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Survey of Apex Predators (Sharks and Swordfish) in the Vicinity of a Cold Core Gulf Stream Ring Cruise Results - R/B WIECZNO Cruise 84-02

by

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CRUISE PERIOD AND AREA

The cruise period was from 26 April - 18 May 1984. The areas of operation were from 34°00' to 39°00' N; 66°00' to 74°30' W, primarily in a cold core ring in the northwestern part of the Sargasso Sea, and along the continental shelf between Cape Lookout, N.C., and the Virginia Capes (Figure 1).

OBJECTIVES

The objectives of the cruise were to: (1) investigate a newly-formed cold core ring for concentrations of large apex predators (primarily sharks, tunas and swordfish); (2) conduct food habit studies by examining stomachs of apex predators taken in the different water masses; (3) collect vertebral samples from sharks for age and growth studies; (4) collect biological material for reproductive studies of sharks; (5) collect blood samples from tuna for bacteriological studies; (6) collect parasites from sharks; and (7) tag sharks and tunas for migration studies.

METHODS

Fishing operations were conducted with longline gear supplied by R/V WIECZNO. Branch lines (gangions) were both Japanese (23 meters long) and US (5 meters long) types fished in five hook units between floats, with float lines 14 meters long. At each station 250-300 hooks were fished; mackerel or squid were used as bait. The gear was most frequently set during the night (2200-0200) and hauled during the day starting at 0600. The gear was then set again during the day (1300-1400) and hauled during late afternoon and early evening (1600-2000).

Surface temperature data from satellite imagery was provided by the Atlantic Environmental Group (AEG) and was used in developing the cruise plan. During the cruise satellite information was continuously updated by AEG and radioed to vessel. Subsurface temperature profiles (XBT) were taken at each station and whenever appropriate to locate frontal zones.

All fish taken on longlines were either brought on board for biological examination or tagged and released. Data on length, weight, sex, and stomach content was obtained routinely from each fish brought on board. Subsequent handling of the catch included sampling of liver and muscle tissue, vertebrae and parasites.

RESULTS

Fishing Operations

Six hundred and twenty-three fish (22 species) were collected from 30 longline sets (Figure 2 and Table 1). Two hundred and ninety-eight were brought on board the vessel or lost at the rail; 325 were tagged and released. The principal species obtained were blue, scalloped hammerhead, night, sandbar and bignose sharks and yellowfin tuna. The highest overall catches were obtained from night sets. This may be due in part to a longer fishing time for night versus day sets. Some daytime sets had high catch rates however, particularly along strong frontal zones. There was no obvious difference between the effectiveness of Japenese and US gear, or between squid and mackerel bait. Other factors such as the depth of the thermocline, water depth, and proximity of frontal zones appeared to be more important in determining catch rates.

Temperature Observations

Inclement weather accompanied by rough seas hampered operations in the vicinity of a recently formed cold ring at 36°00'N, 68°00'W (Figure 1). Nevertheless, three longline sets in and around the ring did not show large concentrations of apex predators in this area (Figure 2, Table 1). The highest catches of sharks during the cruise were along the continental shelf between Cape Lookout, NC, and Washington Canyon (34°00' and 38°00'N) in depths of 60 to 150 meters. The highest catch rates were along thermal fronts which showed warm (18° to 22°C) water intruding into cooler (11° to 13°C) shelf water (Figures 6-15).

An area of warm water near Washington Canyon (sets 20-29) contained concentrations of several species of sharks; depths ranged from 70 to 110 meters in this area. Surface temperatures were as low as 13°C, but XBT traces indicated underlying warmer (18° to 20°C) layers at those stations producing high catch rates. Exceptionally strong temperature inversions and thus significant temperature gradients of up to 7° per 20 meters of depth were recorded at station 29. The highest number of fish caught during the entire cruise, 62, were from this set. Longline stations where depths exceeded 300 meters had lower catch rates than inshore stations in similar temperatures. The sharks from the same sets in the Washington Canyon area included highly pelagic temperate species (blue and mako) and warm temperate and tropical forms (sandbar, night, bignose, and tiger). Several species apparently penetrate colder shelf water as long as warm Gulf Stream water is nearby.

Reproduction, Age & Growth, and Photography

Samples were taken from 60 sharks for reproductive studies. Measurements of organs and tissue samples were taken from both male and female scalloped hammerheads (24), bignose (14), night (7), tiger (6), shortfin mako (5), and blue sharks (4).

Most sharks boated were juveniles. Significant exceptions were a mature male tiger and a very large, mature female blue shark. The female had pups last season and was ready to ovulate this season. This specimen suggests that blue sharks bear young every other year. If spermatozoa are revealed by histological processing of the shell glands, then this blue shark will prove to be a valuable specimen. Vertebral samples were taken from 65 sharks to augment age studies.

Much of the work done during the cruise was documented photographically. Records of dissecting, shark identifications, and tagging procedures were made with 35 millimeter still cameras. In addition, a series of videotape recordings were made to begin a project on shark identification. The subsequent edited videotape is for sports fishing clubs and expositions. The tape should be of value to cooperating shark taggers; it will aid them in identifying common Atlantic sharks. Over five hours of videotape records were made as source material for this documentatary.

Parasite Studies

Parasites were collected from approximately 120 individual fishes (sharks and teleosts), particular attention was directed to ectoparasite copepods and

monogenes. Almost all fishes examined were infested with at least one species of ectoparasite. Blue sharks often hosted as many as five copepod species (Echthrogaleus sp., Pandarus sp., Kroyeria sp., Kroyerina sp., and Phyllotherius sp.). Ectoparasites generally showed high levels of host and attachment site selectivity. For example, the monogenetic trematode Dermophthirius sp. was found to exclusively infest the bignose shark. This host preference allowed species differentiation between the quite similar bignose and sandbar sharks to be corroborated by parasitological data. Pathologies associated with parasitic infestations were often evident and tissue samples (diseased and normal) were collected for later histological assessment.

Food Studies

Food habits studies included the examination of stomachs from 116 sharks and 52 teleosts consisting of blue, scalloped hammerhead, night, bignose, tiger, sandbar, and mako sharks and yellowfin tuna, bigeye tuna, wahoo, and swordfish.

An average of 50 percent of the shark stomachs were empty. Those with food contained well digested remains of squid and a variety of demersal and benthic fish species. Prey items common to the scalloped hammerhead, blue and tiger sharks included bluefish, goosefish, and other sharks. Mammal remains including blubber and the skull of a porpoise were found in a few blue and tiger sharks. One tiger shark contained shell fragments from a loggerhead turtle estimated to have a lateral width of 50 centimeters.

Food remains found in tunas included squid, flying fish, and various small fish species associated with flotsam and Sargasso weed. Invertebrates included amphipods, isopods, and euphausids. All tuna stomach content remains were frozen for future detailed analysis at the NEFC laboratory at Narragansett, Rhode Island.

DISPOSITION OF DATA

Samples of vertebrae from various species of sharks have been brought to the NEFC laboratory at Narragansett, Rhode Island, and will be examined for studies on age and growth.

Stomachs from 51 yellowfin tuna were frozen for detailed food analysis to be made at the Narragansett Laboratory.

Liver samples from blue sharks were collected for bioenergetic studies to make comparisons with caloric values obtained for other seasons of the year.

Sections of the guts of the samples of copepods obtained from the gills of a blue shark will be examined at the University of Connecticut at Storrs and should give some indication of both the volume and rate of evacuation of their blood vessels. Blood samples from tunas were collected for parasitological studies being conducted at the NMFS Oxford Laboratory.

SCIENTIFIC PERSONNEL

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Table 1. Summary of Longline Catch Data by Station (Set) for R/V WIECZNO Cruise 84-02
Survey of Apex Predators--Sharks and Swordfish, during 26 April - 18 May 1984.

