A Botanical Survey of the Shore at Rathcor, Co. Louth

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All photos by Ciarán Flynn.

About the Author

Ciarán Flynn is a freelance ecologist with extensive botanical experience. Having attended Trinity College Dublin (TCD), he attained a first-class honours degree in Zoology. As part of these studies, he was awarded a Gold Medal for his exceptional degree results and elected Scholar by the Board of TCD. His thesis examined the potential natural vegetation of Black Mountain, Cooley using fossil pollen analyses to reconstruct previous plant communities. To further pursue his interest in the Irish flora, he has drafted a PhD proposal focussing on Atlantic bryophyte ecology in Irish temperate rainforests.

The development of his botanical field skills has been achieved through regular participation with the Botanical Society of Britain and Ireland (BSBI) and Dublin Naturalists' Field Club (DNFC). As a BSBI county recorder for Louth, he possesses detailed knowledge of important botanical sites and species within the county. Notable finds include *Trichomanes speciosum* (Killarney Fern) (gametophyte) on Slieve Foy and *Trifolium ornithopodioides* (Bird's-foot clover) on Clogherhead, the latter comprising the first county record since 1837. Moreover, he is currently engaged in a study of bryologically significant sites in Slieve Gullion, Co. Armagh, supported by an Irish Naturalists' Journal Grant (2024). His avid bryophyte recording efforts in Cooley have yielded new county records for the moss *Orthotrichum pulchellum* and the thallose liverwort *Metzgeria conjugata*.

Previous professional experience includes habitat classification (UK BAP) and vegetation surveys undertaken for the Northern Ireland Countryside Survey, as well as habitat and plant surveys of Rathcor and Baltray for the Louth Nature Trust. Desk-based projects include a 'County Meath Biodiversity Audit' conducted with FitzGerald Ecology. This involved a synthesis of records and data relating to many habitats and taxonomic groups, data cleaning in R and production of shapefiles in QGIS. Furthermore, he drafted much of the accompanying report which, *inter alia*, identifies important sites for biodiversity and highlights knowledge gaps.

Finally, Ciarán is a member of both the BSBI's Committee for Ireland and DNFC's Board and Research and Publications Subcommittee. He has written several articles on his botanical discoveries in Co. Louth and has been editor of the BSBI's *Irish Botanical News* since 2024.

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1. Introduction

An inventory of ecologically significant sites is critical for effective conservation. Comprehensive data on species, communities and habitats, collected in the field, are needed to inform site selection for such an inventory. The resulting baseline data can be used to assess trends when future surveys are completed. Where available, older data can be compared with present-day site conditions. Surveys of undesignated sites should be a key focus. There is often less historical data from these sites in comparison to protected areas such as Special Areas of Conservation (SACs). Furthermore, such sites are often of county importance and vulnerable to damaging human impacts.

Louth Nature Trust commissioned Flynn Ecology to conduct a botanical survey of an undesignated coastal site in Cooley, Co. Louth. The area includes the coastline at Rathcor along with areas to the west and east (see section 2.1.). The aims of the study are as follows:

- To generate a comprehensive list of vascular plants found in the study site.
- To record a selection of bryophytes (mosses and liverworts).
- To classify and record the habitats present according to Fossitt (2000).
- To describe the physical and floristic composition of habitats, with an emphasis on species indicative of particular habitats.

