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NASA TECHNICAL MEMORANDUM

NASA TM X-73391

HEAO-A NOMINAL SCANNING OBSERVATION SCHEDULE

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By G. J. Fishman and R. L. Stone

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16. ABSTRACT

The High Energy Astronomy Observatory-A (HEAO-A) observatory, scheduled for launch in late June 1977, will spend most of its orbital lifetime in a scanning mode, spinning from 0.03 to 0.1 rpm about an axis aligned with the Sun. The dates of availability in the scan band are given for a list of 248 X-ray sources. Celestial maps of source locations and scan planes, and examples of the nighttime elevation of available sources are presented. This document is intended to aid ground-based observers in planning coordinated observations with HEAO-A.

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TECHNICAL MEMORANDUM X-73391

HEAO-A NOMINAL SCANNING OBSERVATION SCHEDULE

I. INTRODUCTION

This document is intended to aid investigators in planning and performing observations in conjunction with the High Energy Astronomy Observatory-A (HEAO-A) Guest Observer Program. It contains data on the schedule of availability of known X-ray sources by the observatory during normal scanning operation; celestial maps showing scan planes as a function of time; and, for coordinated optical observations, examples of the elevation of sources in the scan plane during the night. These data should serve only as observing guides; more precise data depend on refined source locations, actual spacecraft spin axis attitude, and detector angular response functions.

The HEAO-A spacecraft (Fig. 1) carries four large X-ray and gamma-ray astronomy experiments designed to scan the entire celestial sphere in a 6 month period. Experiments A-2, A-3, A-4, and one module of A-1 are coaligned in the +Y direction, while the remaining six modules of the A-1 experiment view in the -Y direction. Several modules of the A-2 experiment are offset by 6 degrees in the XY plane. These experiments will locate and determine spectral and temporal characteristics of perhaps several thousand sources in addition to over two hundred presently known X-ray sources. Table 1 shows several key characteristics of the four experiments.

II. HEAO-A MISSION PLAN

HEAO-A is scheduled for launch in late June 1977 into a circular orbit with an altitude of 445 km, an inclination of 22.75 degrees, and a period of 93 min. During most of its orbital life, the observatory will operate in a scanning mode, spinning at a rate of from 0.03 to 0.1 rpm (a spin period, P_s, of 10 to 30 min) with the spacecraft's +Z axis (Fig. 1) aligned within 0.5 degree of the Sun (Fig. 2). Although the spin rate will be controlled to ~10 percent, the spin phase will not be controlled and most likely will not be predictable more than several orbits in advance, if at all.

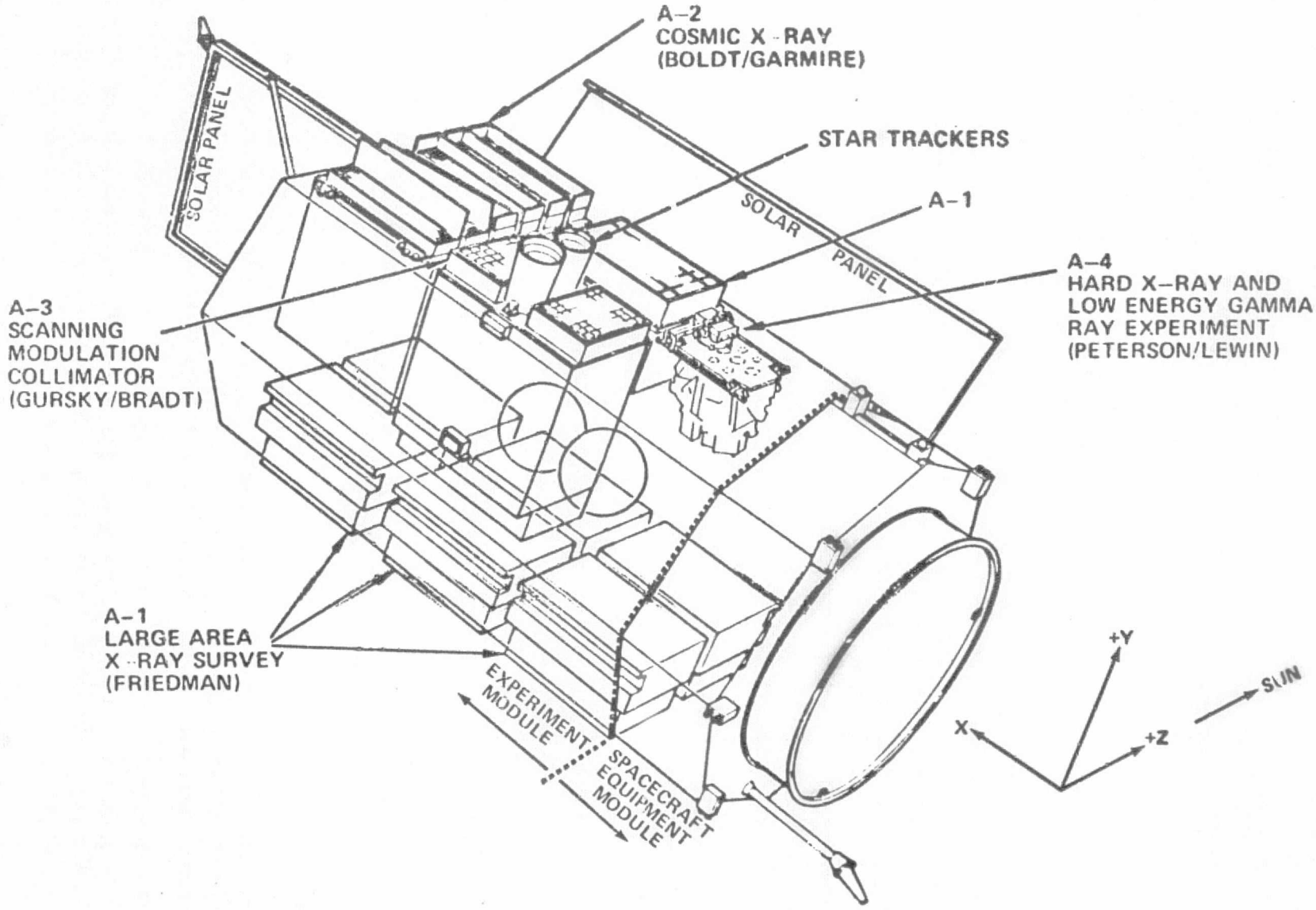

Figure 1. HEAO-A observatory, experiments, and coordinate systems.

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TABLE 1. HEAO-A EXPERIMENT CHARACTERISTICS

Experiment	Major Objectives	No. of Detectors	FOV XY × FOV YZ (FWHM)	Total Area (cm^2)	Energy Range
A-1 Friedman (7 large area collimated proportional counters)	Survey entire sky for X-ray sources down to $\sim 10^{-4}$ Crab. Measure spectra, locations, and and temporal variations.	4 2 1	1° × 4° 1° × 1/2° 8° × 2°	8800 4400 2200	0.15 keV to 20 keV 0.15 keV to 20 keV 0.15 keV to 20 keV
A-2 Boldt/Garmire (6 collimated proportional counters)	Measure spectrum and isotropy of diffuse X-ray background. Observe spectral and temporal characteristics of discrete sources.	2 1 3	1 1/2°, 3°, 6° × 3° 1 1/2°, 3° × 3° 1 1/2°, 3°, 6° × 3°	2000 1000 3000	0.2 keV to 3 keV 1.5 keV to 20 keV 2 keV to 60 keV
A-3 Gursky/Bradt (2 high-resolution modulation collimators, star trackers)	Locate stronger X-ray sources to ~5 arc s. Measure structure of extended sources on 0.5 to 16 arc min scales.	1 1	4° × 4° 0.5 arc min modulation collimator 4° × 4° 2 arc min modulation collimator	450 450	1.5 keV to 15 keV 1.5 keV to 15 keV
A-4 Peterson/Lewin (7 scintillation detectors in an active collimator)	Extend spectra of stronger point sources to ~1 MeV. Measure spectrum and isotropy of diffuse X-ray and gamma ray background.	2 4 1	1° × 20° 20° circular 40° circular	220 170 120	10 keV to 200 keV 100 keV to 5 MeV 200 keV to 10 Mev

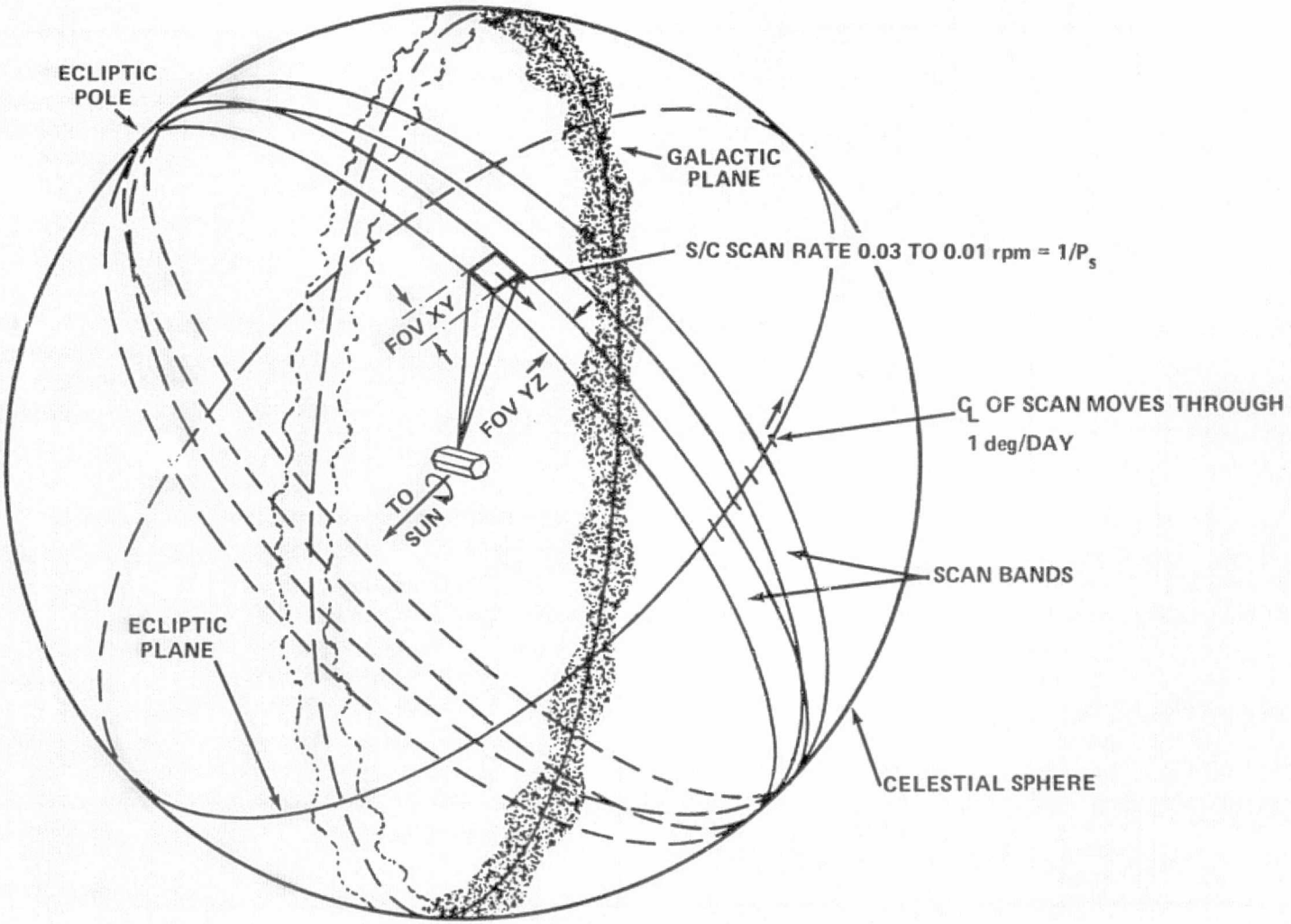

Figure 2. HEAO-A celestial scan geometry.

The date at which a point on the celestial sphere is in the scan band is determined by the ecliptic longitude of the point. The duration of availability depends upon the field-of-view of the detector in the YZ plane (FOV YZ) and the ecliptic latitude of the source. When a source is available (i.e., in the scan band), it is viewed each spacecraft rotation, subject to Earth occultation, for a period

$$t_s = \frac{(\text{FOV YY})^\circ}{360^\circ} P_s \quad .$$

Figure 2 shows the scanning geometry for HEAO-A. The duration of Earth occultation for a given direction depends upon the orbital altitude and orbital orientation being a maximum for directions in the orbital plane. Soon after the HEAO-A orbital insertion, the orbital parameters and precession will be known with sufficient accuracy to predict specific source occultation times many weeks in advance if they are needed for an observational program.

After the first 3 months of normal scanning observations, HEAO-A is scheduled to perform special maneuvers such as offset scanning and pointing. In the offset scan mode, the spin axis is moved up to 7 degrees from the solar direction while maintaining a normal spin rate. During pointing operations, the spacecraft is pointed in inertial space for a period of at least two orbits while maintaining the Z axis within 7 degrees of the solar direction. However, these special maneuvers may be modified depending on propellant gas consumption and the operating performance of HEAO-A while in orbit. The approved HEAO-A mission is 6 months, although the operational lifetime is 1 year. If the mission is extended beyond 6 months, the normal scan bands will repeat at 6-month intervals.

III. X-RAY SOURCE CATALOG

The catalog used in this report (Table 2) was provided by Dr. G. Riegler, Jet Propulsion Laboratory (JPL). It combines data from various sources, including preprints, the open literature, and IAU circulars. It was compared with a similar catalog provided by Dr. W. Baity, University of California, San Diego (UCSD), and with several published catalogs. The locations given are the

TABLE 2. X-RAY SOURCE CATALOG

INDEX	NAME 1	NAME 2	MEAN OF 1950.0 EQUATORIAL COORD			
			RA		DEC	
			HR	MN	DEG	MN
1	3U0001-31		0	1	-31	2
2	3U0012-05		0	12	-5	16
3	3U0021+42	M 31	0	21	42	0
4	3U0022+63	TYCHO SNR	0	22	63	54
5	MX0053+60	GAMMA CAS	0	3	60	27
6		GAM7 SN 1572	0	24	56	0
7	A 0024+19		0	25	19	23
8	3U0026-09		0	26	-9	41
9	3U0032+24		0	32	24	12
10	3U0042+32		0	42	32	46
11	MX0050+59		0	50	59	12
12	3U0055-79		0	55	-79	41
13	3U0057-23		0	57	-23	55
14	3U0115-73	SMCX-1	1	15	-73	46
15	3U0115+63		1	15	63	33
16	3U0136-01		1	36	-1	20
17	3U0143+01		1	43	61	19
18	3U0151+36		1	51	36	45
19	3U0227+43		2	27	43	42
20		FEIGE 24	2	32	3	31
21	3U0254+13	AB 4N1	2	54	13	15
22	MX0255+41	NEAR PER CLU	2	54	41	42
23	3U0256+60		2	58	60	43
24	3U0302-47		3	2	-47	17
25		BETA PERS	3	4	40	45
26	3U0305+53		3	5	53	1
27	3U0316+41	PERSEUS CL.	3	16	41	21
28	3U0318+55		3	18	55	9
29	3U0328-52		3	28	-52	28
30	3U0352+30	X PER	3	52	30	54
31	3U0400-59		4	0	-59	0
32	3U0405+10		4	5	10	2
33	3U0426-63		4	26	-63	32
34	3U0430+37		4	30	37	14
35	3U0431-10		4	31	-10	0
36	4U0432+05	3C120	4	31	5	0
37	3U0440+06		4	40	6	59
38	3U0446+44		4	46	44	57
39	3U0449+06		4	49	66	50
40	3U0510-44		5	10	-44	39
41		CAPELLA	5	12	45	57
42	MX0513-40	NGC1851	5	13	-40	5
43	3U0521-72	LMC X-2	5	21	-72	0
44		NP 0527	5	25	21	58

0.30	-31.05
3.15	-5.28
5.45	42.00
5.60	63.90
0.89	60.45
6.00	56.00
6.40	19.40
6.50	-9.70
8.20	24.20
10.71	32.78
12.63	59.20
13.86	-79.69
14.43	-23.92
16.93	-73.76
16.67	63.56
24.55	-1.34
25.62	61.33
27.05	36.75
36.80	43.70
36.21	3.52
43.65	13.25
43.70	41.70
44.65	60.72
45.64	-47.30
46.22	40.76
46.48	53.02
49.15	41.35
49.55	55.15
52.00	-52.48
56.09	30.91
60.10	-59.00
61.50	10.04
66.70	-63.55
67.70	37.24
67.90	-10.00
68.00	5.00
70.01	6.99
71.66	44.96
72.38	66.84
77.66	-44.66
78.25	45.95
78.35	-40.10
80.32	-72.00
81.44	21.97

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TABLE 2. (Continued)

