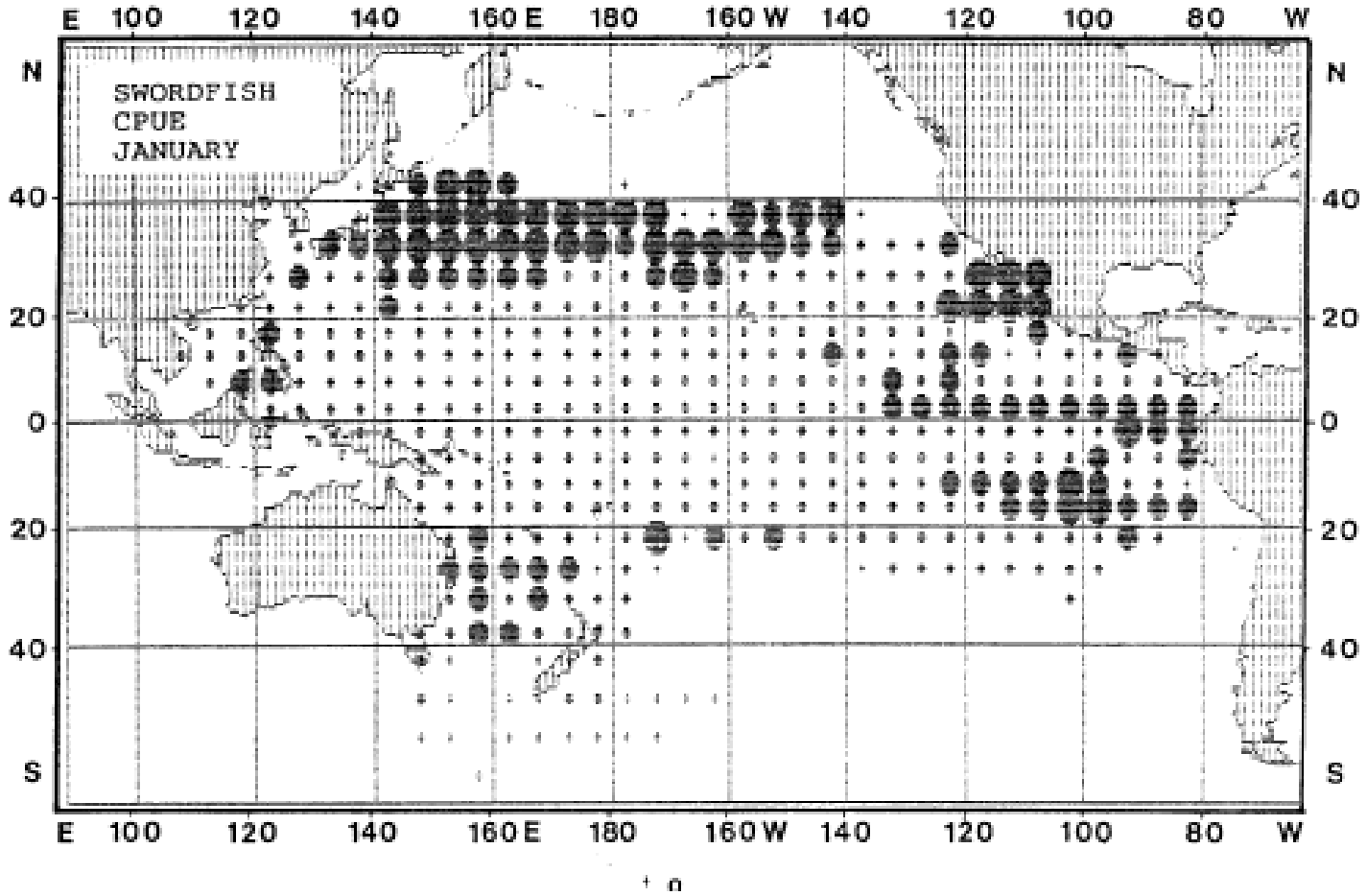
Pacific SWO Stock Structure

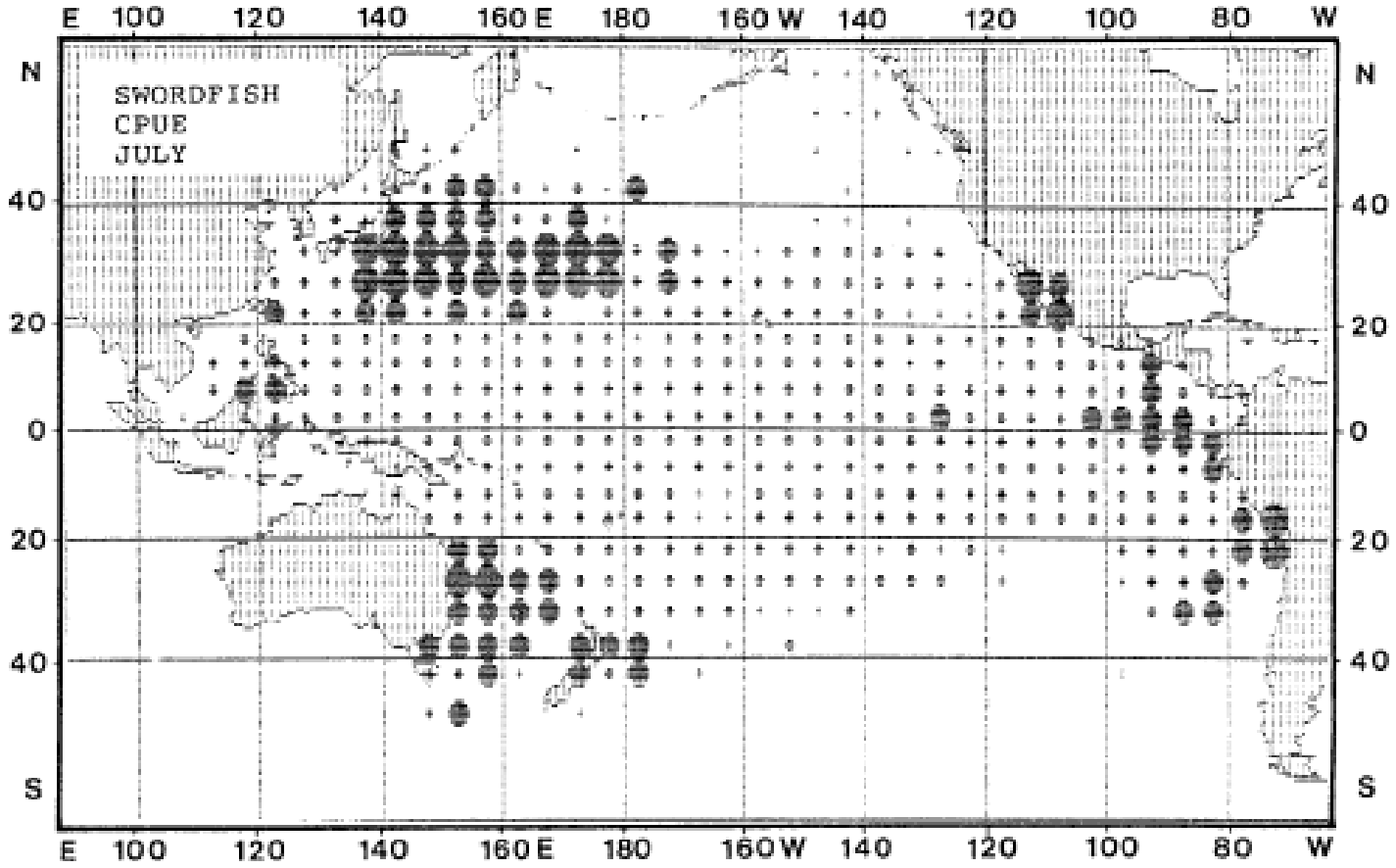
- Fisheries analyses with nominal CPUE
- Fisheries analyses with standardized CPUE
  - Hinton & Deriso (1998)
  - Hinton (2003)
    - Fishing effort distributions 1970s-1990s
    - CPUE distributions by areas w/in EPO
    - LF distributions by area 1970s-1990s
    - CPUSE distributions, temporal
    - SEPO fishery (Chilean)
- Genetics
  - Reeb et al (2000)
  - Alvarado Bremer et al (2006)
  - Tests of ad hoc structures using genetic data

Japanese LL CPUNE January



Source: Sosa & Shimizu (1991)

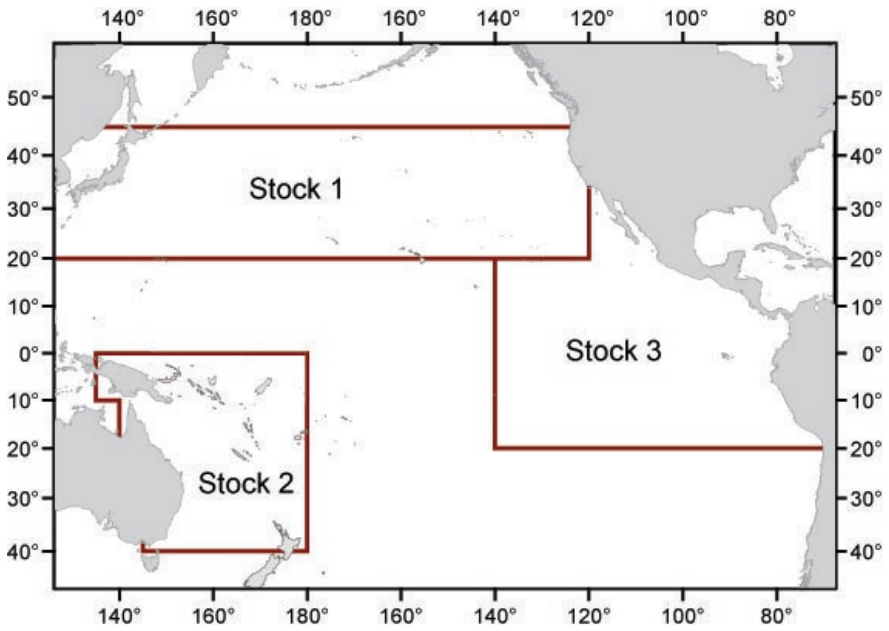
Japanese LL CPUNE July



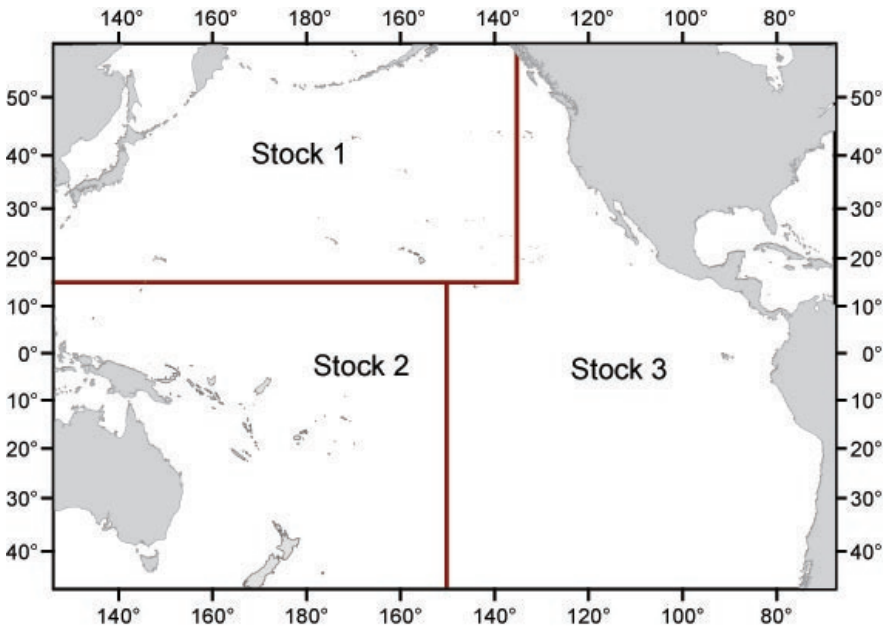
Source: Sosa & Shimizu (1991)

Ad hoc CPUNE-based Stock Areas

Sakagawa & Bell (1980)

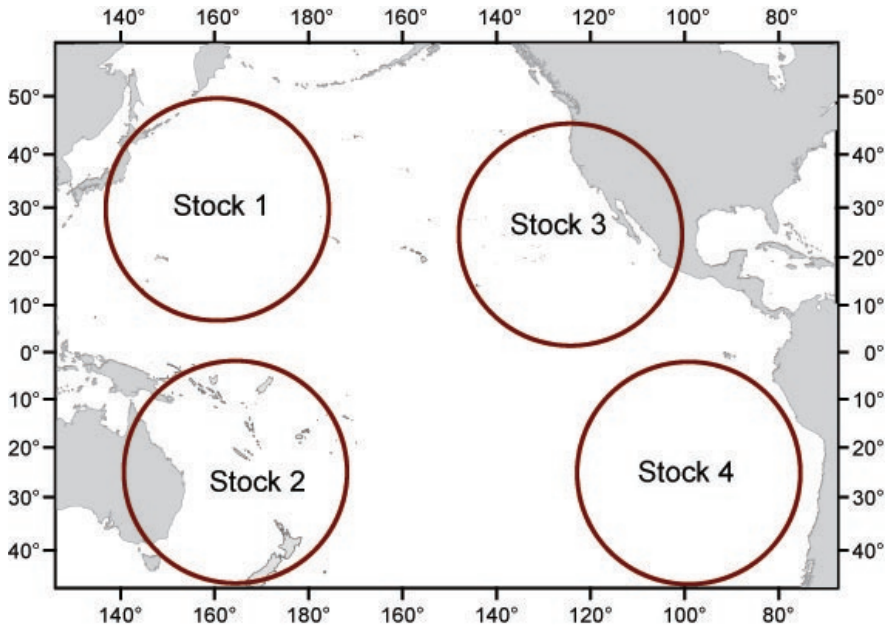


Bartoo & Coan (1988)

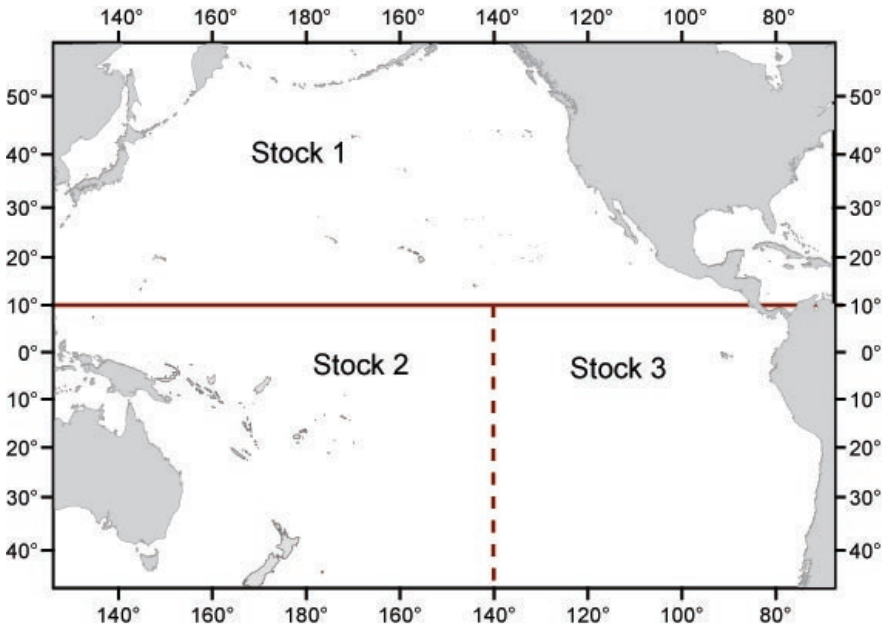


Ad hoc CPUNE-based Stock Areas

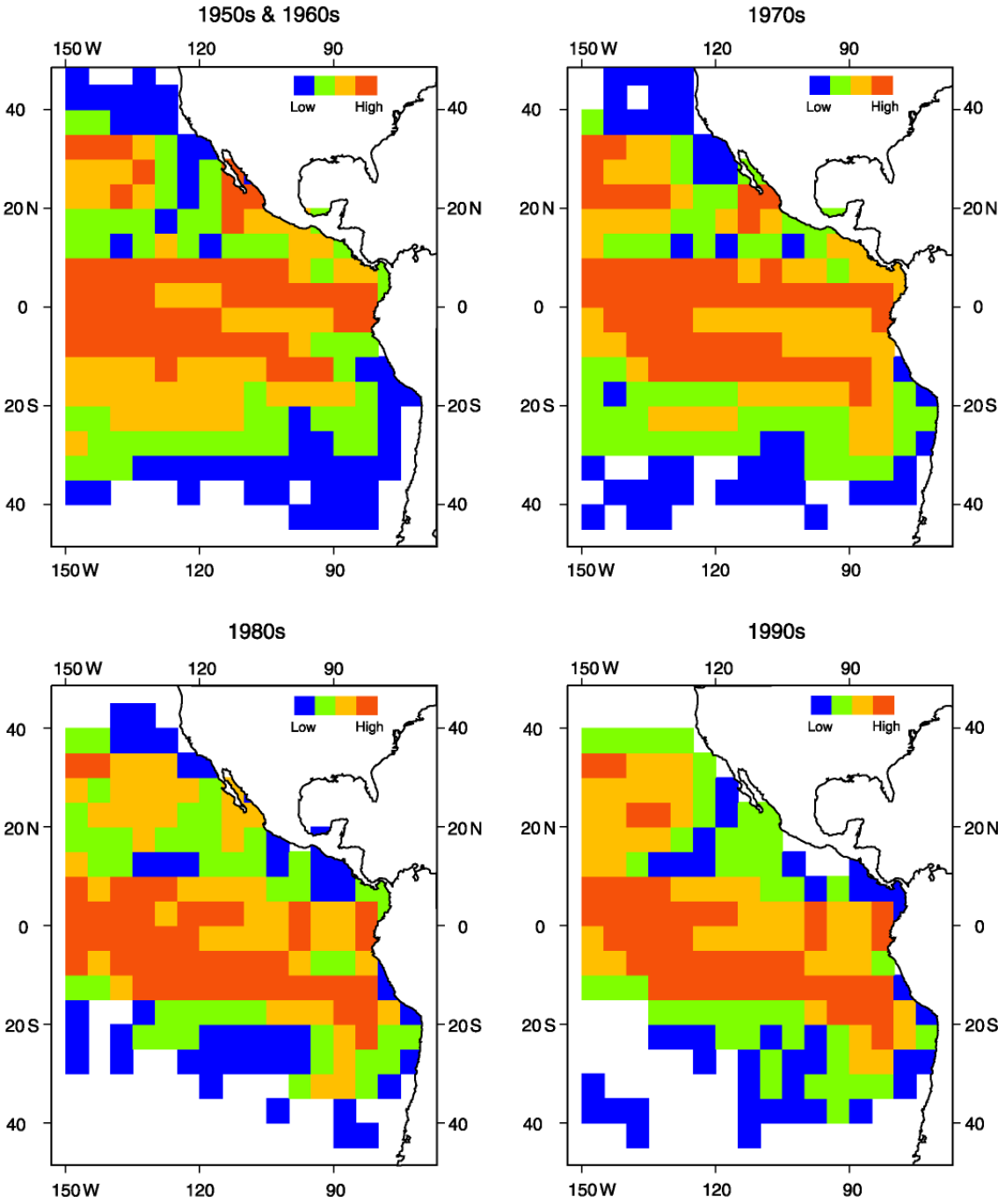
Sosa-Nishizaki & Shimizu (1991)

