Heritage Research Project R00261

An Chomhairle Oidhreachta
The Heritage Council

To investigate Critical Habitats for Threatened Species of Shark and Ray

Purse Search Ireland

Galway Atlantaquaria

Final Report

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Marine Dimensions

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Marine Dimensions

Prepared by Dr Sarah Varian, Marine Dimensions, 30th November, 2010
Photograph courtesy of Hamish Currie.

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We would also like to thank all those wonderfully dedicated volunteer observers who went to the trouble of reporting their sightings of mermaids' purses for the Purse Search project. Thanks also to all the project interviewees for their interest and enthusiasm.

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Summary

To investigate critical habitats for threatened species of shark and ray is a research project that has been prompted by results obtained from Purse Search Ireland, a public participation programme that aims to encourage people to report their observations of shark and ray eggcases (aka mermaids' purses) washed up on beaches around Ireland's coasts. These sightings can then be used to provide valuable information on the location of nursery areas for Ireland's sharks and rays, some of which are endangered or rare. Observations to date have highlighted several areas as potential hotspots, including bays that may serve as refuge areas for threatened species. Interviews with Purse Search observers and local fishing communities have confirmed that Tralee Bay serves as a nursery area for the critically endangered White Skate *Rostroraja alba* and endangered Undulate Ray *Raja undulata*, while Clew Bay serves as a nursery area for critically endangered Common Skate *Dipturus batis*. Continuation of the Purse Search project in 2010 has also highlighted a new nursery area for White Skate in Galway Bay. Although Clew Bay and Tralee Bay are known to have been important habitats for Angel Shark historically, these populations now appear to be severely depleted. Improved conservation management in these areas needs to be encouraged through community based initiatives, including a targeted public awareness programme.

Introduction

This research project has been prompted by the results obtained from a public participation programme entitled *Purse Search Ireland*. This project (similar in style to *The Great Eggcase Hunt* project run by the Shark Trust), was set up in 2006 with the aim of encouraging the Irish public to report their observations of shark and ray eggcases (aka mermaids' purses) around Ireland's coastline. It was hoped that the public's participation could be used to identify nursery areas for Ireland's egglaying skates and rays, whilst at the same time raising awareness for Ireland's marine wildlife and environment. Since then, a total of 3033 purses from 12 species of shark, skate and ray have been reported from 184 locations around Ireland's coastline, including eggcases from three threatened species of skate; the Common Skate, *Dipturus batis*, White Skate, *Rostroraja alba* and Undulate Ray, *Raja undulata*. The popularity of the project continues to grow and many schools now include eggcase hunts in their annual nature programmes (Varian, 2007, 2008, Varian et al, 2009).

As a result of the Purse Search project, two bays in the west of Ireland (ie. Tralee Bay and Clew Bay) were highlighted as hotspots and possible refuge areas for threatened species of shark and ray in 2009. Observations of eggcases confirmed by scientists and liaison with local angling groups indicated that Tralee Bay was likely to be a nursery area for White Skate, Common Skate and Undulate Ray. Similarly, liaison with the angling community in Clew Bay indicated that the area was likely to serve as a nursery for Common Skate. Review of the Central Fisheries Board's tagging programme records also indicated that these bays may serve as critical habitats for a number of vulnerable bottom dwelling elasmobranchs. For example, both bays had been noted as being important areas for the Common Skate and Angel Shark, with associated recreational fisheries and angling tourism. Although the Angel Shark fishery has been in serious decline in recent years, the Common Skate populations in Clew Bay appear to recovering somewhat, whilst Tralee Bay is the only area where Undulate Rays are caught in Ireland (Dunlop *pers comm*.).

The present study aims to investigate the role of these two bays further, through continuation of the eggcase sightings scheme and communication with local interest groups, eg. angling clubs, chartered recreational skippers etc.

Specific goals

Specific goals of the project were as follows:

Objective 1 To investigate the indigenous knowledge of fishing communities in Tralee Bay and Clew Bay in order to establish the location of nursery areas and critical habitats for threatened species of shark and ray, ie. the Common Skate, White Skate, Undulate Ray and Angel Shark.

Objective 2 To improve, review and compile information on the above named species in order to inform decision makers and managers in relation to conservation management in Ireland.

Methods

Objective 1

To investigate the indigenous knowledge of fishing communities in Tralee Bay and Clew Bay in order to establish the location of nursery areas and critical habitats for threatened species of shark and ray, ie. the Common Skate, White Skate, Undulate Ray and Angel Shark.

Indigenous knowledge of fishing communities in Tralee Bay and Clew Bay was investigated through:

- continuation of the public sightings scheme, Purse Search Ireland, which encourages people to report their observations of shark, skate and ray eggcases washed up on beaches (and underwater) around Ireland's coastline.

- communication with local interest groups, eg. angling clubs, chartered recreational vessel skippers etc.

Methods of communication included emailing and online correspondence through the Purse Search programme (Table 1), phone interviews and face to face meetings (Appendix I).

Objective 2

To improve, review and compile information on the above named species in order to inform decision makers and managers in relation to conservation management in Ireland.

The broad scope of this objective was found to be beyond the limits of funding available for project expenditure (only 50% of funding required to run the project was raised). However, a sister project has now been set up in association with the National Biodiversity Data Centre with funding from the National Parks and Wildlife Service. This project aims to establish an inventory of data for Ireland's sharks and rays (including threatened species), with a view to setting up an All Ireland Elasmobranch Database that may be subsequently used in the assessment of conservation status, eg. Red List Assessments.

Results

Continuation of the Purse Search Ireland project

Administration for the Purse Search Ireland project was continued this year, with resulting observations of mermaids' purses regularly being reported online through the Purse Search project page and online recording form at www.marinedimensions.ie. In all, 350 purse reports have been received from observers over a period of 3.5 years, with a total of 3033 eggcases from 12 species of shark, skate and ray reported from 184 locations. Of these reports, 59% of observers sent eggcases on to project scientists for confirmation of species identification (improving quality of information), whilst a small percentage (5%) provided photographs. The popularity of the project continues to grow and many schools now include eggcase hunts in their annual nature programmes.

A number of beaches around Ireland's coastline have been highlighted as possible indicator sites (ie. where observations of numerous eggcases have been confirmed by scientists) as a result of volunteers' observations, including bays that may serve as nursery areas for several commercial species of ray (eg. Thornback Ray *Raja clavata*, Spotted Ray *Raja montagui*, Painted Ray *Raja microocellata* and Blonde Ray *Raja brachyura*), as well as more sensitive

areas associated with rare or vulnerable species (eg. the Common Skate *Dipturus batis*, White Skate *Rostroraja alba* and the Undulate Ray *Raja undulata*). Figs 1-3 show the distribution of eggcases around Ireland's coastline for 10 species reported by volunteer observers.

