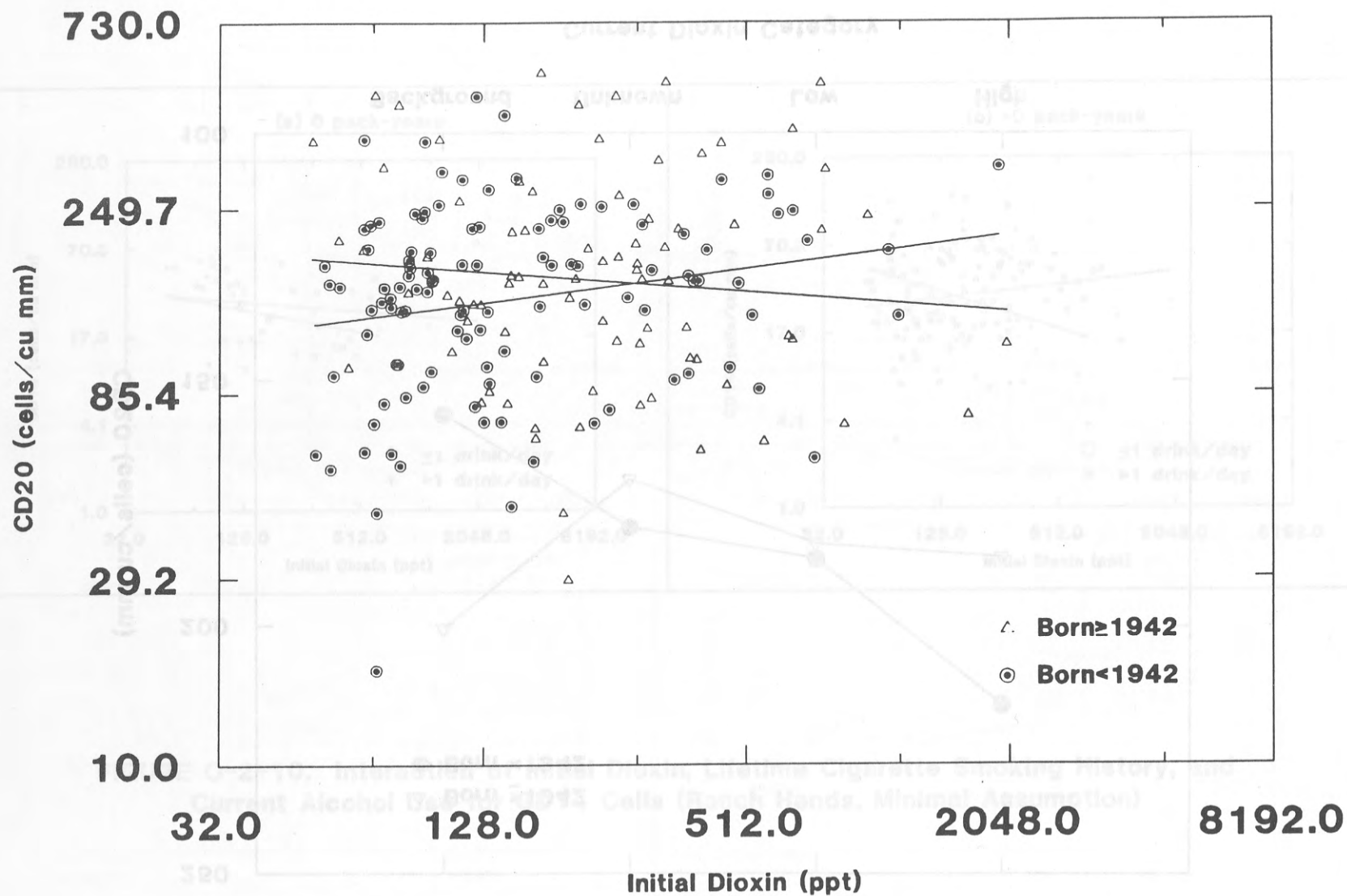




**FIGURE O-2-8. Interaction of Initial Dioxin and Age for CD20 Cells
(Ranch Hands, Minimal Assumption)**

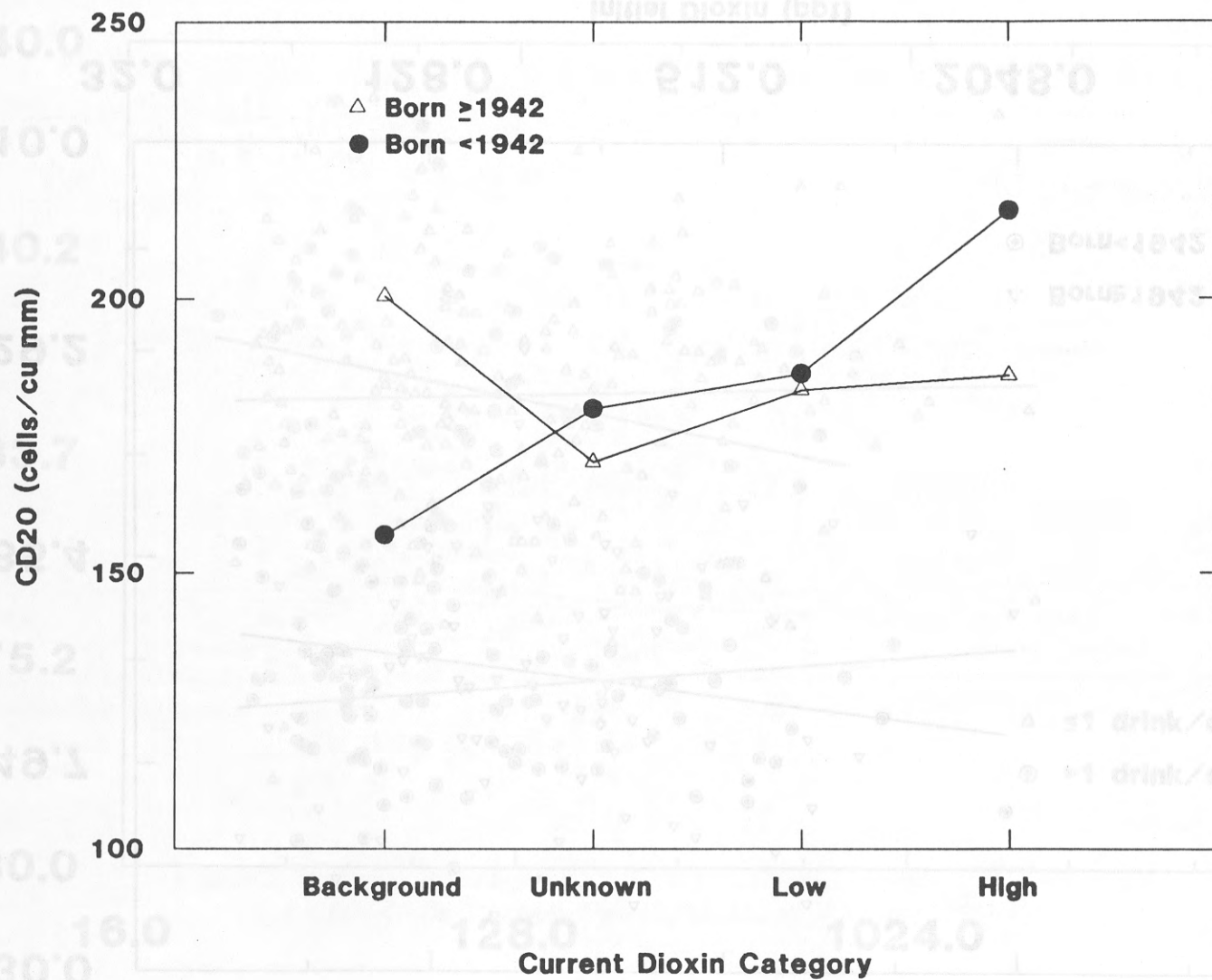


FIGURE O-2-9. Interaction of Categorized Current Dioxin and Age for CD20 Cells

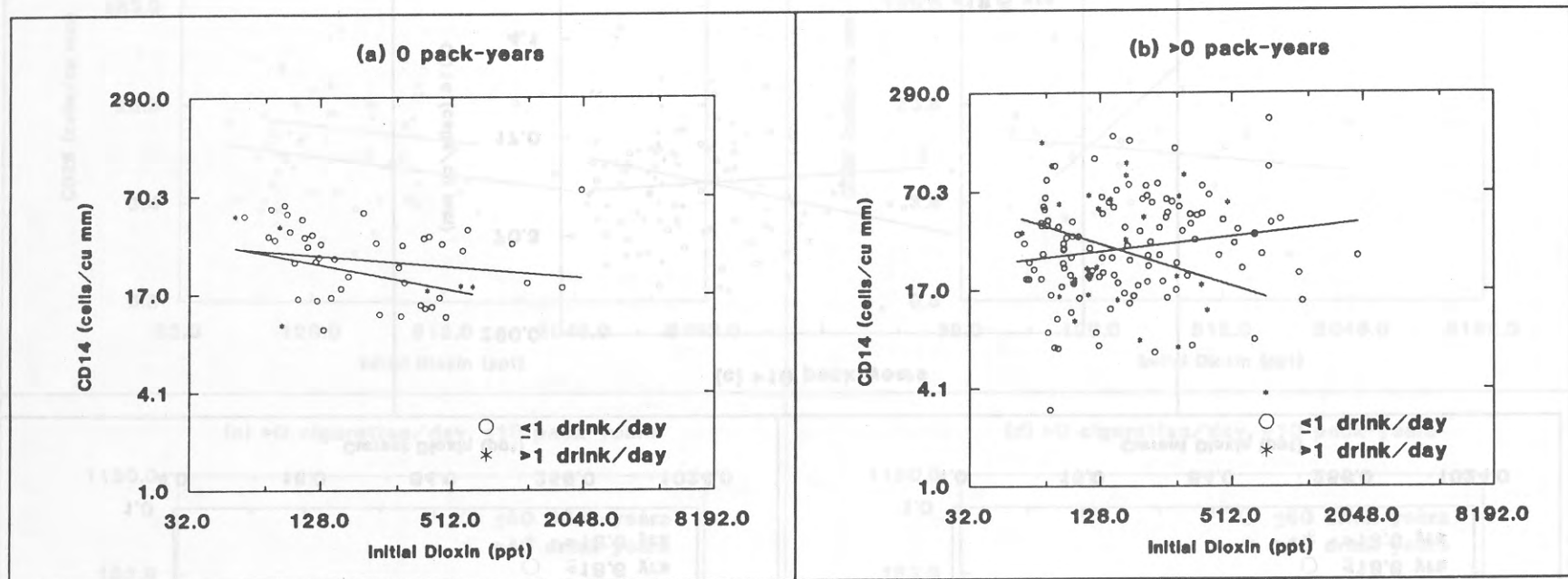


FIGURE O-2-10. Interaction of Initial Dioxin, Lifetime Cigarette Smoking History, and Current Alcohol Use for CD14 Cells (Ranch Hands, Minimal Assumption)

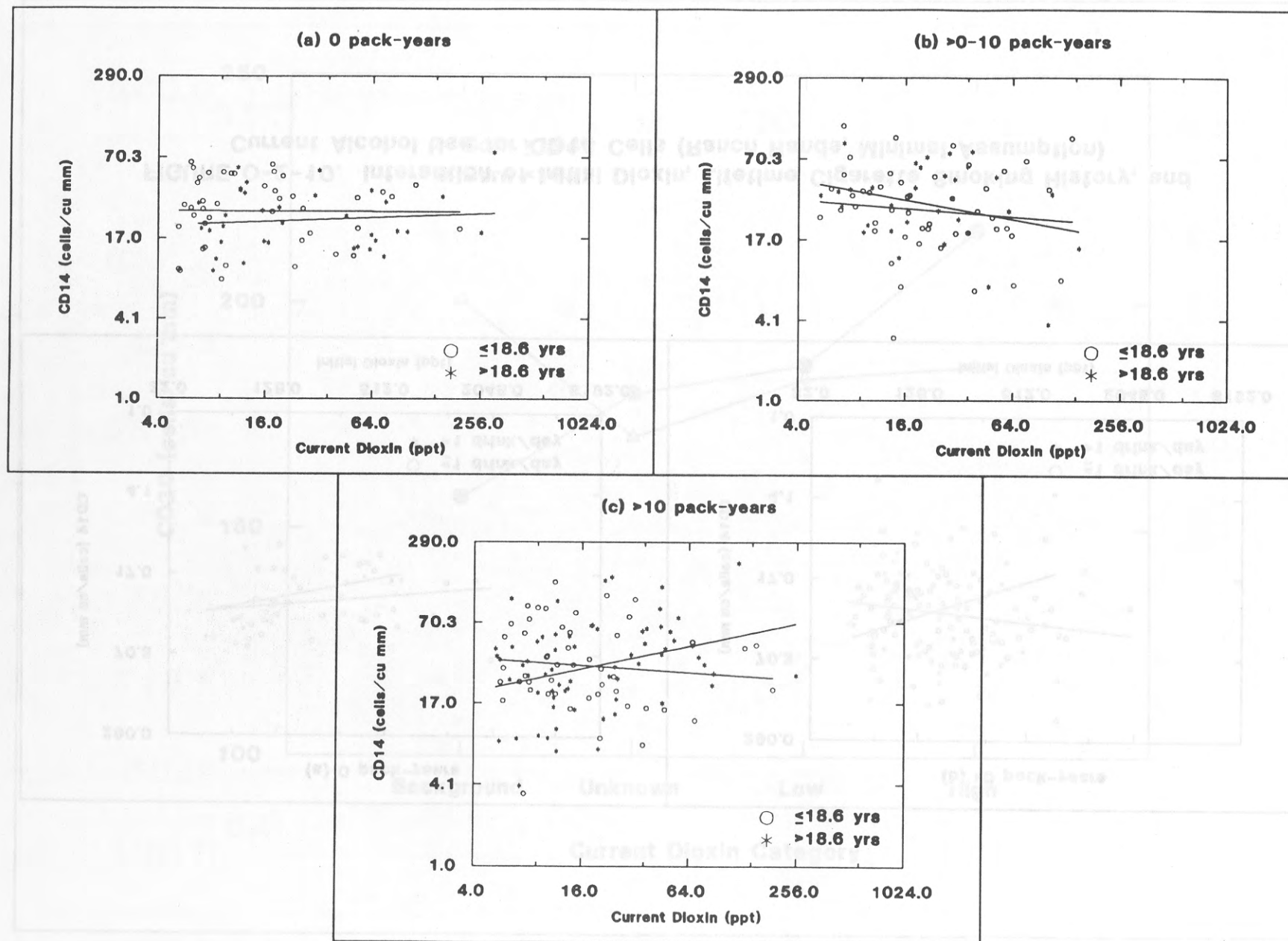


FIGURE O-2-11. Interaction of Current Dioxin, Time, and Lifetime Cigarette Smoking History for CD14 Cells (Ranch Hands, Maximal Assumption)

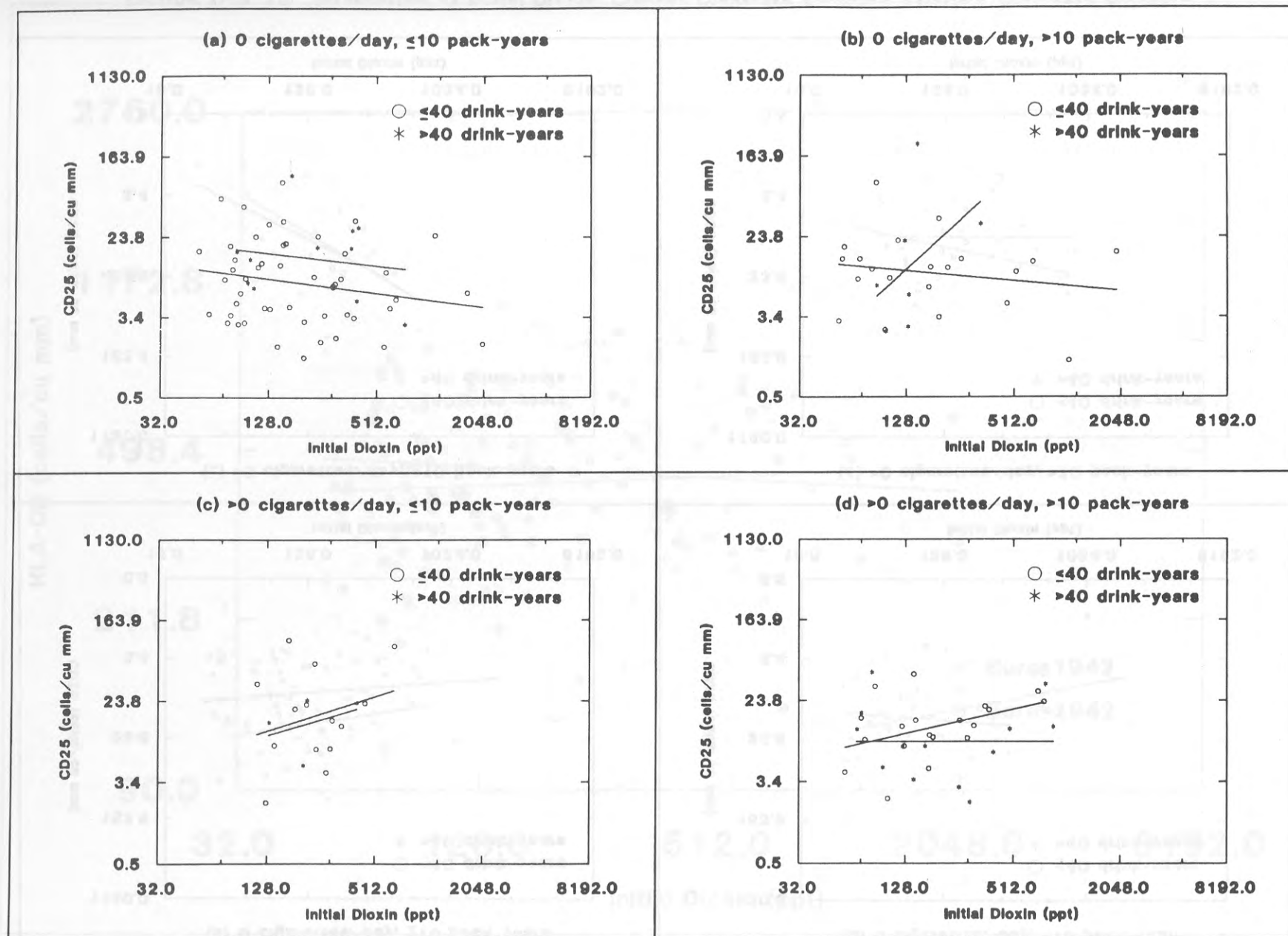


FIGURE O-2-12. Interaction of Initial Dioxin, Current Cigarette Smoking, Lifetime Cigarette Smoking History, and Lifetime Alcohol History for CD25 Cells (Ranch Hands, Minimal Assumption)