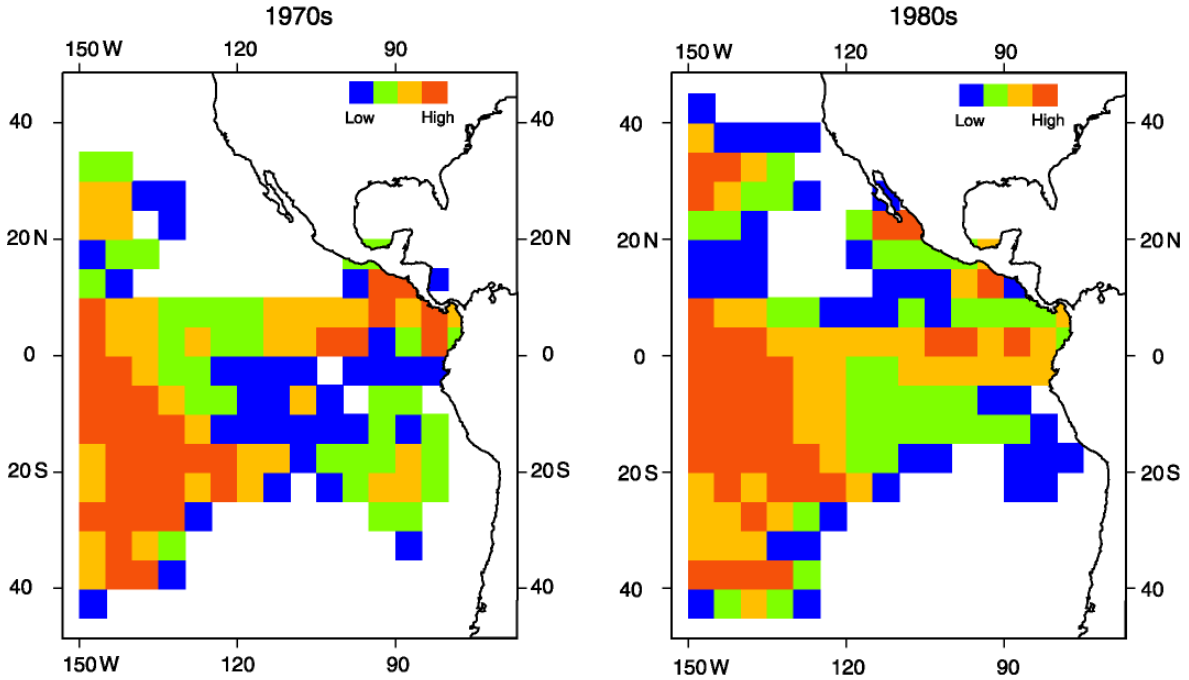


Nakano (1994)

