# The French RECOAM project : study of the biology and ecology of five skate (Rajidae) species present in the coastal waters of the western English Channel and central Bay of Biscay.

E. Stéphan<sup>1</sup>, C. Hennache<sup>2</sup>, A. Delamare<sup>3</sup>, V. Legrand<sup>4</sup>, N. Leblanc<sup>4</sup>

<sup>1</sup> Association pour l'Etude et la Conservation des Sélaciens (APECS), BP 51151, 29211 Brest cedex 1, France

<sup>2</sup> Centre Régional d'Expérimentation et d'Application Aquacole (CREAA), Prise de terdoux, 17480 Le Château d'Oléron, France

<sup>3</sup> Association du Grand Littoral Atlantique (AGLIA), Quai aux vivres, 17314 Rochefort cedex, France

<sup>4</sup> Comité régional des pêches maritimes et des élevages marins de Basse Normandie, 9 quai du Général Lawton Collins, BP 445, 50104 Cherbourg cedex

Correspondence: eric.stephan@asso-apecs.org

## Introduction

In the Celtic seas and the Biscay/Iberian ecoregions, most of skates species are little known. It's particularly the case for species that seems to have patchy coastal distribution which are not well sampled by the scientific fishery-independent surveys. Information on the mixing between skates of different areas and the populations structures but also on biology and possible movements between ecologically important grounds are needed for management purposes.

The RECOAM project was set up to contribute to a better knowledge of five skate species, undulate ray (*Raja undulata*), blonde ray (*Raja brachyura*), small-eyed ray (*Raja microocellata*), thornback ray (*Raja clavata*) and spotted ray (*Raja montagui*), working in two areas of the French waters of particular interest, one in the western English Channel and one in the Bay of Biscay. These two areas were chosen because skates are regularly caught and because they are concerned by marine protected areas creation projects. Furthermore, the undulate ray (*Raja undulata*) can be locally common in these two coastal areas and the fishermen, who feel that the European Commission regulation introduced in 2009 is poorly adapted to their local situation, agreed to take part to a study that could improve scientific knowledge and give the possibility to re-evaluate the status of this species.

The aims of the project are to :

- evaluate the length at maturity for each area which is a fundamental parameter given its importance in the assessment models,
- enhance the understanding of skates movements which could contribute to identify important grounds in their life cycles,
- precise the stocks structure which is essential for abundance assesment

To achieve them, biological, tagging and genetic studies were initiated in 2012 and will continue until 2014.



Figure 1 : Map of the 2 study areas in the Bay of Biscay and in the western English Channel

# Methods

Cost compensated fishing trips targeting skates are done with volunteer coastal fishing vessels, mainly gillnetters and demersal longliners. Because undulate ray (*Raja undulata*) fishing is prohibited under the European Commission TAC regulation, special authorizations are delivered by the French authorities to each boat involved in the project. Areas fished are determined based on fishermen knowledge and experience and gear deployment are of commercial duration for longline and are shorter for gillnets when possible (24h instead of the standard 30-48h). Data on each gear deployment are recorded.

When a skate is caught, species and sexe are determined, total length  $(L_T)$  and width  $(D_W)$  are measured to the centimeter below. For males, the inner side of the right clasper is measured to the half centimeter below.

The sexual maturity stage is determined using anatomical criteria according to the scale defined by ICES (ICES 2010). It's done systematically for males, and because internal examination is necessary for females, this data is only collected for dead females and for a fixed number of sacrificed individuals which are landed for later analysis. In the case of undulate ray (*Raja undulata*), a landing possibility is lead down on the fishing authorization delivered by the French authorities.

For the genetic study, a non-lethal tissue sample is taken on the bottom edge of the pectoral or dorsal fin<sup>1</sup>. A one centimeter notch is sufficient. Each sample is placed in a tube filled with alcohol and correctly labelled.

