

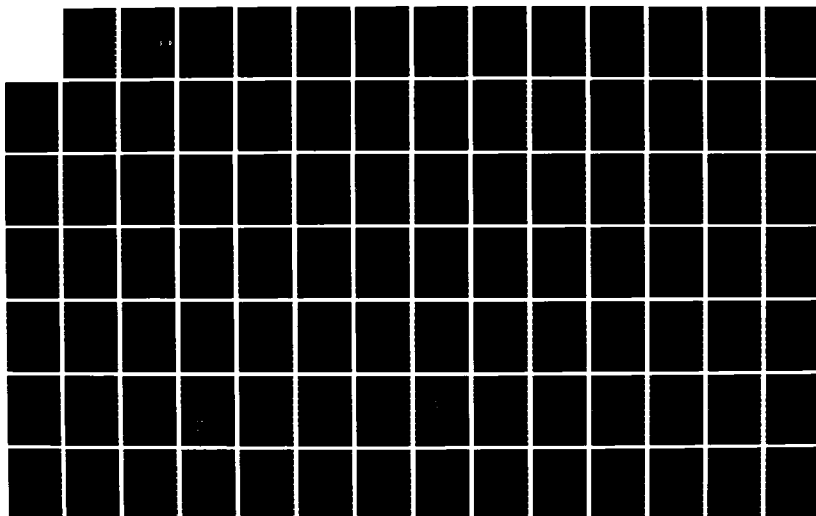
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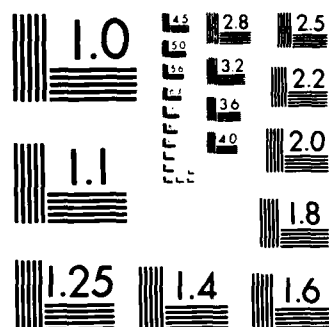
AIRCRAFT AUTOMATED ESCAPE SYSTEMS (AAES) DATA ANALYSIS 1/4
PROGRAM SYMPOSIUM H. (U) NAVAL SAFETY CENTER NORFOLK VA
1981

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VOL. IV

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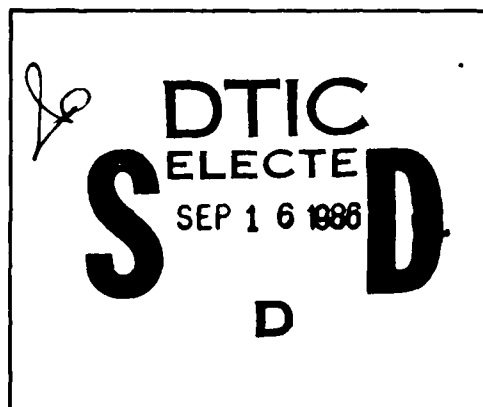
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**AIRCREW AUTOMATED ESCAPE SYSTEMS
(AAES)**

**DATA ANALYSIS PROGRAM
SYMPOSIUM**

VOL IV

(COPIES OF VISUAL PRESENTATION AIDS & ADDITIONAL INFORMATION)

Presented by:

**NAVAL AIR SYSTEMS COMMAND
NAVAL SAFETY CENTER
NAVAL WEAPONS ENGINEERING SUPPORT ACTIVITY**

**APPROVED FOR PUBLIC RELEASE:
DISTRIBUTION UNLIMITED**

**6,7,8 OCTOBER, 1981
NAVAL SAFETY CENTER
NORFOLK, VIRGINIA**

AIRCREW AUTOMATED ESCAPE SYSTEMS (AAES)

DATA ANALYSIS PROGRAM SYMPOSIUM

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NORFOLK, VIRGINIA**



DEPARTMENT OF THE NAVY
NAVAL SAFETY CENTER
NAVAL AIR STATION
NORFOLK, VIRGINIA 23511

IN REPLY REFER TO:

122:gc
3750
Ser 4223
4 September 1981

From: Commander, Naval Safety Center
To: Distribution

Subj: Automated Airborne Escape Systems (AAES) Symposium

Encl: (1) Agenda for subject symposium

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J. C. Steele
T. C. STEELE

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INSTITUTE OF AVIATION MEDICINE, RN
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AFPRO SEATTLE WA
AFPRO FT WORTH TX
AFPRO FARMINGDALE, NY
GENERALDYNAMICS
APPLIED COMBUSTION TECHNOLOGY
MANTECH INTERNATIONAL CORP

AGENDA DAY 1

0800-0850	Registration
0900-0915	Opening Remarks - Welcome
	RADM T. C. Steele
0915-0945	Introduction of Host Reps
	Area Orientation
0945-1000	Break
1000-1050	AAES Data System Program Introduction
1100-1150	Review of AAES Use and Non-use
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1330-1420	Through vs Jettison Canopy Injuries
1430-1520	Helmet Retention/Loss Factors

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1000-1150	In-Service System Reliability
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1330-1420	Overwater Survivability
1430-1520	Aircrew Size/Anthropometry
1530-1620	Expected Impact of AAES Data System Usage

AGENDA DAY 3

To be used as necessary based on progress
during days 1 and 2

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Objectives
Interface NAVSAFECEN/NAVAIR
Present Status - Future Plans
Constraints
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Results: Survivability
Trends in Usage Rates
Non-survived Ejection Cause Factors
Usage Conditions
AAES non-use trends
Success Criteria
3. Through-canopy vs Jettisoned-canopy Injuries NAVAIR/NAVSAFECEN
Vertebral
Upper-lower limbs
Head/neck
4. Helmet Retention/Loss Factors NAVAIR/NAVSAFECEN
Vertebral Injury
Varying levels of consciousness
Head/Neck Injury
5. Ejection Flail-tumbling Factors NAWESA/NAVAIR
As a function of airspeed
As a function of system design
As a function of Escape initiation method

6. In-service Reliability NAVWESA/NAVAIR

Ejections attempted but not accomplished

Other failure/malfunction modes

7. Ejection Survivability in Low Altitude Overwater Environment NAVSAFECEN/
NAVAIR

. Land vs Water Survival

. Overwater Fatalities

. Parachute/RSSK Divestment and LPA Inflation Variables

8. Aircrew Restraint Factors NAVSAFECEN/NAVAIR

. Negative "G" Environment

. Research on "G" Restraint Systems

9. Expected Impact of AAES Data System Program NAVAIR/NAVWESA

. Short Range

. Long Range

PROPOSED ATTENDEES

U. S. NAVY; Representation from:

OPNAV - 05F, 506N
CHNAVMAT
COMNAVAIRSYSCOM
NAVAIRDEVCON
NAWPNCEN CHINA LAKE
BUMED
MONTEREY
CNET
ONR
NAVAIRTESTCEN
NAVORDSTA
NAMRL PNCLA
NAMI PNCLA
NAVAL BIODYNAMICS LAB
NAVAIREWORKFACS (6)
TYCOM - Safety; Flight Surgeons; Physiologists
OPTEVFOR

USAF; Representation from:

NORTON AFB
WRIGHT PATTERSON AFB
BROOKS AFB
ANDREWS AFB
KELLEY AFB

ARMY; Representation from:

FORT RUCKER
ST LOUIS

NASA

LANGLEY AFB
MANNED SPACE CENTER

CONTRACTORS

PRIME AIRFRAME

Grumman; Boeing; Vought; Douglas; McDonnell; Republic; Fairchild-Miller; Lockheed; Convair; Martin-Baker LTD, U.K.

OTHERS

Teldyne Ryan; Stencel Aero Engineering Corp.; Pacific Scientific; Talley; Biotechnology; Humanoid Systems; Dayton T. Brown; East-West Industries; Explosive Technology; Space Ordnance Systems; Person-System Integration; Advanced Logistics Management Inc.; University of Cincinnati; Wayne State University; University of Southern California

FOREIGN GOVERNMENTS (having similar AAES)

CANADA

GREAT BRITAIN

FEDERAL REPUBLIC OF GERMANY

CLASSIFICATION

UNCLASSIFIED

05 NOV 1980 PAGE 1 OF 3

ADDRESSEE Director, Naval Weapons Engineering Support Activity Systems Analysis Dept. (ESA-31) Washington Navy Yard, Wash.D.C. 20374	AIRTASK NO A512-512C/184-4/1512-000-055 WORK UNIT NO A5312B-04 EFFORT LEVEL NORMAL CLASSIFICATION OF AT NO UNCLASSIFIED	AMEND NO AMEND NO
NAVAIR PROJECT ENGINEER Mr. Frederick C. Guill AV 222-7486	ICE AIR-531C	

1. The ~~XXXXXX~~ WORK UNIT ASSIGNMENT described below is assigned in accordance with the indicated effort level and schedule. Fund-
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plished as assigned, advise the NAVAIR HQ cognizant code. No work beyond the planning phase will be accomplished unless the addressee
has funds in hand or written assurance thereof.

2. Cancellation, References and/or Enclosures.

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under AIRTASK A512-512C/184/0512-000-055 amend. 1.

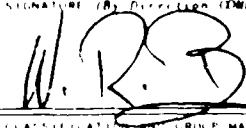
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Projects 10 October 1980
(2) Schedule

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the general lowering of AAES in-service reliability and cause the general worsening of
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c. Background. At present there exist special arrangements for investigating
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manifest themselves in fatalities, serious injuries and/or very great difficulties
experienced by the ejectee, which under slightly different conditions could have
caused serious injuries. Some problems also manifest themselves in increased

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DEPARTMENT OF THE NAVY
NAVAL SAFETY CENTER
NAVAL AIR STATION
NORFOLK, VIRGINIA 23511

IN REPLY REFER TO:

122:gc
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Ser 4223
4 September 1981

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T. C. STEELE

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 - . Long Range

PROJ SED ATTENDEES

U. S. NAVY; Representation from:

OPNAV - 05F, 506N
CHNAVMAT
COMNAVAIRSYSCOM
NAVAIRDEVCON
NAVPENCEN CHINA LAKE
BUMED
MONTEREY
ONET
ONR
NAVAIRTESTCEN
NAVORDSTA
NAMRL PNCLA
NAMI PNCLA
NAVAL BIODYNAMICS LAB
NAVAIREWORKFACS (6)
TYCOM - Safety; Flight Surgeons; Physiologists
OPTEVFOR

USAF; Representation from:

NORTON AFB
WRIGHT PATTERSON AFB
BROOKS AFB
ANDREWS AFB
KELLEY AFB

ARMY; Representation from:

FORT RUCKER
ST LOUIS

NASA

LANGLEY AFB
MANNED SPACE CENTER

CONTRACTORS

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Grumman; Boeing; Vought; Douglas; McDonnell; Republic; Fairchild-
Miller; Lockheed; Convair; Martin-Baker LTD, U.K.

OTHERS

Teldyne Ryan; Stencel Aero Engineering Corp.; Pacific Scientific;
Talley; Biotechnology; Humanoid Systems; Dayton T. Brown; East-West
Industries; Explosive Technology; Space Ordnance Systems; Person-
System Integration; Advanced Logistics Management Inc.; University of
Cincinnati; Wayne State University; University of Southern California

FOREIGN GOVERNMENTS (having similar AAES)

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FEDERAL REPUBLIC OF GERMANY

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05 NOV 1980 PAGE 1 OF 3

ADDRESSEE Director, Naval Weapons Engineering Support Activity Systems Analysis Dept. (ESA-31) Washington Navy Yard, Wash.D.C. 20374		AIRTASK NO. A512-512C/184-4/1512-000-055	AMEND NO.
NAVAIR PROJECT ENGINEER Mr. Frederick C. Guill AV 222-7486		WORK UNIT NO. A5312B-04	AMEND NO.
CODE AIR-531C		EFFORT LEVEL NORMAL	
		CLASSIFICATION OF AT/WU UNCLASSIFIED	

1. The ~~XXXXXX~~ WORK UNIT ASSIGNMENT described below is assigned in accordance with the indicated effort level and schedule. Fund-
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SIGNATURE (By Direction COMNAVAIR) <i>W. R. B. Burris</i>	DATE 11/5/80
CLASSIFICATION AND GROUP MARKING UNCLASSIFIED	

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W.U. A5312B-04
AIRTASK A512-512C/184-4/1512-000-055

maintenance efforts and costs and/or increased hazards to maintenance personnel. Since there at present is no systematic review of in-service AAES data, there is no valid method of identifying AAES in-service problems deserving management attention short of awaiting death, serious injury or major complaints. Thus NAVAIR is forced into a "squeaky wheel" reaction mode of operation versus the more desirable mode of allocating resources based on a continuous analysis of the total AAES in-service experience.

d. Detailed Requirements/Cost Estimates. \$90.0 K for FY-81 in support of applicable projects listed on enclosure (1) Priority List, to be obligated quarterly as follows: first quarter \$30.0 K, second quarter \$30.0 K, third quarter \$30.0 K. Program element - 78012N (O & MN).

Continue establishment of a system for the systematic review of such sources of AAES in-service data as 3-M Systems, Unsatisfactory Reports, Medical Officer Reports of Aircraft Accidents, and Naval Air Rework Facility data systems, in a manner designed to identify and assess the significance of the many commonly occurring in-service problems affecting AAES in-service reliability and maintainability. The system outputs shall be structured to provide data of assistance to NAVAIR Headquarters in the management of the scarce AAES resources; e.g., problems experienced, frequency of occurrence, experience severity, potential severity, and range of activities and/or AAES experiencing the problems. Once established and documented the system(s) can be integrated into regular reporting systems to assure regular, early notification to NAVAIR Headquarters concerning in-service problems being experienced and should assist considerably in the identification of causes and development of remedial actions. In addition, perform specific analytical tasks of high priority as assigned.

e. Detailed Program Plan. Not applicable.

f. Field Activity Contact. Mr. G. Opresko, NAVWESA (ESA-31).

g. Headquarters Technical Support. None.

4. Schedule. See Enclosure (2).

5. Reports and Documentation.

a. Reports.

(1) Upon completion of each task, present data and findings in letter-type reports to NAVAIR Headquarters (AIR-531).

(2) A semi-annual program review shall be held at NAVAIR in February and August with NAVAIR publishing a report of findings in March and September.

UNCLASSIFIED

W.U. A5312B-04
AIRTASK A512-512C/184-4/1512-000-055

(3) NAVWESA shall report to the Commander, Naval Air Systems Command (AIR-512C) the man years and associated cost, cost of materials, travel and cost of contracts awarded by NAVWESA for this project. This report shall be submitted 1 May 1981 and 1 November 1981 for final status.

b. Requirements for Future Planning Information. Prepare and submit to NAVAIRHQ (AIR-531) for approval, a letter-type project plan. The primary effort shall be for establishment of baseline data to aid in subsequent identification of trends and specific problems. Subsequent tasks shall be for extending previous analytical techniques and data sources investigating efforts to identify specific AAES in-service reliability and maintainability problems.

6. Contractual Authority. Contracts to perform all or portions of the Work Unit are hereby authorized within the funding indicated by the Work Unit cost estimate.

7. Source and Disposition of Equipment. Not applicable.

8. Aircraft Requirements. None.

9. Status of Applicable Funds. Funds for this Work Unit will be provided separately.

10. Security Classification. All prescribed work under this Work Unit is unclassified. In performing the prescribed work, access to information which is classified and/or to areas containing classified equipment may be required. Any reference to such classified material shall be in accordance with the applicable materials security classification. Particularly, reference to information concerning survivability/vulnerability shall be classified in accordance with OPNAVINST. C5513.2A, Encl. (63); OPNAVINST. S5513.8, Encl. (7).

Copy to:

Addressee (3)
NAVMATDATASYSGRU, Morgantown, W.Va. 26505
NAVAIRDEVCON (CSD), Warminster
NAVAIRTESTCON (SY-70), PAXRIV
NAVORDSTA (Code 5123), Indian Head
NAVORDSTA (Code 515), Indian Head
NAVWPNCEN, China Lake (Code 64)
NAVSAFECEN, Norfolk
COMNAVAIRPAC, North Island
CGFMFLANT
CGFMFPAC
NAVPLANTREPO, Bethpage
NAVPLANTREPO, Dallas
NAVPLANTREPO, Burbank
NAVPLANTREPO, Long Beach
AFPRO, St. Louis
DCASMA (DCRA-GACB), Marietta

UNCLASSIFIED

JAN 1969 - DEC 1979

[illegible]

JAN 1969 -- DEC 1979

[illegible]

TOTAL EJECTS 237
SURVIVORS 179
INJURED SURVIVORS 155

JAN 1969 - DEC 1979

-24-

TOTAL EJECTEES: 1321
FATALITIES: 201
RECOVERED: 137 LOST: 64

-25-

JANUARY 1969 - DECEMBER 1979

[illegible]

FATAL INJURY CITATIONS/U.S. NAVY/EJECTIONS ACCOMPLISHED CLEAR OF AIRCRAFT AND INADVERTENT
THROUGH-THE-CANOPY
(EXCLUDING AV-8A & TA-7)

JANUARY 1969 - DECEMBER 1979

FATALITIES 58

INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY DIAGNOSIS		INJURY 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DROWNINGS INJURY CITATIONS/U.S. NAVY EJECTIONS ACCOMPLISHED CLEAR OF AIRCRAFT & INADVERTENT
(EXCLUDING AV-8A & TA-7)

JAN 1969 - DEC 1979

DROWNINGS 18

INJURY DIAGNOSIS	BODY PART INJURED	INJURY DIAGNOSIS		TRANSECTION (47)	COMMINUTED FRACTURE (99)	COMPRESSION FRACTURE (12)	SIMPLE FRACTURE (12)	DISLOCATION (26)	STRAIN (26)	SPRAIN (26)	RUPTURE (26)	CONTUSION (14)	UNKNOWN/OTHER (99)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION (47)	COMMINUTED FRACTURE (99)	COMPRESSION FRACTURE (12)	SIMPLE FRACTURE (12)	DISLOCATION (26)	STRAIN (26)	SPRAIN (26)	RUPTURE (26)	CONTUSION (14)	UNKNOWN/OTHER (99)
		HEAD/NECK	TRUNK																						
SKULL (81)																									
FACE (82)																									
EYE (83)																									
NOSE (84)																									
NECK (85)																									
ARM																									
UPPER ARM (14)																									
LOWER ARM (15)																									
ELBOW (22)																									
Wrist (16)																									
Wrist (17)																									
LEG																									
UPPER LEG (18)																									
LOWER LEG (19)																									
ANKLE (23)																									
FOOT (13)																									
TRUNK																									
SHOULDER (60)																									
THORAX (61)																									
ABDOMEN (62)																									
PELVIS (63)																									
GENITAL (64)																									
BACK (18)																									
BUTTOCKS (65)																									
INTERNAL ORGANS																									
THORAX (66)																									
OTHER (18)																									
MULTI BODY PARTS (67)																									
TOTAL BODY (68)																									

JANUARY 1969 - DECEMBER 1979

[illegible]

JANUARY 1969 - DECEMBER 1979

-30-

JAN 1969 -- DEC 1979

[illegible]

[CODES: 1 & 5]

JAN 1969 ~ DEC 1979

TOTAL EJECTS: 160
FATALITIES: 19

[illegible]

ICODES: 1 & 5)

JAN 1969 - DEC 1979

TOTAL EJECTES: 124
SURVIVORS: 110
INJURED SURVIVORS: 9

[illegible]

(CODES: 1 & 5)

JAN 1969 -- DEC 1979

RECOVERED: 10 LOST: 4

-34-

JAN 69 - DEC 79

-35-

IG-2 FATALITY INJURY CITATIONS/U.S. NAVY/EJECTIONS ACCOMPLISHED CLEAR

(CODES: 1 & 5)

JAN 69 - DEC 79

TOTAL EJECTEES: 41
FATALITIES: 19
LOST: 3 RECOVERED: 7

INJURY DIAGNOSIS	AMPUTATION		AVIATION	DECLATIFICATION	EVICTION	TRANSECTION	EXHAUSTION	COMMINUTED	COMPOUND	FRACTURE (110)	COMMINUTED	FRACTURE (121)	SIMPLE FRACTURE	CRUSHING	DERANGEMENT	DISLOCATION	TEAR MUSCLE/ LIGAMENT (140)	STRAIN	SPRAIN	CONCUSSION	UNCONSCIOUSNESS	COLD INJURY	SUBMERSION	NON-FATAL (124)	FIRE/EXPLOSION	TRAUMATIC	SHOCK (101)	INTERNAL	RUPTURE	HEMORRHAGE	EMBOLISM	BURNS (49)	INFARCT	THERMAL BURN	FOREIGN BODY	LACERATION	PERFORATION	SCALD	BITE	ACUSTIC	TRAUMA (102)	CONTUSION	EDEMA	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	SYSTEMIC	MULTIPLE	EXTREME (105)	CODE NOT IN EFFECT	MANUAL (78)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION	COMMINUTED	COMPRESSION	SIMPLE	DISLOCATION	STRAIN	SPRAIN	MURDER	CONCUSSION	UNKNOWN/OTHER	TOTAL BODY (68)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION

(CODES: 1 & 5)

JAN 1969 - DEC 1979

TOTAL EJECTEES 43
SURVIVORS 40
INJURED SURVIVORS 30

INJURY DIAGNOSIS		INJURED SURVIVORS 30		INJURY DIAGNOSIS		INJURED SURVIVORS 30	
INJURY	DIAGNOSIS	INJURY	DIAGNOSIS	INJURY	DIAGNOSIS	INJURY	DIAGNOSIS
HEAD/NECK	SKULL (01)	1	1	1	1	1	1
	FACE (02)						
	NOSE (03)						
	NECK (04)						
ARMS	UPPER ARM (14)						
	LOWER ARM (15)						
	Wrist (16)						
	HAND (17)						
LEGS	UPPER LEG (10)						
	LOWER LEG (11)						
	ANKLE (12)						
	FOOT (13)						
TRUNK	SHOULDER (05)						
	THORAX (06)						
	ABDOMEN (07)						
	PELVIS (08)						
	GRUIN (23)						
	BACK (18)						
	BUTTOCKS (09)						
INTERNAL ORGANS	HEART (04)						
	LUNGS (25)						
	OTHER (19)						
MULT BODY PARTS (20)							
TOTAL BODY (00)							

(CODES: 1 & 5)

JAN 1969 - DEC 1979

TOTAL EJECTEES: 43
FATALITIES: 3
LOST: 1 RECOVERED: 2

- 38 -

TOTAL EJECTEES: .
SURVIVORS: 1
INJURED SURVIVORS: 1

[illegible]

JAN 1969 - DEC 1979

TOTAL KILLED: 88
SURVIVORS: 83
INJURED SURVIVORS: 43

[illegible]

JAN 1969 - DEC 1979

TOTAL EJECTEES: 88
FATALITIES: 5
RECOVERED: 3 LOST: 2

[illegible]

(CODES: 1 & 5)

JAN 1969 - DEC 1979)

TOTAL EJECTEES: 30
SURVIVORS: 26
INJURED SURVIVORS: 23

-42-

TOTAL EJECTEES: 38
FATALITIES: 12
RECOVERED: 7 LOST: 5

[illegible]

JAN 1969 -- DEC 1979

-44-

[illegible]

JAN 1969 - DEC 1979

-45-

(CODES: 1 & 5)

JAN 1969 - DEC 1979

TOTAL EJECTEES: 67
SURVIVORS: 54
INJURED SURVIVORS: 38

[illegible]

TOTAL EJECTEES: 67
FATALITIES: 11
RECOVERED: 9 LOS

INJURY DIAGNOSIS	INJURY DIAGNOSIS		INJURY DIAGNOSIS
	BODY PART INJURED	TRANSACTION	
HEAD/NECK	SKULL (01)	AMPUTATION (03)	VERTEBRAL C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100 C101 C102 C103 C104 C105 C106 C107 C108 C109 C110 C111 C112 C113 C114 C115 C116 C117 C118 C119 C120 C121 C122 C123 C124 C125 C126 C127 C128 C129 C130 C131 C132 C133 C134 C135 C136 C137 C138 C139 C140 C141 C142 C143 C144 C145 C146 C147 C148 C149 C150 C151 C152 C153 C154 C155 C156 C157 C158 C159 C160 C161 C162 C163 C164 C165 C166 C167 C168 C169 C170 C171 C172 C173 C174 C175 C176 C177 C178 C179 C180 C181 C182 C183 C184 C185 C186 C187 C188 C189 C190 C191 C192 C193 C194 C195 C196 C197 C198 C199 C200 C201 C202 C203 C204 C205 C206 C207 C208 C209 C210 C211 C212 C213 C214 C215 C216 C217 C218 C219 C220 C221 C222 C223 C224 C225 C226 C227 C228 C229 C230 C231 C232 C233 C234 C235 C236 C237 C238 C239 C240 C241 C242 C243 C244 C245 C246 C247 C248 C249 C250 C251 C252 C253 C254 C255 C256 C257 C258 C259 C260 C261 C262 C263 C264 C265 C266 C267 C268 C269 C270 C271 C272 C273 C274 C275 C276 C277 C278 C279 C280 C281 C282 C283 C284 C285 C286 C287 C288 C289 C290 C291 C292 C293 C294 C295 C296 C297 C298 C299 C300 C301 C302 C303 C304 C305 C306 C307 C308 C309 C310 C311 C312 C313 C314 C315 C316 C317 C318 C319 C320 C321 C322 C323 C324 C325 C326 C327 C328 C329 C330 C331 C332 C333 C334 C335 C336 C337 C338 C339 C340 C341 C342 C343 C344 C345 C346 C347 C348 C349 C350 C351 C352 C353 C354 C355 C356 C357 C358 C359 C360 C361 C362 C363 C364 C365 C366 C367 C368 C369 C370 C371 C372 C373 C374 C375 C376 C377 C378 C379 C380 C381 C382 C383 C384 C385 C386 C387 C388 C389 C390 C391 C392 C393 C394 C395 C396 C397 C398 C399 C400 C401 C402 C403 C404 C405 C406 C407 C408 C409 C410 C411 C412 C413 C414 C415 C416 C417 C418 C419 C420 C421 C422 C423 C424 C425 C426 C427 C428 C429 C430 C431 C432 C433 C434 C435 C436 C437 C438 C439 C440 C441 C442 C443 C444 C445 C446 C447 C448 C449 C450 C451 C452 C453 C454 C455 C456 C457 C458 C459 C460 C461 C462 C463 C464 C465 C466 C467 C468 C469 C470 C471 C472 C473 C474 C475 C476 C477 C478 C479 C480 C481 C482 C483 C484 C485 C486 C487 C488 C489 C490 C491 C492 C493 C494 C495 C496 C497 C498 C499 C500 C501 C502 C503 C504 C505 C506 C507 C508 C509 C510 C511 C512 C513 C514 C515 C516 C517 C518 C519 C520 C521 C522 C523 C524 C525 C526 C527 C528 C529 C530 C531 C532 C533 C534 C535 C536 C537 C538 C539 C540 C541 C542 C543 C544 C545 C546 C547 C548 C549 C550 C551 C552 C553 C554 C555 C556 C557 C558 C559 C560 C561 C562 C563 C564 C565 C566 C567 C568 C569 C570 C571 C572 C573 C574 C575 C576 C577 C578 C579 C580 C581 C582 C583 C584 C585 C586 C587 C588 C589 C590 C591 C592 C593 C594 C595 C596 C597 C598 C599 C600 C601 C602 C603 C604 C605 C606 C607 C608 C609 C610 C611 C612 C613 C614 C615 C616 C617 C618 C619 C620 C621 C622 C623 C624 C625 C626 C627 C628 C629 C630 C631 C632 C633 C634 C635 C636 C637 C638 C639 C640 C641 C642 C643 C644 C645 C646 C647 C648 C649 C650 C651 C652 C653 C654 C655 C656 C657 C658 C659 C660 C661 C662 C663 C664 C665 C666 C667 C668 C669 C670 C671 C672 C673 C674 C675 C676 C677 C678 C679 C680 C681 C682 C683 C684 C685 C686 C687 C688 C689 C690 C691 C692 C693 C694 C695 C696 C697 C698 C699 C700 C701 C702 C703 C704 C705 C706 C707 C708 C709 C710 C711 C712 C713 C714 C715 C716 C717 C718 C719 C720 C721 C722 C723 C724 C725 C726 C727 C728 C729 C730 C731 C732 C733 C734 C735 C736 C737 C738 C739 C740 C741 C742 C743 C744 C745 C746 C747 C748 C749 C750 C751 C752 C753 C754 C755 C756 C757 C758 C759 C760 C761 C762 C763 C764 C765 C766 C767 C768 C769 C770 C771 C772 C773 C774 C775 C776 C777 C778 C779 C780 C781 C782 C783 C784 C785 C786 C787 C788 C789 C790 C791 C792 C793 C794 C795 C796 C797 C798 C799 C800 C801 C802 C803 C804 C805 C806 C807 C808 C809 C810 C811 C812 C813 C814 C815 C816 C817 C818 C819 C820 C821 C822 C823 C824 C825 C826 C827 C828 C829 C830 C831 C832 C833 C834 C835 C836 C837 C838 C839 C840 C841 C842 C843 C844 C845 C846 C847 C848 C849 C850 C851 C852 C853 C854 C855 C856 C857 C858 C859 C860 C861 C862 C863 C864 C865 C866 C867 C868 C869 C870 C871 C872 C873 C874 C875 C876 C877 C878 C879 C880 C881 C882 C883 C884 C885 C886 C887 C888 C889 C890 C891 C892 C893 C894 C895 C896 C897 C898 C899 C900 C901 C902 C903 C904 C905 C906 C907 C908 C909 C910 C911 C912 C913 C914 C915 C916 C917 C918 C919 C920 C921 C922 C923 C924 C925 C926 C927 C928 C929 C930 C931 C932 C933 C934 C935 C936 C937 C938 C939 C940 C941 C942 C943 C944 C945 C946 C947 C948 C949 C950 C951 C952 C953 C954 C955 C956 C957 C958 C959 C960 C961 C962 C963 C964 C965 C966 C967 C968 C969 C970 C971 C972 C973 C974 C975 C976 C977 C978 C979 C980 C981 C982 C983 C984 C985 C986 C987 C988 C989 C990 C991 C992 C993 C994 C995 C996 C997 C998 C999 C1000 C1001 C1002 C1003 C1004 C1005 C1006 C1007 C1008 C1009 C1010 C1011 C1012 C1013 C1014 C1015 C1016 C1017 C1018 C1019 C1020 C1021 C1022 C1023 C1024 C1025 C1026 C1027 C1028 C1029 C1030 C1031 C1032 C1033 C1034 C1035 C1036 C1037 C1038 C1039 C1040 C1041 C1042 C1043 C1044 C1045 C1046 C1047 C1048 C1049 C1050 C1051 C1052 C1053 C1054 C1055 C1056 C1057 C1058 C1059 C1060 C1061 C1062 C1063 C1064 C1065 C1066 C1067 C1068 C1069 C1070 C1071 C1072 C1073 C1074 C1075 C1076 C1077 C1078 C1079 C1080 C1081 C1082 C1083 C1084 C1085 C1086 C1087 C1088 C1089 C1090 C1091 C1092 C1093 C1094 C1095 C1096 C1097 C1098 C1099 C1100 C1101 C1102 C1103 C1104 C1105 C1106 C1107 C1108 C1109 C1110 C1111 C1112 C1113 C1114 C1115 C1116 C1117 C1118 C1119 C1120 C1121 C1122 C1123 C1124 C1125 C1126 C1127 C1128 C1129 C1130 C1131 C1132 C1133 C1134 C1135 C1136 C1137 C1138 C1139 C1140 C1141 C1142 C1143 C1144 C1145 C1146 C1147 C1148 C1149 C1150 C1151 C1152 C1153 C1154 C1155 C1156 C1157 C1158 C1159 C1160 C1161 C1162 C1163 C1164 C1165 C1166 C1167 C1168 C1169 C1170 C1171 C1172 C1173 C1174 C1175 C1176 C1177 C1178 C1179 C1180 C1181 C1182 C1183 C1184 C1185 C1186 C1187 C1188 C1189 C1190 C1191 C1192 C1193 C1194 C1195 C1196 C1197 C1198 C1199 C1200 C1201 C1202 C1203 C1204 C1205 C1206 C1207 C1208 C1209 C1210 C1211 C1212 C1213 C1214 C1215 C1216 C1217 C1218 C1219 C1220 C1221 C1222 C1223 C1224 C1225 C1226 C1227 C1228 C1229 C1230 C1231 C1232 C1233 C1234 C1235 C1236 C1237 C1238 C1239 C1240 C1241 C1242 C1243 C1244 C1245 C1246 C1247 C1248 C1249 C1250 C1251 C1252 C1253 C1254 C1255 C1256 C1257 C1258 C1259 C1260 C1261 C1262 C1263 C1264 C1265 C1266 C1267 C1268 C1269 C1270 C1271 C1272 C1273 C1274 C1275 C1276 C1277 C1278 C1279 C1280 C1281 C1282 C1283 C1284 C1285 C1286 C1287 C1288 C1289 C1290 C1291 C1292 C1293 C1294 C1295 C1296 C1297 C1298 C1299 C1300 C1301 C1302 C1303 C1304 C1305 C1306 C1307 C1308 C1309 C1310 C1311 C1312 C1313 C1314 C1315 C1316 C1317 C1318 C1319 C1320 C1321 C1322 C1323 C1324 C1325 C1326 C1327 C1328 C1329 C1330 C1331 C1332 C1333 C1334 C1335 C1336 C1337 C1338 C1339 C1340 C1341 C1342 C1343 C1344 C1345 C1346 C1347 C1348 C1349 C1350 C1351 C1352 C1353 C1354 C1355 C1356 C1357 C1358 C1359 C1360 C1361 C1362 C1363 C1364 C1365 C1366 C1367 C1368 C1369 C1370 C1371 C1372 C1373 C1374 C1375 C1376 C1377 C1378 C1379 C1380 C1381 C1382 C1383 C1384 C1385 C1386 C1387 C1388 C1389 C1390 C1391 C1392 C1393 C1394 C1395 C1396 C1397 C1398 C1399 C1400 C1401 C1402 C1403 C1404 C1405 C1406 C1407 C1408 C1409 C1410 C1411 C1412 C1413 C1414 C1415 C1416 C1417 C1418 C1419 C1420 C1421 C1422 C1423 C1424 C1425 C1426 C1427 C1428 C1429 C1430 C1431 C1432 C1433 C1434 C1435 C1436 C1437 C1438 C1439 C1440 C1441 C1442 C1443 C1444 C1445 C1446 C1447 C1448 C1449 C1450 C1451 C1452 C1453 C1454 C1455 C1456 C1457 C1458 C1459 C1460 C1461 C1462 C1463 C1464 C1465 C1466 C1467 C1468 C1469 C1470 C1471 C1472 C1473 C1474 C1475 C1476 C1477 C1478 C1479 C1480 C1481 C1482 C1483 C1484 C1485 C1486 C1487 C1488 C1489 C1490 C1491 C1492 C1493 C1494 C1495 C1496 C1497 C1498 C1499 C1500 C1501 C1502 C1503 C1504 C1505 C1506 C1507 C1508 C1509 C1510 C1511 C1512 C1513 C1514 C1515 C1516 C1517 C1518 C1519 C1520 C1521 C1522 C1523 C1524 C1525 C1526 C1527 C1528 C1529 C1530 C1531 C1532 C1533 C1534 C1535 C1536 C1537 C1538 C1539 C1540 C1541 C1542 C1543 C1544 C1545 C1546 C1547 C1548 C1549 C1550 C1551 C1552 C1553 C1554 C1555 C1556 C1557 C1558 C1559 C1560 C1561 C1562 C1563 C1564 C1565 C1566 C1567 C1568 C1569 C1570 C1571 C1572 C1573 C1574 C1575 C1576 C1577 C1578 C1579 C1580 C1581 C1582 C1583 C1584 C1585 C1586 C1587 C1588 C1589 C1590 C1591 C1592 C1593 C1594 C1595 C1596 C1597 C1598 C1599 C1600 C1601 C1602 C1603 C1604 C1605 C1606 C1607 C1608 C1609 C1610 C1611 C1612 C1613 C1614 C1615 C1616 C1617 C1618 C1619 C1620 C1621 C1622 C1623 C1624 C1625 C1626 C1627 C1628 C1629 C1630 C1631 C1632 C1633 C1634 C1635 C1636 C1637 C1638 C1639 C1640 C1641 C1642 C1643 C1644 C1645 C1646 C1647 C1648 C1649 C1650 C1651 C1652 C1653 C1654 C1655 C1656 C1657 C1658 C1659 C1660 C1661 C1662 C1663 C1664 C1665 C1666 C1667 C1668 C1669 C1670 C1671 C1672 C1673 C1674 C1675 C1676 C1677 C1678 C1679 C1680 C1681 C1682 C1683 C1684 C1685 C1686 C1687 C1688 C1689 C1690 C1691 C1692 C1693 C1694 C1695 C1696 C1697 C1698 C1699 C1700 C1701 C1702 C1703 C1704 C1705 C1706 C1707 C1708 C1709 C1710 C1711 C1712 C1713 C1714 C1715 C1716 C1717 C1718 C1719 C1720 C1721 C1722 C1723 C1724 C1725 C1726 C1727 C1728 C1729 C1730 C1731 C1732 C1733 C1734 C1735 C1736 C1737 C1738 C1739 C1740 C1741 C1742 C1743 C1744 C1745 C1746 C1747 C1748 C1749 C1750 C1751 C1752 C1753 C1754 C1755 C1756 C1757 C1758 C1759 C1760 C1761 C1762 C1763 C1764 C1765 C1766 C1767 C1768 C1769 C1770 C1771 C1772 C1773 C1774 C1775 C1776 C1777 C1778 C1779 C1780 C1781 C1782 C1783 C1784 C1785 C1786 C1787 C1788 C1789 C1790 C1791 C1792 C1793 C1794 C1795 C1796 C1797 C1798 C1799 C1800 C1801 C1802 C1803 C1804 C1805 C1806 C1807 C1808 C1809 C1810 C1811 C1812 C1813 C1814 C1815 C1816 C1817 C1818 C1819 C1820 C1821 C1822 C1823 C1824 C1825 C1826 C1827 C1828 C1829 C1830 C1831 C1832 C1833 C1834 C1835 C1836 C1837 C1838 C1839 C1840 C1841 C1842 C1843 C1844 C1845 C1846 C1847 C1848 C1849 C1850 C1851 C1852 C1853 C1854 C1855 C1856 C1857 C1858 C1859 C1860 C1861 C1862 C1863 C1864 C1865 C1866 C1867 C1868 C1869 C1870 C1871 C1872 C1873 C1874 C1875 C1876 C1877 C1878 C1879 C1880 C1881 C1882 C1883 C1884 C1885 C1886 C1887 C1888 C1889 C1890 C1891 C1892 C1893 C1894 C1895 C1896 C1897 C1898 C1899 C1900 C1901 C1902 C1903 C1904 C1905 C1906 C1907 C1908 C1

(CODES: 1 & 5)

JAN 1969 - DEC 1979

TOTAL EJECTEES: 348

SURVIVORS: 798

INJURED SURVIVORS: 107

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(CODES: 1 & 5)

JAN 1969 - DEC 1979

TOTAL EJECTEES: 349

FATALITIES: 52

FATALITIES: 02
 RECOVERED: 20 LOST: 23

[illegible]

TOTAL EJECTEES: 7
SURVIVORS: 7
INJURED SURVIVORS: 0

[illegible]

JANUARY 1969 - DECEMBER 1979

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(18 & 5 LESS TA-7 & AV-8)

JANUARY 1969 - DECEMBER 1979

FATALITIES 11

TOTAL BODY (00)

JANUARY 1969 – DECEMBER 1979

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JANUARY 1969 - DECEMBER 1979

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JANUARY 1969 - DECEMBER 1979

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JANUARY 1969 - DECEMBER 1979

INJURY DIAGNOSIS	AMPUTATION		DECAYATION	EVERTATION	EXANGUINATION	COMPOUND FRACTURE (108)	COMPOUND FRACTURE (109)	COMPOUND COMMINUTED FRACTURE (110)	COMMINUTED FRACTURE (111)	COMPRESSION FRACTURE (112)	SIMPLE FRACTURE (113)	CRUSHING FRACTURE (114)	DISLOCATION	TEAR MUSCLE/ LIGAMENT (115)	STRAIN	SPRAIN	CONCUSSION	UNCONSCIOUSNESS	COLD INJURY	SUBMERSION	(NON-FATAL) (116)	PNEUMO/HYMO THORAX (117)	TRAUMATIC SHOCK (118)	INTERNAL INJURY (119)	RUPTURE	HEMORRHAGE	EMBOLISM	BURNS (120)	INFARCT	THERMAL BURN	FOREIGN BODY IN ORIFICE (121)	LACERATION	PERFORATION	SCALD	BITE	ACUSTIC TRAUMA (122)	CONUSION	EDEMA	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (123)	EXTREMITY (124)	CODE NOT IN SAFECEN	MANUAL (125)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (126)	COMPRESSION FRACTURE (127)	SIMPLE FRACTURE (128)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (129)	EXTREMITY (130)	CODE NOT IN SAFECEN	MANUAL (131)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (132)	COMPRESSION FRACTURE (133)	SIMPLE FRACTURE (134)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (135)	EXTREMITY (136)	CODE NOT IN SAFECEN	MANUAL (137)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (138)	COMPRESSION FRACTURE (139)	SIMPLE FRACTURE (140)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (141)	EXTREMITY (142)	CODE NOT IN SAFECEN	MANUAL (143)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (144)	COMPRESSION FRACTURE (145)	SIMPLE FRACTURE (146)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (147)	EXTREMITY (148)	CODE NOT IN SAFECEN	MANUAL (149)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (150)	COMPRESSION FRACTURE (151)	SIMPLE FRACTURE (152)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (153)	EXTREMITY (154)	CODE NOT IN SAFECEN	MANUAL (155)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (156)	COMPRESSION FRACTURE (157)	SIMPLE FRACTURE (158)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (159)	EXTREMITY (160)	CODE NOT IN SAFECEN	MANUAL (161)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (162)	COMPRESSION FRACTURE (163)	SIMPLE FRACTURE (164)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (165)	EXTREMITY (166)	CODE NOT IN SAFECEN	MANUAL (167)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (168)	COMPRESSION FRACTURE (169)	SIMPLE FRACTURE (170)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (171)	EXTREMITY (172)	CODE NOT IN SAFECEN	MANUAL (173)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (174)	COMPRESSION FRACTURE (175)	SIMPLE FRACTURE (176)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (177)	EXTREMITY (178)	CODE NOT IN SAFECEN	MANUAL (179)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (180)	COMPRESSION FRACTURE (181)	SIMPLE FRACTURE (182)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (183)	EXTREMITY (184)	CODE NOT IN SAFECEN	MANUAL (185)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (186)	COMPRESSION FRACTURE (187)	SIMPLE FRACTURE (188)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE	ABRASION	DROWNING	UNKNOWN/OTHER	POISONING	MULTIPLE SYSTEMIC (189)	EXTREMITY (190)	CODE NOT IN SAFECEN	MANUAL (191)	INJURY DIAGNOSIS		TRANSECTION	COMMINUTED FRACTURE (192)	COMPRESSION FRACTURE (193)	SIMPLE FRACTURE (194)	DISLOCATION	STRAIN	SPRAIN	RUPTURE	CONCUSSION	HEMATOMA	HEMORRHAGE

JANUARY 1969 - DECEMBER 1979

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JANUARY 1969 - DECEMBER 1979

FATALITIES OVER WATER 9

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JANUARY 1969 - DECEMBER 1979

[illegible]

NON-MULTIPLE EXTREME, NON-GROUND-IMPACT FATAL INJURY CITATIONS/U.S. NAVY/
EJECTIONS ACCOMPLISHED CLEAR OF AIRCRAFT AND INADVERTENT
THROUGH-THE-CANOPY
(1 & 5 LESS TA.7 AND AV.8)

JANUARY 1969 - DECEMBER 1979

FATALITIES 18

INJURY DIAGNOSIS	BODY PART INJURED	AMPUTATION (03)	AVULSION (04)	DECAVITYATION (18)	EVICTION (19)	TRANSECTION (47)	EXAMINATION (43)	COMMINUTED FRACTURE (10)	COMPOUND FRACTURE (08)	COMPOUND FRACTURE (11)	COMPRESSION FRACTURE (12)	SIMPLE FRACTURE (26)	CRUSHING (15)	DENAGEMENT (40)	DELOCATION (40)	TEAR MUSCLE (40)	STRAIN (26)	SPRAIN (26)	CONCUSSION (13)	UNCONSCIOUSNESS (41)	COLD INJURY (17)	SUBMERSION (17)	(NON FATAL) (26)	PNEUMO/HEMO THORAX (76)	TRAMATIC SHOCK (80)	INTERNAL INJURY (84)	HEMORRHAGE (23)	EMBOISM/ BENDS (49)	INFECT (80)	THERMAL BURN (53)	FOREIGN BODY IN ORIFICE (20)	LACERATION (30)	PERFORATION (32)	SCALD (24)	BITE (05)	ACUSTIC TRAUMA (02)	CONTUSION (14)	EDOMA (48)	HEMATOMA (28)	HEMORRHAGE (28)	ABRASSION (01)	DROWNING (55)	UNKNOWN/OTHER (55)	POISONING SYSTEMIC (05)	MULTIPLE EXTREME (08)	CODE NOT IN SAFECEN MANUAL (78)	INJURY DIAGNOSIS	BODY PART INJURED	TRANSECTION (47)	COMMINUTED FRACTURE (09)	COMPRESSION FRACTURE (12)	SIMPLE FRACTURE (26)	DISLOCATION (46)	STRAIN (26)	SPRAIN (26)	LIGAMENT (40)	TEAR MUSCLE (40)	DEFORMATION (15)	CRUSHING (26)	FRACTURE (11)	COMPOUND FRACTURE (10)	COMPOUND FRACTURE (08)	FRACTURE (10)	FRACTURE (11)	FRACTURE (12)	FRACTURE (13)	FRACTURE (14)	FRACTURE (15)	FRACTURE (16)	FRACTURE (17)	FRACTURE (18)	FRACTURE (19)	FRACTURE (20)	FRACTURE (21)	FRACTURE (22)	FRACTURE (23)	FRACTURE (24)	FRACTURE (25)	FRACTURE (26)	FRACTURE (27)	FRACTURE (28)	FRACTURE (29)	FRACTURE (30)	FRACTURE (31)	FRACTURE (32)	FRACTURE (33)	FRACTURE (34)	FRACTURE (35)	FRACTURE (36)	FRACTURE (37)	FRACTURE (38)	FRACTURE (39)	FRACTURE (40)	FRACTURE (41)	FRACTURE (42)	FRACTURE (43)	FRACTURE (44)	FRACTURE (45)	FRACTURE (46)	FRACTURE (47)	FRACTURE (48)	FRACTURE (49)	FRACTURE (50)	FRACTURE (51)	FRACTURE (52)	FRACTURE (53)	FRACTURE (54)	FRACTURE (55)	FRACTURE (56)	FRACTURE (57)	FRACTURE (58)	FRACTURE (59)	FRACTURE (60)	FRACTURE (61)	FRACTURE (62)	FRACTURE (63)	FRACTURE (64)	FRACTURE (65)	FRACTURE (66)	FRACTURE (67)	FRACTURE (68)	FRACTURE (69)	FRACTURE (70)	FRACTURE (71)	FRACTURE (72)	FRACTURE (73)	FRACTURE (74)	FRACTURE (75)	FRACTURE (76)	FRACTURE (77)	FRACTURE (78)	FRACTURE (79)	FRACTURE (80)	FRACTURE (81)	FRACTURE (82)	FRACTURE (83)	FRACTURE (84)	FRACTURE (85)	FRACTURE (86)	FRACTURE (87)	FRACTURE (88)	FRACTURE (89)	FRACTURE (90)	FRACTURE (91)	FRACTURE (92)	FRACTURE (93)	FRACTURE (94)	FRACTURE (95)	FRACTURE (96)	FRACTURE (97)	FRACTURE (98)	FRACTURE (99)	FRACTURE (100)	FRACTURE (101)	FRACTURE (102)	FRACTURE (103)	FRACTURE (104)	FRACTURE (105)	FRACTURE (106)	FRACTURE (107)	FRACTURE (108)	FRACTURE (109)	FRACTURE (110)	FRACTURE (111)	FRACTURE (112)	FRACTURE (113)	FRACTURE (114)	FRACTURE (115)	FRACTURE (116)	FRACTURE (117)	FRACTURE (118)	FRACTURE (119)	FRACTURE (120)	FRACTURE (121)	FRACTURE (122)	FRACTURE (123)	FRACTURE (124)	FRACTURE (125)	FRACTURE (126)	FRACTURE (127)	FRACTURE (128)	FRACTURE (129)	FRACTURE (130)	FRACTURE (131)	FRACTURE (132)	FRACTURE (133)	FRACTURE (134)	FRACTURE (135)	FRACTURE (136)	FRACTURE (137)	FRACTURE (138)	FRACTURE (139)	FRACTURE (140)	FRACTURE (141)	FRACTURE (142)	FRACTURE (143)	FRACTURE (144)	FRACTURE (145)	FRACTURE (146)	FRACTURE (147)	FRACTURE (148)	FRACTURE (149)	FRACTURE (150)	FRACTURE (151)	FRACTURE (152)	FRACTURE (153)	FRACTURE (154)	FRACTURE (155)	FRACTURE (156)	FRACTURE (157)	FRACTURE (158)	FRACTURE (159)	FRACTURE (160)	FRACTURE (161)	FRACTURE (162)	FRACTURE (163)	FRACTURE (164)	FRACTURE (165)	FRACTURE (166)	FRACTURE (167)	FRACTURE (168)	FRACTURE (169)	FRACTURE (170)	FRACTURE (171)	FRACTURE (172)	FRACTURE (173)	FRACTURE (174)	FRACTURE (175)	FRACTURE (176)	FRACTURE (177)	FRACTURE (178)	FRACTURE (179)	FRACTURE (180)	FRACTURE (181)	FRACTURE (182)	FRACTURE (183)	FRACTURE (184)	FRACTURE (185)	FRACTURE (186)	FRACTURE (187)	FRACTURE (188)	FRACTURE (189)	FRACTURE (190)	FRACTURE (191)	FRACTURE (192)	FRACTURE (193)	FRACTURE (194)	FRACTURE (195)	FRACTURE (196)	FRACTURE (197)	FRACTURE (198)	FRACTURE (199)	FRACTURE (200)	FRACTURE (201)	FRACTURE (202)	FRACTURE (203)	FRACTURE (204)	FRACTURE (205)	FRACTURE (206)	FRACTURE (207)	FRACTURE (208)	FRACTURE (209)	FRACTURE (210)	FRACTURE (211)	FRACTURE (212)	FRACTURE (213)	FRACTURE (214)	FRACTURE (215)	FRACTURE (216)	FRACTURE (217)	FRACTURE (218)	FRACTURE (219)	FRACTURE (220)	FRACTURE (221)	FRACTURE (222)	FRACTURE (223)	FRACTURE (224)	FRACTURE (225)	FRACTURE (226)	FRACTURE (227)	FRACTURE (228)	FRACTURE (229)	FRACTURE (230)	FRACTURE (231)	FRACTURE (232)	FRACTURE (233)	FRACTURE (234)	FRACTURE (235)	FRACTURE (236)	FRACTURE (237)	FRACTURE (238)	FRACTURE (239)	FRACTURE (240)	FRACTURE (241)	FRACTURE (242)	FRACTURE (243)	FRACTURE (244)	FRACTURE (245)	FRACTURE (246)	FRACTURE (247)	FRACTURE (248)	FRACTURE (249)	FRACTURE (250)	FRACTURE (251)	FRACTURE (252)	FRACTURE (253)	FRACTURE (254)	FRACTURE (255)	FRACTURE (256)	FRACTURE (257)	FRACTURE (258)	FRACTURE (259)	FRACTURE (260)	FRACTURE (261)	FRACTURE (262)	FRACTURE (263)	FRACTURE (264)	FRACTURE (265)	FRACTURE (266)	FRACTURE (267)	FRACTURE (268)	FRACTURE (269)	FRACTURE (270)	FRACTURE (271)	FRACTURE (272)	FRACTURE (273)	FRACTURE (274)	FRACTURE (275)	FRACTURE (276)	FRACTURE (277)	FRACTURE (278)	FRACTURE (279)	FRACTURE (280)	FRACTURE (281)	FRACTURE (282)	FRACTURE (283)	FRACTURE (284)	FRACTURE (285)	FRACTURE (286)	FRACTURE (287)	FRACTURE (288)	FRACTURE (289)	FRACTURE (290)	FRACTURE (291)	FRACTURE (292)	FRACTURE (293)	FRACTURE (294)	FRACTURE (295)	FRACTURE (296)	FRACTURE (297)	FRACTURE (298)	FRACTURE (299)	FRACTURE (300)	FRACTURE (301)	FRACTURE (302)	FRACTURE (303)	FRACTURE (304)	FRACTURE (305)	FRACTURE (306)	FRACTURE (307)	FRACTURE (308)	FRACTURE (309)	FRACTURE (310)	FRACTURE (311)	FRACTURE (312)	FRACTURE (313)	FRACTURE (314)	FRACTURE (315)	FRACTURE (316)	FRACTURE (317)	FRACTURE (318)	FRACTURE (319)	FRACTURE (320)	FRACTURE (321)	FRACTURE (322)	FRACTURE (323)	FRACTURE (324)	FRACTURE (325)	FRACTURE (326)	FRACTURE (327)	FRACTURE (328)	FRACTURE (329)	FRACTURE (330)	FRACTURE (331)	FRACTURE (332)	FRACTURE (333)	FRACTURE (334)	FRACTURE (335)	FRACTURE (336)	FRACTURE (337)	FRACTURE (338)	FRACTURE (339)	FRACTURE (340)	FRACTURE (341)	FRACTURE (342)	FRACTURE (343)	FRACTURE (344)	FRACTURE (345)	FRACTURE (346)	FRACTURE (347)	FRACTURE (348)	FRACTURE (349)	FRACTURE (350)	FRACTURE (351)	FRACTURE (352)	FRACTURE (353)	FRACTURE (354)	FRACTURE (355)	FRACTURE (356)	FRACTURE (357)	FRACTURE (358)	FRACTURE (359)	FRACTURE (360)	FRACTURE (361)	FRACTURE (362)	FRACTURE (363)	FRACTURE (364)	FRACTURE (365)	FRACTURE (366)	FRACTURE (367)	FRACTURE (368)	FRACTURE (369)	FRACTURE (370)	FRACTURE (371)	FRACTURE (372)	FRACTURE (373)	FRACTURE (374)	FRACTURE (375)	FRACTURE (376)	FRACTURE (377)	FRACTURE (378)	FRACTURE (379)	FRACTURE (380)	FRACTURE (381)	FRACTURE (382)	FRACTURE (383)	FRACTURE (384)	FRACTURE (385)	FRACTURE (386)	FRACTURE (387)	FRACTURE (388)	FRACTURE (389)	FRACTURE (390)	FRACTURE (391)	FRACTURE (392)	FRACTURE (393)	FRACTURE (394)	FRACTURE (395)	FRACTURE (396)	FRACTURE (397)	FRACTURE (398)	FRACTURE (399)	FRACTURE (400)	FRACTURE (401)	FRACTURE (402)	FRACTURE (403)	FRACTURE (404)	FRACTURE (405)	FRACTURE (406)	FRACTURE (407)	FRACTURE (408)	FRACTURE (409)	FRACTURE (410)	FRACTURE (411)	FRACTURE (412)	FRACTURE (413)	FRACTURE (414)	FRACTURE (415)	FRACTURE (416)	FRACTURE (417)	FRACTURE (418)	FRACTURE (419)	FRACTURE (420)	FRACTURE (421)	FRACTURE (422)	FRACTURE (423)	FRACTURE (424)	FRACTURE (425)	FRACTURE (426)	FRACTURE (427)	FRACTURE (428)	FRACTURE (429)	FRACTURE (430)	FRACTURE (431)	FRACTURE (432)	FRACTURE (433)	FRACTURE (434)	FRACTURE (435)	FRACTURE (436)	FRACTURE (437)	FRACTURE (438)	FRACTURE (439)	FRACTURE (440)	FRACTURE (441)	FRACTURE (442)	FRACTURE (443)	FRACTURE (444)	FRACTURE (445)	FRACTURE (446)	FRACTURE (447)	FRACTURE (448)	FRACTURE (449)	FRACTURE (450)	FRACTURE (451)	FRACTURE (452)	FRACTURE (453)	FRACTURE (454)	FRACTURE (455)	FRACTURE (456)	FRACTURE (457)	FRACTURE (458)	FRACTURE (459)	FRACTURE (460)	FRACTURE (461)	FRACTURE (462)	FRACTURE (463)	FRACTURE (464)	FRACTURE (465)	FRACTURE (466)	FRACTURE (467)	FRACTURE (468)	FRACTURE (469)	FRACTURE (470)	FRACTURE (471)	FRACTURE (472)	FRACTURE (473)	FRACTURE (474)	FRACTURE (475)	FRACTURE (476)	FRACTURE (477)	FRACTURE (478)	FRACTURE (479)	FRACTURE (480)	FRACTURE (481)	FRACTURE (482)	FRACTURE (483)	FRACTURE (484)	FRACTURE (485)	FRACTURE (486)	FRACTURE (487)	FRACTURE (488)	FRACTURE (489)	FRACTURE (490)	FRACTURE (491)	FRACTURE (492)	FRACTURE (493)	FRACTURE (494)	FRACTURE (495)	FRACTURE (496)	FRACTURE (497)	FRACTURE (498)	FRACTURE (499)	FRACTURE (500)	FRACTURE (501)	FRACTURE (502)	FRACTURE (503)	FRACTURE (504)	FRACTURE (505)	FRACTURE (506)	FRACTURE (507)	FRACTURE (508)	FRACTURE (509)	FRACTURE (510)	FRACTURE (511)	FRACTURE (512)	FRACTURE (513)	FRACTURE (514)	FRACTURE (515)	FRACTURE (516)	FRACTURE (517)	FRACTURE (518)	FRACTURE (519)	FRACTURE (520)	FRACTURE (521)	FRACTURE (522)	FRACTURE (523)	FRACTURE (524)	FRACTURE (525)	FRACTURE (526)	FRACTURE (527)	FRACTURE (528)	FRACTURE (529)	FRACTURE (530)	FRACTURE (531)	FRACTURE (532)	FRACTURE (533)	FRACTURE (534)	FRACTURE (535)	FRACTURE (536)	FRACTURE (537)	FRACTURE (538)	FRACTURE (539)	FRACTURE (540)	FRACTURE (541)	FRACTURE (542)	FRACTURE (543)	FRACTURE (544)	FRACTURE (545)	FRACTURE (546)	FRACTURE (547)	FRACTURE (548)	FRACTURE (549)	FRACTURE (550)	FRACTURE (551)	FRACTURE (552)	FRACTURE (553)	FRACTURE (554)	FRACTURE (555)	FRACTURE (556)	FRACTURE (557)	FRACTURE (558)	FRACTURE (559)	FRACTURE (560)	FRACTURE (561)	FRACTURE (562)	FRACTURE (563)	FRACTURE (564)	FRACTURE (565)	FRACTURE (566)	FRACTURE (567)	FRACTURE (568)	FRACTURE (569)	FRACTURE (570)	FRACTURE (571)	FRACTURE (572)	FRACTURE (573)	FRACTURE (574)	FRACTURE (575)	FRACTURE (576)	FRACTURE (577)	FRACTURE (578)	FRACTURE (579)	FRACTURE (580)	FRACTURE (581)	FRACTURE (582)	FRACTURE (583)	FRACTURE (584)	FRACTURE (585)	FRACTURE (586)	FRACTURE (587)	FRACTURE (588)	FRACTURE (589)	FRACTURE (590)	FRACTURE (591)	FRACTURE (592)	FRACTURE (593)	FRACTURE (594)	FRACTURE (595)	FRACTURE (596)	FRACTURE (597)	FRACTURE (598)	FRACTURE (599)	FRACTURE (600)	FRACTURE (601)	FRACTURE (602)	FRACTURE (603)	FRACTURE (604)	FRACTURE (605)	FRACTURE (606)	FRACTURE (607)	FRACTURE (608)	FRACTURE (609)	FRACTURE (610)	FRACTURE (611)	FRACTURE (612)	FRACTURE (613)	FRACTURE (614)	FRACTURE (615)	FRACTURE (616)	FRACTURE (617)	FRACTURE (618)	FRACTURE (619)	FRACTURE (620)	FRACTURE (621)	FRACTURE (622)	FRACTURE (623)	FRACTURE (624)	FRACTURE (625)	FRACTURE (626)	FRACTURE (627)	FRACTURE (628)	FRACTURE (629)	FRACTURE (630)	FRACTURE (631)	FRACTURE (632)	FRACTURE (633)	FRACTURE (634)	FRACTURE (635)	FRACTURE (636)	FRACTURE (637)	FRACTURE (638)	FRACTURE (639)	FRACTURE (640)	FRACTURE (641)	FRACTURE (642)	FRACTURE (643)	FRACTURE (644)	FRACTURE (645)	FRACTURE (646)	FRACTURE (647)	FRACTURE (648)	FRACTURE (649)	FRACTURE (650)	FRACTURE (651)	FRACTURE (652)	FRACTURE (653)	FRACTURE (654)	FRACTURE (655)	FRACTURE (656)	FRACTURE (657)	FRACTURE (658)	FRACTURE (659)	FRACTURE (660)	FRACTURE (661)	FRACTURE (662)	FRACTURE (663)	FRACTURE (664)	FRACTURE (665)	FRACTURE (666)	FRACTURE (667)	FRACTURE (668)	FRACTURE (669)	FRACTURE (670)	FRACTURE (671)	FRACTURE (672)	FRACTURE (673)	FRACTURE (674)	FRACTURE (675)	FRACTURE (676)	FRACTURE (677)	FRACTURE (678)	FRACTURE (679)	FRACTURE (680)	FRACTURE (681)	FRACTURE (682)	FRACTURE (683)	FRACTURE (684)	FRACTURE (685)	FRACTURE (686)	FRACTURE (687)	FRACTURE (688)	FRACTURE (689)	FRACTURE (690)	FRACTURE (691)	FRACTURE (692)	FRACTURE (693)	FRACTURE (694)	FRACTURE (695)	FRACTURE (696)	FRACTURE (697)	FRACTURE (698)	FRACTURE (699)	FRACTURE (700)	FRACTURE (701)	FRACTURE (702)	FRACTURE (703)	FRACTURE (704)	FRACTURE (705)	FRACTURE (706)	FRACTURE (707)	FRACTURE (708)	FRACTURE (709)	FRACTURE (710)	FRACTURE (711)	FRACTURE (712)	FRACTURE (713)	FRACTURE (714)	FRACTURE (715)	FRACTURE (716)	FRACTURE (717)	FRACTURE (718)	FRACTURE (719)	FRACTURE (720)	FRACTURE (721)	FRACTURE (722)	FRACTURE (723)	FRACTURE (724)	FRACTURE (725)	FRACTURE (726)	FRACTURE (727)	FRACTURE (728)	FRACTURE (729)	FRACTURE (730)	FRACTURE (731)	FRACTURE (732)	FRACTURE 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(997)	FRACTURE (998)	FRACTURE (999)	FRACTURE (1000)	FRACTURE (1001)	FRACTURE (1002)	FRACTURE (1003)	FRACTURE (1004)	FRACTURE (1005)	FRACTURE (1006)	FRACTURE (1007)	FRACTURE (1008)	FRACTURE (1009)	FRACTURE (1010)	FRACTURE (1011)	FRACTURE (1012)	FRACTURE (1013)	FRACTURE (1014)	FRACTURE (1015)	FRACTURE (1016)	FRACTURE (1017)	FRACTURE (1018)	FRACTURE (1019)	FRACTURE (1020)	FRACTURE (1021)	FRACTURE (1022)	FRACTURE (1023)	FRACTURE (1024)	FRACTURE (1025)	FRACTURE (1026)	FRACTURE (1027)	FRACTURE (1028)	FRACTURE (1029)	FRACTURE (1030)	FRACTURE (1031)	FRACTURE (1032)	FRACTURE (1033)	FRACTURE (1034)	FRACTURE (1035)	FRACTURE (1036)	FRACTURE (1037)	FRACTURE (1038)	FRACTURE (1039)	FRACTURE (1040)	FRACTURE (1041)	FRACTURE (1042)	FRACTURE (1043)	FRACTURE (1044)	FRACTURE (1045)	FRACTURE (1046)	FRACTURE (1047)	FRACTURE (1048)	FRACTURE (1049)	FRACTURE (1050)	FRACTURE (1051)	FRACTURE (1052)	FRACTURE (1053)	FRACTURE (1054)	FRACTURE (1055)	FRACTURE (1056)	FRACTURE (1057)	FRACTURE (1058)

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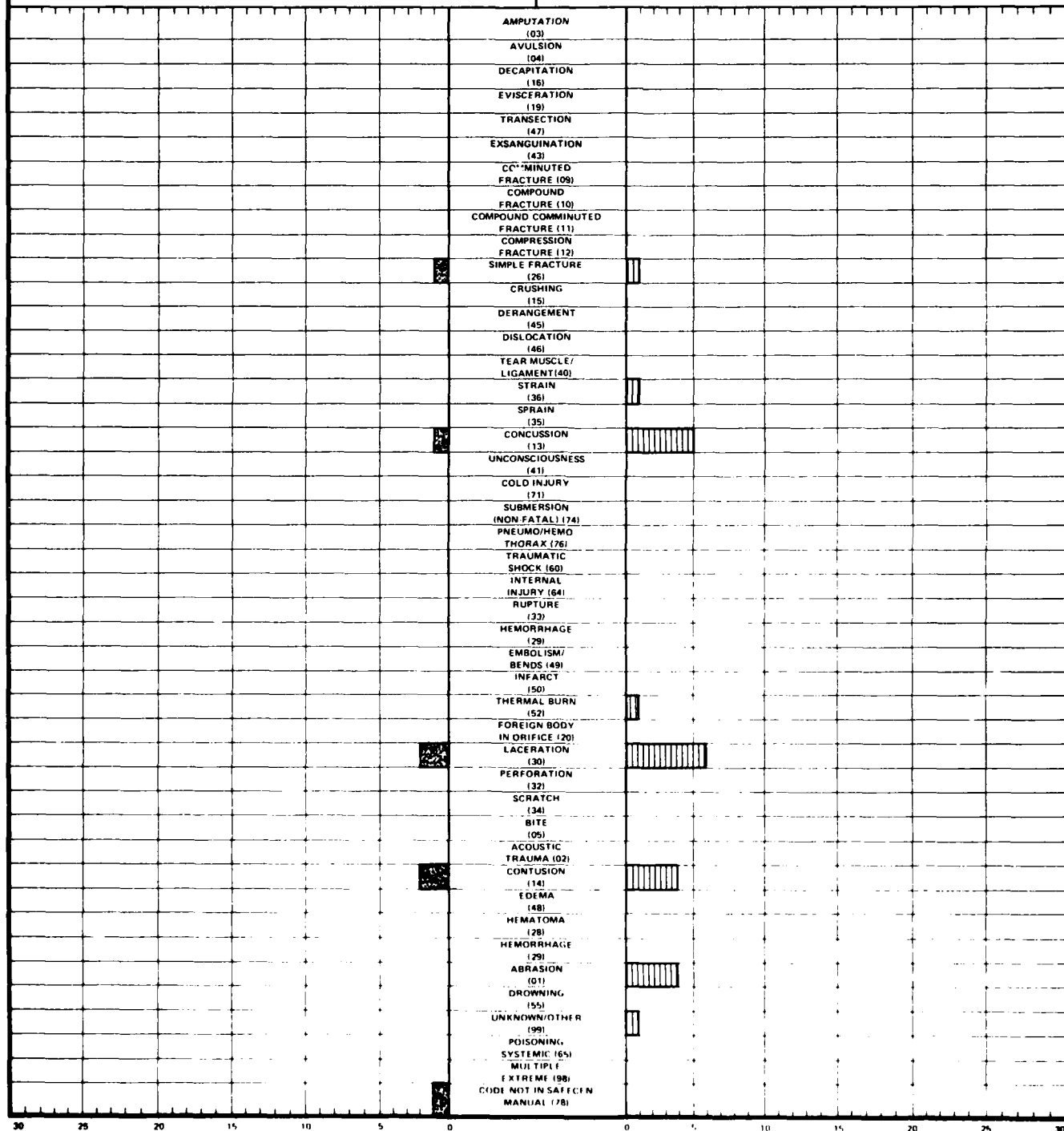
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

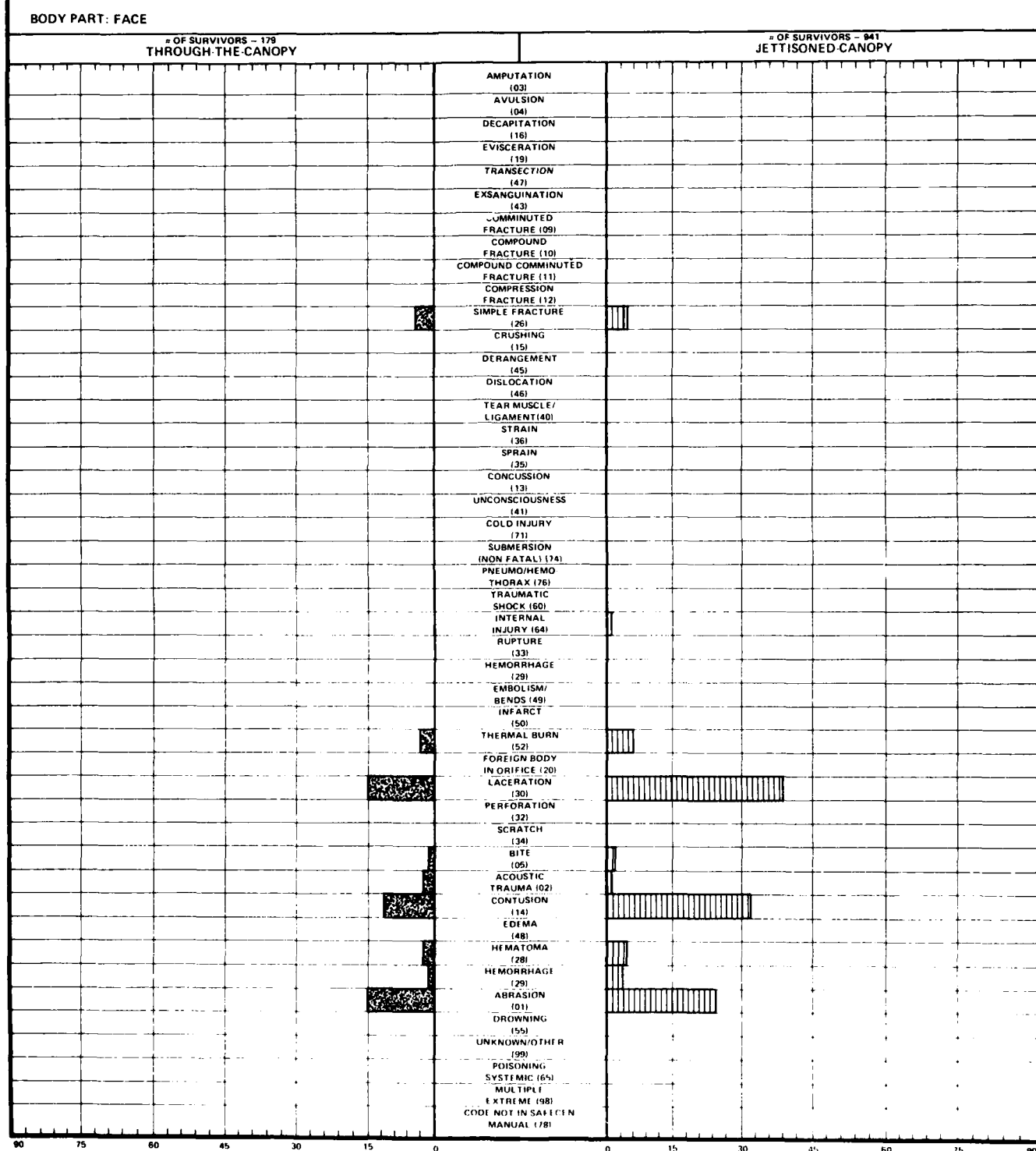
BODY PART: SKULL

OF SURVIVORS - 178
THROUGH-THE-CANOPY

OF SURVIVORS - 841
JETTISONED-CANOPY



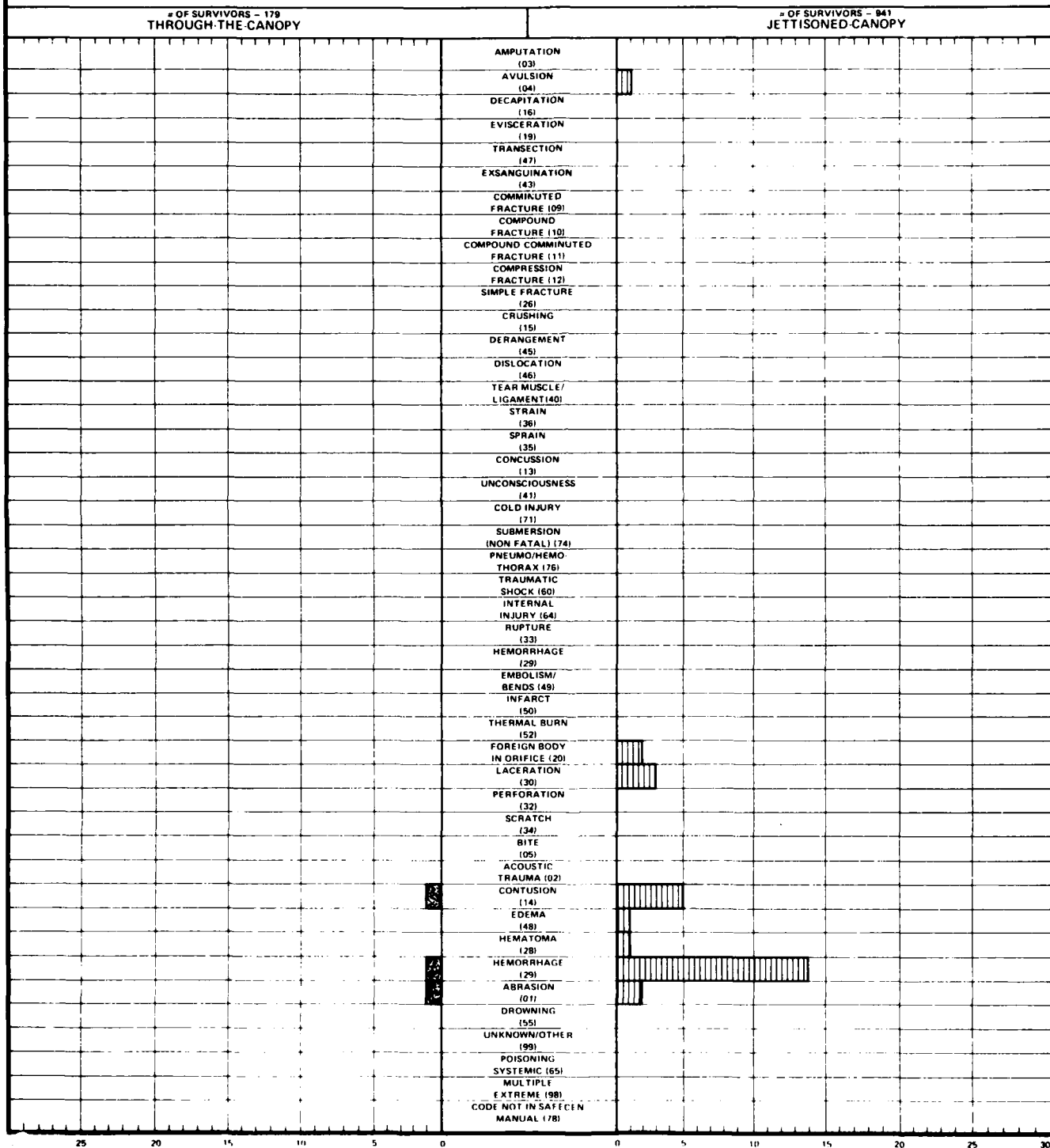
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)



JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: EYE

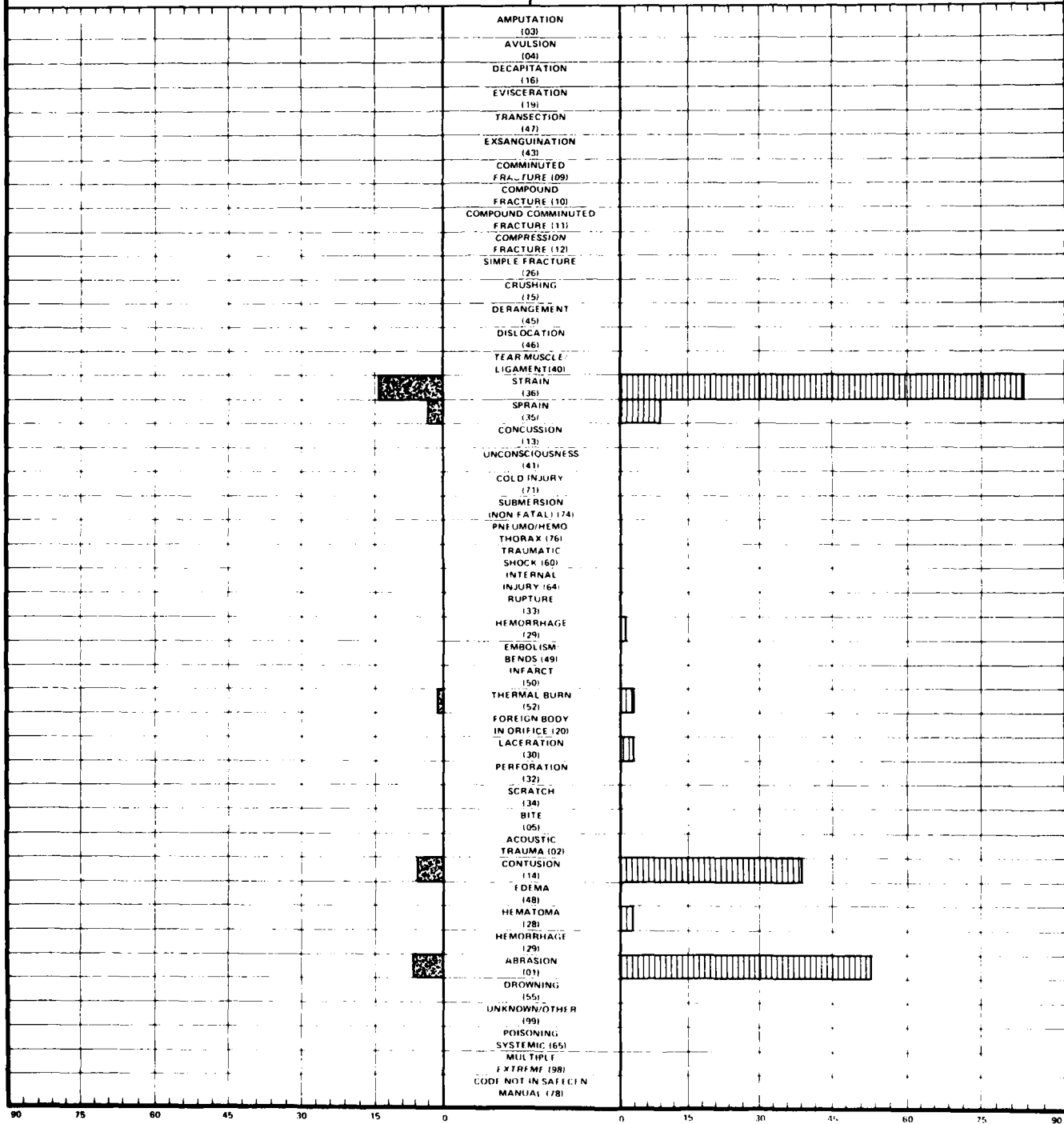


COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: NECK

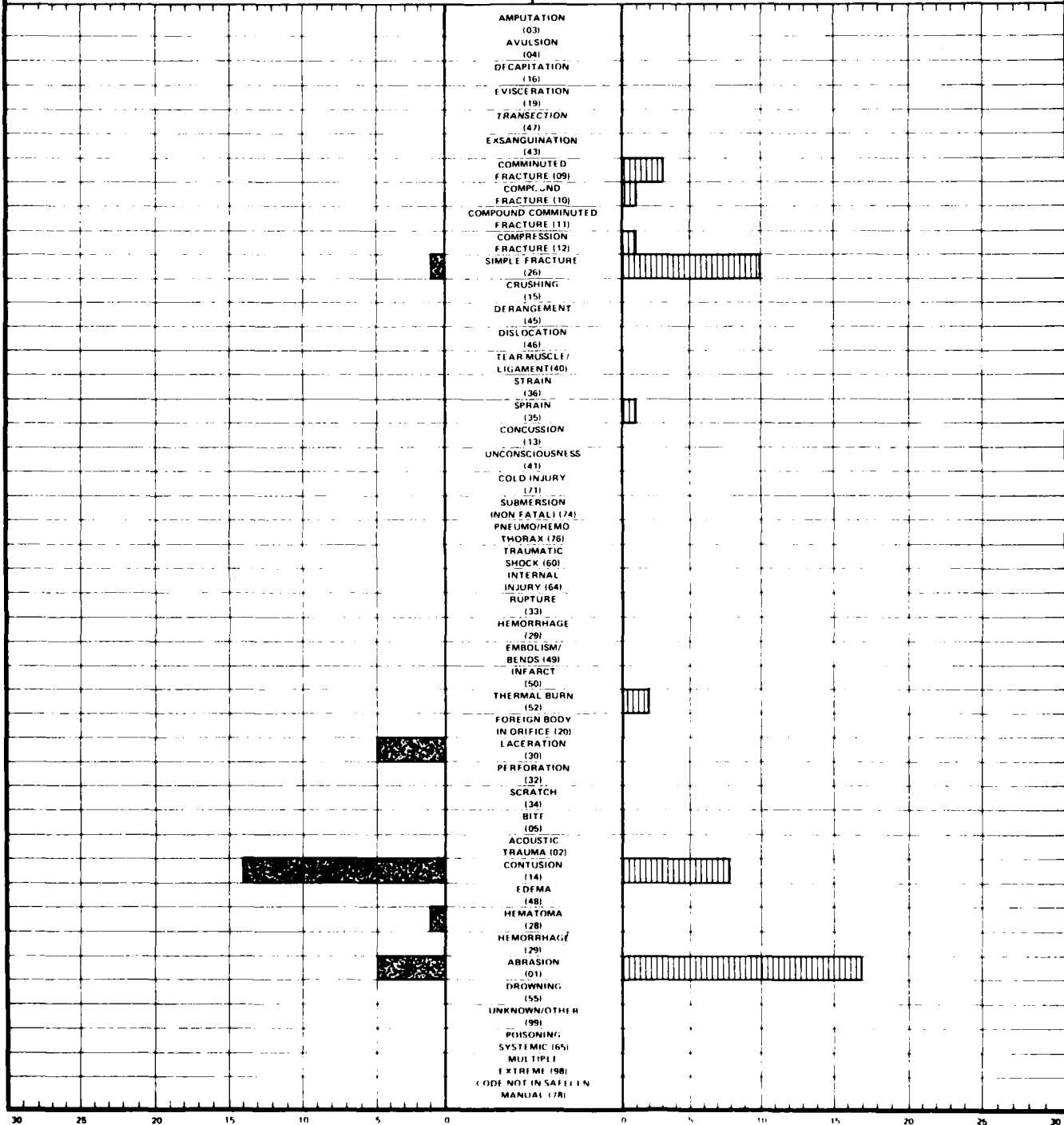
OF SURVIVORS - 179
THROUGH-THE-CANOPY

OF SURVIVORS - 941
JETTISONED-CANOPY



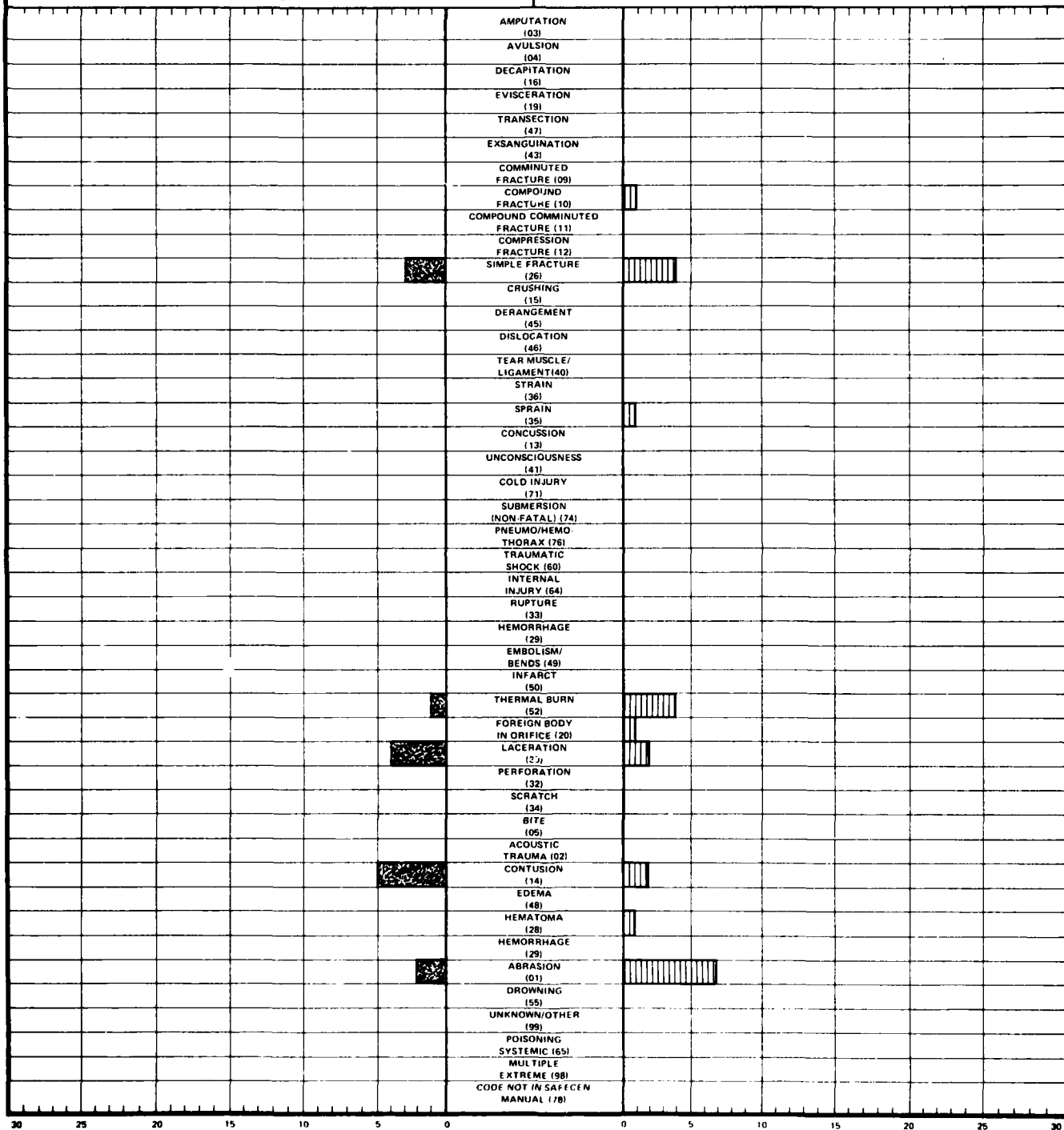
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH THE CANOPY VS. JETTISONED CANOPY EJECTIONS

BODY PART: UPPER ARM

OF SURVIVORS - 179
THROUGH THE CANOPY# OF SURVIVORS - 941
JETTISONED-CANOPY

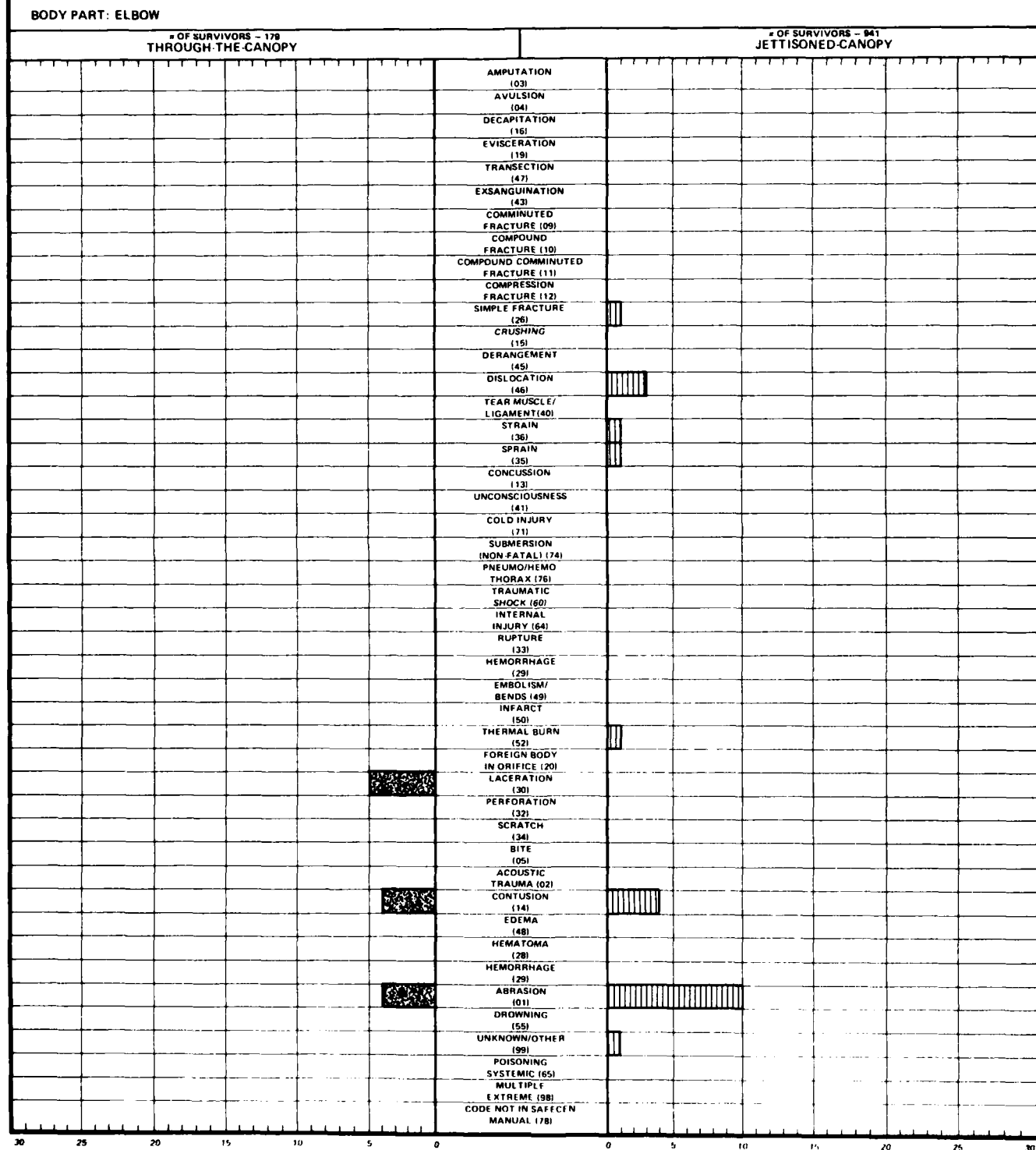
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: LOWER ARM

OF SURVIVORS - 179
THROUGH-THE-CANOPY# OF SURVIVORS - 941
JETTISONED-CANOPY

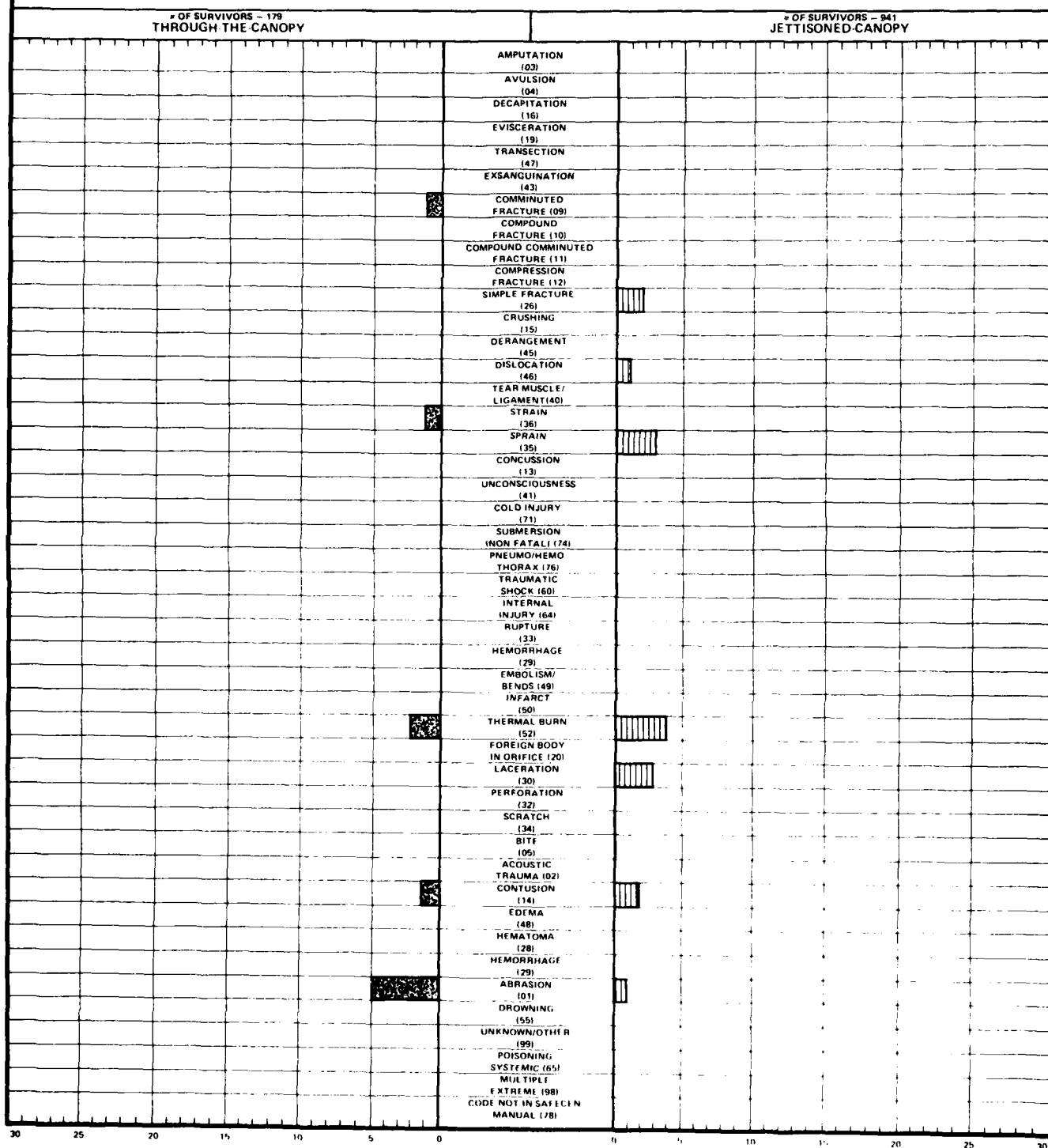
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)



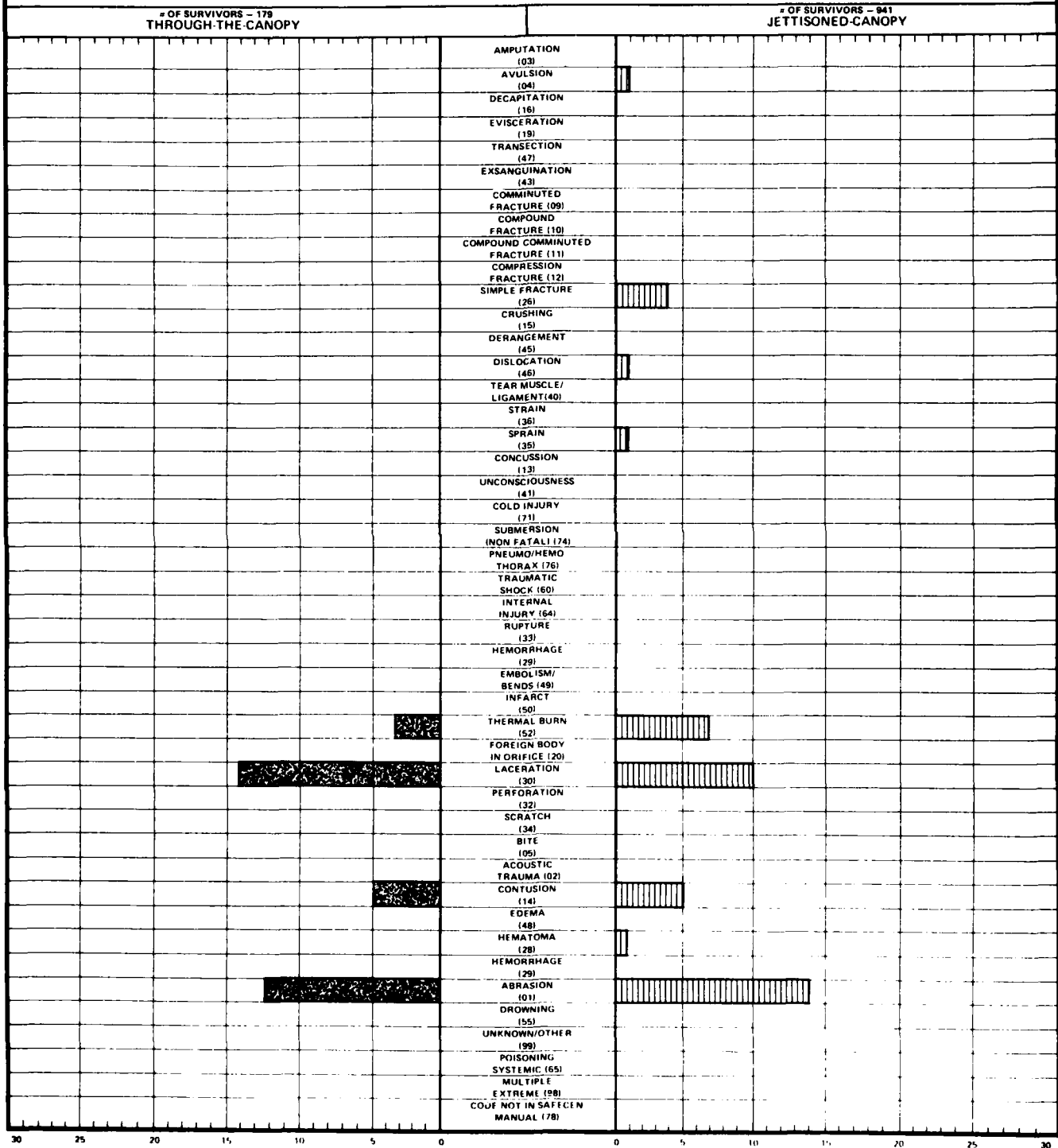
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: WRIST



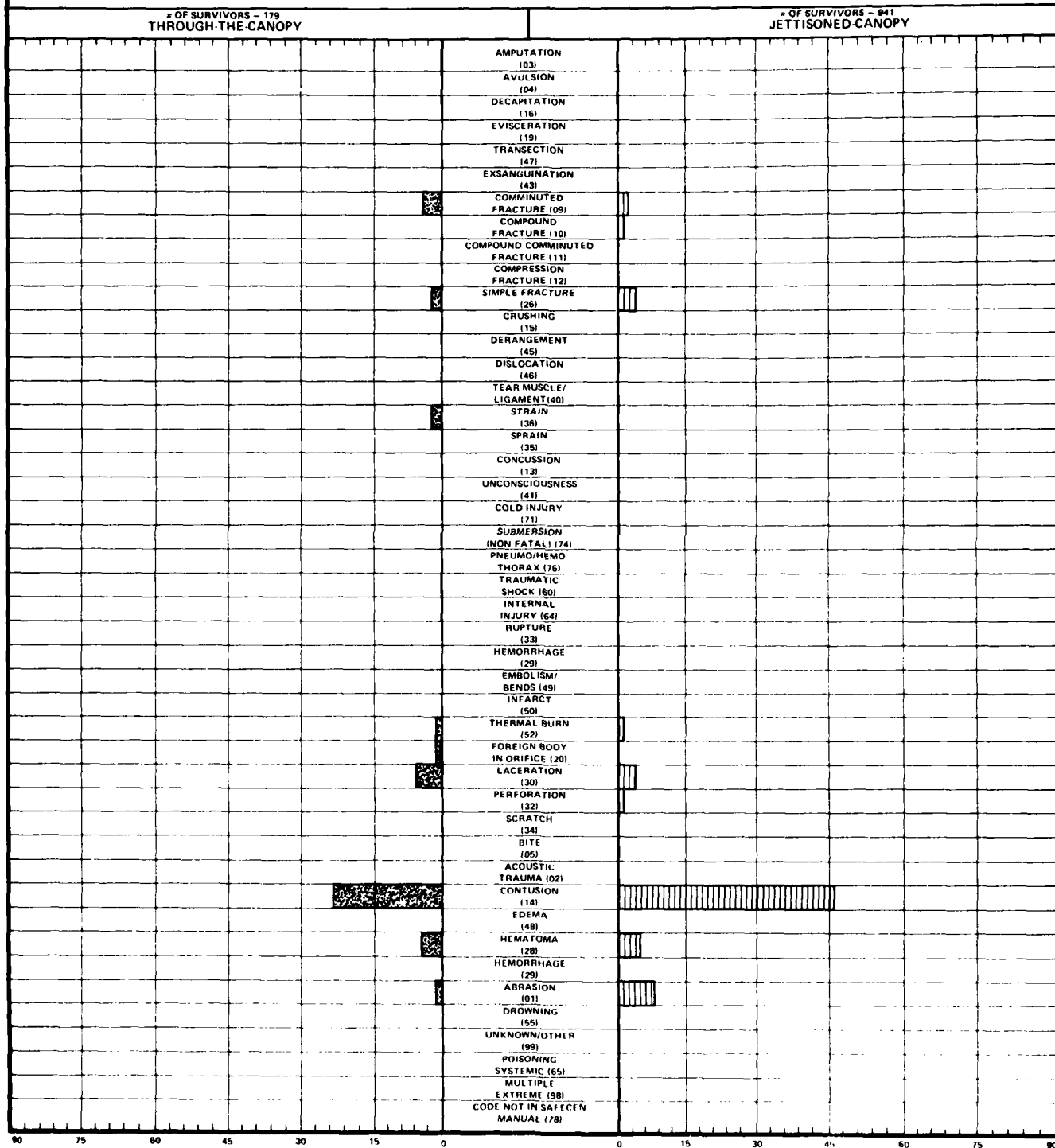
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: HAND



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: UPPER LEG



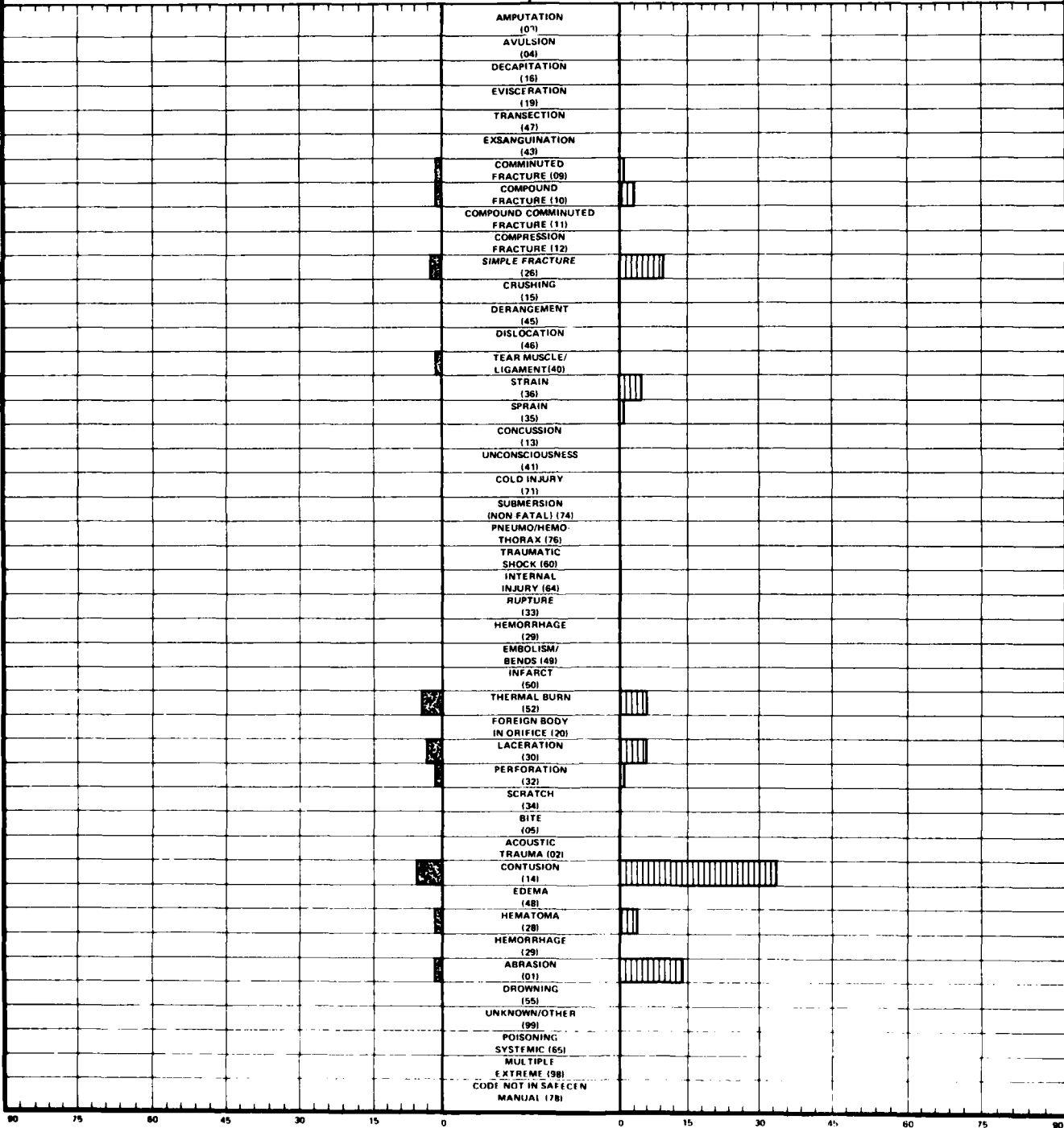
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: LOWER LEG

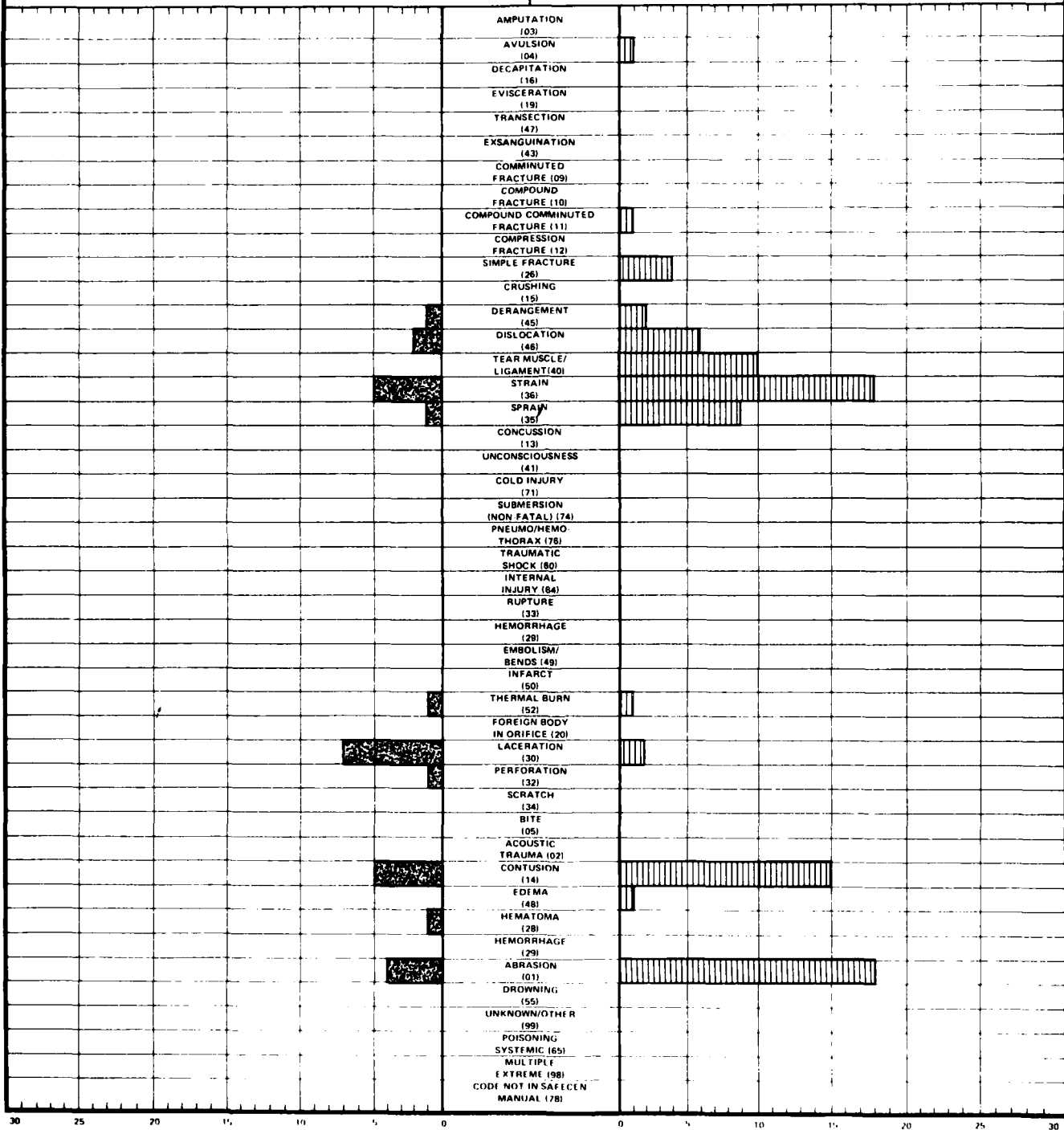
OF SURVIVORS - 179
THROUGH-THE-CANOPY

OF SURVIVORS - 941
JETTISONED-CANOPY



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: KNEE

OF SURVIVORS - 179
THROUGH-THE-CANOPY# OF SURVIVORS - 841
JETTISONED-CANOPY

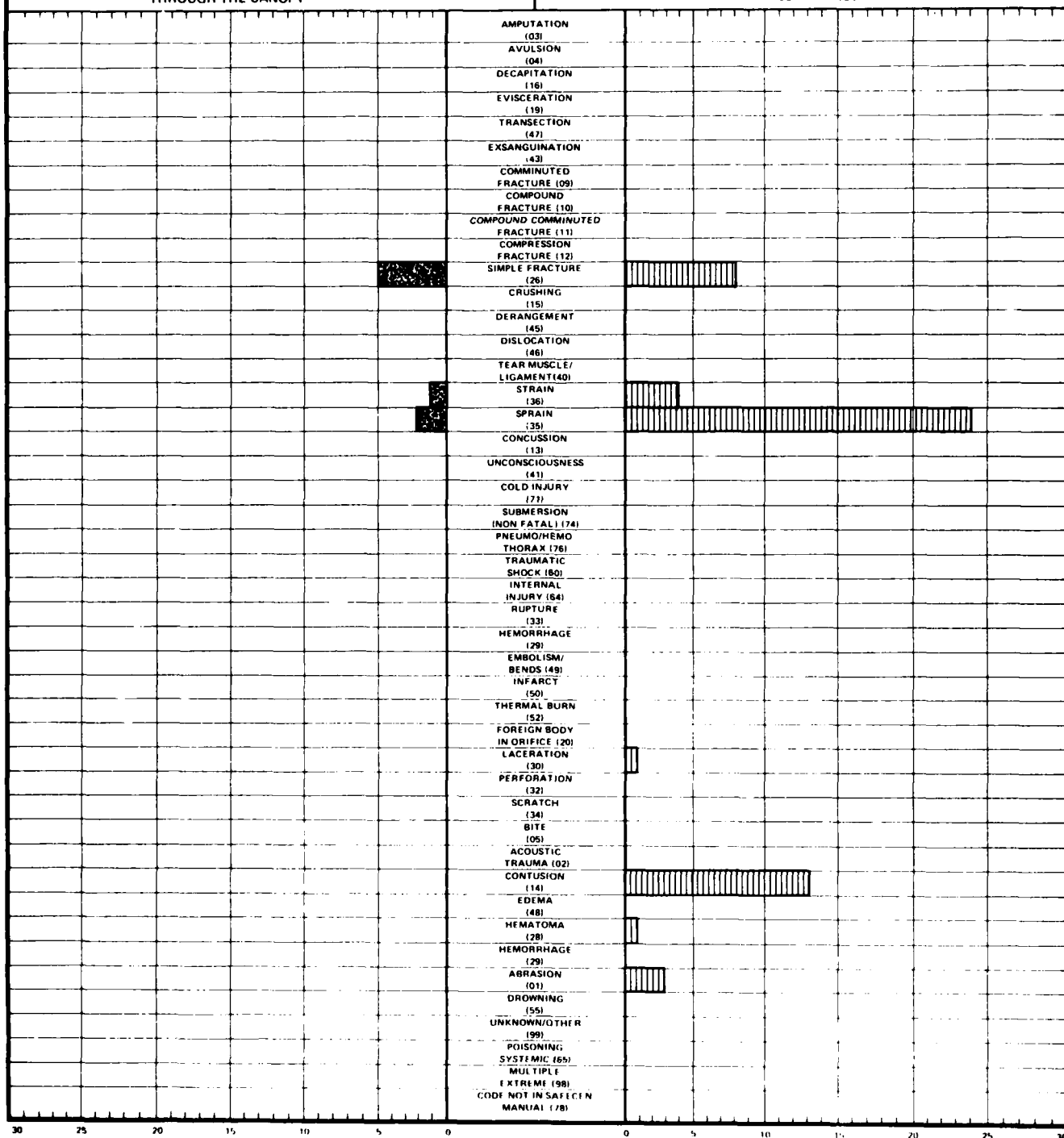
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: ANKLE

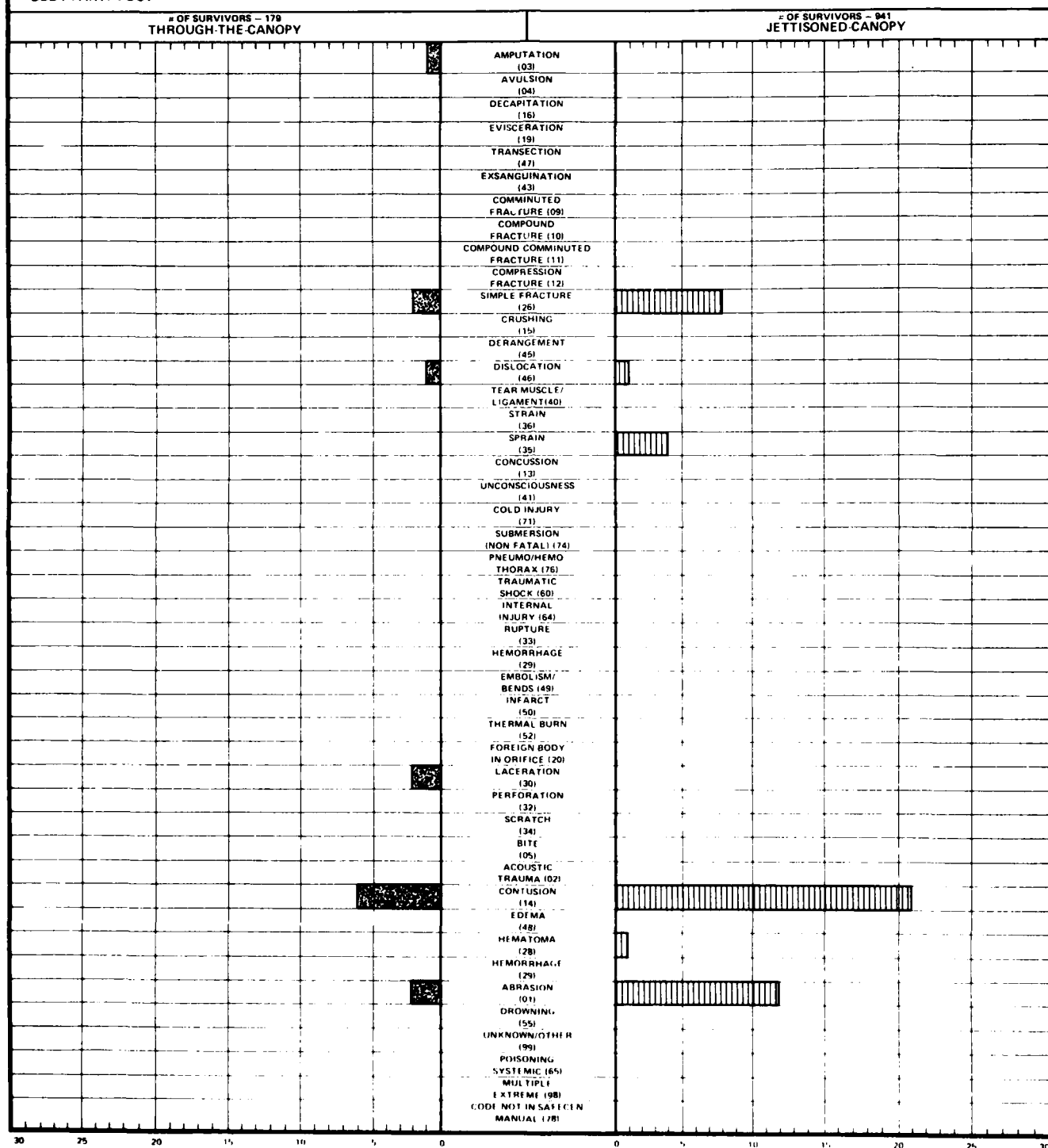
OF SURVIVORS - 179
THROUGH-THE-CANOPY

OF SURVIVORS - 941
JETTISONED-CANOPY



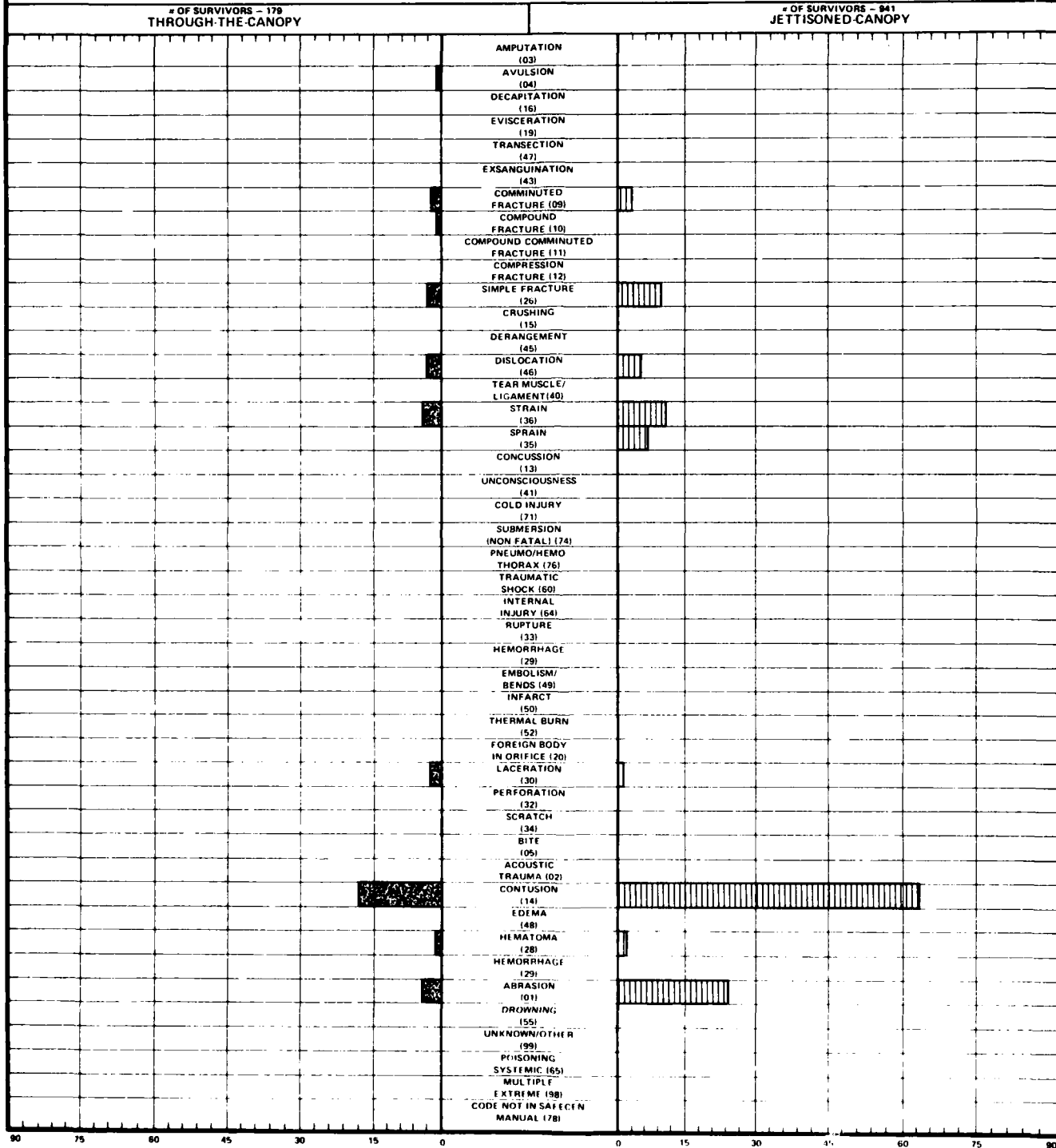
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: FOOT



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

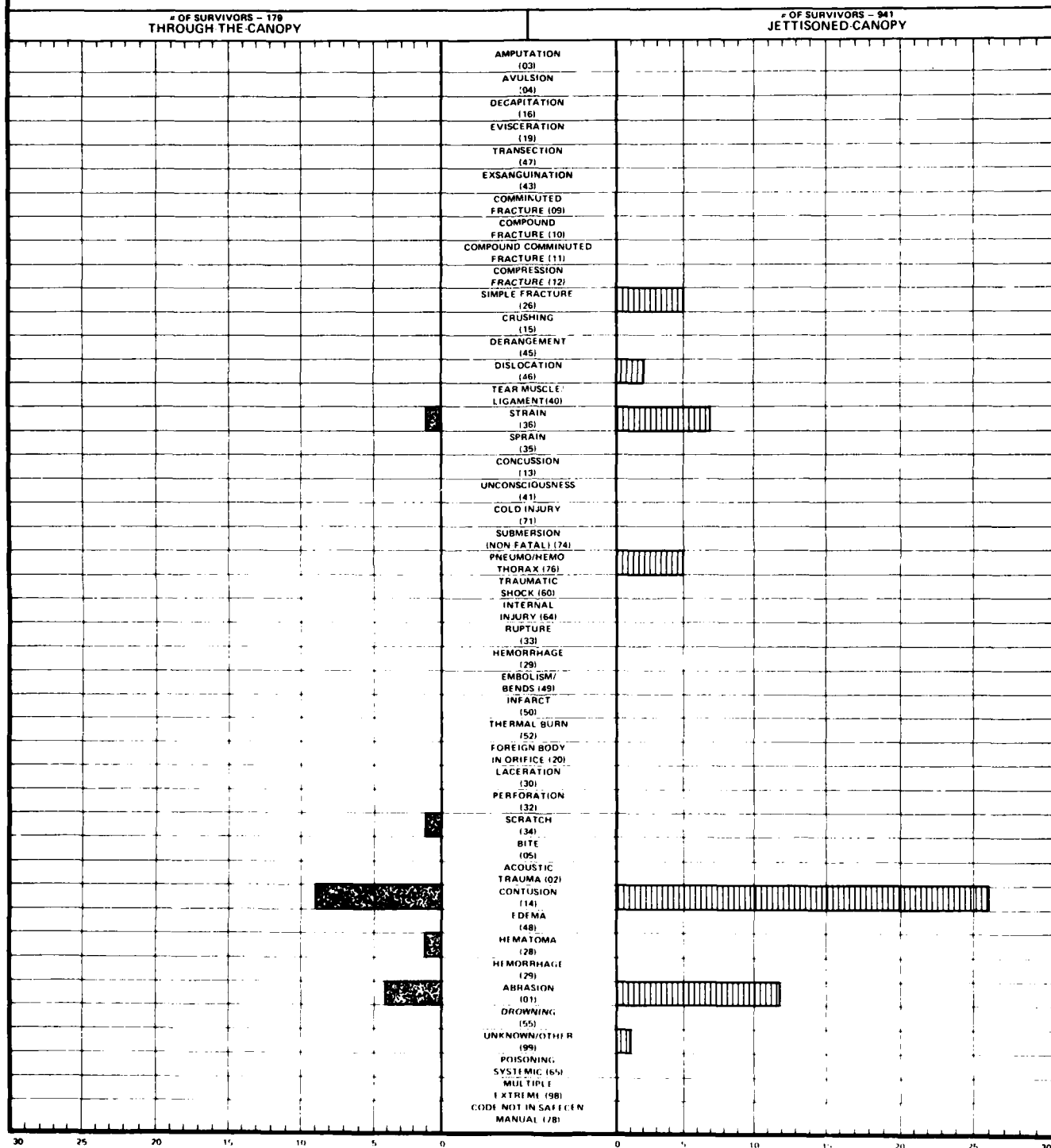
BODY PART: SHOULDER



JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: THORAX



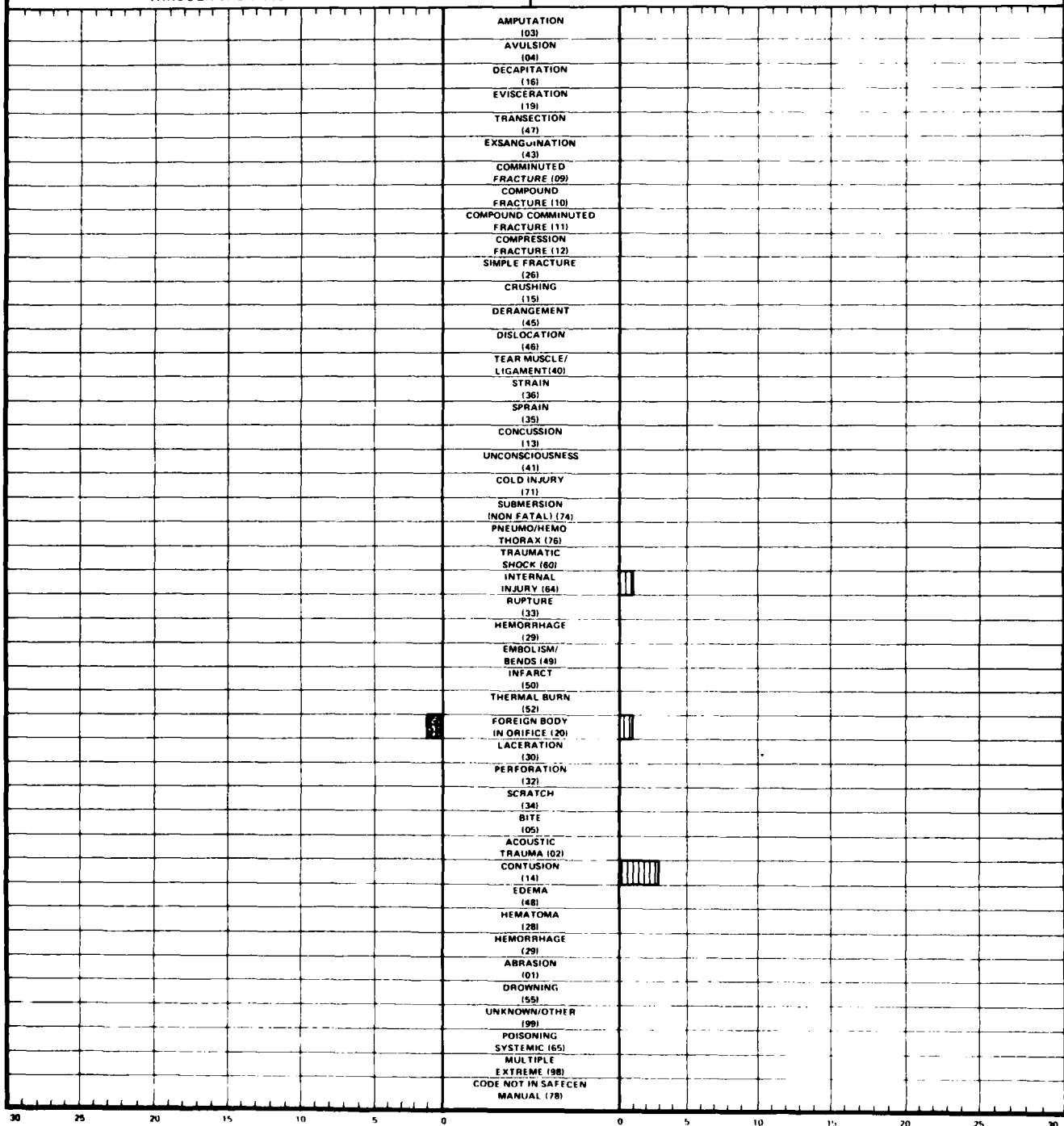
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: ABDOMEN

OF SURVIVORS - 178
THROUGH-THE-CANOPY

OF SURVIVORS - 841
JETTISONED CANOPY



JANUARY 1969 - DECEMBER 1979

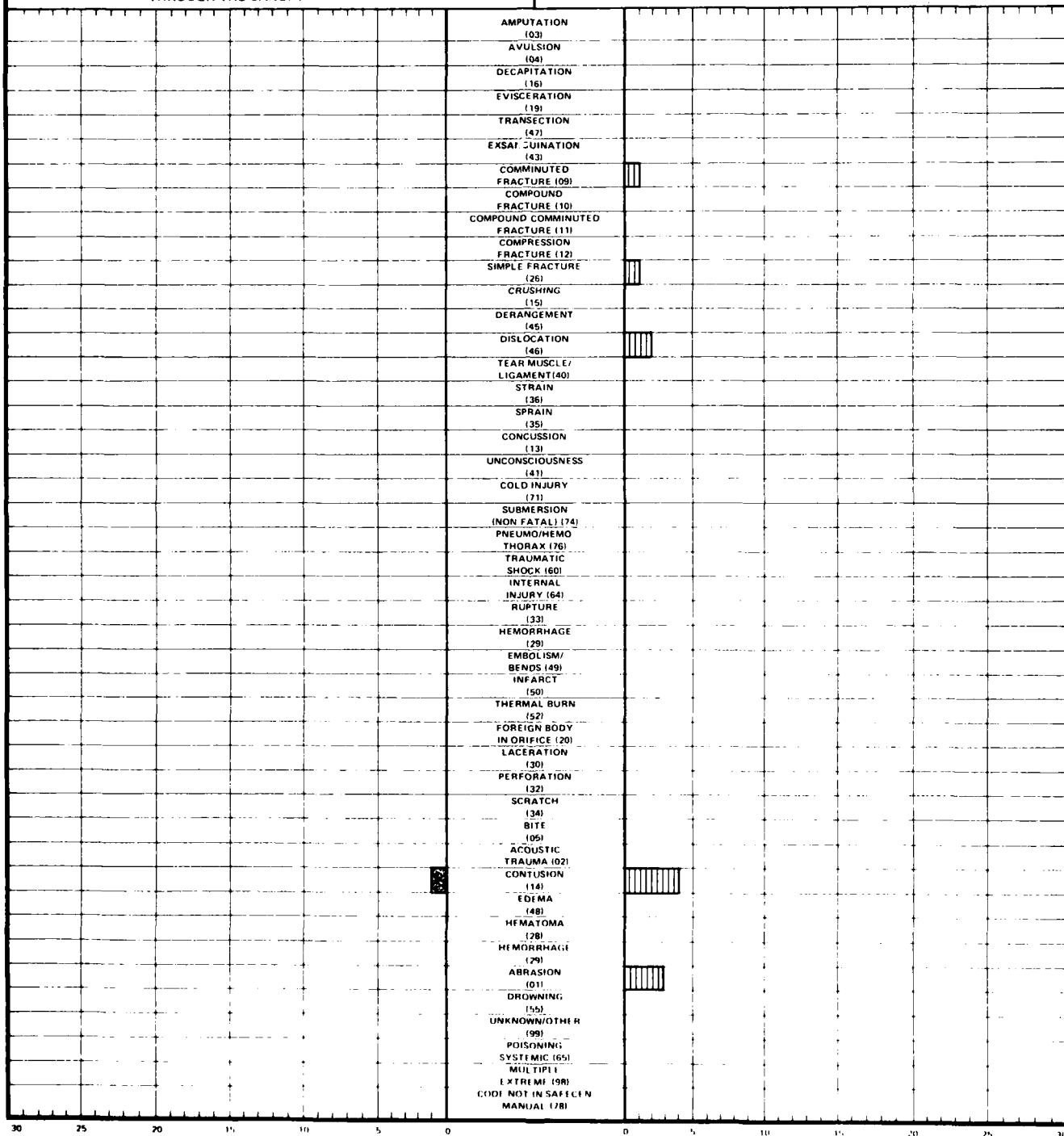
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

BODY PART: PELVIS

OF SURVIVORS - 179
THROUGH-THE-CANOPY

OF SURVIVORS - 941
JETTISONED-CANOPY



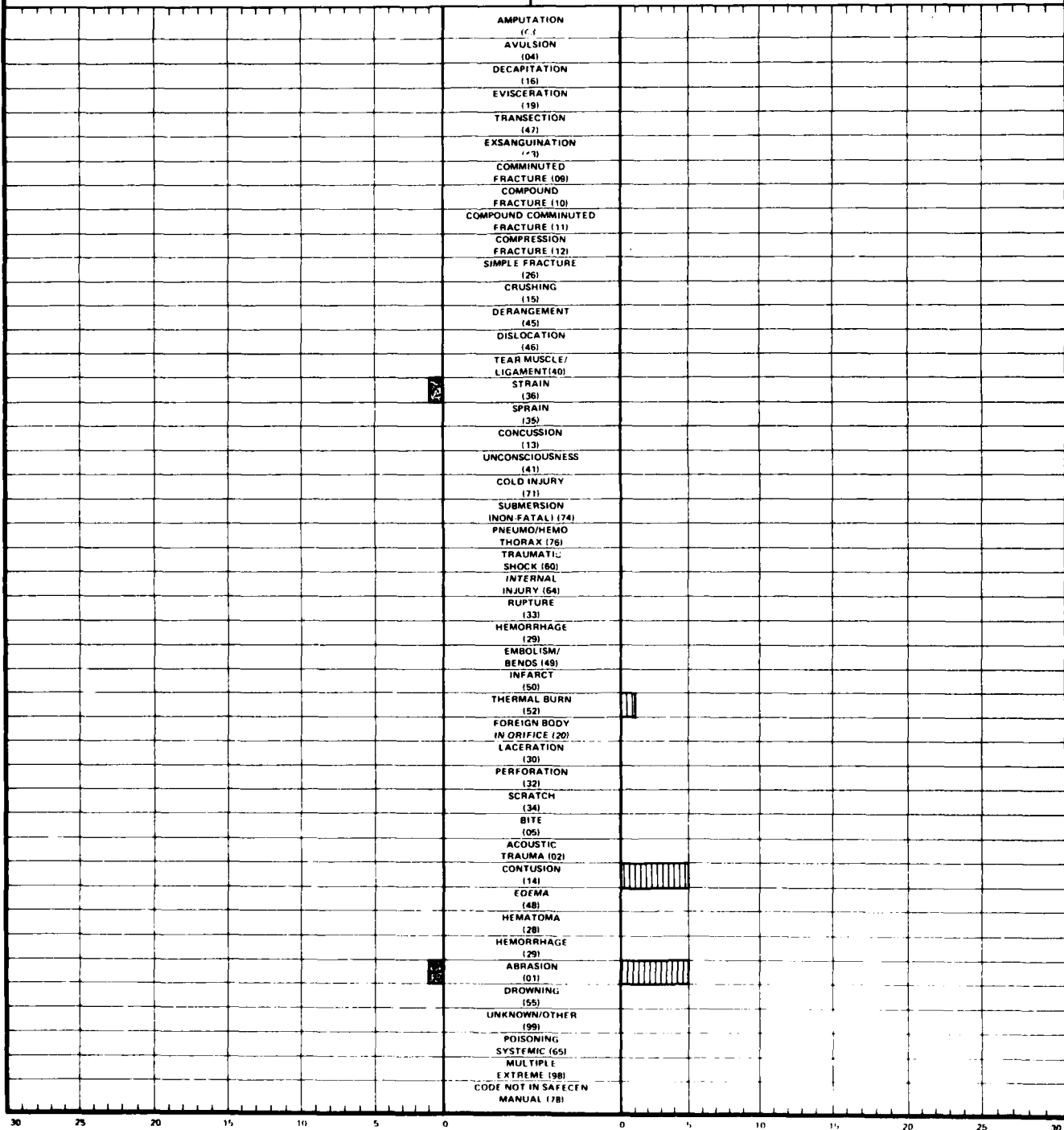
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH THE CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

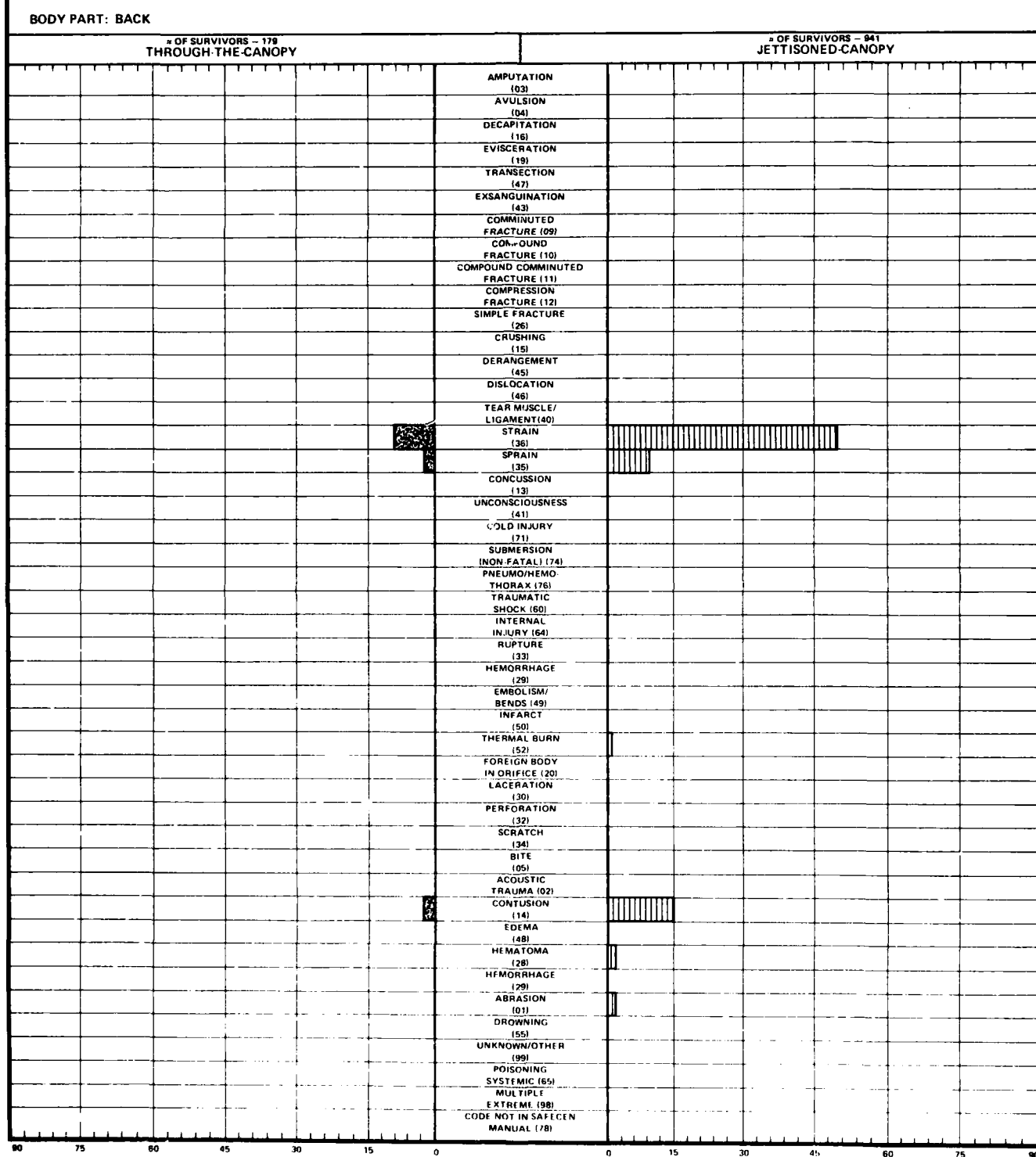
BODY PART: GROIN

OF SURVIVORS - 179
THROUGH-THE-CANOPY

OF SURVIVORS - 941
JETTISONED-CANOPY



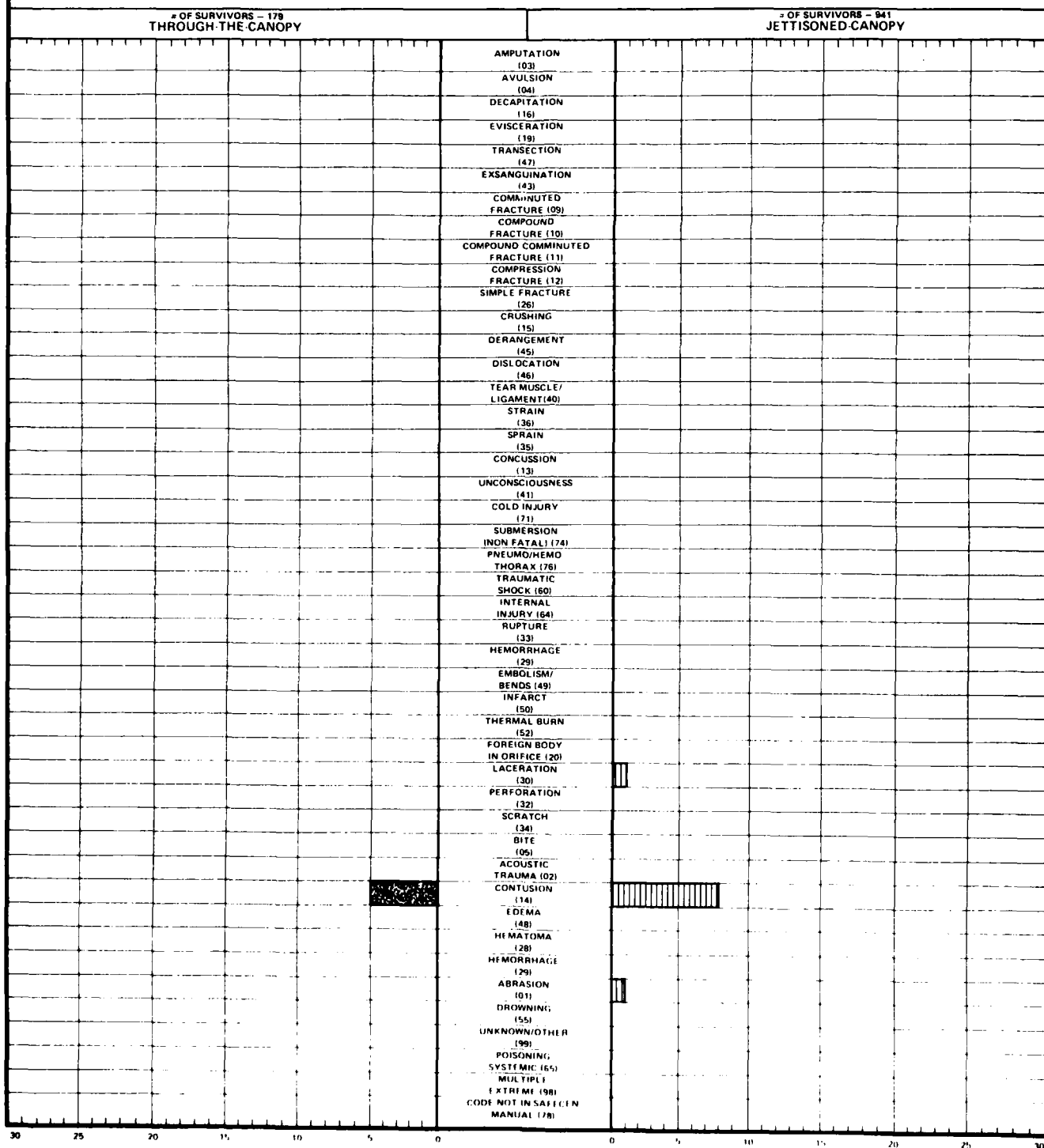
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

BODY PART: BUTTOCKS



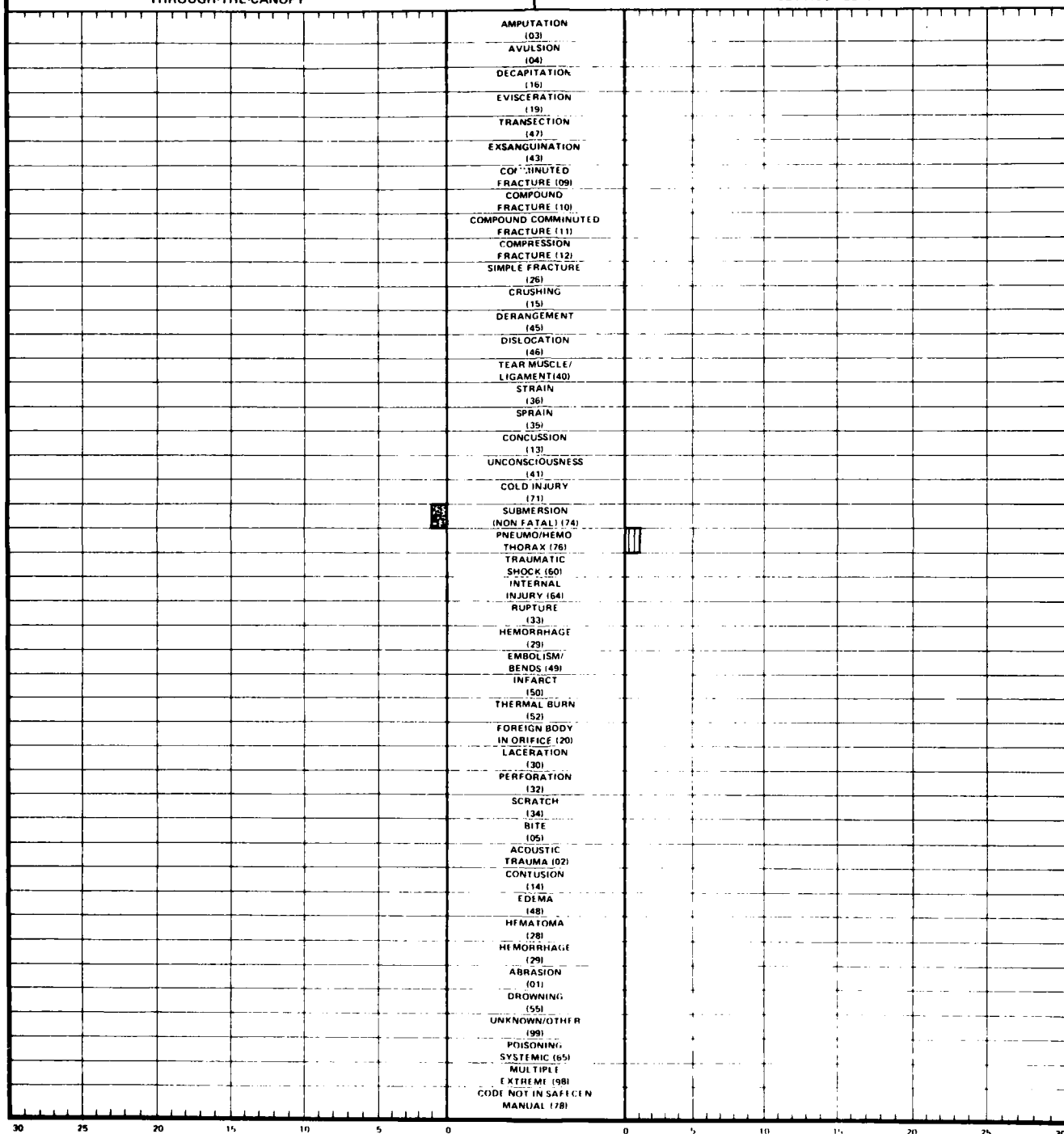
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: LUNGS

OF SURVIVORS - 179
THROUGH-THE-CANOPY

OF SURVIVORS - 941
JETTISONED-CANOPY



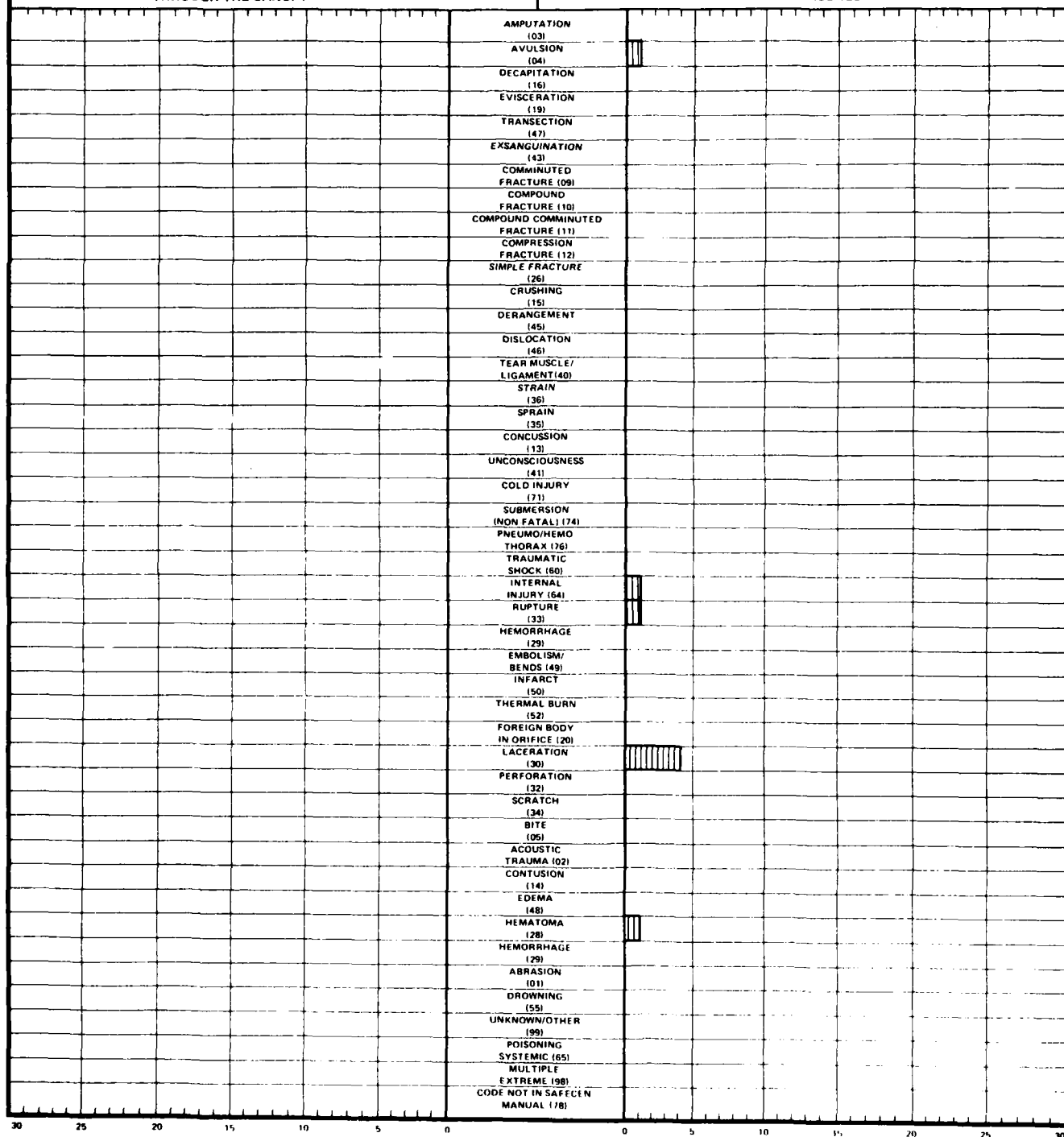
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: OTHER

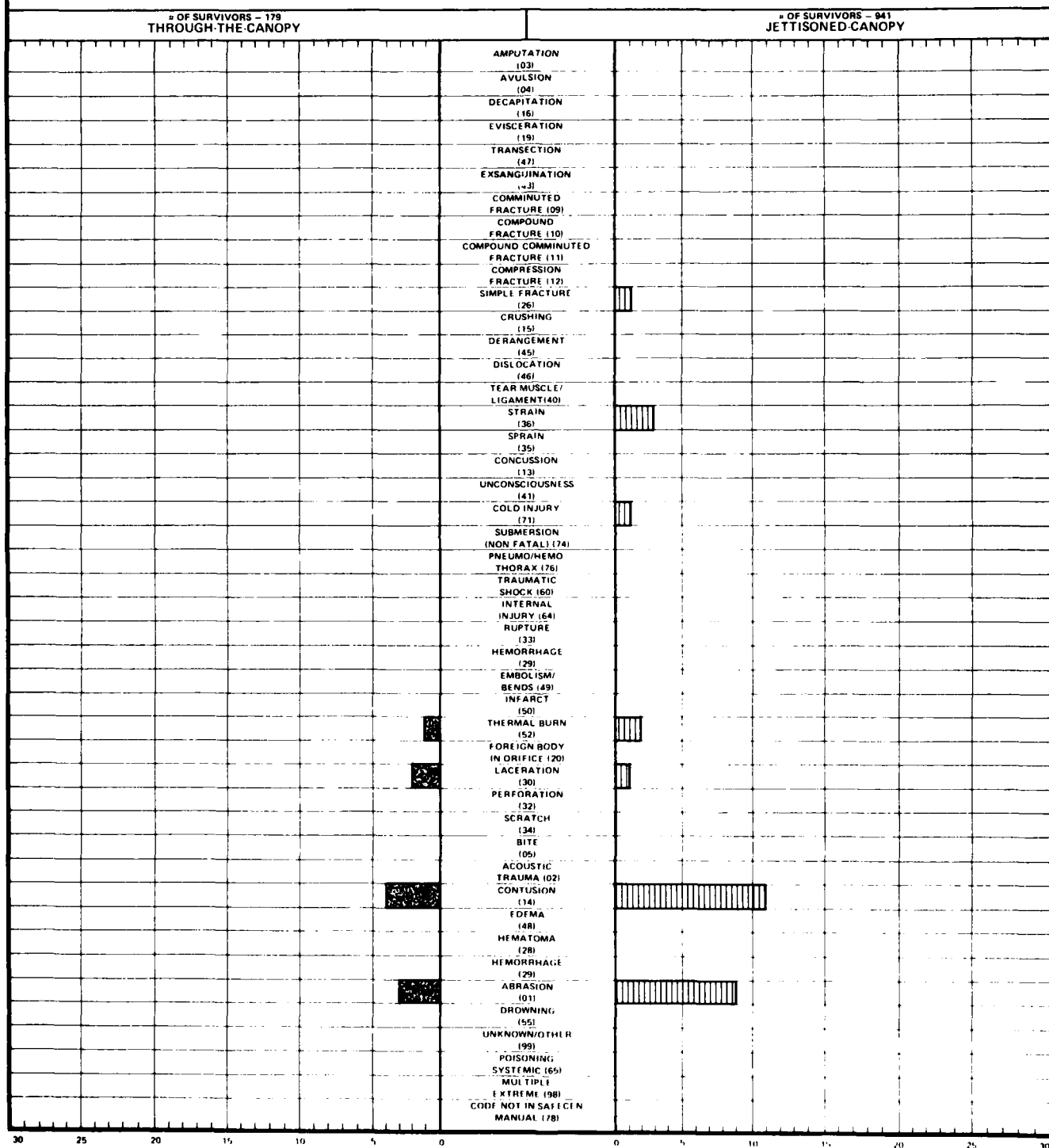
OF SURVIVORS - 179
THROUGH-THE-CANOPY

OF SURVIVORS - 941
JETTISONED-CANOPY



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: MULT. BODY PARTS



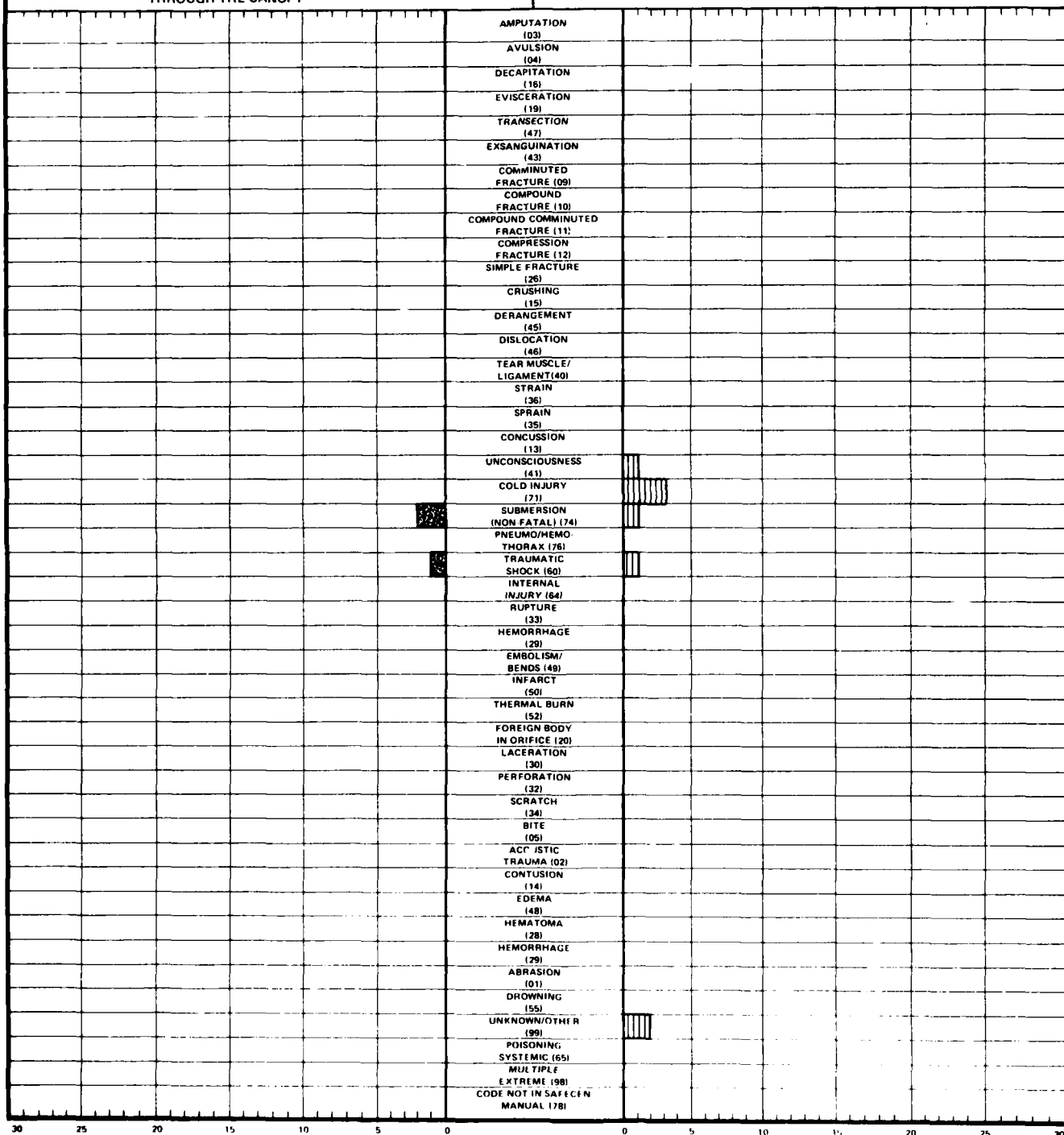
JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)

