Report

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The management of tree mallow and puffin habitat on Craigleith: a first proposal

Summary:
This document sets out a proposed management plan aimed at reducing the extent of tree mallow on the island of Craigleith to increase the density of breeding puffins and their habitat. The desired end point is the creation of large zones on the island where tree mallow is of no hindrance to puffins or cliff vegetation. A staggered approach will be adopted, in which tree mallow will be removed from previously identified zones through cutting. Importantly, conservation action on Craigleith will be community-based, with local volunteers operating from the Scottish Seabird Centre maintaining areas previously cleared. Monitoring will be in place to evaluate whether intervention has the desired positive effects envisaged, without major undesired side effects. The expectation is that in five to ten years time the majority of the island is free of tree mallow and that low-level maintenance will suffice to keep the island in an ecologically favourable state.

1. Background information

1.1 General: Craigleith is an uninhabited island situated in the Firth of Forth opposite North Berwick, which is owned by Sir Hew Hamilton-Dalrymple and is in custody of Scottish Natural Heritage. Whilst relatively small in size (7.67 ha), Craigleith is seen as an asset by the local community and its visitors because of its wildlife at close proximity. The breeding population of puffins in particular is seen as valuable (Fischer and Van der Wal, submitted), as flocks of birds could be observed on the water between the island and North Berwick and boat trips to the island allowed visitors and locals alike to observe this iconic bird at close distance. Numbers of breeding puffins have dwindled, particularly during the last decade (Harris et al. 2003), and this marked decline has been attributed to the recent rapid spread of tree mallow rendering the island far less suitable for breeding puffins.

1.2 New evidence: Research has demonstrated that tree mallow reduces the number of occupied puffin burrows, and hence the breeding population on the island (Van der Wal et al. 2003). Moreover, persistently high cover of tree mallow leads to an almost complete disappearance of the typical grass dominated cliff vegetation dominated by red fescue that typically stabilises the soil.

2. The expansion of tree mallow

2.1 Status of tree mallow: This biannual plant is native to the SW of the UK where it survived the last glaciation, but has been introduced by humans to a wide range of coastal sites from which it has spread. In the Firth of Forth, tree mallow was reported as far back as the 17th century when it was seen as an asset of the Bass Rock. Whereas the species may be classified as an alien or non-native by ecologists, most members of the general public do not necessarily

share this view but see it as a species that "has been here for a long time". Moreover, one may label the plant as an 'archeophyte' rather than a 'neophyte' and hence different statutory obligations may apply. Irrespective of its status, the species is clearly invasive in the Firth of Forth and reaches high abundance on Craigleith and Fidra and also locally on the Bass Rock. Smaller populations occur on Inchcolm and the Lamb and scattered plants are found along the mainland shoreline.

2.2 Why tree mallow has expanded in the Firth of Forth: Research is still in progress but on existing information, it seems that there are three key reasons. First, the disappearance of rabbits from the islands has enabled grazer-intolerant species to establish and expand with greater ease. The absence of tree mallow on the Isle of May, for instance, is likely due to the very high density of rabbits there. Given that rabbit food is in short supply in early spring, seedlings of tree mallow are unlikely to mature unnoticed in the heavily trimmed vegetation. Second, milder winters have allowed tree mallow to prosper; in particular the low frequency of severe spring frosts seems to have benefited the species, providing conditions for expansion where seedling establishment is possible. Third, the expansion of the puffin population itself seems to be the ultimate reason for the spread of tree mallow on Craigleith. Whereas it is difficult for tree mallow seedlings to establish in dense grass swards, the moist and fertile soil in the entrances of puffin burrows provides ideal conditions for germination and seedling growth.