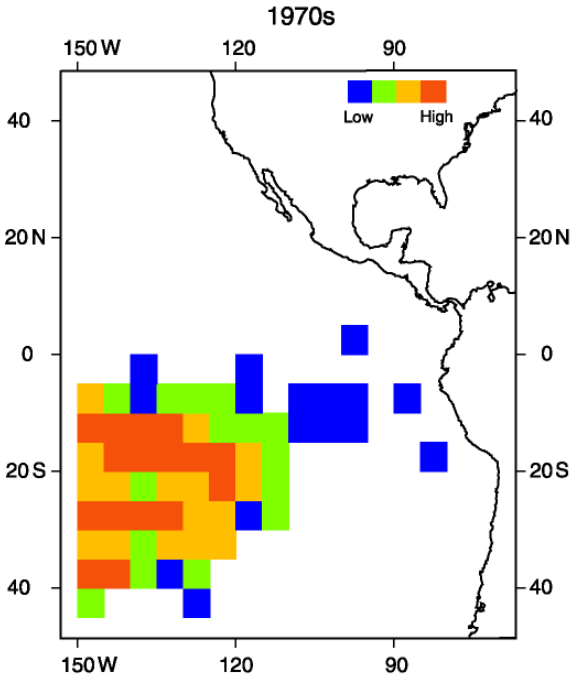


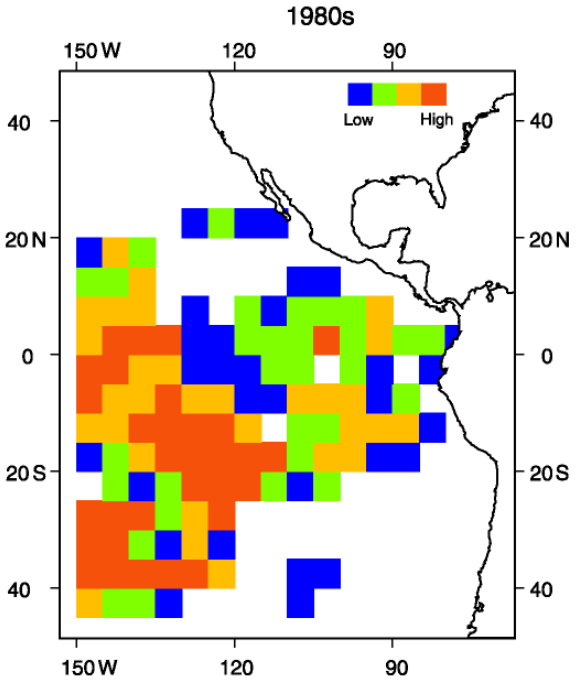
Japan


1950s & 1960s
1970s
1980s
1990s
Low
High
150 W
120
90
40
20 N
0
20 S
40

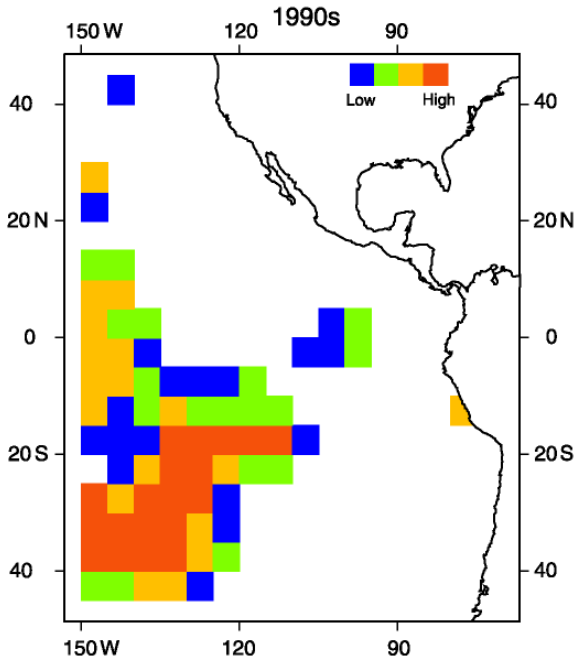


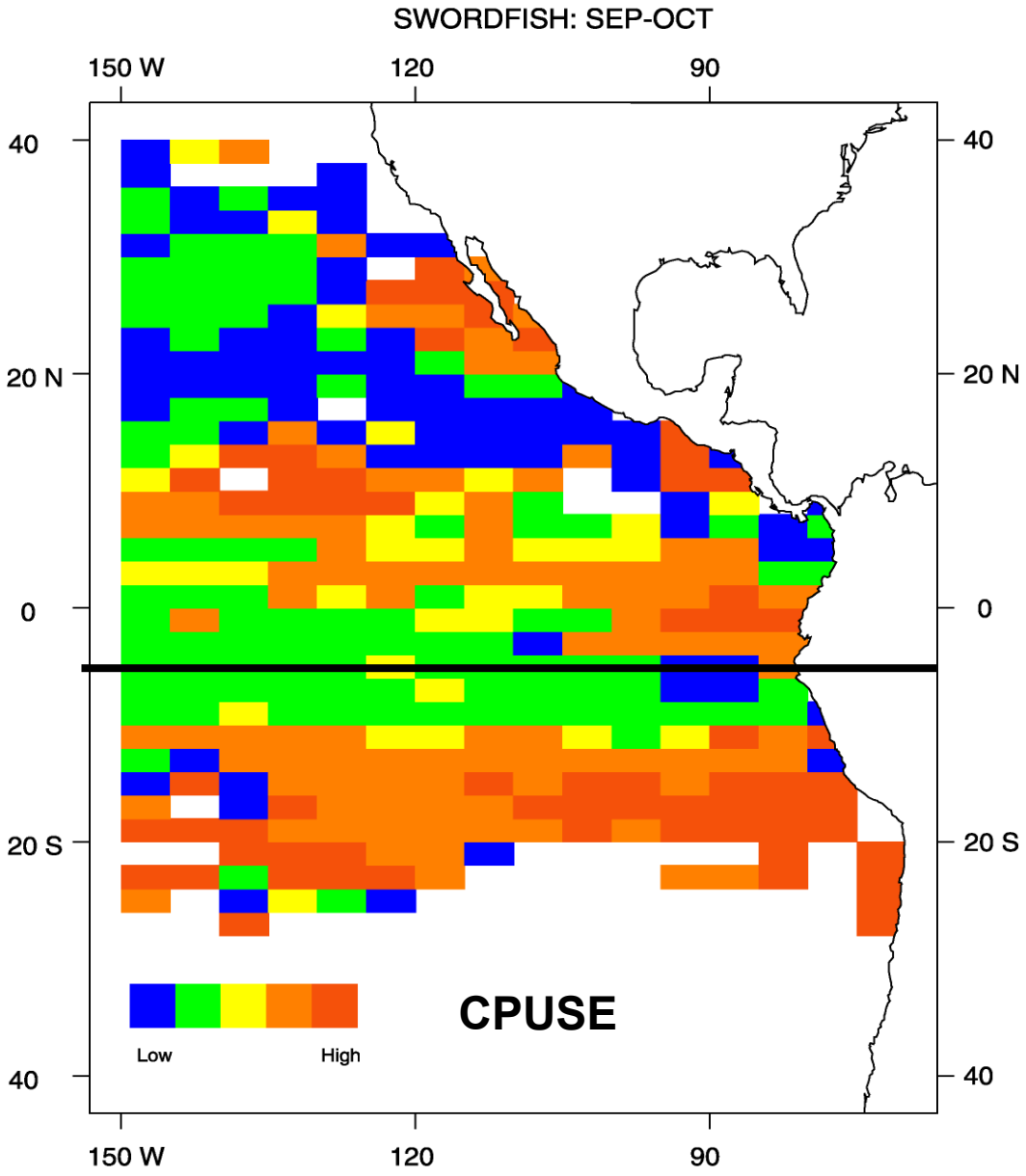
Korea


1970s
150 W
120
90
40
20 N
0
20 S
40
Low
High

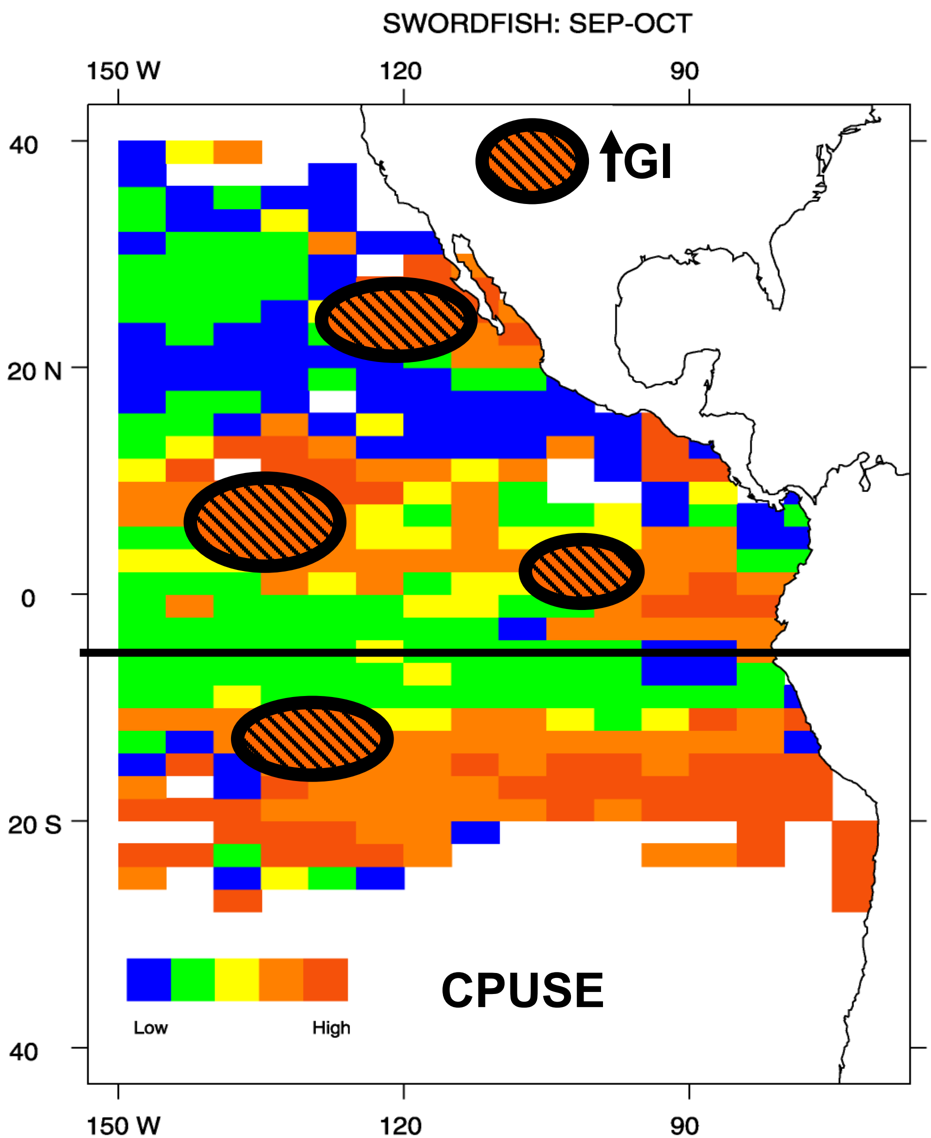

1980s
150 W
120
90
40
20 N
0
20 S
40
Low
High

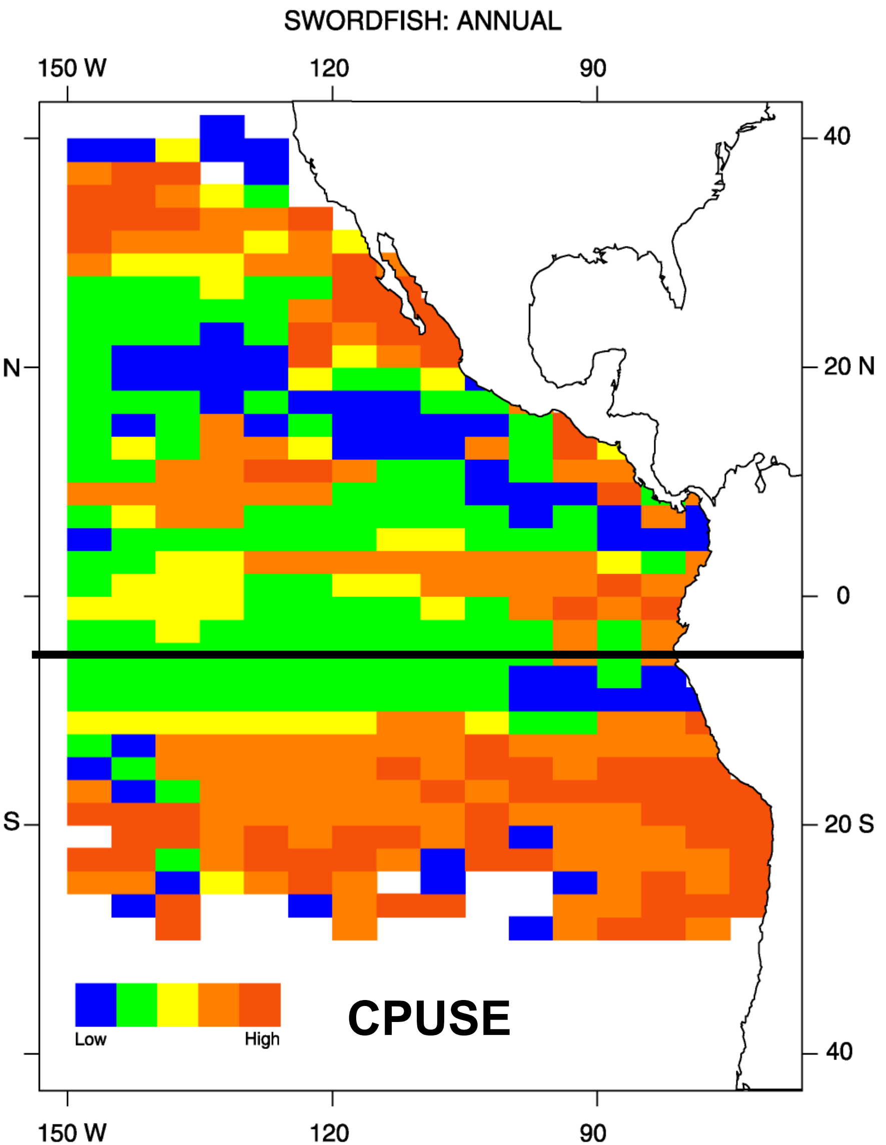
Taiwan


1990s
150 W
120
90
40
20 N
0
20 S
40
Low
High

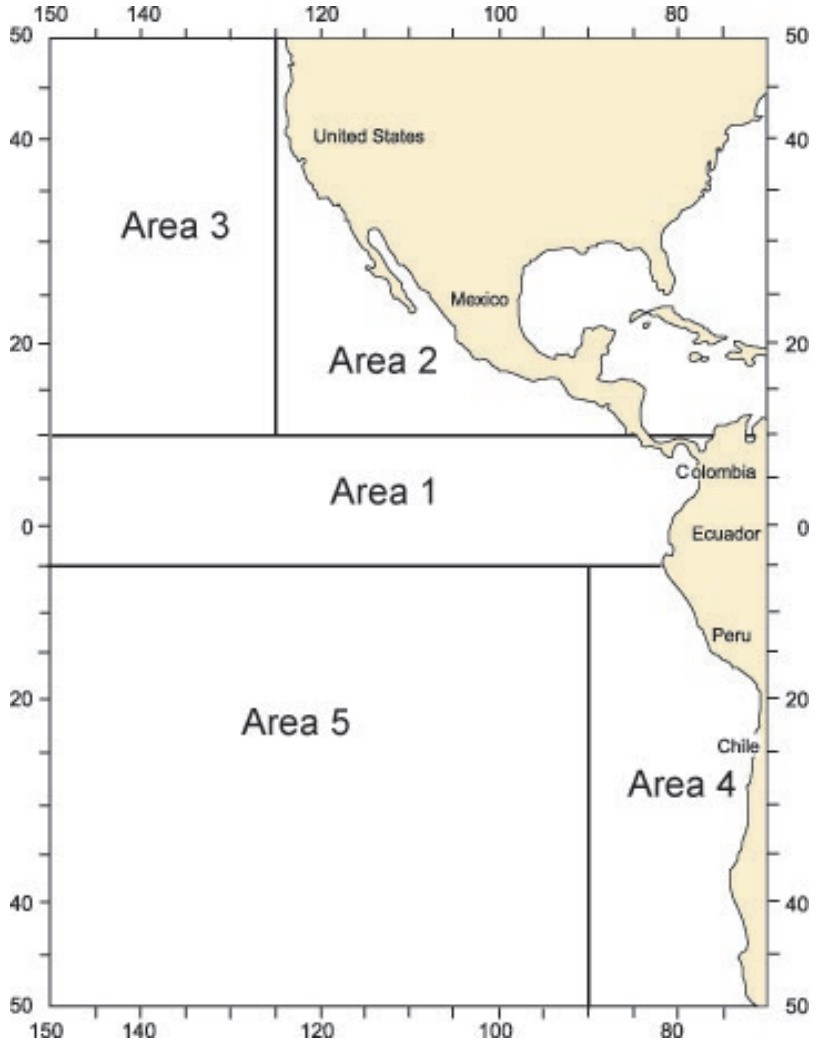

SWORDFISH: SEP-OCT
150 W
120
90
40
20 N
0
20 S
40
CPUSE
Low
High

EPO CPUSE Distribution

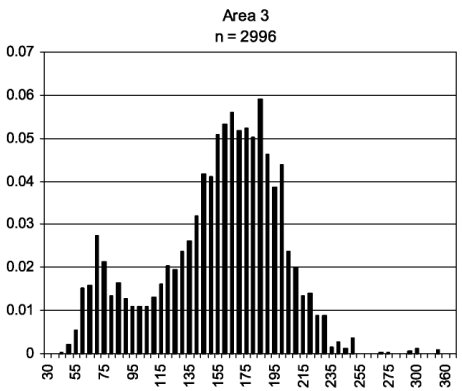


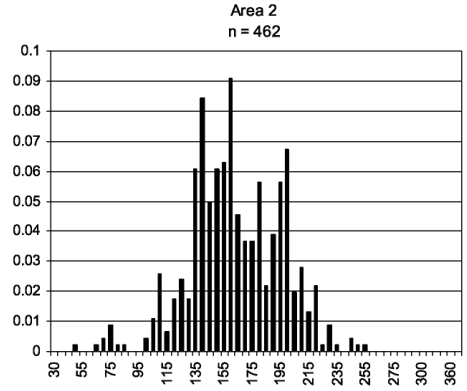


EPO sub-Area Structure

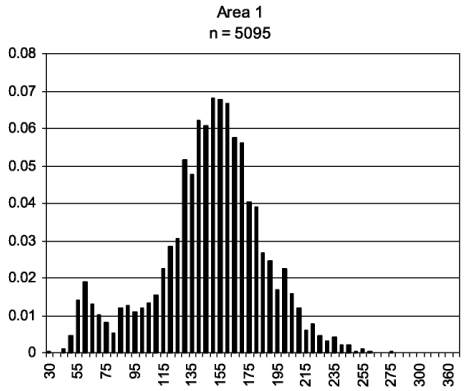


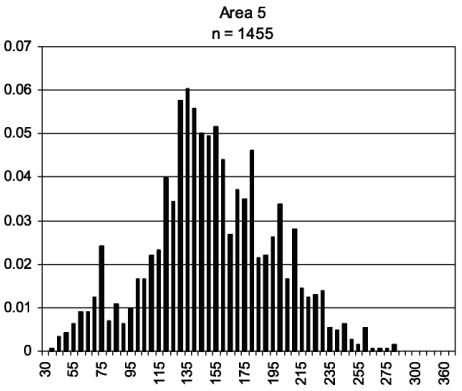
EPO LF distributions by sub-Area

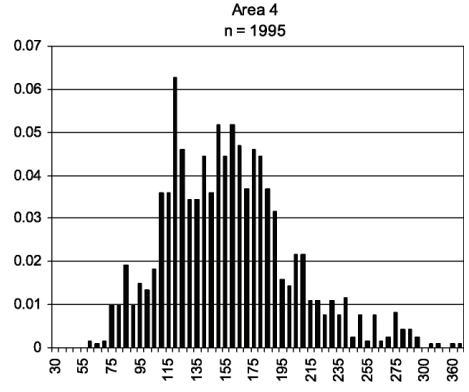




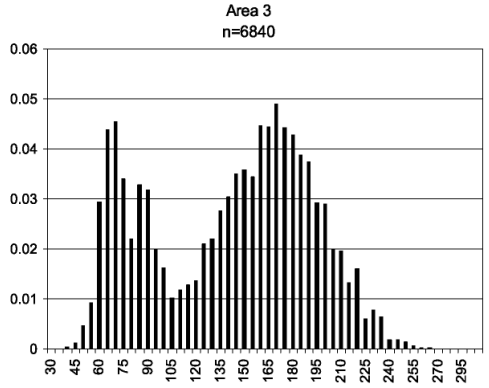
1970s

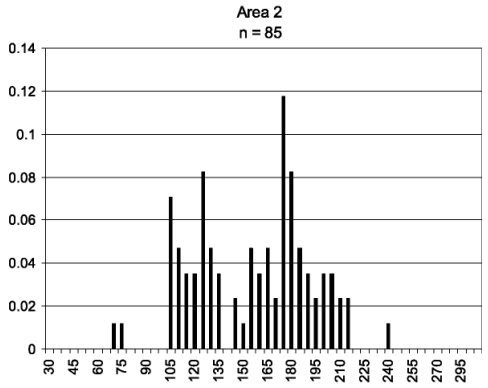




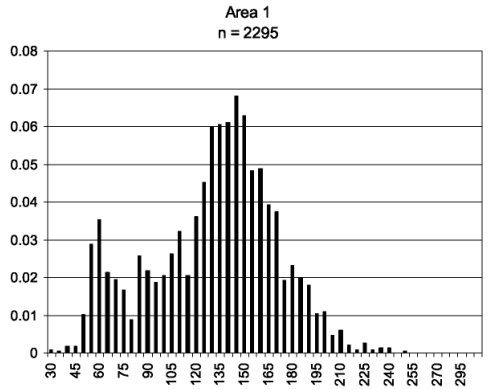


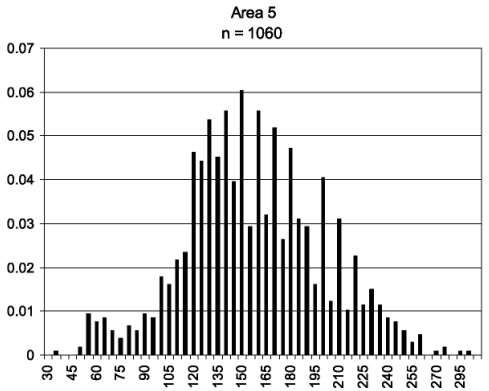
EPO LF distributions by sub-Area

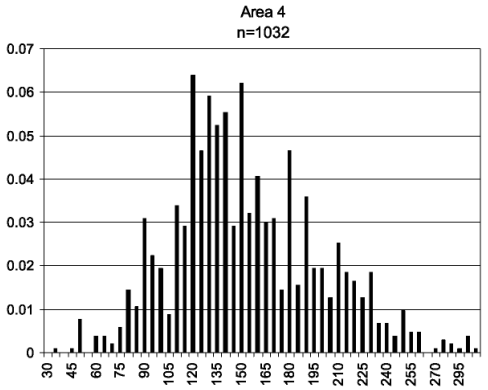




1980s

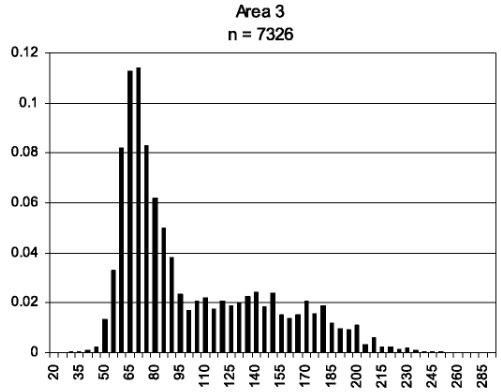


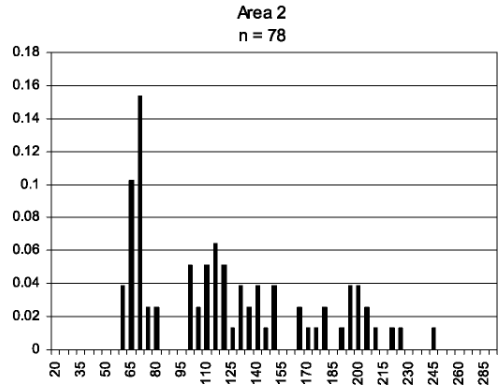


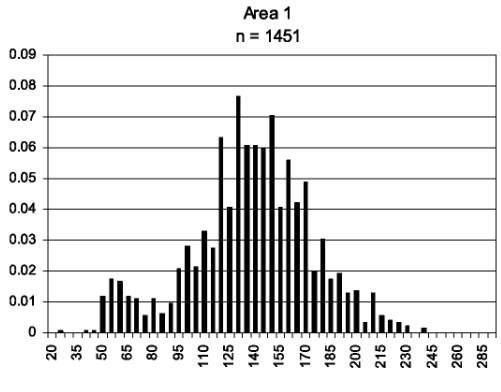


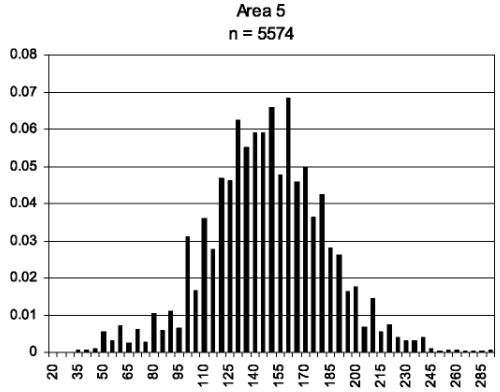
EPO LF distributions by sub-Area

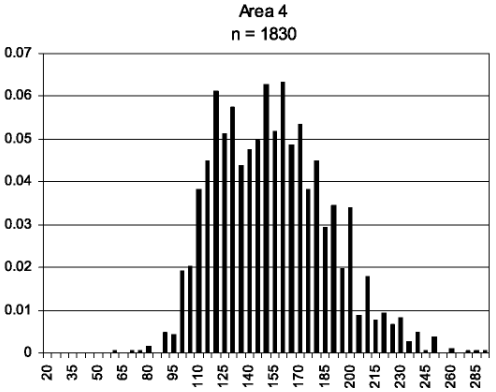
1990s



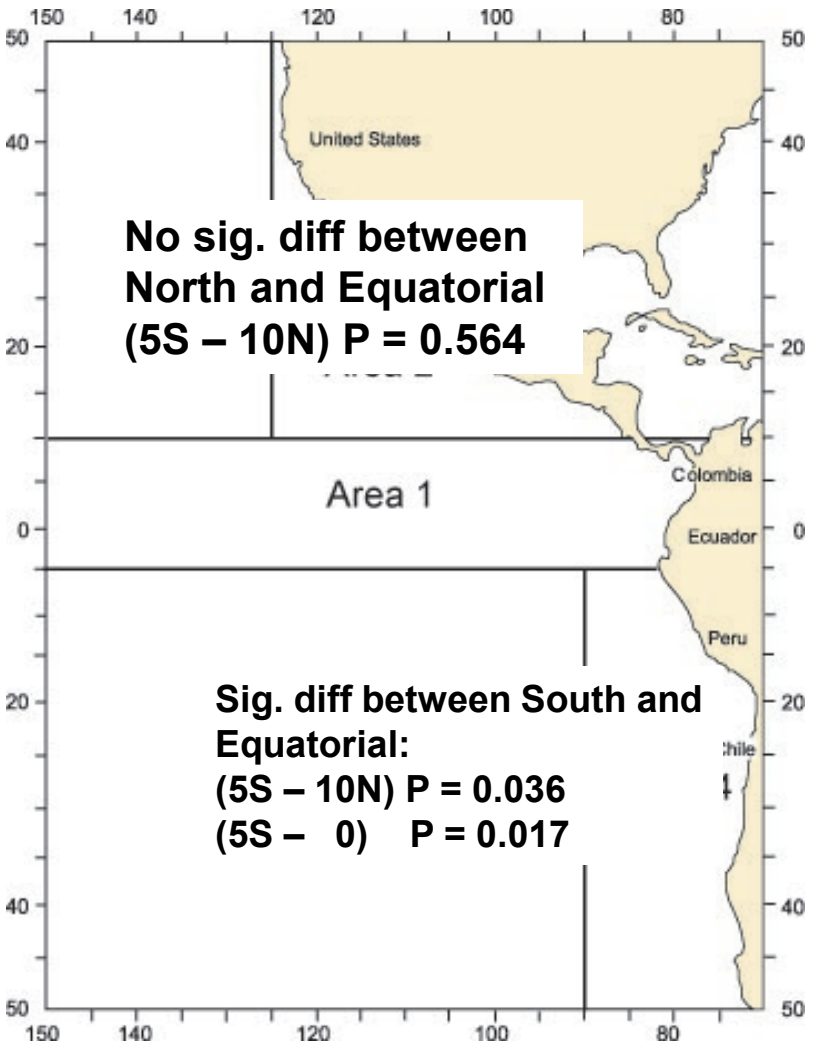






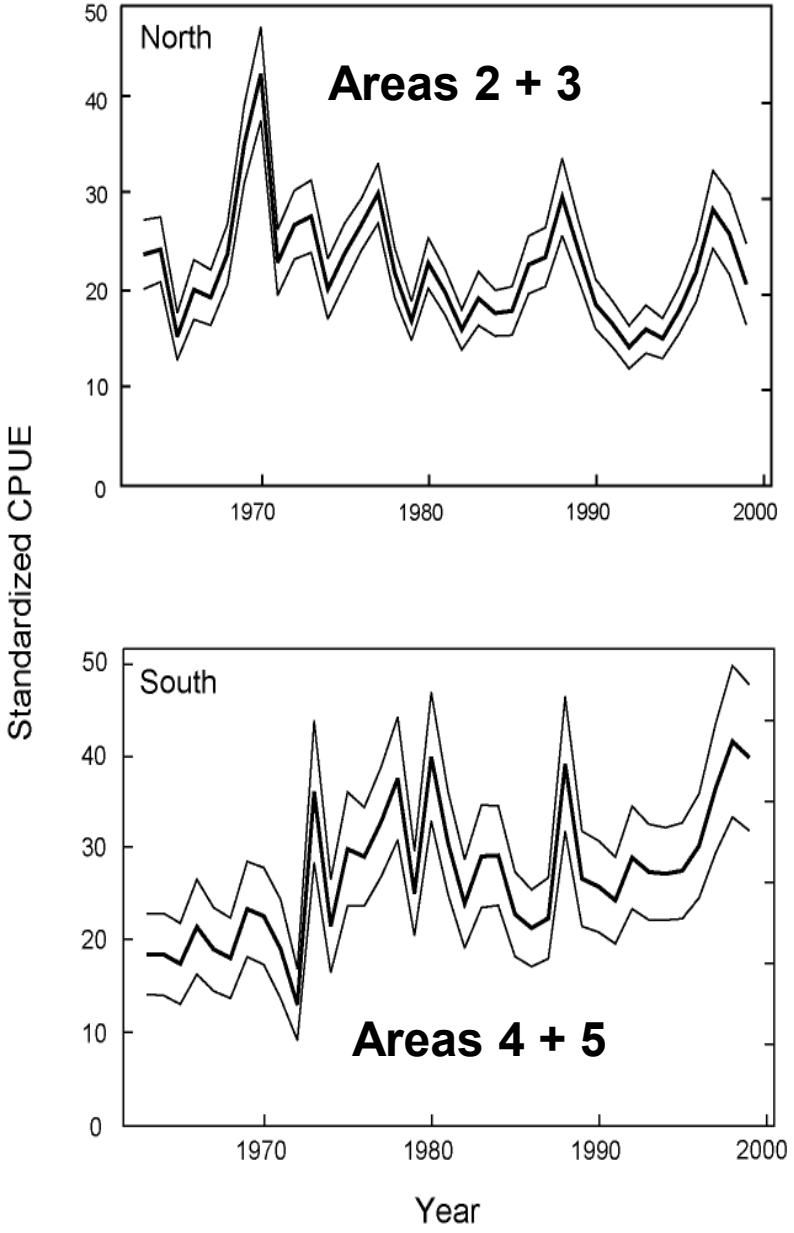


EPO CPUSE-based Area Structure

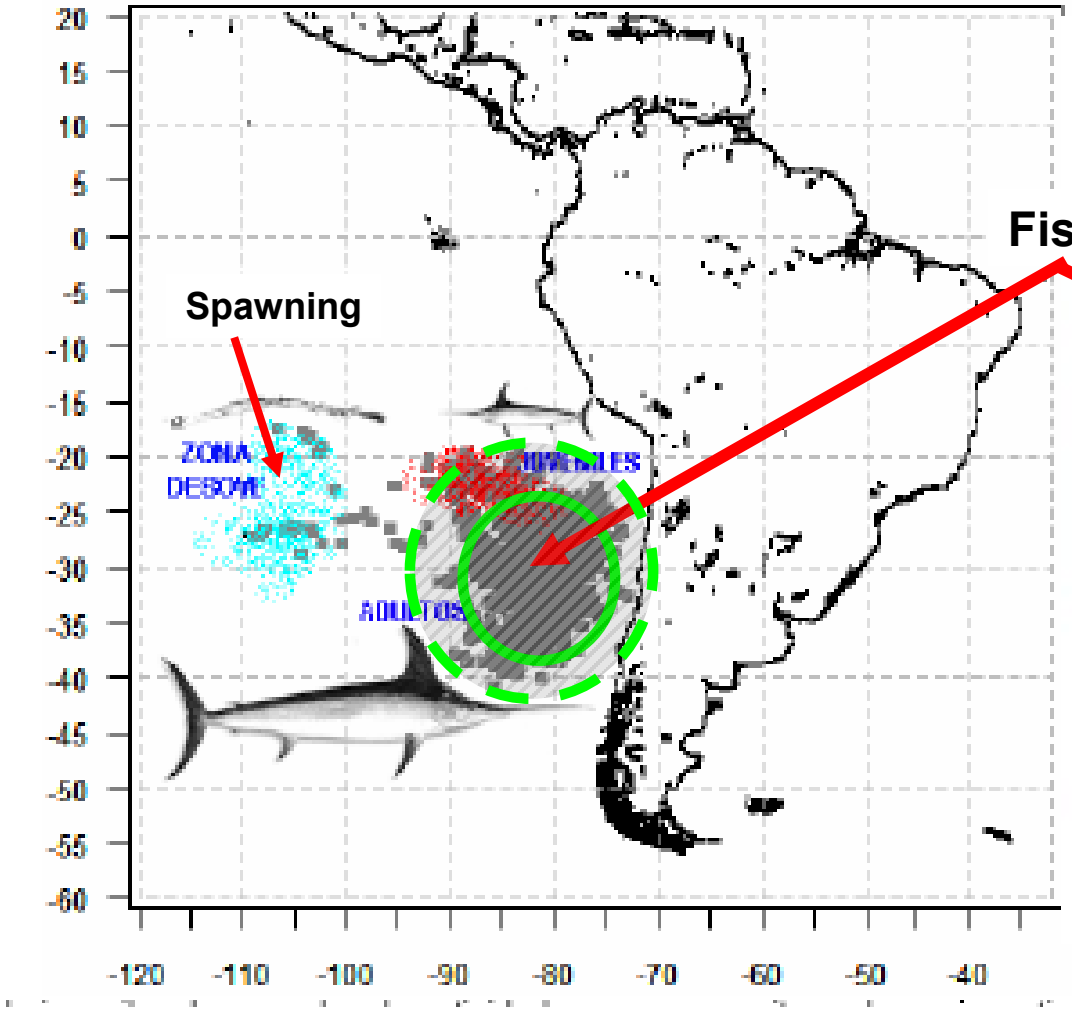


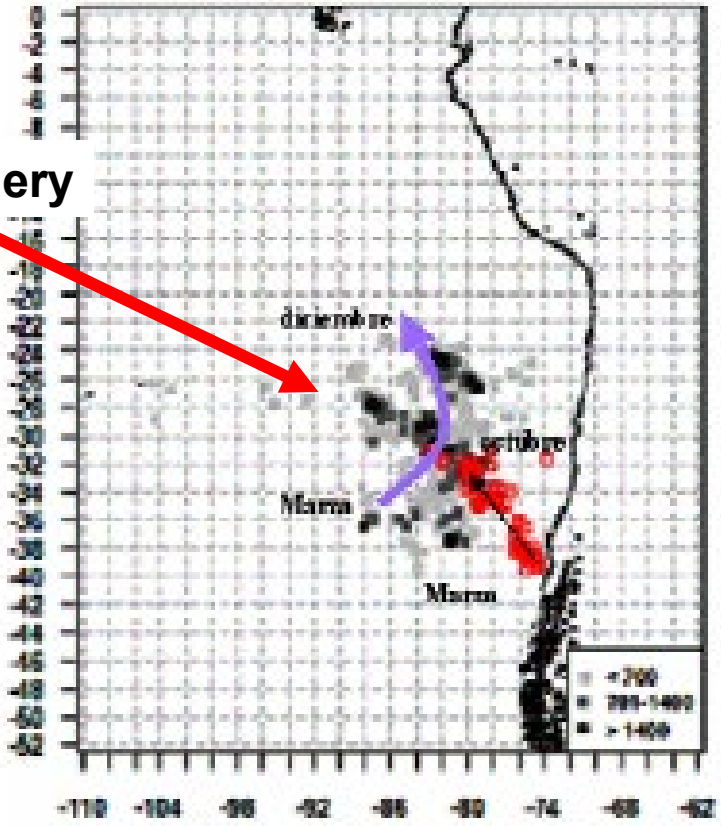
No sig. diff between North and Equatorial (5S – 10N) P = 0.564