2. Methodology

2.1. Site description

The study area comprises one of the few undesignated stretches of coastline on the Cooley Peninsula (Figure 2.1, Figure 2.2). Located on the southern margin of the peninsula, the site extends approximately 4km from the mouth of the Castletown River (Irish Grid Reference J 168 054) to Shellinghill (J 209 049) in the east. Stretches of sandy and rocky shoreline are bounded by cliffs consisting mostly of gravel and sand. This unsorted sediment (glacial till) was transported and deposited by glaciers near the end of the last glacial period. Ice streams from the north-west were the sources of these sediments (Knight, 2024a). Both till and gravels derived from granite are mapped from the area (Geological Survey of Ireland, 2024). Importantly, studies of the exposed sediments at Rathcor have informed theories of ice sheet dynamics in Dundalk Bay (Knight, 2024b). Given that these cliffs are composed of soft sediments, they are quite easily eroded. Heavy rainfall causes waterlogging of the soil which frequently leads to sediment mass movement. Freshly exposed substrates provide a habitat for early colonising plant species. Beneath the glacial till lies Carboniferous limestone bedrock. This underlies the southern lowlands of the peninsula (Baxter, 2008). No outcrops of limestone bedrock are known to occur within the study site. However, their influence on groundwater chemistry and habitats is evident by the occurrence of petrifying springs.

The flora and vegetation of the petrifying springs at Rathcor have been previously described by Lyons (2015). These develop where spring water precipitates calcium carbonate upon contact with the atmosphere. The resultant deposit is known as tufa (Lyons and Kelly, 2021). As the granite-derived till is probably acidic in character, it appears likely that groundwater flows over the limestone bedrock. The groundwater consequently becomes enriched in calcium carbonate. In addition to the springs, bryophytes and vascular plants have been previously recorded from the site. *Glaucium flavum*, a Near

Threatened species in Ireland (Wyse Jackson *et al.*, 2016) has been observed recently (C. Flynn pers. obs.). Moreover, new county records for two uncommon mosses, *Fissidens celticus* and *Oxyrrhynchium speciosum*, were made here (Pilkington, 2024). Previous work evidences the botanical interest of this coastline. This is in addition to both the site's geological and archaeological value.

The archaeological interest of the area is based on a proposal by Mitchell (1992). Based on an analysis of the rock compositions, he posits that the cobbles at the entrances to Newgrange and Knowth were mainly collected from the shore at Rathcor. Should this be correct, it would further underscore the scientific value of the area across several disciplines.