3. Intervention on Craigleith

3.1 Reasons for intervention: If it is the desire of the landowner and SNH as the governing body to intervene on Craigleith, tree mallow may be reduced in extent on the island step by step. There is public backing for such conservation action (Fischer and Van der Wal, 2006), but only if low-risk strategies are employed, such as manually cutting tree mallow. Other potential methods such as the introduction of rabbits, or application of pesticides received less support and a far greater level of disapproval. Any intervention may have undesirable side effects and therefore a risk assessment (likelihood and severity of negative outcomes) of the proposed measures and subsequent monitoring is of great importance. The general public appears to be aware of the potential side effects specific to the case.

3.2 Alternatives to intervention: An alternative approach is to leave tree mallow on Craigleith as it is. This is likely to lead to a further expansion of tree mallow and even lower numbers of puffins unless a series of severe winters or springs curtails tree mallow growth naturally. Whereas the dominance of tree mallow and low puffin numbers may be seen as undesirable, one may view this alternative state as a unique ecosystem which, as far as we know, is only found on a handful of islands off the coast of Australia and in the Firth of Forth.

As clearing tree mallow from Craigleith is a formidable task, removing the species from Fidra might be more tractable because it covers less of the ground there. That way, at least one of the two islands near North Berwick will remain suitable for puffins. Currently, regular boat trips to Fidra in summer allow visitors to observe puffins on the island, whereas Craigleith is not accessible for landings by the public.

3.3 Taking position: to intervene or not intervene: As outlined above, it is now critically important to decide what to do with Craigleith. Both scenarios (intervention and non-intervention) are viable and have relatively predictable outcomes though their economic costs and management input differ widely. The outcome of discussions between the landowner, SNH, the Scottish Seabird Centre and CEH is that intervention on Craigleith desirable. In particular, by developing a strong community involvement, the conservation work to be conducted on the island provides local ownership and furthers people's interest in, and care for, their local environment.

3.4 Involvement of RDF Media: The interested parties view as desirable the kick-starting of the conservation work through involvement with RDF media and the associated publicity. This is because it enables a large audience to be informed and inspired by the intricacies of island ecosystems, the role of climate in modifying the local environment, and the possibility of making a difference through longer-term community based conservation action. RDF media would therefore be allowed by the Landowner and SNH to initiate and film conservation action on the island, albeit under the constraints laid down in the long-term management plan and possible additional measures required by SNH.

4. Proposed long-term Management Plan for Craigleith

4.1 Main purpose of a Management Plan for Craigleith: To develop a long-term strategy for tree mallow control on the island. The proposed management plan below sets out objectives and the means to achieve them, and identifies protocols to evaluate outcomes. Risks associated with intervention are highlighted and appropriate mitigating factors are suggested. Economic costs of the plan are estimated and a management structure proposed.

4.2 Overall management objective: The main management aim is to reduce the extent of tree mallow on the island of Craigleith to enable an increase in the number of breeding puffins. Whilst complete eradication of tree mallow from Craigleith may be desired, it could be difficult to achieve (section 4.3). Thus, *the proposed 'desired end point' is therefore to reduce tree mallow cover in large parts of the island sot that it is of no hindrance to puffins or other ground breeding birds* (such as cormorants) and cliff vegetation has been restored. The overall objective can only be achieved if there is ongoing monitoring and follow

up action. This requires local involvement because cut areas must be inspected at least once a year and newly emerged plants cut down (for more detail see below).
The specific objectives are:

1) to increase the number of burrows used by puffins
2) to increase the extent of cliff vegetation
3) to ascertain local community involvement and ownership
4) to enhance interest in local environmental issues through publicity.

4.3 Why is complete eradication of TM difficult to achieve?
Research during the last three years has shown that larger tree mallow plants are easily cut down and that regrowth is minor. However, seedlings will emerge from the soil for several years and need to be cut down when tall enough. The number of seedlings that emerge will be greatest where modest understorey vegetation exists. Dense understorey vegetation will likely suppress tree mallow seedlings whilst on bare ground the environment will be too harsh for many tree mallow seedlings to establish. We do not know how long the seedbank will last, but complete exhaustion is likely to take several years. However, by preventing seedlings from maturing to set seed, no further contribution is made to the soil seedbank and the number of emerging seedlings is likely to drop considerably over a period of three years. To completely eradicate tree mallow from a relatively sizeable cut area is unlikely to be achieved, as disproportionate effort is necessary to remove the last few plants. There are many sites that are difficult to human access where seedlings will escape cutting but, with an increasing area of island being cleared, extra effort might prevent even those plants from flowering so that seed set is prevented.