INDEX	NAME 1	NAME 2	MEAN OF 1950.0 EQUATORIAL COORD					
			RA		DEC		RA	DEC
			HR	MN	DEG	MN	DEG	DEG
45	MX0520-68	LMC X-5	5	20	-68	24	82.10	-68.40
46	3U0527-05	M 42 ORION	5	27	-5	50	81.90	-5.85
47	3U0530-57		5	30	-57	0	82.50	-57.00
48	3U0531+21	TAU X1	5	31	21	58	82.80	21.98
49	3U0532-66	LMC X-4	5	32	-66	24	83.24	-66.42
50	A 0535+26		5	35	26	16	83.95	26.28
51	3U0539-64	LMC X-3	5	38	-64	6	84.71	-64.11
52	3U0540-69	LMC X-1	5	40	-69	46	85.04	-69.78
53	3U0545-32		5	45	-32	12	86.36	-32.20
54	MX0000+46		0	0	46	30	90.05	46.50
55	3U0014+09		0	14	9	9	93.00	9.15
56	A 0620-00	NOVA MON 75	0	20	0	19	95.15	-0.32
57	3U0620+23	IC 443	0	20	23	23	95.10	23.40
58	3U0624-55		0	24	-55	4	96.00	-55.08
59		SIRIUS	0	42	-16	38	100.74	-16.05
60	MX0656-07		0	56	-7	11	104.00	-7.20
61	3U0657-35		0	57	-35	5	104.40	-35.10
62	3U0705-55		7	5	-55	9	106.40	-55.15
63		YZ C MI	7	42	5	41	115.52	5.00
64	3U0750-49		7	50	-49	27	117.60	-49.45
65	3U0757-26		7	57	-26	25	119.45	-26.40
66	3U0804-53		8	4	-55	2	121.20	-55.05
67	3U0821-42	PUP A	8	21	-42	59	125.59	-42.66
68	3U0835-45	VELA X	8	35	45	0	128.41	45.01
69	MX0836-42		8	36	-42	55	129.15	-42.04
70	3U0900-40	VEL X1	9	0	-40	21	135.05	-40.36
71	3U0901-09	AR 754	9	1	-9	25	135.40	-9.46
72	3U0917+63		9	17	63	27	139.44	63.45
73	3U0918-55		9	18	-55	0	139.69	-55.02
74	3U0943+71		9	43	71	15	145.90	71.26
75	3U0946-30		9	46	-30	45	146.56	-30.75
76		CP 0950	9	54	8	9	147.65	8.16
77	3U1022-55		10	22	-55	29	155.62	-55.49
78	4U1043-59	G287.8-0.5	10	45	-59	22	161.25	-59.38
79	3U1044-27	AR1060	10	54	-27	15	163.67	-27.25
80	A 1103+38		11	3	38	33	165.70	38.56
81	3U1109+59		11	9	59	42	167.38	59.70
82	A 1118-61	NEW CEN	11	18	-61	0	169.50	-61.00
83	3U1118-60	CEN X3	11	18	-60	19	169.73	-60.32
84		NEW CEN SOUR	11	33	-63	30	173.40	-63.50
85	3U1134-61		11	34	-61	35	173.61	-61.60
86	3U1144+19	AR1367	11	44	19	43	176.02	19.72
87	3U1144-74		11	44	-74	49	176.20	-74.83
88	3U1145-61		11	45	-61	55	176.30	-61.89

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TABLE 2. (Continued)

INDEX	NAME 1	NAME 2	MEAN OF 1950.0 EQUATORIAL COORD					
			RA		DEC		RA	DEC
			HR	MN	DEG	MN	DEG	DEG
89	3U1207+39	NGC4151	12	7	39	46	181.89	39.77
90	3U1210-64		12	10	-64	38	182.59	-64.64
91	3U1223-62	GX301-2	12	23	-62	33	185.96	-62.56
92	3U1224+02	3C273	12	24	2	18	186.23	2.31
93	3U1228+12	M 87 VIRGO	12	28	12	41	187.12	12.70
94	3U1231+07	1C3576	12	31	7	8	187.90	7.14
95	3U1237-07		12	37	-7	11	189.44	-7.20
96	3U1247-41		12	47	-41	2	191.83	-41.04
97	3U1252-28		12	52	-28	57	193.12	-28.96
98		GX 304-1	12	53	-64	0	193.75	-64.00
99	3U1254-69		12	54	-69	1	193.59	-69.02
100	3U1257+28	COMA CLUSTER	12	57	28	11	194.37	28.19
101	3U1258-61		12	58	-61	20	194.51	-61.34
102	MX1313+29	HZ 43	13	14	29	22	198.50	29.37
103	3U1320-61		13	20	-61	43	200.18	-61.72
104	3U1322-42	NGC5128 CENA	13	22	-42	47	200.55	-42.79
105	MX1329-31		13	29	-31	23	202.32	-31.40
106	MX1347-32		13	47	-32	5	206.80	-32.10
107	3U1349+24		13	49	24	27	207.50	24.45
108		ETA BOOTES	13	52	18	38	208.07	18.65
109	MX1353-64		13	53	-64	30	208.48	-64.50
110	MX1406-61		14	6	-61	54	211.73	-61.90
111	3U1410-05		14	10	-5	5	212.73	-5.06
112	MX1418-61		14	18	-61	24	214.63	-61.40
113		MSH14-63	14	58	-62	14	219.68	-62.24
114	3U1439-59		14	39	-39	1	219.76	-59.03
115	3U1443+43		14	43	43	2	220.76	43.04
116		SN1006	14	59	-41	32	224.77	-41.53
117		LUPUS LOOP	15	9	-40	9	227.27	-40.17
118	3U1510-59	MSH15-52	15	10	-59	0	227.53	-59.00
119	MX1514+06	AB A2052	15	14	6	48	228.55	6.80
120	3U1516-56	CIR X1	15	16	-56	59	229.20	-56.99
121		B NOVA 1	15	23	-62	0	231.00	-62.00
122	A 1524-61	TRA X-1	15	24	-61	42	231.03	-61.71
123	3U1538-52		15	38	-52	10	234.56	-52.18
124	A 1540-53		15	41	-53	24	235.30	-53.40
125	3U1543-62		15	42	-62	24	235.75	-62.41
126	3U1543-47		15	43	-47	33	235.96	-47.56
127	3U1544-75		15	44	-75	45	236.00	-75.75
128	3U1551+15	HERC CLUSTER	15	51	15	53	237.90	15.90
129	MX1553-54		15	53	-54	15	238.48	-54.26
130	3U1555+27	AB2142	15	56	27	21	239.07	27.36
131	3U1556-60		15	56	-60	37	239.23	-60.63
132	MX1606-52	NORMA BURSTR	16	9	-52	24	242.50	-52.40

TABLE 2. (Continued)

INDEX	NAME 1	NAME 2	MEAN OF 1950.0 EQUATORIAL COORD					
			RA		DEC		RA	DEC
			HR	MN	DEG	MN	DEG	DEG
133	3U1617-15	SCO X1	16	17	-15	31	244.27	-15.52
134	3U1625+05		16	25	5	24	245.80	5.40
135	3U1624-49		16	24	-49	5	246.08	-49.09
136	3U1626-67		16	26	-67	21	246.67	-67.36
137	3U1630-47		16	30	-47	16	247.55	-47.27
138	3U1632-64		16	32	-64	8	248.20	-64.14
139	3U1636-53	NOR X1	16	36	-53	59	249.23	-53.65
140	3U1639+40	AB2199	16	26	39	35	246.72	39.60
141	3U1642-45	ARA X1	16	42	-45	51	250.52	-45.53
142		GG341+1 GX34	16	43	-44	0	250.80	-44.00
143	3U1645+21		16	45	21	32	251.31	21.54
144	3U1653+35	HZ HER,HERX1	16	56	35	25	254.01	35.42
145	3U1658-48		16	58	-48	45	254.74	-48.73
146	MX1659-29	MXB1659-29	16	59	-29	52	254.75	-29.87
147	3U1700-37	HD153919AT	17	0	-37	46	255.14	-37.77
148	3U1702-36	SCO X2	17	2	-36	21	255.58	-36.36
149	3U1702-42		17	2	-42	58	255.58	-42.98
150	3U1704-32		17	4	-32	6	256.13	-32.11
151			17	5	-43	10	256.29	-43.17
152	3U1705-44		17	5	-44	2	256.35	-44.05
153	3U1706+32		17	5	32	5	256.00	32.10
154	3U1706+78		17	6	78	52	256.70	78.54
155	A 1707-27	NGC6293	17	7	-27	16	256.75	-27.27
156	MX1709-40		17	9	-40	35	257.33	-40.60
157	3U1709-23		17	9	-23	21	257.36	-23.36
158		AB2255	17	12	64	0	258.00	64.00
159	3U1714-39		17	14	-39	17	258.75	-39.50
160	MX1716-31		17	15	-31	47	259.05	-31.80
161	MX1720-34	3U1721-33	17	20	-33	47	262.12	-33.80
162		GX9+9	17	28	-16	55	262.21	-16.95
163	3U1726-24	GX 1+4	17	26	-24	42	262.24	-24.71
164	MX1730-33	RAPID BURSTR	17	30	-33	21	262.53	-33.35
165		RGX345-6	17	31	-45	0	263.00	-45.00
166	3U1735-44		17	35	-44	25	263.80	-44.42
167	3U1735-28		17	35	-28	27	263.85	-28.45
168	3U1736+43		17	36	43	2	264.10	43.05
169	A 1742-28	GAL. CTR IRA	17	42	-28	55	265.61	-28.92
170	A 1743-29	MXB1742-29	17	42	-29	36	265.70	-29.60
171	A 1743-29	GAL.CTR.TRAN	17	43	-29	31	265.75	-29.52
172	3U1743-29	GAL.CENTER	17	43	-29	7	265.90	-29.15
173		MXB1743-28	17	43	-28	30	265.90	-28.50
174	3U1744-26	GX 3+1	17	44	-26	33	266.18	-26.56
175	A 1745-36		17	44	-36	7	266.23	-36.12
176	MX1746-20	NGC6440	17	46	-20	21	266.54	-20.35

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TABLE 2. (Continued)

INDEX	NAME 1	NAME 2	MEAN OF 1950.0 EQUATORIAL COORD RA HR	RA MN	DEC DEG	DEC MN	RA DEG	DEC DEG
177	3U1746-37	NGC6441	17	46	-37	1	266.70	-37.03
178	3U1755-33		17	55	-33	47	268.89	-33.80
179	3U1758-25	GX 5-1	17	58	-25	4	269.53	-25.08
180	3U1758-20	GX 9+1	17	58	-20	32	269.64	-20.54
181	MX1803-24		18	3	-24	36	270.95	-24.60
182			18	5	-16	37	271.38	-18.62
183			18	7	-27	28	271.82	-27.48
184	3U1809+50	AM HER	16	15	49	50	273.75	49.84
185	3U1811-17	GX 13+1	18	11	-17	11	272.92	-17.18
186	3U1812-12		18	12	-12	6	273.02	-12.11
187	3U1813-14	GX 17+2	18	13	-14	3	273.30	-14.05
188	3U1820-30	NGC6624	18	20	-30	23	275.11	-30.39
189	3U1822-37		18	22	-37	11	275.56	-37.19
190	3U1822-00		18	22	0	2	275.72	0.04
191	3U1825+81	3C390.3	18	25	81	10	276.40	81.30
192	A 1829-10		18	29	-10	30	277.30	-10.50
193	A 1829-06		18	29	-6	41	277.40	-6.70
194	3U1832-23		18	31	-23	13	278.00	-23.22
195	3U1832-05		18	32	-5	18	278.04	-5.30
196			18	36	-22	42	279.00	-22.70
197	3U1837+04	SER X-1	18	37	4	59	279.37	4.99
198	A 1840+01		18	40	1	17	280.20	1.30
199	3U1843+67		18	43	67	30	280.86	67.50
200	A 1845-02		18	45	2	35	281.30	2.00
201	A 1847-05		18	47	-5	18	281.90	-5.30
202	3U1849-77		18	49	-77	5	282.25	-77.10
203			18	49	-7	57	282.42	-7.96
204	A 1850-08	NGC6712	18	50	-8	46	282.64	-8.78
205	A 1850+00		18	50	0	42	282.70	0.70
206		SGR G-1	18	58	-36	54	284.70	-36.90
207	3U1901+03		19	1	3	1	285.42	3.02
208	3U1904+67		19	4	67	0	286.20	67.00
209	A 1905+00		19	5	0	0	286.30	0.00
210	MX1906+00	MXB1906+00	19	5	0	6	286.48	0.10
211	3U1906+09	A1907+09	19	7	9	31	286.95	9.53
212	3U1908+00	AQL 1	19	8	0	30	287.18	0.51
213	A 1909+04		19	9	4	45	287.35	4.75
214	3U1912+07	A1908+07	19	7	7	15	287.00	7.25
215			19	13	-5	26	288.46	-5.44
216	3U1915-05	A 1916-05	19	16	-5	14	289.07	-5.24
217	A 1918+14		19	17	14	36	289.50	14.60
218	3U1921+43	ABEL 2319	19	19	43	52	289.83	43.88
219		PSR 1929+10	19	29	10	52	292.47	10.88
220	3U1955+31		19	53	31	56	298.48	31.94

TABLE 2. (Concluded)

INDEX	NAME 1	NAME 2	MEAN OF 1950.0 EQUATORIAL COORD			
			RA	DEC	RA	DEC
			HR MN	DEG MN	DEG	DEG
221	3U1956+65		19 55	65 0	299.00	65.00
222	3U1956+35	CYG X1	19 56	35 3	299.12	35.06
223	3U1956+11		19 56	11 36	299.20	11.60
224	3U1957+40	CYG A	19 57	40 35	299.30	40.60
225	3U1959-69		19 59	-69 41	299.90	-69.70
226		W 66	20 20	40 1	305.14	40.02
227	3U2030+40	CYG X3	20 30	40 47	307.64	40.78
228	3U2041+75		20 41	75 25	310.48	75.42
229		HB 21	20 43	50 39	310.77	50.65
230		CYG LOOP	20 52	30 0	313.00	30.00
231		CYG X4	21 15	38 0	319.00	38.00
232	3U2052+47		20 52	47 55	313.10	47.92
233	3U2120+81		21 28	81 35	322.20	81.60
234	3U2129+47		21 29	47 1	322.49	47.05
235	3U2131+11	NGC7078.M15	21 28	12 4	322.10	12.07
236		SS CYGNI	21 40	43 21	325.19	43.36
237	MX2140-60		21 40	-60 12	325.23	-60.20
238	3U2142+38	CYG X2	21 42	38 5	325.65	38.09
239	3U2208+54		22 8	54 29	332.15	54.49
240	3U2233+59		22 32	59 32	338.25	59.55
241		LAC X3	22 39	54 0	340.00	54.00
242	MX2244-24		22 44	-24 12	341.10	-24.20
243		GRB 72-6	23 0	-68 0	345.00	-68.00
244	MX2321-23		23 21	-23 0	350.25	-23.00
245	3U2321+58	CAS A	23 21	58 33	350.30	58.56
246	MX2346+26		23 45	-64 41	356.40	-64.70
247	3U2346+26		23 46	26 30	356.53	26.50
248	MX2346-65		23 58	-64 5	359.71	-64.10

most probable; location uncertainties range from optical identifications up to several degrees. The index number is used in tables and figures in this document. Name 1 is from an existing X-ray source catalog. Name 2 is an alternate, usually older, X-ray source designation or the name of an identified optical or radio counterpart. For convenience, the celestial coordinates of each source are given in both hours and minutes and in decimal degrees. Figure 3 shows the X-ray sources mapped onto the celestial sphere in each of three coordinate systems. Most individual sources in the galactic plane cannot be discerned due to crowding.

IV. NOMINAL SCAN SCHEDULE FOR CATALOG SOURCES

Table 3 gives the X-ray source locations in galactic and ecliptic coordinates. The ecliptic longitude determines the scan date which is given in the last column. The length of time a source remains in a scan band depends upon the ecliptic latitude and the field-of-view. Table 4 gives the inclusive dates of availability for two representative fields-of-view, 1 degree and 4 degrees (FWHM), rounded to the nearest day. These data are plotted in Figure 4. Dates of availability for other fields-of-view may be extrapolated from the dates given. The center lines of the scan bands are shown in 15-day intervals together with the location of 22 prominent sources (Table 5) in Figure 5.

These tables and scan maps were generated covering a 6-month period beginning April 1, 2 weeks prior to the originally scheduled HEAO-A launch date. The delayed launch does not affect these data since they are governed only by the Earth-Sun-celestial sphere orientation. The scan dates repeat at 6-month intervals so that scan dates beyond October 1 can be derived from earlier scan dates.