Of the 10 species of shark and ray eggcase identified, the Lesser Spotted Dogfish was the most frequently sighted and the most widespread; the larger Greater Spotted Dogfish was reported much less frequently (Table 2). Spotted Ray and Thornback Ray eggcases were common and widespread, whereas other commercial species, such as the Small Eyed Ray, Cuckoo Ray and Blonde Ray, were not as frequently reported.

Two species records have yet to be confirmed by scientists, ie. the Starry Skate, *Amblyraja radiata,* and the Long Nosed Skate, *Dipturus oxyrinchus*. We suspect that the unconfirmed observation of a Starry Skate eggcase on Rossbeigh beach in Glenbeigh, Co. Kerry, may have been misidentified, since this species is known to have a more northern distribution, with its southernmost limits extending to the north coast of Ireland (Shark Trust, 2009). Identification of the Long Nosed Skate eggcase, sampled from Barley Cove Beach in Co. Cork, also needs to be confirmed (Fig. 4). We are currently liaising with other elasmobranch eggcase experts regarding eggcase morphology for this species in order to clarify identification.

Threatened Species

Common Skate, *Dipturus batis*

Common Skate eggcases have been confirmed from Dingle Bay, Ballinaskelligs Bay (Co. Kerry), Horse Island, White Strand (Co. Clare) and Clew Bay (Fig. 3). Interviews with observers have indicated that some of the unconfirmed sightings of Common Skate eggcases reported in 2007 in Tralee Bay were in fact White Skate eggcases. There has been no evidence to suggest from interviews conducted through this study that Tralee Bay is a nursery area for Common Skate. Photographs of eggcase specimens provided by observers have been used to clarify species identification (Fig. 4).

Interviews with skippers and anglers have indicated that Clew Bay is likely to be a nursery area for Common Skate. Two skippers mentioned that they had seen small Common Skate caught on a rod and line (ie. fish with a wing span of 10-20 inches); one fish was sighted in the Mallaranny area, the other fish were sighted in areas near deep holes or channels (exact locations not given) (Fig. 5). Another observer also reported regularly sighting eggcases on an island close to the lighthouse in the bay. None of the anglers interviewed in this study had ever seen a Common Skate releasing eggcases on deck following capture.

Although the bay represents an important area for recreational skate fishing (11 boats were fishing during the Helm Skate Festival with four fish caught over a period of two days), there have been relatively few records of skate eggcases reported through the project. This may be related to the fact that many of the eggcases are likely to be washed up on the numerous small islands distributed throughout the bay, thereby reducing the chances of incidental observations by beachcombers. It is also possible that the Common Skate eggcases may be being overlooked by observers on the seashore, since they do not possess the distinctive horns and purse like appearance that characterise most skate eggcases. They could easily be mistaken as a piece of seaweed or terrestrial plant matter.

It should be noted that recent scientific research has shown the Common Skate *Dipturus batis* to be actually two species, ie. the Blue Skate *Dipturus intermedia* and the Flapper Skate *Dipturus flossada* (Iglesias et al., 2009). However, the difference in eggcase morphology between these species is as of yet unclear. Further research is required to determine whether discarded eggcases from these species may be used to identify associated nursery areas.

White Skate, *Rostroraja alba*

Numerous sightings of White Skate eggcases have been reported from the Tralee Bay area, including observations of live embryos in eggcases at sea, confirming the bay's role as a nursery area (Figs 3 and 6). The live samples (ie. 2 eggcases) were collected by Tralee Institute of Technology on board the Celtic Voyager during a routine trawl survey, which was conducted as an educational field trip for Aquatic Science students in October, 2010. One eggcase was accidentally damaged (the embryo was preserved and retained for teaching purposes), while the other was returned to sea. The eggcases were sampled off Sandy Bay near the Maharee Islands. Discarded eggcases have also been sighted on beaches in the bays on either side of Tralee Bay, ie. Ballyheigue Bay and Brandon Bay.

Observations made in 2010 also indicated that Galway Bay is likely to serve as a nursery area for White Skate; two separate sightings of discarded eggcases on beaches were confirmed for Tawin Island. The captain of the Celtic Voyager also reported sightings of these eggcases during surveys in Galway Bay, while a local fishermen is known to have given a live eggcase to Galway Atlantaquaria three years ago. The juvenile skate was subsequently reared in the aquarium and is now the only White Skate known to be held in captivity.

Undulate Ray, *Raja undulata*

There have been numerous confirmed sightings of Undulate Ray eggcases on beaches around Tralee Bay and Ballyheigue Bay, with two separate unconfirmed observations of purses in Galway Bay and Dingle Bay (Figs 3 and 6). Tralee Bay's role as a nursery area has also been confirmed by an angler's observations of an Undulate Ray releasing an eggcase on deck following capture on rod and line. This fish was taken approximately 50 yards from the shores of Derrymore Island.

Angel Shark, *Squatina squatina*

Interviews conducted through this study have indicated that Tralee Bay and Clew Bay have both been important areas for the Angel Shark historically, with sightings of the shark releasing pups on deck following capture confirming Tralee Bay's role as a nursery area for this species. However, the population appears to have become severely depleted in recent years. Only one interviewee reported knowledge of an angel shark being caught in recent years on a rod and line in Clew Bay.

Conservation concerns

Anglers interviewed in this study revealed some conservation concerns. For example, in Clew Bay, some fears were expressed about the effects of trawl fishing on skate populations in the bay. There is also concern for the survival of threatened elasmobranch populations in Tralee Bay, since demersal skate and sharks may be unintentionally taken as bycatch in crayfish nets. It also appears that crayfish may be being taken from a crayfish conservation area within the bay. Fishermen appear to be exploiting a loophole in the legislation (The Crawfish Fisheries Management and Conservation Order, 2002 [SI no 179 of 2002]) which allows crayfish nets to be used to take flat fish in the bay.

Communications, education and outreach

Press and media coverage have been pursued in order to raise awareness for the Purse Search project and associated outreach programme. The following articles and radio programmes featured the project this year:

- The Mayo News. Aug. 24th, 2010. *Marine wildlife roadshow to visit Clew Bay primary schools*.
- Biodiversity Ireland magazine. Issue 5, Spring 2010. Biodiversity Tales. *Sharks, skates and rays.*
- Irish Angler's Digest. Vol. 12, No, 7. *The Westport 2010 Helm Skate Festival*.
- The Daily Star. Angling news column featured the Purse Search project.
- East Coast Radio. Don Swift interview with Sarah Varian for Heritage Week.

