

A SUMMARY OF THE 1980 CANADIAN SWORDFISH SURVEY

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SUMMARY

A 50-day swordfish longline research survey was conducted in 1980, from Cape Hatteras to the Grand Banks. The survey rationale was to sample swordfish from four geographically distinct areas of the northern part of the species range during the period of maximum dispersion in order to gather data pertaining to stock discrimination, age determination, reproductive biology and general biology. Material collected consisted of: detailed morphometric data, ageing structures, gonads, internal and external parasites, stomach contents, and tissues for electrophoresis, heavy metal, organochlorine, and lipid analysis. A description of sampling techniques is presented. Preliminary analysis of the catch data shows an east to west trend of decreasing size in both sexes and an increasing proportion of females in the catch.

RESUME

Une campagne palangrière de recherche sur l'espadon a été menée en 1980 du Cap Hatteras au Grand Banc. L'objectif visé était d'échantillonner de l'espadon dans quatre secteurs géographiques distincts de l'aire de distribution nord-occidentale de

l'espèce à l'époque de dispersion maximale, afin de rassembler des données sur la distinction entre stocks, la détermination de l'âge, la biologie de la reproduction et la biologie générale. Les éléments d'étude réunis comprenaient: données morphométriques détaillées, pièces dures du poisson permettant d'observer son vieillissement, gonades, parasites internes et externes, contenus stomacaux, et tissus destinés aux analyses sur l'électrophorèse, la teneur en métaux lourds, l'organochlorine et les lipides. Les techniques d'échantillonnage sont décrites dans le présent rapport. L'analyse préliminaire des données de capture indique une tendance décroissante de la taille d'est en ouest, et ceci pour les deux sexes, ainsi qu'un pourcentage croissant de femelles dans la prise.

RESUMEN

Durante 1980, se efectuó un crucero de palangre para pez espada, de 50 días de duración, desde Cape Hatteras hasta Grand Banks. Su principal objetivo era muestrear pez espada en 4 distintas áreas geográficas de la parte norte del territorio durante el período de máxima dispersión, con el fin de recopilar datos pertenecientes a la discriminación del stock, determinación de la edad, biología reproductiva y biología general. El material recogido con

sistió en : datos morfométricos detallados, estructuras para la determinación de la edad, gónadas, parásitos internos y externos, contenidos de estómagos, tejidos para electroforesis, metales pesados, organoclorina y análisis de lípidos. Los análisis preliminares de los datos de captura muestran, de Este a Oeste, una tendencia hacia la disminución de tallas en ambos sexos, y una creciente proporción de hembras en las capturas. El documento presenta una descripción de las técnicas de muestreo.

INTRODUCTION

A lack of adequate catch, effort, and biological data has hampered attempts to apply standard analyses used in population dynamics to swordfish in the Atlantic (Beardsley 1978). In an attempt to obtain the necessary biological data, a major swordfish research survey was mounted in the northwest Atlantic during the summer/fall of 1980. This season was chosen in an attempt to coincide with the period of maximum population dispersion. Four areas of operation were chosen: Cape Hatteras to Hydrographer Canyon, Georges Bank, the Scotian Shelf, and the Grand Banks, based upon observations presented by Beckett (1971, 1974) and Beckett and Freeman (1974). For logistical reasons, a separate trip was made to each of the four areas. The survey rationale was to sample swordfish from four geographically distinct areas in the northern part of the species range during the period of maximum dispersion to collect data pertaining to stock discrimination, age determination, reproductive biology, and general biology. The materials collected consisted of: detailed morphometric data, ageing structures, gonads, internal and external parasites, stomach contents, and tissues for electrophoresis, heavy metal, organochlorine, and lipid analysis.

DESCRIPTION OF OPERATIONS

A 27-m Canadian commercial swordfish longliner, the MV Jane R, was chartered for the survey. The gear used was a drifting longline, typically used by Canadian swordfish longliners, but with only 500 to 1000 Mustad 3/0 hooks per set. The number of hooks per set was adjusted depending upon catch rates of swordfish and/or sharks. The mainline carried hooks at 12-fm intervals with a buoy every 5 hooks and a radar beacon every 80 hooks. Ganging and buoy-line lengths were adjusted to suit local conditions, as determined by the vessel captain, and the gear configuration was altered as dictated by catch rates.

The gear was set each evening and hauled early the following morning. Immediately prior to and following both setting and hauling the gear, 460 m XBT and 60 m MBT casts were made, sea-surface temperature recorded and surface salinity sample collected. Detailed fishing and sampling logs were completed daily.