BODY PART: TOTAL BODY

OF SURVIVORS - 178
THROUGH-THE-CANOPY

OF SURVIVORS - 841
JETTISONED-CANOPY

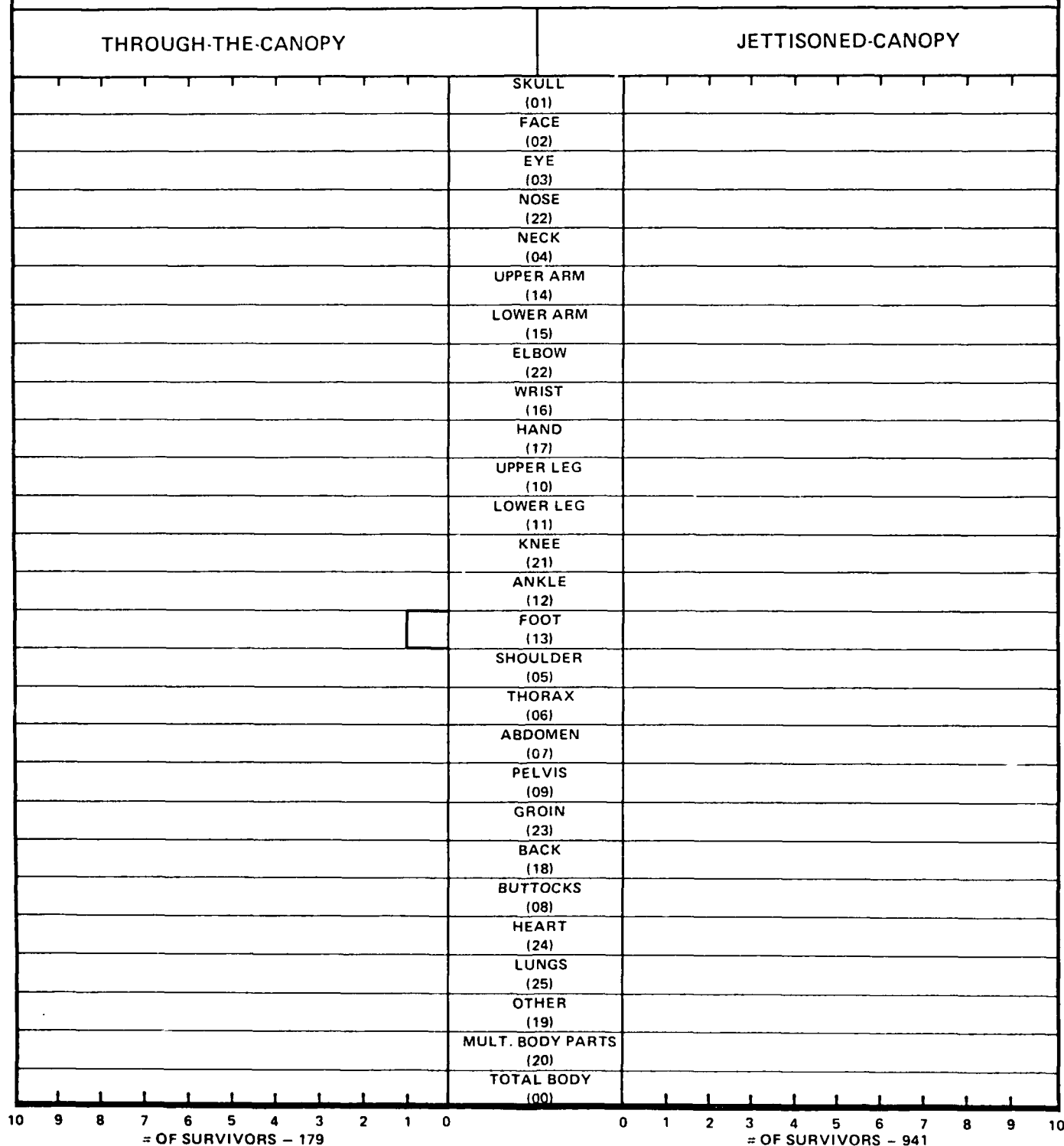


JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

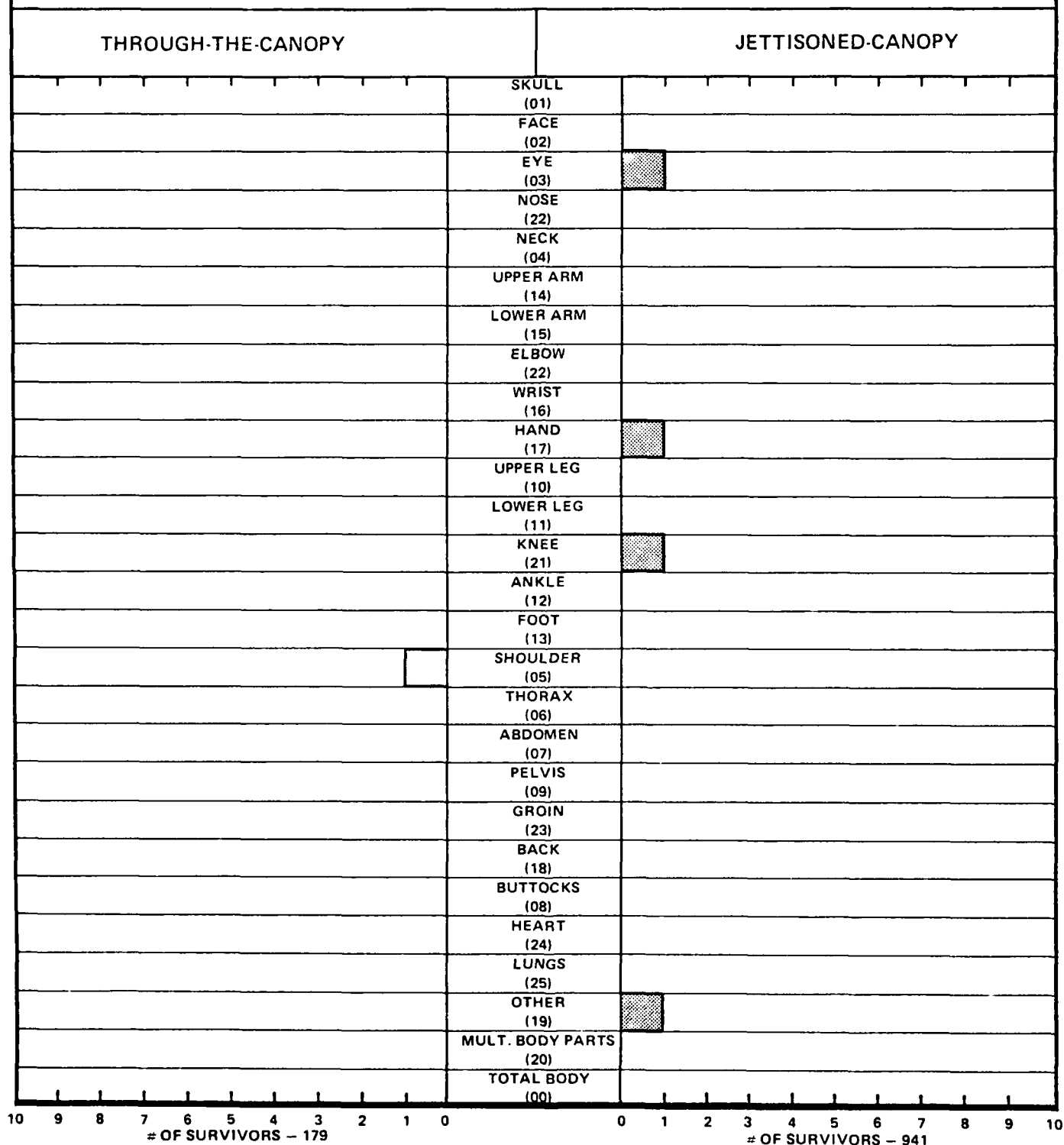
INJURY DIAGNOSIS: AMPUTATION



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

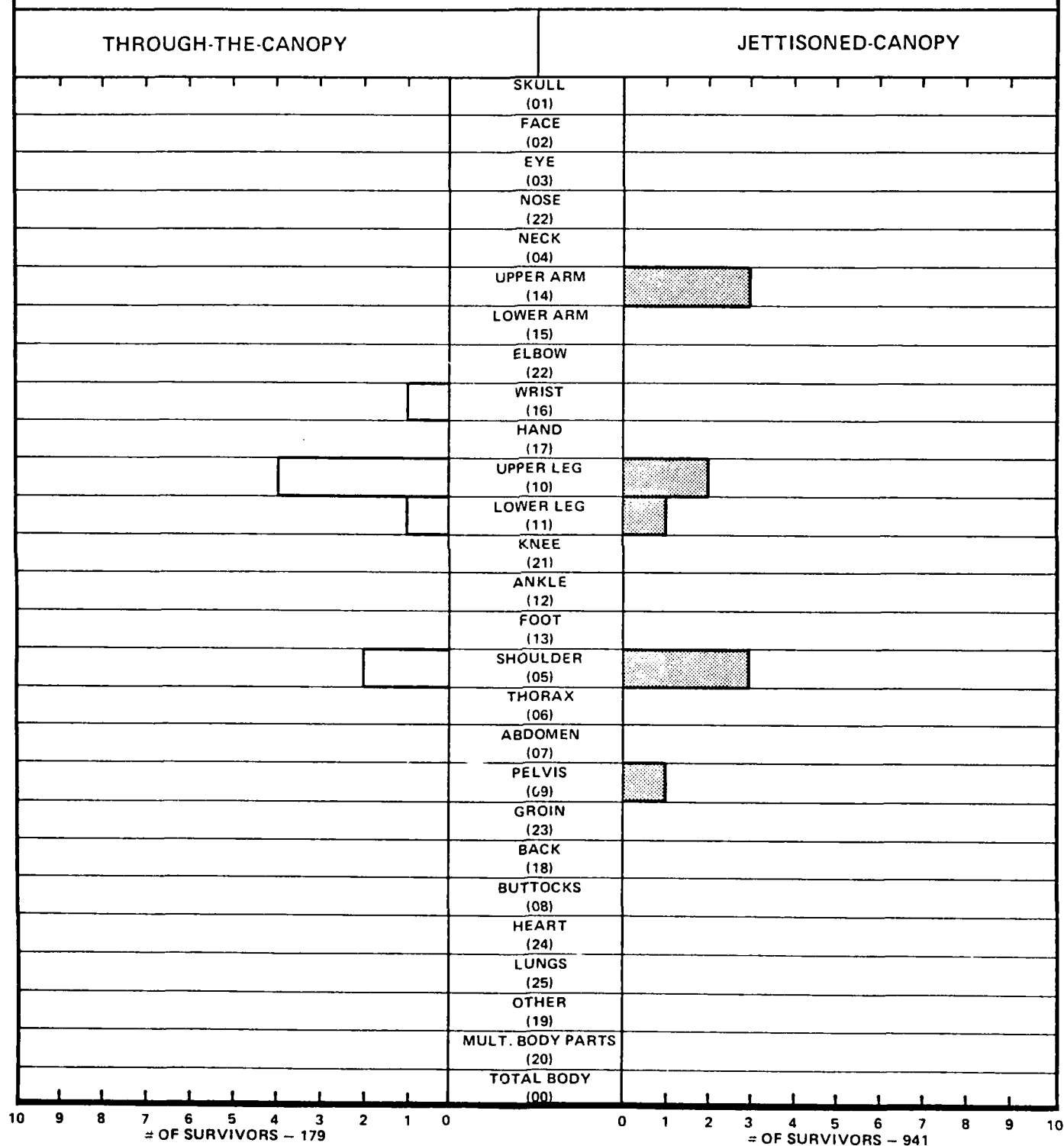
INJURY DIAGNOSIS: AVULSION



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

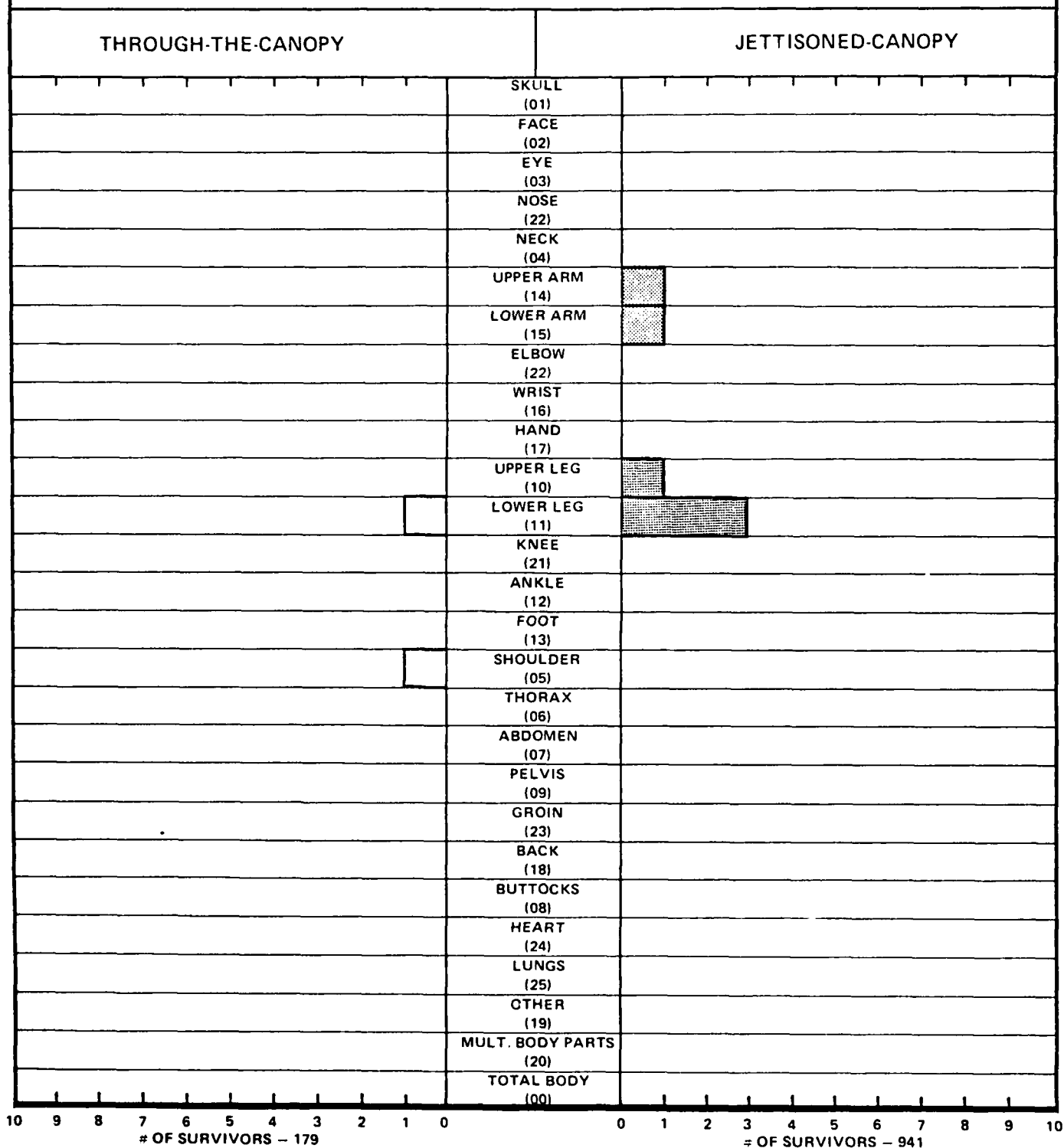
**INJURY DIAGNOSIS: COMMINUTED
FRACTURE**



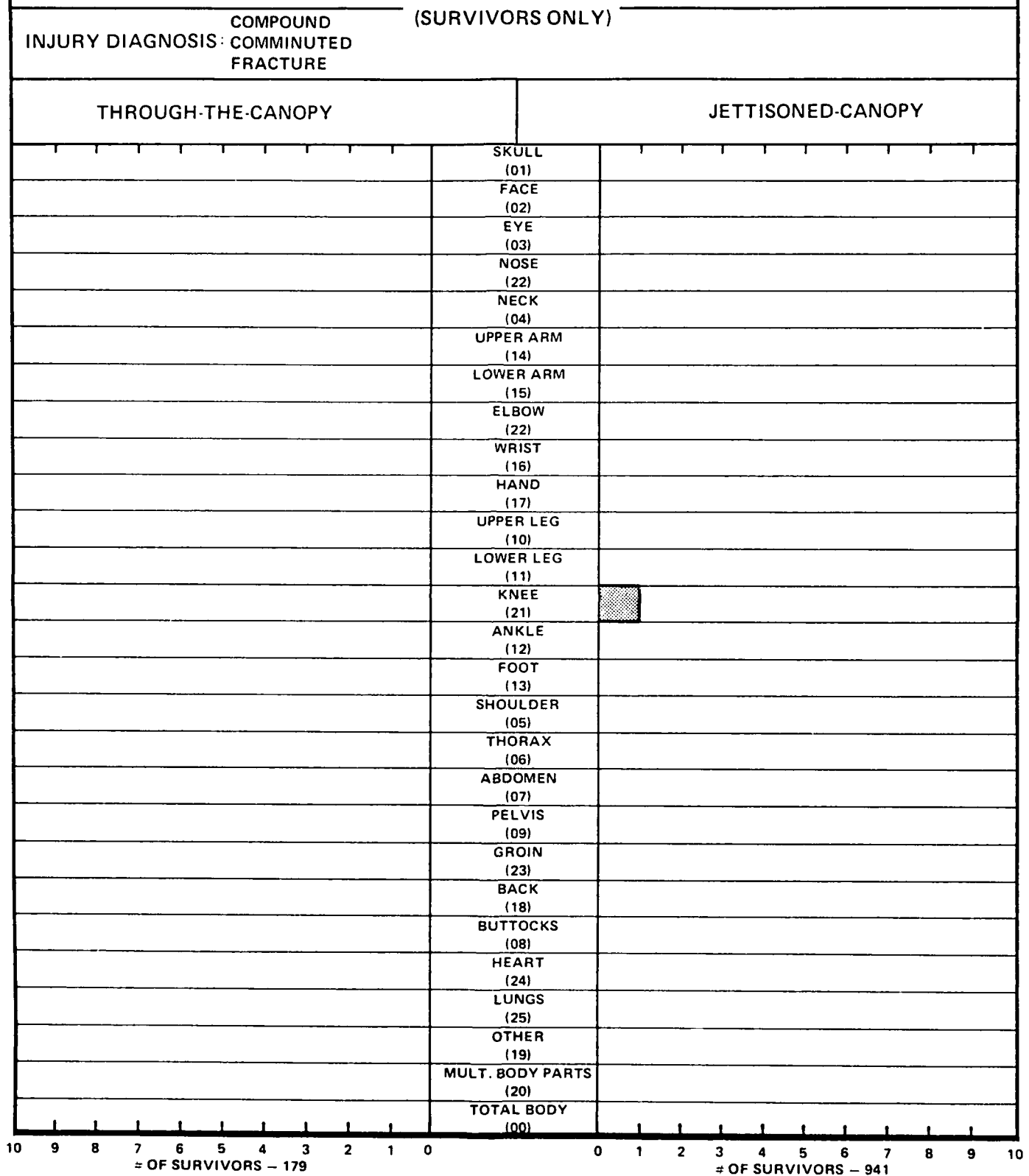
**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

**INJURY DIAGNOSIS: COMPOUND
FRACTURE**

(SURVIVORS ONLY)

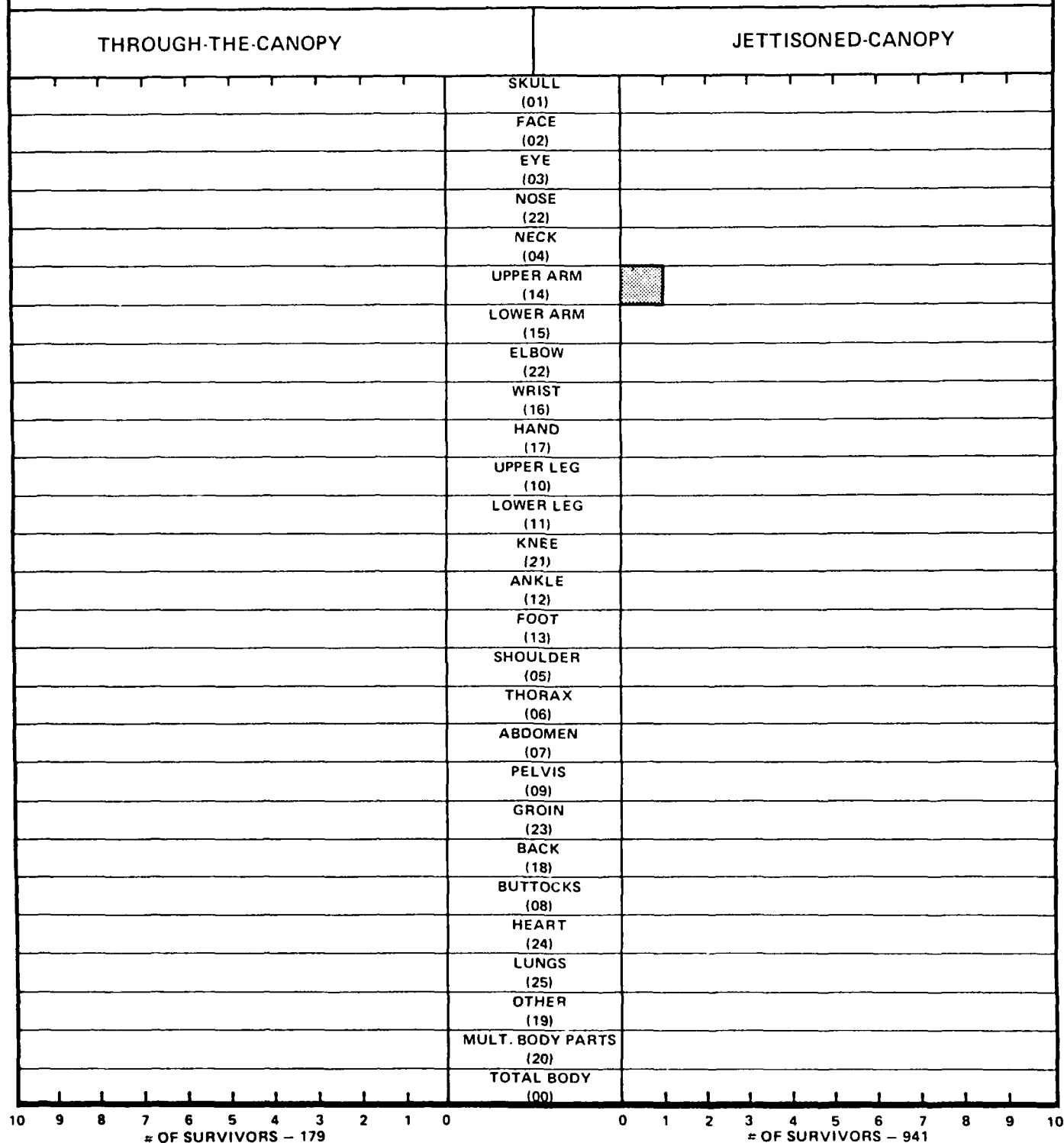


**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

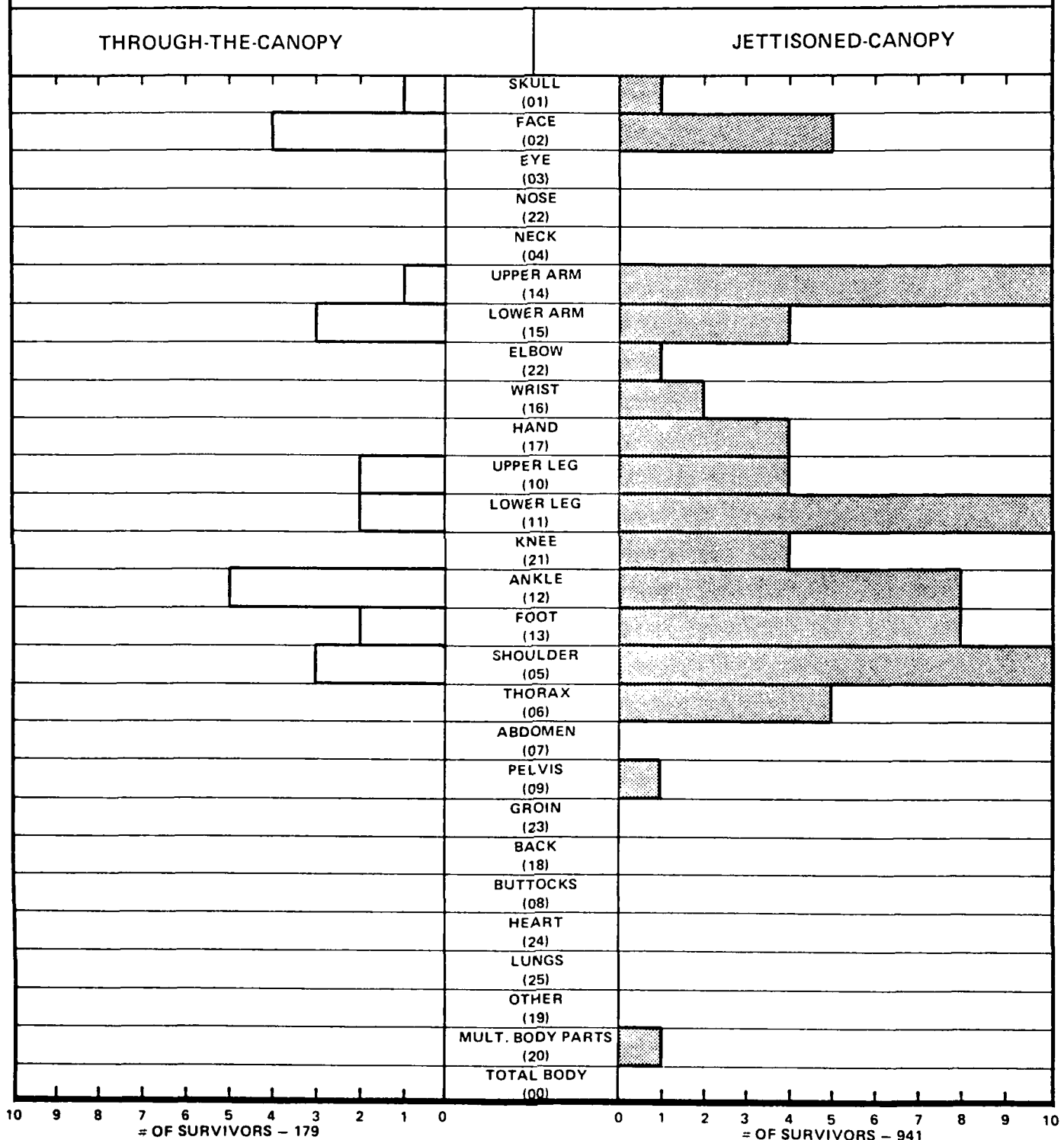
(SURVIVORS ONLY)

INJURY DIAGNOSIS: COMPRESSION
FRACTURE

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

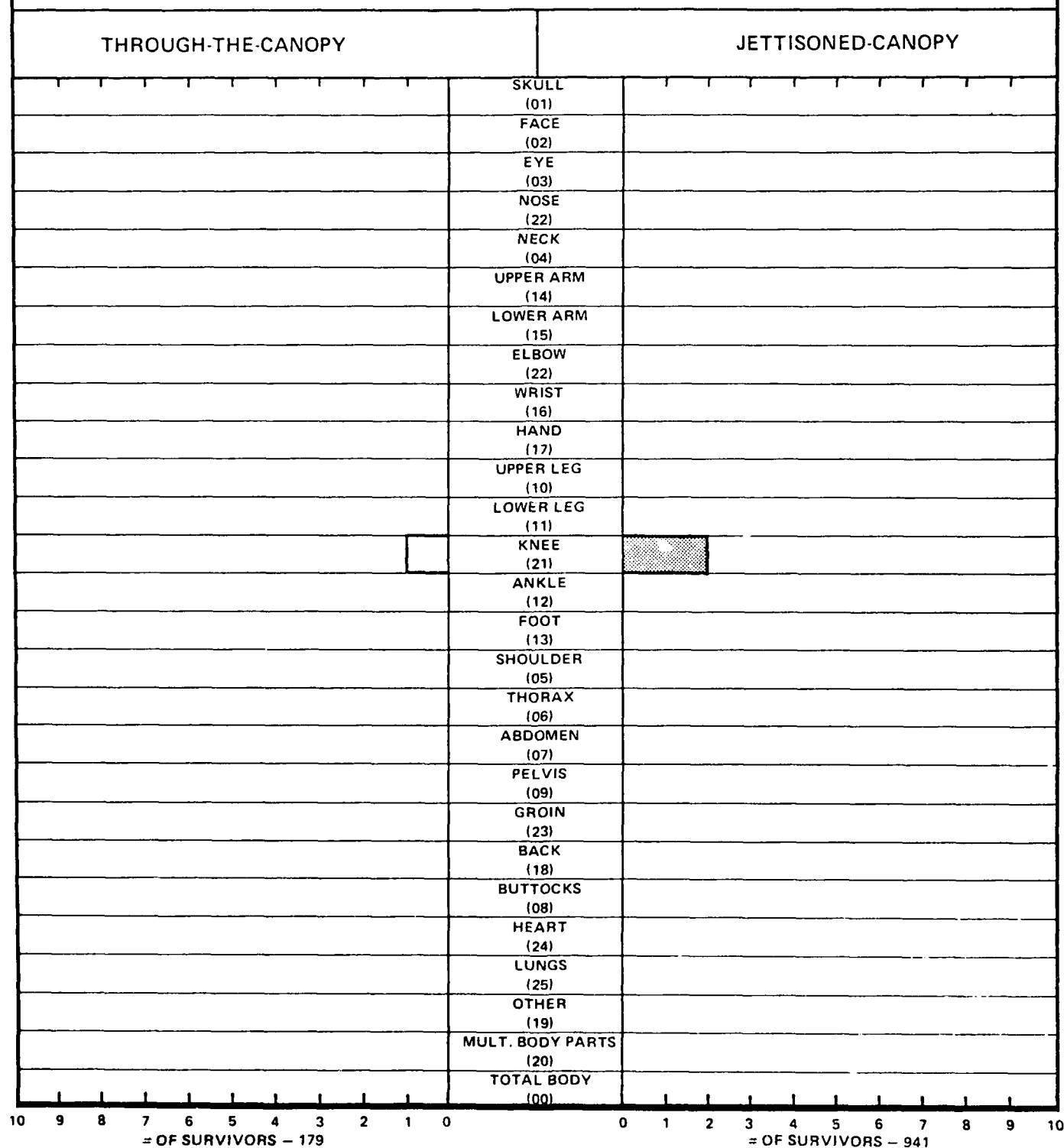
INJURY DIAGNOSIS: SIMPLE FRACTURE



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

INJURY DIAGNOSIS: DERANGEMENT



ND-A171 659

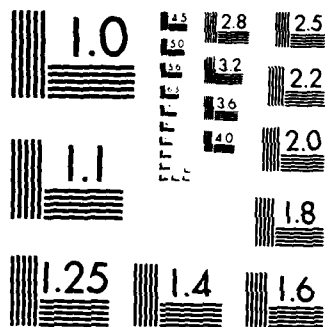
**AIRCRAFT AUTOMATED ESCAPE SYSTEMS (AAES) DATA ANALYSIS
PROGRAM SYMPOSIUM H. (U) NAVAL SAFETY CENTER NORFOLK VA
1981**

2/4

UNCLASSIFIED

F/G 1/3

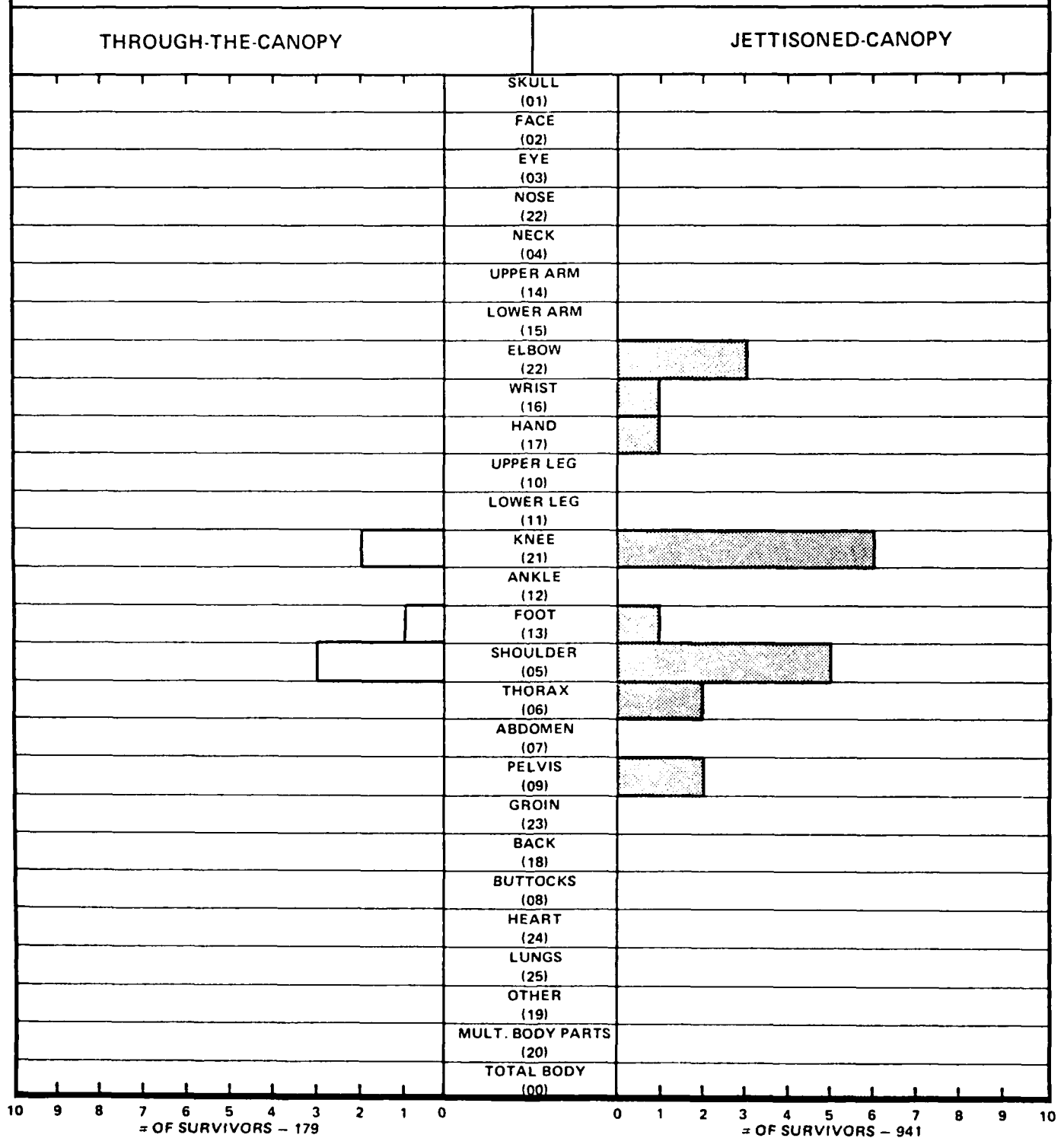
ML



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

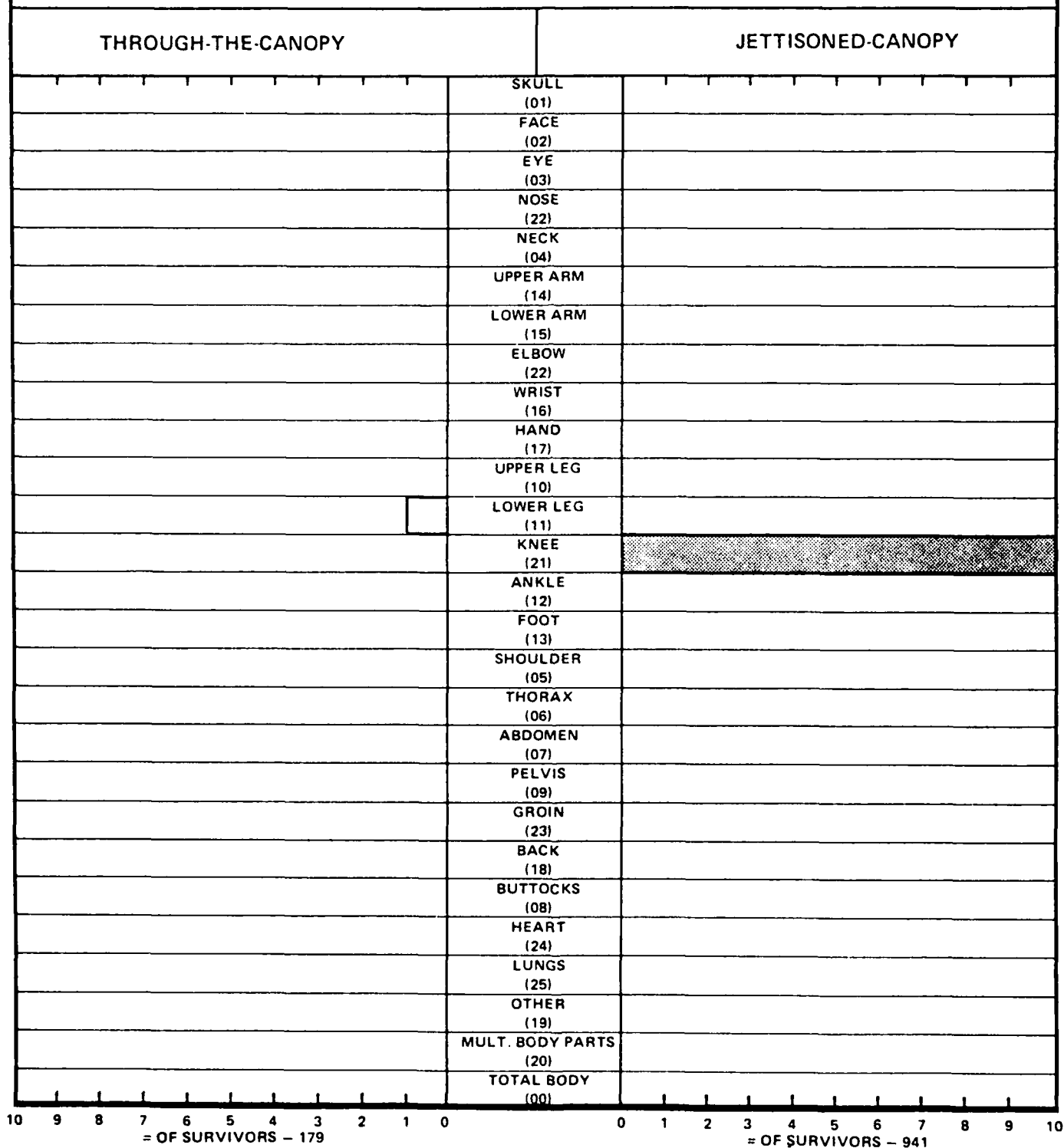
**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS
(SURVIVORS ONLY)**

INJURY DIAGNOSIS: DISLOCATION



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

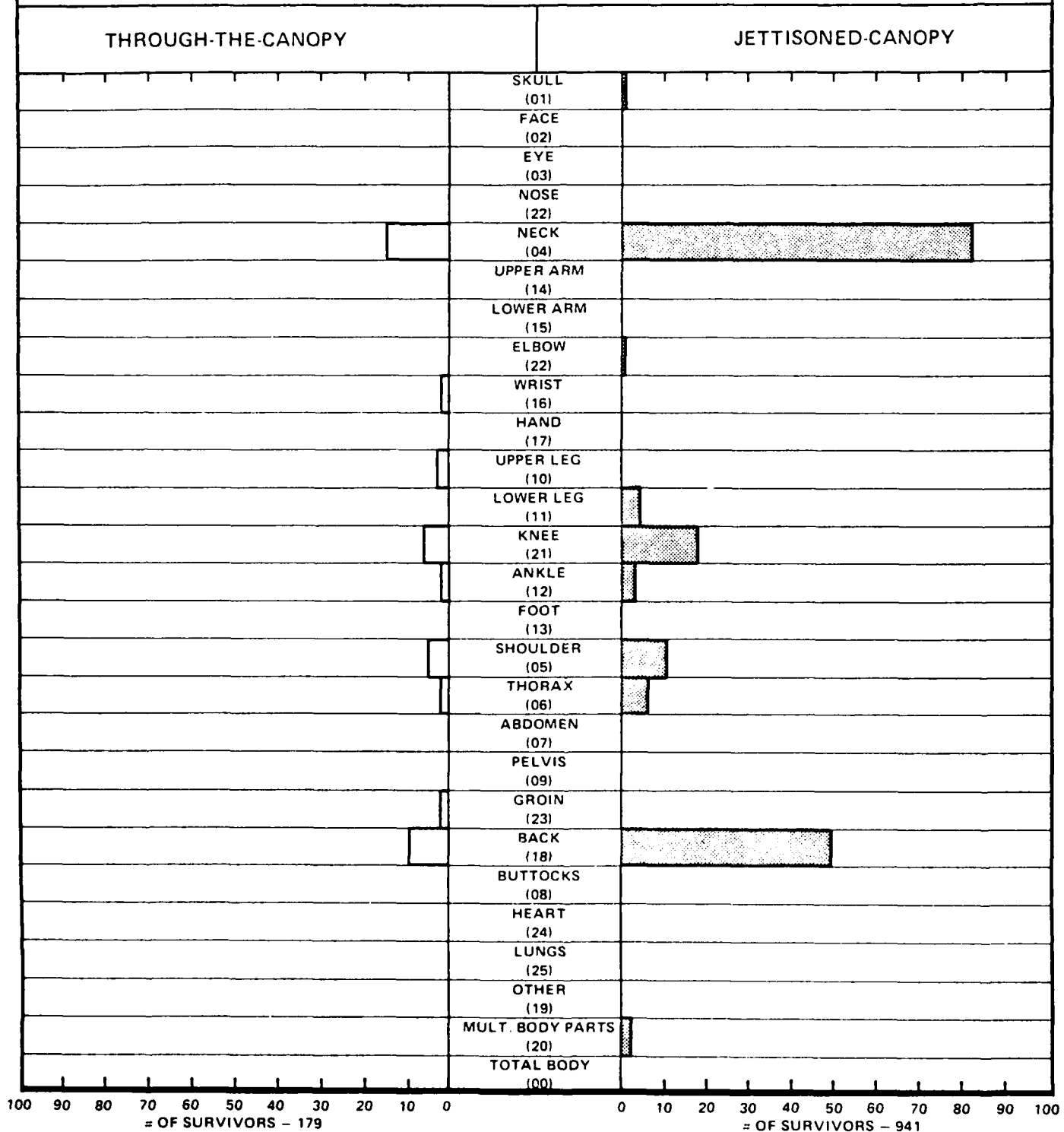
INJURY DIAGNOSIS: TEAR MUSCLE/
LIGAMENT

JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

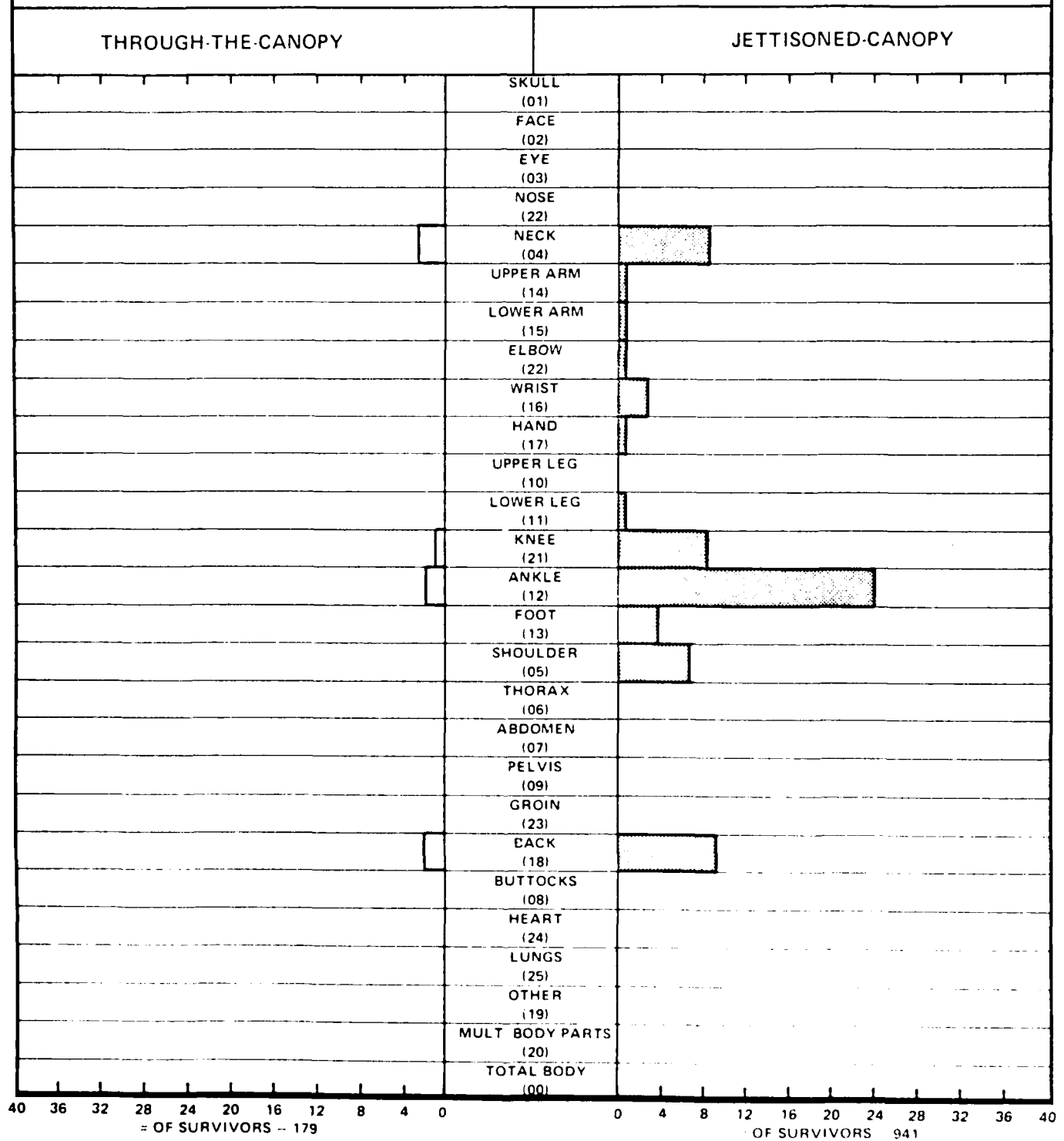
(SURVIVORS ONLY)

INJURY DIAGNOSIS: STRAIN



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

INJURY DIAGNOSIS: **SPRAIN**

JANUARY 1969 – DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

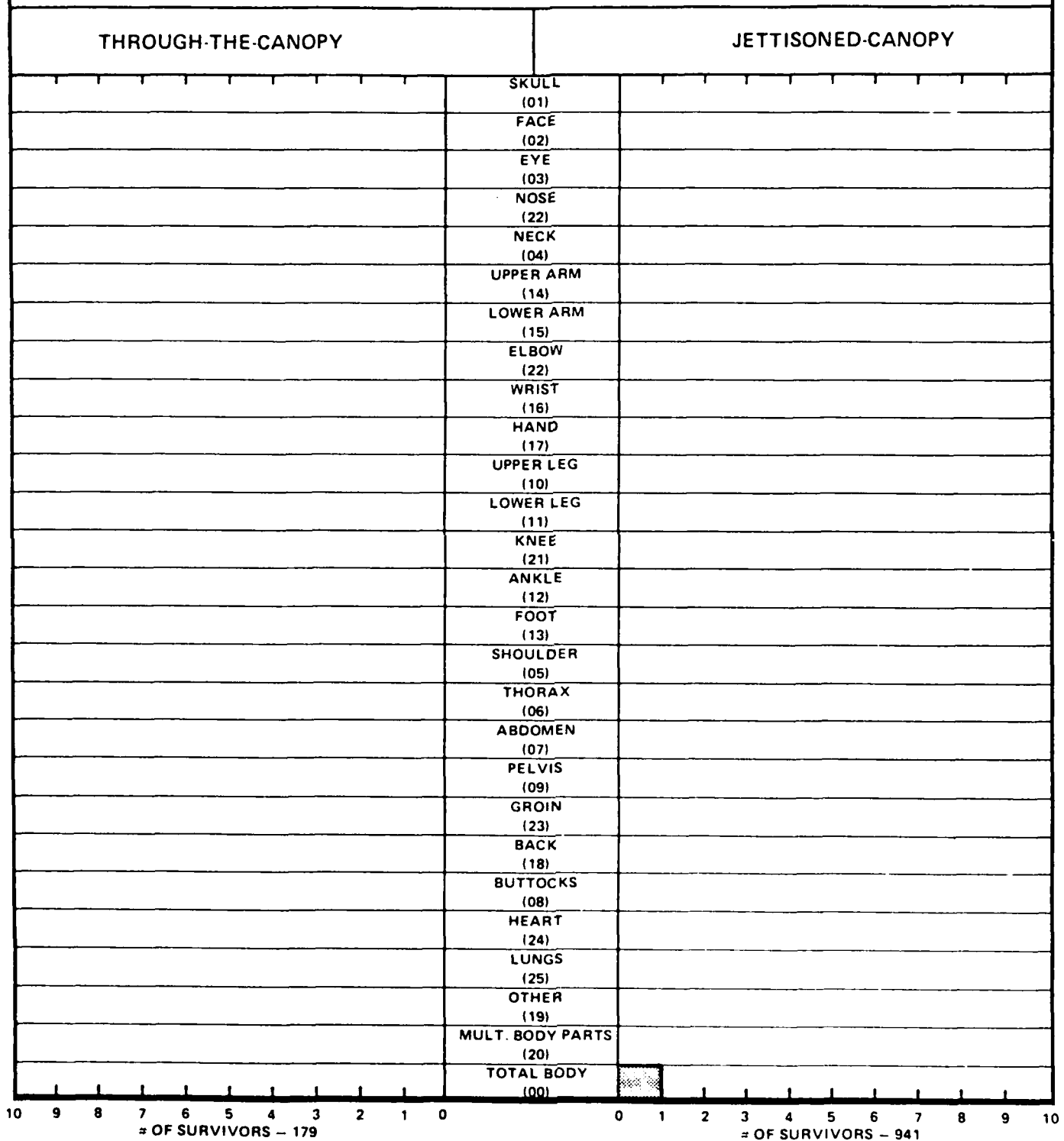
INJURY DIAGNOSIS: CONCUSSION

THROUGH-THE-CANOPY											JETTISONED-CANOPY										
											SKULL (01)										
											FACE (02)										
											EYE (03)										
											NOSE (22)										
											NECK (04)										
											UPPER ARM (14)										
											LOWER ARM (15)										
											ELBOW (22)										
											WRIST (16)										
											HAND (17)										
											UPPER LEG (10)										
											LOWER LEG (11)										
											KNEE (21)										
											ANKLE (12)										
											FOOT (13)										
											SHOULDER (05)										
											THORAX (06)										
											ABDOMEN (07)										
											PELVIS (09)										
											GROIN (23)										
											BACK (18)										
											BUTTOCKS (08)										
											HEART (24)										
											LUNGS (25)										
											OTHER (19)										
											MULT. BODY PARTS (20)										
											TOTAL BODY (00)										
10 9 8 7 6 5 4 3 2 1 0											0 1 2 3 4 5 6 7 8 9 10										
# OF SURVIVORS - 179											# OF SURVIVORS - 941										

**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

INJURY DIAGNOSIS: UNCONSCIOUSNESS

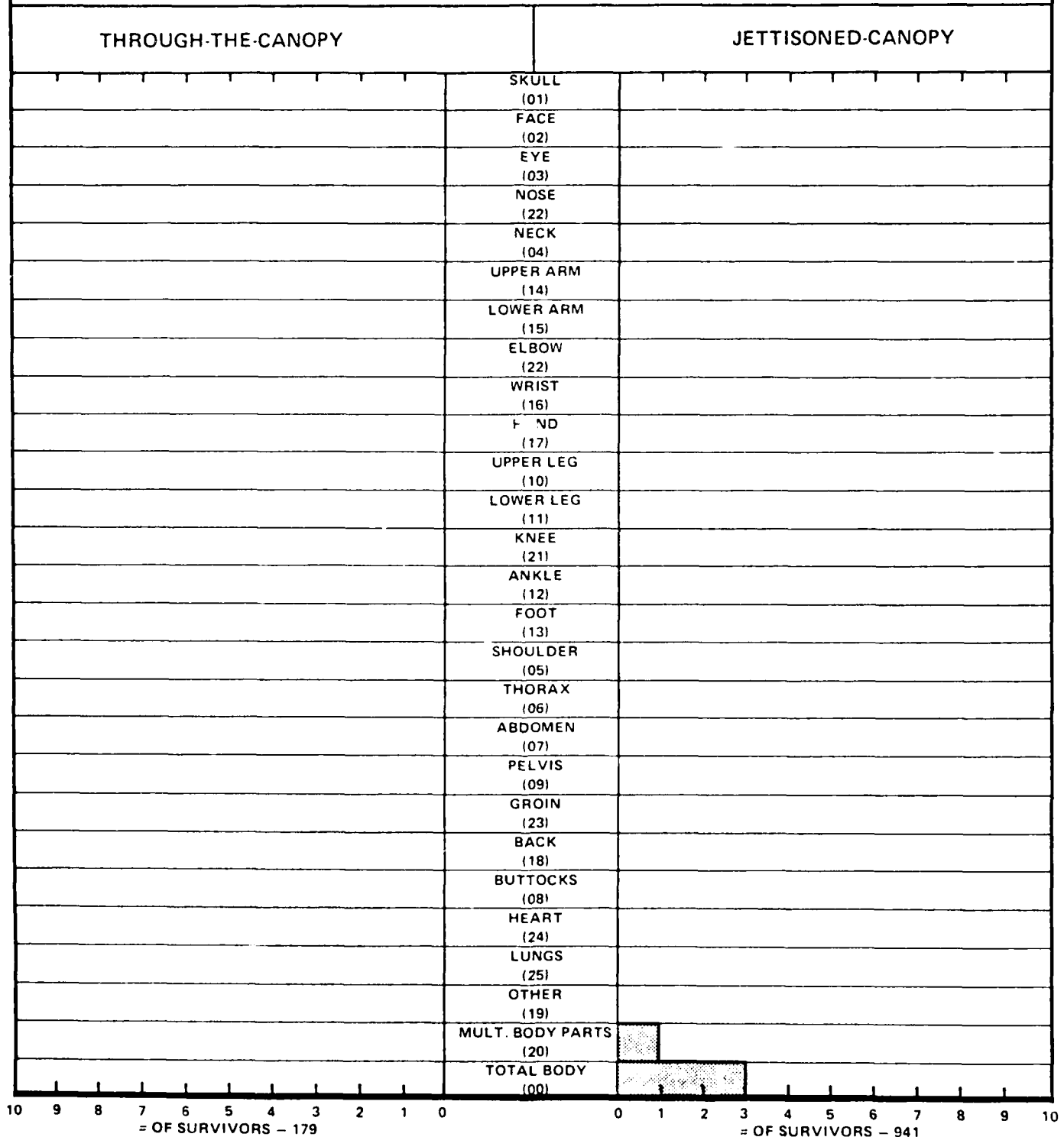


JANUARY 1969 - DECEMBER 1979

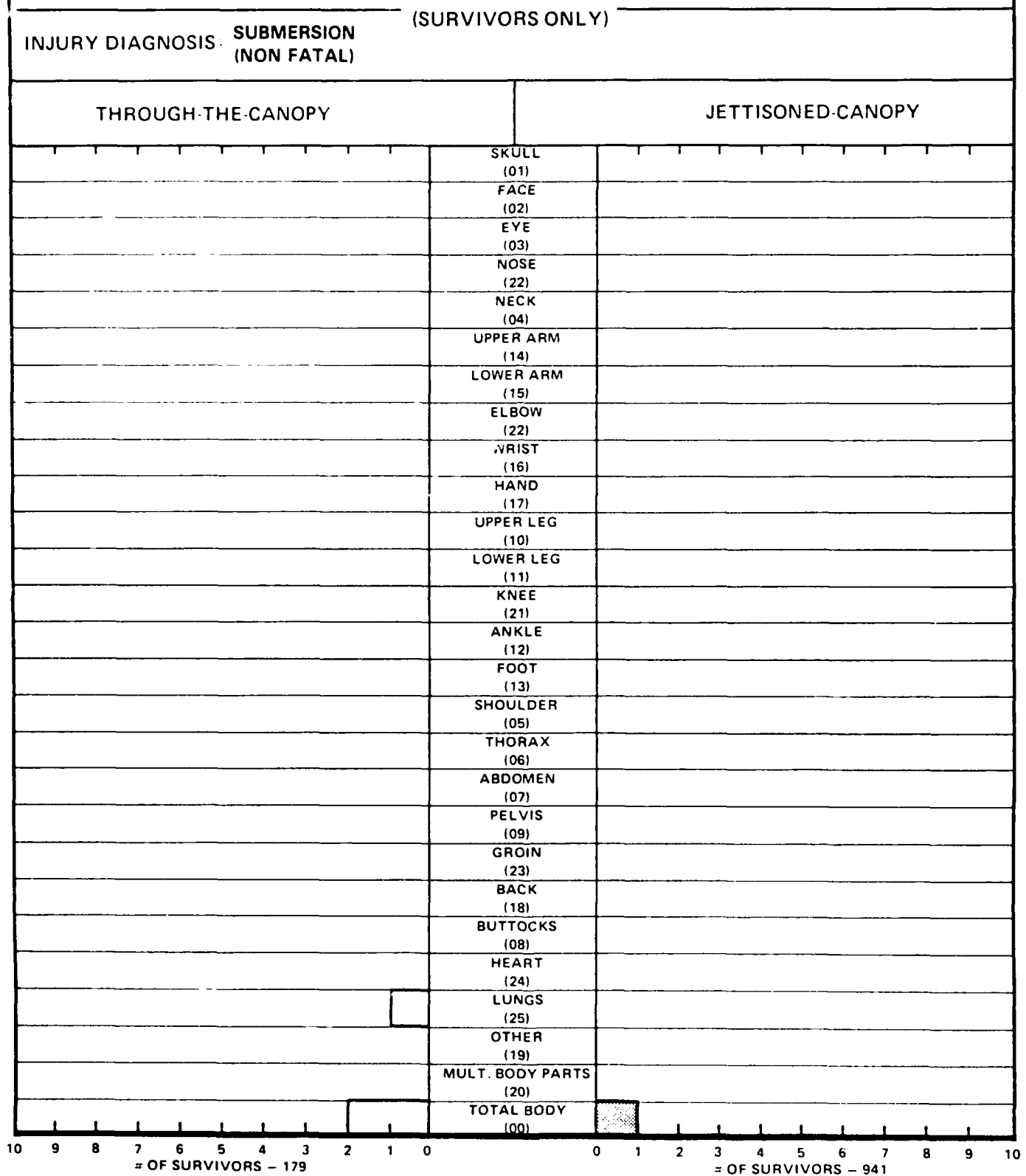
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

INJURY DIAGNOSIS: COLD INJURY

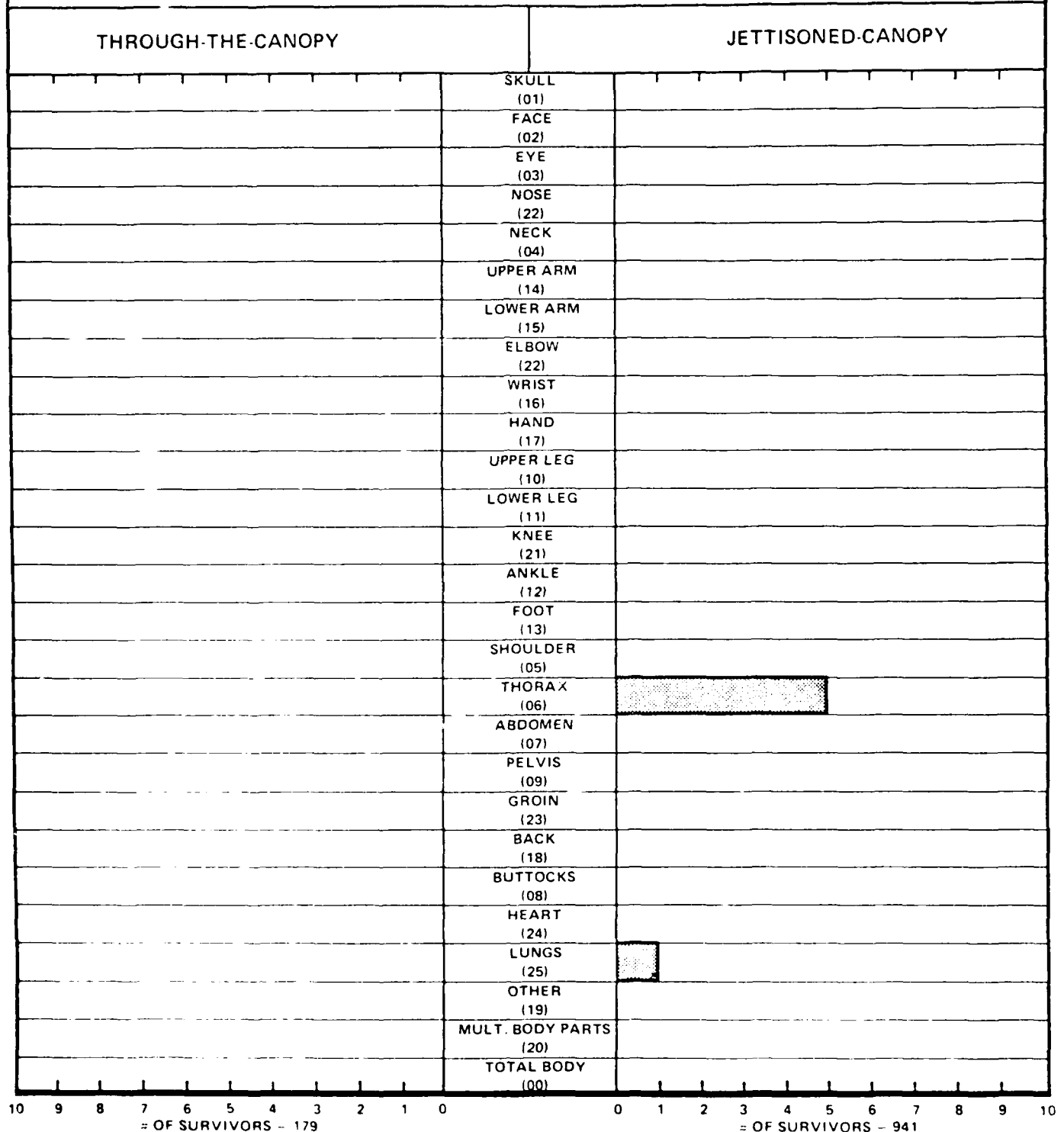


**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

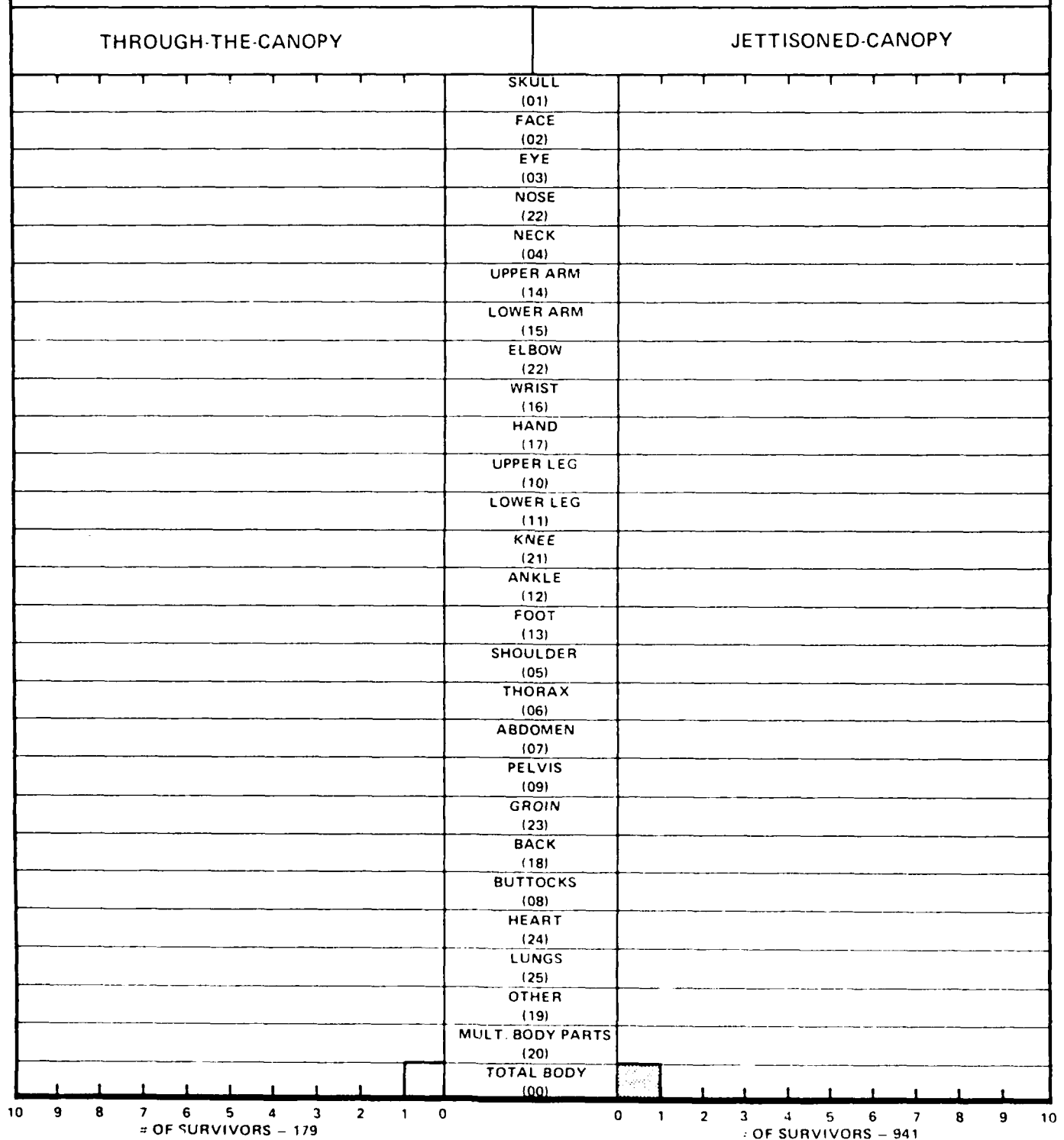
INJURY DIAGNOSIS: **PNEUMO/HEMO-THORAX** (SURVIVORS ONLY)



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

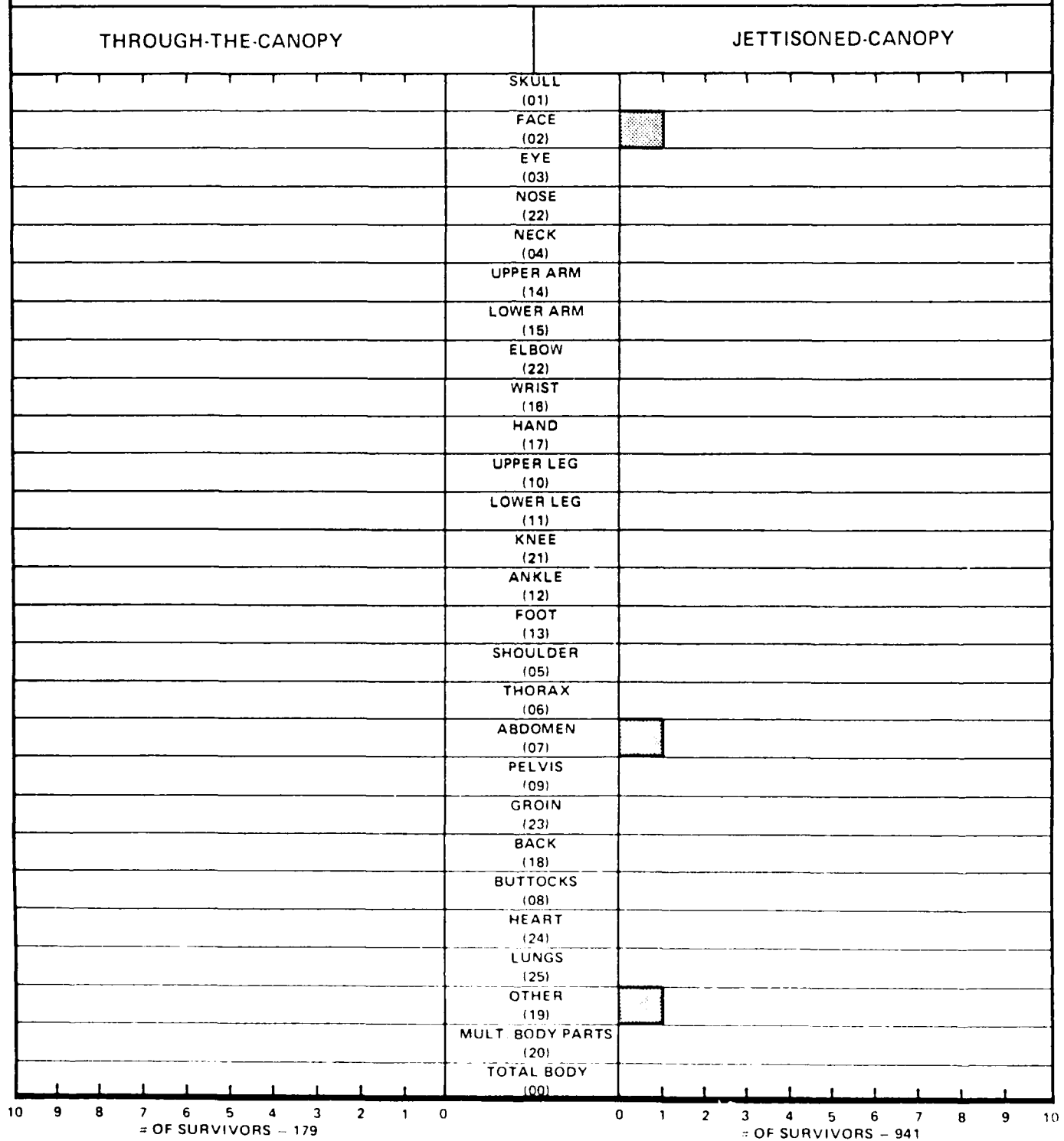
INJURY DIAGNOSIS: TRAUMATIC SHOCK



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

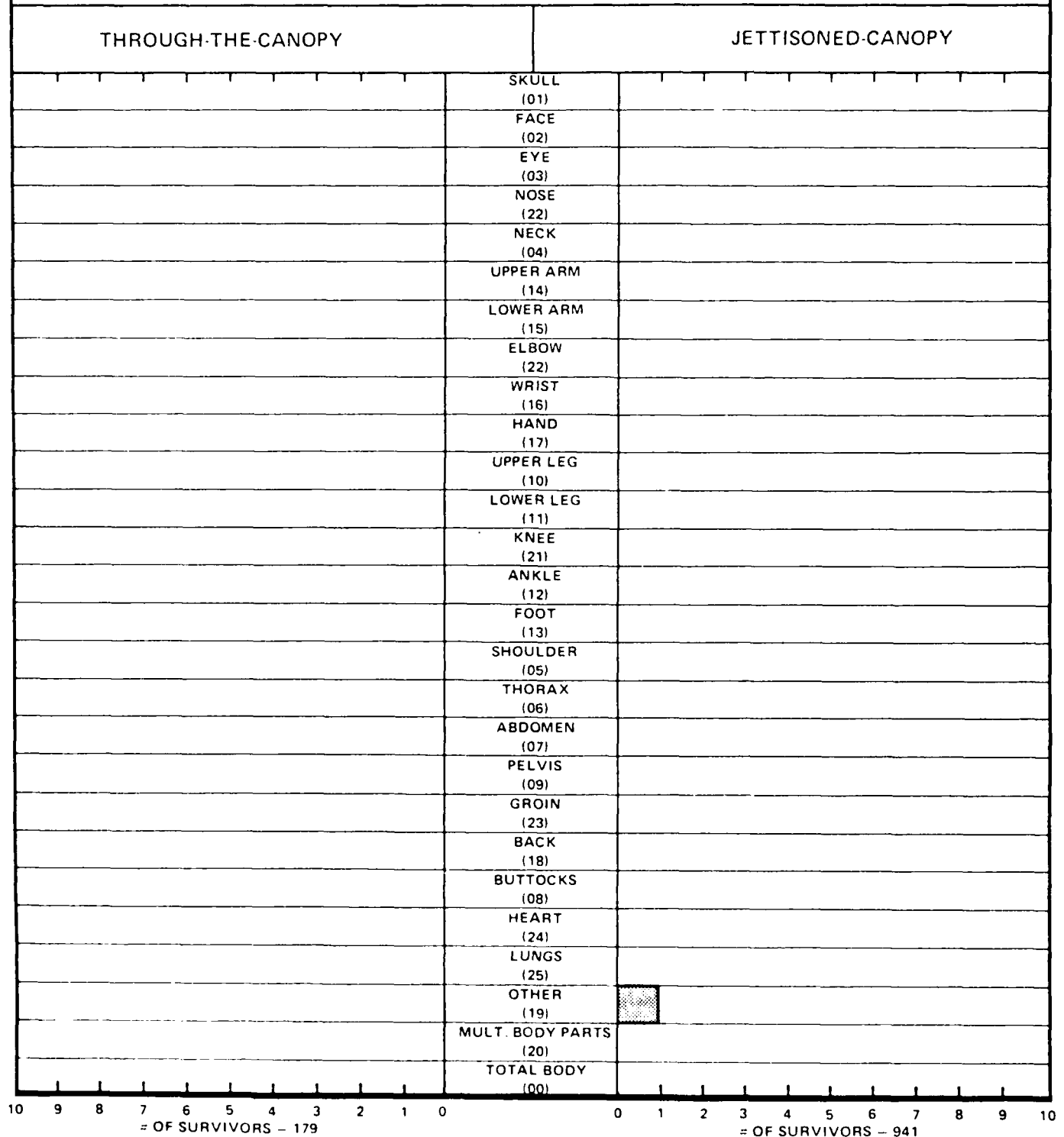
INJURY DIAGNOSIS: INTERNAL INJURY



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

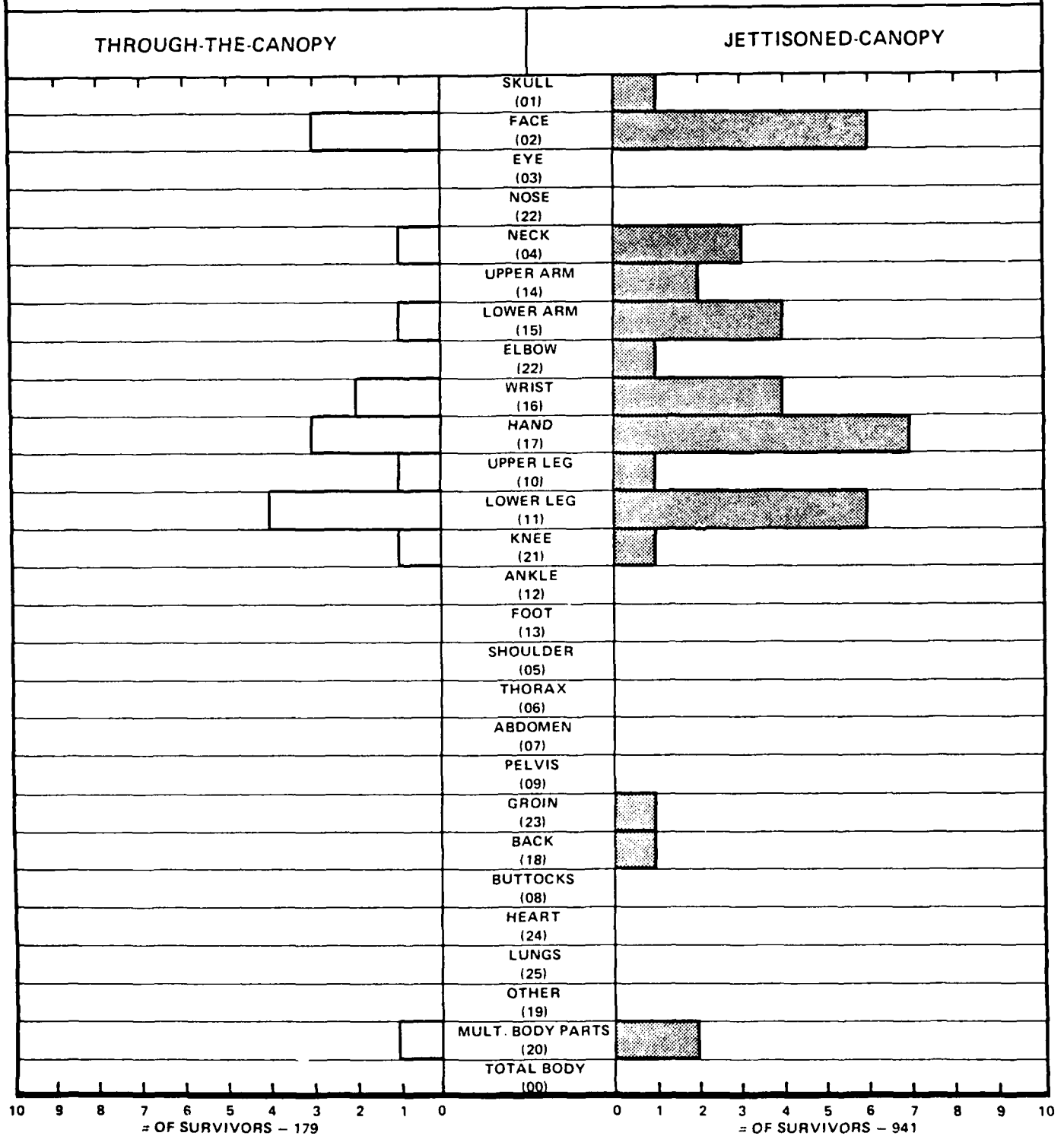
INJURY DIAGNOSIS: RUPTURE



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

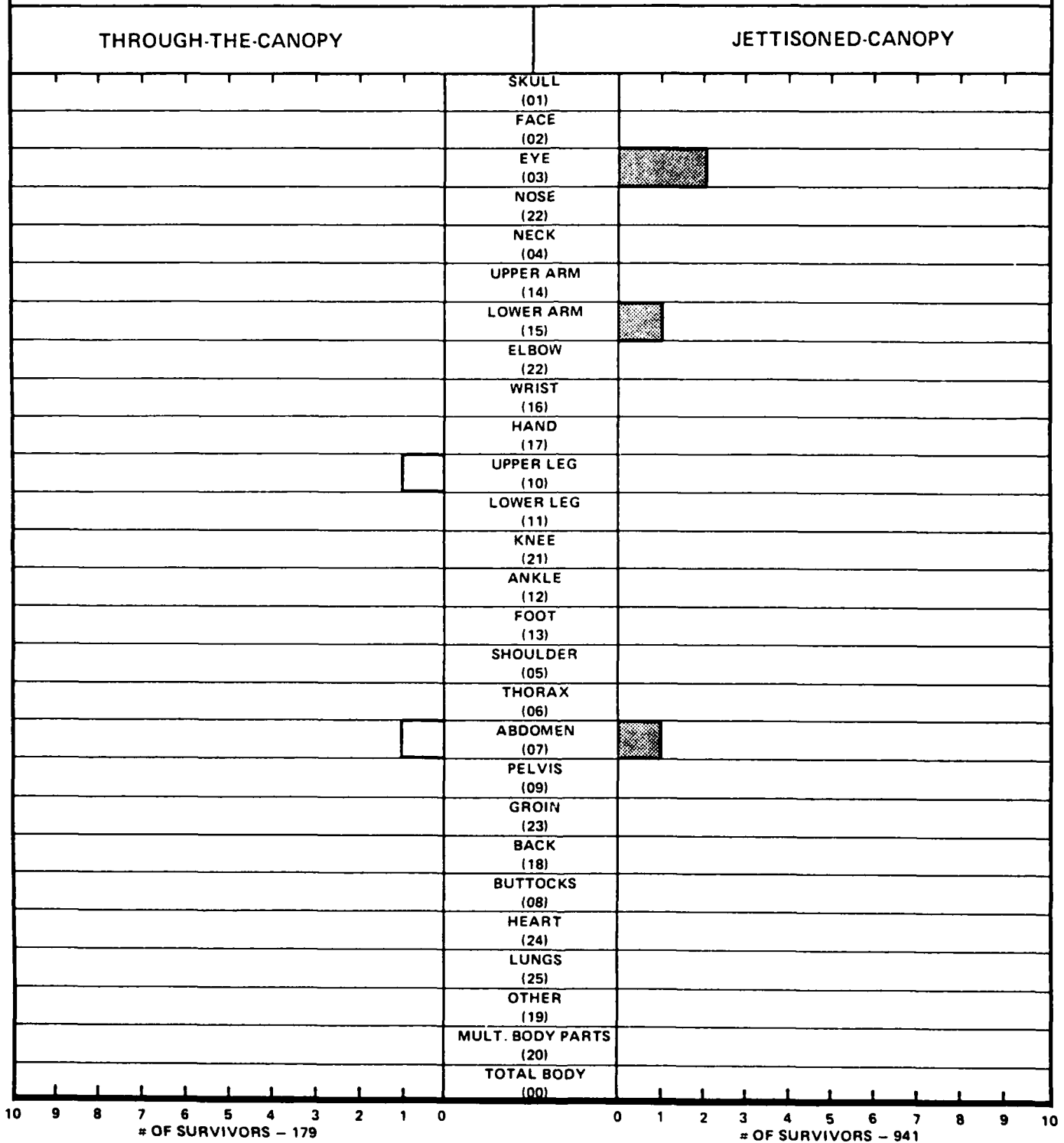
(SURVIVORS ONLY)

