WORKSHOP ON MARK-IDENTIFICATION TAGGING (WKTAG)

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Contents

i Executive summary

The Workshop on Mark-Identification Tagging (WKTAG) provided a platform for experts from across and beyond the ICES areas to share knowledge in an effort to improve coordination and collaboration of tagging work and data. The group focussed on presenting institutional tagging data, reviewing guidelines and protocols with respect to best practice in animal welfare and data management, identified gaps in knowledge and how tagging data could be better coordinated and implemented in stock assessments within ICES.

With attendees spanning 15 countries and 28 organisations, WKTAG highlighted the clear appetite within the expert community for sharing data and knowledge and learning more about how these data can enhance stock assessments. Expertise spanned scientific research and citizen science projects, conventional-, external satellite and archival- and internal acoustic tagging.

WKTAG will work to establish links with an existing database platform through which conventional and electronic tagging data, metadata and/or raw data can be hosted. WKTAG experts will work with ICES to develop a webpage collating outputs of the workshop, related past and future training courses, and a link to the external data platform once established. A communication channel has been setup to facilitate better, and continued knowledge sharing in this field and explore future options for continuing collaborative efforts such as hosing conference theme ses-sions, publishing papers and holding future workshops.

ii Expert group information

Expert group name	Workshop on Mark-Identification Tagging [(WKTAG)]
Expert group cycle	Annual
Year cycle started	2024
Reporting year in cycle	1/1
Chairs	Sophy McCully Phillips, United Kingdom
	Pia Schuchert, Northern Ireland
Meeting venue(s) and dates	29-31 January 2024, Copenhagen, Denmark (41 participants)

1 Introduction

1.1 Terms of Reference

2022/WK/EOSG06 The Workshop on Mark-Identification Tagging (WKTAG), chaired by Sophy McCully Phillips (UK) and Pia Schuchert (Northern Ireland), will be established and will meet 29-31 January 2024 to review recent tagging programmes for fish (including shellfish) in the ICES area, in order to:

(a) Summarise data from recent and ongoing tagging programmes, primarily focussing on mark-identification tagging, but also using the platform to collate summary information on acoustic and electronic tagging, conducted by national institutes (2000-2022) (Science Plan codes: 1.4,1.8,3.1,3.2,3.3,3.5, 4.2); including providing summaries of:

(i) Details of the species being tagged by ICES Division, year, season/quarter, and platform (e.g. chartered fishing vessel, research vessel);
(ii) The tag types used for the various species and attachment methods;
(iii) Mark-recapture data available;
(iv) Contact details for tag reporting and relevant publicity awareness information.

(b) Review relevant guidelines and protocols used by national institutes for handling, tagging and releasing fish, and identify best practices for both relevant tag types and species (Science Plan codes: 3.1,3.2,3.3, ,3.5,3.6).

(c) Identify opportunities for improved coordination and collaboration in relation to mark-recapture studies, including specifying where additional mark-recapture studies could address relevant data gaps for species and stocks assessed by ICES and where existing studies could be used to enhance assessments or ecosystem analyses (Science Plan codes: 1.4, 1.7, 1.8,3.1,3.2,3.3,3.5, 5.2).

(d) Identify an appropriate time-line for future Expert Group meetings on tagging (Science Plan codes: 3.1).

WKTAG will report by 29 February 2024 for the attention of the EOSG committee.

1.2 Current ICES expert groups of relevance to WKTAG

There are linkages with survey planning groups (e.g. IBTSWG and WGBEAM) that may provide platforms for mark-identification tagging, expert groups addressing biological sampling (WGBIOP) and stock identification (SIMWG), expert groups addressing defined taxonomic groups (e.g. WGEF, WGNAS), the regional assessment working groups (e.g. WGNSSK, WGCSE, WGBIE) and groups examining discard survival (WGMEDS).

2 Best practice guidelines for database management

The management of tagging data was chosen as the opening topic for this workshop as it underpins all tagging work, is fundamental to the delivery of the ToRs, and was raised by attendees as crucial to discussions despite not being explicitly described in the ToRs.

Through early discussions with participants, it was realised that not all organisations have a central repository where their institutional tagging data are held. This hampers longevity of the data when staff leave or retire, security, and also the potential to share data and collaborate. It was also evident that different approaches are needed to capture different tagging data, such as mark-recapture, acoustic and data storage tags. Therefore, it was decided that an initial session focussed on how different organisations manage their data and in developing some best practice guidelines for those that don't have a system in place or for those wishing to make their system more robust, would be a sensible foundation upon which to build the rest of the workshop.

2.1 Presentations

This Fishtag Australia – how things work down under

Bill Sawynok; Infofish Australia, Suntag Australia

Summary

This presentation was about the underlying infrastructure of Fishtag Australia, a volunteer conventional tagging partnership that incorporates a number of programs that all use a common database developed by Infofish Australia. The major partner is Suntag in Queensland while other partners are Westag in Western Australia, AFANT tag in the Northern Territory and Saftag in South Australia. Collectively these programs have tagged over 1.03 million fish with 78,000 recaptures over the last 40 years.

The infrastructure core is a database developed based around a Sequel Server platform with Access and Excel used for analysis and graphic presentation while QGIS and Google Earth are used for geographic presentation. The programming language "R" is used extensively to manage database manipulation and data management. The database is housed in the Amazon Cloud for increased security. Dashboards are used extensively for information delivery.

The database collects all the normal tag and recapture details at the individual fish level. Locations are based on geocoded grid maps or GPS and photos of tagged and recaptured fish are also stored. Beyond the tag data the database is used to collect data such as details of catch, competitions, and research projects. A range of templates are also available to generate tag and recapture certificates provided to both the recapture fisher and the tagger.

Tag data are collected through an Excel spreadsheet or a Trackmyfish phone app based around a photo of the fish. Recapture data are collected through a toll-free phone number on the tag or through a webpage for reporting recaptures which also allows photos of recaptured fish to be submitted and stored in the database. For each recapture a certificate is generated using one of the templates and sent by email or postal service. For recaptures where there has been significant movement a simple map generated using Google Earth is also provided.

Volunteer taggers can access their own tag and recapture data (read only) through a secure login to the database through the website. There are a range of tagger dashboards that monitor a wide

range of aspects of tagging effort and achievement awards that recognise milestones that taggers reach, such as tagging a certain number of fish of a target species.

Dashboards are also used to make sense of the data based around locations such as regional areas, catchments, or lakes. Currently there are over 65 dashboards with over 2,000 maps and graphs that are updated every 6 months. The dashboards endeavour to present data that helps understand what is happening in (fish) and above (fishers) the water. While tag and recapture data form the base information the dashboards include competition, commercial, recruitment, environmental, habitat and climate information where these help to understand what is going on.

While the focus of most tagging programs is on understanding fish, attention has turned onto the fishers tagging and recapturing the fish to better understand what is going on. Data are collected on where they live, timeframe when they fish (month, weekday), how far they travel, releasing legal fish and the gender of those recapturing fish. Most of which is already collected when obtaining tag and recapture data. A number of examples were presented of data both from below and above the water.

Q&A

As people have access to see their own records in database – does this imply that the rest of the data isn't public? No, they cannot look at other individual's data. But a significant amount of data is published regarding tagging in an area but an individual's data cannot be teased out from this. Question as to whether anglers are given training on how to tag fish correctly? Yes, they are given protocols and hands on training before they can tag. Trained through videos and sometimes meet them on the water, to do some on the water tagging. Need to meet certain protocols before being allowed to tag the fish.

Cefas Tagged Fish Database: Databases, access, challenges, and lessons learned

Silva, J. F, Burt, G., Hampton, N., Loveday, J. and Gouldby, A.

Summary

The Cefas Tagged Fish Database (TFD) was developed in late in 1990s as a Microsoft Access database. It captures information on both releases and recaptures of individual fishes, primarily on marine species tagged with conventional and/or electronic tags. This database has changed over time with a series of enhancements being made, including but not limited to modifications towards a better connectivity between the different main tables (experiments, capture/release station, tag release and tag recapture); the introduction of new fields (e.g. electronic tag number and type, release gear, release weight, skate and ray wing width, maturity, outside ICES limits, etc.) and, reporting facility to provide release records by species and ICES divisions databased and yet to be digitised thus also, enabling archival of historical experiments.

The TFD is currently under redevelopment to a supported platform (SQL 2019/.NET C#) as to improve on data security and integrity. Additional features are being considered such as having a single table for release and recapture records; information related to Cefas Animal Policy Welfare and new fields. These would include though not limited to haul duration, details on tag return (e.g. if with or without specimen, only conventional or electronic tag, both conventional and electronic tag), fate of the tag (e.g. if encountered on the beach), location of raw files for the electronic tags, ownership of data especially when colleagues retire and/or staff leave.

The brief presentation on the current TFD allowed to address the advantages of having a centralised system to store mark-recapture data and the potential use of these data post the end of individual studies/projects aims; the challenges that were and/or could be encountered and lessons learned thus, understanding that a database may need to evolve through time.

It was also noted that no study on tagging marine, freshwater and/or shellfish species would be successful without the engagement with other stakeholders from the scientific community, commercial and/or recreational fishers and/or members of the public, amongst others. The recapture information by the return of the tag would not be possible without their valuable collaboration hence, good communication is vital to the success of any tagging study.

Cefas has a dedicated 24-hour tag-reporting hotline and email. Further information is available on Returning tagged fish and shellfish - Cefas (Centre for Environment, Fisheries and Aquaculture Science).

Q&A

Is the Cefas data accessible to the public? No, not all of the data is publicly available. Some projects have made the data public through the CEFAS Data Portal (e.g. starry smooth-hound). Issues with sharing and confidentiality stops complete public sharing. Some projects are not finished – so there's a process before the data becomes public. Is the data being collected only Cefas data? There is some additional data that has been collected with other institutes but this cannot be shared without a data sharing agreement with all partners. Cefas can provide contact details of partners/collaborators if requested.

The International Commission for the Conservation of Atlantic Tunas (ICCAT) database experiences

Jesus Garcia

Summary

The ICCAT Secretariat presented an overview of the tagging activities in ICCAT, describing the ICCAT Secretariat's workflow, as well as the different formats used to share tagging information, such as Excel files, dashboard or map viewers. A summary of the tagging stats by species was presented, showing a total number of tags implanted (700k) and recovered (53k). A graph displayed the total tags implanted and recovered for the main species managed by ICCAT.

In addition, a summary of the project was presented for the Atlantic Ocean Tropical tuna Tagging Programme **(**AOTTP) available at https://www.iccat.int/aottp/en/index.html. This presentation showed the general figures of the project (120k conventional tags releases and 600 electronics implanted). References were provided to pertinent scientific documents within ICCAT, such as (1) "Desing and exploitation of the AOTTP tagging database" or (2) "Lessons learned and recommendations from the Atlantic Ocean Tropical Tuna Tagging Program (AOTTP) – Evidence based approach for sustainable management of tuna resources in the Atlantic".

SCRS/2023/167 https://iccat.int/Documents/CVSP/CV080_2023/n_10/CV080100021.pdf

SCRS/2022/163 https://iccat.int/Documents/CVSP/CV079_2022/n_1/CV079010922.pdf

Information was also shared regarding the progress of the new Electronic Tagging Database (ETAG) within ICCAT. The primary objective of this initiative is to consolidate all data derived

from electronic tags and associated metadata into a centralized relational database. Phases one and two has been completed, including the inventory of data, the creation of the loading files, the installation of the database or the loading the electronic tagging data into the system. The initial operational version of the database was unveiled at the Atlantic BFT Electronic Tagging GBYP Workshop, and the full report can be downloaded (download report SCRS/2023/133).

In addition, the ICCAT Secretariat presented two dashboards and a map viewer to examine dynamically and interactively the tagging data for the Blue shark species. The first figure (snapshot in Figure 2-1), displays information for conventional tags, showing a summary of releases and recoveries of the tags implanted. The second graphical representation (snapshot in Figure 2-2), is a map viewer that shows the layer with release, recoveries and the estimated movements. The third figure (snapshot in Figure 2-3) provides information on electronic tagging, showing a summary with data extracted from metadata. The dashboards and map viewers for conventional tagging and electronic tags metadata for some species are available on the ICCAT website https://www.iccat.int/en/accesingdb.html.

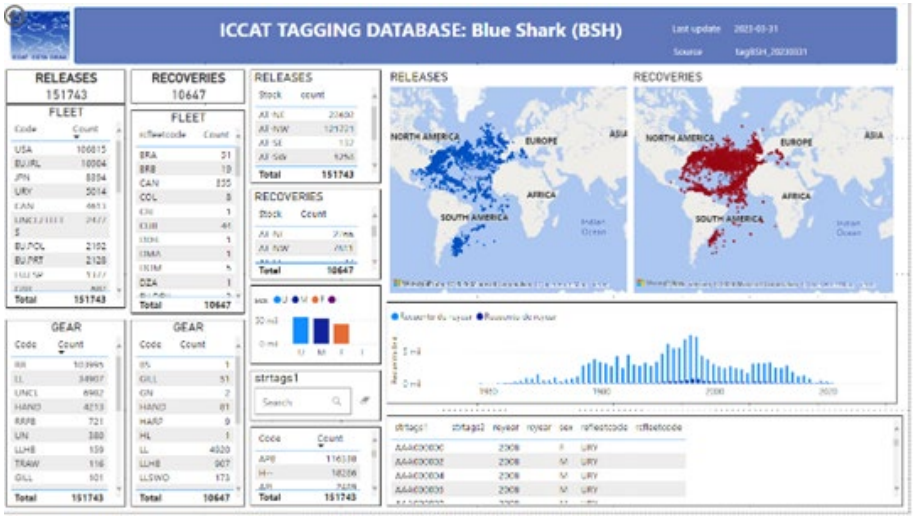

Figure 2-1 Screenshot of the conventional tagging dashboard

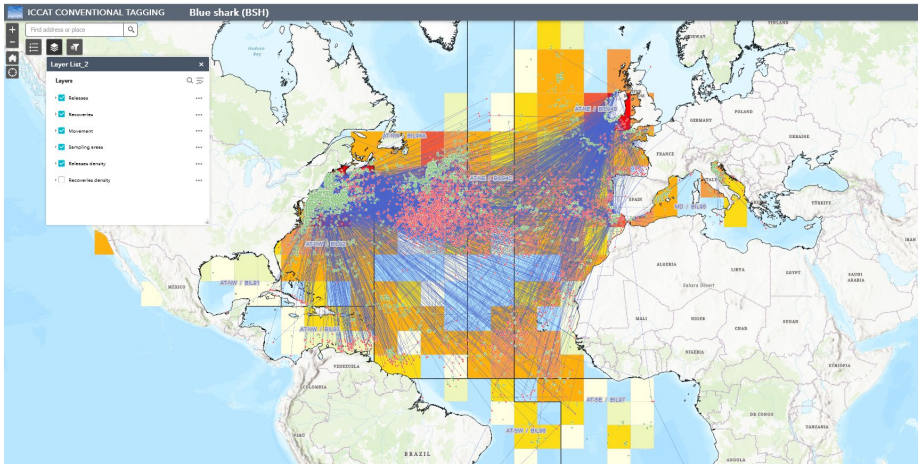

Figure 2-2 Screenshot of the map viewer.

