

The Conservation and management of Sea Buckthorn (*Hippophaë rhamnoides*) in the UK

Report of the workshop held at Saltfleetby-
Theddlethorpe Dunes and Gibraltar Point SAC on 17-
18 September 2009



Paul Rooney, John Houston and Graham Weaver

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Organised by the Sand Dune and Shingle Network
on behalf of Natural England

Report prepared by
Paul Rooney, John Houston and Graham Weaver



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Foreword

The Sand Dune and Shingle Network supports the dissemination of good practice in coastal dune and shingle management through national and international networking activities, the organisation of conferences, seminars, workshops and training events and contributions to the development of technical advice based on existing knowledge, information and data.

The network was established in 2006 with a grant from the Higher Education Innovation Fund provided through the Higher Education Funding Council for England. The network works closely with the UK statutory agencies for nature conservation and through a Memorandum of Agreement with Natural England between 2008 and 2011 delivered a series of tasks, one of which was the 'Sea Buckthorn Workshop' which makes up this volume.

The establishment of an occasional series of publications allows Liverpool Hope University to disseminate a range of products through the network website at www.hope.ac.uk/coast. The series will include workshop reports, subject reviews, reports of study tours and curriculum materials.

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The report was proofread by Marc Jones with design and layout by Ray Burns of Liverpool Hope University.

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Cover photographs clockwise from top left: Demonstration of management equipment at workshop; suckering sea buckthorn scrub at Gibraltar Point; brown-tail moth caterpillar on Terschelling; sea buckthorn scrub in foredune community at Ainsdale Sand Dunes NNR; sea buckthorn fruit; sea buckthorn clearance in East Lothian © East Lothian Council. All other photographs © John Houston.

Note on nomenclature; Both *Hippophaë rhamnoides* and Sea Buckthorn have various spellings in the literature. In this document lower case 'sea buckthorn' is used and the spelling *Hippophaë* preferred. The EU interpretation manual of European Union Habitats uses Sea-buckthorn and *Hippophae rhamnoides*. As far as possible the spelling linked to its source has been retained (e.g. Ranwell 1972, Rodwell 2000).

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1. Introduction to the workshop

Graham Weaver

Sea buckthorn (*Hippophaë rhamnoides*) is a native British species but one which has been widely introduced beyond its native range for reasons including dune stabilisation, protection of forestry plantations, visitor control and amenity. The invasive nature of the species became apparent in the years following the outbreaks of myxomatosis in the 1950s which virtually wiped out rabbit populations in many dune systems.

The problems and a discussion of what to do with the species at selected sites was the subject of a specific study group in the 1960s, chaired by Derek Ranwell of the Coastal Ecology Research Station (part of the then Nature Conservancy) which led to the publication of *The Management of Sea Buckthorn (Hippophaë rhamnoides L.) on selected sites in Great Britain* (Ranwell, 1972).

Since that publication, and largely or partly because of it, several sites have adopted policies to eradicate or control sea buckthorn scrub. Recently, however, a number of developments have put some of this work into a new perspective and there is a need to re-visit some of our basic management assumptions.

The publication of *The Nature Conservation Value of Scrub in Britain* (Mortimer *et al.* 2000) re-considered the place of scrub as part of a habitat mosaic and the Habitats Directive of 1992¹ has identified 'Dunes with *Hippophae rhamnoides*' as an EU habitat in need of conservation.

The present situation is that two Special Areas of Conservation (SAC) in England now include sea buckthorn scrub as a conservation feature and a number of dune managers are re-thinking their attitude to scrub in general. What place does sea buckthorn have in dune vegetation?

It is true that our knowledge of dune scrub has lagged behind our knowledge of other aspects of dune ecology and so the workshop was intended to stimulate discussion.

The objectives of the workshop were;

To create an opportunity for those involved to share their knowledge and discuss the challenges, and

To begin to develop a consensus on management and methods

One of the key questions, as yet unanswered, is whether we should be worried at all about sea buckthorn 'invasion'. Might it not be a part of a cycle of scrub growth and scrub decline? But can we afford to take the chance?

¹ Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

2. Current UK status and guidance

Graham Weaver

The Sand Dune Survey of Great Britain (1987-1990)² (Dargie 1993, 1995; Radley 1994) recorded 650ha of sea buckthorn scrub in the UK, of which 250ha is considered to be in its native range along the east coast.



Figure 1: The native range of sea buckthorn in the UK © JNCC

For England the survey recorded a total area of dune scrub of about 760 ha, split into 370 ha of sea buckthorn scrub and 390 ha of 'other scrub'. This covers about 14% of the total dune habitat in England (c. 5500 ha).

Dune scrub, and especially sea buckthorn scrub, has not generally been considered to be a desirable feature on sand dunes in the UK. Although there has been some reconsideration of this position the current guidelines (1989) for the selection of biological SSSIs on sand dunes³ states:

"Except in a limited number of cases (e.g. native *Hippophae rhamnoides* in south-east England), dune scrub, particularly with *Ulex europaeus*, *Pinus* spp., and *Betula* spp., represent an artificial phase in dune succession. Dune systems in Britain are not large enough nor do they normally have a sufficient age to support true succession to primary dune scrub or woodland, though any known examples should be selected."

The UK Biodiversity Action Plan also considers the development of dune scrub to be an undesirable trend which is best countered by management practices such as grazing. The UK Habitat Action Plan for coastal sand dunes 1999⁴ states;

² The reports for Scotland, Wales and England are published both separately and together. The combined report is cited as Radley G.P. and Dargie T.C.D., Sand Dunes - Parts 1, 2 and 3 together, ISBN 1 873701 31 4. See <http://jncc.defra.gov.uk/page-2158> for details.

³ The guide to the selection of SSSIs on coastlands in the UK is found at www.jncc.gov.uk/PDF/sssi_ptC1.pdf

⁴ Although now superseded the UK Habitat Action Plan for coastal sand dunes is available at www.ukbap.org.uk/UKPlans.aspx?ID=28

“The fixed dune communities ... are, or have been, maintained by grazing, whether by domestic stock or by rabbits. In their absence, the succession proceeds to rough grass and scrub. Dune scrub can include several species but only one of them, sea buckthorn, is largely confined to dunes; it is native to eastern England and south-east Scotland and has been widely introduced elsewhere, where its very invasive nature can cause problems. ”

“In the absence of human interference, most stable dunes, with the exception of those experiencing severe exposure, would develop into scrub and woodland. The preponderance of grassland and heath vegetation on British dunes is due to a long history of grazing by livestock. Continued grazing is normally necessary to maintain the typical fixed dune communities ...”

“A more widespread problem is under-grazing, leading to invasion by coarse grasses and scrub, though rabbits are locally effective in maintaining a short turf.”

The statutory nature conservation agencies in the UK are responsible for the assessment of ‘condition’ of sand dune habitats. The assessment of condition follows Common Standards Monitoring Guidance prepared by the Joint Nature Conservation Committee. The Common Standards Monitoring Guidance for Sand Dune Habitats⁵ gives the following target (as an example) in relation to fixed dune grassland;

Fixed dune grassland - Vegetation composition: negative indicator species: Non-native species, including sea buckthorn where introduced, should be no more than rare.

The guidance makes the comment that where *Hippophae rhamnoides* is native (e.g. in some sites in eastern England) the species is not counted as a negative indicator but it has been widely introduced elsewhere and has proved very invasive.

However, the Common Standards Monitoring Guidance does recognise that the EU Habitats Directive identifies sea buckthorn scrub as forming a unique and special component of the habitat mosaic in dune systems. The EU Habitat type H2160 ‘Dunes with *Hippophae rhamnoides*’ is described as ‘Sea-buckthorn formations of forest colonisation in both dry and humid dune depressions’ with the main species being *Hippophae rhamnoides*⁶. The UK guidance confirms that ‘H2160 Dunes with *Hippophae rhamnoides*’ is a qualifying feature on two sites in eastern England, where *Hippophae rhamnoides*, generally an introduced species, is native.

The UK habitat account for 2160 dunes with *Hippophae rhamnoides*⁷ states that “the distribution and ecological variation of native stands in the UK is limited, so one site in eastern England has been selected to represent the native occurrence of the habitat. Stands resulting from introductions are not considered eligible for site selection in the UK.”

The main site identified as a Special Area of Conservation (Natura 2000 site) in the UK is the Salfleetby-Theddlethorpe Dunes and Gibraltar Point SAC⁸ in Lincolnshire. The other UK site where ‘dunes with *Hippophae rhamnoides*’ is included on the SAC citation as a qualifying feature but not a main reason for selection is the Humber Estuary.

5 The Common Standards Monitoring Guidance for Sand Dune Habitats (Version August 2004) can be found at www.jncc.gov.uk/pdf/CSM_coastal_sand_dune.pdf

6 From Interpretation manual of EU habitats

http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

7 See <http://jncc.defra.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H2160>

8 See <http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUcode=UK0030270>

The Habitats Directive, under Article 17 (information), has a requirement for Member States to report on the condition of habitats and species at six-yearly intervals. The UK submitted its second report under Article 17 to the European Commission in 2008.⁹ This included an assessment of the current conservation status for Habitat H2160 - Dunes with *Hippophae rhamnoides* in the UK (see Chapter 4).