INJURY DIAGNOSIS: THERMAL BURN



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

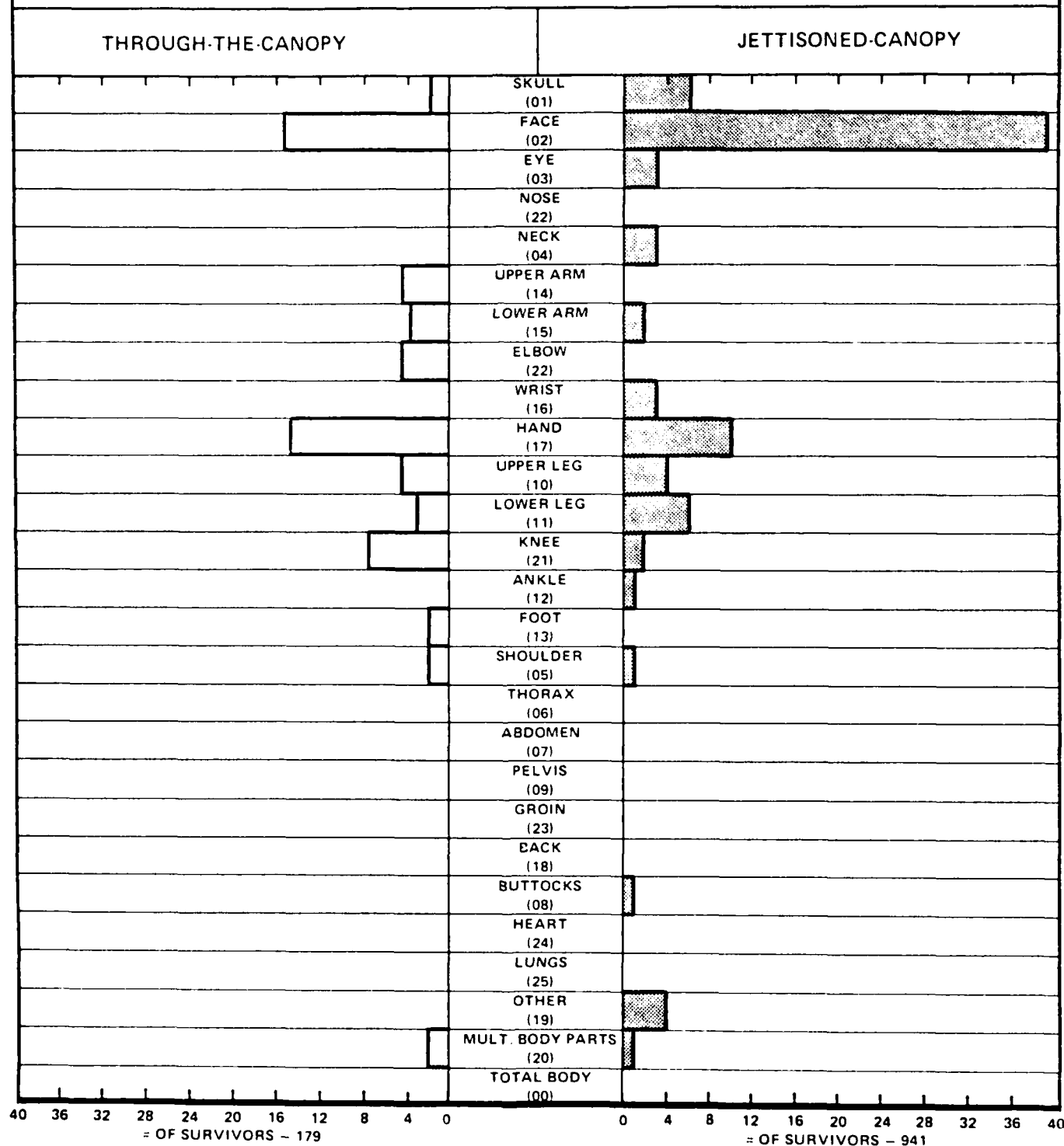
**INJURY DIAGNOSIS: FOREIGN BODY
IN ORIFICE** (SURVIVORS ONLY)



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

INJURY DIAGNOSIS: LACERATION

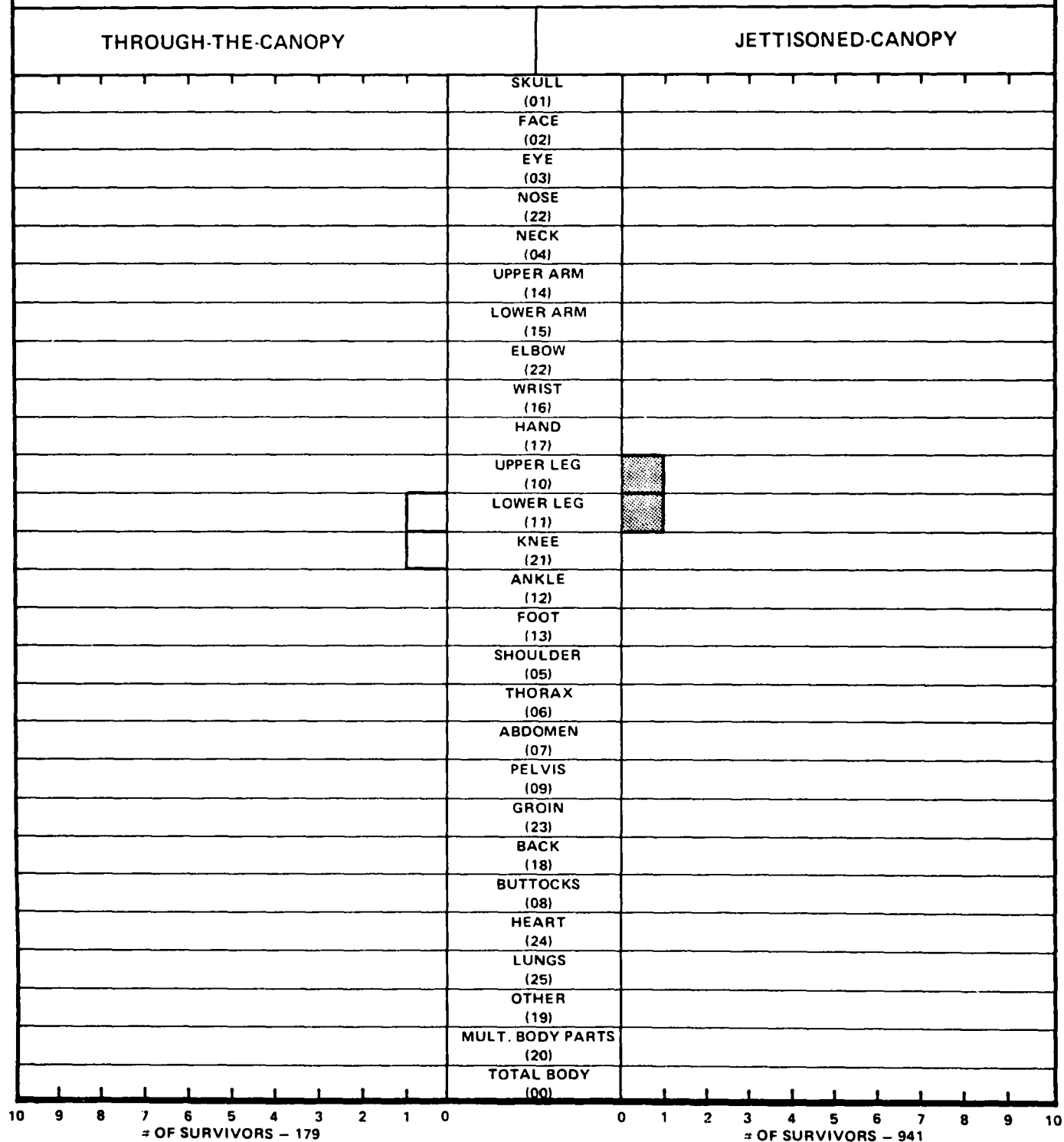


JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

INJURY DIAGNOSIS: PERFORATION



JANUARY 1969 – DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

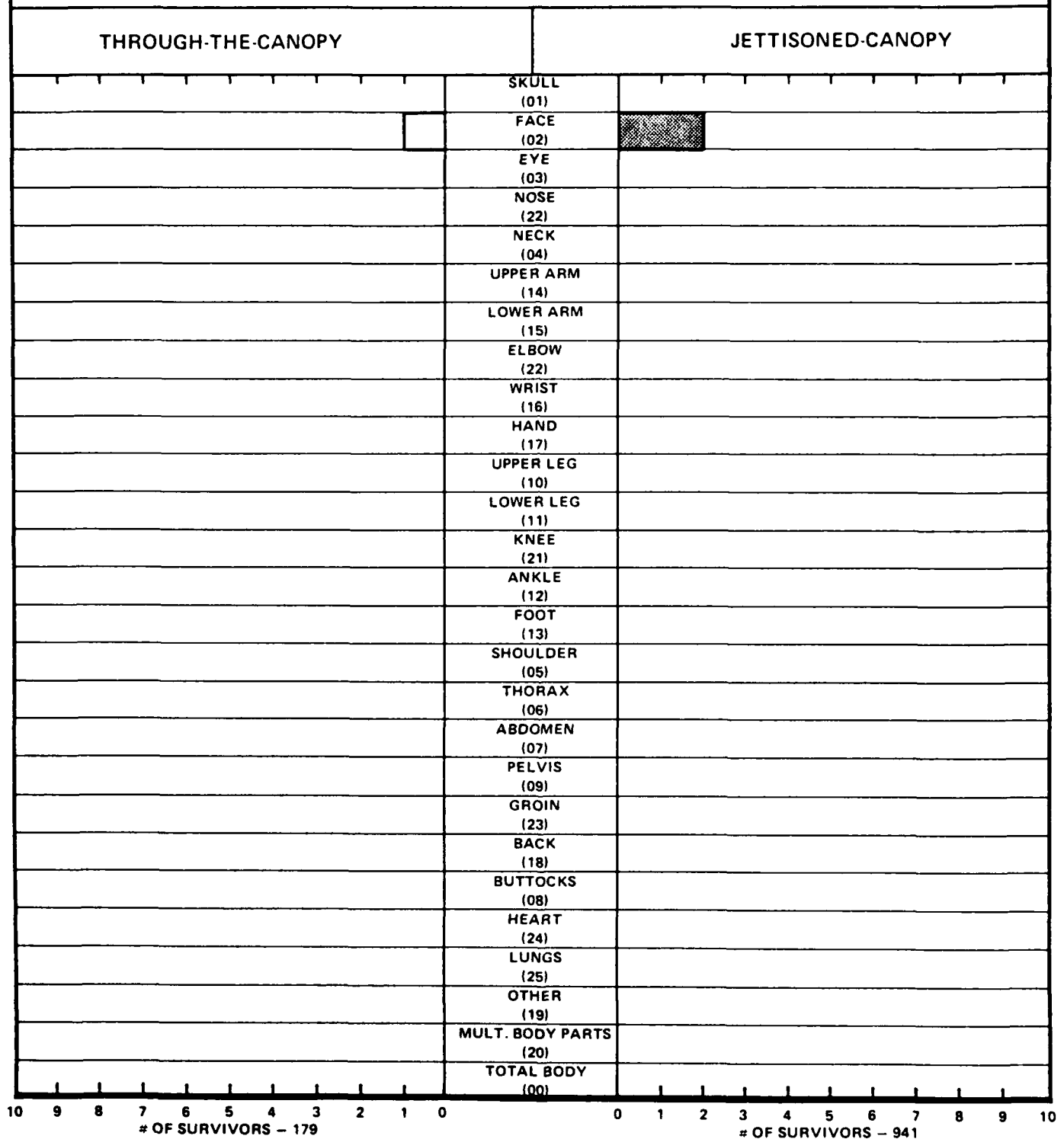
(SURVIVORS ONLY)

INJURY DIAGNOSIS: SCRATCH

THROUGH-THE-CANOPY											JETTISONED-CANOPY											
											SKULL											
											(01)											
											FACE											
											(02)											
											EYE											
											(03)											
											NOSE											
											(22)											
											NECK											
											(04)											
											UPPER ARM											
											(14)											
											LOWER ARM											
											(15)											
											ELBOW											
											(22)											
											WRIST											
											(16)											
											HAND											
											(17)											
											UPPER LEG											
											(10)											
											LOWER LEG											
											(11)											
											KNEE											
											(21)											
											ANKLE											
											(12)											
											FOOT											
											(13)											
											SHOULDER											
											(05)											
											THORAX											
											(06)											
											ABDOMEN											
											(07)											
											PELVIS											
											(09)											
											GROIN											
											(23)											
											BACK											
											(18)											
											BUTTOCKS											
											(08)											
											HEART											
											(24)											
											LUNGS											
											(25)											
											OTHER											
											(19)											
											MULT. BODY PARTS											
											(20)											
											TOTAL BODY											
											(00)											
10	9	8	7	6	5	4	3	2	1	0	0	1	2	3	4	5	6	7	8	9	10	
# OF SURVIVORS - 179											# OF SURVIVORS - 941											

**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

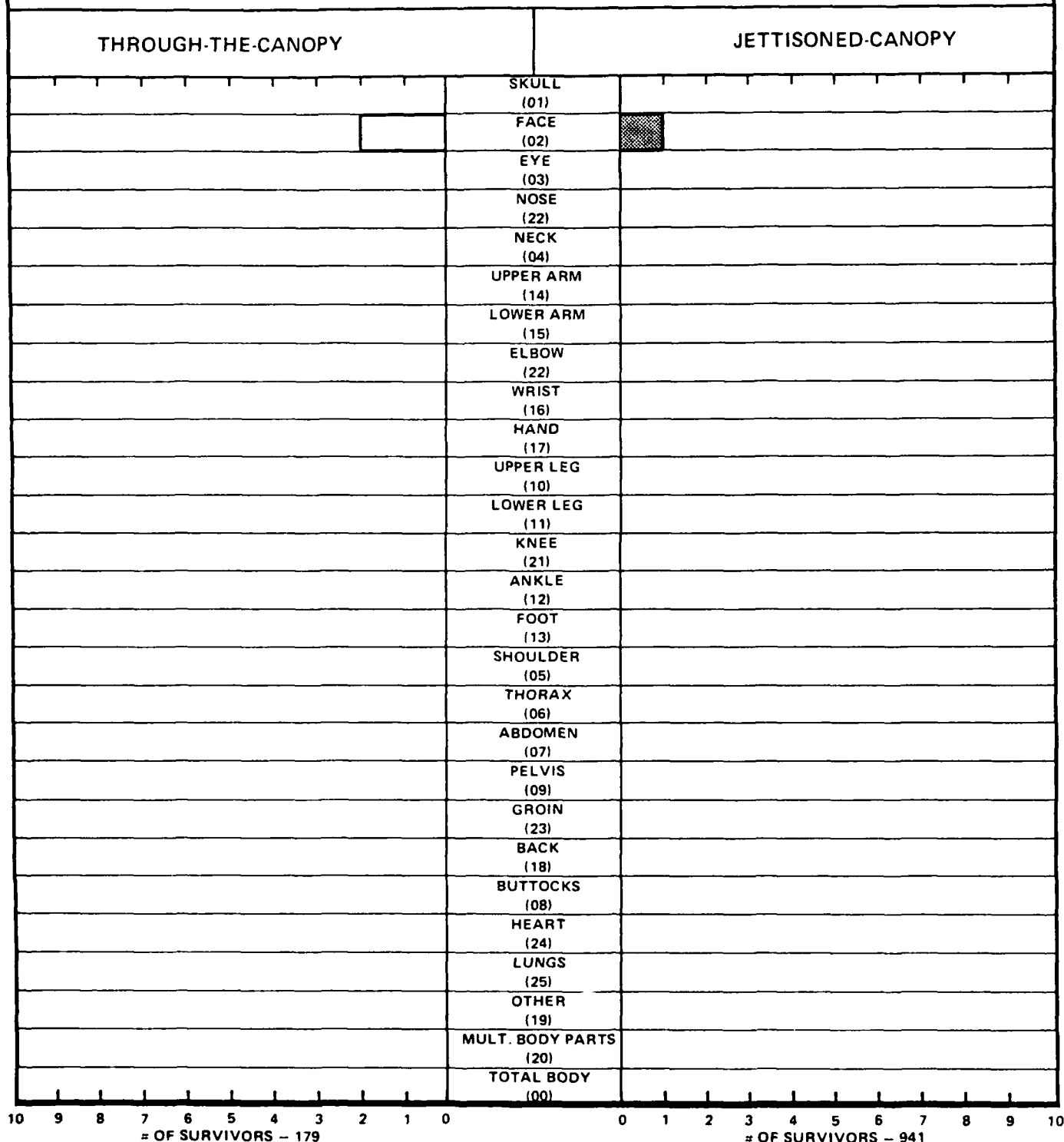
INJURY DIAGNOSIS: BITE (SURVIVORS ONLY)



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

INJURY DIAGNOSIS: ACOUSTIC TRAUMA



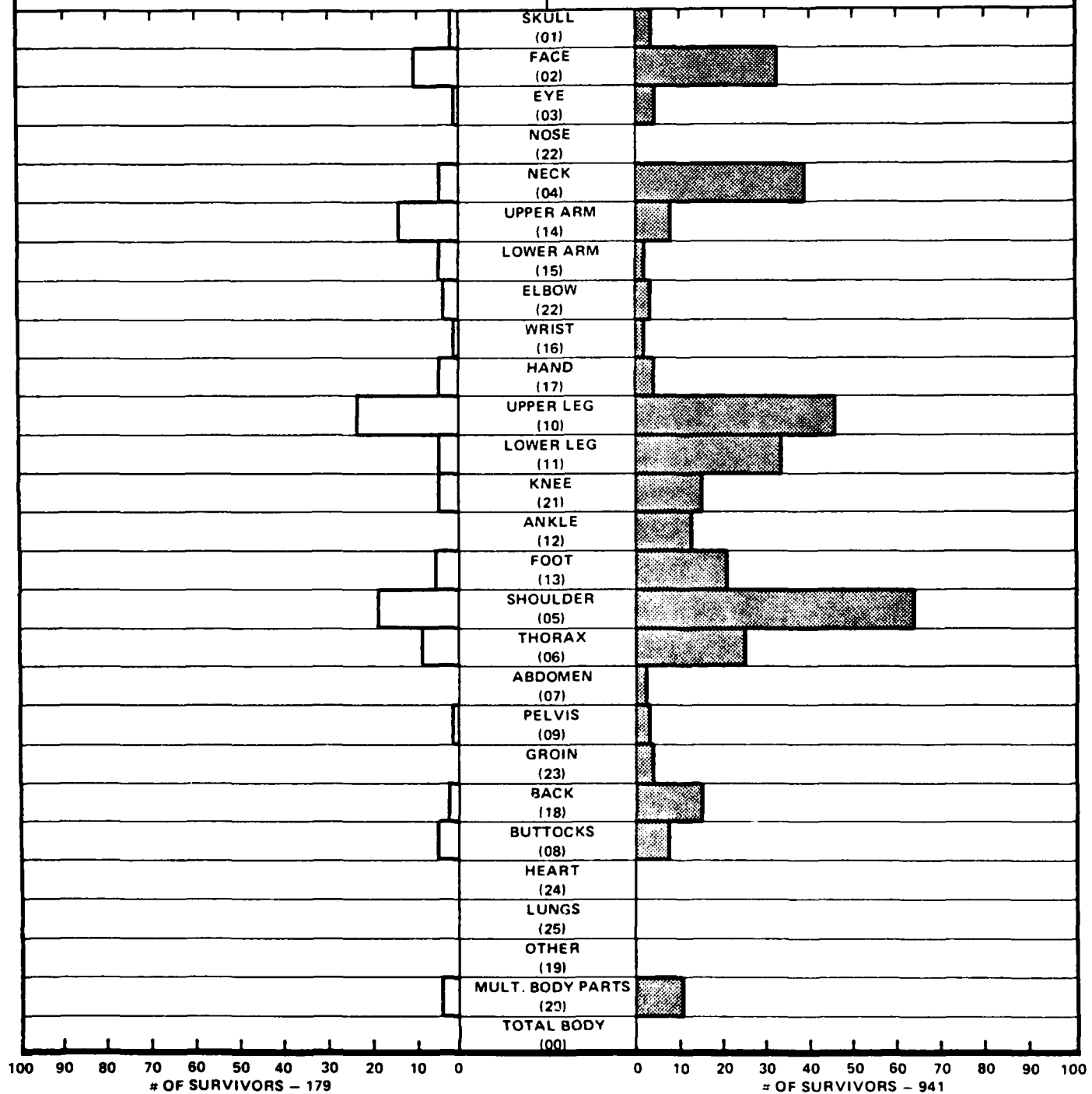
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

INJURY DIAGNOSIS: CONTUSION

THROUGH-THE-CANOPY

JETTISONED-CANOPY

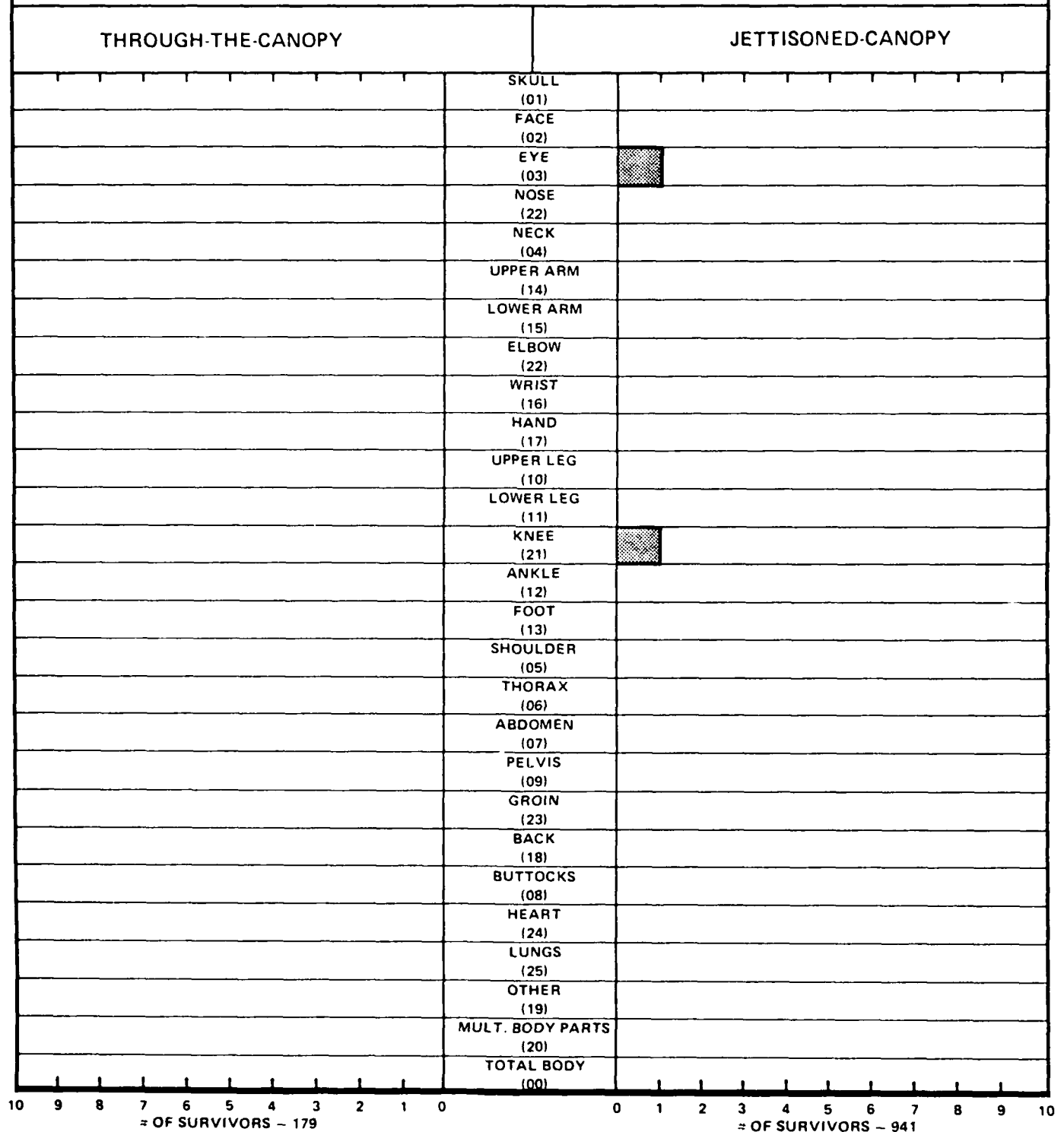


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COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

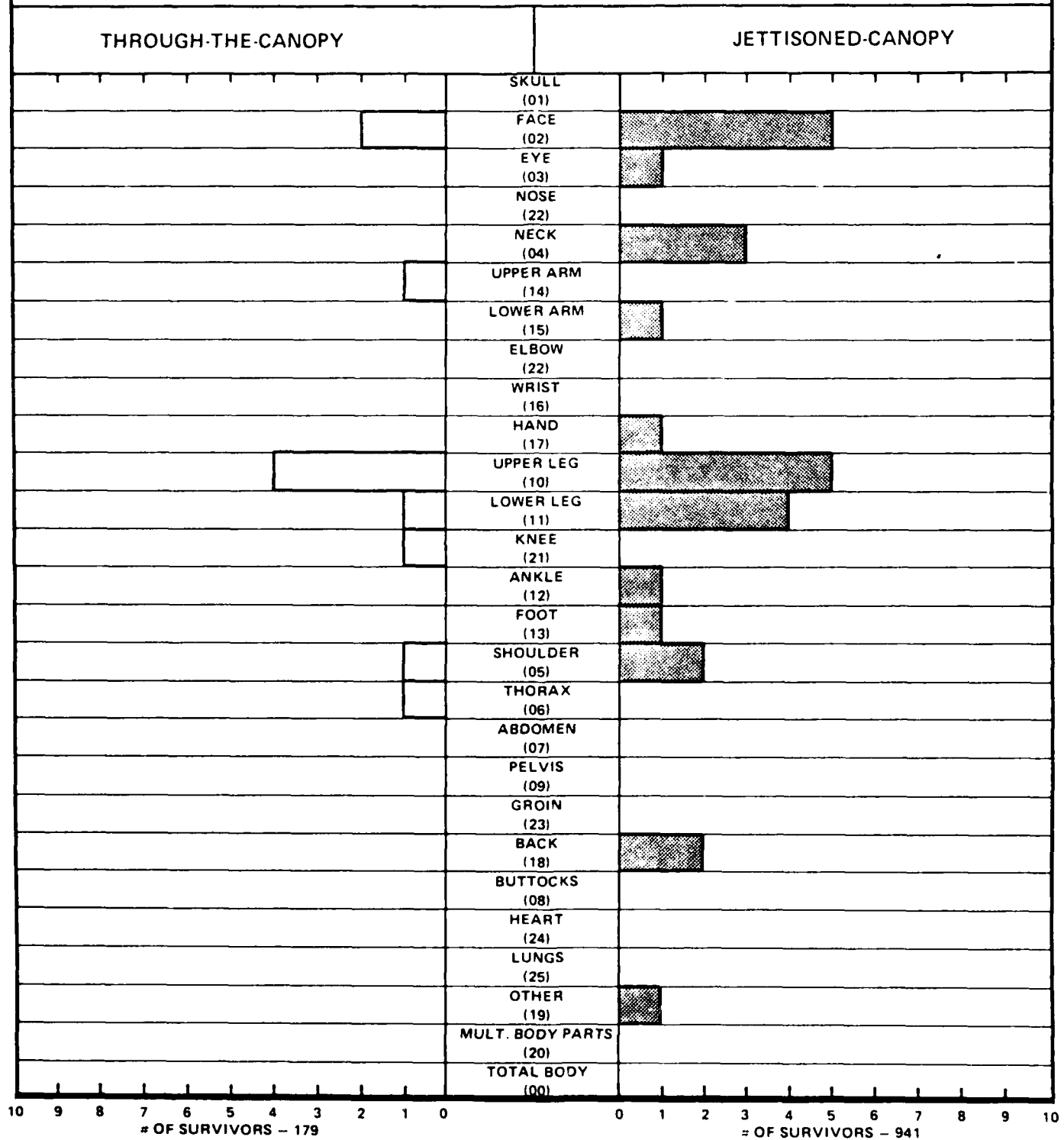
INJURY DIAGNOSIS: EDEMA



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

INJURY DIAGNOSIS: HEMATOMA

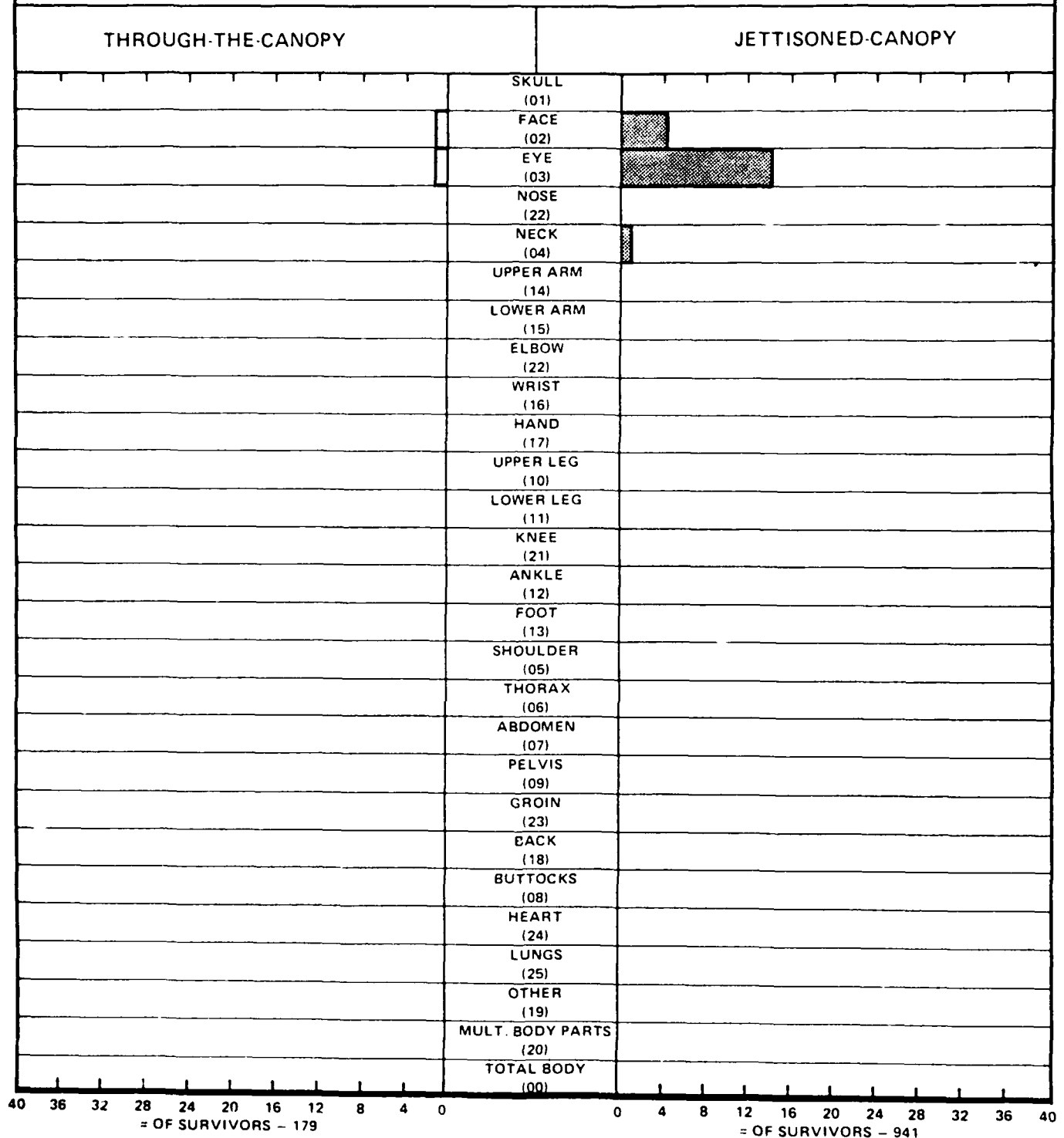


JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

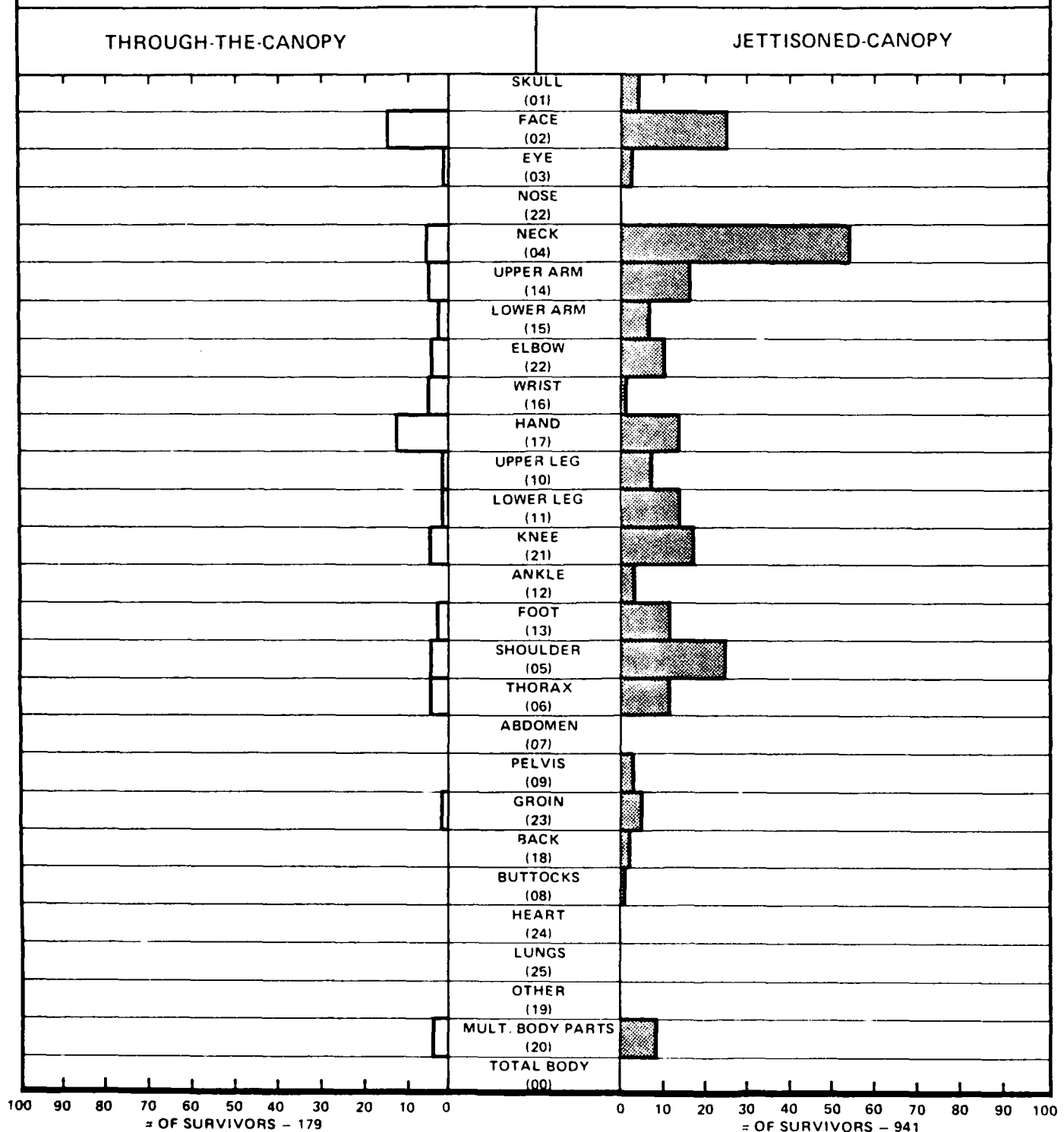
INJURY DIAGNOSIS: HEMORRHAGE



COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

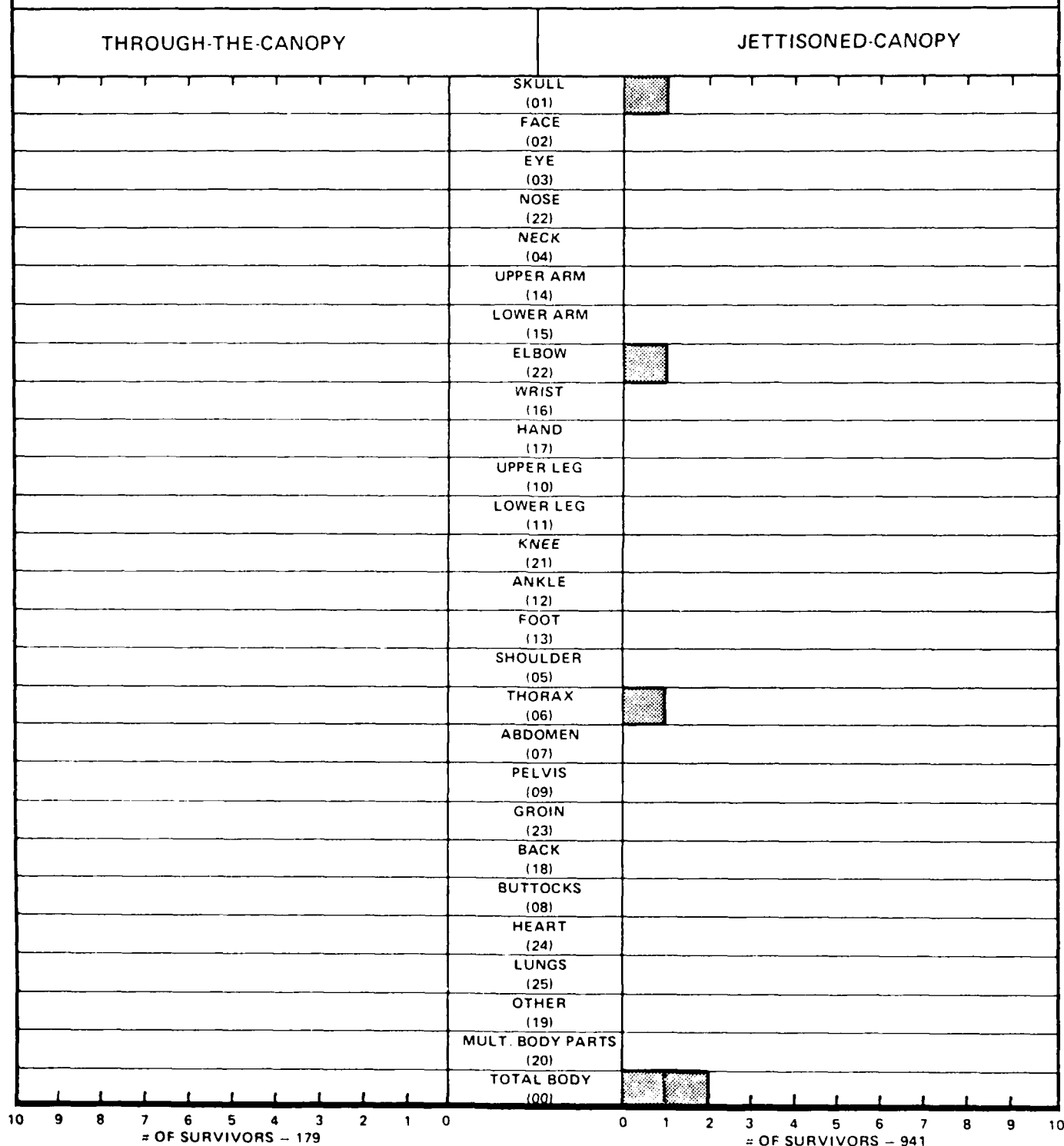
INJURY DIAGNOSIS: ABRASION



**COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

(SURVIVORS ONLY)

INJURY DIAGNOSIS- UNKNOWN/OTHER



100

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY BODY PART INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

(SURVIVORS ONLY)

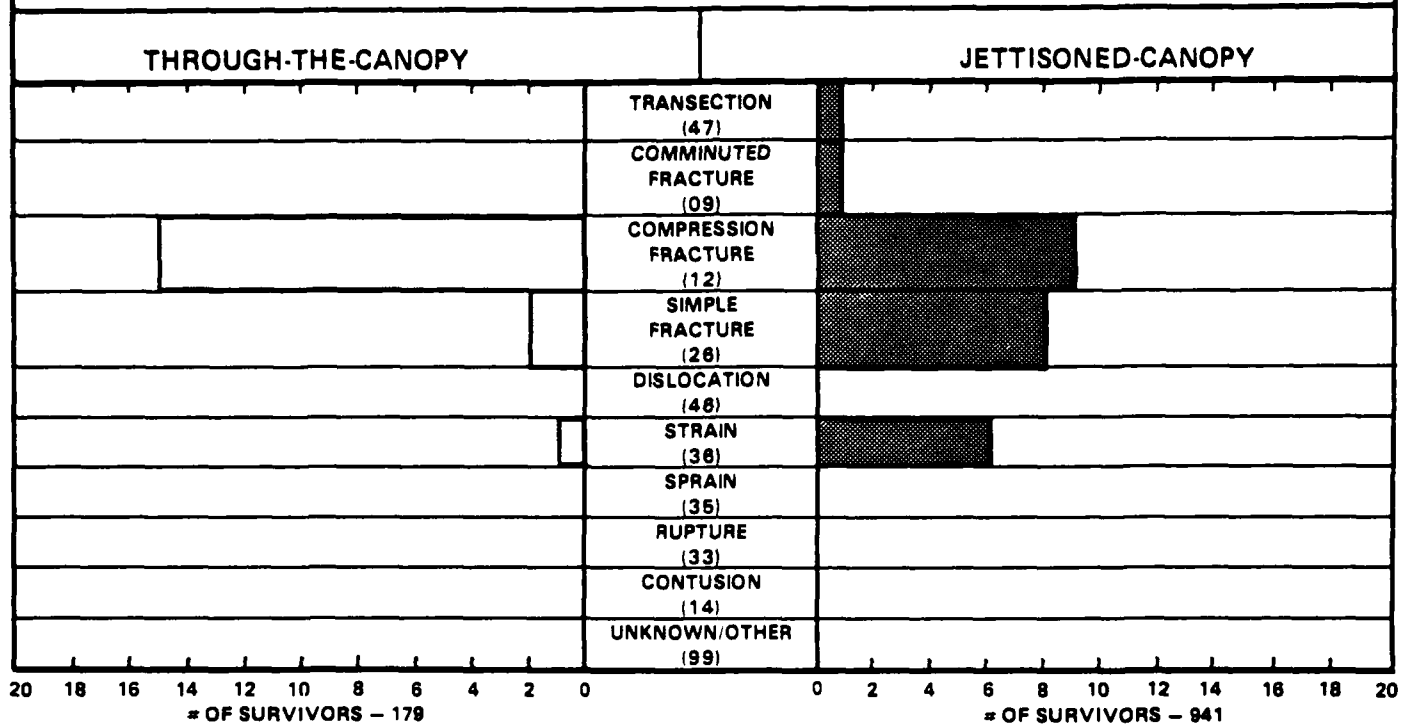
INJURY DIAGNOSIS: CODE NOT IN SAFCE
MANUAL

THROUGH-THE-CANOPY											JETTISONED-CANOPY											
											SKULL											
											(01)											
											FACE											
											(02)											
											EYE											
											(03)											
											NOSE											
											(22)											
											NECK											
											(04)											
											UPPER ARM											
											(14)											
											LOWER ARM											
											(15)											
											ELBOW											
											(22)											
											WRIST											
											(16)											
											HAND											
											(17)											
											UPPER LEG											
											(10)											
											LOWER LEG											
											(11)											
											KNEE											
											(21)											
											ANKLE											
											(12)											
											FOOT											
											(13)											
											SHOULDER											
											(05)											
											THORAX											
											(06)											
											ABDOMEN											
											(07)											
											PELVIS											
											(09)											
											GROIN											
											(23)											
											BACK											
											(18)											
											BUTTOCKS											
											(08)											
											HEART											
											(24)											
											LUNGS											
											(25)											
											OTHER											
											(19)											
											MULT BODY PARTS											
											(20)											
											TOTAL BODY											
											(00)											
10	9	8	7	6	5	4	3	2	1	0	0	1	2	3	4	5	6	7	8	9	10	
# OF SURVIVORS -- 179											# OF SURVIVORS -- 941											

JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL BODY: C1 - T5 (SURVIVORS ONLY)

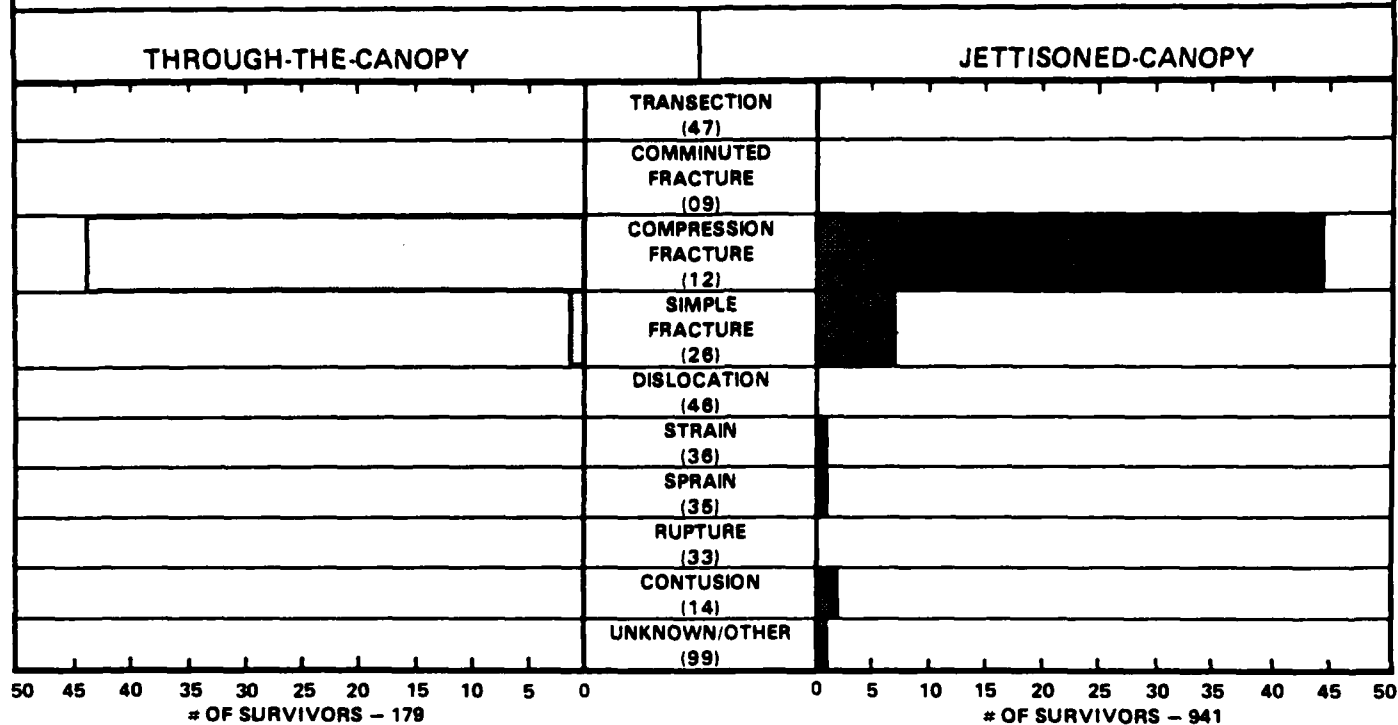


JANUARY 1969 - DECEMBER 1979

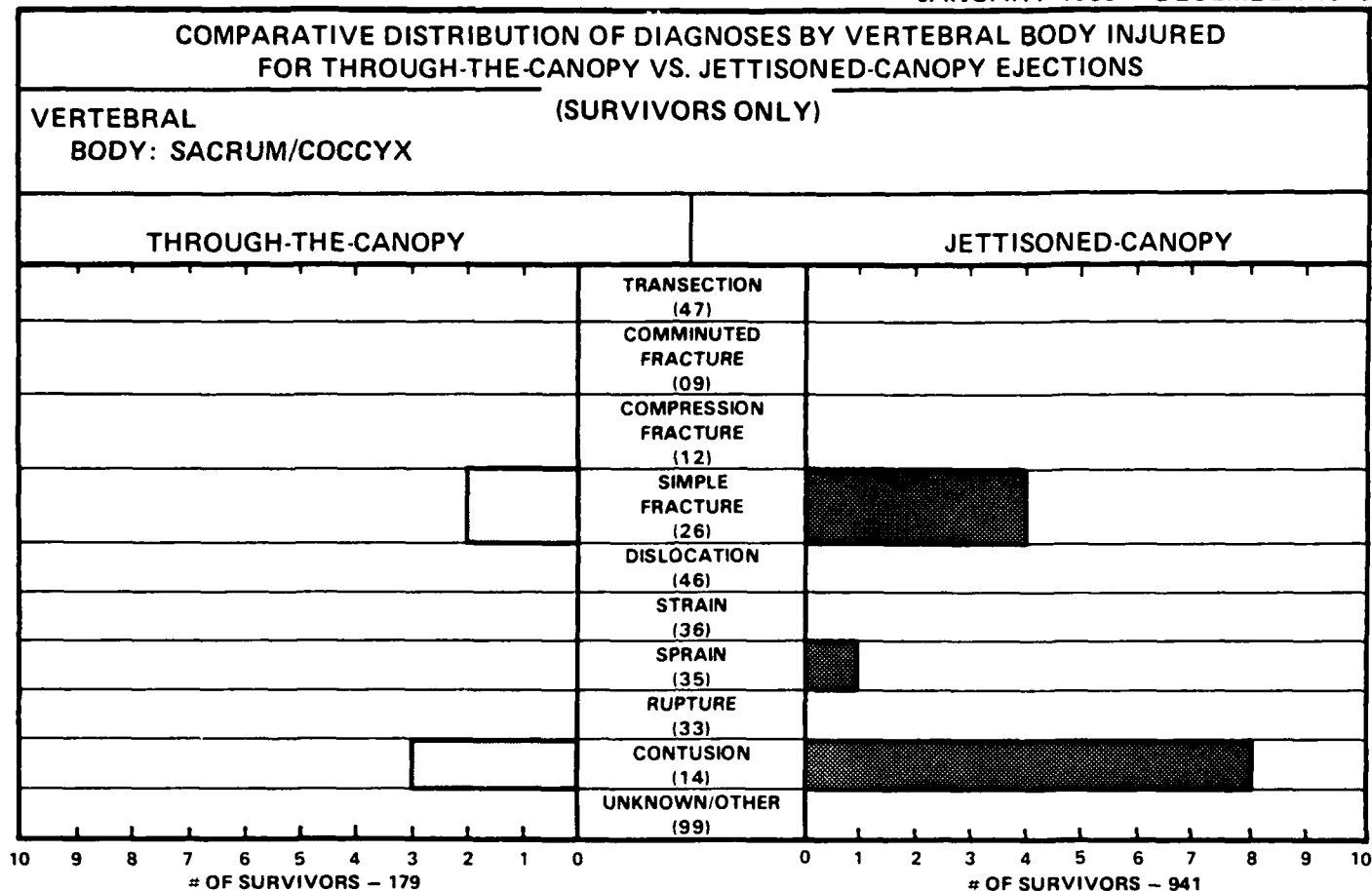
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T6 - L5

(SURVIVORS ONLY)



JANUARY 1969 - DECEMBER 1979



JANUARY 1969 – DECEMBER 1979

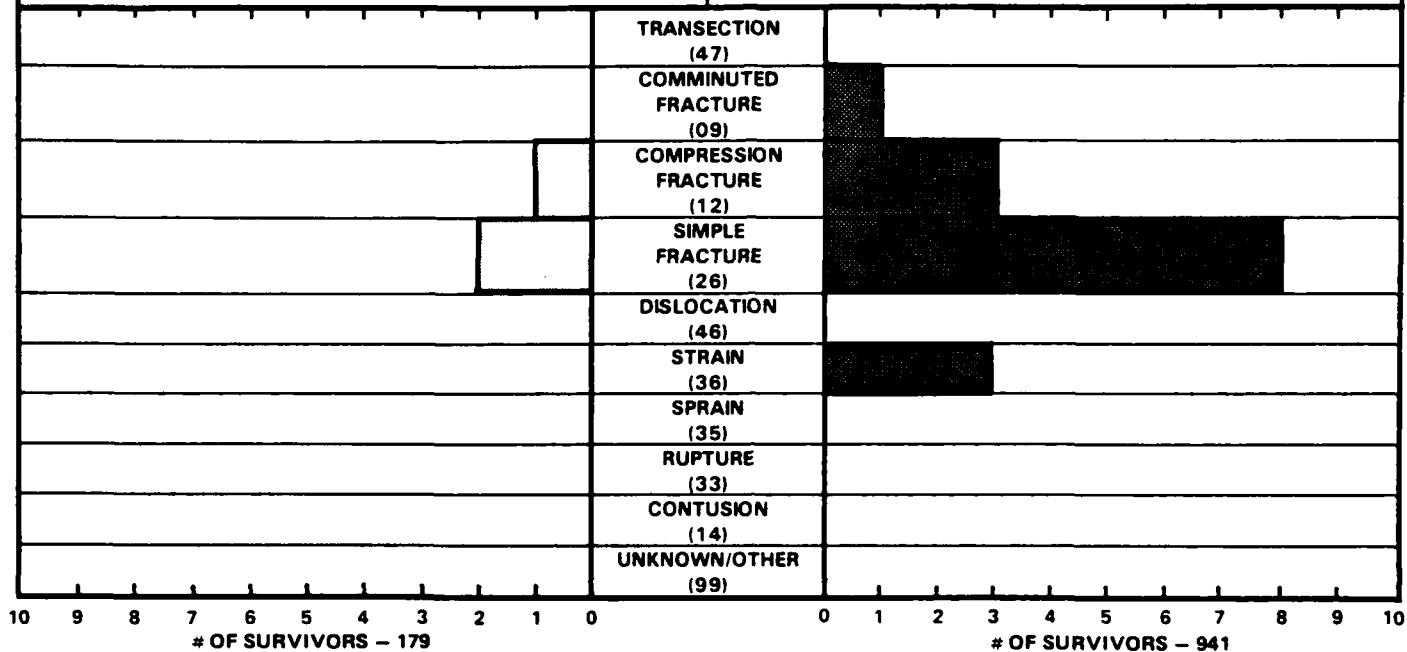
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: C1 – C7

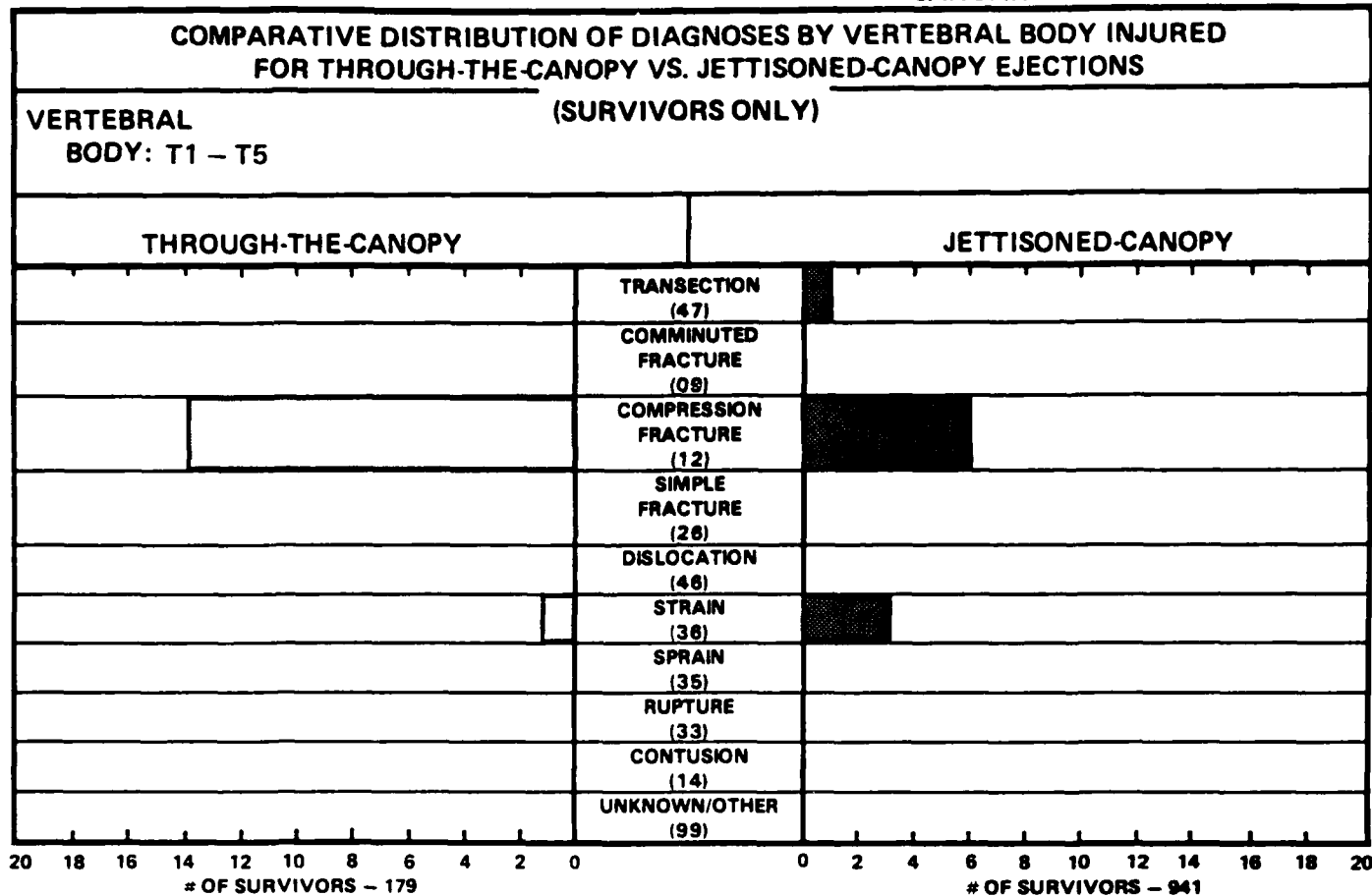
(SURVIVORS ONLY)

THROUGH-THE-CANOPY

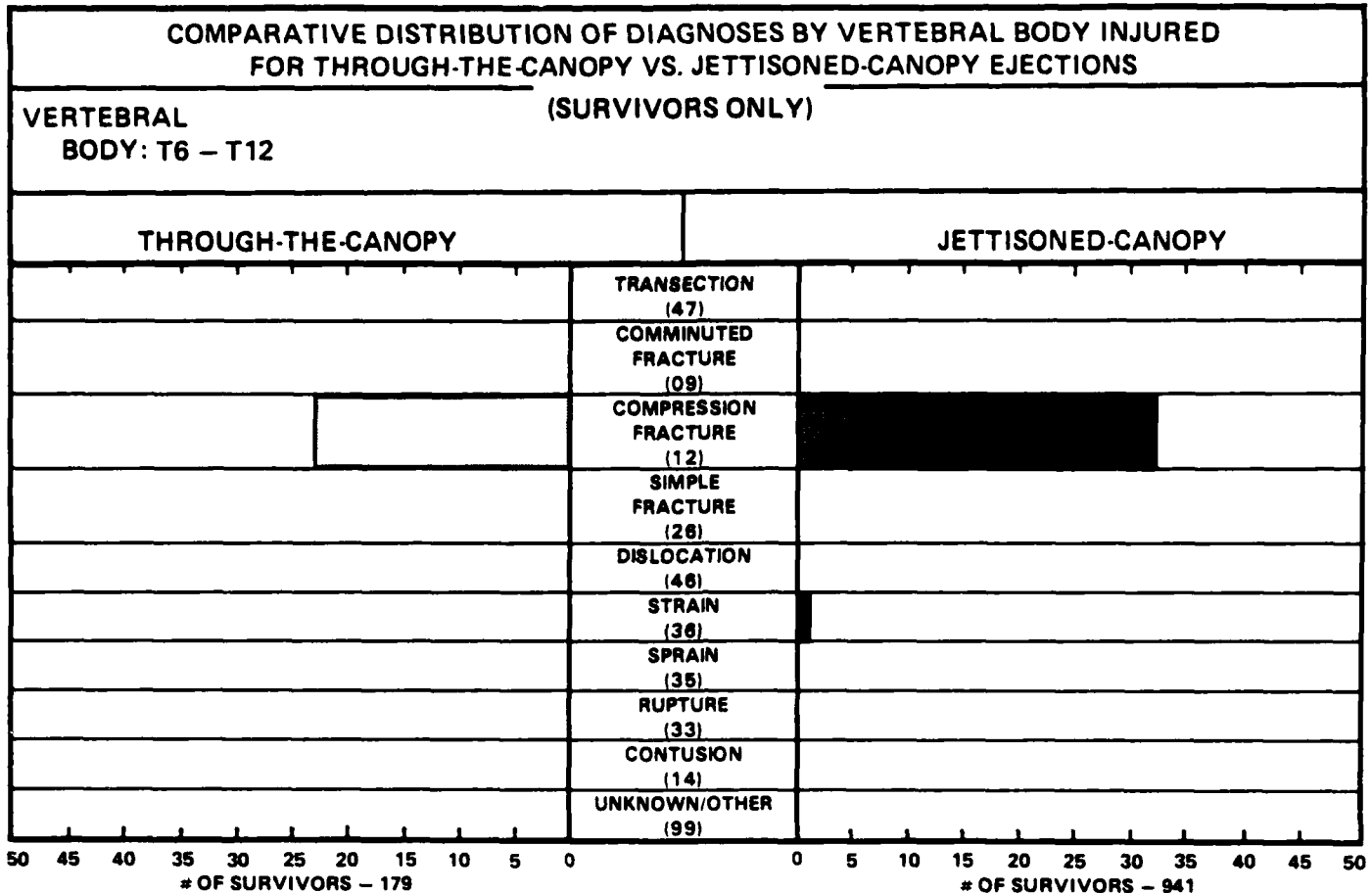
JETTISONED-CANOPY



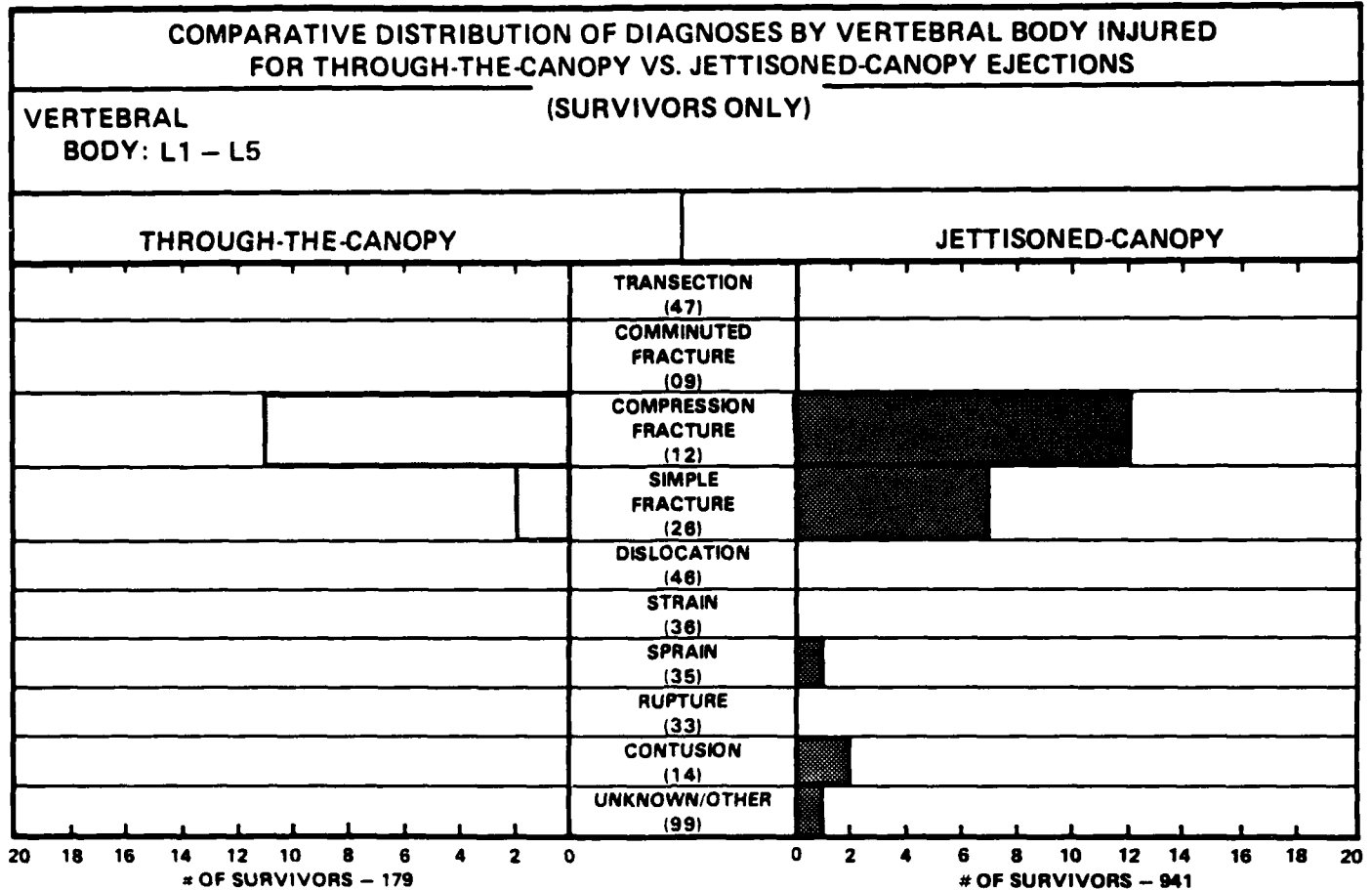
JANUARY 1969 - DECEMBER 1979



JANUARY 1969 - DECEMBER 1979



JANUARY 1969 - DECEMBER 1979



JANUARY 1969 – DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: C2

(SURVIVORS ONLY)

THROUGH-THE-CANOPY

JETTISONED-CANOPY

TRANSECTION
(47)

COMMUNUTED
FRACTURE
(09)

COMPRESSION
FRACTURE
(12)

SIMPLE
FRACTURE
(28)

DISLOCATION
(46)

STRAIN
(36)

SPRAIN
(35)

RUPTURE
(33)

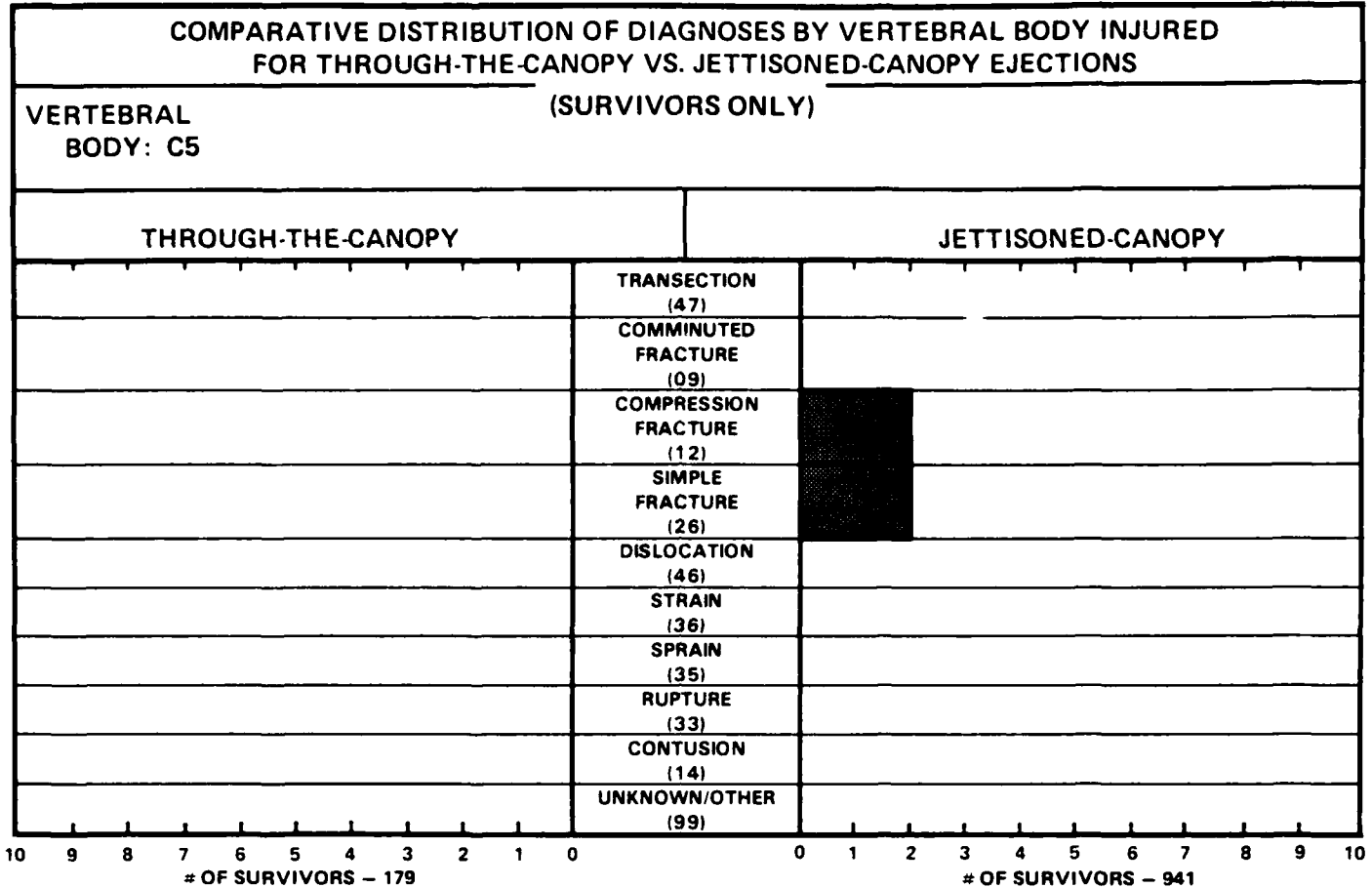
CONTUSION
(14)

UNKNOWN/OTHER
(99)

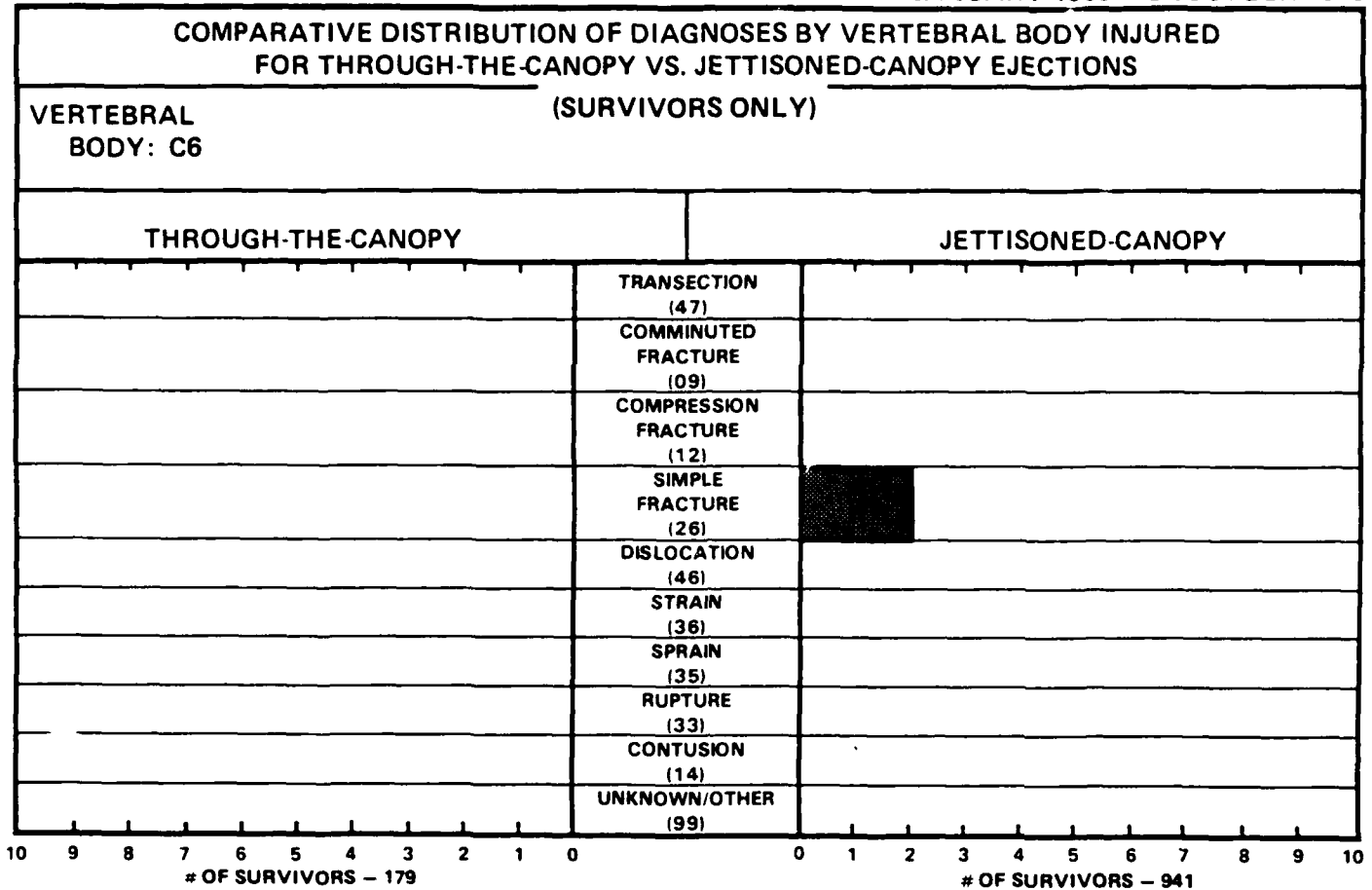
10 9 8 7 6 5 4 3 2 1 0
OF SURVIVORS – 179

0 1 2 3 4 5 6 7 8 9 10
OF SURVIVORS – 941

JANUARY 1969 - DECEMBER 1979



JANUARY 1969 - DECEMBER 1979



JANUARY 1969 - DECEMBER 1979

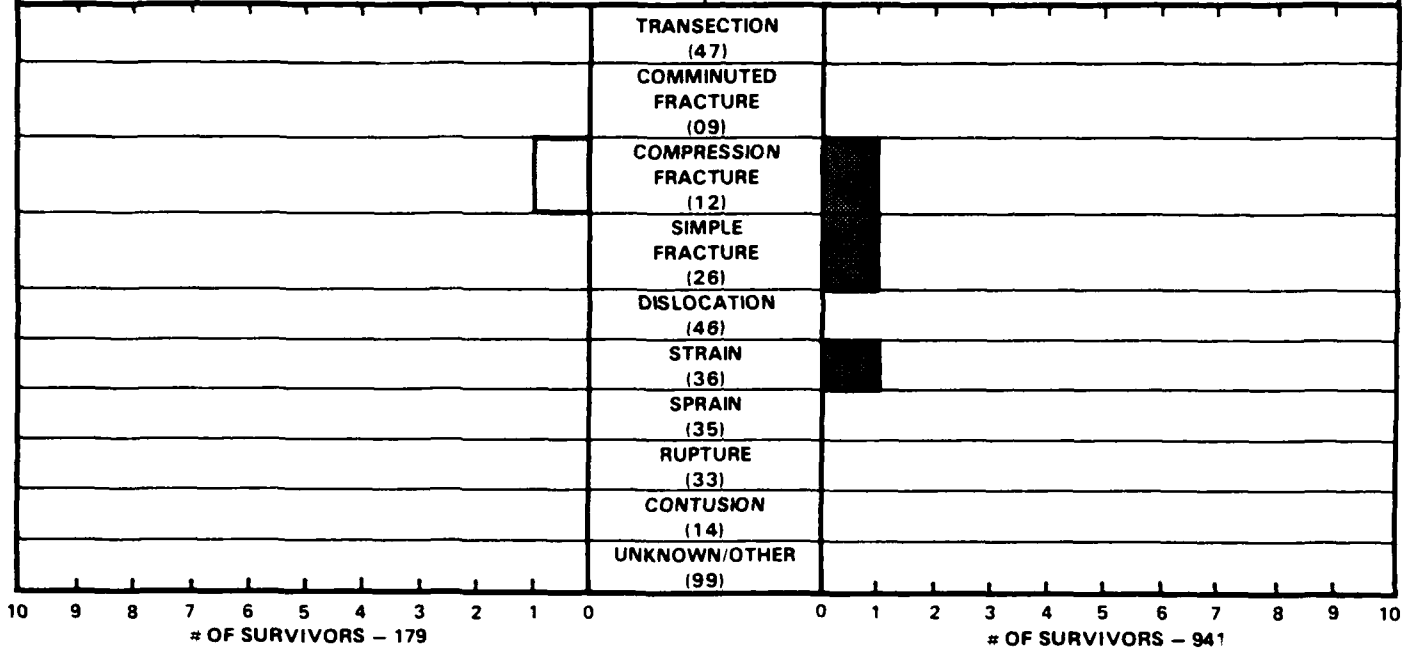
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: C7

(SURVIVORS ONLY)

THROUGH-THE-CANOPY

JETTISONED-CANOPY



JANUARY 1969 – DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T1

(SURVIVORS ONLY)

THROUGH-THE-CANOPY

JETTISONED-CANOPY

TRANSECTION
(47)

COMMINUTED
FRACTURE
(09)

COMPRESSION
FRACTURE
(12)

SIMPLE
FRACTURE
(26)

DISLOCATION
(46)

STRAIN
(36)

SPRAIN
(35)

RUPTURE
(33)

CONTUSION
(14)

UNKNOWN/OTHER
(99)

10 9 8 7 6 5 4 3 2 1 0
OF SURVIVORS – 179

0 1 2 3 4 5 6 7 8 9 10
OF SURVIVORS – 941

JANUARY 1969 - DECEMBER 1979

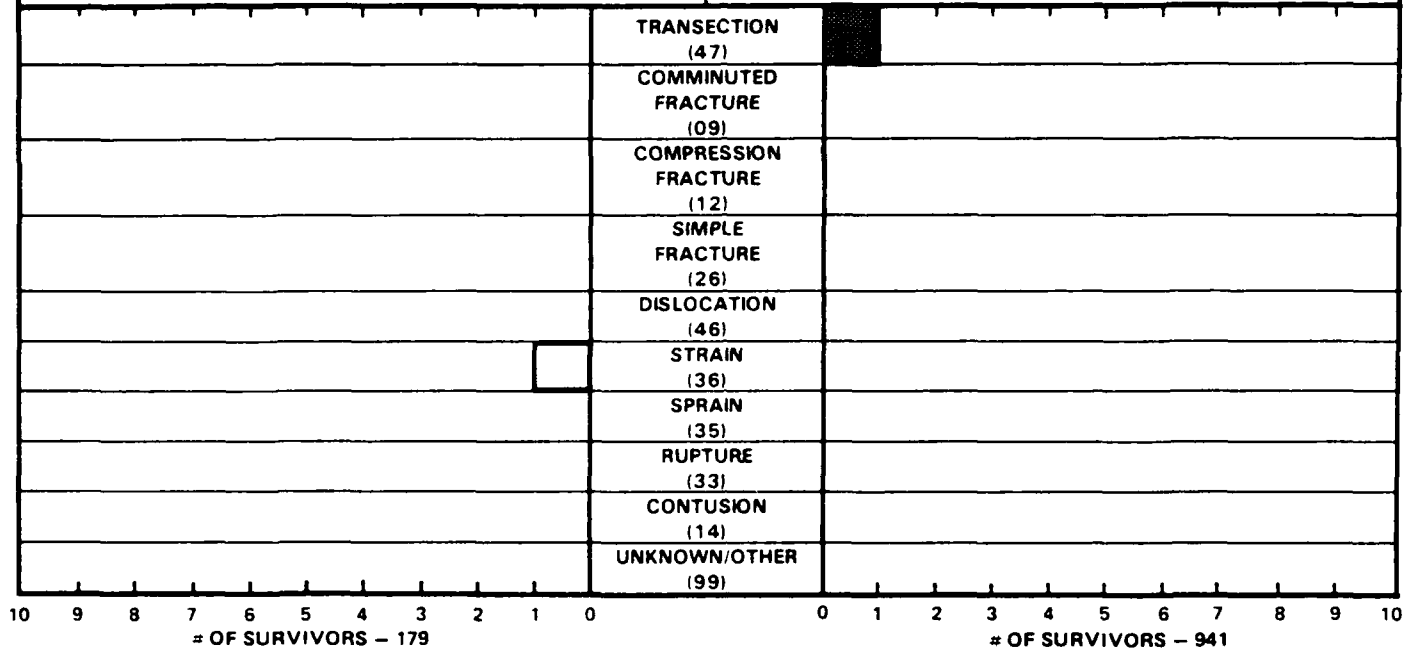
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T2