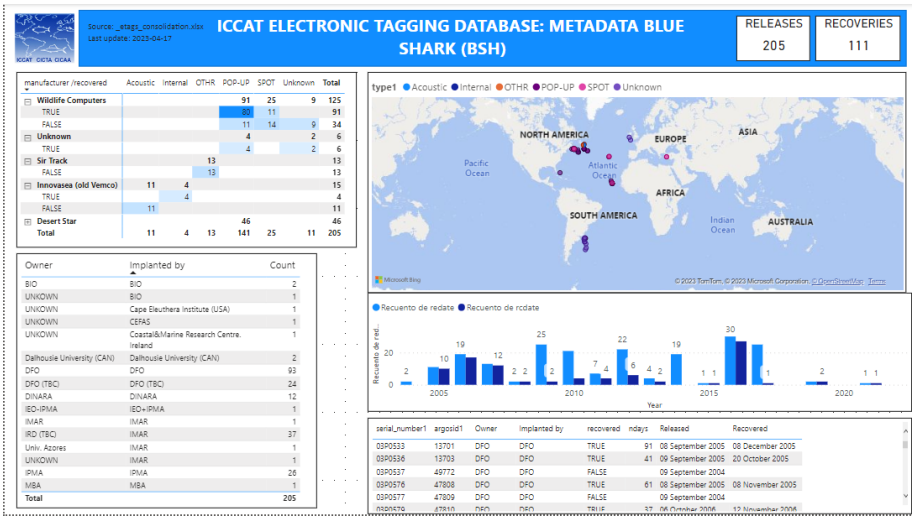

Figure 2-3 Screenshot of the electronic tagging dashboard

Q&A

Is the data received by ICCAT received from member states or collected by ICCAT? The member states participating in the project send in the data. The data is sent in using ICCAT provided templates and integrated into the database.

2.2 Breakout groups: Best practice for database management

This breakout group session was facilitated by the use of Lucid boards to glean feedback from all participants in a common format, allowing members to post thoughts concurrently and allowing equal access to provide comments. The Lucid boards (Annex 4:) were used to harvest the following answers to the four questions posed.

Q1: How does my institution currently store tagging data?

It was acknowledged a variety of current methods for storing tagging data were currently in use such as:

- SQL Server database with web-based front end
- Microsoft Access database
- Microsoft Excel spreadsheets per projects
- Individual hard-drives
- ETN (European Tracking Network) to store and secure acoustic telemetry data (e.g. previously stored in excel files shared via OneDrive or SharePoint within the Institute are now available on ETN).
- Web portal i.e. Wildlife Computers for satellite tag data

Q2: What are the challenges with the current storage (e.g. access)?

There was a consensus that storing some large datasets may be challenging for some institutes, with some currently not having a centralised place to store such data. Various of these challenges would relate to:

- Different data formats may be hampering having data in one single place or location;
- Manpower required to archive and maintain data currently unavailable or potential an issue to acquire;
- Storing data within 'personal' folders / drives would pose security risks increasing a potential data loss event;
- No existent appropriate backup facility;
- Acoustic telemetry where there may be multiple recaptures of the same individual in a short period of time and/or at different life stages (including different lengths).

Q3: What columns are essential data for Mark Recapture tag recording?

Similarly to Q2 there was the consensus of having one single format as complete as possible, this would allow for a centralised data storage facility enabling easier research and data analysis. It was noted that we should be recording as much data as possible. However, noting that research projects may be recording currently more data than citizen science projects where time may be limited, thus constraining the number of variables chosen to be recorded and/or also having some volunteers recording more information than others.

Various variables to be captured should include:

- Tag number for both conventional and electronic tag (if double tagged);
- Release date and location;
- Species with awareness of potential misidentifications due to use of same common names for different species and/or sympatric species, mitigating measures could consider ID guides. As an example, in Australia the same common names may be used for different species like breams from freshwater and from marine environment;
- Animal condition (e.g. if any scarring upon capture and prior to release, if anaesthesia was used and which);
- Animal biological parameters such as length and weight, among others;
- In terms of length, record both in cm and mm, the mm would be useful for estimating changes in length over shorter times-at-liberty;
- Environmental conditions at time of release;
- Considerations that if looking at fish mortality we would be requiring more information e.g. vitality assessments before and after tagging.

- Tag condition upon return (e.g. biofouling)
- Fish condition upon return (e.g. wound healing), photos would be ideal.

However, it was also discussed that a database may need to evolve through time, with introduction of new variables as science may evolve and require different information to be recorded.

Q4: What are the issues with making data publicly shareable.

Some of the issues identified include:

- Data ownership and data sharing agreements, even when implemented they may delay publishing
- Legislation and privacy requirements
- App stores and the clarity in procedures to share information to other organisations. Challenges on how data are reported and to the end-user on how these data are used.
- In citizen science and volunteer programmes sharing of data may be challenging as reporting of locations may not be desirable, which would have effects on the scale of reporting such data.

2.3 Ambition and logistics of creating a Meta-database of tagging across the ICES area

The group agreed early on that having a central tagging Meta-database would be valuable and that it is more a question of how and where the database could be implemented than if.

Discussions were had on the forms of databases already existing in the ICES data-portal. Examples exist in the DATRAS system that would be similar to what is needed for metadata and tag data database. The first step is to define what is required from such a database and if and how it could be incorporated into other types of data recorded in the ICES database.

It is important to define clearly **why** a centralized tagging database is needed. Therefore, it is important to link tagging data to stock assessment and how it can contribute to improving knowledge of stock identification and/or the assessments. Tagging and the metadata could not only be used for assessment but also for spatial management, MPA definition, artificial reef management. There is a lot more that the ICES community works on that these data could be useful for.

The discussion moved on to the question of whether a new database should be created or whether an existing database should be used which builds upon an existing platform. The European Tracking Network is a database aimed at incorporating, centralizing and standardizing tagging data. At present it only includes acoustic tag and data storage tag (DST) information. The ambition is, however, to extend the database to other types of tagging data such as PIT tags and possibly mark-recapture data.

Advantages of having a centralized tagging meta-database that were named by the group include:

- helping to get an idea of who is working on different species with different types of tags and in which area
- comparable data being recorded across tagging programmes
- helping to have good data 'hygiene'
- centralised storage, checking and standardization for further analysis
- helping people to connect and work together.

A next step on creating a tagging database could be that the WKTAG group defines the format of the database and comment on it together. Members agreed that the tagging community support is very important for the use and implementation of such a database.

3 ToR a) summarise data from recent and ongoing tagging programmes

The first step in achieving the ambition of having better coordination, cooperation, centralisation and ultimately use of tagging data is to inform colleagues of what data are held by each institution. This session provided the platform for members of each institution to summarise the tagging data held. The enthusiasm of members to present data during this session evidenced the desire for improving cooperation in this field.

3.1 Presentations

Summary of Cefas marine fish tagging 2000–2022

McCully Phillips, S. R., Hampton, N. T., Burt, G. J., Ellis, J. R. and Silva, J. F.

Summary

Tagging studies have been extensively carried out at Cefas since 1902, including mark-identification tagging and electronic tagging. Historic release and recapture data from recent and ongoing tagging programmes (2000–2022), in relation to species, ICES Division of release and time period, which are held on the Tagged Fish Database data were summarised. Tagging has been conducted widely throughout UK waters and further afield, encompassing twelve ICES divisions from Northwest Scotland to the Bay of Biscay. Since 2000, Cefas have deployed ~30,000 conventional tags on 31 species of finfish, comprising of species of commercial interest (e.g. cod *Gadus morhua* and European seabass *Dicentrarchus labrax*) to a wide diversity of elasmobranchs and species of conservation interest (e.g. Atlantic wolffish, *Anarhichas lupus*). There was an average 9.5% return rate for conventional tags across all tag types, species and years. Additionally, ~3,000 electronic tags have been deployed on 17 species of finfish, with an average 20% return rate across tag types, species and years. The reporting of tag recoveries is encouraged through financial rewards, publicising activities, and managing a tagged fish webpage and 24-hour phoneline to facilitate reporting.

Q&A

There was considerable interest among the other participants in the mackerel tagging programme, in part because programmes of similar spatial and temporal scope were being planned for this and other species. A contact at Cefas was shared with the participants to make further specific enquiries, but it was also made clear that the recent Cefas mackerel tagging programme was designed to be an extension of the Institute of Marine Research programme introduced by Aril Slotte under ToR c) Identify opportunities for improved coordination and collaboration.

Icelandic tagging, past and present

Ingibjörg Jonsdottir

Summary

There is a long history of tagging in Icelandic waters. In 1903, the first tagging experiment was conducted when 280 plaice were tagged north of Iceland. Initial findings indicated that plaice in the north migrated westward for spawning, while those tagged in the east migrated southward. Since then, regular plaice tagging occurred in various regions, continuing until 2012. The initial

tagging of Atlantic cod took place east of Iceland in 1904. These cod, relatively small in size, exhibited a tendency to remain in the east, suggesting the significance of fjords and shallow areas in the east and north as crucial nursery grounds. Later tagging (between 1948 and 1986) showed that 1) mature cod tagged at the main spawning area in the southwest migrated along the west coast toward the northwest for feeding, 2) immature cod tagged at various locations around Iceland tended to stay close to their tagging location but migrated toward spawning locations as they matured, and 3) very few cod (only 38) were recaptured outside the Icelandic ecoregion during this period, primarily migrating towards Greenland but some migrated towards the Faroe Islands, Norway and the North Sea. Tagging data from 1991 to 2008 were i.e. utilized to estimate home ranges. Cod spawning at different spawning locations around Iceland are separated from each other and home ranges rarely overlapped. However, after cod migrate to feeding grounds the home ranges increase in size and the overlap between cod spawning at different locations is greater. In 2019–2023, a tagging program was initiated to look into whether migration patterns from last century had changed. As of now, 1,350 of 20,000 tagged individuals have been recaptured. The migration patterns are like before, except for increased feeding migration to the area north of Iceland and the Dohrn Bank.

Q&A

It was shown that tagging data could be used to gain an understanding of species' movement patterns, including feeding and spawning migrations of cod around Iceland. This, however, also raised the question as to whether tagging might change the behaviour of the individuals under study. Here, as with so many other studies, it is assumed that tagging does not change fish movement behaviours, and proving otherwise would be complicated.

A factor that can inhibit drawing inferences from fish tagging studies is that some fish lose their tags, which can result in potential biases (if tag loss is related to, say, fish size) or small sample sizes, among other problems. In this study, as with others, double tagging was used to reduce the potential impact of tag loss on inferences, and even allow for the effect of tag loss to be incorporated into formal statistical analyses.

It was asked how tags are found in fish when fish catches are large, i.e., could it be like finding a needle in a haystack? Just as with other similar projects, this can indeed be a problem, but every effort is made to find the tags. This led to some comments about the feasibility of using computer vision to spot tags in a streamed video feed of the catch being sorted.

Large scale PIT tagging project for North Sea sandeel

Hans Jakob Olsen

Summary

The TRUST project aimed to investigate whether the lesser sandeel (*Ammodytes marinus*) migrates between management areas and fishing banks or remains in the same area throughout its life. This is crucial for management as it utilizes an area-based stock assessment with corresponding quota setting for each area. Knowledge about the differences in dynamics between sandeel banks in the North Sea is also lacking. For example, it is not clear to what extent sandeel on individual banks originate from local spawning, whether dispersal occurs via larval drift with ocean currents, or whether active migration between spawning banks controls population density and thus the size of the resource in different areas. Through investigations of possible sandeel migrations between banks and areas, our understanding of the spatial stock structure of sandeels and thus the basis for sandeel fishery management in the North Sea is improved.

The project utilizes three different methods for these investigations: PIT tagging of sandeel (Mark-recapture), growth and trace element analyses of otoliths, and genetic analyses. The tags

used for the tagging experiment are 12 mm HDX PIT tags (see Figure 3-1). The tag is inserted into the abdominal cavity of the anesthetized sandeel with a special needle and after a trip in a recovery tank, released at the same place it was caught.

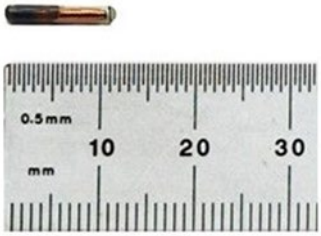

Figure 3-1 A 12 mm PIT tag

At the fishmeal factories scanner systems have been installed on the pumping equipment, which can detect if a PIT tag (in a sandeel) passes by when the catch is landed (Figure 3-2). The recorded tag ID is then uploaded to a DTU server (Figure 3-3). The probability of detecting and recording a recaptured sandeel in a landing was estimated by trials resulting in >98% registration of tagged fish. The tagging of sandeel takes place multiple times and at various times of the year. In 2020 – 2023 more than 25,000 sandeel were tagged and more than 700 recaptures registered. The time at liberty ranged from a few days to more than two years. The sandeel migrates up to 200 km. however, no migrations between management areas were observed. The data from tagging in 2023 primarily reveals stationary behaviour for sandeel.

