

COSEWIC

Assessment and Status Report

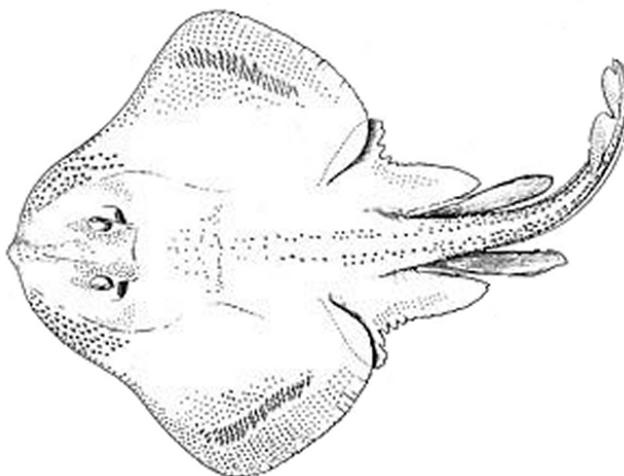
on the

Winter Skate

Leucoraja ocellata

in Canada

Southern Gulf population
Eastern Scotian Shelf population
Georges Bank-Western Scotian Shelf-Bay of Fundy population
Northern Gulf-Newfoundland population



SOUTHERN GULF POPULATION - ENDANGERED
EASTERN SCOTIAN SHELF POPULATION - THREATENED
GEORGES BANK-WESTERN SCOTIAN SHELF-BAY OF FUNDY
POPULATION - SPECIAL CONCERN
NORTHERN GULF-NEWFOUNDLAND POPULATION - DATA DEFICIENT
2005

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC 2005. COSEWIC assessment and status report on the winter skate *Leucoraja ocellata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 41 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note:

COSEWIC would like to acknowledge Jerome Howlett for writing the status report on the winter skate *Leucoraja ocellata* prepared under contract with Environment Canada, overseen and edited by Jeffrey Hutchings, a COSEWIC member-at-large.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
<http://www.cosewic.gc.ca>

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la raie tachetée (*Leucoraja ocellata*) au Canada.

Cover illustration:

Winter skate — Drawing of *Leucoraja ocellata* (winter skate) from Scott & Scott (1988).

©Her Majesty the Queen in Right of Canada 2005
Catalogue No. CW69-14/439-2005E-PDF
ISBN 0-662-40624-9
HTML: CW69-14/439-2005E-HTML
0-662-40625-7



Recycled paper



COSEWIC Assessment Summary

Assessment Summary – May 2005

Common name

Winter Skate (Southern Gulf population)

Scientific name

Leucoraja ocellata

Status

Endangered

Reason for designation

The species possesses life history characteristics that increase vulnerability to exploitation, that reduce rate of recovery, and that increase the risk of extinction. These characteristics include delayed age at maturity, long generation time, low fecundity, and consequently slow population growth rate. Narrow latitudinal ranges and a high degree of endemism have been documented for the skate family worldwide. This population appears to have a restricted distribution, based on distributional maps of fisheries-independent survey catches. Individuals from this population mature at a significantly smaller size than those found elsewhere in Canadian waters. Abundance of mature individuals in the Southern Gulf of St. Lawrence is estimated to have declined 98% since the early 1970s, and is now at a historically low level. The probable cause of decline is an unsustainable rate at which they were captured as bycatch in fisheries directed at other groundfish species.

Occurrence

Atlantic Ocean

Status history

Designated Endangered in May 2005. Assessment based on a new status report.

Assessment Summary – May 2005

Common name

Winter skate (Eastern Scotian Shelf population)

Scientific name

Leucoraja ocellata

Status

Threatened

Reason for designation

The species possesses life history characteristics that increase vulnerability to exploitation, that reduce rate of recovery, and that increase the risk of extinction. These characteristics include delayed age at maturity, long generation time, low fecundity, and consequently slow population growth rate. Narrow latitudinal ranges and a high degree of endemism have been documented for the skate family worldwide. This population appears to have a restricted distribution, based on distributional maps of fisheries-independent survey catches. Individuals from this population mature at a significantly larger size than those in the Southern Gulf and have been reported to mature at a significantly different age than those inhabiting waters further south. Abundance of mature individuals on the Eastern Scotian Shelf is estimated to have declined by more than 90% since the early 1970s and is now at a historically low level. The area occupied by the population appears to have declined significantly since the mid 1980s. Larger, older individuals have been severely depleted from this population, producing a significant truncation in the length distribution of the population over time. The probable cause of the decline is an unsustainable rate at which they were captured as bycatch in fisheries directed at other groundfish species. They have been caught, and continue to be caught, in a directed fishery for skate, although current reported catches are low.

Occurrence

Atlantic Ocean

Status history

Designated Threatened in May 2005. Assessment based on a new status report.

Assessment Summary – May 2005

Common name

Winter skate (Georges Bank-Western Scotian Shelf-Bay of Fundy population)

Scientific name

Leucoraja ocellata

Status

Special Concern

Reason for designation

The species possesses life history characteristics that increase vulnerability to exploitation, that reduce rate of recovery, and that increase the risk of extinction. These characteristics include delayed age at maturity, long generation time, low fecundity, and consequently slow population growth rate. The area of occupancy of this species has been stable. Estimates of population status on Georges Bank show no discernible trend over time. Abundance elsewhere appears to have been stable over time. There is a high probability that the population receives immigrants from the species inhabiting the American portion of Georges Bank. The population is subjected to bycatch in fisheries for other groundfish shellfish species. There are directed fisheries for this species in U.S. waters.

Occurrence

Atlantic Ocean

Status history

Designated Special Concern in May 2005. Assessment based on a new status report.

Assessment Summary – May 2005

Common name

Winter skate (Northern Gulf-Newfoundland population)

Scientific name

Leucoraja ocellata

Status

Data Deficient

Reason for designation

The species exists in low concentrations in the Northern Gulf of St. Lawrence, in the coastal waters off the southern coast of Newfoundland, and on the southern portion of the Grand Bank. A quantitative analysis of spatial and temporal variation in population size is not possible because of the infrequency with which the species is caught. The population is subjected to bycatch.

Occurrence

Atlantic Ocean

Status history

Species considered in May 2005 and placed in the Data Deficient category. Assessment based on a new status report.



COSEWIC
Executive Summary

Winter Skate
Leucoraja ocellata

Species information

Winter skate (*Leucoraja ocellata* Mitchill 1815), also known as the big or eyed skate, are recognized by a flattened disc shape, greatly enlarged wing-like fins, and long tail. The upper surface is usually light to dark brown with a large white eyespot near the rear corner of the pectoral fins, which helps distinguish them from other species of skate.

Distribution

Winter skate are endemic to the Northwest Atlantic and are found from the northern Gulf of St. Lawrence and southern Newfoundland to Cape Hatteras, North Carolina. In Canadian waters, skate are concentrated in 3 areas: southern Gulf of St. Lawrence, eastern Scotian Shelf, and the Canadian portion of Georges Bank. Winter skate have been assessed as four Designatable Units: Southern Gulf of St. Lawrence population, Eastern Scotian Shelf population, Georges Bank-Western Scotian Shelf-Bay of Fundy population, and Northern Gulf-Newfoundland population.

Habitat

The winter skate is a bottom-dwelling species, usually found on sand and gravel. They occur at depths of up to 371 m, but are most common at depths less than 111 m. Most are caught in waters ranging between 5 and 9°C (range: -1.2 to 19°C).

Biology

Very little is known about the biology of winter skate. They grow slowly and reach sexual maturity between 7 and 13 years at lengths estimated to range between 50 cm and 75 cm. Maximum age has been estimated to be as high as 30 years. Generation time is estimated to be between 17 and 22 years. Fecundity ranges between 6 and 50 eggs. Spawning has been reported to occur in late summer/early autumn. The diet consists mainly of rock crab and squid, as well as worms, amphipods, shrimp, clams and small fish.

Population sizes and trends

Population size and trends in abundance can be estimated from fisheries-independent surveys. Estimates of minimum total abundance are 100,000 for the Southern Gulf population, 750,000 for the Eastern Scotian Shelf population, and 1.7 million for the Georges Bank-Western Scotian Shelf-Bay of Fundy population; abundance has not been estimated for the Northern Gulf-Newfoundland population. Since the early 1970s, mature winter skate are estimated to have declined 98% in the Southern Gulf and more than 90% on Eastern Scotian Shelf. There is no discernible trend in the abundance of mature skate in the Georges Bank-Western Scotian Shelf-Bay of Fundy population. Abundance trend information for the Northern Gulf-Newfoundland population is unavailable because of the rarity of the species in these waters. Winter skate on the U.S. portion of Georges Bank, although not defined as being overfished, are at low levels relative to their abundance in the mid-1980s.

Limiting factors and threats

Narrow latitudinal ranges and a high degree of endemism have been documented for the skate family worldwide. Of 58 documented marine fish extirpations, 13 have been experienced by members of the skate family (Rajidae). Winter skate possess life history characteristics that increase vulnerability to exploitation, that reduce rate of recovery, and that increase risk of extinction. These characteristics include delayed age at maturity, large size at birth, long generation time, low fecundity, and consequently slow population growth rate. In Canadian waters, winter skate are subject to capture as bycatch in fisheries for other groundfish species (notably flatfishes) and, on Georges Bank, for scallops. The Eastern Scotian Shelf population is subjected to a small, directed fishery.

Special significance of the species

Winter skate are endemic to the western North Atlantic with a considerable portion of their range in Canadian waters. They are among the most ancient of extant species of vertebrates. The species has, at various times, supported a directed fishery.

Existing protection or other status designations

In Canadian waters, commercial catches are regulated by the Department of Fisheries and Oceans. All populations in Canadian waters are subject to bycatch. The only directed fishery in Canadian waters is a limited one that exists on the eastern Scotian Shelf, where annual Total Allowable Catches (TACs) have declined from 2000t in 1994 to 200t, a TAC set initially in 2002. Winter skate have no status under IUCN.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.



Environment
Canada

Canadian Wildlife
Service

Environnement
Canada

Service canadien
de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Winter Skate *Leucoraja ocellata*

in Canada

Southern Gulf population
Eastern Scotian Shelf population
Georges Bank-Western Scotian Shelf-Bay of Fundy population
Northern Gulf-Newfoundland population

2005

TABLE OF CONTENTS

SPECIES INFORMATION.....	4
Name and classification.....	4
Description.....	4
Designatable units	5
DISTRIBUTION.....	9
Global range	9
Canadian range	10
HABITAT	10
Habitat requirements	10
Trends	10
Protection/ownership	11
BIOLOGY	11
General.....	11
Reproduction	11
Survival.....	13
Movements/dispersal.....	13
Nutrition and interspecific interactions	13
Behaviour/adaptability	14
POPULATION SIZES AND TRENDS.....	14
Southern Gulf Population.....	14
Eastern Scotian Shelf Population	16
Georges Bank-Western Scotian Shelf-Bay of Fundy Population	25
Northern Gulf-Newfoundland Population	27
LIMITING FACTORS AND THREATS	28
SPECIAL SIGNIFICANCE OF THE SPECIES	29
EXISTING PROTECTION OR OTHER STATUS	29
SUMMARY OF STATUS REPORT	29
TECHNICAL SUMMARY – Southern Gulf population	31
TECHNICAL SUMMARY – Eastern Scotian Shelf population.....	33
TECHNICAL SUMMARY – Georges Bank-Western Scotian Shelf-Bay of Fundy population.....	35
TECHNICAL SUMMARY – Northern Gulf-Newfoundland population.....	37
ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED.....	39
INFORMATION SOURCES	39
BIOGRAPHICAL SUMMARY OF REPORT WRITER	41

List of figures

Figure 1. Drawing of <i>Leucoraja ocellata</i> (winter skate) from Scott & Scott (1988).	4
Figure 2. Composite map of the Western Atlantic distribution of winter skate (<i>Leucoraja ocellata</i>) from the ECNASAP database.	6
Figure 3. Map showing the NAFO (Northwest Atlantic Fishery Organization) Divisions that are used as a spatial basis for the management of pelagic and groundfish stocks in the Northwest Atlantic Ocean.....	8

Figure 4.	Boundaries of the four Designatable Units of winter skate in Canadian waters.	9
Figure 5.	Log catch per unit effort (CPUE) of winter skate (50-74cm) from DFO standardized fall research vessel surveys in the Southern Gulf of St. Lawrence from 1971-2001.....	15
Figure 6.	The CPUE of winter skate from Fall RV survey data as actual number per tow for the size classes 0-35, 36-59 and 60-74cm in the Southern Gulf of St. Lawrence (Div 4T) from 1970 to 2002.....	15
Figure 7.	Total number of winter skate as estimated by the RV surveys in Div 4TVWX and 5Z.....	16
Figure 8.	Log catch per unit effort (CPUE) of mature winter skate (75 cm+) from DFO's Scotian Shelf Summer RV Survey (Div. 4VWX) from 1970-2003.....	17
Figure 9.	Distribution of winter skate (#/tow) from the Scotian Shelf Summer RV survey (Div 4VWX) for the years 1970-2002, aggregated into 4-year time blocks.....	18
Figure 10.	Distribution of winter skate (#/tow) from the Scotian Shelf Spring RV Survey (Div 4VWX) for the years 1979-1984, aggregated into 1-year time blocks.....	19
Figure 11.	Log catch per unit effort (CPUE) of mature winter skate (75 cm+) from the DFO 4VW Cod March RV Survey on the Scotian Shelf from 1986-2002.....	20
Figure 12.	Distribution of winter skate (#/tow) on the Scotian Shelf from the Spring 4VsW Cod Survey, aggregated into 4-year time blocks.....	21
Figure 13.	Log catch per unit effort (CPUE) of winter skate from the Fall Sentinel Survey from 1996-2001 on the Eastern Scotian Shelf.	22
Figure 14.	Total biomass (tonnes) of winter skate as calculated for strata 46-58 of the Scotian Shelf from the stratified Spring (1995-2002) and Fall (1995-1999) Industry Surveys.....	23
Figure 15.	Log catch per unit effort (CPUE) of mature winter skate (75 cm+) from DFO standardized winter research vessel surveys conducted on the Canadian portion of Georges Bank from 1986 to 2002.....	25
Figure 16.	Mean number and weight per tow of winter skate in the Georges Bank Winter RV Survey for the years 1986-2002.	26

SPECIES INFORMATION

Name and classification

Winter skate, *Leucoraja ocellata* (Mitchill 1815), belong to the Class Chondrichthyes, Subclass Elasmobranchii, Order Rajiformes and Family Rajidae (Figure 1). Other common names include big skate, eyed skate, spotted skate, and raie tachetée.