In addition to being included in the current research project's outreach programme, Purse Search Ireland has been highlighted through the following 2010 education events:

- A lecture given by Sarah Varian to teachers in the Rathmines Church of Ireland College of Education as part of the INTO/Heritage Council Elective Module.

- Workshops provided to primary schools in Wicklow and Dublin through the Heritage in Schools Scheme.

- A shark and ray arts and crafts workshop, held in association with the Fingal County Council Biodiversity Day public awareness event in Newbridge Demesne in May.

- Workshops held in association with Blue Flag raising events, eg. the Louth County Council Port Beach Blue Flag raised in June.

- Lectures given to adults and teenagers participating in the Marine Dimensions Marine Biology Summer School, run in August in association with the National Sea Life Centre Bray.

- Presentation of a poster entitled *The science of mermaids' purses: Using public participation as a tool for investigating egglaying elasmobranch nursery areas in Ireland* at the European Elasmobranch Association Conference in the Marine Institute, Galway in November (Appendix II).

More information on the Purse Search project results is also available in the 2010 Final Report for Heritage Education, Community and Outreach Project E00275, *To provide marine environmental education and outreach to schools beside special areas.*

Actual outcomes versus expected outcomes

Actual outcomes for this project exceeded expected outcomes. The following outcomes and deliverables were achieved in addition to those outlined above:

- A proposal entitled *To Consider Threatened Sharks and Rays in the County Mayo Heritage Plan* was submitted to Mayo County Council by Marine Dimensions in October (Appendix III).

- Photographs have been sent to Gary Hannon of the Sea Fisheries Protection Authority for use in an Industry Advice leaflet which is designed to raise awareness for the threatened Common Skate.

- Photographs of adult White Skate have been sent to the Tralee Bay Sea Angling Club to assist with identification of specimens. It is possible that White Skate in the area are being misidentified and recorded as Common Skate.

- Information on the Purse Search project and copies of the Heritage Council's *Ireland's Sharks and Rays* poster were given to the following:

    - Tralee Bay Sea Angling Club,
    - Tralee and Fenit Harbour Commissioners,
    - Dingle Oceanworld,
    - European Elasmobranch Association conference participants,
    - Galway Atlantaquaria.

- Photographs of Common Skate eggcases have been sent to Cecilia Mancusi of the Tuscany Environmental Protection Agency, Italy for use in Serena et al's 2010 *Field Identification Guide to the Skates of the Mediterranean Sea*.

Benefits of the works

The project will benefit Ireland's coastal communities and marine heritage by:

- Increasing protection for threatened species of shark and ray through provision of good quality information available for conservation management.

- Recognising the importance of community based management in relation to marine protected areas, voluntary agreements and local conservation plans in Ireland.

- Highlighting and promoting the social, economic and environmental benefits associated with sustainably managed sea angling tourism in Ireland.

- Enhancing public awareness of threatened species and habitats in need of conservation management.

- Promoting public enjoyment of Ireland's marine environmental heritage.

Discussion

There is currently serious concern both at the national and international level over the conservation status of the Common Skate, White Skate, Angel Shark and Undulate Ray. All four species exhibit typical elasmobranch life history traits that make them more susceptible to overfishing, ie. slow growth and late reproductive maturity, producing very few offspring. For example, the Common Skate take around 11 years to reach sexual maturity and they only lay up to 40 eggs every other year. Consequently, the Common Skate, White Skate and Angel Shark have been extirpated from much of their former range (Shark Trust, 2009). Ireland is now one of the few places in the world where these species can now be studied.

In 2009, all four species received protection from the European Council in ICES areas where populations are known to have been severely depleted, meaning that the fish cannot be

retained or targeted if taken as bycatch. The EU Plan of Action for the Conservation and Management of Sharks has also outlined a series of actions that need to be addressed at the regional level by member states. It is now imperative that Ireland responds to this direction by improving conservation management of endangered sharks and rays at the local level. Although the Irish Specimen Fish Committee has removed the Common Skate from listings, encouraging recreational fishers to return specimens to sea, there are still no Species Action Plans available for the above species and other critically endangered elasmobranchs in Ireland. Considering that Ireland is now one of the few countries where these fish survive, it is essential that information be improved in order to facilitate and provide impetus for appropriate conservation measures. On a positive note, the angling tourism industry (worth over €30 million) has experienced considerable growth in recent years in Ireland, thus creating a strong economic incentive for coastal communities to nurture and conserve shark and ray stocks, particularly with respect to large skate (Common Skate can measure up to 3m in length). The economic benefits associated with skate angling tourism may well represent one of the driving forces behind the survival and recovery of these threatened species.

Both Clew Bay and Tralee Bay are designated as Marine Special Areas of Conservation. The wide variety of habitats within the bays listed on Annex I of the E.U. Habitats Directive, and the combination of important flora and fauna, including species listed on Annex II, make these sites of considerable national and international importance. However, it should be noted that Annex II of the EU Habitats Directive does not include threatened species of shark and ray. In addition, there are still no management plans for Marine Special Areas of Conservation in Ireland. Although draft plans were commissioned by the National Parks and Wildlife Service several years ago, these plans still await public consultation and it is unclear whether the plans have considered the conservation management of endangered sharks and rays in these areas.

Anglers interviewed in this study revealed some conservation concerns. For example, in Clew Bay, some fears were expressed about the effects of trawl fishing on skate and ray populations in the bay. The real impact of ray fishing on threatened species, and indeed the sustainability of the ray fishery itself, needs to be investigated further. The marine resource within the bay would benefit from a scientific observer's assessment of bycatch and discards associated with the ray and lobster bait fishery. This would also be in the interest of local fisheries management to ensure sustainability of the ray resource within the bay. The bay's importance as a nursery area for thornback rays also needs to be considered (fishermen interviewed in this study reported catching juvenile thornbacks in shrimp pots).

There is also considerable concern for the survival of threatened elasmobranch populations in Tralee Bay, since demersal skate and sharks may be unintentionally taken as bycatch in crayfish nets. It appears that crayfish may be being taken from a crayfish conservation area within the bay; fishermen appear to be exploiting a loophole in the legislation (The Crawfish Fisheries Management and Conservation Order, 2002 [SI no 179 of 2002]) which allows crayfish nets to be used to take flat fish in the bay. According to the Marine Institute's Stock Book, 'the use of these nets is poorly monitored and substantial numbers of crawfish are probably captured in this gear' (Marine Institute, 2006). This activity needs to be addressed as a matter of urgency, not only to ensure survival of shark and skate species under serious threat, but also to ensure sustainability of the crayfish population itself.