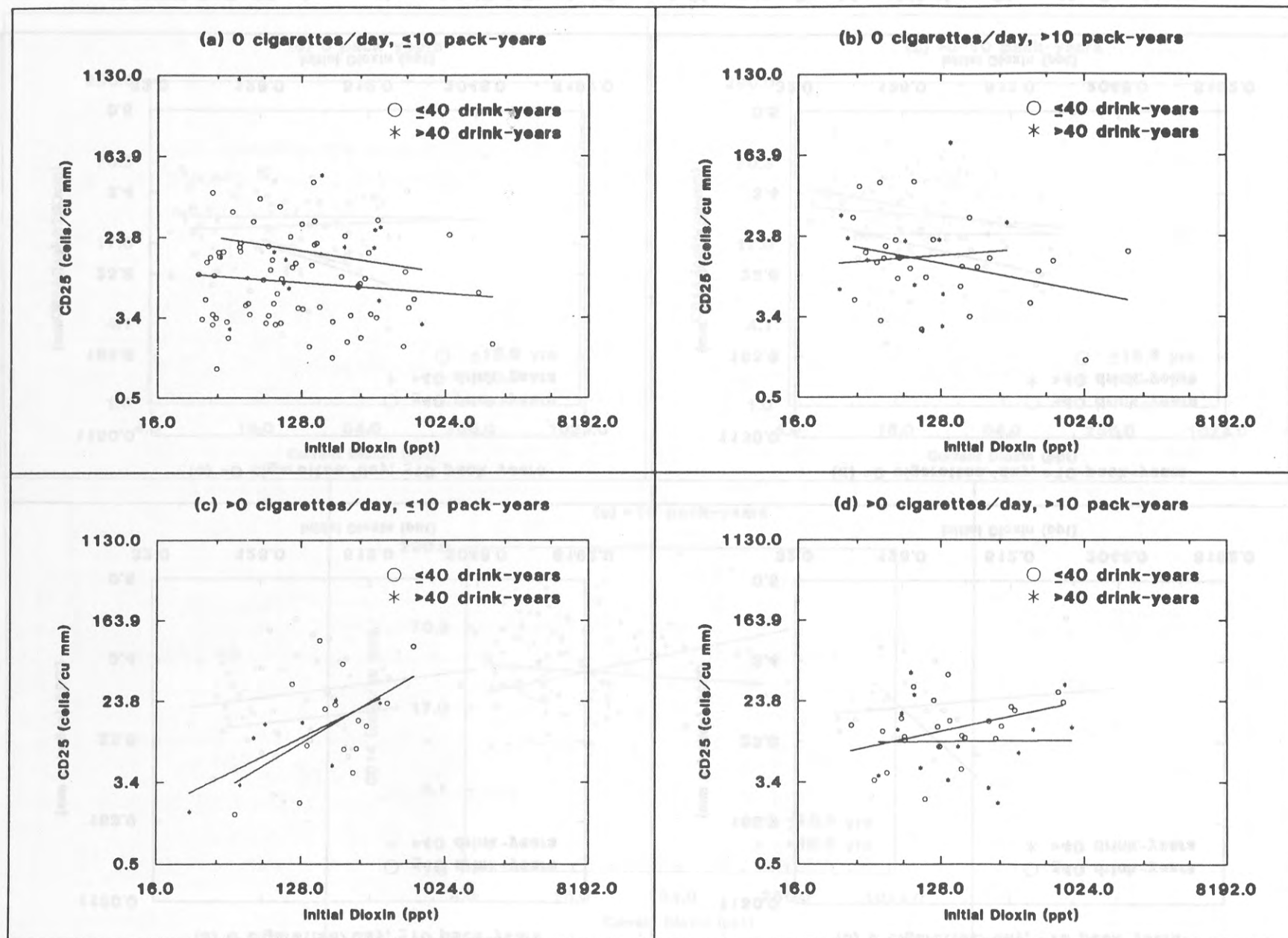


FIGURE O-2-13. Interaction of Initial Dioxin, Current Cigarette Smoking, Lifetime Cigarette Smoking History, and Lifetime Alcohol History for CD25 Cells (Ranch Hands, Maximal Assumption)

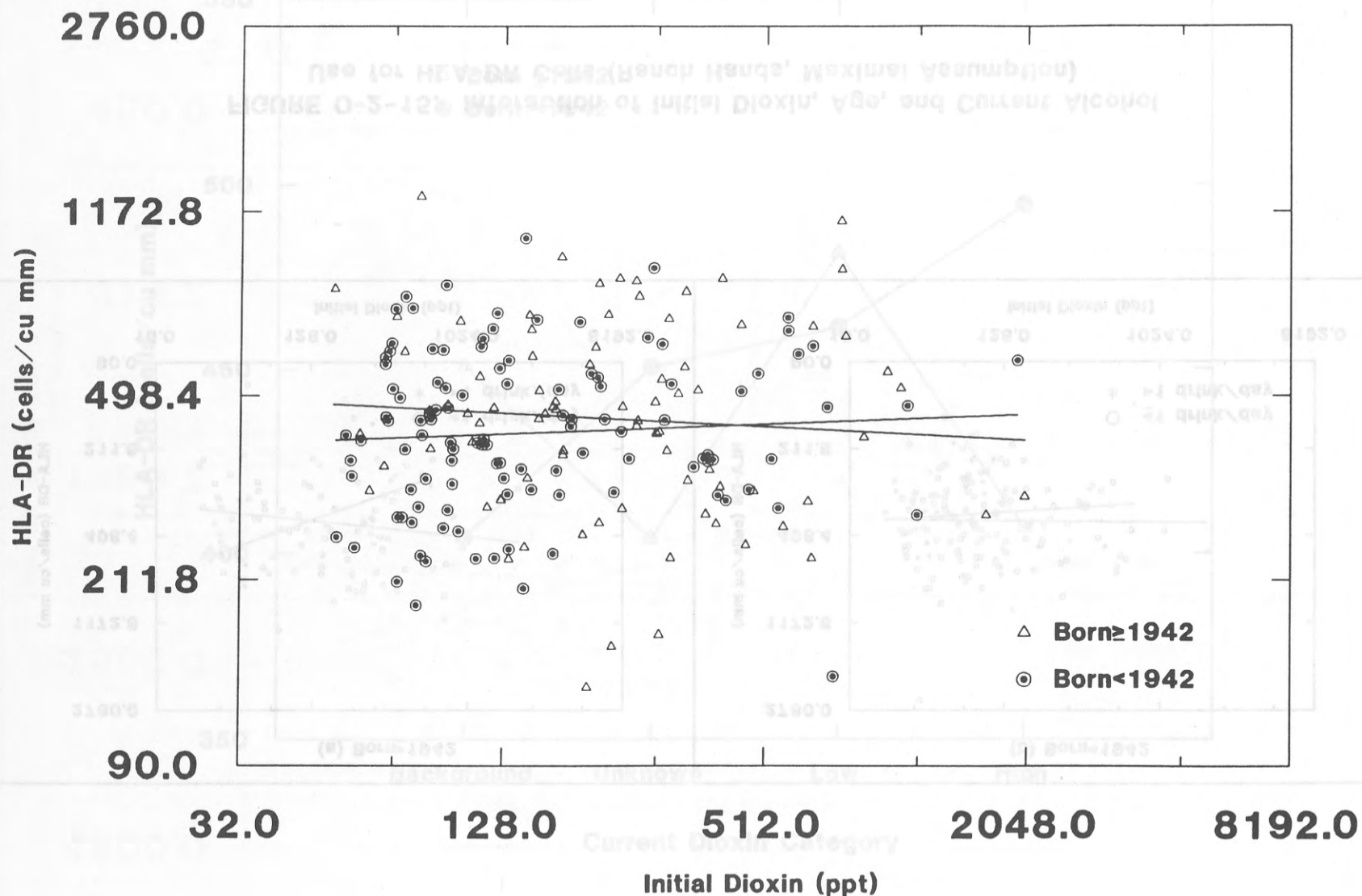


FIGURE O-2-14. Interaction of Initial Dioxin and Age for HLA-DR Cells (Ranch Hands, Minimal Assumption)

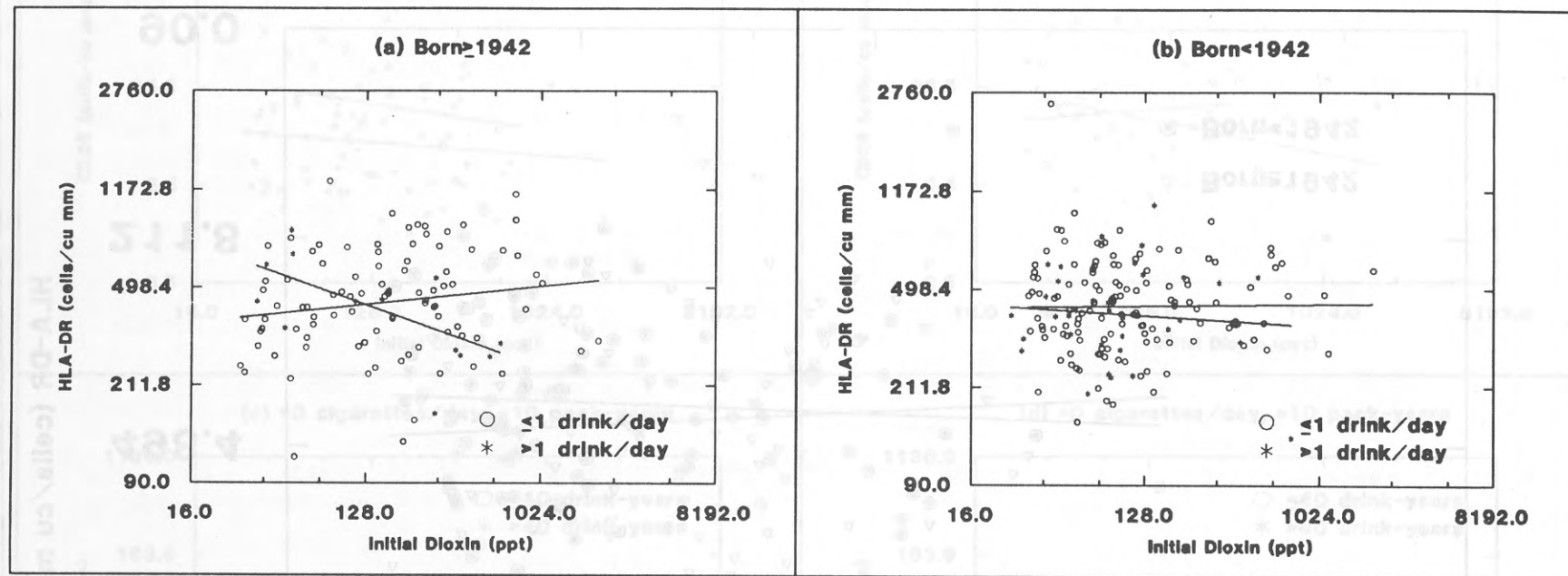


FIGURE O-2-15. Interaction of Initial Dioxin, Age, and Current Alcohol Use for HLA-DR Cells (Ranch Hands, Maximal Assumption)

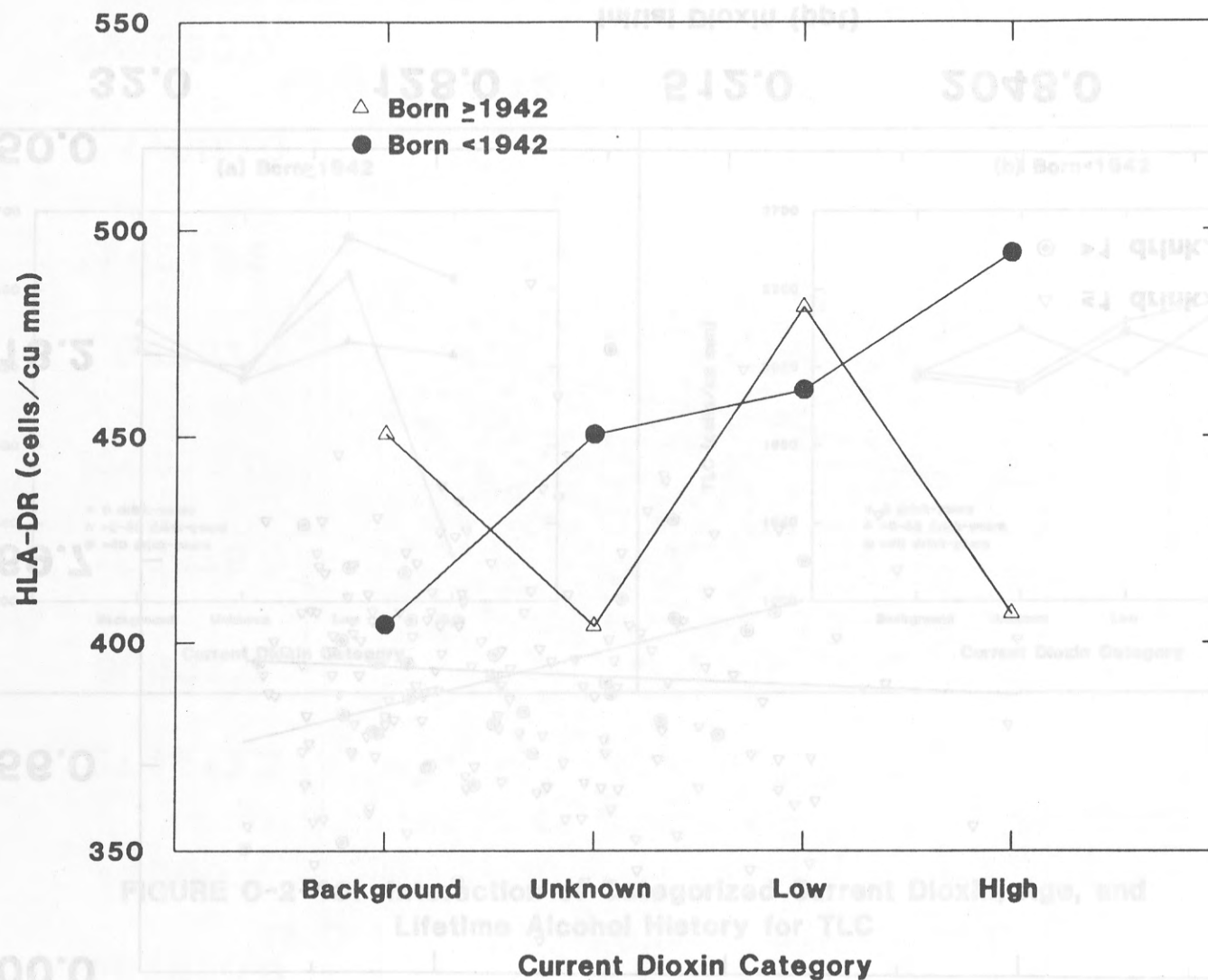


FIGURE O-2-16. Interaction of Categorized Current Dioxin and Age for HLA-DR Cells

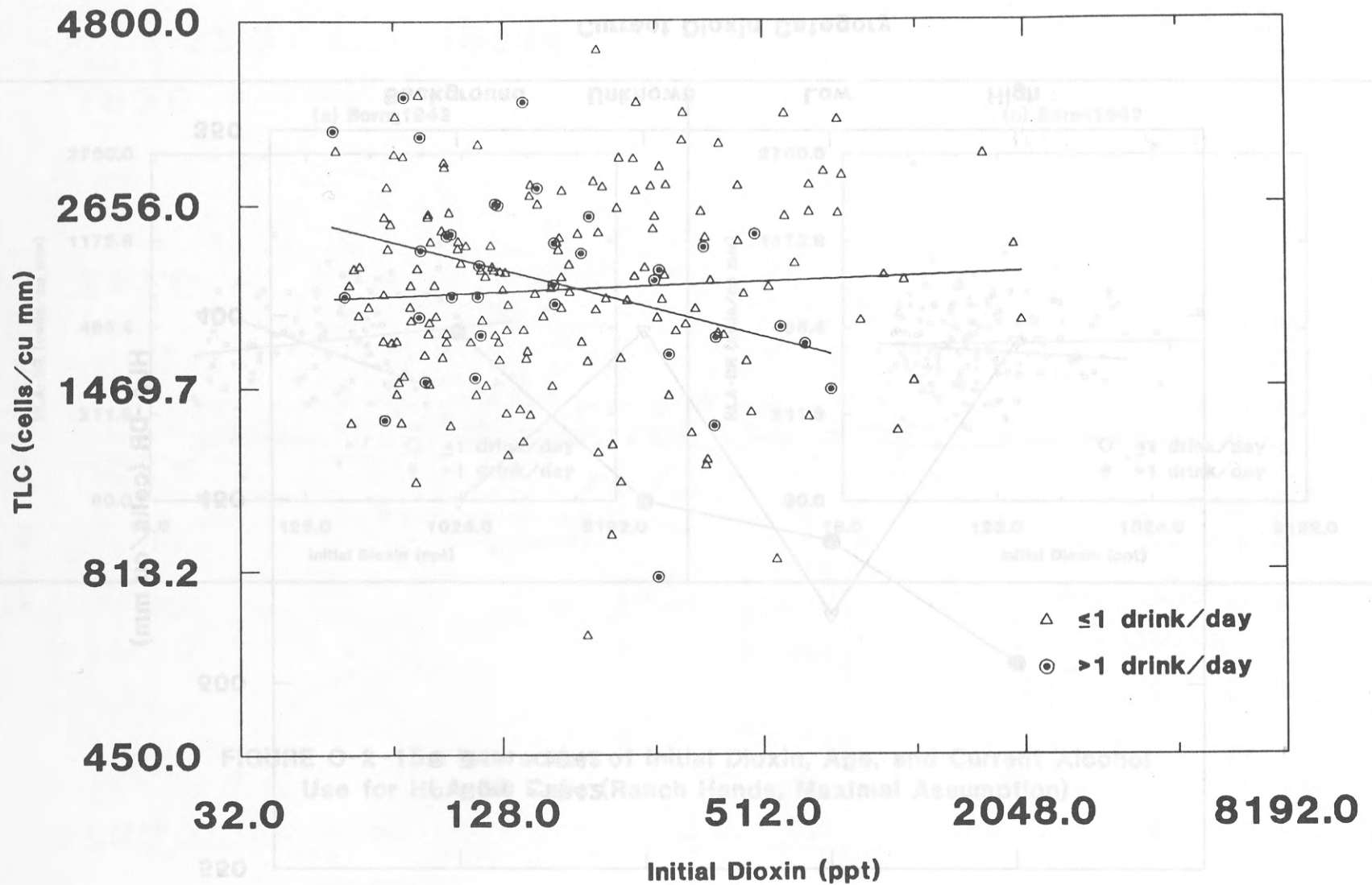


FIGURE O-2-17. Interaction of Initial Dioxin and Current Alcohol Use for TLC (Ranch Hands, Minimal Assumption)

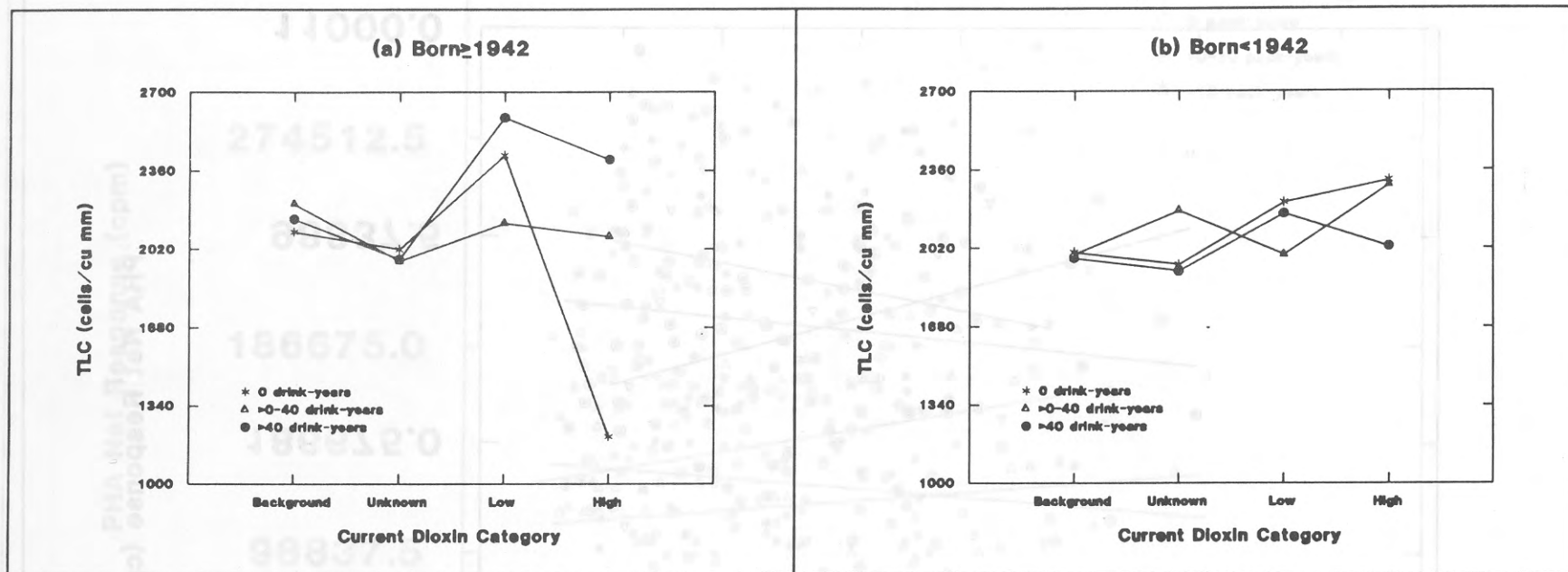


FIGURE O-2-18. Interaction of Categorized Current Dioxin, Age, and Lifetime Alcohol History for TLC