						SHARKS[b]									TUNA[b]			OTHER[b]			
SET NO.	DATE	LAT.[a] (N)	LONG.[a] (W)	SURFACE[a] TEMP. °C	NO. HOOKS	BLU	MKO	SCH	SIL	BGN	SBR	TGR	NGT	BET	YFT	ALB	BGE	SWF	LNF	MISC	TOTAL
1	4/28	35°30'	67°50'	20.2	200*	1															1
2	4/29	36°23'	67°31'	19.9	250	9(3)	1												3		13(3)
3	4/30	35°47'	68°13'	21.1	200*											1			2		3
4	4/30	35°30'	69°14'	20.1	280	2(1)													9		11(1)
5	5/3	34°02'	76°13'	23.0	250*							1			18					1	20
6	5/3	34°15'	76°01'	23.1	250		1	30(12)		5(1)	2(1)				11			1		3(1)	53(15)
7	5/4	34°41'	75°32'	21.8	277			2(2)					56(31)		2						60(33)
8	5/5	34°48'	75°31'	23.4	300*															1	1
9	5/6	33°44'	76°35'	22.8	300			5(3)	2(1)	1(1)		2(2)			4(1)						14(8)
10	5/6	33°59'	76°18'	23.5	300*										10(4)					1	11(4)
11	5/7	39°09'	75°04'	21.7	300			23(20)		3(2)	3(3)		1		2(1)		2			1	35(26)
12	5/7	35°16'	74°59'	21.9	300*		1	4(3)				1(1)			8(4)						14(8)
13	5/8	35°14'	74°59'	23.5	300			9(6)		4(2)	2(2)		11(10)	1	4(3)						31(23)
14	5/8	36°08'	74°45'	20.4	300*	3													1		4
15	5/9	36°21'	74°47'	19.4	300*	4(1)	1				3(2)				2(1)					1	11(4)
16	5/9	36°10'	74°27'	22.1	300	5(1)	1(1)								4(2)			1			11(4)
17	5/10	36°48'	74°31'	19.0	300*	1(1)									3(1)						4(2)
18	5/10	36°24'	74°41'	21.2	300	3									1(1)						4(1)
19	5/11	37°02'	74°38'	20.7	300*										1(1)						1(1)
20	5/11	37°09'	74°35'	20.6	300	14(6)	12(7)	6(3)		2(1)	13(6)	2			1						50(23)
21	5/12	37°09'	74°36'	19.5	200*	17(12)		2(1)				1								1	21(13)
22	5/12	37°10'	74°37'	19.9	300	11(4)	5(3)	14(12)		2(2)	23(12)				1						56(33)
23	5/13	37°24'	74°30'	17.5	300*	12(10)		1(1)							5(3)						18(14)
24	5/13	37°06'	74°32'	20.3	300	8(4)	2(2)								5			1			16(6)
25	5/14	37°11'	74°39'	18.7	300*	3(3)	3(2)	6(6)		12(11)	10(7)	6(5)			1					1	42(34)
26	5/14	37°21'	74°33'	18.1	300	6(2)	4(2)	10(2)		4(4)	1(1)	2(1)									27(12)
27	5/15	37°44'	74°02'	21.0	300*	1(1)									1						2(1)
28	5/15	37°37'	74°04'	20.8	300	8(4)									1(1)			1			10(5)
29	5/16	37°42'	74°19'	13.5	300*	14(6)	6(6)	5(3)		26(18)	6(5)	3(3)			2						62(41)
30	5/17	38°03'	73°20'	16.6	300	8(5)									8(5)				1		17(10)
TOTAL					8507	130(64)	37(23)	117(74)	2(1)	59(42)	63(39)	18(12)	68(41)	1	95(28)	1	2	4	16	10(1)	623(325)

*Day sets.

Figures in () are number of fish tagged.

[a]Positions and temperatures are for start of each set.

[b]BLU - blue shark, MKO - mako, SCH - scalloped hammerhead, SIL - silky, BGN - bignose, SBR - sandbar, TGR - tiger, NGT - night, BET - bigeye thresher; YFT - yellowfin tuna, ALB - albacore, BGE - bigeye; SWF - swordfish, LNF - lancet fish, MISC - miscellaneous species.

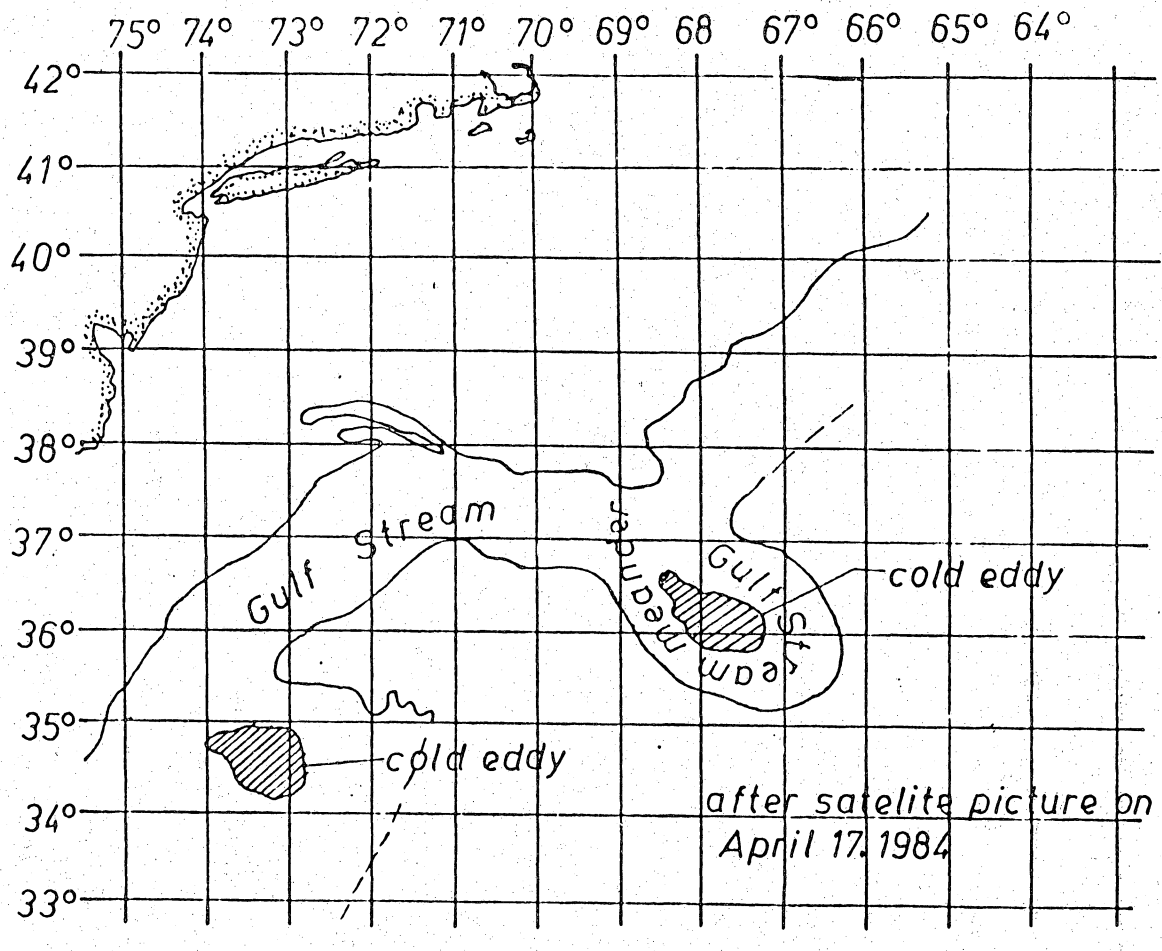

Figure 1. Position of cold core eddy from satellite picture on 17 April 1984.