Conclusions and lessons learned

This project has highlighted the importance of several bays in the west of Ireland for threatened species of egglaying elasmobranch. Continuation of the Purse Search project and interviews with local fishing communities have revealed that Tralee Bay serves as a nursery area for the critically endangered White Skate and endangered Undulate Ray, while Clew Bay

serves as a nursery area for critically endangered Common Skate. Purse Search observers have also highlighted a new nursery area for White Skate in Galway Bay.

Considering the importance of both bays for sea angling tourism and as a refuge for critically endangered species, it is now imperative that that the relevant authorities, ie. the Sea Fisheries Protection Authority, Bord Iascaigh Mhara, the National Parks and Wildlife Service, the Marine Institute and Inland Fisheries Ireland, work together to optimise and integrate conservation management in these areas. A community based management plan for each bay, employing a sustainable livelihoods approach, would perhaps be the most beneficial. Recognition of economic and practical implications for stakeholders is important for the success of any programme. Whilst top down decision making is sometimes necessary for environmental protection, the benefits of a bottom up approach have been widely recognised in the management of marine protected areas around the world (Beumer et al., 2002). Enforcement of regulations needs to be accompanied by communication with stakeholders and awareness programmes that target sea angling and commercial fishing communities.

References

Beumer, J.P., Grant, A. and Smith, D.C. 2002. *Aquatic protected areas. What works best and how do we know?* Proceedings of the World Congress on Aquatic Protected Areas. Cairns, Australia. Hosted by the Australian Society for Fish Biology. 689pp.

Iglesias, S.P., Toulhoat, L. and Sellos, D.Y. 2009. Taxonomic confusion and market mislabelling of threatened skates: important consequences for their conservation status. *Aquatic Conserv: Mar. Freshw. Ecosyst.* Published online in Wiley Interscience. DOI: 10.1002/aqc. 1083

Marine Institute, 2006. Crawfish on Mainly Western Coasts (Sub-areas VI and VII). *The Marine Institute Stock Book*. p. 412.

Serena F., Mancusi C., Barone M. 2010. Guida pratica di identificazione delle razze del Mar Mediterraneo. Linee guida per la raccolta e l'analisi dei dati. *Field identification guide to the skates (Rajidae) of the Mediterranean Sea. Guidelines for data collection and analysis Biol. Mar. Mediterr.*, **17** (Suppl. 2): 204 pp.

Shark Trust, 2009. Sharks: An identification guide to the Sharks, Skates, Rays and Chimaeras. Volume 1: The British Isles. Chapter 1 – Skates and Rays. The Shark Trust. Plymouth, UK.

Varian, S. 2007. Join the hunt for mermaids' purses! Purse Search Ireland - A new public sightings scheme for shark, skate and ray eggcases. The Sherkin Comment. Issue No. 44, p6.

Varian, S. 2008. Purse Search Ireland: A new project raising awareness for Ireland's sharks, skates and rays. The Marine Times. January Issue, pp. 22.

Varian, S. J., Corcoran, K., Gaughran, A. and Hee Oh, K. 2009. Purse Search Ireland: A skate and ray eggcase sightings scheme for Ireland. Final Report Purse Search project, Marine Dimensions. 34 pp.

Varian, S., Corcoran, K., Oh, K.H., Gaughran, A., Dunagan, K., Nunn, W., Armstrong, C. Moloney, A., Mariani, S. and Yearsley, J. 2010. *The science of mermaids' purses: Using public participation as a tool for investigating egglaying elasmobranch nursery areas in Ireland.* Poster presented at the European Elasmobranch Association Conference, Galway.

Table 1: The three phases of action experienced by volunteer observers participating in the Purse Search Eggcase Sightings Scheme.

Phase	Action	Outcome
1. Education and outreach	Potential volunteer observers are informed about the project through: (a) school workshops (b) public outreach events (c) press and media coverage (d) flyers (e) website info Observers are asked to report their observations online through the Purse Search project page at www.marinedimensions.ie. It is also requested that they post a sample of the purse on to the project scientists in order to confirm species identification.	Public awareness is raised. Approximately 7000 people per year are informed through face to face events, with many more informed through press and media coverage.
2. Exploration and discovery	Volunteers discover purses either (a) incidentally on a beach walk or (b) intentionally through a beach survey	Learning is consolidated through outdoor exploration and discovery. Observations may or may not be reported to Marine Dimensions at this stage.
3. Reporting	Volunteers report the sighting online through a recording form or via land mail. The observation may be reported in one of three ways: (a) with no description, photo or sample of the purse, (b) with a description or photo of the purse, but no sample, (c) with a description and sample of the purse. Following receipt of the information, the project scientist e-mails the observer to give them the results of their report and to thank them for their participation.	The sightings are included in the Purse Search database and species identified are classified as either confirmed or unconfirmed, depending on the quality of information provided by the observer through actions (a)-(c): (a) is classified as unconfirmed, (b) may be classified as unconfirmed or confirmed, depending on the quality of information provided, (c) is classified as confirmed.

Table 2: Total number of eggcases identified for each species, reported by volunteers from 2007-2010.

Species name	Common name	No. eggcases (confirmed)	No. eggcases (unconfirmed)
Scyliorhinus canalicula	Lesser spotted dogfish	1690	320
Scyliorhinus stellaris	Greater spotted dogfish	38	5
Raja clavata	Thornback ray	504	32
Raja montagui	Spotted ray	145	15
Raja brachyura	Blonde ray	10	1
Leucoraja naevus	Cuckoo ray	3	1
Raja microocellata	Small eyed ray	19	3
Amblyraja radiata	Starry skate	0	1
Raja undulata	Undulate ray	23	9
Dipturus batis	Common skate	4	1
*Rostroraja alb*a	White skate	25	0
Dipturus oxyrinchus	Long nosed skate	0	1