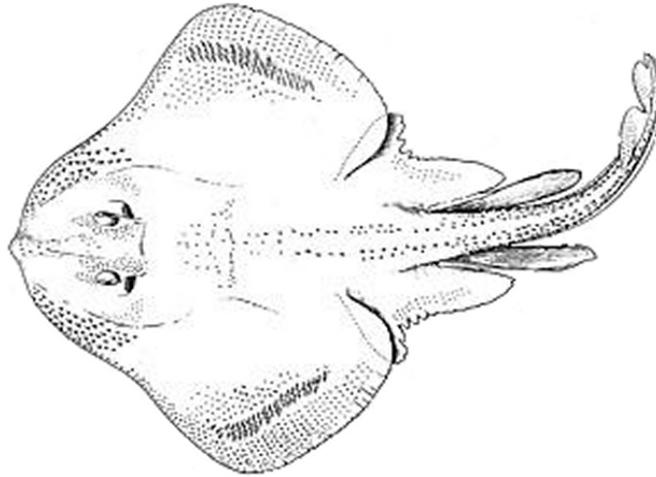


Figure 1. Drawing of *Leucoraja ocellata* (winter skate) from Scott & Scott (1988).

Description

Skate are found worldwide in the ocean from shallow waters to great depths. There are over 200 species. In Canada, there are 13 Atlantic species, 7 Pacific species, 1 Arctic species and 3 Arctic-Atlantic species (Coad, 1995). Skate are recognized by their flattened disc shape. The head, body and greatly enlarged pectoral fins are strongly depressed as a rhomboid or subcircular disc (Coad, 1995). The five gill openings and mouth are ventral. The spiracles are on the upper surface and enable clean water to be passed over the gills for respiration. The tail is a long structure with longitudinal lateral folds, slightly depressed in cross-section, having one or two small caudal fins on the posterior portion (Scott and Scott, 1988). There are two small dorsal fins, about equal in size and shape, set far back on the tail, and two pelvic fins appearing as separate limb-like structures, fan-like in females but modified to form claspers in males (Whitehead *et al.*, 1984). The upper surface is usually light to dark brown and the underside white to grayish in colour (Whitehead *et al.*, 1984).

In the Gulf of Maine, winter skate can be distinguished from other skate species, with the exception of little skate (*Leucoraja erinacea*), by a combination of the following

characters: the snout is very round and obtuse; the midbelt of the disc and tail bears three or more rows of thorns from the shoulder region to the origin of the first dorsal fin, with the mid-row disappearing with growth; and the upper surface is patterned with round dark spots and generally with one or more eye spots near the rear corner of the pectoral fins (Collette and Klein-MacPhee, 2002). However, specimens that lack these spots resemble little skate so closely when small (<35cm) that a distinction cannot be accurately made by visual inspection. (Note that this difficulty in distinguishing winter skate from little skate will not affect the abundance trend estimates reported here because the latter are presented for the mature part of the population only, excluding skate less than 35 cm in length.) Winter skate have more tooth rows in the upper jaw (but the numbers vary with size) and more spines (usually >21) on the midline of the tail than do little skate (Collette and Klein-MacPhee, 2002). Winter skate are also distinguished by their wedge-shaped anterior contour, by the lack of large, conspicuous thorn-like spines behind the shoulders and on posterior part of the tail, and by the dense prickled lower surface (except extreme tip) of the tail (Scott and Scott, 1988). The colour of the upper surface is light brown and the lower surface is usually whitish, sometimes with irregular brownish blotches on the posterior portion of the disc and tail (Scott and Scott, 1988).

Designatable units

There is reason to believe that a single designation would inadequately or inappropriately reflect the status of the winter skate throughout its Canadian range; declines evident in the southern Gulf and eastern Scotian Shelf are not evident in waters further south. In addition, there are significant spatial differences in life history traits that are inextricably linked to individual fitness and, thus, population growth rate. The assessment of the species as separate Designatable Units is further supported by spatial discontinuities in distribution.

The distribution of winter skate in Canadian waters is characterized by three concentrations, each of which is separated by a spatial disjunction in the locations in which skate have been captured by fisheries-independent research surveys (Figure 2). These areas of concentration occur in the southern Gulf of St. Lawrence, eastern Scotian Shelf, and, more broadly, in the Bay of Fundy, western Scotian Shelf (notably Browns Bank) and on the Canadian portion of Georges Bank. These concentrations are separated by areas in which exceedingly few skate have been caught. These areas of negligible skate concentration range between approximately 330 and 450 km in size, distances considerably greater than the maximum lifetime distances that have been documented for winter skate and a closely related species. Winter skate tagged in the Gulf of Maine prior to 1950 moved a maximum of 190 km from their site of release (Whitehead *et al.*, 1984). A recent study of a related species of skate in the North Sea, the thornback ray (*Raja clavata*), indicated that the annual migration cycle, based on conventional and electronic tagging experiments, was restricted to an area 1° latitude X 1° longitude in area (i.e., approximately 110 km X 110 km) (Hunter *et al.* submitted). Thus, it appears as though the distances separating the concentrations of winter skate in Canadian waters exceed the distances across which winter skate are likely to disperse.

East Coast of North America Strategic Assessment Project
 Distribution of Winter skate (*Raja ocellata*)

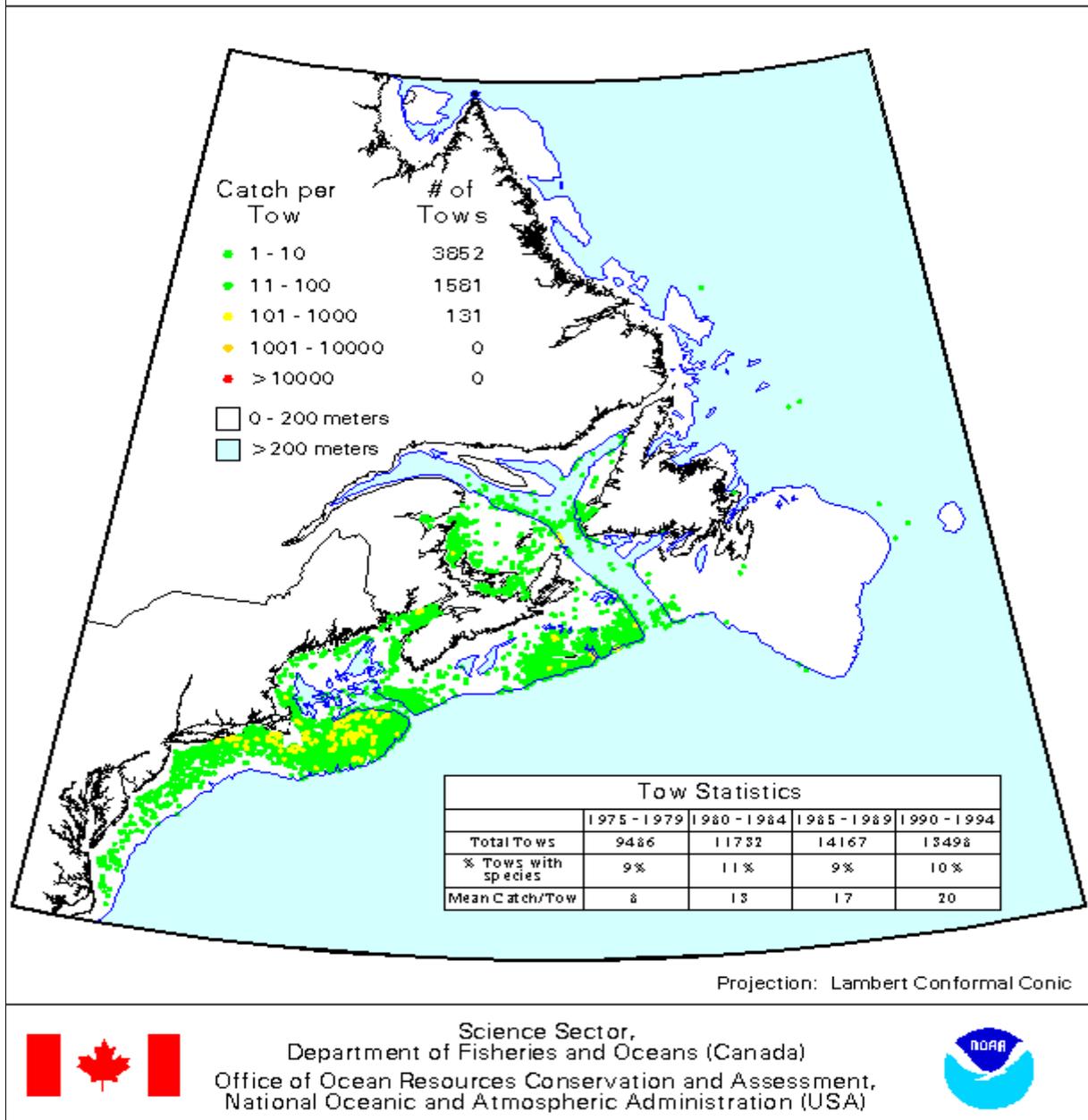


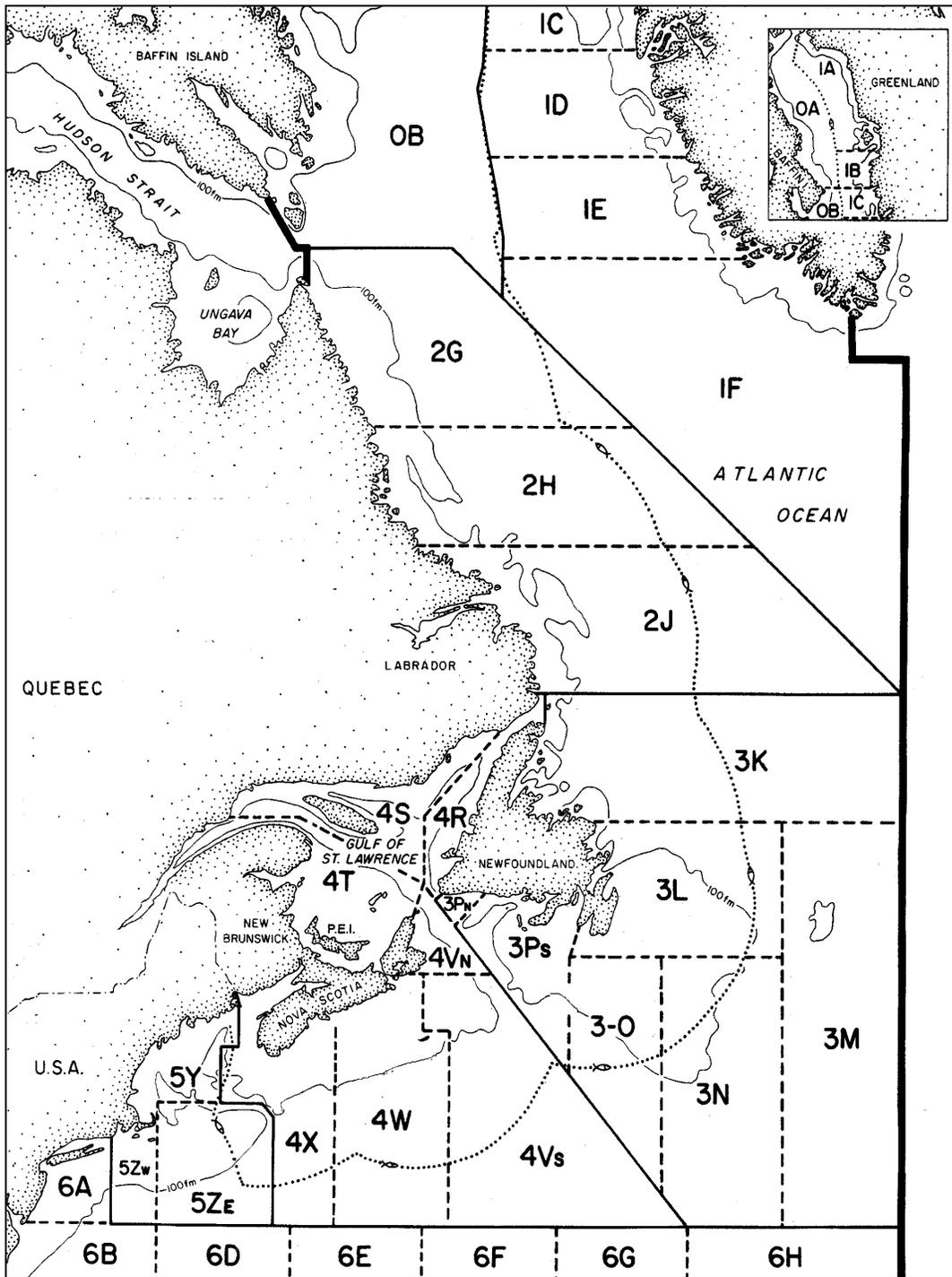
Figure 2. Composite map of the Western Atlantic distribution of winter skate (*Leucoraja ocellata*) from the ECNASAP database.

Available data indicate that these spatial differences in the concentrations of winter skate are associated with spatial differences in heritable life history traits. The most compelling evidence for separate consideration comes from differences in size and age at maturity. Winter skate generally mature at a length of 75 cm (Simon *et al.*, 2003), but in the southern Gulf of St. Lawrence size at maturity is closer to 50 cm and they do not attain the same maximum size that they do elsewhere (McEachran & Martin, 1977). Limited aging data suggest that age at 50% maturity for skate on the eastern Scotian Shelf ranges between 7 and 8 years; maximum age has been estimated to be 20 to 30 years (Simon and Frank, 2000; Sosebee and Terceiro, 2000). A study undertaken in the Gulf of Maine indicates an age at maturity of 12-13 years and maximum age estimates of 18-19 years (Sulikowski *et al.*, 2003).

Additionally, skate in the southern Gulf of St. Lawrence appear to differ from other populations in regard to morphological traits such as the number of tooth rows, body size and jaw size, but the degree to which these characters provide reliable metrics of population identity has not been unequivocally demonstrated (McEachran & Martin, 1977). No genetic research has been undertaken to compare winter skate populations from different areas in Canadian waters.

Finally, as the available data on trends in population abundance suggest (see below), the status of winter skate appears to differ throughout its Canadian range. Skate in the southern Gulf and on the eastern Scotian Shelf have shown dramatic reductions in abundance since the early 1970s; in contrast, skate in the most southerly part of its Canadian range appear to have been relatively stable in abundance over the time period for which data are available.

Thus, on the basis of observed differences in spatial distribution, life history traits, inferred and observed constraints on individual movements, and spatial differences in abundance trends, winter skate in Canadian waters can be divided into four Designatable Units (DUs), the boundaries of which can be delineated by Northwest Atlantic Fishery Organization (NAFO) divisions (Figure 3): 1) **Southern Gulf population** (NAFO division 4T); 2) **Eastern Scotian Shelf population** (NAFO divisions 4VW); 3) **Georges Bank-Western Scotian Shelf-Bay of Fundy population** (NAFO divisions 4X5Ze); and 4) **Northern Gulf-Newfoundland population** (NAFO divisions 3NOP4RS) (Figure 4). Rather than being distinguished by known or inferred differences in biology, behaviour and life history, the fourth of these DUs identifies winter skate in waters at the northern edge of the species' range where they are rare.