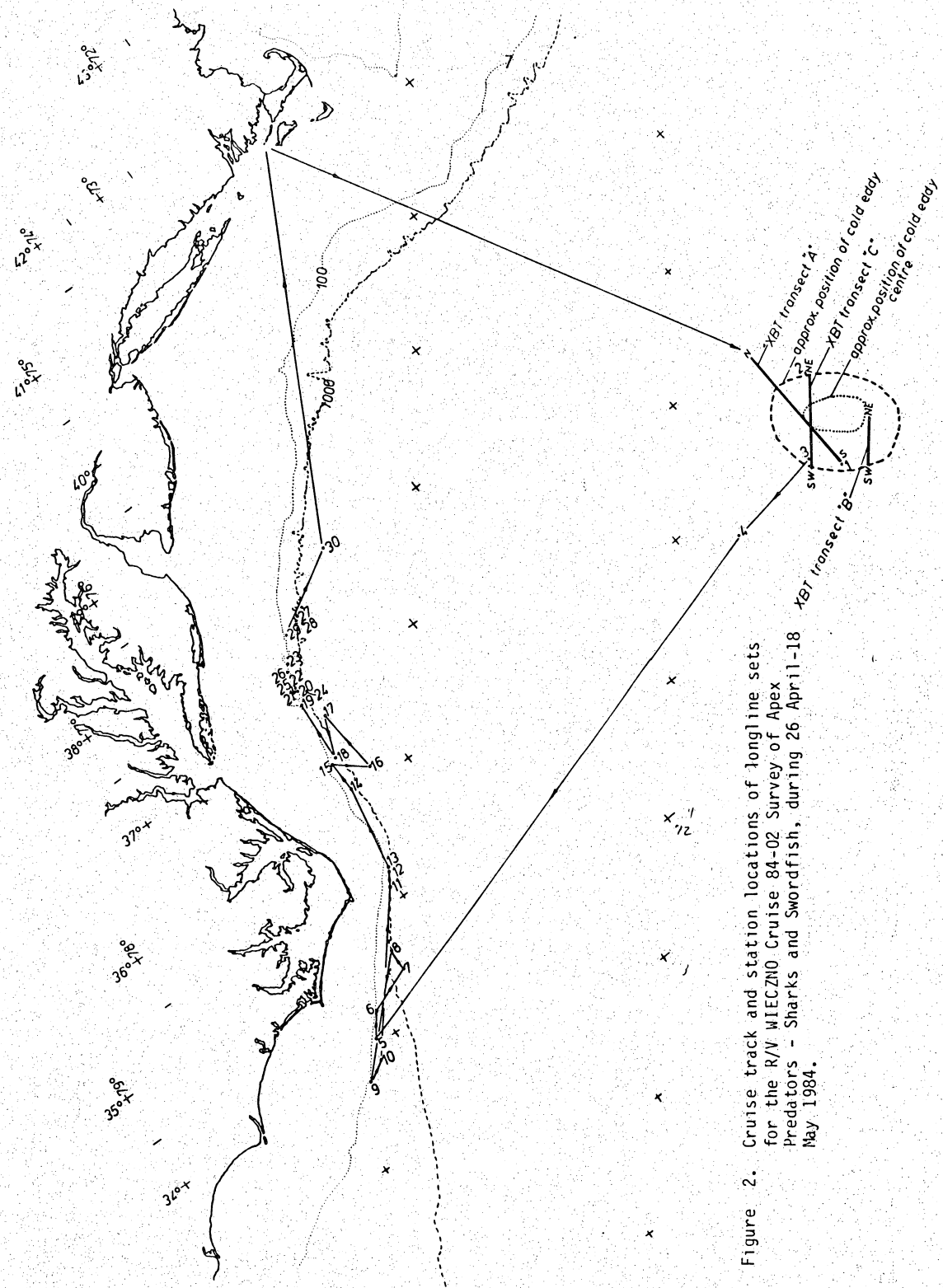

Figure 2. Cruise track and station locations of longline sets for the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984.

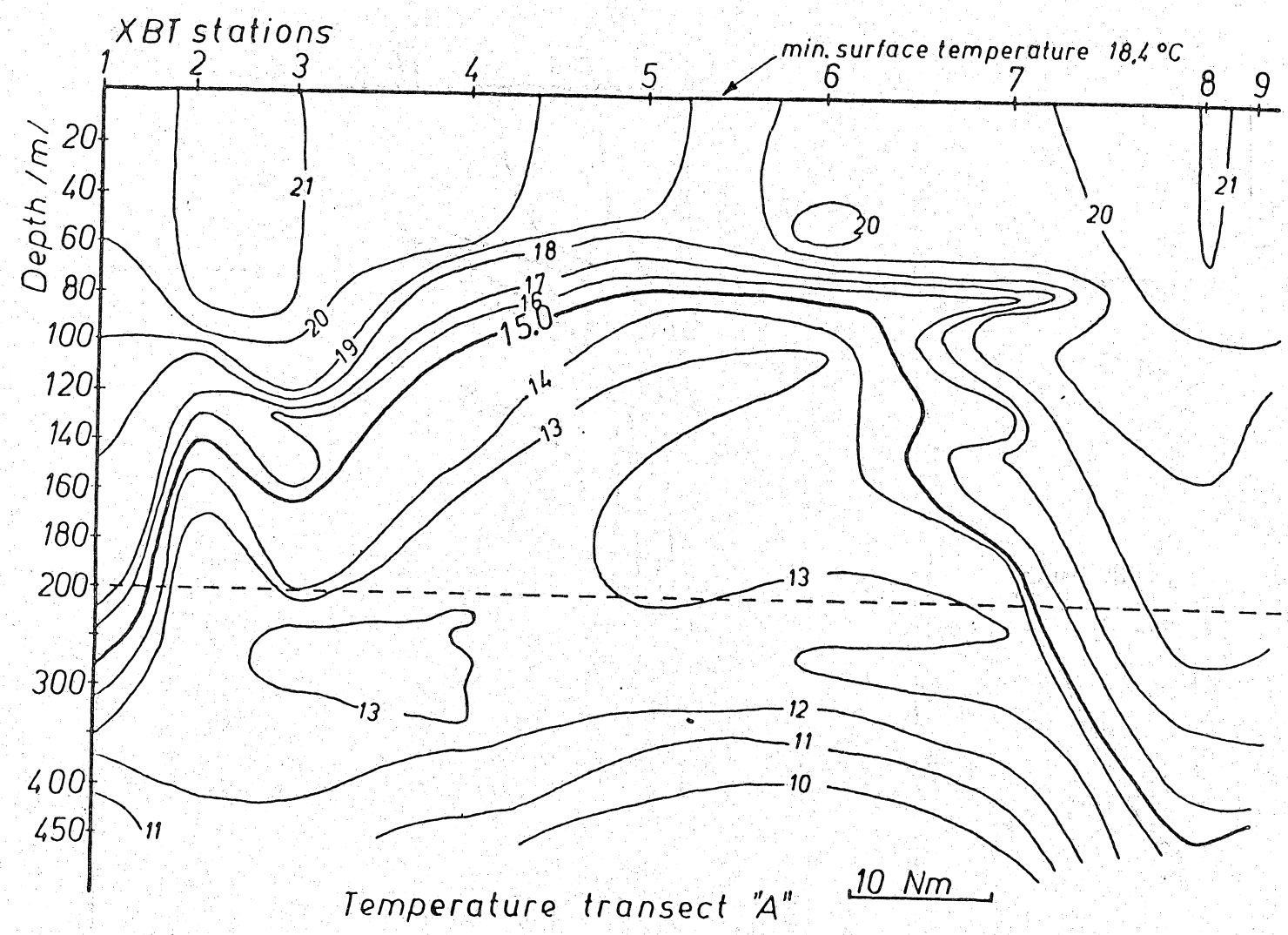

Figure 3. XBT transect "A" across cold core eddy (see Figure 2) for R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984.