So, in the UK, the adoption of the EU Habitats Directive, has created a situation where the sea buckthorn scrub community is now recognised as a component of the native vegetation (in Eastern England). This adds an interesting dimension to discussions on future approaches to the conservation and management of the species in the UK.

⁹ Joint Nature Conservation Committee 2007 Second Report by the UK under Article 17 on the implementation of the Habitats Directive from January 2001 to December 2006. Peterborough: JNCC. www.jncc.gov.uk/article17

3 Sea buckthorn in the UK: a review

Paul Rooney

Introduction

Hippophaë rhamnoides L. Sea Buckthorn (Elaeagnaceae) is a Eurasian, woody, dioecious, wind pollinated, much branched thorny shrub with drupe-like orange or yellow fruit and seed that are mostly dispersed by birds. It occurs in a range extending from the Atlantic coasts of Europe across to northwestern China. Sea buckthorn was introduced from Russia to the Canadian prairies in the 1930s (Li and Beveridge, 2003). In Europe it has a highly fragmented distribution and is largely confined to the coast, with some inland exceptions along rivers and sub-alpine areas. Sea buckthorn occurs as a coastal species in north-west Europe along the Atlantic and North Sea coasts from Norway to northern France. In the UK it is found at scattered coastal localities and has been planted both inland and at coastal sites.¹⁰ In 2009 the trials began for commercial sea buckthorn farming in the UK.¹¹

Pollen Record

The pollen record suggests that sea buckthorn was widespread in Britain on late and early postglacial raw soils in Britain. Bartish *et al.* (2006) describe how reforestation in the early Holocene restricted populations to coastal habitats in northern Europe. Sea buckthorn is not tolerant of shade.

Intriguingly, Bartish *et al.* (2006) suggest two expansions for Continental populations of sea buckthorn in historic times at c.4200 and c.1800 years ago. These spread from central Europe into Denmark and Scandinavia respectively. They speculate that these most recent periods of expansion followed the path of human forest clearances along coastal corridors, and identify that more work is required to firmly establish if this human impact replaced climate change as a major driving force for the latest expansion(s) of sea buckthorn in northern Europe.

Current Status

Rogers (1961) and Pearson and Rogers (1962) consider sea buckthorn to be native on dunes on the coast of east and south-east England. They describe it as planted and thoroughly naturalized on dunes elsewhere in Britain. However, they offer no evidence to support their claims for the native, or otherwise, status of sea buckthorn yet it seems that subsequent conservation management value judgments for this species and its associated habitat in Britain rely heavily on these claims. Preston *et al.* (2002) describe sea buckthorn as being native, and go further to describe it as native in Britain only in coastal habitats. They provide a map to further illustrate its distribution and status.

Dargie (2002) considers sea buckthorn scrub to be native on British dunes only on parts of the east coast, from East Sussex (Dungeness) to Dunbar in East Lothian (Groves, 1958, Perring and Walters, 1962, Ward, 1972, Ainsworth, 1994). Bacon (2003) identifies that the provenance of sea buckthorn in Sussex is contested, but agrees that it occurs 'naturally' on the east and south east coasts from Kent to Scotland. There seems to be agreement that it is introduced on the north western coasts of England and scattered west coast sites. Therefore, in Britain sea buckthorn is described as native and introduced. Bacon (2003) describes it as not present in Ireland as a native species, but being present as an introduction.

¹⁰ The current range of sea buckthorn based on records can be accessed through the BSBI hectad mapping scheme <http://www.bsbimaps.org.uk/atlas/main.php>

¹¹ Trial plots of sea buckthorn varieties from Germany and Finland were established at Devereux Farm on the Essex Coast. The story can be followed at http://www.onthewildsideproducts.co.uk/development_news.html

Baker (1996) highlights the role of birds in the distribution and spread of sea buckthorn by voiding seed at a distance from the fruiting bush. Baker (1996) also cites the work of Gillham (1987) noting that seeds voided by birds are six times more likely to germinate than seeds that have not passed through the gut of a bird. The role and importance of birds in spreading sea buckthorn within and between sites deserves greater attention.

Description as Scrub

Scrub is difficult to define (Bacon, 2003). It is often a transitional stage from one seral stage to another, while some scrub communities may be part of a climax vegetation type. Scrub in general terms is a valuable conservation feature and an important part of several UK Biodiversity Action Plan habitats and EU Habitats Directive Annex I habitats.

Dunes with sea buckthorn comprise scrub vegetation on more-or-less stable sand dunes in which sea buckthorn is abundant. The shrub may either form dense thickets, with sparse nitrophilous associates such as common nettle *Urtica dioica*, or occur as more scattered bushes interspersed with various grasses, typically marram *Ammophila arenaria* and red fescue *Festuca rubra*, and associated herbs of dune grassland. In terms of phytosociological associations, sea buckthorn scrub is described in the National Vegetation Classification (NVC) as SD 18 *Hippophae rhamnoides* dune scrub (Rodwell, 2000). Dargie (2002) in an ecological assessment of sea buckthorn considers that the detailed ecology of sea buckthorn is not well known.

The Sand Dune Survey of Great Britain 1987-1990 (Dargie, 1993, 1995; Radley, 1994) recorded 372 ha of sea buckthorn habitat in England. This work notes that most stands of the habitat result from introductions. Bacon (2003) and Mortimer *et al.* (2000) comment that it is difficult to accurately assess the distribution of scrub for a number of reasons including unclear boundaries and an inability of remote sensing techniques to effectively define or classify it. They also note that the distribution of scrub can only partially be determined from site designation information and from National Vegetation Classification community data. As such, the Sand Dune Survey of Great Britain is highly likely to be inaccurate in terms of assessing the extent of sea buckthorn scrub.

Dargie (2002) considers the extent and distribution of sea buckthorn dune scrub resulting from the NVC mapping for the Sand Dune Survey of Great Britain. He argues that the results from this survey strongly suggest that sea buckthorn dune scrub is not a serious threat at a national scale (based on its extent being less than 5% of the overall dune resource) as long as management employs removal or control methods.

Expansion of Sea Buckthorn

There has been a widespread expansion of sea buckthorn on British dunes since the 1950s due to a reduction of grazing pressure from rabbits. This was a consequence of the effects of the disease myxomatosis on the rabbit populations. Grazing pressure by rabbits checked the growth and expansion of sea buckthorn. As this pressure was relaxed it was possible for scrub and rank vegetation communities to develop. In addition to invasion of habitats, sea buckthorn has nitrogen fixing abilities which enrich the soil.

Sea buckthorn is usually considered a serious threat for many dune systems due to its invasive nature, especially on the west coast of Britain where it is thought to be introduced and is therefore treated as a non-native species (Bacon, 2003). However, a comparatively small number of studies have been made of the expansion history of sea buckthorn in only a few sites. Dargie (2002) comments that studies on the expansion of sea buckthorn completed on sites such as Spurn Head, Merthyr Mawr and Portstewart have not been drawn together. All show rapid expansion in the 1950s and 1960s probably relating to decline in rabbit numbers post myxomatosis. For several important dune systems the situation of sea buckthorn expansion is not written up.

Perception of the expansion problem

The British and Irish literature for this plant usually treats it as an aggressive invasive alien on coastal dunes viewing it as a problem rather than an asset. Even within its 'natural' distribution in Great Britain, sea buckthorn is often treated as a conservation problem. However, it is also treated as an important (and desirable) part of the dune habitats on the east coast.

Sea buckthorn scrub is a widespread habitat type in the neighbouring dune systems of north France, Belgium and the Netherlands. For example, along the central mainland coast of the Netherlands, in the Amsterdam area, the EU habitat type 'Dunes with *Hippophae rhamnoides*' is well represented. It is a valuable component of the overall habitat mosaic and is itself threatened by the spread of the invasive alien species Bird Cherry *Prunus serotina*.

However, in the southern Netherlands, Dutch Wadden Sea islands, Belgium and northern France sea buckthorn scrub can be invasive especially in young primary and secondary dune slacks. Its spread has been addressed by management activity including mowing, grazing and turf-stripping (Houston 2008a, 2008b). On the Belgian nature reserve of De Westhoek, for example, the management approach is a combination of 'pattern management' which actively controls vegetation and 'process management' which allows a more natural transition from fixed dune, through scrub to woodland.

It is worthy of note that there have recently begun significant changes in views in Britain regarding the ecological value of scrub. These changes may move the perception of sea buckthorn as a problem species in the British context.

Succession

It is possible that (most?) British stands of sea buckthorn post 1950 expansion are very young and have therefore not had the time to mature and develop into a sea buckthorn landscape type as on some of the sites on the Continent. This should be considered in the context of much British vegetation as Rodwell (2000) comments that our stands of sea buckthorn are "too young for us to know what the end product of...succession will be". Dargie (2002) argues that there is good evidence that British stands lack the range of variation found on the Continent – especially absence of wet ground types and evidence of transitions to woodland vegetation. This may be a consequence of their relative immaturity.

