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Sand lizard Species Recovery Programme project (1994 - 1997) Final report

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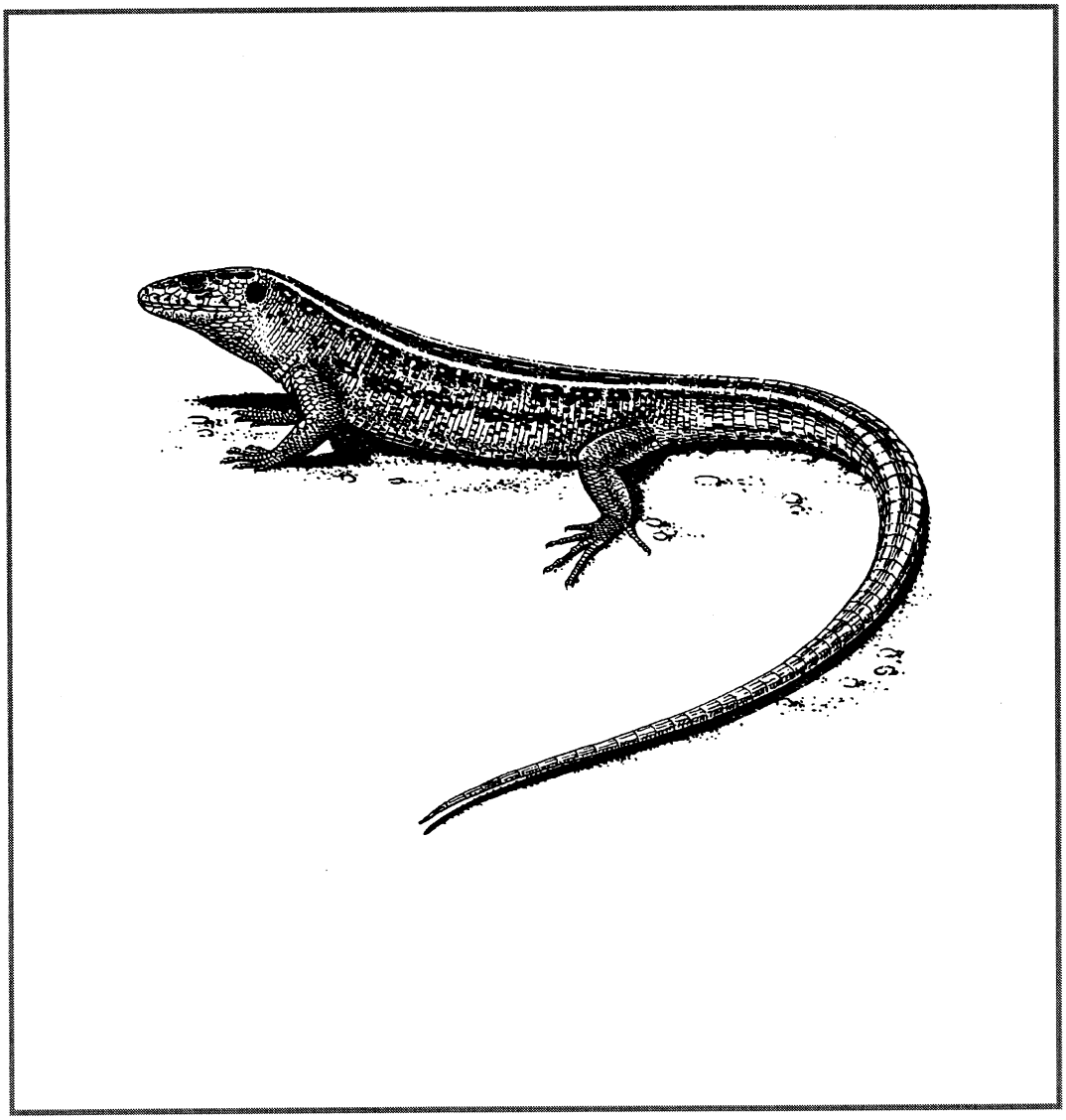

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English Nature Research Reports

Number 288

Sand Lizard Species Recovery Programme Project (1994-97)

K.F. Corbett & N. Moulton

A separate volume of appendices to this report has been produced. However, as this contains details of sites it has been classified "In Confidence" and has a restricted availability

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Contents

Summary

Because of the continuing decline and threats to the survival of this species in the United Kingdom, the sand lizard (*Lacerta agilis*) was included in English Nature's Species Recovery Programme. A three-year contract was given to the Herpetological Conservation Trust (HCT) to undertake the work from April 1994 to September 1997. This was jointly funded by HCT, English Nature (EN), Worldwide Fund for Nature (WWF) and Countryside Council for Wales (CCW). The project met or exceeded all the prescribed targets.

a. Habitat management

From the outset it was realised that site management for this species was only practical (and justifiable) at a level of *'foci'*. These are definable 'hot spots', often with clearly identifiable and favourable topographical features. Work concentrated on *foci* with lizards (actual *foci*) and those that could become suitable following management (potential *foci).*

The Sand Lizard Species Recovery Programme project (SLRP) completed and initiated management respectively in 120 and 26 *foci* exceeding the target of managing between 50 and 100 *foci.* This, however, equates to less than one quarter of the extant and potential *foci* in the UK. Fifteen habitat linkage schemes were undertaken (linking 30 populations). Although this met the target (set at between 10 and 20 'links') this is a lower number than had been hoped. We regret that more progress could not have been made with other habitat schemes in furthering the objectives of the SLRP. Many schemes, potentially relevant to this project, were largely ineffective or even proved detrimental to the aims of *foci* management. There is considerable scope to develop such schemes further to promote the conservation of measures for specific species in future.

b. Translocations

The SLRP had a target of completing between five and 10 translocations. A total of 972 (833 captive bred and 139 wild-caught) sand lizards were re-introduced to 11 sites, nine of which are completed (the remaining two are ongoing). Six reintroductions were to heathland sites and five completed reintroductions were to high priority dune sites. These translocations re-established the species in four Counties/areas where the species had become extinct. All of these translocations have initially been successful. Three new sand lizard vivaria were built, mainly to support Merseyside and Wealden captive breeding stock which were at precariously low levels at the outset of the project. The initial sand lizard captive breeding stock of 85 adults has been increased to 116.

c. Production and implementation of regional strategies

The SLRP was charged with assisting with between three and six local strategies and/or projects. Regional and local sand lizard strategies and other strategies relevant to sand lizard conservation eg Habitat Action Plans (HAPs), site management plans, etc. were written or consulted on during the SLRP in four different Regions. In addition help was given to local Biodiversity Action Plans and a Heathland Re-creation Plan within these areas. However many of these strategies have not yet realised their potential for the conservation of this species.

During the SLRP, 17 previously undesignated sand lizard sites have been given SSSI status, the majority of which are in Dorset. Three critical sites however remain in need of this protection in Merseyside.

d. Survey, monitoring and research

Extensive habitat and species surveys were undertaken during the SLRP. The *c*3000 observations of sand lizards obtained now need to be logged onto the HCT Rare Reptile Database. This database was set up as part of the SLRP by Joint Nature Conservation Committee (JNCC).

Survey methods for the species were evaluated. Random transects were shown to be inappropriate and impractical for repeatable and accurate monitoring. Pre-determined routes around features associated with this species proved to be the most reliable and effective technique. Intensive monitoring at one specific transect confirmed that the chance of seeing individual sand lizards was highly variable. Generally only a small proportion of the population would be seen in any transect. A maximum of 25% of the population was seen in any one visit: this occurring in only four of the 571 "passes" (<1% of samples) and that the number of sightings per hour was weather dependant.

Due to the high costs involved no genetic studies could be undertaken during the SLRP, though we hope that work on this will be done at Sussex University in due course.

There were 681 heath fires in Dorset during Summer 1995 and Spring 1996. These caused an average of 66% damage to 31 *foci* (ie the equivalent of 18% of the total managed during SLRP and nearly all of these were on sites that had been managed) and destroyed an estimated 85%+ of the lizards in these populations. Of these sites 80% had subsequent fires. In all, more than 1100 heathland fires were attended by the fire brigade in Dorset during the three seasons of SLRP. These fires are mainly the result of arson and due to the ever increasing public pressure on the Dorset heaths and such damage seems set to escalate due to the continuing process of urbanisation of adjacent land. This problem has drawn to the attention of the Bern Convention, and a field appraisal will be undertaken in Summer 1998. To date police resources provided to curb such arson have been negligible and there have still been no prosecutions. However, this is an area where we anticipate progress in the future.

The amount of sand associated with sand lizard colonies in dunes has been estimated as being between 5-34 % compared with a mean of 6-12% on heathland colonies. However, for heaths it has only proved practical (and widely acceptable) to expose sand at levels up to 2%. Even so, this has been proven to at least maintain breeding. The most efficient sand exposure methods are blading and turfing. Cultivation/rotovation produced a peat rich substrate unsuitable, at least initially, for egg incubation. Experimental bladed strips were positioned on a heath at various distances from known *foci* and at different aspects. Initially the strips closest to *foci* were used, though after three years all were used for egg laying. South and south-west facing exposures were favoured.

The value of retaining scattered trees on managed heathland has been the subject of debate. HCT retain a number of trees to reduce the effect of Summer heat and drought stress on the heath and so improve vitality of the heather. An independent botanist was contracted to assess the effects of HCT's management and found that the only detrimental tree species was *P. pinaster*, a species that HCT already preferentially removes.

The success of bracken control using the herbicide Asulox depends on the concentration used. At the maximum dilution permitted (1:20) control is effective and does not appear to produce the apparent resistance noted from previous spraying programmes that used lower dilutions (1:50 - 1:100). Long term monitoring is continuing.

Twenty nine *foci* are currently threatened and degrading due to the recent encroachment by the plant *Gaultheria shallon*. Control options were investigated. The restriction of its future sale and its eradication from lowland heaths must remain a high priority.

e. Publicity and education

Publicity and education work was undertaken throughout the SLRP. Events and information at local, regional and national levels were held and publicised via newspapers, radio, television, lectures, meetings, etc.

f. Conclusions

Although the SLRP met its targets for *foci* management, translocations, etc, its effectiveness was seriously reduced by events outside the control of the project. Heathland fires, continuing large housing developments, the neglect of or inappropriate *foci* habitat management and the lack of emphasis for management directed towards the needs of specific species were, and continue to be, a problem for the conservation of the species. It is suspected therefore that rather than recovering and enhancing the sand lizard in the UK, our considerable efforts simply balanced the adverse effects of continuing pressures. It is only via enforced species and habitat policies, and guaranteed long-term and realistic funding that the species will be able to attain a favourable conservation status. These should be at the heart of the Species Action Plan for the sand lizard, which is being developed through the UK Biodiversity Action Plan.

Introduction

Of the six native species of reptile, the sand lizard *Lacerta agilis* is the most endangered and yet also the most attractive. It is a 'stocky' species with a deep set head, is rather short legged and measures up to a total length of 20-22cm including the tail. Their markings and pattern are extremely variable and provide excellent camouflage. They are generally grey or brown with an intricate pattern of light and dark ocellate markings, with the males' flanks becoming vividly green during the breeding season. In the United Kingdom those from heathland habitats are notably spotted while those from dunes tend to be striped.

Sand lizards are found in a limited number of habitats. They are associated with heathland and sand dunes. Within these areas the species is localised and is associated with: a) sunny topographical features (termed *foci*) in mature dry heath on sandy heathlands and b) in dense marram grass *Ammophila arenaria* stands on coastal frontal sand dunes. In all habitats, areas of open unshaded sand are essential for successful egg incubation. In both situations the deep structure of ground vegetation is important. Only with such optimal conditions can they sustain a natural "colony" status. Populations can survive in deteriorated and secondary habitats though such situations often require active management.

Sand lizards are diurnal; after emerging from their burrows (either excavated by the lizards themselves or dug by a mammal) the animals bask in the sun. They need to warm themselves to become active to hunt a variety of invertebrate prey, court, and mate, etc. They retire into these sandy burrows at the end of their active day. They use the same refuges for their annual hibernation of 6-7 months, between September/October and March/April. Mating occurs in late April and May and eggs are laid by early June in unshaded exposed sand, including tracks, paths and fire-breaks. In years with early warm Spring and Summer weather some females can successfully lay two clutches of eggs. The juveniles emerge in August and September, and later for any second clutches. Males and females become sexually mature at 2 and 3 years respectively. They can live for 8-10 years.

The sand lizard is found across northern and central Europe into Asia within a taxon recognised as having nine sub-species. The UK has the sub-species *Lacerta agilis agilis*. *Lacerta agilis* is declining and under threat throughout its Palearctic range and beyond. The species is therefore listed on Annexe II of the Bern Convention (and subject to Recommendation 26, 1991 which calls for specific conservation action in a number of states party to the Convention) and Annexe IVa of the EC Habitats and Species Directive. It, together with its habitats, is therefore subject to protection under UK law. This is achieved via listing on Schedule 5 of the Wildlife and Countryside Act 1981 and Schedule 2 of the Conservation (Natural Habitats, etc) Regulations, 1994.

In the UK, natural populations have become extinct over much of their former range ie Kent, Sussex, north Surrey, Hampshire, Wiltshire, Devon, Cornwall, Berkshire, Cheshire and the whole of north and west Wales. Surviving populations are mostly on heathland habitats in south-east Dorset, often fragmented and surrounded by coniferous forests and urban developments. Only a few surviving populations remain in their previous strongholds on the Wealden heathlands of south-west Surrey and in Merseyside's dunes. Reintroductions have offset some of these historic losses. Historic losses and the current status of the sand lizard is shown in Figure 1 and Table1.