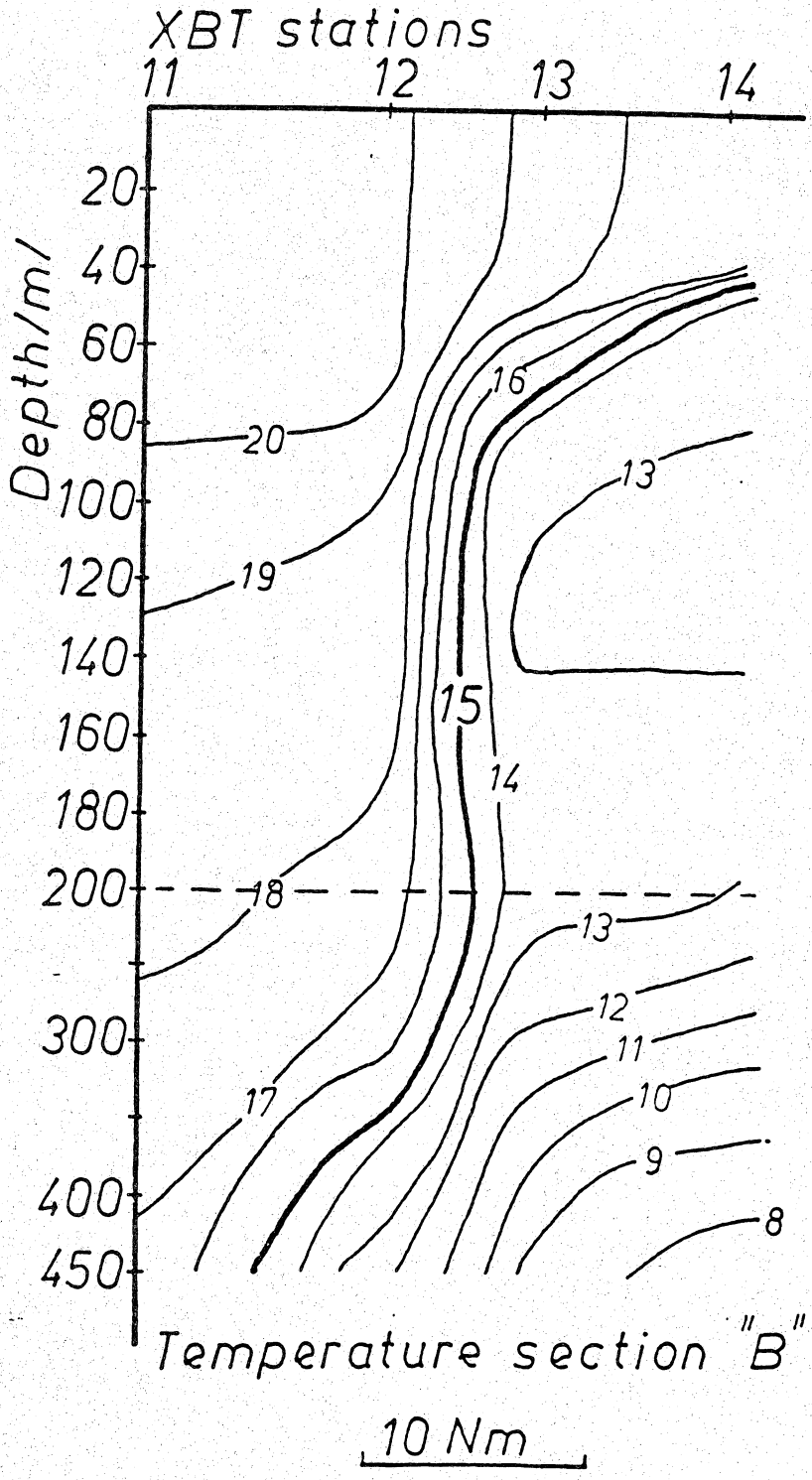

Figure 4. XBT transect "B" across cold core eddy (see Figure 2) for R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984.

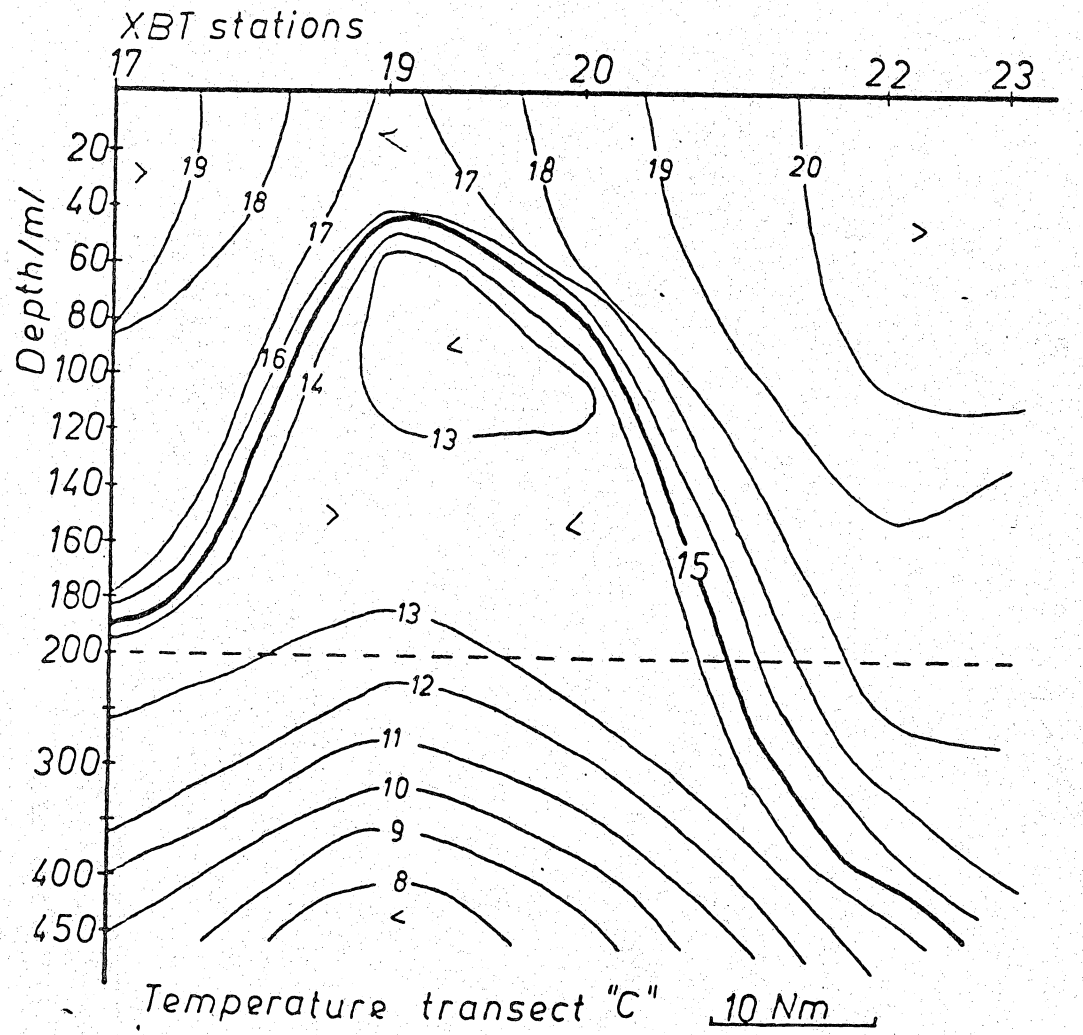

Figure 5. XBT transect "C" across cold core eddy (see Figure 2) for R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984.