Sig. diff between South and Equatorial:
(5S – 10N) P = 0.036
(5S – 0) P = 0.017



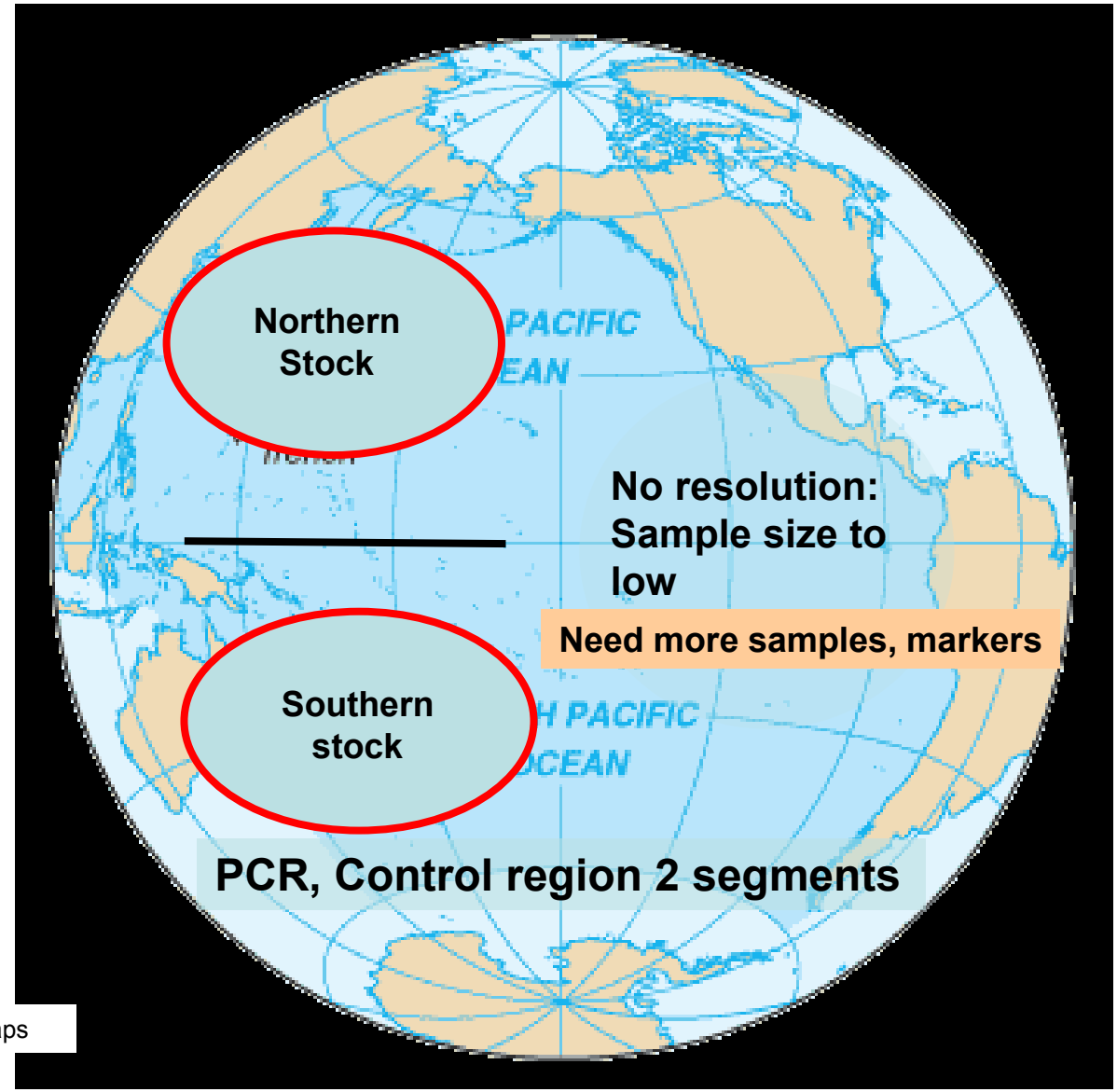
Chilean Fishery & SWO Distribution





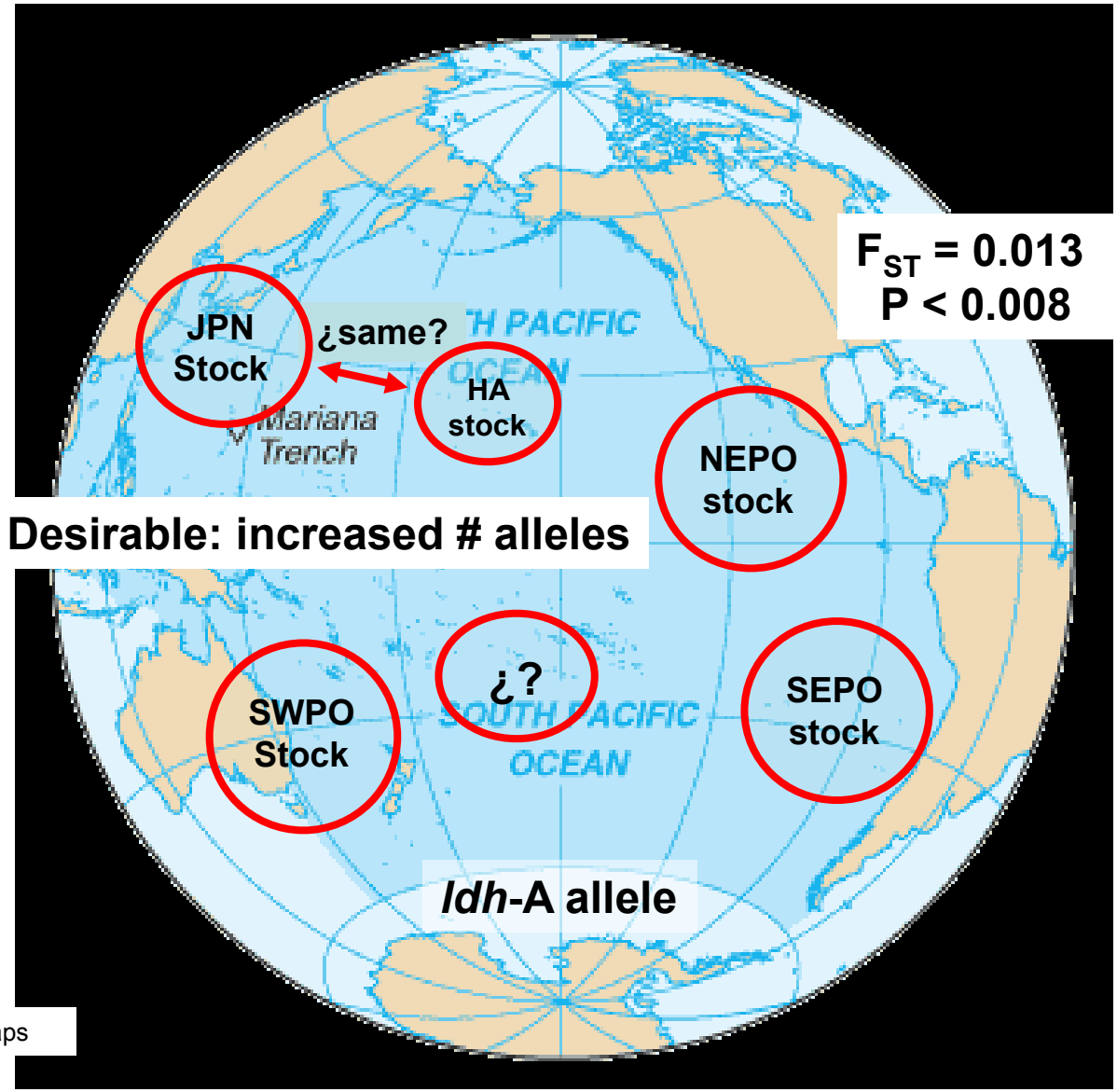
Source: CPPS, 2005

Reeb et al (2000) mtDNA



http://www.lib.utexas.edu/maps

Alvarado Bremer et al (2006) scnDNA



F_{ST} = 0.013
P < 0.008

Desirable: increased # alleles

http://www.lib.utexas.edu/maps

Can Small F_{ST} Values (<0.02) be Meaningful?

- F_{ST}: measure of distribution of genetic variation among population
- Marine populations: Median F_{ST} = 0.02
- Intra-locus sampling contribution to signal:noise α 1/(2S), S = sample size

  S = 25: 1/(2S) = 0.02 : error ~ Median F_{ST}
- Alvarado Bremer et al (2006)

  S = 305: 1/(2S) = 0.001: error ~ 8% F_{ST}(obs)

  F_{ST}(obs) = 0.013 significant at P < 0.008 after corrections

example from Waples (1994)

How well do Prior Structures Fit Genetics?

Stock Hypothesis	Source / Basis	F_{ST}	HWE*
3-stock: NW, SW, & EPO	Bartoo & Coan (1988)	0.0085	No for EPO (P = 0.0002)
3-stock: N; and SW & SE boundary at 10°N	Nakano (1994)	0.0111	No for SEPO (P = 0.0002)
2-Stock alternative: N & S of 10°N	Nakano (1994)	-0.0009	N/A
4-stock NW, SW, NE, & SE	Sosa-Nishizaki & Shimizu (1991) Alvarado Bremer *et al.* (2006)	0.0130	Yes

***HWE: Hardy-Weinberg Equilibrium**

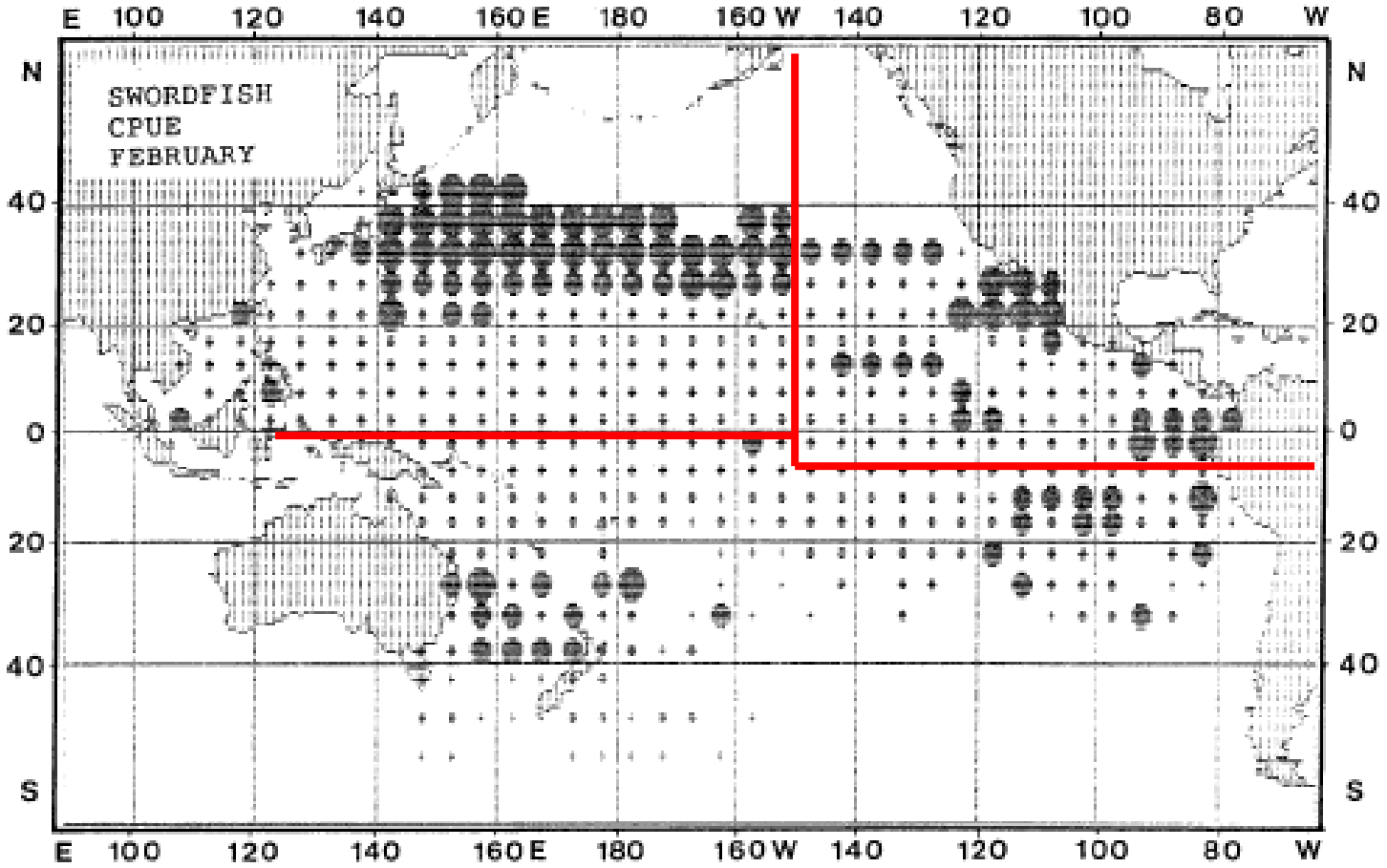
Summary Conclusions

- 4 stocks of swordfish in Pacific
- EPO structure in Hinton & Deriso (1994) & Hinton (2003) from fisheries analysis supported by Alvarado Bremer et al (2006)
- Ad hoc stock structure approaches taken previously are not supported by genetics or fisheries analysis in the EPO