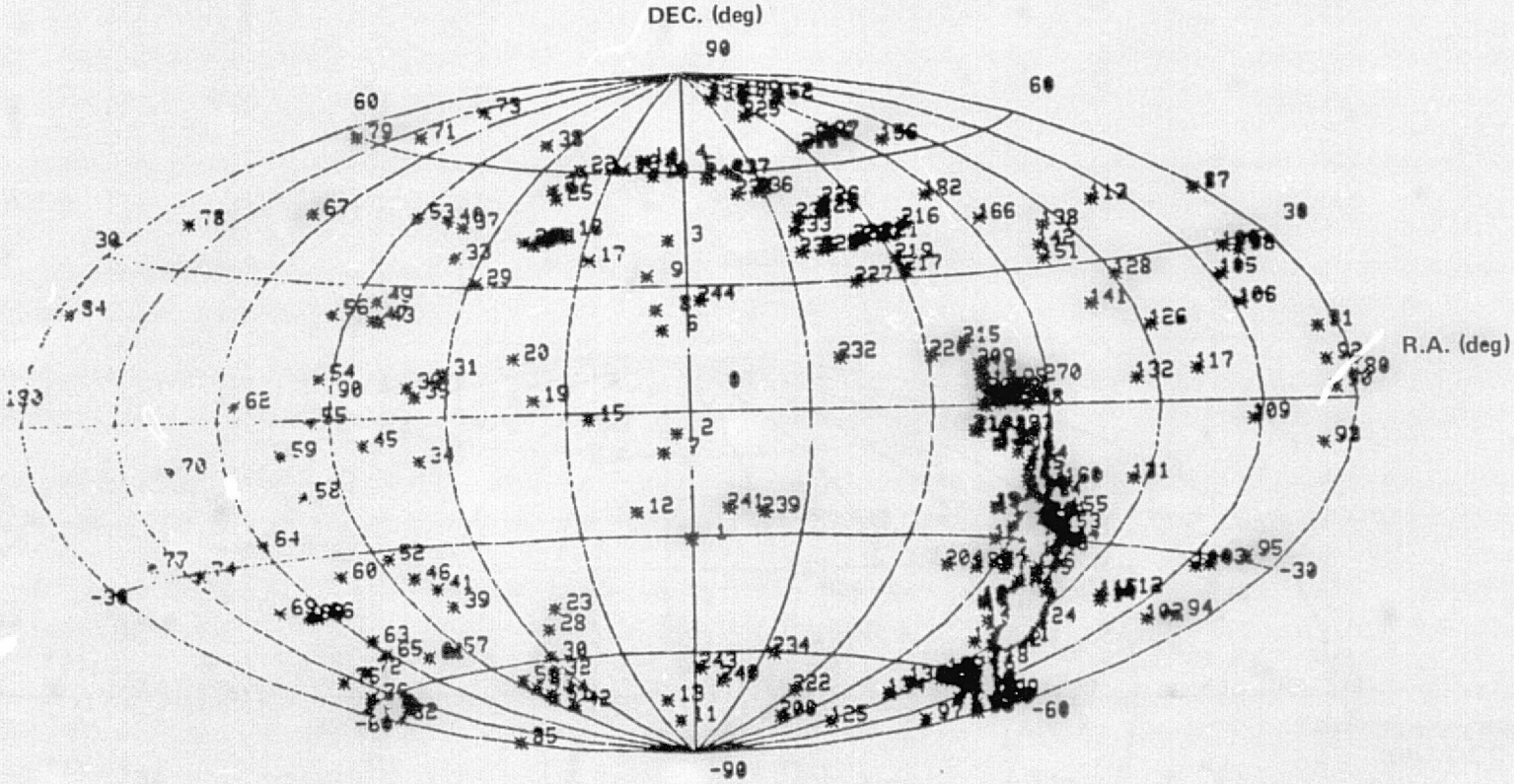
V. SCAN DATES FOR OTHER OBJECTS

The ecliptic longitude, λ, and ecliptic latitude, β, may be derived for a source with right ascension, α, and declination, δ, from the following formulae:

$$\sin \beta = \sin \delta \cos \epsilon - \cos \delta \sin \alpha \sin \epsilon$$

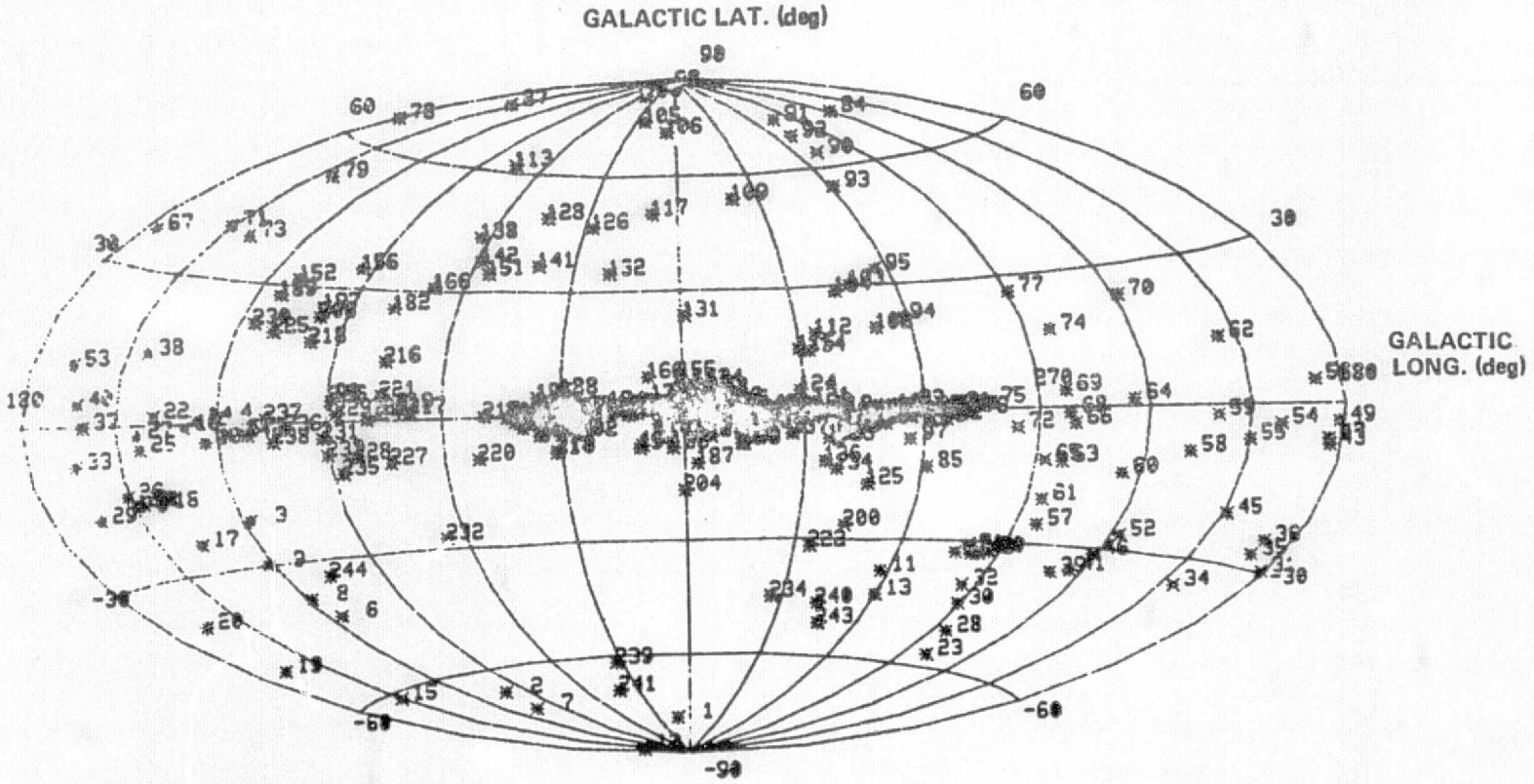
$$\sin \lambda \cos \beta = \cos \delta \sin \alpha \cos \epsilon + \sin \delta \sin \epsilon$$

where ϵ is the obliquity of the ecliptic (23.45 degrees).



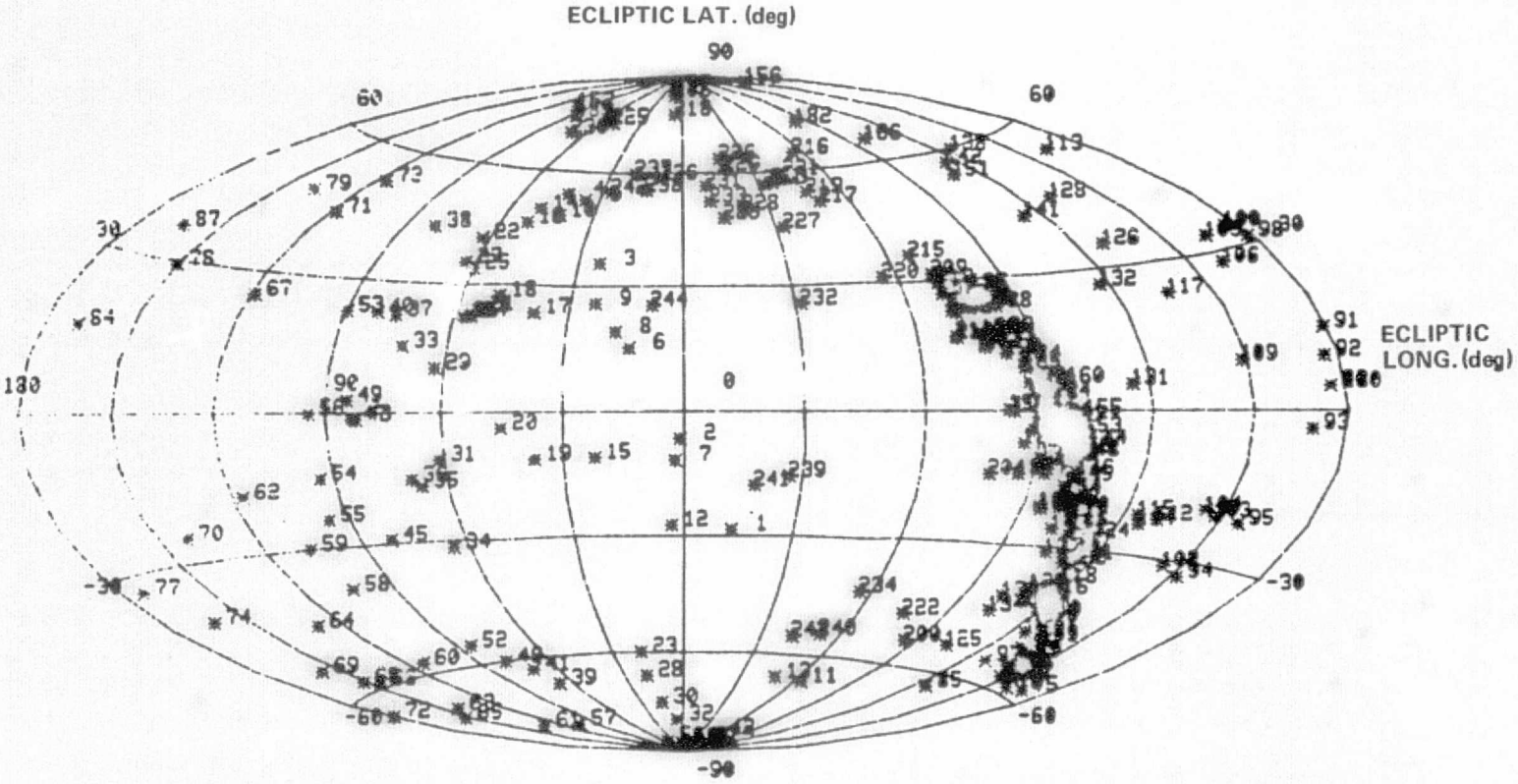
a. Equatorial coordinates.

Figure 3. X-ray sources mapped onto the celestial sphere in each of three coordinate systems.



b. Galactic coordinates.

Figure 3. (Continued).



c. Ecliptic coordinates.

Figure 3. (Concluded).

TABLE 3. X-RAY SOURCE LOCATIONS AND SCAN DATE CENTERS

INDEX	GALACTIC		ECLIPTIC		SCAN DATE
	LONG	LAT	LONG	LAT	MO/DAY
1	10.85	-78.96	346.79	-26.36	6/ 8
2	99.99	-66.24	8.76	-6.67	6/22
3	117.62	-26.32	24.11	35.80	7/17
4	126.14	1.45	42.21	53.76	6/ 5
5	117.43	-1.66	35.62	52.66	7/29
6	119.66	-4.44	36.58	49.11	7/30
7	115.46	-42.86	15.71	15.24	7/ 6
8	134.66	-71.49	2.67	-11.46	6/24
9	118.36	-36.25	17.57	18.92	7/16
10	121.51	-29.86	23.47	25.76	7/16
11	123.19	-5.40	41.06	46.63	8/ 4
12	302.64	-57.71	290.27	-66.68	4/16
13	152.91	-86.01	3.87	-27.56	6/25
14	306.45	-43.49	311.48	-66.48	5/ 2
15	125.94	1.11	49.22	49.63	8/12
16	149.42	-61.44	22.24	-10.76	7/15
17	129.46	-0.59	51.59	46.20	8/14
18	136.66	-24.19	34.36	23.58	8/ 2
19	141.16	-15.42	49.27	27.48	6/12
20	166.36	-56.22	36.99	-16.92	7/30
21	163.88	-39.21	45.15	-5.27	6/ 8
22	146.79	-15.65	55.82	25.89	8/17
23	138.26	1.99	62.29	41.56	8/26
24	259.42	-57.24	17.82	-66.15	7/16
25	146.97	-14.96	55.47	22.42	8/16
26	142.85	-4.24	60.62	34.61	8/25
27	136.58	-13.25	57.95	22.54	6/21
28	145.27	-1.46	62.93	35.44	6/26
29	204.45	-51.55	18.39	-66.73	7/11
30	165.09	-17.11	62.54	16.45	6/26
31	270.61	-44.53	14.94	-74.59	7/ 1
32	161.72	-29.52	61.25	-10.59	8/24
33	274.86	-34.94	6.16	-79.79	6/28
34	104.35	-7.65	71.76	15.19	9/ 4
35	205.66	-34.96	64.25	-31.49	8/28
36	190.84	-21.24	67.97	-16.71	6/30
37	196.27	-24.46	69.43	-15.24	9/ 2
38	160.53	6.51	76.66	22.39	9/ 9
39	143.62	14.43	80.48	43.97	9/15
40	250.63	-35.89	66.98	-67.13	8/30
41	162.56	4.57	81.16	22.86	9/14
42	244.34	-34.80	76.28	-62.75	9/ 5
43	285.69	-32.69	297.65	-83.58	4/16
44	165.04	-6.91	82.06	-1.24	9/15

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TABLE 3. (Continued)

INDEX	GALACTIC		ECLIPTIC		SCAN DATE
	LONG	LAT	LONG	LAT	MO/DAY
45	278.75	-32.72	324.95	-86.46	5/16
46	208.79	-20.73	80.77	-29.04	9/14
47	241.65	-31.04	78.04	-60.14	9/11
48	184.56	-5.79	85.40	-1.30	9/16
49	276.35	-32.51	359.76	-87.30	6/21
50	181.45	-2.65	84.57	2.95	9/17
51	273.58	-32.06	45.46	-86.72	8/ 8
52	280.22	-31.31	297.47	-86.28	4/18
53	257.24	-26.80	84.54	-55.58	9/17
54	165.42	11.81	90.64	23.85	9/23
55	200.88	-3.57	93.66	-14.25	9/27
56	209.96	-0.54	95.51	-23.67	9/29
57	189.01	4.67	94.68	0.63	9/28
58	263.86	-25.64	106.96	-78.18	4/ 7
59	227.22	-0.98	145.40	-39.60	4/ 5
60	224.19	-1.76	100.67	-29.87	4/ 6
61	245.69	-15.73	112.22	-57.44	4/12
62	265.68	-19.95	132.46	-76.17	5/ 3
63	215.85	15.47	110.79	-17.42	4/17
64	263.25	-11.56	143.10	-67.87	5/14
65	244.12	1.75	129.27	-45.91	4/30
66	267.56	-11.21	135.73	-69.68	5/25
67	200.37	-5.17	140.65	-59.54	5/18
68	175.65	57.03	119.09	25.36	4/19
69	201.92	-0.97	151.19	-50.04	5/22
70	263.66	5.95	150.55	-55.95	5/28
71	258.46	25.82	140.92	-25.18	5/12
72	151.00	40.60	116.61	44.85	4/19
73	275.85	-5.88	178.15	-64.06	6/19
74	140.47	59.25	110.14	52.05	4/16
75	202.90	17.52	102.14	-41.11	6/ 3
76	228.91	43.70	147.01	-4.03	5/18
77	283.24	1.40	192.39	-56.11	7/ 4
78	207.79	-0.49	201.74	-56.72	7/14
79	209.66	26.54	172.13	-35.28	6/13
80	179.45	65.26	150.75	29.69	5/22
81	145.89	53.49	137.91	48.44	5/ 9
82	292.19	-0.32	209.25	-56.68	7/22
83	292.07	0.50	208.52	-56.52	7/21
84	294.71	-2.12	214.09	-57.29	7/28
85	294.20	-0.27	212.53	-55.90	7/26
86	256.86	73.20	168.52	16.47	6/ 9
87	298.75	-12.76	234.66	-63.17	8/18
88	295.60	-0.20	214.54	-55.19	7/26

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TABLE 3. (Continued)

INDEX	GALACTIC		ECLIPTIC		SCAN DATE
	LONG	LAT	LONG	LAT	MO/DAY
89	155.14	74.94	163.24	36.65	6/ 4
90	298.88	-2.35	221.41	-55.21	8/ 4
91	300.11	-0.10	220.90	-52.07	8/ 3
92	289.04	64.26	184.80	4.60	6/26
93	283.56	74.51	181.30	14.43	6/23
94	290.69	69.32	184.40	9.69	6/26
95	298.10	55.29	191.50	-2.88	7/ 3
96	302.66	21.56	208.64	-32.74	7/21
97	303.92	33.63	203.75	-21.42	7/16
98	303.66	-1.41	226.79	-51.54	8/ 9
99	303.48	-6.43	232.21	-55.40	8/15
100	56.33	87.96	180.85	51.36	6/22
101	304.09	1.24	224.69	-49.21	8/ 7
102	54.15	84.16	184.05	34.05	6/26
103	306.75	0.64	228.57	-47.98	8/11
104	309.45	19.39	216.40	-31.38	7/30
105	312.97	30.42	212.59	-20.42	7/26
106	317.07	28.91	216.62	-19.60	7/30
107	24.08	76.16	195.10	33.08	7/ 7
108	5.31	73.03	198.63	28.09	7/11
109	309.92	-2.77	235.35	-48.28	8/18
110	312.04	-0.67	235.28	-45.29	8/18
111	339.17	53.70	211.59	9.55	7/25
112	313.50	-0.63	236.67	-44.21	8/20
113	315.40	-2.30	240.16	-43.90	8/23
114	325.27	18.76	229.79	-22.53	8/13
115	74.66	62.17	196.71	54.69	7/ 9
116	327.60	14.78	234.59	-23.48	8/16
117	330.00	15.00	236.10	-21.61	8/19
118	320.31	-1.21	243.24	-39.43	8/27
119	8.88	49.90	224.04	23.88	8/ 7
120	322.12	0.04	243.44	-37.24	8/27
121	320.15	-4.66	246.70	-41.67	8/30
122	320.32	-4.43	246.59	-41.39	8/30
123	327.40	2.24	245.29	-31.73	8/29
124	327.02	0.99	246.19	-32.78	8/30
125	321.71	-6.29	249.68	-41.36	9/ 2
126	330.93	5.36	244.91	-27.03	8/28
127	313.24	-16.75	256.49	-53.90	9/ 9
128	27.51	46.30	231.32	35.14	8/14
129	327.95	-0.85	246.62	-33.13	9/ 1
130	44.21	48.68	228.50	46.45	8/11
131	324.13	-5.97	251.11	-39.18	9/ 4
132	330.98	-1.04	250.86	-30.76	9/ 5

TABLE 3. (Continued)