All live fish found on the gear at haulback were tagged and released, after species had been identified and length and weight estimated. All moribund swordfish were taken aboard and hook position of the fish on the gear recorded. Round weight, morphometric measurements and sex were recorded (see Appendix 1 for detailed description of morphometric measurements). Serum, liver, heart, dorsal muscle, and eye lens samples were collected and frozen at -20°C for electrophoretic analysis. Electrophoresis samples were transferred to -40°C freezer storage immediately upon return to port. Liver and dorsal muscle samples were collected and frozen for heavy metal and organochlorine contamination studies, and lipid content and composition studies. Gills and digestive tracts were collected and frozen for parasite and food habit studies. Caudal vertebrae, dorsal and anal fins, and a section of the head were collected and frozen for ageing studies. Gonads were collected and fixed in 10% buffered saline formalin for reproduction studies. Weight, sex, morphometric data, and tissue samples for electrophoresis and contamination studies were collected from a subsample of other species caught. (See Appendix 2 for detailed description of tissue sampling techniques).

Ultrasonic pressure transmitters and electronic timers to be attached to the gear for gear performance and feeding behaviour studies were designed and constructed, but delays in obtaining parts prevented these studies from progressing beyond the de-bugging stage.

SUMMARY OF CATCH DATA

Set locations are shown for each trip in Fig. 1. The second trip, to the Grand Banks, covers two 5° squares, and as a result when data is presented by 5° square for comparison to existing datasets, this trip is separated into two parts.

The catch by species is shown in Table 1. A total of 989 fish (18 species) were taken, of which 236 were tagged and released. Of the total, 359 were swordfish, of which 48 were tagged and released.

A summary of the catch data is shown in Table 2 and length frequencies are shown in Figure 2. Daily catch-per-unit-effort values for swordfish ranged from 0 to 52 fish per 1000 hooks and 0 to 2.2 mt per 1000 hooks. No real trends are present in the catch-per-unit-effort data; however a clear pattern is evident in the mean-weight, mean-length, and sex-ratio data. Both mean weight and mean length show an east to west trend of decreasing size. The catch was predominantly female in all areas and there was an east to west trend of increasing predominance of females in the catch. As expected, sea-surface temperature shows an increasing east to west trend. Males were consistently smaller in all areas and the size trends were observed in both species.

Detailed analyses of the materials collected are presently being conducted and the results of each study will be reported as completed.

REFERENCES

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- Beckett, J. S. 1971. Canadian swordfish longline fishery. ICCAT SCRS/71/36: 14 p.
- Beckett, J. S. 1974. Biology of swordfish, *Xiphias gladius* L., in the northwest Atlantic Ocean. U.S. Dept. Commer., NOAA Tech. Rep. NMFS SSRF-675: 103-106.
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Table 1. Catch by species.

		Trip #				Total
		1	2	3	4	
Swordfish	<u>Xiphias gladius</u>	94 (9)*	77(10)	80(11)	108(18)	359 (48)
Bluefin tuna	<u>Thunnus thynnus</u>	-	2 (1)	-	-	2 (1)
Bigeye tuna	<u>Thunnus obesus</u>	-	1	3 (1)	-	4 (1)
White marlin	<u>Makaira albida</u>	2	-	-	-	2
Dolphin	<u>Coryphaena hippurus</u>	-	-	-	1 (1)	1 (1)
Escolar	<u>Lepidocybium flavobrunneum</u>	-	-	-	1	1
Longnose lancetfish	<u>Alepisaurus ferox</u>	-	9	10	-	19
Bigeye thresher shark	<u>Alopias superciliosus</u>	1	-	-	1	2
Mako shark	<u>Isurus oxyrinchus</u>	15 (6)	3 (2)	7 (3)	9 (3)	34 (14)
Silky shark	<u>Carcharhinus falciformis</u>	60 (6)	-	-	-	60 (6)
Blacktip shark	<u>Carcharhinus limbatus</u>	1	-	-	-	1
Sandbar shark	<u>Carcharhinus milberti</u>	77(29)	-	-	-	77 (29)
Dusky shark	<u>Carcharhinus obscurus</u>	35(10)	-	-	-	35 (10)
Night shark	<u>Hypoprion signatus</u>	16(5)	-	-	-	16 (5)
Blue shark	<u>Prionace glauca</u>	44(16)	26(11)	28(25)	72(24)	170 (76)
Scalloped hammerhead shark	<u>Sphyrna lewini</u>	182(42)	-	-	-	182 (42)
Pelagic stingray	<u>Dasyatis violacea</u>	-	-	2	20 (2)	22 (2)
Manta ray	<u>Manta birostris</u>	2 (1)	-	-	-	2 (1)
						989(236)

*Figures in parentheses indicate number tagged and released.