Questions
Black Hole

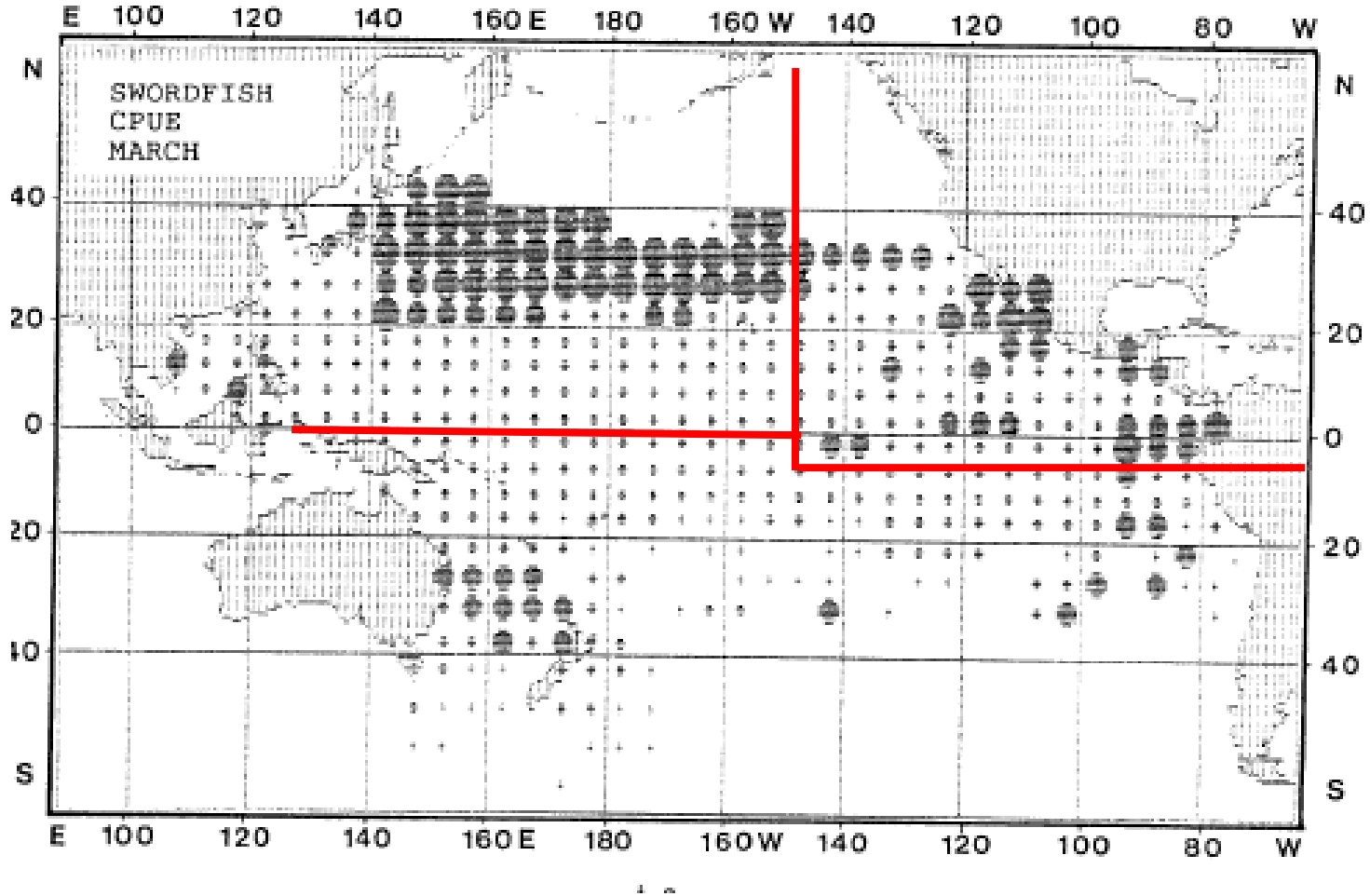
by NASA

Japanese LL CPUNE February



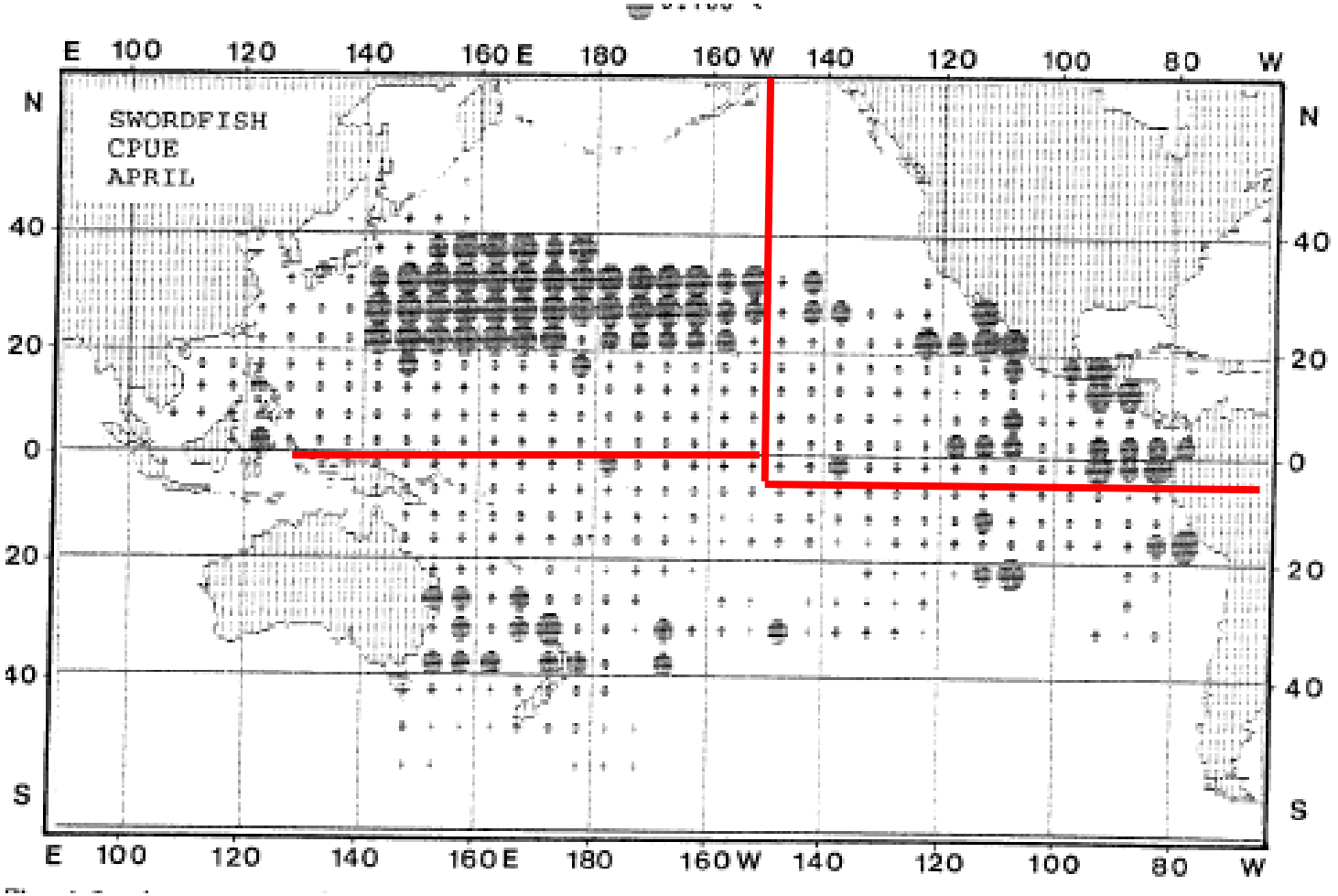
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE March



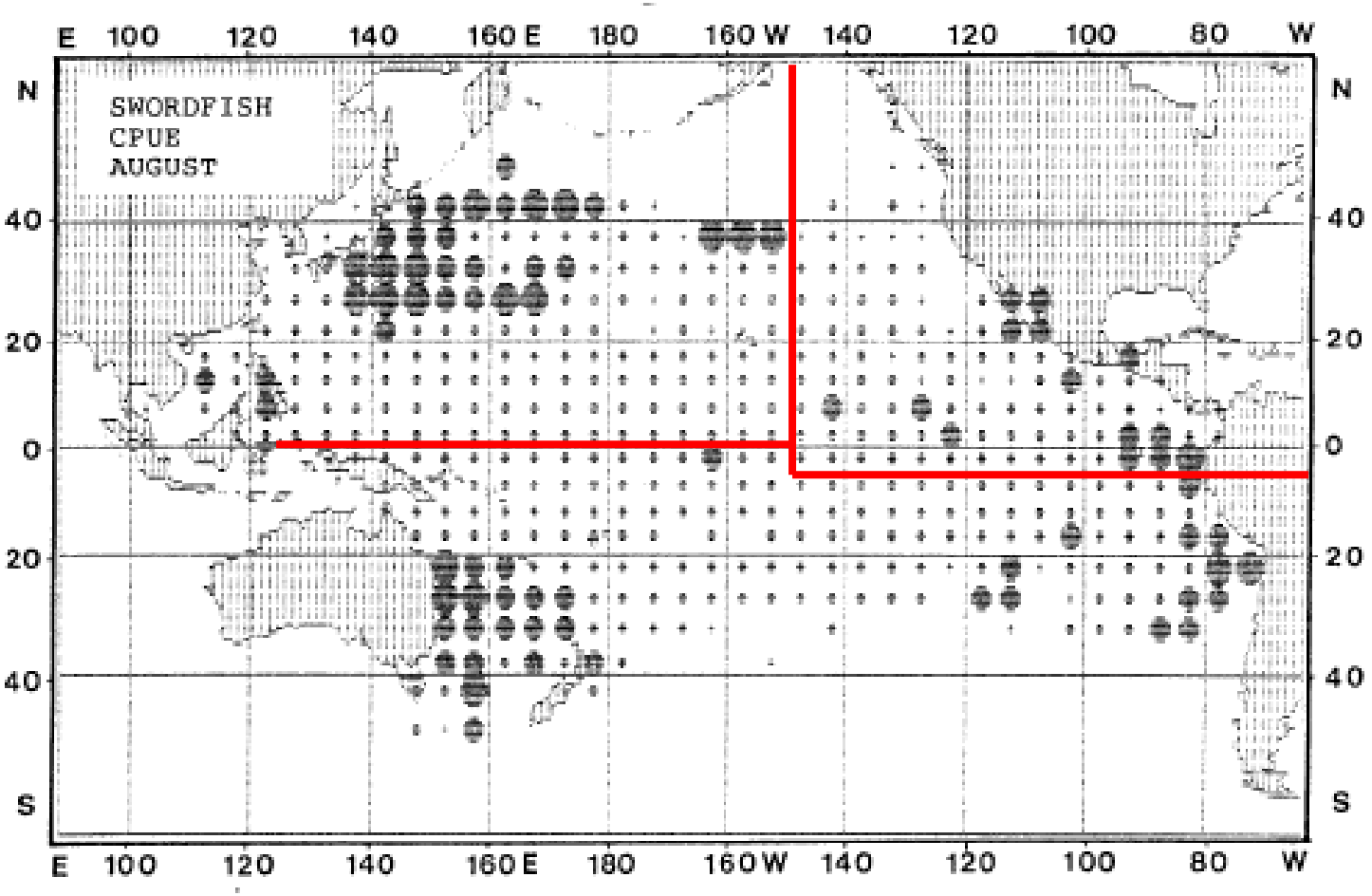
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE April



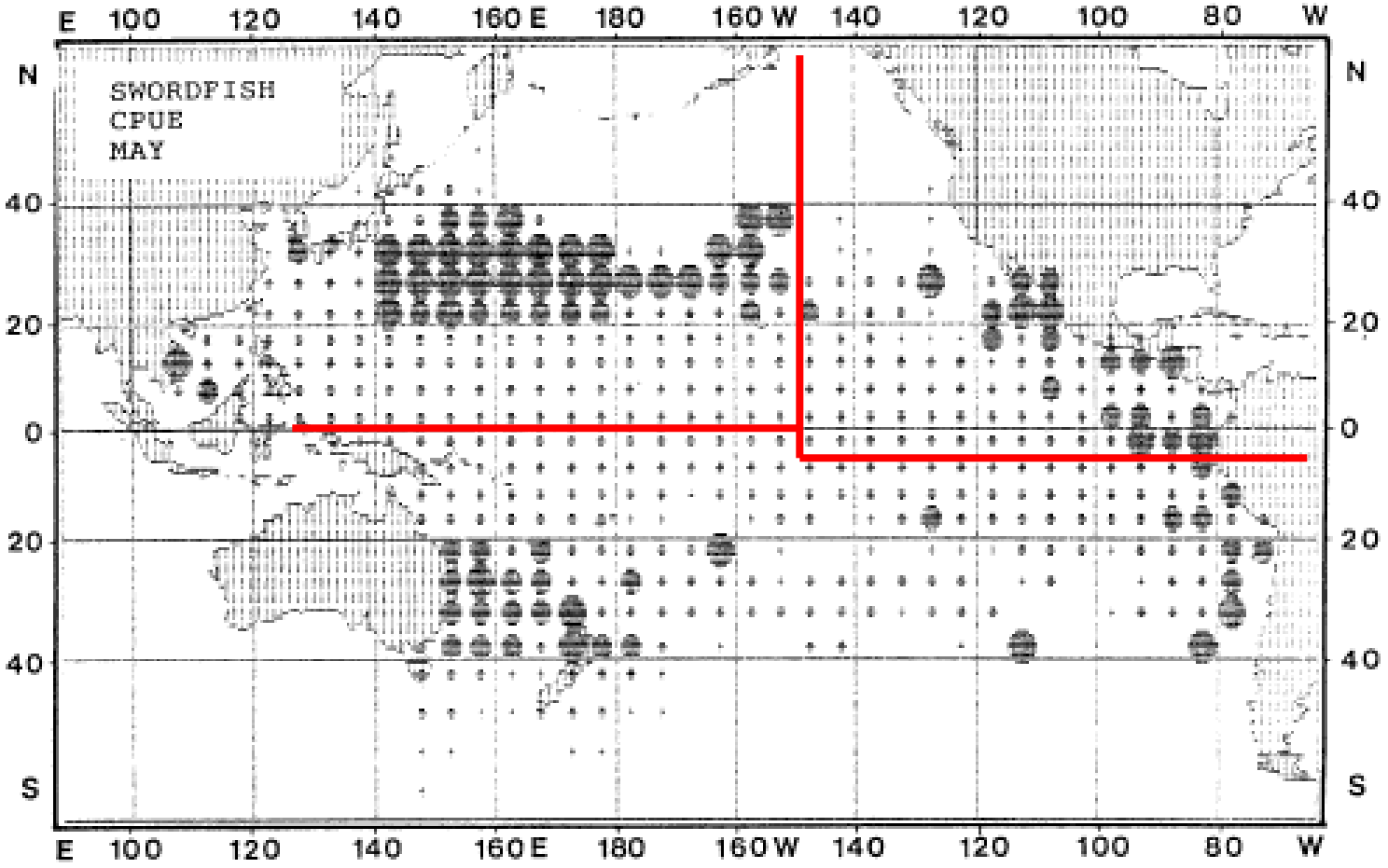
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE August



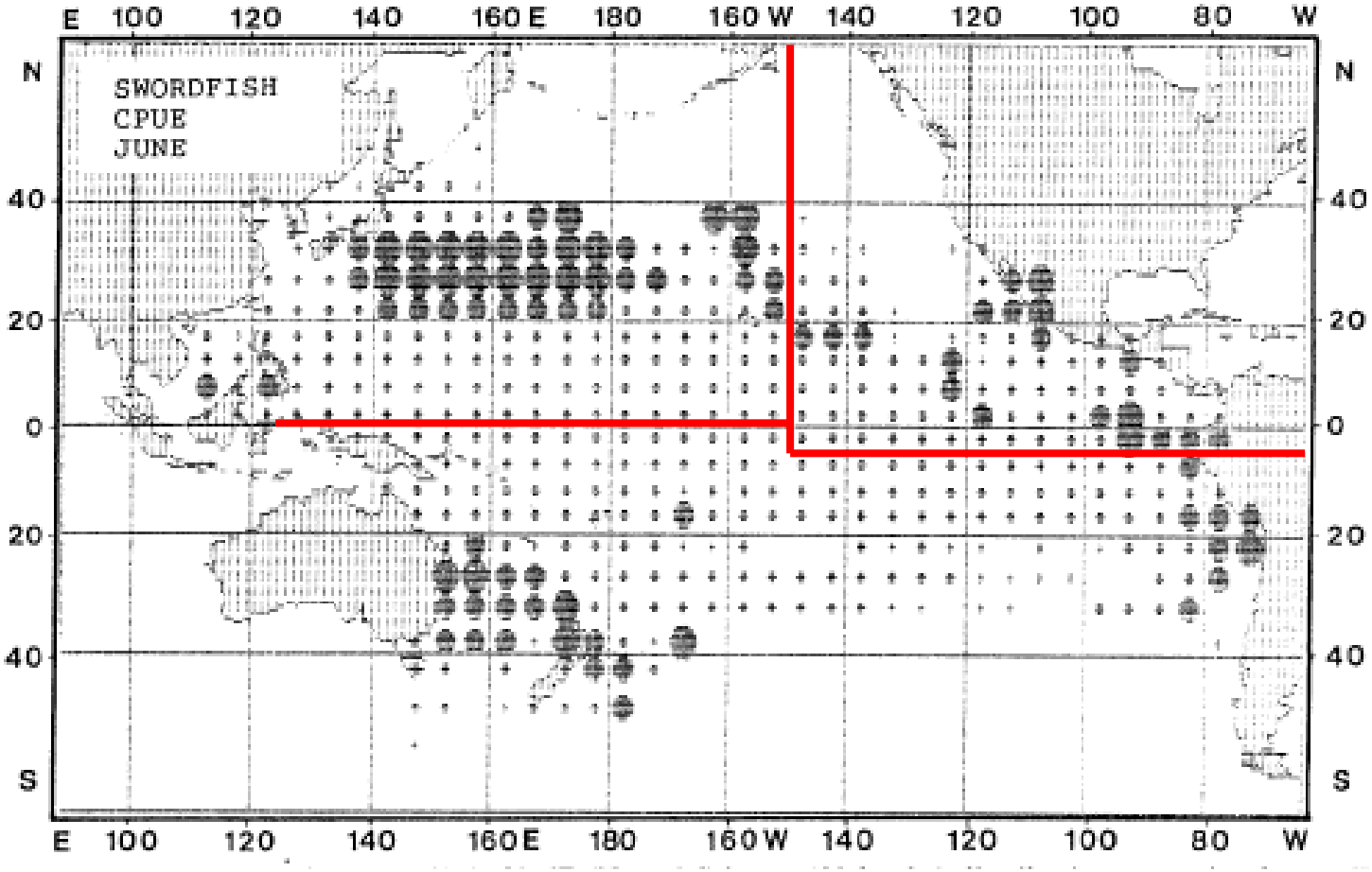
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE May