4.4 How to progressively reduce the extent of tree mallow? This will be achieved through sequential cutting of tree mallow in designated areas. In the first year (September 2006) tree mallow will be cut in two areas and both will require subsequent maintenance for at least five further years. In year 2 other designated areas will be cleared and subsequently maintained. Thus over several years, the medium-term objective is to have cleared tree mallow from the whole of the island except for the rocky fringe and the low-lying interior. Here, clearance will generate very little additional puffin habitat but could enable the expansion of the gull colony with its associated enhanced predation of young puffins. A suggested approach is visualised in Fig. 1 and would result in tree mallow control in all major puffin breeding areas on Craigleith. This might need modification following experience in Year 1 and monitoring. Clearance cuts are best made when tree mallow is relatively tall and after most puffins have left the island, i.e. late July or August. Cutting later is possible but less good because seeds will have been formed. A small number of large clearance areas will be created rather than a large number of small clearance areas for two reasons. First, large areas are easier to maintain and second, environmental conditions (summer drought but most importantly winter/spring frost) are likely to be harsher for tree mallow seedlings to survive.

4.5 Looking after cut areas: The main premise of maintaining cut areas is to prevent establishment of new tree mallow plants that will set seed and so replenish the seedbank. To prevent this, two revisits a year are recommended: in March/April and July/August. The spring cut is least important as puffins can breed in areas with relatively low tree mallow cover. Moreover, plant growth during winter is generally low and many seedlings may die during spring frost or extended late cold spells. Only when winters have been very mild and no extensive cold periods in spring have occurred, is cutting back seedlings in spring a necessity. Importantly, the summer cut will prevent plants from flowering and also, the majority of plants that have escaped cutting in spring will now be tall enough to be noticed and can be cut down with ease. Based on previous experience, maintaining cut areas becomes easier over time as successively fewer seedlings emerge.

4.6 How to cut tree mallow: Cutting tree mallow and uprooting seedlings is the most effective and safest method. It is important that mature plants are cut as low as possible so that no regrowth takes place, and the soil should not be disturbed as that encourages seedlings next spring. Damage to other plant species should be minimized, as they (particularly grasses) are essential for soil stabilisation and future suppression of tree mallow seedlings. A clearance cut is best done with loppers, but also shears may be used. For maintaining cut areas, shears are the best instrument.
Under tree mallow swards, a plethora of older decomposing tree mallow stems can be found. Whereas these can be removed from places where there is ample grass cover and the risk of soil erosion is negligible, old stems should not be removed from places where there is very little grass cover. Chickweed (*Stellaria media*) may seem to provide reasonable cover and can grow relatively luxuriant underneath well-established mallow stands, but once exposed will vanish rapidly to leave bare soil. Particular care should be taken on the dry south facing slopes where, with little organic matter to bind it, the soil erodes easily. Here in particular, old tree mallow stems provide organic material to hold moisture, enabling grasses and forbs to establish.
As intervention in 2006 will take place after seed set, a vacuum machine will be employed to suck up seeds in a series of clearly marked (white plastic pipe) 5m × 5m plots. Erecting adjacent plots from which no seeds are being removed will determine the efficacy of seed removal.

4.7 Disposal of tree mallow: Cut plant material has to be brought to allocated disposal sites. Utmost care must be taken to not have disposed tree mallow material piled up on top of existing puffin burrows. Material can be shred but does not have to because leaves will decompose within a season and stems within one or two years.