Figure 3-2 Antenna mounted on the fish factory pumping system

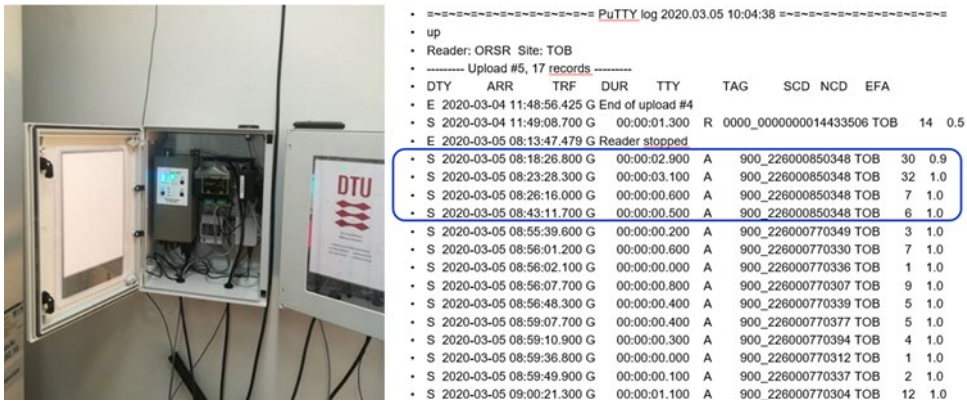

Figure 3-3 Upload of detected PIT tag to server

Q&A

Sandeels are prey for many marine species, including birds that can dive to considerable depths. It was asked whether any measures were taken to minimise the potential impact of predation on sandeels at the point of their release after tagging. It was explained that sandeels are released approximately 10–15 m below the surface via fyke nets, and that this seemed to be effective against diving marine birds.

It was asked whether the tags could be detected in the stomach of predators, which might bias any estimates of survival. This happens for tagged Atlantic salmon in the stomachs of spurdog and cormorant. It was acknowledged that this could indeed occur, as it could for tagged salmon, but that recently emerging technology, such as predation tags, could be used to guard against this problem or help to quantify it.

Summary of European Tracking Network

Jan Reuben

Summary

An overview was given of:

Objectives and structure of ETN and how it links to the other initiatives in the world

How the data-system of ETN works

General data flow

Dataset catalogue

Objectives and structure of ETN

Overall objective: Development of a pan-European telemetry network to track aquatic animals across Europe to better understand, protect and manage them, in support of 1) *European policy priorities and initiatives* in relation to biodiversity, nature conservation/restoration, food security and blue economy; 2) breakthrough science and cutting-edge technological innovation.

Specific objectives:

Infrastructure

Stimulate the development of telemetry infrastructure at strategic locations across Europe

that is fully compatible and working towards a united set of standards in all aquatic systems to support management, enhance collaborations and advance the science.

Theoretical & Applied Research

Identify priority research questions linked to EU policy, and promote initiatives and collaborations to answer these questions.

1. **Promote scientific discussions** among telemetry users in Europe (through the organization of regular symposia or more dedicated online meetings or workshops for specific topics).
2. **Identify research needs** and opportunities (emerging from discussions, papers, etc..) that could be relevant for the ETN community.
3. **Facilitate collaborative studies** (by connecting researchers with common interests or by spreading calls of interests for collaborative papers; by maintaining a list of ongoing collaborative papers, etc).

Data Management

Be the central data hub for aquatic animal telemetry data in Europe. Be inclusive in technologies and brands captured and adopt FAIR data principles to maximise the value of the data gathered. Participate in international efforts for the creation of data and metadata standards related to telemetry (naming conventions, data structures, etc.). Improve data interoperability and exchanges with other networks and biodiversity data repositories.

Integration & Embedding

Integration and embedding of telemetry data as a reliable source of environmental information on which policy decision making can be based. Via:

1) Integrate and embed ETN in existing initiatives and data systems working on ocean observations, biodiversity, species conservation and species, as well as habitat management in aquatic environments at a European and global scale to maximise the value, efficiency, and impact of the network;
2) Translate telemetry knowledge gathered into useful data products, fact sheets and policy briefs to support decision making, directives and legislation on regional, national and European level (in collaboration with WG Communications).

Funding

Coordinate funding opportunities and prioritise project development.

Communication & Dissemination:

Communicate in an open and inclusive way, and disseminate the knowledge gathered within the ETN to all stakeholders involved using different channels (social media, peer reviewed publications, symposia etc.). Provide continuous training to the scientific community to share knowledge and advance excellence in science in Europe and beyond.

Data system of ETN

Detailed info on the system: see manual and Figure 3-4.

Tracking data generated in a project is first uploaded from the receivers (for acoustic telemetry) or tags (DST) to the personal computer using the software provided by the manufacturer. In the

next step, the raw data is uploaded to the ETN data portal and automatically stored in the Marine Data Archive (MDA). Project information is stored in the Integrated Marine Information System (IMIS). In ETN the metadata and data can be organised and downloaded.

The RShiny application is available for data visualisation purposes and for the in-depth analyses the ETN R-package can be used. Data-exchange is possible between ETN and the data system of the Ocean Tracking Network (OTN). To enter (meta)data to ETN, several steps should be performed in the correct order (Figure 3-5). Access to the data portal is restricted to registered members only. You can register at http://www.lifewatch.be/etn/login. By registering, you automatically agree with the data policy. Once your account has been created, you will be added to specific user groups by the administrators. A user group has restricted access to (meta)data of specific projects. The next step is the creation of a project. Data is linked to a project, and thus it needs to be created before (meta)data can be uploaded. The template to create a project is available at https://www.lifewatch.be/etn/assets/docs/ETN-project-template.xlsx. This template ensures that all necessary metadata to describe the project is available and understandable. Thereafter specific metadata and data, linked to the telemetry technology at stake, can be added.

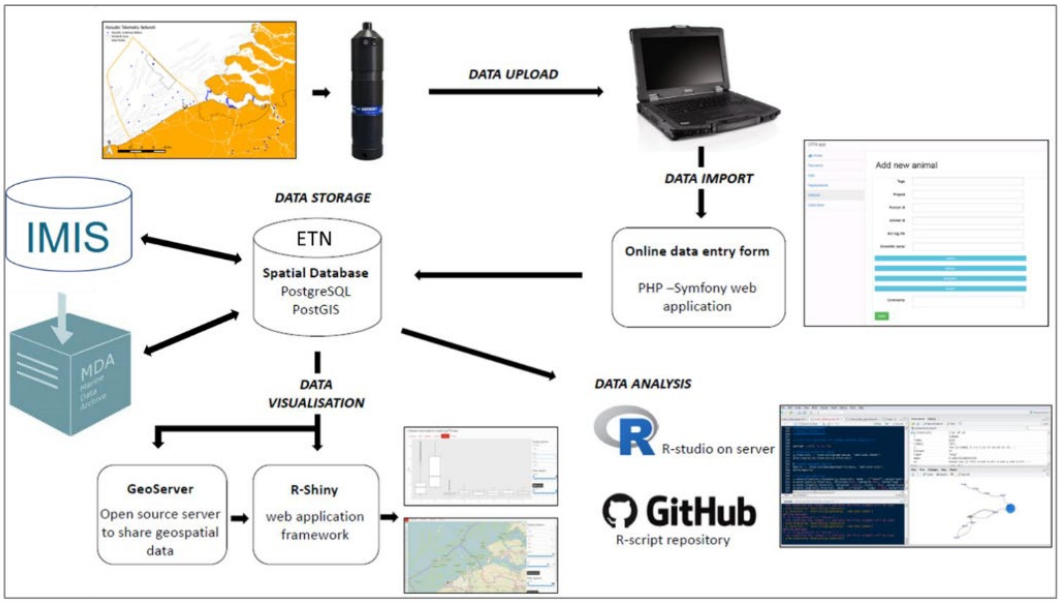

Figure 3-4 Data flow fish tracking data

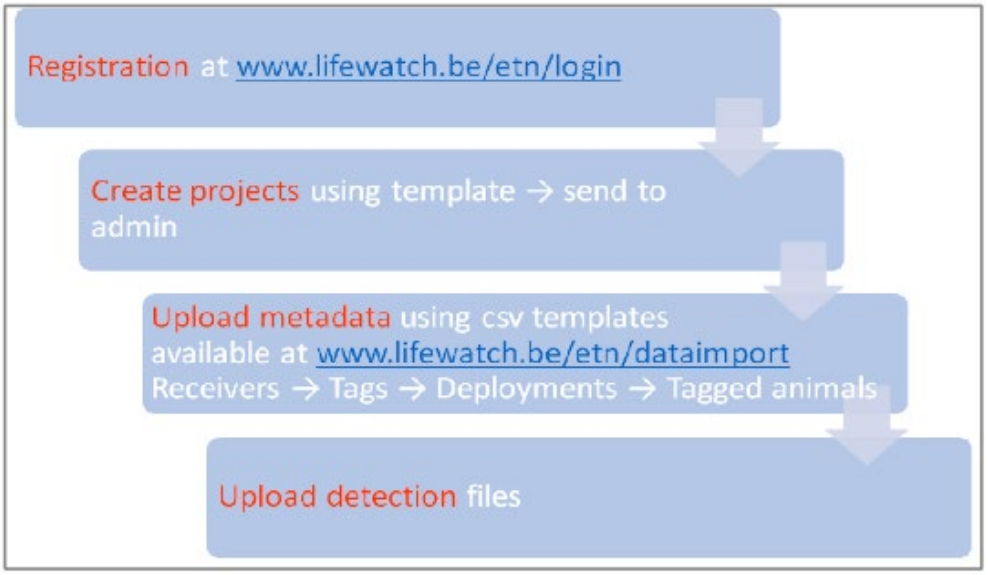

Figure 3-5 Steps to follow to upload data to ETN.

Storing and accessing Project information

Project information linked to any type of tracking technology can be stored, accessed and visualised. Storage is done in the integrated Marine Information System (IMIS) using a template, so ensure all necessary metadata linked to the project is captured. To visualize project information the ETN dataset catalogue can be used (Figure 3-6). Specific filter options are available and help to specify specific searches.

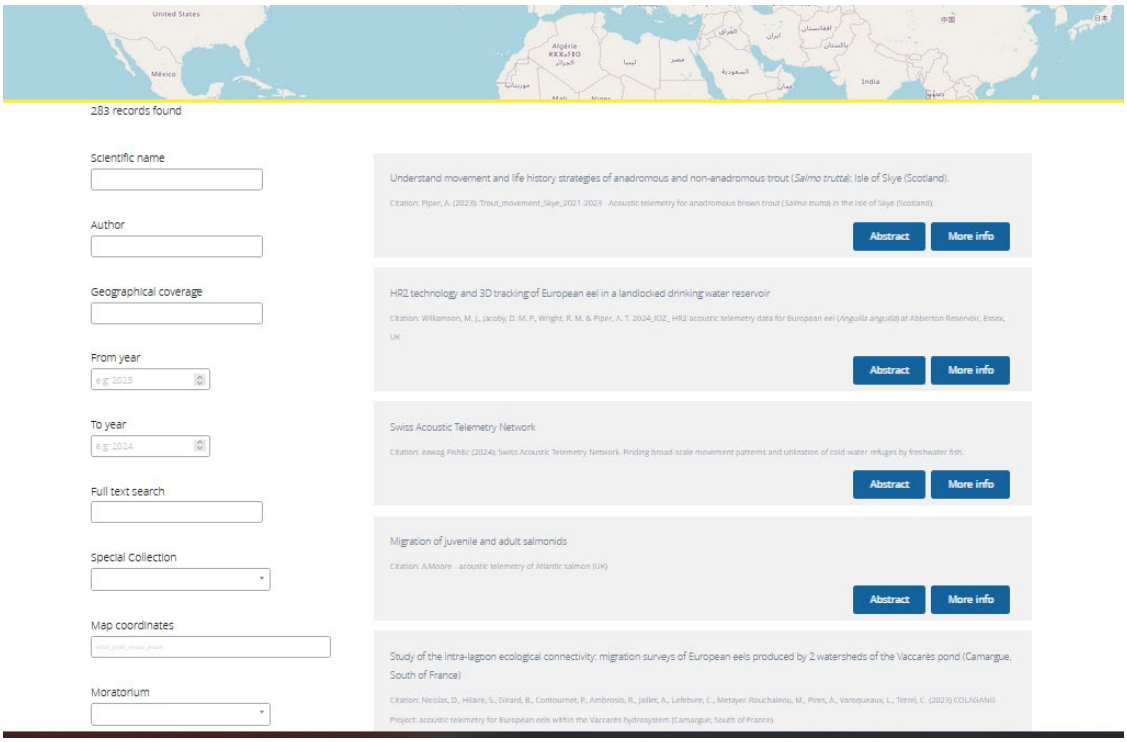

Figure 3-6 View of the ETN dataset catalogue.

Q&A

Would there be the opportunity to use ETN database to store historical and present data from different institutes, including mark-recapture (currently not featured in)? Some institutes may not have at present or in the short-term capacity to have their own database. Would a centralised database as ETN be a potential solution? ETN would be open to new data (including historical), it will require further discussions on the practicalities of this (e.g. changes to database, sharing agreements, etc). Similarly, ICCAT noted that has been some exchanges already between ICCAT and ETN to interchange data to allow for further collaborative research, a positive step moving forwards. Additionally, IPMA noted that as, a recurrent issue within ICES is stock identification and if the existing stock units are appropriate such collaborations are vital, as if not all data are published (or even metadata) it could detriment decision making.

The compatibility issues between different manufacturers acoustic telemetry equipment, meant that ETN has been working on open protocols with the industry to allow for acoustic data to be used throughout independently of brands, with manufacturer buy-in to become more compatible. Workshop participants enquired as to if there are any further updates on making open protocols free (currently a payable service)? Open protocols are a medium-term solution and fees can be costly. It is the responsibility of each individual user (or institute) to agree with the manufacturers a fee for such service as unfortunately there is not a single fee. There is though the push and interest to have such protocols in place either free of charge or a single fee across the board if the encryption is not removed in the future. ETN does recommend therefore, users to research open tag protocols when considering the purchase of equipment.

ILVO telemetry studies (dart tags and acoustic transmitters) on sole, seabass and plaice

Jade Maes

Summary

The Flanders Research Institute for Agriculture, Fisheries and Food aims to generate knowledge on a variety of subjects to increase overall sustainability. Throughout the last couple of years it has executed a number of studies where tagging of fish was used to gather information. This presentation listed three of those studies, which used different tags and different species. The first study wanted to better understand the behaviour of European plaice in relation to Offshore Windfarms (OWF). In order to obtain this knowledge, European plaice where caught from the Belwind wind farm off the Belgian coast and externally tagged with an MP9 transmitter. Receivers were also deployed within the wind farm, in various formations. From this study it was concluded that there is high residency within the OWF(s) and high site fidelity towards OWF after spawning. Offshore wind farms protect plaice during the feeding season (but not during spawning migrations). The next study aimed at attaching dart-tags on seabass in order to better understand their life-history. The seabass were caught and tagged around the port of Zeebrugge and they relied on local fishers to recapture the fish. When recaptured, the number of injuries, the length, weight, age, location, date and time were recorded to gain some insights into the seabass population in the Southern North Sea.

