



**REPORT BY CORRESPONDENCE OF THE
STUDY GROUP ON ELASMOBRANCH FISHES**

September 1996

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1 INTRODUCTION

1.1 Participants

R. Bonfil	Canada
M. de Cardador	Portugal
M. H. Du Buit	France
M. Fogarty	USA
N. Kohler	USA
M. Pawson	UK
D. Power	Canada
P. Rago	USA
H. Silva (Chairman)	Portugal
K. Sosebee	USA
M. Stehmann	Germany
M. Vinther	Denmark
P. Walker	Netherlands

1.2 Terms of reference

The Study Group on Elasmobranch Fishes, under the chairmanship of Dr. H. Silva (Portugal-Azores) will work by correspondence during 1996, and report to the 1996 Annual Science Conference, to:

- a) advise on the preparation of identification sheets for deep-water sharks and skates and rays, including 'skate-wings' and identify the most important species;
- b) compile the data available on the geographical distribution of species and identify species for which the data are sufficient for analytical assessment;
- c) plan a meeting in 1997 to conduct analytical assessments and evaluate the effects of exploitation and/or environmental change on the stocks considered;
- d) explore the possibility that the 1997 meeting is a joint meeting with ICCAT and/or NAFO.

2 BACKGROUND

The background of the study group and its scope of work were extensively handled in the 1995 report. In the same report the fisheries throughout the North Atlantic Ocean was treated on a country by country basis and an attempt was made to determine the stock status for various species. Other topics included the ecological role of elasmobranch fish (predation and competition), reproductive dynamics, techniques for age determination and verification in elasmobranchs, modelling and assessment and compensatory mechanisms (Anon., 1995).

This report by correspondence will address the terms of reference decided at the 1995 meeting.

3 IDENTIFICATION SHEETS

Matthias Stehmann has prepared a draft key to 13 species of *Raja* in poster format. This is included as an Appendix to this report. The other two poster keys (deep-water sharks and 'skate wings') will be produced if a positive recommendation follows from the ICES Annual Science Meeting in Reykjavik, 1996. It has been suggested that the posters be produced by ICES as a special publication, as durable wall posters in English, French, Spanish and Portuguese (for the 'skate wings' only in English and French).

4 OVERVIEW OF AVAILABLE DATA

According to the term of reference the available data on the geographical distribution of species was to be compiled and a number of species would be identified for which the data are sufficient for analytical assessment. The data are organised by country as this is the format in which the information was received. Some of the information is taken from the Study Group 1995 report.

4.1 Canada

Data for rays and skates are taken from two internal reports made available to the Study Group in 1995 and included in the 1995 report (Atkinson, 1995; Smith & Frank, 1995). Data presented in Table 4.1.

4.2 Denmark

The Danish elasmobranch data include almost only the landing statistics from the ministry and data from the EU logbook. The Danish cooperate in ICES coordinated surveys. See Table 4.2.1 to 4.2.3 for species information.

4.3 France

French commercial landing data are quite detailed and have been so for the past 18 years. The species/categories identified in 1993 were: *Squalus acanthias*, *Scyliorhinus canicula*, *S. stellaris*, *S. sp.*, *Galeorhinus galeus*, *Mustelus sp.*, *Lamna nasus*, *Prionace glauca*, *Alopias vulpinus*, *Cetorhinus maximus*, *Centroscymnus spp.*, various sharks, *Raja batis*, *R. clavata*, *R. montagui*, *R. naevus*, *R. fullonica*, *R. circularis*, *R. undulata*, various skates, various rays, *Squatina squatina*, *Torpedo marmorata*, *Dasyatis pastinaca*, *Myliobatis aquila*, various sharks, rays, chimaeras. The French cooperate in ICES coordinated surveys. Data available on two deep-water sharks are shown in Table 4.3.

4.4 Germany

German data consist of landing data in the following categories and codes:

Spiny dogfish (*Squalus acanthias* - DGS); Sharks (DGX); Skates and Rays (SKA); Porbeagle (*Lamna nasus* - POR); Large sharks (SHX).

Monthly landing statistics for the North Sea are available, totals for 1995 are shown in Table 4.4.

4.5 The Netherlands

Dutch data consist of commercial landing data according to the ICES coding given in 4.4 above. Since 1983 landing data have not been reported to ICES but are still available. The Netherlands cooperates in various ICES coordinated surveys (1970-1995). Species caught are: *Squalus acanthias*, *Scyliorhinus canicula*, *S. stellaris*, *M. mustelus*, *M. asterias*, *Etmopterus spinax*, *Raja batis*, *R. brachyura*, *R. clavata*, *R. montagui*, *R. naevus* and *R. radiata*. Between 1992 and 1996 information on ageing, growth and reproduction of rays and skates (*Raja spec.*) in the North Sea has been collected. Between 1992 and 1995 tagging experiments on rays and skates were carried out in the North Sea. See Table 4.5 for an overview of the available information.

4.6 Portugal

Portuguese data includes commercial landing data, fisheries independent surveys and research on biology of selected species. See Table 4.6 for species information. Data on skates and rays is also available in the national database.

A report on shark landings in Portugal from 1992-1995, prepared for the group, includes graphs on two-monthly landings, yearly average landings and average price/kg for the five most common species: *Dalatias licha*, *Centroscymnus coelolepis*, *Centrophorus granulosus*, *Prionace glauca* and *Centrophorus squamosus* (Correia, 1995). Landing data from all Portuguese ports, including the Azores and Madeira.

4.7 United Kingdom

The United Kingdom has commercial landing data and contributes to ICES coordinated surveys, as well as having their own surveys. See Tables 4.7.1-4.7.5 for details.

Samples of ray vertebrae suitable for age determination studies are available for the period 1964-1974. Some age determination has been carried out by a student from N. Ireland on samples 1971-1972. Lowestoft laboratory staff had been examining various techniques for age determination of rays using vertebrae, with some success. Work was stopped when the main staff involved left. Wilson (1985; University of Wales) wrote an MSc dissertation on age determination in *Raja clavata*, but used vertebrae from another source.

Release lists available show that tagging experiments took place in the Irish Sea and Western Approaches during 1959-1965 (Platessa, Onaway, Tellina cruises). Tagging experiments were carried out in the North Sea and eastern English Channel between 1959 and 1976.

4.8 United States of America

Data for *Squalus acanthias* are taken from an internal report made available to the Study Group in 1995 and included in the 1995 report (Rago, *et al.*, 1994). See Table 4.8 for species information.

5 SPECIES ASSESSMENT

The following areas and species have been identified for which the data are considered sufficient for analytical assessment. Two or three group members should be responsible for coordination of data collection and analysis for each of the species identified. See Action Plan below.

5.1 Skates and Rays

There is extensive and ongoing research on a number of skate and ray species. Much of the historical data has been published and the current data is either in the process of being published by various authors or is easily accessible. It is probably most informative to analyse data on a number of species, as shifts in species composition have been known to occur and species are interchangeable on the commercial market.

British & French coastal waters & North Sea (data from Netherlands, France, UK):

R. clavata, *R. montagui*, *R. brachyura*, *R. naevus*

Northern Atlantic (data from Netherlands, Canada, UK, USA):

R. radiata

5.2 Spiny dogfish (*Squalus acanthias*)

An extensive data set exists for this species from both sides of the Atlantic Ocean. Much of the data has already been published and is easily accessible.

North Atlantic: data from Canada, France, Norway, UK, USA.

5.3 Other species

An attempt should be made to collect enough information on species for analytical assessment from two other areas of distribution. Species important off the Atlantic coast of France, Spain and Portugal (e.g. *Dalatias licha*, *Centroscymnus coelolepis* or *Centrophorus squamosus*) and a pelagic species which utilises the entire Atlantic Ocean (e.g. *Prionace glauca*). This should be explored before the 1997 meeting.

6 1997 MEETING

6.1 Terms of reference for 1997 meeting

The Study Group on Elasmobranch Fishes, under the chairmanship of Dr. H. Silva (Portugal-Azores) will meet during 1997 (26th-30th May, venue to be announced), and report to the 1997 Annual Science Conference to:

- a) analyse the data available on the geographical distribution of species and identify species for which the data are sufficient for analytical assessment;
- b) conduct analytical assessments and evaluate the effects of exploitation and/or environmental changes on the stocks considered;
- c) re-evaluate the ICES species coding for sharks, skates and rays;
- d) put forward a proposal for Working Group status.

It is still being discussed if the meeting should be a joint meeting with ICCAT and/or NAFO.

6.2 Recommendations for other topics for the 1997 meeting

Terms of reference have absolute priority but some members have mentioned subjects they would like to have discussed.

- Evaluate the calculation of effort for CPUE data (Du Buit).
- Give priority to collecting information on length at maturity (i.e. key Stehmann in SG 1995 report) for identification of minimum size (Correia/Cardador).
- At the 1995 meeting we discussed arranging a workshop on ageing; action should be taken on this (Walker).

Another point for discussion is the future of the Study Group. We need to streamline activities and method of communication. Make sure members (and ICES) have updated addresses, telephone and FAX numbers and e-mail. We should ask for Working Group status and plan the meeting around the Annual Science Conference or other international venue to make optimal use of time.

6.3 Action Plan September 1996 - May 1997

- Each species (group) to be coordinated by 2/3 members. Tentative suggestions follow:
- Skates and rays: Stehmann, Walker & Power;
- Spiny dogfish: Rago, Sosebee & Pawson;
- Pelagic species (blue shark?): Silva, Bonfil & Fogarty
- Deep-dwelling' eastern Atlantic species: Du Buit & Cardador/Correia

Aim to prepare necessary information for the 1997 meeting.

Try to get information and/or delegate from Spain and Ireland (Silva & Walker).

7 REFERENCES

Anonymous, 1995. Report of the Study Group on Elasmobranch Fishes, ICES CM 1995/G:3, 88 pp.

Atkinson, D.B. 1995. Skates in NAFO Divisions 3LNO and Subdivision 3Ps: a Preliminary Examination. Department of Fisheries and Oceans Atlantic Fisheries Document 95/26, 10 pp.

Correia, J. 1995. Summary Report on Shark Landings in Portugal from 1992-1995, IPIMAR internal report, 9pp.

Rago, P.J., Sosebee, K.A., Brodziak, J.K.T., Murawski, S.A. & Anderson, E.D. 1994. Distribution and dynamics of Northwest Atlantic Spiny Dogfish (*Squalus acanthias*), Northeast Fisheries Science Center Reference Document 94-19, 82 pp.

Simon, J.E. & Frank, K.T. 1995. An Assessment of the Skate Fishery in Division 4VsW. Department of Fisheries and Oceans Research Document 95/71, 41 pp.

8 TABLES

Table 4.1 Overview of available Canadian data on *Raja radiata*, *R. ocellata* and *R. senta*. Data taken from Atkinson, 1995 and Simon & Frank, 1995.

Species: <i>Raja radiata</i> <i>R. ocellata</i> <i>R. senta</i>	Description of data	Period over which data extends
commercial landing data	weight	1961-1995
fisheries independent data		1970-1995
CPUE data	number/weight per tow	1970-1995
distribution	work by Templeman*	1980's
migration (sex-specific)	work by Templeman*	1980's
mortality estimates	none	
ageing	none	
growth	none	
length-at-maturity	work by Templeman*	1980's
fecundity	work by Templeman*	1980's

* Only *Raja radiata*.Table 4.2.1 Overview of available Danish data for *Squalus acanthias*.

Species: <i>Squalus acanthias</i>	Description of data	Period over which data extends
commercial landing data	- total landing weight by ICES fishing areas, month and vessel category	1970-1995 data before 1987 not easily accessible
fisheries independent data	- ICES coordinated surveys	
CPUE data	- EU logbook data	1987-1995
distribution	- distribution of catches by statistical rectangles - EU logbook data (bad quality)	1987-1995
migration (sex-specific)	none	
mortality estimates	none	
ageing	none	
growth	none	
length-at-maturity	none	
fecundity	none	

Table 4.2.2 Overview of available Danish data for *Lamna nasus* and 'Rays & Skates'

Species: <i>Lamna nasus</i> 'Rays & Skates'	Description of data	Period over which data extends
commercial landing data	- total landing weight by ICES fishing areas, month and vessel category	1970-1995 data before 1987 not easily accessible
fisheries independent data	- ICES coordinated surveys	
CPUE data	none	
distribution	none	
migration (sex-specific)	none	
mortality estimates	none	
ageing	none	
growth	none	
length-at-maturity	none	
fecundity	none	

Table 4.2.3 Overview of available Danish data for *Raja radiata*.

Species: <i>Raja radiata</i>	Description of data	Period over which data extends
commercial landing data	- total landing weight by ICES fishing areas, month and vessel category	1970-1995 data before 1987 not easily accessible
fisheries independent data	- ICES coordinated surveys - at sea sampling of landings and discards on fishing vessels, including 100-600 days at sea	1993-1996
CPUE data	none	
distribution	none	
biological data	North Sea	1983-1988

Table 4.3 Overview of available French data on two deep-water sharks.

Species: <i>Centrophorus squamosus</i> <i>Centroscymnus coelolepsis</i>	Description of data	Period over which data extends
commercial landing data	+	1991 ->
fisheries independent data	0	
CPUE data	+	1991 ->
distribution	bathymetric	1995 ->
migration (sex-specific)	0	
mortality estimates	0	
ageing	0	
growth	0	
length-at-maturity	+	1995 ->
fecundity	ovarian and uterine	1995 ->
other	sex ratio and size in catches	1995 ->

Table 4.4 Overview of German landing data in kg. Spiny dogfish (*Squalus acanthias* - DGS); Sharks (DGX); Skates and Rays (SKA); Porbeagle (*Lamna nasus* - POR); Large sharks (SHX).