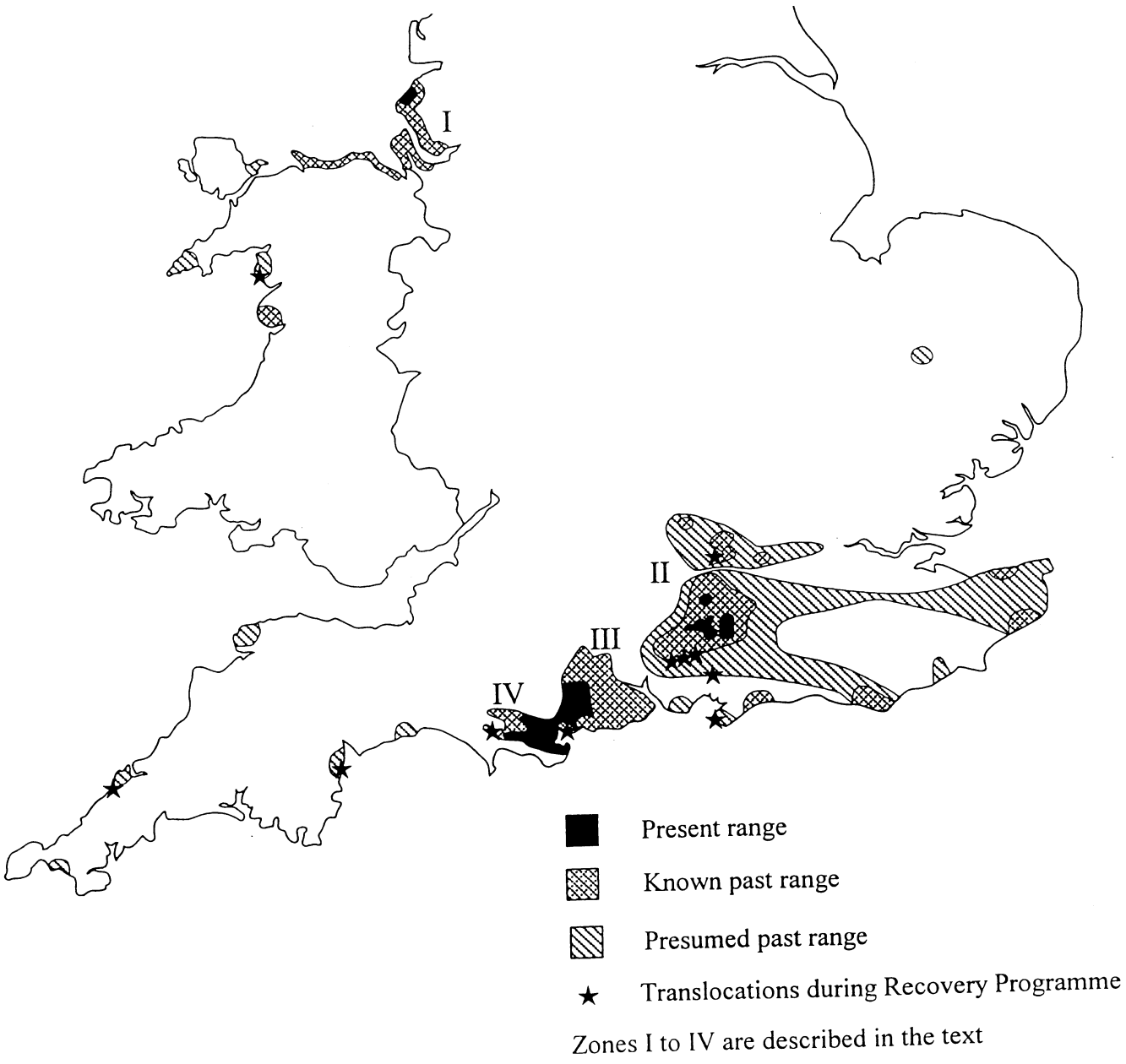

Figure 1. Sand lizard distribution UK including Sand Lizard Recovery Programme translocations 1994-7

Table 1. Historic losses and current status of the sand lizard (1997)

Zone	County/Area	Historic Losses	*Lacerta agilis* Status Pre SLRP 1994 (Including the % of populations from re-introductions)	*Lacerta agilis* Status Post SLRP 1997
I	Merseyside	97%	*c*300 adults (11% from 1 re-introductions	> 300 adults
	Cheshire	100%	Extinct	Extinct
	N.&W. Wales	100%	Extinct	1 re-introduction
II	Kent	100%	Extinct	Extinct
	Berkshire	100%	Extinct	Extinct
	Surrey	95%	*c*900 adults (72% from 12 re-introductions.)	> 900 adults + new 1 re-intro. = 13 re-introductions
	Sussex	100%	2 re-introductions	2 new re-introductions = 4 re-introductions
	Hampshire	100%	3 re-introductions	3 new re-introductions = 6 re-introductions
	Isle of Wight	100%	Extinct	Extinct
IIIa	New Forest	100%	*c*50 adults from 5 re-introductions	Unstable
	Wiltshire	100%	Extinct	Extinct
IIIb-IVb	Dorset	90%	*c*5300 adults (0.8% from 2 re-introductions.)	5300* adults + 2 new re-introductions = 4 re-introductions
IVc	Devon	100%	Extinct	1 re-introduction
	Cornwall	100%	Extinct	1 re-introduction

Source: Corbett, K. (1994) and Webb, N. (1986)

* = Losses from fires have counteracted SLRP conservation measures, such that comprehensive updating survey is now required.

Sand lizards and their habitat are particularly vulnerable to various types of damage and even to short-term changes in habitat quality. The animals themselves are slow colonisers even in ideal conditions. This means populations can easily be lost.

Threats which have been responsible for past losses and which are continuing include:

- loss and fragmentation of heathland to conifer afforestation, mineral winning, agricultural reclamation, urban development, etc; with dune systems vulnerable to coastal development, unfettered recreation, conifer plantation and, especially, the disruption of accretion processes by coastal defence works;

- deterioration of habitat through pine *Pinus* spp, birch *Betula* spp, bracken *Pteridium aquilinum*, gorse *Ulex* spp and other scrub encroachment (including shallon *Gaultheria shallon* on heath *foci*) and encroachment of sea buckthorn *Hippophae rhamnoides*;

- fires, both directly and via the subsequent invasion of bracken, gorse and birch;

- inappropriate management of *foci*, ie burning, over-grazing, forage harvesting, use of heavy machinery, etc;
- shortage of suitable breeding sand on heathland sites;
- urban pressures and recreational (mis)use, eg refuse dumping, erosion, mountain biking;
- trampling of vegetation on frontal sand dune ridges and public pressure erosion of frontal and fixed dune ridges;
- collection of sand lizards;
- cat and magpie predation;
- rabbit gassing.

Because of the continuing threat to the survival of this species it was included in English Nature`s Species Recovery Programme. A pilot study was undertaken to determine conservation objectives (Corbett 1994). A three-year contract was then awarded to the Herpetological Conservation Trust to undertake the work which was jointly funded by the HCT, English Nature (EN), the World Wide Fund for Nature (WWF) and the Countryside Commission for Wales (CCW), with welcome co-operation from the Ministry of Defence (MoD) and the British Herpetological Society (BHS).

The sand lizard was identified in the short list of species in need of action plans (UK BAP Steering Group 1995a and b), which rightly recognised this species as a UK priority for conservation action. During the period of the Sand Lizard Species Recovery Programme project (SLRP), the sand lizard Species Action Plan for UK was produced.

Species Recovery Programme project: logistics including targets

The SLRP project was based at the Herpetological Conservation Trust's offices in Bournemouth and organised from there by Dr Keith Corbett and Mr Nick Moulton. All aspects of the SLRP were undertaken by HCT staff, where possible in partnership with various organisations - see Acknowledgements. The SLRP project had the following objectives and targets:

The objectives of the project were to:

- Maintain existing populations and, where practicable, to enhance *foci* and link existing sites.
- Re-establish the species especially in representative sand dune sites across its historical range through a programme of translocations.

These objectives were to be achieved via the following targets:

- Management of 50-100 *foci*.
- Linkage of 10-20 populations.
- Translocation of sand lizards to 5-12 sites.
- Establishment and co-ordination of captive breeding facilities.
- Undertaking of applied ecological and conservation research.
- Assisting 3-6 local projects/strategies.
- Development of the Rare Reptile Database.
- Production and achievement of necessary publicity.
- Production of a *Conservation handbook* for sand lizards.
- Production of a long term conservation strategy for the sand lizard.

Meetings took place annually between SLRP project personnel and the Sand Lizard SRP Steering Group to monitor progress, and interim reports were produced at the end of the first and second years 1994 and 1995 respectively (Corbett & Moulton 1995 and Corbett & Moulton 1996a). SLRP project personnel also attended three Species Recovery Programme seminars at Peterborough and London, and gave presentations at two of them between 1994-7.

The rest of this report outlines the progress and problems in all of the target areas during the three and a half years of the SLRP project, ie April 1994 to September 1997.

Habitat management

General strategy

The main objective of the site management during the SLRP project was to identify extant and potential sand lizard *foci* and populations either at particular risk due to a lack of management input or which could be improved substantially by management activity. These identified *foci*/populations were incorporated into a three year work programme undertaken predominantly by HCT field-staff but also by some contractors under their direct supervision. Site management was achieved across the four main geographical zones of England where the sand lizard occurs. These are:

Zone I	Merseyside sand dunes - north Wales coast.
Zone II	Wealden heaths/Thames Basin area, ie north Surrey/north Hampshire and the coasts of Kent, Sussex and Hampshire (east of Solent).
Zone III a	New Forest heaths.
Zone III b	Dorset: Avon Valley - Lytchett Bay.
Zone IV a	Dorset: west of Lytchett Bay - Dorchester north of the River Frome.
Zone IV b	Dorset: west of Lytchett Bay - Warmwell south of the River Frome.
Zone IV c	Devon and Cornwall Coasts.

Effective sand lizard management and management techniques have been refined and undertaken on heathland sites for over 27 years via British Herpetological Society's Conservation Committee (BHSCC) and more recently through greatly increased professional HCT staff input.

Sand lizard management is very site specific though shares the basic aims and seasonal restrictions of current heathland/dune management in that it combats scrub, tree and bracken invasion. On heathlands it diverges somewhat in requiring more positive measures against fire, for sand exposure on localised *foci* and in the retention of a few trees to alleviate summer heat and drought stress on mature heather. Burning, grazing and foraging are incompatible with species management of sand lizard *foci* as they can cause damage to the species' specific habitat structure and to the resident populations for considerable periods of time.

The SLRP aimed to undertake management of 50-100 *foci* during its duration. This management included a combination or all of the following proven sand lizard management techniques: sand/firebreaks, scrub and tree clearance, bracken control and fencing. Work was completed of 120 *foci* and instigated at a further 26 *foci*.

Table 2 shows a summary of the *foci* management that were either completed or initiated during the SLRP by geographic zone. Summary information at the 'site' level is given in **Appendix 1**. Other sites that were initially managed by the SLRP are now managed by HCT and supported by other management schemes, eg Reserves Enhancement Scheme (RES).

Habitat management for sand lizards is seasonally restricted, ie sand (*c*.mid-April to mid-May), Bracken (*c*.July-end of August) and Scrub (*c*.mid-September to end of March). Any management undertaken out of the indicated timescale risks serious damage/disturbance to resident sand lizard populations and/or other wildlife - see **Appendix 2** Dorset Heathland Management Calendar.

Table 2. Completed and initiated *Foci* management

	SLRP *Foci* Management	
Zone	***Foci* Completed**	***Foci* Initiated**
I	7	1
II	28	1
IIIa	1	2
IIIb	56	17
IVa	8	0
IVb	19	5
IVc	-	-
Total	**120**	**26**

Sand/firebreaks

Provision and maintenance of open sand are possibly the most critical management requirements for *L. agilis* conservation as areas of unshaded sand are essential for successful egg incubation and therefore population recruitment. The only substrates suitable for egg incubation are: sands, gravels in a sandy matrix or, occasionally, friable well-drained clay wastes. Sand management is necessary on both fixed-dune and heath *foci*; mobile dune *foci* however have high amounts of bare sand and do not require any active sand management. The proportion of sand associated with sand lizard *foci* is reviewed on page 37.

Small areas of artificially exposed sand positioned around *foci* can quickly re-convert back to heath leaving this highly static species with few or no areas of suitable substrate to lay eggs. Population senescence and then localised loss of this species occurs without regular sand management.

There are a variety of methods available for initial sand management: turfing (ie removal of turfs of heather to expose bare ground), cultivating/rotovating (digging through vegetation to churn up open sand) and blading (use of bulldozer blade to reveal bare ground). For successful egg-incubation *L. agilis* requires a fine, well drained sand or gravel within a sandy matrix, with a low ratio of organic matter. Research undertaken throughout the SLRP has shown that only blading and turfing are successful in producing sand conducive to *L. agilis* egg-incubation. All other methods produced high peat:sand ratios that could not be used effectively by *L. agilis*. The results of studies of these varied methods for sand provision and the use of such exposed sand by *L. agilis* is summarised in the Survey, monitoring and research section (pages 38-40).

Where practical sand provision was also incorporated with fire prevention measures. Careful bulldozing (blading) along the edges of mown firebreaks around *foci* allows for both successful egg incubation and fire protection afforded by the provision of a sterile strip which can prevent fires spreading by side and back-burning through the peat layer.

Sand provision achieved under the SLRP is summarised in Table 3. Also see **Appendix 3** - for full schedule of sand management undertaken.

Table 3. Sand management

Zone	No. of sites managed	Exposed sand		
		Length (m)	Area (sq.m)	Firebreaks
I	7	-	123	0
II	18	7692	10830	7
IIIa	3	300	942	1
IIIb	53	2760	5206	7
IVa	7	2120	3512	3
IVb	12	3291	6065	4
IVc	1	-	8	0
Total:	**101**	**16163 (16k m)**	**26686 (2.6 Ha)**	**22**
Total man days: 124				

Bracken management

Bracken *Pteridium aquilinum* is both highly invasive and persistent, especially after fires, and is detrimental to most heathland wildlife. It is a serious threat to *L. agilis foci* habitat. Without effective management bracken can soon degrade/destroy *foci* habitat and consequently their sand lizard populations. See **Appendix 4** for detailed bracken management schedule.