The most recent study aimed at assessing the potential impact of a DST micro-TD tag on common sole. In order to better understand how the attachment of an external tag can influence the overall well-being of sole, the behavioural performance and physiological condition of tagged as well as control fish was monitored over a period of four weeks in a controlled environment. Mortality was checked every day, while the weight of all fish was measured every week in order to compare the control group with the tagged group. Additionally, a RAMP-test was set-up weekly, in which five common reflexes were tested which would become impaired when the individuals were under stress. As the mode of attachment of the DST-tag seemed to inflict a lot of injuries on the fish, we need to explore alternative tagging procedures that reduce complications and protect the well-being of the experimental subjects.

Q&A

It was noted by members that there could be the potential for an impact on post-release mortality not accounted for as the experiment was (is being) conducted in a tank with no obstacles, so could possibly not be as representative of the 'real' environment where sole may occur.

Summary of IEO marine fish tagging on skates and rays in NW Spain

Julio Valeiras

Summary

Rajidae species are an important marine resource in the fisheries of Northern Spain and in particular for the otter bottom trawl and trammel net fleets. Skates and rays are usually discarded due to their small sizes, low value, lack of fishing quota or be prohibited species. Discard rates of skate and rays by bottom trawling in north Iberian waters (ICES Divisions 8.c and 9.a) are 30% for the most important commercial species, undulate ray and thornback ray. DESCARSEL project carried out a tagging program and survival rate estimation assessment of discarded skates and rays caught by commercial trawlers and trammel netters operating in northwestern Atlantic

Spanish waters. Our results indicated that 66.8% and 100% of sampled rays caught by bottom trawlers and trammel nets, respectively, survive fishing and handling operations on board. Following the ICES recommendations, a tagging program has been carried out to improve knowledge of the status and spatial ecology from recapture data and implication in fisheries interactions. Understanding the patterns of discarding and survivability rates could be used to reduce the fishing impact on skate and ray stocks and improve fisheries management.

Between 2018 and 2023, a total of 1,199 rays and skates have been tagged and released from fishing and oceanographic vessels in NW Spain. These specimens were from five species. To date, 26 recaptures of three species have been made. The most recaptured species was the thornback ray, which is the most released. But undulate ray and blonde ray have larger recapture rates: undulate ray 11.54% (n=1), thornback ray 1.98% (n=22) and blonde ray 6.25% (n=3)

Q&A

Where the recaptures observed in the similar season as tagging? No, these were throughout the year(s).

Was there much biofouling encountered on the larger button tags? Yes, biofouling was encountered on both dart tags and button tags (e.g. green algae and stellate barnacle). Norway has also observed biofouling with miniPAT archival tags, but the use of antifouling product in the newer tags seems to have solved the issue.

It was also mentioned, following a presentation on second day from IPMA on skate tagging, that they have observed rusting on the Petersen wires. Participants queried if these were stainless steel or titanium, as these should prevent issues with rusting. Spanish tags are completely made of plastic and do not rust. Further investigations are to be made for future projects.

Recent and ongoing tagging activities of the Thünen Institute of Baltic Sea Fisheries in the western Baltic Sea

Uwe Krumme

Summary

The Thünen Institute of Baltic Sea Fisheries, Rostock, Germany, tags cod (*Gadus morhua*) in the brackish-water western Baltic Sea since 2014, and since 2017 also plaice (*Pleuronectes platessa*), flounder (*Platichthys flesus*), dab (*Limanda limanda*) and turbot (*Scophthalmus maximus*). The initial objective was age validation of wild fish using chemically-marked otoliths, but issues of growth, movements, migrations, habitat use and stock identification have become additional objectives. Tagging involves t-bar tags, chemical tagging, liquid latex, DST, acoustic transmitters and satellite pop-up tags (planned for salmon). Fish tagging occurs mainly onboard research vessels and on piers where live fish are kept in nets pens, fish boxes, or cod pots. Outcomes of the international project Tagging Baltic Cod (TABACOD; https://tabacod.dtu.dk/) likely contains information useful for the tasks of WKTAG, e.g. a tagging guide.

Q&A

There was a discussion in terms of the limitation tagging studies may face when changes in fisheries occur with the reduction of fishing effort. This can hamper the implementation of experiments with the decline in knowledge of current spatial distribution of species of interest but also lead to a low tag return. This is being experienced in the Baltic Sea (as this presentation showed) but also in Northern Ireland.

Summary of Cefas freshwater and diadromous fish tagging 2000-2022

Pearson, L., Gillson, J.P., Bašić, T., Davison, P.I., Ives, M., Walker, A.M., and Moore, A

Freshwater and diadromous fish have long been at the forefront of Cefas' tagging efforts. This working document identified that a total of 366,938 individual fish across 20 freshwater and diadromous species were tagged by Cefas between 2000 and 2022. Two species in the family Salmonidae, the Atlantic salmon (*Salmo salar*) and trout (*Salmo trutta*), provided the largest contribution to the numbers of tagged fish, with 308,112 and 50,433 individuals tagged, respectively. In addition, 1,107 European grayling (*Thymallus thymallus*) were also tagged. These fish have been tagged in large numbers because of the organisation's involvement in long-term salmonid population monitoring programmes and a wide range of research projects, covering topics such as investigating anthropogenic impacts on salmonid populations and the factors influencing migration timing. Moreover, 1,450 European eels (*Anguilla anguilla*) were tagged by Cefas in the same period during projects studying the migrations and behaviours of different life stages and assessing the impacts of conservation efforts on population sustainability. Tagging projects have sought to assess the spawning migrations of European smelt (*Osmerus eperlanus*) using movement data collected from 114 tagged individuals. Cefas also tagged 2,931 non-native fish in the specified period, most notably during a study that investigated the survival and tag retention in the wild for two species, the pumpkinseed (*Lepomis gibbosus*) and pikeperch (*Sander lucioperca*). The other remaining fish tagged by Cefas over this period comprised 12 native freshwater species during studies that assessed the efficacy of predator mitigation methods and behavioural responses to anthropogenic pressures. Tagging procedures were often performed on land, usually on the banks of rivers, ponds, and lakes, but occasionally vessels were chartered in larger water bodies or estuaries. Eight tag types were used by Cefas in these efforts, with internal tags (mostly passive integrated transponder (PIT) tags and coded wire tags (CWT), but also acoustic, data storage, and radio tags) placed within the body of the fish most frequently employed, followed by external tags (T-bar, pop-off satellite, and data storage tags) attached outside the body cavity of the fish.

Q&A

Would these data be held within the Cefas Tagged Fish database? No, these data are currently recorded in different project specific excel spreadsheets as the current database does not have the facility to hold multiple recaptures of the same individual, at the same and/or different lengths and/or life stages.

Conventional Tagging of Raja undulata in Portuguese continental waters (Division 27.9a) and additional information on survivability to trammel net fisheries

Catarina Maia, Bárbara Serra Pereira, Neide Lagarto and Ivone Figueiredo

Summary

In 2009, the undulate ray *Raja undulata* was included in the European list of prohibited species, based on which the species could not to be retained, transhipped or landed by European Union (EU) commercial fishing vessels in E.U. waters. This management measure was in place until 2014, and was very unpopular among fishing communities in several geographical areas, as the species can be locally abundant. Since that time, various European laboratories have conducted investigations, largely due to the controversy surrounding its listing on the prohibited species.

In mainland Portugal, data on undulate ray caught by the trammel net fleet of the polyvalent segment were collected under two scientific projects developed by IPMA: DCF Pilot Study on Skates (2011–2013) and UNDULATA project (2014–2015). Under the later, a conventional tagging programme was implemented with close collaboration with the fishing sector, and a summary of the data collected was presented to WKTAG.

Undulate ray specimens captured by polyvalent vessels operating with trammel nets, and with total length larger than 60 cm, were tagged using Petersen discs applied in the middle of the disc. The individual serial number and georeferenced location were recorded. The tagging was both performed by scientific observers and by fishermen collaborating with the project. News in local journals, posters in every fishing port and meetings with fishing associations were used to disseminate the tagging project and promote the success of recaptures. For recaptured individuals, Peterson disc serial number, total length and georeferenced location were registered.

A total of 353 specimens (201 by scientific observers and 152 by fishermen) of undulate ray were tagged in the area of Setúbal/Sesimbra, in SW Portugal mainland waters. From those, 40 were recaptured, which corresponds to a return rate of 11%. The maximum recorded travelled distance was 26 km and 75% of the recaptures were located at distances less than 10 km from the tagging location. The time at liberty ranged from 1 to 313 days, with an average of 54 days.

Information on Categorical vitality assessment (CVA) of undulate ray after capture by trammel net fisheries, collected from onboard sampling under the UNDULATA project and the DCF Pilot Study on Skates was also presented to WKTAG. In general, it is concluded that the vitality status after capture is high for the species, with more than 79% of specimens caught in 'Excellent' conditions for all sampled mesh sizes and soaking times. The results obtained in those projects suggested that the vitality after capture of undulate ray by trammel nets is not related to its size.

The results presented here are an example of a positive collaboration between science and the fishing sector to collect relevant information to inform on the status and biology of a pertinent species, including those from tagging. This collaboration has provided a good inter-change of knowledge, facility to go onboard the commercial vessels to conduct scientific experiments and a good engagement on recapturing tags.

Q&A

No specific questions were asked.

Historical and ongoing fish tagging programmes along the Coast of Latvia

Loreta Rozenfelde

Summary

The Institute of Food Safety, Animal Health and Environment "BIOR" is actively involved in fish tagging programs in the Baltic Sea, Gulf of Riga, and inland waters. The first fish tagging records in Latvia was back to 1957 - 1977, during which 7,695 Eastern Baltic cod (*Gadus morhua*) were externally tagged on their dorsal fins. The percentage of recaptured fish varied between 1.4% and 9.4% over the years. The research indicates that hydrological conditions are a significant factor in cod spawning behaviour. During periods of high oxygen levels, cod from Bornholm migrate to the Latvian coast to spawn. However, in years of low oxygen levels, cod stop their migration to the Gdansk coast. Historical tagging information is also available for the European flounder (*Platichthys flesus*). Between 1967 and 1975, 24,098 fish were tagged with yellow plastic

label tags in the Eastern and North-Eastern Baltic. The research confirmed the flounder's ability for long pelagic migrations high above the bottom and for homing.

BIOR currently maintains a database of tagged fish that includes biological data, information about fish migration and recapture locations, etc. The 'Latvian National Fisheries Data Collection Programme' includes an assessment of the smoltification of Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*) to determine the optimal time and location for fish release. The BIOR provides scientific advice for fisheries and aquaculture management in compliance with its competence. Ongoing projects involve tagging of Atlantic salmon with internal 16x46 mm radio transmitters (Lotek MCFT2-3A) to investigate their spawning and post-spawning migration behaviour, survival, and the effects of catch-and-release (C&R) angling in the Salaca River. During the post-spawning period, four patterns of behaviour were observed. The majority of tagged salmon (44%) descended to deeper, calmer waters prior to overwintering. Salmon and trout were also tagged with external tags such as polyethylene streamer tags ('HALLPRINT') and Visible Implant Elastomer tags to assess the effectiveness of fish traps, the total number of sea-migrating smolts and the survival of aquaculture-reared smolts during spawning. In freshwater, tagging will also be used to collect migration data on pike (*Sander lucioperca*), river lamprey (*Lampetra fluviatilis*), eel (*Anguilla Anguilla*) and pike (*Esox lucius*). The ongoing fish tagging project in the marine area is LIFE REEF, which focuses on controlling the invasion of the round goby. Between 2022 and 2023, approximately 8,000 round gobies (*Neogobius melonostumus*) were tagged with external T-tags ('HALLPRINT') along the Latvian coast of the Baltic Sea. So far, 3% of the tagged fish have been recaptured. Initial results indicate that round gobies are passive swimmers, and only a few specimens were recaptured more than 10 km from the tagging sites. The assessment of the distribution range of the round goby using tagging methods will provide information for more effective spatial management of fisheries.

Ongoing satellite tagging of marine bony and cartilaginous fishes by the IMR in Norway

Claudia Junge

Summary

Three species of sharks are currently being tagged in Norwegian waters, spurdog (*Squalus acanthias*), porbeagle (*Lamna nasus*) and basking shark (*Cetorhinus maximus*). Spurdog have been tagged between 2019 and 2022 with satellite archival pop-up tags (miniPATs) and since 2021 with acoustic tags. Porbeagle and basking shark are tagged since 2022 with miniPATs and both require significant collaboration and communication with the public and fishers to obtain real-time location tips, including a 24h “shark hotline”. Other species which are tagged with miniPATs are Atlantic bluefin tuna (*Thunnus thynnus*) in collaboration with ICCAT-GBYP since 2018 and saithe (*Pollachius virens*) since 2021.

Tagging is done as part of ongoing research activities, collaboration with ICCAT and other research institutions like NORCE (NO) and the University of Stanford (USA), as well as within specific research projects funded by the Research Council of Norway (“Sharks on the Move” RCN #326879 and LOST “325840” led by IMR and NORCE, respectively).

Q&A

No specific questions were asked - this work was not presented but was added to the SharePoint during the meeting.

4 ToR b) Review relevant guidelines and protocols used by national institutes for handling, tagging and releasing fish, and identify best practices for both relevant tag types and species

With the expansion of tagging undertaken globally, as a method for both answering behavioural questions and for providing empirical data to assessment models, WKTAG wanted to use this workshop as a platform to bring together experts in these approaches from multiple countries and institutes to share best practices in terms of animal welfare. The whole process from capture to handling, tag and attachment choice and method, to release protocols were discussed and framed in the context of sharing institutional practices. The desire is to open dialogue and where possible for all members to consider their approaches and whether improvements could be made from other's previous experiences.