Tansley (1965) states that the establishment, history and fate of dune scrub have not been closely studied. Rodwell (2000) argues that it is possible that sea buckthorn on dunes may progress to Carpini woodland. Rodwell (2000) concurs with Tansley (1965) noting that there is little information about what the natural succession beyond existing sea buckthorn stands might be. Bacon (2003) and Mortimer *et al.* (2000) both state that the classification of scrub for conservation should take account of the current conservation value of the stand. Importantly they go on to argue that such evaluations must consider the likely outcome of changes caused by succession. The extent to which contemporary dune managers do this is highly uncertain: Bacon (2003) notes that the amount of published work on scrub management is small.

Management Responses

In an early response to concerns about the expansion and potential impacts of sea buckthorn on dune habitats, the '*Hippophaë* Study Group' was convened by The Nature Conservancy (Ranwell, 1972). This group brought together the then current understanding of the biology of sea buckthorn in Britain, attempted to provide a balanced view on the conservation value of the species especially in relation to the dune habitats, and made some specific management policy recommendations. In drafting the report a survey of the status and management actions undertaken at grade 1 sites (National Nature Reserves) in Britain was conducted around 1970. The final report proposed the following management strategies for sea buckthorn.

- Maintain zero *Hippophaë* population of any sites currently free from *Hippophaë* by uprooting seedlings as they are found

- Where establishment is at an early stage, attempt to eliminate *Hippophaë*
- Where *Hippophaë* is well established, control so as to maintain habitat diversity (but allowing a proportion of the stands to develop naturally to maturity)

The survey was repeated for the same sites in the early 1980s by Dr. Pat Doody of the Chief Scientist's staff in the Nature Conservancy Council. The results of this survey have not been published, but have recently been compiled and summarized by Paul Rooney of Liverpool Hope University with the intention of repeating the survey and publishing the results in full.

During the 1970s, 1980s and 1990s a variety of scrub control methods were deployed (successfully and unsuccessfully) against sea buckthorn at dune sites in Britain. Although this experience is incompletely recorded, four case studies are presented in Chapter 5 and the result of the major clearance project at Merthyr-Mawr in terms of the re-establishment of dune vegetation has recently been assessed by Richards and Burningham (2011).

According to Dargie (2002) English Nature's (and now Natural England's?) thinking on sea buckthorn seems to be that each stage of scrub maturity (pioneer seedlings, scattered bushes and suckers, closed canopy, and mature scrub with other woody shrubs) should be represented as a part of each of the other habitats where it is presently found (mobile dunes, fixed dunes and humid slack). However, the present overall areas of sea buckthorn scrub may need to be reduced in some of these habitats.

Bacon (2003) sets out a range of five basic scrub management operations. It may be possible to apply these to sea buckthorn and it would inform debate if we understood which of the following were being pursued at each site where sea buckthorn is present:

1. enhancement – increase extent
2. enhancement – increase quality
3. maintenance
4. reduction
5. eradication

Considering options 4 and 5 as objectives both at a site, regional and national scale it should be noted that they may be difficult to achieve due to the significant amount of resources required.

Conclusion

On British coastal dunes sea buckthorn is both valued as an EU habitat type, and at the same time it is perceived as a conservation management problem creating a resource demanding dilemma for decision makers. It is recognized that the place in succession to dune woodland occupied by sea buckthorn on British dunes is not well understood. The species is a relatively new 'problem' for British conservationists. Whilst it generally forms a component of the dune habitat mosaic on the Continent it can also prove to be invasive, especially in slack habitats.

Sea buckthorn on coastal dunes epitomises a host of challenging research (and ethical?) problems in that the management decisions taken in relation to this species and its associated dune habitat require evaluation of their relative intrinsic value and degree of naturalness.

It may be argued that sea buckthorn is 'natural', and where it is not it is at least fully 'naturalised,' across most of its occurrence on the British coast. This may have implications for site designation and conservation management practices.

4 Conservation of the EU Habitat Type

Graham Weaver and John Houston

Introduction

Coastal dunes with sea buckthorn have now been recognized by the UK Government as a habitat of European nature conservation importance. The EU Annex I habitat H2160 dunes with *Hippophae rhamnoides* has been identified as a 'primary reason' for the selection of the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC, as a 'qualifying feature' (but not a primary reason for site selection) for the Humber Estuary SAC and it is noted as present in a further 11 SACs¹² in the UK including west coast dune systems. The EU habitat category corresponds with the UK NVC type SD18 *Hippophae rhamnoides* dune scrub.¹³

The only significant site in the UK is the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC.¹⁴ The site description states that "the site supports a good example of dunes with *Hippophae rhamnoides* in the main part of its natural range in the UK. The habitat develops on dune areas and is present in a range of successional stages from early colonisation to mature scrub associated with other species such as elder *Sambucus nigra*, hawthorn *Crataegus monogyna* and ivy *Hedera helix*, typically associated with an understorey of ruderal species. These stands of scrub are important for both migratory and breeding birds".

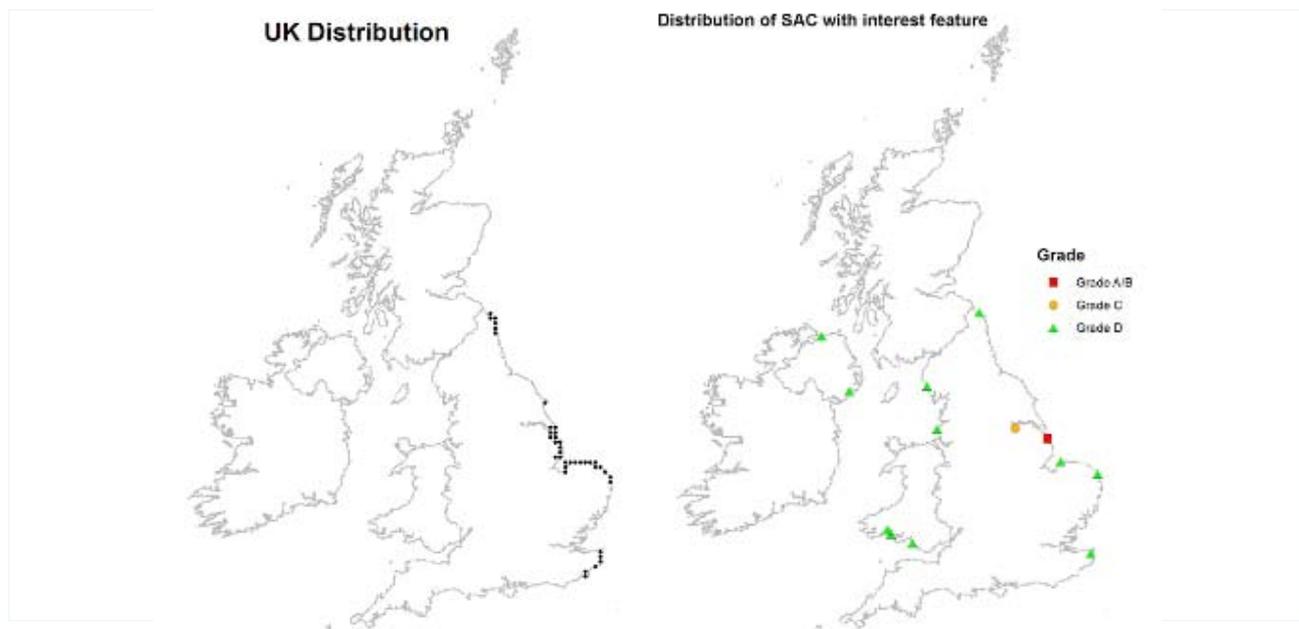


Figure 2: Information on the accepted native distribution of *Hippophae rhamnoides* in the UK and the SACs where the species is noted. Source © JNCC

Key to SAC interest features:

Grade A is an 'outstanding example of the feature in a European context'

Grade B is an 'excellent example of the feature, significantly above the threshold for SSSI/ASSI notification but of somewhat lower value than a grade A site'

Grade C is an example of the feature of at least national importance but not significantly above this. These features are not the primary reason for SACs being selected.

Grade D is for features of below SSSI quality occurring on SACs. These are non-qualifying features ("non-significant presence") but this is not a formal global grade.

¹² <http://www.jncc.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H2160>

¹³ However, only examples of this NVC community within the natural range of *Hippophae rhamnoides* in the UK are included in this definition

¹⁴ <http://www.jncc.gov.uk/ProtectedSites/SACselection/sac.asp?EUcode=UK0030270>

The UK Government has to draw up plans to ensure the conservation of the EU habitat type (to achieve/maintain favourable conservation status) and also to report on the conservation status of the habitat through the six-yearly Article 17 reports to the European Commission. The information below is drawn largely from the JNCC website, the conservation status assessment for H2160: dunes with *Hippophae rhamnoides* and draft guidance (Natural England, unpublished) for dune grassland and *Hippophae rhamnoides* scrub.

Current knowledge on the status and distribution of sea buckthorn scrub in the UK is summarised in the second report by the United Kingdom under Article 17 of the Habitats Directive prepared by the JNCC and the UK statutory agencies Coastal Lead Coordination Network.¹⁵ The report (JNCC, 2007) raises a number of issues regarding both conservation (mainly within its native range) and control (mainly outside its native range) of the species.