INDEX	GALACTIC		ECLIPTIC		SCAN DATE
	LONG	LAT	LONG	LAT	MO/DAY
133	359.10	23.79	245.14	5.74	8/28
134	19.74	34.64	242.85	26.00	8/26
135	334.92	-0.27	252.65	-27.07	9/ 5
136	321.75	-15.06	257.57	-44.92	9/10
137	330.91	0.28	255.37	-25.11	9/ 6
138	324.63	-11.36	257.48	-41.63	9/10
139	332.91	-4.81	255.77	-31.22	9/ 8
140	62.85	43.70	232.42	60.05	8/15
141	339.58	-0.07	255.29	-23.06	9/ 8
142	340.86	0.78	255.27	-21.53	9/ 8
143	40.56	36.41	245.77	45.43	8/29
144	58.15	37.52	243.30	57.50	8/29
145	338.93	-4.32	258.88	-25.86	9/12
146	353.84	7.20	250.71	-7.12	9/ 9
147	347.76	2.17	257.89	-14.95	9/11
148	349.09	2.76	258.10	-13.50	9/11
149	343.84	-1.27	256.81	-20.09	9/12
150	352.76	4.96	258.13	-9.23	9/11
151	344.00	-1.80	259.58	-20.22	9/12
152	343.32	-2.36	259.55	-21.10	9/12
153	54.64	54.76	230.17	54.63	9/ 3
154	110.82	31.81	102.13	77.44	4/ 2
155	357.00	7.40	256.21	-4.56	9/11
156	346.52	-0.88	259.93	-17.59	9/13
157	0.55	9.24	250.41	-0.42	9/11
158	93.60	34.99	201.39	84.58	//14
159	348.21	-0.99	260.94	-16.20	9/14
160	354.48	3.14	200.60	-8.71	9/13
161	354.28	-0.12	203.55	-10.55	9/16
162	8.51	9.05	262.50	0.52	9/15
163	1.94	4.79	262.45	-1.45	9/16
164	354.84	-0.10	263.67	-10.07	9/17
165	345.25	-6.80	254.00	-21.00	9/16
166	346.05	-6.97	265.20	-21.07	9/18
167	359.57	1.56	264.57	-5.12	9/17
168	66.85	31.00	259.24	66.20	9/12
169	0.00	-0.00	260.14	-5.55	9/19
170	359.40	-0.43	250.24	-0.21	9/19
171	359.56	-0.42	200.28	-6.12	9/19
172	359.95	-0.55	200.40	-5.75	9/19
173	0.49	0.00	200.38	-5.10	9/19
174	2.27	0.80	200.58	-5.16	9/20
175	354.13	-4.20	255.87	-12.71	9/20
176	1.70	5.75	260.75	5.66	9/20

TABLE 3. (Continued)

INDEX	GALACTIC		ECLIPTIC		SCAN DATE
	LONG	LAT	LONG	LAT	MO/DAY
177	353.54	-5.00	267.29	-13.61	9/20
178	357.24	-4.91	269.06	-10.35	9/22
179	5.08	-1.03	269.57	-1.63	9/23
180	9.07	1.15	269.66	2.91	9/23
181	6.13	-1.91	270.86	-1.16	9/24
182	11.55	0.68	271.31	4.83	9/24
183	4.00	-4.00	271.62	-4.04	9/25
184	77.85	25.67	278.38	73.18	10/ 2
185	13.52	0.00	272.81	6.24	9/26
186	18.01	2.45	273.01	11.31	9/26
187	16.43	1.28	273.24	9.56	9/26
188	2.78	-7.91	274.44	-7.02	9/28
189	356.79	-11.29	274.56	-13.83	9/28
190	30.02	5.81	276.23	23.36	9/29
191	113.19	27.94	86.22	75.17	9/19
192	21.41	-0.49	277.36	12.76	10/ 1
193	24.82	1.20	277.67	16.55	10/ 1
194	10.41	-6.95	277.35	0.03	10/ 1
195	26.36	1.28	278.42	17.92	10/ 2
196	11.29	-7.54	278.30	0.49	10/ 1
197	36.12	4.84	280.60	28.10	10/ 4
198	33.21	2.42	281.21	24.35	4/ 1
199	97.66	25.68	17.60	85.66	7/10
200	34.87	2.04	282.53	25.56	4/ 2
201	28.13	-2.13	282.44	17.64	4/ 2
202	317.47	-26.65	274.61	-53.85	9/28
203	26.00	-3.80	282.73	14.94	4/ 2
204	25.37	-4.37	282.88	14.11	4/ 3
205	33.83	-0.08	283.87	23.54	4/ 4
206	0.08	-17.86	282.08	-14.00	4/ 2
207	37.14	-1.42	287.12	25.56	4/ 7
208	97.83	23.50	11.45	83.61	7/ 3
209	34.87	-3.59	287.68	22.45	4/ 8
210	35.04	-3.71	287.89	22.54	4/ 8
211	43.61	0.26	289.78	31.82	4/10
212	35.73	-4.14	288.70	22.85	4/ 9
213	39.57	-2.32	289.49	27.03	4/ 9
214	41.62	-0.85	289.48	29.56	4/ 9
215	31.00	-8.00	289.22	16.79	4/ 9
216	31.46	-8.45	289.88	16.90	4/10
217	49.26	0.43	293.68	36.46	4/14
218	75.69	13.57	305.23	64.92	4/25
219	47.38	-3.89	296.36	32.30	4/16
220	68.39	1.89	310.50	51.46	5/ 1

TABLE 3. (Concluded)

INDEX	GALACTIC		ECLIPTIC		SCAN DATE
	LONG	LAT	LONG	LAT	MO/DAY
221	97.82	10.00	6.01	78.11	6/28
222	71.34	3.07	312.99	54.25	5/ 3
223	51.30	-9.27	304.15	31.65	4/24
224	76.14	5.85	316.84	59.38	5/ 7
225	325.80	-31.67	284.92	-47.79	4/ 5
226	70.10	1.80	324.14	57.05	5/15
227	79.84	0.71	321.89	50.92	5/19
228	109.50	19.06	52.44	74.59	8/15
229	89.00	5.00	342.22	64.23	6/ 3
230	74.03	-9.58	327.10	45.50	5/16
231	63.41	-7.77	330.92	52.40	5/30
232	87.05	2.09	341.40	61.12	6/ 2
233	116.07	21.84	69.07	70.00	9/ 2
234	91.00	-5.11	350.00	50.77	6/12
235	65.27	-27.59	328.77	25.52	5/20
236	90.50	-7.11	349.78	52.66	6/11
237	353.61	-44.44	305.99	-43.10	4/24
238	67.53	-11.52	345.71	47.96	6/ 7
239	101.05	-1.14	8.51	58.75	6/30
240	100.53	1.30	19.94	69.95	7/12
241	104.68	-5.96	15.98	55.51	7/ 6
242	52.43	-61.05	353.29	-14.98	5/24
243	317.50	-40.25	300.52	-54.29	4/29
244	40.58	-69.64	341.79	-17.24	6/ 2
245	111.75	-2.12	20.73	54.85	7/19
246	313.77	-51.50	317.97	-54.96	5/ 9
247	105.99	-54.02	0.15	25.53	6/30
248	311.95	-52.42	320.50	-55.53	5/11

TABLE 4. SOURCE AVAILABILITY DATES

INDEX	SCAN	FOV 1 DEG		FOV 4 DEG	
1	6/ 8	6/ 7	6/ 8	6/ 5	6/10
2	6/22	6/22	6/23	6/20	6/24
3	7/17	7/16	7/17	7/14	7/19
4	8/ 5	8/ 4	8/ 6	8/ 1	8/ 8
5	7/29	7/28	7/30	7/25	8/ 1
6	7/30	7/29	7/30	7/26	8/ 2
7	7/ 6	7/ 5	7/ 6	7/ 4	7/ 8
8	6/24	6/23	6/24	6/21	6/26
9	7/10	7/ 9	7/10	7/ 7	7/12
10	7/16	7/15	7/17	7/14	7/18
11	8/ 4	8/ 3	8/ 5	8/ 1	8/ 7
12	4/16	4/15	4/18	4/11	4/21
13	6/25	6/24	6/25	6/22	6/27
14	5/ 2	5/ 1	5/ 3	4/27	5/ 7
15	8/12	8/11	8/13	8/ 9	8/15
16	7/15	7/14	7/15	7/13	7/17
17	8/14	8/13	8/15	8/11	8/17
18	8/ 2	8/ 1	8/ 2	7/30	8/ 4
19	8/12	8/11	8/13	8/10	8/14
20	7/30	7/30	7/31	7/28	8/ 1
21	8/ 8	8/ 7	8/ 8	8/ 6	8/10
22	8/17	8/16	8/17	8/14	8/19
23	8/26	8/25	8/26	8/23	8/28
24	7/10	7/ 9	7/11	7/ 8	7/14
25	8/18	8/18	8/19	8/16	8/21
26	8/23	8/23	8/24	8/21	8/26
27	8/21	8/20	8/22	8/19	8/25
28	8/26	8/26	8/27	8/24	8/29
29	7/11	7/ 9	7/12	7/ 5	7/16
30	8/26	8/25	8/26	8/24	8/28
31	7/ 7	7/ 5	7/ 9	6/29	7/15
32	8/24	8/24	8/25	8/22	8/27
33	6/28	6/25	7/ 1	6/16	7/10
34	9/ 4	9/ 4	9/ 5	9/ 2	9/ 6
35	8/28	8/27	8/28	8/25	8/30
36	8/30	8/30	8/31	8/28	9/ 2
37	9/ 2	9/ 1	9/ 2	8/31	9/ 4
38	9/ 9	9/ 8	9/ 9	9/ 7	9/11
39	9/13	9/13	9/14	9/10	9/16
40	8/30	8/29	9/ 1	8/25	9/ 5
41	9/14	9/13	9/15	9/12	9/16
42	9/ 3	9/ 2	9/ 4	8/29	9/ 7
43	4/18	4/13	4/22	3/30	5/ 6
44	9/15	9/14	9/15	9/13	9/17

TABLE 4. (Continued)

INDEX	SCAN	FOV 1 DEG		FOV 4 DEG	
45	5/16	5/ 8	5/24	4/11	6/21
46	9/14	9/13	9/14	9/11	9/16
47	9/11	9/10	9/12	9/ 7	9/15
48	9/16	9/16	9/17	9/14	9/18
49	6/21	6/10	7/ 3	5/ 5	8/10
50	9/17	9/17	9/18	9/15	9/20
51	6/ 8	7/30	8/17	6/30	9/16
52	4/18	4/10	4/26	3/16	5/21
53	9/17	9/17	9/18	9/14	9/21
54	9/23	9/23	9/24	9/21	9/25
55	9/27	9/26	9/27	9/25	9/29
56	9/29	9/28	9/29	9/26	10/ 1
57	9/28	9/27	9/28	9/26	9/30
58	4/ 7	4/ 4	4/ 9	3/28	4/17
59	4/ 3	4/ 2	4/ 4	4/ 1	4/ 6
60	4/ 6	4/ 5	4/ 6	4/ 4	4/ 8
61	4/12	4/11	4/13	4/ 8	4/16
62	5/ 3	5/ 1	5/ 5	4/24	5/12
63	4/17	4/16	4/17	4/15	4/19
64	5/14	5/13	5/15	5/ 8	5/19
65	4/30	4/29	4/30	4/27	5/ 3
66	5/25	5/23	5/26	5/19	5/31
67	5/18	5/17	5/19	5/14	5/22
68	4/19	4/19	4/20	4/17	4/21
69	5/22	5/21	5/23	5/16	5/26
70	5/28	5/27	5/29	5/24	5/31
71	5/12	5/11	5/12	5/ 9	5/14
72	4/19	4/18	4/19	4/16	4/22
73	6/19	6/18	6/21	6/15	6/24
74	4/16	4/15	4/17	4/13	4/20
75	6/ 3	6/ 2	6/ 3	5/31	6/ 5
76	5/18	5/17	5/18	5/16	5/20
77	7/ 4	7/ 3	7/ 5	6/30	7/ 8
78	7/14	7/13	7/15	7/10	7/18
79	6/13	6/13	6/14	6/11	6/16
80	5/22	5/21	5/22	5/19	5/24
81	5/ 9	5/ 8	5/ 9	5/ 5	5/12
82	7/22	7/21	7/23	7/18	7/26
83	7/21	7/20	7/22	7/18	7/25
84	7/28	7/27	7/29	7/24	8/ 1
85	7/26	7/25	7/26	7/22	7/29
86	6/ 9	6/ 9	6/10	6/ 7	6/11
87	8/18	8/16	8/19	8/13	8/22
88	7/28	7/27	7/29	7/24	7/31

TABLE 4. (Continued)

INDEX	SCAN	FOV 1 DEG		FOV 4 DEG	
89	6/ 4	6/ 3	6/ 5	6/ 1	6/ 6
90	8/ 4	8/ 3	8/ 5	7/31	8/ 7
91	6/ 3	6/ 2	8/ 4	7/31	8/ 7
92	6/26	6/26	6/27	6/24	6/29
93	6/23	6/22	6/23	6/21	6/25
94	6/26	6/25	6/27	6/24	6/28
95	7/ 3	7/ 3	7/ 4	7/ 1	7/ 6
96	7/21	7/21	7/22	7/19	7/24
97	7/16	7/16	7/17	7/14	7/19
98	8/ 9	8/ 9	8/10	8/ 6	8/13
99	8/15	8/14	8/16	8/11	8/19
100	6/22	6/22	6/23	6/20	6/25
101	8/ 7	8/ 6	8/ 8	8/ 4	8/10
102	6/26	6/25	6/26	6/23	6/28
103	8/11	8/10	8/12	8/ 8	8/14
104	7/30	7/29	7/30	7/27	8/ 1
105	7/26	7/25	7/26	7/23	7/28
106	7/30	7/29	7/30	7/28	8/ 1
107	7/ 7	7/ 7	7/ 8	7/ 5	7/10
108	7/11	7/10	7/12	7/ 9	7/13
109	8/18	8/18	8/19	8/15	8/21
110	8/18	8/18	8/19	8/15	8/21
111	7/25	7/24	7/25	7/22	7/27
112	8/20	8/19	8/20	8/17	8/23
113	8/23	8/23	8/24	8/20	8/26
114	8/13	8/12	8/13	8/10	8/15
115	7/ 9	7/ 8	7/10	7/ 5	7/13
116	8/18	8/17	8/18	8/15	8/20
117	8/19	8/19	8/20	8/17	8/21
118	8/27	8/26	8/27	8/24	8/29
119	8/ 7	8/ 6	8/ 7	8/ 4	8/ 9
120	8/27	8/26	8/27	8/24	8/29
121	8/30	8/29	8/31	8/27	9/ 2
122	8/30	8/29	8/31	8/27	9/ 2
123	8/29	8/28	8/29	8/26	8/31
124	8/30	8/29	8/30	8/27	9/ 1
125	9/ 2	9/ 1	9/ 3	8/30	9/ 5
126	8/28	8/28	8/29	8/26	8/31
127	9/ 9	9/ 8	9/10	9/ 6	9/13
128	8/14	8/13	8/15	8/12	8/17
129	9/ 1	8/31	9/ 2	8/30	9/ 4
130	8/11	8/10	8/12	8/ 8	8/14
131	9/ 4	9/ 3	9/ 4	9/ 1	9/ 6
132	9/ 3	9/ 3	9/ 4	9/ 1	9/ 6

TABLE 4. (Continued)

INDEX	SCAN	FOV 1 DEG		FOV 4 DEG	
133	8/28	8/28	8/29	8/26	8/31
134	8/26	8/26	8/27	8/24	8/28
135	9/ 5	9/ 5	9/ 6	9/ 3	9/ 8
136	9/10	9/10	9/11	9/ 7	9/13
137	9/ 6	9/ 5	9/ 7	9/ 4	9/ 8
138	9/10	9/10	9/11	9/ 7	9/13
139	9/ 8	9/ 8	9/ 9	9/ 6	9/11
140	8/15	8/14	8/16	8/11	8/19
141	9/ 8	9/ 7	9/ 9	9/ 6	9/10
142	9/ 8	9/ 7	9/ 8	9/ 6	9/10
143	8/29	8/28	8/30	8/26	9/ 1
144	8/29	8/28	8/30	8/25	9/ 1
145	9/12	9/11	9/12	9/ 9	9/14
146	9/ 9	9/ 9	9/10	9/ 7	9/11
147	9/11	9/10	9/11	9/ 8	9/13
148	9/11	9/10	9/11	9/ 9	9/13
149	9/12	9/11	9/12	9/ 9	9/14
150	9/11	9/10	9/11	9/ 9	9/13
151	9/12	9/12	9/13	9/10	9/14
152	9/12	9/12	9/13	9/10	9/15
153	9/ 3	9/ 2	9/ 4	8/30	9/ 6
154	4/ 2	3/31	4/ 4	3/24	4/11
155	9/11	9/10	9/11	9/ 9	9/13
156	9/13	9/12	9/13	9/11	9/15
157	9/11	9/11	9/12	9/ 9	9/13
158	7/14	7/ 9	7/19	6/22	8/ 5
159	9/14	9/13	9/14	9/12	9/16
160	9/13	9/13	9/14	9/11	9/15
161	9/16	9/16	9/17	9/14	9/18
162	9/15	9/15	9/16	9/13	9/17
163	9/16	9/15	9/16	9/14	9/18
164	9/17	9/16	9/17	9/14	9/19
165	9/18	9/17	9/18	9/15	9/20
166	9/18	9/18	9/19	9/16	9/20
167	9/17	9/17	9/18	9/15	9/20
168	9/12	9/11	9/13	9/ 7	9/17
169	9/19	9/19	9/20	9/17	9/21
170	9/19	9/19	9/20	9/17	9/21
171	9/19	9/19	9/20	9/17	9/21
172	9/19	9/19	9/20	9/17	9/21
173	9/19	9/19	9/20	9/17	9/21
174	9/20	9/19	9/20	9/17	9/22
175	9/20	9/19	9/20	9/18	9/22
176	9/20	9/19	9/20	9/18	9/22

TABLE 4. (Continued)