There are various management regimes for controlling bracken. However the repeated mechanical control of bracken by spraying, cutting, rolling or pulling has not been seen to work during the SLRP. This has the added disadvantage of physical damage to the mature heather structure. The only viable method of controlling bracken in expanses of mature dry heath/*foci* remains the use of spraying using backpacks containing diluted 1:20 Asulam ("Asulox"). This is both cost and labour intensive and the areas treated can often be somewhat limited due to the very short effective spraying season. However, it remains the only appropriate method of control.

The possibility of bracken acquiring chemical resistance through previous sub-lethal Asulox treatments and the effectiveness of both current SLRP and past HCT/BHS management was assessed - see Survey, monitoring and research section (page 43).

Bracken management achieved throughout the SLRP is summarised in Table 4.

Table 4. Bracken management

Zone	No. of Sites Managed	Treated (sq.m)
I	-	-
II	19	219995
IIIa	-	-
IIIb	20	155510
IVa	6	111000
IVb	9	53680
IVc	-	-
Total:	**54**	**540185 (54 Ha)**
Total Man Days: 73		

Scrub and tree management

Scrub and tree invasion and the associated problems of shading, leaf-fall and soil eutrophication cause the deterioration and senescence of the mature dry heath on *foci* and the consequent loss of *L. agilis* populations.

The removal of some or the majority of the scrub to recover both the habitat and the species is essential, though the amount is dependant upon the individual site's requirements. If there are any areas of mature dry heath remaining it is also essential that they are not damaged, therefore the use of any vehicle/heavy plant should be prohibited or severely restricted. Subsequently the majority of the management during the SLRP was undertaken by small teams with chain-saws which took every precaution to minimise damage to *foci* habitat.

Denser cover is usually tackled in two phases over several seasons with cut stumps of deciduous trees being chemically treated to prevent re-growth. Phased management allows time for the mature heather to recover and reduces trampling damage to already stressed plants. Depending upon the individual *foci* conditions, some strategically placed scrub/trees are left to alleviate Summer heat and drought stress.

Old stands of gorse are removed (especially in the vicinity of access paths) to reduce the risk of fire. All of the cut material was disposed of by burning on-site in a safe area under suitable weather conditions or, in some cases, disposed of by more costly methods eg tractor mounted "chippers". See **Appendix 5** for detailed schedule of scrub and tree management.

Scrub management achieved through the SLRP is summarised in Table 5.

Table 5. Scrub management

Zone	No. of *Foci* Managed	Managed (sq.m)
I	9	22250
II	3	179720
IIIa	2	17500
IIIb	51	229425
IVa	8	70080
IVb	7	92940
IVc	-	-
Total:	**110**	**614915 (61.5 Ha)**
Total Man Days: 842		

Fencing

Fences are used to reduce/exclude sensitive *foci* from certain types of public pressure(s) usually related to habitat trampling, eg by bikes, vehicles, horses, etc. Therefore the provision of fences around the periphery of *foci* allows the habitat and resident sand lizard population to remain undamaged and, where previously damaged, allows for the habitat to recover. See **Appendix 6** for detailed schedule of fencing work.

A variety of fences were placed around sensitive *foci* during the SLRP mostly by using the cost-effective post and wire design or knee-rails.

Table 6a summarises the fencing schemes that were agreed/completed during the SLRP.

Table 6a. Fencing schemes agreed/completed during SLRP

Zone	Sites completed	Area (km)	Sites agreed/outstanding	Refused
I	4	*c.*1	3	0
II	1	1	-	0
IIIa	-	-	-	-
IIIb	7	3.2	-	1
IVa	-	-	-	-
IVb	0	-	1	-
IVc	1	0.5	-	-
Total:	**13**	**5.7**	**4**	**1**

During the SLRP we were keen to ensure that sand lizard *foci* were not damaged by grazing animals. We therefore feel strongly that such features should be excluded from grazing regimes by fencing. Grazing animals do not generally eat the unpalatable mature dry heath though can

cause drastic trampling damage even on a very short timescale. This can destroy sand lizard habitat and adversely affect population levels. A full assessment of the sand lizard interest should be undertaken before installing of fencing to ensure that no damage occurs on the sensitive *foci* during this operation.

Table 6b summarises the sites where exclusion fences have been agreed/completed on sites with grazing regimes during the SLRP.

Table 6b. Exclusion fencing from grazing regimes

Zone	*Foci* requested to be excluded	Sites Completed	Sites outstanding/ agreed in principle	Ongoing Discussions/ monitored sites	Sites Refused
I		-	-	-	-
II	1	-	-	-	1
IIIa	-	-	-	-	-
IIIb	6	2	1	3	0
IVa	2	1	0	1	0
IVb	14	4	5	3	2
IVc		-	-	-	-
Total:	**23**	**7**	**6**	**7**	**3**

Linkage

Habitat linkage within sites and between *foci* can be achieved by any combination of scrub, bracken, sand or fencing management, or habitat restoration, depending on the particular site's characteristics. Linking populations/*foci* locally increases the species' conservation status and assists natural dispersal, re-colonisation after fire, etc. During the SLRP the target was to link 10-20 populations/*foci*. Although most of the proposed links in Dorset could not be agreed, the SLRP still achieved 15 links between 30 sand lizard populations. These were notably within the Weald and Sefton. See **Appendix 7** for detailed schedule of works relating to linking populations.

During the SLRP, extensive fieldwork was undertaken to assess suitable site habitat and linkage possibilities throughout all Zones. These sites were prioritised and where possible incorporated into the SLRP management programme. There was great potential for linkage in Zone III-IV notably between the isolated heath sites within the great forest blocks of Wareham, Purbeck, Puddletown, Hurn and Ringwood Forests. Unfortunately our negotiations with Forest Enterprise (FE) in Dorset were unsuccessful. None of our proposed links were agreed except where they coincided with FE's Ride Improvement Plan. Due to management methods considered incompatible with the SLRP objectives, none of these proposed links could be progressed.

It was also unfortunate that the SLRP was not more involved in the early stages of the Dorset Heathland Re-creation Plan, which was contracted to Institute of Terrestrial Ecology (ITE). This would have helped to achieve a major objective of the SLRP. Although the sand lizard was included in the plan as an indicator species, the information concerning its range was generally

either poor or wrong. A meeting was organised with SLRP, EN and ITE personnel to try to reconcile these errors and amendments were provided by the SLRP. As yet these have not been included in the plan. These should be included to ensure that the restored habitat and potential links will be beneficial to the sand lizard.

Table 7 summarises the links undertaken during the SLRP. In Zone I and II one and three major linkage schemes were undertaken respectively compared with the generally more localised links undertaken in Zones IIIb-IVb.

Table 7. Linkage

Zone	No. of Links Managed	No. Of Linked Populations	Area Managed (sq.m)
I	3	6	118800
II	3	6	100700
IIIa	-	-	-
IIIb	6	12	109000
IVa	2	4	65000
IVb	1	2	15000
IVc	-	-	-
Total:	**15**	**30**	**408500 (40.8 Ha)**

Other habitat management schemes

Habitat management schemes are making significant advances for wildlife conservation. However, the majority of these that are relevant to the sand lizard have not to date provided explicit provisions necessary for the conservation of this species. It is our view that general habitat prescriptions will not adequately address the full range of interests on a site. These can even cause damage to the specific habitats needed by sand lizards.

We would have welcomed a greater involvement in many meetings that were important for sand lizard conservation, but did offer advice on a number of schemes and plans. We believe considerably more would have been achieved for this species if SLRP personnel had been invited to comment on all schemes that affected sand lizard sites and if a greater emphasis could have been given to addressing species conservation measures.

During the SLRP a number of seriously degraded sand lizard *foci*, some of which are SSSIs, could not be managed due to the landowner(s)/manager(s) opposition towards conservation. Even when permissions to manage *foci* were granted some landowners/managers did not allow some of the essential works to take place consequently reducing the effectiveness of the management. The majority of sympathetic managers, eg Local Authorities, County Wildlife Trusts, etc, allowed the SLRP permission to work on their nature reserves. Only a few, though, gave either practical assistance or guaranteed to undertake any necessary subsequent management. We have concerns over the long-term management for the species following the conclusion of the SLRP.

The management of species within habitat management schemes can often be limited due to the resources available, ie via WES, Countryside Stewardship, etc . This puts pressure on land managers to use efficient, but insensitive methods, eg where mechanised contractors are used to clear large areas of scrub. Although such contractors can manage large areas at a time, without sufficient information and supervision, they can cause significant long-term damage to *foci*. Such damage is easily avoidable. Specific incentive payments towards species management in such habitat management schemes are likely to provide significant benefits for conservation of complex species like the sand lizard.

Grazing is perceived as a traditional management technique on heathland. However, it has limited value on dry heath and can be detrimental to *L. agilis foci* habitat structure. The botanical paper by Byfield and Pearman (1994), on whose conclusions much of the EN Heathland WES and RSPB grazing philosophy in Dorset appears to be based, is primarily concerned with rare flora on wet and humid heath. We therefore question the rationale behind the use of this management practice on dry heath. Up to mid-1997 over one third of the heaths in Dorset have been entered into WES schemes. More research and experimentation is needed to assess the impact of these schemes on reptile populations in the UK if grazing continues to be promoted as the main means of managing heaths.

We have noted some damage to *foci* on sites grazed in Dorset, Hampshire and Surrey caused by trampling and nutrient enrichment from dung, with the possible promotion of rank grasses and bracken. Many of these sites are predominantly dry heath and have limited feeding areas; consequently the trampling damage to *foci* can be noticeable as the cattle wander to try and find other feeding areas. However, these sites do illustrate the need for a cautious approach where sand lizard *foci* could be affected. Due to herpetological concerns such reptile *foci* are excluded from grazing on German heaths and are soon to be excluded on the Dutch heaths.

Translocations

The introduction or re-introduction of the species to unpopulated, though suitable, sites has been an essential component of the SLRP. As the majority of suitable habitats are fragmented and surrounded by housing, forestry plantations, etc the process of re-colonisation onto many sites cannot naturally re-occur, therefore translocations are undertaken to redress this problem.

The SLRP aimed to undertake 5-12 sand lizard translocations preferably to high-priority receptor sites. **A total of 972 sand lizards (112 adults, 164 immatures and 692 juveniles) were translocated to 11 sites.** To date nine of these translocations have been completed on high and medium priority sites though due to various site problems, ie the postponement of some of the releases by land managers the remaining two re-introductions will have to be completed in 1998 (see also Figure 1, page 11).

Of particular significance was the re-establishment of the species on dune systems. Historically the majority of sand lizard populations on dunes have become extinct and therefore suitable sites were given the utmost priority to offset these losses. Five dune re-introductions were completed during the SLRP though two others could not be undertaken due to issues beyond our control, ie ongoing negotiations about land management objectives and unsuitable habitat management respectively.

The SLRP translocation strategy has to date re-established the sand lizard in four Counties/ areas where the species was previously extinct.

At present there are no identified receptor sites available in Cheshire, Wiltshire, Berkshire or Kent. These counties should, however, be looked at favourably for future long-term translocation requirements.

General strategy

Maps showing the sand lizard`s historic, presumed and current distribution were prepared in the Pilot Study (Corbett 1994, see also revised map Figure 1 to this report). From these, possible sites were selected and prioritised using a combination of criteria, ie zonal and county status, site protection, status of habitat and type, public pressure, size of site and further colonisation possibilities, etc. These options were formalised and rationalised by Dr Tony Gent (1994) in an unpublished EN working document (see **Appendix 8**). In principle, translocations should be undertaken only where they introduce animals to representative habitats within their natural range. While this focuses on known or presumed range, it is occasionally appropriate to release to other sites within the general biogeographic area to compensate for irreversible losses elsewhere.

Animals translocated must all be of the same or nearest zonal stock to preserve the genetic integrity of the three "races", ie Merseyside (I) Surrey (II) and Dorset (III/IV). Historically, however some isolated sites in the Weald had already been populated with Dorset stock in a programme initiated prior to the SLRP. Further isolated sites in this zone could be further populated with Dorset progeny without the risk of "hybridisation", ie mixing populations.

Site management prior to translocation

Translocations cannot be undertaken unless the site is safe from threats in the medium to long-term and ideally is protected and the habitat suitable to support breeding populations of *L. agilis*. Site management prior to translocation may consist of any combination of scrub, bracken, sand, fence and fire-break management dependant upon the individual site's requirements. Subsequent management is often necessary, eg to further promote *L. agilis* establishment after translocation on to potential *foci* throughout the site, re-expose breeding sand, prevent bracken encroachment, etc. Sites 2, 3, 4, 5, 6, 9 and 11 required habitat management prior to translocation.

Translocations undertaken

Due to the highly limited number of sites suitable for translocation in the short-term, and protracted and sometimes unsuccessful negotiations relating to a number of these key sites, we were not able to achieve as many translocations as we may have hoped. High priority sites where conservation gain could have quickly materialised often could not be utilised which consequently led to problems of looking after "surplus" juveniles in the vivaria. As the majority of the vivaria are not suitable for the retention of large numbers of juveniles these animals had to be released to other sites, though generally with a lesser conservation gain.

Translocated animals were generally from captive bred stock though wild-caught animals, either taken at low, sustainable levels from strong populations or acquired from planning mitigation schemes, were also used.

The number of captive bred juveniles reared from vivaria can be exceedingly variable due to differences in husbandry techniques and weather. To establish a viable and demographically structured population three annual releases of *c*50 juveniles is required. Breeding can occur *c*3 years after the initial release. Juveniles are released in August and early September though can be "over-wintered" in specialised vivaria and released in late Spring to try and improve their survival rate.

Wild caught adult and immature animals are usually only taken from sites to be lost to development where planning permission has been granted, or exceptionally are "culled" from sites with high-density and self-sustaining populations. Breeding will then generally occur during the same year of release. Due to the logistics involved in catching, housing, feeding, etc a large number of wild animals, most animals were translocated and released as quickly as possible after capture to prevent stress, tameness, dietary deficiencies, etc. Table 8 summarises the translocations undertaken during the SLRP. See **Appendix 9** for detailed schedule of completed and initiated translocations.