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Table 2. Summary of swordfish catch data.

Trip	Dates	5° square	# sets	# hooks	Catch		CPUE		Mean wt (kg)	Mean length (cm)	Sex ratio
					# fish*	Weight (mt)**	#/ 1000 hooks	Mt/ 1000 hooks			
I	Aug. 5-18	35 70	9	3845	94(9)	4.225	24.5	1.10	45.0	138.7	5.4:1
II	Aug. 25-Sept. 8	40 50	5	3073	43(4)	4.523	14.0	1.47	105.2	187.2	1.3:1
"	Aug. 25-Sept. 8	40 55	3	2720	34(6)	2.960	12.5	1.09	87.1	176.4	3.5:1
III	Sept. 15-24	40 60	7	5947	80(11)	5.570	13.5	0.94	69.6	160.7	3.1:1
IV	SEpt. 29-Oct. 8	40 65	7	3990	108(18)	7.353	27.1	1.84	68.1	158.3	3:1:1

*Figures in parentheses indicate number tagged and released.

**Calculated using total number caught and mean weight of fish sampled.

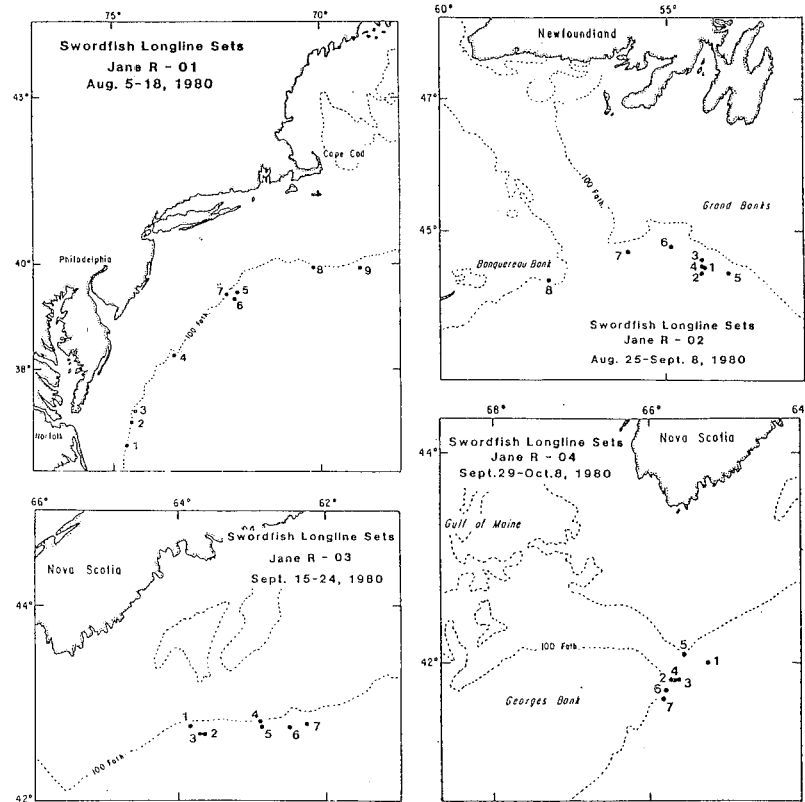


Figure 1. Set locations of the Canadian swordfish research survey.