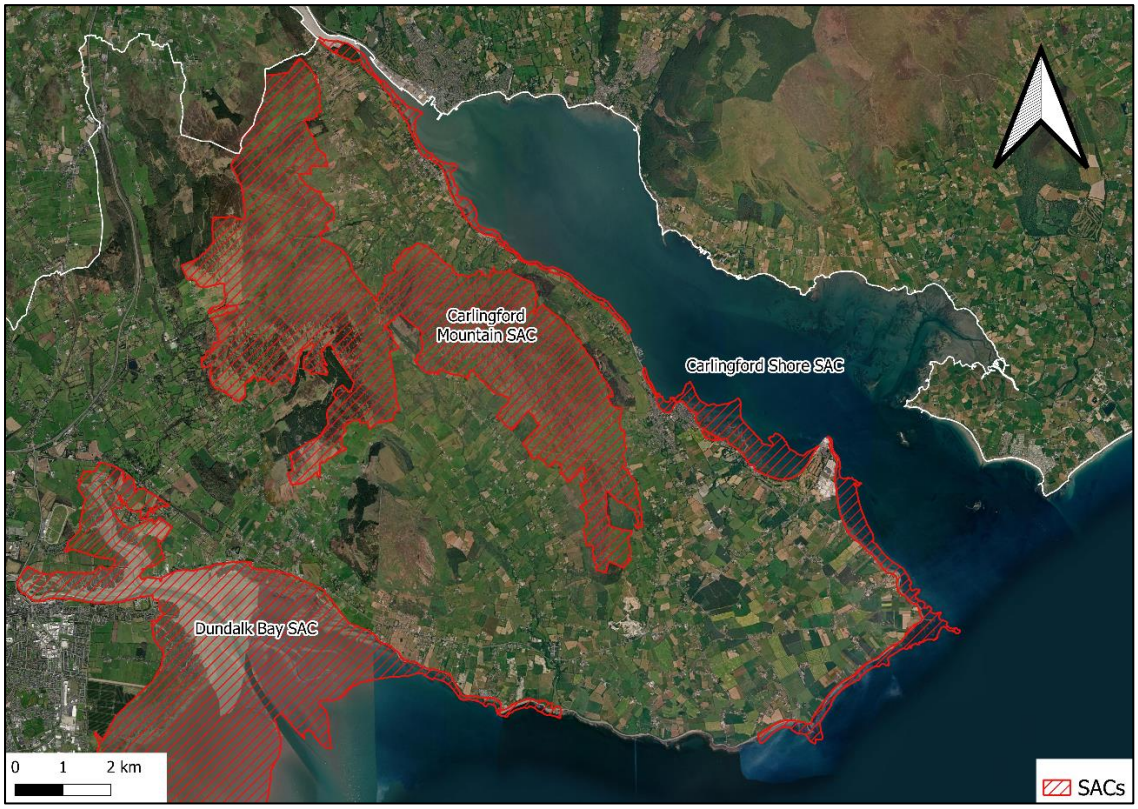

Figure 2.1. Special Areas of Conservation (SACs) on the Cooley peninsula, Co. Louth.

Figure 2.2. Location of the study area between two SACs on the south coast of Cooley.

2.2. Fieldwork

Site visits were carried out on the 8th July and 9th – 11th September 2024. All vascular plant species were recorded and later compiled into a comprehensive species list. A small number of bryophytes were also recorded where these appeared to be of interest. Samples were collected for microscopic examination to confirm identifications. The keys and descriptions in Smith (2004) and the British Bryological Society website (British Bryological Society, 2024) were consulted alongside genus-specific papers for *Racomitrium* (Ottley, 2021) and *Didymodon* (Blockeel and Kučera, 2019). Stace (2019) was consulted for vascular plant identification. Habitats were classified according to Fossitt (2000). Details of the physical and floristic structure of each habitat were gathered in the field.

Vascular plant nomenclature follows Stace (2019). Bryophyte nomenclature follows Blockeel *et al.* (2021).

3. Results

3.1. Overview of results

Ninety-nine vascular plant (Appendix A) and ten bryophyte species (Appendix B) were found in the study area. The continued presence of the rare poppy *Glaucium flavum* was confirmed. Eight habitats

were recorded, ranging from various dry grassland habitats to shingly and sandy shores along with calcareous springs (FP1). Accounts of each habitat and their associated species are described below.

3.2. Calcareous springs (FP1)

The petrifying springs are arguably the most important botanical feature of the site. Here, spring water precipitates calcium carbonate, producing a deposit known as tufa (Lyons and Kelly, 2021). The springs are restricted to a section between Rathcor and Shellinghill. Groundwater probably flows over and through the limestone bedrock in the area. This leads to the concentration of calcium carbonate in the eventual spring water. At least some of these springs are likely referable to the priority Annex I habitat '7220 Petrifying springs with tufa formation (*Cratoneurion*)' (EU Habitats Directive). Tufa formation and the presence of positive indicator species (Denyer *et al.*, 2023) supports this assessment. It must be stressed, however, that no attempt was made to definitively assign areas to Annex I habitats during this survey.