4.8 Operation of larger groups: Clearance cuts will involve relatively large groups of people on the island. It is therefore important to operate in a structured way to optimize effective cutting and minimize detrimental side effects and personal risks. Cutting should only take place under the guidance of an authorised person who takes decisions on the ground. When splitting up in teams, additional team leaders need to be identified. Personal health and safety of the volunteers is discussed under **x.y.** Here we focus on potential damage to the ecosystem, particularly puffin burrows.
Puffins use large part of the ground on Craigleith and their burrows are long-term structures that represent a major investment of individual birds and must be treated with respect. Collapse of a burrow is likely to lead to the eviction of a pair of birds and would require the construction of a new burrow during subsequent years. Moving through dense tree mallow makes it difficult to spot burrow entrances and thus nearby underground nest chambers and subterranean tunnels. It is therefore important to minimize movement through the area by creating paths over which most of the walking takes place. Those paths should traverse areas where puffin burrow density is low, and cut tree mallow (preferably non-flowering bigger plants) can be used to lay down a temporary carpet over which people can walk between cutting areas and disposal sites.

4.8 The selection of areas to be cut: The rationale behind site selection for year 1 (see Fig. 1) was to clear a sizeable yet manageable area so that the local community realises that intervention can make a difference. The two areas to be cut in September 2006 (together 1.2 hectare, or 16 % of the island surface) have been selected for different reasons. The most southern area (0.59 ha) is a glen visible from North Berwick so tree mallow clearance there can be easily seen from the mainland and could encourage further local involvement in future conservation action on the island. Also, because of its relatively sheltered position, cutting on dry south facing slopes in this glen is a good way to identify whether soil erosion is going to be a major problem on the other, more exposed, southern slopes.
The second area (0.64 ha) is a slope on the NW crest of the island. Tree mallow removal here will offer excellent puffin breeding habitat but. Also, because it is the highest part of the island, the area will no longer act as a direct seed source for lower lying areas.
The areas identified for clear-cutting in Fig. 1 in the years 2-5 are drawn for indication only. How to exactly proceed in 2007 and beyond will depend on experience with cutting in 2006 and the evaluation of monitoring vegetation, soil and puffins.

4.9 Will cutting bring back puffins?
Almost certainly; our research findings clearly indicate that tree mallow is the cause of puffin breeding decline on the island, and that the number of occupied burrows increases within a single year following a cut. The number of puffin

burrows doubled in the third year after the removal of tree mallow in small experimental (3m × 3m) plots. Recovery rates may even be greater over larger cut areas.

4.10 Will cutting bring back cliff vegetation?
In areas where tree mallow has not completely shaded out all understorey vegetation, annual grasses are likely to cover the ground extensively within 1-2 years (*Hordeum murinum*, or wall barley in particular). Over time, the perennial grasses *Festuca rubra*, or red fesque and, in the more moist and fertile places *Holcus lanatus*, or Yorkshire fog are expected to expand and stabilise the soil. On sunny slopes with little understorey vegetation, however, this process will be very slow. The prediction therefore is that cliff vegetation in cut area 2 will recover swiftly, whilst for parts of cut area 1 it may take several years before there is sufficient plant cover to bind the soil.

4.11 Are there any undesired side effects to be expected? The prediction is that soil erosion will occur on sunny slopes in particular, where grasses and other vascular plants will expand only very slowly. However, the risk of this occurring broad scale is low because further cutting on dry slopes is contingent on the results of the trial in the relatively sheltered southern glen. The intention is to experiment with the retention of old tree mallow stems (see earlier) as a mitigating measure. Data on soil erosion and plant recolonisation in cut and untreated control areas and will form the basis for modifications to the management plan with implications for future conservation action.
Another, perhaps undesired, side effect is likely to be the expansion of herring and lesser black-backed gulls. Numbers of these birds have also decreased substantially due to the expansion of tree mallow. By not cutting the low lying and flat central part of the island, their prime breeding site will remain occupied by tree mallow, which may continue to suppress their numbers. However, based on findings from our small experimental plots it is to be expected that gulls will also benefit from tree mallow clearing in our target areas.