Area	DGS	DGX	SKA	SHX	POR
Ila	1	0	0	0	0
IIIaS 21	6	0	0	0	0
IIIId 25	0	0	4	0	0
IVa	2572	25216	4345	0	0
IVb	20745	1099	877	0	0
IVc	2422	22	905	0	0
Vb	0	10300	41	0	0
VIa N	0	43714	0	0	0
VIb	0	37676	16759	0	0
VIIb	0	20	0	0	0
VIIc	0	12224	2315	0	0
VIII-j	0	132196	0	0	0
VIIk	0	3767	0	0	0
XIV	0	0	9687	0	0
TOTAL	025746	266234	34933	0	0

Table 4.5 Overview of available Dutch data for the North Sea for *Raja* species.

Species: <i>Raja radiata</i> , <i>R. clavata</i> , <i>R. montagui</i> <i>,R. naevus, R. fullonica</i> <i>,R. brachyura</i>	Description of data	Period over which data extends
Commercial landing data	- all species mixed	- 1947-1983 (data are still collected but not published)
Fisheries independent data	- ICES surveys	- 1970-1995
CPUE data	- RIVO survey data - ICES survey data	- 1951-1995 - 1970-1995
Distribution	- ICES surveys - RIVO tagging data*	- 1970-1995 - 1992-1995
Migration (sex specific)	- RIVO tagging data*	- 1992-1995
Mortality estimates	- RIVO tagging data*	- 1992-1995
Ageing	- RIVO tagging data (tetracycline)* and unpublished data Walker	- 1992-1996
Growth	- tagging (tetracycline)* and unpublished data Walker - lab. experiments juveniles <i>R. radiata</i> & <i>R. clavata</i>	- 1992-1995 - 1992-1993
Age/length at maturity	- unpublished data Walker	- 1992-1996
Fecundity	- unpublished data Walker	- 1992-1995

* Excluding *R. fullonica*.

Table 4.6 Overview of available Portuguese data. Information supplied by Jo_o Correia

	Species	Description of data	Period
commercial landing data	all species in summary report*	- species specific landings (kg) by month and port - species specific total price of meat (PTE) by month and port	since 1988
fisheries independent data (IPIMAR)	<i>Etmopterus pusillus</i> <i>Etmopterus spinax</i>	-individual length/weight	since 1994
fisheries independent data (IPIMAR)	<i>Galeus melastomus</i> <i>Deania calceus</i> <i>Centrophorus granulosus</i> <i>Dalatias licha</i> <i>Scymnodon ringens</i>	- distribution of total lengths per 1 cm length class - macroscopic maturity stage (5 stage scales) - number/size of embryo's capsules - individual weight	since 1994
CPUE data	<i>Centrophorus squamosus</i> <i>Centrophorus granulosus</i> <i>Centroscymnus coelolepis</i> <i>Dalatias licha</i> <i>Scymnodon ringens</i>	- number of hooks and individuals per line set	since May 1996
distribution	<i>Galeus melastomus</i> <i>Deania calceus</i> <i>Centrophorus granulosus</i> <i>Centrophorus squamosus</i> <i>Dalatias licha</i> <i>Scymnodon ringens</i> <i>Etmopterus pusillus</i> <i>Etmopterus spinax</i>	-list of individual occurrences along Portugese Continental Slope**	since 1994
distribution	<i>Mitsukurina owstoni</i>	- sporadic individual occurrences reported by fishermen	since 1995
migration (sex-specific)	<i>Prionace glauca</i> <i>Isurus oxyrinchus</i> <i>Sphyrna</i> sp.	- tag recaptures	in prep.
mortality estimates	none		
ageing	<i>Galeus melastomus</i> <i>Scyliorhinus canicula</i>	- vertebral bands (over 1.000 centra read)	since 1994
ageing	<i>Daenia calceus</i>	- growth rings in 2nd dorsal spines (still under research, needs more work)	since 1994
growth	<i>Galeus melastomus</i> <i>Scyliorhinus canicula</i>	- preliminary (unvalidated) growth curves	since 1995
growth	<i>Galeus melastomus</i>	- validated growth curve (based on centra from several months in year) underway	1996
age/length-at-maturity	<i>Galeus melastomus</i> <i>Daenia calceus</i>	- maturity stage from histology on gonads & age from vertebrae or spines	under preparation

* Species in order of abundance: *Dalatias licha*, *Centroscymnus coelolepis*, *Centrophorus granulosus*, *Prionace glauca*, *Centrophorus squamosus*, *Mustelus* spp., *Carcharhinus* spp., *Galeorhinus* spp., *Oxynotus centrina*, *Sphyrna* spp., *Isurus oxyrinchus*, *Galeus melastomus*, *Alopias vulpinus*, *Sphyrna* spp., *Squalus acanthias*, *Somniosus microcephalus*, Squatinidae, *Lamna nasus*, *Galeorhinus galeus*, *Hexanchus griseus*, *Mustelus mustelus*, *Sphyrna zygaena*, *Etmopterus* spp., *Echinorhinus brucus* *Mustelus asterias*.

** NOTE: individuals captured by bottom trawls, meaning that occurrences of *C. granulosus*, *C. squamosus*, *D. licha* and *S. ringens* are highly underestimated (these species normally fished by longline).

Table 4.7.1 Overview of available British data - Skates & Rays.

Species: Skates and rays*	Description of data	Period over which data extends
Commercial landing data	- weight: landed wt (whole) by ICES division - lengths: original measurement forms only	- 1947-1984 Bulletin Statistique - MAFF England & Wales 1950-1995 - 1983-1990 (west side England & Wales)
Fisheries independent data	See Table MAFF Surveys Elasmobranch data	
CPUE data	- MAFF survey data - commercial trawl data	
Distribution	- MAFF survey data	
Migration (sex specific)	- Results from tagging	
Mortality estimates	- Tank held ray experiments - Published work Holden	- 1975-1976
Ageing	- Published data Holden, Tucker (1); see text	1970's
Growth	- Published data Holden, Brander (2) - Tag returns (2)	1970s/1980's
Age/length at maturity	- Published data Holden (3) - length/maturity data - beam trawl surveys in VIIa, f + g (3)	- 1970's - 1992-1995
Fecundity	- Published data Holden (4)	

* All species landed mixed; in some landings species can be guessed: i.e. Northern North Sea - mainly *Raja radiata*; Central Irish Sea - mainly *R. naevus*; Cardigan Bay - *R. clavata* and *R. montagui*.

(1) *R. clavata* (tag returns of tetracycline rays)

(2) *R. brachyura*, *R. clavata* and *R. montagui* (tag returns and Irish Sea surveys)

(3) *R. clavata*, *R. montagui* and *R. naevus*

(4) *R. clavata* (RV and commercial vessel catches 1968 & 1972)

NOTE: recent survey data and samples supplied to: Jim Ellis (Swansea) and Nick Dulvy (Univeristy of East Anglia).

Table 4.7.2 Overview of available British data - spiny dogfish (*Squalus acanthias*).

Species: Spiny dogfish	Description of data	Period over which data extends
Commercial landing data	- weight: landed wt (whole) by ICES division - LD by ICES division	- 1947-1984 Bulletin Statistique - MAFF England & Wales 1950-1995 - 1966-1995
Fisheries independent data	- occasional catches on MAFF surveys	
CPUE data	- mainly trawl data (line CPUE not reliable)	1966-1995
Distribution	- from landed data and MAFF surveys	1966-1995
Migration (sex specific)	- Results from tagging published and unpublished	1959-1977 (MAFF tagging)
Mortality estimates	- Published work Holden	
Ageing	- Published data Holden, Tucker	
Growth	- Published data Holden, Tucker, Vince - Tag returns	
Age/length at maturity	- Published data Holden	
Fecundity	- Published data Holden	

Table 4.7.3 Overview of available British data - lesser and greater spotted dogfish (*Scyliorhinus canicula* and *S. stellaris*).

Species: Lesser and greater spotted dogfish	Description of data	Period over which data extends
Commercial landing data	- weight: landed wt (whole) by ICES division - See Table MAFF Surveys Elasmobranch data for lengths	- 1947-1984 Bulletin Statistique species combined - MAFF England & Wales 1950-1995 - species separate
Fisheries independent data	See Table MAFF Surveys Elasmobranch data	
CPUE data	See Table MAFF Surveys Elasmobranch data	
Distribution		
Migration (sex specific)		
Mortality estimates		
Ageing		
Growth		
Age/length at maturity		
Fecundity		

Table 4.7.4 Overview of available British data - sharks, including tope.

Species: Sharks, (all including tope)	Description of data	Period over which data extends
Commercial landing data	- weight: landed wt (whole) MAFF England & Wales by ICES division	1950-1995
Fisheries independent data		
CPUE data		
Distribution		
Migration (sex specific)	- Tope paper Holden (tagging results)	1957-1976
Mortality estimates		
Ageing		
Growth		
Age/length at maturity		
Fecundity		

Table 4.7.5 Overview of MAFF Surveys Elasmobranch data

Area (ICES)	Years	Data description	Species occurring regularly
North Sea (IV)	1977-1995	Catch weights by species and length distributions	CUR, SDR, THR, SYR, DGS, GAG, SDS, LSD
	1929-1995	Scottish survey data	CUR, LNS, SKT, SYR
Celtic Sea (VII i-j)	1984-1995	Catch weights by species and length distributions	CUR, SDR, SKT, BLR, LNS, THR, DGS, GAG, LSD, DGH, SDS, SMH
Bristol Channel (VII f+g)	1988-1995 (4m beam)	Catch weights by species and length distributions	BLR, THR, PTR, SDR, LSD, DGH, SDS
Irish Sea (VIIa)	1988-1995 (4m beam)	Catch weights by species and length distributions	BLR, THR, SDR, CUR, DGS, DGH, SDS
Irish Sea (inshore N. Wales survey)	1978-1990 (otter trawl)	Catch by species and length distributions	THR, BLR, SDR, CUR, LSD
English Channel (VII d)	1988-1995 (4m beam)	Catch weights by species and length distributions	BLR, THR, SDR, PTR, UNR, LSD, SDS
English Channel (VII e)*	1988-1995 (4m beam)	Catch weights by species and length distributions	BLR, THR, SDR, PTR, UNR, LSD, DGS, <i>Mustelus</i> spp.

* mainly 26E6

BLR - *R. brachyura*
 CUR - *R. naevus*
 DGH - *S. stellaris*
 DGS - *S. acanthias*
 GAG - *G. galeus*

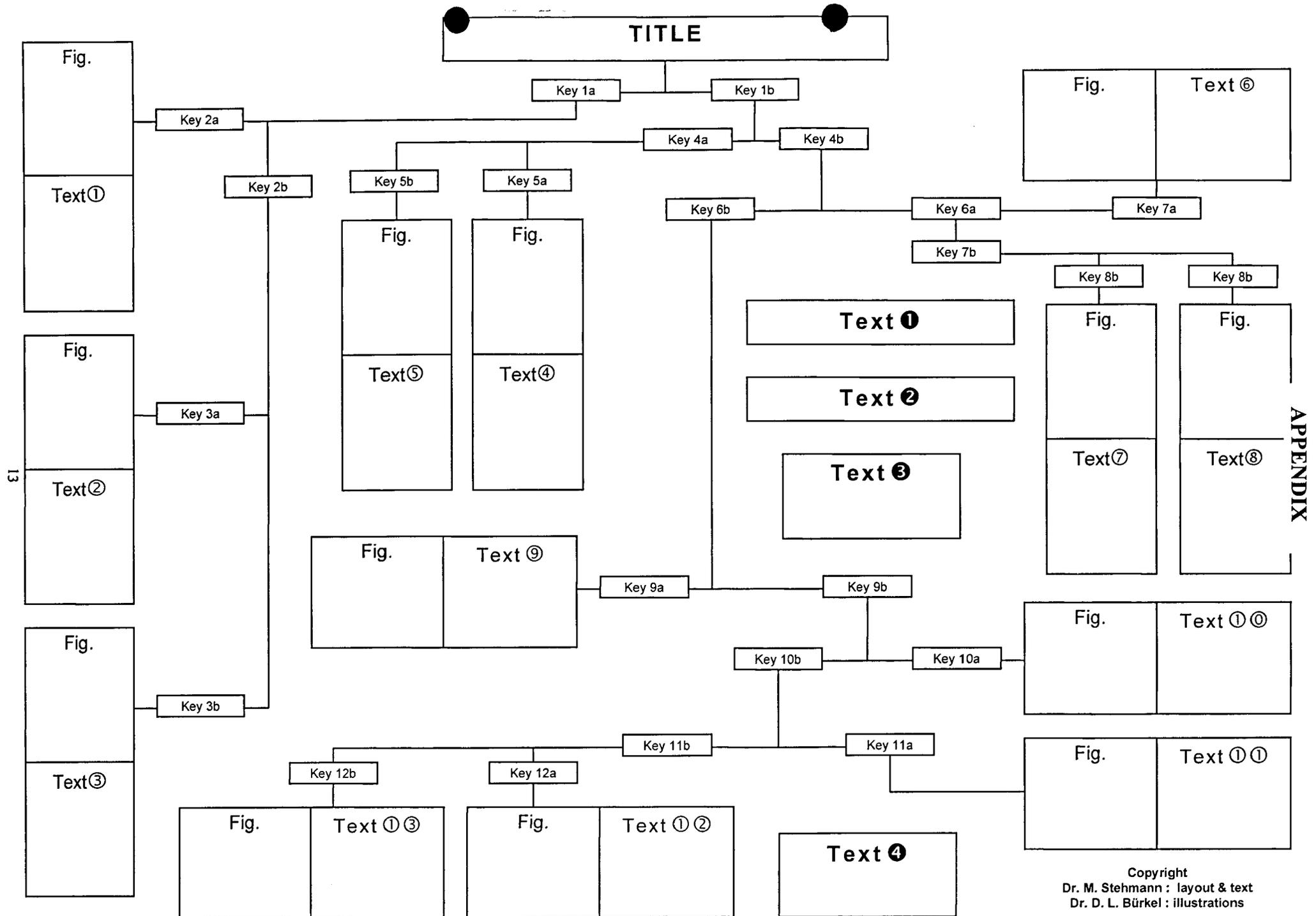
LNS - *R. fullonica*
 LSD - *S. canicula*
 PTR - *R. microocellata*
 SDR - *R. montagui*
 SDS - *M. asterias*

SKT - *R. batis*
 SMH - *M. mustelus*
 SYR - *R. radiata*
 THR - *R. clavata*
 UNR - *R. undulata*

Table 4.8 Overview of American data on *Squalus acanthias*. Data taken from Rago *et al.*, 1995.