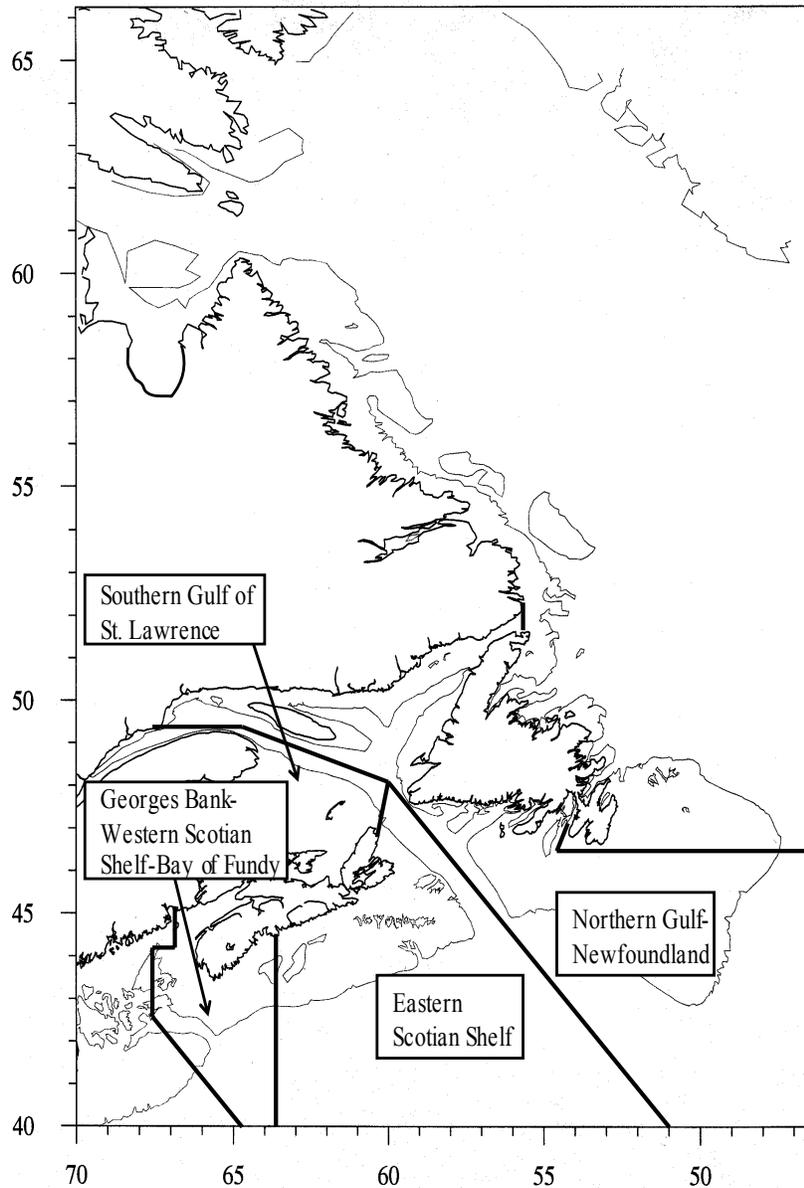


Figure 4. Boundaries of the four Designatable Units of winter skate in Canadian waters. The boundaries are delineated by heavy lines. The depth contour is at 200 metres.

DISTRIBUTION

Global range

Winter skate are restricted to the northwest Atlantic (Scott and Scott, 1988). They are found from the Gulf of St. Lawrence and southern Newfoundland to Cape Hatteras, North Carolina (Robins and Ray, 1986) (Figure 2).

Canadian range

The distribution of winter skate in Canadian waters is characterized by three concentrations, each of which is separated by a spatial disjunction in the locations in which skate have been captured by fisheries-independent research surveys (Figure 2). These areas of concentration occur in the southern Gulf of St. Lawrence, eastern Scotian Shelf, and, more broadly, in the Bay of Fundy, western Scotian Shelf and on the Canadian portion of Georges Bank (Simon *et al.*, 2003). Winter skate are rare in the northern Gulf of St. Lawrence, southern Newfoundland waters, and along the southern edge of the Grand Bank (Simon *et al.*, 2003). Approximately 50% of the species' global range occurs in Canadian waters.

HABITAT

Habitat requirements

The winter skate is a benthic species closely confined to sandy or gravelly bottoms, usually in depths less than 111 m (Scott and Scott, 1988), although they have been caught at depths approaching 400 m; research vessel survey data show that more than 90% of specimens are caught in less than 150 m of water. In the southern Gulf, winter skate can occupy very shallow depths in late summer/early autumn; the median depth at which winter skate are captured in DFO's September research surveys is about 30 m. On the Scotian Shelf, Scott and Scott (1998) indicate a preferred depth of 37-90 m.

Winter skate have been reported in waters ranging between -1.2° and 19°C . In the Southern Gulf, the average temperature occupied by winter skate during the September survey has varied between 5.8° and 12.4°C (D. P. Swain, Department of Fisheries and Oceans, PO Box 5030, Moncton, NB, unpublished data). Elsewhere, temperatures at depth of capture have been reported to be 1.1° to 12.7°C off eastern Nova Scotia and 2° to 15°C from southern Nova Scotia to Cape Hatteras. On the Scotian Shelf, they are most frequently found at depths where temperatures range between 5° and 9°C (Collette and Klein-MacPhee, 2002). The salinity of the waters inhabited by skate typically ranges between 32.0‰ and 34.4‰; some individuals may be exposed to salinities as low as 29 ‰ in the southern Gulf of St. Lawrence (Bigelow and Schroeder, 1953).

Trends

Winter skate have been termed a « winter periodic» because their seasonal migration suggests a preference for cool temperatures (Tyler, 1971). Winter skate tend to withdraw from very shallow waters along southern New England in early summer when the temperature has risen to $18-19^{\circ}\text{C}$ and to reappear there and near New York in early autumn (Bigelow and Schroeder, 1953). Winter skate are present inshore regularly during summer in Passamaquoddy Bay at the entrance to the Bay of Fundy, in Nova Scotian waters, and around Prince Edward Island (Bigelow and Schroeder, 1953). Based on observer reports, a movement from deeper waters onto the banks of the

Scotian Shelf (Div. 4VsW) has been observed to occur after the second quarter of the year (Simon and Frank, 1996).

The area occupied by winter skate can be estimated from research vessel survey data. In the southern Gulf, stratified mean percent occurrence data indicate a highly fluctuating trend in area occupied since 1971 (Simon *et al.*, 2003). There is some evidence to suggest that area occupied was somewhat larger in the late 1970s and 1980s than it is at present. Based on surveys conducted throughout the Bay of Fundy and both western and eastern portions of the Scotian Shelf, area occupied shows no discernible trend since the early 1970s (Simon *et al.*, 2003). By contrast, when data are restricted to the eastern Scotian Shelf only (4VW Cod March RV Survey), area occupied at present appears to be approximately half that of the mid-1980s. Distribution indices for Georges Bank winter skate show no discernible trend since the mid-1980s (Simon *et al.*, 2003).

Protection/ownership

Winter skate have not been assessed previously by COSEWIC, the IUCN, or under the auspices of any other convention on species protection. Winter skate are the target of a directed fishery in New England in the United States and on the eastern Scotian Shelf in Canada. They are also caught as bycatch in other fisheries for groundfish and in fisheries for shellfish. The small directed fishery in Canadian waters is regulated by catch quotas.

BIOLOGY

General

Despite increased fishing effort and a broad geographic range (Sulikowski *et al.*, 2003), little information exists on the biology and distribution of winter skate and other skate. Data have routinely been collected during research surveys in the northwest Atlantic but there has been only limited examination of this information (Kulka *et al.*, 1996).

Reproduction

Like all elasmobranches (sharks, skate, rays), winter skate are slow-growing, produce very few young each year, and almost certainly, as a consequence, have a slow population growth rate. Skate that are part of the Eastern Scotian Shelf and the Georges Bank-Western Scotian Shelf-Bay of Fundy populations mature at considerably larger sizes than those in the Southern Gulf population. On Georges Bank and the Gulf of Maine, individuals mature between 70 and 109 cm total length (TL). Length at 50% maturity for female winter skate on the eastern Scotian Shelf has been estimated to be 75 cm (Simon *et al.*, 2003). Skate in the Southern Gulf of St. Lawrence population mature at a smaller size (50 cm) and do not attain as large a size as in other populations (McEachran and Martin, 1977).

Preliminary aging of winter skate on the eastern Scotian Shelf suggests that the length at 50% maturity corresponds to an age of 7-8 years, although it should be noted that these estimates are based on very limited sample sizes. Maximum age for skate in this region has been estimated to be 20 to 30 years (Simon and Frank, 2000; Sosebee and Terceiro, 2000). These studies were carried out on the eastern Scotian Shelf and have not been validated.

These estimates of age at maturity and maximum age differ from those reported from a study conducted in the Gulf of Maine (Sulikowski *et al.*, 2003). Age at maturity and maximum age were estimated from vertebral band counts, morphological variability, and histological data as well as steroid hormone concentrations. Examination of 96 males and 88 females indicate an age at 50% maturity to occur between 769 to 776 mm for females, corresponding to an age of 12-13 years. For males, 50% maturity was estimated at 730 mm, which corresponds to an age of 11 years. Maximum age was estimated at 18 years for females and 19 years for males (Sulikowski *et al.*, 2003). The aging study by Sulikowski *et al.* (2003) was undertaken only on skate from the U.S. portion of the population and may not provide accurate estimates of age at maturity for winter skate in Canadian waters. It does, however, provide the most comprehensive information on the age of winter skate at sexual maturity. Mating probably occurs throughout the year although precise details are lacking (Scott and Scott, 1988).

Generation time was estimated as Age at Maturity + 1/M, where M is the instantaneous rate of natural mortality. Based on the estimates provided by Sulikowski *et al.* (2003), age at maturity was set at 12 years for skate in the Southern Gulf and Georges Bank-Western Scotian Shelf-Bay of Fundy populations. Available, albeit limited, data suggest an age at maturity of 7 years for Eastern Scotian Shelf skate. Based on estimates provided by J. Simon (DFO, Bedford Inst. Oceanography), M was set at 0.1, an estimate of natural mortality that is reasonable for long-lived species such as winter skate. Using these parameter estimates, the generation time is estimated to be 17 years for the Eastern Scotian Shelf population and 22 years for the Georges Bank-Western Scotian Shelf-Bay of Fundy populations.

Winter skate are thought to deposit from six (Bigelow and Schroeder, 1953) to fifty egg cases (Holden, 1977), although the exact number of purses laid is unknown (Collette and Klein-MacPhee, 2002). One fisherman from Isle aux Morts reported 4 to 6 egg cases in winter skate he has cut open. Eggs can take as long as 22 months to develop (Simon & Frank, 1998). If 22 months is an accurate estimate, this may mean that mature females only spawn every two years, but this hypothesis has not been empirically tested.

Eggs of winter skate are deposited throughout the year off southern New England and from summer to autumn off Nova Scotia (Vladykov, 1936; Collette and Klein-MacPhee, 2002). Industry has previously noted females extruding complete purses only in the late summer/early autumn west of Sable Island and suggestions were made that this may be a spawning area (Simon and Frank, 2000). Each embryo is contained in a tough brown egg case, 5.5-8.6 cm long, and 3.5-5.2 cm wide, excluding horns

(Scott and Scott, 1988). There are four long filaments, which are thought to serve as anchors (Collette and Klein-MacPhee, 2002). Specimens so recently hatched that their abdomens are still swollen with yolk range from about 112-127 mm in length (Collette and Klein-MacPhee, 2002).

Survival

Little is known about predation on winter skate, but they are eaten by many predators including sharks, other skates (such as *L. erinacea*), and grey seals (Scott and Scott, 1988). Winter skate are also prone to several parasites, including protozoans, myxosporidian, haematazoa, trematodes and nematodes (Scott and Scott, 1988).

Winter skate are the targets of directed fisheries in the United States and Canada. The principal commercial fishing method used to catch skate is otter trawling. They are also caught as bycatch in groundfish trawls and scallop and shrimp trawls, after which they are usually discarded (Sosebee and Terceiro, 2000). These methods of fishing have been hypothesized to disrupt bottom habitats occupied by winter skate as well as other skate species (Sosebee and Terceiro, 2000).

Movements/dispersal

Research vessel survey data for the Scotian Shelf suggest that winter skate are concentrated in deeper warmer waters in the winter and move into shallower waters during spring and summer. Three specimens tagged in the Gulf of Maine were recaptured between 130 and 190 km east of where they were released (Whitehead *et al.*, 1984). A recent study of a related species of skate in the North Sea, the thornback ray, indicated that the annual migration cycle, based on conventional and electronic tagging experiments, was restricted to an area 1° latitude X 1° longitude in area (i.e., approximately 110 km X 110 km) (Hunter *et al.* submitted). In the southern Gulf of St. Lawrence, Clay (1991) concluded that winter skate move from shallow waters to deeper, warmer water in winter (see also Darbyson and Benoît, 2003).

Nutrition and interspecific interactions

Although rock crab and squid are favoured by winter skate, they also prey upon annelid worms, amphipods, shrimps, and razor clams, and they eat whatever small fish are readily available (Collette and Klein-MacPhee, 2002). Historical information shows that they eat other small skate and that sandlance appear to be a favoured species of fish (Simon and Frank, 2000).

Studies of food habits of winter skate and little skate by McEachran *et al.* (1976) have shown that although the two species occur together over most of their range, they probably avoid serious competition with one another by consuming different proportions of the same food resources. Winter skate tend to eat infauna and little skate eat epifauna. Winter skate also overlap with thorny skate (*Amblyraja radiata*) in the northern portion of their Canadian range, but little is known of the relationship between the two species.

Behaviour/adaptability

Very little is known about the behaviour of winter skate.

POPULATION SIZES AND TRENDS

There are four principal sources of data that can potentially be used to assess changes in winter skate population size: 1) annual fisheries-independent research vessel (RV) surveys conducted for decades by DFO, using standard protocols; 2) non-standard research vessel surveys, conducted prior to 1970, that precede the current standardized surveys; 3) short-duration industry/science surveys that began in the mid-1990s, using either fixed or mobile gear; and 4) information from the directed commercial fishery for winter skate on the Scotian Shelf. Generally, these data indicate number or weight caught, latitude and longitude, depth of capture, time of day, and gear type. Detailed information such as individual length, weight and sex are available for subsets of some surveys (Simon *et al.*, 2003). The sampling areas are delineated by NAFO divisions (Figure 3). Throughout the report, emphasis is placed on the change in abundance of sexually mature winter skate. Declines are estimated as $100 \cdot (1 - 10^{-(b \cdot t)})$, where t is the time in years and b is slope of the regression of the \log_{10} of survey CPUE plotted against year.

Southern Gulf Population

Southern Gulf of St. Lawrence Fall RV Survey (Div. 4T)

Data on the Southern Gulf population are available from random-stratified bottom trawl surveys that have been conducted each September since 1971. Comparative fishing experiments did not indicate a change in fishing efficiency when vessels and/or gear changed in 1985 and 1992. More important was the change from day-only fishing before 1985 to 24-hr fishing since 1985. And although winter skate are much more catchable at night than during the day, the abundance index data presented here have been adjusted to account for this change in catchability.