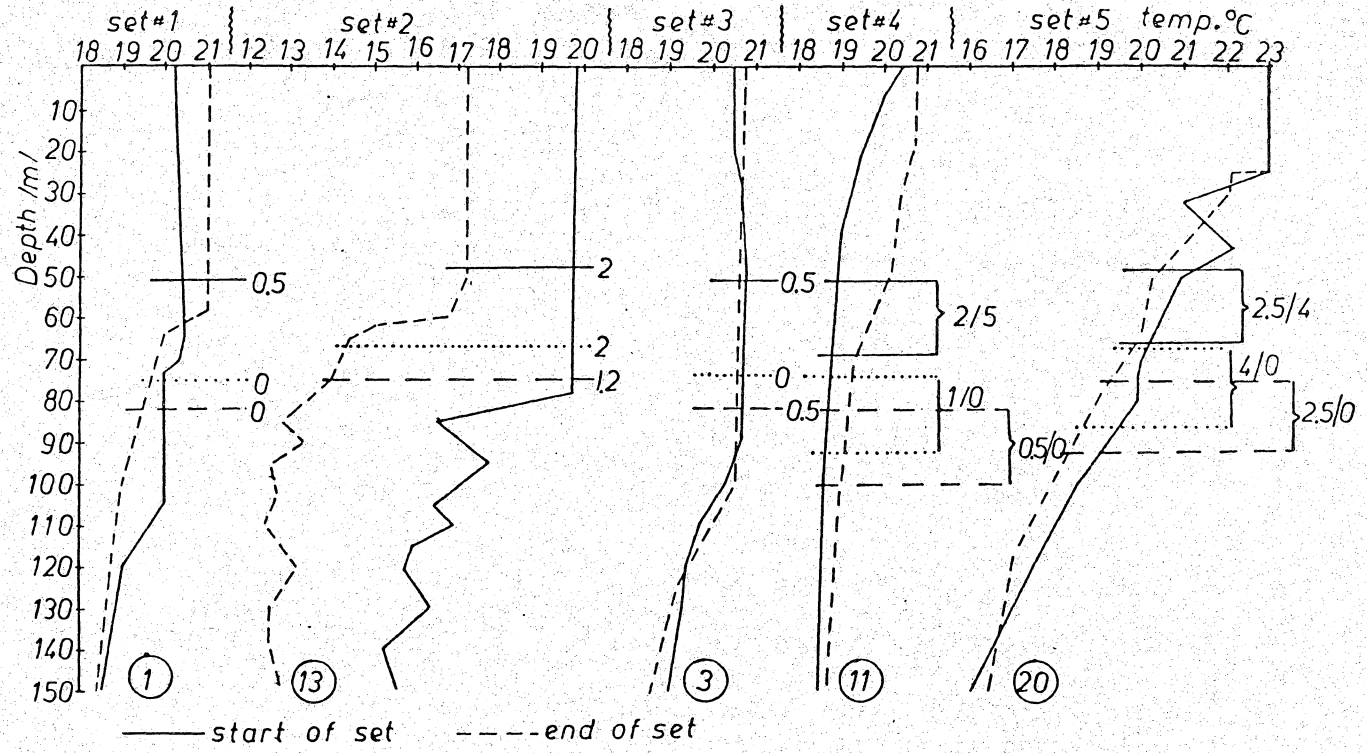

Figure 6. Temperature versus depth profiles for sets 1-5 for the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984. Solid horizontal lines indicate the fishing depth range of hooks 1 and 5 (upper line U. S. gear, lower line Japanese gear); dotted horizontal lines indicate fishing depth range of hooks 2 and 4, and broken horizontal lines fishing depth range of hook 3. Hook depths represented by a single horizontal line refer to sets using U. S. gear only. Numbers opposite the horizontal lines are catch per 100 hooks for U. S. and Japanese gear, respectively. Numbers in circles are total number of fish obtained.