(SURVIVORS ONLY)

THROUGH-THE-CANOPY

JETTISONED-CANOPY



JANUARY 1969 - DECEMBER 1979

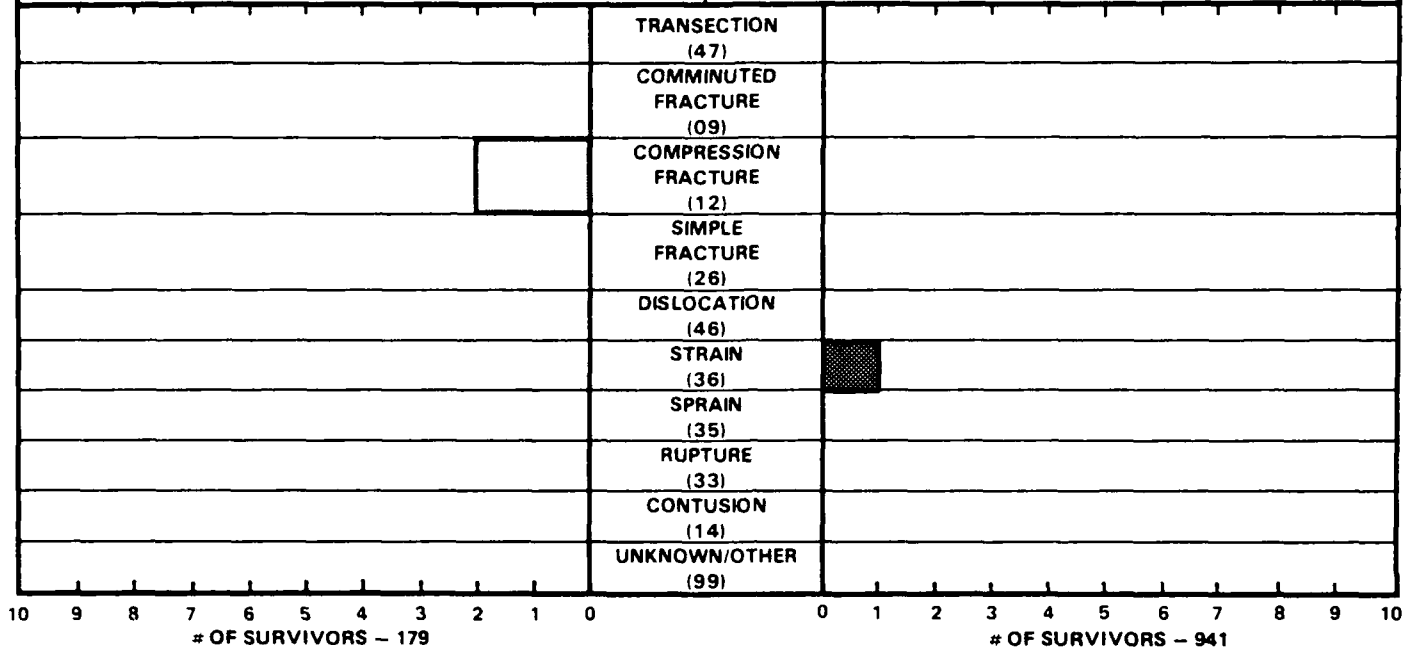
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T3

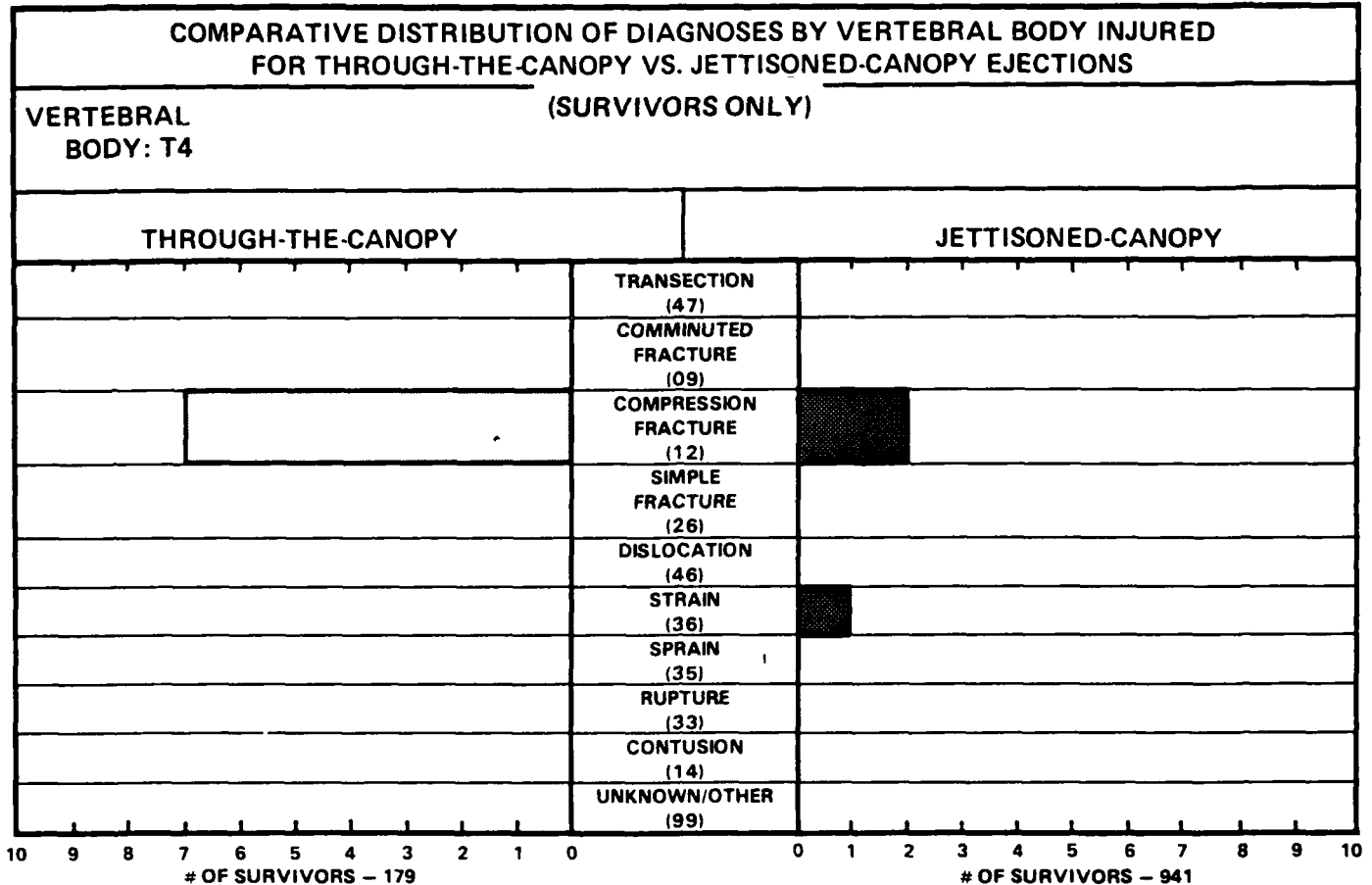
(SURVIVORS ONLY)

THROUGH-THE-CANOPY

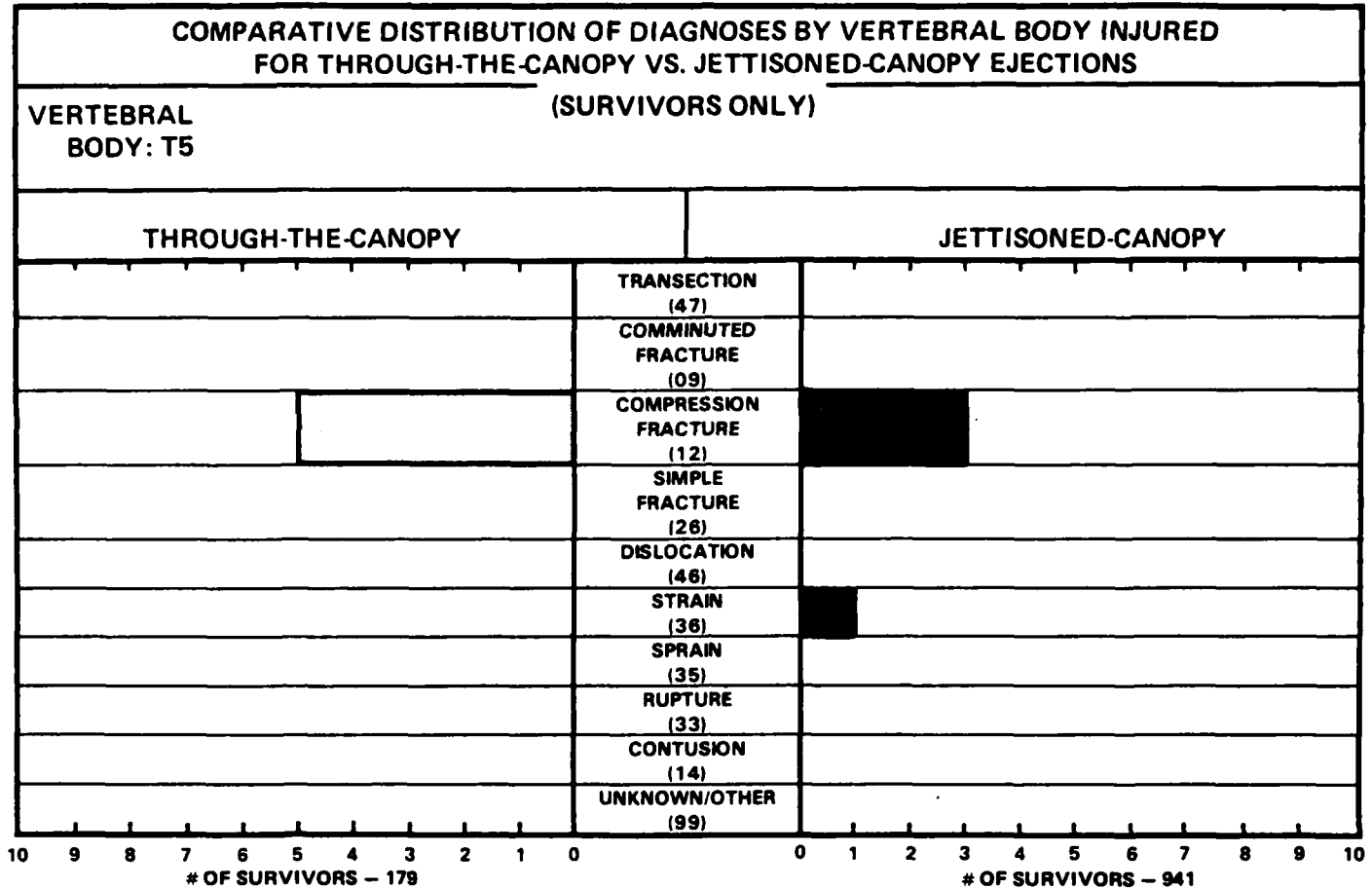
JETTISONED-CANOPY



JANUARY 1969 - DECEMBER 1979



JANUARY 1969 – DECEMBER 1979



JANUARY 1969 - DECEMBER 1979

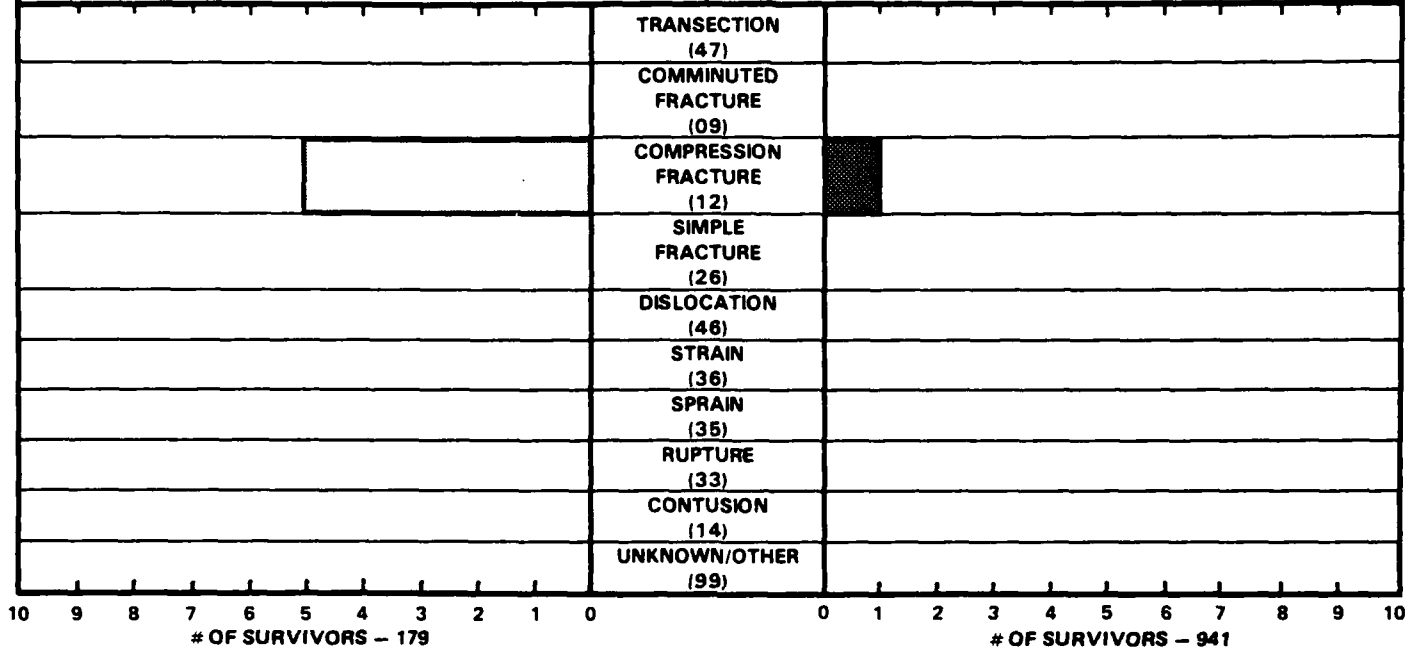
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T6

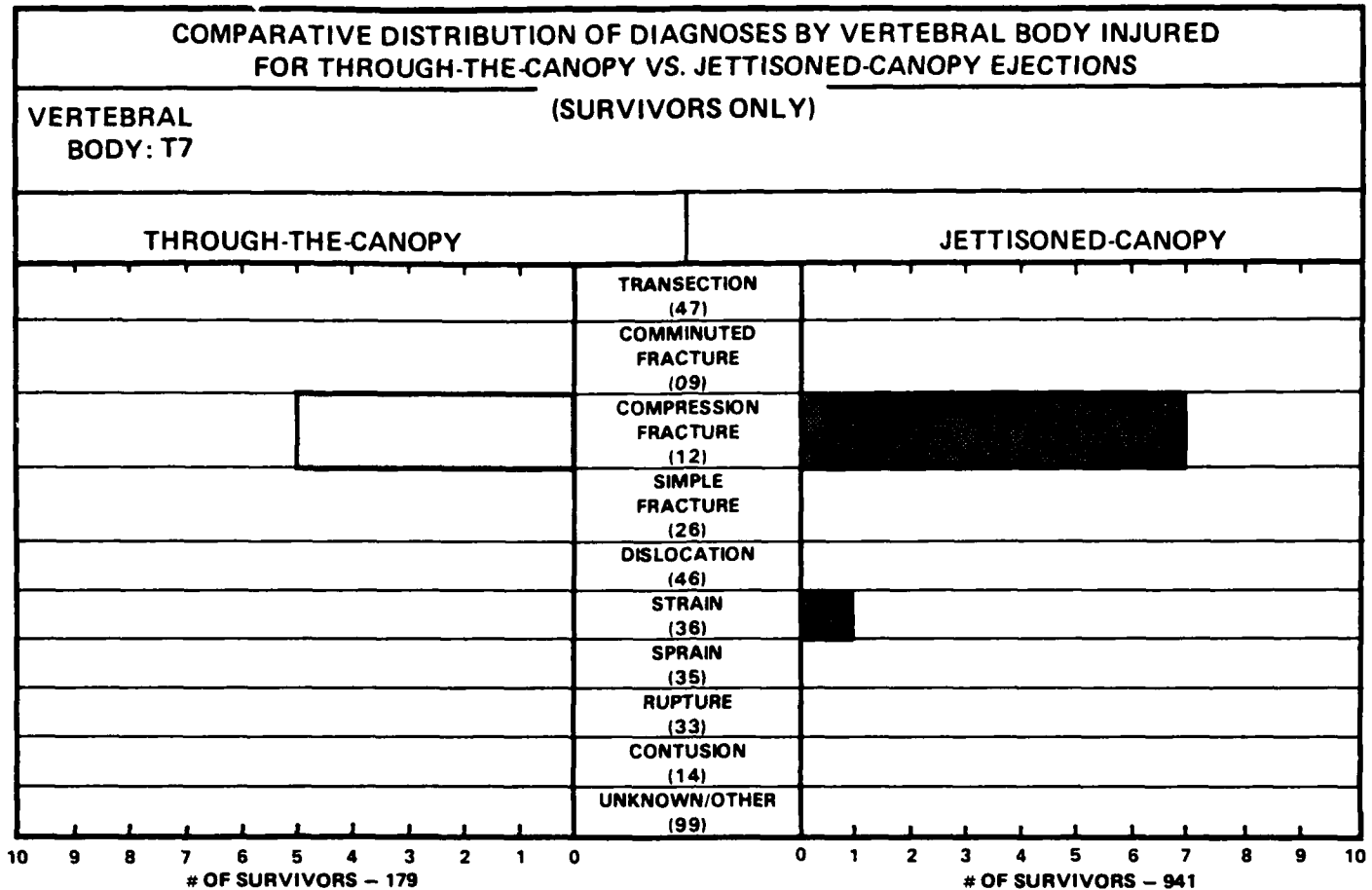
(SURVIVORS ONLY)

THROUGH-THE-CANOPY

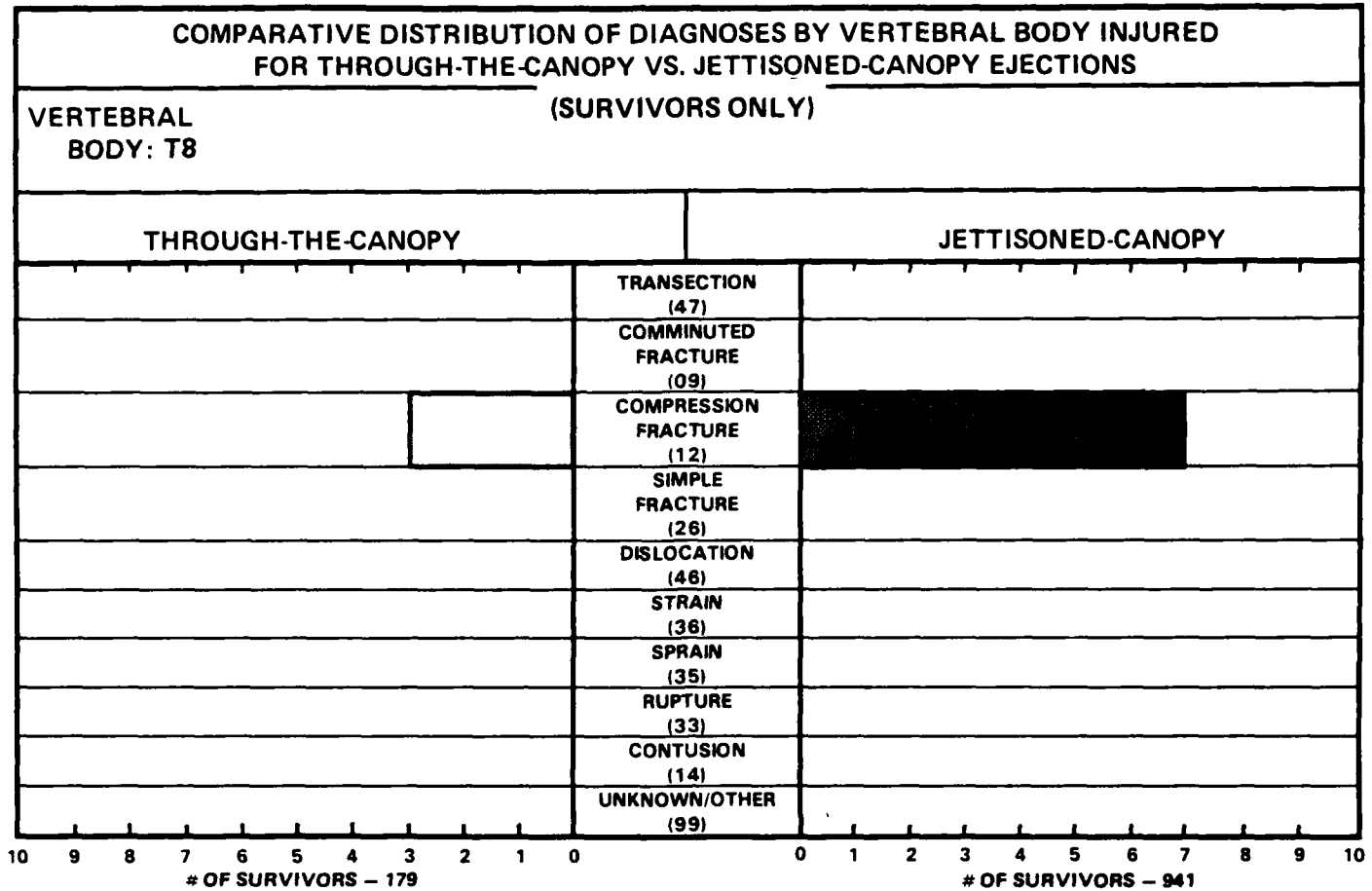
JETTISONED-CANOPY



JANUARY 1969 - DECEMBER 1979



JANUARY 1969 – DECEMBER 1979



JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T9

(SURVIVORS ONLY)

THROUGH-THE-CANOPY

JETTISONED-CANOPY

TRANSECTION
(47)

COMMUNUTED
FRACTURE
(09)

COMPRESSION
FRACTURE
(12)

SIMPLE
FRACTURE
(26)

DISLOCATION
(46)

STRAIN
(36)

SPRAIN
(35)

RUPTURE
(33)

CONTUSION
(14)

UNKNOWN/OTHER
(99)

10 9 8 7 6 5 4 3 2 1 0
OF SURVIVORS - 179

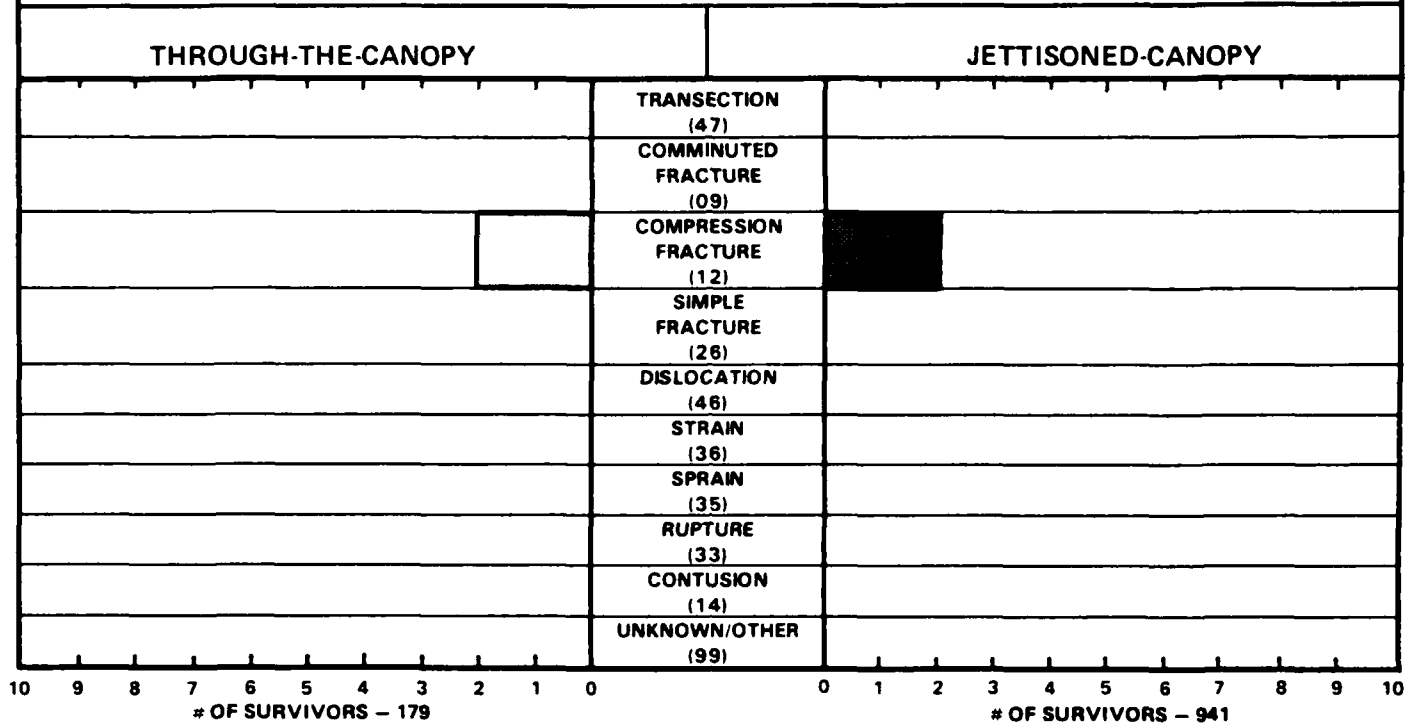
0 1 2 3 4 5 6 7 8 9 10
OF SURVIVORS - 941

JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T10

(SURVIVORS ONLY)

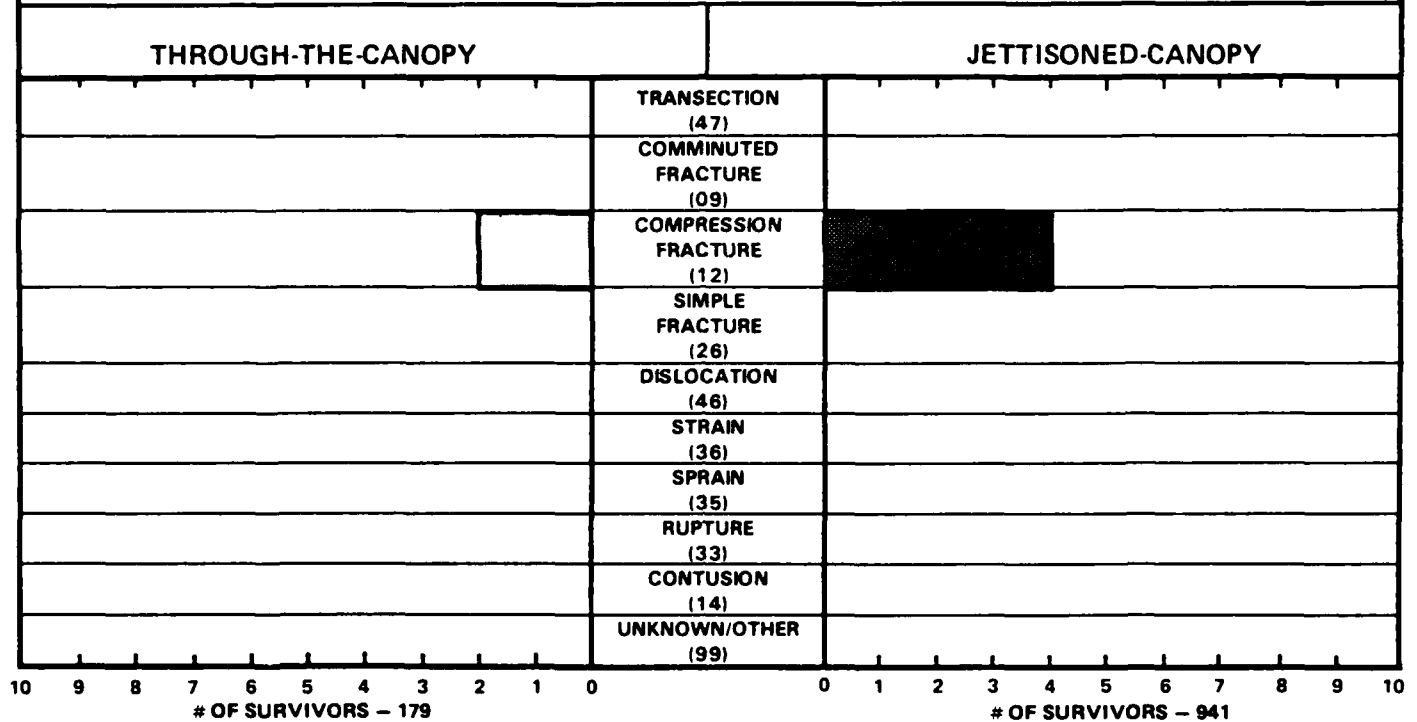


JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T11

(SURVIVORS ONLY)

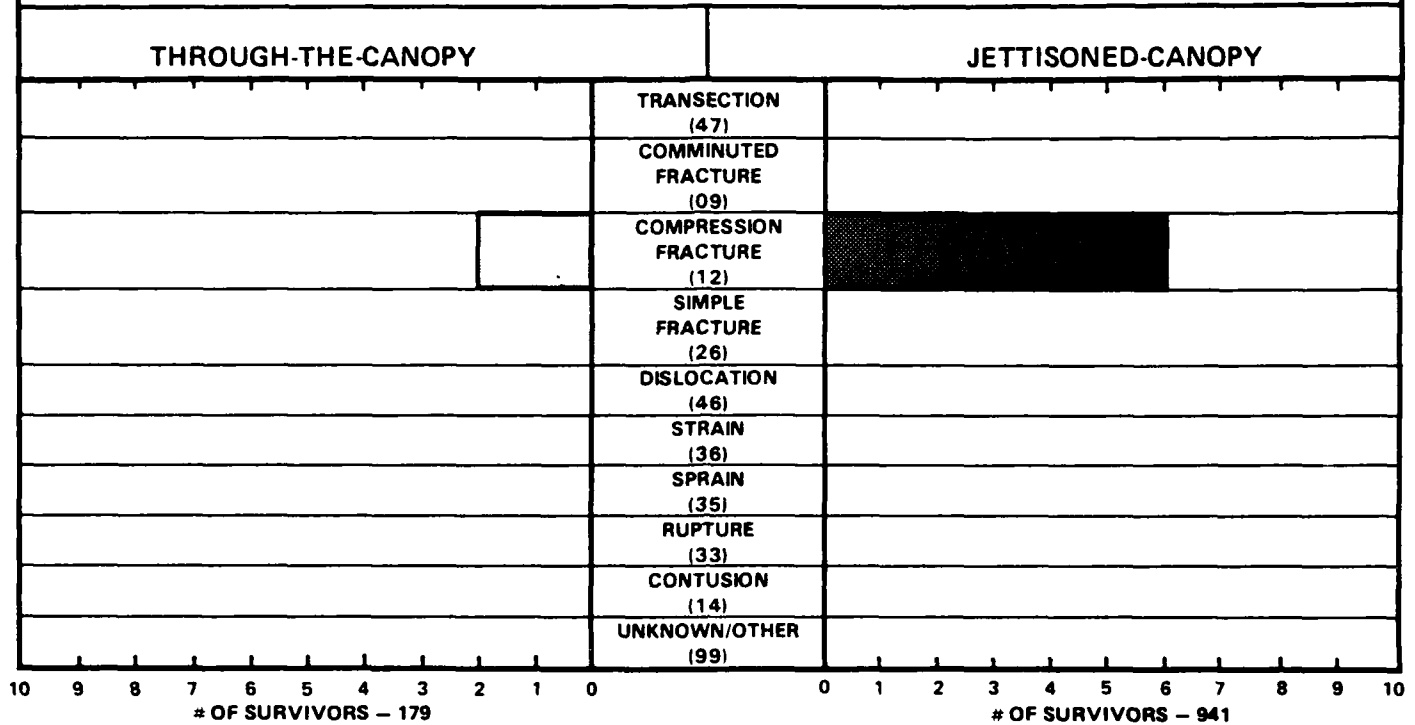


JANUARY 1969 – DECEMBER 1979

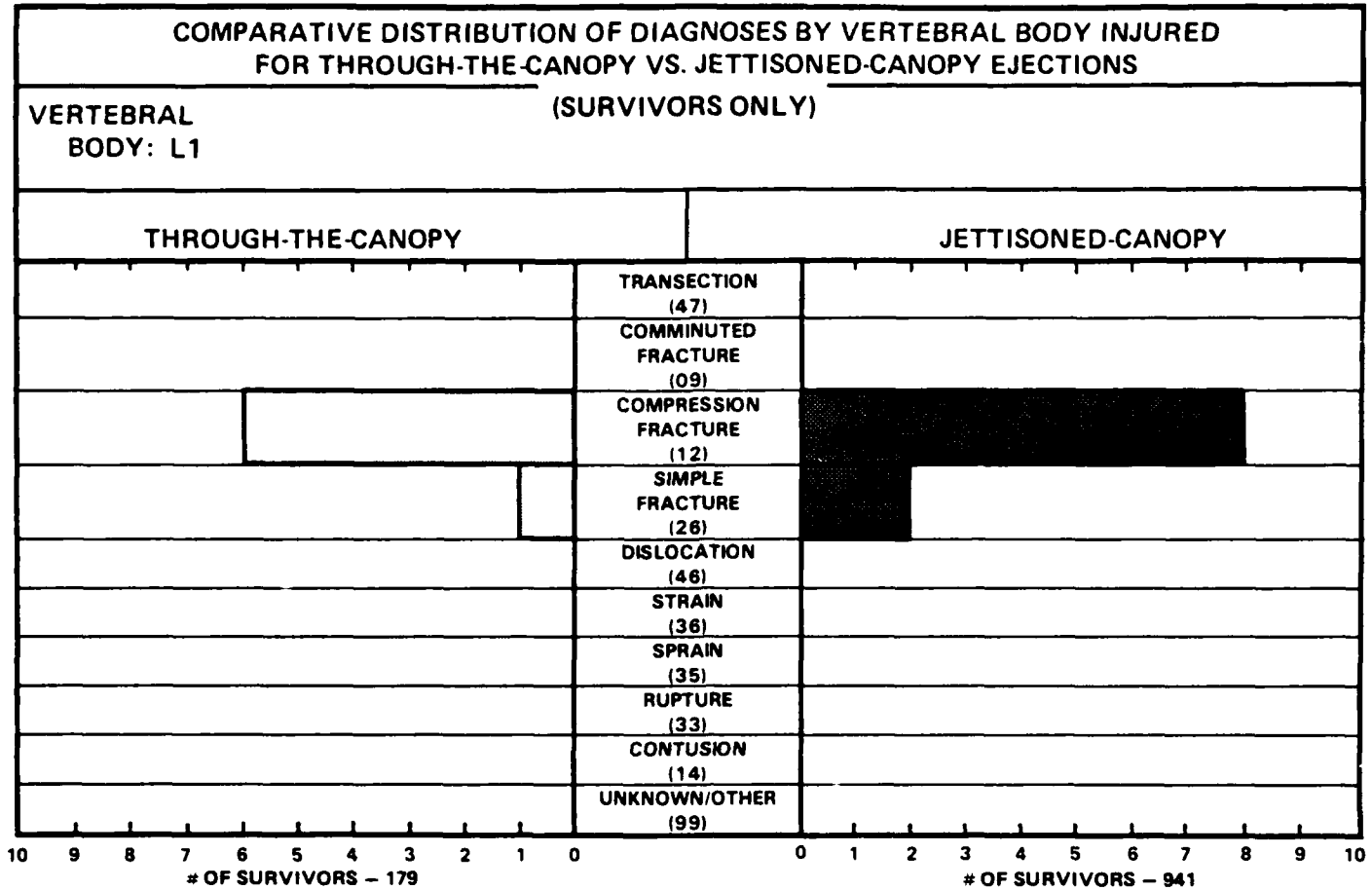
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL
BODY: T12

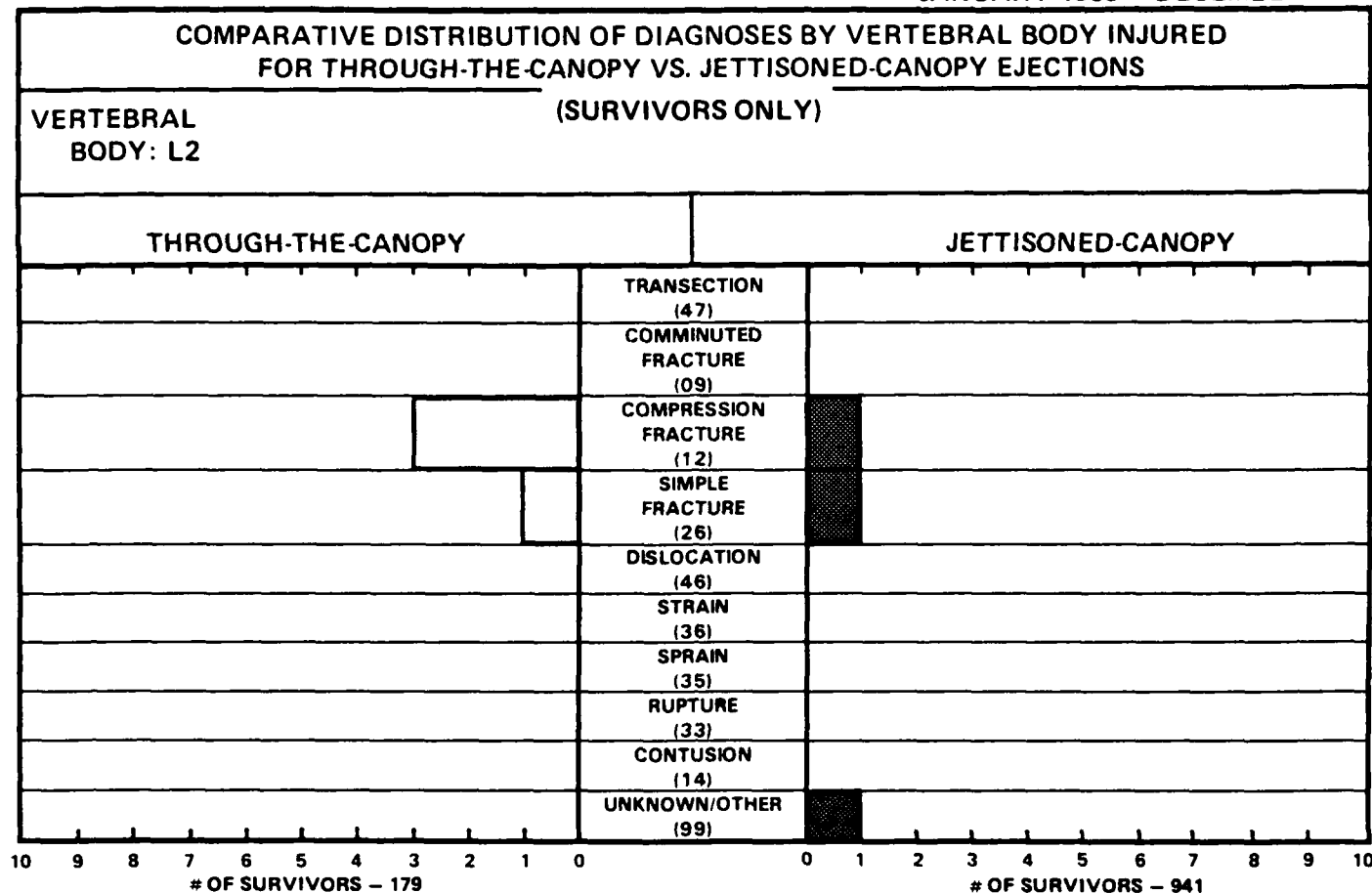
(SURVIVORS ONLY)



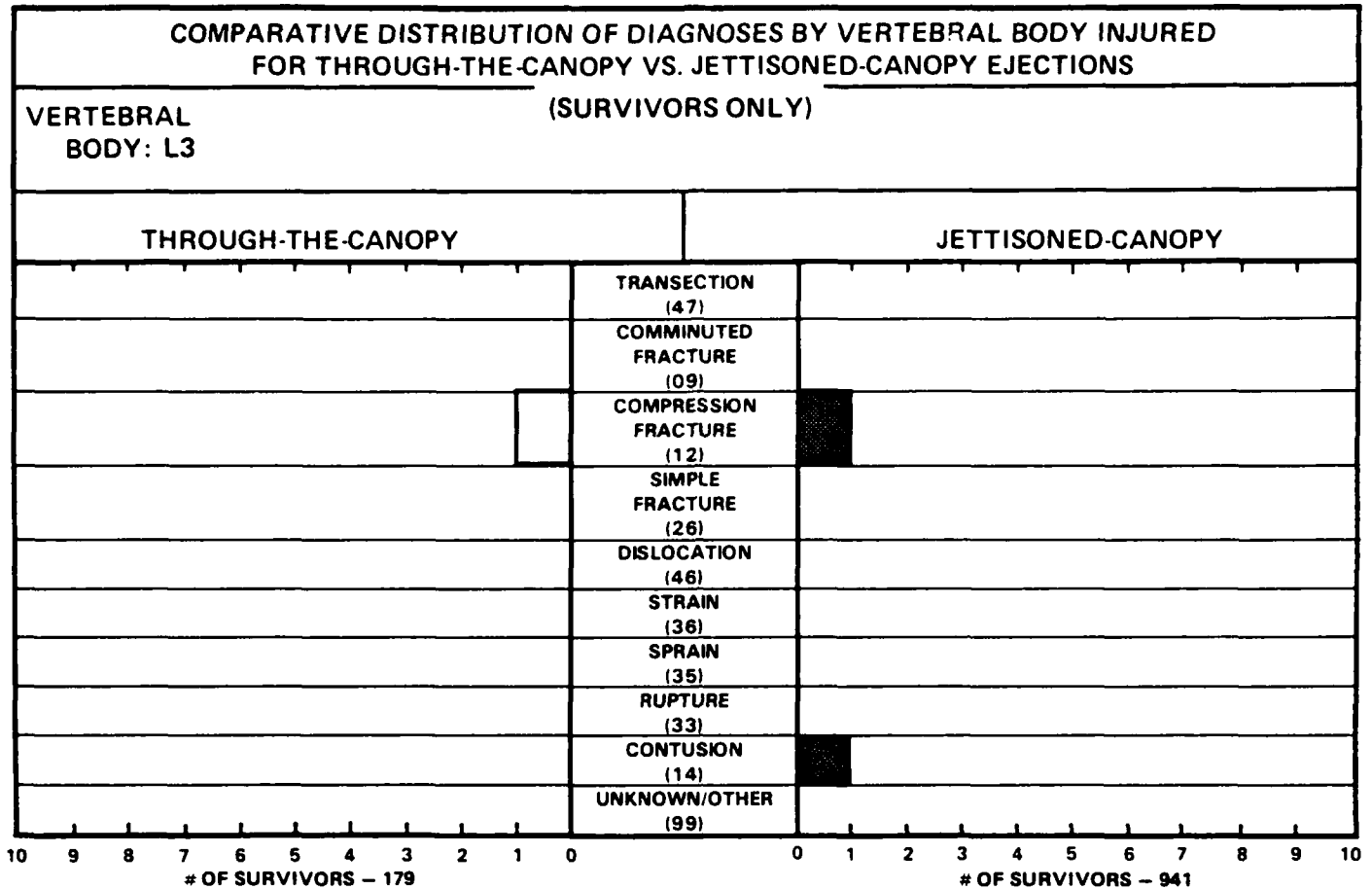
JANUARY 1969 - DECEMBER 1979



JANUARY 1969 - DECEMBER 1979



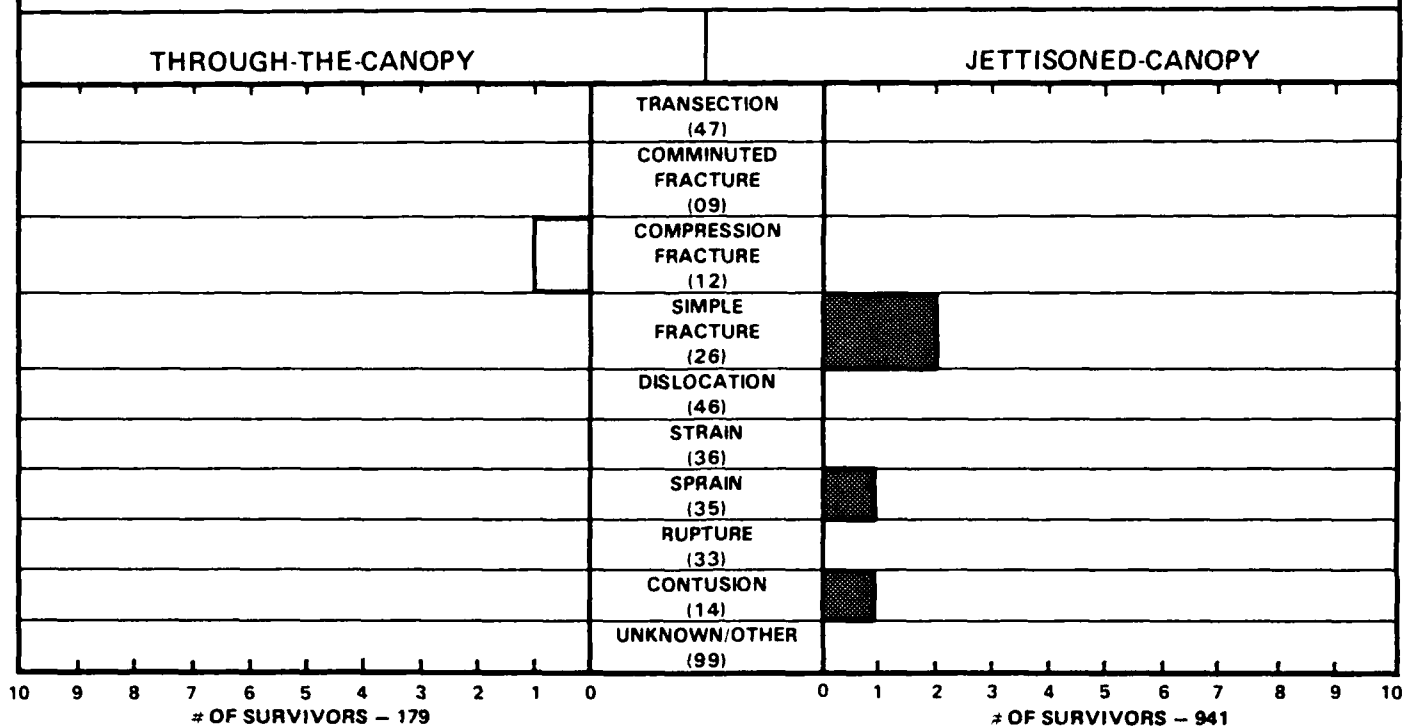
JANUARY 1969 - DECEMBER 1979



JANUARY 1969 - DECEMBER 1979

COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

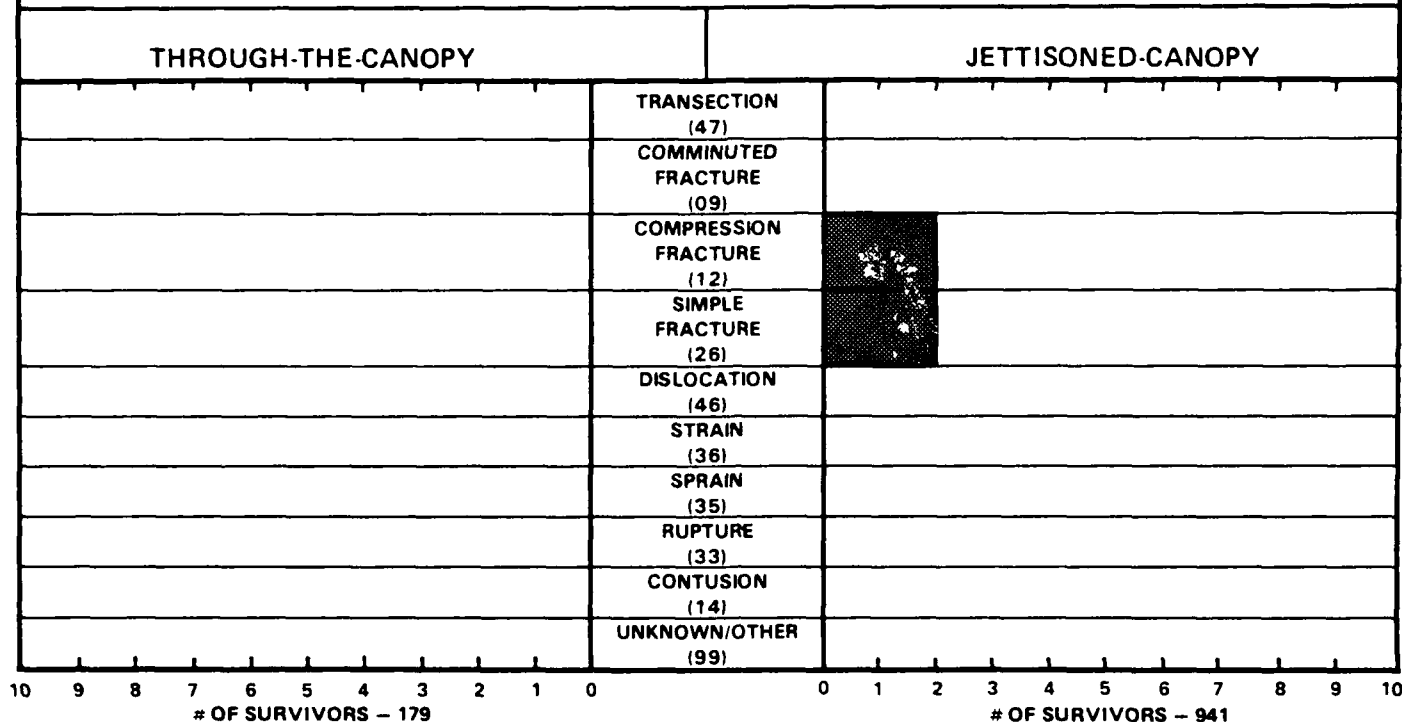
VERTEBRAL BODY: L4 (SURVIVORS ONLY)



JANUARY 1969 - DECEMBER 1979

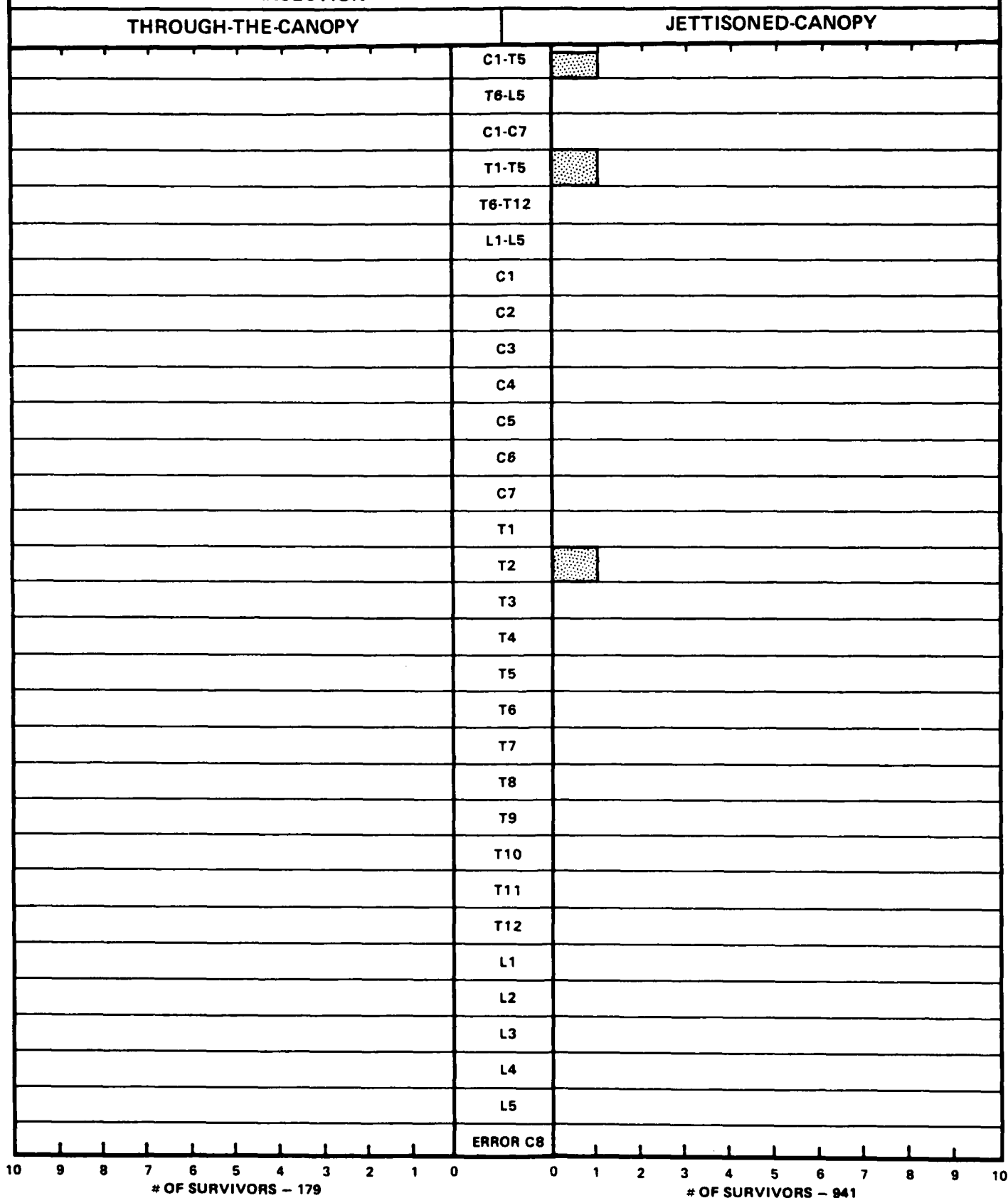
COMPARATIVE DISTRIBUTION OF DIAGNOSES BY VERTEBRAL BODY INJURED
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

VERTEBRAL BODY: L5 (SURVIVORS ONLY)



**COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

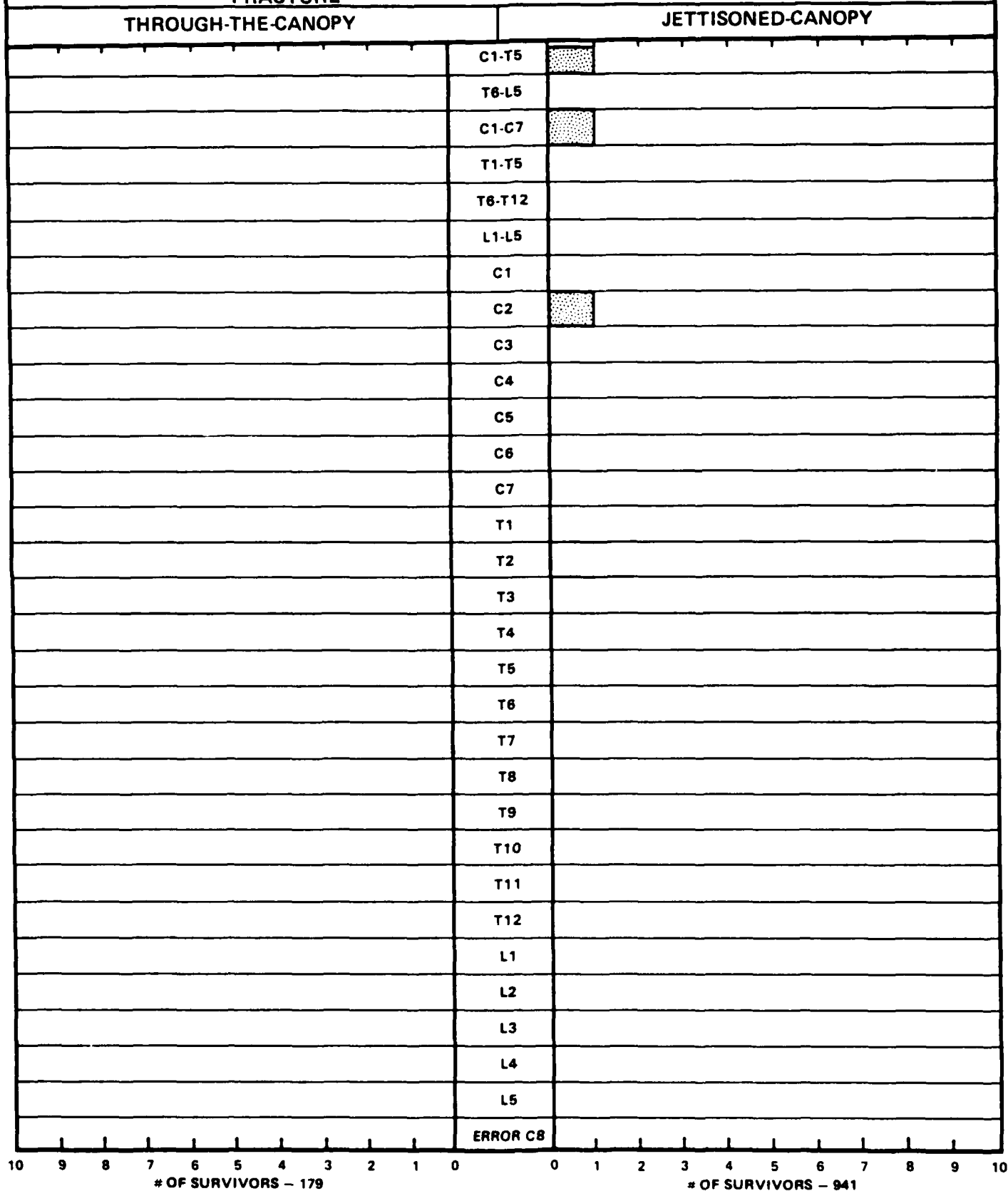
INJURY DIAGNOSIS: TRANSECTION (SURVIVORS ONLY)



JANUARY 1969 - DECEMBER 1979

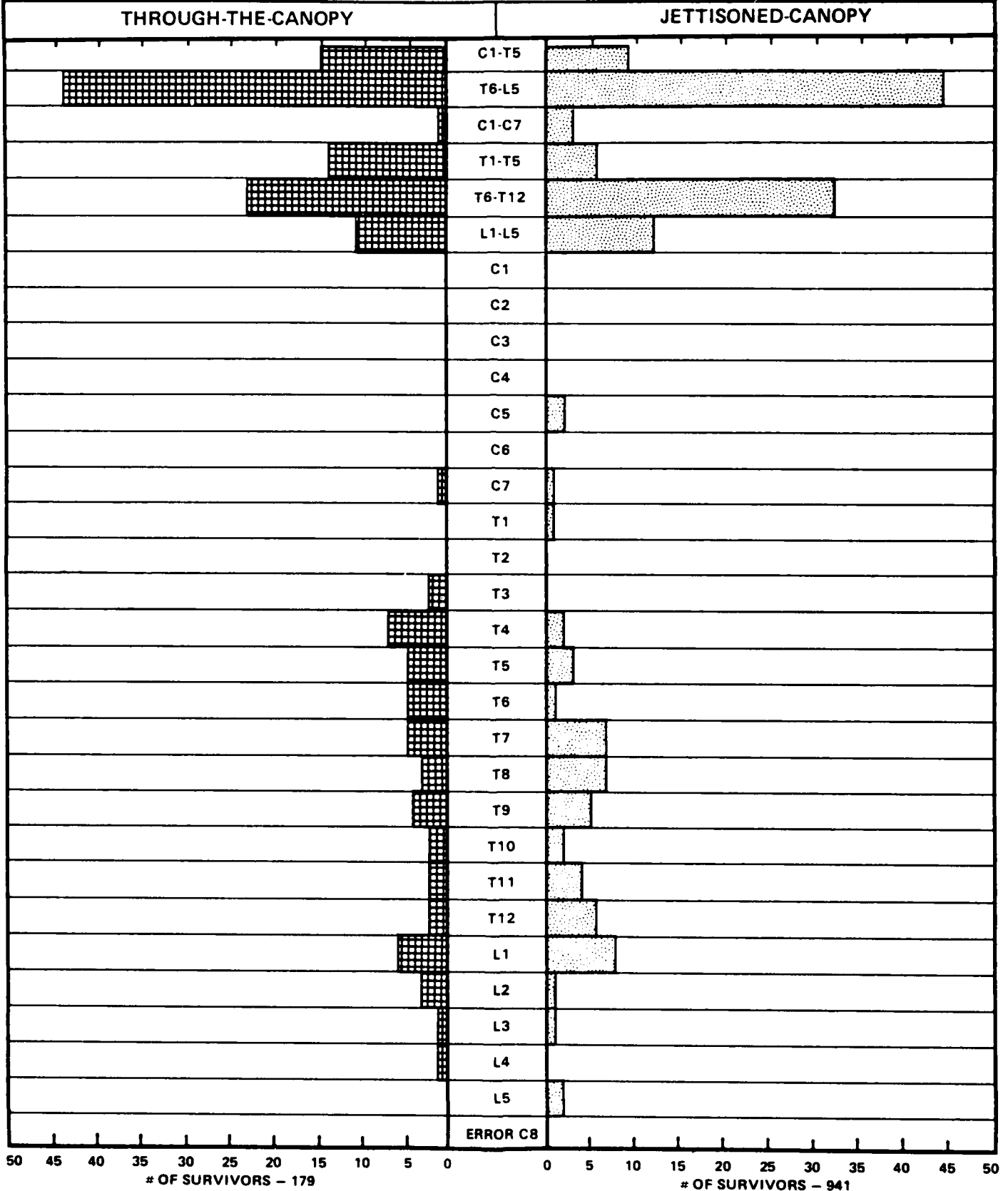
COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

INJURY DIAGNOSIS: **COMMUNUTED FRACTURE** (SURVIVORS ONLY)



**COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

INJURY DIAGNOSIS: COMPRESSION FRACTURE (SURVIVORS ONLY)

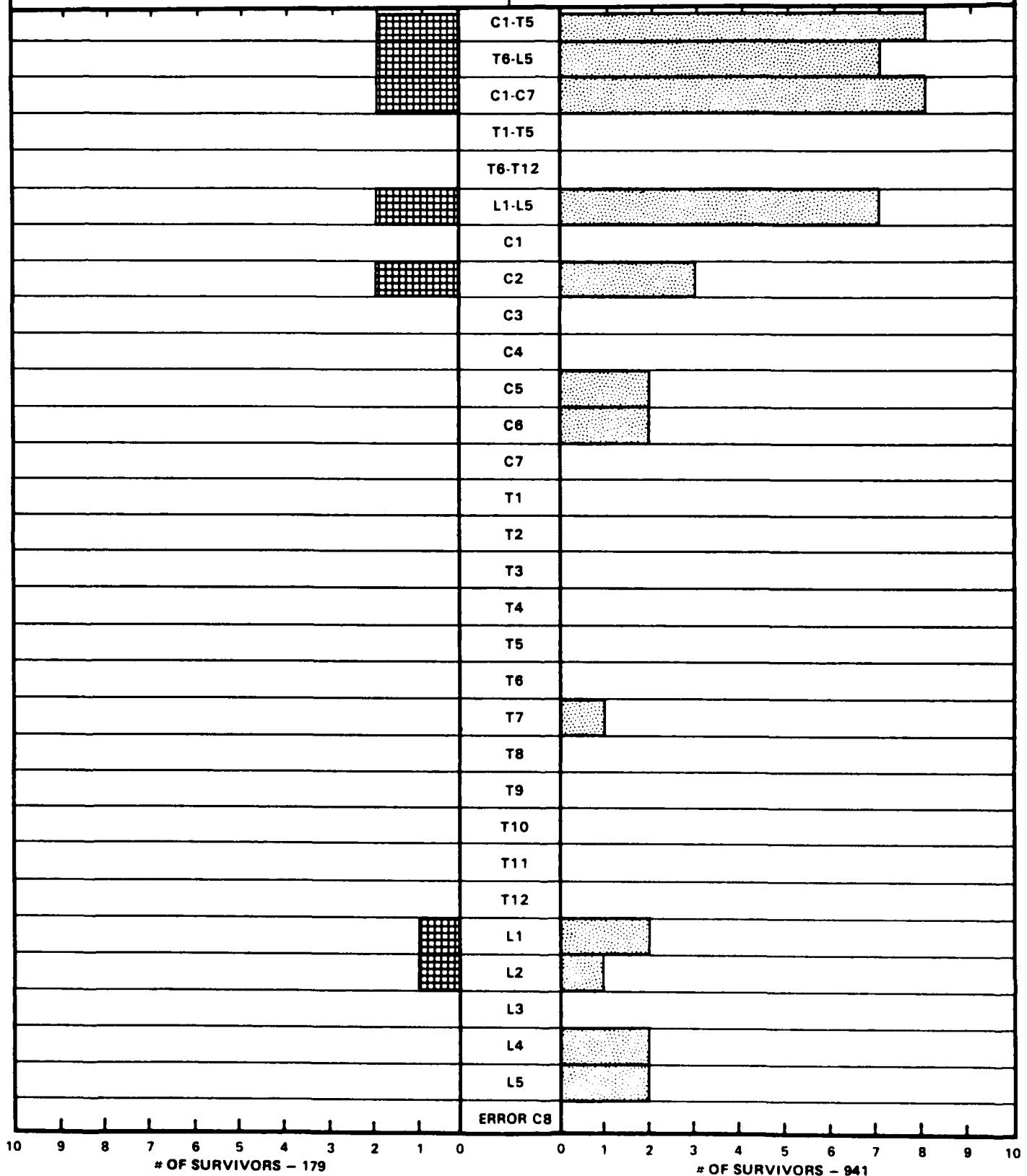


COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

INJURY DIAGNOSIS: SIMPLE FRACTURE (SURVIVORS ONLY)

THROUGH-THE-CANOPY

JETTISONED-CANOPY



JANUARY 1969 – DECEMBER 1979

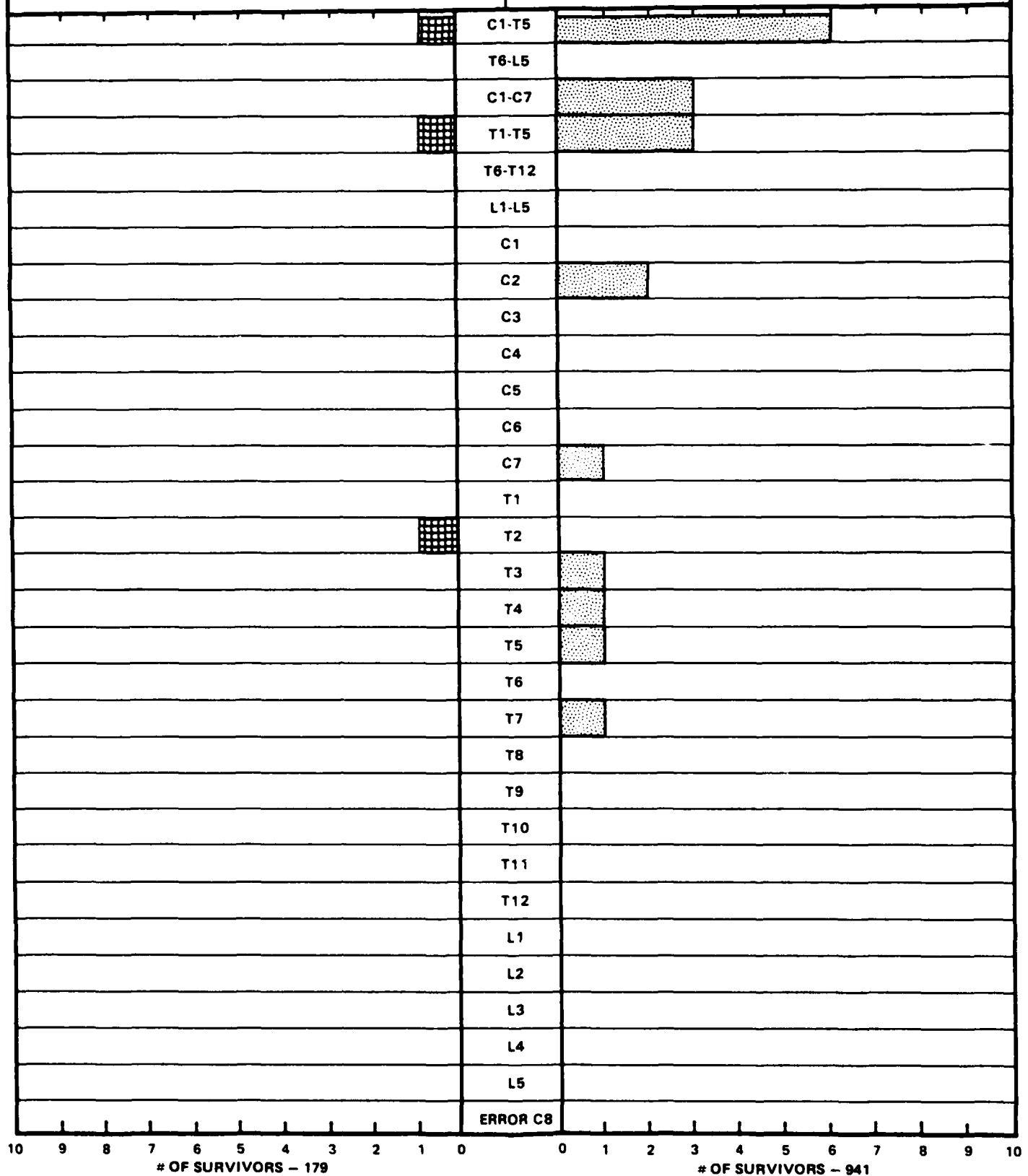
COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

INJURY DIAGNOSIS: STRAIN

(SURVIVORS ONLY)

THROUGH-THE-CANOPY

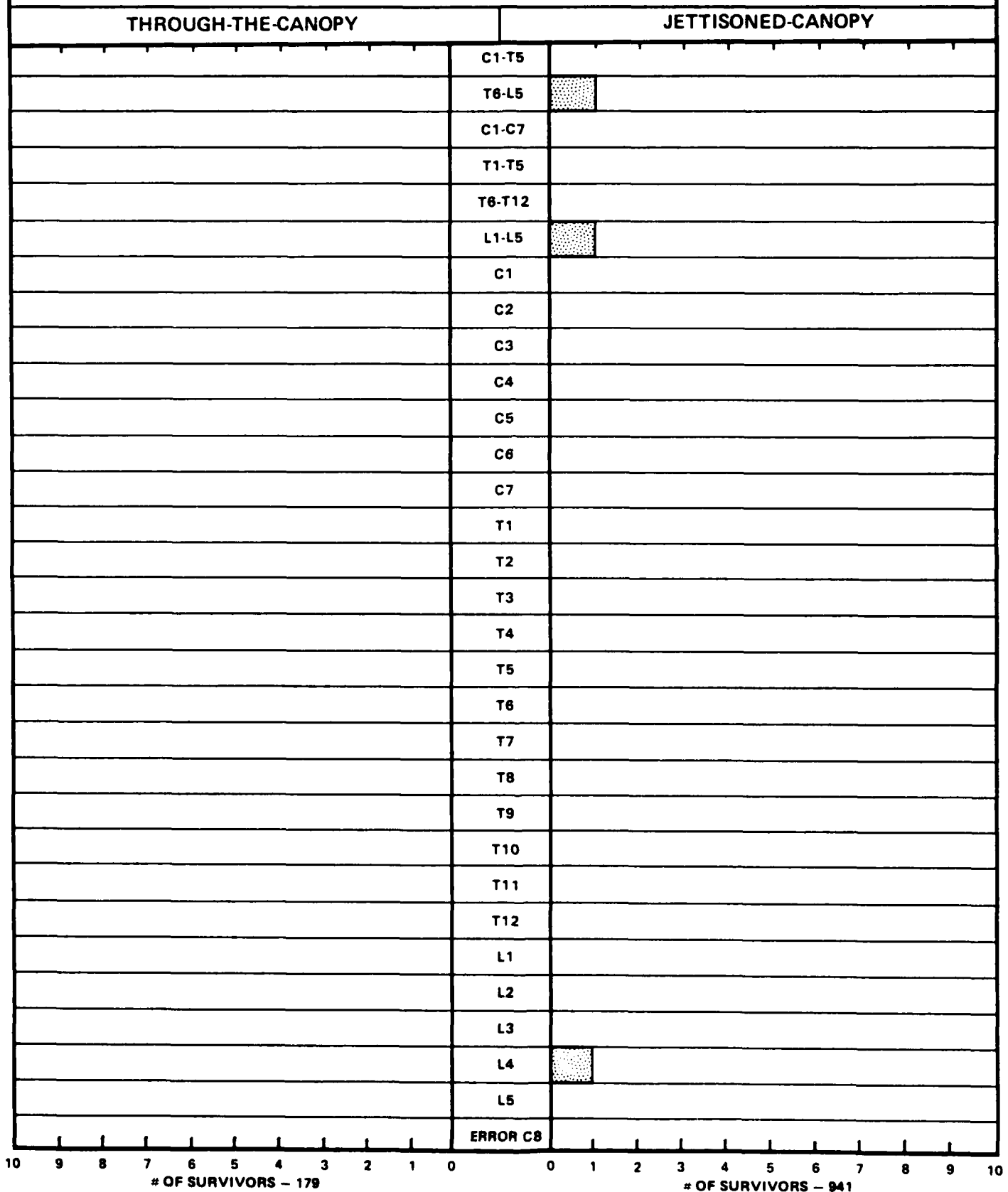
JETTISONED-CANOPY



**COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS**

INJURY DIAGNOSIS: SPRAIN

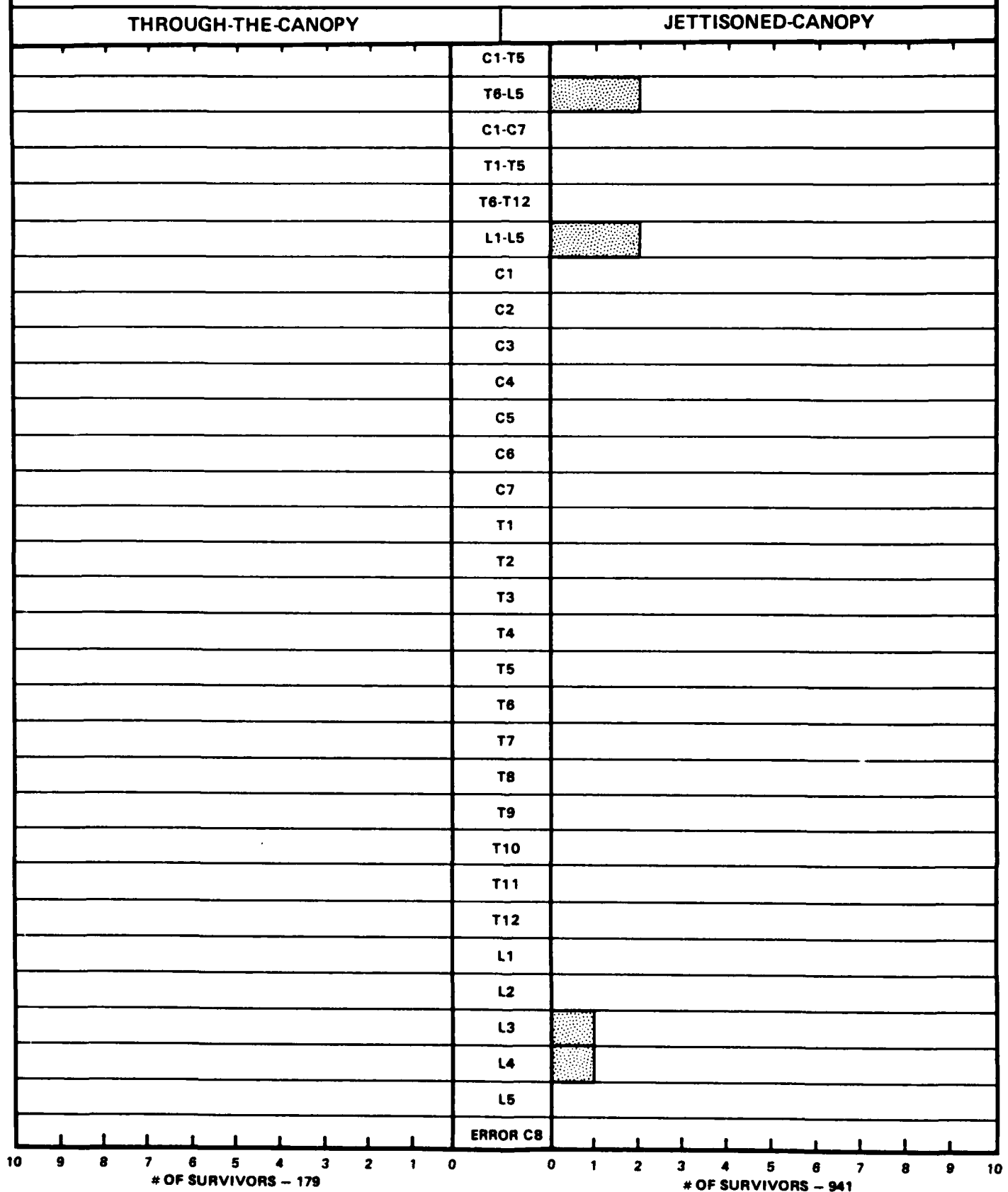
(SURVIVORS ONLY)



JANUARY 1969 - DECEMBER 1979

COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

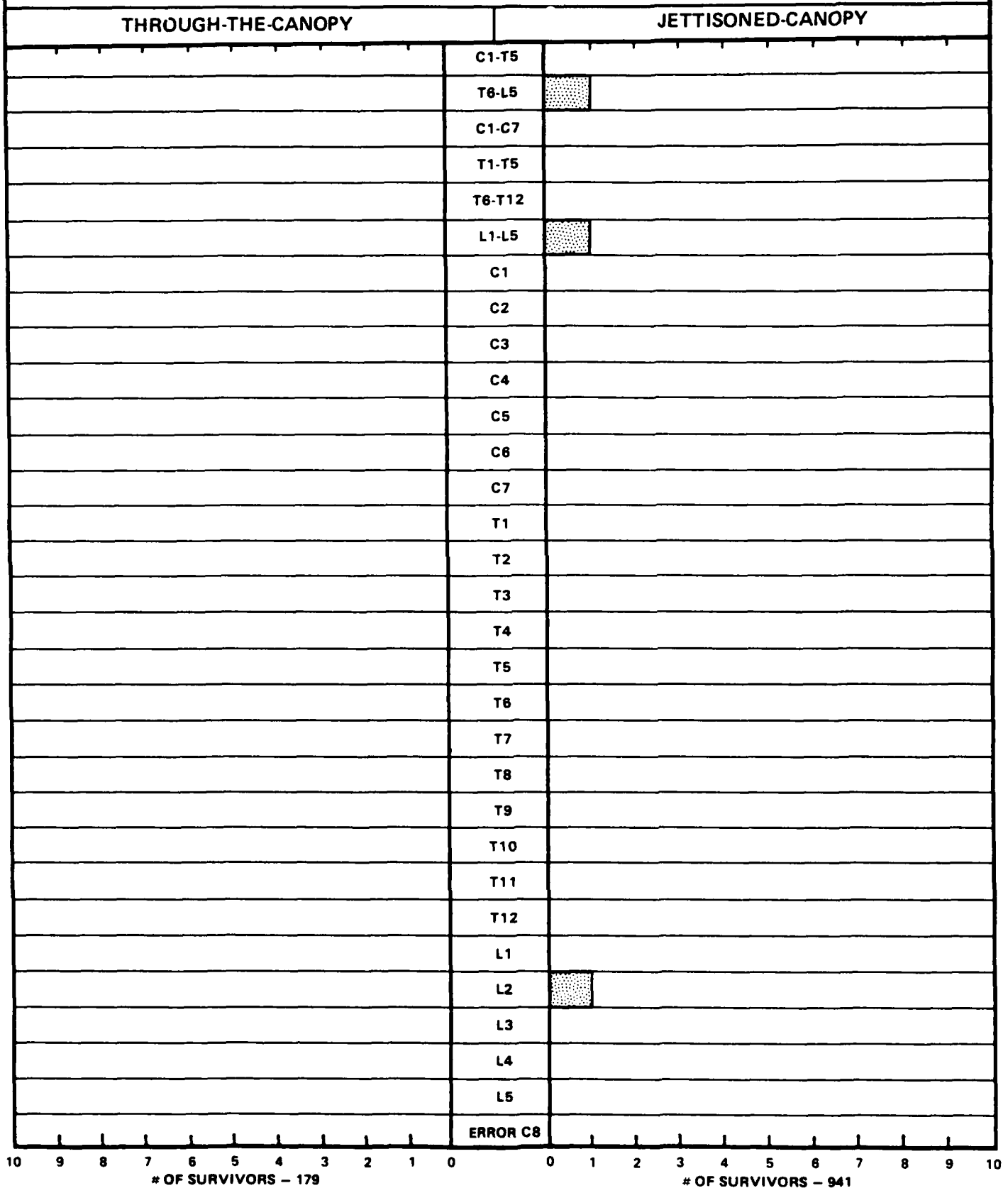
INJURY DIAGNOSIS: CONTUSION (SURVIVORS ONLY)