Based on these fisheries-independent survey data, Southern Gulf mature winter skate (>50 cm) are estimated to have declined 98.1% (95% confidence limits = 96.1-99.1%; $r^2=0.79$) from 1971 to 2002 (Figure 5). For all size classes, a decline of 89.3% was estimated for the same time period; this is the same decline estimate reported by Benoît *et al.* (2003a). The number of winter skate caught per tow (CPUE) was highest in the mid-1970s, declined from a high of 0.6 fish per tow in 1978, and has been below 0.1 fish per tow in 7 of the last 9 years of the survey.

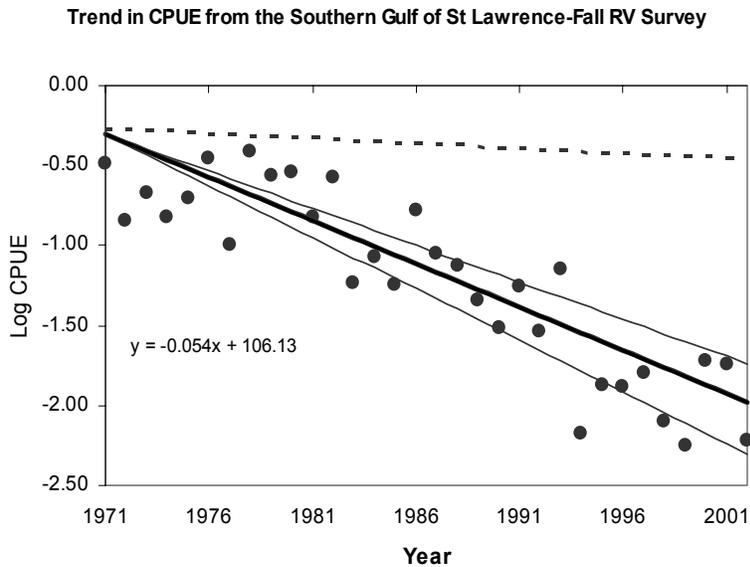


Figure 5. Log catch per unit effort (CPUE) of winter skate (50-74 cm) from DFO standardized fall research vessel surveys in the Southern Gulf of St. Lawrence from 1971-2001. The trend line (solid heavy line) = 98.1% decline ($r^2=0.79$); chances are 19 out of 20 that the actual decline is in the range 96.1-99.1% (light lines). Heavy dashed line indicates 50% decline.

Annual length frequencies from the survey (Figure 6) show that there have been fewer large skate (>50 cm) than the long term mean since 1994 (Benoît *et al.*, 2003a; Simon *et al.*, 2003). Of special interest is the fact that no fish over 80 cm have been caught. Since the 1970s, winter skate have experienced a severe truncation in size structure; very few large (>50 cm) individuals are now sampled by the survey (Simon *et al.*, 2003).

Trend in CPUE per Size Class from the Southern Gulf of St. Lawrence Fall RV Survey

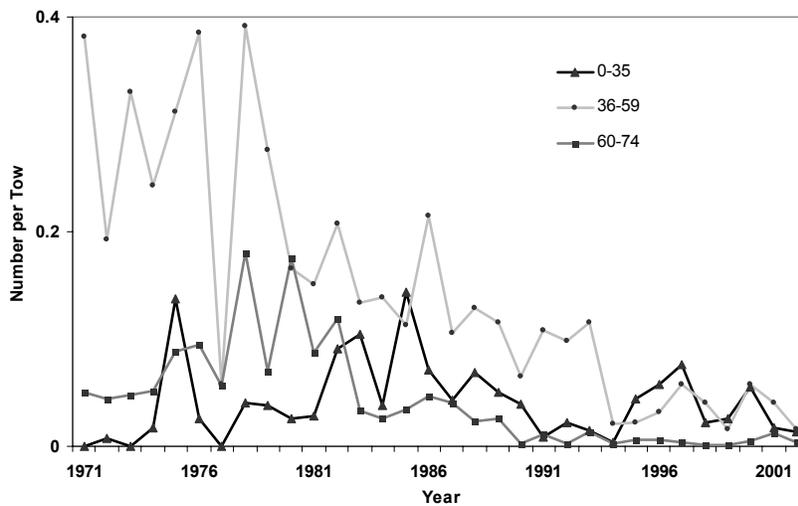


Figure 6. The CPUE of winter skate from Fall RV survey data as actual number per tow for the size classes 0-35, 36-59 and 60-74cm in the Southern Gulf of St. Lawrence (Div 4T) from 1970 to 2002. Data are from Simon *et al.* (2003).

The mean percent occurrence of null sets (zero catches) is one indicator of area occupied and suggests how the distribution of winter skate changes over time. Percent occurrence varied a great deal but generally increased during the 1970s and 1980s. It has declined continuously since then to comprise about 3,000 km² in 2002 to levels comparable to those observed in the 1970s.

Estimates of minimum total abundance (mature and immature individuals combined) of winter skate have been reported by Simon *et al.* (2003) (Figure 7). The Southern Gulf total population estimate has ranged from 50,000 to 1 million individuals. The overall average has been 400,000. The decadal averages have been 650, 450 and 170 thousand individuals in the 1970s, 1980s and 1990s, respectively. Current research vessel surveys have estimated the minimum total number of individuals in 2002 to be about 100,000 in the southern Gulf of St. Lawrence (Figure 7).

Trends on Total Number of Winter Skate

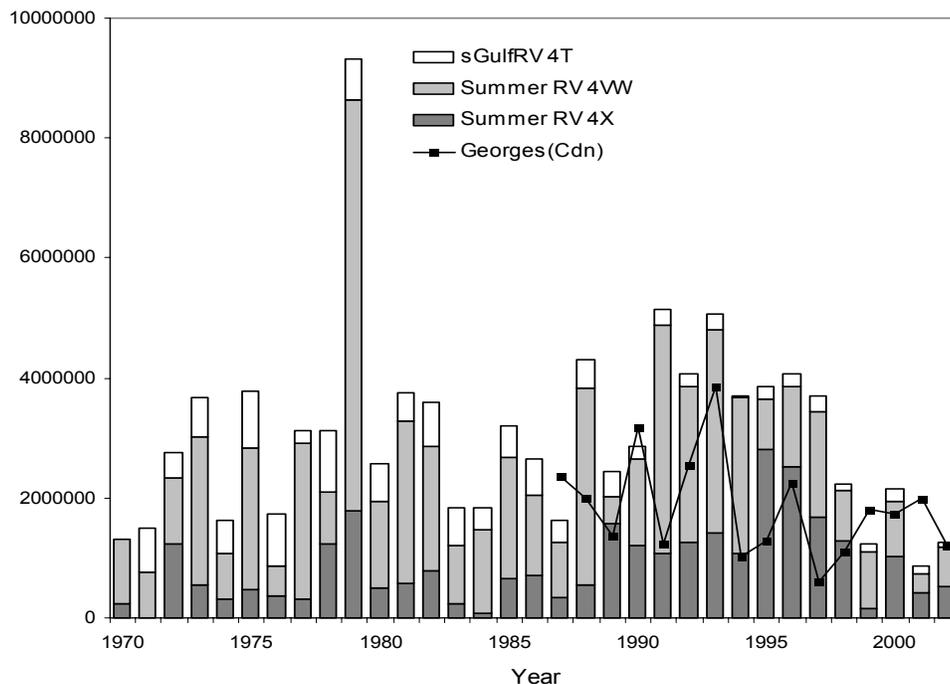


Figure 7. Total number of winter skate as estimated by the RV surveys in Div 4TVWX and 5Z. Note that the 4T survey began in 1971 and the 5Z survey began in 1986. Data are from Simon *et al.* (2003).

Eastern Scotian Shelf Population

Scotian Shelf Summer RV Survey (Div. 4VWX)

This is the longest running RV survey for winter skate in the Maritimes and is used as one of two primary sources for estimating declines. Other surveys in this area are used for comparison in regards to population trends. Mature winter skate (>75 cm) on the Scotian Shelf have decreased by 91.8% (95% confidence limits = 76.1-97.2%;

$r^2=0.40$) from 1970-2003 (Figure 8). Over the same time period the abundance of winter skate of all sizes displays no significant trend.

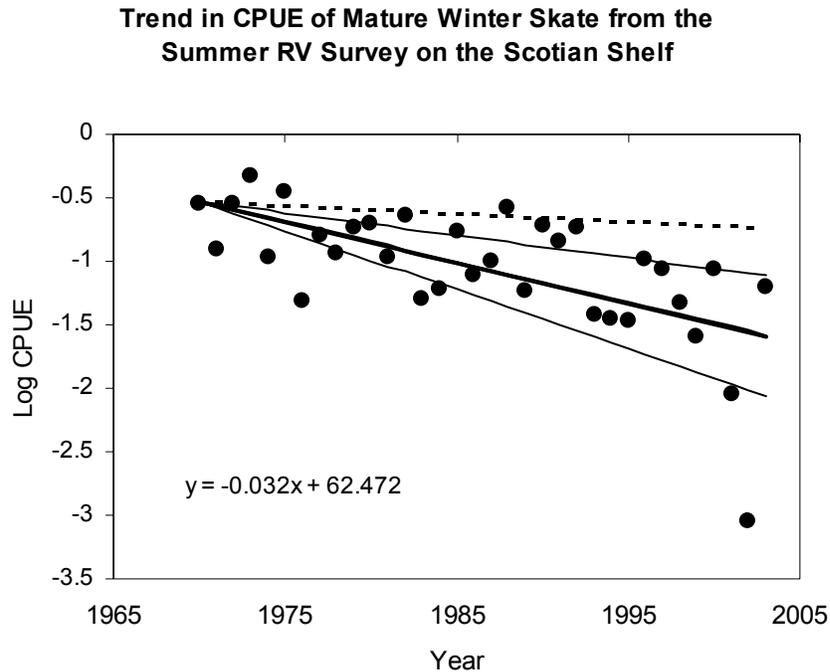


Figure 8. Log catch per unit effort (CPUE) of mature winter skate (75 cm+) from DFO's Scotian Shelf Summer RV Survey (Div. 4VWX) from 1970-2003. The trend line (solid heavy line) = 91.8% decline ($r^2=0.40$); chances are 19 out of 20 that the actual decline is in the range 76.1-97.2% (light lines). Heavy dashed line indicates 50% decline.

The summer research vessel survey has been conducted every July from 1970 to the present (Simon *et al.*, 2003). The sampling gear (bottom trawls) and survey vessel changed in 1982. There were 5,621 sets over the survey up to 2002 with winter skate occurring in 815 (14.5%). Catch rates of all skate, including both mature and immature individuals, have varied over the time series, ranging from a high of 2.1 fish per tow in 1979 to a low of 0.3 per tow in 2002. The mean number per tow has declined since the mid-1990s. The 2003 value, however, is near 1.0 per tow and is above the average of the time series.

Composite length frequencies revealed a size range of 9 to 121 cm, with a peak at 49 cm. Catches of skate between 0-35 cm and 36-59 cm have remained stable over the time series. Skate in the size range of 60-74 cm and 75+ cm have shown a steady decline in numbers, reflecting a severe truncation in the size structure of the population (Simon *et al.*, 2003). Eighty percent of the skate caught in the entire survey were smaller than 75 cm in size, the estimated size at maturity for skate in this region; for the time period 1995-2002, 93% of winter skate caught were smaller than 75 cm. Recent trawl surveys have captured only juvenile winter skate in any quantities while adults have been rarely captured (Simon *et al.*, 2003).

The area occupied by winter skate displayed an increasing trend from the 1970s until the early 1990s and has since declined (Simon *et al.*, 2003). The proportion of non-zero sets was highest in 1992 at 21.2% and lowest in 2000 at 8.5%. The composite distribution pattern revealed areas of winter skate concentration, notably in the upper

Bay of Fundy, Browns Bank, and the eastern banks and adjoining slopes of the Scotian Shelf. The distribution data decomposed into 4-year time blocks suggest the persistence of concentrations in those areas (Figure 9).

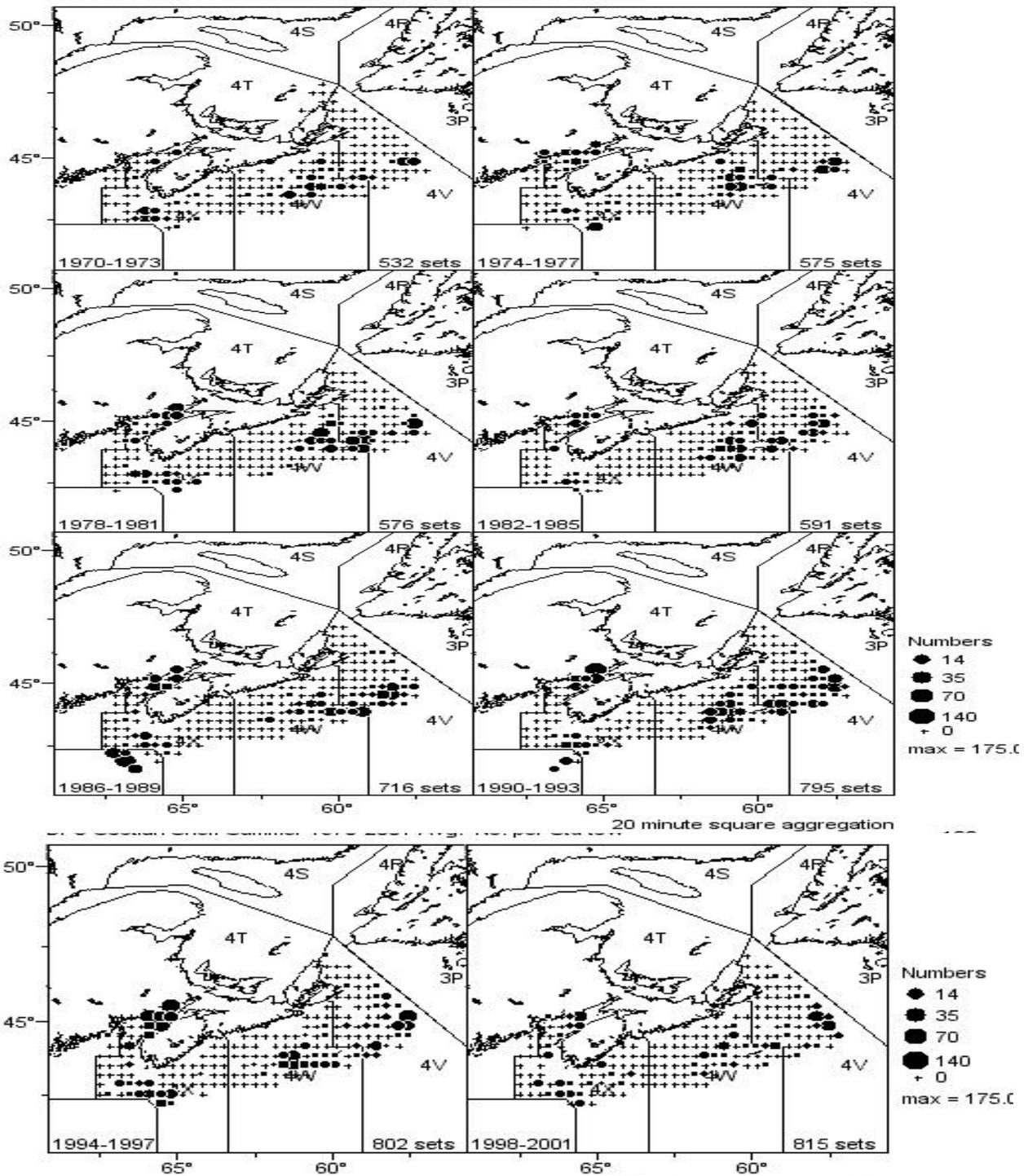


Figure 9. Distribution of winter skate (#/tow) from the Scotian Shelf Summer RV survey (Div 4VWX) for the years 1970-2002, aggregated into 4-year time blocks.