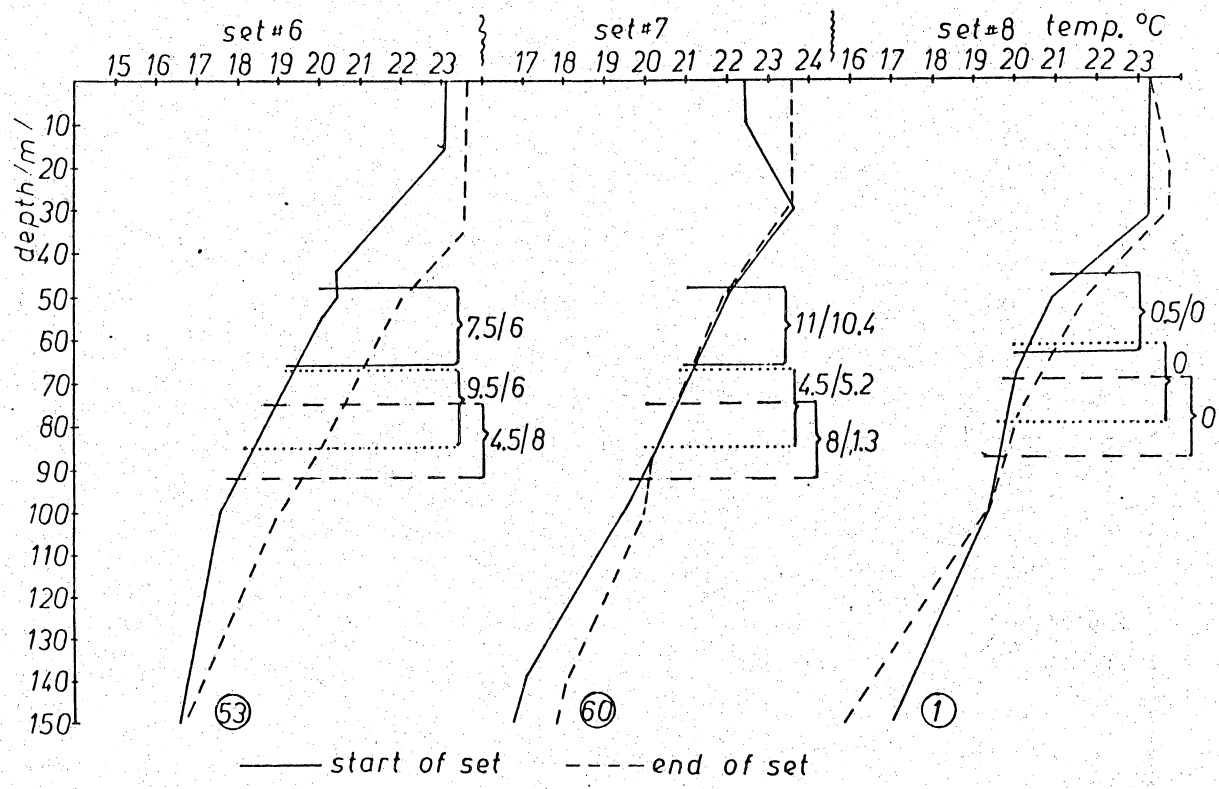

Figure 7. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

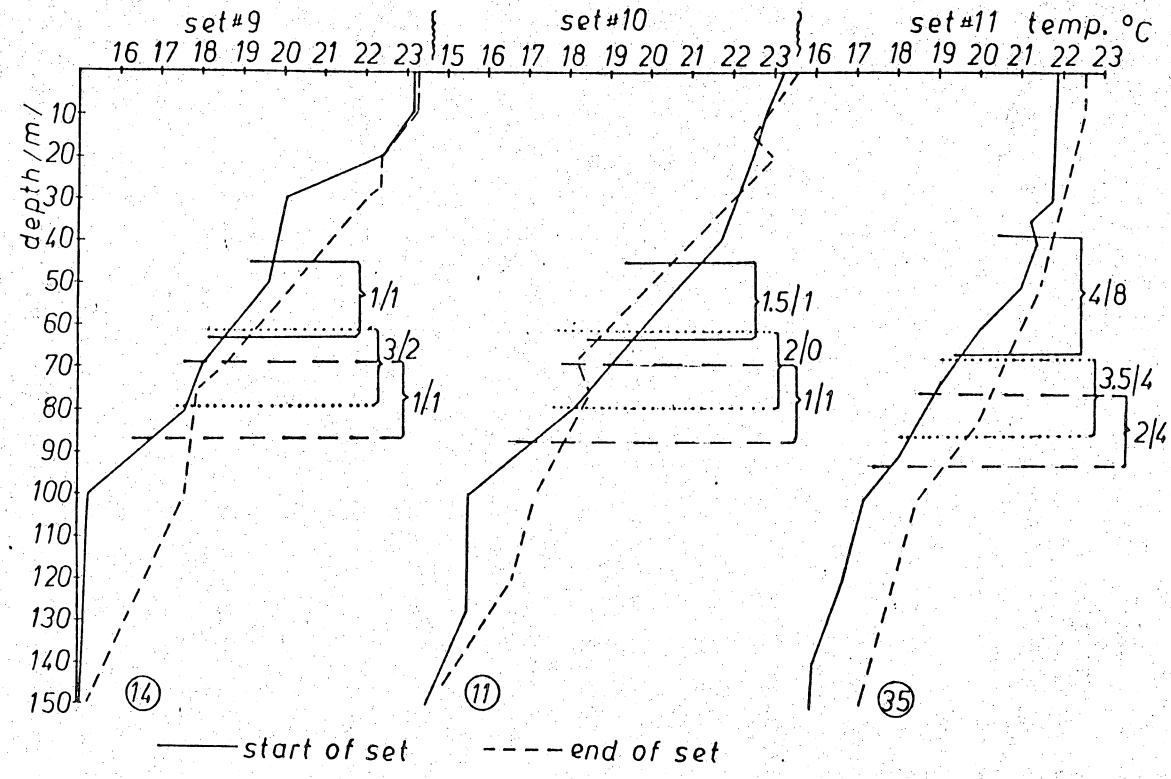

Figure 8. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

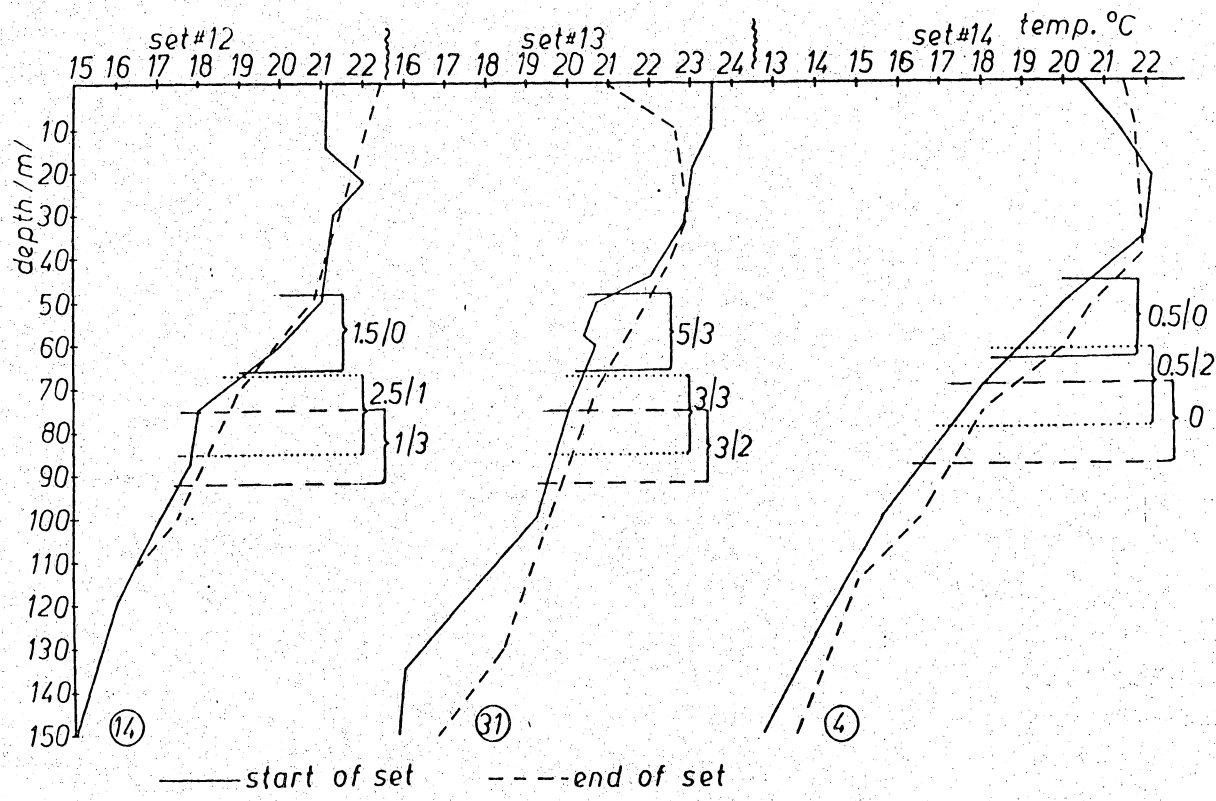

Figure 9. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

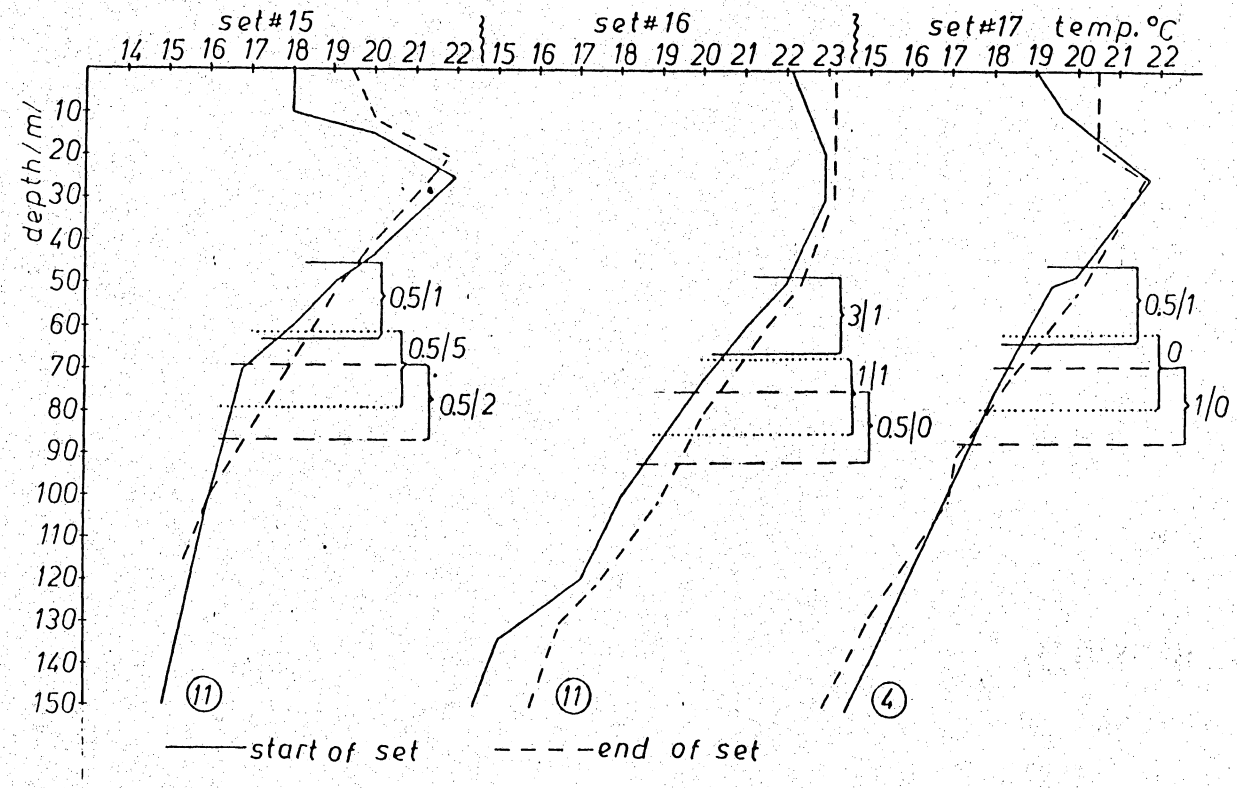