Conservation status assessment: the Article 17 report

The JNCC Article 17 report (JNCC, 2007) provides information on range, area, current condition and future prospects for the European habitat in the UK.

The report concludes that “the native range of sea buckthorn has remained stable for at least 100 years whilst, through planting over a longer period, it has become widespread around much of the UK coast”. See Figure 1.

The JNCC report only recognises the species as native to England and gives its total native extent at 235 ha (from Sand Dune Survey of Great Britain). The total area of habitat in England, Scotland and Wales is given as 644 ha so there is more sea buckthorn outside its native range than within it.

Between 1950 and 2006 the trend in the area covered was increasing as a result of natural expansion. The reason given repeats the view of several authors that until the 1950s sea buckthorn, even where introduced, was held in check, probably by intensive rabbit grazing. Following myxomatosis in the mid-1950s, sea buckthorn has greatly expanded on many sites, both within and outside the native range and where control measures are not in place, it continues to spread.

Over the last 25 years, substantial effort has been expended in containing and reducing the area of sea buckthorn (Chapter 5) both within and outside its native range. However, in spite of control and succession to woodland, there is still a considerably larger area of ‘Dunes with *Hippophae rhamnoides*’ than there was in the early 1950s, with no reduction in area since 1994.

The JNCC report has set the measured area of 235 ha as the ‘favourable reference area’ for the UK. This is considerably larger than the area in the early 1950s and with no reduction in area since 1994. It is clear, however, that the actual extent of sea buckthorn scrub across all sites will exceed this target (unless a significant control programme is initiated).

In terms of meeting the obligations of the Habitats Directive the focus for appropriate habitat management is on the Saltfleetby- Theddlethorpe Dunes and Gibraltar Point SAC. At this site a provisional objective has been set for the habitat type Dunes with *Hippophae rhamnoides* to be about 30% of the overall dry dune area and to achieve this there will need to be some clearance of sea buckthorn scrub (see Chapter 5).

However, the JNCC report goes on to suggest that on other sites within its native range there may be scope for some expansion, arguing that “although this may prove controversial, it is currently only present in small and isolated patches on most sites within its native range outside of Lincolnshire”. The report also concludes that “it is extremely unlikely that sea buckthorn will be eradicated from all the sites that it has been introduced to outside its current native range. Indeed, on a number of sites it is likely to become an accepted part of the dune vegetation, rather than an unwelcome lodger”.

15 <http://www.jncc.gov.uk/pdf/Article17/FCS2007-H2160-audit-Final.pdf>

The EU habitat type 'dunes with *Hippophae rhamnoides*' can be affected by pressures, leading to loss of habitat extent. These include;

- Deliberate clearance (by mowing, cutting and grubbing up) driven by objectives to conserve open dune habitats/remove invasive species
- A reduction in mobile dune conditions leading to an increase in fixed dune grassland at the expense of plants of semi-fixed habitats
- The succession to mixed scrub and woodland, shading out sea buckthorn scrub
- A potential negative impact of atmospheric pollution (the habitat is considered 'potentially sensitive')

Although climate change is considered a major threat to the future condition of the habitat in the long term there is a high degree of uncertainty in all models.

The pressures are not considered 'significant' and the overall conclusion of the Article 17 assessment, based on the results of condition monitoring, is that the UK resource of sea buckthorn habitat is 'favourable'. However, the report notes that there is a predominance of early and mid successional stages of the habitat with limited examples of mature stands.

Future prospects for the EU Habitat

Considering future prospects for the habitat the JNCC report states that "although still controversial, attitudes within the nature conservation community towards scrub are in the process of changing – acknowledging it as a habitat in its own right, and not simply as a problem for other more open habitats. Reassessment of the place of scrub and woodland on dunes is less advanced but it is likely that, in the future, scrub and woodland will be more actively retained on dunes, both within and outside the native range of sea buckthorn".

The east coast dune systems are relatively narrow and there are not many opportunities for the development of new areas of scrub. One consequence is that the large pulse of sea buckthorn scrub that has developed over 50 years will mature but will not be followed by an equivalent area of young scrub. There is therefore perhaps more opportunity on west coast dune systems to allow a range of age classes to develop.

The future prospects for the habitat in the UK are also considered to be favourable: i.e. its range and area are stable or increasing and more than 95% of the habitat area is likely to be in favourable condition in 12-15 years.

Setting Conservation Objectives

Now that 'Dunes with *Hippophae rhamnoides*' is a recognised habitat in England there is an opportunity to develop conservation objectives and monitor habitat quality through the Common Standards Monitoring approach (currently dune scrub seems to fall between guidance for coastal sand dunes and woodlands). At key sites the objective is to accommodate a full representation of sea buckthorn scrub types – ranging from colonising young buckthorn in mobile/semi-fixed dunes, through to senescent sea buckthorn in mixed-species mature scrub.

Because of the mosaic of habitats which form a dune system there will be a need to find a balance between EU habitat types, in particular the balance between sea buckthorn scrub and the European habitats H2120 'Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)' and H2130 'Fixed coastal dunes with herbaceous vegetation (grey dunes)'.

Natural England coastal ecologists have considered the need to offer guidance for setting Conservation Objectives for dunes with a mosaic of grassland and scrub habitats. The following approach is suggested:

- Core areas of dune grassland to be retained. The relevant Common Standards Monitoring (CSM) guidance should be applied to these areas. The current generic target is for scrub/trees to be no more than occasional or less than 5% cover.
- Core areas of sea buckthorn scrub to be retained. When setting Conservation Objectives for dunes with sea buckthorn scrub the generic targets set out in the condition assessment for scrub and wood pasture sites should be used.
- Areas where it is acceptable (or even desirable) for there to be some fluctuation over time of the boundaries between the grassland and sea buckthorn scrub. This may be where a mosaic of grassland and sea buckthorn scrub occurs, or it may be where there is a long 'front' between the two.

Table 1: Suggested Favourable Condition table for 'Dunes with *Hippophae rhamnoides*'

ATTRIBUTE	MEASURE	TARGET	COMMENT
Extent	Area (ha.) of dunes with sea buckthorn; measured once every 5 years from aerial photos.	30% of dry dune area to be covered by sea buckthorn scrub.	
Vegetation succession and structure	Relative proportions of height classes of sea buckthorn scrub; measured once every 5 years from aerial photos, and measured once every 10 years from sample surveys. Relative proportions of colonising (<50% cover sea buckthorn) and established (>50% cover sea buckthorn) scrub; measured once every 5 years from aerial photos, and measured once every 10 years from sample surveys.	Maintain at least three height classes of sea buckthorn scrub. Maintain a range of sea buckthorn age classes, in particular 30% of scrub area being in colonising stage (SD18a), and 10% of scrub less than 5 years old and 20% more than 20 years old. Also allow 5% of sea buckthorn scrub to develop into dune woodland.	It is not yet clear how long structural variety can be maintained in stands of sea buckthorn by rotational cutting. It may be easier to cater for the "less than 5 years old" category in a "grassland-scrub mosaic" feature. This 5% area needs to be taken account of when setting a woodland feature extent figure (if any).
Absence of non-native flora	Relative proportion of non-native trees and shrubs; measured once every 5 years from aerial photos, and measured once every 10 years from full survey.	Less than 5% cover of non-native trees and shrubs.	

An overall target for the protected site might therefore be for a minimum of 30% grassland, a minimum of 30% *Hippophae* scrub and the balance (40%) being either habitat or a mixture of them. There can be considerable flexibility in the balance between the two main habitat types without affecting the overall condition assessment.

There is interest in developing remote sensing techniques for monitoring dune habitats including dune scrub. The value of remote sensing has been assessed in a study of alien and invasive woody species on the Dutch Wadden Sea island of Vlieland (Hantson *et al.* 2010)

5 Management case studies

Edited by John Houston

The chapter is based on the workshop contributions of Claire Weaver (Natural England), Kev Wilson (Lincolnshire Wildlife Trust), Simon Cooter (Natural England), Duncan Ludlow (Countryside Council for Wales) and Duncan Priddle (East Lothian Council).

Several sites in the UK have undertaken long-term approaches to eradication, control and management of sea buckthorn scrub. These sites include Braunton Burrows, Ainsdale Sand Dunes, Saltfleetby-Theddlethorpe Dunes and Gibraltar Point in England, Portstewart and Murlough Dunes in Northern Ireland, the East Lothian coast in Scotland and Merthyr Mawr and Kenfig in Wales.

As Rooney (chapter 3) shows the 'traditional' managers' attitude to sea buckthorn in the 1970s and 1980s was that it was a 'thorny problem' which required attention. Thus the BTCV practical handbooks (BTCV 1979 pp. 99-105, BTCV 1986 pp. 89-93) give detailed information on control methods including hand cutting, grubbing-up, burning, using herbicides and mowing. The second edition of the handbook includes a section on treatment after clearance, an issue discussed at the workshop and by Richards and Burningham (2011).

The BTCV guidance was based largely on the report of the *Hippophaë* Study Group (Ranwell 1972) and reports of practical experience at Braunton Burrows (Venner 1971) and Murlough (Ellis 1983). Experience on the Sefton Coast, Merseyside, in the early 1990s (Rooney, 1998) also supported the development of management practice. As Rooney (chapter 3) notes there are changing attitudes to the place of scrub on dune sites arising out of a better understanding of the conservation value of scrub (especially Bacon 2003) and the challenge of the Habitats Directive to identify sites in the UK where sea buckthorn is a primary reason for conservation.