Scotian Shelf Spring RV Survey (Div. 4VWX)

The Spring RV Survey was conducted in March each year from 1979 to 1984. The survey covered the entire Scotian Shelf. Distribution maps aggregated into 1-year time blocks reveal similar areas of concentration as identified in the Summer RV Survey (above) as well as some decrease in area occupied by 1984 (Figure 10). The very limited time period during which this survey was conducted over the entire shelf precludes reliable estimates of decline rate.

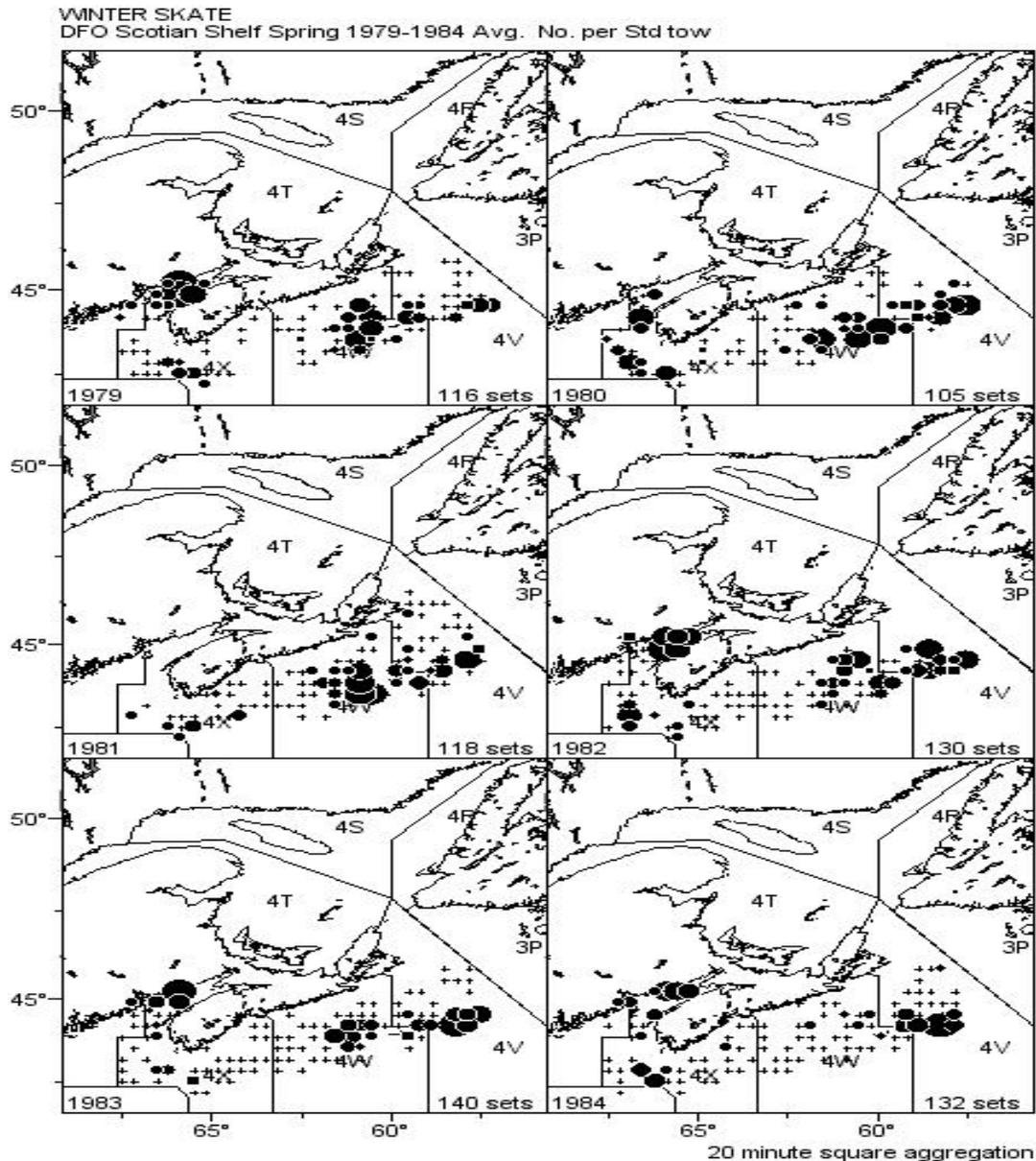


Figure 10. Distribution of winter skate (#/tow) from the Scotian Shelf Spring RV Survey (Div 4VWX) for the years 1979-1984, aggregated into 1-year time blocks.

4VW Cod March RV Survey (Div. 4VsW)

The survey began in spring 1986 and continues to the present. Data are missing in 1996 (incomplete survey) and 1998 (no survey). With the exception of the anomalously high catch of 20.7 fish per tow in 1994, the rate has never been higher than 6.0 fish per tow (in 1988). The mean number per tow has declined since 1994 to about 0.2 fish per tow, which is below the series average of 3.0 per tow. The estimated decline of mature winter skate (>75 cm) from 1986 to 2001 is 96.4% (90% confidence limits = 49.4-99.2%; $r^2=0.32$) for this survey (Figure 11). Note that this estimate of decline includes the unusually high 1994 datum; the 96.4% decline estimate for mature individuals can, thus, be considered an underestimate. For all size classes, a decline of 90.6% was noted for the time period (90% confidence limits = 50.5-98.5%).

Distribution maps suggest that the area occupied in later years may be smaller than usual (Figure 12). Two distribution indices (area occupied and a metric of population density) suggest a 50% reduction in area occupied since the mid-1980s ((Simon *et al.*, 2003). There is some evidence of a shift in concentration towards deeper slope water although detailed analyses of such a potential shift have not been undertaken.

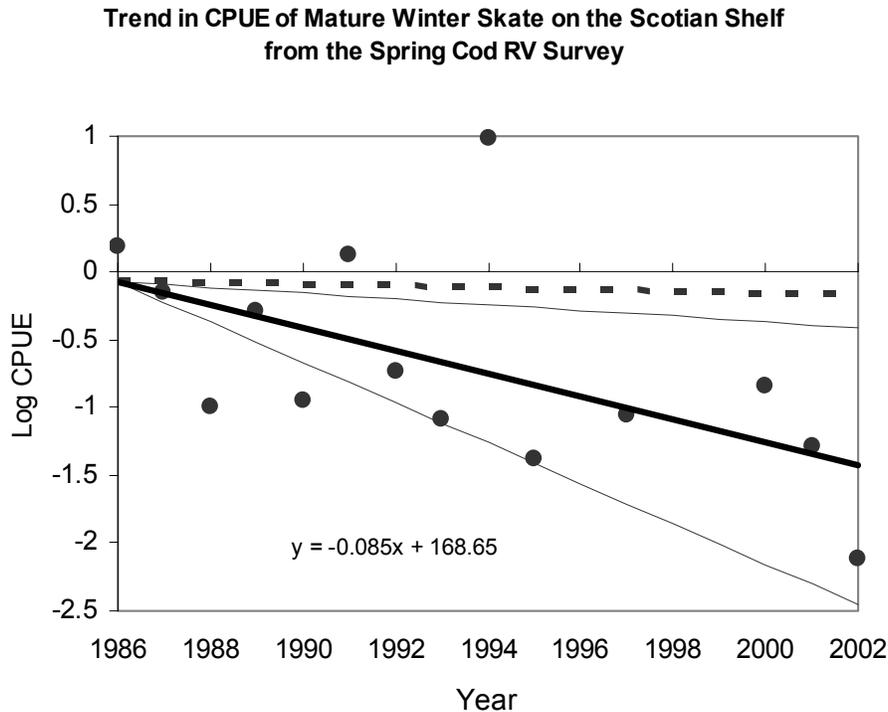


Figure 11. Log catch per unit effort (CPUE) of mature winter skate (75 cm+) from the DFO 4VW Cod March RV Survey on the Scotian Shelf from 1986-2002. The trend (solid heavy line) = 96.4% decline ($r^2=0.32$); chances are 1 out of 10 that the actual decline is in the range 49.4-99.2% (light lines). Heavy dashed line indicates a 50% decline.

Trend in Distribution of Winter Skate on the Scotian Shelf from the Spring Cod Survey

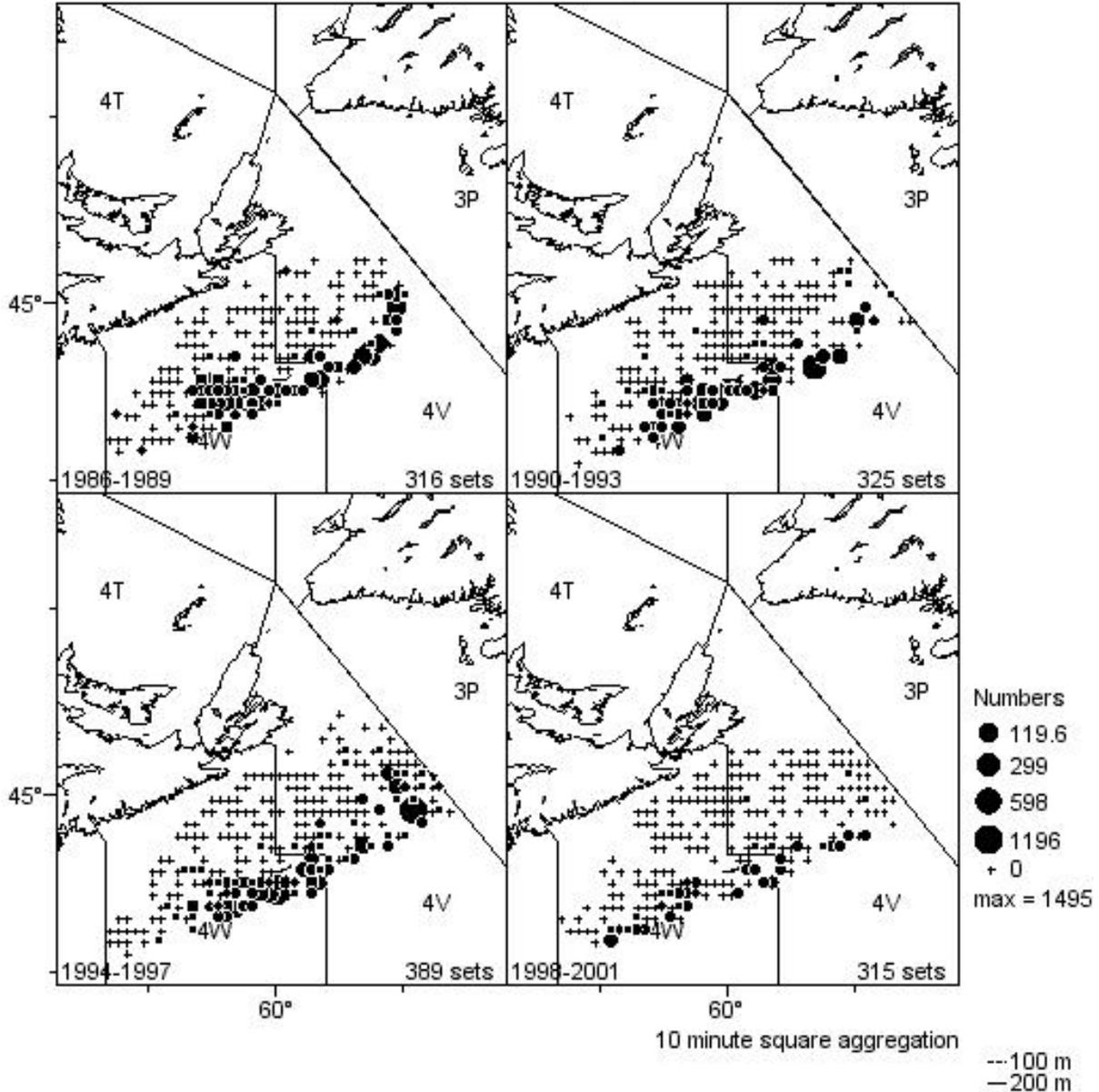


Figure 12. Distribution of winter skate (#/tow) on the Scotian Shelf from the Spring 4VsW Cod Survey, aggregated into 4-year time blocks. The data for 1996 are considered invalid; there was no survey in 1998.

Eastern Scotian Shelf Fall Sentinel Survey (Div. 4VsW)

A sentinel fishery for cod and haddock began in September 1995 in Division 4VsW with winter skate caught as bycatch, and has continued to present. This fisherman-conducted survey used longlines instead of the standard bottom trawl gear used in DFO research vessel surveys. Skate were not identified to species until 1996. The brevity of the survey time series, coupled with an absence of length frequency data (which

prevents identification of mature individuals), precludes the use of these data for estimating magnitude of decline (Figure 13). Winter skate catches were concentrated on Sable Island Bank, with a secondary concentration on the eastern shoal of Banquereau Bank (Simon *et al.*, 2003).

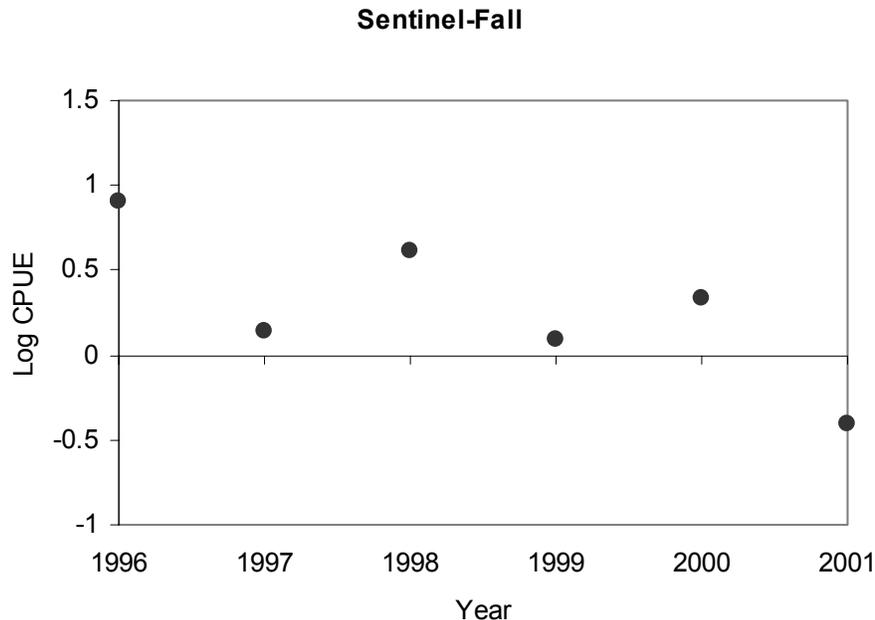


Figure 13. Log catch per unit effort (CPUE) of winter skate from the Fall Sentinel Survey from 1996-2001 on the Eastern Scotian Shelf.