Skates are finally tagged on the left pectoral fin using a numbered Petersen disc (16mm diameter) and released. Individuals who remain very weak (no movement of the pectorals or body and small movements of the spiracles) even after having spent time in a stabilizing tank are not tagged. Smaller skates (below 30 cm) are not tagged as this would require the tag to be fitted very loosely to leave space for growth (i.e. thickening of the wing) which could generate an important risk of the tag snagging.



Figure 2 : Tissue sampling and Petersen disc used

The database is also updated by data collected by scientific observers in the frame of two other regional projects set up in the French waters, the project RaieBECA in the Bay of Biscay (Delamare et al. 2013) and the project Raimouest in the Normand-breton Gulf (Leblanc et al. 2013). The scientific observers have been trained and the same protocol is implemented. For the Bay of Biscay study area, the database is also updated by tagging data from fishermen self-tagging operations designed in the frame of the project RaieBECA.

Partnerships are also established with some professional fishing guides in the Bay of Biscay who also contribute to the tissue sampling and tagging.

To enhance the recovery of information on recaptured tagged skates, information posters were widely distributed on the English Channel and Atlantic French coasts and a media campaign was executed. Recapture data can be supplied by telephone or via an online form (http://www.asso-apecs.org/Signalez-la-capture-d-une-raie.html).

# Planned data analysis

The proportion of mature rays will be plotted against length and a sigmoid function will be fitted. The equation used to fit the curve to the data is as follows :

where  $P_{Li}$  is the proportion of mature rays at length  $L_i$ , b is the steepness of the curve and  $L_{50}$  is the length at which 50% of the rays are mature ( $P_{Li}=0.5$ ).

For each recaptured skate with information on date and location, the days at liberty and distances (km) between tagging and recapture sites will be calculated. Days at liberty, distance data and recapture location information will then be analyzed by release area, sexe

<sup>&</sup>lt;sup>1</sup> Within the RECOAM project, the genetic study will not be led on the thornback ray (R. clavata) because the work has already undergone in NE Atlantic (Chevolot et al. 2006). The samples will nevertheless be collected in order to prepare for a possible prolongation of this study.

and size based on the total length at tagging in order to investigate movement's patterns. These data will also help to support or refute hypotheses on population structure and stock identity.

Tissue samples will be used to analyze the genetic polymorphism in order to investigate the population structure. This molecular detection of population structure will be done in collaboration with a specialized laboratory.

# **Project progress**

The 15<sup>th</sup> of May 2013, 6 fishing operations were done in Atlantic and 4 in the English Channel. Data were also collected during 45 and 7 observers boarding in the frame of the projects RaieBECA and Raimouest respectively. For the Atlantic study area, data from the fishermen self-tagging operations and from a professional fishing guide are also included in the database.

A total of 2002 skates were caught in the Atlantic study area, 1805 undulate ray (90.2%), 174 small-eyed ray (8.7%) and 23 thornback ray (1.1%). Undulate ray (20-100cm  $L_T$ ) were caught in the whole area whereas small-eyed (26-93cm  $L_T$ ) and thornback (40-93cm  $L_T$ ) were caught mainly north and south of the mouth of the Gironde.

In the English Channel study area, 418 skates were caught, 283 undulate (67.7%), 113 blonde ray (27%), 14 spotted ray (3.3%), 7 thornback and 1 small-eyed ray (Table 1).

Data collected (maturity stage, tissue sample) and number of skates tagged and released are summarized by area, species and sexe in table 1.

## Length at maturity

To date, the length at maturity was calculated only for males undulate ray for the Atlantic study area. Maturity was recorded for 431 male of which 191 were mature. First maturity was 74 cm  $L_T$ , with 50% maturity reached at 80 cm  $L_T$  (Figure 3). The largest immature fish was 89 cm  $L_T$ .