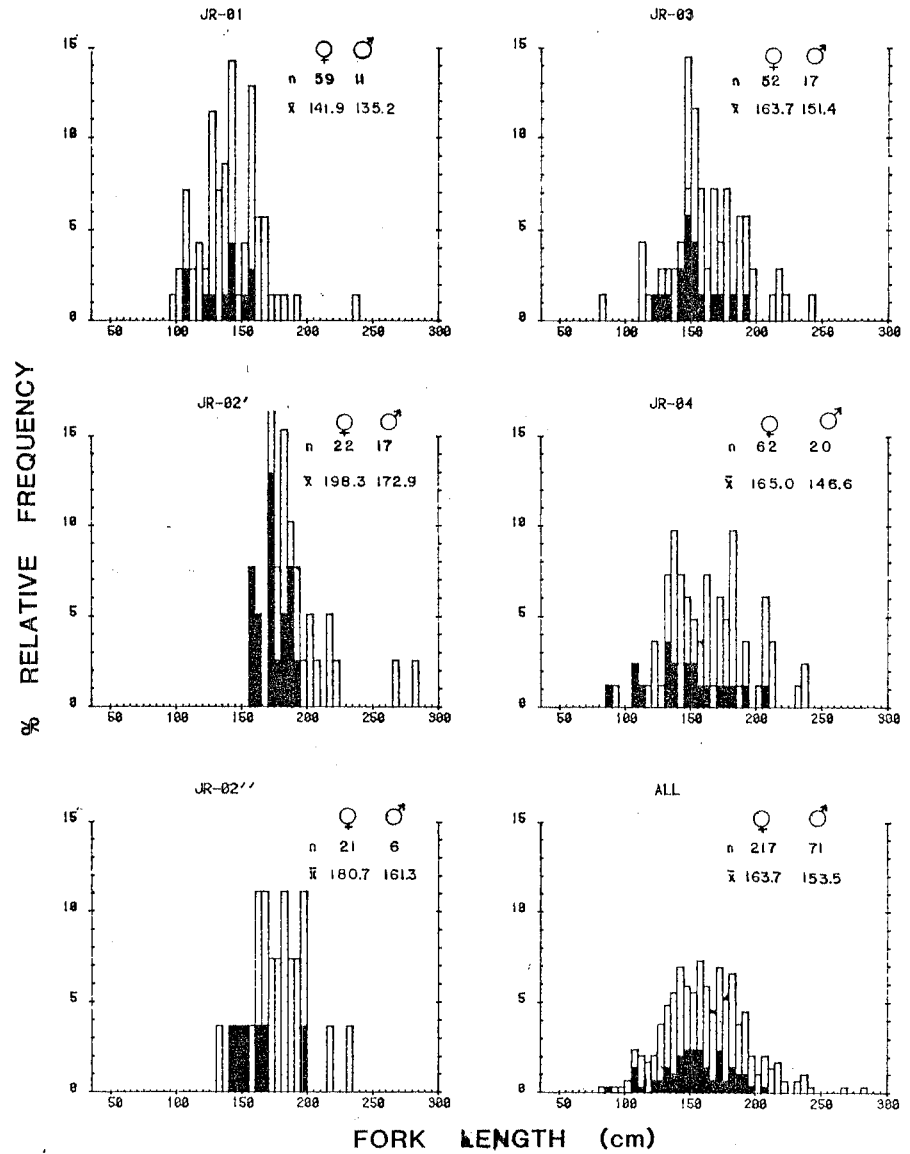


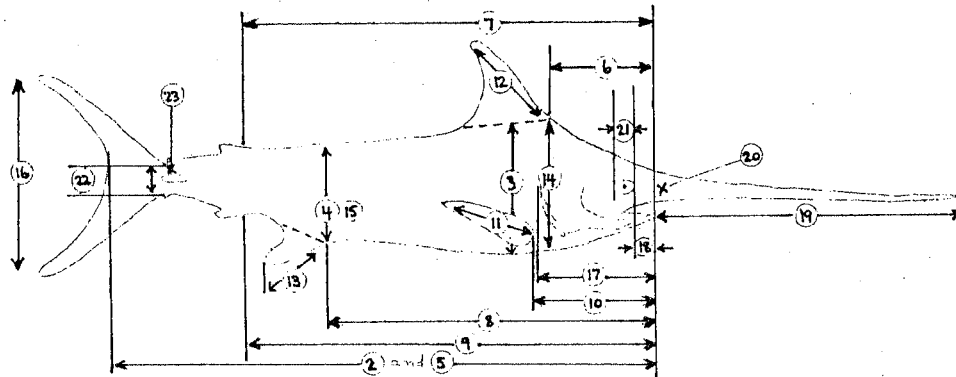
Figure 2. Length frequency of swordfish by area (□ ♀, ■ ♂, n=sample size, \bar{x} =mean length).

APPENDIX 1

Description of Swordfish Measurements

(All measurements in centimetres to nearest millimetre)