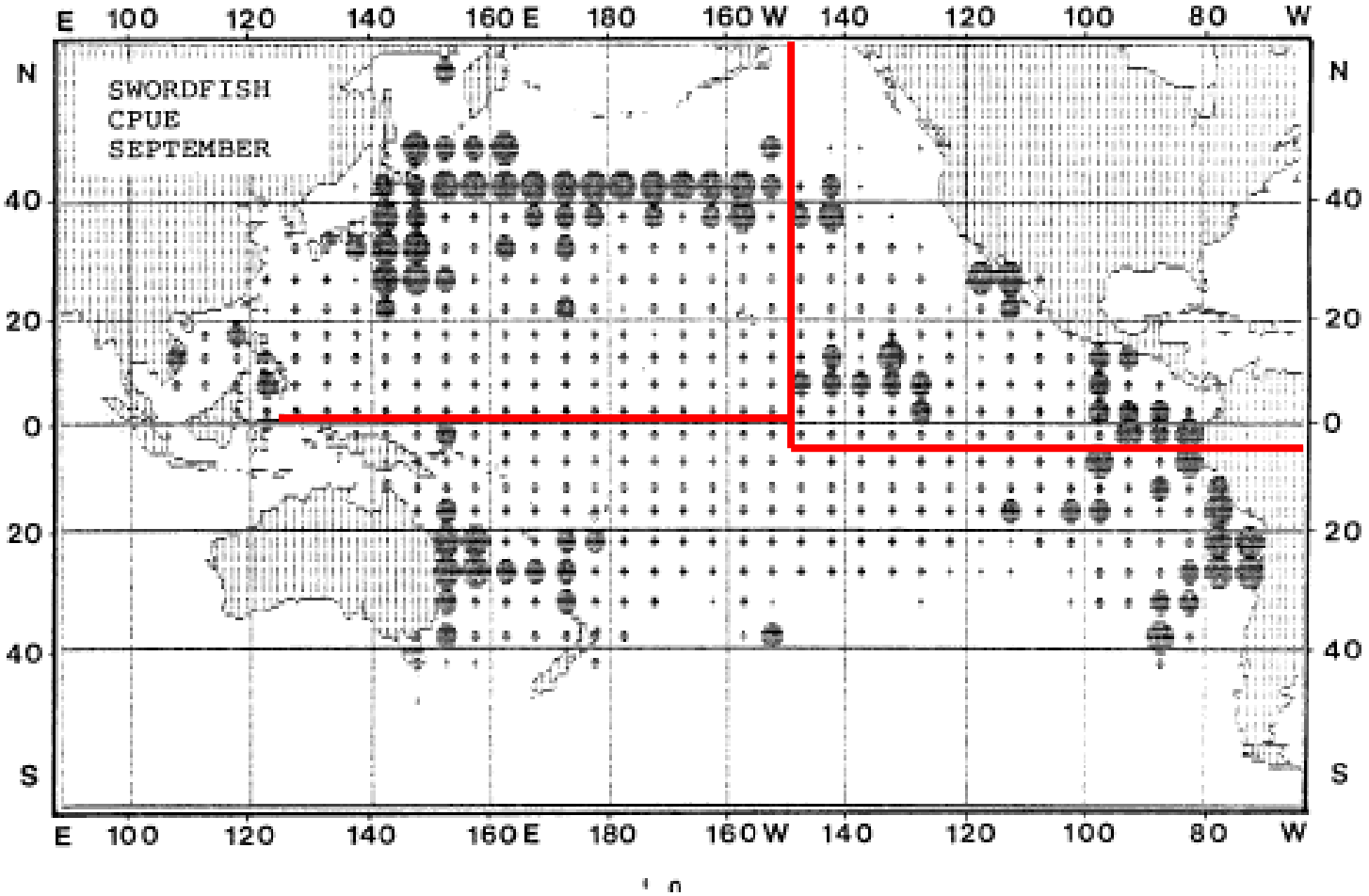
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE June



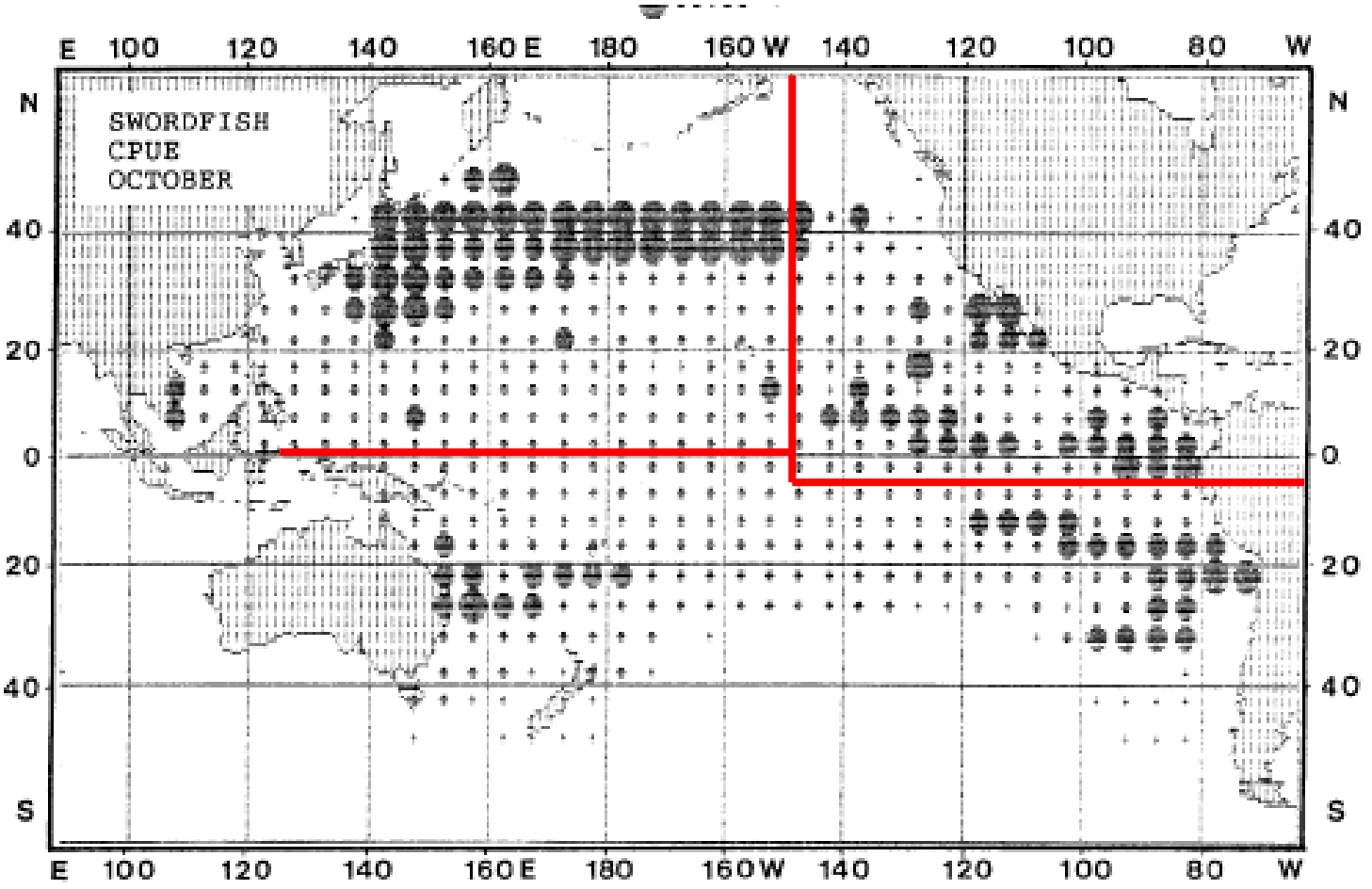
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE September



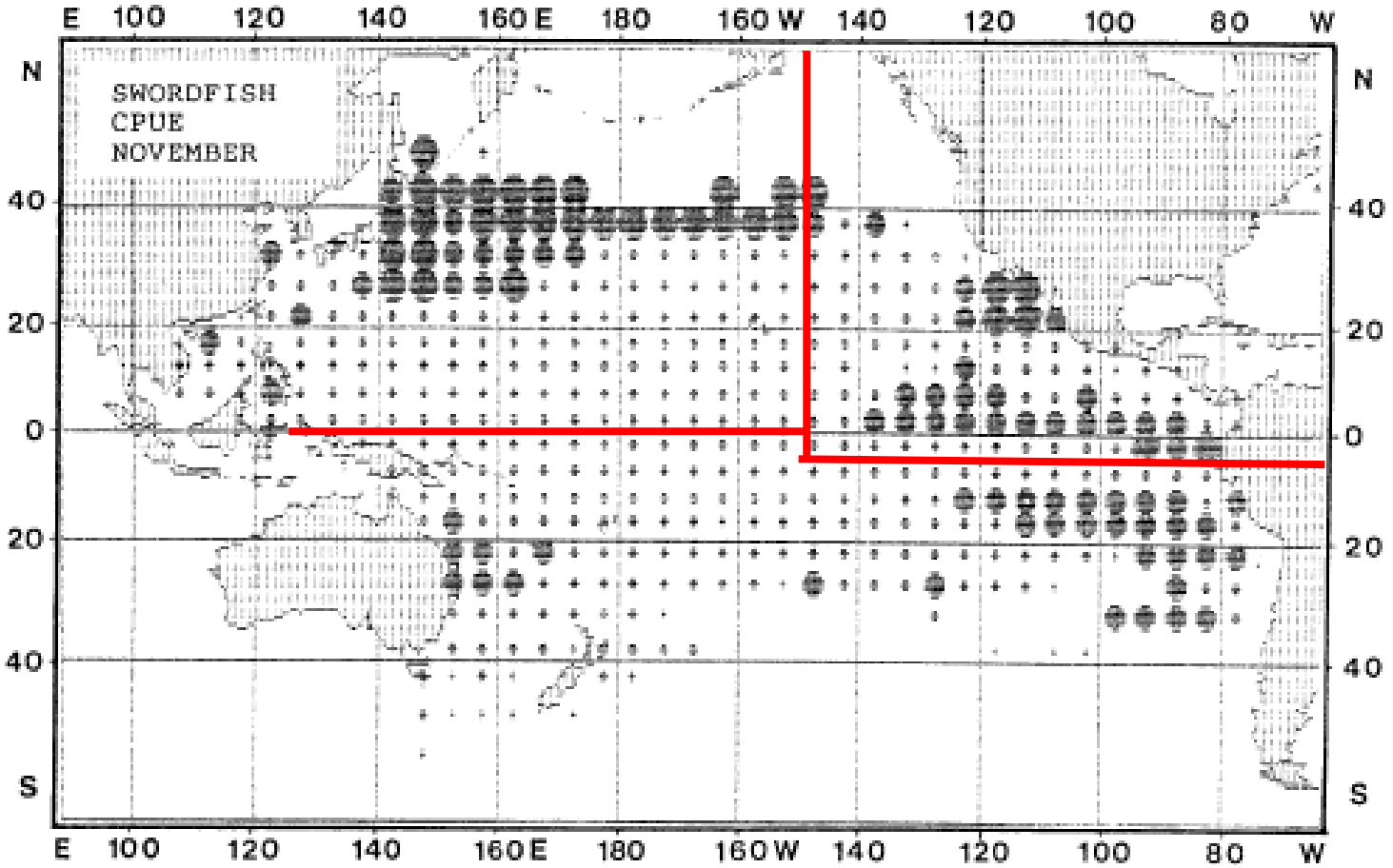
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE October



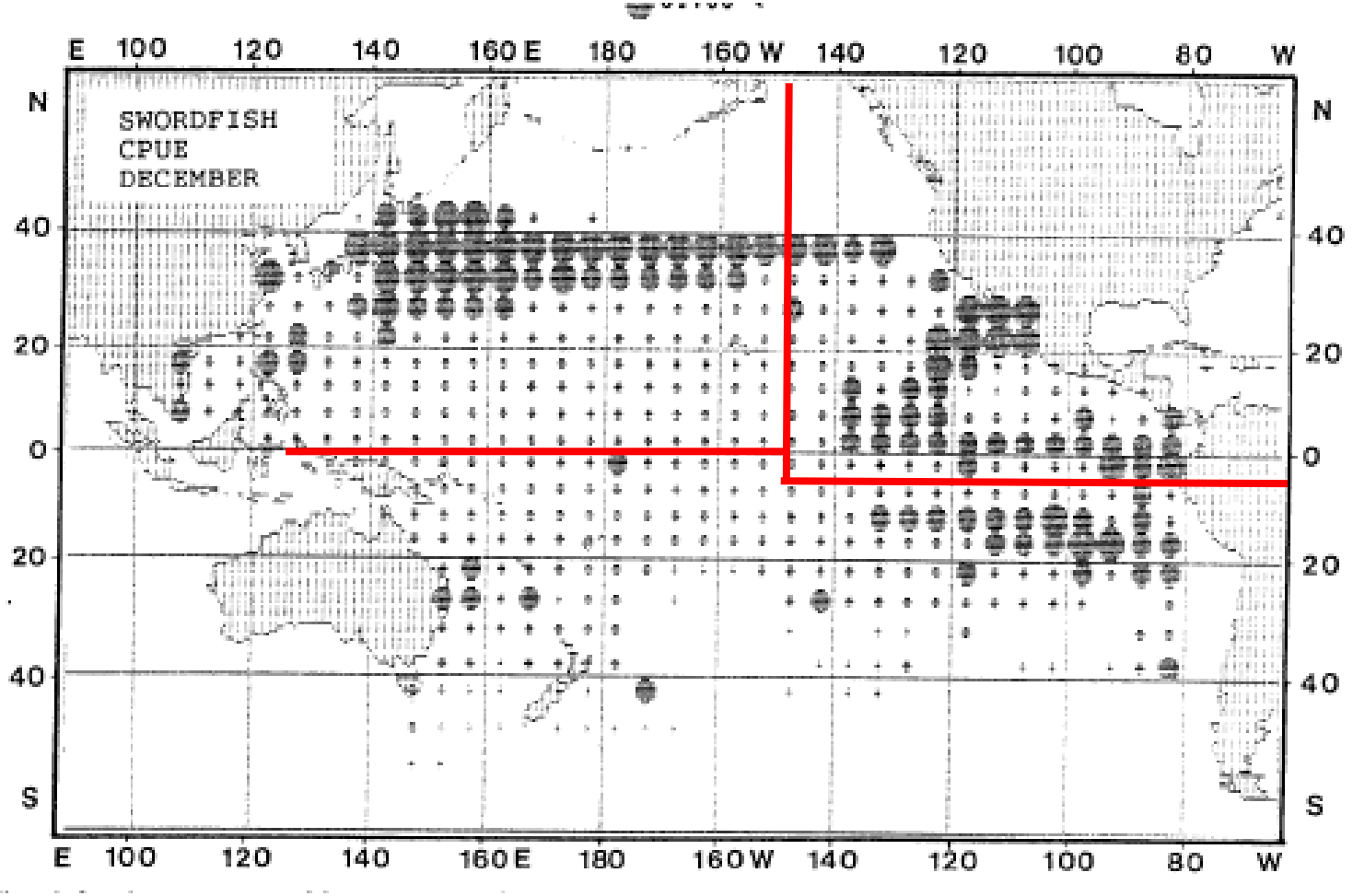
Source: Sosa & Shimizu (1991)

Japanese LL CPUNE November

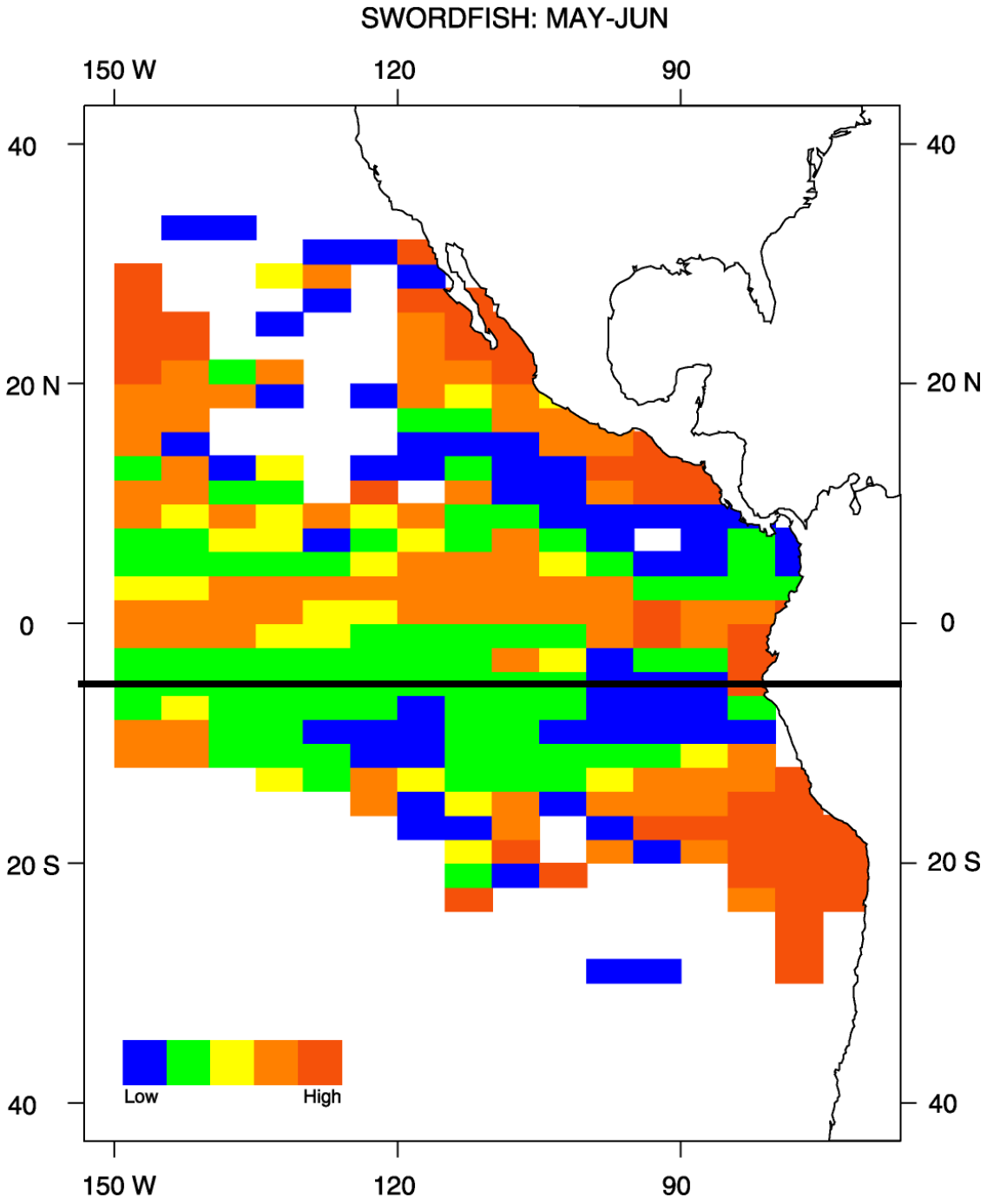


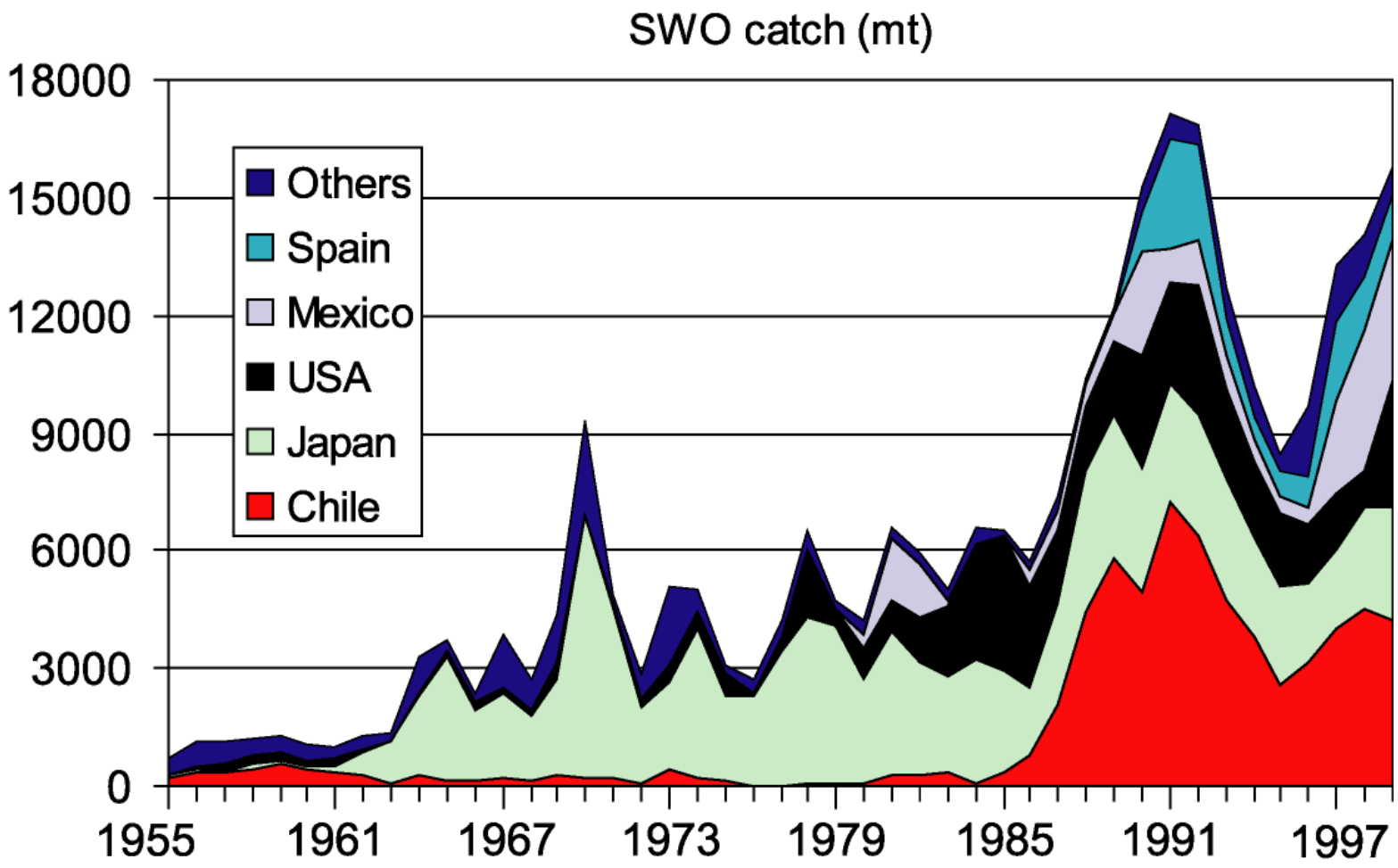
Source: Sosa & Shimizu (1991)