Scotian Shelf Industry/Science Skate Spring and Fall Surveys (Div. 4VsW)

As part of the Conservation Harvesting Plan for skate established in 1994, the commercial fishing industry agreed to conduct two industry/science surveys per year (spring and fall) on the Scotian Shelf. In 1994, an exploratory skate survey was initiated. DFO specified the fishing locations and the use of 155-mm mesh commercial bottom trawl gear. In 1995, a random-stratified survey design was used with 255-mm mesh gear. The area surveyed was chosen to coincide with the winter skate distribution of the Summer RV Survey (strata 46-58). In 1996, the survey gear reverted back to 155-mm mesh to provide more complete sampling of the size range of the population (Simon *et al.*, 2003). A total of 378 sets were completed in the Spring Survey with 48.2% of the sets catching winter skate. The fall series had 274 sets with 49.6% catching winter skate (Simon *et al.*, 2003).

Winter skate biomass estimates from the Spring Industry survey ranged from a high of 20,500 t in 1996 to a low of 4,900 t in 1997 with the 2002 estimate being 5,600 t (Figure 14). The Fall Industry survey estimates ranged from a low of 9,400 t in 1995 to a high of 47,800 t in 1999. Average biomass estimates since 1995 have been 10,000 t,

20,000 t and 1,300 t from the Spring Industry, Fall Industry and summer RV surveys, respectively. The industry estimates are on the order of 6-12 times greater than the summer RV biomass (which were calculated only for the same strata as those surveyed by industry). This reflects the increased catchability of the rockhopper gear used in this survey as compared to the Yankee 36 and Western IIA trawls used in the Summer RV Survey. This indication of the low catchability of the RV survey gear makes any population estimates derived from that source highly underestimated (Simon *et al.*, 2003). Decadal averages for the Summer RV Survey were calculated to be approximately 6,000 t in the 1970s, 3,800 t in the 1980s and 1,300 t in the 1990s to present. Of note are the extremely low estimates in 2001 and 2002 from the Summer RV Survey (200 t and 50 t, respectively). The Industry Survey suggests there has been little change in biomass since 1996 (Simon *et al.*, 2003).

Trends in Total Biomass of Winter Skate on the Scotian Shelf Calculated from the Spring and Fall Industry Surveys

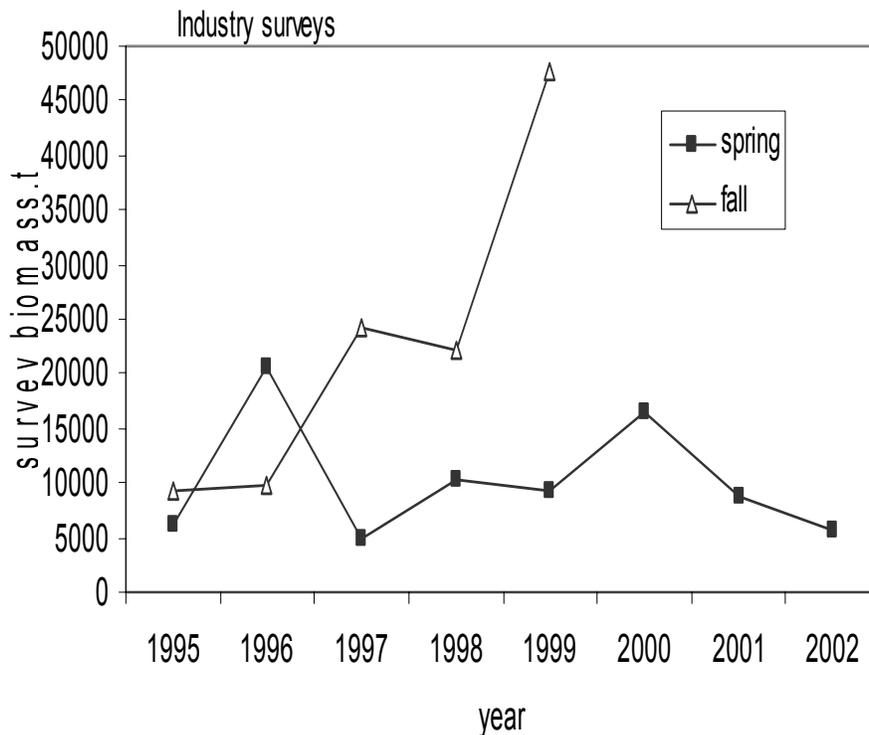


Figure 14. Total biomass (tonnes) of winter skate as calculated for strata 46-58 of the Scotian Shelf from the stratified Spring (1995-2002) and Fall (1995-1999) Industry Surveys.

Stratified length frequency data were not collected during these surveys, precluding the estimation of abundance of mature winter skate. The Spring Industry Survey caught most fish on the edges of Banquereau Bank and the eastern Scotian Shelf. The Fall Survey catches exhibited a similar pattern, but in addition there was a concentration of skate west of Sable Island (Simon *et al.*, 2003).

Scotian Shelf Commercial Fishery

A small developmental directed commercial fishery for skate by Canada began in 1994 on the Eastern Scotian Shelf (Div. 4VsW) with a total allowable catch (TAC) of 2000 t allocated to four otter trawlers. Landings by that directed fishery declined from 2152 t in 1994 to less than 400 t in 2001, an 81% decline reflecting progressive reductions in TAC. Reductions in TAC arise from concerns about the impact of the directed fishery on stock status and have resulted in a reduction of in the number of vessels prosecuting the fishery to 3 in 2001 and 1 in 2002. Landings have been primarily winter skate (>90%) with the majority of the fishery centred on Banquereau Bank (Simon *et al.*, 2003). Average total landings for the years 1980-1993 when the fishery was open to all countries were about 1000 t annually (Simon and Frank, 2000).

Discards of winter skate by groundfish fisheries prior to closures in 1994 were estimated to be greater than 1000 t. Since 1994, discards were estimated to have been generally less than 100 t (Simon *et al.*, 2003), although it should be recognized that this estimate is highly uncertain.

Commercial sampling of winter skate began in 1995. The length frequency peaked in 1995 at 76 cm and included many fish up to and greater than 100 cm. In 1996, the peak shifted to 71 cm and remained there to 2002. This is slightly below the estimated size at maturity of 75 cm.

The percentage of fish greater than 90 cm declined from 25% in 1995 to 6% in 1996 and less than 4% since 1997 (Simon *et al.*, 2003). Length frequency observations by the International Observer Program (IOP) from the commercial phase of the directed fishery showed a similar loss of larger individuals from the population as the commercial sampling, but there was some indication of improvement in the percentage of numbers of fish greater than 76 cm. The percentage of fish greater than 90 cm decreased from 22% in 1995 to less than 3% from 1996-2000. In 2001 and 2002, the percentage increased to 4 and 5%, respectively (Simon *et al.*, 2003).

The summer research vessel survey abundance estimate for the entire Scotian Shelf indicated that the minimum population numbers peaked in the early to mid-1990s and have been below the long-term average of 2.6 million up to 2002. The dynamic range of the data has been from 8 million in 1979 to 750,000 in 2001. The 4VW Cod Survey showed that total numbers of winter skate have averaged about 4.8 million individuals, excluding the high estimate in 1994 of 43 million individuals. The summer RV estimate for the comparable area averaged 1.7 million individuals. In the last 11 years, the mean spring RV estimate was 3 million individuals while the summer RV estimate was 1.5 million (Simon *et al.*, 2003).

In 2002, the minimum estimate of the total number of individuals on the eastern Scotian Shelf (4VW), based on data obtained from the Summer RV survey data, was approximately 750,000 individuals (Figure 7).

Georges Bank-Western Scotian Shelf-Bay of Fundy Population

Scotian Shelf Summer RV Survey (Div. 4VWX) and Spring RV Survey (Div. 4VWX)

The composite distribution pattern from both surveys revealed areas of winter skate concentration in the Bay of Fundy and on Browns Bank off southwestern Nova Scotia. The distribution data decomposed into 4-year time blocks suggest stability in these concentrations in those areas over the years for which data are available (Figure 9). Estimates of the minimum abundance of the total population size of winter skate in NAFO division 4X have remained relatively stable since the early 1970s (Figure 7).

Georges Bank Winter RV Survey (Div. 5Z)

Based on data collected during the Georges Bank (Div 5Z) Winter RV Survey, the abundance of mature winter skate (>75 cm) declined from 1986 through 1994, but exhibited a general increase thereafter to 2004 (Figure 15). Given the long generation times that have been estimated for winter skate in this area (22 years), the comparatively short time period over which these changes in abundance were observed suggests that these reductions and increases in abundance might be attributable to small-scale distributional shifts by winter skate into and out of Canadian waters on Georges Bank.

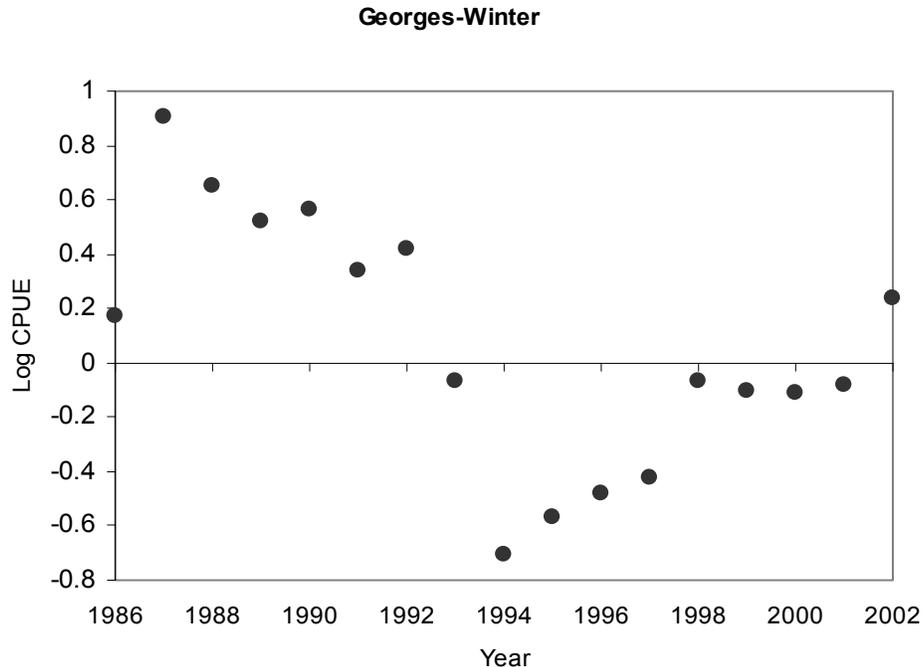


Figure 15. Log catch per unit effort (CPUE) of mature winter skate (75 cm+) from DFO standardized winter research vessel surveys conducted on the Canadian portion of Georges Bank from 1986 to 2002. Note: The log (CPUE) data for 2003 and 2004, although not shown in this figure, were between 0 and 0.2.

The Georges Bank survey began in 1984 when a partial survey was conducted. In 1986, the survey was expanded to cover both the Canadian and U.S. portions of the bank (Simon *et al.*, 2003). A total of 1,556 sets have been completed with 1,098 (70.5%) containing winter skate. The number per tow (Figure 16) has been variable, with a mean catch rate of 18.1 fish per tow.

Trend in Mean Number and Weight per Tow from the Georges Bank RV Survey.

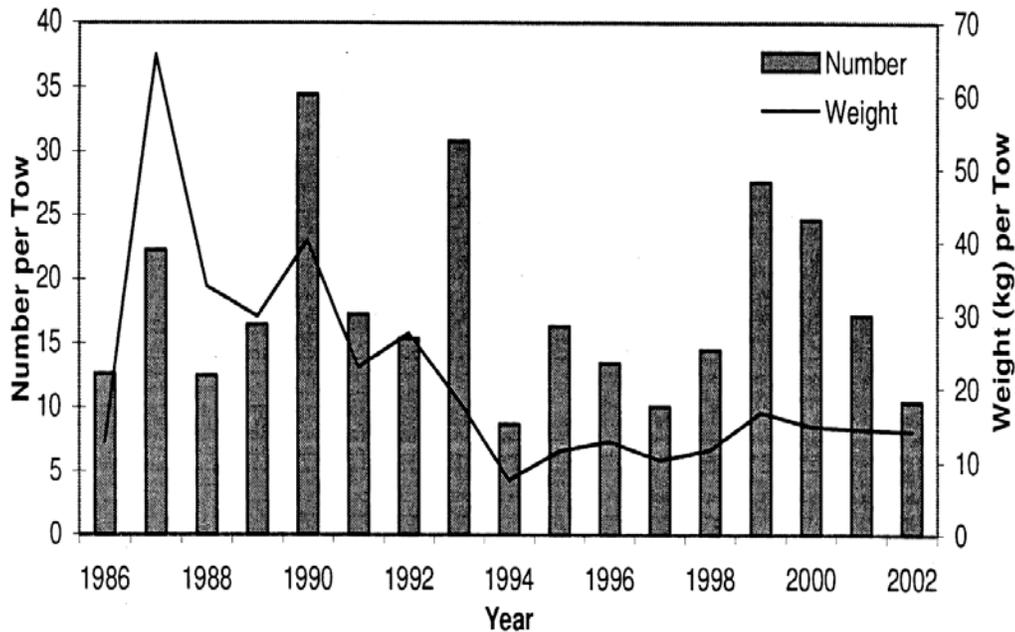


Figure 16. Mean number and weight per tow of winter skate in the Georges Bank Winter RV Survey for the years 1986-2002.

Composite length frequencies showed a size range from 9-112 cm, with a peak at 55 cm. Catch rates for winter skate <35 cm and 36-59 cm have been variable over the time series with only a slight decrease. A decline in the proportional representation of skate greater than 75 cm to 1994 was followed by an increase thereafter to 2004.

Distribution maps indicate that winter skate are found throughout Georges Bank and that the area occupied seems to have undergone little change from 1986 to 2000. No trend in overall winter skate number per tow is evident, though the index has risen in 2004 to 37.3, which is well above the series mean of 19.2 fish per tow.

The Georges Bank RV survey (winter) revealed overall population numbers ranging from 6.9 million in 1994 to 48 million in 1990. When considering only the Canadian portion of the population, numbers have ranged from 600,000 to 3.8 million and average 1.8 million. No trend in the data was evident (Simon *et al.*, 2003).

In 2002, the minimum estimates of the total number of individuals in NAFO divisions 4X and 5Ze were approximately 500,000 and 1.2 million, respectively (Figure 7), resulting in a minimum estimate of total abundance of 1.7 million for winter skate in this Designatable Unit.

