Dissection events

March 2023

SiARC

Cronfa Treftadaeth Heritage Fund

Mewn Partneriaeth â Llywodraeth Cymru
In Partnership with Welsh Government

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ON THE EDGE

The partnerships

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Executive Summary

Strandings of elasmobranchs (sharks, skates and rays) occur globally and if collected for examination, provide an important opportunity to investigate species biology, ecology and potential causes of death.

In 2022, in collaboration with the Cetacean Strandings Investigation Programme (CSIP), Aberystwyth School of Veterinary Science (ASVS), Irish Elasmobranch Group (IEG), Inland Fisheries Ireland (IFI), Sea Fisheries Protection Authority (SFPA) and University College Dublin Veterinary Hospital (UCDVH), Project SIARC were able to conduct #CSIofTheSea examinations of five Angelsharks that had either stranded or been accidentally caught and landed under special dispensation for scientific purposes.

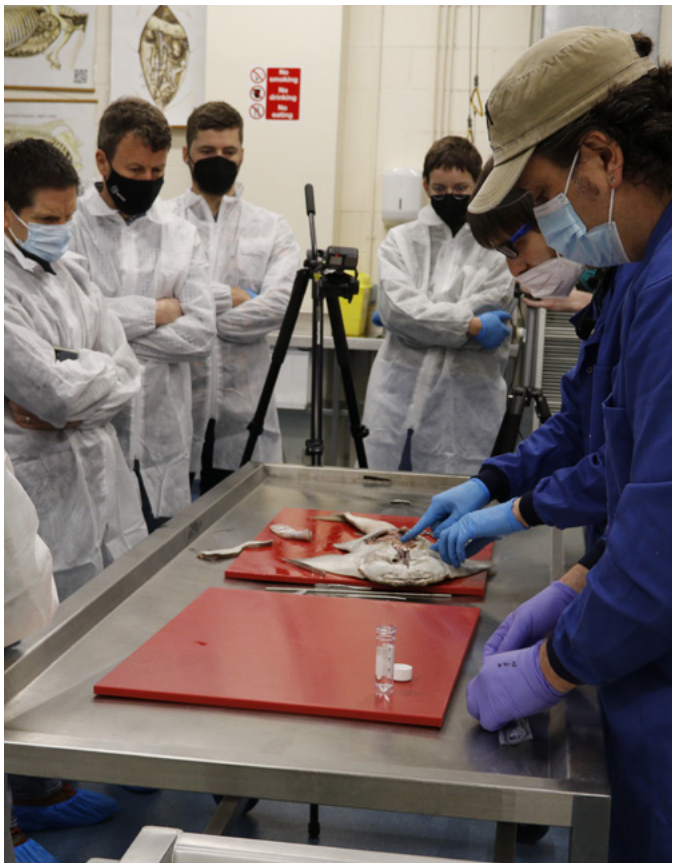
A range of biological samples were taken from all the Angelsharks, which will be used to better understand the biology and ecology of this Critically Endangered species. Alongside this, in collaboration with Swansea University and UCDVH, Project SIARC tested additional methodologies to gather more information from the sharks, including 3D scanning, CT scanning and X-Ray.

Initial reports from the examinations suggest four Angelsharks were healthy prior to stranding or capture, including one that was in the early stages of pregnancy, and one Angelshark that was too degraded to assess health status. Once all examination reports are gathered, they will be combined with results from sample analysis and written up into a scientific manuscript for publication.

The dissection events provided an incredible opportunity to both strengthen and expand current collaborations in Wales and Ireland. This included bringing together those working on Angelsharks in the region to share research techniques, discuss next steps, foster new collaborations and build the capacity for elasmobranch conservation in the region.
Strandings of elasmobranchs (sharks, skates and rays) occur globally and if collected for examination, provide an important opportunity to investigate species biology, ecology and potential causes of death.