Species: <i>Squalus acanthias</i>	Description of data	Period over which data extends
Commercial landing data	weight	1960-1993 (1995?)
Fisheries independent data		
CPUE data	commercial fisheries independent*	1976-1993 (1995?) 1967-1994
Distribution	from survey data	1967-1994
Migration (sex specific)	transatlantic migrations; work by Templeman	1976
Mortality estimates	yes	
Ageing	yes	
Growth	yes	
Age/length at maturity	yes	
Fecundity	yes	

* Canadian data also available



APPENDIX

FIELD KEY to COMMON SKATE SPECIES (*Raja* spp.) in NORTHERN EU SHELF WATERS

①

Skates are seemingly often difficult to identify, because they all appear to look very much alike due to their flattened, more or less rhombic body disc and rather rudimentary tail being sharply marked off. However like with flatfishes, knowing the features distinguishing the various species and giving specimens a closer look will allow their specific identification, without being an expert, as in more familiar bony fishes. The following key refers to easily recognisable external features only of general disc shape, a few major proportions, squamation and colouration.

②

Being typical bottom dwellers, skates tend to adapt their colour and pattern closely to the bottom substrate and may thus vary in colour appearance within one and the same species. Furthermore, their body proportions, principal squamation (scale coverage) and prominence, as well as arrangement of enlarged thorns may vary considerably depending on size and age, and between females and males. As both sexes can easily be recognised externally from smallest postembryonic size onward through the paired, rod-like 'claspers' of males along inner margins of their pelvic fins, specimens should always be registered by sex. Illustrations of this key show only mature males of the species, with claspers extending distinctly beyond tips of posterior pelvic lobes along both sides of the tail.

③

A few terms of squamation are used in the key, namely spinules, thornlets, thorns: **spinules** are the small dermal denticles forming the principal coverage, totally or partly, of placoid scales on a skate's upper side, as well as partly or wholly on the underside at least in some species; shape of spinules hardly recognisable without magnification, but their presence can be felt in any case, as spinulose areas are more or less rough to touch like sandpaper of different grain-size. **Thornlets** are modified spinules of medium size, usually on a discernibly radiated basal plate and with sharp tip; without forming a definite pattern, they appear mostly on certain regions of the upper surface only, e.g., on snout, along anterior disc margins and arranged as additional parallel rows along back of trunk and tail. **Thorns** are modified placoid scales of very distinct size and shape, appearing only on certain regions of the upper surface in rather species specific arrangement and numbers, e.g., on orbital rims, nape and shoulders, along back of trunk and tail, as well as on sides and lower edges of tail; a circular to oval basal cone may be ribbed or smooth and bears a medially or asymmetrically placed more or less erect, or rearward inclined or curved sharp tip. Only exceptionally, thorns will also be found on a skate's underside in irregular distribution in very few species.

Maturing males develop two sex-specific, paired fields of thorns on upper disc: **malar thorns** (often only of thornlet size) in an irregular patch or stripe at anterior disc margins about level with eyes and spiracles. Very characteristic, claw-like **alar thorns** with long, obliquely inward directed tips; in species treated here, each alar thorn is erectile from its individual dermal pocket, and they are arranged in a stripe of several longitudinal rows running across the outer wing tips. All illustrations of this key show mature males with their malar and alar thorn fields.

④

Illustrations by D.L. Bürkel of this key are presented in a way, that only the part-region of the left upper wing (pectoral fin) shows primary colour and colour pattern components, whereas on remainder of upper surface the principal spinulation, distribution of thornlets and especially number, arrangement and pattern of thorns are illustrated. If underside views of species are given in addition, the smaller part-area indicates squamation, the larger one colour and its eventual pattern or specific components. Experiences gathered in the past have shown, that primary colour, colour pattern and squamation components cannot be combined adequately in one and the same drawing for identification purposes. The unusual appearance of the present figures is thus only for the benefit of presenting specific key characters as clear as possible.

[1a] Snout very long and pointed; a line from tip of snout to outer wing-tip not touching front margin of disc. Width between nasal openings, in front of mouth on underside, usually less than 70% of distance from a nasal aperture to snout tip. Thorns on upper disc usually absent, except for a few small ones on eye rims in young specimens.

[1b] Snout moderately long to short; a line from tip of snout to outer wing-tip touching or cutting front margin of disc. Width between nasal openings, in front of mouth on underside, usually more than 70% of distance from a nasal aperture to snout tip. Thorns on upper disc always present, at least before shoulder girdle on head.

[2a] Underside white, with a broad blackish (young) to grey margin (larger specimens) around disc and pelvic fins. Mucus and sensory pores on underside of disc not marked by colour.

① *Raja alba*

White Skate, Bottlenose Skate

[2b] Underside more or less dark, with mucus and sensory pores marked as blackish dots and/or dashes.

[3a] Snout extremely long and pointed; its length in front of eyes 5.5-7.0 times as long as distance between eyes. Back of tail with only 4-11 moderately large median thorns. Each jaw with only up to 40 rows of relatively large teeth.

② *Raja oxyrinchus*

Long-nosed Skate

[3b] Snout long but less pointed at wider angle; its length in front of eyes only 2.5-4.0 times as long as distance between eyes. Back of tail with 12-28 median thorns. Each jaw with 40-56 rows of relatively large teeth.

③ *Raja batis*
Skate, Common Skate

[4a] Upper side of disc variegated, typically with long blackish transverse bands or with light bands running almost parallel with disc margins.

[4b] Upper side of disc either plain coloured or with eye-spots, light and/or dark spots and blotches, which may give a marbled, banded or reticulate pattern.

[5a] Upper side of disc with several light bands plus larger spots running almost parallel with disc margins. Eyes conspicuously small; distance between eyes 1.5-2.0 times (young) to more than twice (adult) the length of an eye; even combined length of eye and spiracle opening (directly behind eye) usually less than half the distance between eyes.

④ *Raja microocellata*
Small-eyed Ray/Skate

[5b] Upper side of disc with several dark bands plus larger spots running almost transverse and partly parallel with disc margins; each dark band bordered by numerous small whitish spots like pearl strings. Eyes larger; distance between them equal to (young) or up to 1.7 times as long as length of an eye.

⑤ *Raja undulata*
Undulate Ray/Skate

[6a] Upper side of disc plain coloured, or usually so; at least no clearly defined colour pattern.

[6b] Upper side of disc always variegated, with eye-spots, symmetrically arranged dark and light spots and blotches, with regular pattern of mainly dark circular spots, or with a combination of several of these components.

[7a] Prominent thorns, with distinctly ribbed basal cone, along back of trunk and tail only in a persistent and regular median row of less than 20; if present, parallel rows consist of much smaller sharp thornlets only, which in addition regularly also scattered on the pectoral wings.

⑥ *Raja radiata*
Starry Ray/Skate

[7b] Prominent thorns with normally smooth basal cone, along back of trunk and tail in 2-4 parallel rows. Median row of thorns either present in young only and being totally reduced with growth, or median thorns much smaller than those of parallel rows.

[8a] Disc rhomboid, with angled wing tips; snout moderately elongated and rather pointed. Tail about as long as distance from snout tip to mid-anus. Along midline of nape/shoulder region, 3-9 thorns in line persisting, whereas median thorns along back of trunk and tail missing (except in very young). Generally two parallel rows of about 50 closely-packed thorns from shoulder region to first dorsal fin, but those on trunk usually reduced in large specimens.

⑦ *Raja fullonica*
Shagreen Ray/Skate

[8b] Disc roundish, with broadly rounded outer corners; snout very short and obtusely angled. Tail obviously longer than distance from snout tip to mid-anus. Except for very young, a large triangular patch of thorns on nape/shoulder region. Several irregular parallel rows of prominent thorns running as a broad band from shoulder region onto tail, whereas thorns in median row, if persisting at all, much smaller.

⑧ *Raja fyllae*

Round Ray/Skate

[9a] A large eye-spot on each upper inner pectoral wing shortly posterior to shoulder girdle (occasionally a few smaller ones in addition on wings) consisting of a dusky roundish blotch with irregular yellowish spots and worm-like stripes.

⑨ *Raja naevus*

Cuckoo Ray/Skate

[9b] Upper side colour pattern either consisting of few small creamy spots, or of dark and/or light blotches, spots and dots in various arrangements. Dark spots or dots may form eye-spot-like rings differing from real eye-spots by not consisting of various colour components and a solid centre.

[10a] A more or less complete half ring of thorns on eye rims and a triangular patch of thorns over nape/shoulder region. Prominent thorns along back of trunk and tail generally set in two parallel rows plus additional two outer parallel rows on anterior half of tail; median row of thorns either present only in young, or median thorns much smaller than parallel ones. Upper side reddish-brown to dark brown with a constant colour pattern (very rarely missing) of 4-6 paired small circular creamy spots on posterior two thirds of pectoral wings and posterior pelvic lobes; these spots being symmetrically arranged and each encircled by a dusky ring.

⑩ *Raja circularis*

Sandy Ray/Skate

[10b] Thorns on eye rims singly, those on nape/shoulder region not set in a triangular patch but separately medially on nape and mid-shoulder, as well as on each shoulder. A prominent and regular row of persistent median thorns along back of trunk and tail; additional parallel rows, if present, of distinctly smaller thorns or thornlets only. Upper side of disc with various arrangements of numerous light and/or dark dots, spots and blotches.

[11a] Tooth rows in upper jaw 60-90. Upper side of disc with pattern of numerous small dark spots reaching to extreme outer disc margins; the spots sometimes encircling a few light blotches appearing thus eye-spot-like.

①① *Raja brachyura*
Blonde Ray/Skate

[11b] Less than 60 tooth rows in upper jaw. Upper side of disc either dark spotted, but not to disc margins, or spotted and mottled light and dark to varying degrees.

[12a] Upper surface of disc almost smooth in young, more spinulose in larger specimens, but spinules never covering the entire surface. Median row of 20-50 usually persistent thorns from nape onto tail to first dorsal fin, but no additional thorns on the pectoral wings or underside of disc. Upper side a warm brown with many circular dark spots not extending to extreme outer disc margins and frequently forming eye-spot-like rings at centre of pectoral wings; tail without distinct light cross-bars.

①② *Raja montagui*
Spotted Ray/Skate

[12b] Upper surface of disc rough spinulose at all sizes. Median row of 30-50 thorns from nape onto tail to first dorsal fin, but those on back of trunk regularly reduced in size or missing in large mature males; additional large and sharp thorns with 'swollen' smooth base ('bucklers') often scattered on upper wings in large specimens, as well as relatively often on underside of disc mainly in large females. Basic colour of upper disc all shades of brown, with light and dark spots and blotches forming all kinds of colour pattern to an extreme degree of variability, including eye-spot-like blotches. Tail usually with variously distinct light cross-bars.

① ③ *Raja clavata*

Thornback Ray/Skate, Roker

Dr. M. Stehmann

① *Raja (Rostroraja) alba* Lacepède, 1803

White Skate, Bottlenose Skate

[Raie blanche (F), Raya bramante (E)]

FIELD CHARACTERS: Snout very long and pointed. its tip pronounced. Disc broadly rhombic, with outer corners (wing tips) acutely angled and more or less undulated front margins distinctly concave; except for very small young, a theoretical line from snout tip to wing tip not touching front margin of disc. **Squamation:** Upper surface of disc only devoid of spinules in early juveniles but almost entirely spinulose in larger specimens, which at most show bare patches on wings. A thorn in front of and behind eyes in young only, more but smaller thorns in larger specimens. In general, no thorns on nape, shoulder region and back of trunk, but about 15 somewhat irregular and wide spaced thorns in median row along tail, rarely expanding forward onto hind part of trunk, and usually a thorn in space between dorsal fins near tail tip. Larger specimens usually with a row of strong thorns on either side of lower tail edge. Underside smooth in juveniles, except for snout and anterior front margins, but more or less spinulose, including tail, in large specimens which have only outer wings smooth. **Colour:** Upper surface reddish-brown mainly in young, rather dark greyish-blue in larger specimens, with numerous variously obvious light or pale spots. Underside white, with a broad blackish (young) to grey margin (larger specimens) around disc and pelvic fins; tail at least partly dusky; mucus and sensory pores on disc not marked by colour. **Size:** a very large growing, heavy species, to over 200 cm total length.

DISTRIBUTION and HABITAT: NE-Atlantic coasts northward to south-western Ireland, also western Mediterranean. Bottom dwelling from inshore to upper slope down to about 400 m.

② *Raja (Dipturus) oxyrinchus* Linnaeus, 1758

Long-nosed Skate

[Pocheteau noir (F), Picón (E)]

FIELD CHARACTERS: Snout extremely long and pointed but its tip not markedly pronounced. Disc broadly rhombic, with wings tips acutely angled and somewhat undulated front margins very deeply concave; a theoretical line from snout tip to wing tip not touching front margin of disc. **Squamation:** Upper surface of disc only devoid of spinules in juveniles but almost entirely spinulose in larger specimens, which at most show bare patches on wings. No thorns on upper disc, except for small ones in front of eyes in smaller specimens. A median row of 4-11 thorns along tail, often more or less worn off in adults, and 0-1 thorn in interspace between separate small dorsal fins; few thorns on either side of lower tail edge in large specimens. Underside smooth only in young, becoming almost entirely spinulose in adults, but bare patches on pectoral wings. **Colour:** Upper side from light brown in juveniles to dusky brown or grey in larger specimens, with a pattern of more or less distinct light spots and black dots. Underside almost dark brown to blue-grey, somewhat lighter in young. Mucus and sensory pores on both surfaces of disc marked as blackish dots and streaks, which are very numerous on anterior two thirds of disc underneath. **Dentition:** only up to 40 tooth rows in each jaw. **Size:** large growing species, to about 150 cm TL.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to the Faroes, the Shetlands and central Norway, also northern North Sea and Skagerrak; also in the Mediterranean but hardly at less than 500 m. Bottom dwelling from mid-shelf depth at about 90 m to mid-slope depth to about 900 m, but mainly around 200 m.