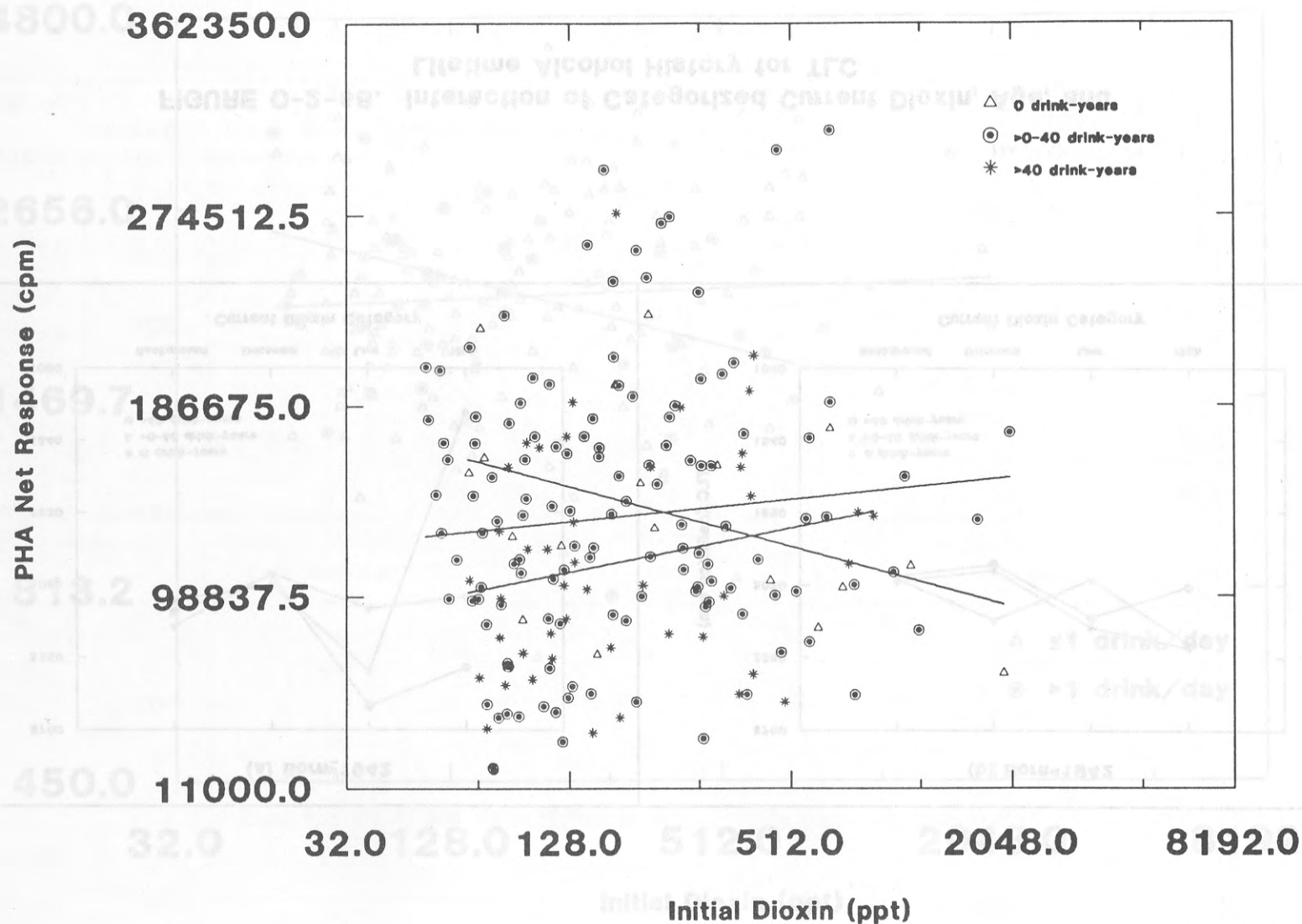


FIGURE O-2-19. Interaction of Initial Dioxin and Lifetime Alcohol History for PHA Net Response - Concentration 1 (Ranch Hands, Minimal Assumption)

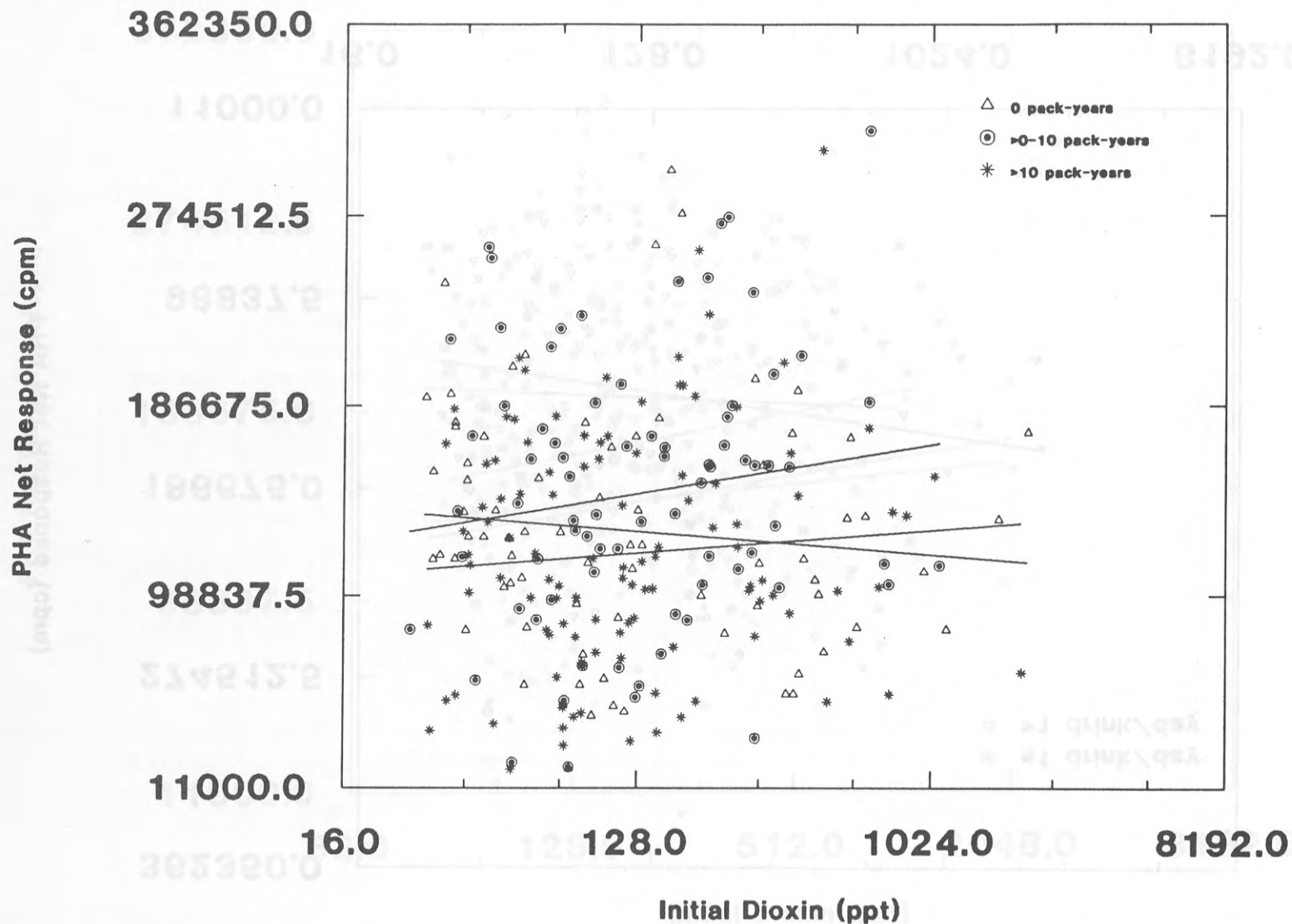


FIGURE O-2-20. Interaction of Initial Dioxin and Lifetime Cigarette Smoking History for PHA Net Response - Concentration 1 (Ranch Hands, Maximal Assumption)

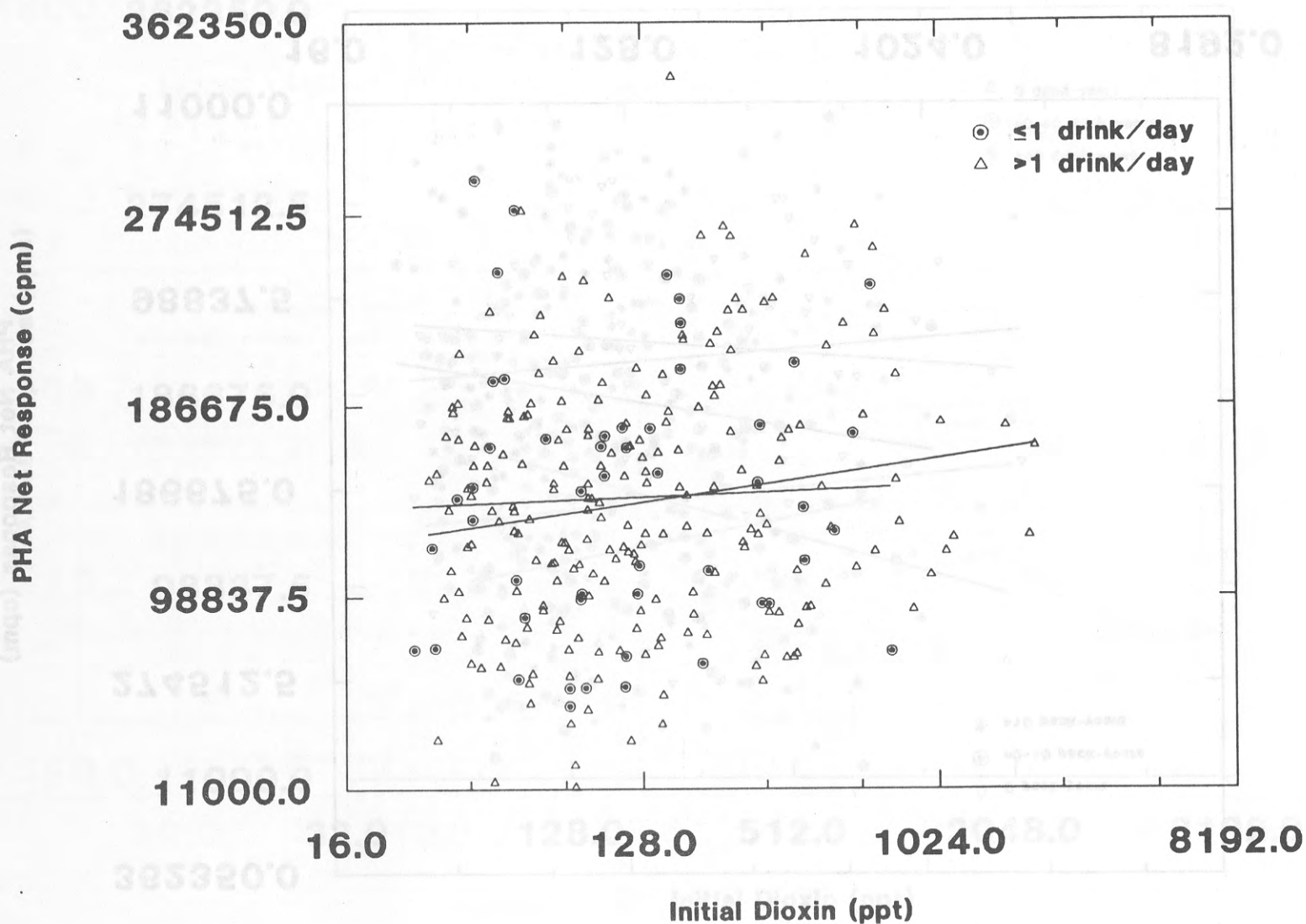


FIGURE O-2-21. Interaction of Initial Dioxin and Current Alcohol Use for PHA Net Response - Concentration 3 (Ranch Hands, Maximal Assumption)

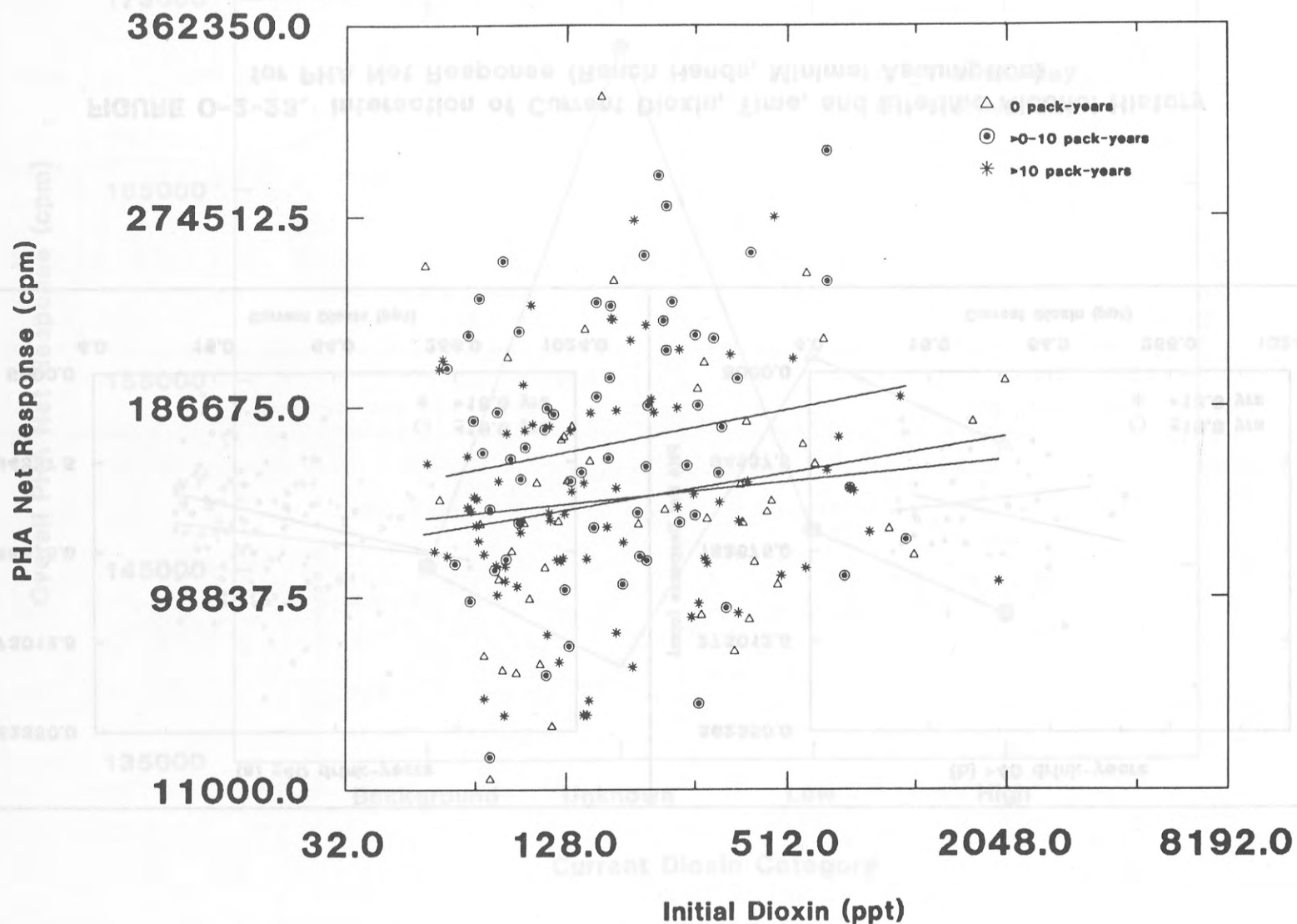


FIGURE O-2-22. Interaction of Initial Dioxin and Lifetime Cigarette Smoking History for PHA Net Response (Ranch Hands, Minimal Assumption)

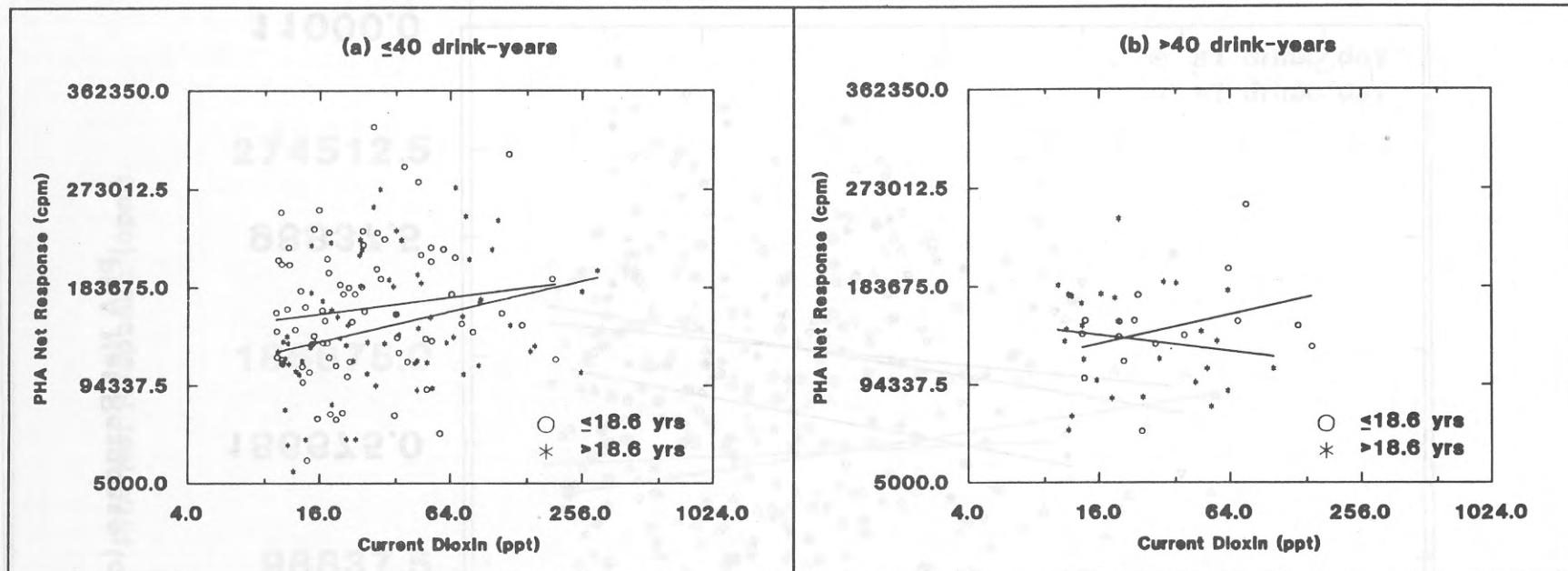


FIGURE O-2-23. Interaction of Current Dioxin, Time, and Lifetime Alcohol History for PHA Net Response (Ranch Hands, Minimal Assumption)

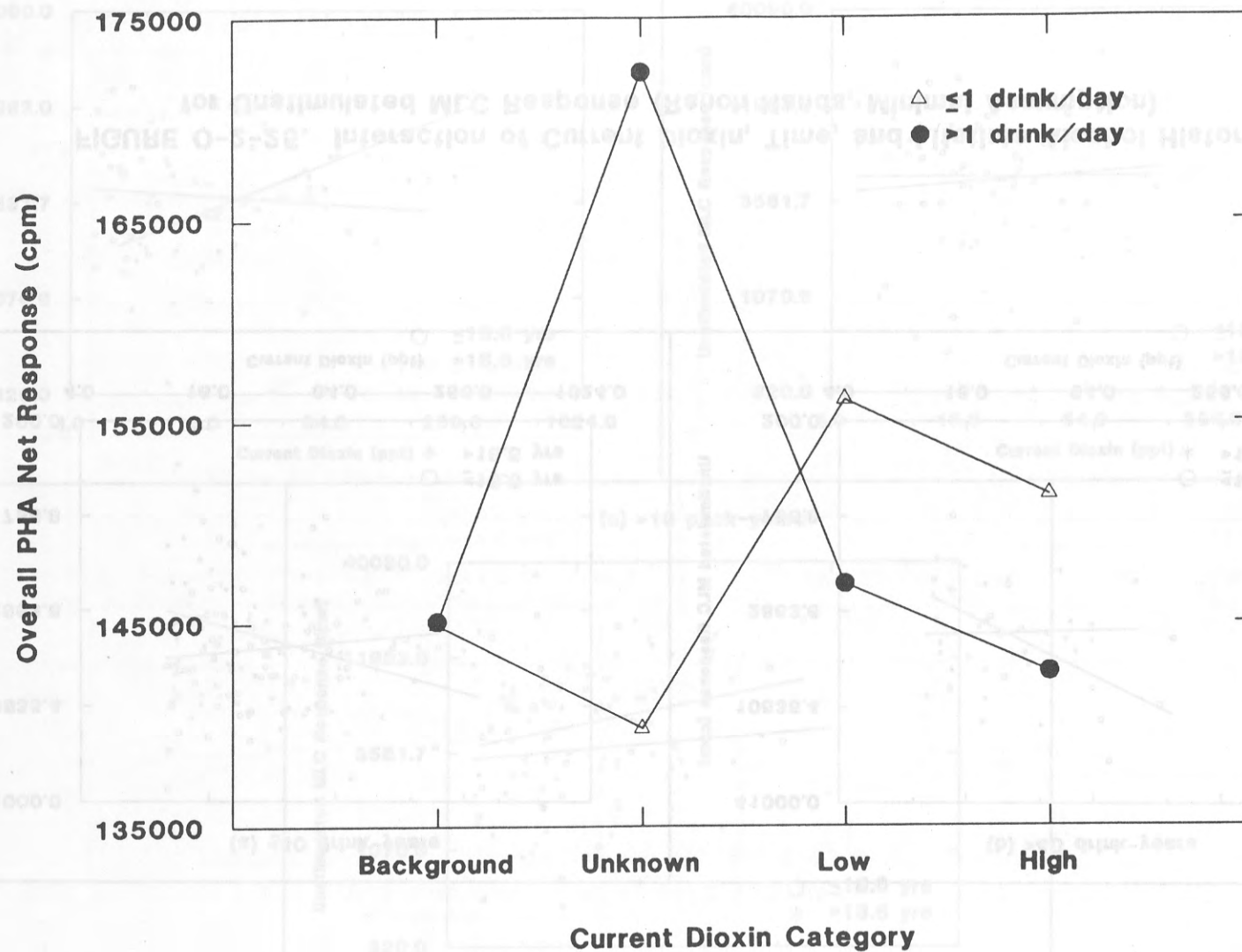


FIGURE O-2-24. Interaction of Categorized Current Dioxin and Current Alcohol Use for Overall PHA Net Response - Concentration 3