Key Findings

- Two dissection events were held in Aberystwyth and Dublin, a further dissection was completed at ZSL.
- Five Angelsharks from the Northeast Atlantic range were dissected between March – July 2022.
- Samples from these individuals were sent for stomach content analysis, contaminant analysis, genetic analysis and stable isotope analysis.
- Project SIARC in collaboration with Swansea University and UCDVH tested additional methodologies to gather more information from the sharks: 3D scanning, CT scanning and X-Ray.



Crynodeb Gweithredol

Mae achosion o elasmobranciaid (morgwn a morgathod) yn cael eu dal ar draeth yn bodoli'n fyd-eang ac, os cânt eu casglu i'w harchwilio, maent yn rhoi cyfle pwysig i ymchwilio i fioleg ac ecoleg rhywogaethau ac achosion posibl eu marwolaeth.

Yn 2022, ar y cyd â'r Rhaglen Ymchwil i Forfilod wedi Tirio (CSIP), Ysgol Gwyddorau Milfeddygaeth Aberystwyth (ASVS), Grŵp Elasmobranciaid Iwerddon (IEG), Pysgodfeydd Mewndirol Iwerddon (IFI), yr Awdurdod Diogelu Pysgodfeydd Morol (SFPA) ac Ysbyty Milfeddygol Coleg Prifysgol Dulyn (UCDVH), roedd Prosiect SIARC yn gallu cynnal archwiliadau #CSIofTheSea o bum maelgi a oedd naill ai wedi tirio neu wedi'u dal ar gam ac wedi cael eu glanio dan ganiatâd arbennig at ddibenion gwyddonol.

Cymerwyd ystod o samplau biolegol o bob un o'r maelgwn, a fydd yn cael eu defnyddio i ddeall bioleg ac ecoleg y rhywogaeth hon sydd mewn perygl difrifol yn well. Ochr yn ochr â hyn, mewn cydweithrediad â Phrifysgol Abertawe ac Ysbyty Milfeddygol Coleg Prifysgol Dulyn, profodd Prosiect SIARC fethodolegau ychwanegol i gasglu mwy o wybodaeth o'r morgwn, gan gynnwys sganiau 3D, sganiau tomograffeg gyfrifiadurol a sganiau pelydrau- X.

Mae adroddiadau cychwynnol o'r archwiliadau'n awgrymu bod pedwar o'r maelgwn yn iach cyn iddynt dirio neu gael eu dal, gan gynnwys un a oedd yng nghamau cynnar beichiogrwydd, ac roedd un maelgi yn rhy ddirywiedig i bennu statws iechyd. Unwaith y bydd yr holl adroddiadau archwilio wedi'u casglu, cânt eu cyfuno â chanlyniadau dadansoddi samplau a'u defnyddio i ysgrifennu llawysgrif wyddonol i'w chyhoeddi.

Roedd y digwyddiadau dyrannu yn gyfle gwych i gryfhau ac ehangu'r cydweithio presennol yng Nghymru ac Iwerddon. Roedd hyn yn cynnwys dod â'r rhai sy'n gweithio ar faelgwn yn y rhanbarth ynghyd i rannu technegau ymchwil, trafod y camau nesaf, meithrin cydweithrediadau newydd, a meithrin y gallu ar gyfer cadwraeth elasmobranciaid yn y rhanbarth.