Table 8. Completed and initiated translocations

Zone	No. of Sites	Completed Translocations	Un-completed Translocations	Dune	Heath	No. of Animals Released
I	1	1	0	1	0	58
II	6	4	2	1	5	627
III-IVb	2	2	0	1	1	216
IVc	2	2	0	2	0	71
Total:	**11**	**9**	**2**	**5**	**6**	**972**

Site 1 (Gwynedd): (Zone I stock)

Twenty immature (1994) sand lizards were released during spring 1995 to a site in Wales. A further release of 20 juveniles (1996) were released during September 1996. Initial low captive-breeding stock, high captive-bred juvenile mortality and the need to divide the captive population to establish the vivarium at Chester Zoo compounded by the current low level of productivity there, has reduced the effectiveness of this translocation. A further release of 14 juveniles was undertaken in 1997. This was meant to complete the translocation to Wales; however, a further release would be beneficial to ensure that the translocation is a success. Limited initial surveys have proven that animals have both hibernated and bred successfully on-site, ie juveniles from two clutches were found in August and October 1997.

Site 2 (Surrey): (Zone II stock)

Fifty juvenile (1994) sand lizards were released during September 1994. Due to very high egg-clutch mortality a limited second release of only 19 immature (1995) was undertaken in Spring 1996. In May 1997 26 immature (1996) animals were released and a further 45 juvenile (1997) were released in September 1997 completing this translocation. Juveniles have been seen both in 1996 and 1997, therefore breeding has been successful.

Site 3 (Hampshire): (Zone II stock)

Thirty-five immature (1994) juveniles were released in Spring 1995. During 1995 very high egg-clutch mortality prevented the second annual release to this site. A further two adult ♀ were released in 1997 after male animals were recorded on-site. Further releases and surveys for juveniles will be undertaken.

Site 4 (Hampshire): (Zone III-IV stock)

The favoured release site (leased by Hampshire County Council (HCC)) remained unavailable during the course of the SLRP project and so an adjacent site (leased by HCT) was managed to allow the release of 117 juveniles in August and September 1997. Two further releases will be necessary to complete this re-introduction.

Site 5 (Hampshire): (Zone III-IV stock)

A total of 200 juvenile *L. agilis* were released during Septembers of 1994, 1995 and 1996. During the 1995 release a larger compliment of juveniles were translocated than was necessary due to the unavailability of two other Zone II sites. Though the proposal for release had been agreed in advance, formal consent for bladed sand management has, to date, not been forthcoming. Therefore the translocation is in serious jeopardy of failing as there is no suitable breeding substrate for the animals. It is hoped that this situation will be resolved and sand will be provided in Spring 1998.

Site 6 (West Sussex): (Zone III-IV stock)

Initially EN did not allow this translocation to go ahead during 1995 as originally planned because grazing at the site was planned and there was concern over conflict. The proposed fencing of a area for exclusion was also not allowed. The first release of 75 juveniles was delayed until September 1996. Due to the continuing unavailability of another Zone II site a second release of 11 adults (ie six ♂ and five ♀) was effected during Spring 1997 to complete this translocation. It is too early to assess whether breeding has occurred.

Site 7 (West Sussex): (Zone III-IV stock)

The translocation of 28 adult *L. agilis* occurred during Spring, 1996. A further 19 immature 1996 animals were released in Spring, 1997 to supplement the completed translocation. Initial though limited surveys have established that animals have both colonised the habitat on the chosen *foci* and also successfully bred on-site in the first year.

Site 8 (Dorset): (Zone III-IV stock)

A total of 20 juvenile (1997) animals were released on two prime areas of remnant dunes in September 1997. This translocation is effectively completed due to the small areas of the sites involved. Surveys to assess hibernation and breeding success will be undertaken in 1998.

Site 9 (Dorset): (Zone III-IV stock)

A total of 178 juvenile and immature *L. agilis* were released during September 1994 and 1995. The majority of these animals were from captive-bred stock though 27 immature (1994) were rescued from three development sites in Dorset. Due to the unavailability of two Zone II sites during 1995 an unscheduled third release was effected to complete this site's translocation requirement. A further 18 adults/immatures caught from a development site were released in Spring 1997 due to the continuing unavailability of one of the previously mentioned Zone II sites. Surveys have established that both successful hibernation and breeding is occurring.

Site 10 (Devon): (Zone III-IV stock)

A total of 42 adult and sub-adult sand lizards (ie 16 ♂, 22 ♀, and four immature (1992) were translocated over 23/5/94, 1/6/94 and 26/8/94 to this key dune site. These animals were "rescued/culled" from seven sites following consultation with EN. Surveys in generally poor weather conditions during 1994-6 were successful. On one visit *c*10 adults were re-identified on the chosen *foci*. Successful breeding, ie four juveniles representing two clutches, was recorded in 1996.

Site 11 (Cornwall): (Zone III-IV stock)

A total of 29 adult and immature sand lizards (ie 10 ♂, one ♀ immature (1993), 16 ♂ and two ♀ immature (1993)) were released on: 1-2/5/95, 17/5/95 and 27/6/95. These animals were "rescued/ culled" from six sites after consultation with EN. Survey has re-identified a number of animals occupying prime habitat and established that breeding has occurred, ie three juveniles were observed representing two clutches on the chosen *foci* in 1996.

Captive breeding programme co-ordination

Over the last 30 years the BHSCC & HCT have progressively refined the methods of captive breeding sand lizards for re-introductions to the wild. The SLRP was charged to coordinate this work and establish further capture breeding facilities where needed. Captive breeding meetings were held to discuss husbandry, rectify problems and to predict and organise the numbers of juveniles available for release to the wild.

Methods involve the use of large outdoor vivaria that are well insolated, predator and escape proof, and optimally vegetated by heath/marram with areas of open sand for egg deposition. Some natural invertebrate prey is available throughout the season though the staple diet consists of commercially bred crickets and meal-worms. Calcium and vitamin D is added to the drinking water to reduce calcium deficiency in eggs and young.

When the eggs are laid and can be found, they are removed and artificially incubated to prevent cannibalism of the juveniles by the adults, increase the juvenile survival rate and increase the time available for the juveniles to feed and grow than would naturally occur, which consequently increases their viability to survive their first hibernation.

After this rearing the juveniles are either released in late August-early September or, "over-wintered" and released the following Spring, on an optimal locality of the receptor site in good weather conditions. From previous heathland re-introductions ie undertaken during 1969-93 the

success rate (as outlined in the Pilot Study) has been between 85-93% (Corbett 1994). From surveys of the SLRP dune re-introductions the initial breeding success has so far been 100%; however further surveys are required to determine their long-term viability. Table 9 highlights the initial (1994) and current (1997) vivaria and stock.

Table 9 Initial and current vivaria stock (1994-7)

Keeper	Zonal Stock	Initial Stock 1994	Current Stock 1997	Ideal Stock
C.Davis (Worthing 1)	I	1♂ 1♀ 3 imm.92 1 imm.93	2♂ 6♀ 3 imm.95	5 ♂ 15 ♀
K.Brown (Chester)	I	0	2♂ 3♀ 2 imm.95	7 ♂ 20 ♀
M.Preston (Guildford)	II	2 ♂ 15 ♀	3 ♂ 16 ♀ 78 juv.97	6 ♂ 20 ♀
J.Webster (Worthing 2)	II	0	2 ♂ 7 ♀ 2 juv.97	3 ♂ 8 ♀
P.Edgar (Marwell)	III-IV	7 ♂ 15 ♀ 6 imm.93	0	7 ♂ 30 ♀
M.Langford (Hedge End)	III-IV	3 ♂ 9 ♀ 3 imm.93	4 ♂ 11 ♀ 2 imm.95	4 ♂ 12 ♀
M.Noble (Holmsley)	III-IV	1 ♂ 4 ♀ 2 imm.93	1 ♂ 7 ♀ 5 imm.95 6 imm.96	4 ♂ 12 ♀
D.Thompson (Holidays Hill)	III-IV	2 ♂ 8 ♀	2 ♂ 7 ♀	2 ♂ 10 ♀
D. Gow (Nature Quest)	III-IV	0	1 ♂ 10 ♀ 6 imm.95	2 ♂ 10 ♀
J.Clemons (Coventry)	III-IV	1 ♂ 3 ♀	1 ♂ 3 ♀ 1 juv.97	N/A
M.Jones* (Suffolk)	III-IV	0	?	N/A
S.Derham* (Kent)	III-IV	0	2 ♂ 4 ♀	N/A

* Not yet integrated within SLRP captive breeding agreement. N/A = not applicable/ integrated.

Mr Chris Davis, the sand lizard Captive Breeding Co-ordinator, has instigated and regularly updated the *Stud Book* to ascertain the needs of each vivarium and advised on all aspects of animal husbandry during the SLRP.

An agreement has been signed by 10 out of 12 vivaria keepers defining that the animals in captivity belong to the SLRP. This agreement was instigated to control the movement of animals between vivaria and other parties.

Zone I

At the start of the SLRP the captive breeding Zone I stock was both critically low in number and about to lose its only remaining vivarium. Therefore in 1994 the vivarium was in Worthing (Worthing 1) to house and increase this stock. During the SLRP three ♂ and nine ♀ were caught from a number of sites to increase the viability of the stock. To date, though, juvenile production has been sporadic.

In 1996, after consultation on the design, the Chester Zoo vivarium was opened. Initially the vivarium was insecure and the habitat unsuitable for the programmed release of the two ♂ and three ♀ sand lizards from the Worthing (1) vivarium. Although the habitat is now adequate at Chester and a limited number of adults are present, juvenile success over the last two years has been negligible because the eggs were not removed and incubated.

Therefore during SLRP there has been a short-fall in the expected number of Zone I juveniles produced for re-introduction purposes. It is expected that with further wild-caught adults and improved husbandry both vivaria should be able to consolidate their gains and greatly increase juvenile production.

Zone II

At the start of the SLRP the Zone II captive breeding stock was relatively precarious. Although the stock was adequate in number juvenile productivity was erratic, therefore in 1996 a second vivarium was initiated in Worthing (Worthing 2) by Mr Jonathan Webster with some of the animals from the Guildford vivarium. In 1997 all of the females in the Guildford vivaria "double-clutched" producing 142 juveniles. It is now expected that both captive breeding stocks and juvenile productivity will be able to increase.

Zone III-IV

At the start of the SLRP the zone III-IV stock was relatively stable though producing somewhat less than expected numbers of juveniles. All captive breeding stocks have therefore been increased with animals rescued from development sites. A further vivarium, ie Nature Quest, was established at Ashurst and successfully produced juveniles. However, Marwell Zoo`s vivarium the main Zone III-IV captive breeding facility was closed during 1997. It is possible that this vivarium will be re-opened during 1998.

Production and implementation of regional strategies

Various strategies have been initiated/completed during the SLRP. The SLRP was charged with assisting with between three and six local projects and/or strategies. Although many of these strategies have now been produced it is by no means certain whether there will be funding to implement them.

The Species Action Plan for the sand lizard was compiled by JNCC following wide consultation. as part of the UK Biodiversity Action Plan.

North-west Strategy (Zone I)

The North-west Strategy is principally concerned with the sand dunes managed by Sefton Metropolitan Borough Council (SMBC) and a number of fixed dune remnants on various golf courses. Potential translocation sites using Zone I stock also include the Wirral and north-west Wales including Anglesey.

SLRP personnel liaised regularly with EN North-west Team, CCW, SMBC Coast & Countryside Services, Sefton Coast *Life* Project and the relevant golf clubs.

The SLRP assisted and advised on both the updating of Sefton Coast`s sand lizard Strategy 1997-2002 and the Sefton Coast Nature Conservation Strategy which is now involved with the candidate Special Area of Conservation (SAC). These strategies are aimed at delineating site protection, conservation of dune dynamics, controlling recreation pressure, habitat loss and fragmentation, and the local co-ordination of sand lizard conservation, captive breeding, translocations, research, monitoring, grazing, etc. Further consultation has been undertaken on

the Sefton Coast Management Plan 2nd Review 1997-2002, and over site specific management plans. Table 10 summarises the work undertaken in Zone I.

Table 10. Strategy implementation in Zone I

Zone	Management			Translocations
	Completed	Unfinished	Linkage	
I	7	1	3	1

Management was undertaken by HCT, Sefton Coast & Countryside Services and Sefton Coast Life Project personnel.

Of special significance is the completion of the extensive vehicle exclusion fencing at both the frontal dunes on the Sefton Coast. This has allowed the restoration of natural dynamics which should provide for both a sustainable ecosystem and should guarantee accretion of sand lizard habitat.

Extensive habitat and species surveys have been undertaken throughout the SLRP - see Survey, monitoring and research section (page 33). Of special mention is the *Life* Project *L. agilis* survey of the railway corridor in Sefton. In future many of these isolated inland *L. agilis* sites could be linked via the railway corridor if adequate management is undertaken.

During the SLRP vivaria at both Chester and Worthing were constructed and now hold captive breeding Merseyside stocks. Although the Worthing vivarium had consistent, though limited, juvenile successes, Chester to date has been largely unsuccessful. Further wild-caught adults are required to guarantee juvenile output from both vivaria.

No translocations have yet been initiated within Sefton or the Wirral though future releases at five areas (four in Sefton, one in the Wirral) are possible. The translocation in west Wales has already shown early and encouraging breeding success. Future translocation sites in north-west Wales have been assessed and three sites there have been identified as priorities.

South-east Strategy (Zone II)

The South-east Strategy is currently being revised and covers the Wealden Heaths/Thames Basin area (north Surrey/north Hampshire) and the coasts of Kent, Sussex and Hampshire (east of Solent). Table 11 summarises the work undertaken in Zone II.