INDEX	SCAN	FOV	1 DEG	FOV	4 DEG
177	9/20	9/20	9/21	9/18	9/22
178	9/22	9/22	9/23	9/20	9/24
179	9/23	9/22	9/23	9/21	9/25
180	9/23	9/22	9/23	9/21	9/25
181	9/24	9/23	9/24	9/22	9/26
182	9/24	9/24	9/25	9/22	9/26
183	9/25	9/24	9/25	9/23	9/27
184	10/ 2	9/30	10/ 3	9/25	10/ 9
185	9/26	9/25	9/26	9/24	9/28
186	9/26	9/26	9/27	9/24	9/28
187	9/26	9/26	9/27	9/24	9/28
188	9/28	9/27	9/28	9/26	9/30
189	9/28	9/27	9/28	9/26	9/30
190	9/29	9/29	9/30	9/27	10/ 2
191	9/19	9/17	9/21	9/11	9/27
192	10/ 1	9/30	10/ 1	9/28	10/ 5
193	10/ 1	9/30	10/ 1	9/29	10/ 3
194	10/ 1	9/30	10/ 1	9/28	10/ 5
195	10/ 2	10/ 1	10/ 2	9/29	10/ 4
196	10/ 1	10/ 1	10/ 2	9/29	10/ 4
197	10/ 4	10/ 5	10/ 4	10/ 2	10/ 6
198	4/ 1	4/ 1	4/ 1	3/30	4/ 3
199	7/10	7/ 3	7/17	0/11	8/ 8
200	4/ 2	4/ 2	4/ 3	3/31	4/ 5
201	4/ 2	4/ 2	4/ 3	3/31	4/ 4
202	9/28	9/27	9/29	9/24	10/ 1
203	4/ 2	4/ 2	4/ 3	4/ 1	4/ 5
204	4/ 3	4/ 2	4/ 3	4/ 1	4/ 5
205	4/ 4	4/ 3	4/ 4	4/ 1	4/ 6
206	4/ 2	4/ 1	4/ 2	3/31	4/ 4
207	4/ 7	4/ 6	4/ 7	4/ 5	4/ 9
208	7/ 3	6/29	7/ 8	6/14	7/23
209	4/ 8	4/ 7	4/ 8	4/ 5	4/10
210	4/ 8	4/ 7	4/ 8	4/ 6	4/10
211	4/10	4/ 9	4/10	4/ 7	4/12
212	4/ 9	4/ 8	4/ 9	4/ 6	4/11
213	4/ 9	4/ 9	4/10	4/ 7	4/12
214	4/ 9	4/ 9	4/10	4/ 7	4/12
215	4/ 9	4/ 9	4/10	4/ 7	4/11
216	4/10	4/ 9	4/10	4/ 8	4/12
217	4/14	4/13	4/14	4/11	4/16
218	4/25	4/24	4/27	4/21	4/30
219	4/16	4/16	4/17	4/14	4/19
220	5/ 1	4/30	5/ 2	4/28	5/ 4

TABLE 4. (Concluded)

INDEX	SCAN	FOV 1 DEG		FOV 4 DEG	
221	6/28	6/25	6/30	6/17	7/ 8
222	5/ 3	5/ 3	5/ 4	4/30	5/ 7
223	4/24	4/24	4/25	4/22	4/27
224	5/ 7	5/ 6	5/ 8	5/ 3	5/11
225	4/ 5	4/ 4	4/ 5	4/ 2	4/ 8
226	5/15	5/14	5/16	5/11	5/19
227	5/19	5/18	5/20	5/15	5/23
228	8/15	8/13	8/17	8/ 7	8/23
229	6/ 3	6/ 2	6/ 4	5/29	6/ 8
230	5/18	5/17	5/19	5/15	5/21
231	5/30	5/30	5/31	5/27	6/ 3
232	6/ 2	6/ 1	6/ 3	5/29	6/ 6
233	9/ 2	9/ 1	9/ 4	8/27	9/ 8
234	6/12	6/11	6/12	6/ 8	6/15
235	5/20	5/19	5/20	5/17	5/22
236	6/11	6/10	6/12	6/ 7	6/14
237	4/24	4/23	4/25	4/21	4/27
238	6/ 7	6/ 6	6/ 8	6/ 4	6/10
239	6/30	6/29	7/ 1	6/26	7/ 4
240	7/12	7/11	7/13	7/ 6	7/16
241	7/ 6	7/ 5	7/ 7	7/ 2	7/10
242	5/24	5/24	5/25	5/22	5/27
243	4/29	4/28	4/30	4/25	5/ 2
244	6/ 2	6/ 2	6/ 3	5/31	6/ 5
245	7/19	7/19	7/20	7/16	7/23
246	5/ 9	5/ 8	5/10	5/ 5	5/12
247	6/30	6/29	7/ 1	6/28	7/ 2
248	5/11	5/10	5/12	5/ 8	5/15

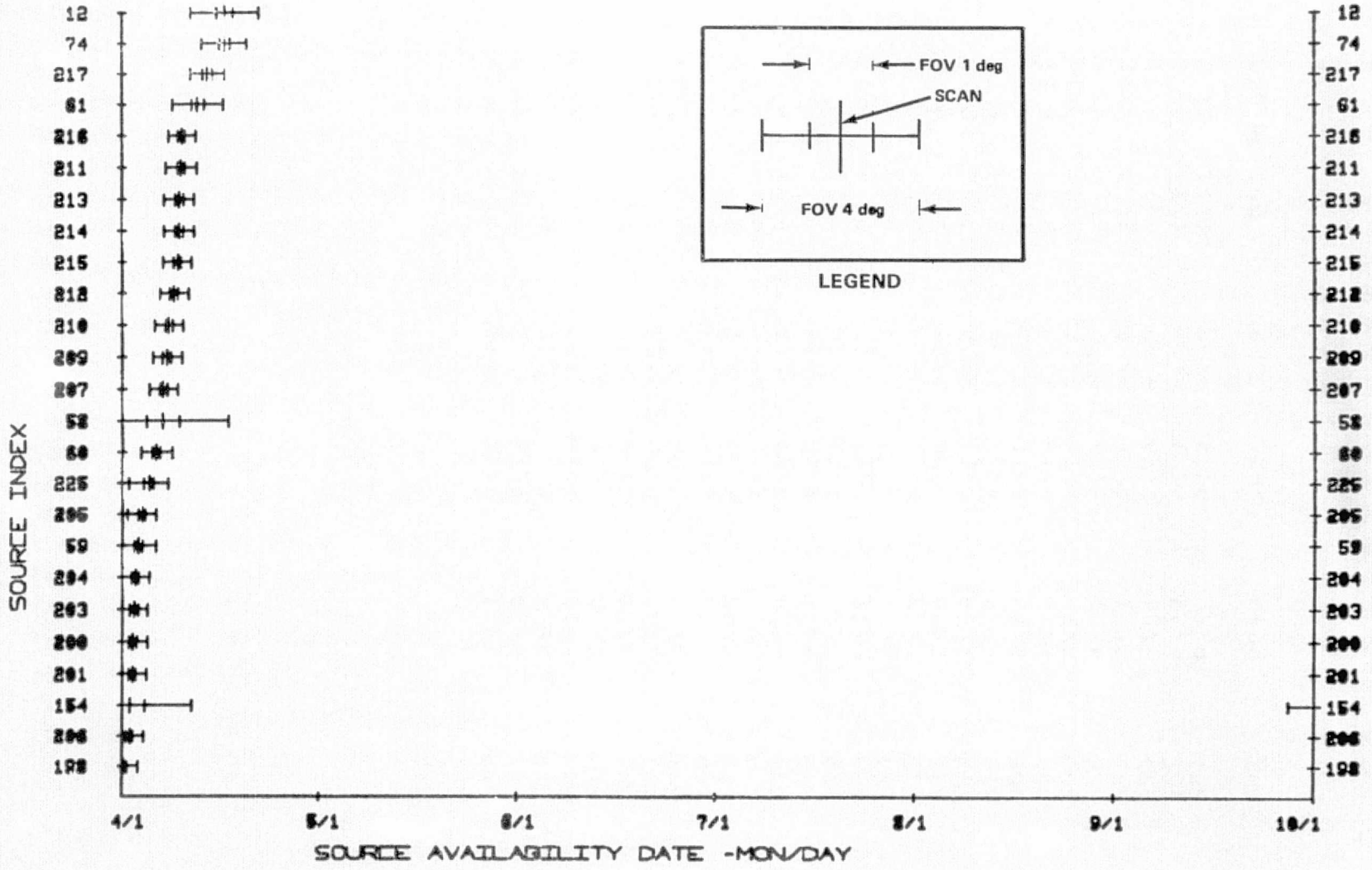


Figure 4. Plot of scan availability dates.

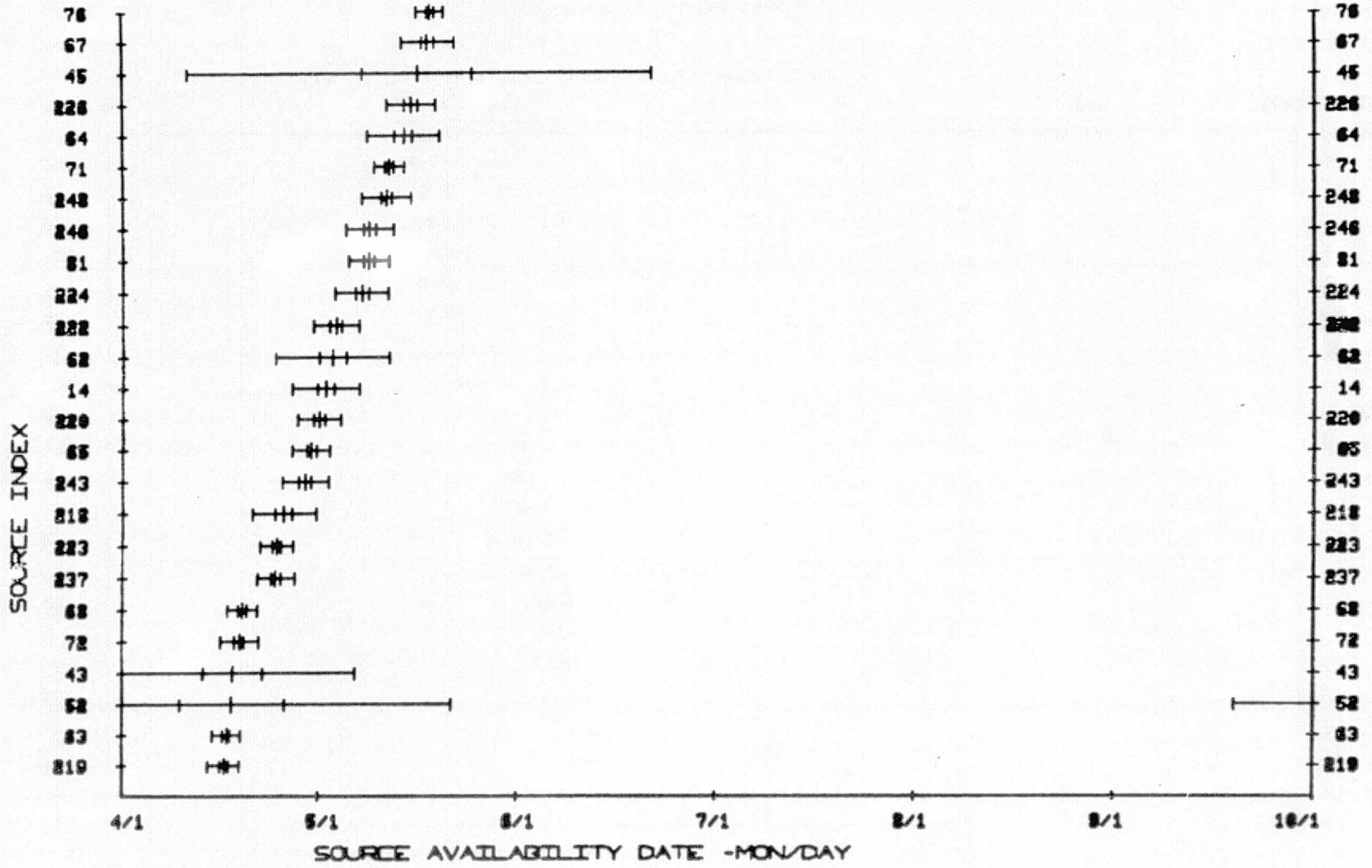


Figure 4. (Continued).

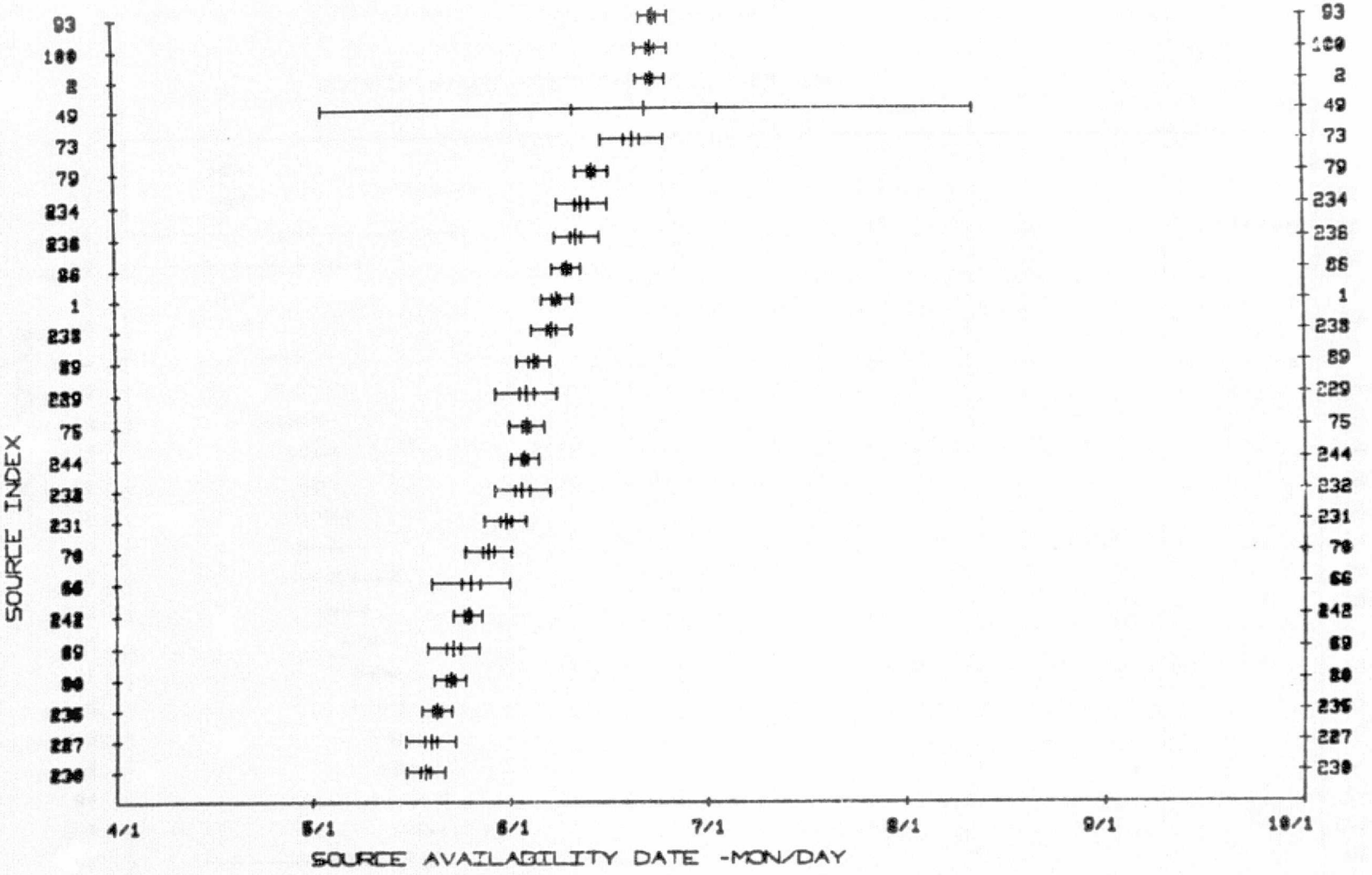


Figure 4. (Continued).