③ *Raja (Dipturus) batis* Linnaeus, 1758

Skate, Common Skate

[Pocheteau gris (F), Noriega (E)]

FIELD CHARACTERS: Snout very long and pointed but its tip not markedly pronounced. Disc broadly rhombic, with wings tips acutely angled and somewhat undulated front margins deeply concave; a theoretical line from snout tip to wing tip not touching front margin of disc. **Squamation:** Upper surface of disc only devoid of spinules in juveniles but spinulose in larger specimens along front margins; large females may show more intense spinulation. No thorns on upper disc, except for separate small thorns at eyes in juveniles. A median row of 12-18 thorns along tail, often more or less worn off in adults, and normally 1-2 thorns between dorsal fins. Additional strong thorns often along lower edges of tail, regularly so in adult females. Underside of disc more or less spinulose in adults of both sexes. **Colour:** upper side olive-grey or brown with a variable pattern of light spots, dusky blotches and often an oval eye-spot-like colour mark on each pectoral wing especially in subadult specimens. Underside ashy-grey to blue-grey. Mucus and sensory pores on both surfaces of disc marked as blackish dots and streaks, which are numerous all over underside of disc. **Dentition:** Each jaw with 40-56 rows of large teeth. **Size:** The largest growing and heaviest skate in European waters; females attain up to 285 cm total length and 200 cm disc width, males remain somewhat smaller up to about 200 cm total length, and weights to 113 kg have been reported.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to Iceland, the Faroes and northern coasts of Norway, North Sea except for southern part, Skagerrak and Kattegat (rare); also in the Mediterranean, but rare in eastern part. Bottom dwelling from coastal waters to mid-slope depth at about 600 m, but mainly within the 200 m range.

④ *Raja (Raja) microocellata* Montagu, 1818

Small-eyed Ray/Skate

[Raie mêlée (F), Raya colorada (E)]

FIELD CHARACTERS: Disc evenly rhombic, with angled wing tips and straight to gently undulated front margins; snout short and bluntly angled, its tip a little marked off. Eyes conspicuously small, distance between them 1.5-2.0 times (young) to more than twice (adult) the length of an eye. **Squamation:** Upper surface of disc largely spinulose, but centre and posterior third of pectoral wings almost smooth. Thorns at eyes and on nape/shoulder regions separate. A regular median row of about 50 closely set thorns from nape onto tail to first dorsal fin, reduced in size and number on back of trunk in adults; additional distinct thorns along lower edges of tail, particularly in large females. No thorns between close set dorsal fins. Underside of disc smooth only in juveniles but more or less spinulose in larger specimens. **Colour:** Upper side greyish, or olive to light brown, with a characteristic pattern of light blotches, mainly on wing centres, posterior pelvic lobes and along sides of tail, and long whitish bands arranged almost parallel to front and rear margins of disc; the light markings often edged dusky. Underside white. **Size:** up to about 80 cm total length and 60 cm in width, adult males remain somewhat smaller; adult weight 5-6 kg.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to southwestern Ireland and England, southern Irish Sea and western English Channel; not in the North Sea and Mediterranean. Bottom dwelling from close inshore tidal areas, bays and estuaries to about 100 m shelf depth preferably on sandy grounds.

⑤ *Raja (Raja) undulata* Lacepède, 1802

Undulate Ray/Skate

[Raie brunette (F), Raya mosaica (E)]

FIELD CHARACTERS: Disc rhombic, with wings tips narrowly rounded rather than angled, and with undulated front margins; snout short and bluntly angled, its tip hardly marked off. Eyes of larger size, their length almost equal to distance between eyes, or nearly so. **Squamation:** Upper disc largely spinulose, except for centres and hind parts of pectoral wings and posterior pelvic lobes in large specimens. Thorns at eyes and on nape/shoulder regions separate. A largely regular median row of up to 55 relatively closely set thorns from shoulder region onto tail to first dorsal fin; midline thorns gradually disappearing on back of trunk in larger specimens, so that about 20 thorns along tail may remain only. Mostly with 1-2 median thorns between separate dorsal fins. Mainly adult males may show an additional parallel row of thornlets on either side of back of tail, whereas mature females tend to develop additional lateral thorns along lower edges of tail. Underside smooth, except for rough spinules on snout, front edges of disc and occasionally on tail. **Colour:** Yellowish- to greyish- or deep brown with a characteristic pattern of several more or less undulating dark bands and elongated blotches which all edged with small white spots like pearl-strings. Underside white, sometimes with tail end greyish-brown. **Size:** northern specimens usually up to 100 cm total length and 6-7 kg weight, southern representatives growing up to 120 cm.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to south-western Ireland and England and western English Channel; not in the North Sea but in western Mediterranean. Bottom dwelling from shallow coastal waters to the shelf edge at about 200 m depth, mostly between about 45 m and 100 m, and preferably on soft and sandy grounds.

⑥ *Raja (Amblyraja) radiata* Donovan, 1808

Starry Ray/Skate

[Raie radiée (F), Raya radiante (E)]

FIELD CHARACTERS: Disc rhomboid, with wing tips roundish rather than acute, and with undulated or convex front margins; snout short and bluntly angled, its extreme tip a little marked off. Tail rather broad and relatively short. Mature males with massive copulatory organs (claspers), terminal region of which distinctly club-like widened and with a stiff spine at outer edge of upper lobe. **Squamation:** Upper surface very rough and spiny, less so from spinules than from solid thornlets usually scattered over pectoral wings. Thorns conspicuously large, with their massive bases typically ribbed and with the margins stellate, as also in the thornlets. A fairly constant pattern of few separate thorns at eyes, one each on mid-nape and mid-shoulder, and usually two on each shoulder; a regular median row of mostly 13-17 prominent thorns persisting from anterior trunk onto tail to first dorsal fin; if dorsal fins separate (rare), sometimes a thorn between them. Parallel rows along trunk and tail, if present at all, only consisting of smaller thornlets. **Colour:** Upper surface greyish-brown, sometimes clouded with darker or a few pale blotches, but often with black dots arranged as rosettes; tail often with dark cross-bars. Underside white, with occasionally few small dark blotches. **Size:** a relatively small species somewhat differing in size according to its great geographical and depth range; to about 60 cm total length at lower latitudes and moderate depth, but up to 90-100 cm in deep water and at high latitudes. Males in the North Sea and around the British Isles becoming sexually mature already at about 40 cm total length.

DISTRIBUTION and HABITAT: all over northern North Atlantic up to Arctic latitudes and with southern limit of its range at Ireland and the British Isles, in the North Sea (except in its southeastern part) and the very western Baltic Sea. Bottom dwelling at high latitudes from inshore to more than 1000 m depth, but mostly between 50 m and 100 m in European Seas, and on nearly all kinds of bottom substrate.

⑦ *Raja (Leucoraja) fullonica* Linnaeus, 1758

Shagreen Ray/Skate

[Raie chardon (F), Raya cardadora (E)]

FIELD CHARACTERS: Disc rhombic, with wing tips gently angled and with front margins weakly undulated; snout relatively long (ca. 3 times distance between eyes), narrowly angled (ca. 90°-100°) and pointed, with the tip somewhat marked off. Length of tail about equal to disc length from snout tip to rear edges. Jaw teeth pointed in both sexes. **Squamation:** Upper surfaces entirely spinulose. A complete half-ring of about eight thorns on eye rims, median ones may become reduced in large adults. A line of 3-9 median thorns on nape always present, whereas small individual thorns on mid-shoulder and shoulders present only in young, as well as a median row of thorns along back of trunk and tail. Generally with two rows of about 50 closely set thorns parallel to midline along back of trunk and tail, but these thorns on disc soon being reduced and completely disappearing with growth; no thorns between separate dorsal fins. Underside of head spinulose, but hind two thirds of pectoral wings mostly smooth. **Colour:** Upper side plain ashy-grey, often rather pale, without colour pattern. Underside white. **Size:** a medium-sized species growing to about 120 cm total length, but mostly around 100 cm.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to Iceland, the Faroes, along Norway to the Murman coast, in the northern North Sea and Skagerrak, also western Mediterranean. Bottom dwelling on the shelf and upper slope in cold water from about 30 m to 550 m; mostly on the outer shelf at around 200 m in the north, deeper in the south. Regular catches by longliners may indicate a preference for rough grounds.

⑧ *Raja (Rajella) fyllae* Lütken, 1888

Round Ray/Skate

[Raie ronde (F), Raya redonda (E)]

FIELD CHARACTERS: Disc roundish, particularly in young and half-grown specimens, rather than subrhombic, with wing tips very broadly rounded and front margins convex, except deeply undulated front margins in mature males. Snout very short and obtusely angled at up to ca. 155° angle, its short tip marked off. Tail conspicuously longer than disc from snout tip to rear margins. **Squamation:** Upper surface entirely rough with coarse spinules on head and pectoral wings and many thornlets concentrated on head and hind parts of disc; bare patches on wing centres mainly in adult males. Thorns at eyes, on nape and shoulder regions singly only in very young; larger specimens with complete half-rings of 5-9 thorns on eye rims and a large triangular patch of many thorns over nape/shoulder area. Median thorns along back of trunk and tail distinct only in juveniles, but with growth gradually becoming smaller or totally disappearing. A broad band of prominent thorns in several irregular parallel rows from shoulder region onto tail always present. Dorsal fins may be confluent or separated, and then sometimes a thorn in interspace. Underside usually completely smooth. **Colour:** ashy-grey to dark brown, often with inconsistent variable pattern of dark and pale spots, or clouded darker or paler, and tail often with dark cross-bars; dark blotching more distinct in juveniles. Underside predominantly white, but regularly with greyish-brown spots on snout, along disc margins, around anus, on pelvics and on tail. **Size:** A small growing species with up to about 55-60 cm total length and 30 cm in width.

DISTRIBUTION and HABITAT: entire northern North Atlantic in cold water of 1-7 °C to beyond the Arctic Circle. Southern limit in NE Atlantic at about 45° N in northern Bay of Biscay, and in northern North Sea and Skagerrak. Bottom dwelling from shelf into deep water at higher latitudes, only at upper to mid-slope depths at lower latitudes; most common at 300-800 m but deepest record from 2.050 m.

⑨ *Raja (Leucoraja) naevus* Müller & Henle, 1841

Cuckoo Ray/Skate

[Raie fleurie (F), Raya santiguesa (E)]

FIELD CHARACTERS: Disc roundish rather than rhombic, with wing tips broadly rounded and front margins more or less undulated, more so in mature males. Snout relatively short and bluntly angled, with its tip a little marked off. Solid tail somewhat longer than disc from snout tip to rear margins. **Squamation:** Upper disc almost completely covered by spinules, only pectoral wing centres smooth in large specimens. Complete half-rings of 9-13 distinct thorns on eye rims, middle ones sometimes reduced in adults), and a large triangle of thorns on nape/shoulder region (thorns rarely singly). Two parallel rows of prominent thorns along each side of midline of trunk and onto tail, where additional lateral thorns present along lower edges of tail in larger specimens; parallel rows on back of trunk, particularly the outer one, often beginning on posterior trunk, or even origin of tail in large specimens. Median row thorns present only in juveniles and completely disappearing with growth. Dorsal fins close set and no thorn between them. Underside smooth, except for spinules on snout and at anterior front margins. **Colour:** Upper side ochre to more or less light greyish-brown with faint light and dark spots. A large, roundish very distinct blackish eye-spot, marbled with irregular yellowish spots and worm-like stripes, on each inner pectoral wing near level of shoulder girdle; rarely a few additional smaller eye-spots of this kind on hind and outer parts of wings. Underside white. **Size:** up to about 70 cm total length and about 3 kg weight.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to around Ireland and Britain and in the northern and central North Sea to Kattegat, also western Mediterranean but very rare in eastern part. Bottom dwelling on shelf and upper slope at 20-250 m, most common between 70 m and 100 m but deeper to the south, where deepest record off Rio de Oro at 900 m.

⑩ *Raja (Leucoraja) circularis* Couch, 1838

Sandy Ray/Skate

[Raie circulaire (F), Raya falsa vela (E)]

FIELD CHARACTERS: Disc subrhombic, with broadly rounded wing tips and distinctly undulated front margins. Snout relatively short and bluntly angled, its tip marked off. Solid tail somewhat longer than disc from snout tip to rear margins. **Squamation:** Upper disc almost entirely spinulose, but large adults often with centre and hind part more or less smooth. Complete half-rings of about eight thorns on eye rims, and a triangle of more or less loosely set thorns on nape/shoulder area. Two parallel rows of close-set prominent thorns from behind shoulder girdle, but originating farther back in large specimens, onto tail where a second outer parallel row appearing on anterior half. Median row of smaller thorns along trunk and tail to first dorsal fin present only in juveniles but usually completely disappearing with growth. Dorsal fins confluent or close set, no thorns between them. Underside of disc largely smooth, but spinules present on snout and at front margins, in large specimens also between gill slits and on abdomen. **Colour:** Upper side reddish-brown to dark brown with a typical constant pattern (very rarely missing) of 4-6 small creamy spots, each encircled dusky, on each pectoral wing in hind two thirds and on posterior pelvic lobe, and these spots symmetrically arranged on both wings. Underside white. **Size:** a medium-sized species growing up to 120 cm total length, usually around 70 cm, and about 10 kg in weight.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to Scotland, Faroes, southern Norway, northern and central North Sea and Skagerrak, also in western Mediterranean. Bottom dwelling on shelf and upper slope from about 70-275 m, mainly at 50-100 m.