Bacon (2003 pp. 4/153-156) summarises management techniques for sea buckthorn scrub by grazing, cutting and herbicide application. Even on sites such as Gibraltar Point where sea buckthorn is native (case study in Bacon 2003) management is required to achieve a balance between scrub communities and open communities.

Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC

The Special Area of Conservation includes Saltfleetby-Theddlethorpe Dunes and Gibraltar Point National Nature Reserves and management is guided by conservation objectives and the specific site management plans.

In terms of overall objectives Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC is notified for its fixed dunes with herbaceous vegetation ('grey dunes'), dunes with sea buckthorn, humid dune slacks and embryonic shifting dunes. The Special Area of Conservation is the UK's premier site for the conservation of sea buckthorn scrub (some 200ha) within the framework of the EU Habitats Directive. Natural England has responsibility for setting the objectives and for developing management practice which will conserve the habitat.

The most vigorous stands of sea buckthorn are mainly found in the more mobile yellow dune area (Cooter 2008). From here it spreads mainly by suckering, and to a lesser degree through seed dispersal, into the grey dunes inland and to the embryonic dunes seaward. On the grey dunes the sea buckthorn forms a mixed dune scrub with hawthorn *Crateagus monogyna*, wild privet *Ligustrum vulgare* and elder *Sambucus nigra*. It is succeeded by a more mature scrub and then ash *Fraxinus excelsior* and sycamore *Acer pseudoplatanus* woodland. Without management intervention the other interest features of the site would be smothered by scrub.

The objectives in relation to dune scrub for the SAC are:

- Rotational coppice of closed-canopy stands to diversify age structure (applied to 75-80% of scrub) at both sites;
- Removal of 9ha *Hippophae* at Gibraltar Point, mainly by coppicing;
- Maintain key areas of other habitat free from *Hippophae* e.g. fixed dune at both sites;
- Retain oldest stands and allow to senescence and continued scrub succession at both sites;
- Maintain mobile foredune ridges clear of *Hippophae* at both sites.

The statutory advisers responsible for setting conservation objectives for the sea buckthorn scrub in England will have to consider the following questions;

- How to diversify the sea buckthorn stands and keep enough of the scrub 'middle aged'?
- If coppicing does not work would grazing be the answer?
- What to do about the low quantity of pioneer sea buckthorn stands on these narrow, stable dune systems?
- How to balance invading buckthorn scrub with the need for some shifting *Ammophila* dune?

Gibraltar Point National Nature Reserve

Gibraltar Point NNR is a nationally important site for sand dunes, dune slacks, sand flats and mud flats. The reserve consists of a series of almost parallel dune ridges separated by salt marsh and dividing the site into East Dunes and West Dunes. The most inland dunes are probably 500 years old and support calcareous dry dune grassland. Sea buckthorn scrub is also of conservation importance (case study in Bacon 2003) but is controlled to protect dry grassland and dune slack habitats. The overall aim of management is to create a balance between scrub and grassland habitats through scrub control and grazing.

The dune scrub with sea buckthorn at Gibraltar Point also includes elder, privet, dog rose *Rosa canina* and hawthorn. Succession within dune slacks is shown by sallow *Salix caprea* in limited areas and on drier dunes succession into maritime woodland is shown by sycamore. Management aims to reduce the total extent of sea buckthorn scrub to coverage similar to that of the early 1960s, by recognising that scrub needs to be controlled where it threatens other habitats including yellow dune, grey dune and dune slack. In the mid-1960s the first common bird census showed that the open scrub mosaic was a particularly rich habitat for breeding birds, with some of the densest populations ever recorded. The total area of sea buckthorn scrub is to be reduced from 62% of the dry dunes to 25-30% of the dry dunes to restore open dune grassland communities. This will entail clearing c. 10 ha. About 5% of the sea buckthorn scrub will be allowed to develop into dune woodland.

One of the targets is to maintain a representative mix of age classes of scrub including young (<5 years old) and mature (>20 years old). The target on the 25-30% of the dunes covered in scrub is for c. 30% open scrub mosaic, 30% dense middle-aged growth and 30% senescent growth. Some of the factors which determine the structure and spread of sea buckthorn scrub (as identified in the NNR management plan) are;

- Former sheep grazing had ceased by the 1920s and the re-introduction of sheep grazing from the mid-1980s has helped to suppress colonising scrub on the grey dunes but at current levels it has not eradicated colonising growth. Site managers may consider heavier grazing with Hebridean sheep.
- Sea buckthorn colonisation appears to be suppressed by intensive rabbit grazing: young shoots are stripped of leaf buds in the winter. Sea buckthorn colonised extensively following the outbreaks of myxomatosis in the early 1950s.
- On older dune ridges there are areas of senescing elder and sea buckthorn scrub. Where dieback is extensive sea buckthorn may re-colonise, but the opportunity may be taken by sycamore.
- The dune scrub communities on the East Dunes can be completely swamped by vigorous growth of *Clematis vitalba* (Old Man's Beard).

The strong presence of clematis is interesting. It is not considered to be an alien species but occurs more on the East Dunes where it is presumed to be established through bird droppings from migrant birds from the near Continent. Dargie (2002) considers that it is a valid component of native scrub on the Continent. It is the host plant for four uncommon species of moth including Petty Chalk Carpet *Melanthia procellata* and Small Waved Umber *Horisme vitalbata*. It is also highly susceptible to grazing by Hebridean sheep and Dexter cattle that quickly defoliate it in late summer and early autumn.

In 2002 research was commissioned by English Nature to advise on management options. The recommendations presented by Dargie (2002) have since been modified by Natural England and Lincolnshire Wildlife Trust but can still be grouped into four regimes:

1. Clearance: To redress the balance of scrub on open grey dune and yellow dune areas.
2. Non-intervention: Several areas of scrub in the southern part of the site were identified for non-intervention where the mixed dune scrub of sea buckthorn, elder and hawthorn would develop naturally (except for eradication of non-native species).
3. Scrub-grazing: Livestock grazing would be allowed to influence the scrub structure and develop a mosaic of scrub and grassland.
4. Coppicing: Blocks of scrub would be coppiced to ground level in both young and old dune systems to maintain the community and diversity the age range.

Clearance work began first on the West Dunes in the early 1960s by Lincolnshire Wildlife Trust when a bulldozer was used to create two parallel rides. Other clearance was carried out by the military in 1969 to check for unexploded ordnance and to restore dune grassland. Clearance continued on a smaller scale on the dunes at the south end of the nature reserve (where access was easiest) and gains in open habitat here were probably offset to some extent by scrub advancement further north in the dune system. With better information on vegetation cover in the 2000s a more targeted approach to scrub clearance was developed.

In the early 1990s areas of grey dunes on the East and West Dunes were cleared of sea buckthorn scrub by manual techniques (clearing saw or chain saw), linked to an expansion of the grazing programme. The general policy has been to work out from remaining open areas to push the scrub back. The Lincolnshire Wildlife Trust has a medium-term programme of scrub clearance set out in the management plan for Gibraltar Point NNR. Most of the cut material is burned on site avoiding areas of open dune grassland and using fire pits which are covered with fresh sand after use. As well as problems with re-growth, weed species such as creeping thistle *Cirsium arvense*, rosebay willowherb *Epilobium angustifolium*, ragwort *Senecio jacobaea*, spring beauty *Claytonia perfoliata* and nettle *Urtica dioica* are all abundant on the rich soils remaining after clearance. Sea buckthorn re-growth can be sprayed with Timbrel or weep-wiped with Glyphosphate: good results have been achieved in September. The management of the ragwort, rosebay willowherb and thistle includes hand pulling (especially ragwort with the lazy-dog tool), brushcutting (for rosebay willowherb), selective herbicide and grazing.

Experience at Gibraltar Point shows that the amount of work required in the follow-up stage to actual clearance should not be under-estimated and needs to be built in to project planning. Ideally the enriched soil layers would be scraped off but the issues of disposal and cost would be too great. Unexploded ordnance also remains a problem despite Gibraltar Point being given a Land Clearance Certificate in the late 1960s. In terms of techniques there is a strong argument for uprooting scrub with heavy machinery which may reduce the amount of follow up work required and may bring up fresh sand to the surface. Inverting part of the topsoil and exposing fresh sand should provide better conditions for the re-establishment of dune vegetation.

With non-intervention the older areas of sea buckthorn and elder scrub on the inland ridges may be gradually replaced by sycamore. The presence of sycamore can lead to a transition from dune scrub to maritime woodland and this succession is allowed to continue in parts of the West Dunes.

Sheep grazing was practised at Gibraltar Point in the early 20th Century although probably limited to the southern part of the West Dunes. This had ceased by the 1920s. An extensive grazing regime was re-established in the West Dunes in the 1980s and expanded to the East Dunes in the 1990s mainly with Hebridean sheep and Lincoln Red cross and Dexter cattle. The cattle help to create good 'edge' habitat between grassland and scrub by pushing through the scrub and breaking bushes and create good conditions for follow-up grazing by sheep. The Hebridean sheep positively select woody material as browse and will preferentially graze sea buckthorn. The stock fencing was installed under Higher Level Stewardship (England agri-environment scheme) capital works programme.