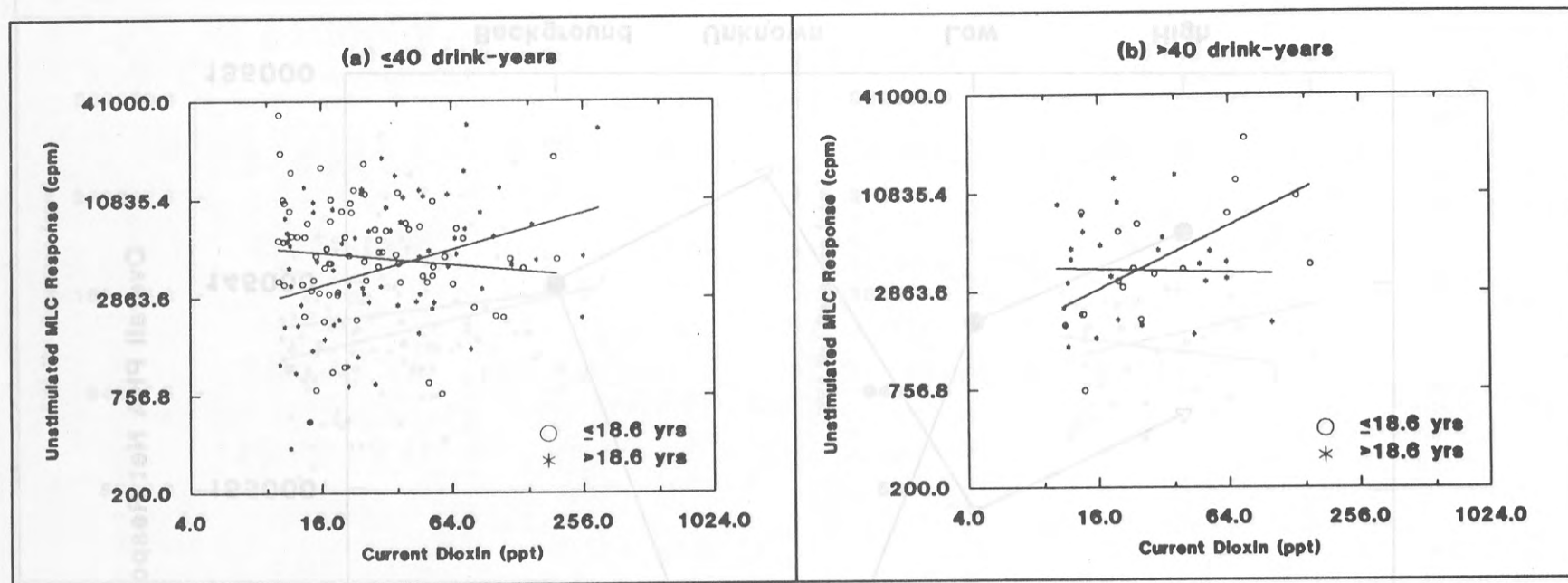


FIGURE O-2-25. Interaction of Current Dioxin, Time, and Lifetime Alcohol History for Unstimulated MLC Response (Ranch Hands, Minimal Assumption)

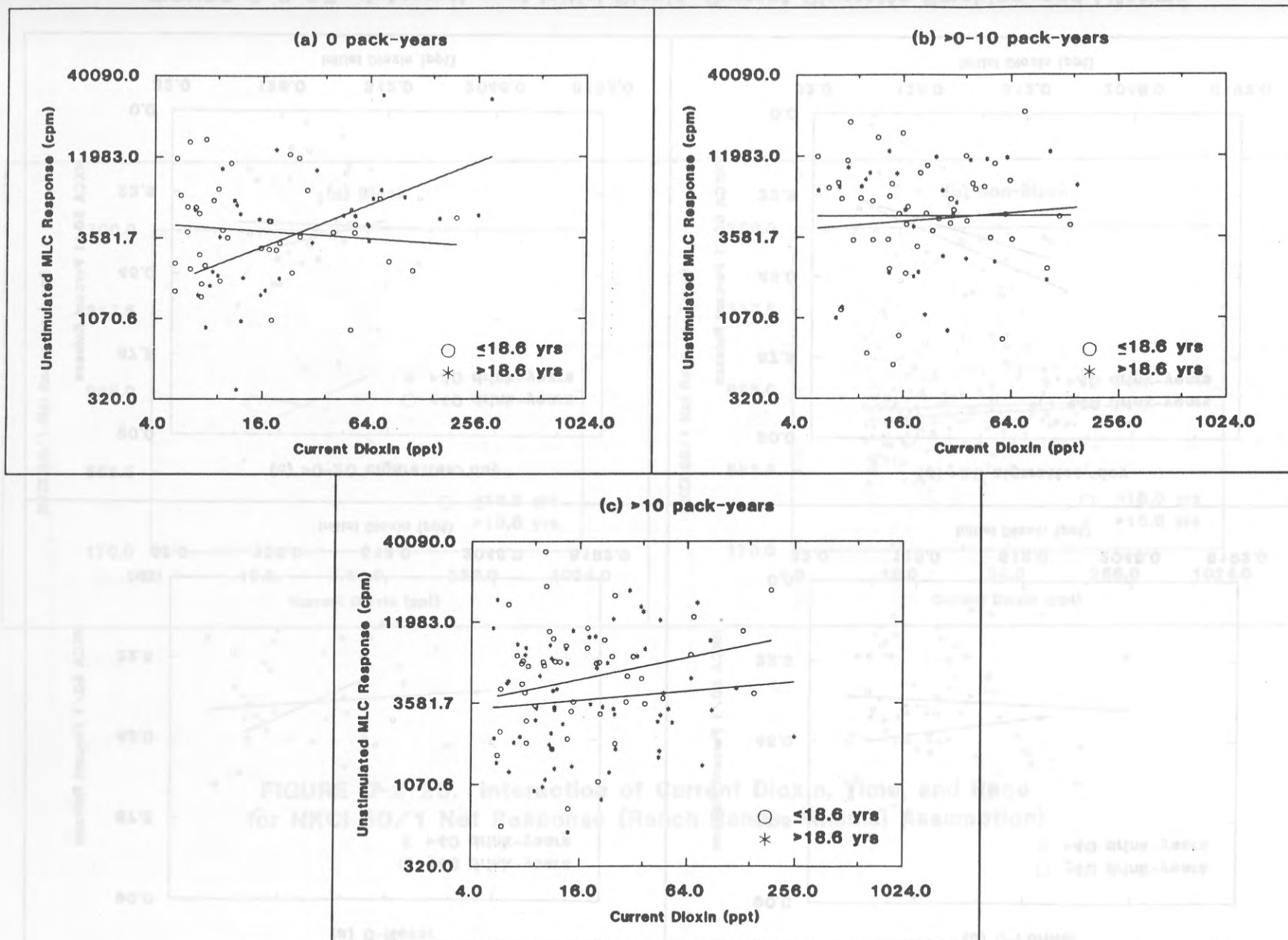


FIGURE O-2-26. Interaction of Current Dioxin, Time, and Lifetime Cigarette Smoking History for Unstimulated MLC Response (Ranch Hands, Maximal Assumption)

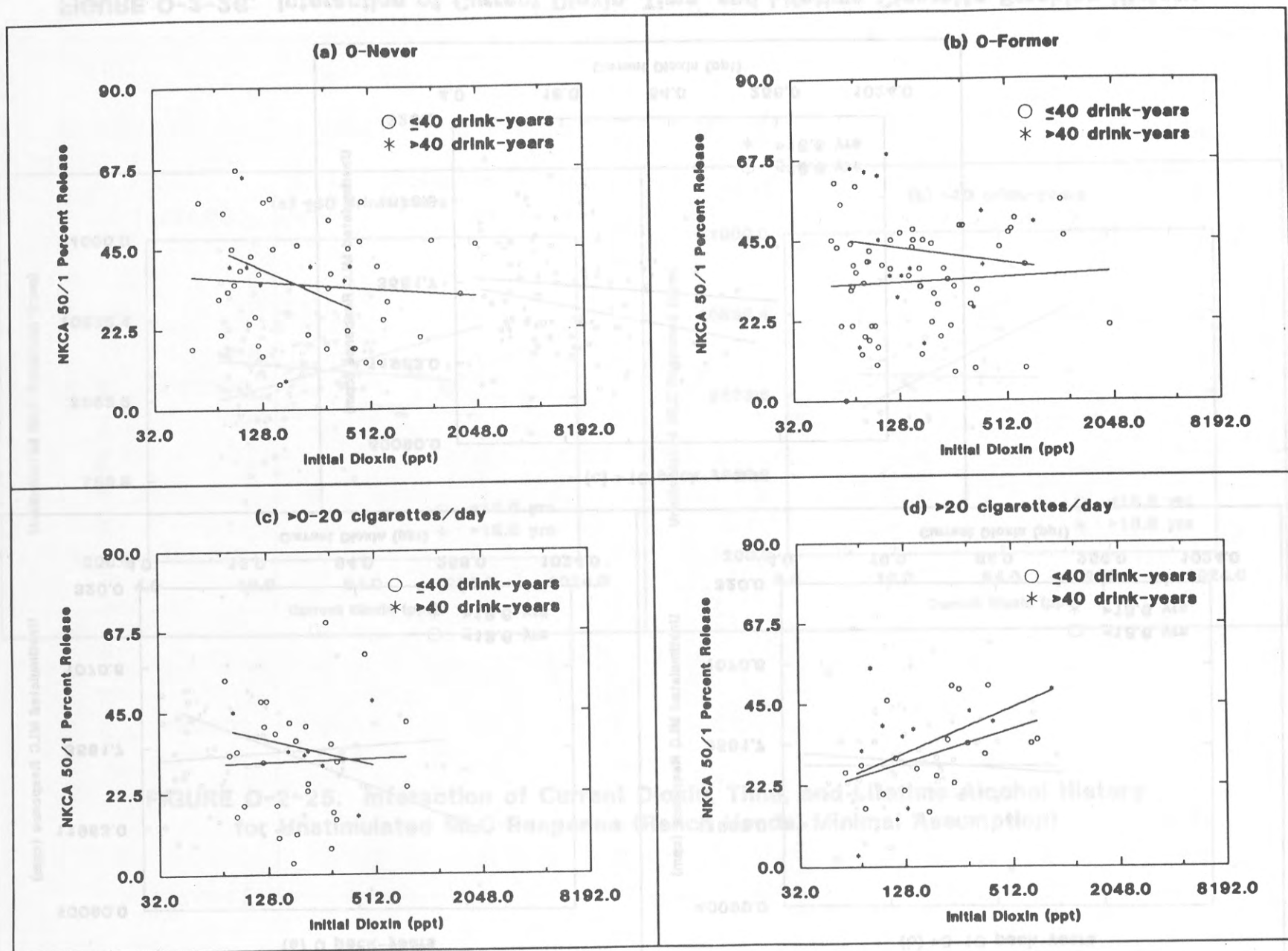


FIGURE O-2-27. Interaction of Initial Dioxin, Current Cigarette Smoking, and Lifetime Alcohol History for NKCA 50/1 Percent Release (Ranch Hands, Minimal Assumption)

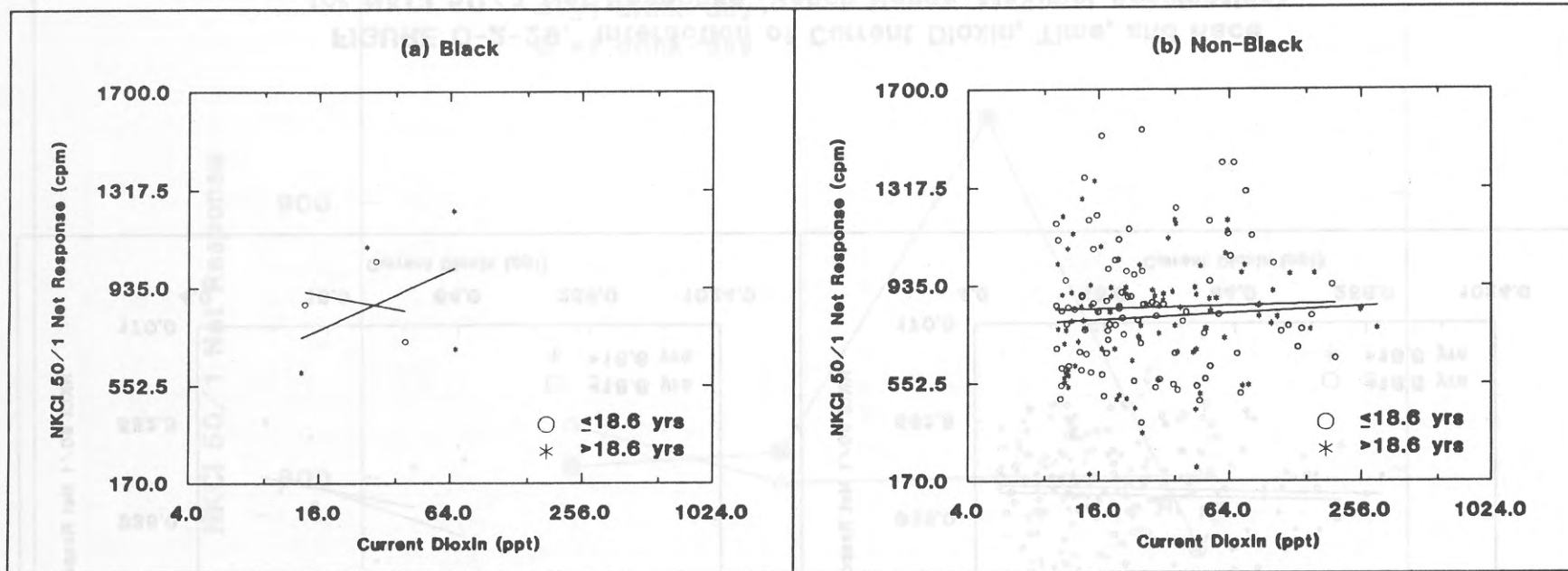


FIGURE O-2-28. Interaction of Current Dioxin, Time, and Race for NKCI 50/1 Net Response (Ranch Hands, Minimal Assumption)

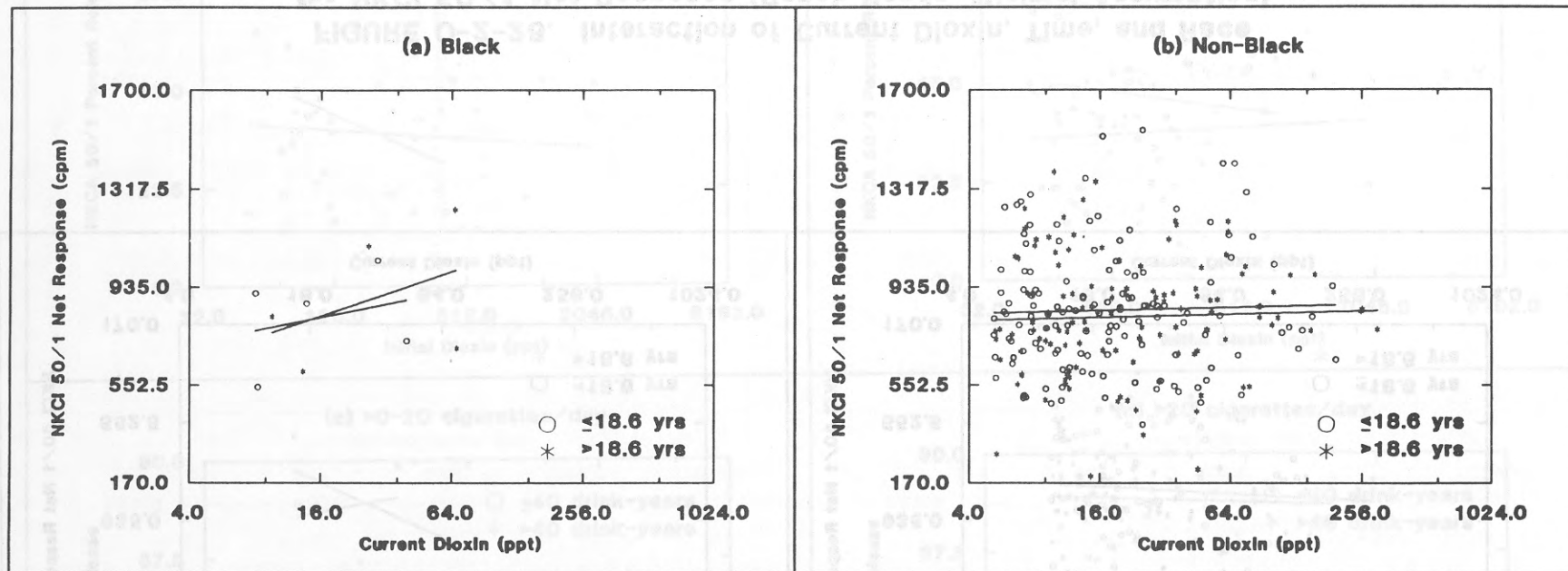


FIGURE O-2-29. Interaction of Current Dioxin, Time, and Race for NKCI 50/1 Net Response (Ranch Hands, Maximal Assumption)

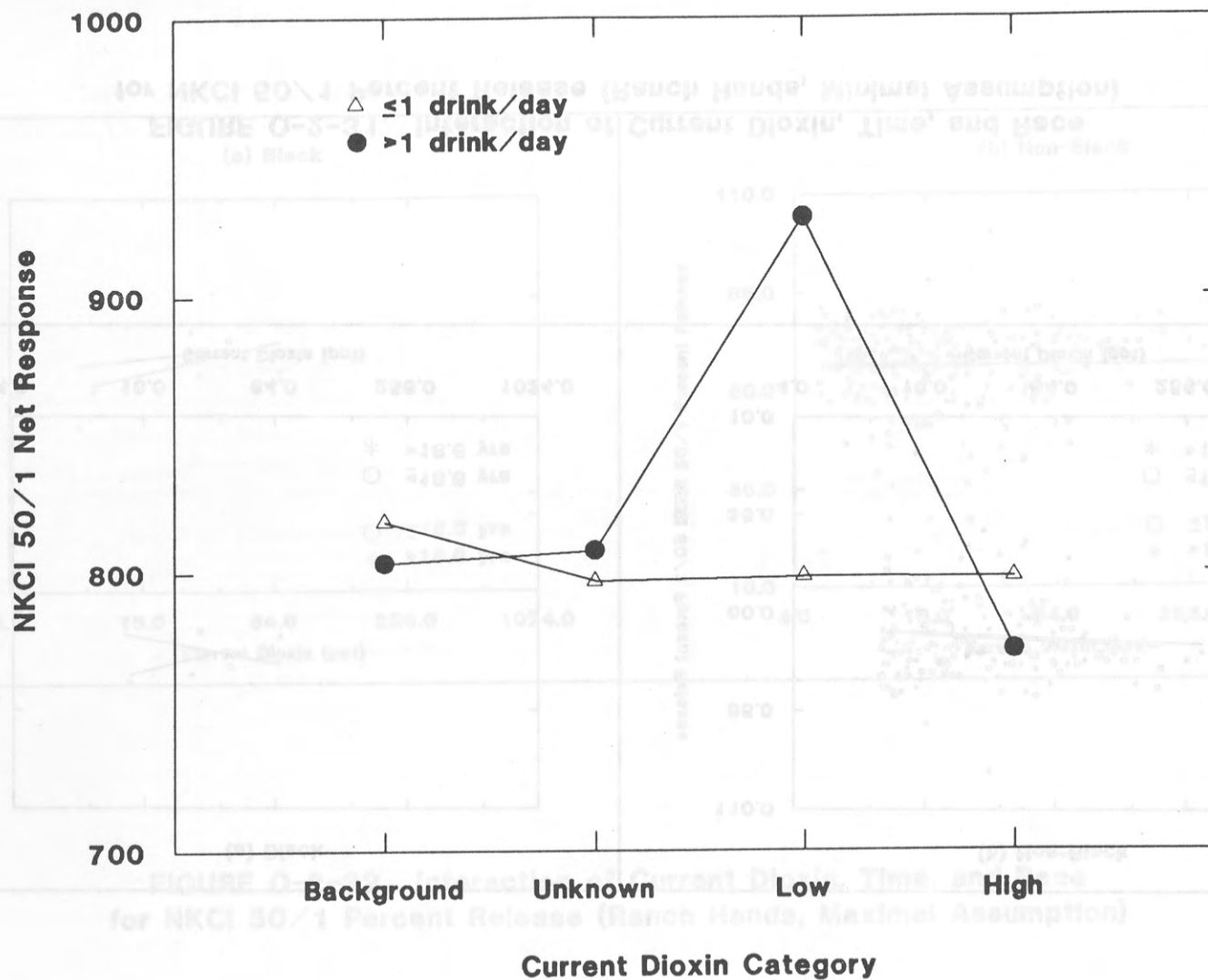


FIGURE O-2-30. Interaction of Categorized Current Dioxin and Current Alcohol Use for NKCI 50/1 Net Response (Non-Blacks only)