JANUARY 1969 - DECEMBER 1979

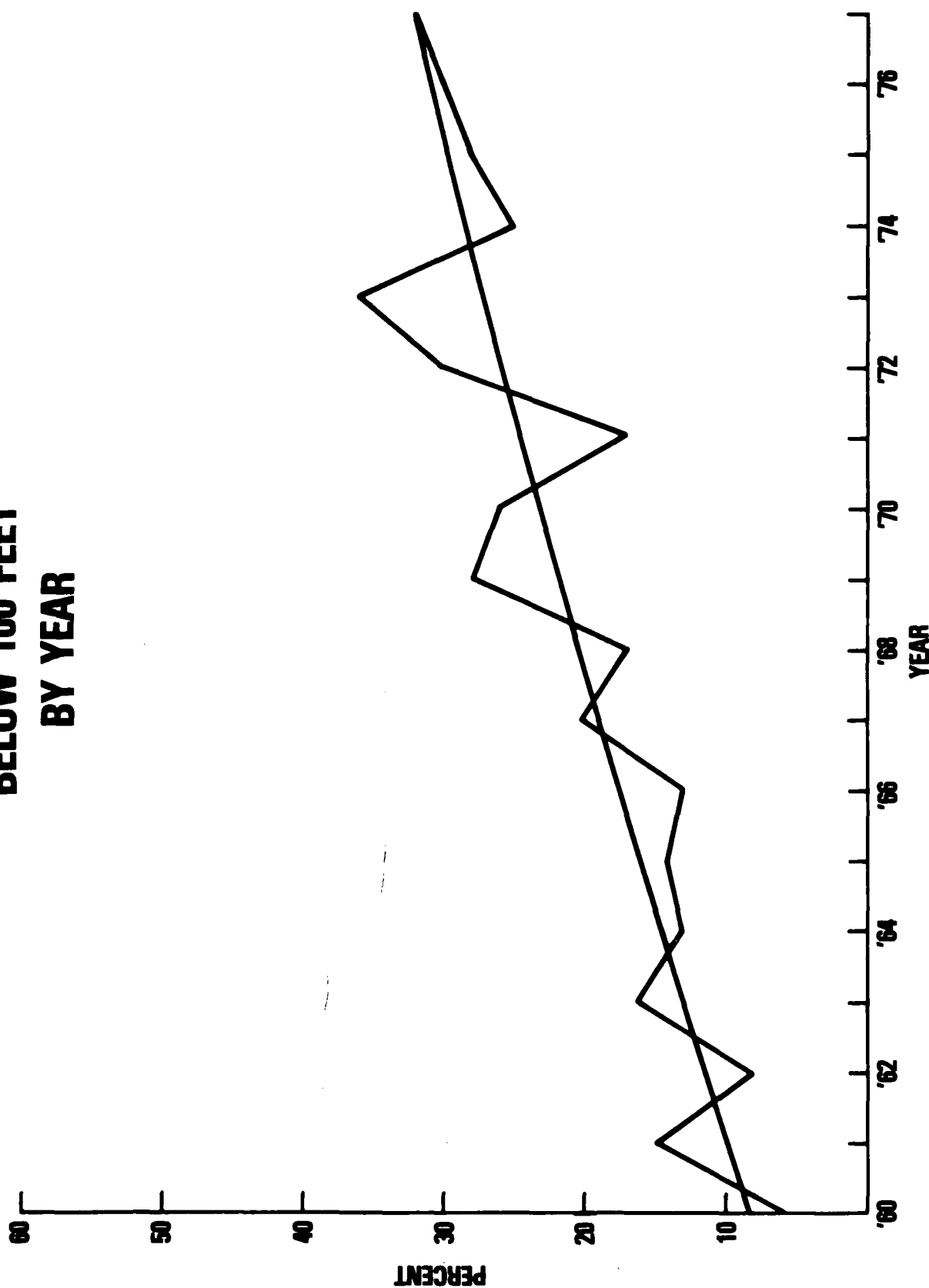
COMPARISON OF INJURED VERTEBRAL BODIES BY INJURY DIAGNOSES
FOR THROUGH-THE-CANOPY VS. JETTISONED-CANOPY EJECTIONS

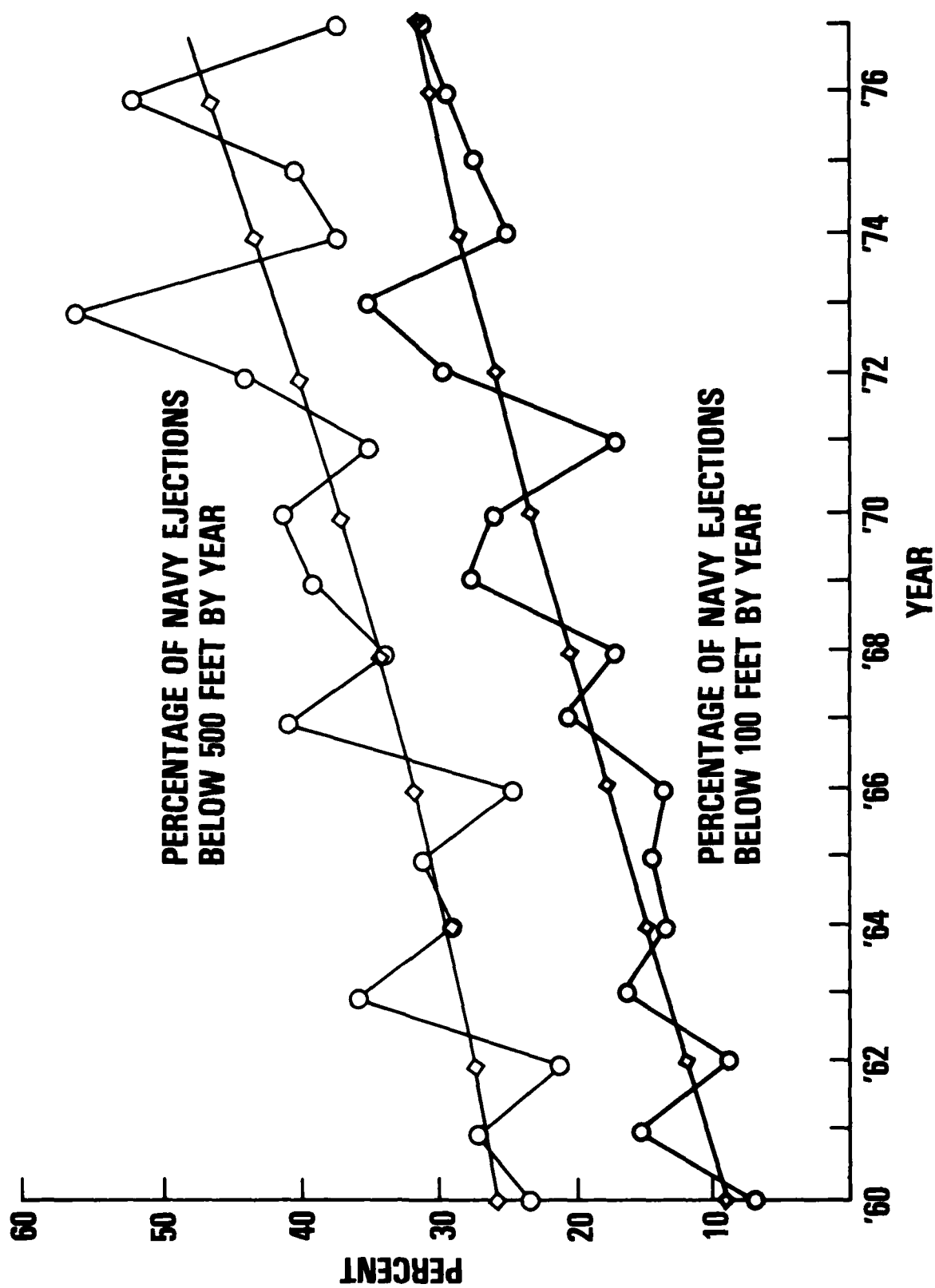
INJURY DIAGNOSIS: UNKNOWN/OTHER (SURVIVORS ONLY)



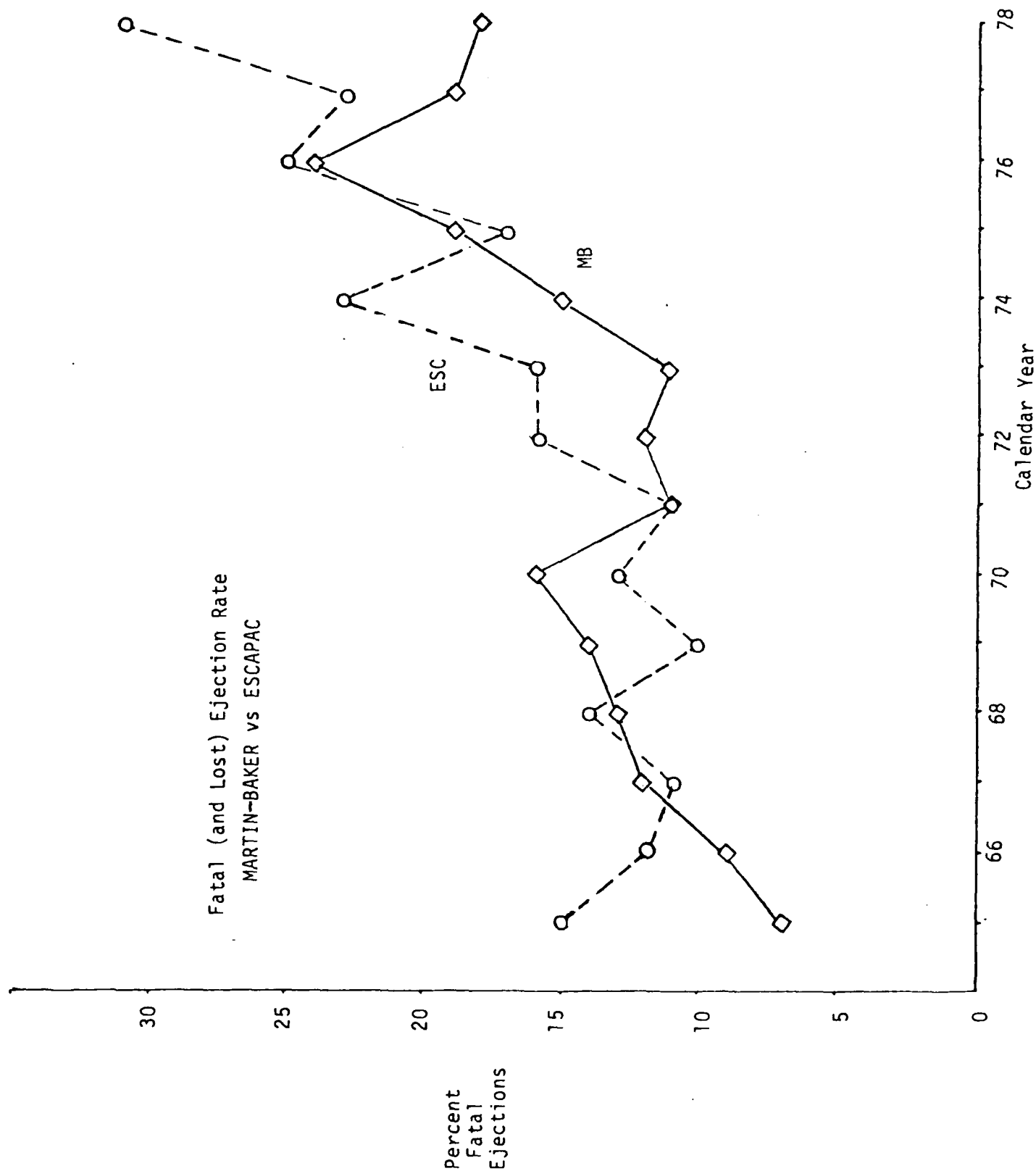
EJECTION STATISTICS &
ANALYSES

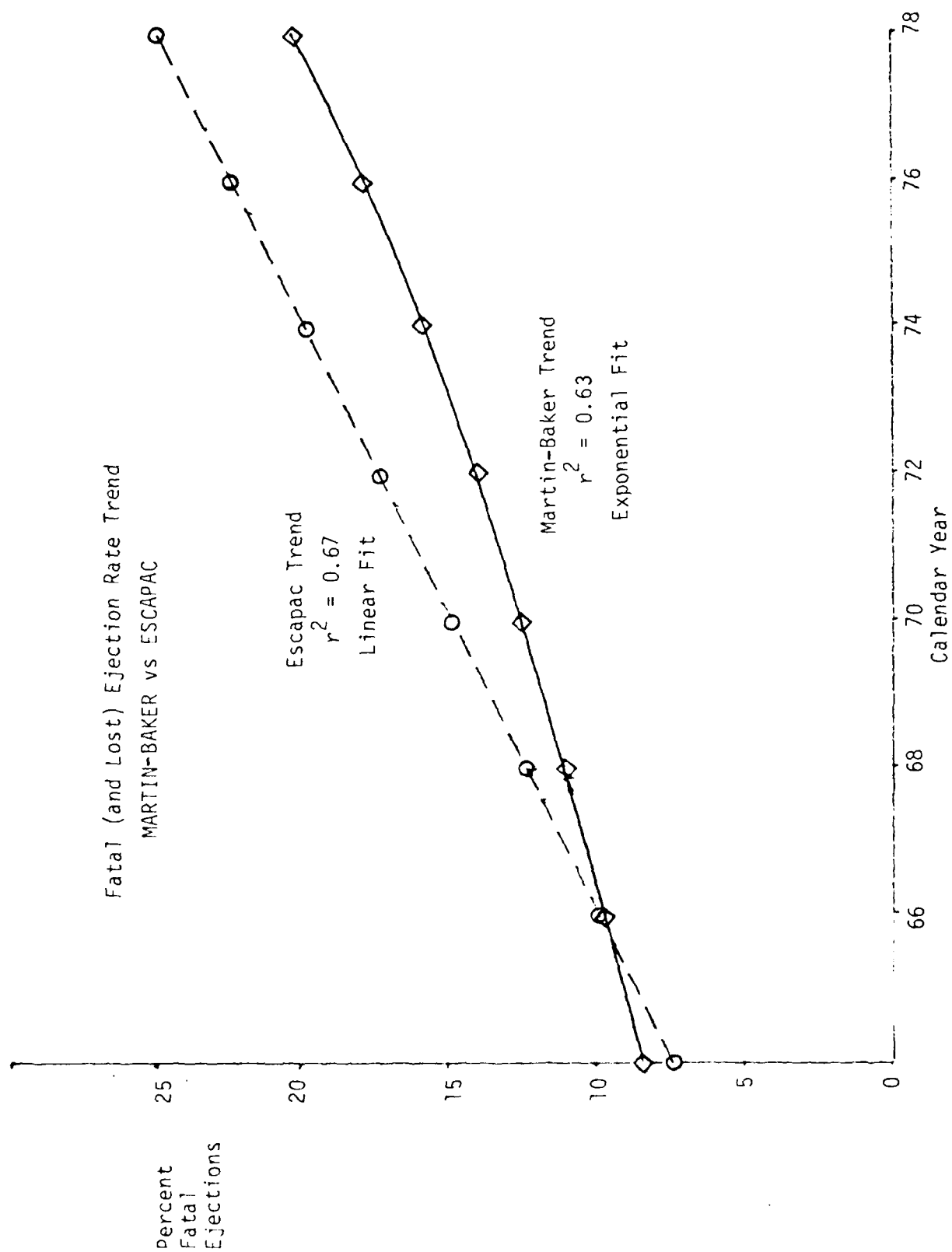
PERCENTAGE OF NAVY EJECTIONS BELOW 100 FEET BY YEAR





Fatal (and Lost) Ejection Rate MARTIN-BAKER vs ESCAPAC

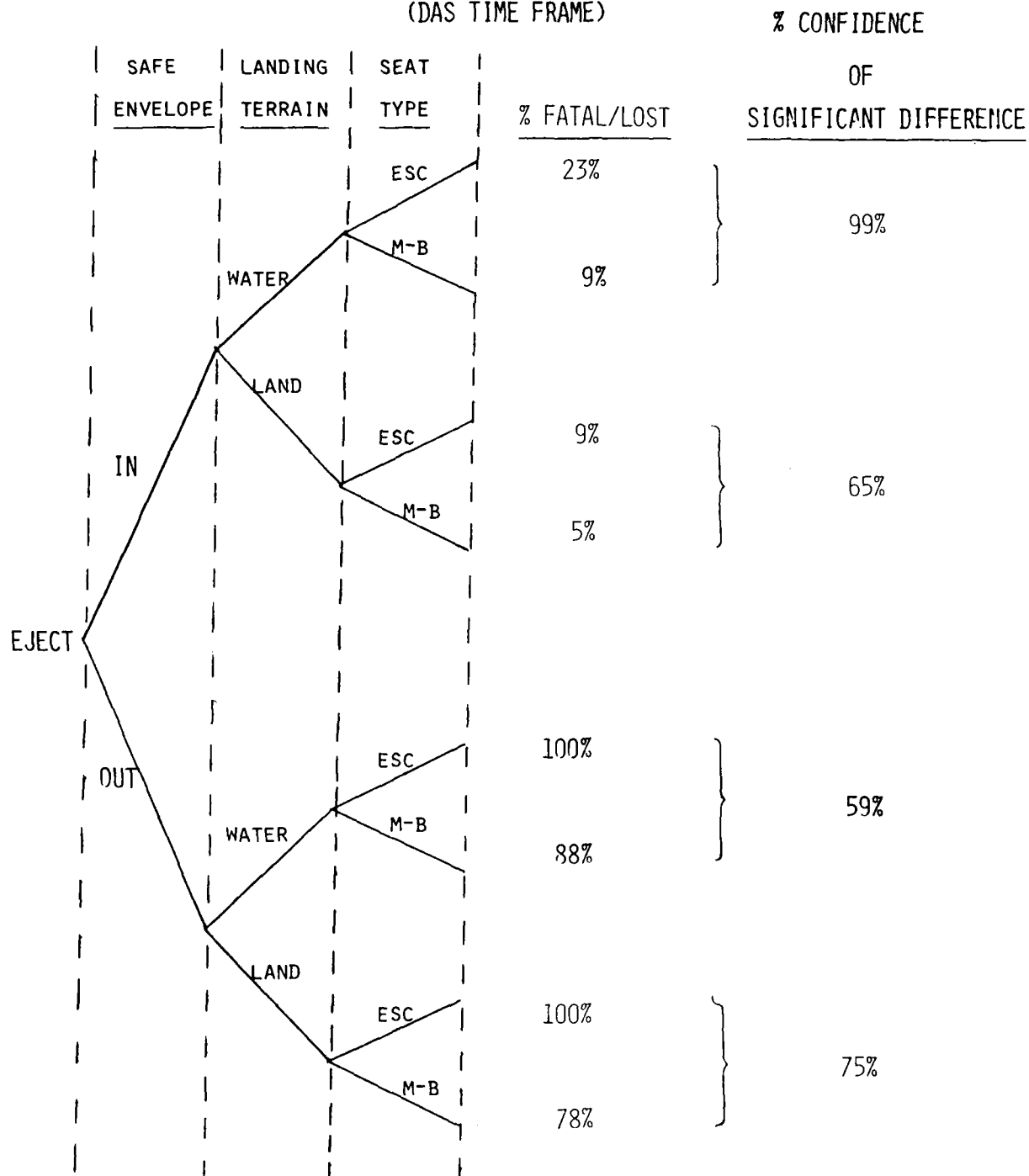




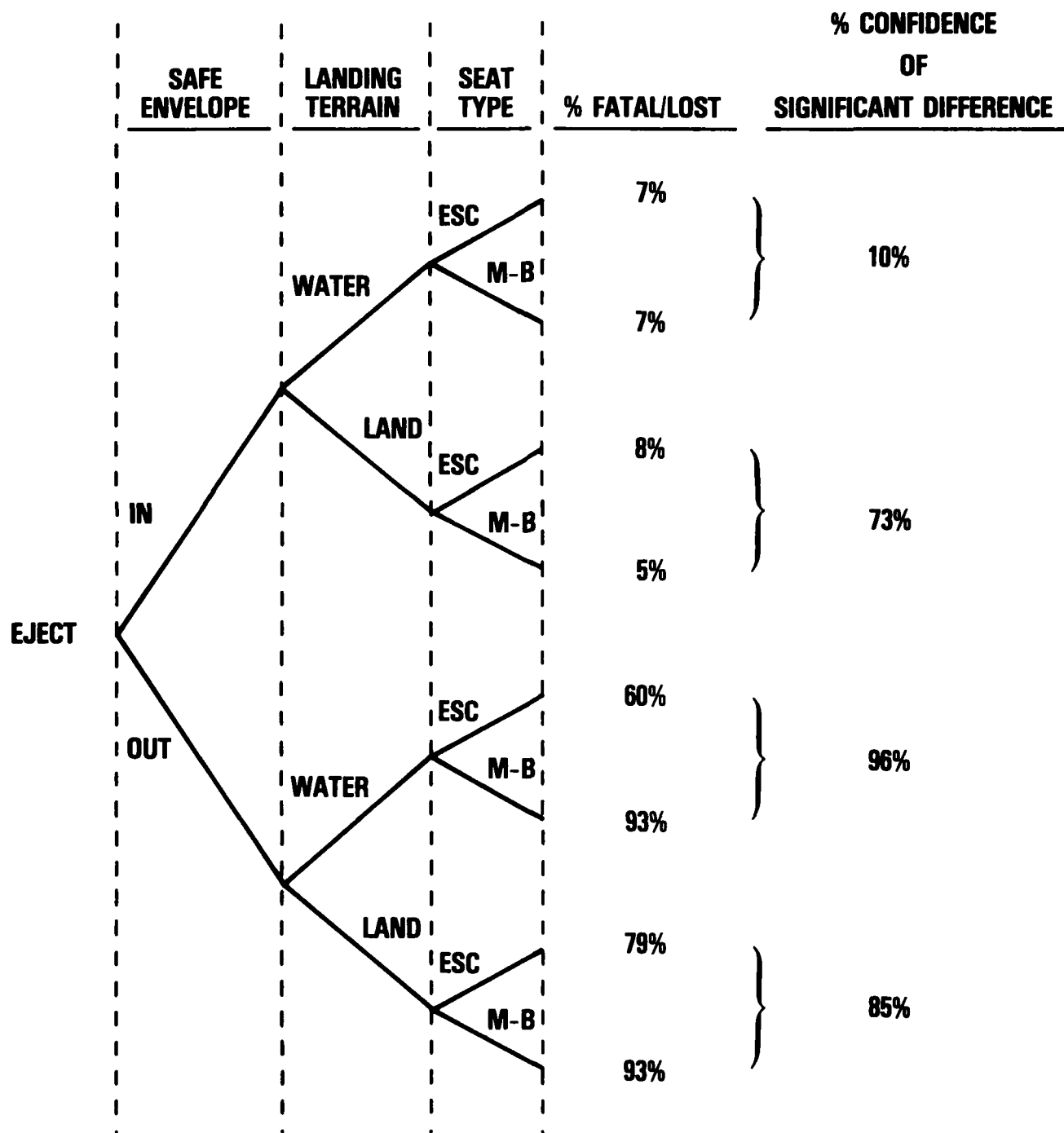
ESCAPAC vs MARTIN-BAKER FATAL/LOST DIAGRAM

(CY1974 THROUGH JUNE 30 1978)

(DAS TIME FRAME)

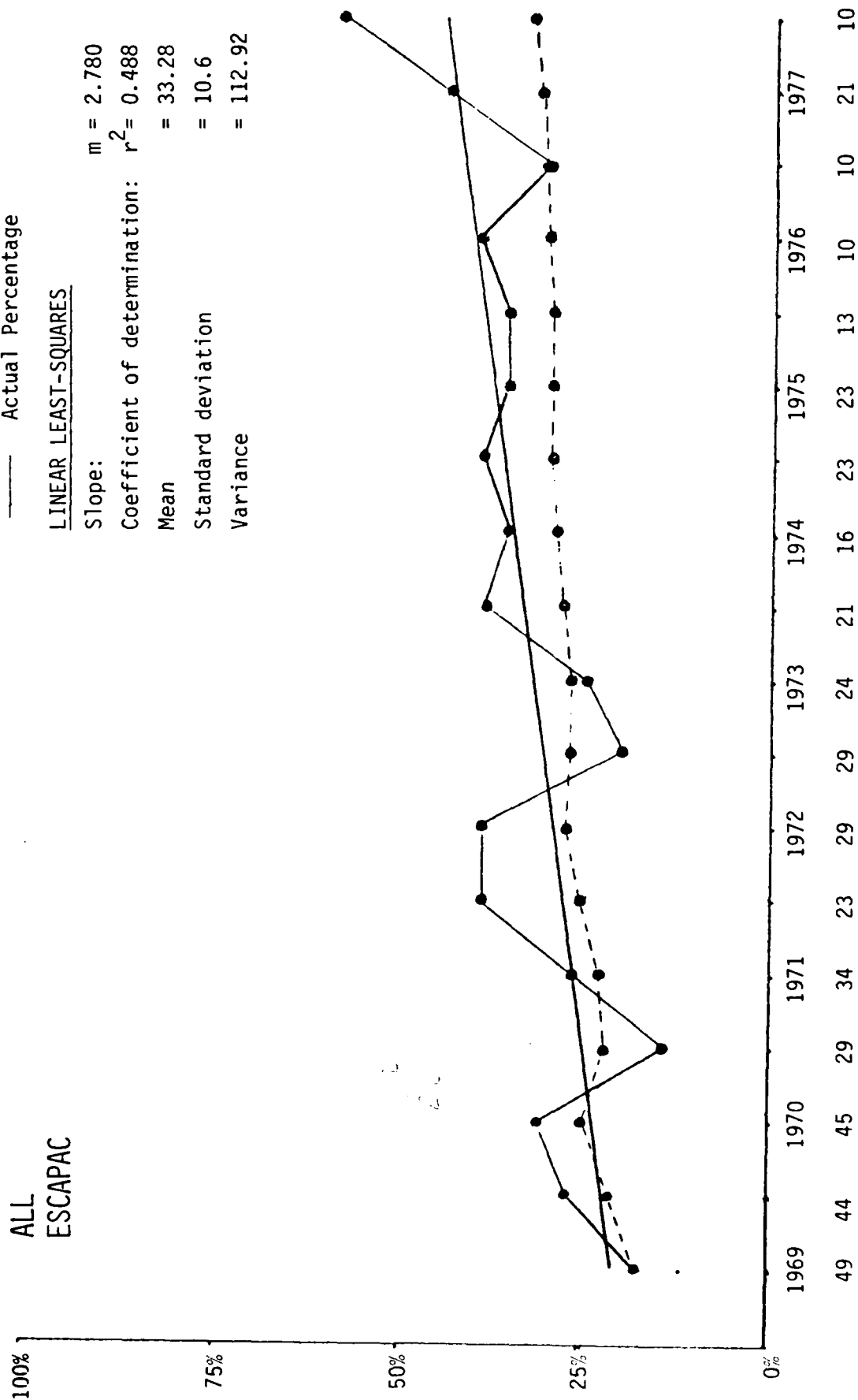


ESCAPAC VS MARTIN-BAKER FATAL/LOST DIAGRAM (CY1969 THROUGH CY1973)



TIME SERIES OF THE % OF ATTEMPTS WITH FATAL OR MAJOR INJURIES OR LOST

----- Cumulative
 ----- Actual Percentage
LINEAR LEAST-SQUARES
 Slope: $m = 2.780$
 Coefficient of determination: $r^2 = 0.488$
 Mean = 33.28
 Standard deviation = 10.6
 Variance = 112.92

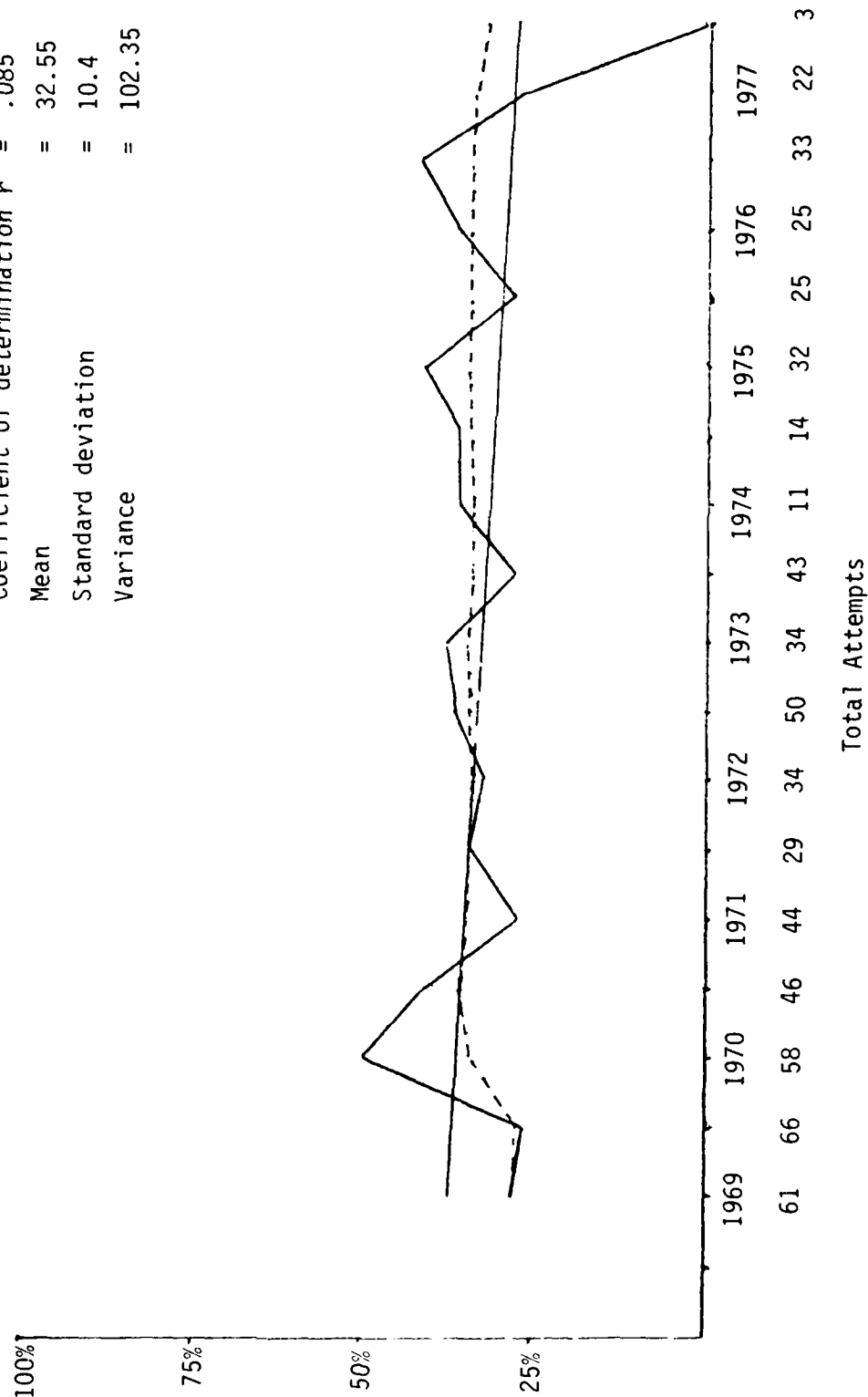


TIME SERIES OF THE % OF ATTEMPTS
WITH FATAL OR MAJOR INJURIES OR LOST
FOR THE MARTIN BAKER SEAT TYPES

--- Cumulative Running Average
— Actual Percentage

LINEAR LEAST SQUARES

Slope: $m = -.570$
Coefficient of determination $r^2 = .085$
Mean = 32.55
Standard deviation = 10.4
Variance = 102.35



CHANGES IN ESCAPAC INJURY RATES OVER THE PAST DECADE

<u>INJURY</u>	<u>1969 - 1973 (INCL.)</u>	<u>1974 - 1978 (INCL.)</u>	<u>Δ</u>
FATAL/LOST	13%	23%	+ 10%
MAJOR	14%	17%	+ 3%
MINOR/MINIMAL/NONE	73%	60%	- 13%
TOTAL # EJECTIONS	336	149	-187

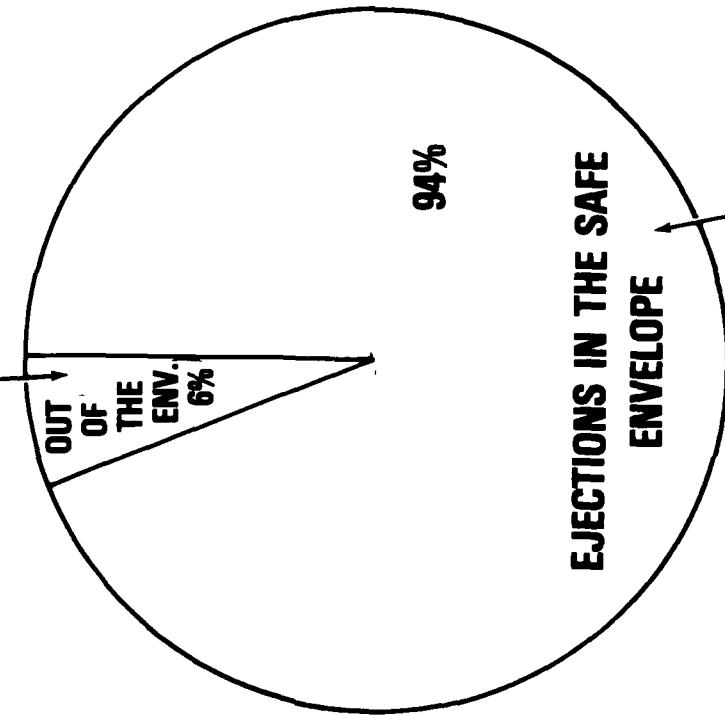
% CONFIDENCE OF SIGNIFICANT DIFFERENCE 99%

(I.E....AT A CONFIDENCE LEVEL OF 99% THE INJURY CATEGORIES REFLECT TWO DISTINCT SAMPLE POPULATIONS RATHER THAN RANDOM OCCURENCES DRAWN FROM THE SAME POPULATION).

DATA PERIOD : 1/1/69 THRU 12/31/73

ESCAPAC

72% FATALITY RATE



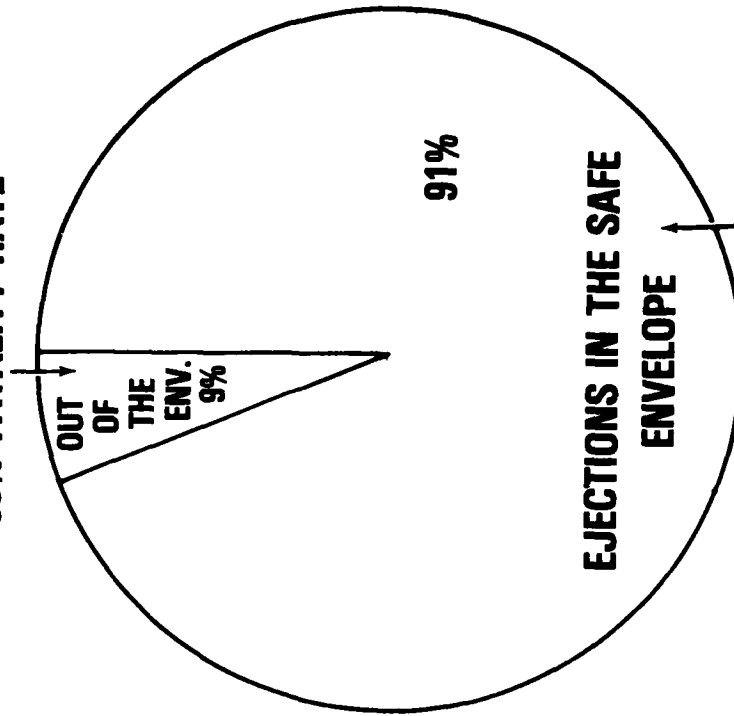
7% FATALITY RATE

$$.06 \times 72\% + .94 \times 7\% = 11\%$$

OVERALL
FATALITY
RATE

M-B

93% FATALITY RATE



6% FATALITY RATE

$$.09 \times 93\% + .91 \times 6\% = 14\%$$

OVERALL
FATALITY
RATE

WHY IS THE FATALITY RATE APPROXIMATELY EQUAL BETWEEN ESCAPAC AND MARTIN-BAKER?

(DAS TIME FRAME 1/1/74-6/30/78)

ESCAPAC

M-B

100% FATALITY RATE

OUT OF THE ENV. 7%

93%

EJECTIONS IN THE SAFE ENVELOPE

15% FATALITY RATE

82% FATALITY RATE

OUT OF THE ENVELOPE 17%

83%

EJECTIONS IN THE SAFE ENVELOPE

8% FATALITY RATE

$$.07 \times 100\% + .93 \times 15\% = 21\%$$

OVERALL FATALITY RATE

$$.17 \times 82\% + .83 \times 8\% = 21\%$$

OVERALL FATALITY RATE

FATALITY RATE COMPARISON BETWEEN

ESCAPAC IA-1, IC-2, IC-3 AND ESCAPAC IE-1, IF-3, IG-2, IG-3

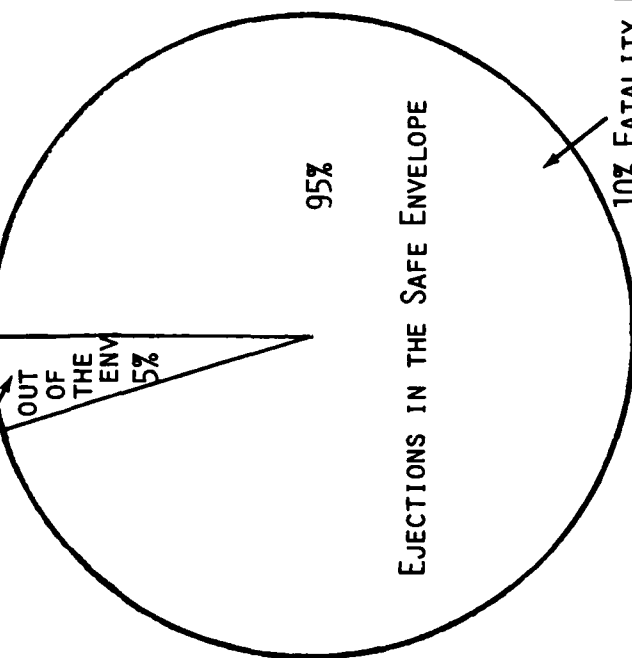
(DAS TIME FRAME 1/1/74-6/30/78)

ESCAPAC IA-1, IC-2, IC-3

ESCAPAC IE-1, IF-3, IG-2, IG-3

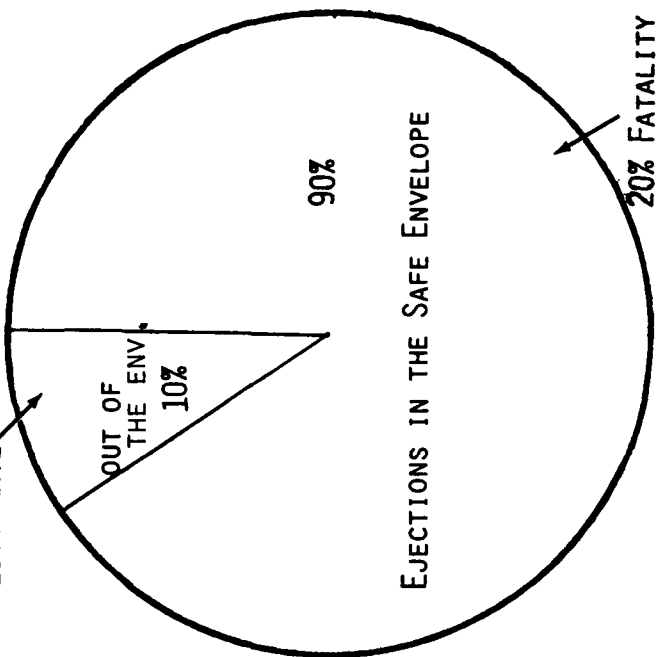
100% FATALITY RATE

88% FATALITY RATE



$$.05 \times 100\% + .95 \times 10\% = 14\%$$

OVERALL
FATALITY
RATE



$$.10 \times 88\% + .90 \times 20\% = 27\%$$

OVERALL
FATALITY
RATE

(1/1/74-6/30/78)

COMPARATIVE FATALITY RATES

ESCAPAC IA-1, IC-2, IC-3 vs IE-1, IF-3, IG-2, IG-3

EJECTIONS IN THE SAFE ENVELOPE

	<u>#</u>	<u>%</u>	<u>%</u>
	EJECT	SURVIVORS	FATAL & LOST
IA-1, IC-2, IC-3	58	90%	10%
IE-1, IF-3, IG-2, IG-3	71	80%	20%

% CONFIDENCE

OF

SIGNIFICANT DIFFERENCE

86%

COMPARATIVE FATALITY RATES

(1/1/74-6/30/78)

ESCAPAC IA-1, IC-2, IC-3, vs IE-1, IF-3, IG-2, IG-3

EJECTIONS OUT OF THE SAFE ENVELOPE

	# EJECT	% SURVIVORS	% FATAL & LOST
IA-1, IC-2, IC-3	3	0%	100%
IE-1, IF-3, IG-2, IG-3	8	12%	88%

% CONFIDENCE
OF
SIGNIFICANT DIFFERENCE

48%

1/1/74 - 6/30/78

% OF EJECTIONS IN vs OUT OF THE ENVELOPE

<u>SEAT</u>	<u>TOTAL EJECTIONS</u>	<u>% IN THE ENVELOPE</u>	<u>% OUT OF THE ENVELOPE *</u>
ESCAPAC	140	93%	7%
MARTIN-BAKER	230	83%	17%

% CONFIDENCE
OF

SIGNIFICANT DIFFERENCE

99%

* IN PART REPRESENTS DEGREE OF AIRCREW OVER-CONFIDENCE IN SYSTEM.

1/1/74 - 6/30/78

COMPARATIVE FATALITY
RATES
IN THE SAFE ENVELOPE
LAND & WATER

SEAT	# EJECTIONS	% SURVIVORS		% FATAL & LOST*
ESCAPAC	130	85%		15%
MARTIN-BAKER	191	92%		8%

% CONFIDENCE
OF
SIGNIFICANT DIFFERENCE

97%

* ESCAPAC FATALITY RATE FOR ALL "IN ENVELOPE" ESCAPE ATTEMPTS TWICE THAT OF MARTIN-BAKERS

1/1/74 - 6/30/78

COMPARATIVE FATALITY RATES

WHILE

EJECTING IN THE SAFE ENVELOPE

WATER ONLY

SEAT	# EJECTIONS	% TOTAL & LOST	% SURVIVORS
ESCAPAC	56	23%	77%
MARTIN-BAKER	117	9%	91%

% CONFIDENCE

OF

SIGNIFICANT DIFFERENCE

99%

* ESCAPAC FATALITY RATE FOR ALL "IN ENVELOPE - WATER" EJECTION ATTEMPTS GREATER THAN 2X LARGER THAN MBA'S

(PAGE 14)

"THE ESCAPAC SEAT IN THE A-7 AIRCRAFT HAS... ONE OF THE BEST RATES (85% PERCENT) IN THE NAVY".

• ALL A-7 ESCAPACs

FATAL	10 (18%)
MAJ. INJ.	10 (18%)
TOTAL	57

• HOWEVER, THIS MASKS SIGNIFICANT EFFECTS RESULTING FROM UPGRADING ESCAPAC IC-2 TO ESCAPAC IG-2:

	<u>ESCAPAC IC-2</u>	<u>ESCAPAC IG-2</u>
FATAL	0 (0%)	10 (31%)
MAJ. INJ.	5 (20%)	5 (16%)
TOTAL	25	32

(DATA 1/1/74 THROUGH 6/30/78)

ESCAPAC FATAL/LOST INJURIES

COMPARATIVE INCIDENCE RATES AMONG ALL ESCAPE ATTEMPTS

A-4

IA-1
14
16%

DATES: 69-78

IC-3
17
13%

DATES: 69-77

IF-3
4
20%

DATES: 72-77

IG-3
7
20%

DATES: 74-78

A-7

IC-2
19
12%

DATES: 69-76

IG-2
10
29%

DATES: 75-78

S-3

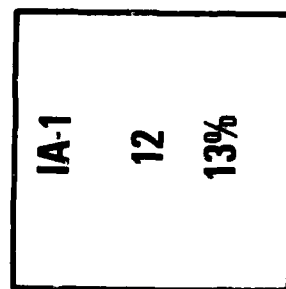
IE-1
7
64%

DATES: 73-78

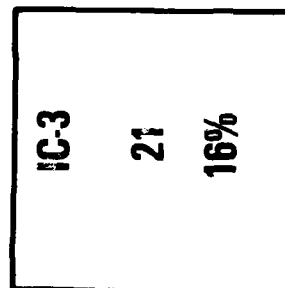
ESCAPAC MAJOR INJURIES

COMPARATIVE INCIDENCE RATES AMONG ALL ESCAPE ATTEMPTS

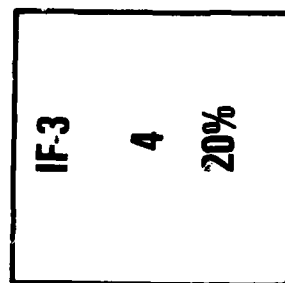
A-4



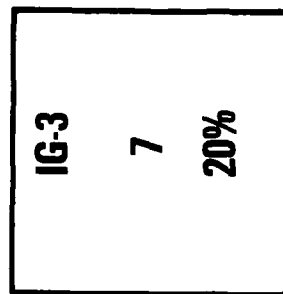
DATES: 69-78



DATES: 69-77

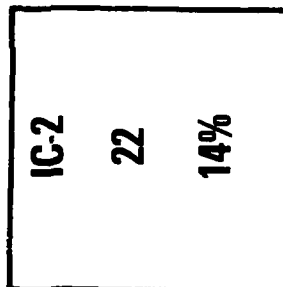


DATES: 72-77

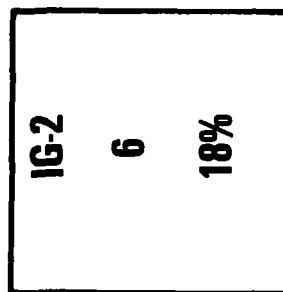


DATES: 74-78

A-7

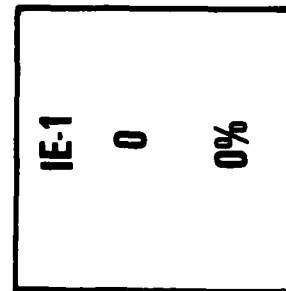


DATES: 69-76



DATES: 75-78

S-3



DATES: 73-78

ESCAPAC MAJOR INJURIES **COMPARATIVE INCIDENCE RATES** **AMONG SURVIVORS & NON-LOST/IMPACT MULTIPLE** **EXTREME FATALITIES**

A-4

IA-1
12
15%

DATES: 69-78

IC-3
21
19%

DATES: 64-77

IF-3
4
21%

DATES: 72-77

IG-3
7
23%

DATES: 74-78

A-7

IC-2
22
15%

DATES: 69-76

IG-2
6
21%

DATES: 75-78

S-3

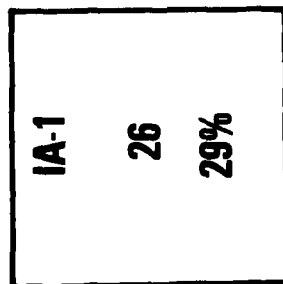
IE-1
0
0%

DATES: 73-78

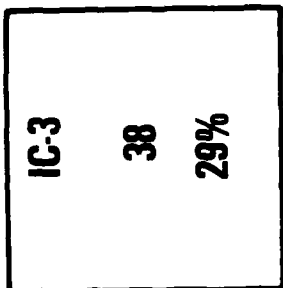
ESCAPAC FATAL/LOST & MAJOR INJURIES

COMPARATIVE INCIDENCE RATES AMONG ALL ESCAPE ATTEMPTS

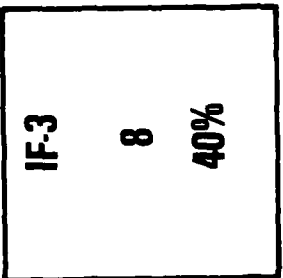
A-4



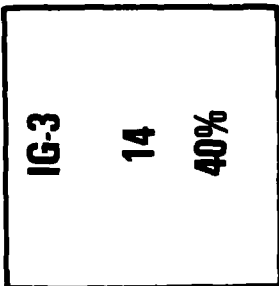
DATES: 69-78



DATES: 69-77

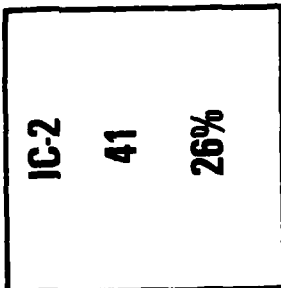


DATES: 72-77

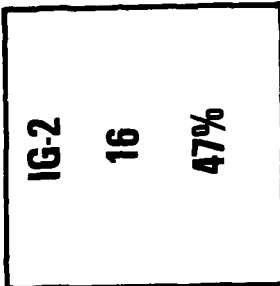


DATES: 74-78

A-7

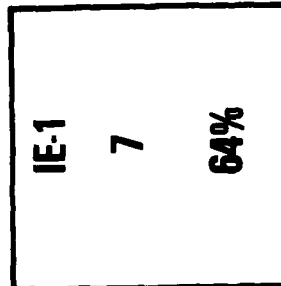


DATES: 69-76



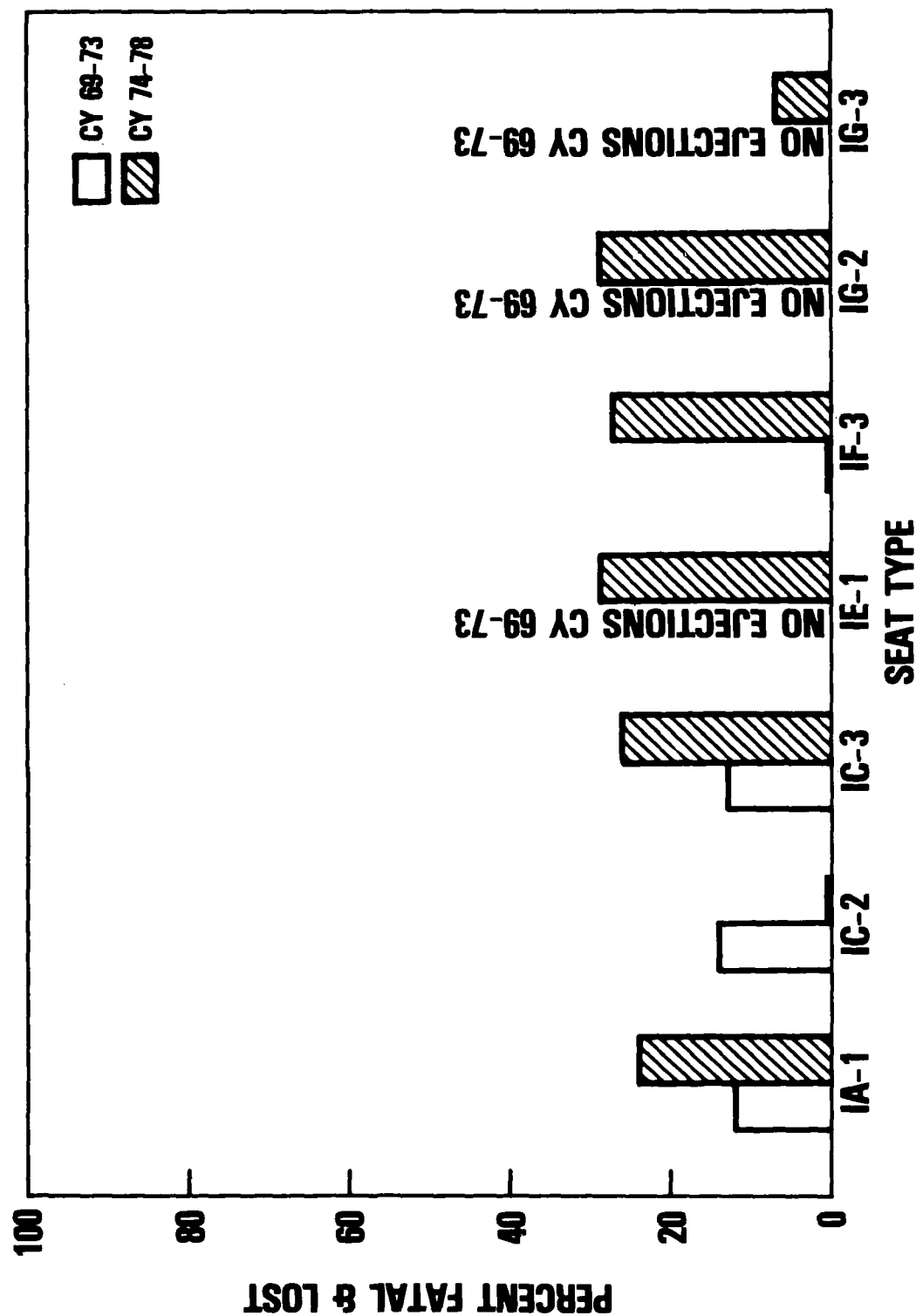
DATES: 75-78

S-3

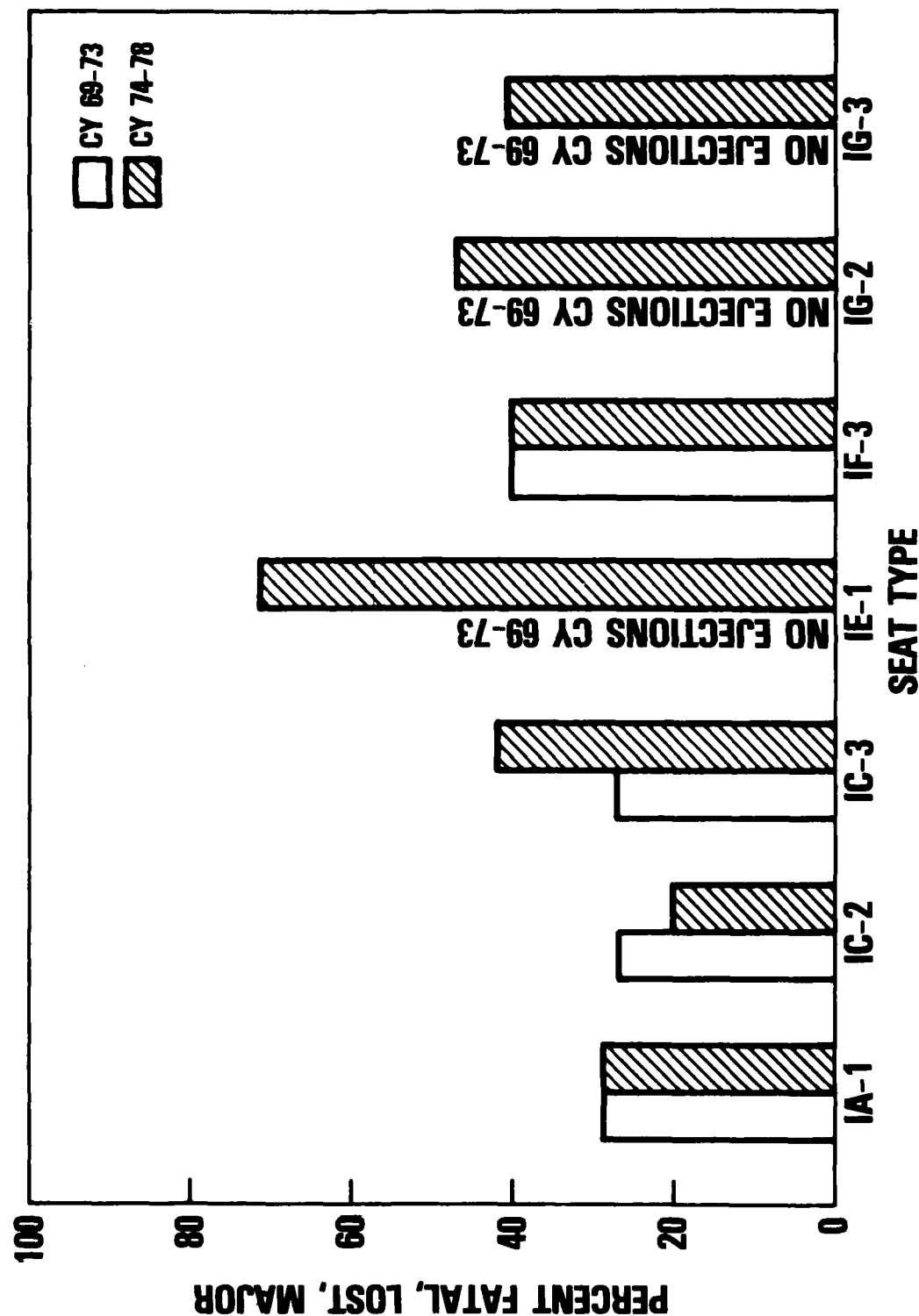


DATES: 73-78

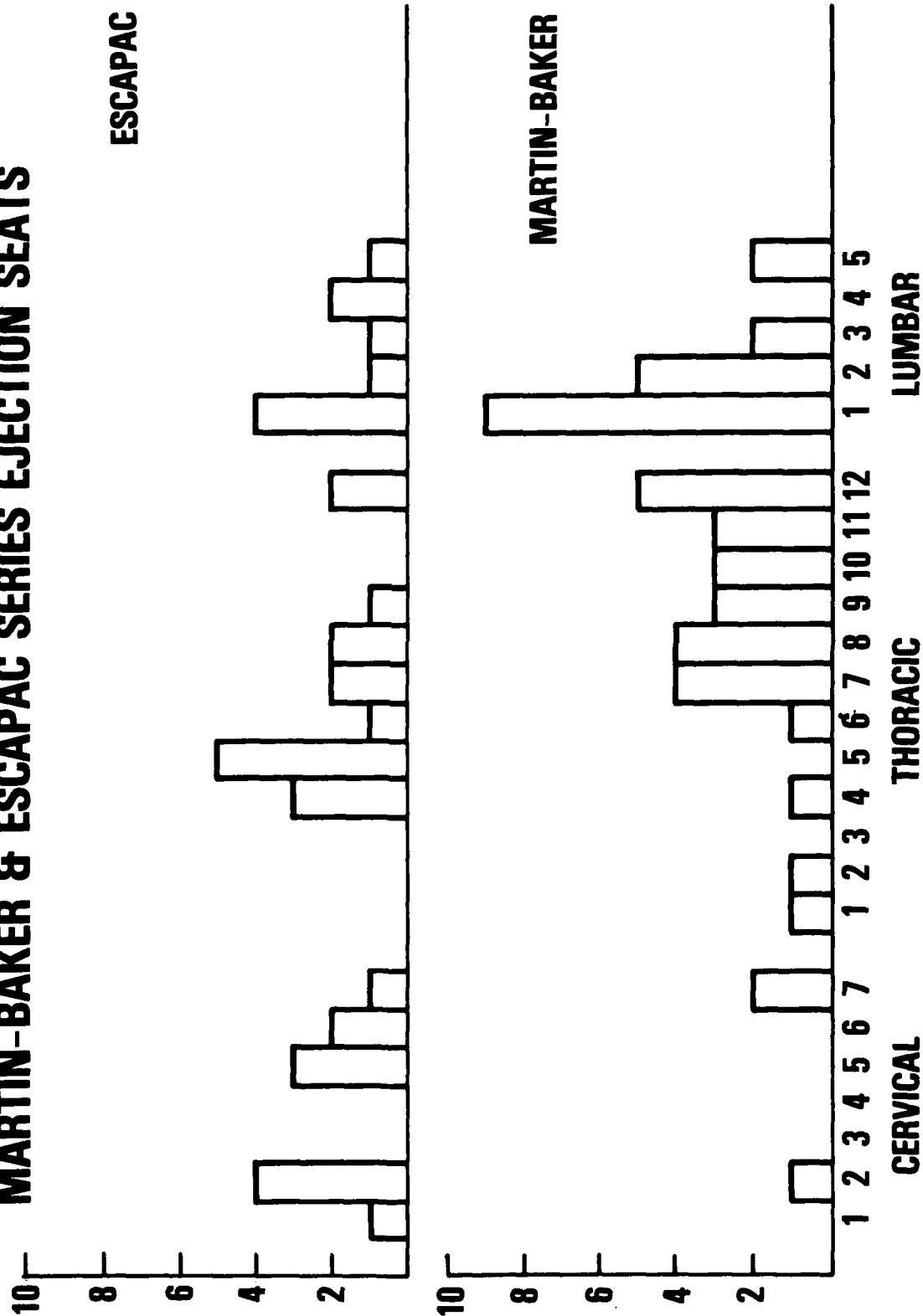
COMPARISON OF FATAL AND LOST INJURIES BY ESCAPAC SEATS CY 69-73 VS CY 74-78



COMPARISON OF FATAL, LOST, MAJOR INJURIES BY ESCAPAC SEAT TYPE CY 69-73 VS CY 74-78

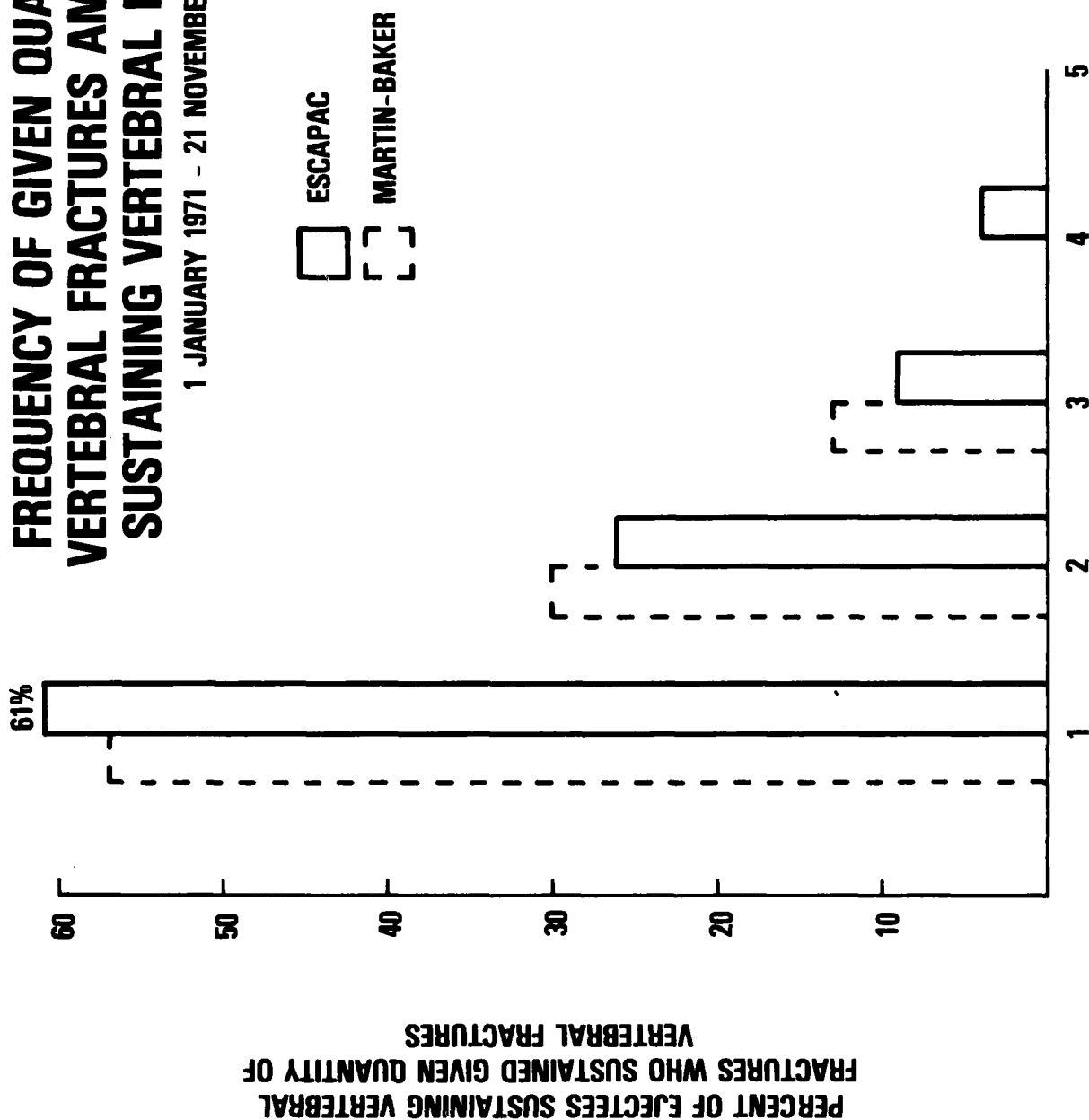


VERTEBRAL FRACTURE DISTRIBUTION AMONG USN EJECTEES 1 JANUARY 1971 - 21 NOVEMBER 1978 MARTIN-BAKER & ESCAPAC SERIES EJECTION SEATS



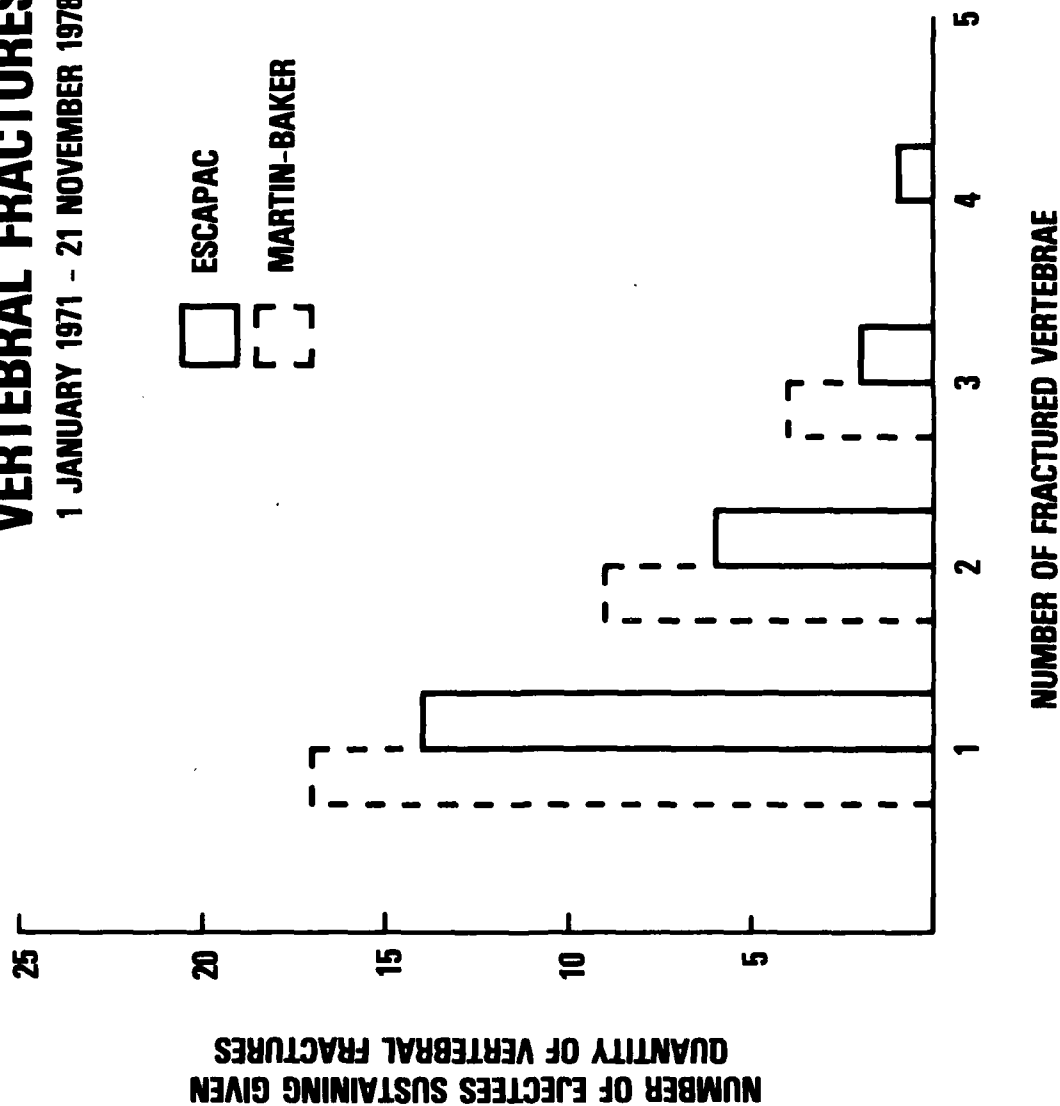
FREQUENCY OF GIVEN QUANTITIES OF VERTEBRAL FRACTURES AMONG THOSE SUSTAINING VERTEBRAL FRACTURES

1 JANUARY 1971 - 21 NOVEMBER 1978



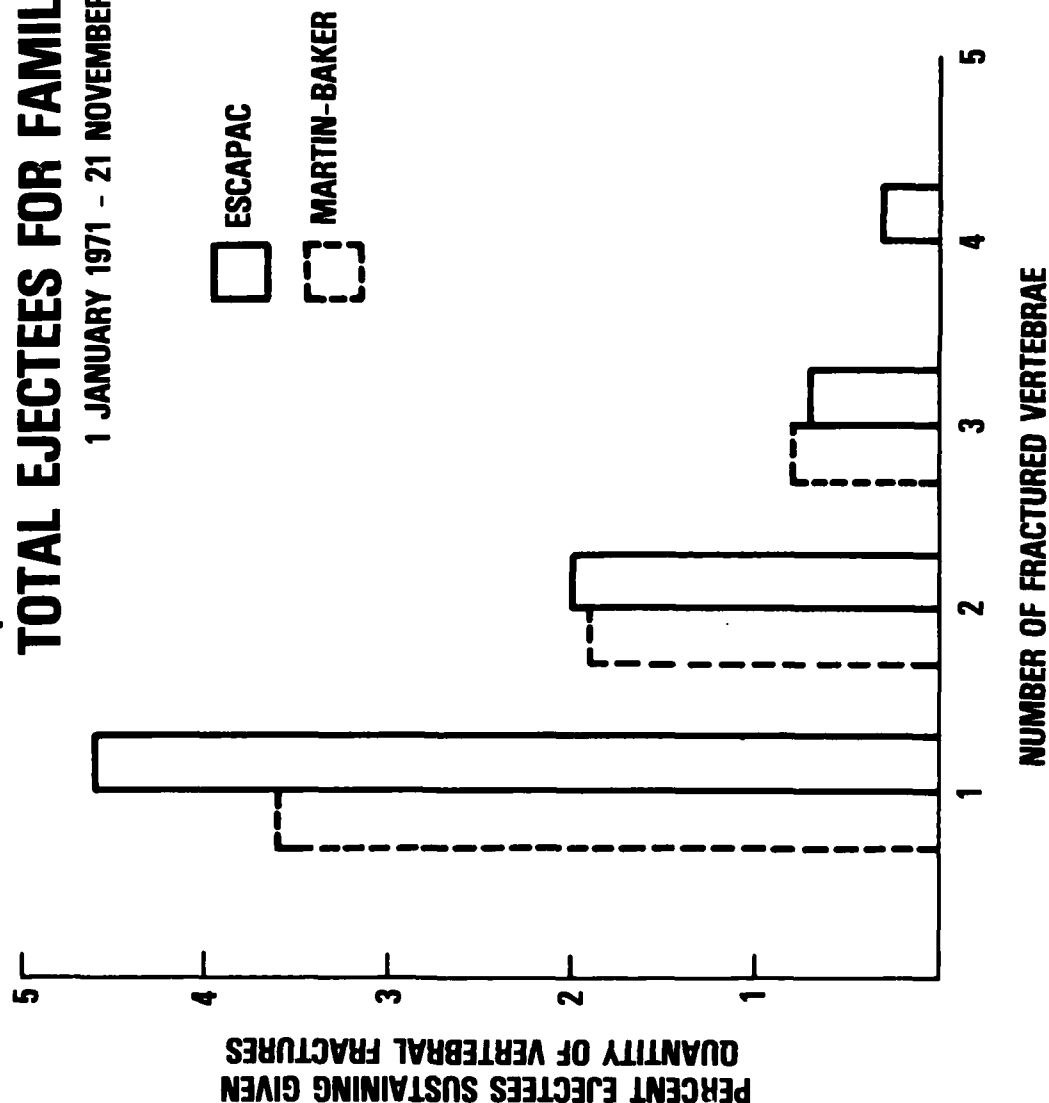
NUMBER OF VERTEBRAL FRACTURES PER EJECTEE SUSTAINING ONE OR MORE VERTEBRAL FRACTURES

1 JANUARY 1971 - 21 NOVEMBER 1978



NUMBER OF VERTEBRAL FRACTURES PER EJECTEE SUSTAINING ONE OR MORE VERTEBRAL FRACTURES (EJECTEES EXPRESSED AS PERCENT OF TOTAL EJECTEES FOR FAMILY OF SEATS)

1 JANUARY 1971 - 21 NOVEMBER 1978



MOR (MARTIN-BAKER) INJURY DATA
1 JANUARY 1969 THRU 31 DECEMBER 1978

NUMBER OF INJURIES BY AIRCRAFT

INJURY TYPE	A-6	F-4	F-8	F-9	F-14	T-1	AV-8A	TOTALS
MINOR/ MINIMAL/NONE	81	264	91	15	40	2	4	497
MAJOR	34	35	7	14	7	2	3	102
FATAL	16	36	6	4	10	2	1	75
LOST	11	25	4	1	1	0	0	42
TOTALS	142	360	108	34	58	6	8	716

MOR (MARTIN-BAKER) INJURY DATA
1 JANUARY 1969 THRU 31 DECEMBER 1973
NUMBER OF INJURIES BY AIRCRAFT MODEL

INJURY TYPE	A-6	F-4	F-8	F-9	F-14	T-1	AV-8A	TOTALS
MIN/NONE	47	188	76	15	2	2	0	330
MAJOR	19	28	6	14	0	2	1	70
FATAL	12	21	6	4	0	2	0	45
LOST	3	14	4	1	0	0	0	22
	—	—	—	—	—	—	—	—
TOTALS	81	251	92	34	2	6	1	467

MOR (MARTIN-BAKER) INJURY DATA
1 JANUARY 1974 THRU 30 JUNE 1978
NUMBER OF INJURIES BY AIRCRAFT MODEL

INJURY TYPE	A-6	F-4	F-8	F-9	F-14	T-1	AV-8A	TOTALS
MINIMAL/MINOR/NONE	28	72	15	0	32	0	4	151
MAJOR	15	7	1	0	7	0	2	32
FATAL	3	15	0	0	10	0	1	29
LOST	6	11	0	0	1	0	0	18
	—	—	—	—	—	—	—	—
TOTALS	52	105	16	0	50	0	7	230

MARTIN-BAKER EJECTIONS BY SEAT TYPE NUMBER AND PERCENT OF INJURIES BY INJURY CLASSIFICATION

1 JANUARY 1969 THRU 31 DECEMBER 1978

SEAT TYPES	FATAL	%	LOST	%	MAJOR	%	MINOR	%	MINIMAL NONE	%	TOTALS	%
A 5	4	5	1	2	8	8	3	2	3	0.9	19	3
A 7	0	0	0	0	5	5	1	1	2	0.6	8	1
F 5	2	3	2	5	1	1	5	3	7	2	17	2
F 7	4	5	2	5	6	6	16	9	63	19	91	13
GRU 5	13	17	4	10	23	22	32	19	18	5	90	13
GRU 7	3	4	4	10	7	7	11	6	10	3	35	5
GRU 7A	10	13	1	2	7	7	11	6	27	8	56	8
GRUEA 7	0	0	3	7	4	4	7	4	5	2	19	2
H 5	0	0	1	2	3	3	5	3	4	1	13	2
H 7	36	48	24	57	32	31	76	44	179	55	347	48
TYPE-9	1	1	0	0	3	3	2	1	2	0.6	8	1
L 5	2	3	0	0	2	2	1	1	1	0.3	6	0.8
Z 5	0	0	0	0	1	1	1	1	5	2	7	0.9
TOTALS	75		42		102		171		326		716	

MARTIN-BAKER EJECTIONS BY INJURY CLASSIFICATION AND SEAT TYPE

1 JANUARY 1969 THRU 31 DECEMBER 1973

(INJURY BY SEAT TYPE)

INJURY TYPE	A 5	A 7	F 5	F 7	GRU 5	GRU 7	GRU 7A	H 5	H 7	TYPE-9	L 5	Z 5	TOTALS
MINIMAL/NONE	3	2	7	48	16	2	1	4	117	0	1	5	206
MINOR	3	1	5	16	29	0	1	5	62	0	1	1	124
MAJOR	8	5	1	5	18	1	0	3	25	1	2	1	70
FATAL	4	0	2	4	10	2	0	0	21	0	2	0	45
LOST	1	0	2	2	3	0	0	1	13	0	0	0	22
TOTALS	19	8	17	75	76	5	2	13	238	1	6	7	467

AD-A171 659

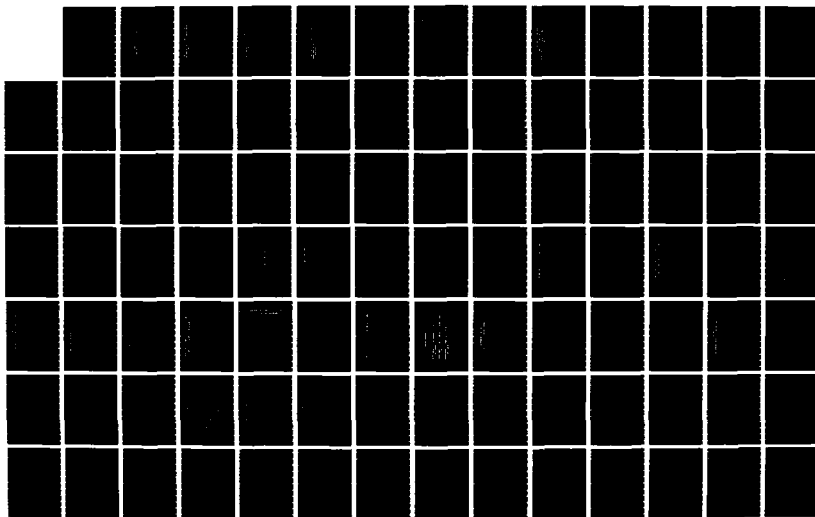
AIRCREW AUTOMATED ESCAPE SYSTEMS (AAES) DATA ANALYSIS
PROGRAM SYMPOSIUM H. (U) NAVAL SAFETY CENTER NORFOLK VA
1981