①① *Raja (Raja) brachyura* Lafont, 1873

Blonde Ray/Skate

[Raie lisse (F), Raya boca de rosa (E)]

FIELD CHARACTERS: Disc broadly rhombic, with wing tips more or less acutely angled at about 90° and weakly (females) to moderately (males) undulated anterior margins. Snout relatively short and bluntly angled, its tip a little marked off. Tail solid and somewhat shorter than disc from snout tip to its rear margins. **Squamation:** Upper disc only partly spinulose in juveniles but wholly prickly in adults. Few separate thorns in front of and behind eyes often reduced in large adults; median row of 3-7 thorns along nape and a thorn usually on mid-shoulder, whereas thorns on shoulders mostly missing. A regular median row of 40-45 relatively small thorns along back of trunk and onto tail to first dorsal fin in juveniles and larger females, these thorns often reduced on back of trunk in adult males and also large adult females, so that between 19 and less than 40 remain on tail only. Irregular parallel thornlets may occur on outer back of tail in large adults. Lateral thorns along lower edges of tail often present in juveniles and larger females, usually missing in large males. Dorsal fins separate, 1-2 median thorns in interspace. Underside of disc largely smooth in juveniles, with spinules only on snout and along front margins but extending along midbody in large specimens. **Colour:** Upper surface ochre to various shades of lighter brown, with few pale spots or blotches on disc and constant pattern of numerous small, circular blackish spots extending to the very outer edges of disc, posterior pelvic lobes and along tail. Dark spots rather regularly encircling pale spots and blotches to form eye-spot-like components. Underside white. **Dentition:** 60-90 rows of small pointed teeth in both sexes, the high count being obvious when looking into the mouth. **Size:** A medium-sized species growing to maximum of about 120 cm total length and up to 20 kg weight, but usually found of smaller size only.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward along western side of Ireland and Britain to the Shetlands and western North Sea, also English Channel and western Mediterranean. Bottom dwelling on the shelf from inshore to about 100 m depth but most common on sandy grounds at around 40 m depth.

①② *Raja (Raja) montagui* Fowler, 1910

Spotted Ray/Skate

[Raie douce (F), Raya pintada (E)]

FIELD CHARACTERS: Disc rhombic, with wing tips more or less acutely angled at about 90° and weakly (juveniles and females) to moderately (males) undulated anterior margins. Snout relatively short and bluntly angled, its tip a little marked off. Tail moderately slender and somewhat shorter than disc from snout tip to its rear margins. **Squamation:** Upper surface of disc nearly smooth in young, but increasingly spinulose in larger specimens, except for bare centres and hind parts of pectoral wings. Juveniles with few separate thorns in front of and behind eyes, as well as 2-5 median thorns on nape and 1-2 on each shoulder, which all often reduced or missing in large adults. A median row of 20-50 relatively distinct thorns usually persisting along back of trunk onto tail to first dorsal fin, but the number of thorns on trunk may be reduced in large specimens. Irregular parallel thornlets may develop along outer back of tail with growth. Lateral thorns along lower edges of tail mainly present in juveniles, but are irregularly spaced to scarce in large individuals. Dorsal fins separate, with 1-2 thorns in interspace. Underside of disc largely smooth, except for narrow bands of spinules along front margins and small prickly patches in gill region and on belly in larger specimens. **Colour:** Upper surface a warm brown, with constant pattern of numerous circular blackish spots not extending to the extreme margins of disc and posterior pelvic lobes and along tail. Some pale spots and blotches may occur on disc, and frequently a large pale blotch on posterior centre of wing is encircled by black spots giving the appearance of an eye-spot on each wing, with dark spots also in centre. Underside white. **Dentition:** Jaw teeth pointed in adult males, blunt in juveniles and adult females and set in 38-60 rows in upper jaw, mostly distinctly less than 60 rows. **Size:** A medium-sized species growing up to about 75 cm total length and 50 cm in width with a weight hardly exceeding about 3.5-4 kg. Fully grown males remain smaller than females.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to the Shetlands, English Channel, North Sea (except for southeastern part), Skagerrak and Kattegat, also in western Mediterranean. Bottom dwelling on the shelf from deeper inshore waters at about 25 m to about 120 m depth. More common than the Blonde Ray.

①③ *Raja (Raja) clavata* Linnaeus, 1758

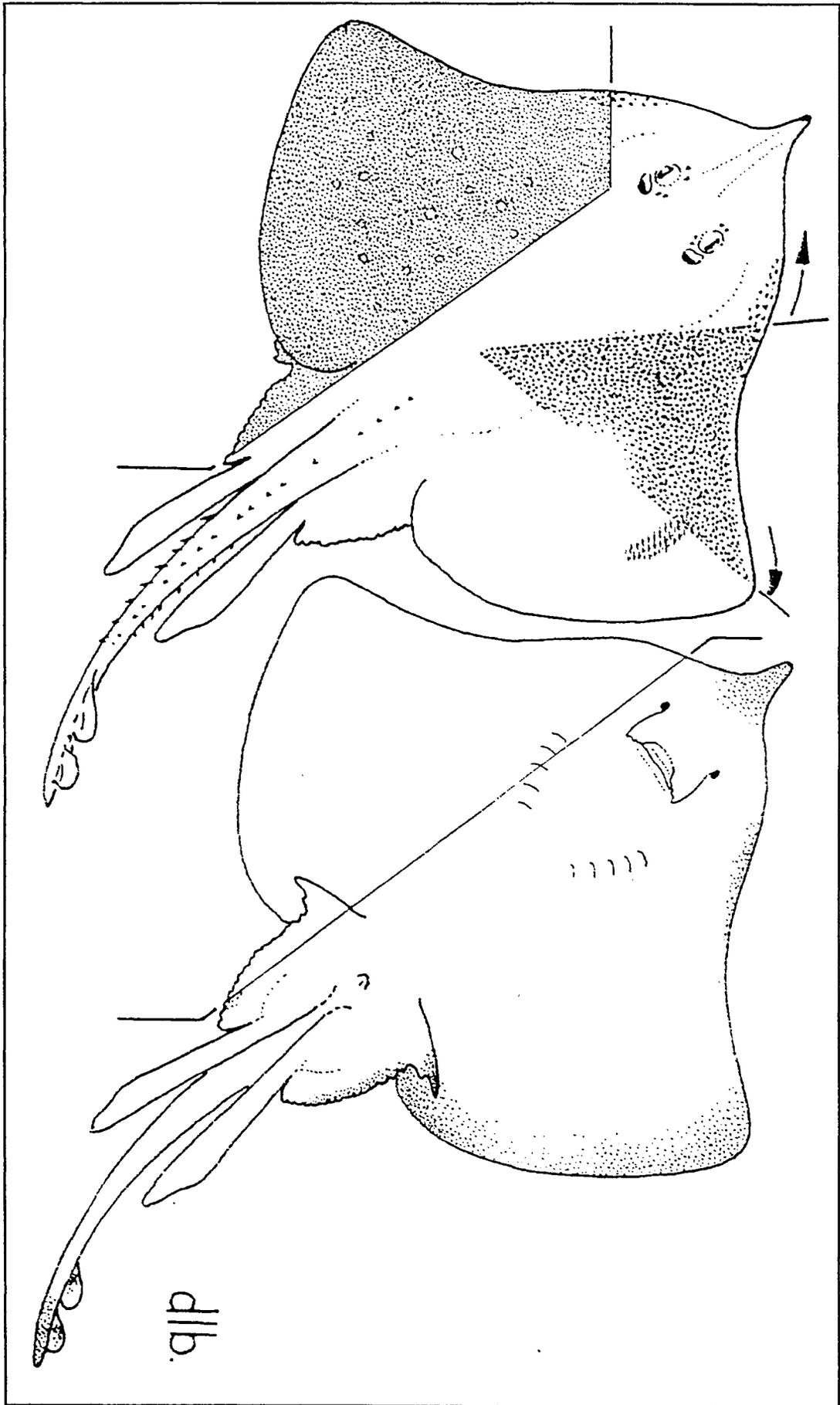
Thornback Ray/Skate, Roker

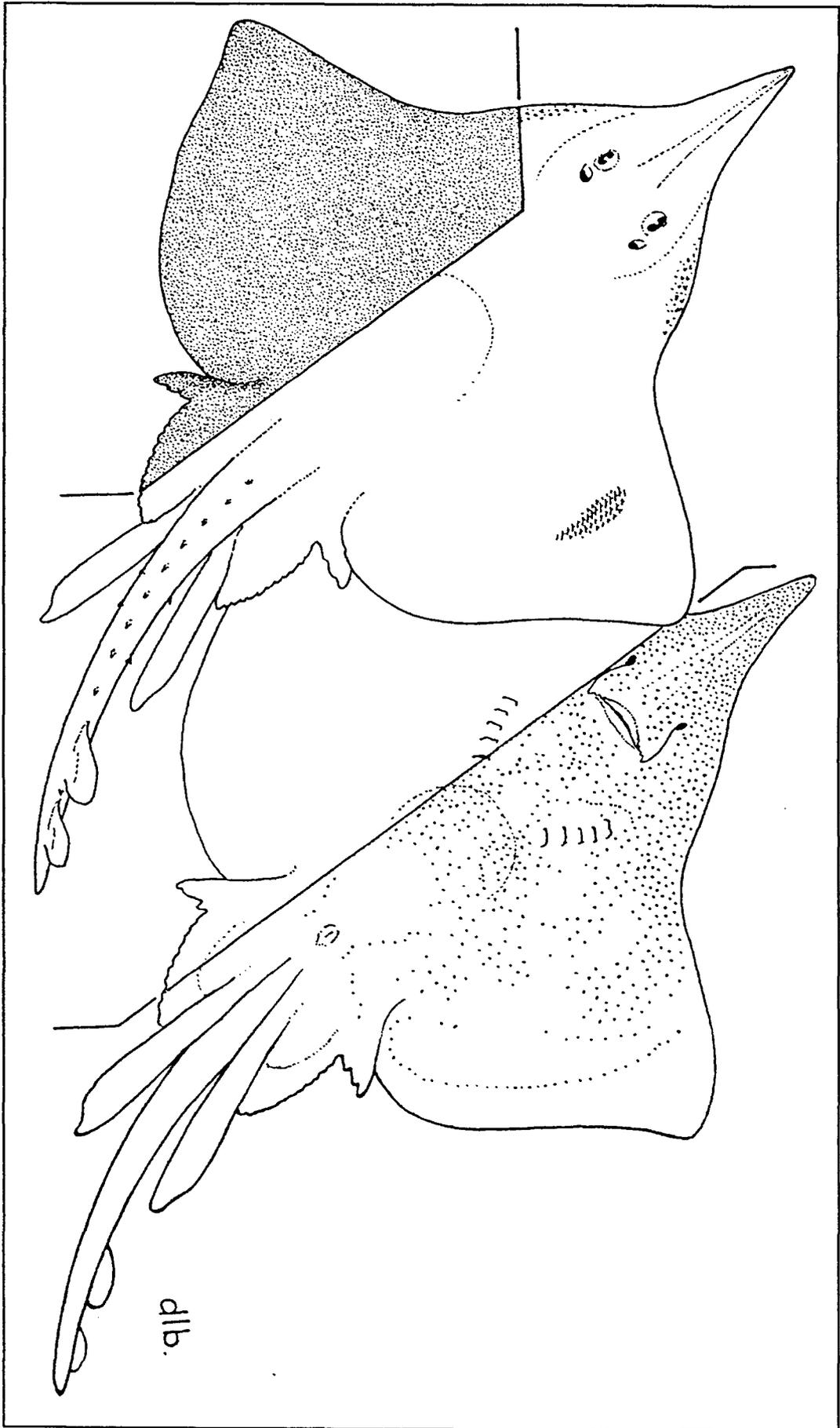
[Raie bouclée (F), Raya de clavos (E)]