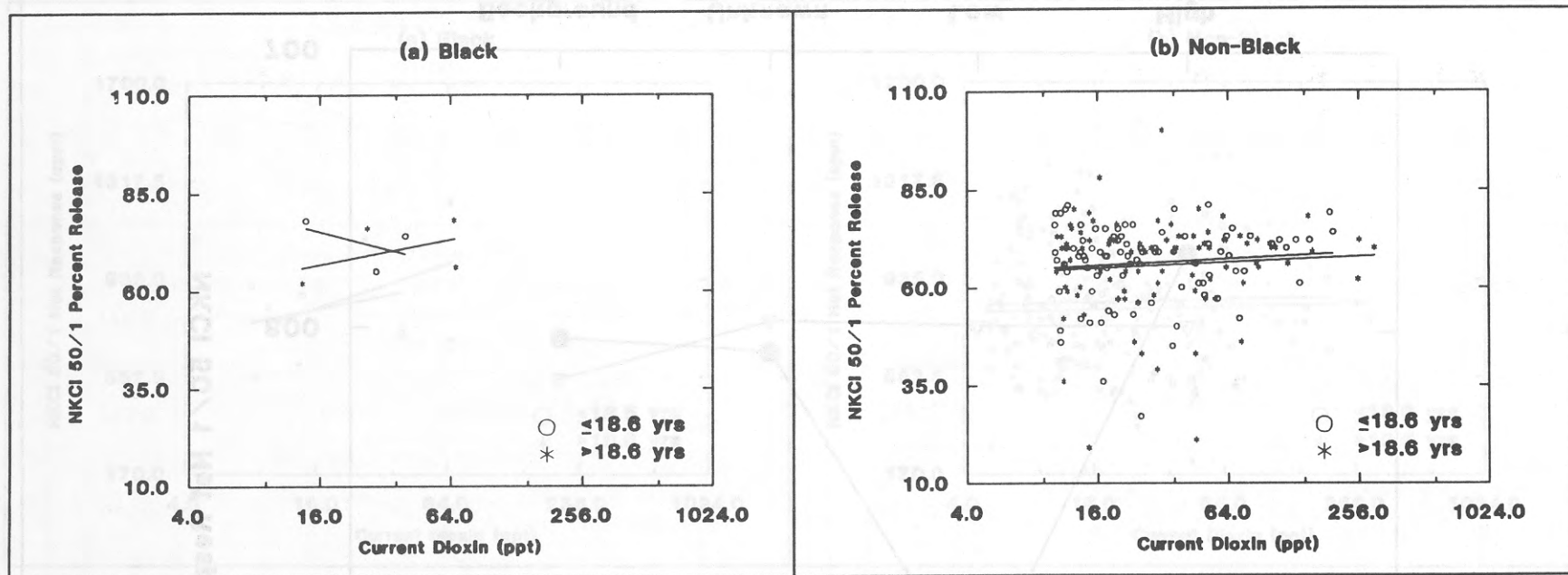


FIGURE O-2-31. Interaction of Current Dioxin, Time, and Race for NKCI 50/1 Percent Release (Ranch Hands, Minimal Assumption)

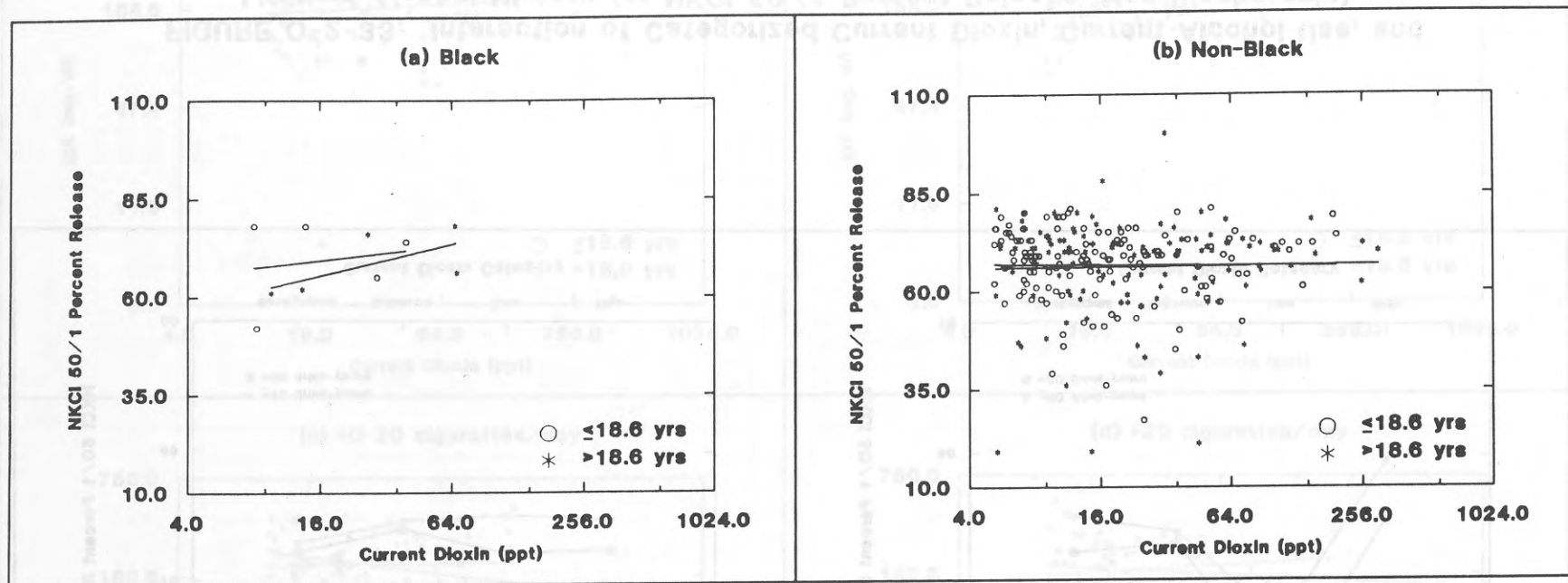


FIGURE O-2-32. Interaction of Current Dioxin, Time, and Race for NKCI 50/1 Percent Release (Ranch Hands, Maximal Assumption)

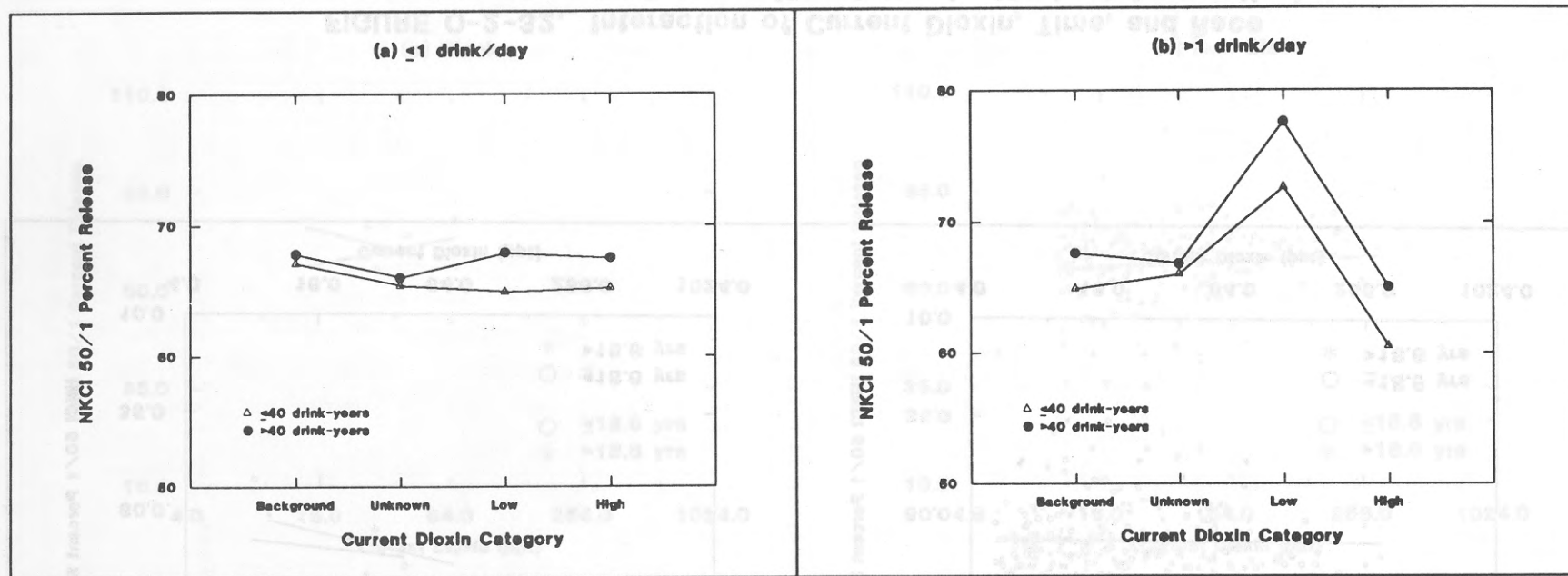


FIGURE O-2-33. Interaction of Categorized Current Dioxin, Current Alcohol Use, and Lifetime Alcohol History for NKCI 50/1 Percent Release (Non-Blacks only)

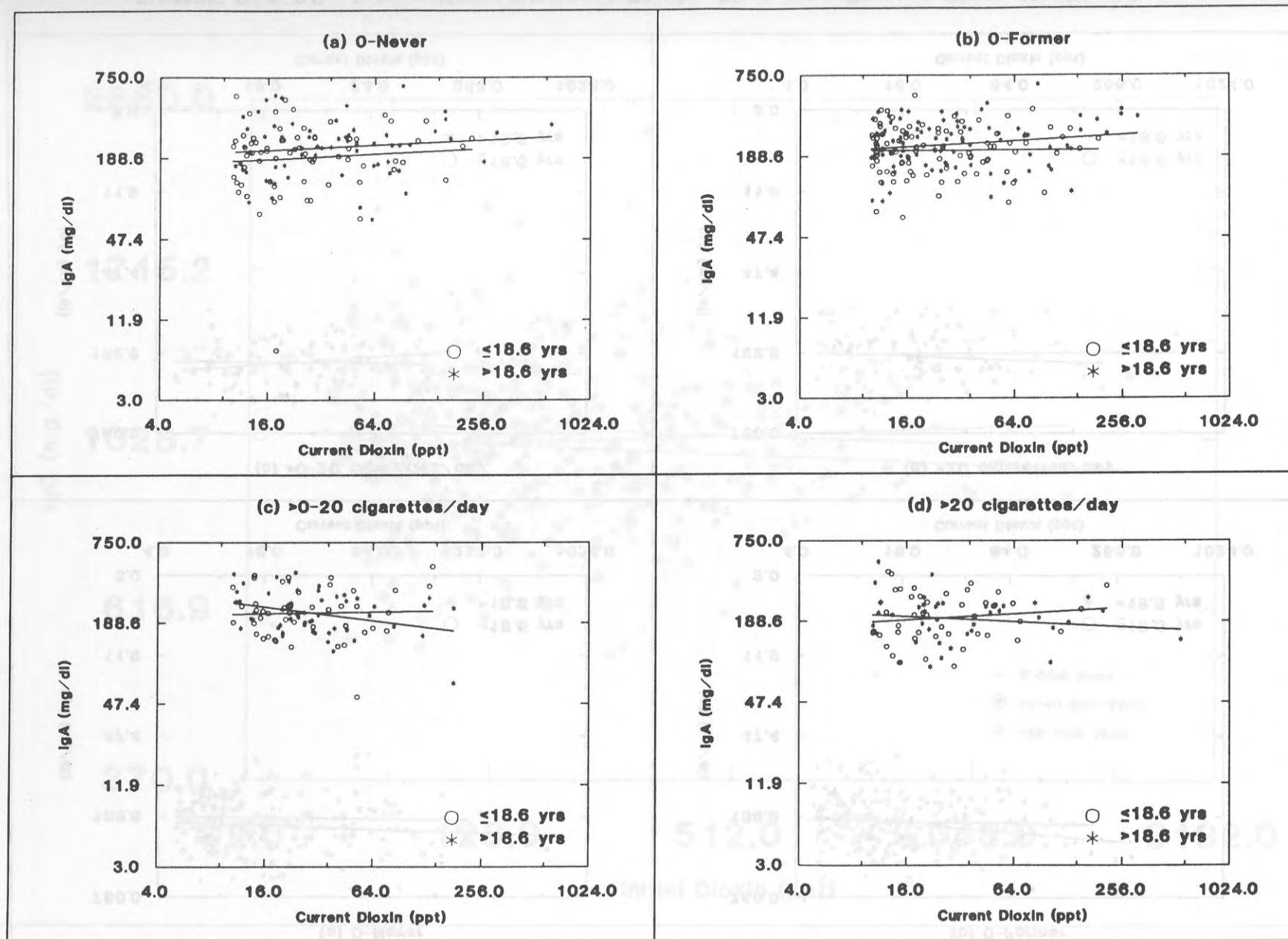


FIGURE O-2-34. Interaction of Current Dioxin, Time, and Current Cigarette Smoking for IgA (Ranch Hands, Minimal Assumption)

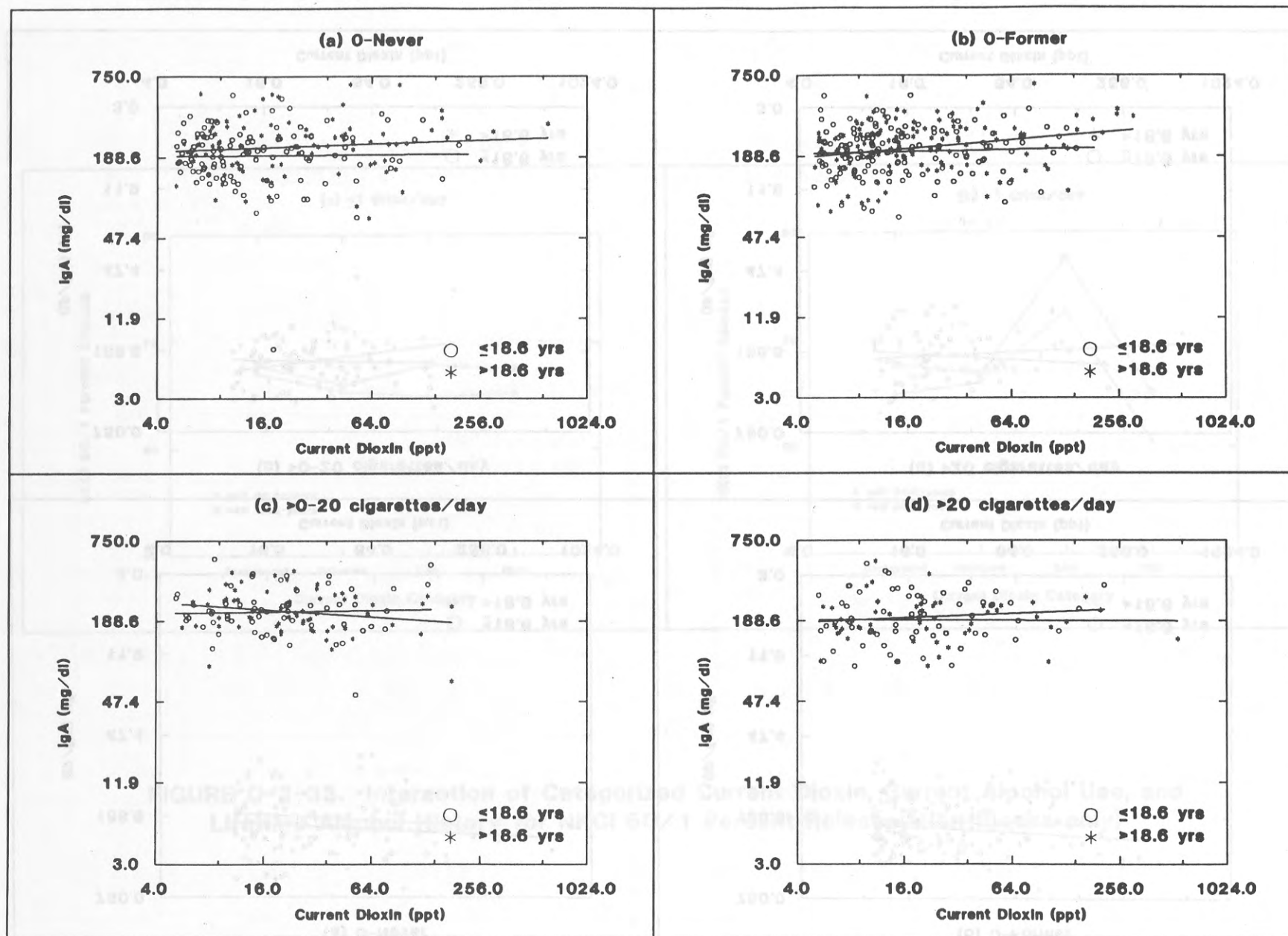
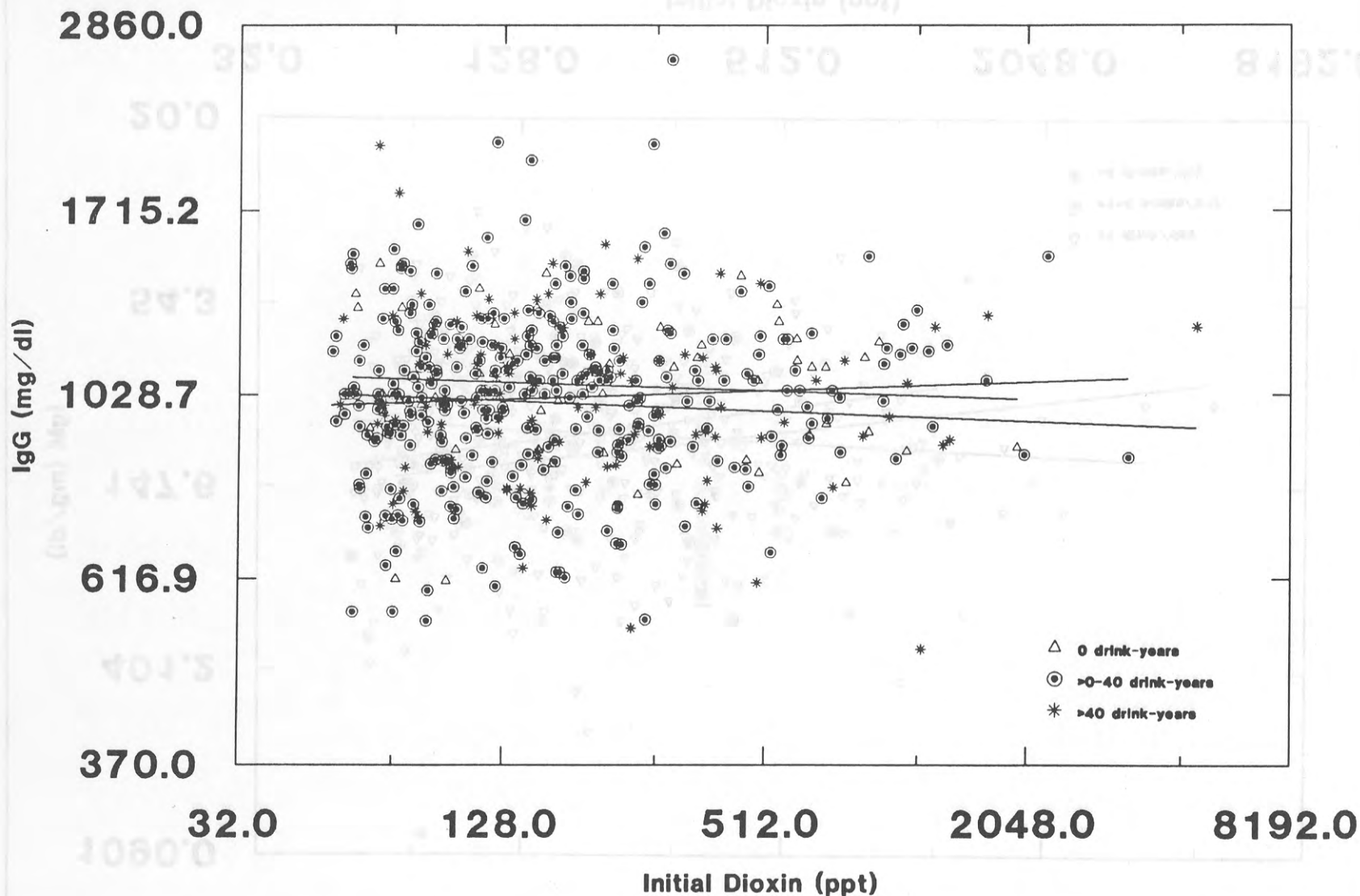
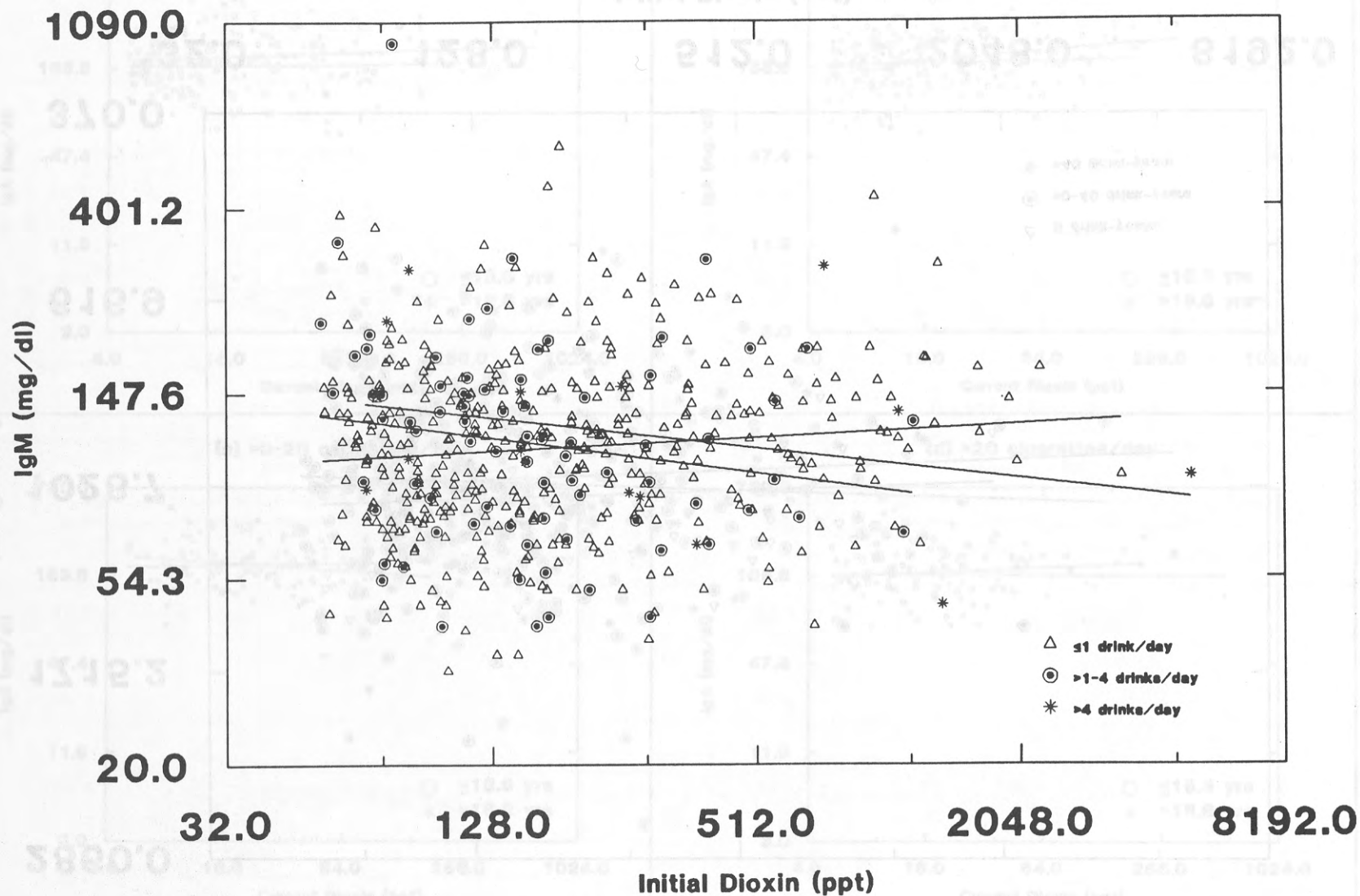