Canfyddiadau Allweddol

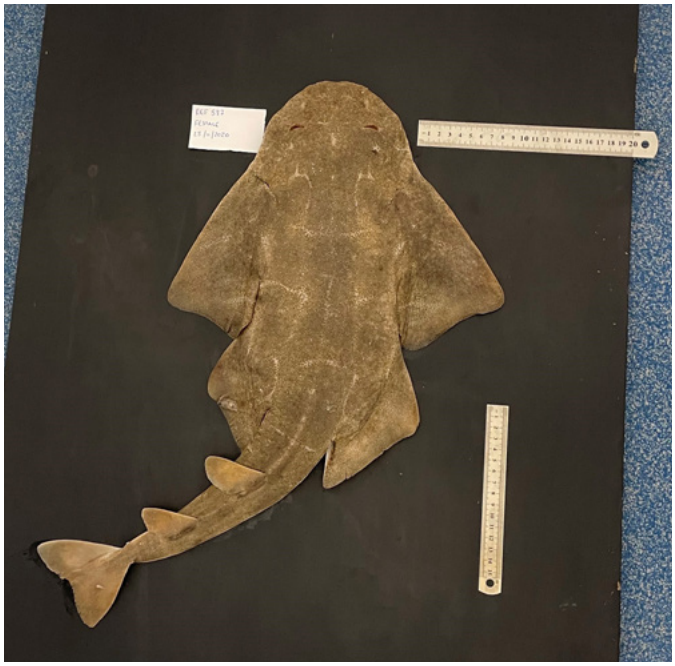
- Cynhaliwyd dau ddigwyddiad dyrannu yn Aberystwyth a Dulyn, cwblhawyd dyraniad arall yn ZSL.
- Cafodd pum maelgi o ardal gogledd-ddwyrain yr Iwerydd eu dyrannu rhwng Mawrth a Gorffennaf 2022.
- Anfonwyd samplau o'r unigolion hyn ar gyfer dadansoddiad o gynnwys y stumog, dadansoddi halogion, dadansoddiad genetig a dadansoddiad o isotopau sefydlog.
- Mewn cydweithrediad â Phrifysgol Abertawe ac UCDVH, profodd Prosiect SIARC fethodolegau ychwanegol i gasglu mwy o wybodaeth gan y siarcod: Sganio 3D, sganio CT a phelydrau X.

Introduction

The collaborative Cetacean Strandings Investigation Programme (CSIP) coordinated by ZSL has coordinated the investigation of cetacean strandings around the UK coast since 1990. Large bodied sharks were added to the CSIP remit in 2017, to replicate the work done with cetaceans and provide valuable information about these mysterious and in some cases, rare elasmobranchs. This ensures the best scientific data is gathered from these events, to better understand and safeguard the future of these species.

Stranded animals can provide an accurate picture of species living in adjacent waters and show local and seasonal distribution. Data gathered through post-mortem examinations and the further analysis of collected samples allow us to determine the possible causes of death and general health of the individual, including information on disease and contaminants exposure. This provides us with valuable data, and in some cases can help detect disease outbreaks or unusual increases in mortality, giving us an idea of the general health of the wider populations living around our coasts. They can also provide us with insight into the lives of these marine animals, such as their diet, reproductive patterns, genetic structure and connectivity to other populations. Angelsharks are a protected species, included in various national and international legislation which means it's illegal to target, retain, injure, kill or land Angelsharks around UK and EU waters (table 1).

Although no targeted fishing for Angelsharks occurs, occasionally they are accidentally caught during fishing activities. Fishers actively supporting the project by following best practice guidance to safely release Angelsharks if accidentally caught. By working closely with recreational, commercial and charter boats in the region we can gather vital data to better understand one of the rarest species of shark in Europe. A paper published by Angel Shark Project: Wales (ASP:W) and Project SIARC team highlights the importance of this collaboration, and uses fisher-data to investigate the distribution, ecology and habitat use of Angelsharks in coastal waters of Wales and the central Irish Sea. Information like this will help towards safeguarding this enigmatic species.



Regulation/Legislation	Listing Date	Mandate
National		
Wildlife and Countryside Act (1981)	2008	Schedule 5
The Wildlife (Northern Ireland) Order 1985 "Animals which are protected at all times"	2011	Schedule 5
Sharks, Skates and Rays (Prohibition of Fishing, Transhipment and Landing) (Scotland) Order 2012	2012	
Environment (Wales) Act (2016)	2016	Section 6.1, 6.5, 7.1, 7.3
International		
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	2017	Appendix I & II
European Union Regulation No. 2019/1241 of the EU Parliament and the Council	2019	

Table 1. See the Wales Angelshark Action Plan for more detail on these listings.