Rabbit grazing appears to suppress the spread of sea buckthorn by stripping young shoots of leaf buds and bark and by gnawing bark on older growth in hard winters. Sea buckthorn spread from suckers and possibly through seed following the outbreak of myxomatosis in the 1950s. This spread of scrub may have contributed to the loss of natterjack toad *Epidalia calamita* and the brown argus *Aricia agestis*.

The scrub coppicing programme started in 1995/6 on part of the site known as Measures, involving the coppicing of c. 0.5 ha /year on a 20 year rotation. In each block, 75% of the scrub is coppiced with cut material either burnt or used as dead hedging. In some areas re-growth has been browsed by rabbits unless it is coppiced high. As well as diversifying the canopy structure and rejuvenating scrub the coppicing also exposes temporary bare ground for about three years before the canopy becomes established again. In some areas sheep and cattle will have access to coppice blocks to slow the rate of re-growth.

The management of the Gibraltar Point NNR also has to be taken in the context of the wider dune system which includes Seacroft Golf Course, where 10ha of scrub was removed in the mid-late 2000s, and Seacroft Marsh SSSI, which is a non-intervention site owned by East Lindsey District Council. Although there is a poor floral association with sea buckthorn scrub there are some invertebrates which are totally dependent on the species. One of these, the micro-moth *Gelechia hippophaella* was first described at Gibraltar Point. The larvae of this moth can cause severe defoliation.



Gibraltar Point NNR: hand digging of sea buckthorn suckers © John Houston

The sea buckthorn scrub at Gibraltar Point is particularly noted for its value for wintering, passage and breeding birds. The dune scrub can support one of the highest densities of nesting birds of any UK habitat: the dense scrub is favoured by dunnoek *Punella modularis*, reed bunting *Emberiza schoeniclus* and linnets *Carduelis cannabina* whereas an older scrub with hawthorn is favoured by turtle dove *Streptopelia turtur*, yellowhammer *Emberiza citrinella* and long-eared owl *Asio otus*. The bird observatory, established in 1948, studies the migrant birds including warblers, thrushes, flycatchers and finches.

The management plan for Gibraltar Point NNR notes that fire can have a catastrophic effect on dune scrub. Where this does happen the management response is likely to accept a change towards dune grassland.

Saltfleetby-Theddlethorpe Dunes National Nature Reserve

Saltfleetby-Theddlethorpe Dunes NNR is a nationally important site stretching 8km along the north-east Lincolnshire coast, which includes flats, dunes, salt and freshwater marsh which together support an exceptionally rich flora and fauna. Dunes first began to form in this area in the 13th Century and the coast has continued to accrete. The 552ha National Nature Reserve now includes 175ha of dunes of which 80ha are dominated by dune scrub. In the absence of grazing the dunes become dominated by scrub of sea buckthorn, hawthorn, wild privet and elder, all frequented by migrant birds. Dune scrub is important for nesting dunnoek, wren *Troglodytes troglodytes*, whitethroat *Sylvia communis*, blackcap *Sylvia atricapilla* and willow warbler *Phylloscopus trochilus*. In winter months the berries, along with those of hawthorn and elder, provide food for flocks of fieldfare *Turdus pilaris* and redwing *Turdus iliacus*.

At Saltfleetby-Theddlethorpe Dunes NNR there was a significant increase in scrub from 25ha on 125 ha in 1953 to 80ha on 175ha in 2001. Although this is partly due to natural succession it increased in pace in the 1950s following the decline of the rabbit population. The site has been maintained at the 2001 level by autumn grazing on grey dunes, coppicing of scrub on yellow dunes and the control of scrub on the fore-dunes (Cooter 2009).



Saltfleetby 1953: 25ha of scrub on 125 ha © Natural England
Saltfleetby 2001: 80ha of scrub on 175ha © Natural England

Cooter (2009) reports that the reasons for the spread of sea buckthorn scrub might include natural factors such as dune accretion, the medium-fine nature of the sand, high calcium content of the sand, a lack of root-destroying nematodes and the location of the site which faces east but has a prevailing westerly wind.

Other reasons for the present distribution of scrub, linked to management decisions and practice, might include the cessation of grazing in the 1930s, the loss of rabbits in the 1950s, the clearance of scrub for the re-establishment of grazing from 1978 onwards and the policy of managing for 50% grassland and 50% scrub.



1979: volunteers cutting Sea Buckthorn scrub at Saltfleetby-Theddlethorpe NNR © Natural England

The programme of coppicing, which began in 1990, did not achieve the range of succession states of sea buckthorn scrub as envisaged. The plants were not taken back to a pioneer stage but to a coppiced root stock with vigorous growth (Cooter 2009). This had the effect of producing even-aged blocks of dense sea buckthorn scrub rather than a mosaic of pioneer scrub. To promote early stage succession, sea buckthorn clearance needs to be followed by grazing to maintain a more varied structure.

The following target has been proposed:

Core area of permanent grassland:	50%
Core area of permanent scrub:	25%
Grassland/scrub mosaic:	25% (ranging from 33%-66% scrub cover)

The grassland scrub mosaic is to be maintained by grazing/browsing following successful trials using all-year grazing with Highland cattle on cleared areas and the effective browsing of Hebridean sheep on young sea buckthorn plants.

The target is to clear 17ha of scrub from Saltfleetby-Theddlethorpe Dunes NNR. The areas identified take into account the existing structure of the scrub, the specific target to remove the invasive *Clematis vitalba*, ease of follow up management and public access and use. The beginning of the five year scrub management plan is reported by Cooter (2009).

The clearance involves the use of heavy machinery to grub up sea buckthorn. This has been costed at £5,000/ha. The re-growth is being controlled using the herbicide *Timbrel*¹⁶, applied at 6 litres/ha by boom sprayer, weed-wipe or knapsack sprayer depending upon the density of re-growth. The wetting agent Mixture-B is used to increase the uptake of herbicide. The costs for herbicide application were £500/ha. To help the establishment of dune grassland on the cleared dunes, grass cut by forage harvester (cut and collect) from other areas of grey dune is spread over the cleared areas. Early results are good and the re-establishment of grassland will be followed up by fencing and grazing. Low stocking rates will allow a degree of scrub to return to create the desired scrub/grassland mosaic.

The current objectives for management are;

- Varied and dynamic dune structure
- Increase in open yellow dune
- Control of invasive introduced species (especially *Clematis vitalba*)

¹⁶ Timbrel is a selective herbicide containing 667 g/litre (44.3% w.w) triclopyr butoxy ethyl ester. It controls a wide range of woody weeds while being selective to grass and is also used as a stump treatment.

At Saltfleetby-Theddlethorpe Dunes NNR, it is thought the clematis species was accidentally introduced to the site through garden waste disposal. It has spread rapidly through the sea buckthorn scrub and in areas can completely shade out and kill the sea buckthorn. As *Clematis vitalba* can be a component of dune scrub without becoming rampant managers are not yet sure how to tackle this problem which, for now, seems to be an issue in the UK only on the Saltfleetby-Theddlethorpe and Gibraltar Point SAC¹⁷.



Spread of Clematis vitalba at Saltfleetby-Theddlethorpe Dunes NNR © John Houston

To achieve this objective a five-year programme of sea buckthorn management is being implemented to covert 17.6 ha of permanent scrub to a mosaic of scrub and grassland. Rotational coppicing (practised since the 1990s), although recommended by the earlier report of Dargie (2002) has been discounted as it is very expensive and doesn't always lead to diversity of the scrub community. A more dynamic approach is being used, using machinery to clear scrub from areas which can be fenced, uprooting material where possible but minimising damage to the topography. The work is seasonal (avoiding the main bird breeding period) and designed to require minimal follow up with most areas being maintained by grazing and browsing.



Scrub management work at Saltfleetby-Theddlethorpe NNR© Natural England

¹⁷ A network visit to the Dunes du Perroquet in North France in October 2010 saw a very similar situation to that at Saltfleetby-Theddlethorpe NNR. *Clematis vitalba* was growing up into stands of sea buckthorn and smothering the plant. The managers considered this to be natural.



A range of heads are used on machinery © Natural England

Follow up work includes fencing, grazing, mowing green hay, herbicide application and control of weeds. Monitoring is by fixed point photography, aerial photography and through Common Standards Monitoring.

Merthyr Mawr Warren National Nature Reserve

Merthyr Mawr dunes partly overtop a limestone escarpment making it the site of the highest dunes in Wales. A single-sex colony of sea buckthorn was first planted towards the back of the dune system in the 1840s to provide shelter and stabilise the dunes. For a century this worked well, but between 1930 and 1965 plants of the other sex were introduced and this probably triggered the spread of colonies of scrub (Dargie 1992). By the 1950s the existing stands had begun to spread and coalesce and new stands started to appear across the dune system. Rapid spread is also linked to the introduction of myxomatosis in the 1950s. Prior to this the density of rabbits was controlling the spread of the plant (Dargie 1992).