FIGURE O-2-35. Interaction of Current Dioxin, Time, and Current Cigarette Smoking for IgA (Ranch Hands, Maximal Assumption)



**FIGURE O-2-36. Interaction of Initial Dioxin and Lifetime Alcohol History for IgG
(Ranch Hands, Minimal Assumption)**



**FIGURE O-2-37. Interaction of Initial Dioxin and Current Alcohol Use for IgM
(Ranch Hands, Minimal Assumption)**

Appendix P

Pulmonary Assessment

TABLE P-1.

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

Ranch Hands - Log₂ (Initial Dioxin)

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Percent Yes	Adj. Relative Risk (95% C.I.) ^a	p-Value
Asthma (Minimal-- 17-3 [c])	Initial-by- Current Cigarette Smoking	0-Never	Low	34	2.9	1.15 (0.47,2.87)	0.756
			Medium	61	0.0		
			High	39	5.1		
		0-Former	Low	57	1.8	1.15 (0.66,2.03)	0.618
			Medium	89	4.5		
			High	46	6.5		
		>0-20	Low	18	11.1	0.06 (0.00,1.15)	0.062
			Medium	60	1.7		
			High	23	0.0		
		>20	Low	19	10.5	0.00 (0.00,1.09)	0.052
			Medium	48	0.0		
			High	21	0.0		
Asthma (Maximal-- 17-3 [d])	Initial-by- Current Cigarette Smoking	0-Never	Low	61	4.9	0.80 (0.45,1.43)	0.454
			Medium	91	2.2		
			High	52	3.9		
		0-Former	Low	71	1.4	1.38 (0.88,2.15)	0.158
			Medium	141	3.6		
			High	64	4.7		
		>0-20	Low	23	0.0	0.54 (0.16,1.82)	0.319
			Medium	71	4.2		
			High	37	0.0		
		>20	Low	28	17.9	0.29 (0.09,0.91)	0.034
			Medium	63	1.6		
			High	30	0.0		

TABLE P-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

Ranch Hands - Log ₂ (Current Dioxin) and Time								
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Percent Yes/(n) Current Dioxin			Adj. Relative Risk (95% C.I.) ^a	p-Value
				Low	Medium	High		
Bronchitis (Minimal-- 17-4 [g])	Current-by- Time-by- Race	Black	≤18.6	14.3 (7)	14.3 (7)	0.0 (0)	--	--
			>18.6	0.0 (4)	0.0 (11)	66.7 (3)	--	--
		Non-Black	≤18.6	15.3 (59)	12.5 (120)	7.7 (52)	0.70 (0.45,1.08)	0.415 ^b 0.106 ^c
			>18.6	17.3 (52)	15.5 (116)	11.0 (73)	0.87 (0.64,1.17)	0.344 ^c
Bronchitis (Maximal-- 17-4 [h])	Current-by- Time-by- Race	Black	≤18.6	50.0 (4)	16.7 (12)	0.0 (2)	--	--
			>18.6	0.0 (1)	0.0 (13)	33.3 (6)	--	--
		Non-Black	≤18.6	17.9 (95)	13.4 (172)	8.9 (79)	0.73 (0.56,0.97)	0.265 ^b 0.030 ^c
			>18.6	15.8 (76)	15.0 (160)	12.5 (96)	0.90 (0.57,1.41)	0.634 ^c

TABLE P-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Percent Yes	Contrast	Adj. Relative Risk (95% C.I.)	p-Value
Bronchitis (17-4 [j])	Categorized Current Dioxin-by- Age	Born $\geq$ 1942	Background	315	10.5	All		0.196
			Unknown	115	18.3	U vs. B	1.80 (0.98,3.28)	0.057
			Low	81	9.9	L vs. B	0.93 (0.41,2.10)	0.853
			High	116	14.7	H vs. B	1.52 (0.81,2.85)	0.196
		Born <1942	Background	447	15.0	All		0.130
			Unknown	218	15.0	U vs. B	1.01 (0.64,1.59)	0.970
			Low	110	16.4	L vs. B	1.09 (0.61,1.93)	0.778
			High	67	6.0	H vs. B	0.35 (0.12,1.00)	0.050

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Percent Yes/(n) Current Dioxin			Adj. Relative Risk (95% C.I.) ^a	p-Value
				Low	Medium	High		
Pleurisy (Minimal-- 17-5 [gl])	Current-by- Time-by- Race	Black	$\leq$ 18.6	14.3 (7)	0.0 (7)	0.0 (0)	--	--
			>18.6	0.0 (4)	0.0 (11)	33.3 (3)	--	--
		Non-Black	$\leq$ 18.6	0.0 (65)	0.8 (121)	5.6 (54)	1.57 (0.69,3.54)	0.463 ^b 0.280 ^c
			>18.6	3.7 (54)	4.2 (119)	4.1 (73)	1.10 (0.69,1.76)	0.696 ^c

TABLE P-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

Ranch Hands - Log₂ (Current Dioxin) and Time								
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Percent Yes/(n) Current Dioxin			Adj. Relative Risk (95% C.I.) ^a	p-Value
				Low	Medium	High		
Pleurisy (Maximal-- 17-5 [h])	Current-by- Time-by- Race	Black	≤18.6	0.0 (4)	8.3 (12)	0.0 (2)	--	--
			>18.6	0.0 (1)	0.0 (13)	16.7 (6)	--	--
		Non-Black	≤18.6	2.9 (102)	1.1 (179)	3.7 (81)	1.02 (0.57,1.81)	0.668 ^b 0.950 ^c
			>18.6	2.6 (77)	3.1 (163)	5.2 (97)	1.18 (0.81,1.72)	0.395 ^c
Thorax and Lung Abnormalities (Minimal-- 17-8 [g])	Current-by- Time-by-Age	Born ≥1942	≤18.6	0.0 (24)	4.6 (66)	0.0 (41)	0.78 (0.25,2.39)	0.640 ^b 0.660 ^c
			>18.6	8.3 (12)	4.0 (50)	6.8 (44)	1.05 (0.56,2.00)	0.872 ^c
		Born <1942	≤18.6	2.1 (48)	16.1 (62)	7.7 (13)	1.89 (1.04,3.45)	0.150 ^b 0.038 ^c
			>18.6	15.2 (46)	11.0 (82)	15.2 (33)	1.11 (0.74,1.68)	0.603 ^c
Wheezes (Minimal-- 17-11 [g])	Current-by- Time-by-Age	Born ≥1942	≤18.6	0.0 (24)	1.5 (66)	0.0 (41)	0.75 (0.11,5.21)	0.417 ^b 0.775 ^c
			>18.6	0.0 (12)	2.0 (50)	6.8 (44)	1.70 (0.77,3.76)	0.188 ^c
		Born <1942	≤18.6	0.0 (48)	4.8 (62)	7.7 (13)	2.69 (1.13,6.40)	0.067 ^b 0.026 ^c
			>18.6	6.5 (46)	2.4 (82)	6.1 (33)	0.98 (0.48,1.98)	0.949 ^c

TABLE P-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

Ranch Hands - Log₂ (Initial Dioxin)

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
FVC (Minimal-- 17-14 [c])	Initial-by- Current Cigarette Smoking	0-Never	Low	34	95.4	-2.446 (0.808)	0.003
			Medium	61	92.6		
			High	40	86.9		
		0-Former	Low	58	91.1	-0.993 (0.702)	0.158
			Medium	91	92.7		
			High	47	88.6		
		>0-20	Low	18	88.2	-0.020 (1.204)	0.987
			Medium	60	88.0		
			High	23	90.2		
		>20	Low	20	92.2	0.721 (1.027)	0.483
			Medium	48	88.0		
			High	21	93.7		

TABLE P-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

Ranch Hands and Comparisons by Current Dioxin Category								
Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value
FVC (17-14 [j])	Categorized Current Dioxin-by- Current Cigarette Smoking	0-Never	Background	217	92.4	All		<0.001
			Unknown	101	95.2	U vs. B	2.7 (-0.2,5.7)	0.072
			Low	49	92.1	L vs. B	-0.3 (-4.2,3.6)	0.867
			High	54	85.9	H vs. B	-6.6 (-10.3,-2.8)	<0.001
		0-Former	Background	326	93.0	All		0.005
			Unknown	126	94.1	U vs. B	1.1 (-1.5,3.7)	0.400
			Low	68	92.4	L vs. B	-0.5 (-3.8,2.7)	0.746
			High	64	87.4	H vs. B	-5.6 (-9.0,-2.2)	0.001
		>0-20	Background	127	91.4	All		0.094
			Unknown	58	91.8	U vs. B	0.4 (-3.5,4.3)	0.830
			Low	45	87.5	L vs. B	-3.8 (-8.1,0.4)	0.077
			High	37	87.0	H vs. B	-4.3 (-8.9,0.3)	0.067
		>20	Background	116	88.4	All		0.591
			Unknown	59	90.3	U vs. B	1.9 (-2.0,5.9)	0.338
			Low	34	88.1	L vs. B	-0.3 (-5.1,4.5)	0.910
			High	32	91.0	H vs. B	2.7 (-2.2,7.6)	0.286

APPENDIX P-1
TABLE P-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

The following figures graphically display relationships between the dependent variables

Ranch Hands - Log₂ (Initial Dioxin)

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
FEV ₁ (Minimal-- 17-15 [c])	Initial-by- Current Cigarette Smoking	0-Never	Low	34	100.3	-2.118 (0.930)	0.023
			Medium	61	96.8		
			High	40	92.7		
		0-Former	Low	58	95.6	-0.722 (0.807)	0.372
			Medium	91	93.6		
			High	47	93.1		
		>0-20	Low	18	89.8	0.824 (1.385)	0.552
			Medium	60	89.8		
			High	23	94.5		
		>20	Low	20	91.6	1.382 (1.182)	0.243
			Medium	48	87.8		
			High	21	95.8		
		All	Low	116	87.0		
			Medium	59	87.0		
			High	32	92.7		
		Unknown	Low	34	87.1		
			Medium	59	87.0		
			High	32	92.7		

Note: Initial Dioxin: Minimal-Low: 32-53 ppt; Medium: >53-202 ppt; High: >202 ppt.
Current Dioxin: Minimal-Low: >10-14.65 ppt; Medium: >14.65-42.75 ppt; High: >42.75 ppt.
Maximal-Low: >2.9-0.01 ppt; Medium: >0.01-33.3 ppt; High: >33.3 ppt.

TABLE P-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Pulmonary Variables

Ranch Hands and Comparisons by Current Dioxin Category								
Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value
FEV ₁ (17-15 [j])	Categorized Current Dioxin-by- Current Cigarette Smoking	0-Never	Background	217	96.6	All		0.034
			Unknown	101	99.2	U vs. B	2.6 (-0.8,6.0)	0.137
			Low	49	95.6	L vs. B	-1.0 (-5.4,3.5)	0.663
			High	54	92.0	H vs. B	-4.6 (-8.9,-0.2)	0.039
		0-Former	Background	326	95.3	All		0.228
			Unknown	126	95.0	U vs. B	-0.3 (-3.2,2.7)	0.848
			Low	68	93.9	L vs. B	-1.4 (-5.1,2.4)	0.468
			High	64	91.3	H vs. B	-4.0 (-7.9,-0.1)	0.043
		>0-20	Background	127	91.2	All		0.572
			Unknown	58	91.7	U vs. B	0.5 (-4.0,5.0)	0.815
			Low	45	88.3	L vs. B	-2.9 (-7.7,2.0)	0.248
			High	37	89.3	H vs. B	-1.9 (-7.2,3.4)	0.491
		>20	Background	116	87.0	All		0.225
			Unknown	59	87.0	U vs. B	0.0 (-4.5,4.5)	0.990
			Low	34	87.1	L vs. B	0.1 (-5.4,5.6)	0.973
			High	32	92.7	H vs. B	5.7 (0.1,11.3)	0.046

^aRelative risk for a twofold increase in dioxin.

^bTest of significance for homogeneity of relative risks (current dioxin continuous, time categorized).

^cTest of significance for relative risk equal to 1 (current dioxin continuous, time categorized).

--: Relative risk/confidence interval/p-value not given due to sparse number of abnormalities.

Note: Initial Dioxin: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

Current Dioxin: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.

Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

All: All categories.

Background (B) (Comparisons): Current Dioxin ≤10 ppt.

Unknown (U) (Ranch Hands): Current Dioxin ≤10 ppt.

Low (L) (Ranch Hands): 15 ppt < Current Dioxin ≤33.3 ppt.

High (H) (Ranch Hands): Current Dioxin >33.3 ppt.

APPENDIX P-1.

Data Displays for the Pulmonary Assessment

The following figures graphically display relationships between the dependent variables and measures of dioxin for the pulmonary assessment. The panels are arranged as follows:

Panel	Group	Assumption	Dioxin Measure
a	Ranch Hand	Minimal	Initial
b	Ranch Hand	Maximal	Initial
c	Comparison	--	Current
d	Ranch Hand	--	Current

Dioxin measures are presented in original units, but spacing of intervals is based on the logarithm (base 2) scale, similar to the statistical analysis. The dependent variable is also presented in original units, but spacing is based on the scale used for analysis, as described in the chapter. For continuous variables, current dioxin values of 0.0 ppt are displayed as 0.3 ppt. For these variables, the reference line indicates the general relationship, unadjusted for any covariates, between the dependent variable and $\log_2$ dioxin. For discrete variables, the percent of participants that exhibited an abnormal condition is displayed on the vertical axis for given intervals of dioxin. The intervals of dioxin and the sample sizes (assuming no missing data or exclusions) for each of these intervals are given below. A list of figures found in this appendix follows the table.