4.1 Presentations

Summary Cefas' approach to animal welfare in tagging

Sophy McCully Phillips and Serena Wright

Summary

As Cefas is a signatory to the UK Concordat on openness on animal research, they are committed to openness and transparency regarding the use of animals in research. Aligned to this, their website has public facing documents which formalise their approach, such as their animal welfare policy, and the animals in scientific studies document. The latter contains details on Cefas' Animal Welfare and Ethical Review Body (AWERB), the systems in place to ensure the work is both legal and ethical, how pain and distress is minimised, and how the 3R's (Replace, Reduce, Refine) are considered in our work. The process of initiating any tagging work was loosely summarised into four steps: Design, Sign off, Action and Evaluation. The Design Phase is key and can often not be given the due consideration it necessitates. Some questions which should be considered include:

- Is tagging necessary? Will it answer your research question? Is there an alternative approach (consideration of 'Replace')? Has anyone already done similar tagging work?
- The area of operation and platform choice, could in turn influence other design choices such as handling protocol, tag selection and minimum sample sizes necessary to answer your research question.
- Tag choice and/or settings selected are key to the success of the work and should be determined not only by pre-existing skills or manufacturer preference, but also consider:
    - Whether the species is harvested commercially, geographically restricted or wide-ranging?
    - The size of the study species versus the tag size?
    - Previous experiences with biofouling, and return rates?

- The cost / benefit trade off of, for example, conventional versus electronic tags, which link to welfare and **R**eduction.

- The minimum number of fish to be tagged is essential to consider to meet research aims and is often carried out through power analyses.
- The handling of the fish from capture to release is of paramount importance in terms of animal welfare and can mitigate adverse outcomes. The species size, morphology and physiology will all influence handling considerations, as well as the platform used, method of capture, tag attachment method and release protocols.
- The mechanism through which tags can be returned needs to be well defined beforehand and consideration given to how returns could be increased - from communication to tag choice.

These considerations and answers to all of these questions will form the basis for a protocol for the work and end the 'Design Phase'.

The 'Sign-off Phase' aligns to ensuring the work is both legal and ethical, where AWERB will check the proposed protocol for statistical robustness, tag and method choice. The assigned personnel will have their training and competency records checked and any additional training can be actioned at this stage.

The 'Action' stage begins with cadaver trials. Whereby the proposed protocol is conducted by a team with advisement from experts where possible, on cadavers of the study species of interest or one as similar as possible in terms of morphology. This is especially important when working with 'new' study species and is often revisited in keeping with the 'Refine' principle.

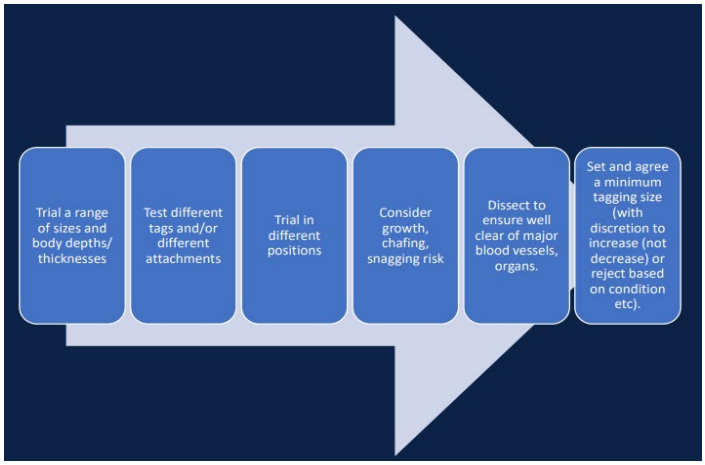

Figure 4-1 Cadaver trial considerations and process

The fieldwork is then undertaken with regular discussions between team members on if/how the procedures could be improved. All personnel record their tagging procedures as part of their training and competency records.

The final stage, 'Evaluate', or elements of it, can often be overlooked in the project/budget end. The reporting is usually necessitated by the funding body, but feedback to AWERB on the work and refinements made and why, coupled with reflections on the tag return numbers are also important elements to consider – especially to inform future tagging work. Finally, the secure,

long-term storage of the tagging data is critical to action (and should form part of the initial design protocol) as discussed in Section 2.

Q&A

The aim of this presentation was to kick-off discussions about what is happening and what has been done by different institutions. Given the amount of different species and tags, this presentation and discussion did not endeavour to cover the specifics of different protocols.

CEFAS approach is to practice the same principles for all types of tagging, whether a Home Office regulated procedure or not.

The thought process outlined (Design, sing-off, action, evaluate) is just the process that is followed within CEFAS, not what 'should be done'.

Very important to consider the size of your species and alternative research actions besides tagging. Important to reach out and using other's expertise, even outside your institute as we can learn a lot from each other.

Issues: sometimes there is not enough time and money for the evaluation phase.

Issue: a lot of people are doing something, but are not talking about the process or documenting this. Incorporate these discussions into the plan and you may not have to go through the same trial and error.

What tag and attachment did you decide for the starry smooth hound in the end? There were four different tag types used (DST attached to the base of the dorsal fin, Pop-off tag behind the dorsal fin).

Is this presentation also written out? Currently Cefas don't have a formalized written protocol. They do have some flow charts of AWERB processes in draft, but don't have this thought process of this presentation in a written manner.

Minimum tagging sample size, how do you define this? Is this decided per species or per project? Power analyses can be used to try and work out the percentage of recaptures, but it is specific to your tag and your project aims. One member disagreed with the power analysis, because you have no idea what to expect and what you're starting point might be. You're doing the study because you want more answers, so doing power analysis might be just per judgement because you don't know anything yet.

Discussion: fish physiology should be taken into account; work should be done in the water and if it needs to be out of the water this time should be minimized. Plus also look at the chemicals you're giving to the fish, because you don't know how the animals might react to these chemicals (e.g. If you anesthetize a fish and put it back in the water it could be that the individual did not yet fully recover, so we need to know the impact this might have). Generic time that fish should be out of water cannot be defined; this may also need to be considered in relation to the species, but also temperature (sea and air) and exposure to direct sunlight. Some species are not tolerant to aerial exposure, others are hardier.

Current methods and best practice recommendations for skate and ray research: Capture, handling, and tag attachment

Danielle Orrell

Summary

At present this is no universal open-access best practice guide on the capture, handling and tagging of skates and rays for research. There are key considerations at each stage of experimental planning, which are often governed by legislation and reinforced by licencing. This presentation provided a high-level overview and an invitation to collaborate on a manuscript that will focus on skate and ray capture, handling, release, tagging (internal and external), anaesthetics and euthanasia. This work aims to provide an overview of current methods and best practice recommendations, highlighting gaps in current knowledge.

Q&A

Capture:

- ➔ Capture considerations: habitat type and animal in question will affect your handling procedure. As well as logistics and safety, partnerships, conditions and questions (question might change your approach)
- ➔ Capture recommendations: appropriate equipment, efficiency, partnerships (eg. Using drones to refine capture techniques to reduce stress on the animal)
- ➔ Handling: looking at the animal size, logistics and safety and partnerships

Tagging:

- ➔ Tag type: internal versus external: there are a lot of different techniques and tags so you should really consider the best practice for your study and species
- ➔ Anesthesia and euthanasia: appropriate methods, health assessments and thresholds
- ➔ Recommendations: using cadavers and asking questions to partners, receive input through collaborations

Very few times that universities actually take on research like this, because of the coming and going of people and because of possibility for long term funding.

Consideration from South Africa: Tagging of stingrays using external dart tags at the base of the tail, but very low recapture rates. The tags might be eaten off (they do have some biofouling and then they get nibbled off).

4.2 Breakout groups: Institutional approaches to tagging

This breakout group session was also facilitated by the use of Lucid boards (Annex 5:). However, this time the three groups discussed different topics around best practice tagging in order to reflect the broad topic, make best use of limited time and harvest the diverse expertise around the table. Participants chose the Group which best reflected their expertise from the following:

Group 1 – Best practice for external mark ID tagging

Group 2 – Internal and external electronic tagging best practices

Group 3 – Best practices in citizen science.

and a facilitator fed back on each board and the resultant discussions.

Group 1

This section focuses on examples of the relevant issues that should be considered when initiating, or appraising existing, mark-identification tagging. Best practice guidelines very much need to be developed for individual studies, and this ensures appropriate species-specific and tag-specific information. Examples of best practice guidelines for mark-identification tagging include Bradford *et al.* (2009), the ICCAT-AOTTP tagging-at-sea handbook (https://www.iccat.int/aottp/AOTTP-Document-Library/Manuals/AOTTP-Tagging-Handbook-EN.pdf), with Metcalfe *et al.* (2006) also providing useful information.

Legal and institutional requirements

- Relevant, national legal instruments, and institutional regulations/frameworks, should be consulted at the start of planning a tagging study.
- Whilst national legal instruments may only (technically) apply to territorial or national waters, it is recommended that best practice should be extended to all geographical areas where work is being undertaken.
- There may be different interpretations on whether the application of a numbered tag on a fish for the purposes of identifying the individual is an experiment (and a regulated procedure) or a part of husbandry. In the case of the latter, there is still a requirement to ensure appropriate training, guidance and ethical consideration of animal welfare.

Why is the study being conducted?

- Define the question(s) being asked of the mark-identification tagging study, which may provide data that can inform on movements, stock identity, growth, migrations, population size and discard survival.
- Designing tagging programmes and work: Which species/stocks are of relevant interest? What would the desired sample sizes and sampling locations be? What are the plans for collecting recapture information? What is the plan for storing data?

Consideration of the three 'Rs'

- Consider the 'three R's' (reduce, refine, replace), 'refine' may be the most relevant of these for mark-recapture studies. It was noted that tagging studies can rarely 'reduce' if adequate sample sizes and spatial-temporal coverage are to be achieved for longer-term programmes. For data interpretation, other approaches (such as otolith microchemistry, genetics) can augment mark-recapture data but it is uncertain whether these approaches would fully 'replace' tagging.
- Additionally, there is a need to better demonstrate/advertise the role of mark-recapture tagging for fisheries work, including for informing assessments and advice. Mark-identification tagging can, over the longer-term, provide greater sample sizes than many electronic tagging programmes, due to the lower unit cost of non-electronic tags. Mark-identification tagging and electronic tagging could usefully be viewed as complementary approaches.

Appropriate staff training

- Training of staff (including maintaining training and documenting experience for different species/tag types). Training should be particularly rigorous and targeted at designated staff if being applied to more fragile fish species (e.g. some pelagic fish). Training should be

specific to the species (or allied species if they share a similar size, morphology and physiology), platform, handling, releasing and tag type and applied to cadaver training initially.
- For some institutes, there may be benefits of ensuring continuity of work and so maintaining institutional knowledge. This could be through having longer-term tagging programmes for flatfish, gadoids, elasmobranchs etc.; or simply ensuring regular training of relevant techniques on cadavers.

Initial planning (tag selection and tagging procedures)

- Applying the tags under consideration to cadavers of the species to be tagged (or related species with a similar morphology) should be undertaken in the laboratory to identify the optimal approach to applying tags. This is of greatest importance when initiating tagging on a species for which established protocols for that species/tag type have not been developed.
- Ideally, aquarium studies to demonstrate tag retention, healing and short-term survival should be undertaken prior to at-sea studies for relevant taxa (unless there is a clear indication from published papers or prior institutional work that the approaches to be conducted are appropriate).
- Tag retention rates may be unknown, and so there may need to be due consideration of parallel experimental work (e.g. aquarium studies and/or double tagging), noting that such approaches may be viewed as experimental (and regulated) investigations.
- There needs to be due consideration of the growth of fish in relation to tag type. For example, button tags which do not allow space for the growth of the body may not be suitable for some species/sizes/tagging locations.
- There also needs to be due consideration of whether the tag might impact on swimming performance, or result in abrasion-related injuries over time.
- Some larger tags may more susceptible to biofouling, which in turn could impact on the fish.
- The tag type (and serial number) needs to be sufficiently obvious to allow for recaught fish to be observed.
- Determine whether there are options for collaborative work with other groups (providing there is sufficient training and appropriate data capture). This should be considered when developing programmes as participation by other fisheries laboratories might enable further mark-identification tagging of a particular case-study species for overlapping or adjacent areas, thus enhancing the sample size and robustness of the study.
- Species and sample sizes: Ideally, sample sizes (with expected return rates, as observed in comparable studies) should be informative and reflect what is known about the species. There is limited benefit of limited tagging for a species for which there are already extensive tagging data for that area. Conversely, opportunistic tagging of some species (if related to the main species being studies) may be relevant if there are no or only very limited data.

Study-specific guidelines

- Guidelines should be developed for different species or grouped taxa (e.g. flatfish, gadoids, skates, dogfish), including the recommended tag type(s), location for tag application, the direction of tag.
- Clear guidelines and protocols for tagging work needs to be prepared before initiating the fieldwork. Experienced staff should be able to refine the techniques if it is to further improve animal welfare.
- There should also be clear guidance on the sized fish that may be considered for tagging (per tag type). What is the minimum size individual that should be tagged? What are the expected

vitalities of the fish, how would they be scored, and for which vitality states is it deemed appropriate to apply a tag (e.g. a minimum condition).

- Guidance in relation to tag application as well as the capture, handling and release for the species in question should be developed, taking the physiology of the particular species into account.
- Guidelines for handling and returning fish should include what to do when fish spend time out of water, and this time should be minimised. For some species of fish, it may be necessary to maintain the fish in water at all times. When a fish is out of the water it should be kept damp, avoiding the sun and any sources of heat, avoiding sharp objects and abrasive surfaces, the body should be supported, fish should not be picked up by the tail or the gills. Abrasion of scales and mucous should be avoided (for relevant taxa). An appropriate surface and working area for tagging should be maintained.
- Standardised data collection forms (species, tag type/number, length (specify whether total length or fork length etc.), weight, sex/maturity (if possible) indicating the dates, times, and locations of fish being released) should be developed. Fish should be released as close to the capture position as possible, and not translocated to different sea areas.