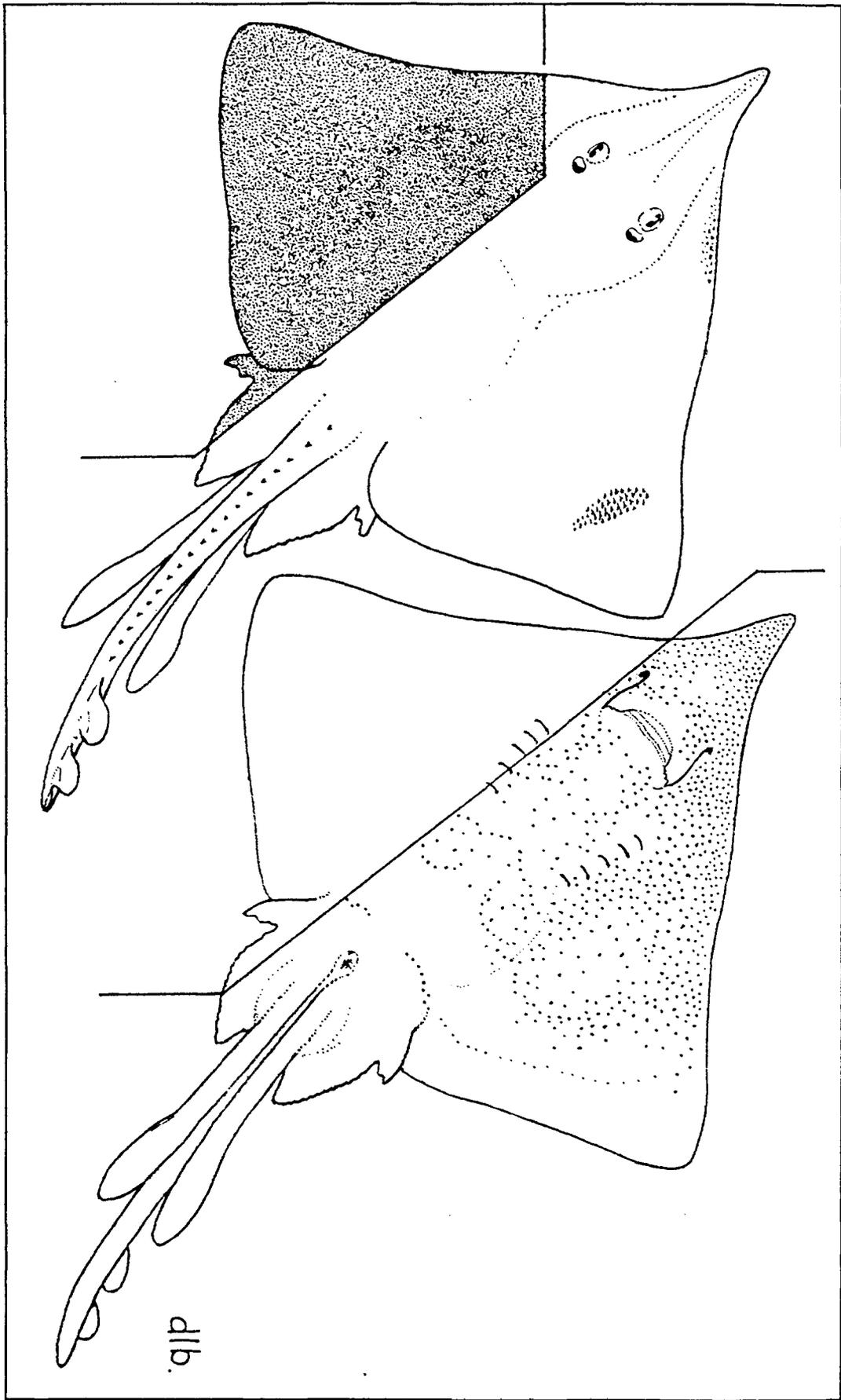
FIELD CHARACTERS: Disc broadly rhombic, with wing tips acutely angled at less than 90° and weakly (juveniles and females) to distinctly (adult males) undulated front margins. Snout relatively short and more or less bluntly angled at about 100°-125°, its tip a little marked off. Tail solid and at most about as long as disc from snout tip to its rear margins. **Squamation:** Upper side always wholly rough and densely spinulose, even in early juveniles. Few thorns in front of and behind eyes separate, and 1-4 median ones on nape, 2-3 on midshoulder, and 1-2 on each shoulder. A regular median row of 25-45 distinct thorns from behind shoulder girdle along back of trunk onto tail to first dorsal fin, and 0-2 thorns between separate dorsal fins; median thorns on trunk becoming more or less reduced especially in mature males. Parallel thornlets on outer back of tail may occur, and strong lateral thorns along lower edges of tail develop particularly in large females. Additional large thorns with button-like 'swollen', smooth base (called 'bucklers') appearing on back of trunk and sides of tail regularly in large specimens and are scattered also on upper wings; particularly large females show such 'buckler' thorns scattered also on underside of disc and develop irregular strong lateral thorns along lower edges of tail. Underside almost entirely spinulose in large females, whereas juveniles and large males have spinules mainly on snout and at front margins of disc. **Colour:** Upper side extremely variable with all shades of brown to greyish, variegated with dark and light spots and blotches, often mottled and marbled and producing reticulate pattern and eye-spot-like structures, but also plain coloured specimens reported. Juveniles tend to be spotted rather, whereas adults become mottled and marbled mostly. Tail usually with distinct light and dark cross-bars. Underside white, with faint greyish margin around disc. **Dentition:** Tooth rows in upper jaw about 35-57, teeth of mature males in parallel rows and sharply pointed. **Size:** A medium-sized species growing to about 90 cm total length and 60 cm in width, when attaining a weight of up to 14 kg. Adult female always growing larger than largest mature males.

DISTRIBUTION and HABITAT: NE Atlantic coasts northward to Faroes, Iceland and Norway (south of Arctic Circle), North Sea, Skagerrak and Kattegat, western Baltic

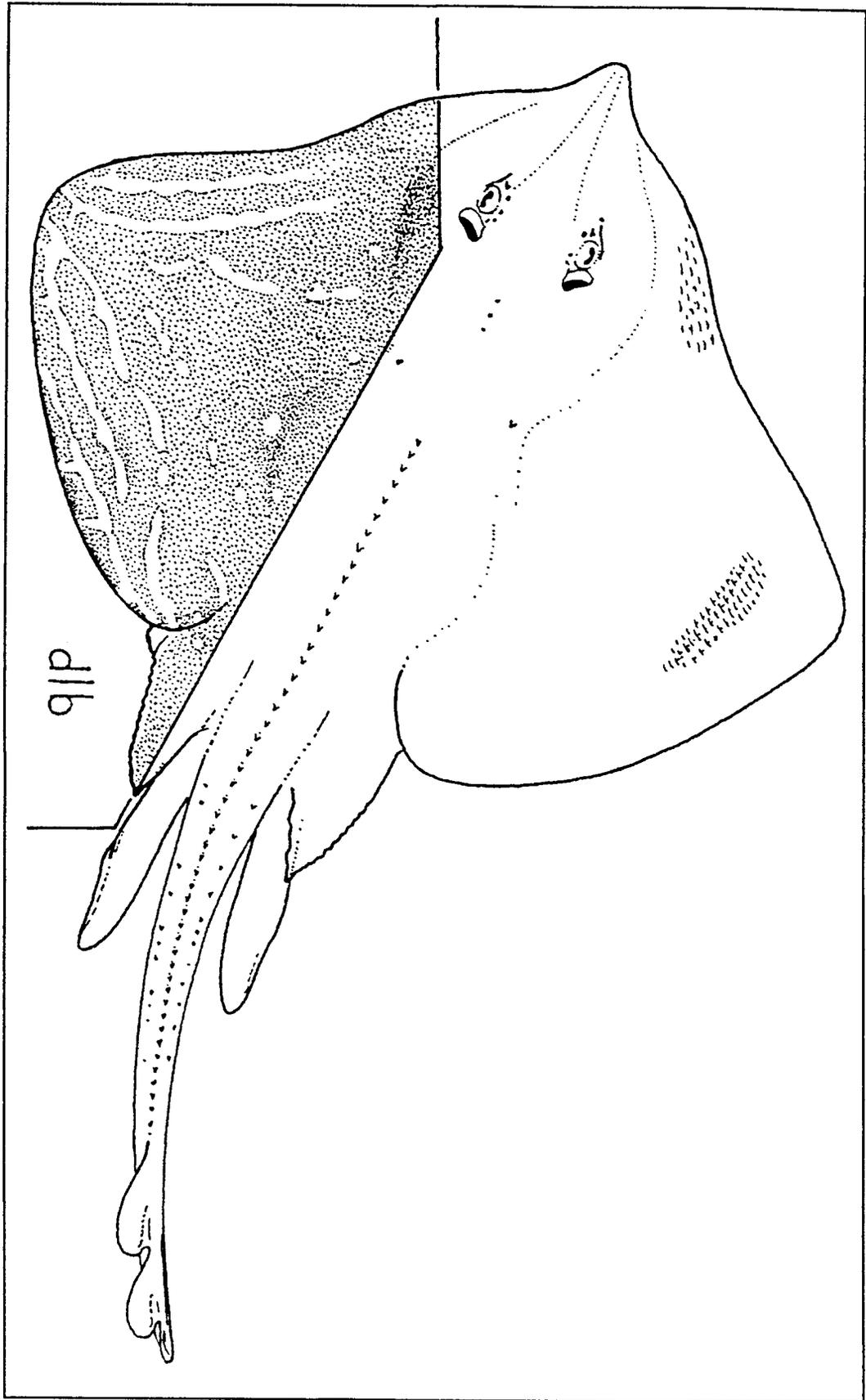
Sea (rare) and entire Mediterranean, as well as Black Sea. Wide spread farther south along West Africa (except on tropical shelf) to South Africa and in SW Indian Ocean. Bottom dwelling on shelf and upper slope from inshore to about 300 m depth on all kinds of bottom substrate but rare on rough grounds. Moderately common species mainly between 10 and 60 m depth.