Status of winter skate in U.S. waters

Until 2000, the U.S. population of winter skate was considered to be in an overfished state. However, its status has been changed such that it is no longer considered to be in an overfished condition (NMFS 2002). In its 2002 report to Congress, NMFS (2002) reported that the most recent survey index for winter skate indicated that the current biomass was above the minimum stock size threshold and that winter skate were now officially listed as “not overfished”. This status for winter skate was reaffirmed by NMFS in its 2003 report to Congress (NMFS 2003).

Although winter skate are no longer considered overfished in U.S. waters, winter skate remain at comparatively low levels of abundance. In accordance with the U.S. Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act (1996), winter skate is defined as being in an overfished condition when the 3-year moving average of the NEFSC (Northeast Fisheries Science Center) autumn survey mean weight per tow is less than one-half of the 75th percentile of the mean weight per tow observed in the autumn trawl survey from 1967 to 1998 (NOAA 2003a). In 2000, although winter skate on Georges Bank was at about the same level of abundance as it was in the early 1970s, it was only 25% of the peak levels of abundance observed in the mid-1980s (NOAA 2003b).

Given the comparatively low level of abundance of winter skate on Georges Bank, the probability that winter skate will immigrate into the Eastern Scotian Shelf population in the foreseeable future is considered to be very small. Thus, the probability of rescue from the U.S. population of winter skate is considered to be very low for the Eastern Scotian Shelf population and negligible for the Southern Gulf population.

Northern Gulf-Newfoundland Population

Newfoundland/Quebec Survey Data (Div. 3KLMNOP4RS)

Winter skate are not and have never been common in Newfoundland waters (Simon *et al.*, 2003). While the survey information available in this region is the most temporally extensive, the earlier years in the series (pre-1978) were not associated with any standard survey design. A random-stratified survey design was adopted in 1970, 1971 and 1978 in divisions 3LNO, 3P and 2J3K, respectively; 58,677 sets were completed from 1947 to 2002 with winter skate occurring in only 240 (0.4%) of them (Simon *et al.*, 2003).

In the winter and summer surveys of the northern Gulf of St. Lawrence (Div. 3Pn4Rs), winter skate were taken in only 33 of 3,615 sets (0.9%) from 1947 to 2002.

Industry sentinel fishery surveys have been conducted in the northern Gulf in July and October annually since 1995 (Simons *et al.*, 2003). Of the 14 surveys that have been conducted to date, only 5 winter skate have been caught.

LIMITING FACTORS AND THREATS

Narrow latitudinal ranges and a high degree of endemism have been documented for the skate family worldwide. Among other things, this is suggestive of a relatively limited dispersal capacity. Importantly, however, it may also increase the probability of local extinctions. Of 58 marine fish extirpations documented by Dulvy *et al.* (2003), 13 have been experienced by members of the skate family (Rajidae), underscoring the potential utility of assessing skate at relatively fine spatial scales.

Although there have been no direct studies of the factors that cause mortality in winter skate, a primary threat to this species in Canadian waters has been the unsustainable rate at which skate have been caught as bycatch in groundfish fisheries, perhaps most notably those for flatfish, and in fisheries for invertebrates, most notably those for scallops. Otter trawls and scallop drags can account for more than 90% of the total discards (Sosebee and Terceiro, 2000). Winter skate removals have been estimated in Div. 4VsW by Simon and Frank (2000) for the period from 1989 to 1999. The highest estimated level of bycatch, based on a relatively small sample size, was 2193 t in 1990. Winter skate removals declined to 150 t in 1994 concomitant with a reduction in traditional landings by Canadian and foreign fisheries. Bycatch removals of winter skate have not been estimated for Div. 4X.

Winter skate is the target of directed fisheries. The pectoral fins of skate, called “wings”, are sold for human consumption in Canada and the U.S. with the bulk of the catch exported to markets in Europe and Asia (Simon and Frank, 2000; Sosebee and Terceiro, 2000). The directed fishery on the eastern Scotian Shelf is currently small. Since the establishment of a Total Allowable Catch (TAC) for this fishery in 1994 (2,000 t), the TAC has declined to 200 t, a level that has been in place annually since 2002. The directed fishery in the U.S. began in the early 1960s.

Although bottom trawling for fish and dredging for scallops and clams may constitute a threat, its potential importance has not been evaluated for winter skate. Dredging and trawling might physically alter bottom habitat; it might also result in a re-suspension of bottom sediments that might smother spawning areas and damage gills (Messeih *et al.*, 1991). However, given the preferred habitat of winter skate on sand and gravel, there may be a low probability that alteration of the bottom by trawling would affect adults. Although survival during the egg case stage may be affected, no studies have been undertaken to evaluate the effects of trawling on the survival of skate.

Information on skate predators is scarce, but they have been found in the stomachs of sharks, seals and other skate (Simon and Frank, 2000). Winter skate are

also prone to infection by several invertebrate parasites, but no studies have been undertaken to determine whether this parasitism affects mortality.

SPECIAL SIGNIFICANCE OF THE SPECIES

Winter skate are endemic to the western North Atlantic, with a considerable portion of their range in Canadian waters. They are among the most ancient of extant species of vertebrates. The species has, at various times, supported a directed fishery.

EXISTING PROTECTION OR OTHER STATUS

In Canadian waters, commercial catches are regulated by the Department of Fisheries and Oceans. All populations in Canadian waters are subject to bycatch. The only directed fishery in Canadian waters exists on the eastern Scotian Shelf where annual Total Allowable Catches (TACs) have declined from 2,000 t in 1994 to 200 t, a TAC set initially in 2002. Winter skate currently have no status under IUCN.

SUMMARY OF STATUS REPORT

Winter skate in Canadian waters comprises four Designatable Units: Southern Gulf population, Eastern Scotian Shelf population, Georges Bank-Western Scotian Shelf-Bay of Fundy population, and Northern Gulf-Newfoundland population. The primary sources of data from which trends in abundance were estimated were those from the following fisheries-independent DFO RV surveys: Southern Gulf of St. Lawrence Fall RV Survey (1971-2002), Scotian Shelf Summer RV Survey (1970-2003), Scotian Shelf 4VW Cod March RV Survey (1986-2002), and Georges Bank Winter RV Survey (1986-2004).

Winter skate has declined throughout a considerable part its Canadian range. In the Southern Gulf of St. Lawrence (Div 4T), a decline in mature winter skate (>50 cm) of 98.1% was estimated from 1971 to 2002, based on data obtained from Southern Gulf of St. Lawrence Fall RV Survey CPUE (catch per unit effort) estimates. No winter skate larger than 75 cm have been caught in this survey. Among the surveys that have been undertaken on the Scotian Shelf, two are of sufficient duration to allow for the estimation of decline rates. Based on data obtained from the Scotian Shelf (Div 4VWX) Summer RV Survey, a decline in mature winter skate (>75 cm) of 91.8% was estimated from 1970 to 2003. Based on 4VW Cod March RV Survey CPUE data, a decline in mature skate (>75 cm) of 96.4% was estimated for the 1986-2002 time period. No discernible trend in abundance is evident for mature winter skate from the Georges Bank Winter RV Survey (1986-2004). Winter skate are rare in Newfoundland and Northern Gulf waters.

Estimates of minimum abundance for skate of all ages and sizes, based on research vessel survey data for 2002, are as follows: Southern Gulf of St. Lawrence

populations – 100,000; Eastern Scotian Shelf population – 750,000; Georges Bank-Western Scotian Shelf-Bay of Fundy – 1.7 million; Northern Gulf-Newfoundland – no estimate available. Abundance estimates for mature individuals only are unavailable.

Winter skate are targets of directed fisheries in Canada and the United States. The TAC on the Eastern Scotian Shelf has declined from 2,000 t in 1994 to 200 t annually since 2002.

TECHNICAL SUMMARY

Leucoraja ocellata

Winter Skate, Southern Gulf population

Raie tachetée

Canadian Range: Southern Gulf of St. Lawrence (Northwest Atlantic Fishery Organization division 4T)

Extent and Area Information	
• <i>Extent of occurrence (EO)(km²)</i>	Approx. 15,000
• <i>Specify trend in EO</i>	Stable
• <i>Are there extreme fluctuations in EO?</i>	No
• <i>Area of occupancy (AO) (km²)</i>	Approx. 3,000
• <i>Specify trend in AO</i>	Decline
• <i>Are there extreme fluctuations in AO?</i>	No
• <i>Number of known or inferred current locations</i>	Unknown
• <i>Specify trend in #</i>	Unknown
• <i>Are there extreme fluctuations in number of locations?</i>	No
• <i>Specify trend in area, extent or quality of habitat</i>	Unknown
Population Information	
• <i>Generation time (average age of parents in the population)</i>	22 Years
• <i>Number of individuals</i>	100,000 (minimum estimate)
• <i>Total population trend:</i>	Decline
• <i>% decline</i>	98.1%
• <i>Are there extreme fluctuations in number of mature individuals?</i>	No
• <i>Is the total population severely fragmented?</i>	No
• <i>Specify trend in number of populations</i>	Unknown
• <i>Are there extreme fluctuations in number of populations?</i>	No
Threats (actual or imminent threats to populations or habitats)	
Winter skate is subjected to bycatch in fisheries for other groundfish species, perhaps most notably by directed fisheries for flatfish.	
Rescue Effect (immigration from an outside source)	
• <i>Status of outside population(s)?</i> Eastern Scotian Shelf population is Threatened; the species is rare in the northern Gulf of St. Lawrence and in Newfoundland waters	
• <i>Is immigration known or possible?</i>	Unknown
• <i>Would immigrants be adapted to survive in Canada?</i>	Yes
• <i>Is there sufficient habitat for immigrants in Canada?</i>	Yes
• <i>Is rescue from outside populations likely?</i>	Unlikely
Quantitative Analysis	Not available
Current Status	
COSEWIC: Endangered (May 2005)	

Status and Reasons for Designation

Status: Endangered	Alpha-numeric code: A4b
<p>Reasons for Designation:</p> <p>The species possesses life history characteristics that increase vulnerability to exploitation, that reduce rate of recovery, and that increase the risk of extinction. These characteristics include delayed age at maturity, long generation time, low fecundity, and consequently slow population growth rate. Narrow latitudinal ranges and a high degree of endemism have been documented for the skate family worldwide. This population appears to have a restricted distribution, based on distributional maps of fisheries-independent survey catches. Individuals from this population mature at a significantly smaller size than those found elsewhere in Canadian waters. Abundance of mature individuals in the Southern Gulf of St. Lawrence is estimated to have declined 98% since the early 1970s, and is now at a historically low level. The probable cause of decline is an unsustainable rate at which they were captured as bycatch in fisheries directed at other groundfish species.</p>	
<p>Applicability of Criteria</p>	
<p>Criterion A (Declining Total Population): meets criterion for Endangered A4b.</p> <p>Criterion B (Small Distribution, and Decline or Fluctuation): extent of occurrence is <20,000 km² but does not apply because the species occurs at >10 locations, is not fragmented, and extreme fluctuations are unknown.</p> <p>Criterion C (Small Total Population Size and Decline): does not apply because number of mature individuals is >10,000.</p> <p>Criterion D (Very Small Population or Restricted Distribution): does not apply because number of mature individuals is >1000 and area of occupancy is >20 km².</p> <p>Criterion E (Quantitative Analysis): not done.</p>	

TECHNICAL SUMMARY

Leucoraja ocellata

Winter Skate, Eastern Scotian Shelf population

Raie tachetée

Canadian Range: Eastern part of the Scotian Shelf off eastern Nova Scotia (Northwest Atlantic Fishery

Organization divisions 4VW)

Extent and Area Information	
• <i>Extent of occurrence (EO)(km²)</i>	Approx. 230,000
• <i>Specify trend in EO</i>	Stable
• <i>Are there extreme fluctuations in EO?</i>	No
• <i>Area of occupancy (AO) (km²)</i>	Approx. 35,000
• <i>Specify trend in AO</i>	Decline
• <i>Are there extreme fluctuations in AO?</i>	No
• <i>Number of known or inferred current locations</i>	Unknown
• <i>Specify trend in #</i>	Unknown
• <i>Are there extreme fluctuations in number of locations?</i>	No
• <i>Specify trend in area, extent or quality of habitat</i>	Unknown
Population Information	
• <i>Generation time (average age of parents in the population)</i>	17 Years
• <i>Number of individuals</i>	750,000 (minimum estimate)
• <i>Total population trend:</i>	Decline
• <i>% decline</i>	91.8% (based on Scotian Shelf Summer RV Survey) 96.4% (based on 4VW Cod March RV Survey)
• <i>Are there extreme fluctuations in number of mature individuals?</i>	No
• <i>Is the total population severely fragmented?</i>	No
• <i>Specify trend in number of populations</i>	Unknown
• <i>Are there extreme fluctuations in number of populations?</i>	No
Threats (actual or imminent threats to populations or habitats)	
Caught as by-catch in fisheries for other groundfish species. The population is also subjected to a small, directed fishery.	
Rescue Effect (immigration from an outside source)	
• <i>Status of outside population(s)?</i> Southern Gulf population is Endangered; Georges Bank-Western Scotian Shelf-Bay of Fundy population is Special Concern	
• <i>Is immigration known or possible?</i>	Yes
• <i>Would immigrants be adapted to survive in Canada?</i>	Yes
• <i>Is there sufficient habitat for immigrants in Canada?</i>	Yes
• <i>Is rescue from outside populations likely?</i>	Possible, but unlikely
Quantitative Analysis	
Not available	
Current Status	
COSEWIC: Threatened (May 2005)	

Status and Reasons for Designation

<p>Status: Threatened</p>	<p>Alpha-numeric code: Meets criterion for Endangered, A4b, but assessed Threatened because the population is not considered to be at imminent risk of extinction.</p>
<p>Reasons for Designation:</p> <p>The species possesses life history characteristics that increase vulnerability to exploitation, that reduce rate of recovery, and that increase the risk of extinction. These characteristics include delayed age at maturity, long generation time, low fecundity, and consequently slow population growth rate. Narrow latitudinal ranges and a high degree of endemism have been documented for the skate family worldwide. This population appears to have a restricted distribution, based on distributional maps of fisheries-independent survey catches. Individuals from this population mature at a significantly larger size than those in the Southern Gulf and have been reported to mature at a significantly different age than those inhabiting waters further south. Abundance of mature individuals on the Eastern Scotian Shelf is estimated to have declined by more than 90% since the early 1970s and is now at a historically low level. The area occupied by the population appears to have declined significantly since the mid-1980s. Larger, older individuals have been severely depleted from this population, producing a significant truncation in the length distribution of the population over time. The probable cause of the decline is an unsustainable rate at which they were captured as bycatch in fisheries directed at other groundfish species. They have been caught, and continue to be caught, in a directed fishery for skate, although current reported catches are low.</p>	
<p>Applicability of Criteria</p> <p>Criterion A (Declining Total Population): meets criterion for Endangered A4b.</p> <p>Criterion B (Small Distribution, and Decline or Fluctuation): does not apply because extent of occurrence is >20,000 km² and area of occupancy is >2,000 km².</p> <p>Criterion C (Small Total Population Size and Decline): does not apply because number of mature individuals is >10,000.</p> <p>Criterion D (Very Small Population or Restricted Distribution): does not apply because number of mature individuals is >1000 and area of occupancy is >20 km².</p> <p>Criterion E (Quantitative Analysis): not done.</p>	

