>23 Sept</td>
<td>Meet Rob Walker, Gulf Islands National Park, Sidney, Vancouver Island. Attend meeting of Parks Advisory Board. Gave presentation to Parks Canada staff on UK conservation and Exmoor Mire Restoration.</td>
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<td>25 Sept</td>
<td>Rest day in Vancouver. Vancouver Canucks ice hockey game!</td>
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<td>26 Sept</td>
<td>Vancouver-London (flight)</td>
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