Figure 10. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

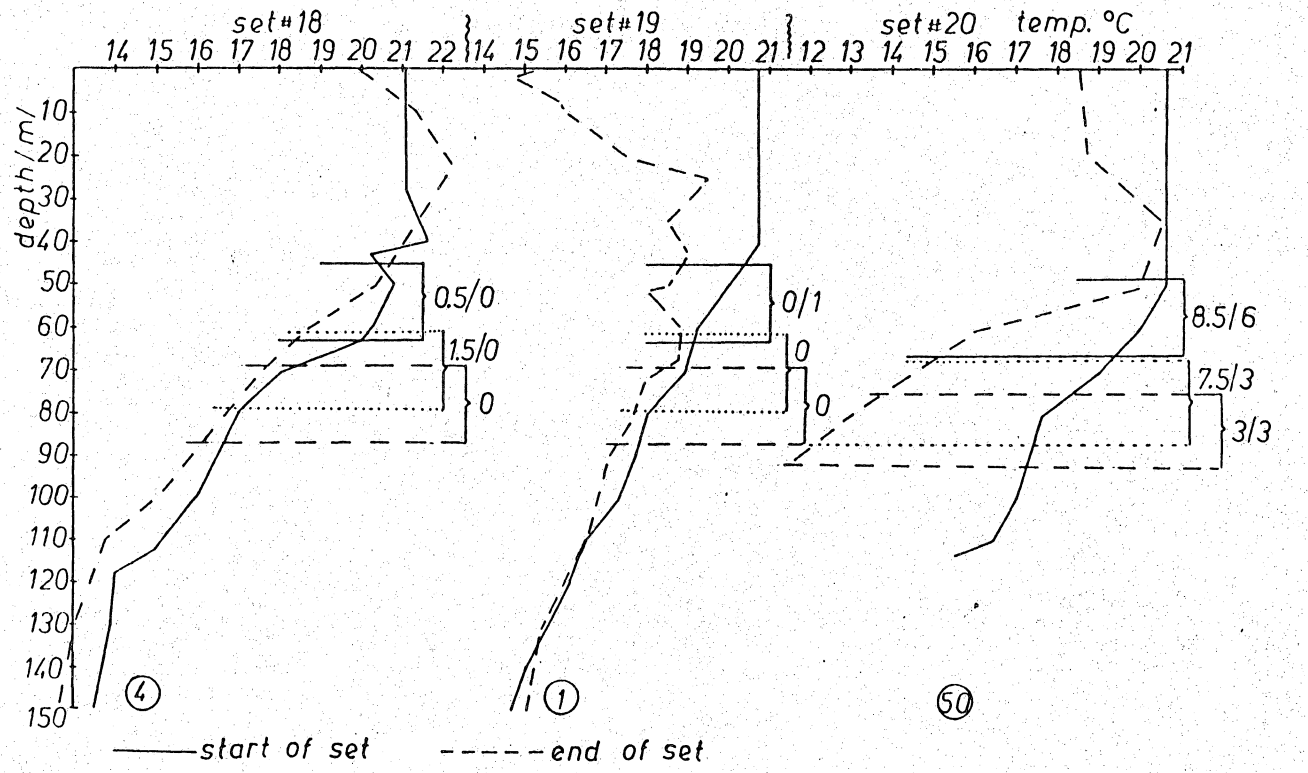

Figure 11. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

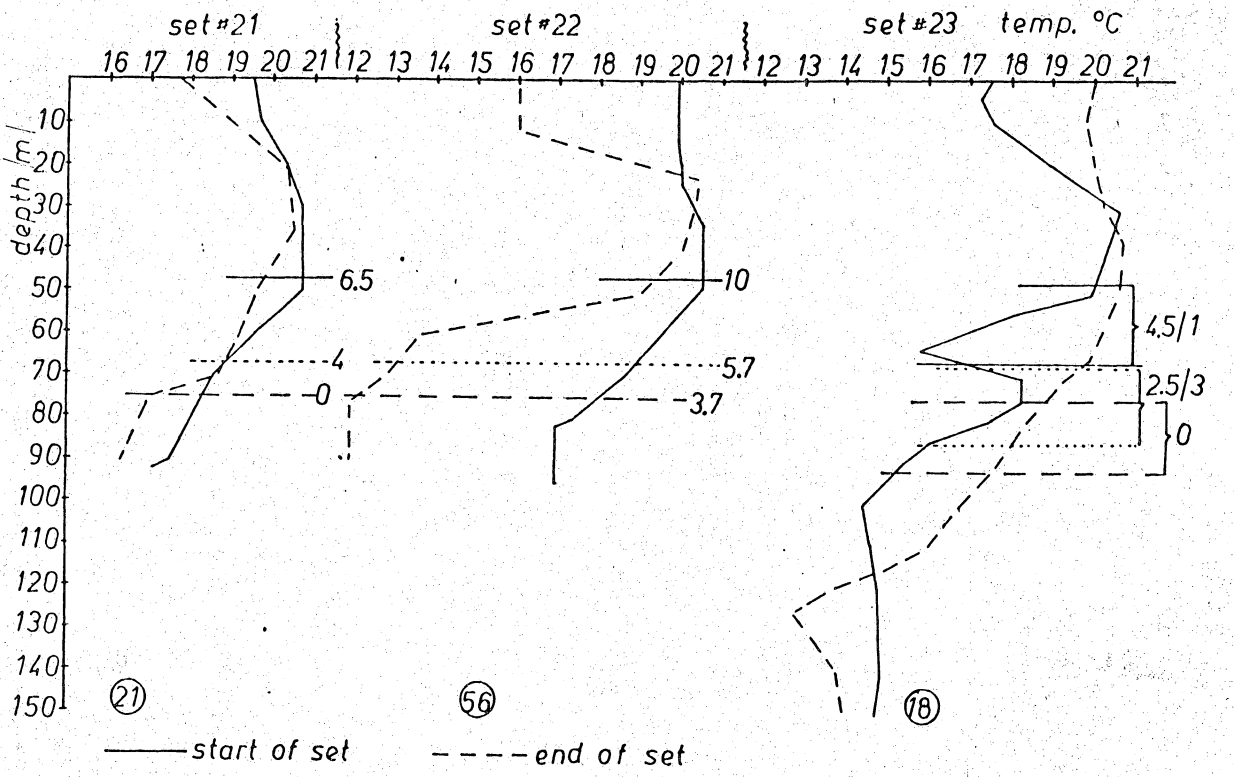

Figure 12. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

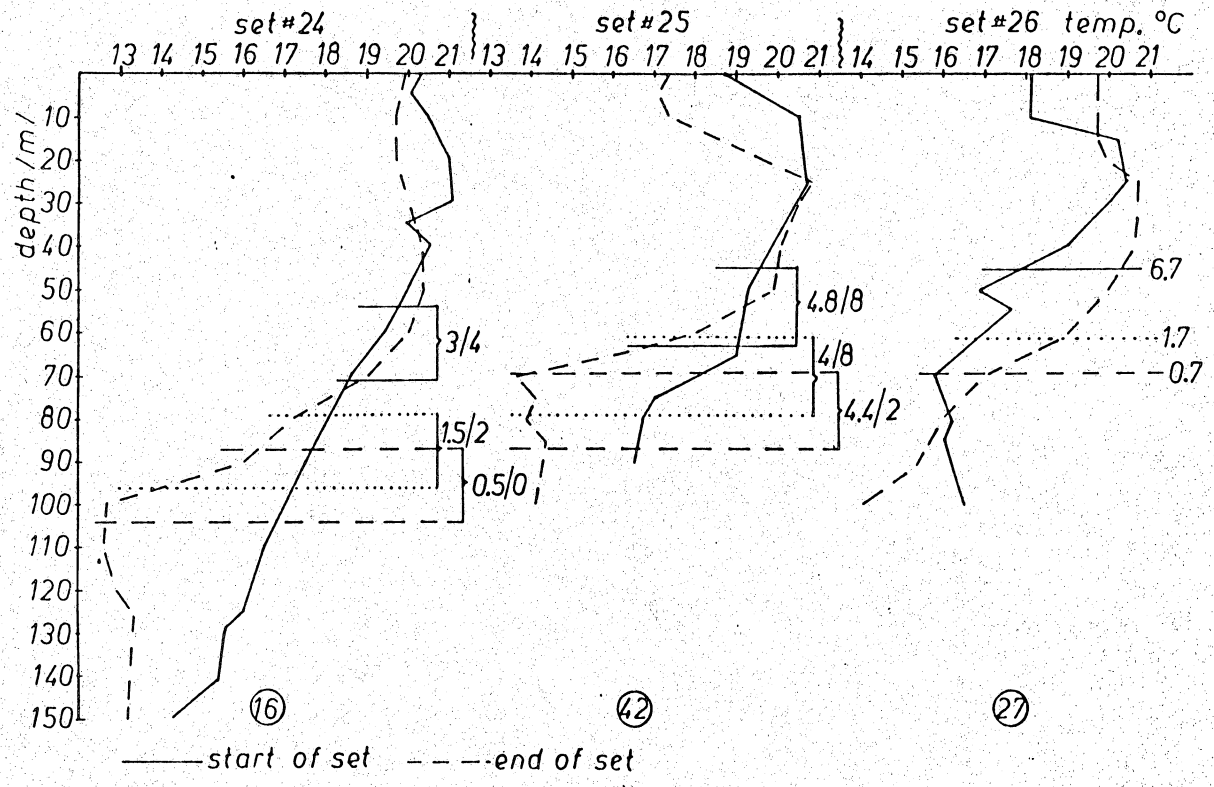

Figure 13. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