By 1992 20% of the 365ha warren was covered in sea buckthorn (Dargie 1992). The led to a large-scale clearance programme linked to the introduction of grazing to some parts of the site.

Table 2: The extent and colony numbers of sea buckthorn at Merthyr Mawr warren (from Dargie 1992)

Air Photo date	Extent (ha)	Number of colonies
1957	1.52	7
1967	16.5	36
1971	17.52	31
1988	42.28	276
1991	53.79	82

The pattern of scrub invasions in the establishment of discrete circular colonies, probably following bird dispersal, which then coalesce to form large continuous blocks of dense scrub. Between 1967 and 1971, for example, the extent of scrub cover increased but the number of colonies decreased. Similarly after an explosion of colonies shown on the 1988 aerial photograph (2726 colonies) these had coalesced to 82 by 1991. Colonies expand to meet each other and then coalesce. Further mapping (Richards and Burningham, 2010) estimates the maximum extent of sea buckthorn scrub at 60.9 ha in 1996.

Dargie (1992) gave estimates of possible increases in sea buckthorn scrub of c. 68ha by 1995 and over 110ha by 2000-2003.



Merthyr Mawr warren 1948 © CCW

Merthyr Mawr warren 2006 © CCW

A clearance programme was initiated in 1996 by which time c.60 ha of the 360 ha site was sea buckthorn scrub. Only 30ha of mobile *Ammophila* dunes were present and the SD18a community was only 4-7ha. Of high priority for clearance were the dune slack areas.



Management work (left) and spread of ragwort *Senecio jacobaea* on cleared areas (right) © CCW

Treatment included extraction using heavy machinery. A large weed rake was found to be effective for grubbing up roots. Other treatments included hand (chain saw) cutting and stump treatment with herbicide and also foliar spraying with *Roundup*.¹⁸ Clearance work between 1996 and 2006 reduced the total area of scrub to 23.5ha (Richards and Burningham, 2011).

Following clearance there were concerns about the presence of ruderal vegetation including ragwort, rosebay willowherb and Himalayan balsam *Impatiens glandulifera*. The ragwort was seen as a particular problem. The study by Richards and Burningham (2011) shows that clearance alone is not enough to recover dune plant communities; the exposed bare sandy soils encourage the spread of ruderal species creating a secondary problem. The authors recommend that different clearance methods should be evaluated, both in terms of their effectiveness of scrub control and in reducing the secondary problem of invasion by ruderal species.

Follow up has included the introduction of cattle to maximise diversity through grazing and browsing. The cattle are mainly Hereford crosses with one or two Highland cattle. Monitoring is by fixed point photography, aerial photography and field surveys two years after clearance then every five years.

¹⁸ Roundup is a total weed control with active ingredient 450g/l glyphosphate.

East Lothian Council

Sea buckthorn scrub is a feature of the coastal dunes in East Lothian. Though long-established in the area, current opinion is that it is not native to the county. East Lothian Council has over 30 years experience of working with sea buckthorn. Its current 'vision' for control has the following elements (East Lothian Council 2010):

- To monitor the distribution, spread and age of sea buckthorn at managed sites
- To reduce and / or eradicate the area of sea buckthorn to restore coastal grassland
- To never plant the species in the foreseeable future
- To contribute towards the development of national policies for the management and control of sea buckthorn
- To encourage private landowners to manage the species

The criteria used to determine control measures, if desirable, are based on work at Aberlady Bay Local Nature Reserve (Harrison, 2008) which developed a scoring system to help prioritise work. The criteria are based on the negative impacts of sea buckthorn (such as size of stands, threats to grassland habitats, threats to key species and rate of spread) weighed against positive impacts (such as wildlife value, usefulness for visitor management value and site-specific issues).



Spread of sea buckthorn scrub by suckering at Yellowcraig © East Lothian Council

The reason for the problem of sea buckthorn in East Lothian stems from active suckering from existing stands; widespread historical planting (especially for coastal erosion control techniques) with ignorance of the consequences of this work; a lack of effective management of sea buckthorn stands; a possible influence of climatic amelioration (warmer, wetter winters and summers giving a longer growing season) and the spread of the plant by birds (frugivory).

The management objective is to contain sea buckthorn to agreed areas within each coastal site owned or managed by East Lothian Council. This will be achieved by a long-term programme of removal of sea buckthorn from identified areas, employing a variety of techniques appropriate to each site and each population stand.

Early management work included hand clearance by lopping and cutting stems to maintain path networks. Hand digging of young plants and their roots was effective but also labour intensive. For

mechanical clearance a tractor (fitted with a back actor digging bucket) was used in the winter months to clear scrub, supported by chainsaw operators. A chain attachment fitted to the rear of the tractor also enabled large plants to be uprooted. Cleared material was either burnt on site or used as dead material in the construction of 'Dutch fences' to counter dune erosion. This programme was effective until the annual work programme was cancelled due to lack of funds. In the following period sea buckthorn rapidly re-grew in most areas.

More recent control methods (2006-present) still employ a combination of manual and mechanical treatments. Hand-digging of young plants, to remove the entire plant and root system, is still an effective method for localised control with little interference to the dune vegetation. These techniques can be used at the edge of large stands, where the plant is spreading into new habitat, and where the plant can still be controlled by hand.

For mechanical clearance there was a move away from tractors to tracked machines. A combination of a tracked forestry mulcher and a 360 degree excavator 'grabber' (with a variety of bucket head attachments) was initially used. The mulcher was effective for 'breaking into' large stands and shredding the woody material but had the disadvantage of leaving debris which enriched the soil and also of leaving cut stems and root systems which had the potential to regenerate.

More recent management practice therefore favours the use of the grabber, which, by using different attachments can handle both smaller (c. 1m) and larger (5m+) plants. The grabber can also shake the uprooted material to return much of the sand.

The grabber was first used in early 2007. Plants were uprooted, stacked in piles, left to dry out, and burnt in the following autumn. Problems were that the piles trapped windblown sand, affecting the topography of the area, and also the stacked material could be set alight. The current approach is now to burn the material as soon as possible, though there is concern over the amount of carbon emissions generated by this process. It is still possible that some piles in remote areas and where there is little movement of sand can be left to dry out. This produces a quicker and less smoky fire in the following autumn / winter.

Two local golf courses, Gullane Golf Club and Archerfield Golf Club, had used chemical treatment as a means of control and East Lothian Council has also adopted this practice using either a glyphosate-based product, e.g. *Roundup*, or Triclopyr emusifiable concentrate based (solvent) herbicides, e.g. *Timbrel* and *Nu-Shot*. Whilst these are effective for killing sea buckthorn, there are some questions about their use, including the appropriateness of the use of chemicals on unimproved grasslands. *Timbrel*, however, is selective and will only kill woody species, and other products can be wiped onto leaves or painted onto cut stumps. Chemical control appears to be particularly effective on small plants and re-growth, if carried out in the spring, 12 months after original clearance, and followed up with an autumn treatment (i.e. 18 months after original removal). Thereafter there is monitoring and respraying of further regeneration.

In summer 2009, ten sheep were put into areas containing sea buckthorn plants at Aberlady Bay Local Nature Reserve to assess their effectiveness in controlling the species. Early indications showed that the sheep preferentially grazed the young sea buckthorn shoots. The experiment would suggest that it is best to clear fencable areas of scrub prior to introducing stock

Ideally, grazing would be able to maintain the mosaic of grassland and scrub and other animals, such as Dexter cattle, may be assessed for their grazing potential.

In summary, the methods employed by East Lothian Council include;

- Manual removal by digging, pulling (small areas only), lopping and cutting (where aim is to provide a path through a stand)
- Stump wiping /spraying- using herbicides such as *Nu-shot*, *Timbrel* or *Roundup*
- Mulching, only used to create the initial cleared area
- Using machinery for grabbing, the preferred technique for clearing larger plants. Different head units, such as tines or stone buckets, can be selected according to the age of the plants/stand, the size of area to cover and the effect upon the underlying topography.

Monitoring of the results of work is carried out through field observations by rangers, using marker posts to delineate hard edges, vegetation (quadrat) surveys, individual plant surveys (growth/regeneration of stumps), fixed-point photography (ground) annually at each site, aerial photography every 5 years and annual records of activity.



Tracked forestry mulcher, piloted in 2007

360 degree grabber with long tines for uprooting plants and roots

Alternate grabber head unit piloted for removal of smaller plants

Stone bucket head piloted in attempt to remove more of the root system

All © East Lothian Council

Some of the issues which arise from the work were what to do with the cuttings from the work, the impact of mechanical grabs on the underlying topography, the season for the work (limited to September-February), public reaction to the use of herbicides, timing of herbicide application and whether the work would encourage the spread of other aggressive non-natives such as pirri-pirri bur *Acaena novae-zelandiae*.

Table 3: Advantages and disadvantages of each technique summarised by East Lothian Council.