Table 11. Strategy implementation in Zone II

Zone	Management			Translocations
	Completed	Unfinished	Linkage	
II	28	1	3	6

Management was undertaken by HCT, BHS, Waverley Borough Council (WBC) and Hampshire County Council (HCC) Heathland Project personnel. Six translocations have been undertaken to high-priority sites in Hampshire, West Sussex and Surrey, four of which have so far been completed.

There has been regular liaison with EN Hampshire and Isle of Wight Team, EN Surrey & Sussex Team, Ministry of Defence (MoD), Sussex Heathland Forum, Surrey Heathland Project, HCC, HCC Heathland Project, WBC, National Trust (NT) and the Cowdray Estate.

Following HCT input, the species now has a specific Species Action Plan in Surrey, but is presently only included at a heathland habitat level in Hampshire (which, we feel, is unsatisfactory).

Extensive habitat and species surveys have been undertaken throughout the SLRP - see Survey, monitoring and research section (page 33).

New Forest Strategy (Zone IIIa)

There is no formal sand lizard strategy for this zone although regular meetings were convened by the Forestry Commission (FC) to advance sand lizard conservation during the SLRP. Table 12 summarises the work undertaken in Zone IIIa.

Table 12. Strategy Implementation in Zone IIIa

Zone	Management			Translocations
	Completed	Unfinished	Linkage	
IIIa	1	2	0	0

Although vast areas of potential sand lizard habitat occurs in this zone, the majority of this habitat is subject to Commoners' Rights, ie grazing and controlled burning, which are strongly supported by the Verderers. These management techniques are directly detrimental to both sand lizard populations and their habitat and we believe led to the species' extinction in this zone in the 1970s. A further problem is the lack of open sand in the area and the general absence of sand management from current management practice. Exclusion fences are not allowed, however re-introductions prior to the SLRP were undertaken in suitable habitat in areas that were fenced. In some cases obtaining permission from FC to undertake essential sand and bracken management has not been possible. These re-introduced populations are surviving at present though will have little or no chance to become fully established or colonise new areas without adequate management and local support.

At present only the very limited areas of private land and inclosures have any scope for successful sand lizard re-introductions. At an inclosure with a previously re-introduced population the SLRP has completed the necessary sand management. Further management has also been undertaken at two areas of a private common that had a recent sighting of a sand lizard.

South-west Strategy (Zone IIIb-IVc)

The South-west Strategy is principally focused on the Dorset heaths but also includes current and proposed translocation projects in Devon and Cornwall. Table 13 summarises the work undertaken in Zone IIIb.

Table 13. Strategy implementation in Zone IIIb

Zone	Management			Translocations
	Completed	Unfinished	Linkage	
IIIb-IVc	83	22	9	4

The SLRP objectives have been agreed with EN as the working base of the sand lizard strategy in Dorset.

Management was undertaken predominantly by HCT with assistance from BHS volunteers, EN, Poole Borough Council (PBC), East Dorset District Council (EDDC), Dorset Wildlife Trust (DWT) and Dorset County Council (DCC) personnel. Four completed translocations have been achieved to high-priority sites in Sussex, Dorset, Devon and Cornwall. However, two targeted high-priority dune translocations in North Devon were not able to go ahead due to agreement not having been reached on management regimes and management practices that would not support sand lizards respectively.

The SLRP project was represented at the Dorset Heathland Forum, five MoD Conservation Groups and the EN Heathland Managers' Conference. At HCT's request meetings with EN Wildlife Enhancement Scheme (WES) personnel have also been undertaken. However, it must be stressed that specific provisions for this species' have usually not been included in many relevant and important projects.

Consultations over various site-specific management plans have been undertaken throughout the SLRP to promote the conservation needs of the species and to see that these are taken into account, for example on sites managed by EDDC, DWT, PBC and RSPB.

Liaison with the following organisations continued to occur over specific sites in the context of this species: EN Dorset Team, EN Devon & Cornwall Team, English Heritage, MoD, Countryside Commission, Forestry Commission, Forest Enterprise, Forest Authority, Hampshire County Council, Dorset County Council, East Dorset District Council, Purbeck District Council, Bournemouth Borough Council, Teighnbridge Borough Council, St.Merryn Parish Council, North Cornwall Heritage Coast & Countryside Services, NT, RSPB, Dorset WT, Cornwall WT, Devon WT, the Morden, Lees, Canford and Rempstone Estates plus Broadstone, Parley, Parkstone, Broadstone and Trevose Golf Clubs, Winfrith AEA., Railtrack, and various private landowners eg Ms Barnard.

In this region serious damage both to the species' habitat and populations was caused by fires during the SLRP - see Survey monitoring and research section (page 36).

It is a credit to the work of the conservation organisation that many of Dorset's heathlands are now under positive management. For example, during the SLRP, more than one-third of the

Dorset heaths were included in WES. However, there is more scope for positive management for the species through such schemes. We remain concerned about the detrimental impacts on sand lizards and their habitats that have occurred, and could continue to occur, as a consequence of certain current prescriptions, eg primary scrub clearance and grazing. It is our view that the prior involvement of herpetological specialist is essential if damage to *foci* is to be avoided. We advise that *foci* should be fenced as a precaution or grazing schemes monitored and fences erected subsequently if shown to be necessary.

A South-west Regional Species Action Plan, and Purbeck Species Action Plan for the Sand lizard has been produced (Corbett and Moulton, 1996b and 1997 respectively). Purbeck District holds *c*56% of the total UK sand lizard population. The species is now also included in the local Biodiversity Action Plans in Poole and Christchurch.

Comments concerning this species' requirements have also been compiled into the South-west Region Lowland Heathland Habitat Action Plan, and the South-west Habitat Action Plan for Sand Dunes (RSPB 1996).

It is essential that at the end of the SLRP these Regional and Local Biodiversity Action Plans should be implemented, though at present no specific resources are available and it is not yet known from where they might come.

Site protection

Many sand lizard sites are currently not designated as SSSIs and therefore are more liable to damage. During the SLRP, EN notified a number of sand lizard sites as SSSIs. This was mostly in Dorset. Recurring delays in Merseyside however have meant that the very necessary protection of three sites is unlikely to occur in the near future. The following sites have became designated as SSSIs:

Zone I:	The east end of Hillside-Birkdale Corridor
Zone II:	Weavers Down complex.
Zone IIIb:	Dudmoor, Dalling Road, south Rossmore, Parkstone Golf Course, Luscombe Valley, Evening Hill and Sandbanks Dunes
Zone IVa:	Blackhill, west Great Ovens Hill, north-west Woolsbarrow, south-west Hyde, Blackheath, Gallows Hill, Stokeford, Spratley Pits and Hethfelton.

The designation of the Dorset Heathland Special Area of Conservation (SAC) (the Natura 2000 site designation) is long overdue. We understand that it was held up by the consultation process but should soon (in part or all) be submitted to DETR.

Survey, monitoring and research

This section provides a summary of the main findings of the survey, monitoring and research undertaken during the SLRP.

Surveys

Extensive habitat and species surveys have been undertaken throughout the SLRP. Habitat surveys were undertaken initially to short-list probable *L. agilis* sites and prospective re-introduction sites. Species surveys were undertaken for a variety of reasons, eg to prove presence/absence of the species, to update the knowledge of the species on particular sites and to assess the effectiveness of various management techniques on the resident populations. During the SLRP *c*3000 individual sand lizard sightings were obtained from *c*100 sites.

Rare Reptile Database

The development of the Rare Reptile Database at HCT was identified as a target for the SLRP. JNCC developed a comprehensive text and mapping programme for use with HCT's computer hardware. An agreement has been reached to allow the dissemination of general data, whilst detailed data will be released on a need-to-know basis. The data for all of the sand lizard zones will be logged onto this database during the next few years.

Monitoring

Transect monitoring

A method was sought for simple, rapid and repeatable monitoring of *L. agilis*. Two approaches were compared: a) use of a straight line point-point (random) transect and b) a standard (Pollard) route embracing features synonymous with the presence of the species. (See **Appendix 9** for full copy of the report).

The routes, on a Dorset site, were matched as closely as possible by topography and were never more than 100m apart. Five monitoring sessions were undertaken in Spring (April-May) and also in Autumn (September-October) 1995. Two experienced herpetologists surveyed both routes alternatively and at the same times to alleviate observer bias.

Chi-square tests on 2*1 and 2*2 contingency tables were used as far as possible to compare absolute numbers of sightings between the two routes and compare relative numbers eg. of the two lizard species respectively. This was supplemented by direct assessment of binomial probabilities (2*1 contingencies) and Fisher Exact probability test (2*2 contingencies) because of the unreliability, and sometimes inapplicability, of use the chi-square test with small numbers of observations.

The different lengths of standard and transect routes were taken into account. Thus if there were no differences in reptile distribution and observability between the two routes 2/5 (40%) of sightings would be expected on the transect and 3/5 (60%) on the standard route. These proportions were used to give "expected" numbers of sightings for chi-square, and for the probability parameter (0.4) for binomial tests. Tables 14-16 summarise the results.

Table 14. Sightings summary and statistical analysis

Species	Age Group	Observed			Expected		Chi 2	Significance	
		Standard	Transect	Total	Standard	Transect		Chi 2	Binomial
L.agilis	2+ Year	13	2	15	9	6	4.44	5%	3%
	Immature	8	0	8	4.8	3.2	na	-	2%
	Both	21	2	23	13.8	9.2	9.39	1%	0.1 %
	Juvenile	9	0	9	5.4	3.6	na	-	1%
	All	30	2	32	19.2	12.8	15.19	0.1%	0.1 %
L.vivipara	1+ Year	14	12	26	15.6	10.4	< 1	ns	ns
	Juvenile	6	2	8	4.8	3.2	na	-	ns
	All	20	14	34	20.4	13.6	< 1	ns	ns
All Identified		50	16	66	39.6	26.4	6.83	1%	0.5 %
Unidentified		5	10	15	9.0	6.0	4.44	5%	4%
All Lizards		55	26	81	48.6	32.4	2.11	ns	ns

Table 15. Relative sightings numbers of sand & common lizards (immature & 2+ yr. old) on the two routes

Species	Standard Route		Transect		Total
	Observed	Expected	Observed	Expected	
L.agilis	21	16.4	2	6.6	23
L.vivipara	14	18.6	12	7.4	26
Total	35		14		49

The higher proportion of sand lizards on the Standard route is significant at the 1% level by both Chi-square and Fisher tests.

Table 16. Relative numbers of identified & unidentified lizards on the two routes

Species	Standard Route		Transect		Total
	Observed	Expected	Observed	Expected	
Identified	50	44.8	16	21.2	66
Unidentified	5	10.2	10	4.8	15
	55		26		81

The higher proportion of Unidentified lizards on the transect route is significant at the 1% level by Chi-square test.

To summarise from the above 2*2 contingency tests there was a higher sand lizard: common lizard ratio on the standard route, as well as a higher identified:unidentified ratio. Further standard and transect monitoring was undertaken in 1996 on another *L.agilis* site with similar results. **From these findings we conclude that the only practical way of undertaking *L.agilis* surveys is to design a route around pre-assessed topographical features synonymous with the**

presence of the species, ie route(s) for individual sites are required. This is the only reliable way of achieving a sufficient sample size for meaningful repeatable surveys.

Intensive transect monitoring

Further transect monitoring was undertaken by Mr Bill Whitaker in the Weald to a) attempt to determine the number of animals using a *focus*; b) to compare the lengths of time that these animals were observable and c) attempt to identify the best weather conditions to monitor them. See **Appendix11** for a copy of the full Report.

The sand lizard *focus* that was monitored was a 200m long south facing dry-heath boundary bank between 1.8 and 0.4m high. This site was chosen because continuous monitoring could be undertaken causing minimum disturbance to the animals.

Monitoring generally commenced before the animals started basking each day, and continued until after the last animal retired at the end of the day. When animals were being seen continuous passes every *c*20 minutes were carried out. When two subsequent passes revealed no animals the regime was changed to one pass per hour. Animals were individually identified by their unique dorsal patterns, size and sex. Table 17 summarises the results.

Table 17. Sand lizard activity

L.agilis	Animal No.	Movement observed (m)	Days seen	Periods seen	Total time seen		No. of passes seen	%
					Hrs	Mins		
Males	1	16	3	4	5	10	16	2.7
	2	55	20	37	46	05	138	24.2
	3	5	2	2	0	40	2	0.35
	4	8	4	6	5	45	17	3.0
	5	9	3	3	1	45	5	0.92
	6	35	5	6	2	35	8	1.4
	7	44	7	7	8	00	24	4.2
Females	1	<1	2	2	2	10	7	1.1
	2	2	6	7	6	30	20	3.4
	3	<1	1	1	0	20	1	0.18
	4	3	2	2	1	00	3	0.53
	5*	7.5	2	2	1	20	4	0.70
			Max 29		Max 190	15	Max 571	

* = sub-adult

In summary, a population of 12 adult and sub-adult sand lizards were seen on the transect. The overall average chance of seeing an animal was 3:1. The chances of seeing any particular individual varied between 4:1 and 600:1.

The maximum percentage of this population seen on a single occasion was only 25%, and the chance of recording this 143:1. However to see 17% of the population the odds decreased to 10:1.

The average rate of reptile sightings per hour was 0.54 for sand lizards and 1.2 including other species. Peak ratios during particularly suitable conditions were as high as 7.3 per hour on two occasions. These peak conditions were recorded shortly after the commencement of "the first decent sunny spell" of the day. From past-records by BHSCC and HCT it is also known that these peak conditions occur after previous days of either prolonged rain or total cloud cover.

Applied research

Genetic study

No genetic studies between the different zonal "races" were undertaken during the SLRP due to the excessive cost required to undertake this research, ie *c*£10,000. It was hoped that Institute of Zoology in London (which is currently undertaking a proportion of EN's SRP genetic research) may have been able to undertake the research, however funding remains doubtful. It is now hoped that genetic research between the races will be undertaken in 1998 in collaboration with Sussex University.

Fire damage on *Lacerta agilis foci*

Fires are undoubtedly one of the most devastating occurrences that either damage or destroy *foci* habitat and their resident sand lizard populations.