Dioxin Interval	Dioxin Scale Midpoint	Panel			
		a	b	c	d
		Sample Size			
0.0-0.5	0.25	0	0	42	8
>0.5-2.0	1	0	0	28	8
>2.0-8.0	4	0	0	681	249
>8.0-32.0	16	0	23	52	408
>32.0-128.0	64	219	417	1	158
>128.0-512.0	256	234	234	0	33
>512.0-2,048.0	1024	65	65	0	2
>2,048.0	4096	3	3	0	0

Figure**Page**

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P-1-17	Loss of Vital Capacity (Moderate/Severe) versus Dioxin	P-1-19
P-1-18	Obstructive Abnormality (Mild) versus Dioxin	P-1-20
P-1-19	Obstructive Abnormality (Moderate/Severe) versus Dioxin	P-1-21

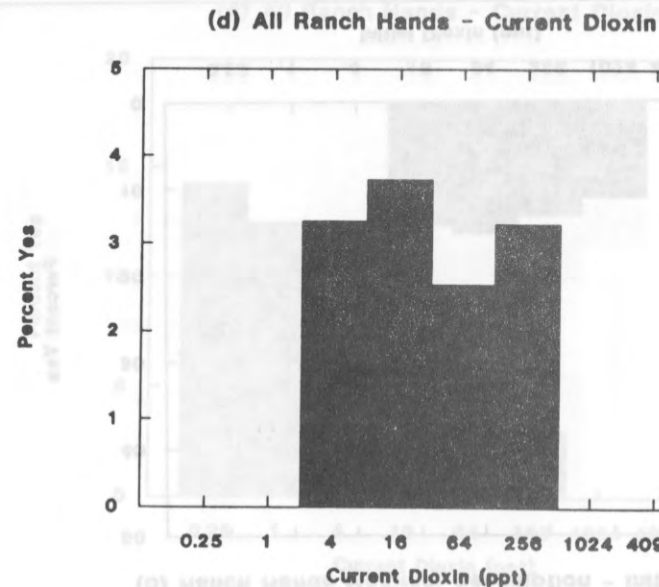
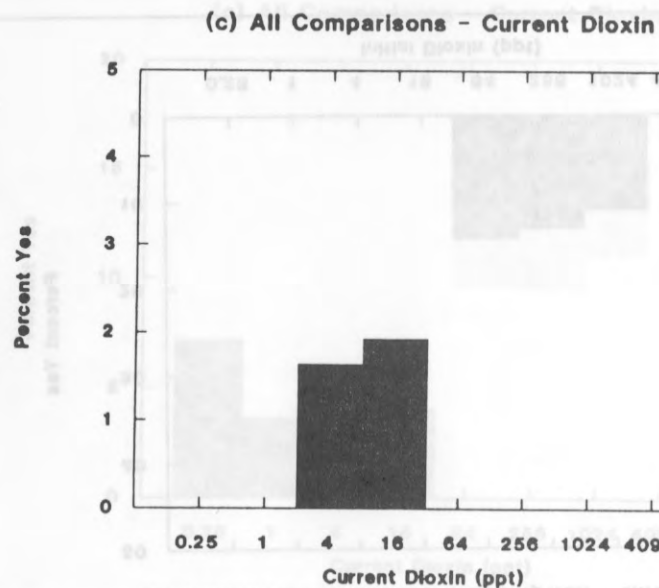
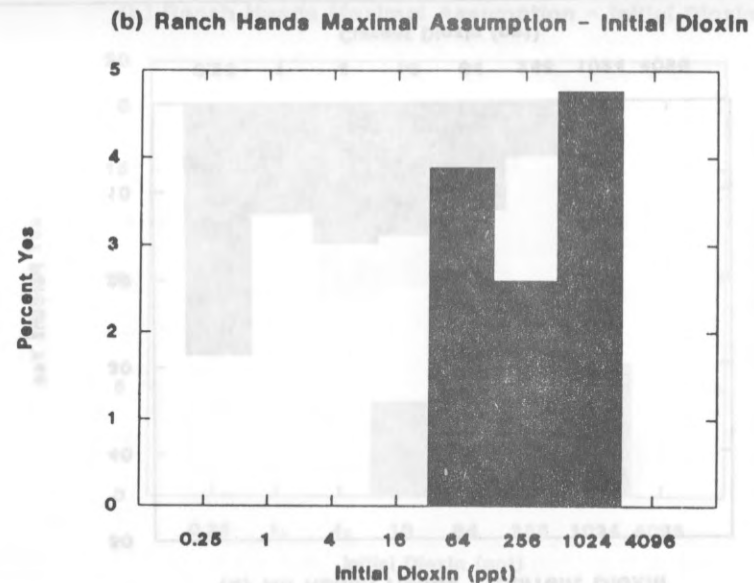
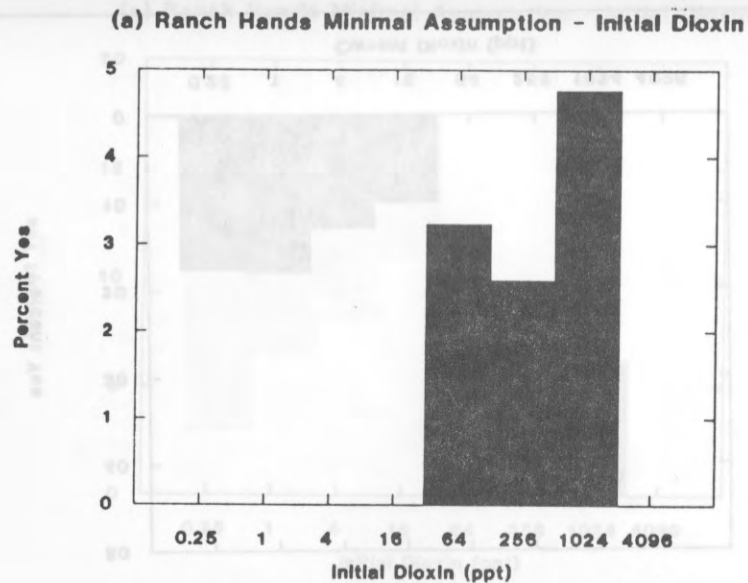
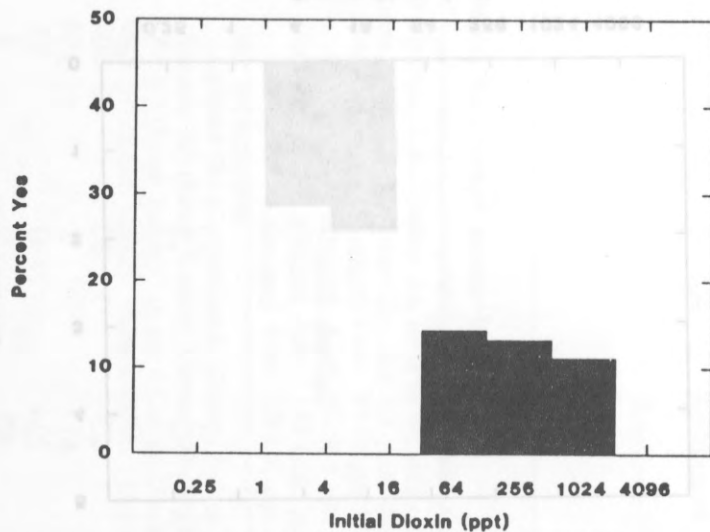
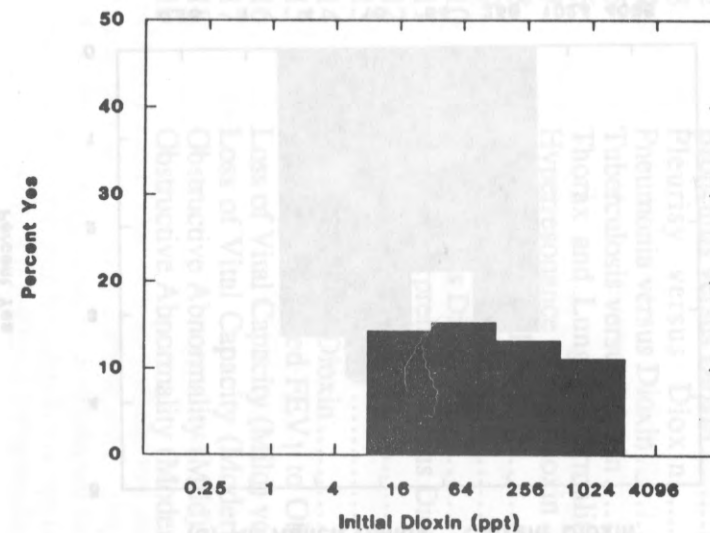


FIGURE P-1-1. Asthma versus Dioxin

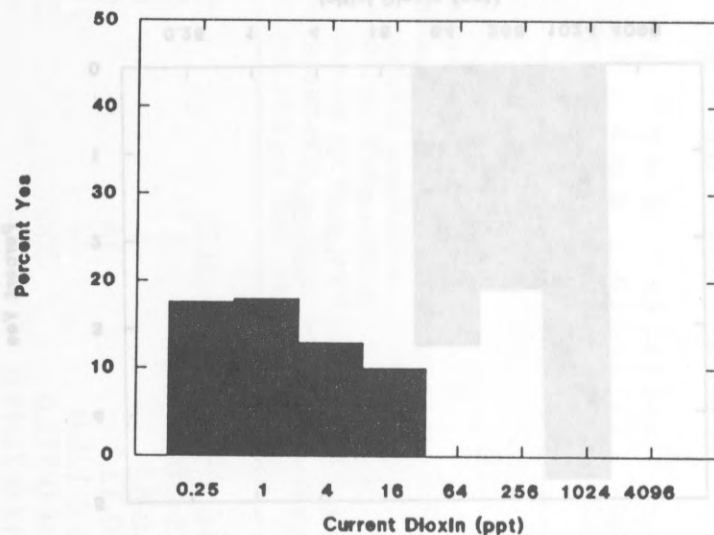
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(b) Ranch Hands Maximal Assumption - Initial Dioxin



(c) All Comparisons - Current Dioxin



(d) All Ranch Hands - Current Dioxin

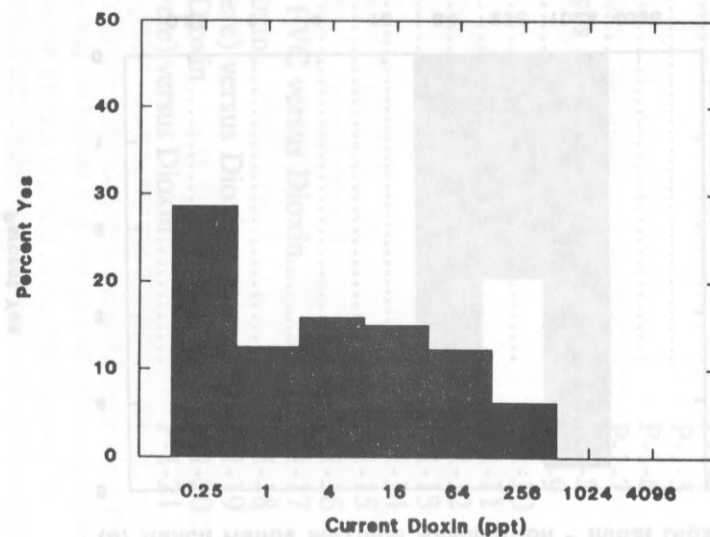


FIGURE P-1-2. BRONCHITIS VERSUS DIOXIN

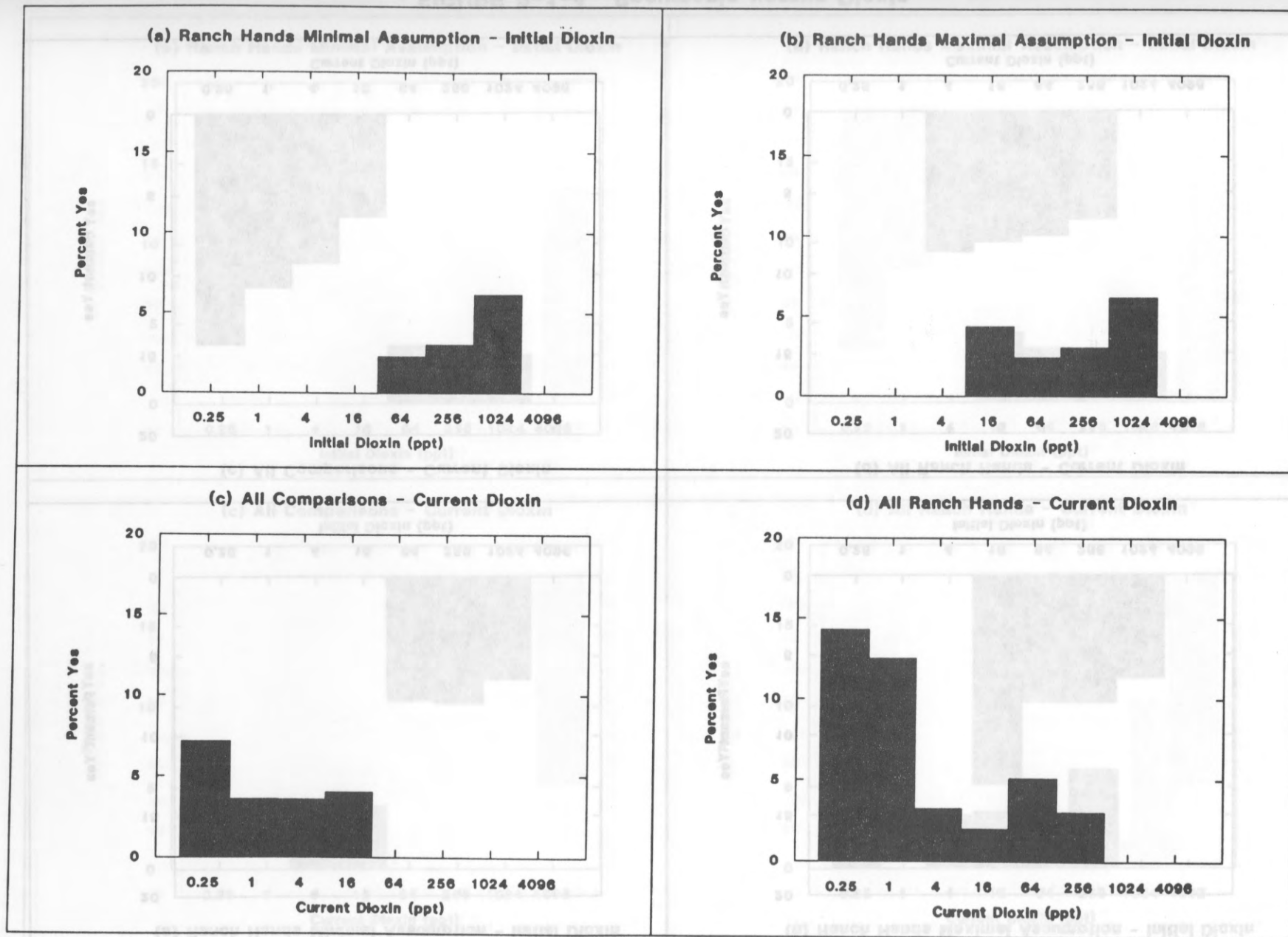
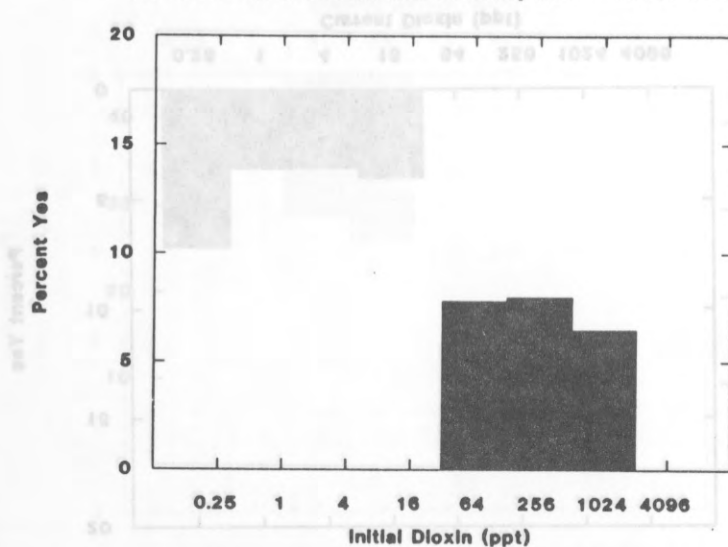
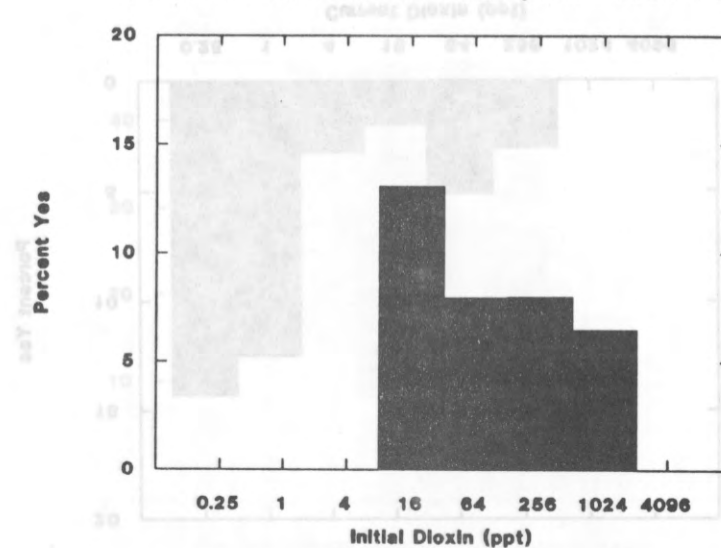


FIGURE P-1-3. Pleurisy versus Dioxin

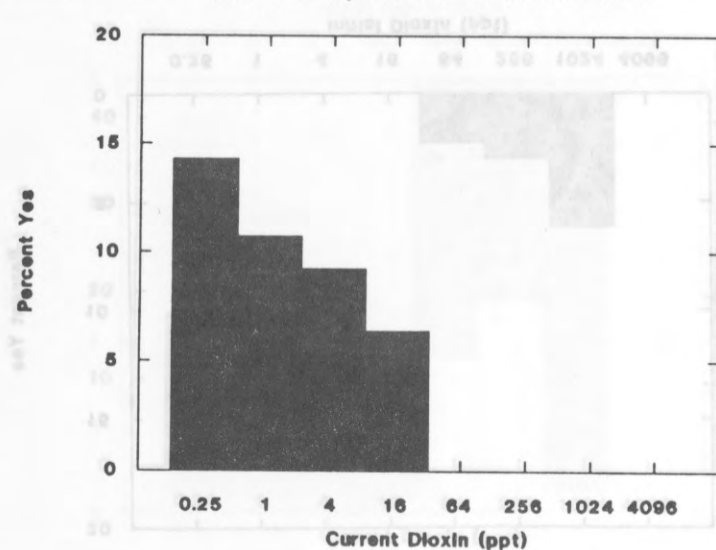
(a) Ranch Hands Minimal Assumption - Initial Dioxin



(b) Ranch Hands Maximal Assumption - Initial Dioxin



(c) All Comparisons - Current Dioxin



(d) All Ranch Hands - Current Dioxin

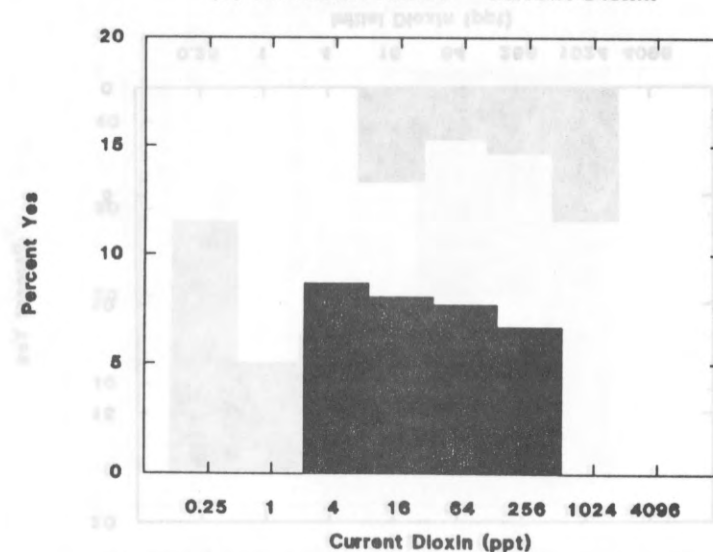
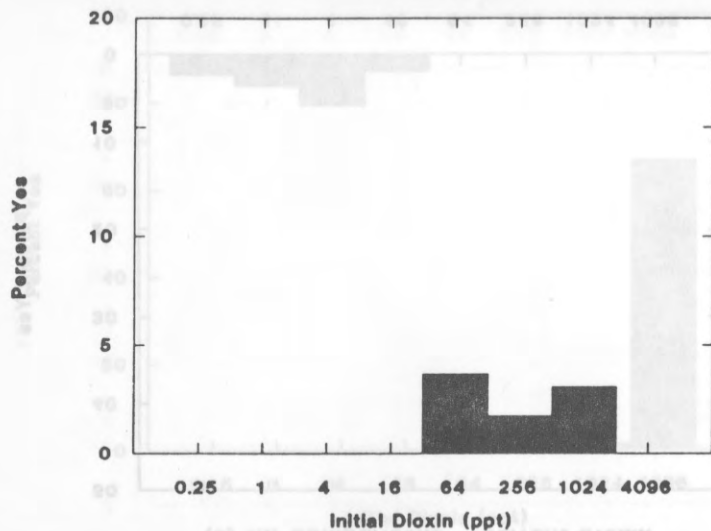
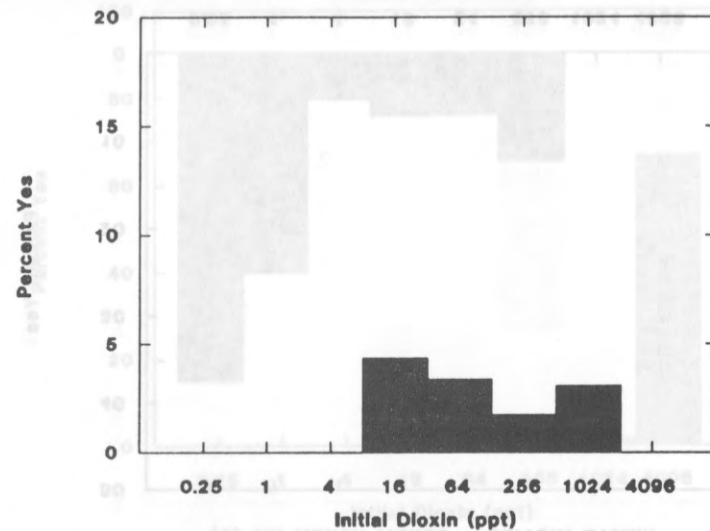
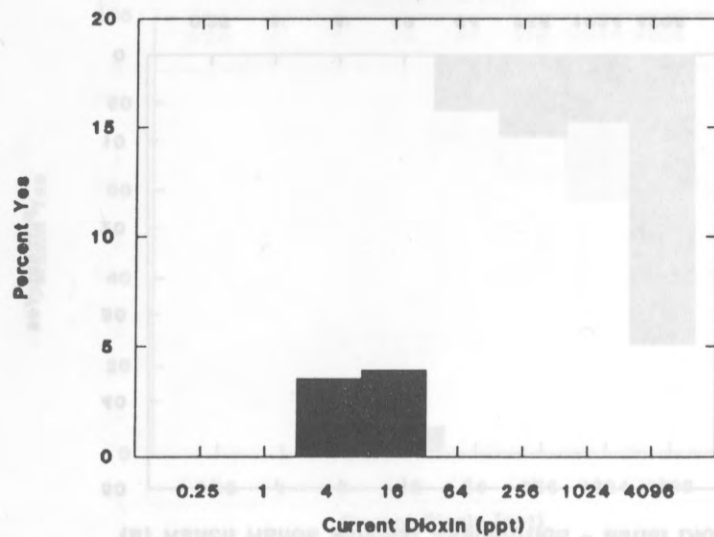
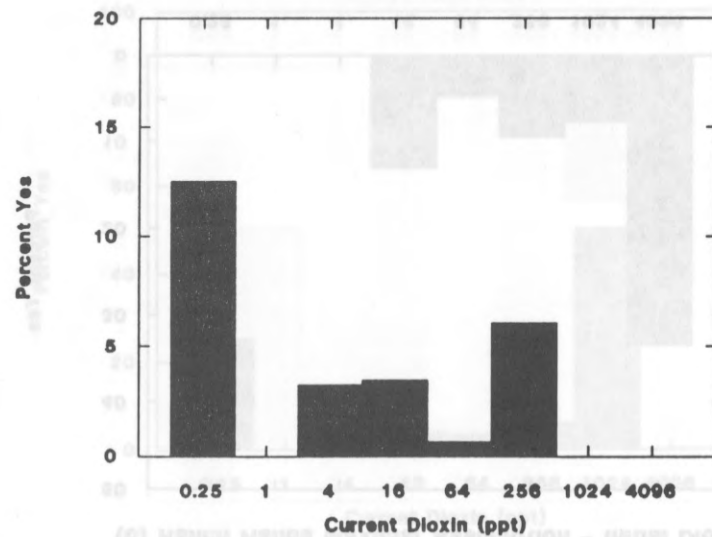