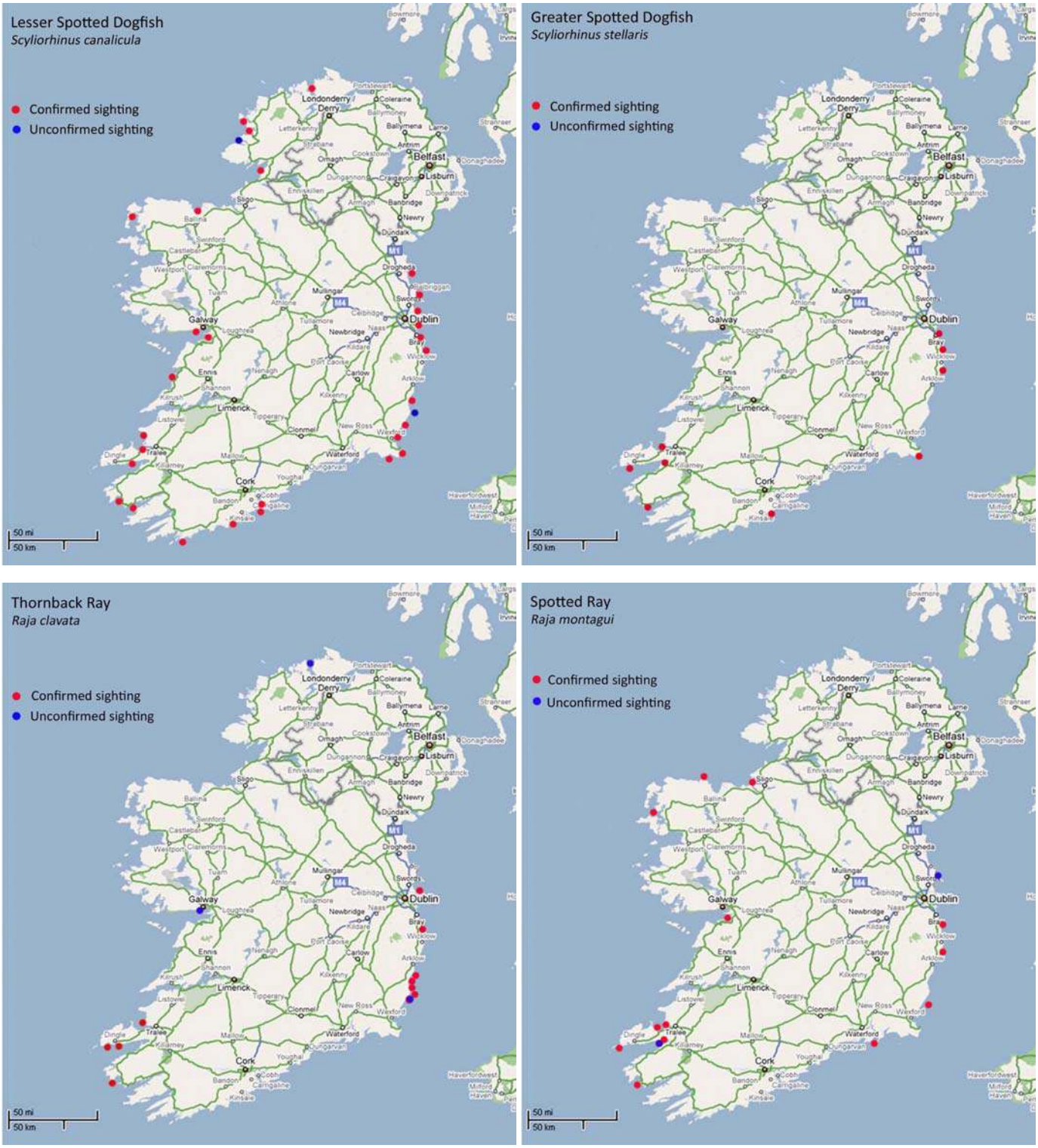

Figure 1: Distribution of eggcases around Ireland's coastline for the four most frequently sighted commercial species, reported by volunteer observers from 2007 to 2009.