Both diffuse seepage zones and distinct springs can be found. It is possible that the seepage zones correspond with rich fen and flush (PF1) instead. As they are closely associated with the petrifying springs, I have included them in FP1. One of the most striking examples occurs between J 20010 04870 and J 19928 04936. This stretch consists of a seepage zone of calcareous groundwater punctuated with several distinct springs and associated small streams. The horsetail *Equisetum telmateia* forms dense stands here (Figure 3.1). Calcicole plant species grow within/adjacent to the springs. Some of these are strongly associated with petrifying springs whilst others are found in a wider range of habitats. Given the role of bryophytes in tufa accretion, they are a prominent component of the spring vegetation. For example, one of these springs contained the mosses *Palustriella commutata*, *Didymodon tophaceus*, *Eucladium verticillatum* and *Cratoneuron filicinum*. A liverwort (*Pellia* sp.) was also recorded here (likely to be *P. endiviifolia*). *Palustriella commutata* and *Eucladium verticillatum* promote tufa deposition, the lower shoots of which are often encrusted in this material. Petrifying springs are a classic habitat (albeit not the only one) for these mosses. In contrast, *Cratoneuron filicinum* occurs in many habitats where water is at least slightly base-enriched such as flushes and damp gravelly soil (Blockeel *et al.*, 2014). Other such generalist species as *Agrostis stolonifera*, *Epilobium hirsutum* and *Festuca rubra* agg. are found here. The salinity of the site is evidenced by the presence of *Bolboschoenus maritimus* at the base of one of the streams.

Another important site can be found 250m south-east of the slipway at Rathcor (J 18966 04776). This area comprises a lightly tramped, wet, calcareous trackway at the edge of the shore (Figure 3.2). It is unclear how important this disturbance is for maintaining the habitat. The damp conditions may also inhibit vegetation succession here. *Palustriella commutata* abounds and forms small mounds in places. Other basiphilous species growing here include *Samolus valerandi* and the sedge *Carex viridula* agg. (*Carex* cf. *lepidocarpa*). *Carex viridula* agg. is a taxonomically complex group of sedges. It is often difficult to confidently assign a species name (from this group) to a specimen. Both the morphology of the plants and the base-rich habitat suggest *Carex lepidocarpa* grows here. The most common species at this site were *Palustriella commutata, Carex* cf. *lepidocarpa* and *Equisetum telmateia*. Other species growing here include *Carex flacca, Juncus articulatus/acutiflorus*, *Mentha* sp., *Tussilago farfara*, *Triglochin palustris*, *Equisetum palustre* and *Equisetum arvense*. *Equisetum*

telmateia formed dense stands at the edge of the track. It also grew with *Schoenus nigricans* on the adjacent bank. Some *Phragmites australis* fringes the areas.

No attempt was made in this present survey to classify the vegetation of the petrifying springs. However, Lyons (2015) conducted three relevés at Rathcor. Two plant communities were recorded here: 'Group 1: *Eucladium verticillatum* – *Pellia endiviifolia* Tufa Cascades' and 'Group 4: *Palustriella commutata* – *Agrostis stolonifera* Springheads'. Both communities are widespread in Ireland (Lyons, 2015).

Reductions in groundwater volume and quality are two potential threats to this habitat. Drainage and water abstraction inland could reduce the flow of water. Equally, eutrophication of groundwater via excessive fertiliser application could damage the habitat (Denyer *et al.*, 2023). Lyons (2015) reports elevated nutrient levels from a sample at J 200 049 (an area with several springs and seepage zones discussed earlier). The nitrate concentration of 35.66 mg/l is higher than the mean value for Irish sites (mean: 5.09 mg/l). Phosphate concentration was quite similar to the mean Irish value (Rathcor: 14µg/l, mean: 16µg/l). Finally, direct removal of the spring could be a threat locally. Perhaps the spring at the slipway at Rathcor is most at risk.

Figure 3.1. Dense stands of the horsetail *Equisetum telmateia* with the moss *Palustriella commutata* at a petrifying spring.

Figure 3.2. Lightly trampled trackway with a range of calcicolous plant species such as *Carex* cf. *lepidocarpa* and *Samolus valerandi*.

3.3. Depositing/lowland rivers (FW2)

Several small streams (not associated with petrifying springs) were found. Along with the petrifying springs, these increase habitat and species diversity in a study area largely dominated by dry habitats. One stream at Shellinghill hosts *Epilobium hirsutum*, *Iris pseudacorus*, *Equisetum telmateia*, *Mentha* sp., *Phragmites australis* and *Helosciadum nodiflorum.* The water-cress *Nasturtium officinale* was also recorded from a stream west of Shellinghill.