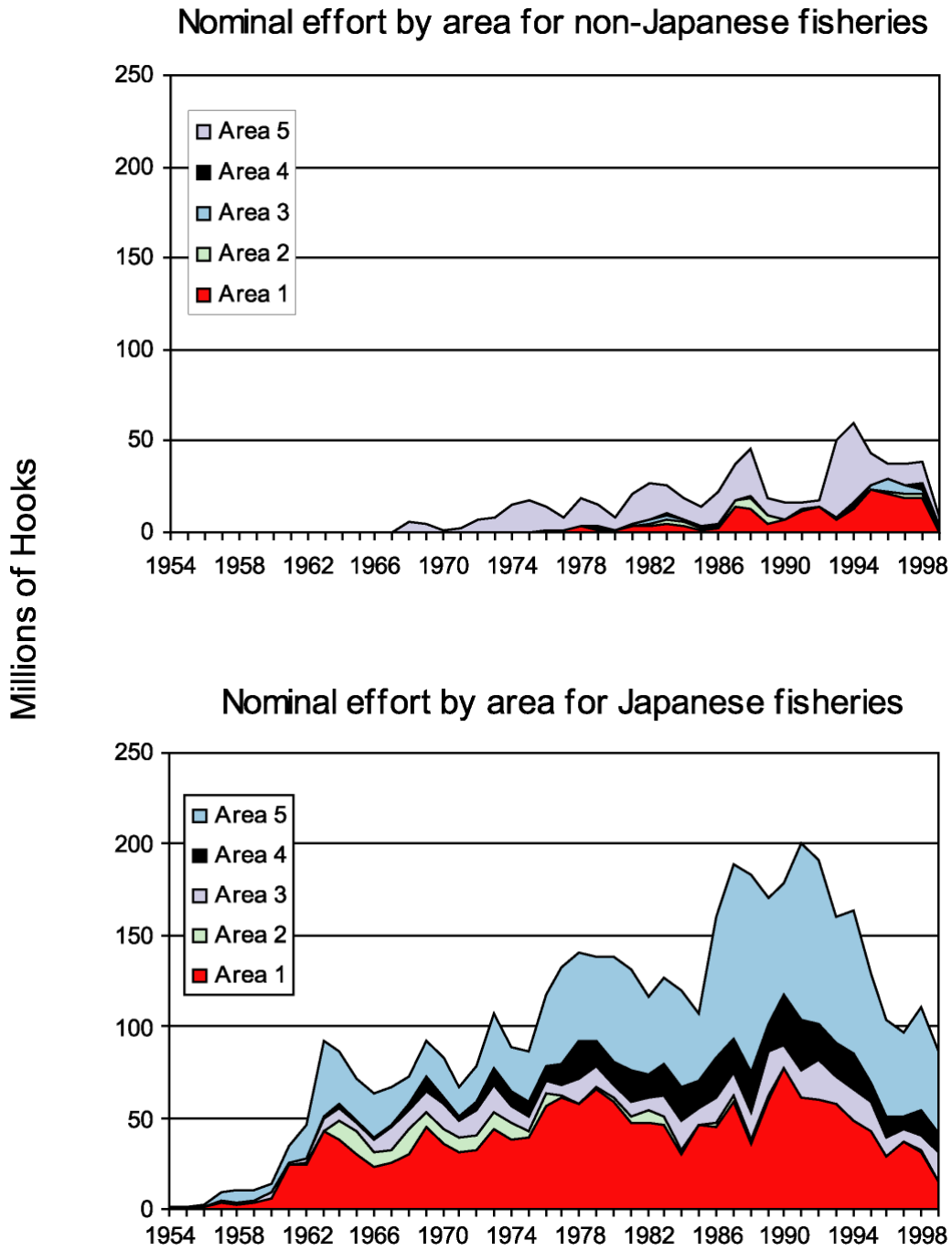
Japanese LL CPUNE December

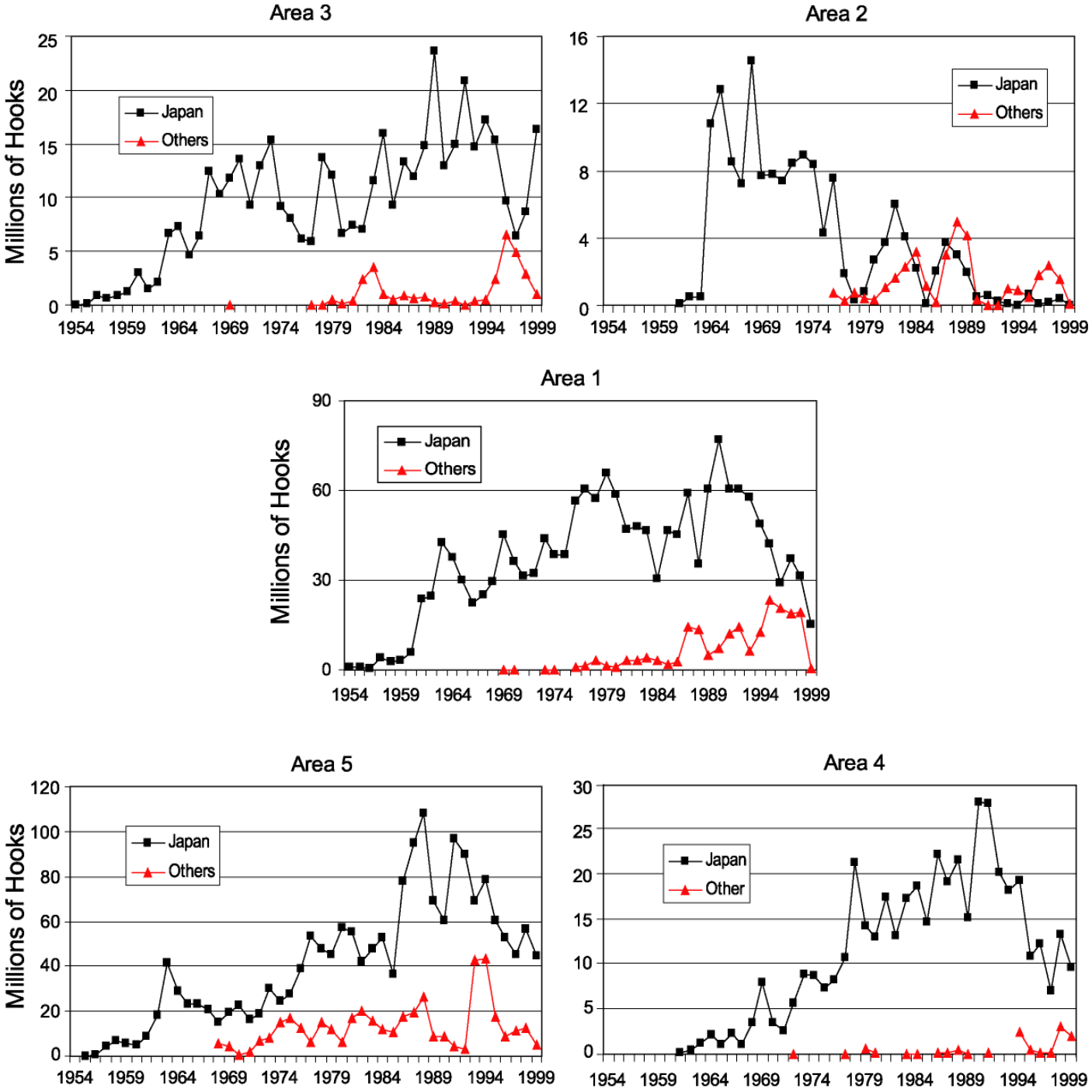


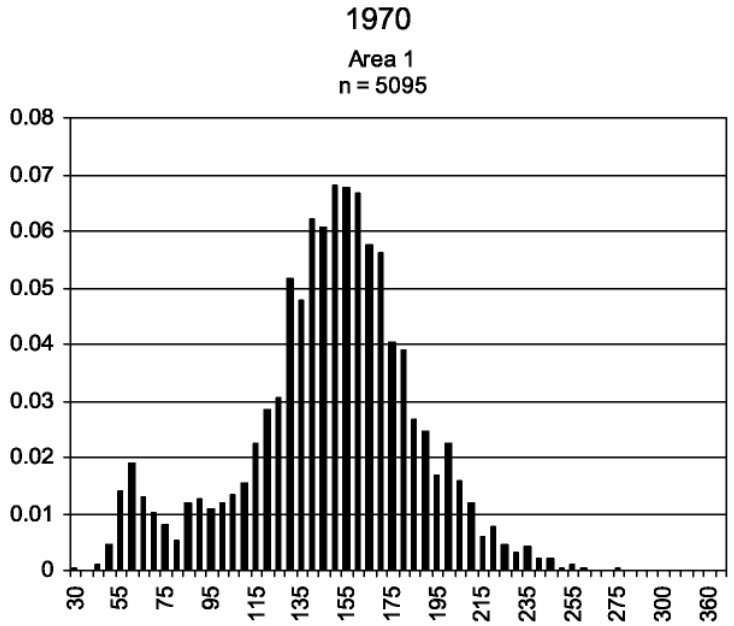
Source: Sosa & Shimizu (1991)

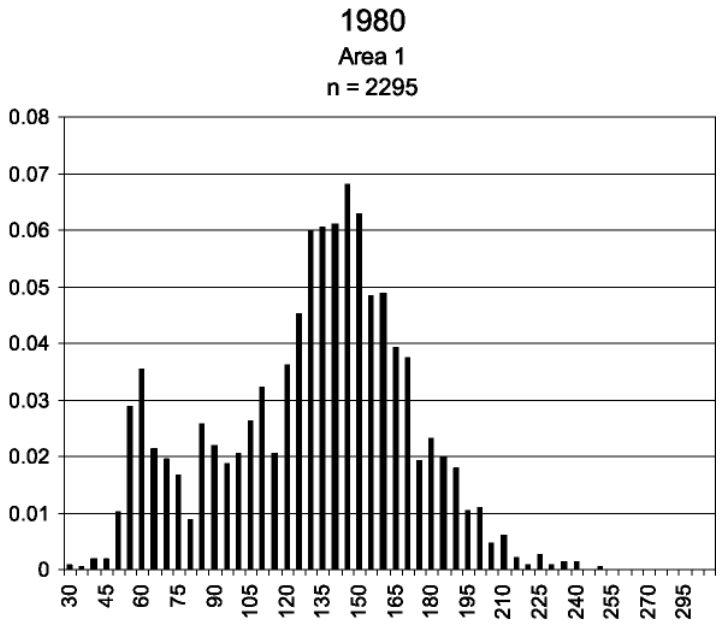

SWORDFISH: MAY-JUN
150 W
120
90
40
20 N
0
20 S
40
Low
High

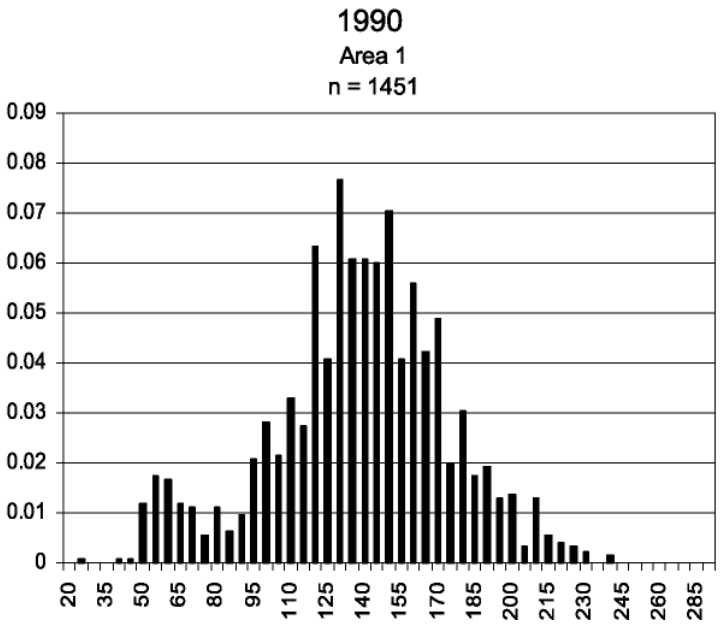

SWO catch (mt)
18000
15000
12000
9000
6000
3000
0
1955
1961
1967
1973
1979
1985
1991
1997
Others
Spain
Mexico
USA
Japan
Chile

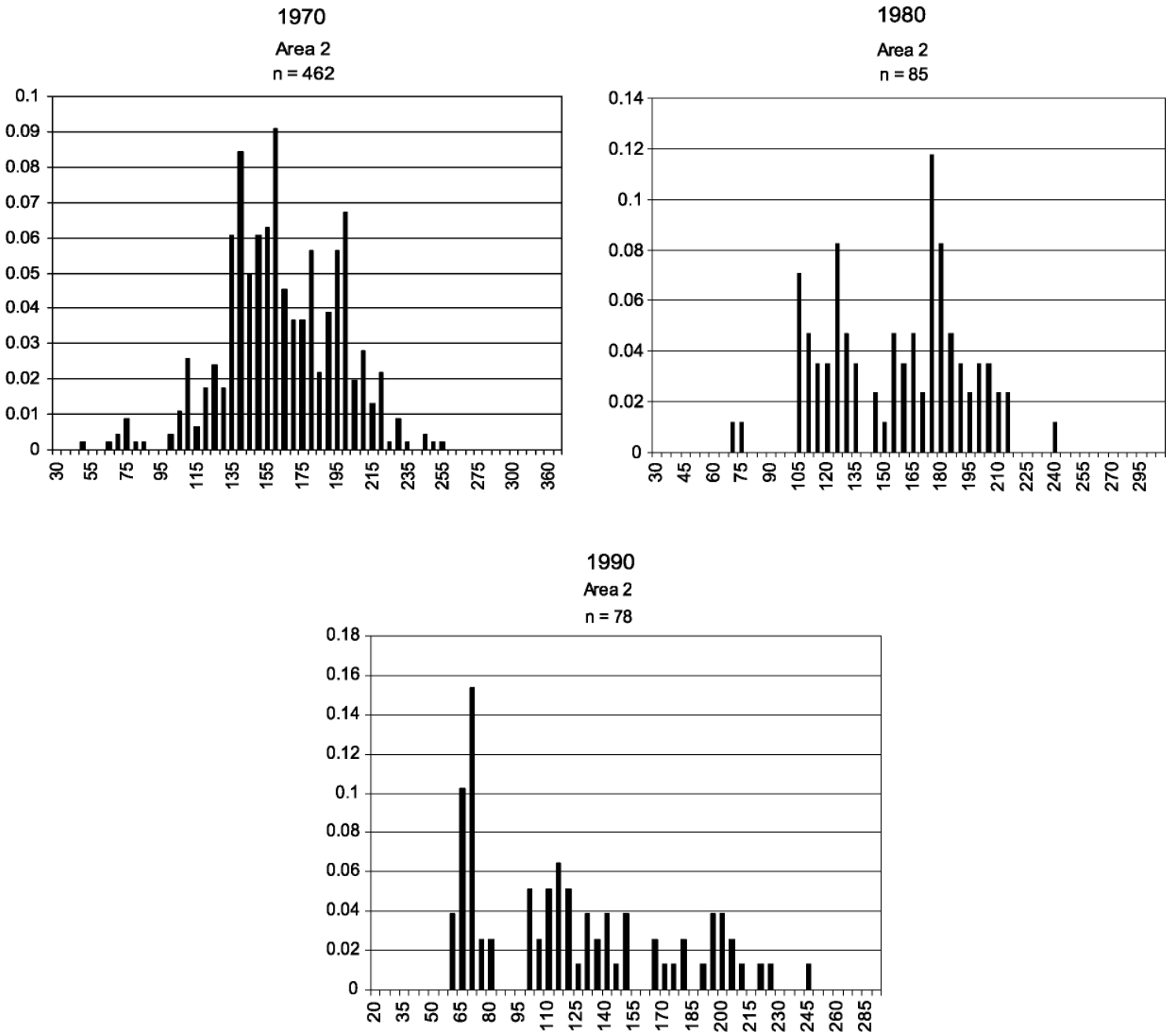

Nominal effort by area for non-Japanese fisheries
Millions of Hooks
250
200
150
100
50
0
Area 5
Area 4
Area 3
Area 2
Area 1
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
Nominal effort by area for Japanese fisheries
250
200
150
100
50
0
Area 5
Area 4
Area 3
Area 2
Area 1
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998