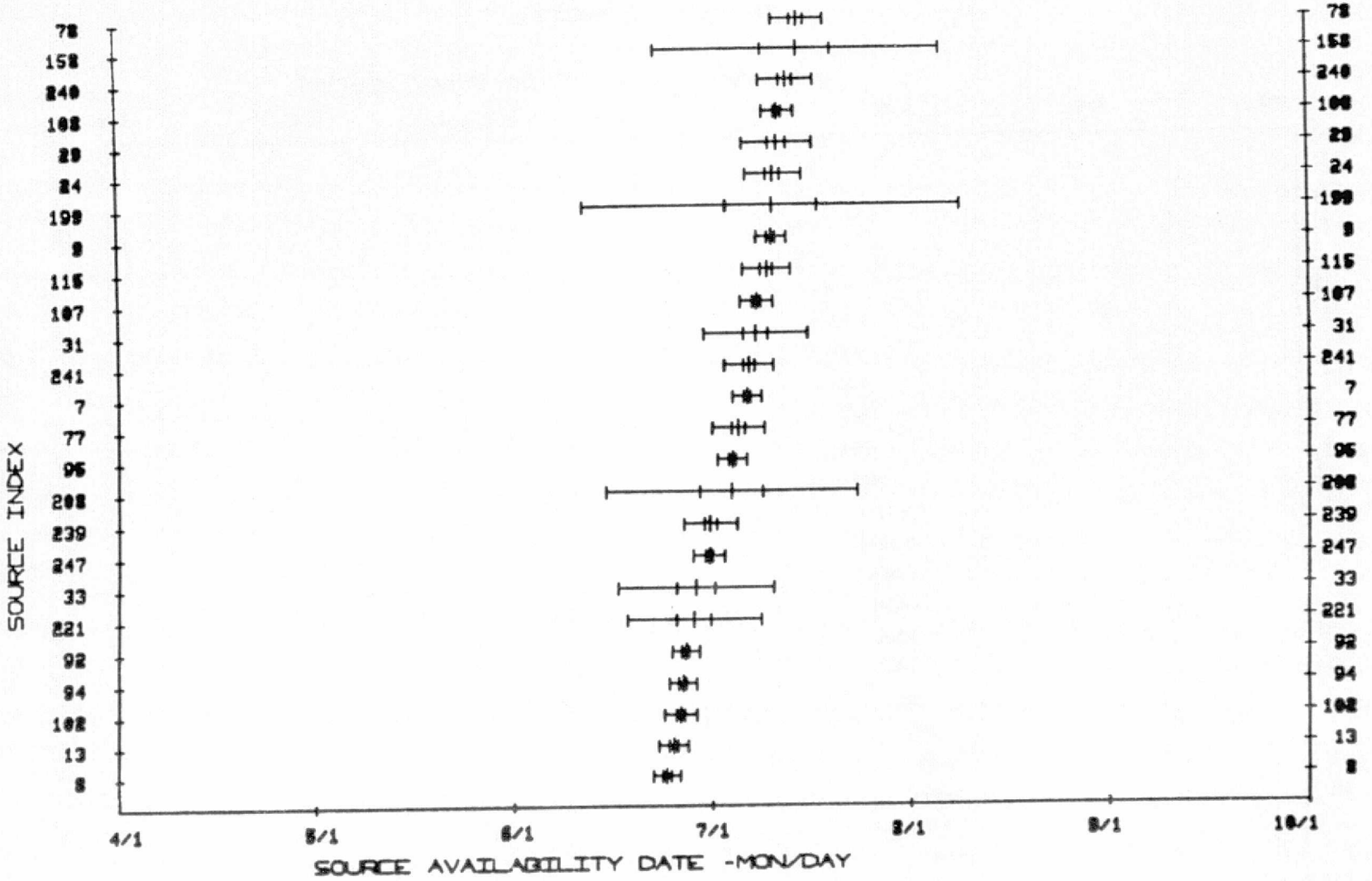


Figure 4. (Continued).

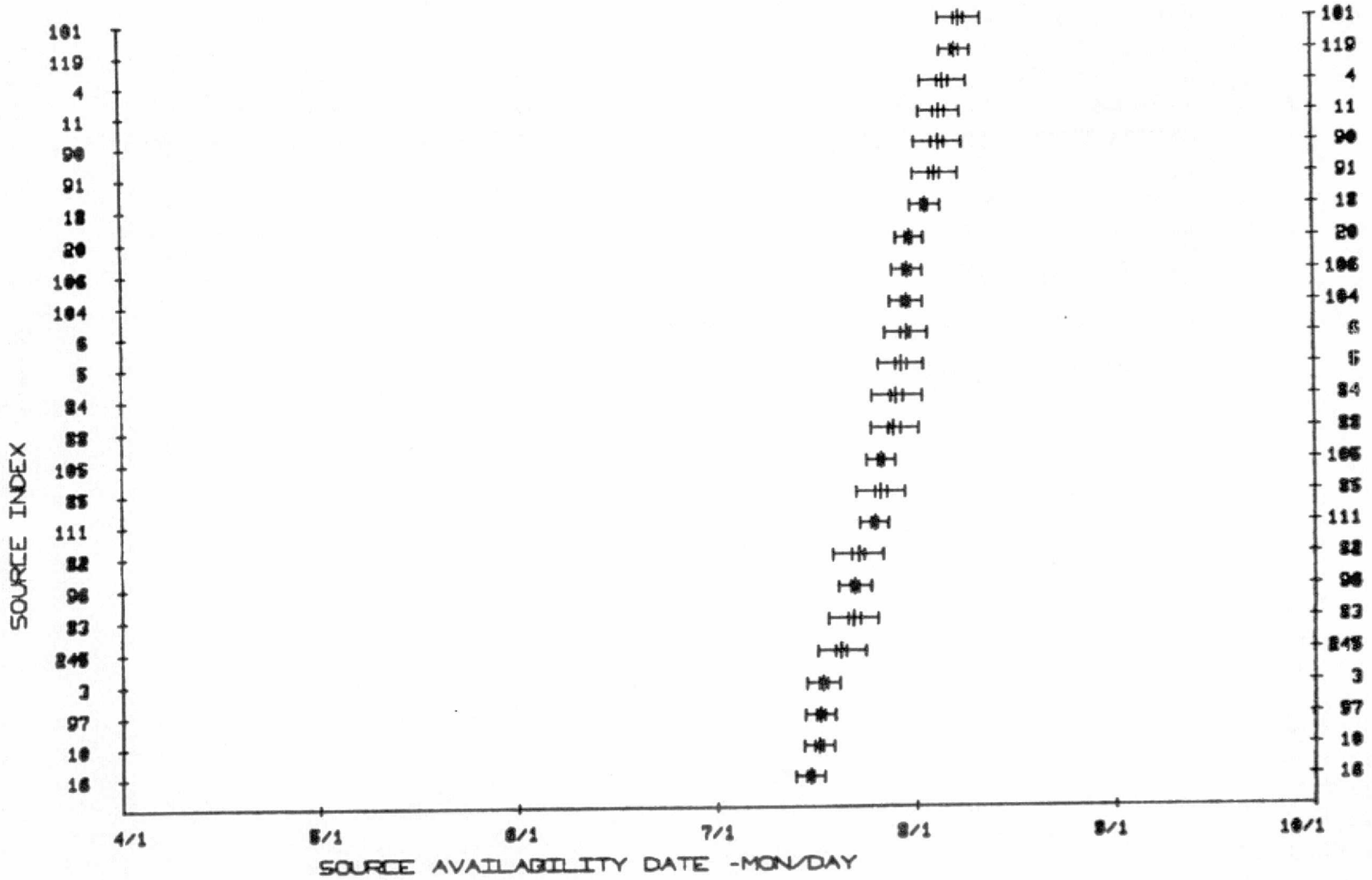


Figure 4. (Continued).

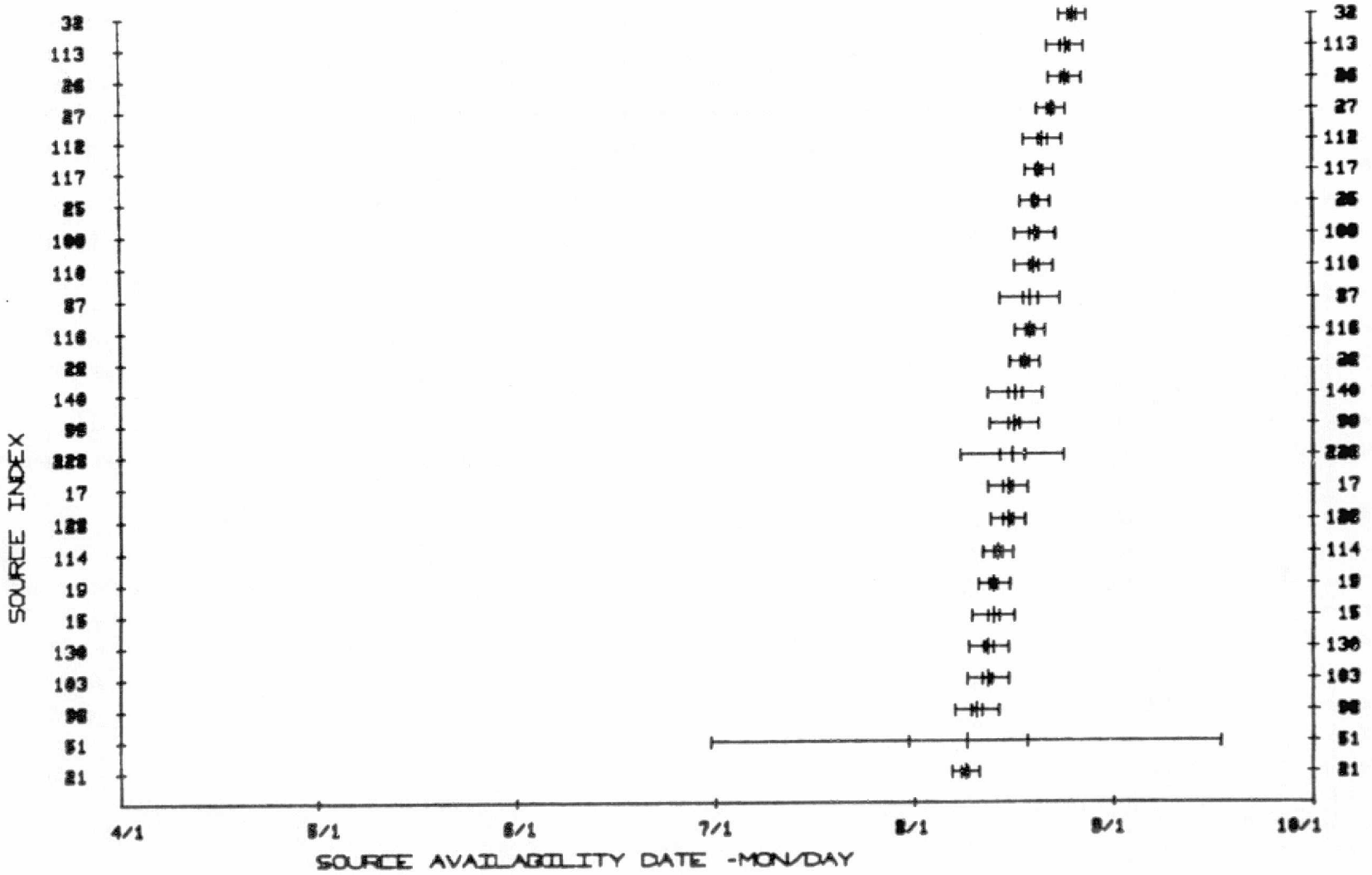


Figure 4. (Continued).

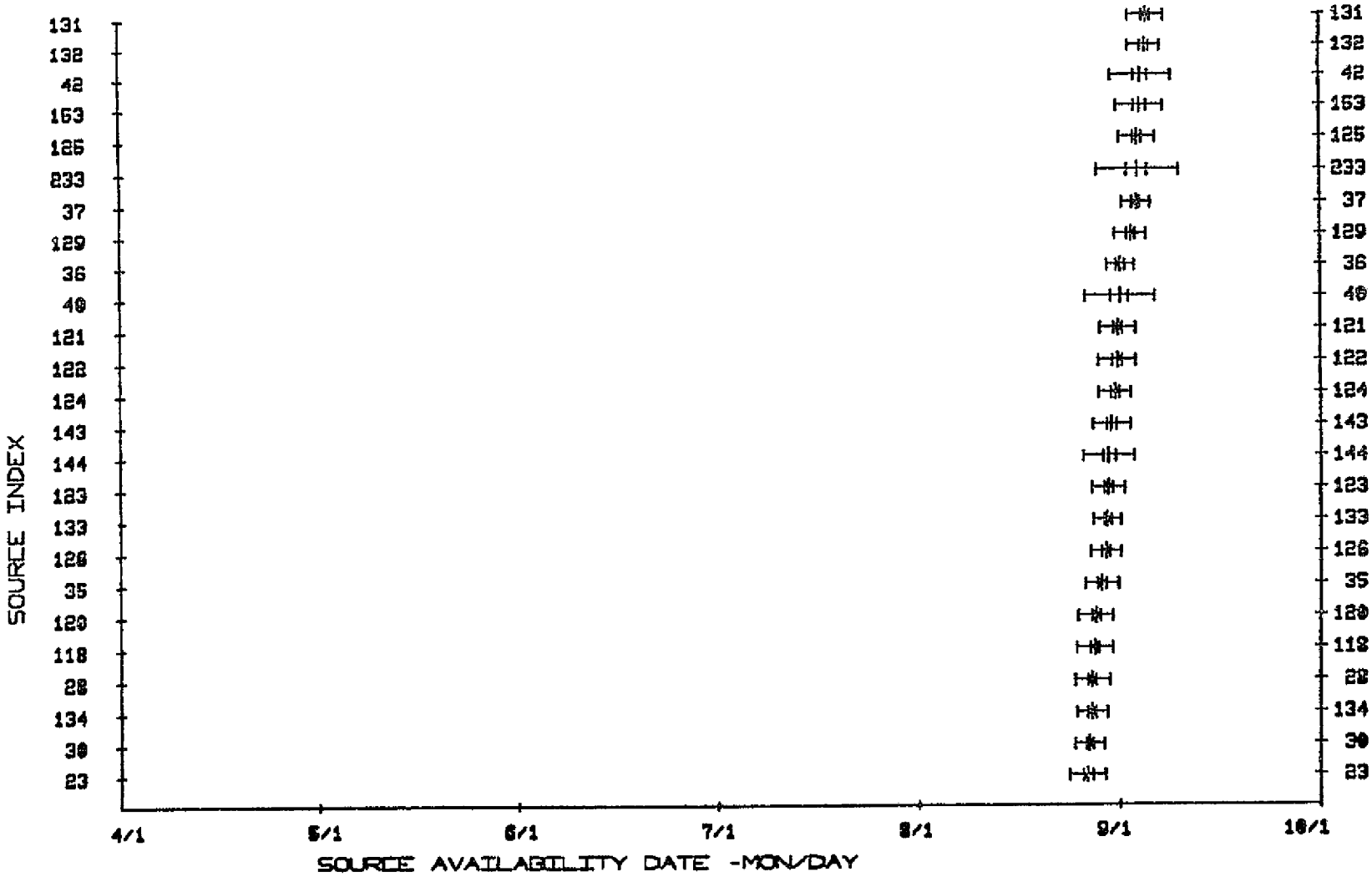


Figure 4. (Continued).

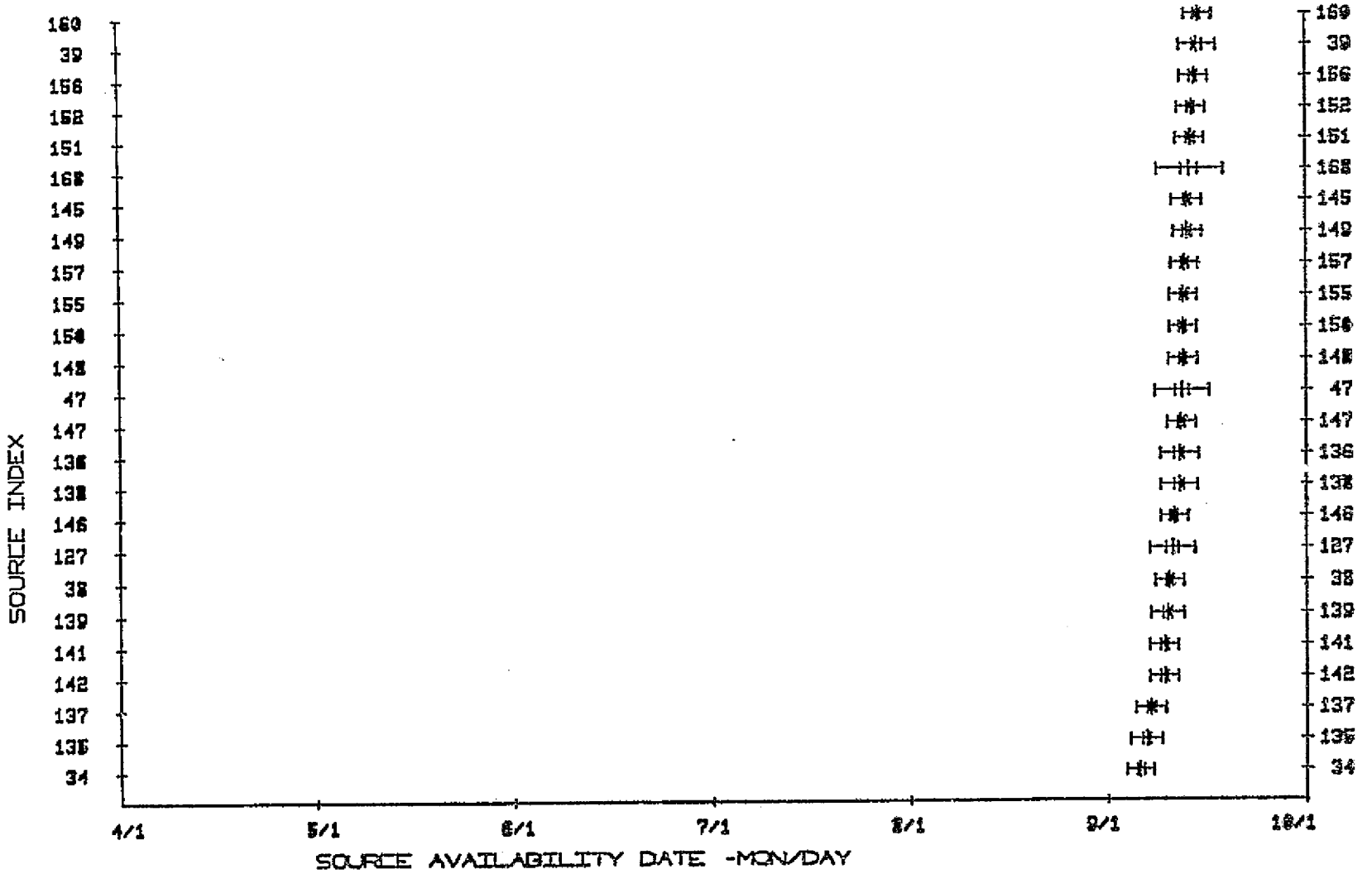


Figure 4. (Continued).