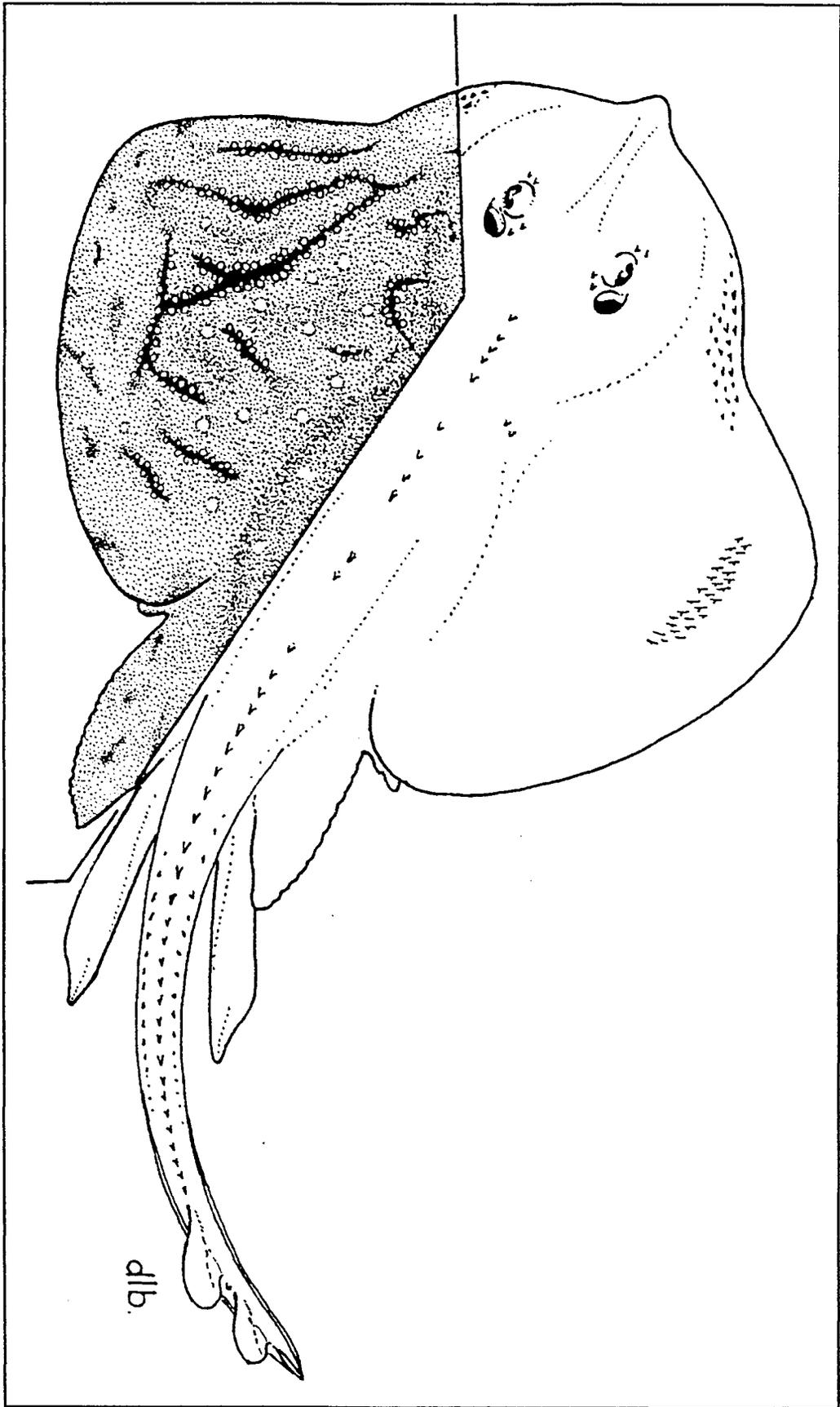


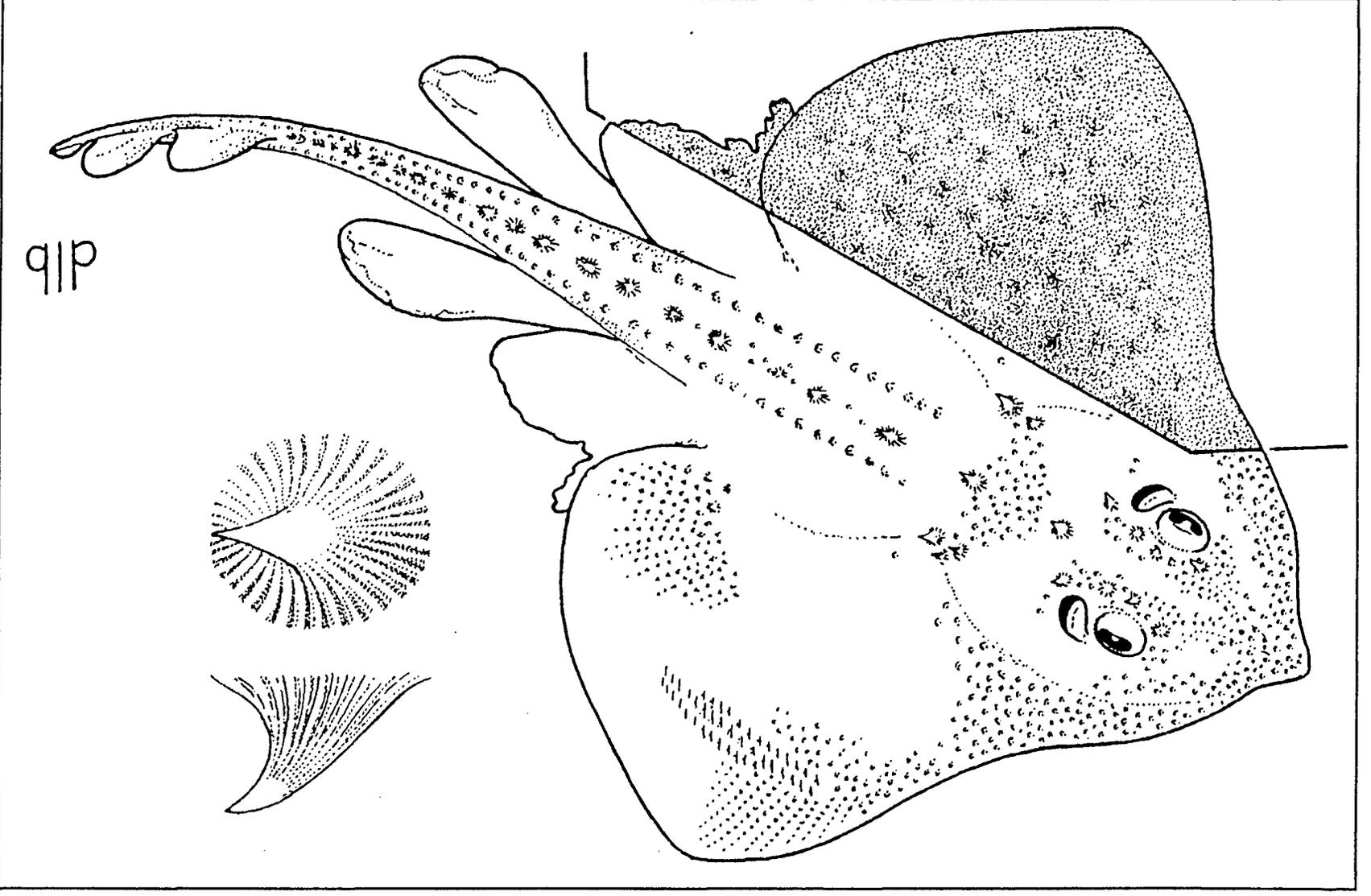




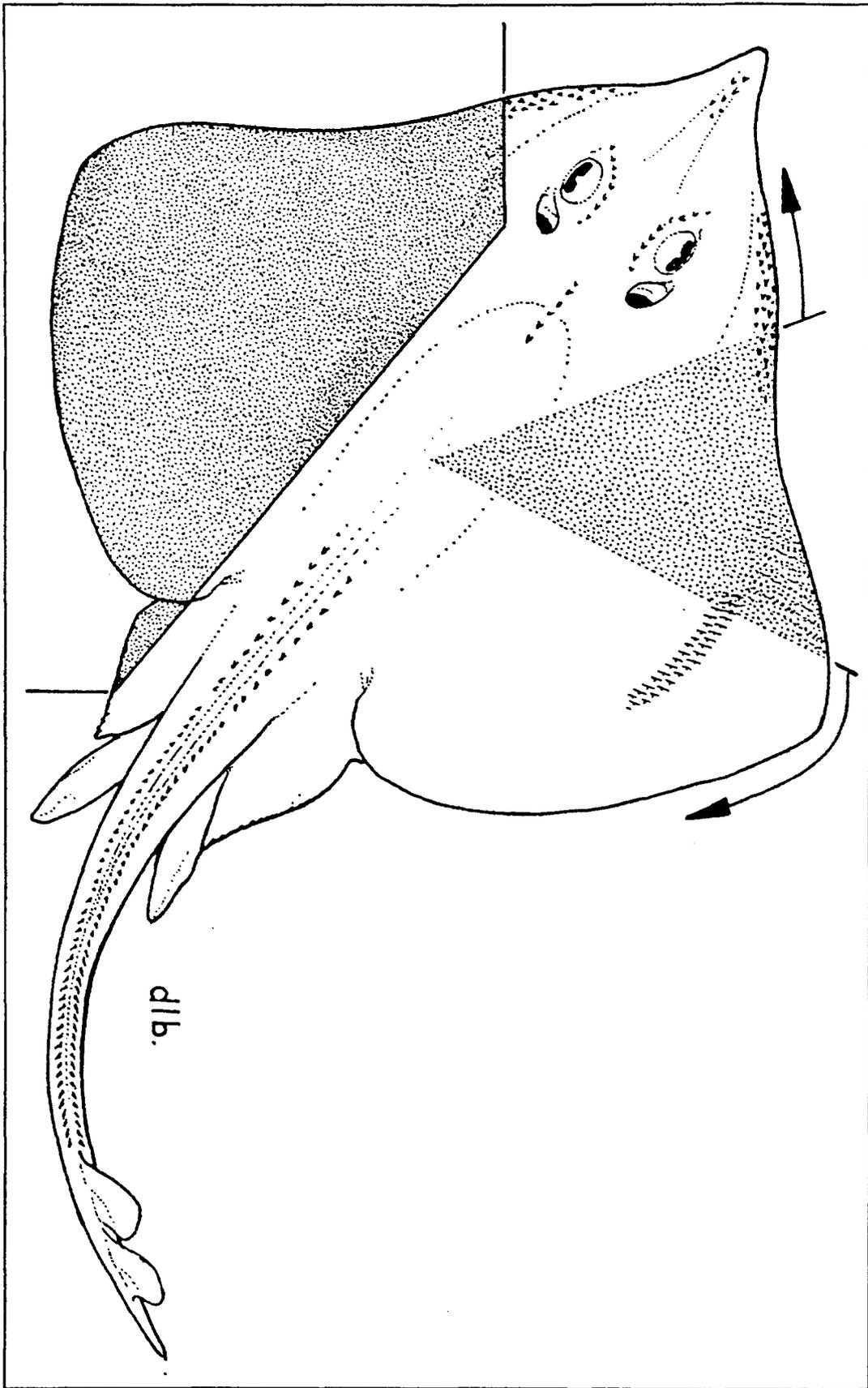
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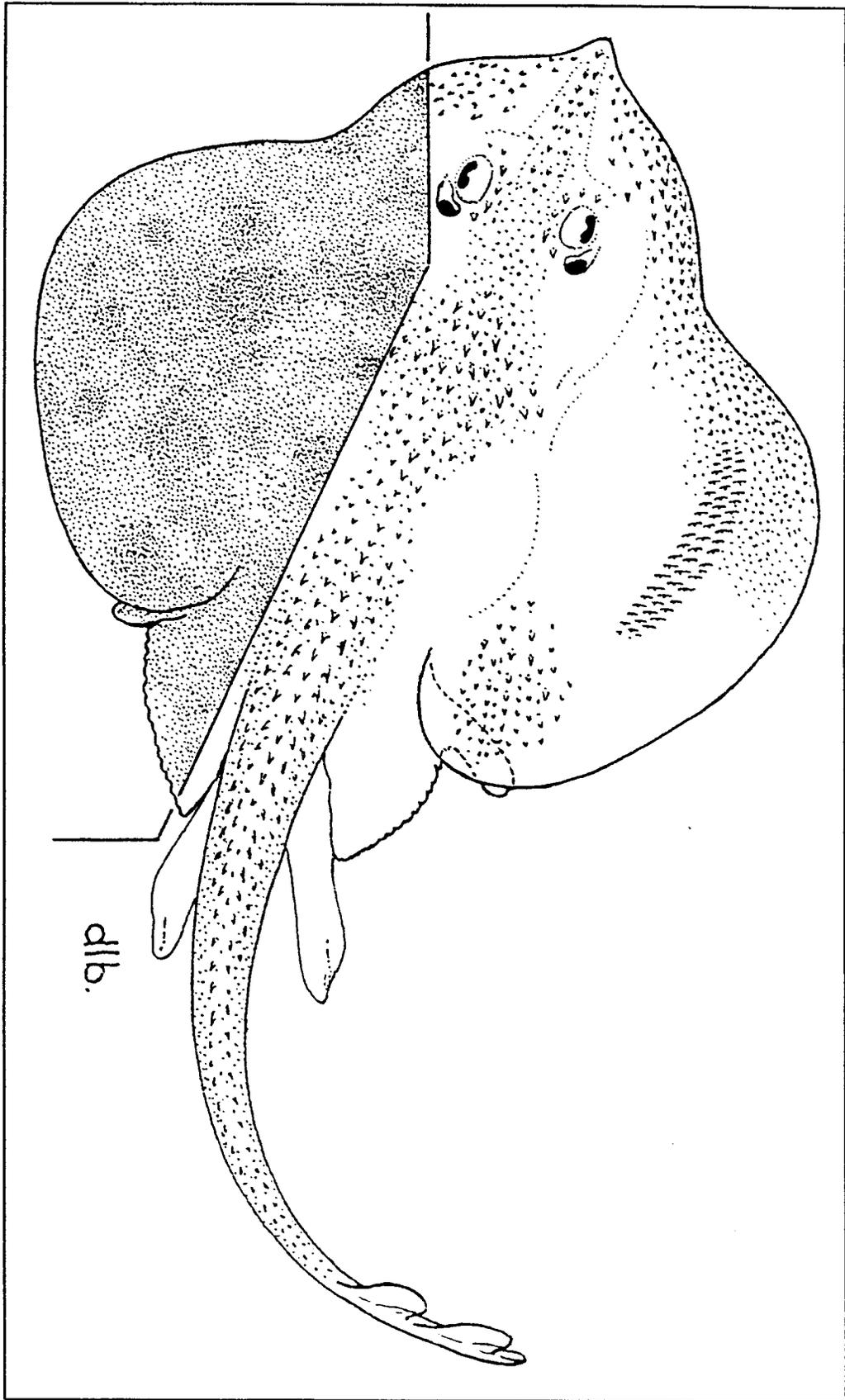