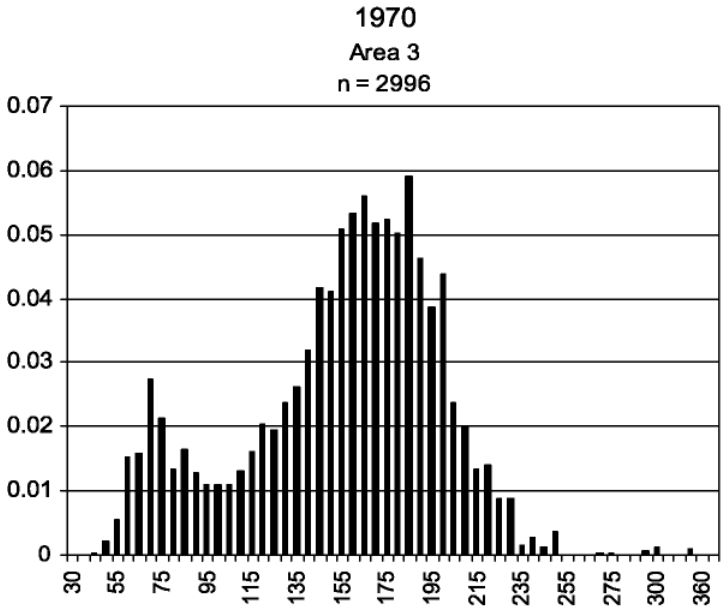

Area 3
Millions of Hooks
Japan
Others
Area 2
Japan
Others
Area 1
Millions of Hooks
Japan
Others
Area 5
Millions of Hooks
Japan
Others
Area 4
Japan
Other
1954 1959 1964 1969 1974 1979 1984 1989 1994 1999

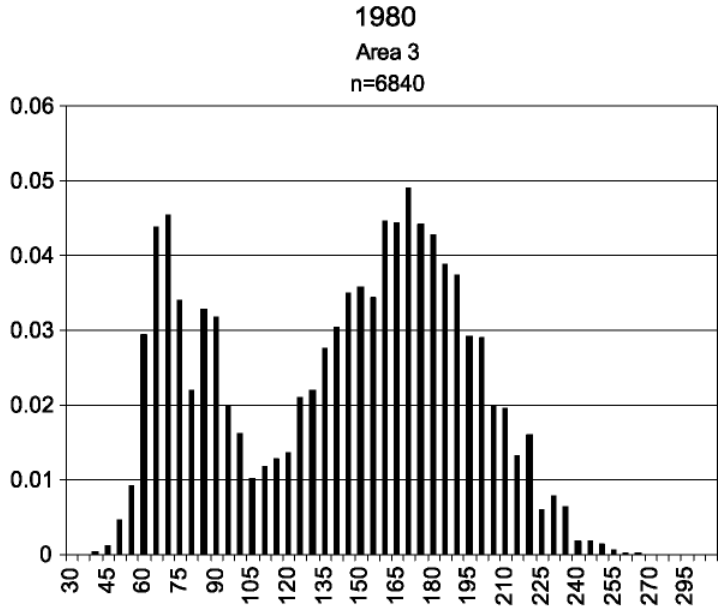

1970
Area 1
n = 5095
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30
55
75
95
115
135
155
175
195
215
235
255
275
300
360

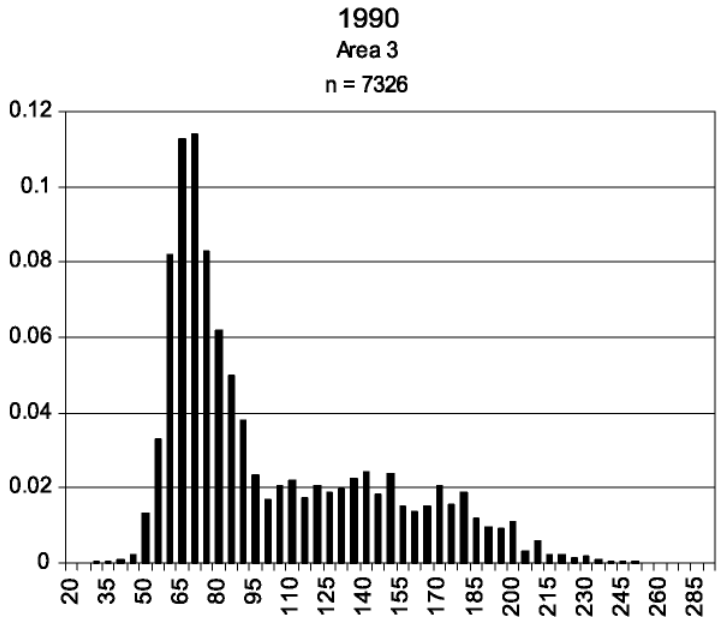

1980
Area 1
n = 2295
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
295

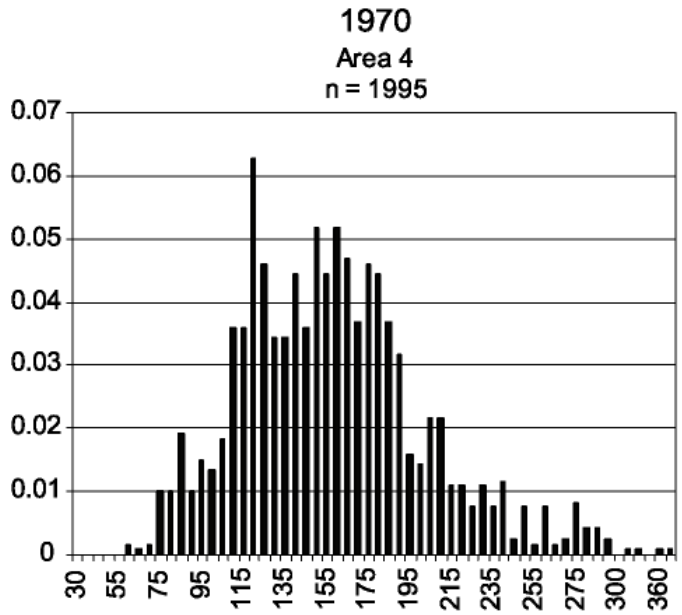

1990
Area 1
n = 1451
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
20
35
50
65
80
95
110
125
140
155
170
185
200
215
230
245
260
285

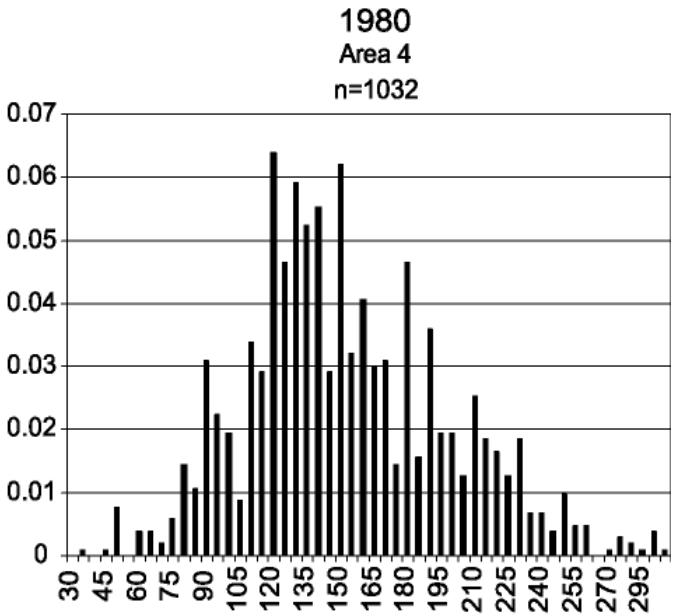

1970
Area 2
n = 462
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30 55 75 95 115 135 155 175 195 215 235 255 275 300 360
1980
Area 2
n = 85
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 295
1990
Area 2
n = 78
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
20 35 50 65 80 95 110 125 140 155 170 185 200 215 230 245 260 285

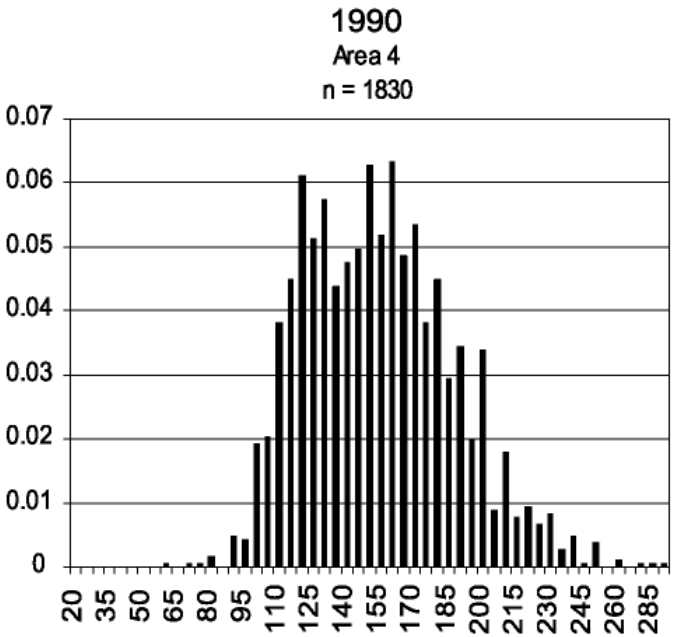

1970
Area 3
n = 2996
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30
55
75
95
115
135
155
175
195
215
235
255
275
300
360

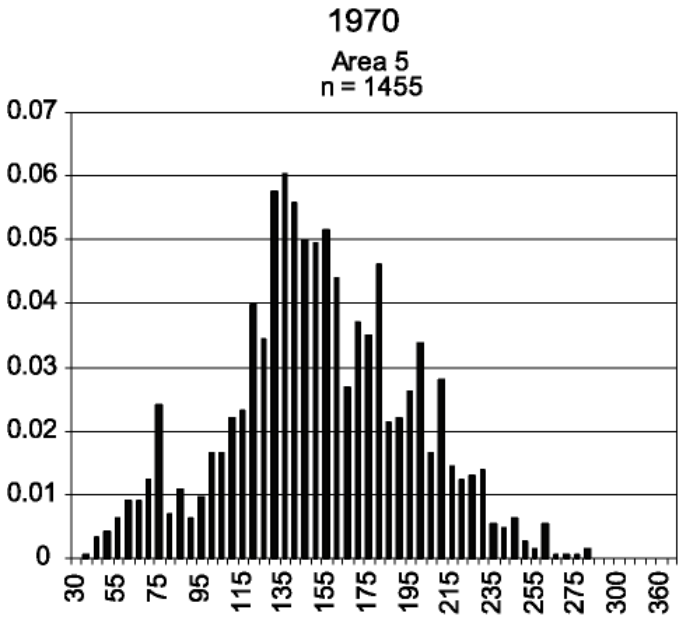

1980
Area 3
n=6840
0.06
0.05
0.04
0.03
0.02
0.01
0
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
295

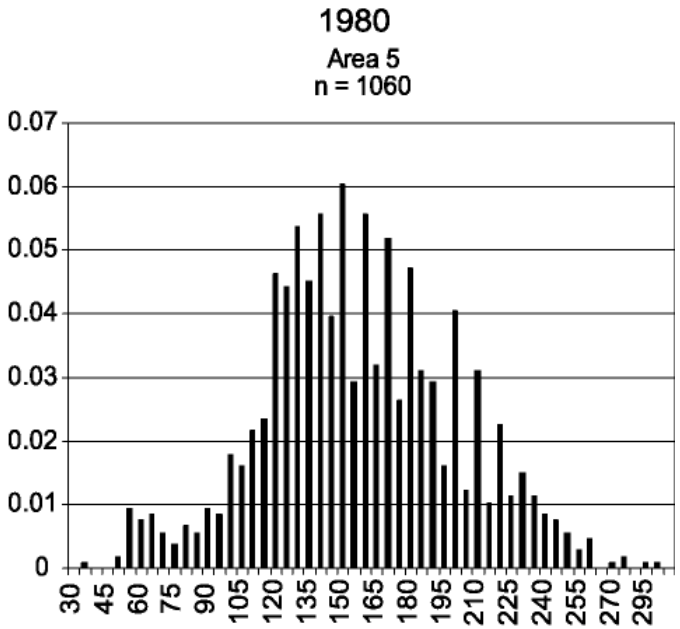

1990
Area 3
n = 7326
0.12
0.1
0.08
0.06
0.04
0.02
0
20
35
50
65
80
95
110
125
140
155
170
185
200
215
230
245
260
285

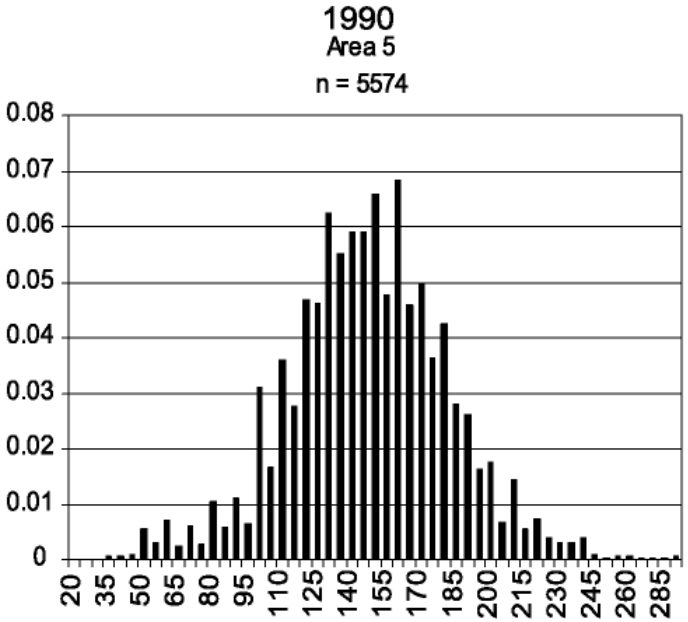

1970
Area 4
n = 1995
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30 55 75 95 115 135 155 175 195 215 235 255 275 300 360

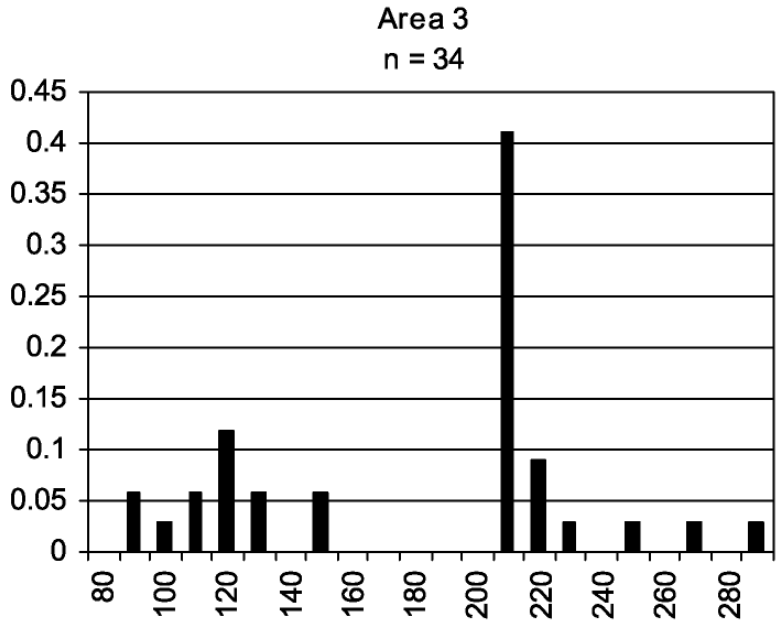

1980
Area 4
n=1032
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 295

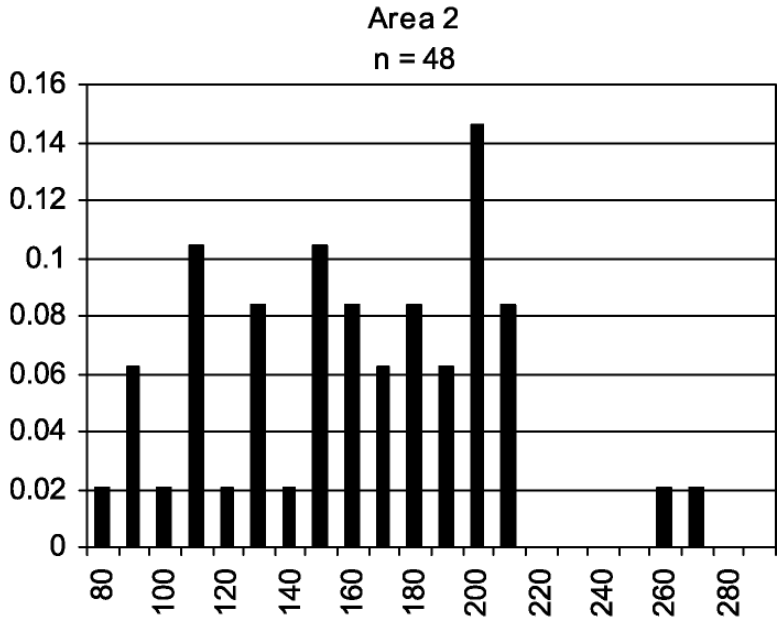

1990
Area 4
n = 1830
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
20 35 50 65 80 95 110 125 140 155 170 185 200 215 230 245 260 285

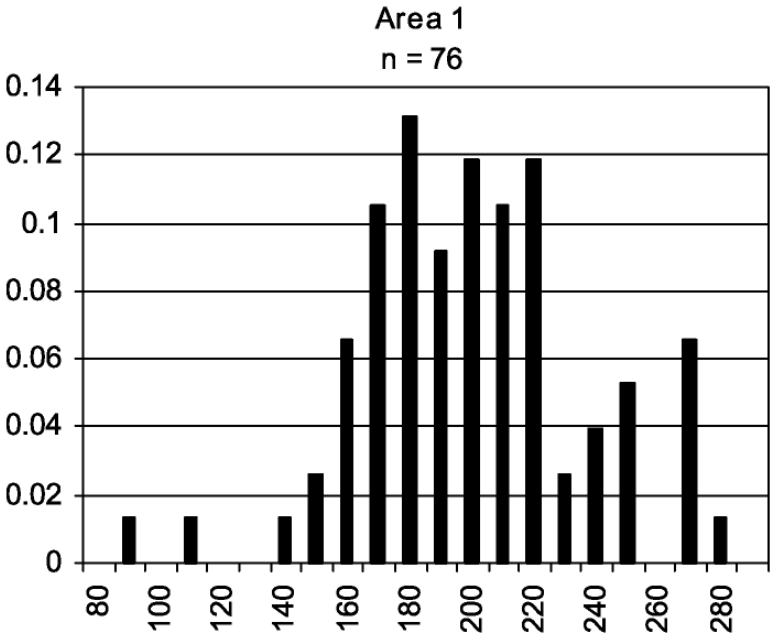

1970
Area 5
n = 1455
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30 55 75 95 115 135 155 175 195 215 235 255 275 300 360


1980
Area 5
n = 1060
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 295


1990
Area 5
n = 5574
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
20 35 50 65 80 95 110 125 140 155 170 185 200 215 230 245 260 285


Area 3
n = 34
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
80
100
120
140
160
180
200
220
240
260
280


Area 2
n = 48
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
80
100
120
140
160
180
200
220
240
260
280


Area 1
n = 76
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
80
100
120
140
160
180
200
220
240
260
280