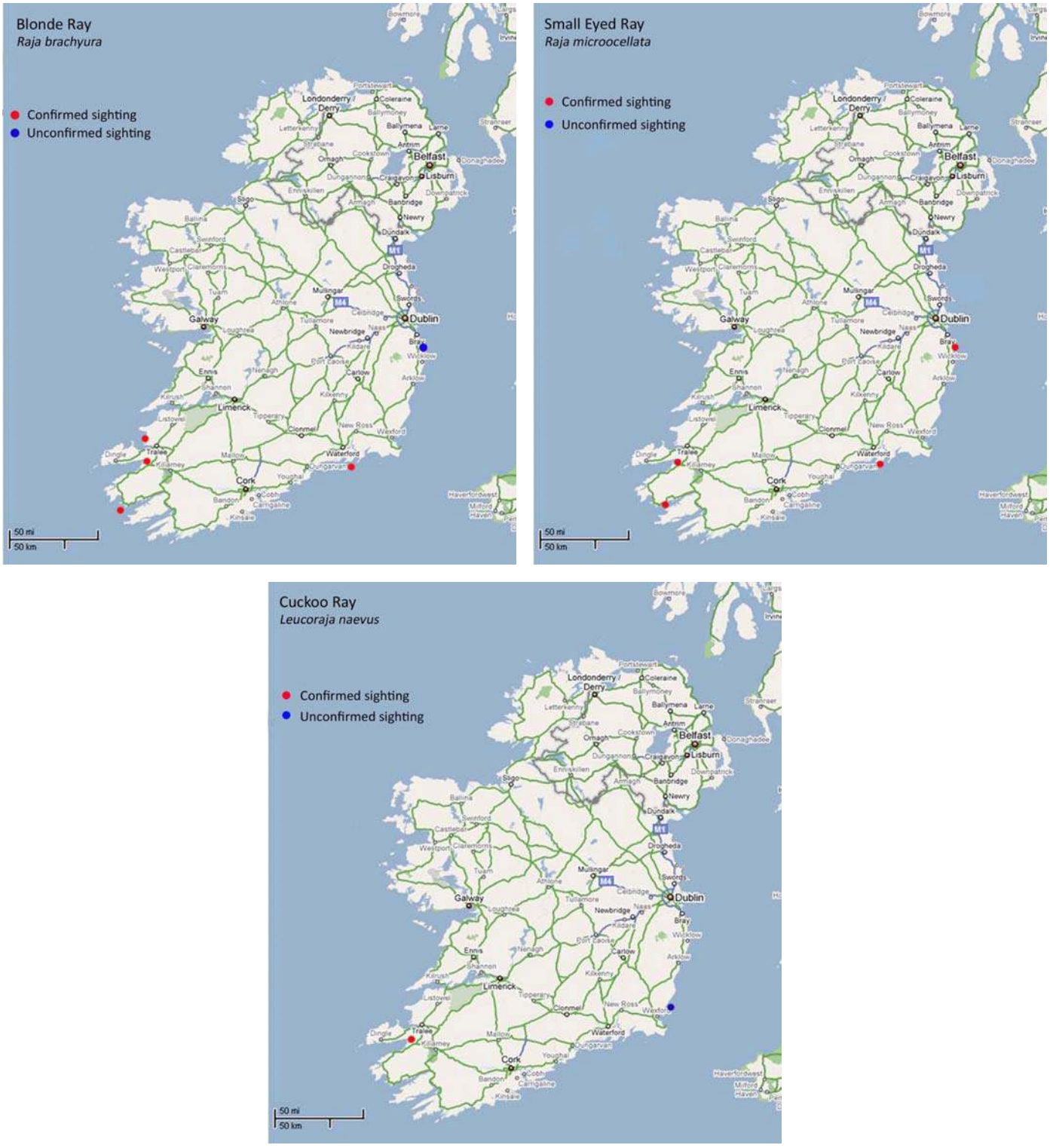

Figure 2: Distribution of eggcases around Ireland's coastline for the three least frequently sighted commercial ray species, reported by volunteer observers from 2007 to 2009.

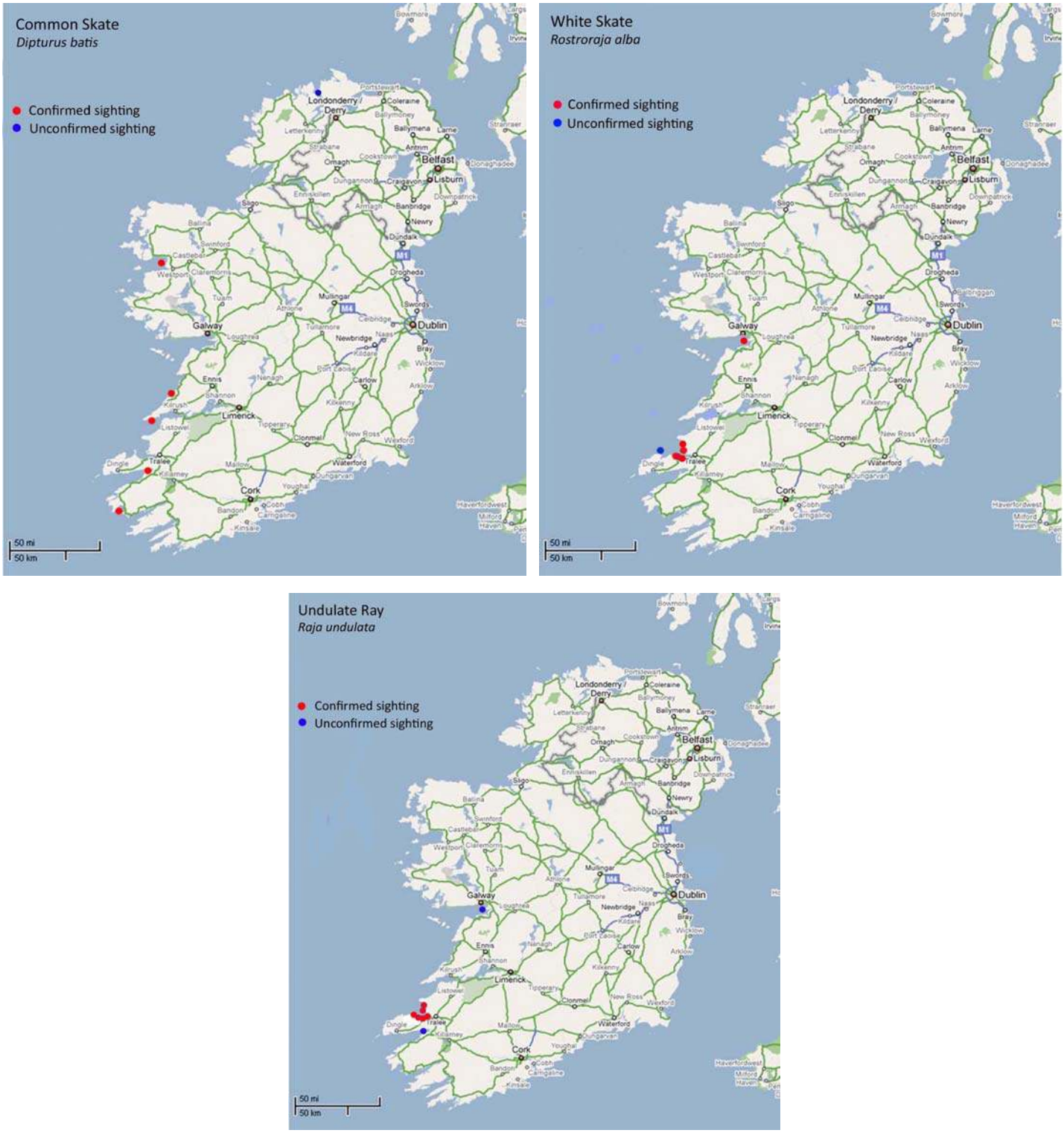

Figure 3: Distribution of eggcases around Ireland's coastline for the three threatened Red List species, reported by volunteer observers from 2007 to 2010.

Common Skate eggcase

White Skate eggcase

Long Nosed Skate eggcase (unconfirmed)

Figure 4: Eggcases from Common Skate, White Skate and Long Nosed Skate (unconfirmed) sent in by Purse Search observers.

Figure 5: Location of sightings for Common Skate eggcases and juveniles reported in Clew Bay. (Black spots represent estimates for location of sightings. Exact coordinates were not available).

Figure 6: Location of sightings for White Skate and Undulate Ray eggcases reported in Tralee Bay. (Note: Precise coordinates were not available for all sightings).

Appendix I: List of individuals and organisations interviewed in the Tralee Bay and Clew Bay areas.

Tralee Bay

Appendix II: Poster presented at the European Elasmobranch Association Conference in the Marine Institute, Galway from 9-11 November, 2010.

The science of mermaids' purses: Using public participation as a tool for investigating egglaying elasmobranch nursery areas in Ireland

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A developing dogfish embryo.

Background and aims

Purse Search Ireland was set up in 2007 with a view to raising public awareness of Ireland's sharks and rays, whilst at the same time improving information available for fisheries conservation management. The main aim was to encourage people to report their observations of mermaids' purses, which are actually the eggcases of sharks, skates and rays. These purses are laid by the adult female fish in a suitable habitat on the seafloor, with the young embryo developing within the eggcase for up to 15 months. The baby shark or skate then hatches out of the purse and swims away, leaving the discarded eggcase behind it. Eggcases can often be seen washed up on the seashore, frequently tangled up in seaweed along the upper shoreline. Observations of these purses on the seashore and underwater can be used to establish the location of nursery areas. Such information is crucial for the management of fish populations that are sensitive to exploitation, such as the cartilaginous fishes.