3.4. Sedimentary sea cliffs (CS3)

Most of the study site is bounded by cliffs composed of glacial till. A range of habitats occupy these cliffs. Variations in factors such as disturbance, topography, hydrology and salinity promote habitat and species diversity. Generally, the unsorted gravel and sand produce a dry, well-drained substrate. Here, dry neutral grassland species can be found. For example, one area east of the Castletown River is host to *Anthyllis vulneraria*, *Scorzoneroides autumnalis*, *Festuca rubra* agg., *Daucus carota*, *Plantago lanceolata*, *Jacobaea vulgaris* and *Lotus corniculatus*. In other areas, the cliff vegetation is scrubbier with dominant *Rubus fruticosus* agg. and *Ulex europaeus*. The slopes are often less steep here, and this may contribute to the development of deeper soils and the colonisation of such woody species. Erosion of the steeper sections of cliffs is evident in several areas (Figure 3.3), most notably in a stretch west of the slipway at Rathcor. These have been colonised by *Tussilago farfara*, *Anthyllis vulneraria*, *Raphanus raphanistrum* subsp. *maritimus* and *Sonchus oleraceus*. Large areas of cliff remain unvegetated, however. Groundwater irrigates sections of the cliff locally (excluding the petrifying springs). These zones yield *Carex distans* and *Juncus gerardii*, both of which are maritime in Ireland (Stroh *et al.*, 2023). Other species indicative of saline conditions growing on the cliffs include *Plantago coronopus*, *Tripleurospermum maritimum* and, occasionally, *Atriplex* sp.

Three plants of the poppy *Glaucium flavum* were found between Rathcor and Shellinghill (J 1970 0498) (Figure 3.4). Two of these grew on recently eroded sediment whilst the third was observed on the cliff here. It is also known from a site west of the Castletown River (slightly outside the study area), having been most recently seen in 2023 (C. Flynn, pers. obs.). *Glaucium flavum* is typical of shingly shores but is also occasionally recorded on sandy substrates (Stroh *et al.*, 2023). With a distribution mostly restricted to the east and south coast of Ireland (Stroh *et al.*, 2023), *G. flavum* is listed as Near Threatened on the Irish Red List (Wyse Jackson *et al.*, 2016).

Figure 3.3. Recent erosion on a section of cliff.

Figure 3.4. A flower and fruits of the poppy *Glaucium flavum*.

3.5. Shingle and gravel shores (LS1)/Shingle and gravel banks (CB1)

Shingly shores are a challenging habitat for plant survival. A key constraint is the mobility of the substrate. Nutrient levels are also generally low except on the strandline. The buttercup *Ranunculus scleratus* was found here. An inhabitant of eutrophic sites such as muddy, cattle-poached fields (Stroh *et al.*, 2023), its presence highlights the elevated nutrients here. Much of the shingle remains unvegetated with most of the plants occupying the back of the shore. Here, patches of *Honckenya peploides, Beta vulgaris* subsp. *maritima* were found along with the sow-thistle *Sonchus arvensis* (Figure 3.5). The grass *Elymus junceiformis* also occurs at the top of the shore. Although it is usually found on sandy substrates such as embryonic dunes, it can also grow on shingle. Similarly, *Eryngium maritimum* occasionally colonises shingle (Stroh *et al.*, 2023). A small population (17 plants) was found in such habitat west of Shellinghill (J 20440 04639) (Figure 3.6). Finally, the orache *Atriplex prostrata* agg. was recorded from several areas of the shore. *Atriplex* spp. frequently present identification difficulties in the field. Hence, only a small number of samples were collected for later determination. It is therefore likely that other *Atriplex* spp. were missed during the present survey.

A small area west of Shellinghill (J 2006 0468) is host to *Limonium humile*, *Spartina anglica* and *Lysimachia maritima* (*Glaux maritima*). This species assemblage suggests the presence of saltmarsh. However, I did not classify this habitat as the area is very small and there was insufficient evidence to support any classification.