Method

Through the relationships built by Project SIARC and ASP: Wales, the team were notified of five dead Angelsharks between November 2020 and June 2022. Three of the Angelsharks were found dead on the Welsh Coastline by beach walkers – luckily those who came across the individuals were able to identify the species correctly and contacted the team about their rare findings. The animals were then collected, with the help of local fishers, NRW and the CSIP team based in Wales, before being stored in freezers to enable dissections to occur once Covid-19 restrictions had eased.

During November 2020, a fisher operating in the Irish Sea accidentally caught two Angelsharks, which were dead when they reached the deck of the boat. The fisher, knowing the importance of this species, quickly contacted colleagues at the IEG and IFI to ask what to do, as they knew it was a rare species in the region. These groups contacted the SFPA, who issued a special dispensation to land the individuals for scientific purposes.

Ensuring that data is collected in a standardised way is hugely important to allow further comparison of samples from across the Angelsharks' range. In collaboration with CSIP, ASVS, IEG, IFI, SFPA, and UCDVH, Project SIARC were able to conduct two #CSIofTheSea dissection events, one in Wales (15-16 March 2022) and one in Ireland (4-5 May 2022). The dissections followed a scientific protocol developed by the Angel Shark Project, which takes a variety of measurements and samples from the individuals (see Annex 1). This protocol was developed using advice from Cefas (Centre for Environment, Fisheries and Aquaculture Science) and taken from a literature review of papers published on Angelshark morphology.

The first set of #CSIofTheSea examinations were conducted on both sharks that washed up on the Welsh coast. Unfortunately, one of the sharks was heavily degraded, so a thorough examination was not possible. Before starting the examination, Swansea University carried out 3D scanning on the shark, which has never been tested on this species before. The team managed to get a perfect render of the shark which has been used by schools across Carmarthenshire to 3D print Angelsharks as part of the Project SIARC school engagement initiative.

The second set of #CSIofTheSea examinations were conducted on the two sharks from the Irish Sea. UCDVH also completed an X-ray and CT scan of the sharks, which helped provide important additional information on the internal anatomy of this species.

A final dissection of an Angelshark washed up in Tywyn, North Cardigan Bay, was conducted by CSIP at the Zoological Society of London in July 2022 – so that the samples from this shark could be analysed alongside those collected during other #CSIoftheSea examinations.

From all the individuals, a range of biological samples were taken (see Annex 1), and the following were sent for analysis:

- Skin samples have been sent to Field Museum's Pritzker Laboratory for genetic analysis, this will allow us to better understand whether the Angelshark populations using the seas around Wales and Ireland are genetically different from those in the other parts of the Angelshark range.
- The stomachs have been sent to Cefas for content analysis, to give us a better idea of Angelshark diet.
- Various samples, including muscle, liver and skin have been sent to University of Windsor, Canada for stable isotope analysis, which can be used to understand what environmental conditions the Angelsharks have grown up in, trophic ecology and potential food sources.
- Liver and muscle samples have been sent to Cefas for heavy metal and contaminant analysis to investigate contaminant exposure within individuals.

Results

- Five Angelsharks were dissected during Project SIARC.
- Five samples processed for stomach content analysis.
- 11 samples processed for genetic analysis.
- 22 samples processed for stable isotope analysis.
- 14 samples processed for contaminant analysis.
- Samples were also collected by CSIP for microbiology, virology and histopathology to determine health status of the individuals.

Morphological results	Angelshark R617	Angelshark R618	Angelshark R586	Angelshark R587	Angelshark R637
Location stranding / source	Harlech Beach, Tremadog Bay, Wales	Shell Island, Tremadog Bay, Wales	Accidentally caught. Irish Sea (128-164m depth)	Accidentally caught. Irish Sea (87m depth)	Dysynni beach, Cardigan Bay, Wales
Location of dissection	Aberystwyth School of Veterinary Science (ASVS)	Schedule 5			
Condition	Degraded	Good	Good	Good	Good
Sex	Undeterminable	Female	Male	Female	Male
Life stage	Adult (presumed)	Adult	Sub-Adult	Sub-Adult	Adult
Total length (tail extended, under body) (mm)	1024	1383	675	636	1300
Total width (pectoral fin width, over body) (mm)	497	882	363	339	720
Whole body weight (g)	NT	NT	2490	2300	29150
Interesting observations	NA	Potential ovulation sites on ovaries and yolk material present.	NA	NA	Spikes on pectoral fins. Cyst present on liver.