1. Round weight: Weighed on scales. Indicate units.
2. Body length, tape: From the fork of the tail to the tip of the lower jaw following the natural curve of the body.
3. Pectoral half girth: From mid-ventral line under the pectoral fin at its posterior insertion to the base of the 1st dorsal fin following the natural curve of the body.
4. Anal half girth: From the base of the 1st anal fin to mid-dorsal line following the natural curve of the body.
5. Body length, calipers: From the fork of the tail to the tip of the lower jaw.
6. 1st Pre-dorsal length: From the anterior part of the base of the 1st dorsal fin to the tip of the lower jaw.
7. 2nd Pre-dorsal length: From the anterior part of the base of the 2nd dorsal fin to the tip of the lower jaw.
8. 1st Pre-anal length: From the anterior part of the base of the 1st anal fin to the tip of the lower jaw.
9. 2nd Pre-anal length: From the anterior part of the base of the 2nd anal fin to the tip of the lower jaw.
10. Pre-pectoral length: From the anterior part of the base of the pectoral fin to the tip of the lower jaw.
11. Length of pectoral: From the most anterior part of the base of the pectoral fin to the most distant part of this fin (straight line).
12. 1st Dorsal height: From the anterior part of the base of the first dorsal fin to the most distant part of this fin (straight line).
13. 1st anal height: From the anterior part of the base of the 1st anal fin to the most distant part of this fin (straight line).
14. 1st dorsal body depth: Depth of the body at the anterior part of the base of the 1st dorsal fin.
15. 1st anal body depth: Depth of the body at the anterior part of the base of the 1st anal fin.
16. Caudal spread: Distance between the two tips of the tail spread in a natural position.
17. Head length: From the tip of the lower jaw to the farthest edge (bony) of the opercle.
18. Snout length: From the anterior margin (fleshy) of the eye to the tip of the lower jaw.
19. Bill length: From the tip of the lower jaw to the end of the sword.
20. Bill width: Width of the bill at the tip of the lower jaw. Measure on under side.
21. Eye diameter: Maximum width of the horizontal exposed part of the eye.
22. Least depth caudal peduncle: Minimum depth just anterior to the tail -- in pre-caudal pits.
23. Width at caudal keels: Maximum width of the caudal peduncle including the keels. (Occasionally there are no keels and this should be recorded).
24. Sex and maturity: Use sex symbol, and describe gonads: immature, ripe, spent.



FISH NUMBER

1. Round weight		14. 1st Dorsal body depth	
2. Body length, tape		15. 1st Anal body depth	
3. Pectoral half girth		16. Caudal spread	
4. Anal half girth		17. Head length	
5. Body length, calipers		18. Snout length	
6. 1st Pre-dorsal length		19. Bill length	
7. 2nd Pre-dorsal length		20. Bill width fleshy bony	
8. 1st Pre-anal length		21. Eye diameter	
9. 2nd Pre-anal length		22. Least depth caudal peduncle	
10. Pre-pectoral length		23. Width at caudal keels	
11. Length of pectoral		24. Sex	Maturity
12. 1st Dorsal height			
13. 1st Anal height			

Electrophoresis

Serum - Draw blood as soon as possible, after morphometrics if this will interfere with measurements. Syringes, sodium heparin and heparinized vacutainers should be kept on ice. Fill syringe with sodium heparin and empty immediately before drawing blood. Fill 10 cc syringe with whole unclotted blood and empty into 10 cc vacutainer. Spin vacutainer in centrifuge for 20 min at full speed. Using pipette, draw off serum (supernatant) ensuring no blood cells are included. Fill labelled 4-mL vial with serum and freeze. Dispose of vacutainer and pipette. Syringes may be re-used if washed immediately in fresh water and re-heparinized.

Liver - Remove a thumb-sized piece of each tissue and place each in a separate small whirl-pac.

Eye-lens - Remove both eye lenses, if possible, and place in small whirl-pac. Place all 4 small whirl-pacs in a large whirl-pac, together with the appropriate metal tag and freeze immediately.

Organochlorines

Wash knife in methylene chloride. Without touching sample, remove a piece of liver tissue approximately 5 cm³ and place in a pre-washed mason jar. Label jar and freeze. Protect against any contact or contamination of jar or sample during procedure.

Lipids

Wash knife in methylene chloride. Without touching sample, remove a piece of liver tissue approximately 5 cm³ and place in an unwashed 100 or 250 mL sample jar. Cover jar with aluminum foil and seal. Label jar and freeze. Wash knife in methylene chloride and repeat procedure for dorsal muscle sample. Protect against contamination.

Mercury

Remove approximately a 1/2 pound dorsal muscle sample, place in a polybag, label and freeze.

Parasites

Remove all gills, place in a labelled fish box and freeze. Tie digestive tract at esophagus and vent, remove intact, place in labelled bucket and freeze. Include metal tag in each. Record occurrence of Penella and other external parasites.

Ageing

Remove first 4 dorsal and anal fin spines including condyles, and caudal vertebrae in region of caudal peduncle, place in polybag or whirl-pac, together with metal tag and freeze. Remove head section (see diagram), attach metal tag and freeze.

Reproduction

Remove both gonads, tie twine around right gonad, place in labelled bucket or quart jar and fix in 10% buffered saline formalin. Add 2 marble chips to container. Ensure 5:1 ratio of fixative to tissue. Cut large ovaries lengthwise to allow fixative penetration. Prepare formalin in carboy by adding a small handful of marble chips to carboy (only replenish when dissolved), adding 135 g salt (pre-measured), 1500 mL of 100% formalin and filling to 15 L with fresh water.