During fire the majority of a sand lizard population is killed directly by either the intense heat or toxic fumes. The few that initially survive further endure a limited existence in an arid landscape devoid of habitat, food or cover where they are easily picked off by predators.

Post-fire re-colonisation can only occur if there are sand lizards remaining in the vicinity of the *foci* and only if the *foci* remains free from post-fire scrub invasion eg. by birch, bracken, gorse, etc. Generally, even when these conditions are met, the habitat has to reach *c*20 years old before initial colonisation occurs. A further *c*20 years is then necessary for population stability.

During the course of the SLRP, the significance of public pressure and related habitat problems was recognised as an increasing threat for sand lizard survival. Deliberate and repeated fires were a particularly serious problem within Zone IIIb where the Springs and Summers of 1995-7 saw 1176 recorded incidents (ie individual heathland sites attended by the fire brigade, discounting multiple visits).

Twelve per cent of sand lizard *foci* managed by SLRP were damaged by fires, but significantly many other sand lizard sites were so damaged - and this has to be seen as partially or wholly negating SLRP's aim of enhancing the species' status in south-east Dorset. See **Appendix 12** for detailed schedule of fires.

Table 18 highlights the damage caused by fires on sand lizard *foci* in Dorset during Summer 1995 - Spring 1996.

Table 18. Fire damage on *L.agilis foci* in Dorset (summer 1995 - spring 1996)

No. of heath fires*	No. of sites seriously affected**	No. of *foci* burnt***	Mean % of *foci* habitat damaged	Estimated % of *foci* population destroyed	% of sites re-burnt ****
681	28	31	66%	85%+	80%

* In Spring, 1997 this figure had already reached 500 ie. effectively doubling the previous springs figure.
** These only include major damage. A very high number of low density *L.agilis* areas have also been severely affected.
*** Ten of these *foci* (and populations) were either destroyed or had a minimum of 95% damage.
**** Some of these subsequent fires have been in excess of 30 incidences.

These fires were mostly caused by school children and youths, and almost always by their lighting gorse bushes rather than heather. Mapping confirmed that the majority were also directly attributable to the increasing urbanisation between Verwood, Christchurch and Poole, where these valuable heath areas now serve as recreational areas or even as Public Open Space designated by the planning authorities.

Whilst the fire service did their best to attend promptly and contain their spread, some fires were nevertheless extensive, eg the decimation (*c*20 Ha) of Canford Heath's southern scarp. The Dorset Police has to date not put heath fires high on their crime-fighting priorities. When they attended such fires they rarely investigated for cause or culprits, and to date no one has ever been brought to Court in Dorset for such arson.

With such high public pressure and misuse it is unlikely that resident sand lizard populations on urban sites will survive even in the short-term. This is further expounded by the Government planning guidance to create new and large housing developments immediately adjacent to some of these heaths, eg Bourne Valley, Holton, Poor Common, Verwood, etc.

SLRP personnel therefore took this problem for discussion to various fora - Dorset Heathland Forum, Department of the Environment, Dorset Heathland Working Group, etc, but without any resolution. The matter has now been referred for international attention in connection with of species and habitat obligations under the provisions of the Council of Europe's Berne Convention.

Effects of bare sand

Amount of sand associated with Lacerta agilis *colonies*

In Zone I the relationship of the percentage of sand associated with "sightings" of *L.agilis* has been recorded by Dr Arnold Cooke (1991) as ranging between 5-34%.

Research was undertaken during the SLRP (in Zone II, III and IV) to quantify the amount of sand associated with a variety of known though unmanaged (for sand) *L.agilis* colonies. This would allow estimations of the future sand management necessary to ensure *L.agilis* population stability. Table 19 summarises the results.

Table 19. Percentage of sand associated with *L.agilis* colonies

No. of sites	Extent of sand (sq.m)		Habitat extent (sq.m)		Sand:Habitat (%)			
	min	max	min	max	max:min	min:min	max:max	min:max
23	64,108	95,610	632,277	1,170,116	294.8	248.9	162.5	143.9
Range max:min %					**31.4-2.0**	**26.9-1.4**	**18.9-1.4**	**15.7-1.3**
Mean %					**12.7**	**10.6**	**7.2**	**6.2**
Overall Mean %					**9%**			

From these results it was found that the over-all mean percentage of exposed sand compared to the *foci* area is in the region of 9%. However in practical terms generally between 2-5% of the total *foci* area is allocated for any sand management which so far has been equally beneficial on sand lizard breeding.

Efficiency of sand exposure methods

The efficient exposure of sand to provide both egg laying and incubation sites and the provision of efficient firebreaks is possibly the most important management objective for *L.agilis* conservation. In England successful egg deposition, incubation and juvenile emergence is essentially associated with areas of unshaded and undisturbed bare sand. Current ecological understanding of the time of egg deposition, characteristics of egg-site, eg substrata, depth, slope, aspect, etc have been well documented, eg NCC (1983), Corbett (1988) and the field and outdoor vivaria observations by BHS/ HCT. See **Appendix 13.**

The best indication of the efficiency of the exposed sand however is by its use by *L. agilis* for egg laying. Surveys for juvenile *L.agilis* were therefore undertaken throughout the SLRP to assess the use of the exposed sand. Table 20 compares these *L.agilis* breeding results with the methods of sand exposure and by zone.

Table 20. *L.agilis* breeding associated with method of sand management

Zone	No. of Sites Surveyed	Positive Results	% Success	Sand Management Efficiency Percentage Success			
				Blade	Turf	T-R	C/R
I	3	2	67%	-	67%	-	-
II	2	1	50%	100%	-	-	0
IIIa	2	1	50%	50%	-	-	-
IIIb	23	18	78%	64 (88*)%	100%	75%	-
IVa	5	3	60%	50 (100*)%	50%	-	100% (P)
IVb	7	3	43%	50 (100*)%	67%	-	0
V	1	1	100%	-	100%	-	-
Total	**43 (36*)**	**29**	**67% (81%*)**	**61% (85%*)**	**82%**	**75%**	**25% (33%*)**

T-R = Turfed **then** rotovated. **C/R** = cultivated/rotovated. **P** = ploughed.
(*) = Discounts results on sites with minimal or no known populations of Sand lizards.

From these results it can be seen that sand is essential for successful *L. agilis* egg incubation throughout its British range. Blading and turfing were found to be the most effective types of sand exposure liable to be used by *L.agilis*, but turfing (and its maintenance) is very labour intensive and therefore rather impractical in terms of sustainable management. Cultivation/ rotovation on its own failed to reveal juveniles even in areas with good populations of *L.agilis*. This is due to the fact that only a sand/humus mixture is uncovered which is not suitable for *L.agilis* egg incubation. Although *L.agilis* bred on the ploughed exposure its very quick re-vegetation (due to high peat and seed content) severely limits its effectiveness as a management option.

Chemical analysis of sand/soil samples

Chemical analysis of sand/soil samples from a "Plaagen" experiment at Blackheath were assessed to compare the differences between turfing (blading) and rotovation (cultivation). This research has now been published (Michael 1998). Table 21 summarises the results.

Table 21. Chemical analysis of sand/soil samples from Blackheath, Surrey

Treatment	TS	R	C	TS	R	C	TS	R	C
Soil depth (cm)	0	0	0	10	10	10	20	20	20
Determinant									
pH (units)	4.57	4.35	3.80	4.3	3.93	4.03	4.13	3.9	4.37
Total nitrogen	391.67	598.67	1584.67	146.67	443.67	282	125.33	389.33	158.33
Available NH_4-N	0.16	2.63	11.73	0.19	0.85	1.28	0.15	0.87	1.3
Available NO_3-N	00.5	1.73	1.21	0.30	0.51	1.9	0.1	0.34	0.63
Extractable PO_4-P	1.56	0.5	7.35	0.34	0.64	0.6	0.44	0.84	0.56
Extractable K	23	36	56.33	13.33	21	15.33	12.67	18.33	12.67
Loss on ignition %	1.71	2.68	8.37	0.85	2.38	2	0.70	1.73	0.8
Exchangeable Ca	16	50	214	13	24.33	16.67	15.33	13	13
Exchangeable Mg	7.27	20.67	43.67	5	5.6	5	5	5	5

TS = turf stripping (blading) **R** = rotovation (cultivation/ploughing) **C** = control
Means of three replicates (and standard errors) are given.
Levels of available NO_2-N were below detection limits in all samples.
Results relate to air dried soils and are expressed as mg. kg^{-1} unless stated otherwise.

The overall results for turf-stripping are generally lower than for rotovation probably because the nutrient rich layer is physically removed via turf-stripping though is only disturbed and remains *in situ* during rotovation.

As samples with the lowest loss on ignition rates (ie lowest humus) would be the most amenable to *L.agilis* egg development (see efficiency of sand exposure methods above) it can be seen that turf-stripping (or blading) removes the highest amounts of organic material especially at greater depths.

Therefore blading and turfing are the most effective management techniques for sand lizard egg incubation. These methods when dug deep enough remove both the highest amount of organic

matter leaving a purer sand which is more effective as an egg-laying substrate. The results for rotovating/cultivating have at present been very poor.

***Use of bladed sand strips for egg incubation by* Lacerta agilis**

Sixteen bladed sand strips were exposed on a Dorset heath at varying distances from known *foci* and at varying aspects to assess their usage as breeding substrates by *L.agilis*. Subsequent visual surveys for juvenile *L.agilis* were undertaken to assess the success rate as summarised in Table 22.

Table 22. Juvenile success (1995-97)

Season	Autumn 1995	Autumn 1996	Autumn 1997
Juvenile Success	43.75%	87.5%	100%

The juvenile success results when compared to the distance of the exposed sand from the *foci* are compared in Table 23.

Table 23. Distance of exposed sand from *foci* and its use by *L. agilis*

Distance of Exposed Sand from *foci* (m)	0	10	15	20	25	30	40	50	55
Juv. Success Year 1	57.1%	14.2%	-	14.2%	14.2%	-	-	-	-
Juv. Success Year 2	44.4%	11.1%	11.1%		11.1%	11.1%	11.1%	-	-
Juv. Success Year 3	35.7%	14.3%	-	7.1%	14.3%	7.1%	7.1%	7.1%	7.1%
Total Juv. Success	**45.7%**	**13.2%**	**3.7%**	**7.1%**	**13.2%**	**6.0%**	**6.0%**	**2.4%**	**2.4%**

Predictably the exposures closest to the known *foci* were found to have had a higher initial use by *L.agilis* as a breeding substrate. This is probably because sand lizards are both highly faithful to their restricted home ranges and generally very poor colonisers.

During subsequent years all of the more distant exposures were also gradually used. This may be relative to progressive colonisation; however from field observations made over the years of similar situations, these results were generally much faster than expected.

South and west facing exposures were found to be used preferentially (presumably due to greater insolation) than were any other aspects.

Effect of limited tree cover

The detrimental effects of tree/scrub succession on *L.agilis* habitat, breeding, population senescence, etc has been well documented, eg. NCC (1983), BHS and HCT field observations, etc. Adequate management is therefore essential to allow the retention and expansion of *L.agilis* habitat.

HCT always retain a certain number of scattered trees in areas of mature dry heath as experience shows that full-scale tree/scrub clearance generally causes the rapid senescence of such heath

through Summer heat and drought stress. HCT's management techniques are site specific and consider various interrelated factors, eg tree species, size, density against the considered status of the dry heath (eg age structure, stress) together with considerations of local topography.

However, there are concerns that such management may not increase but rather decrease heath viability ie as retained trees remove water and shade the heath. Research was therefore undertaken on three sites managed by HCT to ascertain the viability of the heath associated with trees. See **Appendix 14**. A drop disc was used to measure vegetation height close to the trunk of trees and at the four "cardinal points" at the edge of the canopy. This was done for different tree species (six maritime pine *Pinus pinaster,* seven Scots pine *P. silvestris* and a single Corsican pine *P. nigra*) in two areas.

The analysis of variance on St. Catherine's Hill (Table 24) demonstrated that although there were significant differences between tree species, there was no difference in vegetation height correlated with the bearing from the trees (bearing effect $F=0.24$, NS; tree effect $F=3.56$ $p<0.0001$). Repeating the analysis for separate tree species in the two areas led to the conclusion that for Scots pine *Pinus sylvestris* there was no difference either between trees or compass bearing, but both effects were significant for the maritime pine *P. pinaster* (bearing effect $F=3.64$, $p=0.03$; tree effect, $F=5.49$, $p=0.005$). This agrees with HCT's management policy as although scattered *P. sylvestris* (and preferentially birch *Betula pubescens*) are often retained to reduce environmental stress on heathers, *P. pinaster* is always removed, primarily due to its high needle-fall rate.

In conclusion, the presence of low numbers of trees on heathland does not seem detrimental to the heather vitality or its mature structure. General observations suggest that there are probably advantages from leaving scattered trees but this has not been adequately researched.