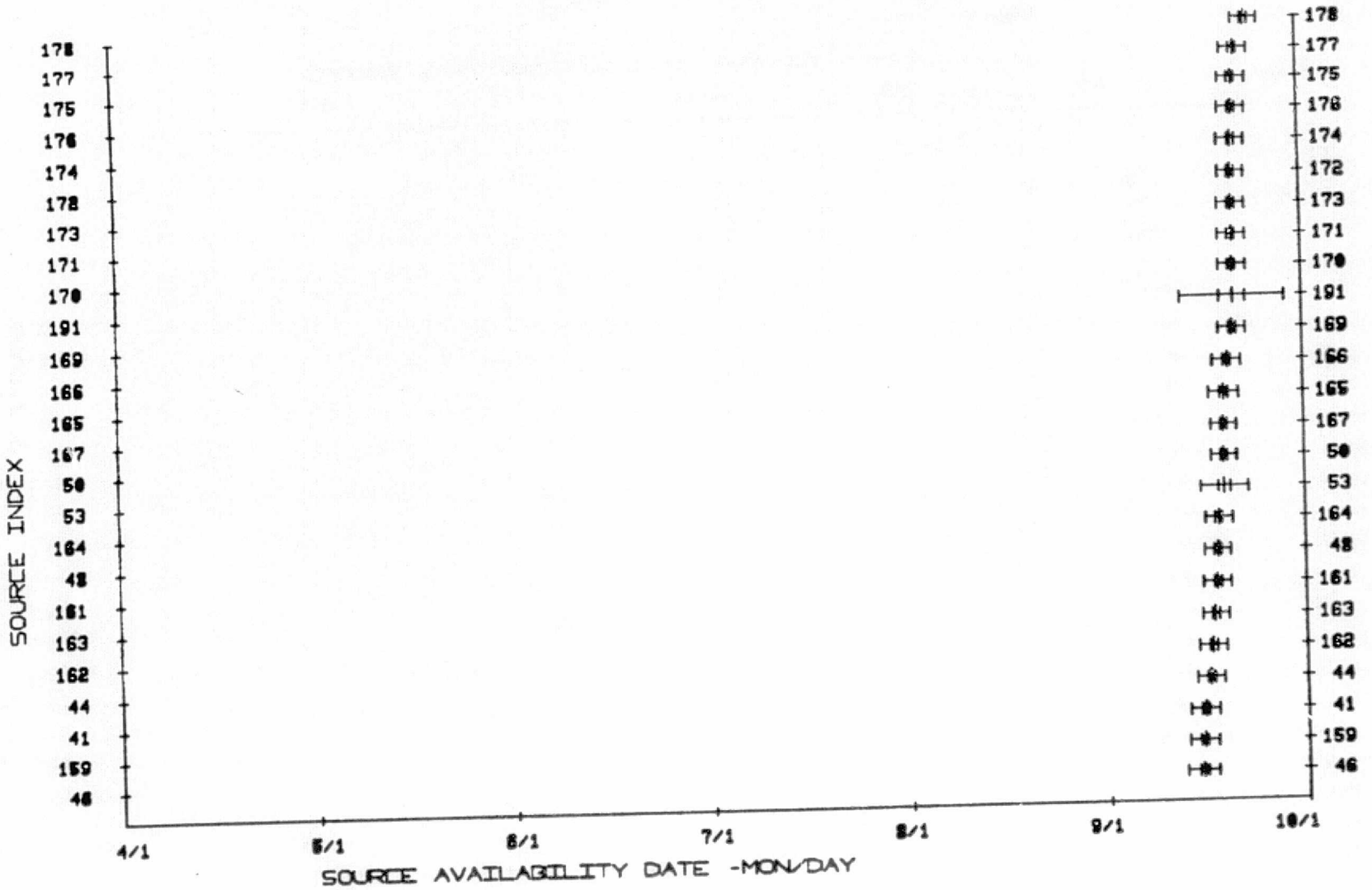


Figure 4. (Continued).

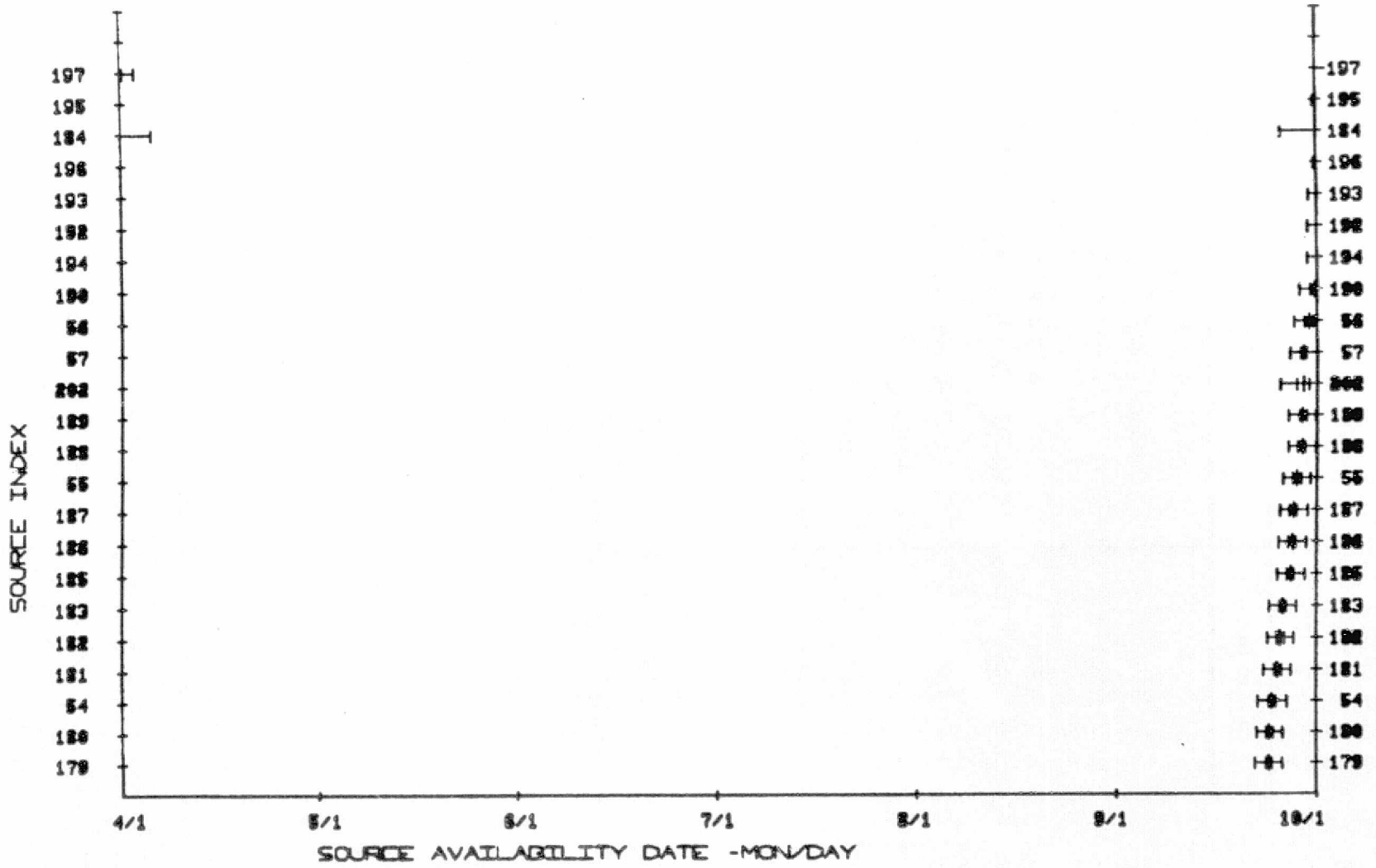
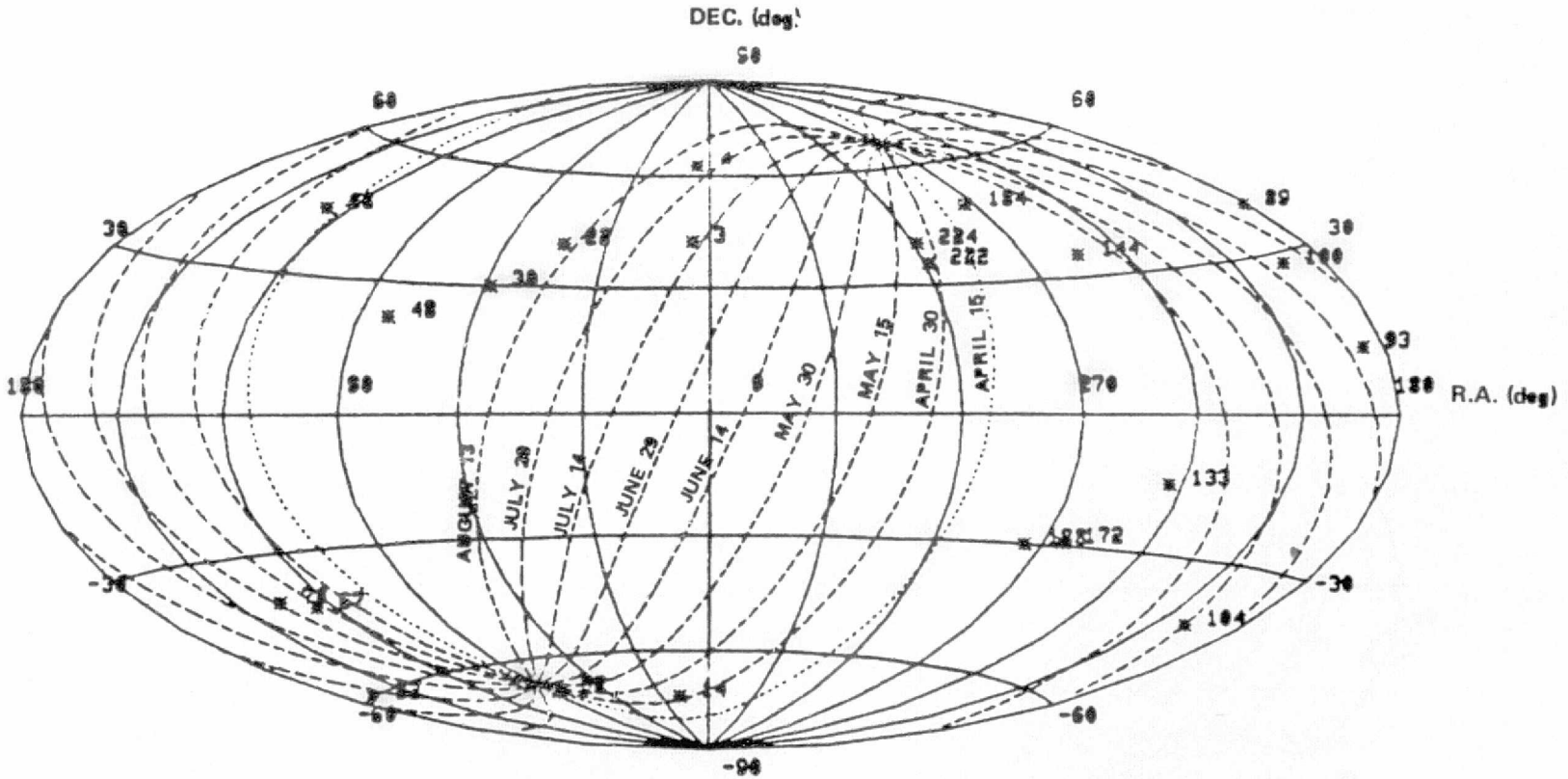


Figure 4. (Concluded).

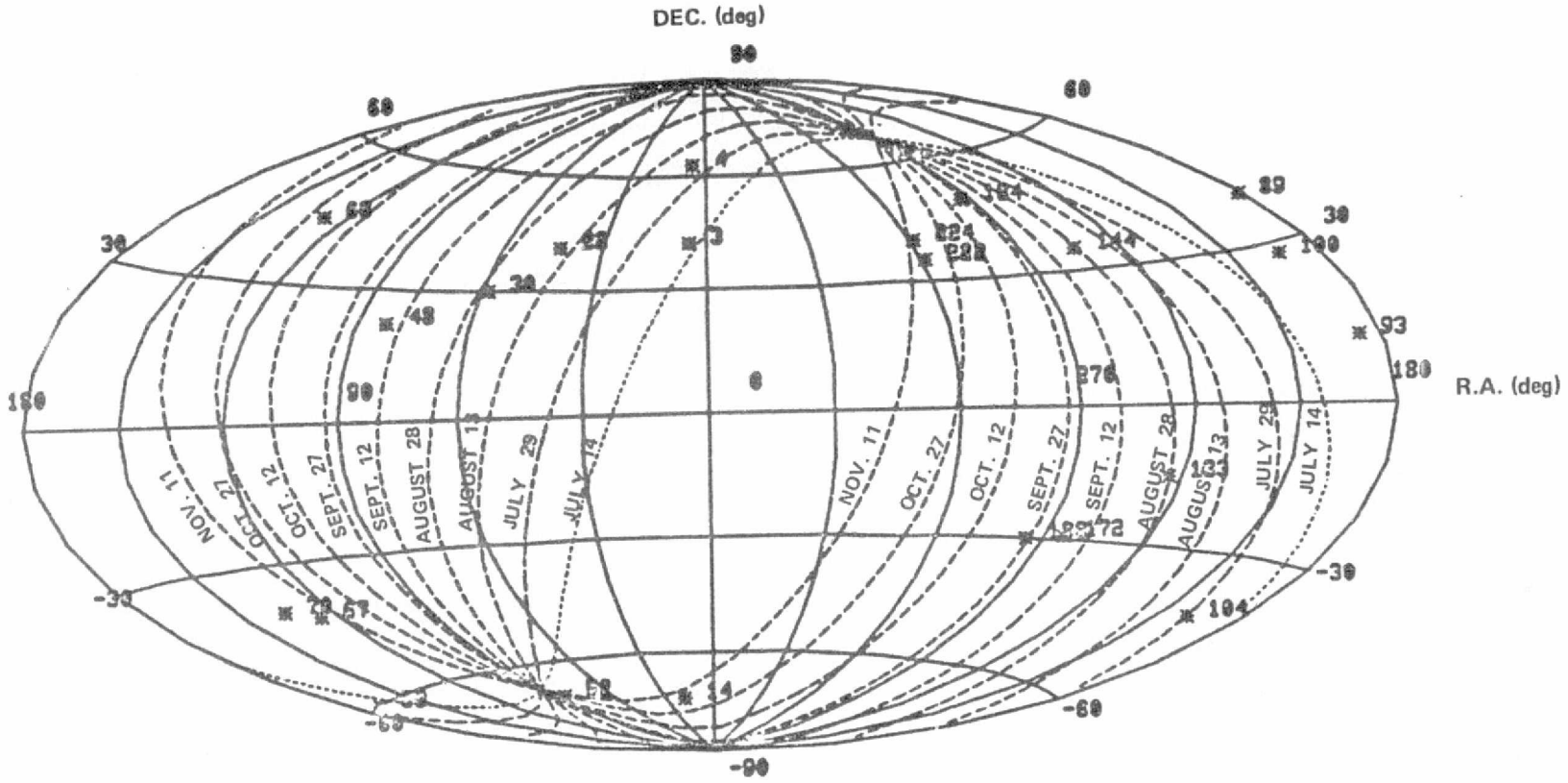
TABLE 5. X-RAY SOURCES PLOTTED ON SCAN MAPS

Index No.	Source
3	M31, Andromeda Galaxy
4	Tycho' s SNR
14	SMC X-1
22	Perseus Cluster
30	X Persei
48	Crab Nebula
52	LMC X-1
67	Puppus A
68	Vela X
70	Vela X-1
83	Cen X-3
89	NGC 4151
93	M87
100	Coma Cluster
104	Cen A, NGC 5128
133	Sco X-1
144	Her X-1, HZ Her
172	Galactic Center
184	AM Her
188	NGC 6624
222	Cyg X-1
224	Cyg A



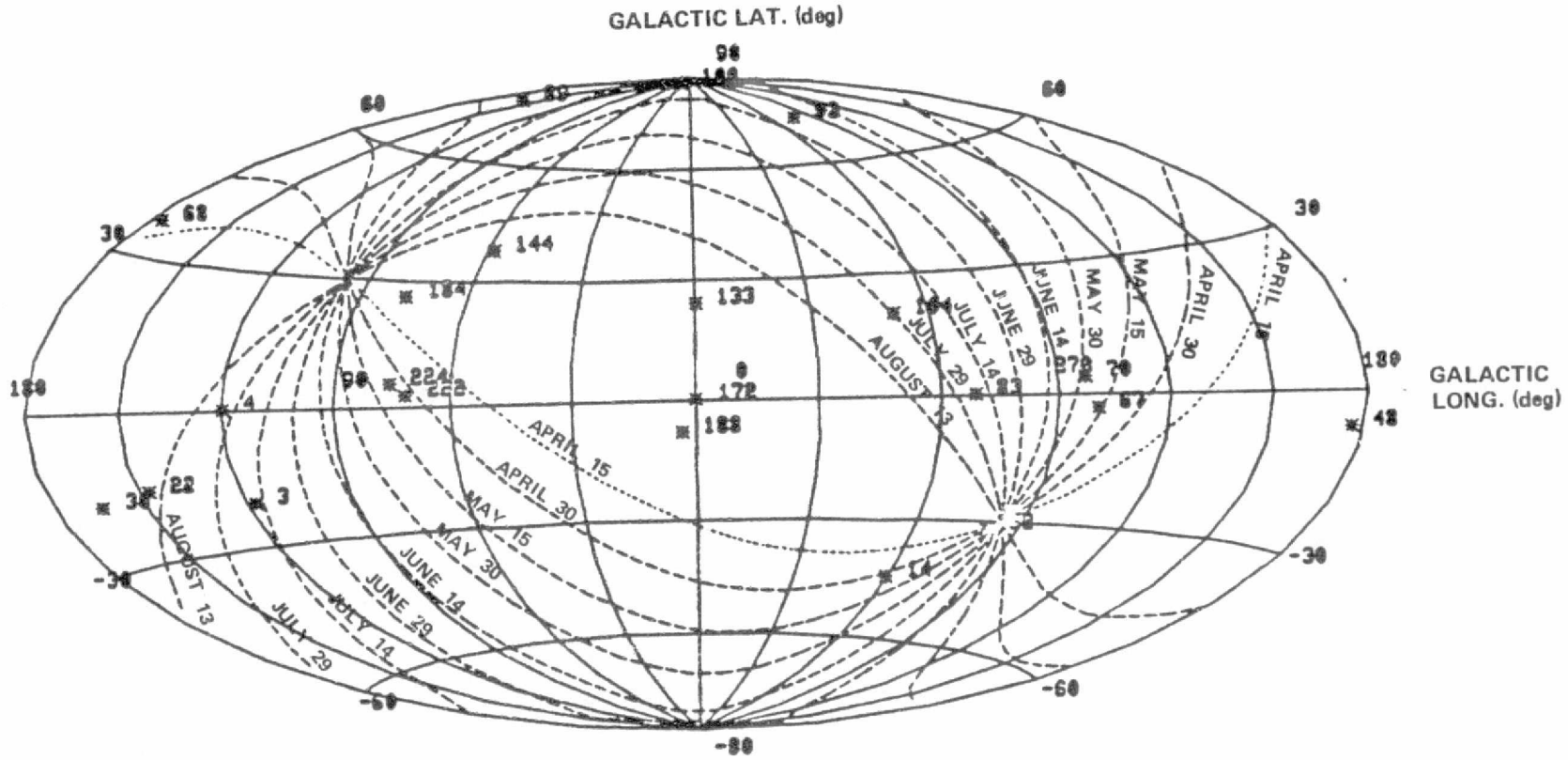
a. Scan plane location, April 15 to August 13.