Education and outreach

An effective public awareness programme has been crucial for the success of the eggcase sightings scheme, encouraging people to report their observations of purses around Ireland's coasts. A comprehensive education and outreach programme has been developed, including shark and ray workshops that are designed to target a wide audience through a schools programme, adult education programme and public events. Workshops are supported by education materials and website features that are specifically designed for the project. Press and media coverage have also been pursued, including radio and TV coverage.

A Purse Search public event.

A young observer.

Purse reports and species identification

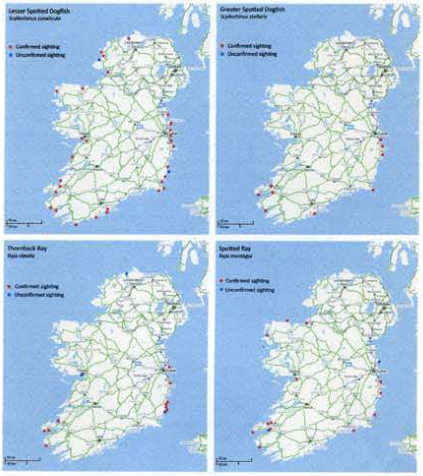
In all, 350 purse reports have been received from observers over a period of 3.5 years, with a total of 3033 eggcases from 12 species of shark, skate and ray reported from 184 locations. Of these reports, 59% of observers sent eggcases on to the project scientists for confirmation of species identification (improving quality of information), whilst a small percentage (6%) provided photographs.

Number of eggcases identified for each elasmobranch species.

Species name	Common name	No. eggcases (confirmed)	No. eggcases (unconfirmed)
Scyliorhinus canalicula	Lesser spotted dogfish	1690	320
Scyliorhinus stellaris	Greater spotted dogfish	38	5
Raja clavata	Thornback ray	504	32
Raja montagui	Spotted ray	145	15
Raja brachyura	Blonde ray	10	1
Leucoraja naevus	Cuckoo ray	3	1
Raja microocellata	Small eyed ray	19	3
Amblyraja radiata	Starry skate	0	1
Raja undulata	Undulate ray	23	9
Dipturus batis	Common skate	4	1
Rostroraja alba	White skate	25	0
Dipturus oxyrinchus	Long nosed skate	0	1

Of the 12 species of shark and ray eggcase recorded, the Lesser Spotted Dogfish was the most frequently sighted and the most widespread; the larger Greater Spotted Dogfish was reported much less frequently. Spotted Ray and Thornback Ray eggcases were common and widespread, whereas other commercial species, such as the Small Eyed Ray, Cuckoo Ray and Blonde Ray, were not as frequently reported.

Species distribution



Distribution of eggcases around Ireland's coastline for the four most frequently sighted species reported by volunteer observers from 2007 to 2009.

Threatened species

Confirmed sightings of eggcases from the critically endangered Common Skate, critically endangered White Skate and endangered Undulate Ray are of particular interest, especially since all three species were afforded protection by the EU in 2009 due to their conservation status. Common Skate eggcases have been confirmed from Dingle Bay, Ballinaskelligs Bay (Co. Kerry), Horse Island and White Strand (Co. Clare). White Skate purses have been sampled from Tralee Bay, Ballyheigue Bay (Co. Kerry) and Galway Bay. There have also been confirmed sightings of Undulate Ray eggcases in Tralee Bay.

Common Skate eggcase, *Dipturus batis*

White Skate eggcase, *Rostroraja alba*

Undulate Ray eggcase, *Raja undulata*

Acknowledgements

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Appendix III: Proposal to include threatened species of sharks and rays in the County Mayo Heritage Plan.

Proposal
Mayo County Council

To Consider Threatened Sharks and Rays in the County Mayo Heritage Plan

Marine Dimensions, October 2010

Marine Dimensions

Prepared by Dr Sarah Varian, Marine Dimensions, 15th October, 2010
Photograph courtesy of Hamish Currie

Proposal Background

The current proposal has been prompted by results obtained from the 2010 Marine Dimensions Research Project, To investigate critical habitats for threatened species of shark and ray (funded by The Heritage Council; Project R00261). The 2010 project aims to investigate the indigenous knowledge of fishing communities in Clew Bay and Tralee Bay in order to establish the location of nursery areas and critical habitats for threatened species of shark and ray, ie. the Common Skate *Dipturus batis*, White Skate *Rostroraja alba*, Angel Shark *Squatina squatina* (all classified as critically endangered by the IUCN) and Undulate Ray *Raja undulata* (endangered). This research arose from results obtained through Purse Search Ireland, a public participation project that aims to encourage the Irish public to report their observations of shark and ray eggcases (aka mermaids' purses) around Ireland's coastline. Public sightings of eggcases reported over a period of three years (2006-2009) indicated that Tralee Bay and Clew Bay were likely to be important areas for egglaying elasmobranchs. Results from 2010 have subsequently confirmed that both areas serve as critical habitats for threatened skate species ; Clew Bay is a nursery area for Common Skate and possibly White Skate, while Tralee Bay is a nursery area for White Skate and Undulate Ray. The Basking Shark Sightings Scheme, run by The Irish Whale and Dolphin Group, has also identified Mayo as being an important area for the recovery of Basking Shark, *Cetorhinus maximus* (currently classified as vulnerable by the IUCN).

There is currently serious concern both at the national and international level over the conservation status of the Common Skate and White Skate. Both species exhibit typical elasmobranch life history traits that make them more susceptible to overfishing, ie. slow growth and late reproductive maturity, producing very few offspring. For example, Common Skate mature at approximately 11 years of age, laying only about 40 eggs per year. Consequently, the species have been extirpated from much of their former range (Shark Trust, 2009). Ireland is now one of the few places in the world where these species can now be studied.

In 2009, the species finally received protection from the European Council in ICES areas where populations are known to have been severely depleted, meaning that the fish cannot be retained or targeted if taken as bycatch. The recently published EU Plan of Action for the Conservation and Management of Sharks has also outlined a series of actions that need to be addressed at the regional level by member states. It is now imperative that Ireland responds to this direction by improving conservation management of endangered sharks and rays at the local level. Although the Irish Specimen Fish Committee has removed the Common Skate from listings, encouraging recreational fishers to return specimens to sea, there are still no Species Action Plans available for the above species and other critically endangered elasmobranchs in Ireland. Considering that Ireland is now one of the few countries where these fish survive, it is essential that information be improved in order to facilitate and provide impetus for appropriate conservation measures.