Table 24. St Catherine's Hill data sheet

Site	S/N	S	S	S	S	S	S	S	N	N	N	N	N	N	N	N	N	N	mean	sd
sp*	Ps/Pn/Pp	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Pp	Pp	Pp	Pp	Pp	Pp	Pn		
dbh	cm	20	20	30	20	21	22	33	20	22	20	20	30	35	24	27	28	36	26	25.18	5.77
brash height	m	2.8	2.0	2.0	2.0	2.7	2.4	2.8	0.5	0.2	1.7	0.5	1.7	1.0	2.2	3.1	0.4	2.9	2.6	1.82	0.97
unvegetated by trunk	%	10	30	100	0	10	100	50	10	80	50	40	30	90	80	70	70	90	50	53.53	34.27
drop-disc by trunk	cm	9	6	0	15	14	0	6	18	0	9	6	8	0	9	1	0	1	1	6.00	5.86
drop-disc at canopy edge N	cm	12	12	16	9	9	12	11	38	12	7	7	11	15	17	16	23	9	11	13.88	7.42
W		6	10	9	14	11	11	5	28	12	4	11	6	13	16	24	22	11	22	12.53	6.70
S		11	14	14	22	16	10	7	17	25	0	8	6	9	25	25	26	15	10	14.71	7.79
E		7	14	6	17	9	10	9	4	12	9	9	27	19	29	36	22	10	13	14.65	9.08
ratio: trunk/(mean canopy)		0.250	0.120	0.000	0.242	0.311	0.000	0.188	0.207	0.000	0.450	0.171	0.160	0.000	0.103	0.010	0.000	0.022	0.018	0.13	0.13
VEGETATION within canopy																					
Calluna vulgaris		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Erica cinerea		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Ulex minor				x				x						x		x					
Cuscuta		x						x	x	x							x				
Pinus (seedling)													x	x							
Quercus		x			x	x		x													
Arbutus (seedling)							x														

NOTE - there are no birch seedlings recorded, despite the proximity of mature birches

* PS = *Pinus sylvestris; Pn = Pinus nigra*; Pp = *Pinus pinaster*

t-Test: Two-sample assuming equal variances
dbh

	Pp	Ps		
Mean	30	22.55	F-Test on variances	
Variance	22	20.67	F	1.064 ns
Observations	6	11		
Pooled Variance	21.1152			
Hypothesized Mean Different	0			
df	15			
t Stat	3.196			
P(T<=t) one-tall	0.003			
t Critical one-tall	1.753			
P(T<=) two-tall	0.006			
t Critical two-tall	2.131			

Conclusion:
there is a tree effect, but not direction
in Ps only, neither effect is significant
in Pp, both effects are significant

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*	*F crit*
bearing	26.33	3	8.778	0.244	0.865	2.786
tree	2173	17	127.8	3.559	2E-04	1.827
residual	1832	51	35.92			
Total	4032	71				

Effect of herbicides

Preliminary assessment of bracken control

Control of bracken using the selective herbicide Asulam ("Asulox") has continued throughout the SLRP and a number of sites have received treatment (see Table 4, page 18). Although extremely labour intensive the method of application is undertaken using hand held equipment. This is the most appropriate procedure for heather dominated areas where mechanical methods would otherwise damage or destroy reptile habitat. Our primary aim is to eradicate this pest species and particularly from reptile *foci* although a more achievable target is to reduce bracken to a level where it does not impinge upon the viability and vitality of the dominant heather infrastructure.

During the SLRP sites previously sprayed with different dilutions of Asulam since 1988 were assessed. Our observations have led us to conclude that two important factors dictate the control (or suppression) of this invasive plant. The first would appear to be determined by the concentration of chemical applied to the affected area. The second is the need for careful monitoring of the subject site on a yearly basis and the immediate treatment of any re-occurrence of growth.

A number of sites where bracken was previously sprayed using Asulam at the recommended dilution of 1 part chemical to 50 or 100 parts water (1:50 or 1:100) have been monitored. It appears that spot spraying at this dosage level is ineffective and produced a maximum of two years suppression. It also seems that, as a consequence of spraying at these concentrations, bracken becomes resilient and re-spraying, even at more concentrated levels (dilutions of 1:20), may now not subdue the rhizome. This may be a consequence of resistance to the chemical by underground rhizomes.

Our field assessments indicate that spraying untreated sites at a dosage rate of an average of 1:20 ratio (equating to 5/11 litres of chemical in 90/175 parts water per hectare) produce good results and kill rates of 90% or more of bracken cover are normally achieved. The future success of this approach will be monitored as part of an ongoing, long-term assessment of HCT's past and present annual bracken spraying programme.

Control of Gaultheria shallon

Shallon *Gaultheria shallon* (Pursh) is a woody rhizomatous perennial shrub native to the Pacific seaboard of North America. It was introduced in the 19th Century on shooting estates as game cover and is now available from garden centres as an ornamental.

G. shallon grows best in semi-shade on free-draining acidic soils where it can sometimes completely dominate the ground layer. Previously the plant was confined to wooded areas, though it is now spreading onto and degrading open heathland. Recent mild winters and global warming may be the causal factor of such spreading.

On heathland *G. shallon* out-competes heather species as the dominant ground flora. With a much faster growth rate *G. shallon* overgrows and shades out the heathers, thus destroying the physical structure and species composition which are the main habitat components for *L. agilis*.

In Dorset there are three main centres of *G. shallon* that are presently threatening sand lizard populations. At present 12 sand lizard sites (29 *foci*) are threatened and degrading due to its encroachment.

G. shallon field trials were undertaken to:

a. identify an effective method of controlling *G. shallon* with regard to timing and method of vegetation removal and susceptibility of regrowth of different ages to herbicide application;

b. to identify the most effective type of herbicide in controlling regrowth;

c. to minimise the impact of herbicide application on sand lizard *foci*.

Two sites were chosen and divided into 2x2m quadrats with a minimum of 12 quadrats per treatment for statistical analysis. Each plot had the % repetitive cover of each species present recorded. The treatments were undertaken then each plot was re-recorded at 6 and 12 months respectively. Table 25 summarises the results at 12 months.

Table 25 *Gaultheria shallon* control at 12 months

Treatment				*x* % Kill of *G. shallon*	+/- s.e.	Rank	Kruskal-Wallis mean rank score	n
Cut (1) Method	Cut (2) Timing	Chemical (3)	Application Method (4)					
H	S	T	S	92.4	2.31	1	261.97	15
H	A	T	S	88.9	3.01	2	236.35	13
M	A	T	S	88.9	1.26	3	226.86	18
M	S	T	S	85.8	3.89	4	221.62	13
H	A	I	S	71.1	8.82	5	191.97	15
M	A	T	P	83.1	1.86	6	187.58	13
H	A	G	S	79.8	3.85	7	186.80	15
M	S	I	S	75.0	7.66	8	185.69	13
M	S	G	S	75.1	5.53	9	175.57	14
H	S	I	S	66.7	8.96	10	166.46	14
H	A	T	P	67.2	6.31	11	148.00	15
M	A	G	S	68.9	4.22	12	141.57	15
H	A	G	P	63.9	6.98	13	137.80	15
M	S	T	P	59.1	8.84	14	134.50	14
H	S	T	P	56.9	8.92	15	131.21	14
H	S	G	S	60.6	9.03	16	130.96	14
M	A	I	S	58.8	6.96	17	117.63	15
M	S	G	P	50.9	9.16	18	116.96	13
H	S	G	P	54.5	7.95	19	112.40	15
M	A	G	P	41.6	6.51	20	87.97	16
CONTROL				9.8	4.15	21	27.31	21

Chi-square = 123.07 d.f. = 20 Significance $p < 0.000$ $\Sigma = 310$

Chi-square = 89.65 d.f. = 19 Significance $p < 0.000$ $\Sigma = 289$ (With control excluded)

1) H=Hand cut M=Mechanical cut 2) A=Autumn S=Spring

3) T=Triclopyr G=Glyphosate I=Imazapyr 4) S=Spray P=Paint

To summarise the results it was found that biomass removal did not significantly differ in effect on *G.shallon* or heather species kill. The timing of biomass removal did not significantly differ in effect on *G.shallon* kill but Autumn cutting cf. Spring caused less heather kill. Spray application had a greater effect on *G.shallon* kill than paint application. Triclopyr had the greatest effect on *G.shallon* kill and the least effect on heather kill of the three herbicides trialed.

Therefore, on sand lizard *foci* it is recommended that *G.shallon* is cut mechanically in Autumn and the regrowth sprayed within 18 months with Triclopyr using an adjuvant.

For areas dominated by *G. shallon* that have no wildlife interest bulldozing can be used to remove the biomass but this must be followed up by chemical spraying to prevent regrowth. It is further essential that this species is classified as a "notifiable species" with further release controlled through the Wildlife and Countryside Act (we would advocate listing the species on Schedule 9) and its sale prohibited. Full report at **Appendix 15.**

Publicity and education

Publicity and education was undertaken throughout the SLRP at local, regional, national and international levels. At all these levels newspaper, radio and televised publicity and presentations were conducted by SLRP personnel on all aspects of the species and the Species Recovery Programme project.

The majority of the local and regional publicity and education generated by the SLRP was delivered via local newspapers, radio and television on specific components of the project, eg the status of the species, habitat damage from fires, the need for active habitat management, translocations and captive breeding, etc.

Further publicity and education was afforded by the production and distribution of Jerry Cole`s (Natures Images) sand lizard T-shirt and fact-sheet (on which SLRP personnel were consulted).

Intensive publicity was achieved during two translocations at local, regional and national levels. Publicised educative material concerning the species is prominent at the four main public vivaria, ie Holidays Hill, Nature Quest, Marwell and Chester Zoos though as yet only Chester Zoo has SLRP information available.

A high profile publicity event was undertaken at the opening of the Chester Zoo vivarium which received significant publicity. Further publicity was produced by the SLRP leaflet which was produced in conjunction with EN`s and WWF`s publicity departments. Other SLRP publicity projects have been highlighted in various other publications notably in the *British Wildlife* magazine, *Coastlines* (the Sefton Coast newsletter), and EN`s Species Recovery Programme publications.

Much of the SLRP education projects were targeted at various landowners/managers and conservation groups to endeavour to highlight the species' needs and threats. Presentations therefore were undertaken at EN`s Heathland Managers' Conference in Dorset, the RSPB`s National Heathland Managers Conference, the Dune Managers Conference in Sefton, the Sussex (South-east England) Heathland Managers Conference and the Dorset County Council's Heathland Forum. Two further presentations were undertaken at EN`s Species Recovery Programme annual meetings at the start and end of the SLRP project.

At an international level the SLRP was formerly recognised and welcomed by the Societas Europaea Herpetologica delegation at the Standing Committee Meeting of the Berne Convention in Strasbourg. The SLRP was also represented at the Third World Congress of Herpetology in Prague. Further representation was also undertaken during combined survey/advice site visits to Belgium and Luxembourg at these countries' requests.

A draft text for a *Conservation Handbook* for the species was produced with a view to publication by EN in financial year 1998/99.

Long term strategy for sand lizard conservation

While the SLRP made a considerable and positive impact for this species' status in Britain, the overall effect was obviously constrained within its three year time frame. Nevertheless, many lessons were learned, management techniques were vindicated and short-falls were identified.

We now need to take forward those key remaining conservation issues identified through the SLRP within the framework of the published UK sand lizard Species Action Plan (SAP) (UK BAP Steering Group 1995b) (see **Appendix 16**). The SAP was drawn up and formally approved (by Government) during the execution of SLRP. Since then HCT and EN have been appointed as its Lead Partners. Unfortunately, as yet there are no indications for any source of the necessary funding, and this looks like being the single biggest initial problem to overcome.

Overall objectives and targets

- To maintain all existing breeding populations at least at current levels and where possible enhance them.
- To reverse the fragmentation of sites by habitat re-creation and management.
- To establish 10 populations in suitable habitat to restore the range and distribution of the species by 2000.

Proposed action

1. *Policy and legislation*

It is essential that the species is included within habitat and site management plants and, that in such plans *foci* are recognised as sensitive areas which have special management requirements.

Agreement with others who own and/or manage key sites and habitats is essential to the success of this strategy. It is also important that the necessary management of sand lizard habitats is taken forward in partnership with other relevant groups. Considerable advances could be made by ensuring that appropriate measures for sand lizard conservation are included in relevant management initiatives, such as the Wildlife Enhancement Scheme and Countryside Stewardship, and taken on board through the Lowland Heathland Habitat Action Plan. There should also be scope for targeting grant aid within these programmes to help implement the Species Action Plan. Such coordination is seen as an urgent and central conservation action.

2. *Site safeguard and management*

Site protection: Although the majority of sites are legally protected, ie SSSIs etc, not all receive such protection. There are still a number of sand lizard populations at risk even on protected sites. These threatened populations should be secured where possible or, if planning permission has been sought or even granted, adequate mitigation packages must be pursued.

Habitat re-creation and linkage: There is a massive potential for further population (*foci*) linkage and considerable scope for habitat restoration and re-creation. Further progress with the former could be made on land owned/managed by Forest Enterprise, while the latter requires strategic attention within County Plans for heathland re-creation and especially that for Dorset. Habitat restoration and re-creation are also possible for dune systems; such schemes also need to include measures for sand lizard conservation in areas where sand lizards occur and those that could be considered for translocation.

3. *Species management and protection*

Heathland: This requires sensitive attention at the level of *foci*. Such detailed management is often needed within sites often being managed at the general level of their habitat type. The importance of sufficient open sand, wherever possible with associated low banks, cannot be overstated.

Measures are required both to combat the source and potential spread of heathland fires, especially in the more urbanised areas of their main range in south-east Dorset. Passive fire-breaks to protect *foci* are essential.

Implementation of management specifically to conserve sand lizards in existing nature reserves is clearly justified. This has yet to be agreed and co-ordinated.

Coastal sand dunes: With the noted exception of Merseyside's fixed dune hinterland, the ongoing problem surrounds the control of public pressure and use of the frontal marram ridges, whilst maintaining the dynamic processes of accretion and dune formation. These processes are essential for ensuring marram vitality and the maintenance of an appropriate vegetation structure.

Reintroductions: A rolling programme of proposals for translocation continues to be assessed within a general framework of range restoration. This needs to consider both known/recorded future sites and habitats and suitable climates in a regional context.

The welcome decrease in 'green field' developments in Dorset, and improved amount of *in situ* conservation in the face of site urbanisation, has reduced the availability of wild-caught 'rescued' stock for direct and indirect re-introductions. Thus the translocation programme needs to determine:

a. How to improve the reliability of captive breeding facilities.

b. The approach to low level collection from large robust and protected populations.

c. The numbers of animals required for captive breeding of Dorset, Weald and north Surrey and Merseyside 'stock'.

4. *Advisory*

Species conservation measures need to be integrated with, and considered part of, management plans and schemes developed for while sites and for habitat types. Our experiences through the SLRP have emphasized the importance of developing good working relationships and cooperation between land managers and conservation organisations. It is important that there is a mutual understanding of objectives, particularly where the needs of an endangered species need to be integrated with other land management objectives.