Initial findings from the examinations suggest four Angelsharks were healthy prior to stranding or capture, and one Angelshark was too degraded to determine health status. Further detail could be determined for the female shark from Wales, which brought up some interesting initial insights.

The stomach contained semi-digested fish bones and fish lenses as well as mud, grit and plant matter. Four very long tapeworms were also found, though these were thought to be unlikely to cause significant disease. It was also thought that the individual was in the early stages of pregnancy, as potential ovulation sites were found on her ovaries and yolk material was also present. Further testing will be carried out to confirm this. Overall, it was determined that the female was otherwise healthy, and had potentially become trapped and isolated in a shallow estuarine pool at low tide. CSIP will continue to test the samples better to understand the animal's health and cause of death.

An initial examination report will be collated for the remaining Angelsharks in the near future.

- 19 people attended the Wales dissection event in person and following steering group meeting, with others joining online.
- 22 people attended the Irish dissection event and following meeting in person, with others joining online.

Next steps

The dissection events provided an incredible opportunity to strengthen and expand current collaborations in Wales and Ireland. Project SIARC consists of a wide range of delivery and collaborative partners, who were able to meet in person for the first time for the dissection event in Wales. In Ireland, the dissection provided the perfect opportunity to bring together those working on Angelsharks in the region, to discuss next steps and identify possibilities for collaboration.

Following these dissections, the Angel Shark Project has received further funding from the Shark Conservation Fund, to formalise Angel Shark Project: Ireland. The project, led by the Irish Elasmobranch Group, will build on the approaches and learnings from Angel Shark Project: Wales, with the aim to safeguard Angelsharks in Ireland using fisher-generated data and stakeholder engagement.

These events highlighted the number of organisations working to conserve Angelsharks and other shark species across the Celtic Sea. Following the events, a research group has formed to facilitate information sharing and further collaboration. Together, we hope to build the capacity for collaborative elasmobranch conservation across the region.

After the samples have been analysed, and examination reports finalised, all results will be interpreted and presented in scientific publications. In addition, multiple archived samples collected during these necropsies are available for future collaborations.

Thank you

Thank you to all of our collaborators who contributed their time and expertise to making these events possible.

In particular, thank you to ASVS and UCDVH for hosting these events.

If you would like to know more – check out our blog (English and Welsh) and video.

Annex 1

Measurement datasheet Date:
Location:

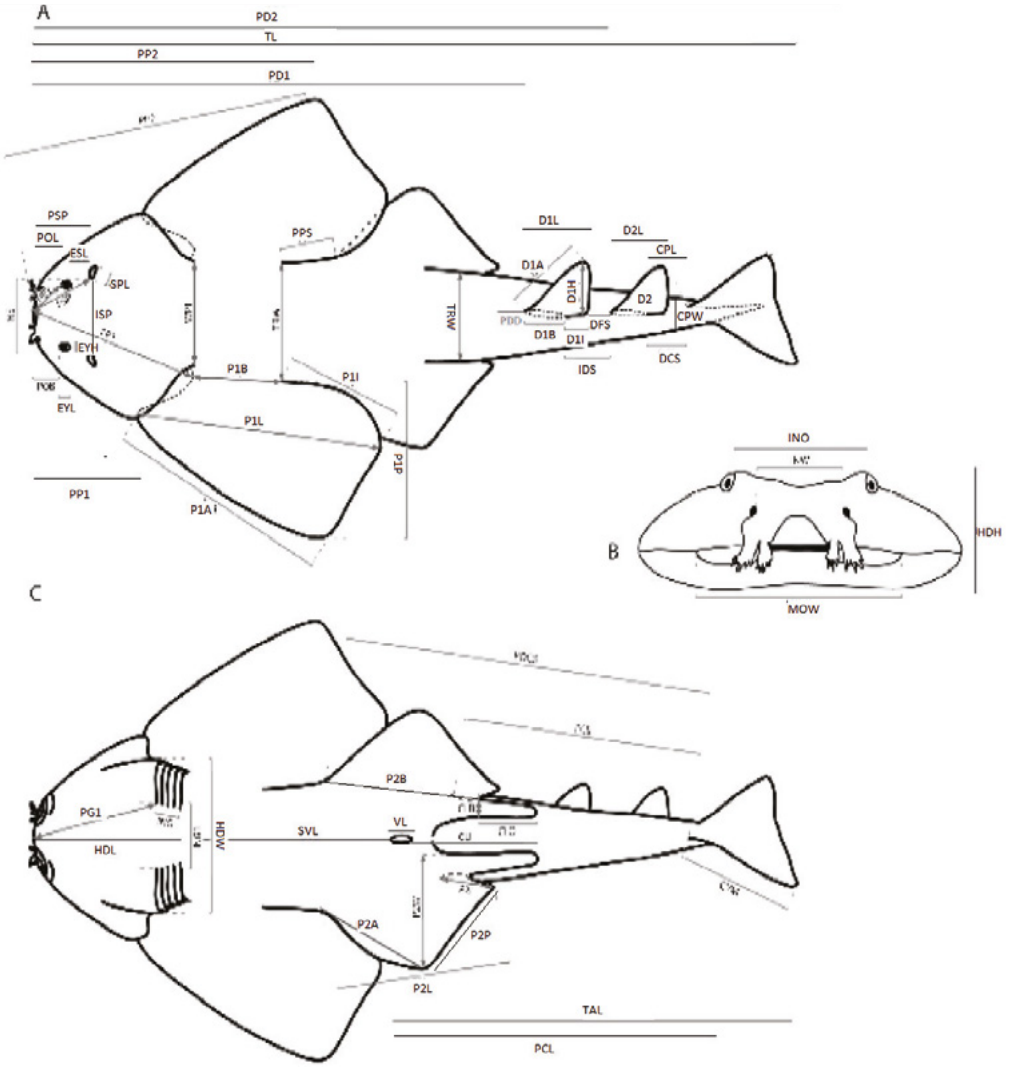
ANGEL SHARK PROJECT

Head of Station:	Notes:		
Measurements Team:			
Angelshark ID:			
Sex:	Source of shark:		
Maturity:			

Measurements (mm) = taken straight over body (not with curvature) on LEFT side unless specified