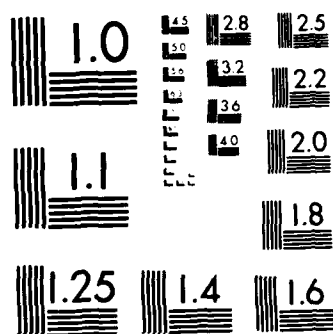
3/4

UNCLASSIFIED

F/G 1/3

ML





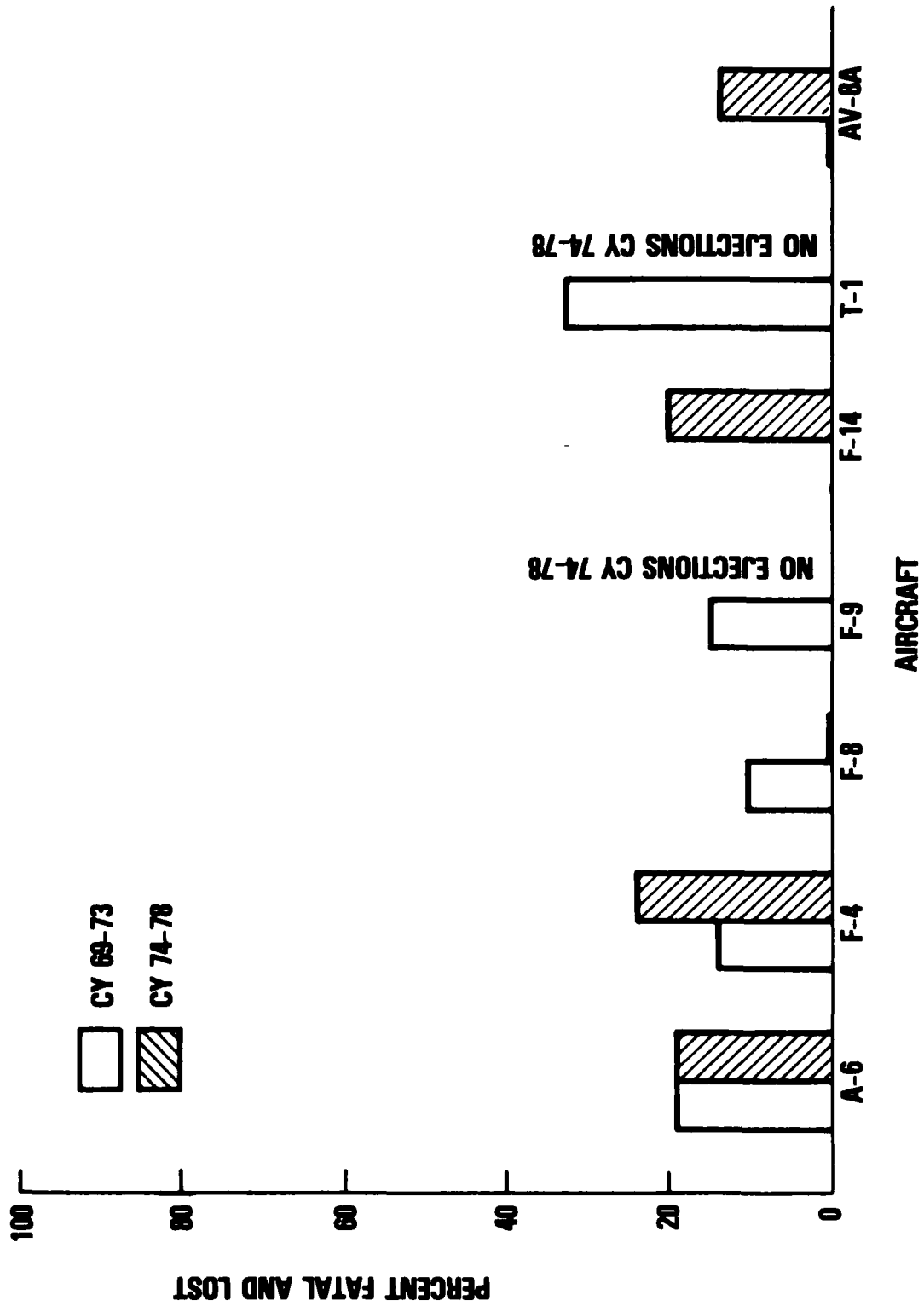
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

MARTIN-BAKER NUMBER OF INJURIES BY SEAT TYPE AND INJURY CLASSIFICATION

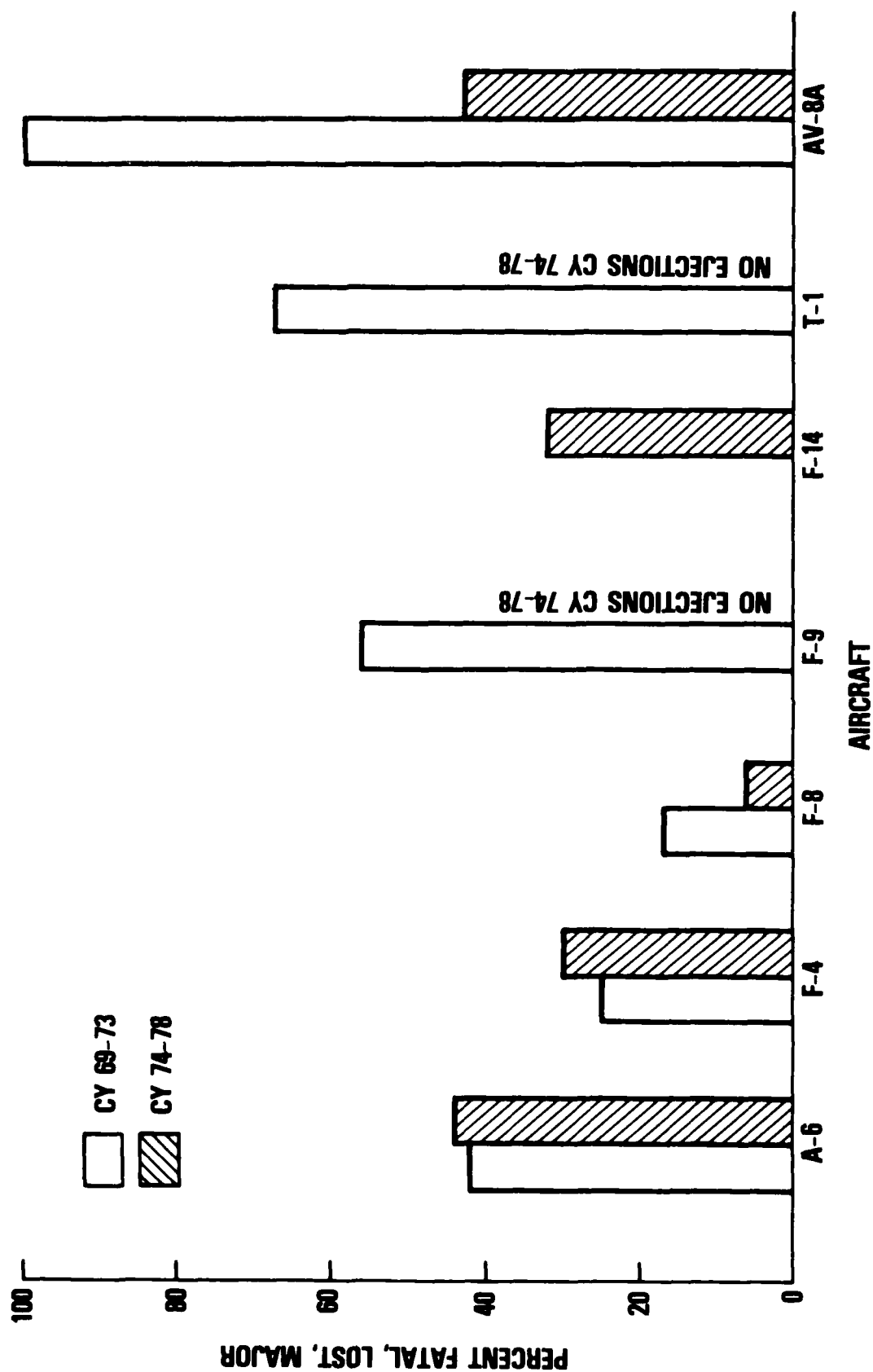
1 JANUARY 1974 THRU 30 JUNE 1978

INJURY TYPE	F 7	GRU 5	GRU 7	GRUEA 7	GRU 7A	H 7	TYPE-9	TOTALS
MINIMAL/NONE	15	2	5	5	22	58	2	109
MINOR	0	3	10	3	10	14	2	42
MAJOR	1	5	6	4	7	7	2	32
FATAL	0	3	0	0	10	15	1	29
LOST	0	1	4	1	1	11	0	18
TOTALS	16	14	25	13	50	105	7	230

PERCENTAGES OF FATAL AND LOST INJURIES RESULTING FROM MARTIN-BAKER EJECTIONS BETWEEN CY 69-73 AND CY 74-78 (BY AIRCRAFT)



PERCENTAGES OF FATAL, LOST, MAJOR INJURIES RESULTING FROM MARTIN-BAKER EJECTIONS BETWEEN CY 69-73 AND CY 74-78 (BY AIRCRAFT)



INCIDENCE OF VERTEBRAL FRACTURES AMONG MARTIN-BAKER & ESCAPAC EJECTEES COMPARISON OF VERTEBRAL FRACTURES

	TOTAL EJECTEES	EJECTEES W/ VERTEBRAL FRACTURES	VERTEBRAL FRACTURE RATE
ESCAPAC	305	23	8%
MARTIN-BAKER	471	30	6%

ESCAPAC

MARTIN-BAKER

PERIOD: 1 JANUARY 1971 - 21 NOVEMBER 1978

USN ESCAPAC SEAT DATA BY AIRCRAFT TYPE

1 JANUARY 1974 THRU 30 JUNE 1978

NUMBER INJURIES BY AIRCRAFT MODEL

INJURY TYPE	A-4	A-7	S-3	TOTALS
MIN/NONE	49	37	2	88
MAJOR	12	10	0	22
FATAL	12	7	3	22
LOST	5	3	0	8
TOTALS	78	57	5	140

ESCAPAC SEAT INJURY CLASSIFICATION BREAKOUT BY SEAT TYPE

1 JANUARY 1974 THRU 30 JUNE 1978

TYPE INJURY	PRE SEAT-MAN ROCKET			SEAT-MAN SEPARATOR ROCKET			
	IA-1	IC-3	IC-2	IE-1	IF-3	IG-2	IG-3
MAJOR	1	3	5	0	2	5	6
FATAL	4	3	0	3	3	7	2
LOST	0	2	0	0	1	3	2
MIN/NONE	12	11	20	2	9	17	17
TOTALS	17	19	25	5	15	32	27

SUMMARY:

TYPE INJURY	NUMBER OF INJURIES		NUMBER OF INJURIES	
	IA-1, IC-3, IC-2		IE-1, IF-3, IG-2, IG-3	
MAJOR	9	(15%)	13	(16%)
FATAL	7	(11%)	15	(19%)
LOST	2	(3%)	6	(7%)
MIN/NONE	43	(71%)	45	(58%)
TOTALS	61		79	
F+L		15%		27%
F+L+M		30%		43%

ESCAPAC MAJOR INJURIES

COMPARATIVE INCIDENCE RATES AMONG ALL ESCAPE ATTEMPTS

A-4	IA-1 12 13% DATES: 69-78	IC-3 21 16% DATES: 69-77	IF-3 4 20% DATES: 72-77	IG-3 7 20% DATES: 74-78
	A-7	IC-2 22 14% DATES: 69-76		IG-2 6 18% DATES: 75-78
	S-3			IE-1 0 0% DATES: 73-78

ESCAPAC MAJOR INJURIES **COMPARATIVE INCIDENCE RATES** **AMONG SURVIVORS & NON-LOST/IMPACT MULTIPLE** **EXTREME FATALITIES**

A-4

IA-1
12
15%

DATES: 69-78

IC-3
21
19%

DATES: 64-77

IF-3
4
21%

DATES: 72-77

IG-3
7
23%

DATES: 74-78

A-7

IC-2
22
15%

DATES: 69-76

IG-2
6
21%

DATES: 75-78

S-3

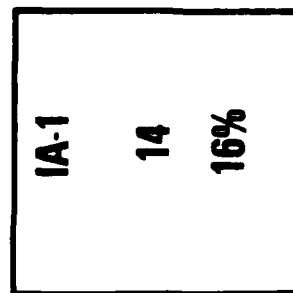
IE-1
0
0%

DATES: 73-78

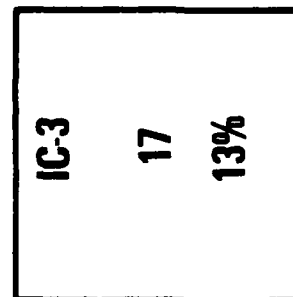
ESCAPAC FATAL/LOST INJURIES

COMPARATIVE INCIDENCE RATES AMONG ALL ESCAPE ATTEMPTS

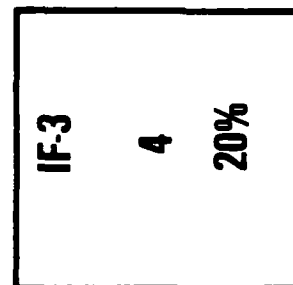
A-4



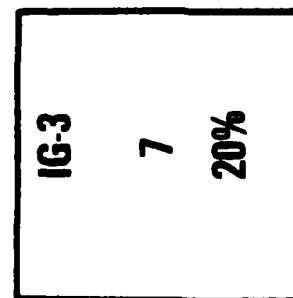
DATES: 69-78



DATES: 69-77

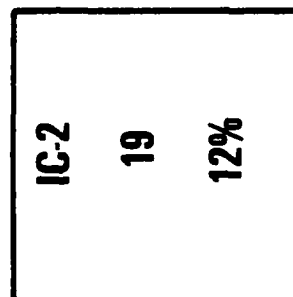


DATES: 72-77

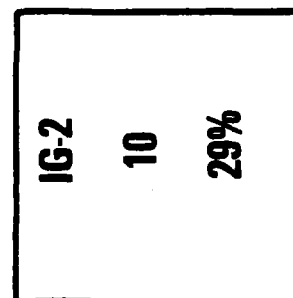


DATES: 74-78

A-7

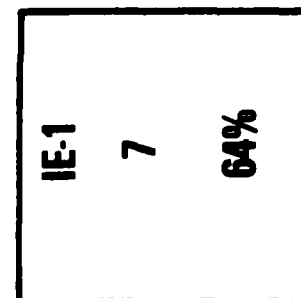


DATES: 69-76



DATES: 75-78

S-3



DATES: 73-78

ESCAPAC FATAL/LOST & MAJOR INJURIES

COMPARATIVE INCIDENCE RATES AMONG ALL ESCAPE ATTEMPTS

A-4	IA-1 26 29% DATES: 69-78	IC-3 38 29% DATES: 69-77	IF-3 8 40% DATES: 72-77	IG-3 14 40% DATES: 74-78
		IC-2 41 26% DATES: 69-76		IG-2 16 47% DATES: 75-78
				IE-1 7 64% DATES: 73-78
A-7				
S-3				

SYNOPSIS A-7 FATALITIES^{a)}

1974 - 1978

<u>CATEGORY</u>	<u>NUMBER</u>
o Fireball involvement	1
o Seat failed, ejection in envelope	1 ^{b)}
o Ejection out of envelope	2 ^{c)}
o Good parachute, did not survive in water	6 ^{d)}

NOTES

- (a) All ejections were with ESCAPAC IG-2
- (b) Pilot impacted water in seat although apex of trajectory estimated to be 150'. Subsequent investigation of recovered seat revealed man-seat separation not initiated due to failure of cartridge on MK 16 Mod 0 rocket catapult.
- (c) One pilot struck ground at approximately full riser stretch. Pilot had previously stated intent to attempt save and aircraft, did not want aircraft loss on record. Other pilot impacted ground approximately 10 feet from seat and 50 yards from aircraft impact crater.
- (d) Among those entering water:
 - (1) Ejection following night ramp strike. Full parachute seen and ejectee then struggling in water. Suffered contusions on face and abrasions on neck (latter from suspension lines). Drowned.
 - (2) Ejection following night ramp strike. Full parachute seen, ejectee not seen even by swimmer at parachute. Lost.
 - (3) Parachute observed by wingman streaming as man (seat) entered undercast. Helmet recovered bearing evidence of high speed escape and severe blow to back of helmet/head from Koch fittings. Lost.
 - (4) Wingman observed fully deployed parachute for period of 1 minute 50 seconds before water contact. Did not report seeing ejectee. Lost.

A-7 FATALITIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-7E	200' (duration of beeper signal)	UNK	UNK	ESCAPAC 1G-2	Multiple extreme, impact with ground.	Fireball destroyed parachute and shroud lines.
A-7E	65'	60	Sliding down deck, R wing low	ESCAPAC 1G-2 TC	Pulmonary edema - drowning. Contusions on face - canopy. Abrasions on neck - suspension lines. Entanglement caused drowning.	Night ejection from carrier deck. Seen struggling in water. LPA initiated. Full parachute seen.
A-7A	75'	80	Slight nose 5° down, L wing down 20-30° sliding off carrier deck	ESCAPAC 1G-2 TC	Lost	Night ejection from carrier deck, full parachute seen. Ejectee lost. Flew with seat full up--may have affected breaker operation.
A-7B	2,500-4,500	UNK	70° nose down uncontrolled flight	ESCAPAC 1G-2 TC	Lost. Investigation of damage to recovered helmet suggested high speed escape and severe blow to helmet/head from Koch fittings.	Helmet struck by Koch fittings - helmet shell fractured. Wingman reported seeing streaming parachute prior to seat-man entering clouds.
A-7A	below 65	120	~ flat	ESCAPAC 1G-2	Recovered seat revealed cartridge of MK 16 ROCKET failed.	Cold cat shot, subsequent ejection. Ejection trajectory reached 150'. No man-seat separation. Seat in a high position.

A-7 FATALITIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-7E	UNK	400 (est)	UNK	ESCAPAC 1G-2 TC	Lost	Wingman saw parachute fully deployed above clouds at 1500-2000'. Did not observe ejectee. Visual observation of parachute for 1 min. 50 secs. before water contact.
A-7E	300-400'	135-175	20-30° R wing down, nose level or slightly elevated	ESCAPAC 1G-2 TC	Drowning. Temporal bone hemorrhage, bilateral contusions R & L superior and anterior shoulders, R & L lateral and anterior upper arms and both groins.	Full parachute observed. Pilot was weak when approached by swimmer 1 min. 37 secs. after ejection; made little effort to help himself.
A-7E	6200-7200 MSL 1000-2000 AGL	250-350	90° nose down	ESCAPAC 1G-2 TC	Multiple extreme impact on ground. Had previously indicated intent to not lose aircraft.	Pilot struck ground just prior to full riser stretch. Unauthorized maneuver, departed controlled flight.
A-7E	10	120	Wings level descending slightly nose up. Cold cat shot.	ESCAPAC 1G-2 TC	Drowning. Multiple contusions upper paravertebral area. Contusion in R periorbital region of face. Subgaleal hemorrhage in R parietal area. Surgeon stated if not injured in ejection, would have survived.	Full parachute observed after tumbling, gave thumbs up signal. Inflated LPA, R not inflated. Passed within 10' of hull, then into wake.
A-7E	1100	200		ESCAPAC 1G-2 TC	Multiple extreme impact with ground.	Body recovered 20' from seat, hip recovered later 10' from body. Body was approximately 50 yds. from A/C impact crater.

SYNOPSIS A-4 FATALITIES

1974 - 1978

<u>CATEGORY</u>	<u>NUMBER</u>
● Ejection during aircraft breakups	1 a)
● Fireball involvement	1 b)
● Drowning/Lost ^{c)}	3 d)
● Seat failed after ejection	2 e)
● Attempted ejection in envelope	6 f)
- Canopy jettisoned, seat stayed	4 f)
- Canopy did not jettison	2 g)
● Attempted ejection outside envelope	4 h)
- Canopy jettisoned, seat stayed	1
- Seat ejected	3 h)

NOTES

- (a) ESCAPAC IC-3 Good parachute seen, no sign of life, ejectee LOST so no determination of injury cause.
- (b) ESCAPAC IA-1 Shorter trajectory and timing of new seats might have prevented entry into fireball.
- (c) One recorded as lost -- insufficient data for placement into any other category, although good parachute was seen (See (d)).
- (d) ESCAPAC IG-3 Wingman saw two good parachutes (ejected from 2-seat TA-4F) no commentary on whether signs of life was present. Ejection was over water, ejectee LOST.
- ESCAPAC IF-3 Ejectee drowned. However ejectee suffered fracture dislocation at C-5/C-6. Such injury capable of immobilizing individual and, with one exception, has proven fatal to ejectees descending onto land.
- (e) ESCAPAC IF-3 Parachute did not deploy. Evidence suggests emergency release handle had released end of parachute pack actuator arming cable.

- ESCAPAC IF-3 Parachute entangled with contents of survival kit which opened during or following man-seat separation.
- (f) ESCAPAC IC-3(2) Four cases in A-4F, 1 A-4L, and TA-4J,
 ESCAPAC IG-3(1) Attempts, as evidenced by canopy jettisoning, were
 ESCAPACIAA1(1) well within seat envelope. Known that their air-
 crew attempted to eject, not known concerning fourth
 (student in TA-4J).
- (g) NOT SPECIFIED Two cases in TA-4J. One cause not determined (air-
 ESCAPAC IG-3 craft lost). Other due to misinstallation/misrig-
 ging MK 73 initiator in canopy jettisoning system.
 Both attempts apparently made within seat envelope.
- (h) ESCAPAC IA-1 Ejectee impacted water just at or immediately prior
 to full riser stretch. Shorter trajectory and timing
 of new seats might have slowed ejectee sufficiently
 for his survival.

A-4 FATALITIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-4M	68,000	+500 KIAS	90° Dive	ESCAPAC IC-3	Lost	Ejection during aircraft breakup observed under chute -- no life observed.
TA-4J	270±50	.90-.92 Mach 500+ KIAS	80° dive	ESCAPAC IG-3	Multiple extreme. (recovered tissue samples)	Unsuccessful ejection attempt at 270±50 followed by aircraft ground impact.
A-4C	95 Parachute opening at 135	140-145	10° nose down wings level	ESCAPAC IA-1	Posterior ribs (R 3 & 5, L 4-10) fractured. Transverse fracture T4 & T5. Compression fracture L2. Fracture/dislocation pelvis. Skin burns 3rd, 4th & 5th degree & 2nd various areas. Laceration of R & L atria & R ventricle of heart. Posterior lacerations of R lung. Homothorax of L lung. Laceration & hemo-pericardium. Diaphragm lacerations.	Internal injuries due to impact with ground - parachute disintegrated in crash fireball.
TA-4J	0 (harness release handle had been releasing parachute actuation arm cable. This ejectee used face curtain.)	30 KTS	Level	ESCAPAC IF-3	Fracture right rib cage. Interstitial hemorrhage right lung. Intraventricular hemorrhage cerebral ventricles. Peri-vertebral hemorrhage. Fracture left humerus. Fracture right scapula. Fracture cricoid cartilage & 1st tracheal ring.	No parachute, impacted ground.
					No injury.	Seat worked normally.

A-4 FATALITIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
NA-4E	500	150-200	Sharply nose down. L wing down spiraling.	ESCAPAC IA-1	Multiple massive injuries due to high velocity impact with surface.	Impact before full line stretch t>2 sec
TA-4J	3,000				Lost	Pilot transmitted. He could not eject -- canopy did not jettison.
A-4M	10,000	UNK		ESCAPAC IF-3	Fracture of skull, basilar fracture, occipital rim fracture, temporal & parietal subluxation C-4, spinous processes fracture C1, C2, C3, C4. Fracture multiple ribs. Fracture of ischium & pubic ramus. Comminuted fracture L femur.	Impact with surface. Parachute entangled in life raft lanyard deployed due to survival kit failure.
TA-4F	1800 (dragged by chute)	180	10° nose up	ESCAPAC IC-3	Pulmonary congestion R & L lungs. Hemorrhage R & L middle ears. Small contusion middle forehead, small contusion bridge of nose (believed not to have caused unconsciousness)	
	(dragged by chute)				Small laceration of upper lip.	Due to survival kit strap unable to open it. Began to drag him under. Ejected by sequence while bent over.
TA-4J	UNK	UNK	UNK	ESCAPAC IC-3	Lost	Evidence of ejectee being in seat at water impact.

A-4 FATALITIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-4F	5000	250	Level	ESCAPAC IG-3		Canopy jettisoned - several attempts at ejection followed by attempted bailout. Impacted water in aircraft
TA-4J	4000	180		ESCAPAC IC-3	Multiple extreme a/c impact w/ground.	Canopy jettisoned. Instruction used face curtain. Student apparently made no attempt.
					Multiple extreme a/c impact w/ground.	
TA-4J				ESCAPAC IG-3	a/c impact w/water. Drowning (managed to release 2 upper kochs & lower R mini-koch)	Attempted ejection - canopy did not jettison. MK 73 did not fire on canopy remover.
TA-4J	1500 2 good parachutes seen	250	Wings level	ESCAPAC IF-3	Mild paravertebral & pectoral muscle strain.	Parachute suspension lines & URT-33 lanyard tangled - evidence of tumbling.
					Drowned. Fracture - dislocation C5-C6.	
A-4E	200	125	60° nose down 130-150° R wing down	ESCAPAC IA-1	Multiple extreme impact w/water.	Pilot impacted water just after seat-man separation.

A-4 FATALITIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
TA-4J	UNK	UNK	70-90° nose down	ESCAPAC IG-3	Lost	
A-4L	1000-1800 AGL			ESCAPAC 1A-1	Multiple extreme impact w/ground in aircraft following ejection seat failure to fire.	Pilot pulled both controls, canopy jettisoned, but seat did not eject. Primer of rocket catapult did not fire after firing pin struck.

SYNOPSIS S-3 FATALITIES^{a)}

1974 - 1978

<u>CATEGORY</u>	<u>NUMBER</u>
o Ejection seat failed	1 ^{b)}
o Ejection initiated outside envelope	2 ^{c)}

NOTES

- (a) All S-3A ejections used ESCAPAC IE-1.
- (b) TACO seat-man separation cartridge did not ignite (primer fired). In addition empty SENSO seat propulsion inflicted various 3rd degree burns on TACO. (Pilot and co-pilot ejected successfully).
- (c) Empty TACO and SENSO seats cleared aircraft approximately 25', lefthand seat completed ejection sequence although ejectee was killed while egressing from aircraft as it disintegrated upon ground impact, right-hand seat upward travel was stopped by aircraft disintegration at ground impact.

S-3 FATALITIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	TYPE SEAT	INJURY DESCRIPTION	EJECTION DESCRIPTION
S-3A	25 rear seats at impact front seats	UNK (stalled)	R wing down	ESCAPAC IE-1 TC	R multiple extreme in disintegration of a/c upon impact w/ ground. L multiple extreme due to contact w/disintegrating cockpit structure during ejection at aircraft impact.	R seat stopped by R wing down crash. L seat ejected, ejectee killed in crash, full parachute obtained.
S-3A	0	20-40 knots rolling on ground leaving runway		ESCAPAC IE-1 TC	R 1st degree burns L & R legs anterior surfaces. Contusions on buttocks. L 1st, 2nd degree burns left leg posterior surface 1st degree burns right leg posterior surface. TACO: Multiple fractures and soft tissue injuries at ground impact. 3rd degree burns left hand, forearm & left posterior neck.	No man-seat separation, received burns from ejected empty seat rocket. Cartridge failed to fire.

SYNOPSIS A-7 MAJOR INJURIES

1974 - 1978

<u>CATEGORIES</u>	<u>NUMBER</u>
o <u>SYSTEM FAILURES</u>	1
- Ejection initiated by windblast through failed canopy glass	1 ^a
o <u>INJURIES</u>	
- Vertebral	
- Cervical	
- Subluxation/fracture-dislocation	1 ^b
- Fracture	-
- Strain/muscle spasm	4
- Thoracic	
- Fracture	3
- Lumbar	
- Fracture	2
- Noncervical paravertebral strain	1
- Joints	
- Shoulder dislocation	-
- Shoulder fractures	-
- Elbow fractures	-
- Knee ligamental strains	1
- Knee derangement	1 ^c
- Limbs	
- Arm fractures	-
- Leg fractures	3 ^{b) d)}
- Chest	
- Rib fractures	-
- Dislocations	-
- Burns	-
- Brain concussion	-
- Unconsciousness	-

NOTES

- (a) ESCAPAC IC-2 Face curtain failed under windblast loads causing ejection. Retention under windblast loads is a design requirement.
- (b) ESCAPAC IG-2 Ejectee felt intense pain in neck during boost period. Unable to look at landing area and broke leg landing on rock slide. During survival phase ejectee was in intense pain -- had to kneel and force head into ground to obtain relief.
- (c) ESCAPAC IC-2 Internal derangement of knee occurred prior to landing believed caused by tumbling and resulting flailing. Injury required surgery to correct.
- (d) ESCAPAC IC-2 Survival kit hanging very low interfered with legs contributing to several fractures in left leg during parachute landing.
- ESCAPAC IG-2 Sustained severe strain during boost phase subsequently inhibiting ejectee's ability to examine landing area. Broke left leg when left foot landed between rocks or roots.

A-7 MAJOR INJURIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-7B	1,500	200 (tumbling noted -- landed in water)	Nose up	ESCAPAC IC-2	B Cervical strain. Contusion on R hand. (hand on stick when ejection initiated using L hand.)	Following flame out, pilot ejected using lower firing control. Felt his hand snap hard to left. Struggling w/kit before getting it open.
A-7B	25,000 est.	270 est.	25° Nose down wings level	ESCAPAC IC-2	B Soft tissue injury R elbow. Burn left hand. Muscle spasm cervical. Possible fracture L-4 (discounted in MOR)	Canopy glass failed at 30,000 ft. While descending pilot was ejected -25,000 ft. by windblast.
A-7B	1,100 (tumbling noted)	194	Nose up slightly 10° wings level	ESCAPAC IC-2	B Internal derangement of R knee (required surgery). Low-thoracic backstrain.	Used lower control to initiate ejection. Head slightly bent forward as seat was full up.
A-7E	12,000	400 KIAS	Nose down 60° Left bank 90°	ESCAPAC IC-2	B Subconjunctival hemorrhage and periorbital ecchymosis of eyes. Abrasions anterior tibia. Abrasions L shoulder.	Pilot was against the canopy in a spin, managed to pull lower handle w/3 fingers L hand. Eyes were swollen shut and was unable to see.
A-7E	12,000	375	Nose down 10° R bank 135°	ESCAPAC IC-2	B Burned eyebrows soft tissue injury R knee. Soft tissue injury L wrist.	Used face curtain to eject a/c on fire.
A-7C	100-200 (experienced back pain during egress)	145	Nose down 5° wings level descending	ESCAPAC IC-2	B Oblique fracture L distal tibia and fibula and proximal fibula. Compression fracture L1. Abrasions, ecchymosis R & L shoulders.	Used alternate firing control following take off flameout. Survival kit hung low and helped produce broken L leg.

A-7 MAJOR INJURIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-7E	800-1000	200	Nose down 2°	ESCAPAC IG-2 TC	B - Compression fracture T4 & T5 Sprain R medial collateral ligaments knee. Contusion shoulders & upper anterior thigh.	Ejected using lower control aware of severe back pain and violent rapid tumbling. Was unable to stand due to pain in R knee. R side of visor struck by UNK object during ejection.
A-7E	8,000 AGL	350 est	Nose down 15° UNK left bank flat/oscillating spin	ESCAPAC IG-2 TC	B - Fracture C-2 pedicle w/slight subluxation. Fracture L fibula laceration of chin. Laceration of L leg.	Pulled lower control while floating off seat in inverted spin. Experienced severe neck pain. Landed on a rock slide (60° slope).
A-7E	2,000	350 (tumbling noted) (water landing)	UNK	ESCAPAC IG-2	B - Probable compression fracture T3. Abrasions on shoulders. (anterior chest) & groin Hematoma & bruise on L mandible.	Following mid-air collision pilot was ejected from aircraft.
A-7E	2,000	350 (water landing)	UNK	ESCAPAC IG-2 TC	B - Compression fracture T12, L2, L3. Bilateral subconjunctival hemorrhage of eyes. Laceration wrist & L thigh.	Used lower control while hanging in straps.
A-7E	2,000	180	5° nose down	ESCAPAC IG-2 TC	B - Displaced fracture L distal fibula. Strain cervical spine. Multiple superficial lacerations both hands.	Used face curtain. Felt pain in neck on boost, felt pain in ankle on landing in rocks or roots.
A-7B	800 AGL	160	Nose up	ESCAPAC IG-2 TC	B - Muscle spasm & contusion neck. Abrasion R MTJ Dorsal index finger. Abrasion L tibia. Abrasion R lateral arm. Contusion inner thigh.	Ejected following engine failure using face curtain.

SYNOPSIS A-4 MAJOR INJURIES

1974 - 1978

<u>CATEGORIES</u>	<u>NUMBER</u>
o <u>SYSTEM FAILURES</u>	3 ^{a)}
- Premature opening survival kit	1 ^{b)}
- Misinstalled rocket	1
- Lower ejection control	1
o <u>INJURIES</u>	
- Vertebral	
- Cervical	
- Subluxation/fractures-dislocation	1 ^{c)}
- Fractures	3 ^{c)} g)
- Strain	1 ^{d)}
- Nerve Root compression	1 ^{e)}
- Thoracic	
- Fractures	2
- Lumbar	
- Fractures	2 ^{e)}
- Joints	
- Shoulder dislocation	1
- Shoulder fractures	2 ^{g)} g)
- Elbow fractures	1 ^{g)}
- Knee ligamental strains	3 ^{d)}
- Limbs	
- Arm fractures	2 ^{f)}
- Leg fractures	e ^{c)}
- Chest	
- Rib fractures	
- Dislocations	1
- Burns 1 ^{h)}	
- Brain concussion	1 ⁱ⁾
- Unconsciousness	2 ^{e)} k)

NOTES

- (a) Possibility of two other failures suggested by data:

TA-4J (seat not specified) Pilot attempted to open survival kit during descent to water. Despite pulling kit latching handle and removing the closure strap pin during descent, kit was not opened until some time after water entry.

TA-4J (ESCAPAC IC-3) Rear seat occupant believed he initiated command ejection sequence. However, pilot saw canopy jettison, was blinded temporarily by windblast then saw instrument panel and pulled face curtain. (Command ejection might not have been selected).

- (b) TA-4J (ESCAPAC IF-3) Should be noted that a similar case (A-4M ESCAPAC IF-3) caused parachute entanglement and resulted in a fatality.
- (c) TA-4J (ESCAPAC IG-3) Pilot during descent was unable to move head, neck or limbs. Survived since he landed on ground.
- (d) TA-4J (ESCAPAC IF-3) Pilot ejected high speed from uncontrolled aircraft, survival kit prematurely opened, landed in water and climbed into raft.
- (e) TA-4J (Seat not specified) Rear seat occupant used lower handle, rocket misinstalled, low trajectory, tumbled badly and had rapid parachute. Ejectee sustained fractures of leg bones and of L5, was unconscious until under water.
- (f) TA-4J (ESCAPAC IC-3) injuries sustained by pilot during post mid-air collision ejection. (See Note (a)).
- (g) TA4-J (ESCAPAC IG-3) Pilot struck ground near horizontal apparently just after parachute opening during the initial post-inflation collapse and swing through phase. Injuries attributed to ground impact.
- (h) TA-4J (ESCAPAC IG-3) Rear seat occupant descended on outskirts of aircraft fireball sustaining burns. Additional burns incurred in approaching aircraft looking for pilot (Note (g)).
- (i) TA-4J (ESCAPAC IC-3) Rear seat occupant suffered amnesia for 24 hours badly dazed (See Note (f) for pilot).

(k) TA-4F (ESCAPAC IC-3 Rear seat occupant sustained dislocated shoulder; believes he blacked out at parachute opening.

GENERAL NOTES

Three ejectees, and possibly a fourth, were unconscious, badly dazed and disoriented, and/or paralyzed as a result of their ejection.

A-4 MAJOR INJURIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
TA-4J	8,000	UNK	R spin nose down	ESCAPAC JF-3	B - Cervical strain. R & L medial collateral ligament strain. Abrasion and contusion left lateral neck. Abrasion right lateral neck. He felt his legs flailing.	Life raft caught in parachute risers. Survival kit opened prematurely. Use life raft, failed to disconnect parachute. Noted stiffness in neck as he descended. Helmet touched canopy had to lean forward to reach F.C. Suspended in harness due to spin.
TA-4J	1,000 (parachute open)	160 (50)	Nose low 30° L wing down 30° High descent rate Left hand turn	ESCAPAC IC-3	B - Compression fracture L1. Separation costochondral junction. Abrasion right neck (riser burn)	Seat contacted ground on collapsed parachute behind ejectee. Empty rear seat struck aircraft stabilizer.
TA-4F	9,000 MSL (landed on ground)	250 KIAS	15-20° nose down left bank 90-110°	ESCAPAC IC-3	G - R Jaw and neck contusions (O ₂ mask slap)	Pilot initiated ejection w/lower handle - failed. Then initiated successfully w/F.C. Heel pulled right, R hand on stick.
A-4L	12,000	250	UNK	ESCAPAC IA-1	B - Left shoulder dislocated (struck against canopy railing).	Possible blackout noted at parachute opening.
					B - Probable compression fracture T-7. Ecchymoses acromio-clavicular areas - bilateral abrasions R side of neck.	Mid-air collision of wingman wing-tip and canopy. Pilot does not recall initiating ejection. Landed in tree.

A-4 MAJOR INJURIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
TA-4J	1,800	190 TAS	Nose down 10° Left bank 15°	ESCAPAC	G — No injury.	Pilot used face curtain. Could not open survival kit until in water.
	2,000 (parachute deployment was almost immediate)	205			B — Compression fracture L5. Avulsion fracture greater tuberosities of bilateral humerus. Fracture lateral plateau L tibia. Avulsion fracture R fibula. 1st & 2nd degree burns 15% of body.	Used lower handle. Seat was observed by wing to exit w/large ball of flame underneath and pitch 90° aft immediately, barely clearing tail. Ejectee unconscious until under water.
A-4M	14,000	250-300	80° nose down Left hand spiral	ESCAPAC IG-3	B — Comminuted fracture C-2 with minimal posterior movement. Loss of 1st R maxillary incisor.	Initiated escape w/F.C. seat full up. Noted pain in neck after parachute opening, unable to flex neck.
TA-4J	800 (water landing) (both seats tumbled 2 or 3 times)	220	Straight and level.	ESCAPAC IF-3	F — Abrasion L cheek. Contusion R arm lateral aspect. Contusions and abrasions axillae & shoulders R & L. Contusions L anterior superior iliac spine area. Contusions popliteal fossae, distal thighs and proximal legs R & L.	Pilot used face curtain to initiate ejection.
				B — Strain of R knee medial collateral ligaments. Compression fracture T5. Contusion upper lateral R side chest wall. Contusion L superior medial-anterior surface.	Sequenced ejection. Saw pilot reach for F.C. and tried to position himself for impending ejection.	

A-4 MAJOR INJURIES

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
TA-4J	2000 est (wing struck nose of another aircraft) (no injury caused by collision)	450 est	90°	ESCAPAC 1G-3	B Evulsion greater tuberosity L shoulder. Fracture L upper arm. Sprain L knee. Abrasion neck. Ecchymosis of face around eyes.	Mid air collision. Pilot believes he used F.C. Saw canopy go. Temporarily blinded by windblast, then seeing instrument panel pulled F.C.
					B Brain concussion. Abrasion R side of neck. Abrasion R arm. Bruise L hip. Ecchymosis of face. Amnesia for 24 hours.	Believes he used alternate handle, command ejection.
TA-4J	Ground	120	Take-off roll w/nose gear steering failure 2-3° nose down	ESCAPAC 1G-3	B Fracture of L clavicle. Fracture of L scapula. Compression fracture C5. Fracture L radial head (elbow) all attributed to ground impact.	Sequenced ejection landed horizontally feet first.
					B 2nd & 3rd degree burns hand and arms. 3rd degree burn back. 2nd degree burn knees position and anterior. All attributed to fire fall involvement.	Face curtain initiation of command sequenced ejection.
TA-4J	2000 (extreme tumbling noted) (landed on back in a thick briar bush) (seat twisting at man-seat separation noted & thought contributing to cervical injuries)	210	10-15° nose down	ESCAPAC 1G-3	B Subluxation C-6/C-7 w/fracture spinous process. Compression fracture C-7 C-8 nerve root compression. Contusion of R collar bone, clavical & shoulder regions.	Initiated escape w/lower handle. Unable to move extremities while descending.

A-7 OTHERS

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-7A	3,500-4,000 (ground landing) (tumbling noted)	220	30° nose down	ESCAPAC IC-2	F Neck muscle strain. Abrasion - R dorsum of hand.	Pulled lower control as aircraft pitched violently downward after engine failure.
A-7E	600 MSL (tumbling seat separation) (ground landing)	200 KIAS	Nose up 5°	ESCAPAC IC-2	F Mild neck strain.	Face curtain following engine failure.
A-7C	3,330 AGL (ground landing)	200 KIAS (survival kit handle lost - could not open kit)	Nose down 2°	ESCAPAC IC-2	G No injuries listed	Face curtain following engine failure.
A-7C	200	120	Nose up 15°	ESCAPAC IC-2	G Minor pain in neck and back.	Face curtain.
A-7A	150 AGL (ground landing)	125 KIAS	Nose down 5-10°	ESCAPAC IC-2	G Minor cervical strain.	Lower control following hydraulic failure.
A-7C	15,000 (water landing)	300	Nose down 90°	ESCAPAC IC-2	G Abrasion, bilateral dorsum of feet. Mild neck muscle strain.	Lower control following mid-air collision - had difficulty reaching it due to negative G forces.
A-7B	7000	UNK	UNK	ESCAPAC IG-2 TC	F Soft tissue injury R knee. Aggravation of old injury R knee. Cervical spine and neck aggravation of old injury. Lumbar spine soft tissue.	Face curtain following mid-air collision.

A-7 OTHERS

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-7E	7000 (slight tumble water landing)	200	Slight nose up	ESCAPAC IG-2 TC	F - Abrasion left hand. Abrasion L chin. Strain R sterno- cleidomastoid.	Pulled face curtain after electrical failure and flameout.
A-7E	1200 (water landing)	220	Nose up	ESCAPAC IG-2 TC	G - Abrasion posterior R neck. Abrasion R hand 2nd MP joint. Laceration L elbow. Mild neck strain.	Face curtain engine failure.
A-7B	50 (water landing)	780	Nose down 5-10° Left bank 45°	ESCAPAC IG-2 TC	F - Contusions R & L dorsums (feet).	Ramp strike following engine failure, aircraft broke up, ejected leaving deck using lower handle.
A-7E	1000 (tumbling noted) (DART not connected to aircraft) (ground landing - ejectee fell on water)	250	30° nose down 30° left bank rolling	ESCAPAC IC-2	G - Bilateral laceration of tongue. Massive hematoma & small laceration L buttocks.	Mid-air collision used lower control.
A-7E	5-10 KTS (ground landing) R canopy breaker evidence L canopy have deployed	(cracked) ejectee breaker may not have deployed	Nose down 10-20° Left bank 15-25° going over embankment.	ESCAPAC IG-2 TC	G - Muscle & ligament strain lumbo- sacral spine. Contusion posterior R thigh. Minor abrasions from being dragged.	Lower ejection handle after over- running runway.
A-7E	Ground (problem noted with sustainer rocket) (ground landing) (ejectee reported being dazed)	130	Nose up. Sliding on runway	ESCAPAC IG-2 TC	F - No injuries noted. Ejectee stated he delayed ejection due to doubts of seat reliability.	Lower control after lifting off, retracting gear and settling back on runway wheels up.

A-7 OTHERS

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-7E	60 (tumbling noted) (water landing)	135 (pilot was dazed)	--	ESCAPAC IG-2 TC	G Abrasion L foot. Minor burn L hand. Minor contusion L orbit.	Used lower control prior to aircraft impacting parked aircraft on deck.
A-7E	150 (water landing)	149 45° face down	Left wing down 30-45°	ESCAPAC IG-2 TC	G Cervical spine strain.	Face curtain during control failure following launch.
A-7E	6,500 (water landing)	0	Flat, upright non-oscillatory spine. Nose down 10°	ESCAPAC IG-2 TC	G Upper back - Interscapular area muscles strained w/mild spasm. Fracture tooth #8. Left eyebrow & adjacent area 1° burn. L wrist 1° burn. Tender teeth and sore jaw.	Lower control from out of control aircraft.
A-7E	60 (water landing)	50	Sliding off bow cold cat shot Nose down 20° Right bank 5°	ESCAPAC IG-2 TC	F(3) Multiple lacerations of lower lip.	Cold cat shot, lower control.
A-7E	80 (landed in wooded area)	150 (wooded area)	Nose up 3° Shallow level descent.	ESCAPAC IG-2 TC	G Abrasion R dorsum (hand)	Face curtain used after loss of power.

A-4 OTHERS

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-4E	Ground level 0	80-100	Level Sliding down runway on wing tanks	ESCAPAC 1A-1	Mild back strain TB/T12. Contusion L buttock.	Ejection initiated with lower hand while sliding gear up on runway. Bent down to look for handle before ejecting.
TA-4J	11,000'	200 KIAS (unable to open kit) (landed on ground)	Inverted flat spin	ESCAPAC 1G-3	G Neck and back muscle strain. G Small contusions with muscle strain in neck.	Both occupants pushed against canopy by negative G. Pilot was ejected w/o warning by command sequence initiated by rear seat occupant.
A-4H	6,000'	350+ (unable to open kit) (kit retention straps torn away) (landed in water)	Nose down 70-80° rolling L	ESCAPAC 1F-3	F Cervical strain. Abrasions and contusions L and R shoulders Bruises posterior buttocks.	Face curtain
A-4L	Ground level (noted backward summersault)	110	Straight & level on runway	ESCAPAC 1A-1 (NES-1G-A chute)	G Contusion over eye Contusion of knee Bruise R shoulder	Aircraft fire, uncontrollable shortly after landing. Face curtain. Helmet visor broken by unknown cause.
A-4L	1,000' (Ground landing)	200	Straight & level	ESCAPAC 1A-1	F Mild cervical strain Contusion on thorax (Grounded 24 days in lieu of 5 since he would not return to activity until then - - reservist.	Engine flameout. Face curtain
A-4E	5,000' est. (Ground landing)	300 est.	Spin, left turn, nose down	ESCAPAC 1A-1	F Ligamentous strain L knee Ligamentous strain R knee Contusion and abrasions anterior neck Numerous other muscular skeletal aches and pains.	Pushed against canopy during spin.

A-4 OTHERS

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
A-4E	14,000	350	Tumbling	ESCAPAC 1A-1	G No injuries listed. Pain in R lateral calf.	Ejection followed mid-air collision. Lower ejection handle.
TA-4J	2,000' (Landed on ground) (Flailing noted) (Tumbling noted)	300	Nose up 15°	ESCAPAC 1C-3	G Abrasions and ecchymosis of skin ~ riser burn	Command ejected following bird strike, hands on throttle and stick.
					F Laxity lateral and medial collateral ligaments (knee) Sprain and laceration R wrist (bird strike)	Initiated escape with lower control. Helmet damaged by bird strike.
TA-4J	Ground 0 (landing on ground)	80-100	Nose level, wings level	ESCAPAC 1G-3	F Hematoma and muscle strain right thigh and knee	Take-off roll loss of control. Lower control.
					G Slight abrasions face and neck	
TA-4J	12,00 (Water landing) (Seat kit sank after release of find lanyard)	100-124 (flailing noted) (Seat kit sank after release of find lanyard)	Nose down spin lap belt fittings	ESCAPAC 1G-3	F Strain L shoulder subjunctional hemorrhage both eyes.	Both pilots forced up against canopy by negative G.
				--could not	G No injuries listed	Lower control, command ejection.
TA-4J	1500-2000 (Landed in a tree) (Notes unconsciousness) (Lost seat pan release handle, O ₂ sheared off)	150	Nose down 30° pin stabilized upright hesitation	ESCAPAC-1G-3	G Contusions and tenderness posterior/inferior aspect of both thighs Laceration dorsum of R wrist (trees?)	Used lower control

A-4 OTHERS

1974 - 1978

A/C	ALTITUDE	SPEED	ATTITUDE	SEAT TYPE	INJURY DESCRIPTION	EJECTION DESCRIPTION
TA-4J	750 (ground landing)	150	Wings level	ESCAPAC IG-3	G Abrasion L knee. Abrasion L elbow. Abrasion R knuckles Abrasion forehead	Was ejected following flameout and accidentally jettisoning canopy.
TA-4J	4,500 AGL 8,500 MSL (RSSK damaged on seat-man separation) kits retention straps failed, ground landing)	230-250 KIAS	Wings level 15° nose down (0° nose down) (ground landing)	ESCAPAC IG-3 torn from kit both	G Strained muscles posterior neck G Contusion shoulder G Sprain R foot and 5th metatarsal. Contusion anterior shoulder mild hyperextension cervical strain G No injuries	Initiated command ejection w/ lower control. Face curtain command eject Command ejected holding torso harness
A-4H	5,000 MSL 3,000 AGL (Felt heat of fireball lift him up) (ground landing)	285	Nose 80-90° down (ground landing)			Face curtain
A-4E	4,200 (Water landing)	0	Nose down 95° inverted spin	ESCAPAC IA-1	G Minor abrasions L and R shoulders and inguinal areas L conjunctival hematoma temporal aspect	Lower control-had difficulty due to being against canopy.
TA-4J	9,000 MSL 7,500 AGL (landed in cactus patch) (Arm flailing)	7,200	Nose down 30-60° inverted oscillating spin	ESCAPAC IG-3	G Lacerations, multiple minor of neck (wore religious chain) Two minor lacerations L wrist (Lost wrist-watch) Both forearm-cactus needle punctures Contusion R forearm medial aspect	Lower control.
TA04J	350 (Ground landing)	115 (DART improperly rigged)	Nose up 5° (DART improperly rigged)	ESCAPAC IG-3	G Lumbosacral strain	Face curtain flameout after take-off

GENERALIZED ESCAPE
SYSTEM DEVELOPMENTAL
HISTORY

**GENERAL INFORMATION CONCERNING
AAES RELIABILITY & MAINTAINABILITY**

Have you heard of the wonderful one-hoss shay,
That was built in such a logical way
It ran a hundred years to a day,
And then, of a sudden, it—ah, but stay,
I'll tell you what happened without delay,
Scaring the parson into fits,
Frightening people out of their wits,—
Have you ever heard of that, I say?

THE DEACON'S MASTERPIECE, OR THE
WONDERFUL "ONE-HOSS SHAY"
A LOGICAL STORY
OLIVER WENDELL HOLMES

Now in building a chaises, I tell you what,
There is always *somewhere* a weakest spot,—
In hub, tire, fellowe, in spring or thill,
In panel, or crossbar, or floor, or sill,
In screw, bolt, thoroughbrace,—lurking still,
Find it somewhere you must and will,—
Above or below, or within or without,—
And that's the reason, beyond a doubt,
That a chaise *breaks down*, but doesn't *wear out*.

THE DEACON'S MASTERPIECE OR THE
WONDERFUL "ONE-HOSS SHAY"

A LOGICAL STORY
OLIVER WENDELL HOLMES

But the Deacon swore (as Deacons do,
With an "I dew vum," or an "I tell yeou,")
He would build one shay to beat the taown
'N' the keounty 'n' all the kentry raoun';
It should be so built that it *couldn'* break daown:
"Fur," said the Deacon, "'t's mighty plain
Thut the weakes' place mus' stan' the strain;
'N' the way t' fix it, uz I maintain,

Is only jest

T' make that place uz strong uz the rest."

THE DEACON'S MASTERPIECE, OR THE
WONDERFUL "ONE-HOSS SHAY"

A LOGICAL STORY
OLIVER WENDELL HOLMES

First of November, Fifty-five!
This morning the parson takes a drive.
Now, small boys, get out of the way!
Here comes the wonderful one-hoss shay,
Drawn by a rat-railed, ewe-necked bay.
“Huddup!” said the parson.—Off went they.

The parson was working his Sunday’s text,—
Had got to *fifthly*, and stopped perplexed
At what the—Moses—was coming next.
All at once the horse stood still,
Close by the meet’n’-house on the hill.
First a shiver, and then a thrill,
Then something decidedly like a spill,—
And the parson was sitting upon a rock,
At half past nine by the meet’n’-house clock,—
Just the hour of the Earthquake shock!
What do you think the parson found,
When he got up and stared around?
The poor old chaise in a heap or mound,
As if it had been to the mill and ground!
You see, of course, if you’re not a dunce,
How it went to pieces all at once,—
All at once, and nothing first,—
Just as bubbles do when they burst.

End of the wonderful one-hoss shay.
Logic is logic. That’s all I say.

THE DEACON’S MASTERPIECE, OR THE
WONDERFUL “ONE-HOSS SHAY”

A LOGICAL STORY
OLIVER WENDELL HOLMES

COUNTING IN-SERVICE FAILURES

- ATTEMPTING TO MAKE RELIABILITY ESTIMATES ON BASIS OF IN-SERVICE USAGE DIFFICULT AND AND UNRELIABLE PROBLEMS AFFECTING CREDIBILITY OF SUCH DATA INCLUDE ESPECIALLY TWO MAJOR ONES:

- LARGE NUMBER OF SEATS NEVER RECOVERED
- VARYING DEGREE OF EXPERTISE APPLIED IN EXAMINING RECOVERED SEATS.

- USN POSITION EXPRESSED IN:

MIL-STD-2067 AIRCREW AUTOMATED ESCAPE SYSTEMS RELIABILITY AND MAINTAINABILITY (R/M) PROGRAM REQUIREMENTS

"3.2.6 IN SERVICE SUCCESS RATE. THAT PERCENTAGE OF EJECTING AIRCREW WHO SURVIVED THROUGH SEPARATION FROM THE ESCAPE SYSTEM AND SURFACE CONTACT. INCLUDES MANY "LUCKY" OR "FLUKE" SAVES FROM AMONG THE "OUT-OF-ENVELOPE" EJECTIONS, UNSUCCESSFUL (NONMALFUNCTION) "OUT-OF-ENVELOPE" EJECTIONS, OTHER NONMALFUNCTION FATALITIES, AND SYSTEM MALFUNCTION CAUSED FATALITIES. SEPARATION OF THESE EFFECTS TO CORRECT THE SUCCESS RATE TO OBTAIN A MEASURE OF IN-SERVICE RELIABILITY IS A MATTER OF JUDGMENTAL INTERPRETATION OF ACCIDENT DATA OF VARYING VERACITY AND AS SUCH IS NOT AN ACCEPTABLE QUANTIFICATION OF AAES RELIABILITY."

AAES MALFUNCTIONS

TYPES OF MALFUNCTION

- **PRECLUDE INFLIGHT
ESCAPE FROM AIR-
CRAFT**
- **IMPAIR AAES
OPERATION**

- NOT ALL AAES MALFUNCTIONS PRECLUDING INFLIGHT ESCAPE FROM AIRCRAFT SHOW IN EJECTION STATISTICS.
- ▲ THOSE THAT DO ARE FATAL ATTEMPTS TO EJECT.
- ▲ SURVIVORS, HOWEVER, SURVIVE NOT BECAUSE OF THE AAES, BUT BECAUSE OF SOME OTHER METHOD OF ESCAPE AND ARE SO CODED.
- RECORDS EXAMINED REVEALED 35 ESCAPES ATTEMPTED, BUT NOT ACCOMPLISHED CASES WITH 17 FATAL EJECTION ATTEMPTS AND 18 NON-EJECTION SURVIVAL METHODS.

- MIL-S-18471 DEFINES EJECTION SEATS
AS ELEMENTS OF

AIRCREW AUTOMATED ESCAPE SYSTEMS

REQUIRING THAT ALL ESCAPE SEQUENCE
EVENTS OCCUR AUTOMATICALLY FOLLOWING
ACTUATION OF A SINGLE CONTROL.

- FAILURE OF AN ACTUATED CONTROL TO
INITIATE THE ESCAPE SEQUENCE OR
INTERRUPTION OF THAT SEQUENCE,
WHETHER OR NOT EJECTEE MANUALLY BY-
PASSES THE FAILURE POINT IS A SYSTEM
FAILURE.

NAVY IDENTIFIED

ESCAPAC FAILURES DURING PERIOD REVIEWED BY DAS 1/1/74-6/30/78

2 - RSSK - PREMATURE OPENING AT SEPARATION
4 - RSSK - OPENING PREVENTED BY DAMAGED AT
SEPARATION.
3 - LANYARD FAILURES
3 - SEAT MAN SEPARATION FAILURES
3 - SEAT FAILED TO FIRE
1 - WINDBLAST INDUCED EJECTION
2 - SUSTAINER ROCKET FAILURES
1 - LOWER HANDLE FAILED
1 - PARACHUTE DID NOT DEPLOY (ARMING CABLE RELEASE)
1 - CANOPY BREAKERS FAILED
21 FAILURES IN 140 NAVY ATTEMPTS

COUNTING IN-SERVICE FAILURES (CONT'D)

- USN DETAILED REVIEW OF ESCAPAC USAGE RECORDS REVEALED THAT OUT OF 140 EJECTIONS DURING PERIOD COVERED BY DAS REVIEW:

- ONLY 80 SEATS WERE RECOVERED OR RECOVERABLE (ALL OVERLAND EJECTIONS CONSIDERED RECOVERABLE-- NOT KNOWN HOW MANY WERE).
- 21 KNOWN FAILURES WERE IDENTIFIED (DETAILS FOLLOWING CHART).
- 17 FAILURES WERE IDENTIFIED AMONG RECOVERED/ RECOVERABLE SEATS.

- GIVEN $F = 21$, $N = 140$

$$R_{.90LCL} = .81$$

- HOWEVER, SINCE 60 SEATS WERE LOST IN OCEAN AND NOT RECOVERED, MORE REALISTIC ESTIMATE GIVEN BY

$$F = 17, N = 80:$$

$$R_{.90LCL} = .71$$

ESTIMATES OF ESCAPAC IN-SERVICE RELIABILITY
(1/1/74 - 6/30/78)

ESCAPAC SEAT TYPE							
IA-1	IC-2	IC-3	IE-1	IF-3	IG-2	IG-3	TOTAL
3	3	3	1	5	3	3	21
3	2	2	1	3	3	2	16
17	25	19	5	15	32	27	140
11	13	13	5	4	15	20	81
.436	.590	.590	.343	.013	.560	.717	.730
.604	.718	.641	.343	.423	.775	.737	.800

NUMBER OF FAILURES

NUMBER OF FAILURES
WITH RECOVERED SEATS

TOTAL NUMBER OF ATTEMPTS

NUMBER OF ATTEMPTS
WITH RECOVERED SEATS

RELIABILITY BASED UPON
RECOVERED SEATS AT 90% LCL

RELIABILITY BASED UPON
TOTAL ATTEMPTS AT 90% LCL

INTERPRETATION OF RELIABILITY AT A LOWER CONFIDENCE LEVEL (CONT'D)

- RELIABILITY IS AN INHERENT FEATURE OF PRODUCT'S DESIGN THAT CANNOT BE MEASURED DIRECTLY.
- TRUE RELIABILITY (R_T) CAN BE QUANTIFIED ONLY AS ESTIMATES BASED UPON TRIAL (TEST) RESULTS.
- CONFIDENCE LEVELS ARE USED TO EXPRESS PROBABILITY THAT R_T IS BOUNDED BY ESTIMATED RELIABILITY VALUES.
- LOWER CONFIDENCE LEVEL RELIABILITY VALUES (R_{LCL}) EMPLOYED AS NOT CONSERVATIVE ESTIMATE OF R_T .
- PROBABILITY R_T IS BELOW R_{LCL} EQUALS $\frac{1 - LCL}{2}$.
- THEREFORE NAVY USE OF $R_{.90LCL} = .98$ STATES USN CONFIDENCE OF 95 PERCENT THAT R_T IS EQUAL TO, OR GREATER THAN 0.98.

RELIABILITY

INTERRELATIONSHIP BETWEEN RELIABILITY AND CONFIDENCE LEVEL DEFINED BY:

$$C = 1 - R^N$$

WHERE

C IS CONFIDENCE LEVEL

R IS RELIABILITY

N IS NUMBER OF TESTS, WITHOUT FAILURES.

RELIABILITY

MANIPULATING THE PREVIOUS EQUATION AS FOLLOWS

$$C = 1 - R^N$$

$$R^N = 1 - C$$

$$N \times \ln R = \ln(1 - C)$$

$$R = e^{\ln(1 - C)/N}$$

CALCULATION OF RELIABILITY BASED UPON OBSERVED FAILURE RATE (CONT'D)

- FROM THESE DATA, THE DAS CALCULATIONAL APPROACH IS:

$$R = 1 - \frac{\text{FAILURES}}{\text{NO. OF TRIALS}}$$

$$= 1 - \frac{4}{179}$$

$$= 0.978$$

- USING THESE DATA (F=4, N=179) SYSTEM RELIABILITY AT 90 PERCENT LOWER CONFIDENCE LEVEL IS:

$$R_{.90_{LCL}} = 0.956 \quad (\text{OBTAINED FROM TABLES})$$

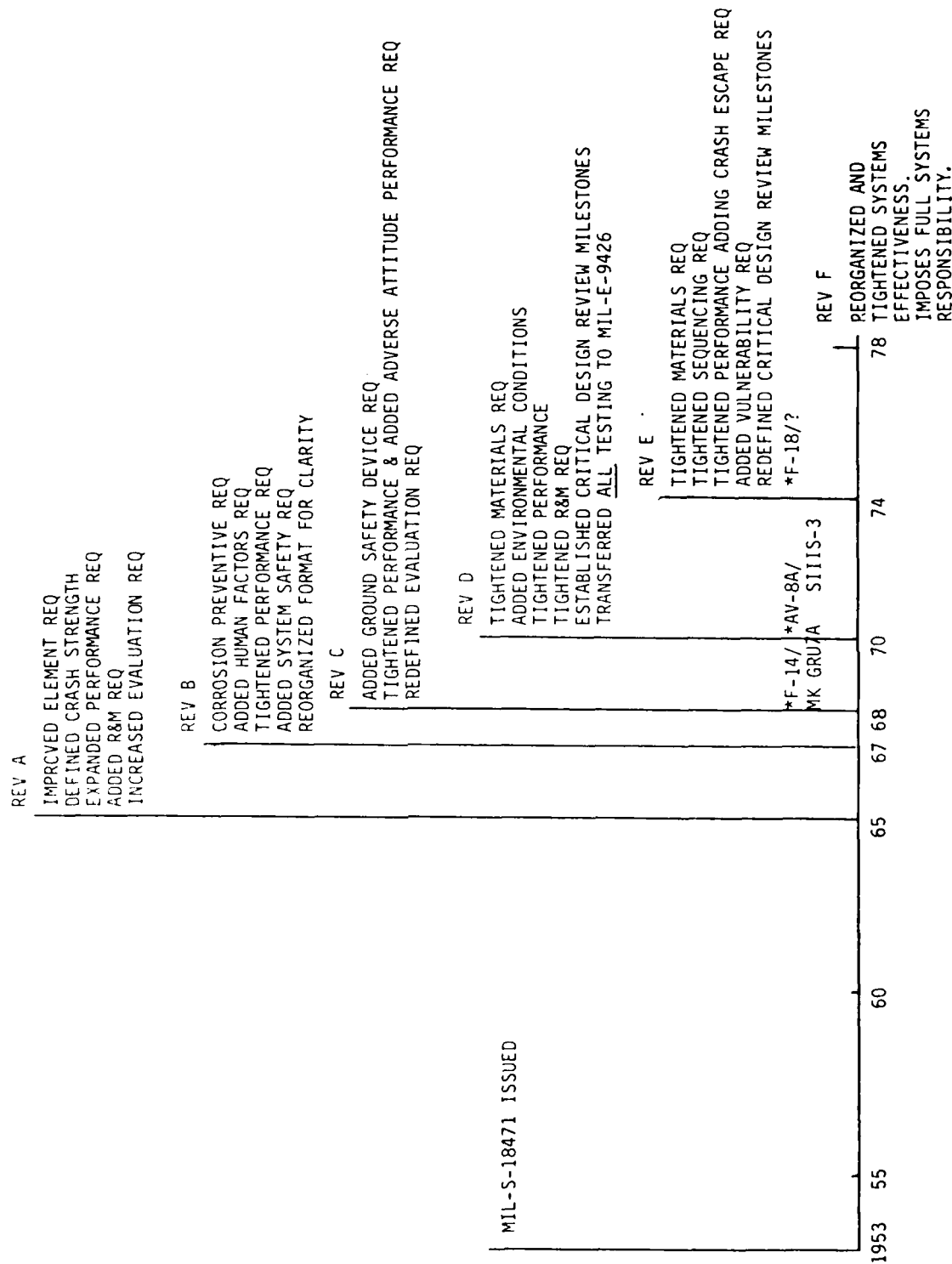
- LOWER CONFIDENCE LEVEL FOR DAS CALCULATED RELIABILITY IS:
71 PERCENT (OBTAINED FROM TABLES)

USN CONFIDENCE IN NEW SEAT RELIABILITIES

(CONT'D)

- RELIABILITY IS DESIGNED IN, NOT TESTED INTO A SYSTEM.
- TESTING PROVIDES DATA WITH WHICH TO ESTIMATE SYSTEM RELIABILITY.
- NAVY SINCE PROCURING INITIAL ESCAPACs HAS UPGRADED
 - DESIGN REQUIREMENTS
 - RELIABILITY, MAINTAINABILITY, SAFETY, HUMAN FACTORS REQUIREMENTS
 - CONTINUOUS DESIGN EVALUATION PROCEDURES
 - TESTING REQUIREMENTS.
- NO ESCAPACs HAVE BEEN PROCURED UNDER THESE. HOWEVER, NEW SEATS HAVE AND REPLACEMENT SEAT WILL BE.
- THESE UPGRADED REQUIREMENTS/PROCEDURES ENHANCE PROBABILITY OF ACHIEVING HIGHER RELIABILITIES WHILE ACHIEVING MAJOR ADVANCES IN PERFORMANCE.

MIL-S-18471 HISTORY



AIRCREW AUTOMATED ESCAPE SYSTEM

SYSTEMS EFFECTIVENESS PROGRAM TOOLS

RELIABILITY

- RELIABILITY SYSTEM BLOCK DIAGRAM & MATH MODEL
- FMEA (FAILURE MODES AND EFFECTS ANALYSIS)
- FTA (FAULT TREE ANALYSIS)
- SINGLE POINT FAILURE ANALYSIS
- ENVIRONMENTAL STUDY
- CRITICAL DESIGN REVIEWS
- COMPONENT PARTS & MATERIAL SELECTION/QUALIFICATION
- SUPPLIER CONTROLS
- FAILURE DATA COLLECTION & ANALYSIS
- FAILURE SUMMARIES
- MOS (MARGINALITY OF SUCCESS ANALYSIS)
- RELIABILITY GROWTH CURVES

MAINTAINABILITY

- MAINTAINABILITY SYSTEM BLOCK DIAGRAM & MATH MODEL
- MAINTAINABILITY GROWTH CURVES
- FMK (FIELD MAINTAINABILITY REVIEW KIT)

SYSTEMS SAFETY

- HMEA (HAZARDS MODES AND EFFECTS ANALYSIS)
- FTA (FAULT TREE ANALYSIS)
- OHA (OPERATION HAZARD ANALYSIS)

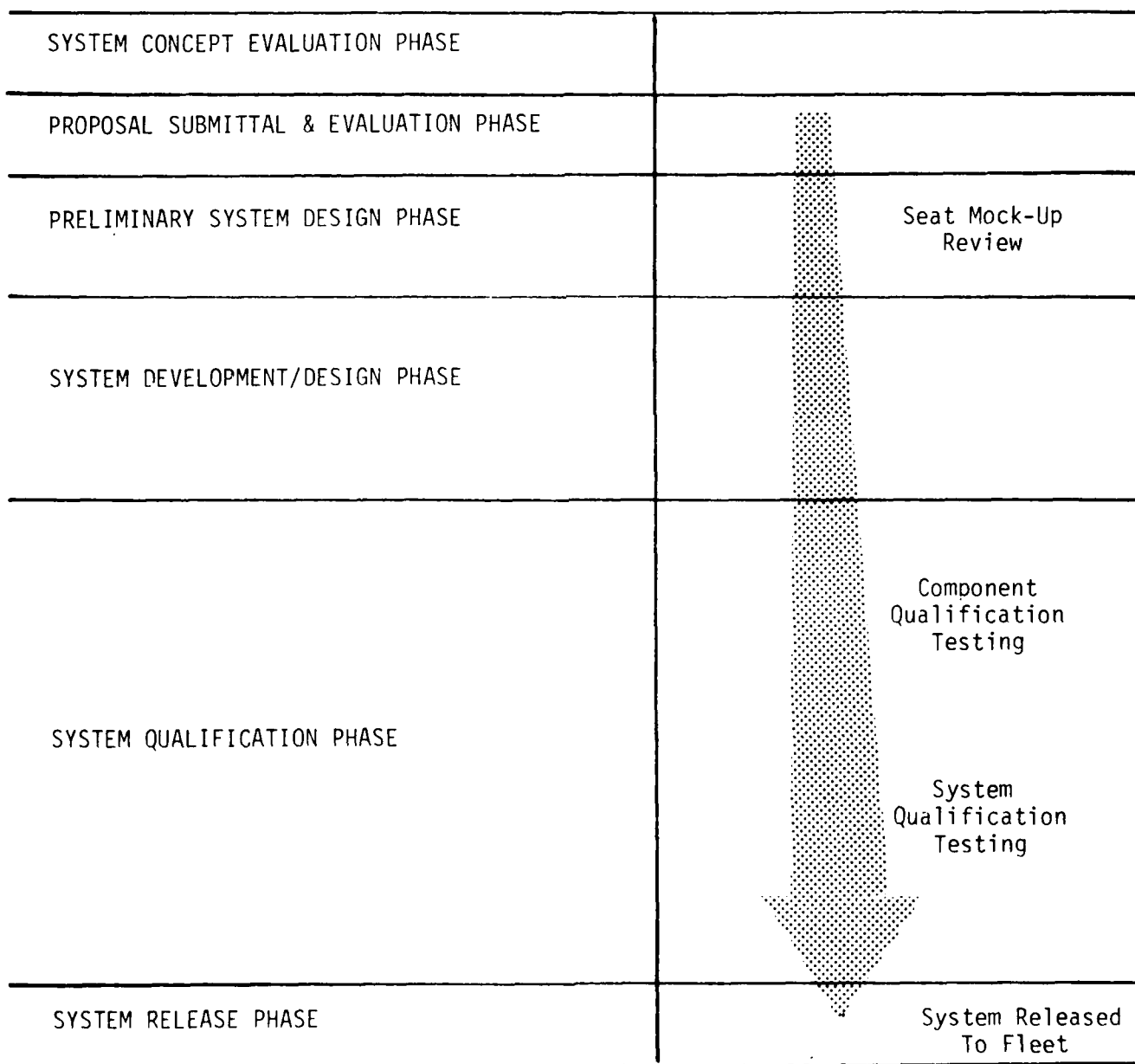
VULNERABILITY ANALYSIS

- CIFMEA (COMBAT-INDUCED FAILURE MODE AND EFFECT ANALYSIS)
- HIT RATE ANALYSES
- VULNERABILITY DESIGN REVIEWS

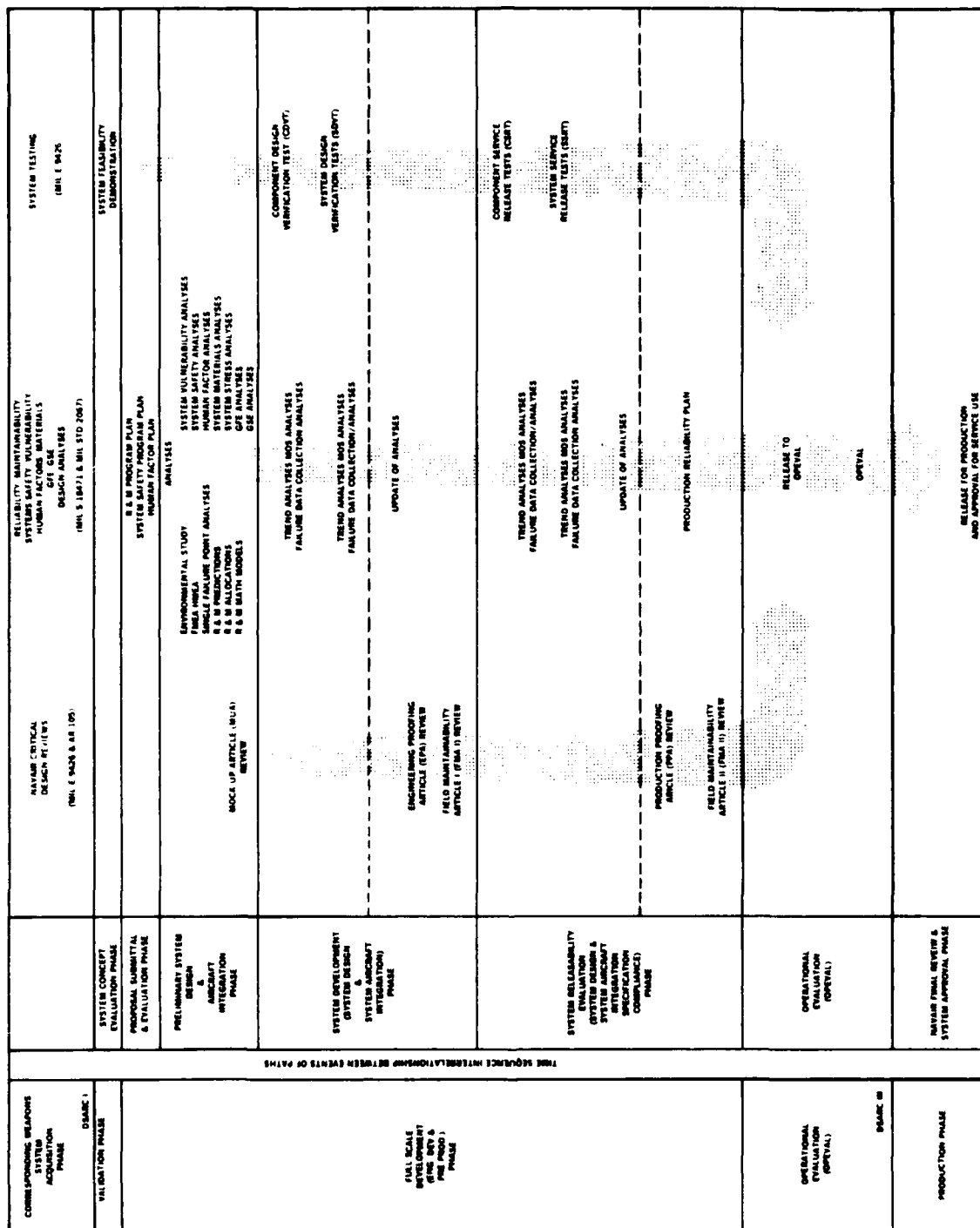
CHANGES HISTORY

NAVAIR EJECTION SEAT DESIGN EVALUATION PROGRAM

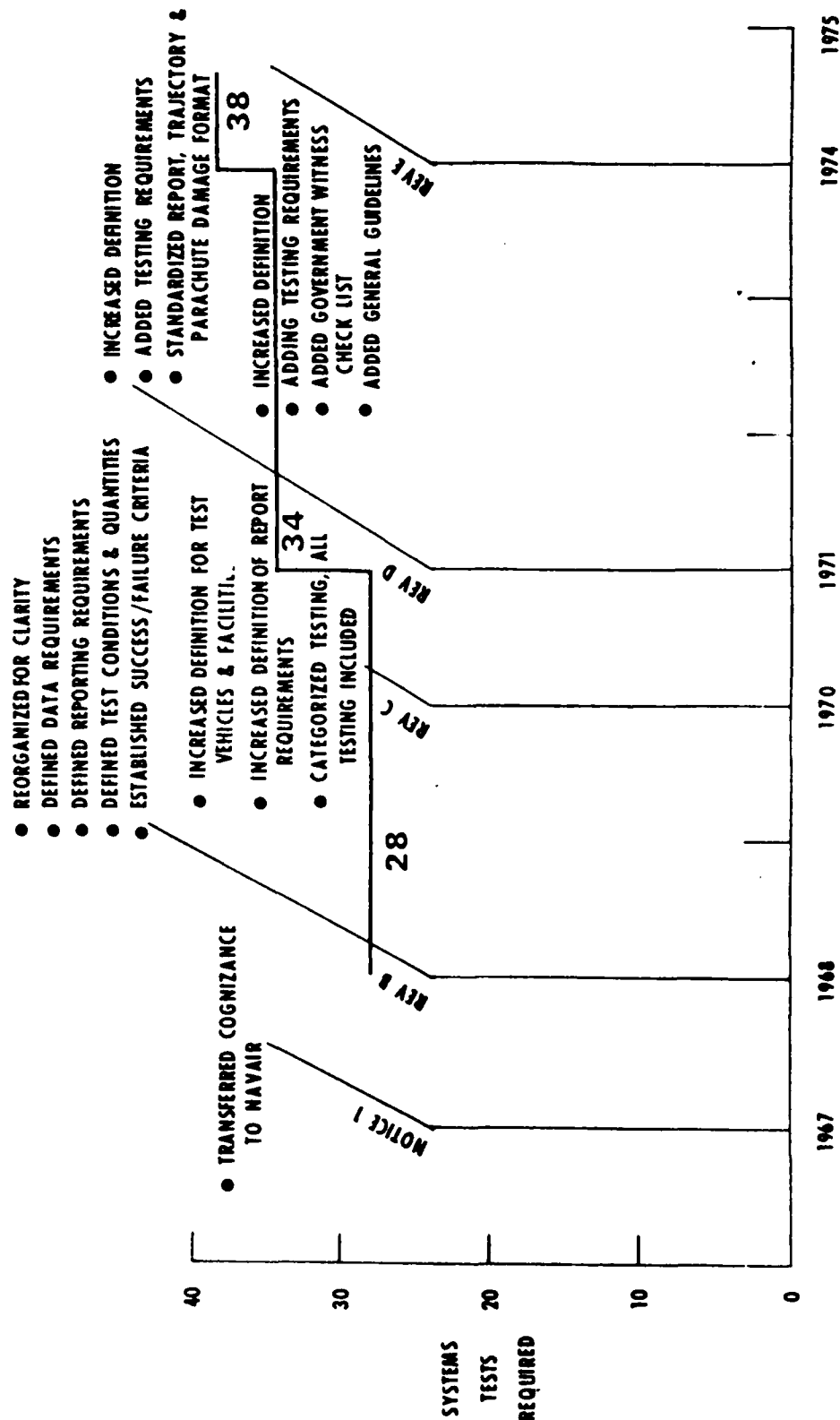
PRE-1968 EVENT FLOW SEQUENCE



AIRCREW AUTOMATED ESCAPE SYSTEM DESIGN EVALUATION PROGRAM EVENT FLOW SEQUENCE DIAGRAM



MIL-E-9426 HISTORY LISTING MAJOR CHANGES



MAINTAINABILITY

- **MAINTAINABILITY IS AN INHERENT FEATURE OF A SYSTEM'S DESIGN.**
- **MAINTAINABILITY CAN BE CONTROLLED DURING DESIGN OF A SYSTEM.**
- **MAINTAINABILITY CANNOT BE TESTED INTO A SYSTEM'S DESIGN.**

EQUIPMENT FAILURES DUE TO FAULTY MAINTENANCE

- NOT ALL FAULTY MAINTENANCE WORK IMPACTS EJECTIONS. SOME IMPACT FLIGHT. SOME IMPACT GROUND PERSONNEL SAFETY.
- NOT ALL FAULTY MAINTENANCE IS FOUND AS A CONSEQUENCE OF EJECTION FAILURES. SOME IS DETECTED BY INSPECTION. SOME IS DETECTED THROUGH SUBSEQUENT MAINTENANCE.

MANY, IF NOT MOST, "MAINTENANCE
ERRORS" RESULT FROM OVERLY
HUMAN DEPENDENT DESIGN

RECENT DESIGN REQUIREMENTS
AIMED AT ELIMINATING
HUMAN DEPENDENCY DESIGNS

MAJOR DESIGN & DESIGN EVALUATION EFFORTS
FOR NEWER EJECTION SEATS WERE CONCEN-
TRATED ON :

- REDUCING MAINTENANCE FREQUENCY
- ELIMINATING MAINTENANCE ERROR POTENTIALS.
(ELIMINATE HUMAN DEPENDENCY DESIGNS)

ASSURANCE CONCERNING NEW SEAT MAINTAINABILITY

- MAINTAINABILITY IS AN INHERENT FEATURE OF A SYSTEM'S DESIGN.
- SINCE PROCURING INITIAL ESCAPACs, NAVY HAS INTRODUCED AND UPGRADED ESCAPE SYSTEM
 - MAINTAINABILITY DESIGN REQUIREMENTS:
 - EXTENDED PERIODS BETWEEN MAINTENANCE ACTIONS
 - EASE AND SAFETY OF PERFORMING MAINTENANCE
 - SPECIFIED E-4 SKILL LEVEL CAPABILITY PERFORM 95% OF ALL MAINTENANCE
 - IMPOSED MAXIMUM TIME LIMITS ON PERFORMING MAINTENANCE
 - MAINTAINABILITY DESIGN EVALUATION REQUIREMENTS
 - MAINTAINABILITY TESTING REQUIREMENTS:
 - TWO SPECIAL TESTS (FIELD MAINTAINABILITY REVIEWS)
 - SPECIAL ATTENTION DURING ALL TESTING.
- NO ESCAPACs HAVE BEEN PROCURED UNDER THESE REQUIREMENTS WHILE NEW SEATS HAVE BEEN AND REPLACEMENT SEAT WILL BE.
- THESE UPGRADED REQUIREMENTS/PROCEDURES ENHANCE PROBABILITY OF ACHIEVING SIGNIFICANTLY IMPROVED SEAT MAINTAINABILITY WHILE ACHIEVING MAJOR ADVANCES IN PERFORMANCE.