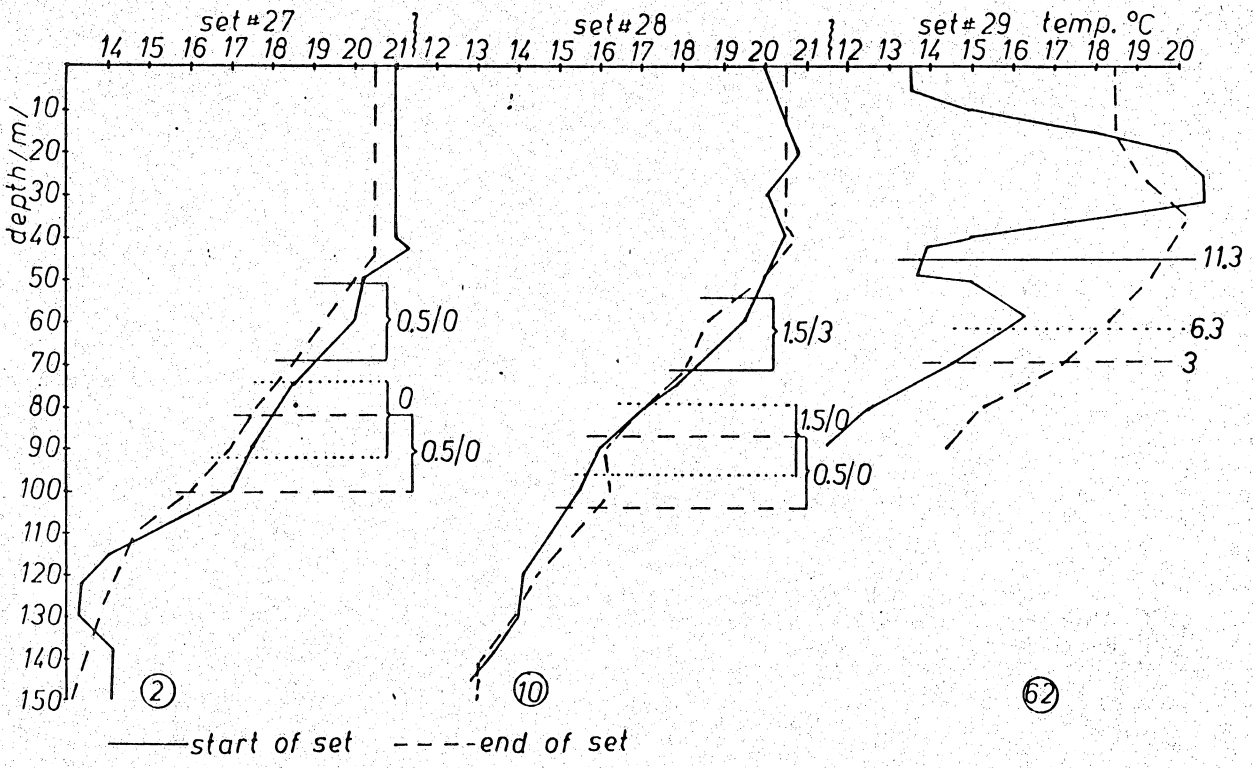

Figure 14. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.

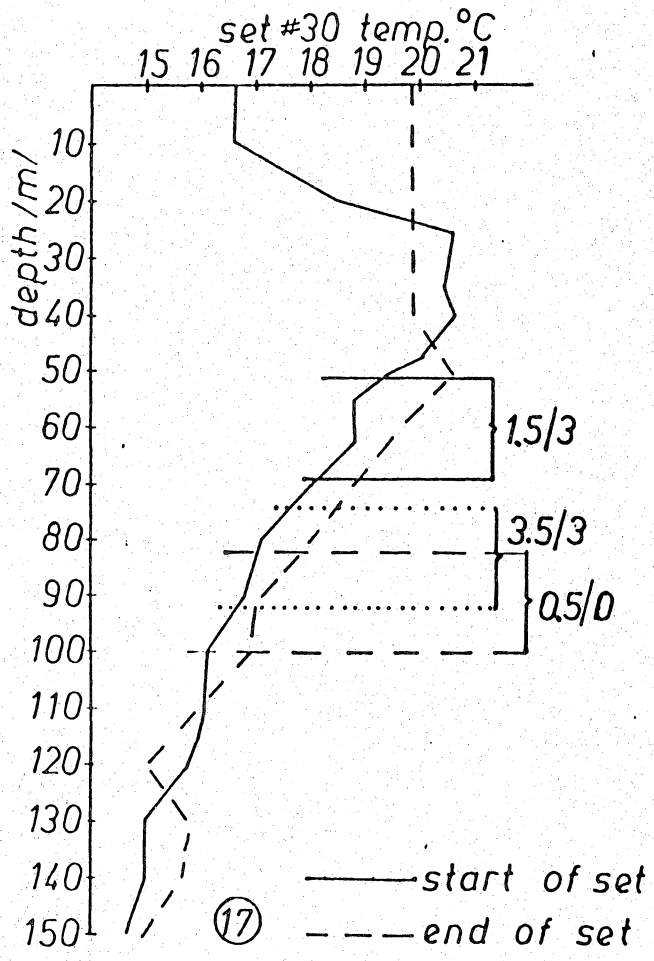

Figure 15. Temperature vs. depth profiles for longline sets on the R/V WIECZNO Cruise 84-02 Survey of Apex Predators - Sharks and Swordfish, during 26 April-18 May 1984 - see explanation on Figure 6.