Figure 3.5. Shingly shore at Shellinghill with *Honckenya peploides*.

Figure 3.6. *Eryngium maritimum* was found growing at the back of the shingle shore west of Shellinghill.

3.6. Sand shore (LS2)

Like shingly shores, sand shores have sparse vegetation cover. Most of the plants occur on the landward side of the shore including *Honckenya peploides* and the grass *Leymus arenarius* (Figure 3.7). The latter species was most common at Shellinghill.

Figure 3.7. A population of *Leymus arenarius* at Shellinghill.

3.7. Dry calcareous and neutral grassland (GS1)

Although both calcareous and neutral grassland are combined in GS1, the former is mostly restricted to thin soil overlying limestone bedrock and eskers. Thus, this account refers solely to dry neutral grassland. It can be found on the cliffs which flank the study area (Figure 3.8). For example, a well-drained, steep slope at Shellinghill hosts *Daucus carota*, *Centaurea nigra*, *Lotus corniculatus*, *Galium verum*, *Anthyllis vulneraria*, *Anthoxanthum odoratum*, *Carex flacca*, *Medicago lupulina* and *Trifolium pratense*. Grazing is often necessary to maintain such this habitat. However, the steep gradient here precludes the development of dry meadow (GS2).

Figure 3.8. Dry neutral grassland with such species as *Galium verum* and *Daucus carota*.

3.8. Dry meadows and grassy verges (GS2)

Shallower slopes with little disturbance promote the development of taller, denser grassland vegetation. This habitat is found throughout the study area and is dominated by robust grasses, especially *Arrhenatherum elatius*. *Urtica dioica*, *Holcus lanatus* and the climber *Calystegia sepium* are also found here. Some areas are dominated by *Rubus fruticosus* agg (Figure 3.9). The horsetail *Equisetum arvense* and grass *Ammophila arenaria* are encountered occasionally. The latter grows at the transition to sandy habitats at the shoreline such as at Shellinghill.

An isolated rock growing within such grassland occurs east of the Castletown River (J 17226 05317). A suite of acrocarpous mosses typical of this dry, exposed substrate occurs here. These are *Grimmia pulvinata*, *Campylopus introflexus*, *Ptychomitrium polyphyllum, Racomitrium lanuginosum* and *R. fasciculare*. *Grimmia pulvinata* is widespread in Ireland. It frequently colonises anthropogenic habitats such as walls in towns in addition to more 'natural' rock exposures. Having been first discovered in Howth in 1942, the introduced *Campylopus introflexus* is now also found throughout Ireland. Bare peat is a classic habitat, but it may also be found on thin soil overlying rock (Blockeel *et*

al., 2014). *Racomitrium lanuginosum* is common in upland areas, including the Cooley Mountains (C. Flynn, pers. obs.). However, it is rarer in the lowlands, perhaps due to intensive land use and the consequent paucity of nutrient-poor stony habitats. Only a small population was found on this rock.

Figure 3.9. Cliff slope with abundant *Arrhenatherum elatius* and *Rubus fruticosus* agg.

4. Discussion

One of the botanical highlights of this locality are the petrifying springs. They are a rare habitat in Co. Louth. Annex I spring habitat has only been reported from four hectads (10x10km squares) in the county (NPWS, 2019). Three of these are in Cooley with another in the south-east. The latter can probably be discounted as much of the area lies within Co. Meath. Spatial resolution is restricted to 10km in this dataset which impairs the precise localisation of sites. However, it is likely that two of these hectads refer to the springs at Rathcor whilst the third encompasses a site near Carlingford Marina. This also corresponds with the Louth sites reported by Lyons (2015) – Rathcor and Carlingford Marina. Recent works at the marina have damaged Annex I spring habitat, however (Lyons and Doogue, 2023). This underscores the importance of maintaining a favourable conservation status for the Rathcor springs. It would appear reasonable to propose an extension of one of the two coastal SACs in Cooley to encompass the current study area. The petrifying springs could be added as a qualifying interest. Given the restricted distribution of this habitat, the value of the Rathcor site should be recognised to prevent any damage. It remains possible, however, that other localities for petrifying springs occur within the three hectads mentioned which I am unaware of.