Technique	Advantages	Disadvantages
Hand clearance	Can remove small suckering plants	Laborious/ not effective on mature plants
	Little disturbance to other vegetation	Reliant upon volunteers being available
		Cuttings need to be burnt or removed off-site
Mulcher	Quick removal areas of mature scrub	Regeneration from roots left in the ground
	Clears young plants (c. 1m) in one pass	Unknown damage to ground flora during access to / from areas of operation
	Chips material – quicker decomposition?	Material into soil -nutrient enrichment
		Cannot access remote / difficult locations
		Cost
Grabber	Removes entire plant/more root system	Disposal – burning not especially 'green'
	Used on steeper gradients/ uneven ground	Cannot access remote / difficult locations
	More selective in operation - better suited to work on sensitive areas	Unknown damage to ground flora during access to / from areas of operation
	Piles up plants - avoiding potential for nutrient enrichment	Cost
	Different head units can be used to suit requirements	Cannot remove smallest plants
Chemical	(Potentially) targeted application - leaves remaining flora unharmed	(Potentially) other flora may be affected by spraying programme
	Kills plant and root system	Dead plants still need to be dug out and removed
	Can access remote locations relatively easily	Longer-term consequences of repeat spraying on natural habitat?
	Can be applied to adult and small plants	Limited 'weather window' for application
		Areas need to be cordoned off from the public (and dogs) during and after treatment
	Cost	
Grazing (by sheep)	Targets regenerating plants and suckers	Cannot graze mature plants
	Constant effort provided	Daily monitoring of flock required
	No material to be burnt or disposed	Effect of droppings / urine on unimproved grassland?
	Public interest	Not practical on sites with large visitor numbers
	Relative cost	Set-up costs / infrastructure

Experience found that prices for the hire of the forestry mulcher and the 360 excavator/grabber varied enormously: from 2007-2009 contractors fees varied from £1,000 / day to £250 / day depending on competition for work. In 2010 the prices were c. £300 / day. Much of the work has been completed through grants from Scottish Natural Heritage.

With more pressure on finances East Lothian Council will perhaps have to seek a market for sea buckthorn to help support the annual programme of work. For example, the Council was approached by a wild food supplier asking permission to harvest the berries to prepare jelly and cordial products for restaurants and specialist food shops in Edinburgh. The Council will have to balance the demand for the wild produce, with its potential income, against the value of berries for wildlife. Also cut plant material may have a market as a fuel although it may be difficult sourcing interested contractors. However, it might make economic sense to allow contractors to remove sea buckthorn annually at no cost to the Council, the contractors making their profit from sales.

Table 4: Summary of case studies (see <http://www.barger.science.ru.nl/life/download/2004/promme.pdf> for further information on PROMME

Site	Problem	Reasons	Objective	Management	Monitoring	Execution
East Lothian	Spread of sea buckthorn on coastal dune grasslands	Active suckering by adult plants Widespread planting (especially for coastal erosion control techniques) Lack of effective management of sea buckthorn Possible influence of climatic amelioration Spread of the plant by birds	Contain (eradicate) sea buckthorn to agreed areas achieved by a long-term programme of removal of sea buckthorn from identified areas, employing a variety of techniques appropriate to each site and each population stand	Hand- digging, pulling, lopping and cutting Stump wiping /spraying- with herbicides. Mulching to create the initial cleared area Grabbing using machinery fitted with a variety of head units including tines and stone buckets	Field observations Marker posts Fixed-point photography Aerial photography Annual reports	Work started winter 2006 Issues: Disposal of woody debris? Impact on topography? Season (September-February) Public reaction to use of herbicides? Spread of non-natives? Public outcry?
Merthyr Mawr	Spread of sea buckthorn from 1950s onwards	Introduction of second sex of plants Reduction in rabbit grazing	Site divided into high, medium and low priority areas for sea buckthorn control	Mechanical clearance	Fixed point photography Aerial photography Field surveys -2 years after clearance and then every five years	Issue of archaeology Techniques included foliar spray Cutting and stump treatment with herbicide Extraction using heavy machinery Issues: colonisation of cleared areas by ruderal species e.g. ragwort, rosebay willow-herb and Himalayan balsam Smoke production from burning sea buckthorn
Saltfleetby-Theddlethorpe NNR	Spread of sea buckthorn scrub Spread of invasive clematis (negative impact of sea buckthorn scrub)	Lack of grazing since 1930s , natural succession, dune accretion, and decline in rabbits from 1950s	Maintain 50% as permanent grassland, 25% as permanent scrub and 25% as grassland/scrub mosaic	Grazing Coppicing Scrub control on fore-dunes Techniques include mechanical clearance, herbicide, removal of re-growth (grass), fencing and introduction of grazing	Fixed Point photography, aerial photography and Common Standards Monitoring (for Dunes with Hippophae rhamnoides)	Re-establish grazing in 1978 Coppicing started 1990 but did not achieve desired results Five year scrub management plan on current objectives to clear 17ha of scrub
Gibraltar Point NNR	Spread of sea buckthorn from 1950s onwards Spread of invasive clematis (negative impact of sea buckthorn scrub)	Loss of sheep grazing and rabbit grazing	Establish a balance of habitats. No significant decrease in total coverage from 1999 baseline but control where it threatens other habitats Maintain age classes	Re-introduction of grazing Coppicing Laissez-faire in some areas	Aerial photography demonstrates pattern of scrub colonisation Undergraduate research project from University of York to assess grazing preferences of Hebridean sheep and Dexter cattle	Sheep re-introduced in mid-1980s to grey dunes Coppicing started 1995-1996. 0.5 ha /year on 20 year rotation Laissez faire approach allows dieback of scrub and re-colonisation

6. Follow up and action points

Graham Weaver

Current status and management of sea buckthorn

A starting point for a wider national review would be to send out questionnaires to sand dune site managers repeating the surveys from the 1970s and 1980s and drawing information together to develop up-to-date strategies.

There have been some early discussions concerning the value of repeating the national sand dune survey. Within this context it would be worth exploring the role of remote sensing in mapping the extent of sea buckthorn scrub on UK dunes.

If remote sensing can provide a good picture of the extent of sea buckthorn scrub on dunes (although it may be difficult to identify colonising scrub within dune grassland) a bid for funding could be prepared.

Setting a nationally agreed strategy for the management of sea buckthorn

Natural England will raise the issue of a coordinated approach to sea buckthorn with the other Country Agencies (Scottish Natural Heritage, Countryside Council for Wales and the Northern Ireland Environment Agency) and the Irish National Parks and Wildlife Service. If there is agreement a national (GB and Ireland) strategy could be developed.

A 'national strategy' would identify individual sites by, initially, three categories – eradication, containment, and 'dynamic management'. The 'containment' and 'dynamic management' categories would be further refined. Within each country this would need to be a collaborative process between the Country Agency and each site's management organisation. The strategy will help to inform resource requirements.

Developing guidelines for management, post-clearance of sea buckthorn scrub

The workshop showed that techniques for the removal of sea buckthorn scrub are well understood, although there is still a discussion to be had over whether or not to minimise soil disturbance at the time of clearance (which links directly with post-clearance management).

The workshop also demonstrated that there is much less understanding about optimum post-clearance management to develop dune grassland and there is a clear need for some guidance.

The Sand Dune and Shingle Network could help to develop draft guidelines, including case studies.

Future monitoring requirements

There is little information on the soils under sea buckthorn on Great Britain and Irish dunes, or on how they change post-clearance. This is of utmost importance in understanding what type of grassland can develop, and over what timescales, without major dune remobilisation to expose raw sand. Therefore soil sampling needs to be incorporated into site monitoring and the preferred soil sampling techniques should be identified.

There is little collated information on sea buckthorn succession on Great Britain and Irish dunes. It would be valuable to assemble information from site managers and through the 'grey literature' (management plans, site reports etc) to build up picture of sea buckthorn succession and to publish a more thorough review.

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The management of Sea Buckthorn *Hippophaë rhamnoides* L. on selected sites in Great Britain.
Norwich, Nature Conservancy

Links to other documents/organisations [Accessed: 5th July 2011]

Sand dune and shingle network:
www.hope.ac.uk/coast

The scrub management handbook: <http://naturalengland.etraderstores.com/NaturalEnglandShop/IN124>

The herbicide handbook:
<http://naturalengland.etraderstores.com/NaturalEnglandShop/IN125>

Grazing Animals Project (GAP):
<http://www.grazinganimalsproject.org.uk/>

The breeds profile:
http://www.grazinganimalsproject.org.uk/breed_profiles_handbook.html

The nature conservation value of scrub in Britain (JNCC report 308)
<http://www.jncc.gov.uk/page-2445>

Condition assessments of protected sites (SSSIs and SACs) – Common Standards Monitoring:
Sand dunes – <http://www.jncc.gov.uk/page-2204>
Introduction to CSM – <http://www.jncc.gov.uk/page-2201>

UK report to EU on Conservation Status of Annex 1 habitats, including 'Sea buckthorn scrub':
<http://www.jncc.gov.uk/page-4064>

EU 'composite reports' on Annex 1 habitats, including 'Sea buckthorn scrub':
<http://biodiversity.eionet.europa.eu/article17/chapter9>

8. Workshop participants

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3. The conservation and management of Sea Buckthorn (*Hippophaë rhamnoides*) in the UK. P.J. Rooney, J.A. Houston, G. Weaver, 2011
4. Coastal dune management at selected sites in The Netherlands: South Holland and Zeeland. C.N. Durkin, 2011

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