4.12 Do untreated areas act as seed source so that the problem repeats itself? A single mature tree mallow plant produces large numbers of seeds and, as far as we currently know, most fall directly underneath. Plants that grow on slopes, however, generate seeds that likely move down hill, so it is important to remove tree mallow from above any cut area so reduce continual passive reseeding.
We anticipate two additional sources of seed transport on the island: birds and humans. Whilst tree mallow seeds are not sticky, walking through mallow stands in late summer, results in an accumulation of seeds in clothing. Thus, our own presence is likely to generate some seed transport into cleared areas. Also, we suspect that seed eating birds, such as linnets and pigeons, transport seeds, although tests are required to establish whether mallow seeds survive

passage through their digestive tracts. Although many seeds could end up in previously cleared areas through the above-mentioned routes, it is likely that only a fraction would successfully germinate and establish. Therefore, the existence of a continuous tree mallow seed source on the island does not necessarily present a major problem, as long as these areas are low lying. New establishment from these areas will be relatively rare, and of far less importance than the seed bank. Moreover, in a system where there are frequent visits during which larger plants are cut down, such new establishments will not re-establish domination by tree mallow.

4.13 Does more need to be done? The measures set out above are expected to be sufficient to reach achieve the specific objectives. Careful monitoring in cut and control areas will reveal whether this is -or will eventually be- the case within a reasonable time frame. Early monitoring findings will help to fine-tune the project and perhaps accelerate the rate of progress and further reduce risks associated with intervention. Any unanticipated additional measures would require effective and risk free trialling before being employed on Craigleith.

5. Monitoring

Monitoring is essential to any conservation action to reveal whether the specific objectives set in a management plan are being achieved. On Craigleith, monitoring is required to see whether following cutting, puffin numbers increase and cliff vegetation expands. Monitoring trials should also clarify the risk of soil erosion and the efficacy of seed removal. Specific objectives 3 and 4 (section 4.2) would benefit from a formal approach involving social sciences, but as a strict minimum local involvement and publicity by Management (see later) should be documented.

5.1 Monitoring the number of breeding puffins: A series of plots will be set up in which the number of puffin burrows and occupancy rate will be recorded. In each cut area, 8 plots of 5m × 5m will be demarked together with 5 similar sized control plots in uncut tree mallow dominated areas. The first assessment of the total number of burrows only will be taken directly after cutting; thereafter monitoring will follow once a year in mid-May for at least 5 years. Occupancy rate will be assessed over a two-day period through placing out small wooden sticks in the burrow entrances, whereby the number of disrupted ones indicate use of a given burrow. Measurements in uncut controls enable an estimate of how the number of occupied puffin burrows would have developed in the absence of any intervention. An additional total puffin burrow count of cut area 2 in Year 1 and 5 is currently being considered.

5.2 Monitoring the development of the vegetation: The extent of ground cover by plants will be measured in the same plots used for monitoring puffins to determine whether vascular plants, particularly perennial grasses, will regain dominance after cutting takes place. Plant cover of all species present will be estimated by eye once a year in mid-late June for at least 5 years.

5.3 Erosion recording: Erosion markers will be placed out in cut areas along transects running South to North in September 2006 to detect under which conditions erosion occurs. Recording will take place in April (to record soil loss over winter, mid-late June and September 2007. Subsequent recording will take place in mid-late June only for a further 4 years.

5.4 Efficacy of seed removal: An experimental trial will be set up in September 2006 to determine whether seed removal after cutting, using a seed sucker, is an effective means to reduce tree mallow emergence from the seed bank. For this, seeds will be hovered from 10 plots of 5m × 5m size, whilst no seeds will be removed from 10 associated and similar sized control plots. Time invested in hoovering will be noted and seeds collected in a bag for disposal at depots used for mallow cuttings. In April, mid-late June and September 2007, the number of emerging seedlings will be counted in all plots and subsequently removed in a similar way as the whole cut area. These data will reveal whether in subsequent clear cuts, seeds will additionally require removal to ease maintenance of mallow-free areas.