PRIORITY (DORSAL SIDE)	**Total length (tail extended, under body)**		PRIORITY (VENTRAL SIDE)	**Head Width (HDW)**	
	Total length (natural tail, under body)			**Head Length (HDL)**	
	PreCaudal Length (PCL) (under body)			**PreBranchial Length (PG1) LEFT**	
	Pectoral fin width (under body)			**PreBranchial Length (PG1) RIGHT**	
	Total length (tail extended, over body w. curve)			**Snout-Vent Length (SVL)**	
	Total length (natural tail, over body w. curve)			**Vent Length (VL)**	
	Fork length (tail extended, over body)			**Pelvic Fin Length (P2L) left**	
	Fork length (tail extended, over body w. curve)			**Pelvic Fin Anterior Margin (P2A) left**	
	PreCaudal Length (PCL)			**Pelvic Fin Base (P2B) left**	
	Pectoral fin width (over body)			**Pelvic Fin Posterior Margin (P2P) left**	
	Girth (pre-pectoral)			**Clasper length inner (left)**	
	Girth (pre-dorsal)			**Clasper length outer (left)**	
	Girth (wrist of tail)			**Clasper length inner (right)**	
	1st Dorsal Length (D1L)			**Clasper length outer (right)**	
	1st Dorsal Height (D1H)			**Tail Length (TAL) - -**	
	2nd Dorsal Length (D2L)		IF TIME - VENTRAL SIDE	Pre- Pectoral Length (PP1)	
	2nd Dorsal Height (D2H)			Pre- Pelvic Length (PP2)	
	Interdorsal Space (IDS)			Pectoral Fin Length (P1L) left	
FOCUS ON HEAD - DORSAL SIDE	Head Height (HDH)			Pectoral Fin Anterior Margin (P1A) left	
	Pre- Orbital Length (POL) LEFT			Pectoral Fin Base (P1B) left	
	Pre- Orbital Length (POL) RIGHT			Pectoral Fin Inner Margin (P1I) left	
	Pre- Spiracle Length (PSP) LEFT			Pectoral Fin Posterior Margin (P1P) left	
	Pre- Spiracle Length (PSP) RIGHT			Pectoral-Pelvic Fin Space (PPS) left	
	Mouth Width (MOW) curved			Pre-1st Dorsal Length (PD1)	
	Mouth Width (MOW) straight			Pre-2nd Dorsal Length (PD2)	
	Internarial Space (INW) *		IF TIME - DORSAL SIDE	Dorsal Fin space (DFS)	
	Nostril Width (NOW) right			1st Dorsal Anterior Margin (D1A)	
	Nostril Width (NOW) left			1st Dorsal Base (D1B)	
	Anterior Nasal Flap Length (ANF) * right			1st Dorsal Inner Margin (D1I)	
	Anterior Nasal Flap Length (ANF) * left			2nd Dorsal Anterior Margin (D2A)	
	Upper Lip Arch Width (UAW) *			2nd Dorsal Fin Base (D2B)	
	Upper Lip Arch Height (UAH) *			2nd Dorsal Inner Margin (D2I)	
	Eye Length (EYL) right			Dorsal Caudal Finspace (DCS)	
	Eye Length (EYL) left			Trunk Height (TRH) (at pelvic fin end)	
	Eye Height (EYH) right			Trunk Width (TRW) (at pelvic fin end)	
	Eye Height (EYH) left			Caudal Peduncle Width (CPW)	
	Interorbital Space (INO)			Dorsal - Caudal Margin (CDM) *	
	Spiracle Length (SPL) right			Preventral Caudal Margin (CPV)*	
	Spiracle Length (SPL) left			Lower Postventral Caudal Margin (CPL) *	
	Eye - Spiracle Space (ESL) right			Upper Postventral Caudal Margin (CPU) *	
	Eye - Spiracle Space (ESL) left			Subterminal Caudal Margin (CST) *	
	Interspiracle Space (ISP)			**Notes:**	
	Key:				
	High priority				
	* Labelled on smaller diagrams of tail/head				

Annex 1



Angel Shark Sampling Datasheet Date: Location:									
Sampling Team:									
Angelshark ID									
Sex (circle one):		Maturity:							
Source of Shark:									
Tissue	Weight (g)	Sample taken?	**Frozen**	**Fixed**	**Bacteriology**	**Virology**	**Ethanol**	Notes	Notes on storage (all samples to be frozen after being taken)
Whole Body Weight		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**		
Body Weight (minus fins)		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**		
Gutted body Weight		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**		
All Fins (combined weight)		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**		
Body	N/A								in labelled sample bag
Jaw (teeth)	N/A								in labelled sample bag
Brain	N/A								in labelled sample bag
Eye lens Left	N/A								Wrap all the eye in foil then put into labelled sample bag
Eye lens Right	N/A								Wrap all the eye in foil then put into labelled sample bag
Fin Clip	N/A								Put in 100% ethanol or DMSO (we need 2 for ASP:CI) (LABEL)
Gills	N/A								Put in 100% ethanol (LABEL)
Ventral skin	N/A								5cm x 5cm square - wrap in foil then put into labelled sample bag
Dorsal Skin	N/A								5cm x 5cm square - wrap in foil then put into labelled sample bag
Red Muscle	N/A								2 x [5cm x 10cm x 3cm] cubes - put into separate labelled sample pot (glass if possible)
White Muscle	N/A								2 x [5cm x 10cm x 3cm] cubes - put into seperate labelled sample pot (glass if possible)
Liver	N/A								5cm x 10cm x 5cm cube - put into labelled sample pot (glass if possible)
Kidney	N/A								

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