Tagging work in the field

- What platform(s) are suitable and available for tagging work? Research/survey vessels, chartered fishing vessels, observers on fishing vessels may all have a role, but this depends on the species, the desired sample sizes, the required geographic areas and the time frame for the work.
- Use of Research Vessel surveys can be cost-effective platform for fishery institutes, but this still needs appropriate planning, in terms of resource (staffing/time) and strategy (species, areas, time frame etc.). In some cases, using mark-identification to answer some questions could require further platforms to be considered (e.g. for un-surveyed areas) if some questions were to be answered effectively.
- Could current discard observer schemes be augmented with additional 'tagging trips', which may facilitate improved engagement with fishers, and could allow for further mark-identification of particular species in desired locations.
- Fieldwork should ensure there are appropriately trained staff who have read the relevant guidelines, and that they are supplied with the necessary equipment for data recording and tag application.
- Need for holding tanks for immediate post-capture should be used where appropriate. Such tanks may potentially be used post-tagging/pre-release. For example, holding tanks should if potential predators (e.g. seabirds) are present in the area which hampers immediate release.
- Tagging equipment to be maintained in appropriate condition and clean, using appropriate cleaning material (alcohol) and consideration of compounds to encourage wound healing (depending on tag type and species).
- Guidelines for returning fish (minimise dropping from height, avoid releasing where predators about, for some species there may be a need to maintain in on-board tanks so that appropriate buoyancy and orientation can be regained). On higher-sided vessels (e.g. research vessels), a fish basket rigged with rope can be used as a ‘tagging basket’ to lower and release fish back into the water. If fish are too large to go into a basket, then using the natural roll of the ship (in certain weather conditions) to minimise the distance to the water. Knowing where the propellor is and avoid returning fish when the vessel is under speed.

Tagging data, including release and recapture information

- There needs to be due consideration of communications for tagging programmes, as it is important that details of recaptured fish can be returned to the institute undertaking the work. Limited point in undertaking mark-recapture studies without maximising return information.
- Collecting recapture data: There is no point in tagging fish if people who may recapture the specimens cannot find out where to return the fish and/or recapture information. The data from tagging studies needs to be fit for purpose and for appropriate analysis (this should include appropriate, accessible longer-term data storage, e.g. at fisheries institutes or other bodies with a longer-term remit in ichthyology).
- Communications, engagement, outreach with fishers, port staff, fish markets, inspectors/enforcement officials to maximise returns of fish/tags (including rewards, website, collaborative work). Showing tagging data (e.g. online atlas of returns could be beneficial).
- Ensure publicity material for tagging programmes is circulated across an appropriate geographical spatial scale of stakeholder groups for likely recaptures. If the species being tagged is widely-distributed then it is important to enable returns from international fleets, in order to minimise potential spatial bias in the data.
- Returned fish: there is a clear rationale to document and photograph returned specimens to monitor wound healing, biofouling of tag etc. in order to allow refinement (e.g. tag type, tagging location).

Group 2

Given the expanse of electronic tag types, methods and topics associated with this field, the members decided to focus on two specific parts based on their personal expertise and appetite for knowledge exchange: attachment methods and use of anaesthetics. The latter part (anaesthesia) dominated the discussions as it clearly identified a real gap in published knowledge and best practice.

General questions posed and discussed?

- Should iodine or cleaning solutions be used on wounds or should this be left with heal naturally?
- What are the best suturing techniques?
- How does the recovery time from different anaesthetics vary and how do members account for this tagging effect?
- Is internal tagging preferable to external e-tag attachment when there is not a need to measure environmental variables such as light, salinity etc.

Anaesthesia:

- Is tonic immobility suitable as a method of anaesthesia?
- Do members have experience in conducting internal tagging without using anaesthesia?
- How do members determine the concentration, dosage, time of anaesthetic?
- Site selection of analgesia
- What is the efficacy of topical anaesthetics?
- Is there a place for electro-anaesthesia?

Needs Identified:

A best approach guide for:

- Tagging sensitive species, such as small pelagic species e.g. herring internally.
- When anaesthetics should be used
- Application of anaesthesia: dosage, concentration and time
- Suturing methods
- Wound cleaning
- Application of antibiotics

Group 3

Following earlier presentations from two established citizen science programmes, the Group was largely positive and confident about the possibilities associated with citizen science tagging.

Needs:

- Good communication was agreed to be the foundation upon which a strong citizen science tagging programme needs to be built. This needs to cover why the work needs to be done, what the scope is in terms of species/sizes/areas, provide training in tagging, data recording and submission of data (records/photos/videos etc).
- Communication also needs to extend to how such programmes are disseminated to the public. A lot of effort needs to be extended to publicising how to report returns, and this can be achieved by using tackle shops, social media and posters.
- A good approach to animal welfare and ethics is needed, and encouragingly this is being demanded by authorities such as fisheries departments in some regions.

Advantages:

- Generally, a real enthusiasm to engage in science.
- A lot of fishing effort undertaken in some areas/on some species.
- An increased appetite towards catch and release (*cf.* retention) fishing, so fishers want to release the fish in good condition thus more open to following/developing guidance to achieve positive outcomes.
- Tagging programmes within a citizen science context can provide so much more data e.g. through fisher surveys which can provide ancillary information such as tourism impact of recreational fisheries.
- The submission of data forms, and photos/videos of the released and recaptured fish can be used to mitigate any concerns regarding individual performance or non-compliance to protocols.

Disadvantages:

- If the programme is geographically diverse training is difficult to achieve hands-on and often needs to be undertaken remotely or through social media (which relies on trust and integrity to undertake and comply).
- Some very keen anglers can want to tag everything – even when the species/area/size is out of scope.
- Some individuals can have bad performance (however this is also the case with scientific tagging).

- There can be some resistance to change historic existing practices.
- The angling sector can be wary of engaging as there can be concern over resultant data being used 'against them' for management restrictions etc.
- Limitations in terms of what species would be suitable to be tagged (e.g. not rare/fragile species) and restricted to ID tags, rather than electronic tags.

General Discussion

Do people look enough into the survivability of the study species? Especially in the case of recreational tagging, they might not get enough training for tagging so how do we improve their education?

➔ Really goes back to your study question!

Concerned that what is happening when tagging is creating artificial behavior that would normally not occur in the wild: example of bluefin tuna that introduce some fight-or-flight response because of the attachment of the tag → it is really crucial to keep the fish in their natural environment as long as possible (but might be difficult with very heavy species and expensive tags that you don't want to lose). Releasing them too early might influence behaviours which is undesirable.

➔ Kingfish tagging in South Africa with acoustic tags followed for six years and here they saw that even though the species were kept in captivity, they took up their natural behavior quite quickly.

5 ToR c) Identify opportunities for improved coordination and collaboration

5.1 Enhancing assessments or ecosystem analyses

IOTC tagging programme

Max Cardinale, Dan Fu

Summary

A short summary was provided by Max Cardinale, using a presentation by Dan Fu, about the use of mark-recapture tagging data in the assessment of tuna stocks in the Indian Ocean. The regional tagging programme tagged more than 150,000 tropical tuna between 2005 and 2009, of which approximately 50% were skipjack, 30% yellowfin and 20% bigeye tuna. A return rate of 15% was estimated for all species. The data was used in a suite of independent analyses and models as well as direct input into stock assessment model SS3. Data have been used to estimate growth, migration, natural mortality and exploitation rates.

Prior to incorporating raw mark-recapture data into models (and into SS3 in particular), data is processed to reduce various sources of potential bias with respect to

- Error Filtering
- Age assignment
- Fishery Assignment
- Initial tag induced mortality
- Chronical tag loss
- Reporting rate
- Tag mixing (i.e. behaviour of tagged individuals)

Further calibrations are done within SS3.

There are some general issues with including the tagging data into the assessment model, such as:

- Significant uncertainty on tag mixing assumption.
- Conflicts between tagging data and CPUE on the estimation of population scaling parameter (R0) may be an indication of violation of mixing assumptions.
- Conflict between tagging data and length composition data.
- Spatial dispersion of tags might be limited -> appropriate spatial partitioning is important to mitigate bias.
- Estimation of movement is highly sensitive to release locations and where the regional boundary is assumed.
- One should incorporate different mixing periods and tag data weighting in final ensemble models (if doing ensemble approach).

The IOTC program is moving from tagging to close-kin mark-recapture assessment in the near future, as this will eliminate some of the uncertainties.

Q&A

The group engaged in a discussion around timeframe of the tagging programmes, data should consider only fish that have been at liberty for at least four to five years to be included in stock assessment models. However, if shorter time frames, the data may still be useful to inform on biological parameters and mortality rates. Tagging data can also be used to inform on movement between areas.

Regarding the IOTC program and southern Indian ocean tuna assessment, one of the biggest challenges with the tagging data is the quick recapture so not enough fish are at liberty for a long enough time thus, potentially hampering the use of such data in the assessments.

Summary discussion of CCAMLR assessments

Tim Earl

A brief overview of CCAMLR's (Commission for the Conservation of Antarctic Marine Living Resources) use of tagging data for stock assessment was presented. Considerable data are available from a tagging program that has run consistently since 2003. For toothfish (*D. eleginoides* and *D. mawsoni*) 405,000 fish have been tagged, and 49,000 recovered, while 71,000 skates have been tagged and 2,000 recovered. CCAMLR provides protocols for effective tagging at https://www.ccamlr.org/node/85702.

These tagging data are mainly used in four ways to assess stocks (https://fisheryreports.ccamlr.org/):

1. Providing information on the movement and mixing of toothfish, noting that it provides most information about adult movement, and no information about the early life stages of the fish or information about connectivity to areas where fishing doesn't occur.
2. A Chapman index of local abundance used with to estimate the vulnerable biomass in an area based on tags recaptured in the 2-3 years following release. This is typically used when the fishing area is thought to be a small part of a larger stock; the short time period reflecting that movement of the fish to other parts of the stock may be substantial after the first few years post-release.
3. Risk assessment of skate in the Ross Sea. This is similar to the Chapman index of local abundance, but estimates a range of exploitation rates based on a range of initial tag survival values (Holmes, 2023).
4. Inclusion in integrated stock assessments. Casal2 is an age/length based integrated assessment method allowing tag recaptures at length or age to be included as a source of tuning data.

The key assumptions that the biomass estimates from tags require are 1) an estimate of the initial tag mortality due to capture and tagging, 2) spatial coverage of the adult habitat is good, or at least consistent over time, 3) tags are identified at the time of recapture with a high probability. Tag loss rate and growth retardation due to the effects of tagging can be estimated using data from the recapture fish (the tag loss rate assumes that fish are double-tagged; Dunn, 2011).

Q&A

Discussion on the possible integration of the tag recaptures at age/length within the stock assessment model, and the discussion once again of timeframe of data and assumptions made and the limitations of using such data. The CCAMLR data may be limited to where the fishery operates as releases and recaptures are from the same area, with no ability to have information on fish moving into shallower/deeper areas outside the allowed fishing area.

ICES training course summary

Pia Schuchert

Summary

An ICES training course on analysing mark-Recapture and DST tagging data was provided by ICES in 2021. The course provided very helpful insight into planning tagging campaigns to be able to finally use tagging data in stock assessments. The training provided a range of practical sessions with regard to analysing the raw data, caveats and examples of implementations in stock assessment models such as SS3 or the use of data outside of models to estimate growth rates, natural mortality, fishing mortality, or migration patterns. Many of the examples and estimation methods presented were the ones used by the IOTC program described above and the Atlantic Ocean Tropical tuna Tagging Program (AOTTP) (https://iccat.int/Documents/CVSP/CV079_2022/n_1/CV079010922.pdf)

Q&A

Agreement between workshop participants that such training course would be beneficial to all attending and their own networks in fish telemetry.

Cod tagging and use in stock assessment

Pia Schuchert

Summary

Methods established in the training course were used in the latest benchmark for Irish Sea cod in 2022 and are documented in the report (ICES, 2023).

Recent and historical tagging data was used to estimate M for mature fish (2+ years) in the Irish sea and resulted in values considerably higher than previously estimated using a Lorenzen method, at 0.65 rather 0.35. For a detailed description please refer to the benchmark report.

Q&A

Discussion about the use of electronic tags in stock assessments; DSTs and satellite tags could expand knowledge including on recruitment areas though such type of programmes can be expensive, and not all lengths would be tagged as per size restrictions if considering fish welfare policies thus, length frequency of tagged fish could become unrepresentative of the length frequency of commercial fish. However, one of the main challenges at this moment in time is that there is no fishery thus hampering catches of specimens to tag, and no tag returns if tagged specimens not caught. It was also discussed the importance of engaging with the community including commercial fishers and potential decline in tag returns in fear of repercussions in terms of the ability to fish. How was the tagging connected with genetics? This could help in terms of stock identification but from the study in 2019/2020 species is well mixed in Division 7.a.

Norwegian (IMR) tagging programs on herring and mackerel

Aril Slotte

Summary

Institute of Marine Research in Bergen has conducted mass tagging on mackerel and herring on annual basis for the last ~50 years. Until 2010 this was done with internal steel tags. RFID

(Radiofrequency Identification) technology, specifically Passive Integrated Transducer (PIT) glass tags (ISO FDX-B 134.3 kHz), were introduced for mackerel in 2011 and for herring in 2016 with over 600,000 and 200,000 releases respectively by now. We have scanned over 3 million tonnes of mackerel and 2 million tonnes of herring for tags though RFID-antenna reader systems at factories in Norway, Iceland, Scotland, and Ireland, with over 15,000 and 10,000 recaptures. Recaptures are updated real time over internet to a data base at IMR.

At WKTAG an overview was presented on the tagging programs, with specific weight put on how this currently is used in the age-based stock assessment of mackerel. This is an example stock when it comes to using mortality trends from tags at the level of year classes, which also involves a great deal of other data then those directly linked to the release and recapture. We need to know how many fish is released by a year class in a release year, and how many fish that was scanned and recaptured from the respective year class in each of the subsequent years. The data process leading to this input data table used in the stock assessment was described, including the monitoring of factories over internet. Underlying assumptions and specific filtering of data according to the latest benchmark decisions were given along with spatiotemporal trends in tagged, scanned, and recaptured fish. In addition, trends in year class abundance and mortality signals derived from the tag-recaptures were presented, including expectations to future improvement for use in stock assessment. Finally, the tagging data from this program is open to everyone, and the process of accessing them was described.

Q&A

Number of releases and recaptures of both mackerel and herring are available on an online platform FishMap (hi.no). Data are publicly available and can be downloaded from PIT-tag time series for studying migrations and use in stock assessment of North East Atlantic mackerel (*Scomber Scombrus*) (nmdc.no), with also a R package available on GitHub - IMRpelagic/taggart: R package for downloading RFID tag data for mackerel with API.