The mosaic of dry and wet habitats adds to the interest of the site. As expected, habitats such as dry grassland and shingly shores were encountered. Localised wetter areas are associated with distinct petrifying springs, diffuse lime-rich seepage zones and small streams. The seepage zones at Rathcor, for instance, provide an example of an increasingly rare habitat. *Schoenus nigricans*, a typical inhabitant of these seepages, has declined in the lowlands over the 20th century (Stroh *et al.*, 2023).

It is now also rare in coastal habitats in Co. Dublin (Doogue *et al.*, 1998). Land use changes including drainage and water abstraction have damaged calcareous fens (another habitat for *S. nigricans*) and reduced the supply of groundwater required to maintain these coastal seepages.

Comparisons with previous records show a broadly similar assemblage of species was found in this survey. Reference was made to the records contained in the Botanical Society of Britain and Ireland's (BSBI) Distribution Database (DDb) (BSBI, 2024). It should be noted, however, that other unpublished records exist including those by John Harron. Species both previously recorded from the site and found during the present survey include *Eryngium maritimum*, *Samolus valerandi* and *Veronica anagallis-aquatica*. Several species such as *Silene vulgaris*, *Myosotis arvensis* and *Elymus* x *laxus* were not re-found. However, it is much more likely that these were overlooked rather than any losses having occurred. The hybrid grass *Elymus* x *laxus*, for example, is under-recorded in Britain and Ireland (O'Mahony, 2007; Stroh *et al.*, 2023). I may have overlooked it for one of the parental species, *Elymus junceiformis*. Species which were not listed on the DDb and found during the survey include *Bolboschoenus maritimus*, *Carex distans* and *Glaucium flavum*. The latter species is known from Rathcor though (C. Flynn, pers. obs.). It can also be found at the mouth of the Castletown River just west of the study area (BSBI, 2024) within Dundalk Bay SAC. Given its status as Near Threatened on the Irish Red List (Wyse Jackson *et al*., 2016) and its restricted distribution in Cooley, Rathcor hosts an important *G. flavum* population both locally and regionally.

This work could be extended in several ways. A similar survey could be conducted both in areas to the west and east of the current site. At Gyles Quay, for example, there is an old quarry with an interesting flora of dry, neutral grassland developed over glacial till. Such a site merits further study. Moreover, the large succulent *Crambe maritima* was previously recorded from shingle shores on the west bank of the Castletown River (J 166 054) (Harron, 1974; J. Harron, unpublished record). This Near Threatened species (Wyse Jackson *et al.*, 2016) has not been recorded recently although it could reappear at its old site or in suitable habitat nearby. One of the rarer denizens of shingle shores, *Mertensia maritima* has been recorded from the eastern/south-eastern shore of Cooley, most recently in 2004 (BSBI, 2024). This species is scheduled on the Flora (Protection) Order 2022 and is listed as Vulnerable on the Irish Red List (Wyse Jackson *et al.*, 2016). According to the distribution map in Stroh *et al.* (2023), this comprises the most southerly recent Irish record for *M. maritima*. Hence, this population is of considerable regional and national importance. Additionally, it is threatened by climate change. Range shifts to the north have been observed in Britain. In Ireland, it appears to have been lost from stations in Wicklow and Dublin (Stroh *et al.*, 2023). It is, therefore, quite important that searches are carried out for this species. However, precise locality data for the record is unavailable. An extension of the survey to the east along Templetown and Ballagan should be undertaken to search for this species. Other plants and habitats here would also be surveyed. As well as a spatial extension of the survey, increasing the coverage of bryophytes is recommended. A comprehensive survey of this taxonomic group would undoubtedly yield extra species. There is also the possibility of interesting species being discovered, evidenced by the new county records for two uncommon mosses within the site (Pilkington, 2024). Finally, vegetation classification and monitoring could be conducted via a network of plots (relevés). This may not be suitable for the foreshore habitats in which the location of populations is quite dynamic. Site walkovers would continue to be preferable here. In contrast, the petrifying spring vegetation could be classified and monitored to detect any potential changes to this important habitat.