RELIABILITY AND MAINTAINABILITY REQUIREMENTS

**DETAILED REQUIREMENTS IN ADDENDUM 3 OF RFP (TAILORED VERSION OF
MIL-STD-2067 R&M FOR ESCAPE SYSTEMS)**

CALCULATED RELIABILITY AT LEAST 0.98 @ 90%

DMMH/FH PER SEAT SHALL NOT EXCEED 0.05 HOURS

MTTR SHALL NOT EXCEED 0.85 HOURS

MAXIMUM CORRECTIVE MAINTENANCE TIME SHALL NOT EXCEED 2.5 HOURS

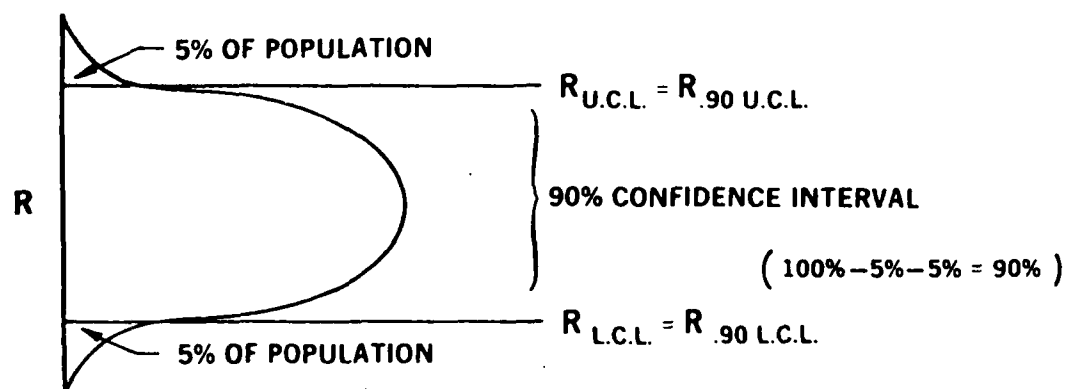
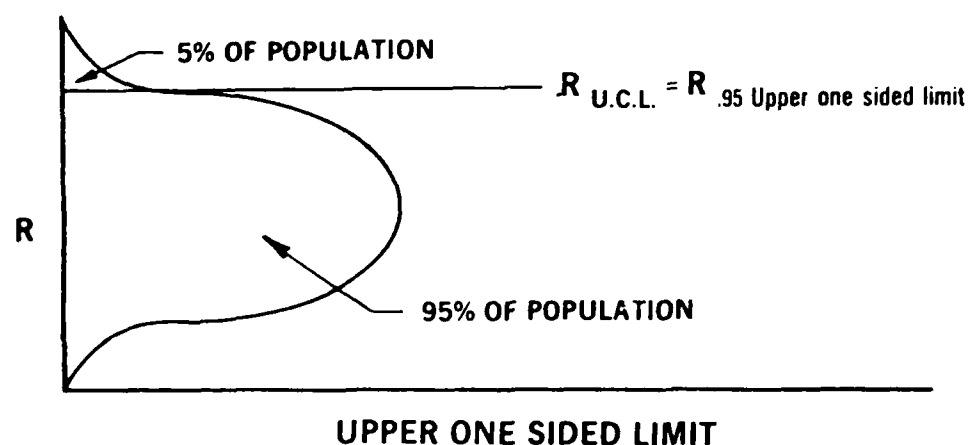
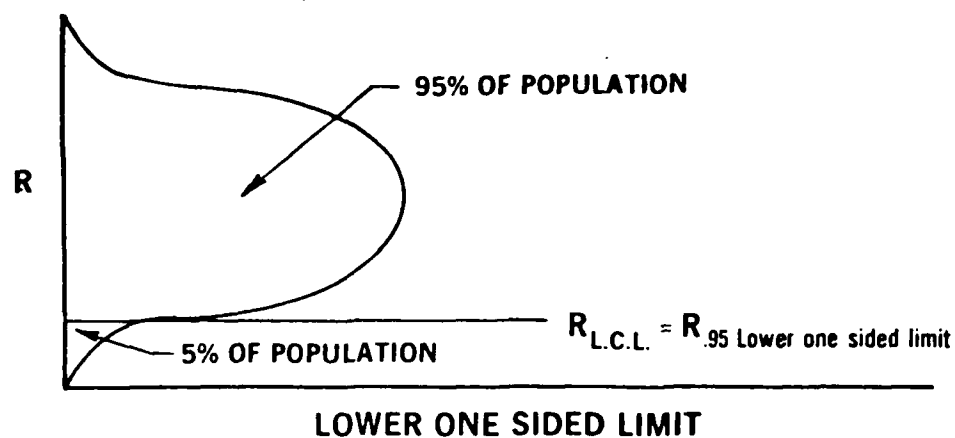
**E-4 MAINTENANCE PERSONNEL ABLE TO PERFORM 95% OF TOTAL
MAINTENANCE ACTIONS**

RELIABILITY

- RELIABILITY IS AN INHERENT FEATURE OF A SYSTEM'S DESIGN.
- RELIABILITY CAN BE CONTROLLED DURING DESIGN OF A SYSTEM.
- RELIABILITY CANNOT BE DIRECTLY MEASURED, IT CAN ONLY BE ESTIMATED ON THE BASIS OF RESULTS OF SYSTEM TRIALS.
- RELIABILITY CANNOT BE TESTED INTO A SYSTEM'S DESIGN.

SYSTEM RELIABILITY

- TRUE VALUE OF NON-PHYSICAL ATTRIBUTES INCAPABLE OF BEING DIRECTLY MEASURED CAN ONLY BE ESTIMATED THROUGH OBSERVING RESULTS OF TRIALS OF SYSTEM POSSESSING THOSE ATTRIBUTES.
- ESTIMATION PROCESSES INVOLVE ATTEMPTING TO "BOUND" TRUE VALUE WITHIN AN UPPER BOUND AND A LOWER BOUND.
- BOUNDING TECHNIQUES INVOLVE STATISTICAL LIKELIHOOD THAT TRUE VALUE IS EITHER:
 - GREATER THAN UPPER BOUND, OR
 - LESS THAN LOWER BOUND.
- THIS "CONFIDENCE LEVEL" IS MEANS FOR EXPRESSING PROBABILITY THAT TRUE VALUE BEING ESTIMATED IS CONTAINED WITHIN THE ESTIMATED BOUNDS.



**COMBINED LOWER AND UPPER ONE SIDED LIMITS WITH
LOWER AND UPPER CONFIDENCE INTERVAL LIMITS**

SAMPLE CALCULATIONS FOR 90% CONFIDENCE INTERVAL

- **PROBABILITY TRUE SYSTEM RELIABILITY GREATER THAN 90% UPPER CONFIDENCE LEVEL VALUE:**

$$\frac{1 - \text{CONFIDENCE INTERVAL}}{2} = \frac{1 - .90}{2} = .05$$

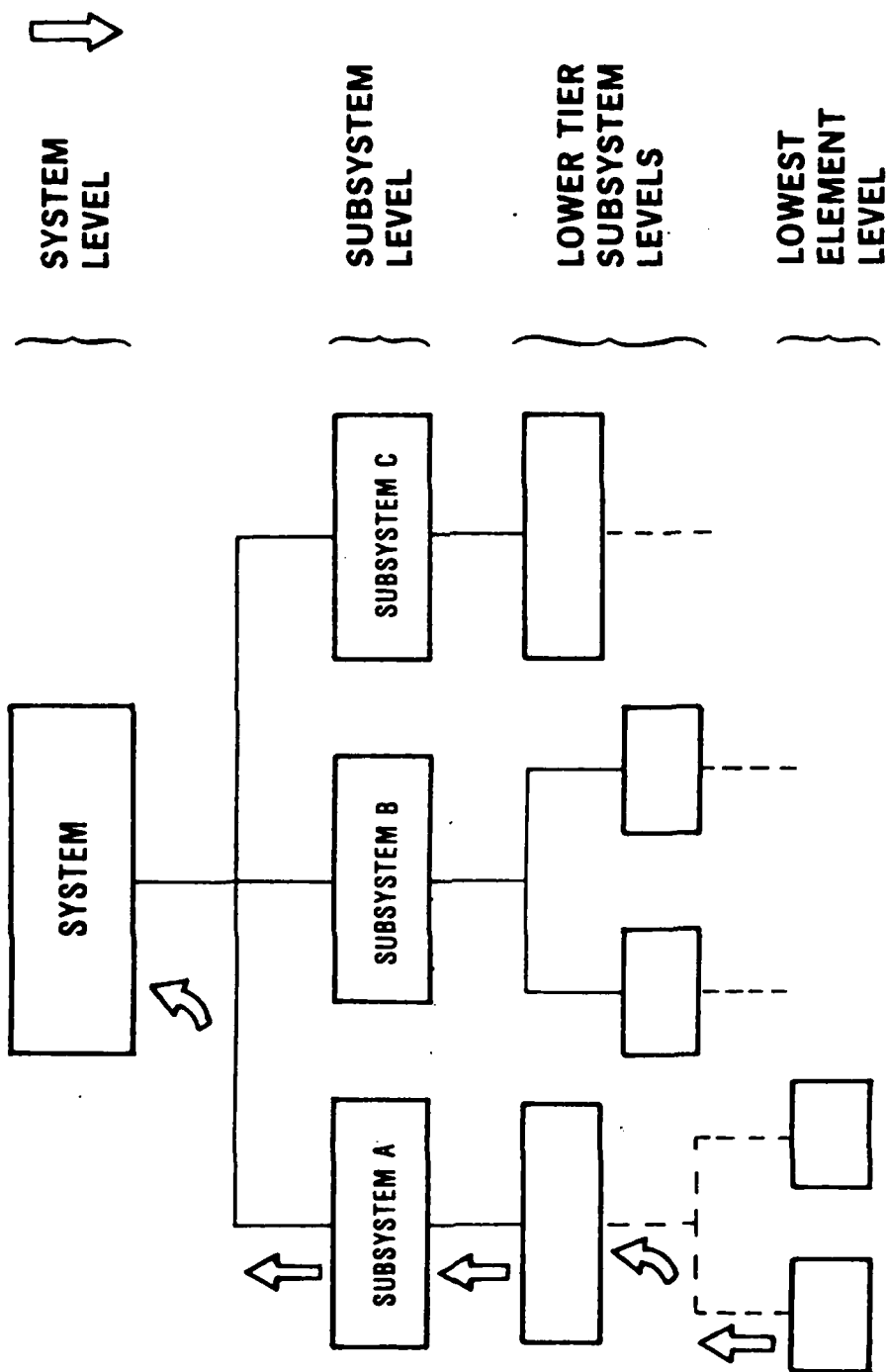
- **PROBABILITY TRUE SYSTEM RELIABILITY LESS THAN 90% LOWER CONFIDENCE LEVEL VALUE:**

$$\frac{1 - \text{CONFIDENCE INTERVAL}}{2} = \frac{1 - .90}{2} = .05$$

- **PROBABILITY TRUE SYSTEM RELIABILITY EQUAL TO, OR GREATER THAN 90% LOWER CONFIDENCE LEVEL VALUE:**

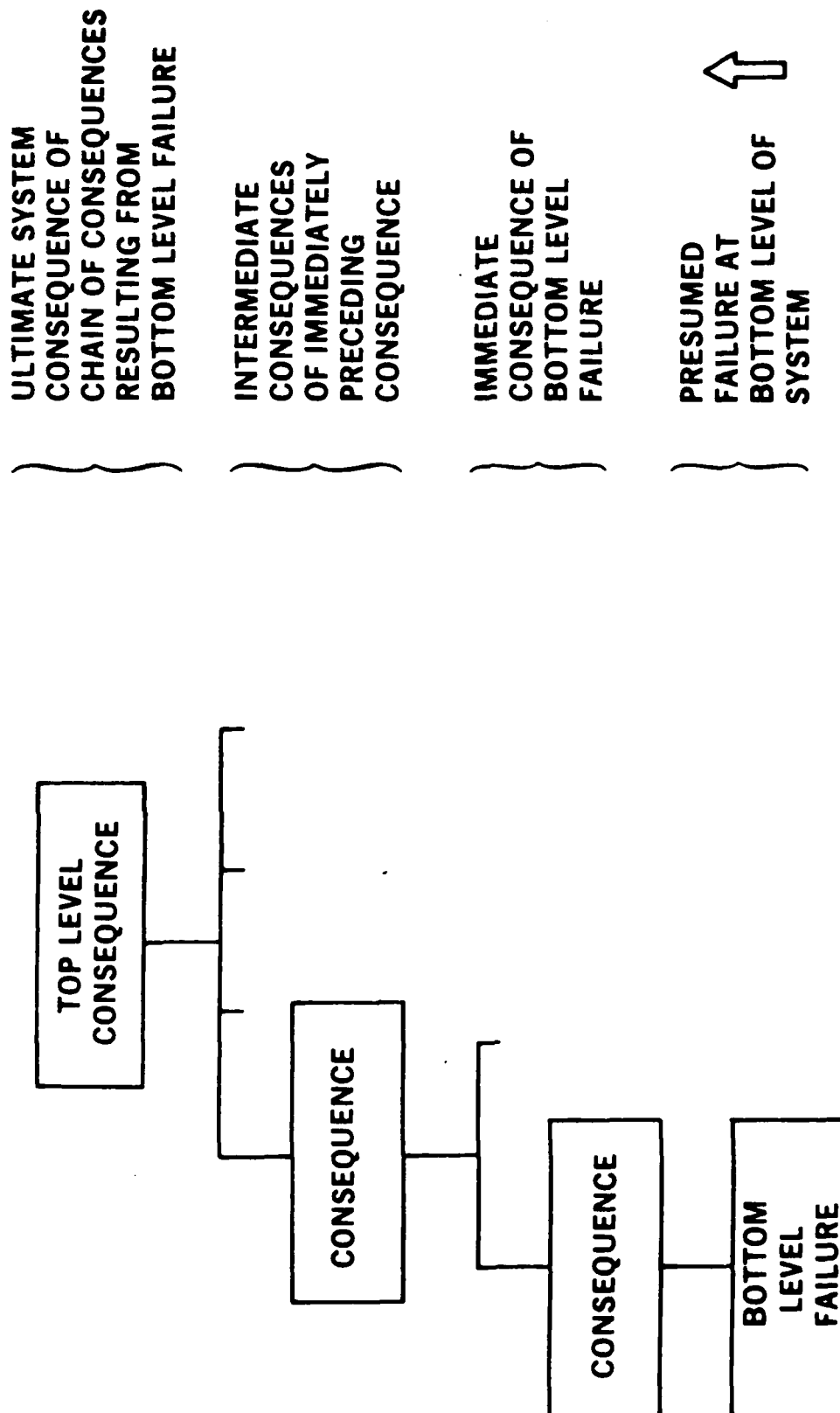
$$\frac{1 + \text{CONFIDENCE INTERVAL}}{2} = \frac{1 + .90}{2} = .95$$

BLOCK DIAGRAM

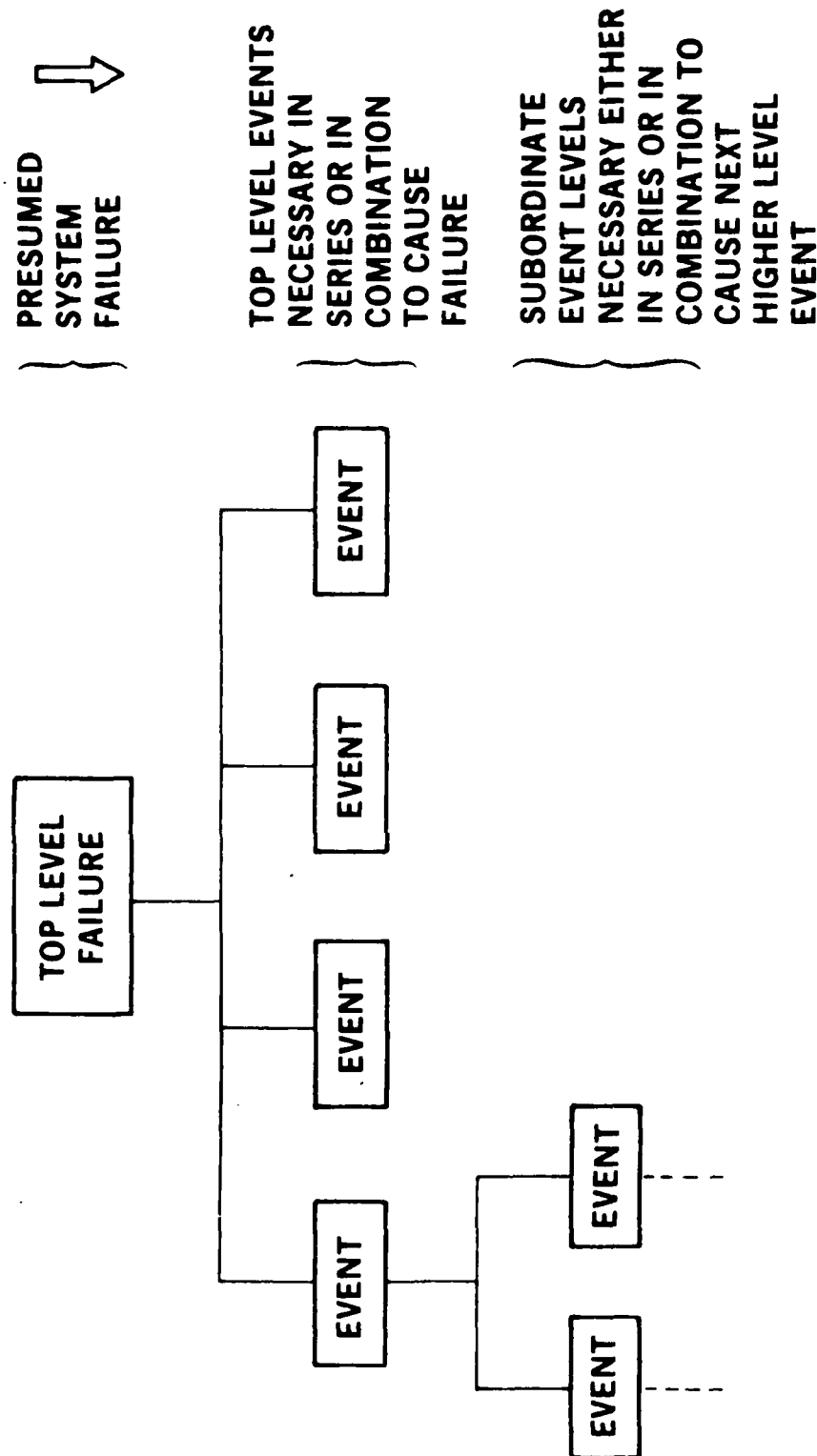


NOTE:
ARROWS () ) DEPICT ONE OF THE FUNCTIONAL TRAINS

FMEA



FTA



PHASES OF MOS ACTIVITIES (I)

● PRE-TEST PLANNING

— REVIEW "ILITIES" ANALYSES

- ▲ POSSIBLE TEST CONDITION IMPACT UPON ARTICLE OPERATION**
- ▲ TYPES OF ARTICLE CONDITION CHANGES (TRANSITORY & PERMANENT)**

- CORRECT OPERATION**
- PARTIALLY INCORRECT OPERATION**
- INCORRECT OPERATION**

▲ TYPES OF DATA NEEDED TO DOCUMENT ARTICLE CONDITION CHANGES

- REVIEW MOS ARCHIVAL DATA**
- REVIEW TEST PLANS & DATA PROGRAM PLANS**

▲ TEST DATA ACQUISITION PROCEDURES & SYSTEM ADEQUACY

- TEST SET-UP DOCUMENTATION PLANS**
- TEST DATA ACQUISITION SYSTEM**

- — DATA PRIORITIES**
- — BACK-UP DATA ACQUISITION**
- — SYSTEM CHECK-OUT**
- — SYSTEM CALIBRATION**

■ POST-TEST DATA ACQUISITION PLANS

- — TEST SITE PROTECTION/ACCESS CONTROL PLANS**
- — TEST SITE SAFETY INSPECTION/DOCUMENTATION PLANS**
- — MOS ON-SITE DATA ACQUISITION PROVISIONS**
- — MOS TEST ARTICLE RECOVERY/TRANSPORT PROVISIONS**

PHASES OF MOS ACTIVITIES (II)

● TEST SITE

— PRE-TEST

▲ REVIEW TEST SET-UP DOCUMENTATION FOR ADEQUACY

- TEST ARTICLE PRE-TEST CONDITION/COMPLIANCE WITH PLAN
- TEST EQUIPMENT PRE-TEST CONDITION/COMPLIANCE WITH PLAN
- TEST SITE PRE-TEST CONDITION/COMPLIANCE WITH PLAN

▲ REVIEW TEST DATA ACQUISITION SYSTEM DOCUMENTATION FOR ADEQUACY

- SYSTEM COMPLIANCE WITH PLAN
- SYSTEM CALIBRATION

— POST-TEST

▲ REVIEW TEST DATA ACQUISITION SYSTEM POST-TEST CALIBRATION CHECKS

▲ CHECK TEST SITE SAFETY INSPECTOR DOCUMENTATION

■ ELEMENTS DISTURBANCE DOCUMENTATION

- — ELEMENT IDENTIFIED
- — ELEMENT LOCATION & CONDITION DESCRIBED
- — NATURE OF DISTURBANCE DESCRIBED (I.E. MOVED, SAFETIED, ETC.)

■ SITE DECLARED SAFE

▲ CONDUCT ON-SITE DOCUMENTATION OF POST-TEST CONDITION OF ARTICLE, EQUIPMENT & SITE

- LOCATE MAP & IDENTIFY ALL ELEMENTS
- PHOTOGRAPH UNDISTURBED ELEMENTS
- DESCRIBE UNDISTURBED CONDITION OF ELEMENTS
- PREPARE ELEMENTS FOR TRANSPORTATION

- — DESCRIBE CHANGES OCCURRING IN ELEMENTS CONDITION

PHASES OF MOS ACTIVITIES (III)

● POST-TEST INVESTIGATION

— PRELIMINARY TEST ARTICLE POST-TEST CONDITION DESCRIPTION

▲ PREPARE UTILIZING ALL PRE-TEST & ON-SITE DOCUMENTATION

▲ IDENTIFY ALL KNOWN ANOMALIES

- TRANSITORY CONDITIONS & CONDITION INTERRELATIONSHIPS**
- PERMANENT CONDITIONS & CONDITION INTERRELATIONSHIPS**

▲ IDENTIFY ALL KNOWN NON-ANOMALOUS CONDITIONS

▲ DEVELOP TEST ARTICLE AUTOPSY PLANS & SUPPORTING RATIONALE

- TO EXPLORE ANOMALOUS CONDITIONS IN DEPTH**
- TO DOCUMENT PRESENCE/ABSENCE OF PREVIOUSLY EXPERIENCED ANOMALIES**

▲ AUTOPSY PLAN REVIEW

- DESIGNERS**
- "ILITIES"**
- MANUFACTURING**
- QUALITY ASSURANCE**
- PROGRAM MANAGEMENT**

— CONDUCT TEST ARTICLE AUTOPSY

▲ STEP-BY-STEP DOCUMENTATION OF PROCEDURES FOLLOWED/CONDITIONS OBSERVED

— CONDUCT ANALYSIS OF DATA

▲ ARCHIVAL REFERENCE FOR PAST EXPERIENCE

▲ ASCERTAIN MOST LIKELY SETS OF CONDITIONS & SEQUENCES OF EVENTS LEADING TO OBSERVED DATA

— PREPARE PRELIMINARY MOS REPORT

PHASES OF MOS ACTIVITIES (IV)

● MOS REVIEW

— MOS REVIEW BOARD

▲ COMPOSED OF REPRESENTATIVES OF

- ENGINEERING**
- "ILITIES"**
- MANUFACTURING**
- PURCHASING**
- QUALITY ASSURANCE**
- TESTING**
- MOS INVESTIGATOR**

▲ IDENTIFY

- PROBABILITY OF ANOMALY OCCURRENCE**
- ANOMALY CONSEQUENCE POTENTIAL SEVERITY**
- COST TO FIX**
- TIME TO FIX**
- NEED FOR, COST & TIME FOR, AND TYPE OF ADDITIONAL INVESTIGATION**

▲ FINALIZE REPORT

- IDENTIFYING ALL OBSERVED ANOMALIES WHETHER UNDERSTOOD OR NOT**
- IDENTIFYING ALL RECOMMENDED ADDITIONAL INVESTIGATION**
- IDENTIFYING ALL FINDINGS CONCERNING OBSERVED ANOMALIES**
- INCLUDING ALL RECOMMENDATIONS CONCERNING REMEDIAL ACTIONS**

— PROGRAM MANAGEMENT/CORPORATE REVIEW

- ▲ CONTRACTUAL SCOPE**
- ▲ IMPLEMENTATION DECISIONS**
- ▲ REFERRAL DECISIONS**

— GOVERNMENT PROCURING AGENCY OR DESIGNEE REVIEW

PHASES OF MOS ACTIVITIES (V)

● ARCHIVAL

- IDENTIFY PARTS CONTAINING ANOMALIES & RETAIN FOR PROGRAM
- IDENTIFY ALL OTHER PARTS & HOLD IN REFERENCE RESERVE
 - ▲ NON-PERMANENT (HOLD FOR SEVERAL TESTS)
 - ▲ HELD IN EVENT NEW ANOMALY OBSERVED IN LATER TEST
- INITIATE ANOMALY TRACKING SYSTEM
 - ▲ UPDATE AFTER EACH TEST
 - ▲ RECORD MARGIN BY WHICH ELEMENT/SYSTEM FAILURE AVOIDED
- MAINTAIN FAMILIAL DATA SYSTEM
 - ▲ UPDATE AFTER EACH TEST
 - ▲ RECORD TRENDS AND/OR STATISTICAL RELATIONSHIP TO FAILURE LIMITS

REQUIRES LARGE DESIGNED

"TRUE" RELIABILITY TO

PROVIDE HIGH PROBABILITY

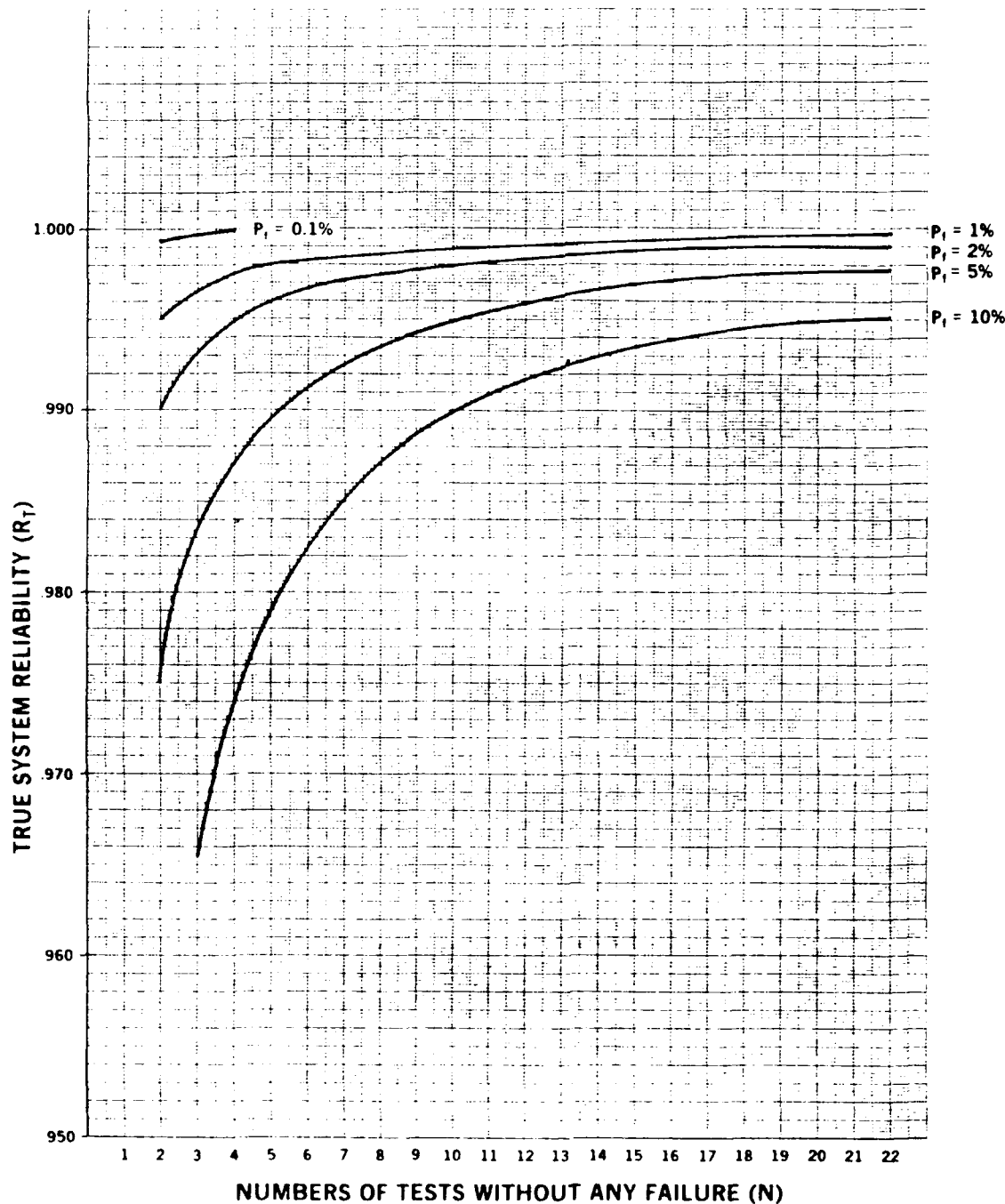
OF DEMONSTRATING A

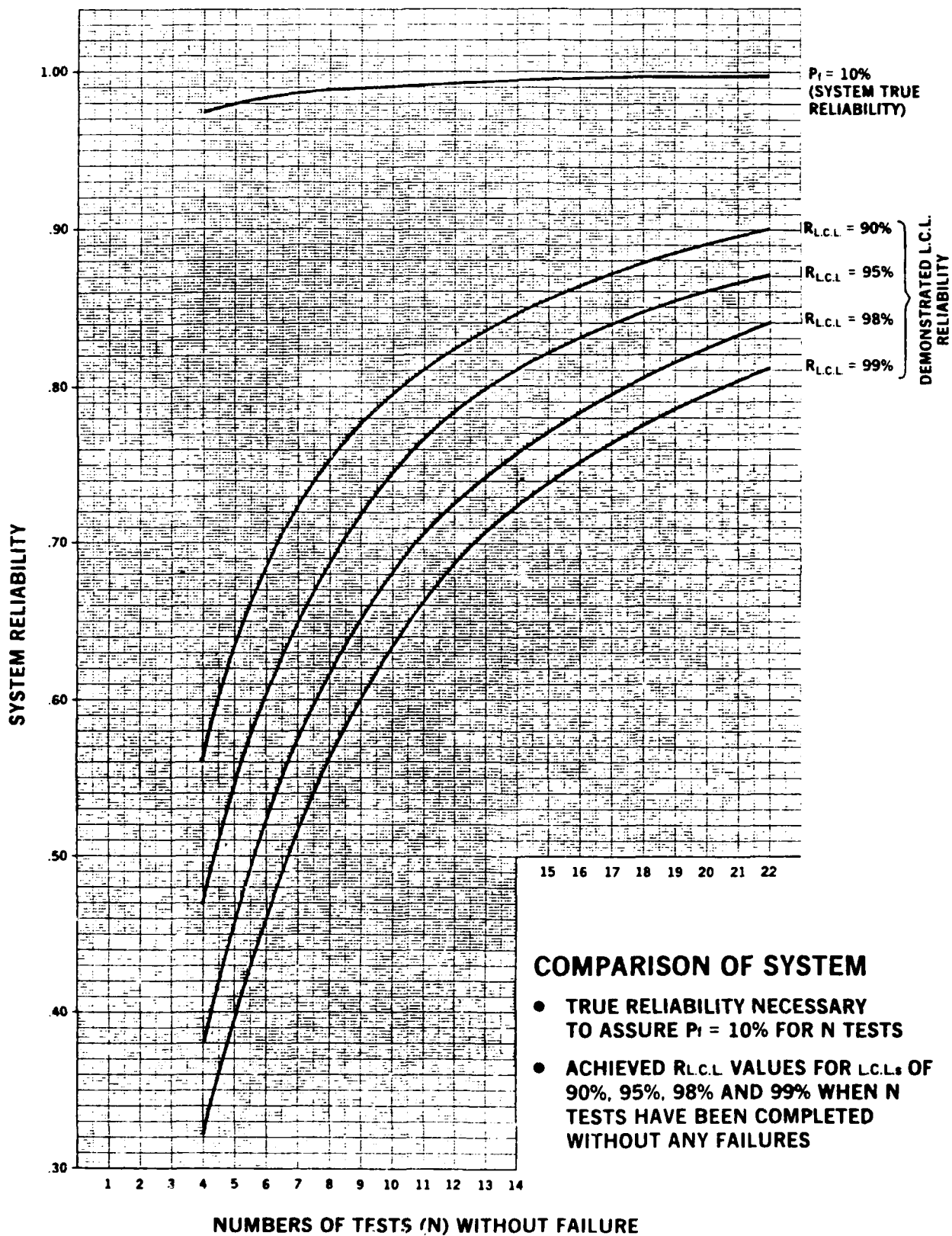
MUCH LOWER "DEMONSTRATED"

RELIABILITY.

TRUE SYSTEM RELIABILITY NECESSARY TO
ASSURE SPECIFIC MINIMAL (NOT TO EXCEED)
LEVELS OF P_f (PROBABILITY OF FAILING TO
COMPLETE A TEST SERIES (N) SUCCESSFULLY)

$$R_T = e^{\frac{\ln(1-P_f)}{N}}$$





PUBLISHED REFERENCE DATA CONCERNING

PHYSIOLOGICAL LIMITS

USED BY NAVAIR

Abrupt Acceleration

"In this time period, tissues react by structural damage or failure. Tissue damage is determined by such physical properties as tissue elasticity, viscosity, frequency of response, tensile and shearing strength, and compressibility. Stress on solid tissues (e.g., bone) produces little or no displacement until the yield point is reached, when fracture results. In visco-elastic tissues (muscle, skin, internal organs), unit stress produces logarithmic displacement; in body fluids, displacement is linear."

Pages 447-448
Human Engineering Guide to Equipment Design
Morgan, Chapanis, Cook, Lund
McGraw-Hill Book Company, Inc.
1963

"Biologically, the limiting factor in human tolerance to headward g in the normal, seated posture is spine fracture, particularly in the upper lumbar portion, just above the "small of the back" concavity. With optimum alignment, up to 35g can be tolerated at less than 500g/sec rate of onset, but, with the back bent forward to the limit of motion, this limit diminishes to below 15g. Animals with spines optimally aligned have withstood 75g (hogs) and 65g (chimpanzees) without fracture at higher than 5,000g/sec onset. Human limits are presumably in this area, but data are lacking. With optimum support, as in immersion baths or form-fitting couches, the limit might be about 1,000g in "zero" time (0.001 sec)."

Page 448

Human Engineering Guide to Equipment Design

Morgan, Chapanis, Cook, Lund

McGraw-Hill Book Company, Inc.

1963

Brief Acceleration

"At about 0.2 sec duration, hydraulic effects begin. These consist of the displacement of fluids in the body cells, changes in the hydrostatic equilibrium between small blood vessels and their surrounding body fluids, changes in permeability and structural failure of blood vessels, and the mechanical displacement or deformation of body structures. Body orientation determines the physiological effect of the hydraulic displacements."

Pages 448-452

Human Engineering Guide to Equipment Design

Morgan, Chapanis, Cook, Lund

McGraw-Hill Book Company, Inc.

1963

"Human tolerance to abrupt acceleration involves the following five mechanical factors:

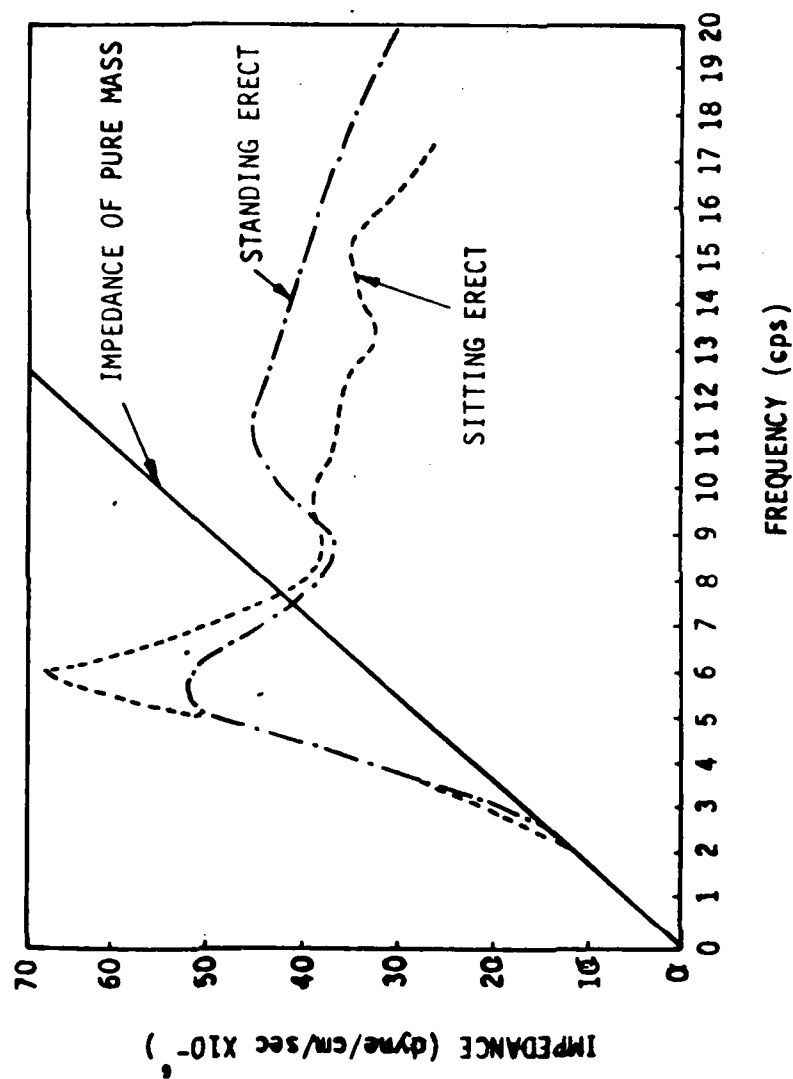
- a. The type of body support or restraint.
- b. The orientation of the body with respect to the direction of force.
- c. The rate and duration of application of the force.
- d. The magnitude of the force.

Of these factors, the type of restraint is probably the most important..."

(Underlining added)

Page 448

Human Engineering Guide to Equipment Design
Morgan, Chapanis, Cook, Lund
McGraw-Hill Book Company, Inc.
1963



Page 469
 Human Engineering Guide to Equipment Design
 Morgan, Chapanis, Cook, Lund
 McGraw-Hill Book Company, Inc.
 1963

"Parachute opening shock is a special case of total body deceleration acting over a 1-2 sec period with the body in various positions. Peak forces, acting for about 0.05 sec, will vary from 8-33g, depending on altitude and on the 4th power of parachute-opening velocity (Webster, 1953)."

"Both operating experience and experiments (Hallenbeck, et al., 1945) indicate that opening shock is greatest at high altitudes. Forces below 20g are considered to be safe, forces of 20-30g are borderline, and forces of over 30g are dangerous for man, parachute, and harness."

Page 452
Human Engineering Guide to Equipment Design
Morgan, Chapanis, Cook, Lund
McGraw-Hill Book Company, Inc.
1963

Pitch Rate

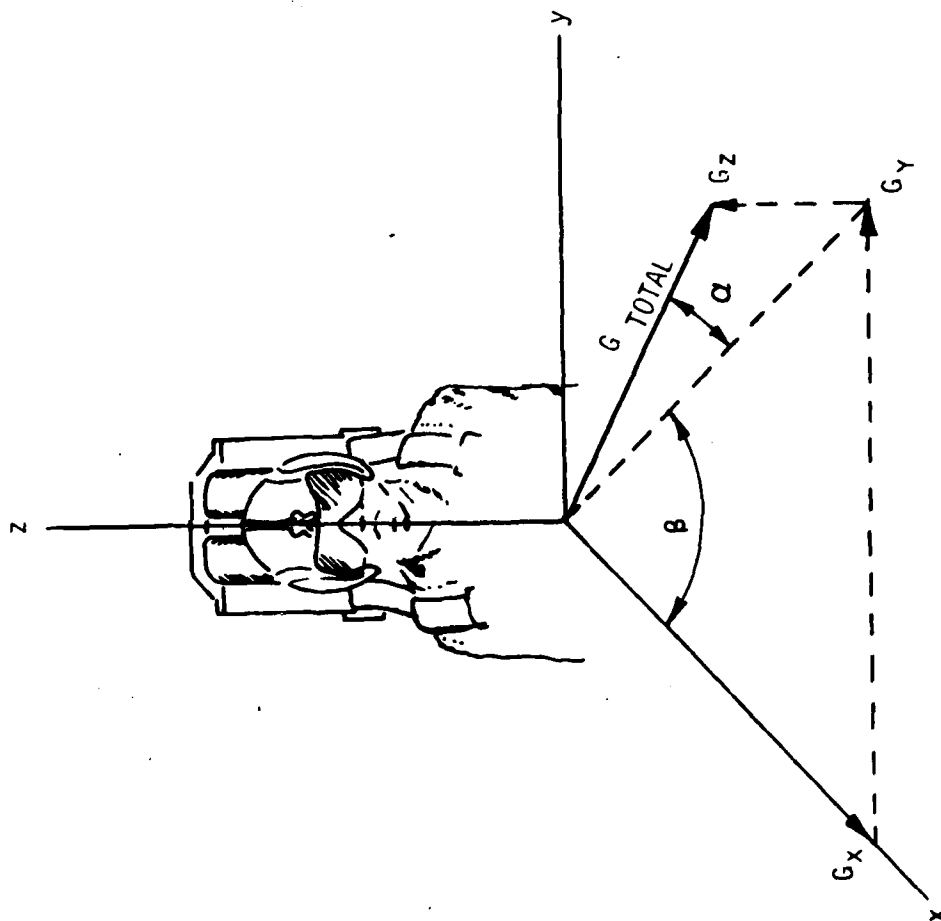
"In the pitch axis, with the center of rotation at the heart level, symptoms of negative acceleration (-Gz) are demonstrated at about 80 rpm and are tolerable for only a few seconds. Some effects of positive acceleration (+Gz), namely numbness and pressure in the legs, are also observed but develop slowly, with pain being evident at about 90 rpm. No confusion or loss of consciousness is found, but in some subjects disorientation, headache, nausea, or mental depression are noted for several minutes after a few minutes of exposure (Weiss et al., 1954).

(Underlining added)

Page 192
Bioastronautics Data Book
J. F. Parker, Jr., Vita R. West
National Aeronautics and Space Administration
1973

"For transverse g in the seated position, tolerance limits are set by hemorrhage into the eyes, retinal detachment, chest pain, and difficulty in breathing. The following forces are tolerable: 3g for 900 sec, 10g for 120 sec, 15g from 5-50 sec, and 25g for 1 sec. In the well supported prone and supine positions, transverse-g tolerance will probably be limited only by the strength of the heart or lungs."

Page 452
Human Engineering Guide to Equipment Design
Morgan, Chapanis, Cook, Lund
McGraw-Hill Book Company, Inc.
1963



LATERAL ACCELERATION (G_y)

$$G_y = (G_{TOTAL})(\cos \alpha)(\sin \beta)$$

TABLE 6-3. COMPLAINTS REGISTERED BY VOLUNTEERS IN APOLLO IMPACT TESTS

Pos. No.	Seat Orientation (Roll-Pitch-Yaw)	Complaint Tests Total Tests	Category of Complaints	Complaint G Range	Sled G Range
1	000-315-000	2/14	4,9	13.2 - 24.6	5.7 - 26.3
2	000-335-330	3/10	7,8,10,10	17.3 - 21.0	6.0 - 21.0
3	000-005-320	2/14	4,8,9,9,10	17.5 - 25.6	9.2 - 25.6
4	000-035-330	4/12	1,1,4,4,6	18.5 - 25.0	10.5 - 25.0
5	000-045-000	5/14	2,4,4,4,5,5,6,9,9,9	5.9 - 25.0	5.9 - 25.0
6	000-035-030	6/12	2,4,4,5,8,9,9,10	18.5 - 24.5	10.2 - 24.5
7	000-005-040	4/11	2,4,4,6,7,9	14.2 - 23.5	10.0 - 23.5
8	000-335-030	1/14	4,9	19.5	8.0 - 24.7
9	000-085-180	1/2	2,4,10	9.8	9.8 - 11.8
10	000-085-220	2/13	4,10,10	13.9 - 15.4	5.9 - 16.0
11	000-085-270	0/2	No complaints	17.4 - 18.7	17.4 - 18.7
12	000-085-320	2/21	1,1,4	15.7 - 17.8	6.4 - 19.5
13	000-085-000	0/2	No complaints	14.6	9.4 - 11.1
14	000-085-040	1/13	4	-	5.8 - 18.2
15	000-085-090	0/2	No complaints	-	11.6 - 13.5
16	000-085-140	3/14	4,5,5	15.1 - 16.0	5.5 - 18.9
17	000-045-180	9/17	1,1,2,2,3,3,3,5,5,5, 5,5,6,7,7,7,7,8,8, 9,10,10	15.0 - 26.1	15.0 - 26.1
18	000-035-210	8/20	1,1,2,2,3,4,5,6,6,6, 7,7,7,8,9	15.2 - 23.2	10.5 - 28.9
19	000-005-220	5/16	1,5,5,6,9,9	16.5 - 28.2	16.5 - 30.0
20	000-335-210	1/6	2	19.8	15.8 - 21.7
21	000-315-180	1/10	2,3	19.0	15.8 - 21.9
22	000-335-150	0/8	No complaints	-	15.0 - 21.9
23	000-005-140	8/19	2,2,4,5,6,8,9,9,9,9, 9,9,10	16.4 - 30.7	16.3 - 30.7
24	000-035-150	8/19	1,1,2,2,5,5,5,6,6,7	11.0 - 29.3	11.0 - 29.3

Note:

¹Headache - Incidence at impact, duration up to several hours.²Stunning/disorientation - Incidence at impact but of brief duration.³Blurred vision/spots before eyes - Incidence at impact but of brief duration.⁴Neck/back muscle spasm/strain - Delayed onset, lasting up to several days.⁵Chest pain - Incidence at impact but of brief duration.⁶Shortness of breath - Incidence at impact but of brief duration.⁷Abdominal visceral displacement sensation - At impact.⁸Joint pain - Delayed onset and lasting up to several days.⁹Lower extremity muscle spasm/pain - Delayed onset and lasting up to several days.¹⁰Upper extremity muscle spasm/pain - Delayed onset and lasting no longer than 1 day.

(Brown et al., 1966)

Page 243

Bioastronautics Data Book

Parker, West

National Aeronautics and Space Administration

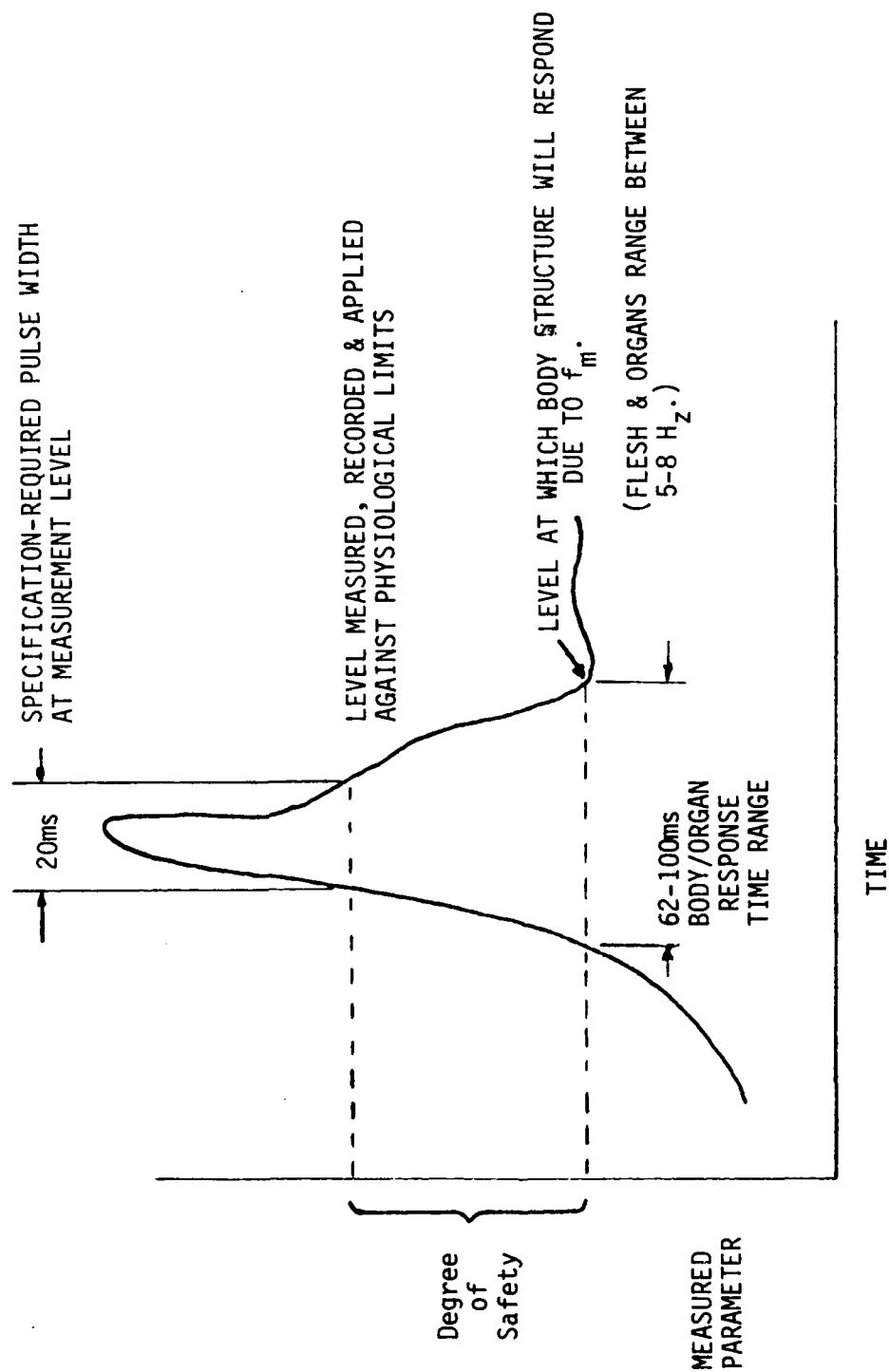
1973

RANGE OF LATERAL ACCELERATION (G_Y)
CAUSING SUBJECT COMPLAINTS*

$$G_Y = (G_{TOTAL})(\cos 50)(\sin 400)$$

POSITION NO.	G_{TOTAL}		G_Y	
	MIN	MAX	MIN	MAX
3	17.5	25.6	11.2	16.4
7	14.2	23.5	9.1	15.0
19	16.5	28.2	10.6	18.1
23	16.4	30.7	10.5	19.7

* NO MAJOR INJURIES REPORTED



AD-A171 639

AIRCRAFT AUTOMATED ESCAPE SYSTEMS (AAES) DATA ANALYSIS
PROGRAM SYMPOSIUM H. (U) NAVAL SAFETY CENTER NORFOLK VA
1981

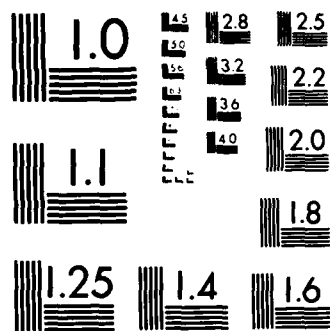
4/4

UNCLASSIFIED

F/G 1/3

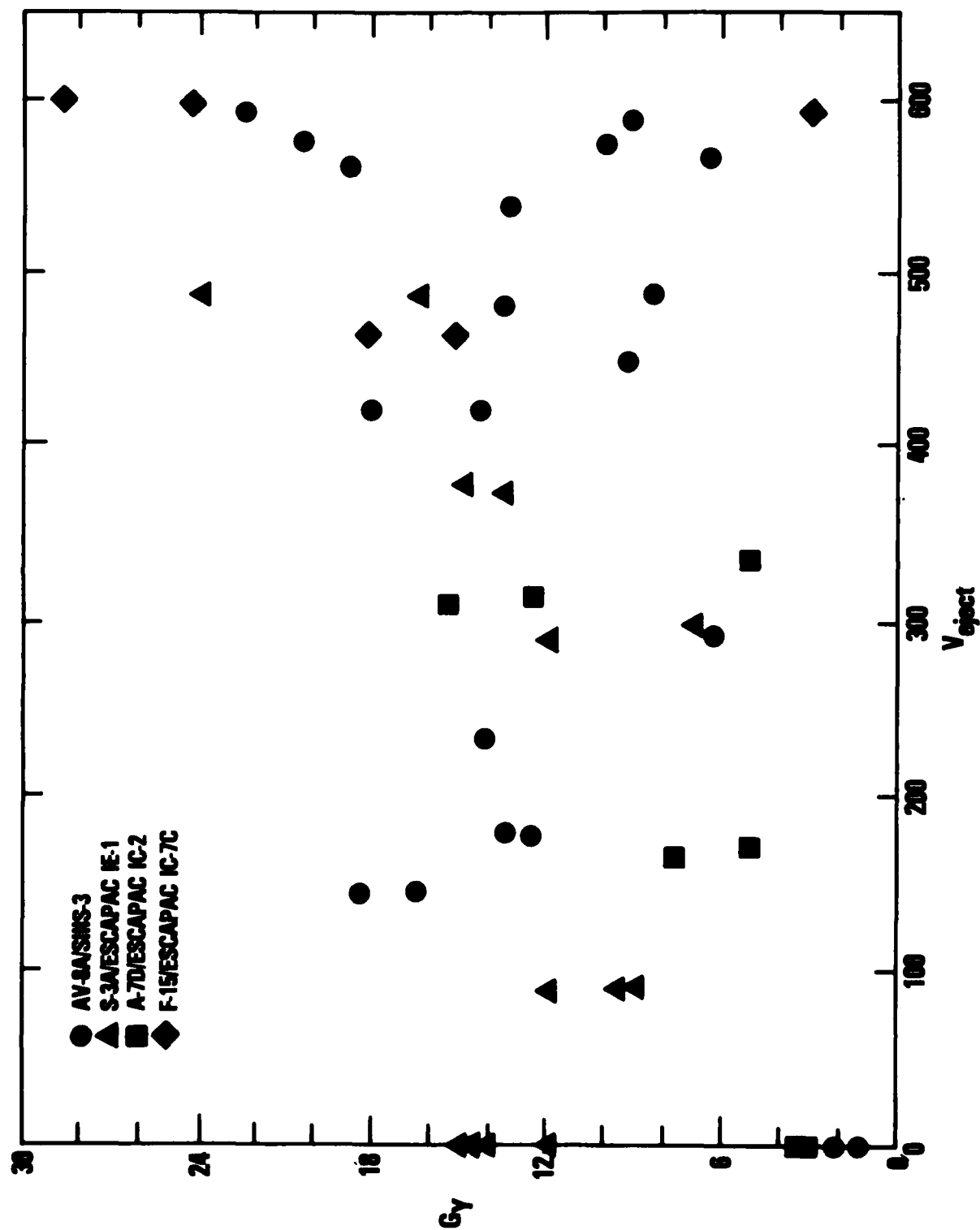
NL



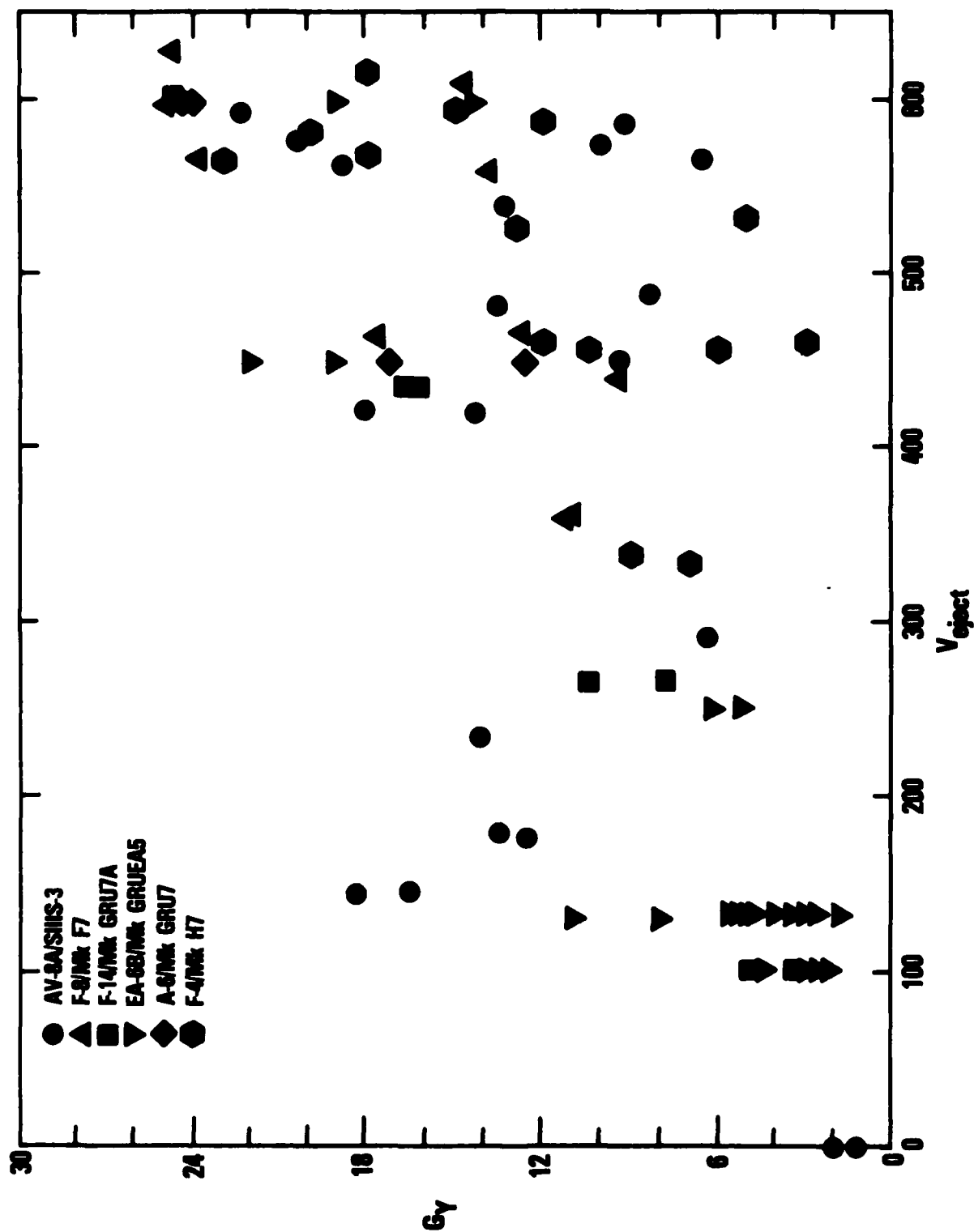


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

LATERAL ACCELERATION COMPARISON

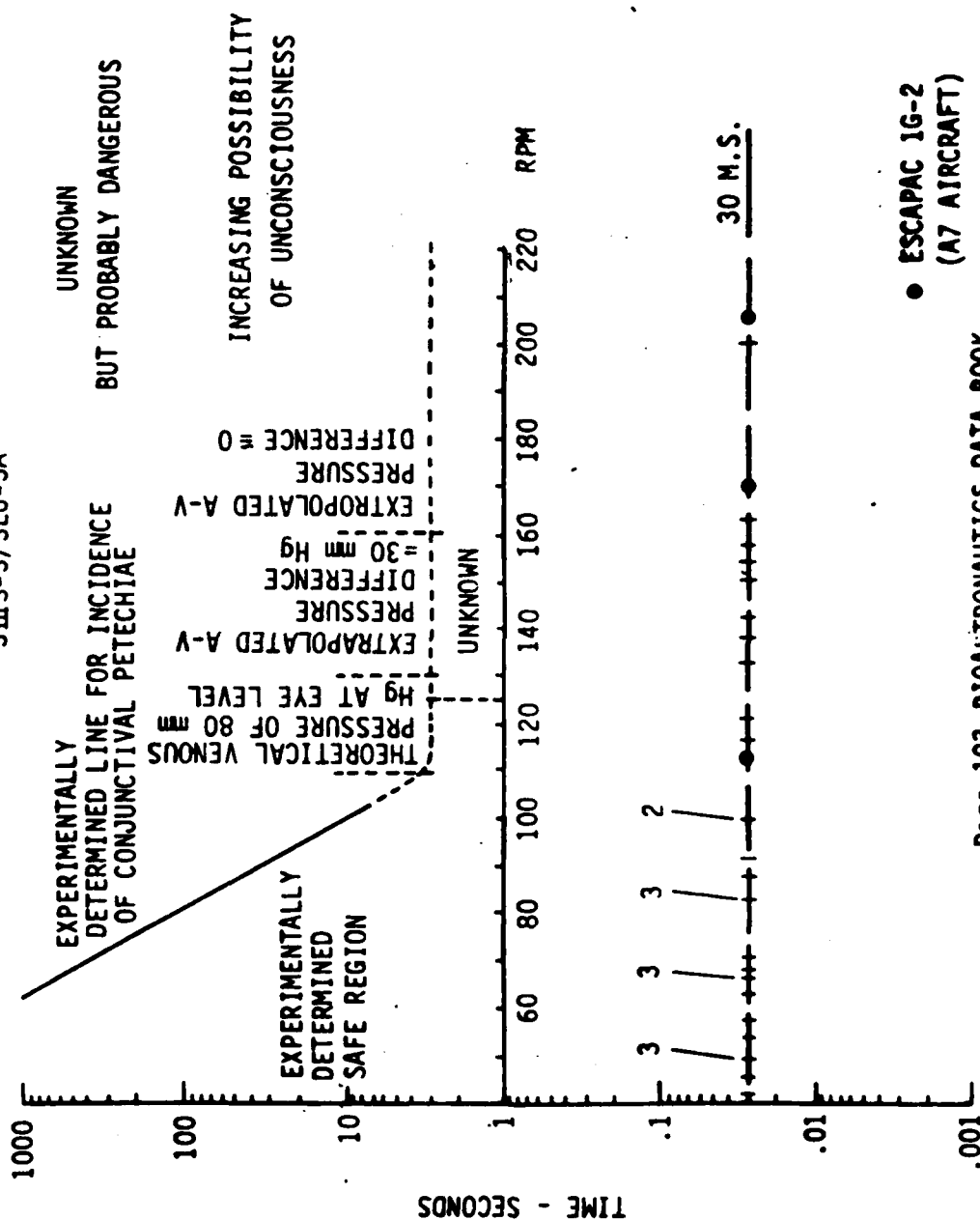


LATERAL ACCELERATION COMPARISON



PITCH ROTATIONAL RATES

SIIS-3/SEU-3A



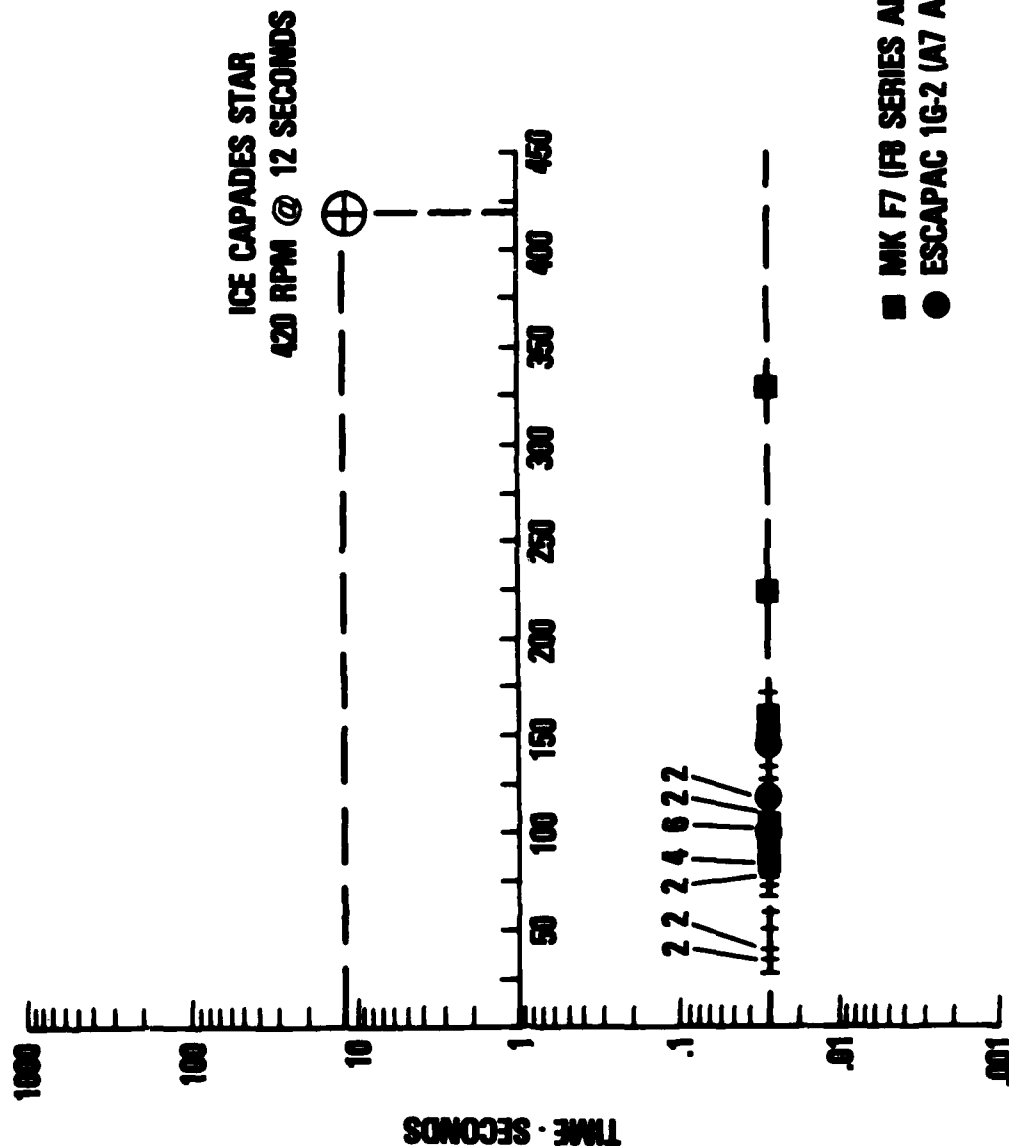
• ESCAPAC 1G-2
(A7 AIRCRAFT)

Page 193 BIOASTRONAUTICS DATA BOOK

J. F. Parker, Jr., Vita R. West

National Aeronautics and Space Administration 1973

YAW ROTATIONAL RATES **SIIS-3/SEU-3A**



"The phenomenon of epicyclic tumbling occurs primarily after emergency ejection from high-speed aircraft. Rates of tumbling as high as 200 rpm can be expected, and the winddrag superimposes a decelerative g field....These decelerative forces are dangerous if encountered alone, but, when superimposed on head-over-heels tumbling, the type of damage that results is qualitatively different from either the effects of deceleration alone or of tumbling alone or of a mere summation of these effects. For example, at 60 rpm in a 30g field, the force exerted on the body is 30g, the vector of this force changes direction by 180 deg every 1/2 sec, and the result is a severe, low-frequency vibration..."

Page 457

Human Engineering Guide to Equipment Design
Morgan, Chapanis, Cook, Lund
McGraw-Hill Book Company, Inc.
1963

"The primary result of epicyclic tumbling, like that of vibration..., is mechanical damage to loosely suspended organs resulting from compression by the changing force vectors. Rigidly held organs are damaged less, and, for this reason, some amount of protection is obtained with abdominal compression produced by pressure suits."

"Animal data and the results of actual ejections indicate that moderate tumbling in a field of less than 15g is not dangerous. This phenomenon is thought to be due to the low-frequency response of the vascular (blood) column, which might suggest that tumbling is beneficial when deceleration occurs. It should be remembered, however, that the mechanical damage associated with tumbling is a more serious result. Thus, except for special instances, when high levels of deceleration are anticipated, stabilized ejection seats are recommended."

Page 458

Human Engineering Guide to Equipment Design
Morgan, Chapanis, Cook, Lund
McGraw-Hill Book Company, Inc.
1963

DURING WORLD WAR II, PILOTS OF AIRCRAFT
DISABLED AT HIGH SPEEDS EXPERIENCED
EXTREME DIFFICULTY EGRESSING COCKPITS
AND IN MANY INSTANCES WERE UNABLE TO
EGRESS DUE TO HIGH WINDBLAST LOADS.

THUS, INITIAL CONCEPTS OF EJECTION SEATS
WERE CONCERNED ALMOST ENTIRELY WITH
EGRESS ASPECT OF ESCAPE. ONCE CLEAR
OF AIRCRAFT EJECTEE PERFORMED MANUAL
BAILOUT FROM SEAT.

THESE INITIAL SYSTEMS PROVIDED VERY LIMITED ESCAPE CAPABILITY:

- WITH WINGS AND NOSE LEVEL AND NO SINKRATE MINIMUM REQUIRED TERRAIN CLEARANCE WAS 2,000 FEET.
- NONLEVEL OR SINKRATE FLIGHT CONDITIONS REQUIRED SIGNIFICANTLY GREATER ALTITUDES FOR SAFE ESCAPE.

BELOW SAFE EJECTION ALTITUDES PILOT WAS FORCED TO RELY ON CONTROLLED DITCH/CRASH OF AIRCRAFT.

MOST EARLY EJECTION SEATS, INCLUDING THOSE IN EARLY A-4 AIRCRAFT (PREDECESSOR TO ESCAPACs), TREATED THE PARACHUTE AS PART OF CREW'S EQUIPMENT EVEN THOUGH STOWAGE SPACE WAS PROVIDED.

FOR SAFE PARACHUTE OPERATION FOLLOWING ESCAPE FROM AIRCRAFT EJECTEE HAD TO:

- UNBUCKLE FROM AND PUSH CLEAR OF SEAT
- WAIT TO ASSURE SUFFICIENT SEPARATION FROM SEAT
- MANUALLY ACTUATE RIPCORD TO OPEN PARACHUTE PACK.

FAILURE TO WAIT OFTEN CAUSED SEAT-PARACHUTE AND/OR SEAT-MAN INVOLVEMENTS GENERALLY RESULTING IN DEATH OR SERIOUS INJURY.

TIME FROM ESCAPE INITIATION UNTIL EJECTEE WAS DESCENDING UNDER FULL PARACHUTE WAS EXTREMELY VARIABLE DUE TO DEPENDENCY ON MANUAL OPERATION BY MAN IN HIGH STRESS SITUATION/ENVIRONMENT.

FATALITY RATES AMONG EJECTEES NEAR OR BELOW SAFE LIMITS, AMONG CREWS ATTEMPTING DEADSTICK LANDINGS FROM BELOW EJECTION LIMITS, AND AMONG CREWS UNABLE EITHER TO EJECT OR CONTROL AIRCRAFT, RESULTED IN ATTEMPTS TO IMPROVE ESCAPE ENVELOPE. OF PARTICULAR CONCERN WAS THE LACK OF COVERAGE FOR CRITICAL LAUNCH AND RECOVERY PHASES OF CARRIER OPERATIONS.

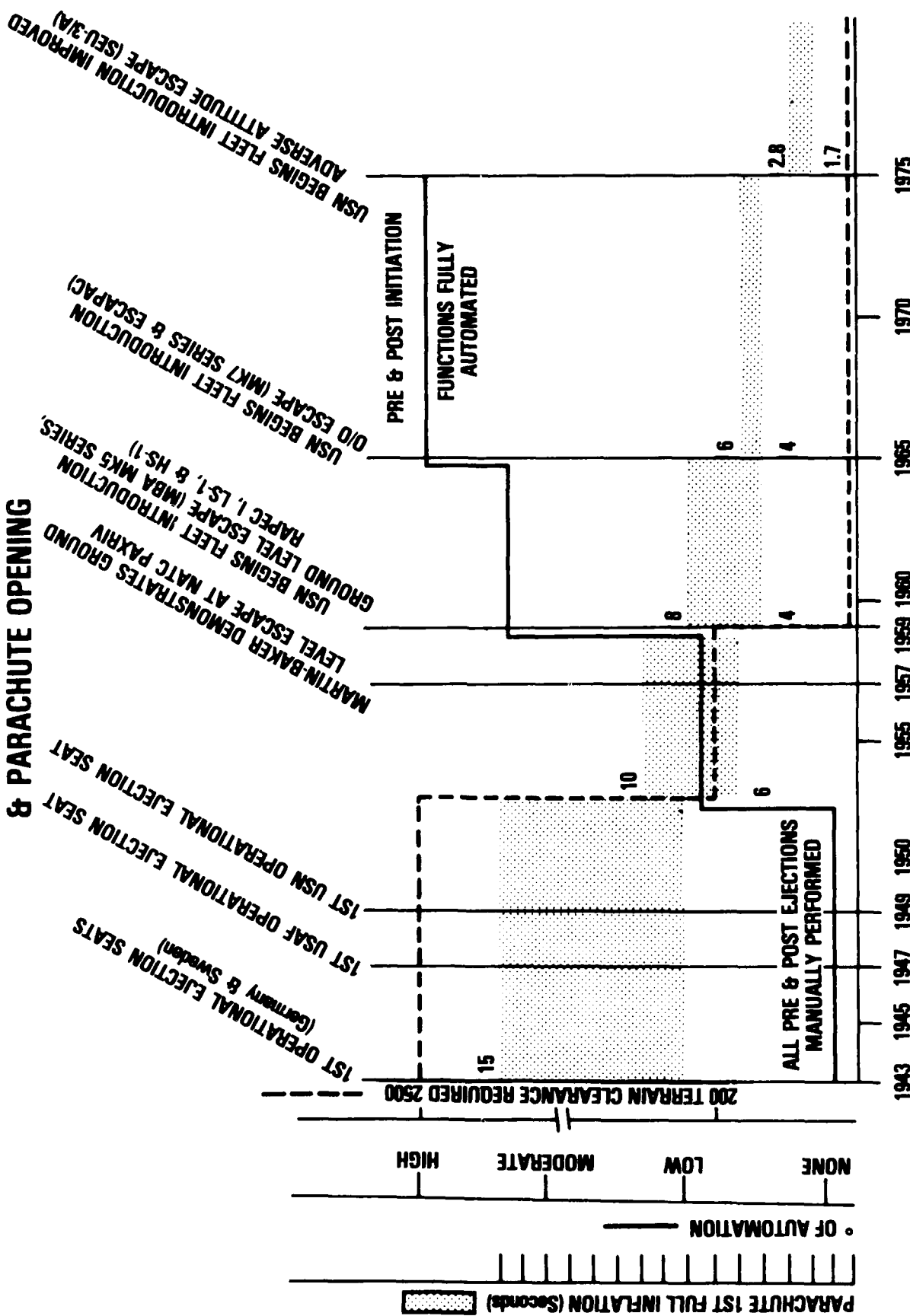
INITIAL PERFORMANCE IMPROVEMENT EFFORTS WERE AIMED AT REDUCING TIME AND UNCERTAINTY ASSOCIATED WITH MANUAL FUNCTIONS BY AUTOMATING THEM.

BY MID- TO LATE-1950's 200 FOOT WINGS/NOSE LEVEL NO SINKRATE ESCAPE WAS BEING ACHIEVED. BETWEEN LATE 1958 AND EARLY 1962 USN UNDERTOOK BOTH MAJOR UPGRADING AND REPLACEMENT ACTION TO OBTAIN GROUND LEVEL ESCAPE CAPABILITY. HOWEVER, THIS DID NOT COVER LAST STAGES OF LANDING OR INITIAL AIRBORNE PHASE OF TAKE-OFF.

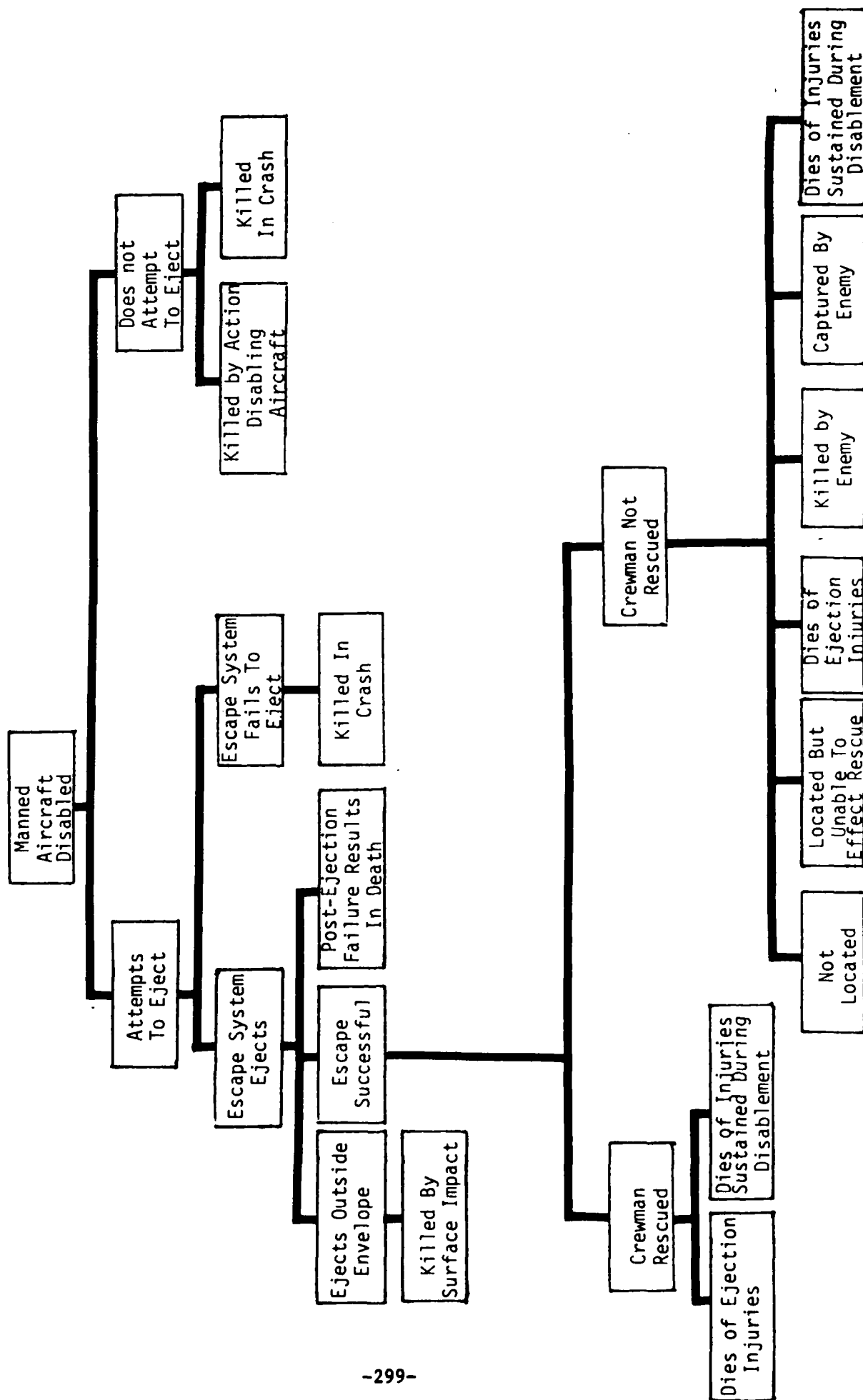
DURING MID- TO LATE 1960's, IN ATTEMPT TO FURTHER
REDUCE ALL AIRBORNE EMERGENCY-CAUSED FATALITIES,
ZERO-ZERO (0/0) ESCAPE WAS OBTAINED THROUGH MAJOR
MODIFICATION PROGRAMS.

PRIMARY PROBLEM SEEN IN OBTAINING 0/0 WAS TO
OBTAIN SUFFICIENT TIME FOR PARACHUTE OPERATION
SINCE ACCEPTABLE MEANS FOR SHORTENING PARACHUTE
OPERATING TIMES DID NOT EXIST. THEREFORE PRIMARY
APPROACH USED WAS TO CHANGE PROPULSION (INTRODUCE
ROCKETS) TO OBTAIN GREATER TRAJECTORY HEIGHT.

EJECTION SEAT HISTORY HIGHLIGHTS DEPICTING TRENDS IN AUTOMATION, TERRAIN CLEARANCE & PARACHUTE OPENING



CAUSES FOR AIRCREW LOSS



IMPROVED EJECTION ENVELOPE BENEFITS

- ESCAPE AVAILABLE FOR MORE AIRCREW (I.E. THOSE ENCOUNTERING LOW LEVEL EMERGENCIES REQUIRING ESCAPE).
- MORE TIME AVAILABLE TO AIRCREW FOR PROBLEM DIAGNOSIS AND SOLUTION.
 - POSSIBLE INCREASED SAVING OF AIRCRAFT

END

10-86

DTIC