5. *Research and monitoring*

Monitoring: A regular programme of survey should be developed to monitor the status of all sites/populations, perhaps on a 5-7 cycle. 'Standard transects' (see-Transect Monitoring, page 34) could be designed for nature reserves. Particular and ongoing attention is required for re-introductions to sand dunes and for the initial stages of those to heathland.

Database: HCT must dedicate resources to update their Rare Reptile Database, which in turn will be used to control the timing and direction of field survey effort.

Research: Apart from monitoring as above, the monitoring of *G. shallon* and bracken controls and, monitoring the effects and significance of grazing on sand lizard populations and their habitat there appear to be four main targets:

a. Genetic study to determine differences (if any) between the three population ranges. This still has resource implications which prevented its inclusion within the SLRP, but may prove possible, eg via co-operation with Sussex University.

b. Analysis of secondary egg-laying substrates, ie clay spoil and chalk in the context of global warming.

c. Significance of predation by crows, cats and pheasants.

d. Dispersal of immatures in particular with respect to the potential for colonisation.

6. *Communications and publicity*

This will be dovetailed within the evolving Species Action Plan programme. Other opportunities might be presented in conjunction with the demonstration of site management, eg Studland, other NNRs and through collections of captive animals, eg Chester Zoo.

Conclusions

The sand lizard Species Recovery Programme project

The SLRP proved very successful in that it either met or surpassed its contracted targets for management and translocation. However, its overall effectiveness was severely hampered and in places even negated by situations beyond the control of the project. These included continuing increases in public pressure and the consequent heathland fires, especially in urban and urban fringe areas. Continuing urbanisation in key areas, driven by high house building targets, eg in south-east Dorset, provides ever increasing threats to sand lizards.

There needs to be a much greater degree of integration of the needs of specific species into management policies and practices and the development of funding to address this. Currently such projects are likely to omit the necessary sensitivity in management and in cases this resulted in damage to features that were important for sand lizards. The achievement of the aims of the SLRP would have been made easier if shared objectives could have been identified earlier and taken forward together.

Working partnerships between relevant organisations are important for achieving and for ensuring a wider appreciation of conservation objectives. However development of such partnerships were hindered by a number of factors, notably resource constraints and differing objectives. A wider appreciation of the specific conservation needs of sand lizards and interest in accommodating these in site management would have helped with the achievement of the aims of the SLRP.

Habitat management

Optimum sand lizard habitat consists of unshaded south to west facing slopes, ridges, etc. dominated with either an uneven aged mosaic of dry heath or mature and dense marram, with high proportions of sand for egg-incubation. These habitats are however highly susceptible to both disturbance and damage.

Management for *foci* (and linking populations) involves any combination of the following management techniques: sand provision and fire-breaking, scrub and tree management, bracken spraying and fencing. However, sand provision and fire-breaking are often the most essential management components for *foci*.

Due to the inherent vulnerability of degraded *foci* habitat, the necessarily sensitive management during the SLRP was undertaken solely by HCT teams and supervised contractors. Every effort must be taken to reduce *foci* habitat damage during such management. It is our firm opinion that management by grazing, burning or mowing regimes should not occur on or immediately adjacent to sand lizard *foci*. Rabbit gassing and sett blocking on or near to *foci* must also be prevented.

One of the SLRP's primary targets was to improve 50-100 degraded and potential sand lizard *foci* throughout the species' natural range. Management was completed or initiated at 120 and 26 *foci* respectively, though this equates to less than a quarter of the extant and potential UK *foci*. Furthermore, it is a sobering fact to note that 18% of these managed *foci* were subsequently degraded/destroyed by fires on Dorset's urban heaths in one year alone.

A further 30 sand lizard populations were linked by habitat management, though vast scope for further linkage schemes remains.

Sand

The amount of sand associated with sand lizard colonies on heathland averaged 6-12%, but it was shown to be only practical (and generally acceptable) to manage up to 2% of a *foci* area for sand, which was still demonstrably beneficial for *L. agilis* breeding.

Blading and turfing are the most effective method of sand management for sand lizard egg-incubation. Chemical analysis indicated that the turfed plots had lower humus and chemical contents than rotovated plots, as the nutrient rich layer is effectively removed during the management process. Such a method delays re-vegetation and lessens the need for maintenance, whilst its provision in the form of strips, pathside or firebreak edges etc is also far easier to maintain than localised patches, although on some steeper sided *foci* there may be no substitute for such hand-dug edges.

Effect of limited tree cover on foci

HCT aim to manage sand lizard *foci* as a natural uneven aged mosaic of heather and dwarf gorse. Such predominately mature stands are particularly prone to losses from drought and heat stress, especially on insolated locations. We therefore always retain a low number of scattered trees on *foci* to reduce the effect of such stress. This helps prevent senescence of the heather and helps maintain mature heath with a varied structure.

However, others perceive that leaving trees is detrimental to the heath structure. An independent botanist was contracted to assess the effects of HCT's management. He found that the only detrimental effect was caused by the retention of maritime pine *P. pinaster*, a species that is always preferentially removed by HCT. This provided evidence that our management philosophy does not have these detrimental effects.

The current alternatives for management of mature heath, ie forage harvesting, grazing and burning, aim to re-vigorate growth before the heather dies. These methods are damaging to sand lizard habitat requirements. We therefore conclude that a light scatter of trees and bushes not only diversifies sand lizard habitat, but is probably important for its long term stability. This though, in turn, implies an ongoing need to control such scrub to this optimum level.

Bracken control

Bracken seems to be resistant to spraying of Asulox herbicide when applied at low dilutions (1:50/1:100). However, such resistance is not shown when greater concentrations (1:20) are used. At present our conclusions are provisional as these are part of an ongoing long-term assessment of HCT's past and present annual bracken spraying programme. It is therefore hoped that spot-spraying of bracken encroachment on reptile *foci* will continue to be an efficient method for heather areas where mechanical methods would otherwise damage or destroy reptile habitats.

Gaultheria shallon *control*

Twenty-nine sand lizard sites were found to be threatened and rapidly deteriorating due to *Gaultheria shallon* encroachment, notably in Dorset. Our experimental field trials on sand lizard *foci* showed that *G. shallon* is best treated by a sensitive cut in Autumn with the regrowth sprayed within 18 months using Triclopyr (8% solution) and a recommended adjuvant. It is essential that this vigorous and highly detrimental species is classified as a 'notifiable species' and its sale prohibited to curtail its ever increasing spread; we understand that for some time English Nature and JNCC have been advising that this species is added to Schedule 9 of the Wildlife and Countryside Act. It is further recommended that land managers undertake the eradication of this species on their sites as a priority but as yet there is very little sign of such progress, even on those sites with the most significant encroachment.

Habitat and site management plans and schemes

Management plans, and the schemes which fund their implementation, have considerable potential for accommodating the specific management needed for sand lizard *foci*. This currently is not being done. The specific needs of the species are often not included when developing a management plan or preparing a specification for funding. Many of the preferred management methods for these plans are not compatible with the management needs of *foci* habitats.

Heathland management regimes in particular have tended to look at general prescriptions for the habitat type. Large scale mechanical clearance may be advocated perhaps followed by grazing or heather management. Such approaches are clearly justified to redress the massive backlog of neglect. However, even in such large schemes, more sensitive management should be incorporated to prevent avoidable damage to important features such as sand lizard *foci*.

It is important that sand lizards are properly represented in relevant management plans. This needs the identification of *foci* as sensitive areas and specific prescriptions to ensure that they are managed correctly. There should also be a greater consideration for the needs of priority species when creating links between habitats or undertaking habitat re-creation projects. If these are not done many future opportunities to further the conservation of this species will be lost.

Translocations

Translocations are an essential component of the sand lizard conservation. The SLRP undertook 11 translocations which have initially re-established the species in four counties/areas where it was previously extinct, though overall the net gain for the species is small. Further translocations to sites in these localities must therefore be considered to bolster the conservation status of this species, even where the proposed receptor site may have no historic records of this species. Further efforts should be made to facilitate the re-introduction of the species to the remaining five Counties/areas where the species remains extinct.

With the reduction of sand lizard rescues from development sites there is now a need to bolster captive breeding facilities to ensure that the proposed re-introduction requirements are met. However, at present the potential of the captive-breeding facilities has not yet been realised and there is a current need to 'cull' animals from sites with high and self-supporting populations. Such 'culling' remains necessary for direct releases and to supplement existing captive-breeding stocks whilst maintaining their genetic integrity and vitality. There are particular difficulties with the

Merseyside stock (Zone 1) due to the shortage of captive breeding stock, and current potential sites for release. The role of zoos in sand lizard captive breeding needs to be reviewed.

Regional strategies

Various national, regional and local sand lizard (and relevant habitat) strategies have been either written or implemented via the SLRP's work programme. However, the partnership approach to implementing these plans remained at an unsatisfactory low level. At the time of writing SLRP/HCT remain the main instigators of field-work directed specifically to sand lizard conservation often with only limited support from other potential partners.

Site protection

Site designation

Site designation is a valuable means of protecting sand lizard habitats. Many of the proposed sand lizard sites put forward by the SLRP have now been notified as SSSIs, most notably in Dorset; however, three notable sites in Merseyside continue to be undesignated.

Development pressures and fires

Continuing development pressures, ie housing around urban heaths (most notably in south-east Dorset) and the associated heathland fires are devastating sand lizard populations and their habitats. Although the Fire Brigade now endeavours to minimize damage, the problem of fire is ever increasing. During Summer 1995 and Spring 1996 there were 681 heath fires in Dorset alone, these seriously damaged 31 *foci* and reduced their populations by *c* 85%. Of these sites 80% had further fires some having as many as 20 separate incidents.

Urban heaths need both sensitive housing and amenity policies and, improved police involvement to curb arson otherwise these semi-urban populations of sand lizards (and other reptile species) will continue to be severely threatened with extinction.

Survey, monitoring and research

Surveys

These were predominantly undertaken by HCT staff due to the lack of experienced field-herpetologists within other conservation bodies, eg Wildlife Trusts. The difficulty in surveying for these animals has meant that there is a need for further reliable surveyors and especially in the under-recorded zones, ie I and II (Merseyside and the Weald/north Surrey and Hampshire).

Database

The data for all of the sand lizard zones now needs to be compiled over the next few years. Appropriate levels of access need to be agreed to ensure this can be used as a valuable conservation tool.

Monitoring

From field-trials it was found that random transect monitoring was inappropriate. However, pre-assessed routes (Pollard walks) around features favoured by the species proved, in the short-term, to be both a reliable and repeatable monitoring technique. Guidelines on survey criteria need to be refined and disseminated to facilitate reliable and repeatable data. However, the continued lack of experienced field herpetologists at the local level and the fact that many site managers have not undertaken reptile surveys mean there are additional problems yet to be overcome.

Genetics

Research into the genetics of the three zonal 'races' could not be undertaken due to the considerable costs, ie *c* £10,000. However, following consultation it is now hoped that this research will be undertaken within the sand lizard SAP in collaboration with Sussex University.

Publicity and education

This was undertaken throughout the SLRP at local, regional and national levels to provide varying levels of information to the general public, land-owners/managers and conservation bodies as to the threats, requirements and relevant issues affecting this species conservation. This must be continued post-SLRP in order to implement the UK sand lizard SAP.

The future

With the end of the well funded SLRP further resources are essential to maintain the gains brought about during the SLRP and to alleviate the previously mentioned negative factors. Whereas the SLRP worked within an annual budget of *c* £143,000 (£100,000 via HCT) the Species Action Grant for 1998/99 was only £5,000. Longer-term and adequate levels of funding are essential.

Some funding is theoretically possible via SAP Champions. However, at present it seems that large, well known conservation organisations, with the infrastructure and professional staff geared towards fund-raising, will benefit the most, probably to the detriment of smaller organisations. Furthermore, Champions prefer to finance species that are considered to be widely 'attractive', eg birds, butterflies, etc.

In contrast, much greater funding is available via Habitat Action Plans, however this assumes that management for the habitat type will always benefit all fauna. Unless *foci* management is sensitively integrated within these schemes, we would have to remain sceptical about the benefits of these schemes to sand lizards.

It is essential that any long term strategy for the sand lizard and thus its Species Action Plan ensures that:

a. the relevant Habitat Action Plans and associated schemes adequately integrate the Species Action Plan needs;

b. there is adequate long-term finance to maintain the SLRP gains and alleviate negative conservation factors. It must be noted that as comprehensive as SLRP was, it still tackled less than a quarter of extant and potential *foci* in the UK;

c. there is a partnership approach towards this species conservation involving all relevant organisations.

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List of Appendices

Appendices are reproduced in a separate volume and, due to them giving details about specific sites, are classified "*In Confidence*"

Appendix 1	Summary of *Foci* management undertaken during the SLRP
Appendix 2	Heathland management calendar (Dorset Heathland Forum)
Appendix 3	Sand management undertaken during the SLRP
Appendix 4	Bracken management undertaken during the SLRP
Appendix 5	Scrub/tree management undertaken during the SLRP
Appendix 6	Fencing undertaken during the SLRP
Appendix 7	Linkage undertaken during the SLRP
Appendix 8	Translocations: rationale and objectives (EN working document by T. Gent) (November 1994)
Appendix 9	Completed and initiated translocations undertaken during the SLRP and proposed future translocation sites
Appendix 10	Straight line transects and monitoring of reptile populations (Draft report to HCT by D. Tamarind) (December 1995)
Appendix 11	Report on transect study (Extract from EN Science Report No. 27 by W. Whitaker) (1996)
Appendix 12	Fire damage on *L. agilis Foci* Summer 1995-Spring 1996
Appendix 13	Efficiency of sand exposure methods - research undertaken during SLRP
Appendix 14	Scattered trees on mature dry heathland: a preliminary assessment (report by R. Walls) (November 1997)
Appendix 15	*Gaultheria shallon* control project report - research undertaken during the SLRP
Appendix 16	UK Biodiversity Action Plan for sand lizard (UK BAP Steering Group, 1995b)