On a positive note, the angling tourism industry (worth over €30 million) has experienced considerable growth in recent years in Ireland, thus creating a strong economic incentive for coastal communities to nurture and conserve shark and ray stocks, particularly with respect to large skate (Common Skate can measure up to 3m in length). The economic benefits associated with skate angling tourism may well represent one of the driving forces behind the survival and recovery of these threatened species. However, there is a need for a communications programme for skippers so that they may be kept informed about best

practice in terms of (a), enhancing survival rates of the fish through correct handling and (b), participation in community based research programmes. The participation of skippers in tagging programmes (such as the programme run by Inland Fisheries Ireland) is also vital for improving information to advise conservation management.

There is still a need for more information on the ecology and biology of threatened skate species in Ireland, particularly in relation to reproductive biology, behaviour and habitat preferences. Inland Fisheries Ireland has gathered good information on the distribution and relative abundance of shark and ray species in Ireland through its long standing Sportfish Tagging Programme (carried out by approximately 70 registered recreational fishing vessels around Ireland's coasts over a period of 40 years). However, the tagging data relating to Common Skate would benefit from being analysed further in order to identify trends in behaviour and population structure. In addition to analysis of existing information, there are also opportunities for developing more advanced tagging techniques, such as the TDR (temperature depth recorder) data storage tagging programme proposed by Marine Dimensions as a research project for 2011. Information on temperature and depth for individual skate measured over time could reveal patterns in movement and behaviour, allowing a much greater understanding of the species' habitat preferences. Such information could be extremely useful for informing conservation management of the species in Ireland and overseas.

Objectives and Actions

It is recommended that the following actions be considered with respect to the objectives outlined in the 2006-2011 Mayo Heritage Plan:

O*bjective 1: Promotion of awareness and appreciation of our heritage*

Actions

- Develop an education and awareness programme for sharks and rays in Mayo, building on outreach already carried out by Marine Dimensions through the Heritage Council's Education, Community and Outreach programme. Such a programme should include:
    - A schools programme,
    - a communications programme aimed at skippers and anglers, including seminars, talks and education materials,
    - leaflets on marine biodiversity (including sharks and rays) available for tourists and visitors to the area, promoting ecotourism and sustainable angling in the area,
    - press and media coverage.

Objective 2: Collection and Dissemination of Heritage Information

Actions

- Support research programmes that aim to improve information on threatened sharks and rays in the Mayo area, eg.

Marine Dimensions research projects

- To examine the behaviour and habitat preferences of critically endangered Common Skate in Ireland (currently seeking sponsors, copy of HC funding application attached).
- To investigate critical habitats for threatened species of shark and ray (funded by the HC).
- Purse Search Ireland: a shark and ray eggcase sightings scheme for Ireland (funded by BIM, the HC, Forfas DSE, NPWS and PADI).

Basking Shark Study Group projects

- Basking Shark tagging programme (funded by the HC).
- Basking Shark Sightings Scheme (run by the IWDG).

Inland Fisheries Ireland

- Sport Fish Tagging Programme.

Objective 3: Promotion of best practice in heritage management and conservation

- Promote best practice in fisheries management and conservation through the education and awareness programme outlined in Objective 1.

Key reports, scientific papers, publications or productions

Ellis, J.R., Cruz-Martinez, A., Rackham, B.D. and Rogers, S.I. 2005. The distribution of chondrichthyan fishes around the British Isles and implications for conservation. J. Northw. Atl. Fish. Sci., 35: 195-213.

Gallagher, M.J., Jeal, F. and Nolan, C.P. 2005a. An investigation of the Irish ray fishery in ICES Divisions VIIa and VIIg. J. Northw. Atl. Fish. Sci. 35: 1-13.

Gallagher, M.J., Nolan, C.P. and Jeal, F. 2005b. Age, growth and maturity of the commercial ray species from the Irish Sea. J. Northw. Atl. Fish. Sci. 35: 47-66.

ICES. 2005. Chapter 13. Demersal elasmobranches in the Celtic Seas (ICES Divisions VI & VII (except Area VIId). Report of the Working Group Of Elasmobranch Fishes. 137-152.

ICES. 2006. Chapter 13. Demersal elasmobranches in the Celtic Seas (ICES Divisions VI & VII (except Area VIId). Report of the Working Group On Elasmobranch Fishes. 187-197.
Shark Alliance website, http://www.sharkalliance.org/. Shark Trust; Great Eggcase Hunt website, http://www.eggcase.org/

Varian, S. 2007. Join the hunt for mermaids' purses! Purse Search Ireland - A new public sightings scheme for shark, skate and ray eggcases. The Sherkin Comment. Issue No. 44, p6.

Varian, S. 2007. Observing mermaids' purses. Inshore Ireland. June Issue, p8.

Varian, S. 2008. Sharks and rays in Irish waters. Inshore Ireland. December Issue, pp. 16-17.

Varian, S. 2008. Purse Search Ireland: A new project raising awareness for Ireland's sharks, skates and rays. The Marine Times. January Issue, pp. 22.

Shark Trust, 2009. Common Skate, Dipturus batis. Shark Facts. www.sharktrust.org.

Varian, S. 2009. Ireland's sharks and rays. Heritage Council Maritime Poster Series.

Varian, S. 2010 in prep. A guide to Ireland's egglaying sharks and rays. Marine Dimensions Publications. 10p.

Varian, S. J., Corcoran, K., Gaughran, A. and Hee Oh, K. 2009. Purse Search Ireland: A skate and ray eggcase sightings scheme for Ireland. Final Report Purse Search project, Marine Dimensions. 34 pp.

Varian, S. 2010. Marine wildlife roadshow to visit Clew Bay primary schools. The Mayo News. August issue. P34.

Varian, S.J. Corcoran, K., Oh, K., Gaughran, A., Dunagan, K., Nunn, W., Armstrong, C., Mariani, S. and Yearsley, J. 2010. The science of mermaids' purses: Using public participation as a tool for investigating egglaying elasmobranch nursery areas in Ireland. Poster presentation. 14th EEA Scientific Conference, Galway.

Went, E.J. 1978. Specimen skates and rays taken in Irish waters (1956 - 1975). Report from the Irish Specimen Fish Committee. 19-30.