The findings generated through the above described monitoring will inform future management action and any potential deviations from the planned approach. In this way, safe and responsible conservation practise will be applied to finally bring back breeding puffins and cliff vegetation to a large part of the island. Whilst monitoring requires clear protocols, it should not be fixed but remain adaptable to changing conditions as knowledge, understanding and issues are raised and resolved.

6. Management structure

A management board will be set up to regulate and implement conservation action on Craigleith, thereby ascertaining and reviewing progress in the light of all objectives set. On the management board should be the Land Owner, representatives of SNH, the Scottish Seabird Centre and a research scientist.

6.1 Specific responsibilities: The board will be lead by SNH, whilst the Seabird Centre will organize 'hands-on' conservation action on the island. The research scientist will provide scientific and experiential guidance to the project and oversees the monitoring on which basis the management board can decide to modify timetables or action on the ground.

As lead organization, SNH will facilitate and coordinate working with board members and ascertain commitment and involvement of other relevant stakeholders, thereby including the local general public.
Maintenance cuts are to be organized by The Scottish Seabird Centre and planned in advance and have a clear and specific objective. Multiple short visits to the island should be avoided where practical and instead, longer visits (twice a year – see earlier) with several participants would be preferred, thereby effectively maintaining clearcut areas. A record should be kept of any action taken on Craigleith, thereby providing date, activity, area, numbers of people involved etc. so that we know what management has been applied. These data should be passed on electronically to the scientific advisor, so that all data (conservation action and monitoring data) are held in one place. It would be ideal if as many local people as possible could participate in the maintenance activities but flexibility is likely to preclude any formal advertisement.

Clear cutting new areas are to be organized by SNH upon agreement of all board members about the exact actions to take and subsequent monitoring to reveal its effectiveness for puffins and cliff vegetation. These actions should be carefully prepared and widely advertised, thereby drawing on the volunteer force mobilized by RDF media for the September 2006 cutting and filming event. Before new areas are being cut, all evidence (monitoring, experience) and any changes in conditions, opinions etc should be reviewed. Any changes to the management plan should be made in writing and supported by all board members.

The research scientist will conduct the agreed monitoring, analyze the data and collate information on site visits of cutting teams. This material forms the basis for a short written report that is circulated to all board members annually, which forms the basis for discussion about the continuation of clear cutting.

6.2 Mechanisms used to encourage local participation: A wide range of instruments can be used to ascertain local participation. Best ways of going about need to be discussed by the board, thereby making use of local circumstances. All activities will be recorded by SNH.

7. Economic costs:

Financial stability is essential for the viability of a longer term sustainable management plan. There will be a wide range of direct and indirect costs associated to the activities planned, but only the main direct costs are listed here.

- Boat journeys to the island (2-4 trips per year for mainenance)

- Monitoring (6 days a year field work; 1 day analyses and report writing)
- Travel costs for management board meetings

The greatest cost however will be time to organize the work to be done, cutting the tree mallow (clear cuts and maintenance work), public consultation, and project development.
This section needs to be developed with SNH and agreed on.

8 Draft timetable

1 September 2006:
Submission of a draft management plan to SNH as condition for the initiation of subsequent conservation action on the ground.

6-12 September 2006: Clearance of areas 1 & 2.

12 September 2006: Presentation of the draft management plan to the North Berwick community.

December 2006: Finalising long-term management plan; inform local community through newspaper etc.

April 2007: First maintenance cut for areas 1 & 2; recording soil erosion in cut areas and seedling emergence in seed removal trial.

June 2007: Recording erosion, puffin and vegetation parameters and seedling emergence in seed removal trial and compile a report; Board to discuss whether deviations from management plan are needed.

July 2007: Second maintenance cut for areas 1 & 2.

Late July – August 2007: Clearance of new areas

September 2007: Recording erosion and seedling emergence in seed removal trial.

December 2006: Board to evaluate progress and modify management plan where necessary and draw a new timetable.