Scientific outputs of the Oceanographic Research Institute's Cooperative Fish Tagging Project in South Africa

BQ Mann and GL Jordaan

Summary

The Oceanographic Research Institute's Cooperative Fish Tagging Project (ORI-CFTP) started in 1984. This is a collaborative citizen science project between scientists and anglers aimed at collecting information on fish movement patterns, growth rates and population dynamics to help ensure their wise and sustainable use and to create an awareness amongst anglers. Different types of external dart tags are used which are purchased from Hallprint© in Australia. Between 1984 and 2022 a total of 7,125 members had joined the project with an average of 483 members active in any one year. By December 2022, 374,897 fish from 375 different species had been tagged with an average of 9,613 fish tagged per year. Of these, 23,611 (6.3%) tagged fish have been recaptured. The top three species tagged include galjoen *Dichtius capensis* (19.3%), dusky kob *Argyrosomus japonicus* (6.8%) and garrick *Lichia amia* (5.3%). The majority of fish have been tagged in the Western Cape (43%), followed by the Eastern Cape (27%) and KwaZulu-Natal (23%) provinces. The major outputs of the ORI-CFTP have been academic achievements, inputs to improved resource management and a change in angler behaviour towards catch and release fishing. The focus of over 150 peer-reviewed scientific papers using data from the ORI-CFTP has been dominated by studies on fish movement, life history, growth rate and the efficacy of marine protected areas. The main reasons for the success of the ORI-CFTP are: 1) maintenance of one national

database; 2) securing long-term funding; 3) provision of regular feedback to tagging members; 4) good communication with the angling public; 5) reliance on influencers to promote tagging; 6) strong focus on scientific output; and 7) maintenance of passion and enthusiasm of the project team.

Q&A

Communication including feedback is vital in citizen science, a key element in a volunteer mark-recapture tagging programme and its success. Collaboration with other tagging projects have been established through ways like, Bruce supplies them the tags and they supply him the data. Presently, there is a database for the conventional tagging with the data from electronic tagging programmes (separate to this one) held by other institutes coordinated under ATAP.

5.2 Breakout room: identifying and addressing data gaps

The final breakout group session was also facilitated by the use of Lucid boards (Annex 6:). Participants were split into three groups and each were posed with the same two questions:

1) Which species, stocks would benefit from additional tagging effort?
2) How could this be coordinated? Through ICES surveys (IBTS and WGBEAM/ EOSG) or wider networks?

A facilitator from each group fed back on the boards and the resultant discussions.

1) Which species, stocks would benefit from additional tagging effort?

Prior to identifying the species of fish (and potentially shellfish) that could benefit from tagging studies, it would be advantageous to do a gap analysis through an evaluation of what has been done or is being done by individual institutes and/or national labs in terms of telemetry studies.

However, some species may already have been identified as a priority 'gap', as current ICES Expert Groups may already be aware of some of the existing knowledge gaps (e.g. some elasmobranch species).

The following types of fish were indicated as potentially benefitting from further tagging efforts, primarily to understand movements and stock units:

- Flatfish (brill *Scophthalmus rhombus*, turbot *Scophthalmus maximus*, witch *Glyptocephalus cynoglossus*, and lemon sole *Microstomus kitt*).
- Black seabream *Spondyliosoma cantharus* and other seabreams (Sparidae).
- Species currently under grouped quotas (Common Fisheries Policy), and quota species with potentially high survival.
- Skates (various species and areas), such as:
    - Flapper skate *Dipturus intermedius* and common blue skate *Dipturus batis.* Ideally such work would verify species identification with genetics.
    - Offshore species such as cuckoo ray *Leucoraja naevus* and shagreen ray *Leucoraja fullonica* for which there may potentially be broader stock units.
    - Species for which releases from certain divisions have been limited (e.g. various skates in 7.e and along the west coast of Ireland).
    - Coastal species (e.g. small-eyed ray *Raja microocellata*).
- Coastal sharks, such as:

    - Tope *Galeorhinus galeus*, given increasing conservation interest and need to better understand movements, migrations and habitat use.
    - Greater-spotted dogfish *Scyliorhinus stellaris* and lesser-spotted dogfish *Scyliorhinus canicula*, given commercial interest (e.g. they are used for pot bait) and lack of information on fundamental ecology (including site fidelity, movement and migrations).
- Other widely distributed sharks, such as:
    - Porbeagle *Lamna nasus*
    - Spurdog *Squalus acanthias*

- Assessed species where there is uncertainty in stock units, for example:
    - Various species that straddle nominal biogeographic boundaries such as between the northern North Sea and NW Scotland (Divisions 4.a-6.a), North Channel (6.a-7.a), The Narrows (7.d-7.e), Dover Strait (4.c-7.d), Cape Breton Canyon (8.b-8.c).
    - Some assessment units of shelf-associated species (e.g. plaice *Pleuronectes platessa* and sole *Solea solea*) have stock units defined as being in 7.h-k. Are such species truly mixing across such an area and forming a discrete stock, or are they connected to adjacent stock units and moving into those areas from neighbouring ICES Divisions?
- Various harvested fish species may occur primarily in coastal waters (e.g. flounder *Platichthys flesus*, grey mullets (Mugilidae), some skates) and it is unclear as to whether such species are mainly in territorial waters or mixing more widely and are shared stocks. Useful to understand the scale of movements along coastlines in order to gauge the appropriate scale of management. In areas such as the English Channel (Divisions 7.d-e), what degree of mixing is there between coastal areas that are separated by a deeper central channel?
- Protected species (e.g. various elasmobranchs). It should be noted that tagging work on such species may be subject to additional regulation depending on national legislation. There are also potential issues of how recaptures of tagged individuals would be reported, given the requirement for such species to be returned to the sea as soon as possible.

Other issues raised included:

- Assess what is the relevant information is missing and what would be the most effective tagging technology/tagging plan to use.
- Collaboration with Stock Identification Methods Working Group (SIMWG) would need to be maintained.
- There is a lot of ongoing work, and a more detailed overview of all such initiatives is required. This work may be undertaken by scientists and institutes associated with the ICES community as well as others.

2) How could this be coordinated? Through ICES surveys (IBTS and WGBEAM/ EOSG) or wider networks?

- IBTSWG could be encouraged to tag certain combinations of species/area (e.g. tope and cuckoo ray) and WGBEAM could be encouraged to tag certain combinations of

species/area (e.g., blonde ray *Raja brachyura* in different areas). A range of other issues should be noted:

- Need the regional/taxonomic assessment working groups to highlight those stocks for which there are greatest uncertainties in stock boundaries, see which species might be appropriate for tagging (i.e. caught in appropriate numbers and sizes, and in appropriate vitality states), and then see if WGBEAM/IBTSWG could provide platforms for tagging studies.
- Need to consider trade-off in surveys between 'biological sampling' and 'tagging', and what the data users (e.g. stock assessors) require as a priority. Samples from standard survey hauls, fish cannot be used for full biological data collection and tagged. What is the main data requirement?
- Standardised methods/tag type for species would be needed, to facilitate collation of release information, collection of recapture data, analysis and reporting. Perhaps one institute could lead on any given species?
- If defined tagging targets were to be developed, then current trawl surveys may need extra time, as the ability to undertake further tows depends on time, weather, survey grid, staffing levels (and whether night-time work was possible). Difference between 'opportunistic tagging' to support scientific investigations versus more formally designed tagging programme to enable sufficient releases (these approaches vary in their costs and benefits).
- Trawling may not be effective for targeting some species for which tagging data are required. The health/vitality may not be great for some specimens (by species/size) caught during trawl surveys and potential concerns over survivability of trawl-caught specimens of some species and sizes (e.g. juveniles and fragile species)
- Would also need to consider the current workload of surveys and the requests for 'more data'. This may vary on whether tagging is part of the core sampling for current hauls, or whether extra hauls were required. Possible advantages in that survey staff should be familiar with animal welfare, and for some institutes the survey staff may already be trained in tagging/handling.
- Ability for RVs / trawl surveys to act as tagging platforms may also depend on vessel layout (e.g., on-deck or below-deck sorting), as well as vitality of the species after the catch has been landed on deck.
- Optics: some institutes report the survey sampling of fish at sea for national reporting of animals being used in research, and so additional tagging work could increase that number. Conversely, there may be benefits of trawl surveys highlighting that x species and y individuals were tagged and released, and helps demonstrate the welfare standards being applied.

- In theory, IBTSWG/WGBEAM should have ability to help (but may depend on different institutes), but it would be unlikely to address all of the data gaps. Hence, smaller-scale, more targeted work (e.g. chartered tagging trips) may also be needed to address specific questions more robustly.
- As trawls may not be the most suitable or effective gear for some of the species for which improved data are required, collaboration with commercial fishers, local fishing associations, chartered fishing vessels, and recreational anglers may still be required.

- There are also other networks, including national networks and also through large international networks such as ETN. Need to support existing regional networks/tagging programmes and reappraise priority species.
- There may be a rationale for promoting tagging programmes under the DCF (e.g. a pilot project or as a part of monitoring programmes).
- MSFD surveys could also be a platform for tagging various coastal species.
- Are there options for combining conventional tagging initiatives/programmes with ongoing electronic tagging efforts?
- For coordination of efforts there is a need an overview of current work and a centralized 'metadata' database.
- Establishing a relevant Working Group on Fish (and shellfish) Tagging may facilitate promoting collaborations more easily, may enable a common metadata database to be developed, enable liaison with relevant assessment working groups and SIMWG to prioritise species for further study and report on a more regular basis.

Some of the issues discussed related to the fact that we should aim for wider networks from citizen science, recreational fisheries, inshore and offshore surveys (including ones already within ICES) as to allow for a larger proportion of fishing gears available (some gears may be unsuitable for certain species) and as may facilitate the fact some nations/institutes may have different licensing procedures. It was suggested that there is the potential to have though some bias in volunteers/anglers as we may end up measuring angling effort and not species distribution so this would have to be accounted for when using volunteer programmes through either introduction of minimum sizes when selecting individuals to tag or other types of measures. However, they have the advantage of being cheaper programmes to run.

In addition, it could be beneficial to complement tagging work with genetic work, though the latter may prove challenging as nations may have different requirements in terms of their animal welfare policies (e.g. when collecting fin clips, blood from live animals).

5.3 Identify opportunities for improved coordination and collaboration

Planned elasmobranch tagging work in the coming year

Paul Mayo

DAERA is leading on an Elasmobranch Conservation Strategy for Northern Ireland in response to target S5.06 of the OSPAR Northeast Atlantic Environmental Strategy 2030. The Elasmobranch Conservation strategy was co-designed by a working group of stakeholders, and outlines key objectives to help implement a managed conservation strategy for 12 priority species. Current available distribution data is largely anecdotal, produced from angling records and so the Department has moved towards telemetry efforts in an attempt to better map key areas of importance for species of high conservation value such as flapper skate. Using acoustic (V13s) and satellite (miniPAT) telemetry, our aim for the first year of this project is to target flapper skate, porbeagle and spurdog. An array of 20 VR2AR receivers is due to be deployed in the north coast between Lough Foyle and Portrush in April 2024, with the hope of tagging spurdog and flapper skate in the same area between June and September. All our acoustic tags will be logged with ETN, and receivers are OP enabled.

Q&A

How the priority species were defined was questioned. They primarily link to those listed on OSPAR. The link between this project collecting data on key areas of importance for elasmobranchs and the Important Shark and Ray Areas (ISRAs) was flagged.

Summary of proposed ETN-UK workshop

Jon Bolland

Over the past 20 years, technological advances in telemetry have transformed our ability to observe aquatic animal behaviour and movement. These developments are revolutionizing the scope and scale of questions that can be asked about the causes and consequences of movement, which directly influence how we manage fish populations, anthropogenic pressures and entire ecosystems. The frequency and extent of telemetry projects in the UK are increasing, but they typically happen under locally or regionally motivated initiatives. Hence, to achieve a bigger impact, a degree of centralisation, collaboration and coordination is necessary. There are attempts to coordinate telemetry research at a European scale via The European Tracking Network (ETN). A ETN-UK workshop is being held at the University of Hull 5-6th February 2024, with a view to using the ETN as a platform to transition from local/regional telemetry initiatives in the UK towards a coordinated and efficient network of telemetry researchers and infrastructure. The workshop is targeted at researchers actively performing aquatic animal telemetry research in freshwater and marine environments.

Q&A

UK-based fish telemetrists were invited to complete the ETN-UK online survey about the status of aquatic animal telemetry research in the UK.

6 Outcome and Decisions

6.1 Best practice guidelines for data management.

There was a clear appetite for having better access to a metadatabase to see what tagging programmes are ongoing. Metadata records with a link to the source raw data (where available) or sources of contact, were desirable for most as opposed to a platform holding all raw data.

Initial discussions were to put such metadata per study area, species, or tag type in a spreadsheet and host it in the workshop SharePoint for now as a starting point, but this was quickly shelved due to the inaccessibility of this approach. Creating a new ICES database to host tagging metadata would not be the most pragmatic or efficient approach. Given the many challenges associated with the management of such data (see Section 2.2) and the fact that similar platforms already exist with a commitment to database management and maintenance, the group decided that it would be sensible to explore utilising one of these platforms.

Discussions of existing platforms led to the ETN being proposed as a suitable candidate to host mark-recapture tagging data. Integrating ETN and ICES can be seamlessly achieved by consolidating all metadata. ETN already manages project metadata efficiently, encompassing details on both ongoing and completed projects, including contact information. A comprehensive overview of projects, categorized by tag type or geographical areas, provides detailed insights into each project. This approach facilitates easy access to project metadata. Additionally, links to related datasets offer a holistic view of information within ETN. Moreover, connecting to conventional data ensures that all project metadata is readily available. Clarifying whether specific metadata will reside in ICES or ETN is crucial, promoting transparency. The ability to search by species, technology, or area enhances the user experience, offering a comprehensive overview of ongoing efforts related to a specific query. This serves as an excellent starting point for effective collaboration and information retrieval.

There is a lot of information on conventional tagging, will this dataset be able to handle this amount of data?