TECHNICAL SUMMARY

Leucoraja ocellata

Winter Skate, Georges Bank-Western Scotian Shelf-Bay of Fundy population

Raie tachetée

Canadian Range: Canadian portion of Georges Bank, western Scotian Shelf off southern Nova Scotia, Bay of Fundy (Northwest Atlantic Fishery Organization divisions 4X5Ze)

Extent and Area Information	
• <i>Extent of occurrence (EO)(km²)</i>	Approx. 110,000
• <i>Specify trend in EO</i>	Stable
• <i>Are there extreme fluctuations in EO?</i>	No
• <i>Area of occupancy (AO) (km²)</i>	Approx. 40,000
• <i>Specify trend in AO</i>	Varies
• <i>Are there extreme fluctuations in AO?</i>	No
• <i>Number of known or inferred current locations</i>	Unknown
• <i>Specify trend in #</i>	Unknown
• <i>Are there extreme fluctuations in number of locations?</i>	Unknown
• <i>Specify trend in area, extent or quality of habitat</i>	Unknown
Population Information	
• <i>Generation time (average age of parents in the population)</i>	22 Years
• <i>Number of individuals</i>	1.7 million (minimum estimate)
• <i>Total population trend:</i>	No overall trend
• <i>% decline</i>	Stable
• <i>Are there extreme fluctuations in number of mature individuals?</i>	No
• <i>Is the total population severely fragmented?</i>	No
• <i>Specify trend in number of populations</i>	Unknown
• <i>Are there extreme fluctuations in number of populations?</i>	Unknown
Threats (actual or imminent threats to populations or habitats)	
The population is subjected to bycatch in fisheries for shellfish on Georges Bank and for other species of groundfish.	
Rescue Effect (immigration from an outside source)	
• <i>Status of outside population(s)?</i> Winter skate on the U.S. portion of Georges Bank, although not overfished, are at low levels relative to their abundance from the late 1960s through to the late 1990s; Eastern Scotian Shelf population is Threatened.	
• <i>Is immigration known or possible?</i>	Yes
• <i>Would immigrants be adapted to survive in Canada?</i>	Yes
• <i>Is there sufficient habitat for immigrants in Canada?</i>	Yes
• <i>Is rescue from outside populations likely?</i>	Yes
Quantitative Analysis	
	Not available
Current Status	
COSEWIC: Special Concern (May 2005)	

Status and Reasons for Designation

Status: Special Concern	Alpha-numeric code:
<p>Reasons for Designation:</p> <p>The species possesses life history characteristics that increase vulnerability to exploitation, that reduce rate of recovery, and that increase the risk of extinction. These characteristics include delayed age at maturity, long generation time, low fecundity, and consequently slow population growth rate. The area of occupancy of this species has been stable. Estimates of population status on Georges Bank show no discernible trend over time. Abundance elsewhere appears to have been stable over time. There is a high probability that the population receives immigrants from the species inhabiting the American portion of Georges Bank. The population is subjected to bycatch in fisheries for other groundfish shellfish species. There are directed fisheries for this species in U.S. waters.</p>	
<p>Applicability of Criteria</p>	
<p>Criterion A (Declining Total Population): does not apply because the population does not exhibit an overall trend in abundance.</p> <p>Criterion B (Small Distribution, and Decline or Fluctuation): does not apply because extent of occurrence is $>20,000 \text{ km}^2$ and area of occupancy is $>2,000 \text{ km}^2$.</p> <p>Criterion C (Small Total Population Size and Decline): does not apply because number of mature individuals is $>10,000$.</p> <p>Criterion D (Very Small Population or Restricted Distribution): does not apply because number of mature individuals is >1000 and area of occupancy is $>20 \text{ km}^2$.</p> <p>Criterion E (Quantitative Analysis): not done.</p>	

TECHNICAL SUMMARY

Leucoraja ocellata

Winter Skate, Northern Gulf-Newfoundland population

Raie tachetée

Canadian Range: Northern Gulf of St. Lawrence, southern Newfoundland, southern Grand Bank (Northwest Atlantic Fishery Organization divisions 3NOP4RS)

Extent and Area Information	
• <i>Extent of occurrence (EO)(km²)</i>	Approx. 420,000
• <i>Specify trend in EO</i>	Unknown
• <i>Are there extreme fluctuations in EO?</i>	Unlikely
• <i>Area of occupancy (AO) (km²)</i>	Approx. 200,000
• <i>Specify trend in AO</i>	Unknown
• <i>Are there extreme fluctuations in AO?</i>	Unknown
• <i>Number of known or inferred current locations</i>	Unknown
• <i>Specify trend in #</i>	Unknown
• <i>Are there extreme fluctuations in number of locations?</i>	Unknown
• <i>Specify trend in area, extent or quality of habitat</i>	Unknown
Population Information	
• <i>Generation time (average age of parents in the population)</i>	Unknown
• <i>Number of mature individuals</i>	Unknown
• <i>Total population trend:</i>	Unknown
• <i>% decline</i>	Unknown
• <i>Are there extreme fluctuations in number of mature individuals?</i>	Unknown
• <i>Is the total population severely fragmented?</i>	Unknown
• <i>Specify trend in number of populations</i>	Unknown
• <i>Are there extreme fluctuations in number of populations?</i>	Unlikely
Threats (actual or imminent threats to populations or habitats)	
Winter skate is caught as bycatch in fisheries for other groundfish.	
Rescue Effect (immigration from an outside source)	
• <i>Status of outside population(s)?</i> Southern Gulf population is Endangered	
• <i>Is immigration known or possible?</i>	Unknown
• <i>Would immigrants be adapted to survive in Canada?</i>	Yes
• <i>Is there sufficient habitat for immigrants in Canada?</i>	Yes
• <i>Is rescue from outside populations likely?</i>	Unlikely
Quantitative Analysis	
Not available	
Current Status	
COSEWIC: Data Deficient (May 2005)	

Status and Reasons for Designation

Status: Data Deficient	Alpha-numeric code:
<p>Reasons for Designation:</p> <p>The species exists in low concentrations in the Northern Gulf of St. Lawrence, in the coastal waters off the southern coast of Newfoundland, and on the southern portion of the Grand Bank. A quantitative analysis of spatial and temporal variation in population size is not possible because of the infrequency with which the species is caught. The population is subjected to bycatch.</p>	
<p>Applicability of Criteria</p>	
<p>Criterion A (Declining Total Population): insufficient data to quantify temporal changes in abundance because of the rarity of the species in this area.</p> <p>Criterion B (Small Distribution, and Decline or Fluctuation): does not apply because extent of occurrence is $>20,000 \text{ km}^2$ and area of occupancy is $>2,000 \text{ km}^2$.</p> <p>Criterion C (Small Total Population Size and Decline): an estimate of the number of mature individuals is not available.</p> <p>Criterion D (Very Small Population or Restricted Distribution): an estimate of the number of mature individuals is not available; area of occupancy is $>20 \text{ km}^2$.</p> <p>Criterion E (Quantitative Analysis): not done.</p>	

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

Acknowledgements

Thanks to Dr. Richard Haedrich of Memorial University and to Jim Simon of the Bedford Oceanographic Institute in Dartmouth, Nova Scotia, for his expedient delivery of the data required for this paper and for his input in interpreting the data. Special thanks go out to Dave Methven for his input and suggestions during the writing.

Funding for the preparation of this status report was provided by the Canadian Wildlife Service, Environment Canada.

Authorities contacted

Dr. Richard Haedrich. Professor, Memorial University of Newfoundland.

Jim Simon. Fisheries Assessment Technician, Fisheries and Oceans Canada, Marine Fish Division, Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

Dr. Howard Powles. Director, Biodiversity Science branch, Department of Fisheries and Oceans, Ottawa.

INFORMATION SOURCES

Benoît, H.P., M.-J. Abgrall, and D.P. Swain. 2003a. An assessment of the general status of marine and diadromous fish species in the southern Gulf of St. Lawrence based on annual bottom-trawl surveys (1971-2002). Can. Tech. Rep. Fish. Aquat. Sci. no. 2472: iv + 183 pp.

Benoît, H.P., Darbyson, E.D., and Swain, D.P. 2003b. An atlas of the geographic distribution of marine fish and invertebrates in the sGSL based on annual bottom trawl surveys (1971-2002). Can. Data Rep. Fish. Aquat. Sci. 1112: 185 p.

Bigelow, H.B. and W.C. Schroeder. 1953. Fishes of the Western North Atlantic. Sawfishes, guitarfishes, skate and rays, chimaeroides. Memoir Sears Foundation Marine Research.

Clay, D. 1991. Seasonal distribution of demersal fish (*Osteichthyes*) and skate (*Chondrichthyes*) in the southeastern Gulf of St. Lawrence. Can. Spec. Publ. Fish. Aquat. Sci. 113.

Coad, B.W. 1995. Encyclopedia of Canadian Fishes. Canadian Museum of Nature.

Collette, B.B., and G. Klein-MacPhee. 2002. Bigelow and Schroeder's Fishes of the Gulf of Maine. Smithsonian Press. Washington

Darbyson, E., and Benoît, H.P. 2003. An atlas of the seasonal distribution of marine fish and invertebrates in the sGSL. Can. Data Rep. Fish. Aquat. Sci. 1113: 294 pp.

Dulvy, N.K., Sadovy, Y., and Reynolds, J.D. 2003. Extinction vulnerability in marine populations. Fish and Fisheries 4: 25-64.

Holden, M.J. 1977. Elasmobranchs, In Fish population dynamics (J.A. Gulland, ed), pp. 187-212. J. Wiley and Sons, London.

- Hunter, E., Buckley, A.A., Stewart, C., and Metcalfe, J.D. Submitted. Migratory behaviour of the thornback ray, *Raja clavata*, in the southern North Sea. Journal of the Marine Biological Association of the British Isles.
- Kulka, D.W., E.M. DeBlois, and D.B. Atkinson. 1996. Non-traditional groundfish species on Labrador Shelf and Grand Banks-Skate. DFO Atlantic Fisheries Res Doc 96/98.
- McEachran, J.D., D.F. Boesch, and J.A. Musick. 1976. Food division within two Sympatric species-pairs of skate (Pisces: Rajidae). Marine Biology. 35: 301-17.
- McEachran, J.D. and C.O. Martin. 1977. Possible occurrence of character displacement in the sympatric skate *Raja erinacea* and *Raja ocellata* (Pisces: Rajidae). Environment and Biology of Fishes 2:121-130.
- Messieh, S.N., T.W. Rowell, D.L. Peer, and P.J. Cranford. 1991. The effects of trawling, dredging and ocean dumping on the eastern Canadian continental shelf seabed. Continental Shelf Research 11 (8-10): 1237-1263.
- NMFS. 2002. Annual report to Congress on the status of U.S. fisheries — 2001. U.S. Dept. Commerce, NOAA, Nat. Mar. Fish. Serv., Silver Spring, MD.
- NMFS. 2003. Annual report to Congress on the status of U.S. fisheries — 2002. U.S. Dept. Commerce, NOAA, Nat. Mar. Fish. Serv., Silver Spring, MD.
- NOAA. 2003a. Magnuson-Stevens Fishery Conservation and Management Act Provisions; Fisheries of the Northeastern United States; Northeast Skate Complex (Skate) Fisheries; Skate Fishery Management Plan. National Oceanic and Atmosphere Administration, Federal Register Vol. 68, No. 160, 19 August 2003, pp. 49693-49698.
- NOAA. 2003b. Essential fish habitat source document: winter skate, *Leucoraja ocellata*, life history and habitat characteristics. National Oceanic and Atmosphere Administration Technical Memorandum NMFS-NE-179, Woods Hole, MA.
- Robins, C.R. and G.C. Ray. 1986. A field guide to Atlantic coast fishes of North America. Houghton Mifflin Company, Boston, U.S.A.
- Scott, W.B. and M.G. Scott. 1988. Atlantic Fishes of Canada. University of Toronto Press. Ontario, Canada.
- Simon, J.E., and K.T. Frank. 1996. Assessment of the Division 4VsW skate fishery. DFO Atl. Fish. Res. Doc. 96/105.
- Simon, J.E., and K.T. Frank. 1998. Assessment of the winter skate fishery in Division 4VsW. DFO Atl. Fish. Res. Doc. 98/145.
- Simon, J.E., and K.T. Frank. 2000. Assessment of the winter skate fishery in Division 4VsW. DFO Canadian Stock Assessment Secretariat Res. Doc. 2000/140.
- Simon, J.E., and K.T. Frank. 2000. Assessment of the winter skate fishery in Division 4VsW. DFO Science Stock Status Report A3-29 (2000).
- Simon, J.E., Harris, L. and T. Johnston. 2003. Distribution and abundance of Winter Skate (*Leucoraja ocellata*) in the Canadian Atlantic. Canadian Science Advisory Secretariat Working Paper. 2003/028.
- Sosebee, K. and M. Terceiro. 2000. Assessment of the United States Northeast Region Skate Complex for 2000. NAFO SCR Doc. 00/15.
- Sulikowski, J.A., Morin, M.D., Suk, S.H. and W.H. Howell. 2003. Age and growth estimates of the winter skate (*Leucoraja ocellata*) in the western Gulf of Maine. Fishery Bulletin 101(2): 405-413.

- Tyler, A.V. 1971. Periodic and resident components in communities of Atlantic fishes. *Journal of the Fisheries Research Board of Canada*. 28: 751-63.
- Vladykov, V.D. 1936. Capsules d'oeufs de raies de l'Atlantique canadien appartenant au genre *Raja*. *Nature Canadian*. 63: 211-231.
- Whitehead, P.J.P., Bauscot, M.L., Hureau, J.C., Neilsen, J. and E. Tortonese. (eds). 1984. *Fishes of the North-eastern Atlantic and the Mediterranean*, UNESCO, Paris, Vol 1

BIOGRAPHICAL SUMMARY OF REPORT WRITER

Jerome Howlett was born in St. John's, NL, and has lived in various parts of Canada over the years. He returned to Newfoundland and completed a B.Sc. (honours) in biology, with a focus in marine biology, in April, 2002. It was during the completion of this degree that an interest in skate was developed. Also during this period he became familiar with the work of COSEWIC and decided to bid on the contract for the status report on winter skate.

Jerome has also been an avid scuba diver for over 15 years and holds advanced diving, rescue diving and scientific diving certificates. During this time as a diver he also noted a general decline in skate abundance around the province of Newfoundland. This was another factor that added to his interest in skate and the work of COSEWIC.

Currently, Jerome is working on an M.Sc. in biology at Memorial University in Newfoundland. The focus is on seasonal growth and ecology of the seaweed species *Laminaria longicuris* and *Alaria esculenta* in the province. In addition, the M.Sc. project is also conducting a feasibility study on the lab culture and aquaculture potential of these two species on the southwest coast of the province.