FIGURE P-1-4. Pneumonia versus Dioxin

(a) Ranch Hands Minimal Assumption - Initial Dioxin**(b) Ranch Hands Maximal Assumption - Initial Dioxin****(c) All Comparisons - Current Dioxin****(d) All Ranch Hands - Current Dioxin****FIGURE P-1-5. Tuberculosis versus Dioxin**

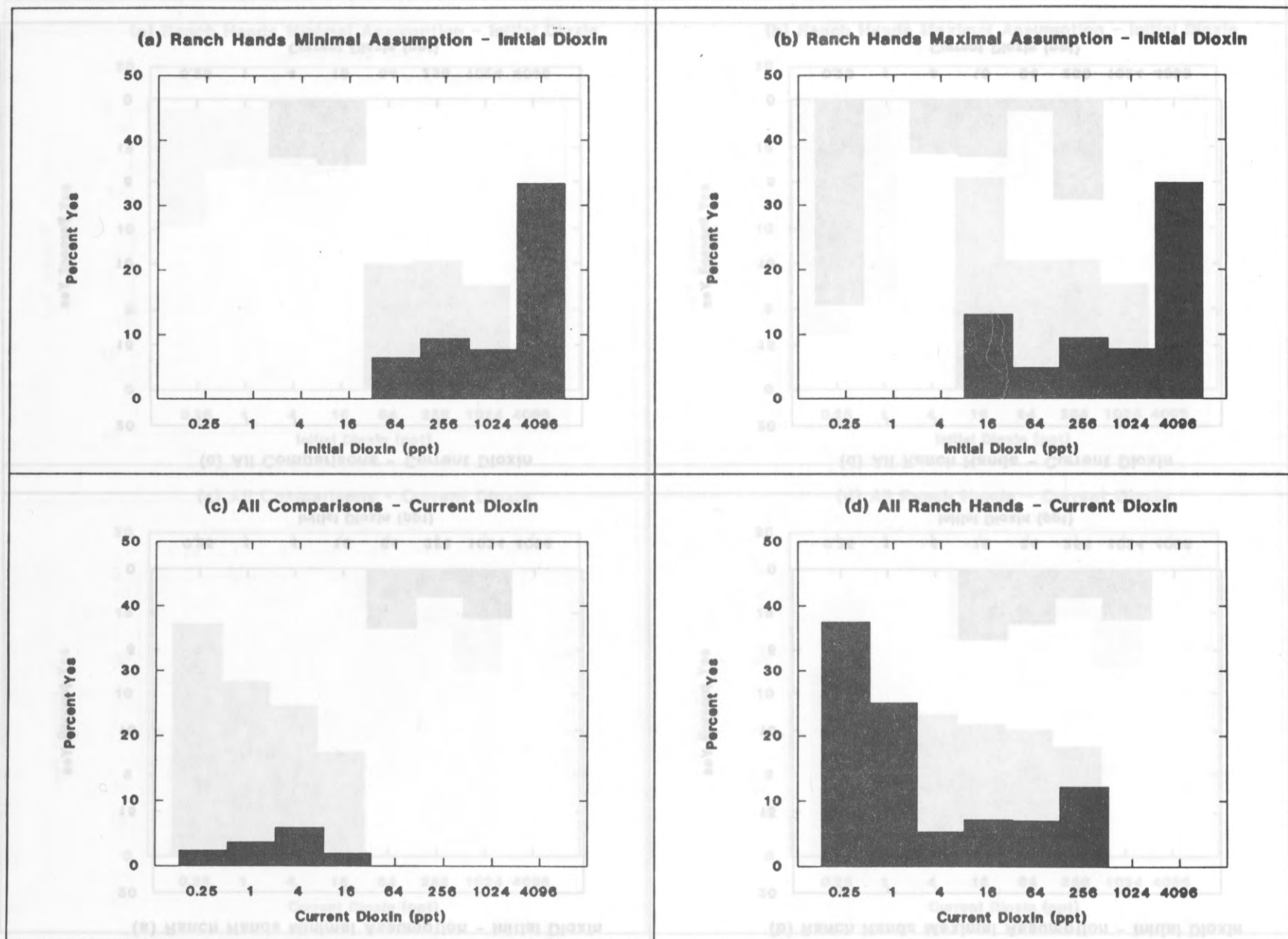


FIGURE P-1-6. Thorax and Lung Abnormalities versus Dioxin

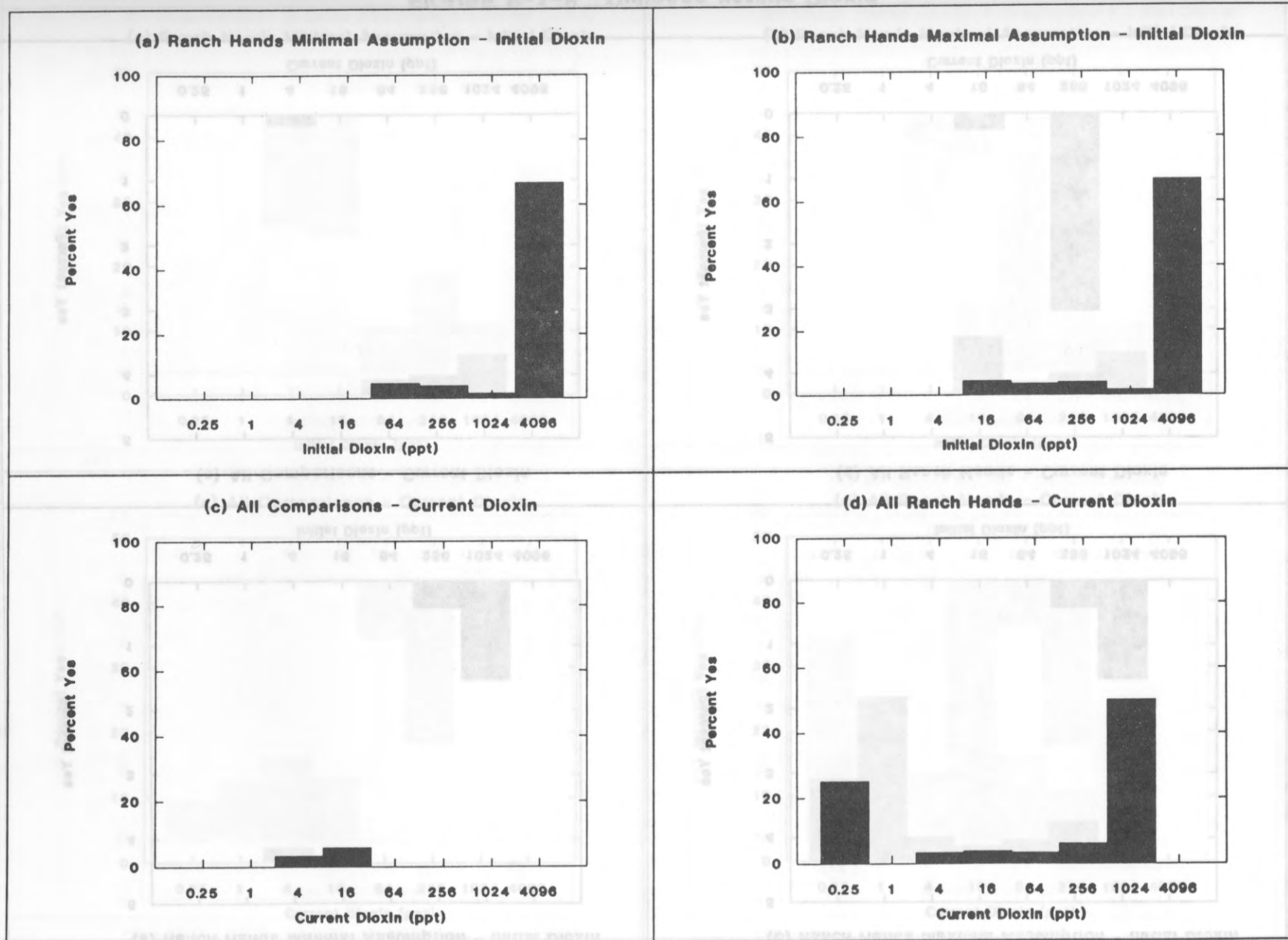
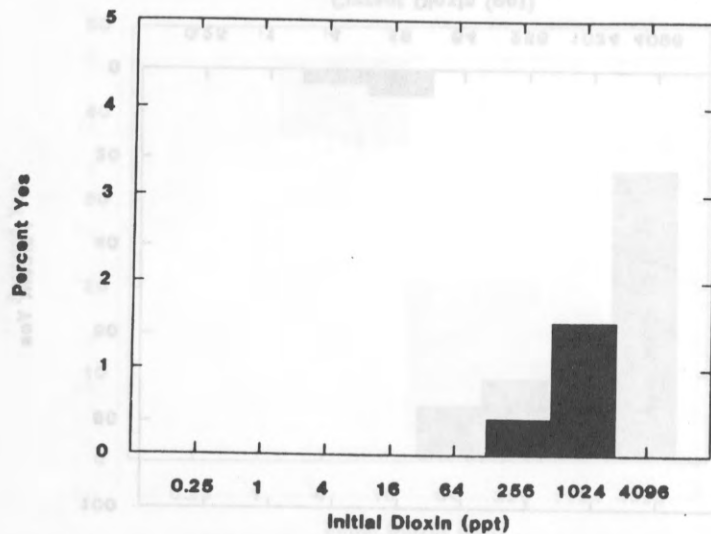
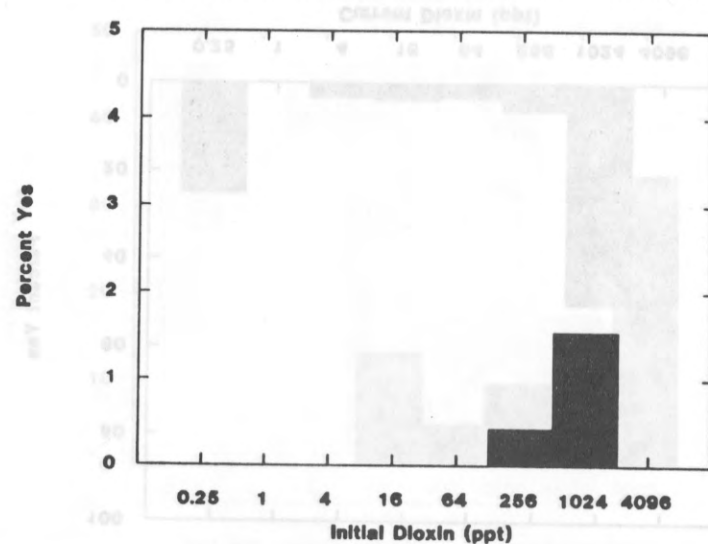


FIGURE P-1-7. Hyperresonance versus Dioxin

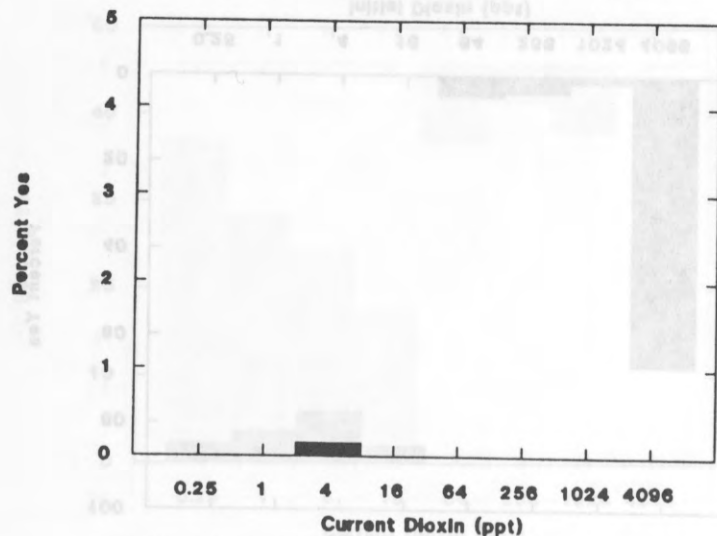
(a) Ranch Hands Minimal Assumption - Initial Dioxin



(b) Ranch Hands Maximal Assumption - Initial Dioxin



(c) All Comparisons - Current Dioxin



(d) All Ranch Hands - Current Dioxin

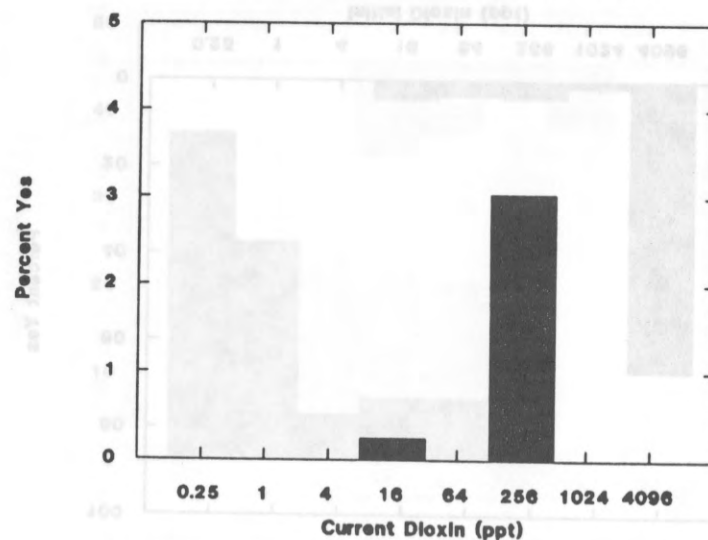
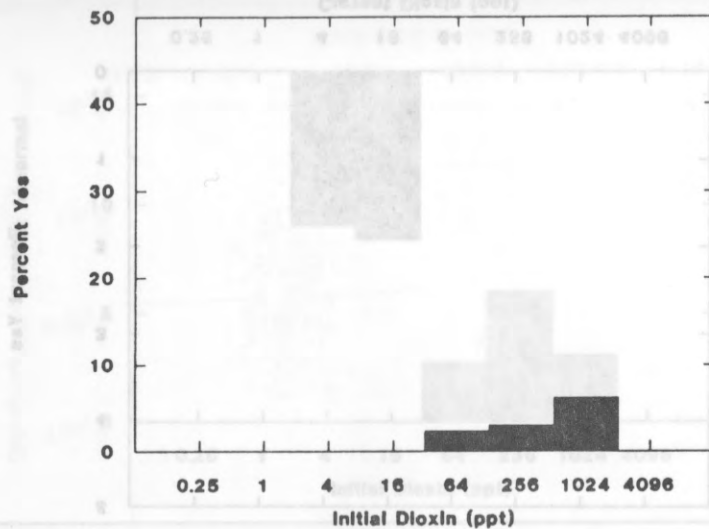
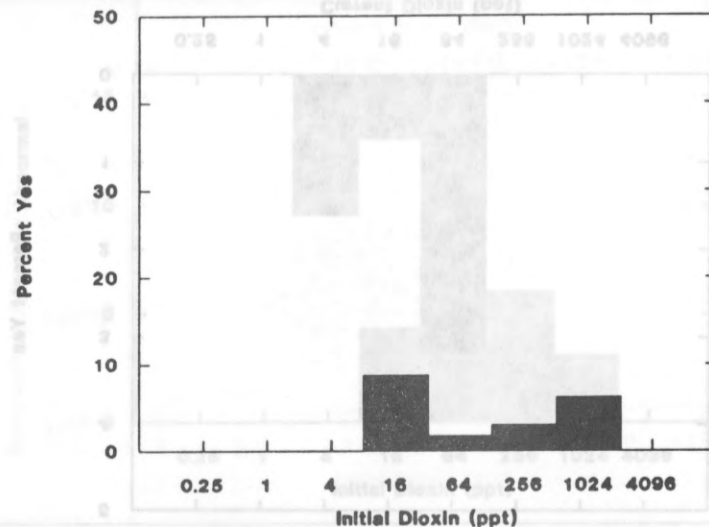


FIGURE P-1-8. Dullness versus Dioxin

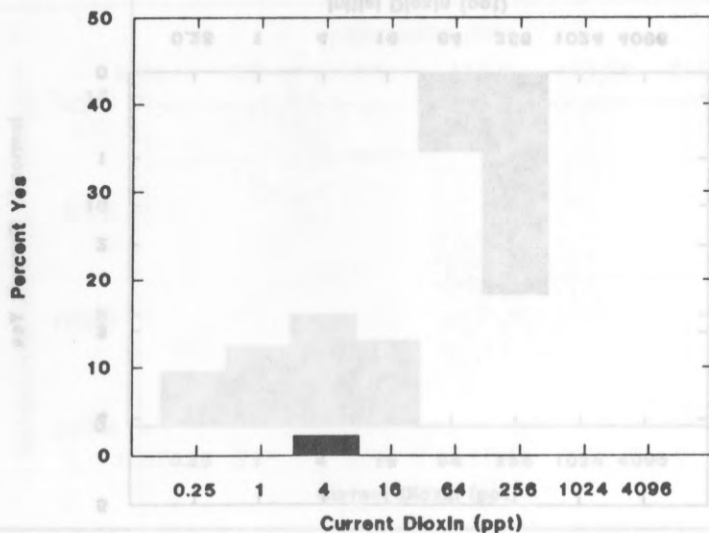
(a) Ranch Hands Minimal Assumption - Initial Dioxin



(b) Ranch Hands Maximal Assumption - Initial Dioxin



(c) All Comparisons - Current Dioxin



(d) All Ranch Hands - Current Dioxin

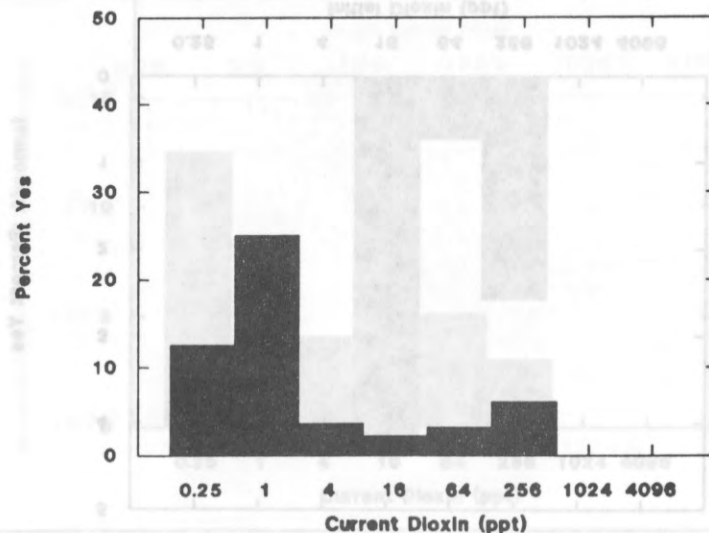


FIGURE P-1-9. Wheezes versus Dioxin