- ➔ Not all information is necessary - just the metadata can be shared. If a project is ongoing, an overview can be provided so other institutions can briefly check what has been done already.
- ➔ Data does not need to made public until a paper is published
- ➔ Sensitive (e.g. personal data) information can be withheld
- ➔ All tagging data can be held in the system, but only the people involved with the project can see <u>all</u> information.
- ➔ The inclusion of conventional tag data in the ETN will need some development/improvement to achieve. This may also require some funding to put it into place. The ability to filter on only 'conventional tagging' only would need to be added as a search key.
- ➔ What ETN proposed is to host the metadata for the conventional tagging, but in case all data needs to be added it will need a further discussion.

When talking about the data, this requires standardisation, agreeing on the format, and shared vocabulary. This will be a big process and it will be extra work every time to be able to share

your data with other institutions. This might be a discussion for later on, for now we can just focus on the metadata.

Do we want the metadata hosted on the ICES site or having it stored on ETN and having ICES link to this metadata?

- ➔ It could be a parallel development and since ETN already has something in place to have a back-up of all the projects and a link between each other, this might be a good option. It would be a shame to start all over if there is already an existing platform out there. Some researchers are already using this and already know how to use it.
- ➔ As a second step we can use the knowledge to develop a more in-depth dataset for which we can discuss what columns we need to add.
- ➔ ICES can link to the ETN so its easily findable. Needs some discussion between the IT teams to see how this can be done.
- ➔ We don't want this to get outdated! We need a lot of checks throughout the years.
- ➔ If using ETN database for conventional tag, one way of having this information available/link on ICES website could be under Dataset Collections instead of Data portals where we could describe a bit the work on tagging within ICES and WKTAG and then have a link there to ETN.

Even though it is the European tracking network, can information from outside Europe be included as well?

- ➔ Needs some more discussion; if we want to go global, we will need to go to OTN (Ocean Tracking network) which is the global player. Otherwise, it is going to get really complicated.
- ➔ We want to stay focused on the science, not the citizen science per se.

Should there be an overlap between the citizen science and the institutional data? A lot of institutions already use a bit of citizen science and recreational taggers so there already is a big overlap. Is the OTN broad enough to also include this metadata?

- ➔ Following the "World Volunteer Fishtag Summit" it was decided to set up a "Global Fishtag Network" to promote collaboration and sharing of information by the world's volunteer fish tagging programs → they want to aid people either way, does not matter if we're talking about researchers or anglers.

How do we make sure the tagged fish eventually get back to the institution that released it?

- ➔ We need to have an idea about what institution's tags look like and have the correct contact information, so the tags return to their original location.
- ➔ National code/ institutional code
- ➔ Maybe from this point on we can decide on a three-letter combination so there is very clear labeling from now onwards (problem is that a lot of institutions still have a huge number of tags that are probably going to be used first)
- ➔ Also include this information in the metadata.

Connections

- ⇨ ICES could link to ETN that holds the European metadata and ETN can also link to OTN to have a more global overview.

- ⇨ ETN communicates with OTN anyway so institutions can decide if they want to relate more to ETN or OTN. Just important that everything ends up in the correct dataset and it is clear where all information can be found.
- ⇨ All institutions need to have a discussion with their IT department to see whether it can be done and how it can be done.

What will the metadata look like?

- ➔ This is a good starting point: Global Fishtag Network Programs Survey (google.com)
- ➔ Institutes should ideally host a generic email address that links to someone with institutional knowledge of what has been done and the respective project leads.

Summary Outcomes

- ✓ The ETN was the preferred option to host conventional tagging metadata. A subsequent agreement (post-WKTAG) was communicated that in principle they were happy to develop the database to include conventional mark-ID tag data.
- ✓ Ideally ICES will develop a webpage to bring together information on the outputs of this workshop and WKTAG page, the link to the data on the ETN and past (e.g. Close-Kin Mark-Recapture: building models and designing projects (ices.dk) and Intro to tag-recapture campaigns (ices.dk)) future training courses related to tagging. It would be desirable to have a page created under 'Biology' of the 'Dataset Collections' section of the website.

6.2 Best practice guidelines for animal welfare / handling.

The considerations and breakout discussion focussed on animal welfare and handling are summarised at length in Section 4.2. However, given the extensive topic, the Group agreed that a more digestable and tangible output of the workshop would be to translate this into an infographic.

There are a great deal of publicly available materials relating to animal welfare and handing including: documents, papers and YouTube video's. A central place to host (or provide an overview of) these would be of benefit when starting a new tagging study.

Summary Outcomes

- ✓ Sophy Phillips will, together with Danielle Orrell & Claudia Junge, make a first start with the infographic.
- ✓ Pia Schuchert will contact ICES to have a webpage dedicated to fish tagging and related documents.

6.3 Other Outcomes

Communications between members of the workshop will be maintained through a Slack workspace.

During the ICES ASC 2024 the outcomes of this workshop will be presented as a poster or talk. There was an ambition for the group to submit a theme session idea on mark-identification tagging to the ICES ASC 2025 to continue to bring together experts in this field from across the ICES area and share best practices.

7 ToR d) Identify an appropriate timeline for future Expert Group meetings on tagging.

The Group decided to reconvene in September or October for a half day workshop to check on progress of the desired outputs from this workshop.

It was decided that if another WKTAG workshop was desired, then it would focus solely on mark-identification tagging (as opposed to also incorporating electronic tagging which is a diverse field with considerable interest which is largely already harnessed through alternate consortia, data sharing projects and conferences). The WKTAG umbrella could be used to examine different matters associated to tagging within the ICES community on a rotation depending on need and interest.

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Annex 1: List of participants

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The following participants although not formally registered provided valuable input upon request and expertise into the Workshop for which the members are grateful.

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Annex 2: Resolution

2022/WK/EOSG06 **The Workshop on Mark-Identification Tagging (WKTAG)**, chaired by Sophy McCully Phillips (UK) and Pia Schuchert (Northern Ireland), will be established and will meet 29-31 January 2024 to review recent tagging programmes for fish (including shellfish) in the ICES area, in order to:

(e) Summarise data from recent and ongoing tagging programmes, primarily focussing on mark-identification tagging, but also using the platform to collate summary information on acoustic and electronic tagging, conducted by national institutes (2000-2022) (Science Plan codes: 1.4,1.8,3.1,3.2,3.3,3.5, 4.2); including providing summaries of:

(v) Details of the species being tagged by ICES Division, year, season/quarter, and platform (e.g. chartered fishing vessel, research vessel);
(vi) The tag types used for the various species and attachment methods;
(vii) Mark-recapture data available;
(viii) Contact details for tag reporting and relevant publicity awareness information.

(f) Review relevant guidelines and protocols used by national institutes for handling, tagging and releasing fish, and identify best practices for both relevant tag types and species (Science Plan codes: 3.1,3.2,3.3, ,3.5,3.6).

(g) Identify opportunities for improved coordination and collaboration in relation to mark-recapture studies, including specifying where additional mark-recapture studies could address relevant data gaps for species and stocks assessed by ICES and where existing studies could be used to enhance assessments or ecosystem analyses (Science Plan codes: 1.4, 1.7, 1.8,3.1,3.2,3.3,3.5, 5.2).

(h) Identify an appropriate time-line for future Expert Group meetings on tagging (Science Plan codes: 3.1).

WKTAG will report by 29 February 2024 for the attention of the EOSG committee.

Annex 3: List of abbreviations and acronyms

AOTTP: Atlantic Ocean Tropical tuna Tagging Programme

AWERB: Animal Welfare and Ethical Review Body

CCAMLR: Commission for the Conservation of Antarctic Marine Living Resources

DATRAS: ICES Database of Trawl Surveys

DCF: Data Collection Framework

DST: Data storage tag

EOSG: Ecosystem Observation Steering Group

ETN: European tracking network

IBTSWG: ICES International Bottom Trawl Survey Working Group

ICCAT: The International Commission for the Conservation of Atlantic Tunas

ICES: International Council for the Exploration of the Sea

IOTC: Indian Ocean Tuna Commission

MPA: Marine Protected Area

OTN: Ocean Tracking Network

OWF: Offshore windfarm

PIT: Passive Integrated Transducer

RFID: Radiofrequency Identification

SIMWG: ICES Stock Identification Methods Working Group

WGBEAM: ICES Working Group on Beam Trawl Surveys

WGBIE: ICES Working Group for the Bay of Biscay and the Iberian Waters Ecoregion

WGBIOP: ICES Working Group on Biological Parameters

WGCSE: ICES Working Group for the Celtic Seas Ecoregion

WGEF: ICES Working Group on Elasmobranch Fishes

WGMEDS: ICES Working Group on Methods for Estimating Discard Survival

WGNAS: ICES Working Group on North Atlantic Salmon

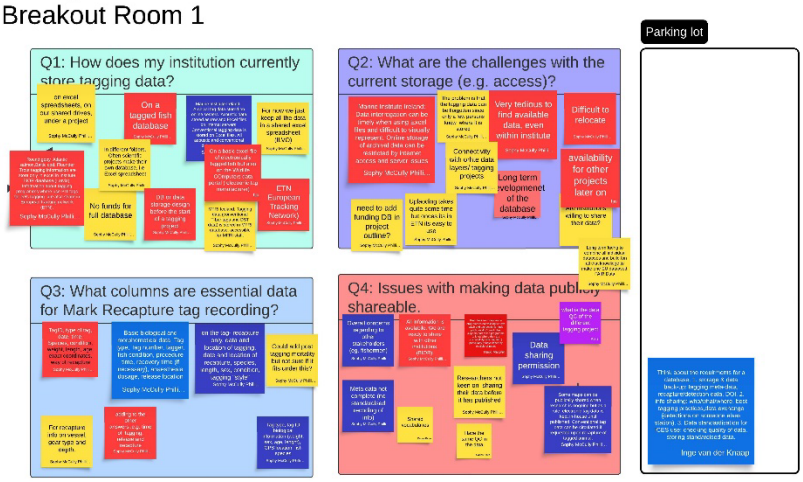
WGNSSK: ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak

WKTAG: ICES Workshop on Mark-Identification Tagging

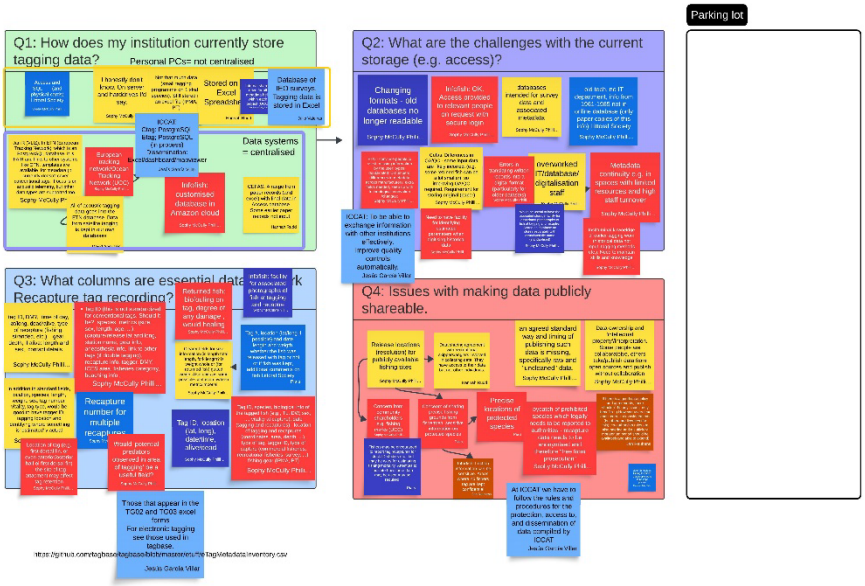
Annex 3: Lucid boards from breakout session 1

To Note: the comments posted to each board should not be associated to the name on each 'post-it' note. Bulk creation of notes (often by the Chairs) were undertaken ahead of the breakout sessions and then used for members own comments. Thus each comments cannot be individually attributed to anyone.

Discussion 1: Best practice guidelines for database management
Breakout Room 1



Discussion 1: Best practice guidelines for database management
Breakout Room 2



Discussion 1: Best practice guidelines for database management
Breakout Room 3

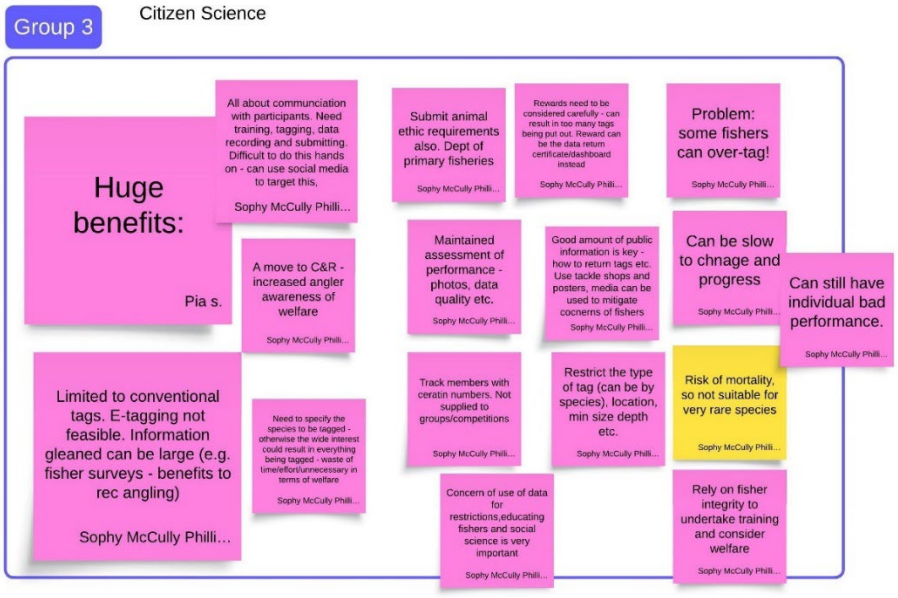
Annex 4: Lucid boards from breakout session 2

To Note: the comments posted to each board should not be associated to the name on each 'post-it' note. Bulk creation of notes (often by the Chairs) were undertaken ahead of the breakout sessions and then used for members own comments. Thus each comments cannot be individually attributed to anyone.

Group 1 – Best practice for external mark ID tagging

Group 2 – internal and external electronic tagging best practices

Group 3 – Best practices in citizen science



Annex 5: Lucid boards from breakout session 3

To Note: the comments posted to each board should not be associated to the name on each 'post-it' note. Bulk creation of notes (often by the Chairs) was undertaken ahead of the breakout sessions and then used for members own comments. Thus, each comments cannot be individually attributed to anyone.