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Appendix A: Vascular plant species list

A total of 99 vascular plant species were recorded. Nomenclature follows Stace (2019) with commonly used synonyms also provided.

Achillea millefolium
Agrostis stolonifera
Ammophila arenaria
Angelica sylvestris
Anthoxanthum odoratum
Anthyllis vulneraria
Artemisia vulgaris
Arrhenatherum elatius
Atriplex prostrata agg.
Beta vulgaris subsp. *maritima*
Bolboschoenus maritimus
Cakile maritima
Calystegia sepium
Carex arenaria
Carex cf. *lepidocarpa*
Carex distans
Carex flacca
Carex panicea
Centaurea nigra
Cirsium arvense
Cirsium palustre
Cirsium vulgare
Convolvulus arvensis
Crepis capillaris
Crocosmia x crocosmiiflora
Daucus carota
Elymus junceiformis (Elytrigia junceiformis)
Elymus repens (Elytrigia repens)
Epilobium hirsutum
Epilobium parviflorum
Equisetum arvense
Equisetum palustre
Equisetum telmateia
Eryngium maritimum
Euphorbia helioscopa
Festuca rubra agg.
Filipendula ulmaria
Fuchsia magellanica
Fumaria sp.
Galium aparine

Galium verum
Geranium dissectum
Glaucium flavum
Helosciadum nodiflorum (Apium nodiflorum)
Holcus lanatus
Honckenya peploides
Hypochaeris radicata
Jacobaea vulgaris (Senecio jacobaea)
Juncus acutiflorus
Juncus bufonius agg.
Juncus effusus
Juncus gerardii
Juncus inflexus
Knautia arvensis
Lathyrus pratensis
Leymus arenarius
Limonium humile
Lolium perenne
Lotus corniculatus
Lysimachia arvensis (Anagallis arvensis)
Lysimachia maritima (Glaux maritima)
Malva arborea
Medicago lupulina
Mentha sp.
Nasturtium officinale
Persicaria sp.
Petasites sp.
Phragmites australis
Plantago coronopus
Plantago lanceolata
Plantago maritima
Poa trivialis
Potentilla anserina
Pteridium aquilinum
Ranunculus repens
Ranunculus scleratus
Raphanus raphanistrum subsp. *maritimus*
Rubus fruticosus agg.
Rumex crispus
Rumex obtusifolius
Schedonorus arundinaceus (Festuca arundinacea)
Schoenus nigricans
Scorzoneroides autumnalis (Leontodon autumnalis)
Senecio vulgaris

Sonchus arvensis
Sonchus asper
Sonchus oleraceus
Spartina anglica
Thymus polytrichus
Trifolium pratense
Trifolium repens
Triglochin palustris
Tripleurospermum maritimum
Tussilago farfara
Ulex europaeus
Urtica dioica
Veronica anagallis-aquatica
Veronica persica
Vicia sativa

Appendix B: Bryophyte species list

Ten bryophyte species were recorded. Nomenclature follows Blockeel *et al.* (2021).

Campylopus introflexus
Cratoneuron filicinum
Didymodon tophaceus
Eucladium verticillatum
Grimmia pulvinata
Palustriella commutate
Ptychomitrium polyphyllum
Pellia sp.
Racomitrium fasciculare
Racomitrium lanuginosum