Figure 3 : Proportion of mature fish at length for male undulate ray (*Raja undulata*) in the Bay of Biscay

Area	Species	Femelle					Male				Unknown			Total	
		n	Maturity stage	Tagged	Tissue sample	n	Maturity stage	Tagged	Tissue sample	n	Tagged	Tissue sample	n	Tagged	Tissue sample
Central Bay of Biscay	Raja undulata	967	24	897	294	805	434	771	217	33	32	0	1805	1700	511
	Raja microocellata	89	16	20	34	60	60	17	23	25	0	0	174	37	57
	Raja clavata	13	3	1	5	10	10	7	5	0	0	0	23	8	10
Western English Channel	Raja undulata	109	8	85	95	174	165	139	154	0	0	0	283	224	249
	Raja brachyura	49	1	28	46	64	63	33	62	0	0	0	113	61	108
	Raja clavata	4	0	3	3	3	1	1	1	0	0	0	7	4	4
	Raja montagui	5	0	3	5	9	9	6	9	0	0	0	14	9	14
	Raja microocellata	1	0	1	1	0	0	0	0	0	0	0	1	1	1

#### Table 1 : Summary table of the data collected for each species in the two study areas

#### Table 2 : Number of tagged and released skates and recapture rates by area and species

			Cer	ntral Bay of Bise	сау	Wes	Western English Channel	
Specie		F	М	unknown	Total	F	М	Total
Undulate ray	Released	897	771	32	1700	85	139	224
	Recaptured				94			5
	% recaptured				5.5			2.2
nall eyed ray	Released	20	17		37	1		1
	Recaptured				1			0
	% recaptured				2.7			0.0
onde ray	Released					28	33	61
	Recaptured							1
	% recaptured							1.6
rnback ray	Released	1	7		8	3	1	4
	Recaptured				1			0
	% recaptured				12.5			0.0
otted ray	Released					3	6	9
	Recaptured							0
	% recaptured							0.0

### Movements

1745 skates were tagged and released in Atlantic, 1700 undulate ray (97.4%) (Figure 4 and 6a), 37 small-eyed ray (2.1%) and 8 thornback ray. Of these skates, 96 (5.5%) were recaptured during the time frame considered (Table 2), most close to the tagged and released area. Only one undulate ray was taken outside of the study area after 64 days, about 72 kilometers south of the released position, along the Gironde coast.

In the western English Channel, 298 skates were tagged, 224 undulate ray (75.2%) (Figure 5 and 6b), 61 blonde ray (20.5%), 9 spotted ray (3%) and 4 thornback and 1 small-eyed ray. To date, 6 were recaptured (2%), all in the study area (Table 2).

Table 3 give information on the number of the days at liberty, distance travelled and speed for undulate ray in the two study areas. The detailed movement's patterns analysis will be done when more recapture data will be available.

#### Table 3 : Preliminary results on movements of undulate ray

	Central Bay of Biscay	Western English Channel
Maximum time at liberty (days)	440	82
Mean time at liberty (days)	87	40
Maximum distance (km)	72	34
Mean distance (km)	11	18
Maximum speed (km/day)	5.30	1.26
Mean speed (km/day)	0.36	0.58



Figure 4 : Released positions of undulate ray tagged in the central Bay of Biscay



Figure 5 : Released positions of undulate ray tagged in the western English Channel



Figure 6 : Length-frequency distribution of undulate ray tagged in the central Bay of Biscay (a) and in the western English Channel (b)

## **Population structure**

The number of tissue samples collected for the genetic study is summarized in table 4. Additional samples will be collected in the two study areas during the next fishing operations and samples from other areas are also required to begin the genetic analysis at least at the scale of the French waters, maybe more if samples from other European areas are available.

Area	R. undulata	R. microocellata	R. brachyura	R. clavata	R. montagui
Eastern English Channel	1		2	22	
Western English Channel	249	1	108	4	14
Iroise Sea	7				
South Brittany	21				
Central Bay of Biscay	511	57		10	
Maroc	5				

Table 4 : Number of tissue samples collected for each species

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