Figure 5. Scan planes on celestial sphere.



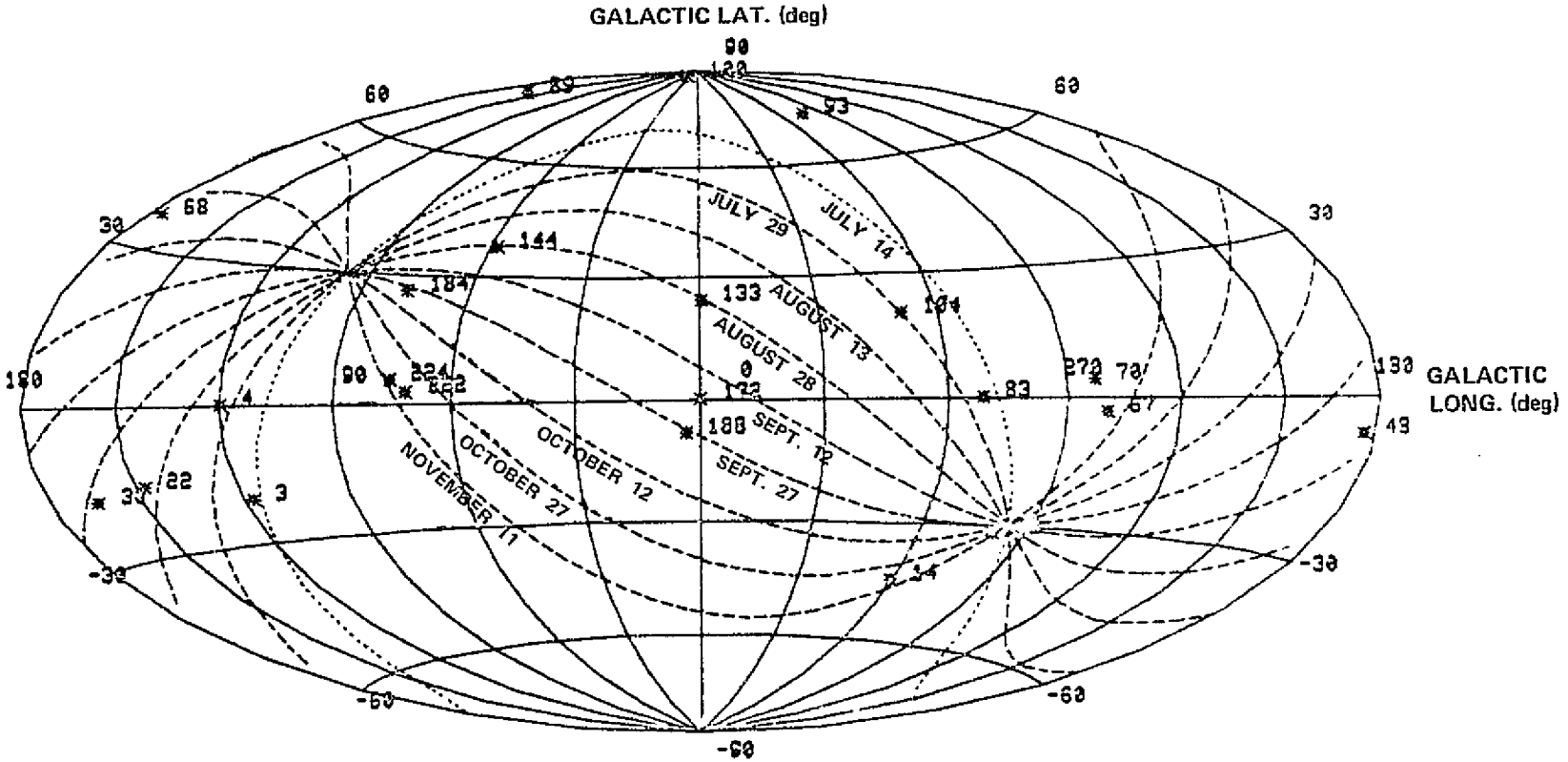
b. Scan plane location, July 14 to November 11.

Figure 5. (Continued).



c. Scan plane location, April 15 to August 13.

Figure 5. (Continued).



d. Scan plane location, July 14 to November 11.

Figure 5. (Concluded).

The source will pass through the scan plane on the date that the longitude of the Sun (as found in the ephemeris) is 90 degrees from λ. This will occur twice each year. The time of availability in the scan band, t_a, is related to the field-of-view in the YZ plane, FOV YZ, by:

$$t_a = \frac{365.25 \times (\text{FOV YZ})^\circ}{360^\circ \times \cos\beta} \text{ days} \quad .$$

VI. COORDINATED NIGHTTIME OBSERVATIONS WITH HEAO-A

Unfortunately, the observing geometry of HEAO-A is not ideal for making coordinated nighttime optical observations, since the accessible sources are in the band coinciding with the twilight band of the Earth projected onto the celestial sphere. The nighttime accessibility of sources in the HEAO-A scan band is illustrated in Figure 6 as a function of declination at the equinoxes and solstices. (Note that the declination of a source and the observation dates are dependent on each other, according to the previous sections.)

A representative observing latitude of +35° was used for Figure 6. The same data may be used for Southern Hemisphere observations (-35°) by changing the sign of the declinations and by changing the date by 6 months. The region of twilight refers to astronomical twilight (when the Sun is 18° below the horizon).

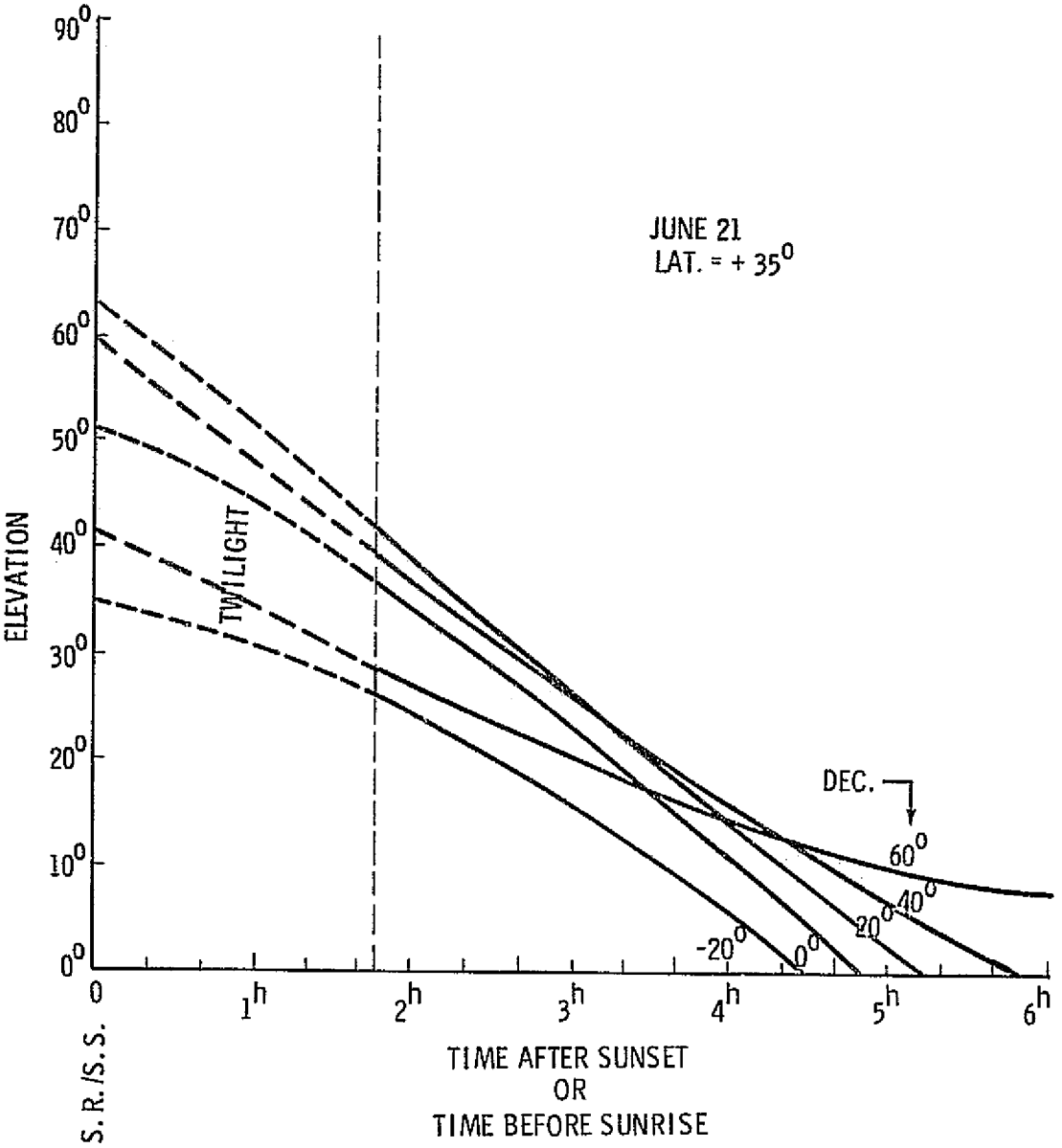


Figure 6. Elevation of sources in the scan band at mid-latitude.

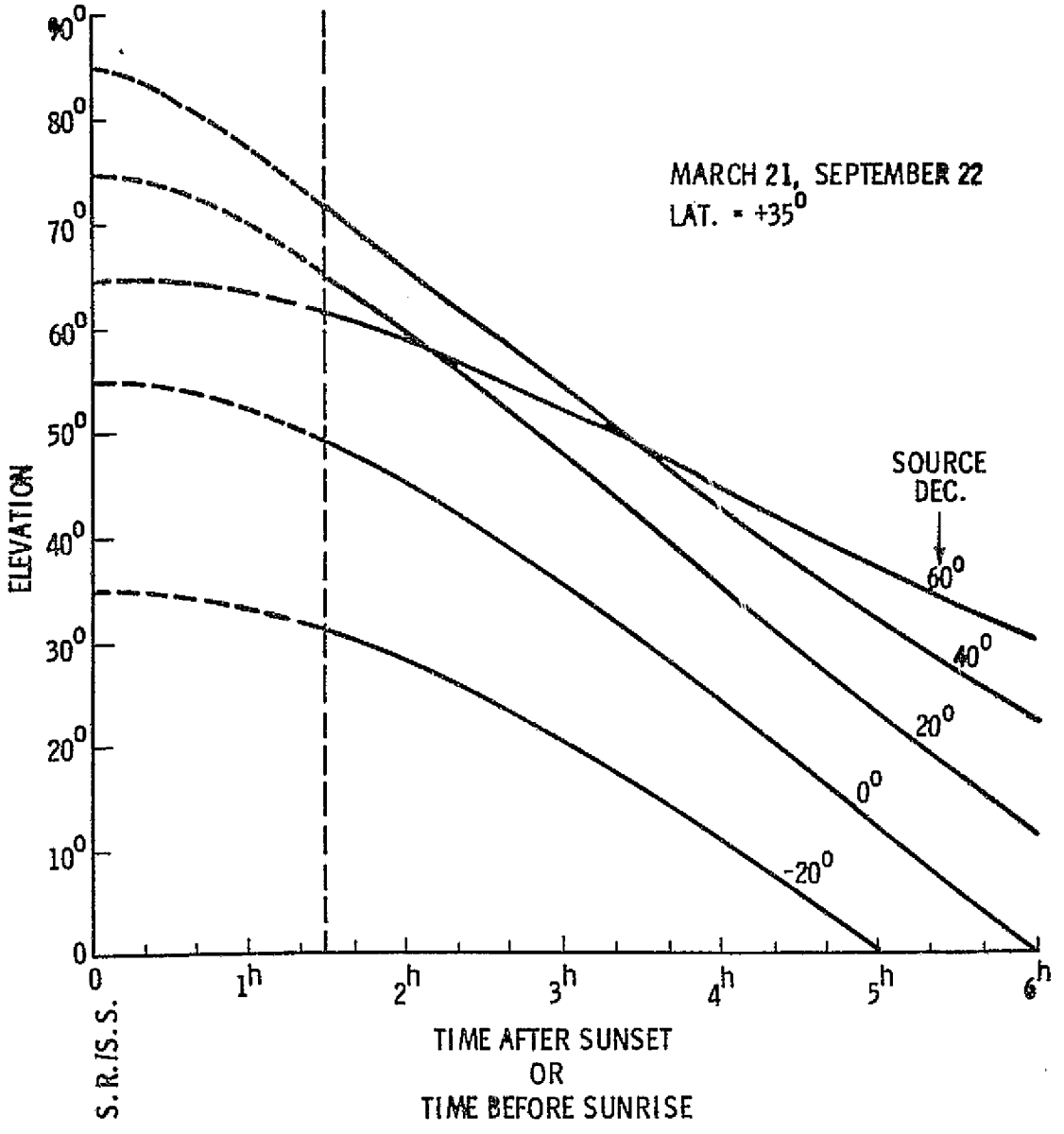


Figure 6. (Continued).

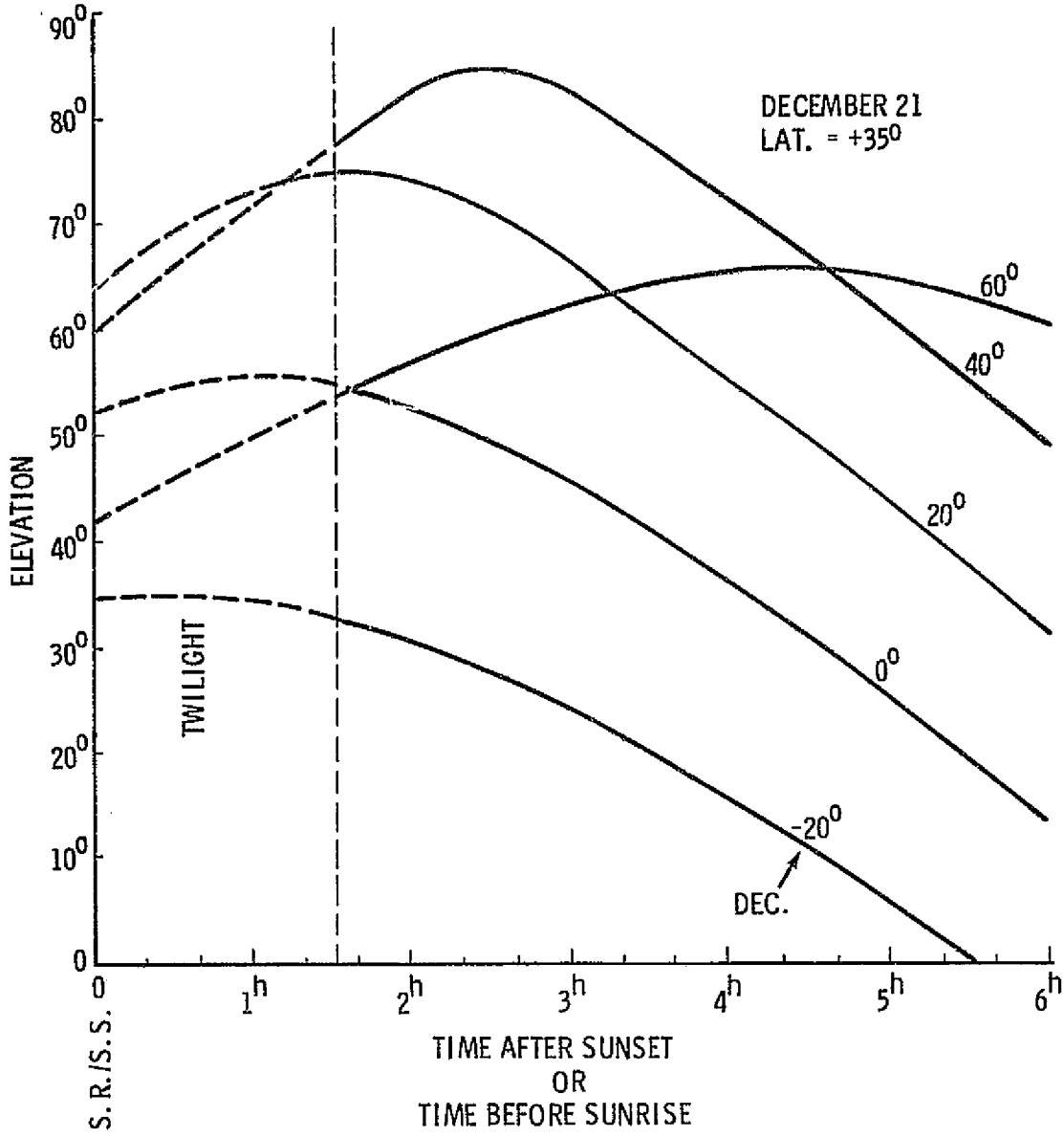


Figure 6. (Concluded).

APPROVAL

HEAO-A NOMINAL SCANNING OBSERVATION SCHEDULE

By G. J. Fishman and R. L. Stone

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

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