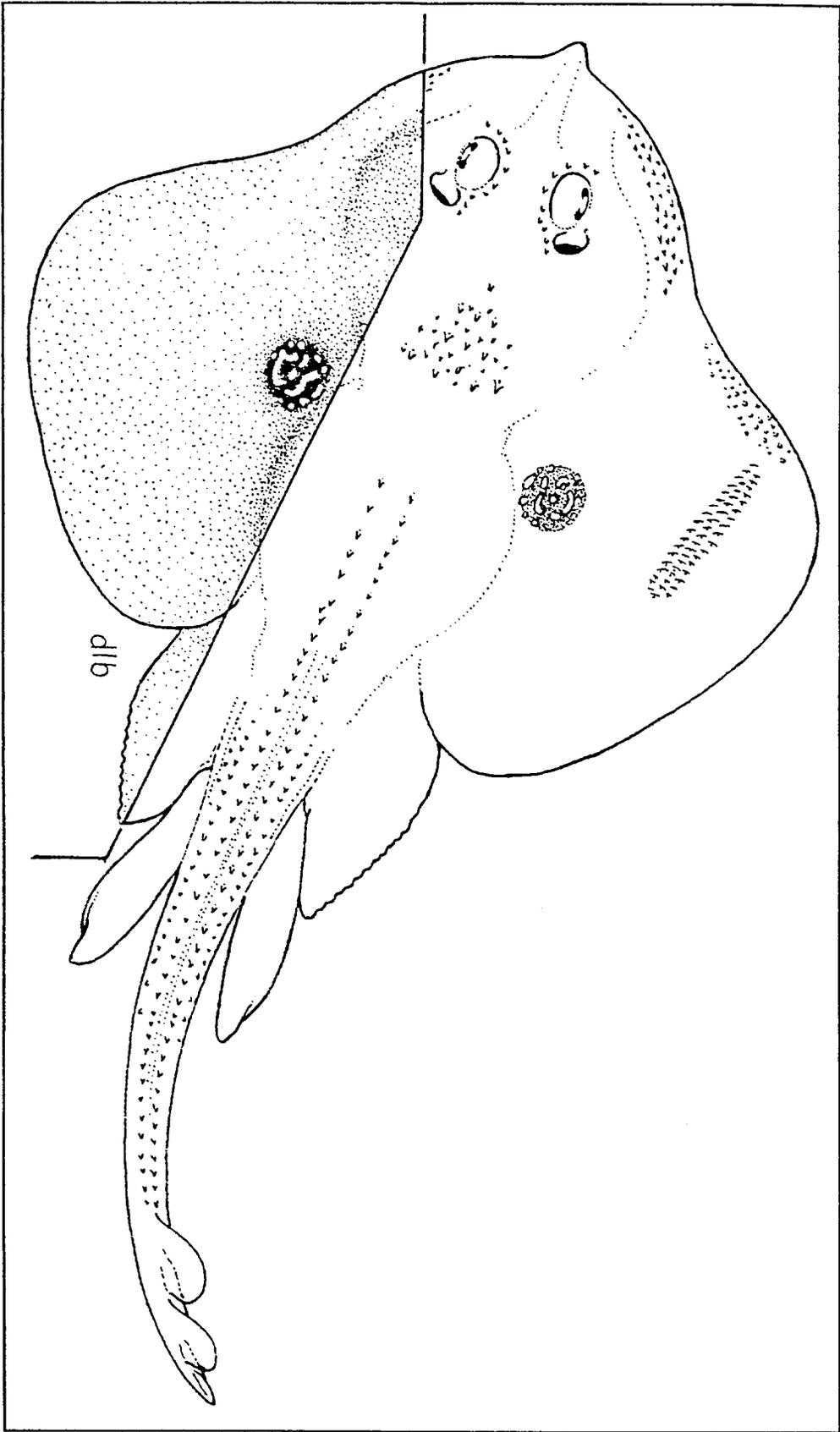


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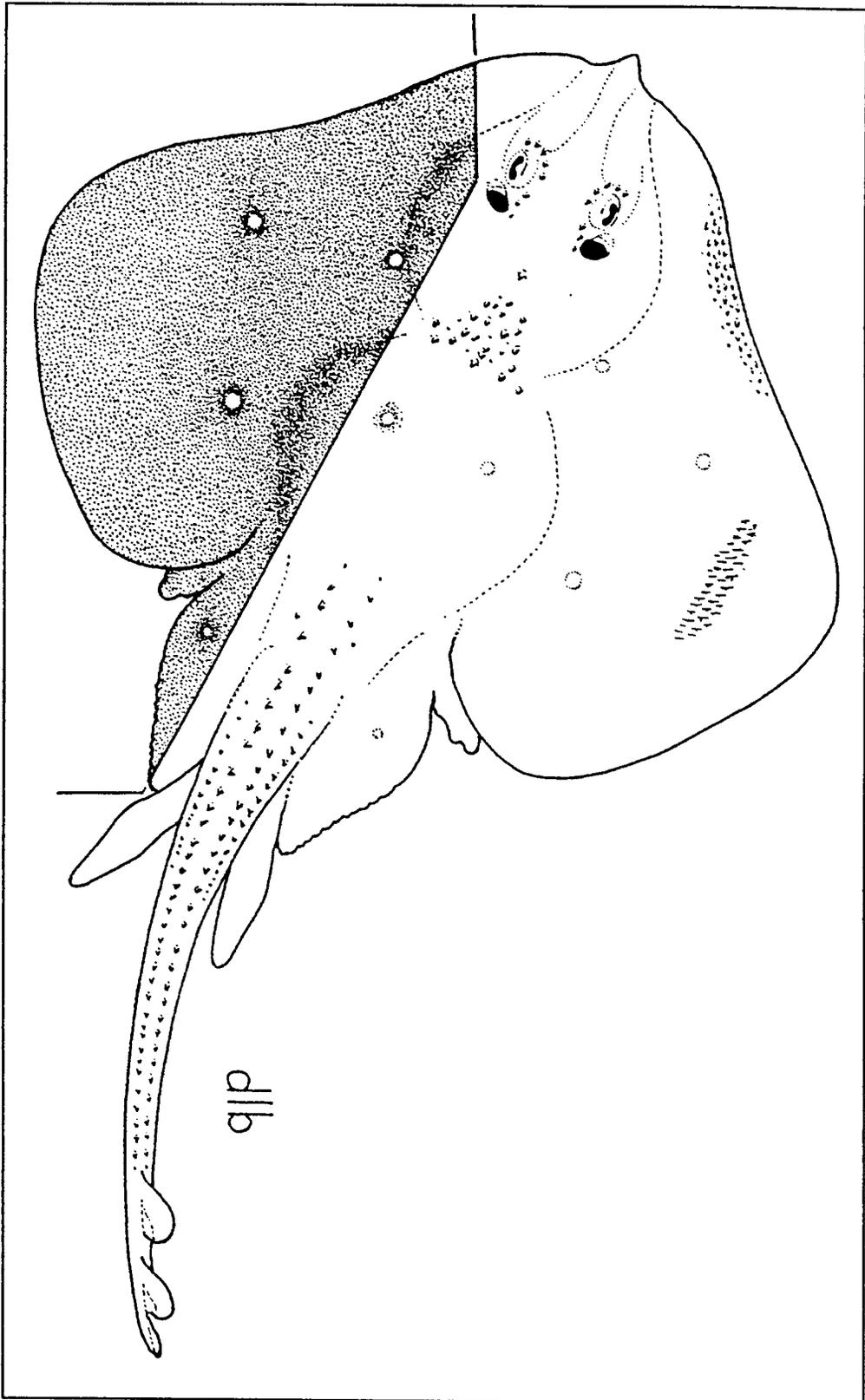


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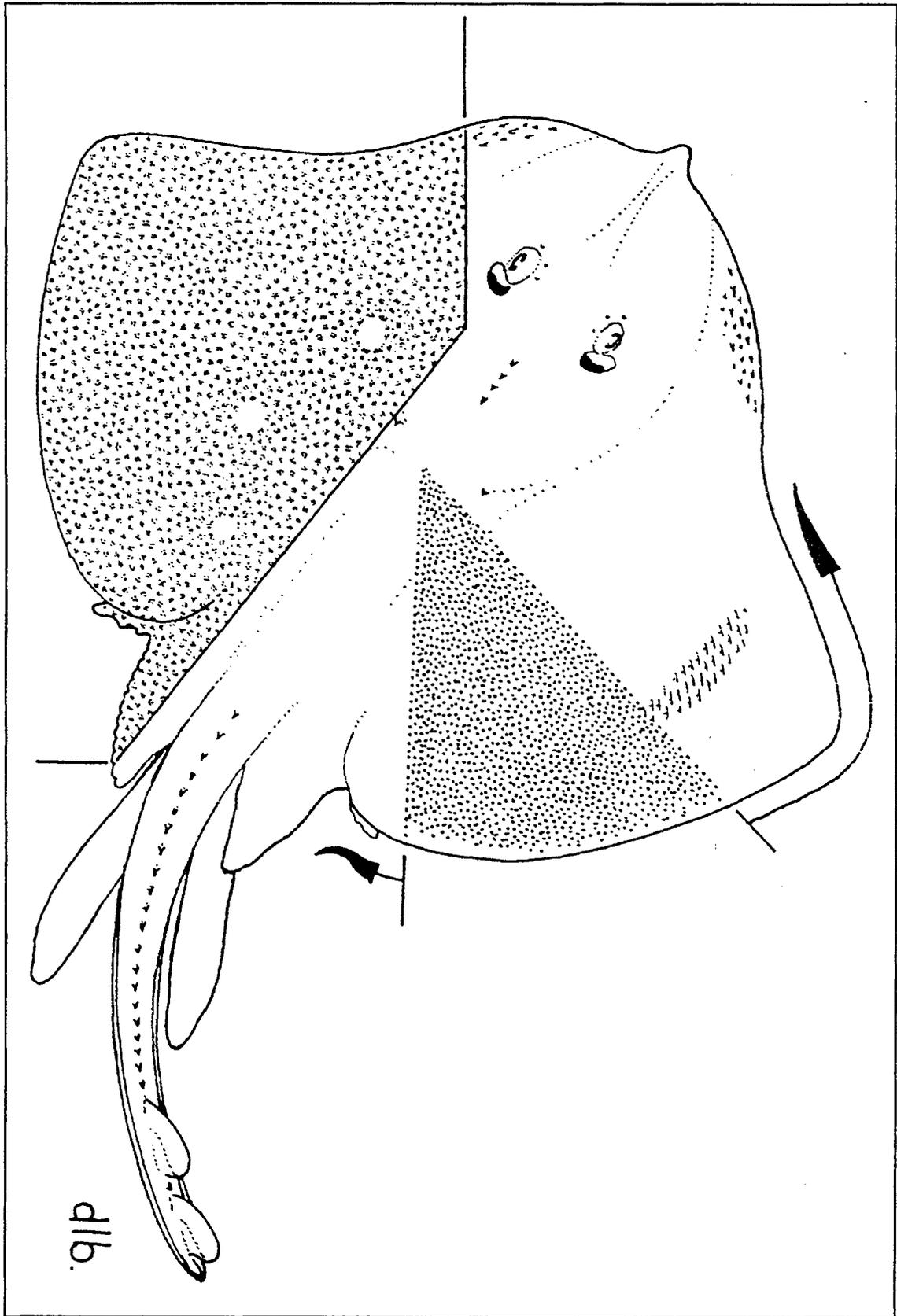


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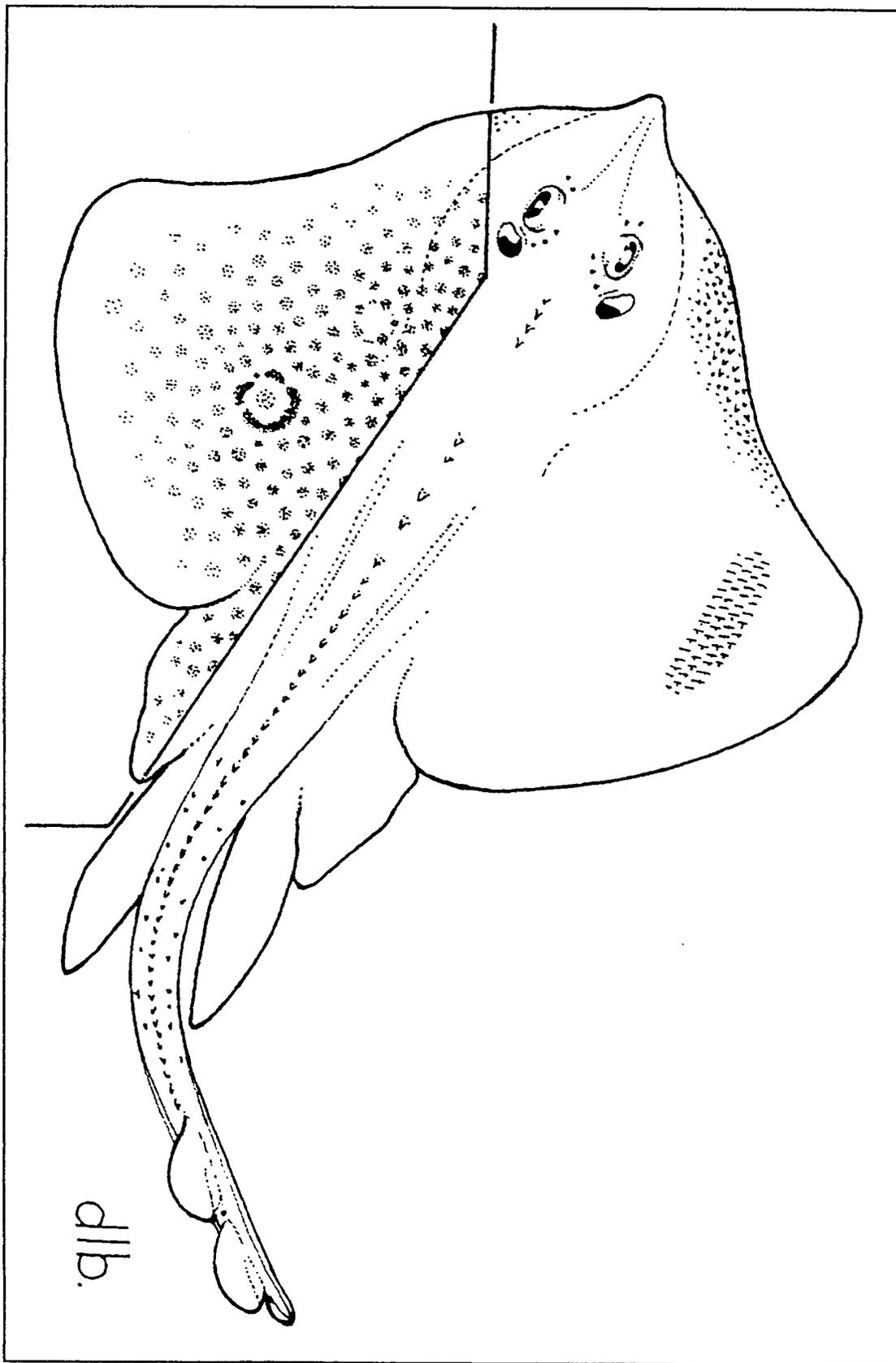


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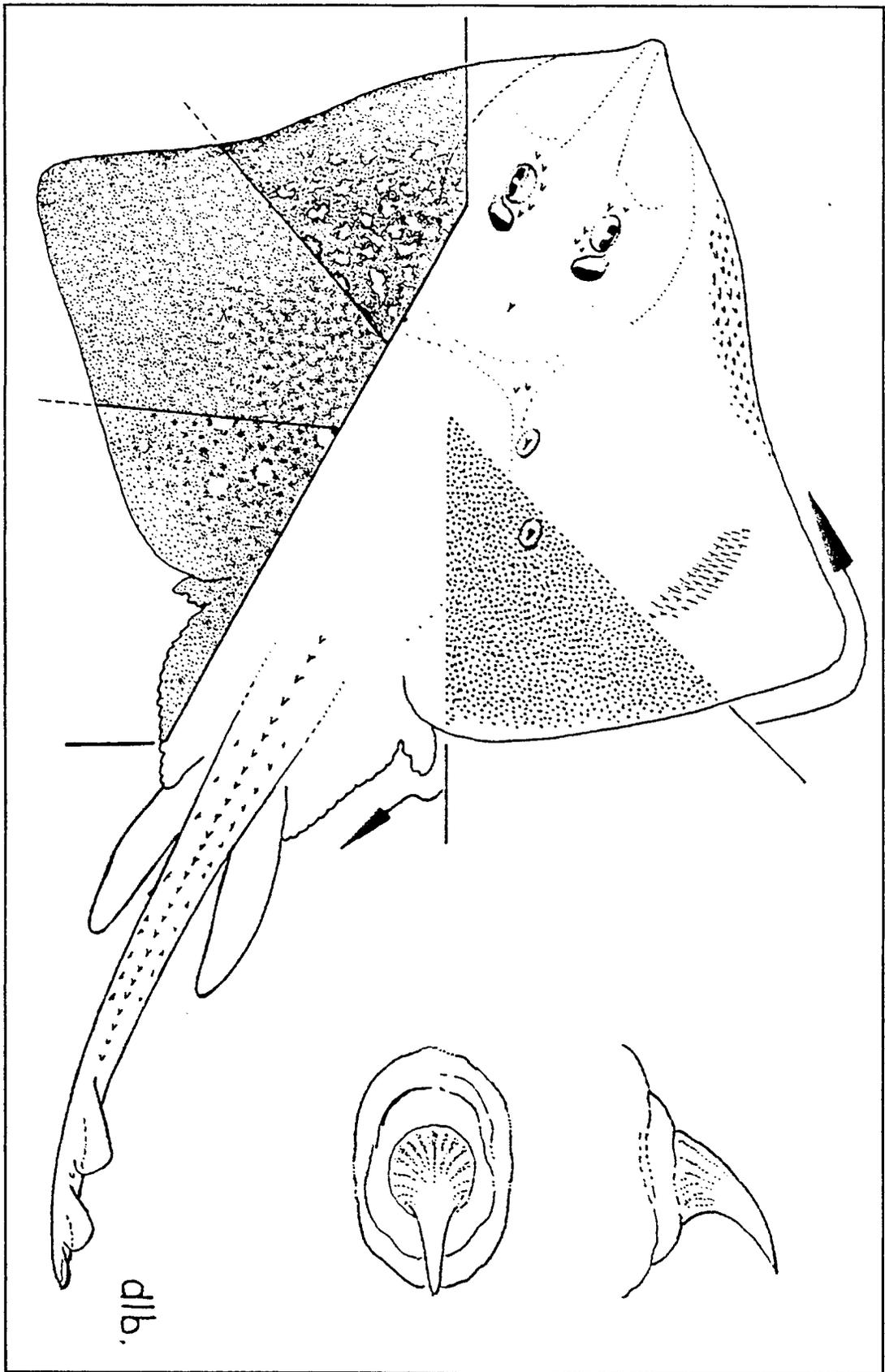
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